SFG1641

Bangladesh Weather and Climate Services Regional Project

Environmental Management Framework

Bangladesh Meteorological Department (BMD)
Bangladesh Water Development Board (BWDB)
Department of Agricultural Extension (DAE)

December, 2015

Executive Summary

Introduction: The **Bangladesh Weather and Climate Services Regional Project** will support modernization of the country's weather, water and climate information infrastructure strengthening both the supply of hydro-meteorological data, information and services and delivery to sectors and communities. It will do so by modernizing meteorological and hydrological monitoring systems, forecasting, strengthening sector specific information services and targeted community based hazard early warning activities in selected districts. This project is part of a World Bank SAR regional "series of projects," the first of which, Nepal Building Resilience to Climate Hazards is under implementation and Bhutan Weather and Disaster Improvement project under preparation. The project will be financed through IDA credit with contributions from GoB counterpart funding.

As per policy and legislative requirement of the World Bank and the GoB, an Environmental Assessment (EA) has to be conducted at the preparation stage of the project. Since the exact location, size and the extent of specific intervention of the project will remain unknown during the preparation phase, a framework approach for EA has been adopted. The Environmental Management Framework (EMF) has been prepared to guide the detailed EAs addressing all environmental safeguard issues on each installation of equipment or physical intervention at any site from preparation, through review and approval, to implementation of the program.

The Proposed Project: The interventions of Bangladesh Weather and Climate Services Regional Project are expected to encompass improved meteorological information services, improved hydrological information services, strengthened forecasting and early warning systems, and improved dissemination of agro-meteorological information. It will be implemented over a period of 5 years.

The Project Development Indicators include (1) Improved accuracy and lead time for weather forecasts and multi-hazard early warnings; (2) Increased sharing of data and information for extreme regional events; (3) Increase in number (%) of end users satisfied by hydro-meteorological services; and (4) Increased farmer satisfaction with agro-meteorological services. The project would be implemented by three agencies

(i) The Bangladesh Meteorological Department (BMD) under the Ministry of Defense;
(ii) The Bangladesh Water Development Board (BWDB) under the Ministry of Water Resources; and
(iii) The Department of Agricultural Extension (DAE) under the Ministry of Agriculture.

The project has four components, the main three components are to be implemented by these three agencies and each component has sub-components. These are:

A. Component A: Strengthening Meteorological Information Services: This Component will help strengthen BMD's meteorological monitoring network, forecasting capacity and delivery of weather and climate services.
B. Component B: Strengthening Hydrological Information Services and Early Warning Systems: The main objective is to improve hydrological observation, forecasting, and early warning systems. The component would be implemented by the BWDB.
C. Component C: Agro-meteorological Information Systems Development: Implemented by DAE this component will provide agro-meteorological services to farmers in order to increase agricultural productivity and assist them in coping with weather and climate extremes.
D. Component D: Contingent Emergency Response Component with zero allocation: Following an adverse natural or man-made event or that causes a major disaster; the Government may request the Bank to re-allocate project funds to this component to support response and reconstruction.

Policy, Legal and Administrative Framework: Regulatory requirements toward protection and conservation of environment have been enunciated by the Government of Bangladesh (GoB) as well as the World Bank (WB) are reviewed. The GoB pertinent policies and regulations among these requirements are summarized as under:

- Environmental Conservation Act (1995) and Amendments
  - ◊ Bangladesh Environment Conservation Act (ECA), 1995
  - ◊ Bangladesh Environment Conservation Rules, 1997
  - ◊ Bangladesh Environment Court Act, 2010

- ◊ Environmental Policies, Strategies and Plans
- ◊ National Conservation Strategy, 1992
- ◊ National Environmental Policy, 1992
- ◊ National Environmental Management Action Plan (NEMAP), 1995
- ◊ Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009
- ◊ Coastal Zone Policy, 2005
- ◊ Coastal Development Strategy, 2006
- ◊ National 3R Strategy for Waste Management, 2010

- Water Policies, Plans, and Legislation
  - ◊ National Water Policy, 1999
  - ◊ National Water Management Plan, 2001 (Approved in 2004)
  - ◊ Guidelines for Environmental Assessment of Water Management (Flood Control, Drainage and Irrigation) Projects (approved 2003, published 2005)
  - ◊ Inland Water Transport Authority Ordinance, 1958
  - ◊ National Water act, 2013
- Agriculture and Land Use Policies and Legislation
  - ◊ National Agriculture Policy, 1999
  - ◊ New Agricultural Extension Policy, 1996
  - ◊ DAE Strategic Plan 1999- 2002
  - ◊ National Agriculture Extension Policy-2015 (Draft)
- Biodiversity, Fisheries, Forestry, and Wildlife Policies and Legislation
  - ◊ National Fisheries Policy, 1998
  - ◊ National Livestock Development Policy, 2007
  - ◊ National Forest Policy, 1994
  - ◊ Bangladesh Wildlife (Protection and Safety) Act, 2012
- Other Relevant Acts, Policies and Rules
  - ◊ National Information and Communication Technology (ICT) Policy, 2002
  - ◊ National Disaster Management Policy, 2012
  - ◊ Bangladesh Disaster Management Act,
  - ◊ Bangladesh National Building Code, 2006

Implication of Government Policies on Project: A schedule attached to the Environment Conservation Rules 1997 categorizes projects as Green, Orange A, Orange B, and Red. According to these rules 'Assembling of scientific and mathematical instruments' are categorized under "Green" and shall be granted Environmental Clearance. Procedure for obtaining Environmental Clearance includes the following:

(i) General information about the project;
(ii) Exact description of the raw materials and the manufactured product; and
(iii) No objection certificate from the local authority.

Most activities in the 'Bangladesh Weather and Climate Services Regional Project' thus fall under 'Green' category and according to the ECR 97, which means EIA and IEE are not required to obtain Environmental Clearance.

However, although specific project location will be known during the implementation phase of the project, the project activities will be implemented nationwide, including the Bay of Bengal and within the ecological sensitive areas such as Sundarban. The following regulatory framework is applicable in these areas:

- Bangladesh Wildlife (Protection and Safety) Act, 2012: during installation of equipment no plants or trees within the ecologically sensitive areas can be uprooted or destroyed
- Environment Conservation Rules 1997: For obtaining Environmental Clearance from DoE and no-objection certificate from Department of Forests is needed.

World Bank's Environmental Safeguard Policy: The World Bank has developed a number of Safeguard Policies to ensure that all possible impacts are considered and mitigation measures are identified prior to the implementation of any proposed project. These are: OP 4.01 Environmental Assessment,OP 4.04, Natural Habitats and OP 4.11, Physical Cultural Resources. The proposed project has been classified as a category 'B' project, and one environmental safeguard policy 'Environmental

Assessment policy (OP/BP 4.01)' has been triggered. In general, the project is not expected to have significant environmental impact due to the nature of investments. However, the project may finance some infrastructure and install some equipment in environmentally sensitive areas. Since the details of the investments are not known at this stage of the project, a framework approach has been taken.

Description of Baseline: The components and activities of the project will be implemented all over Bangladesh and also in the Bay of Bengal. However, component activities and locations are yet to be finalized. As result it is not possible to prepare any project specific environmental baseline. Alternatively, the EMF includes the generic environmental baseline for relevant component type and guideline for collection of information and data. Component wise description

Baseline Information for Component A

Influence Area- The influence area of the each of the installations will be limited to the walled premises of the khas land owned by DAE in Upazila offices or BMD offices.

Determination of physical components -Considering the influence area the following components need to be described in the description of the baseline environment:

Physical Environment:

- ◊ Climate (average precipitation, temperature, humidity)
- ◊ Topography and soil type
- ◊ Hydrology (groundwater levels)
- ◊ Land use and land cover

Ecological Environment:

- ◊ Bio-ecological zone
- ◊ Percentage of area under vegetation
- ◊ Type of trees

Baseline Information for Component B

Influence Area - There are primarily three types of installations. The influence area will vary accordingly based on the location of installations of equipment. The installations and associated influence area are:

- ◊ Water level monitoring equipment installed on concrete column in the river (in the absence of bridge), influence area will be the river and nearest bank, within 3m radius
- ◊ Water level monitoring and weather station on bridge with protection room housing equipment in BWDB premises, influence area will be the walled premises of BWDB
- ◊ Water level monitoring and weather station on bridge with protection room housing equipment adjacent to bridge, influence area will be the khas land within 3m radius adjacent the structure

Determination of physical components-

Physical Environment:

- ◊ Climate (average precipitation, temperature, humidity)
- ◊ Topography and soil type
- ◊ Hydrology (discharge, tide, water levels)
- ◊ Land use and land cover

Ecological Environment:

- ◊ Bio-ecological zone
- ◊ Percentage of area under vegetation
- ◊ Type of trees
- ◊ Fisheries and aquatic biodiversity

Baseline Information for Component C

Influence Area- The influence area of the each of the installations will be limited to the walled premises of the khas land owned by DAE in Upazila offices.

Determination of physical components-

Physical Environment:

- ◊ Climate (average precipitation, temperature, humidity)

- ◊ Topography and soil type
- ◊ Hydrology (groundwater levels)
- ◊ Land use and land cover

Ecological Environment:
- ◊ Bio-ecological zone
- ◊ Percentage of area under vegetation
- ◊ Type of trees

Analysis of Alternatives: Various alternatives need to be considered in siting and design of the project components in environmentally sensitive areas. The analysis of these alternatives should be based on the following considerations,

- ◊ With or without the project activities in environmentally sensitive areas;
- ◊ Analysis criteria to include environmental, technical/design and economic options;
- ◊ Network in environmentally sensitive areas should be basic with equipment installed in already built up areas or khas land;
- ◊ Network should be focussed on optimum locations and data and information should be based on primary data collection in upstream/ downstream region outside of environmentally sensitive areas combined with modelling activities and satellite information.

Potential Project Impacts and Mitigation Measures: The environmental impacts identified at this stage are preliminary in nature and the environment assessment will need to be further elaborated specifically and potential for occurrence has to be ascertained during further stages of component design and implementation when locations will be specified. Based on the types of interventions to be financed under the project, it is expected that the project activities will not cause any significant, irreversible and long-term environmental impacts. The environmental impacts of the project are expected to be mostly minor construction or equipment installation related and limited within the project boundaries. However, there are possibilities of a few likelihood adverse environmental and social impacts like: installation of instruments for automatic weather system and disposal of equipment. Most of the adverse impacts identified are reversible in nature and can be managed by appropriate mitigation measures.

Screening Matrix for Environmental Impact Assessment: All the major environmental parameters covering ecological, physical and human interest related aspects need to be considered in identifying the potential impacts during different phases of the project. The Environmental Screening will be carried out in two stages. These are: (i) Eligibility Screening; and (ii) Impact Screening. The eligibility screening will be carried out by a simple checklists. This will provide information whether the proposed interventions will be eligible for funding under the project. The impact screening will be carried out with the help of matrix or checklists of the environmental parameters identified in Baseline Description for each of the major components during planning phase. In the impact checklist, the magnitude of environmental impacts has been classified as none, low, moderate and severe. Long-term and short-term impacts (identified as L and S, respectively) as well as reversible and irreversible (identified as R and I, respectively) have also been identified in the checklist. This checklist needs to be completed for each of the locations for the different components of the project.

Impact Assessment: The potential impacts and possible mitigation measures have been distinguished for each component.

Component A: Strengthening Meteorological Information Services
Component C: Agro-meteorological Information Systems Development
Adverse Environmental Impacts

- ◊ Vegetation removal: The equipment and necessary hardware will be installed in the compounds of Upazila Parishad offices, Union Parishad offices or BMD office premises across the country. These weather stations will require 5m by 5m land, which means trees or plants may need to be removed.
- ◊ Radio-frequency emissions from equipment: Low-powered, intermittent, or inaccessible transmitters and facilities are normally "categorically excluded" from the requirement for routine evaluation for radio-frequency exposure.
- ◊ Electronic waste: The devices such as batteries, thermometer, barometer, weather balloons, solar panels, transducers and computer related electronics are e-wastes that may contain

mercury, lead, cadmium, nickel, zinc, lithium and compounds such as Manganese dioxide, Potassium hydroxide, Sodium hydroxide and Ammonium chloride. Proper disposal or end-of-life management of the expired equipment needs to be done carefully. Leaching of these chemicals into soil or water or into air affect the environment, wildlife and human health, or the staff/workers may come in direct contact with them.

- ◊ Scouring of benthic habitat: Few buoy stations will installed in the Bay of Bengal. Studies show that depending on the scope of chain, tidal range, and environmental forces where the buoy is located, benthic habitat can be scoured by the buoy chain and anchor. The laying down and picking up of sinkers and chain associated with floating or anchored buoy establishment, disestablishment, and maintenance can temporarily increase turbulence, turbidity, and sedimentation in their vicinities. Additionally, coral and seagrass species through direct contact with equipment can cause coral fragmentation, overturning, and abrasion. Disturbances of seabed biomass hinder organic matter production and nutrient recycling, and destabilize the sediment substrate, which are detrimental to seagrass regrowth.
- ◊ Safety Issues: The installation and inspection of buoys in the sea could be hazardous and cause risk to installation team and inspection team, especially during inclement weather.
- ◊ Damage from lightning: Tall electrical equipment and wiring attracts lightning during thunderstorms and can cause harm to equipment, buildings and even indoor equipment and people near the structures.

Positive Environmental Impacts

- ◊ Promote scientific understandings
- ◊ Improved disaster management

Mitigation measures

- ◊ Clearing natural vegetation will be avoided and equipment will be installed in a natural clearing.
- ◊ The removed trees or plants should be replaced with new plantation at appropriate locations.
- ◊ The lakes, water bodies and lowlands must not be used for disposal of any waste or debris.
- ◊ Solid waste and electronic waste should be properly disposed. The options include: storage, incineration, municipal solid waste landfill, recycling and hazardous waste process.
- ◊ Equipment will not be repaired in the field. But rather in BMD laboratories. Where ever possible prefabrication in built up areas to avoid damage to vegetation.
- ◊ Buoys with environmental friendly anchoring and mooring options need to be installed to reduce impact area of the seafloor. Installations should not be located near coral reefs or sea grass areas.
- ◊ Adequate lightning safety measures should be taken to equip the weather stations with surge protectors to protect appliances and equipment. Precautionary steps during thunder storms should to be taken, live connections for computers and equipment should be turned off and personnel should not be using computers during thunderstorms.
- ◊ Implement suitable safety standards for all workers and site visitors, with sufficient provisions to comply with international standards (e.g. International Labor Office guideline on ‘Safety and Health in Construction; World Bank Group’s ‘Environmental Health and Safety Guidelines’) and contractor’s own safety standards, in addition to complying with national standards.
- ◊ Adequate safety measures should be taken by staff, during travel on boats and vessels during buoy installation and inspection. Vessels must be maintained regularly. Life jackets have to be used by crew and crew has to be trained in life-saving techniques. Only trained professionals will install and inspect buoy. There should be no travel during stormy weather;
- ◊ Ensure the riverine transports, vessels and ships are well maintained and do not have oil leakage to contaminate river water. Contain oil immediately on river in case of accidental spillage from vessels and ships and in this regard, make an emergency oil spill containment plan to be supported with enough equipment, materials and human resources.
- ◊ Provide lightning arrestor

Component B: Strengthening Hydrological Information Services and Early Warning Systems

Adverse Environmental Impacts

- ◊ Vegetation removal: The different equipment and necessary hardware will be installed in BWDB monitoring stations (groundwater monitoring and rain gauges), bridges and adjacent government owned land (water level measuring sensors) and in absence of bridges, on concrete columns

placed in water of the rivers. In many places small 5m by 5m concrete sheds will need to be built to protect equipment, which means trees or plants may need to be removed.

- ◊ Water pollution and disturbance to land ecosystems: Limited pollution of water sources with regular mobility of office staff observers and gauge readers in and around the stations and during measurements using echo-sounder, Acoustic Doppler Current Profiler (ADCP), sub-bottom profiler.
- ◊ Radio-frequency emissions from equipment: Low-powered, intermittent, or inaccessible transmitters and facilities are normally "categorically excluded" from the requirement for routine evaluation for radio-frequency exposure.
- ◊ Hazardous and e-wastes: Devices such as batteries, thermometer, barometer, weather balloons and a computer related electronics are e-wastes that may contain mercury, lead, cadmium, nickel, zinc, lithium and compounds such as Manganese dioxide, Potassium hydroxide, Sodium hydroxide and Ammonium chloride. Disposal or end-of-life disposal of these equipment needs to be done carefully. Leaching of these chemicals into soil or water or into air affect the environment, wildlife and human health, or the staff/workers may come in direct contact with them.
- ◊ Safety Issues: Many of the instruments will be installed on bridges or concrete pillars. Access to these installation sites could be unsafe during installation and inspection of buoys.

Positive Environmental Impacts

- ◊ Promote scientific understandings
- ◊ Improved disaster management

Mitigation measures

- ◊ The removed trees or plants should be replaced with new plantation at appropriate locations.
- ◊ The lakes, water bodies and lowlands must not be used for disposal of any waste or debris.
- ◊ Clearing natural vegetation will be avoided and equipment will be installed in a natural clearing.
- ◊ In Reserved Forest or Ecologically Critical Areas equipment will be installed in government office premises wherever possible, in case this is not possible, equipment needs to be installed in natural clearing.
- ◊ Solid waste and electronic waste should be properly disposed. The options include: storage, incineration, municipal solid waste landfill, recycling and hazardous waste process.
- ◊ Equipment will not be repaired in the field. But rather in BWDB laboratories.
- ◊ All equipment needs to have adequate and safe access provisions for installation, operation and maintenance. Concrete pillars placed in water need adequate facilities (example ladders, steps) to improve access, thereby increasing safety during inspection.
- ◊ During measurement of discharge and bed profiling using catamarans, echo-sounder, Acoustic Doppler Current Profiler (ADCP), sub-bottom profiler surveyors need to be careful not to throw anything in water and prevent leakages of oil from boats and catamarans.
- ◊ Not carrying out in-situ monitoring activities in one place in long, contiguous stretches.
- ◊ Motor boat speed will be limited to 15 km/h in accordance with best international practices.
- ◊ Implement suitable safety standards for all workers and site visitors, with sufficient provisions to comply with international standards (e.g. International Labor Office guideline on ‘Safety and Health in Construction; World Bank Group’s ‘Environmental Health and Safety Guidelines’) and contractor’s own safety standards, in addition to complying with national standards.
- ◊ Ensure the riverine transports, vessels and ships are well maintained and do not have oil leakage to contaminate river water. Contain oil immediately on river in case of accidental spillage from vessels and ships and in this regard, make an emergency oil spill containment plan to be supported with enough equipment, materials and human resources.

Environmental Management Framework: The framework has been prepared fully by considering the GoB regulatory framework and WB safeguard policy. This is not an attempt to predict the specific impacts of projects or activities, but rather to minimize the overall potential change to the natural environment whilst implementing activities. The Environmental Management Framework (EMF) has been prepared based on the: (i) assessment on surrounding environment of the proposed locations; (ii) evaluation of the potential overall environmental impacts of the proposed project activities; (iii) suggestions for component specific standard environmental mitigation and monitoring plan with unit costing; (iv) public consultations; (v) identification of the institutional barriers and capacity building needs for environmental management; and (vi) agreements necessary on the institutional arrangements for the environmental management.

Using the major steps outlined below, the EMF describes the process for ensuring that environmental and social concerns are adequately addressed through the institutional arrangements and procedures used by the project for managing the identification, preparation, approval, and implementation of Components. The major steps are:

- ◊ Screening and Impact Assessment
- ◊ Review, Approval, and Disclosure of Component Safeguard Instruments
- ◊ Implementation, Supervision, Monitoring, and Reporting

Safeguard Screening and Impact Assessment: Key steps in Component preparation during project implementation are safeguard screening and impact assessment. The safeguard screening often includes two steps, eligibility screening and technical screening for assessment of potential impacts, policies triggered and instruments to be prepared. The purpose of "environmental screening" is to get a preliminary idea about the degree and extent potential environmental impacts of a particular installation of equipment or physical intervention at any site, which would subsequently be used to assess the need for further EA.

As mentioned earlier, the project is not expected to have significant environmental impact due to the nature of investments. However, the project may finance few infrastructure and install few equipment in environmentally sensitive areas, thus technical screening is needed. The outcome of the technical screening will be used to classify each installation of equipment or physical intervention at any site into one of three categories, depending on the type, location, sensitivity, and scale of the project component and the nature and magnitude of its potential environmental impacts (World Bank OP 4.01).

Checklists will be used to screen the components and activities of this project**,** based on expert judgment (environmental specialist and trained PIU officials) and FGD with officials and field technicians from implementation agencies and communities living around the installation area, can give direction in using these screening tables. The checklist will be used during eligibility and technical screening. The checklist needs to be completed on the basis of the threshold values highlighted in safeguard policies of WB and environmental policies of GoB. These are: potential risks to natural habitats and forests, pollution risks including land, water and air, human health and occupational safety, land slope stability, and built artifact or heritage. Key potential negative impacts on the environment and local community will be screened during planning and implementation phases. Installation of equipment or physical intervention at any site with medium and high impact will need to develop and implement mitigation measures, monitoring programs, and adequate institutional capacity on safeguards and this will be used as the basis for preparation of EMPs for each of the components.

Environmental Management Plan (EMP): A project's EMP consists of a set of mitigation, monitoring, and institutional measures to be taken during implementation and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. The plan also includes the actions needed to implement these measures. EMPs are essential elements of EIA reports for Category 'A' projects. However, for many Category 'B' projects, the EA may result in a management plan only. For this particular project, EMPs will be required if equipment installations and construction works are conducted in environmentally sensitive areas. The EMP to be prepared should include the analysis of impacts on the sensitive areas and mitigation measures commensurate with the magnitude of impacts.

Environmental Code of Practice (ECoPs): ECoP will consist of routine systematic checking that all mitigations are effectively implemented during the relevant periods of the project. The following ECoPs will be considered and applied for the project based on the nature of the interventions.

- ◊ Tree Plantation ECoP
- ◊ Pollution Prevention ECoP
- ◊ Waste Management ECoP
- ◊ Construction Management ECoP
- ◊ Buoy Installation ECoP
- ◊ Health and safety ECoP

Disclosure of Safeguard Instruments: All the activities of the project that is during planning and equipment installation will be disclosed locally in a timely manner, before approval of the Components, in

an accessible place and in a form and language understandable to key stakeholders. During disclosure the following information needs to be shared,

- ◊ Main objectives, activities and outcomes of the project;
- ◊ Any environmental impacts (positive and negative);
- ◊ Mitigation measures to be taken;
- ◊ Environmental Management Framework.

Implementation Arrangements: The Environmental Management Framework (EMF) implementation requires an organization support structure in the form of organizational requirements, training needs and plan, and information management system. The Government of Bangladesh (GoB) is responsible for overall project management and coordination through its Ministry of Defense (MoD), Ministry of Water Resources (MoWR), and Ministry of Agriculture (MoA). The purpose of project management is to ensure (i) Project Oversight and Policy Direction, (ii) Project Coordination and Management, and (iii) Project Implementation.

To carry out the above functions, (i) a Project Steering Committee (PSC) and (ii) three Project Implementation Units (PIUs) each at BMD, BWDB and DAE will be established. To facilitate coordination between the three PIUs during implementation, the PSC will set up a Project Coordination Unit (PCU) and the PCU will have an Environment Specialist for the duration of the project. Therefore, EMF will have two levels of implementation.

Project Level: A central Project Steering Committee (PSC) will take the lead in overseeing and monitoring of the implementation of components and this unit will periodically supervise and monitor the safeguard implementation performance and include the progress/results in the Project Progress Report. The PSC will be convened by the Secretary of the MoD. The PSC will include the Secretaries, or their representatives from the Finance Divisions, Ministry of Defence, Ministry of Agriculture, Ministry of Water Resources, Ministry of Disaster Management and Relief and any relevant Government Stakeholders.

For more regular project monitoring, BWDB Head Office will create a Project Coordination Unit (PCU) headed by a Project Coordinator (PC) who will be the Chief Planning of the BWDB. Its office will serve as the secretariat to the PSC. The PCU will appoint an Environmental Specialist who will be responsible for effective and timely implementation of safeguard activities, monitoring of the environmental impacts of components throughout the project period and environmental enhancement of project activities.

Component Level: Each implementing agency will establish their own Project Implementation Unit (PIU), which will be responsible for ensuring effective implementation of safeguard measures in close consultation with local authorities and local communities. Each PIU will assign at least one full time staff as the safeguard focal person to be responsible for forging effective implementation of safeguard activities. PIU-BMD and PIU-DAE will assign one additional staff each for training purposes and to ensure continuity in case of transfer of assigned focal person. The PIU will be responsible for incorporating environmental considerations in bidding and contractual documents. During implementation, the PIU will assign local officials for monitor environmental issues. The results will be part of the component progress report and the safeguard focal point will be responsible for ensuring proper documentation of safeguard activities.

Capacity Building, Training and Technical Assistance: The effectiveness of the Environmental Management Framework and implementation depends considerably on the understanding and preparedness of project staff and in particular their Environmental Team. It is important that the project authority to sensitize the team on management of environmental issues**.**

The BMD, BWDB and DAE have little to no experience in working with EA and environmental issues. Capacity building for environmental safeguard management and also supporting a wide and deep base of technical knowledge on environmental issues will need to be carried out at all tiers of the project, including PCU, PIU (BMD, BWDB, DAE), Field Team and contractors). The various aspects that need to be covered under the capacity building will include general environmental awareness with focus on the following,

- ◊ Principles and policies for (natural) environmental mitigation in development projects;
- ◊ Legal and institutional aspects; project mandates;
- ◊ Probable environmental impacts from project;

- ◊ The EMF consisting of the environmental designs and implementation plans; mitigation activities, monitoring, evaluation and reporting methods and mechanisms and, inter-sectoral and inter-agency collaboration, etc.

Capacity building will include training of IT personnel, forecasters and middle management officials. Technicians and engineers in the headquarters and field offices should also undergo training to enhance their knowledge and skills in the operation and maintenance of modern equipment. The following should be considered,

- ◊ Post-training utilization of the trainees and application of knowledge acquired during training activities should be ensured by the management of the agencies. Dependable follow-up measures and structural reformation need be in place to ensure sustainability and effective application.
- ◊ A pool of officers having aptitude, commitment, competence and adaptability need to be identified within each agency to act as trainers and retain the knowledge acquired.
- ◊ Encourage decentralization of the training services to ensure optimal utilization of facilities and resources in the regional offices.
- ◊ Incentives should be given to busy personal to attend the training courses by giving due importance during performance appraisal and career advancement.
- ◊ Mid and junior level officers should be given preference to ensure continuity.
- ◊ Where ever possible capacity building activities for EIA and environmental issues should held in tandem with other capacity building activities of the project

Environmental Management and Monitoring Cost: The cost of overall environmental and social management includes Waste management, Dissemination, and Impact compliance and evaluation and capacity building and is estimated to be **USD 0.62 million** over the project period.

Consultation: Preparation of the project and its environmental and social frameworks included extensive consultations with stakeholders through several focus group discussions, informal consultation meetings. Initial consultations at field level were held during June, 2015 to share the project objectives and potential impacts. A national level consultation meeting with implementing agencies, NGO and civil society held on November 25, 2015 at Dhaka.

List of Acronyms

ADPC	Acoustic Doppler Current Profiling
ARG	Automatic Rain Gauges
BAMIS	Bangladesh Agro-meteorological Information System
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BDT	Bangladesh Taka
BMD	Bangladesh Meteorological Department
BWDB	Bangladesh Water Development Board
DAE	Department of Agricultural Extension
DC	Deputy Commissioner
DG	Director General
DO	Dissolved Oxygen
DoE	Department of Environment
DoF	Department of Fisheries
EA	Environmental Assessment
ECA	Environmental Conservation Act
ECC	Environmental Clearance Certificate
ECoP	Environmental Code of Practice
ECR	Environment Conservation Rules
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ESU	Environmental and Social Unit
ESMP	Environmental and social management plan
FGD	Focused group discussion
GoB	Government of Bangladesh
GTS	Global Telecommunications System
HPC	High Performance Computing
JOWOGRAM	Joint Working Group of on Agrometeorology
khas	Government owned land
MoEF	Ministry of Environment and Forest
NAPA	National Adaptation Program of Action
NEMAP	National Environment Management Action Plan
NEP	National Environment Policy
NFP	National Fisheries Policy
NGO	Non-Governmental Organization
NWMP	National Water Management Plan
NWP	National Water Policy
O&M	Operation and maintenance
PIU	Project Implementation Unit
PSC	Project Steering Committee

PPE	Personal Protective Equipment
PWD	Public Work Department
WB	World Bank
WIS	Weather Information System
WMO	World Meteorological Organization
WRF	Weather Research & Forecasting

Table of Contents

List of Tables

List of Figures

1. Introduction

1. The Government of Bangladesh (GoB) with support from the World Bank intends to strengthen the capacity of the GoB in delivering reliable weather and climate information services and improve access to such services by priority sectors and communities. This objective will be achieved by strengthening hydromet monitoring and forecasting, and service delivery related to water, agriculture and multi-hazard disaster risk management early warning systems. Such national level bottom up capacity strengthening activities support national development goals and also help implement key Regional Agreements relating to environment, disaster and climate resilience. It will be financed through IDA credit with contributions from GoB counterpart funding. The project would be implemented by three agencies (i) The Bangladesh Meteorological Department (BMD), (ii) the Bangladesh Water Development Board (BWDB) and (iii) the Department of Agricultural Extension (DAE).

2. As per policy and legislative requirement of the World Bank and the GoB, an Environmental Assessment (EA) has being undertaken at the preparation stage of the project. Since the exact location of the different components of the project will be unknown during the preparation phase, a framework approach for EA has been adopted. An Environmental Management Framework (EMF) has been prepared to guide the detailed EAs addressing all environmental safeguard issues for proposed interventions from preparation, through review and approval, to implementation of the program.

1.1. Background

3. Given the hydrological setting and largely agrarian economy of Bangladesh, knowledge of weather, water and climate events; reliable weather forecasts; effective warning systems for extreme climate events; understanding of the processes, pathways and consequences of climate change and climate variability are all necessary for sound and sustainable development of socio-economic and environmental programs in the country. Moreover, to maintain and build on development gains, leverage ongoing governance and economic reforms, and meet its ambitious goal of becoming a middle-income country by 2021, strengthening preparedness to weather, water and climate extremes and increasing resilience to natural disasters is critical for Bangladesh.

4. The GoB is making important investments in critical infrastructure and in preparedness and response, particularly with respect to tropical cyclones. This includes over a billion dollars in support from the World Bank to GoB on investments in coastal infrastructure and cyclone shelters. Despite these investments, the country's hydro-meteorological information infrastructure over land, atmosphere and ocean, basic public weather services, forecasting, and multi-hazard end-to end early warning systems remain weak and need to be strengthened. Important weather and climate dependent sectors such as agriculture need tailored weather and climate data, products, information and services to improve planning and decision-making and to mitigate the adverse effects of climate variability and change. Provision of such services at present is limited and needs to be strengthened. Better observational data and data access are necessary to improve knowledge of ongoing changes, to enhance model performance, and facilitate adaptive management. A strong and robust hydrometeorology monitoring network is therefore fundamental to further work on detection and attribution of present-day hydrological changes; in particular, changes in water resources and in the occurrence of extreme events.

5. The interventions of Bangladesh Weather and Climate Services Regional Project are expected to encompass improved meteorological information services, improved hydrological information services, strengthened forecasting and early warning systems, and improved

dissemination of agro-meteorological information. It will be implemented over a period of 5 years. The project has four components. These are:

Component A: Strengthening Meteorological Information Services
Component B: Strengthening Hydrological Information Services and Early Warning Systems
Component C: Agro-meteorological Information Systems Development
Component D: Contingent Emergency Response Component

6. In general, the project is not expected to have significant environmental impact due to the nature of investments. However, the project may finance some infrastructure and install some equipment in environmentally sensitive areas. As a result, although an EMF is not required in the GoB national regulations, it is required for World Bank-financed projects in order to ensure compliance with the World Bank safeguard policies. The reason for adopting framework approach is that site specific interventions to be funded under the project will be identified during project implementation phase. Consequently, an EMF which sets out guidelines and procedures so that proposed project components take into account environmental concerns has been prepared.

1.2. Objectives

7. The main objective of the Environmental Management Framework (EMF) is to provide general policies, guidelines, and procedures to be integrated into the design and implementation of all components under the proposed project. In order to achieve the main objective, the specific objectives of the EMF are to:

i) Establish clear procedures and methodologies for the environmental and social planning, review, approval and implementation of components to be financed under the project;
ii) Provide an overall potential environmental impact assessments of the proposed project activities and suggest component specific standard environmental mitigation
iii) Specify appropriate roles and responsibilities, and outline the necessary reporting procedures, for managing and monitoring environmental and social concerns related to components;
iv) Identify the institutional barriers and determine the training, capacity building and technical assistance needed to successfully implement environmental management practices;
v) Estimate the funding requirement environmental screening, implementation of management plan, monitoring, reporting and capacity building; and
vi) Provide practical information resources for environmental management related to the project.

1.3. Approach

8. In order to prepare the EMF, the project has adopted the following approaches:

- Review of the project details
- Interaction and discussions with the project implementing agencies and the design team
- Review of the policy and regulatory requirements
- Reconnaissance field visit to examine possible installation locations and installed equipment (under separate project of BWDB)
- Consultations with the stakeholders including beneficiary/affected communities
- Development of screening matrix or checklist to identify potential impacts
- Development of Environmental Management Framework (EMF)
- Exploration of institutional mechanisms for implementation of EMF

9. The proposed EMF has been prepared following the standard methodology consisting of the steps listed below (shown in Figure 1.1),

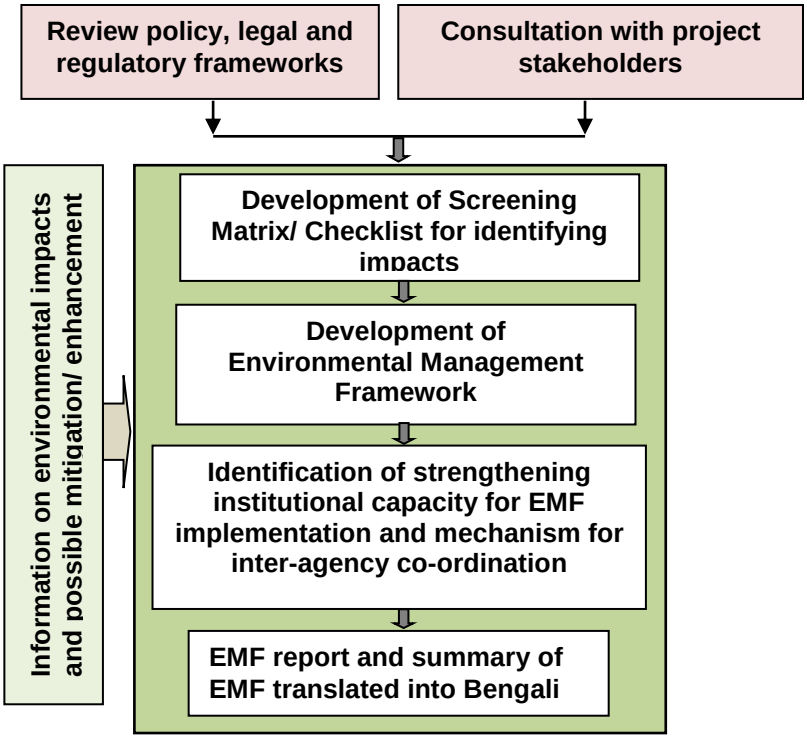


Figure 1.1: Approach of EMF

1.4. Organization of EMF

10. This EMF is organized with the following chapters:

Chapter 1: Project background, objectives, study methodology

Chapter 2: Description of the project and the proposed interventions and other salient information relevant for environmental assessment.

Chapter 3: The policy, legal and administrative framework. Environmental policy and legal requirement analysis: both Statutory and World Bank Group's and implications on the proposed project.

Chapter 4: Baseline information, checklist of information to be collected.

Chapter 5: Potential Project Impacts and Mitigation Measures. An overview of environmental issues related to project components. The assessment includes environmental implications due to the project components and mitigation measures

Chapter 6: Procedures for Review, Clearance, and Implementation of Component Safeguard Instruments. Includes Safeguard Screening and Impact Assessment, Development of Component Documentation, Review, Approval, and Disclosure of Component Safeguards Instruments, Implementation, Supervision, Monitoring, and Reporting

Chapter 7: Implementation Arrangements for implementation of the EMF

Chapter 8: Capacity Building, Training, and Technical Assistance

2. Overview of the Project

11. The GoB with the support from World Bank intends to enhance the capacity to deliver weather and climate information in priority sectors and to respond to climate variability and hydro-meteorological disasters. The expected cost of the project is in the range of USD102 million. It will be financed through IDA credit with contributions from GoB counterpart funding.

2.1. Project Objectives

12. The proposed development objective of this project is "to strengthen the capacity of the Government of Bangladesh to deliver reliable weather and climate information services and improve the access to such services by priority sectors and communities". Such national level bottom up capacity strengthening activities support national development goals and also help implement key Regional Agreements relating to environment, disaster and climate resilience. The objectives related of each of the three main components are:

- **Component A:** to strengthen BMD's meteorological monitoring network, forecasting capacity and delivery of weather and climate services.
- **Component B:** to improve hydrological observation, forecasting, and early warning systems.
- **Component C:** to provide agrometeorological services to farmers in order to increase agricultural productivity and assist the farmers in coping with weather and climate extremes.

2.2. Project Description

13. The project interventions are expected to encompass improved meteorological information services, improved hydrological information services, strengthened forecasting and early warning systems, and improved dissemination of agro-meteorological information. It will be implemented over a period of 5 years. The Project Development Indicators include:

- Improved accuracy and lead time for weather forecasts and multi-hazard early warnings
- Increased sharing of data and information for extreme regional events
- Increase in number (%) of end users satisfied by hydro-meteorological services
- Increased farmer satisfaction with agro-meteorological services

14. The project would be implemented by three agencies:

- The Bangladesh Meteorological Department (BMD) under the Ministry of Defense,
- The Bangladesh Water Development Board (BWDB) under the Ministry of Water Resources and
- The Department of Agricultural Extension (DAE) under the Ministry of Agriculture.

15. As mentioned earlier, the project has four components, the main three components are to be implemented by these three agencies and each component has sub-components. The four components of the project are:

- Component A: Strengthening Meteorological Information Services
- Component B: Strengthening Hydrological Information Services and Early Warning Systems
- Component C: Agro-meteorological Information Systems Development

- Component D: Contingent Emergency Response Component

16. The project components are summarized in the Table 2.1.

Table 2.1: Summary of Project Components

No	Component	Implementing Agency	Sub-Component
A	Strengthening Meteorological Information Services	Bangladesh Meteorological Department (BMD)	Strengthening Meteorological Monitoring and Forecasting
			Institutional Capacity Strengthening, Project Management, Monitoring and Evaluation
			Weather, Disaster Early Warning and Services
B	Strengthening Hydrological Information Services and Early Warning Systems	Bangladesh Water Development Board (BWDB)	Strengthening Hydrological Observation Network and Forecasting
			Institutional Strengthening, Regional Collaboration, Project Management and Monitoring and Evaluation
			Flood Early Warning Systems and Service Delivery
C	Agro-meteorological Information Systems Development	Department of Agricultural Extension (DAE)	Bangladesh Agrometeorological Information System (BAMIS)
			Institutional Capacity Strengthening, Project Management, Monitoring and Evaluation
			Institutional Capacity Strengthening, Project Management, Monitoring and Evaluation
D	Contingent Emergency Response Component		No sub-component

17. The design of this project is based on the recognition that while weather and hydro-meteorological hazards have national level impacts, they are also shaped by weather patterns and systems at regional and global scales. As such, both national capacity strengthening and regional collaboration are critical to improving hydro-meteorological services in Bangladesh. However, for Bangladesh to access already publicly available resources and forecasts, strengthening national level capacity and ICT infrastructure systems is essential. This will need to be complimented by targeted regional and sub-regional consultations to leverage economies of scale and strengthen collaboration with regional partners. This project will support engagement at both levels to harness the linkages between the two.

18. **Component A: Strengthening Meteorological Information Services (USD 42.62 million).** The component seeks to strengthen BMD's capacity to improve public access to weather and climate services through the enhancement of meteorological observation network, forecasting capacity and delivery of weather and climate services. This Component has three Sub-Components as follows:

19. **Sub-component A1: Modernization of Meteorological Observation Systems and Forecasting (USD 28.68 million).** This sub-component will modernize BMD's observation networks, communication and ICT systems, and improve numerical weather prediction and weather forecasting systems. It comprises of the following activities:

(a) Sub-Component A1.1 Modernization of surface, ocean and upper air monitoring networks and ICT systems: This includes (1) support for a Meteorological Systems Integrator (MIS) consultancy to assess, design, prepare technical documentation and support BMD in the implementation of key project activities; (2) upgrade 35 existing synoptic stations and 440 AgMet automatic weather stations; (3) strengthen urban resilience through the addition of 65 new

automatic rain gauges (ARGs) in Dhaka, Chittagong, Khulna, Rajshahi and Sylhet; (4) installation of three C/X band Doppler Weather Radars to measure radar reflectivity to derive quantitative precipitation estimates (QPE) to support civil aviation and extreme urban rainfall events in nearby cities; (5) installation of AWOS and other instrumentation to support civil aviation at the three international airports; (6) install Coastal-Marine Automated Network (C-MAN) comprised of 40 new coastal marine stations to detect meteorological state parameters, wave height, wave period, and storm surge; (7) installation of few buoy stations for measuring ocean temperature, current, wave dynamics, and other parameters; (8) digital elevation map and bathymetric survey, (9) purchase of 11 portable hydrogen generators to support upper air measurements, (10) upgrade of existing equipment maintenance, repair, and calibration equipment at BMD and (11) Strengthen BMD ICT and Data Center with computer servers and software to help store and process data, GTS upgrade to WIS and expansion of GTS/WIS bandwidth, installation of dedicated and reliable high speed internet communications between BMD offices in Dhaka and Rangpur, Sylhet, Barisal Khulna, Rajshahi and Chittagong.

(b) Sub-Component A1.2: Improving Infrastructure for Forecasting: This includes (12) installation of 5 Nowcasting workstations (hardware and software) at BMD headquarters, three airports at (Dhaka, Chittagong and Sylhet) and at Divisional office for providing advisories on short lead time (less than 6 hours) events; (13) installation of 7 weather workstations (hardware and software) for preparing daily, short, medium and long range weather forecasts and to synthesize and visualize data from various sources such as satellite, the modernized surface observing network, radar data, upper air data, model output and wind shear warning system; (14) procurement of a HPC to improve weather and oceanographic forecasting; (15) consultancy to perform digitization and data rescue; (16) Design and implementation of forecast verification system; (17) Consultancy to install, configure and provide training on WRF as applied to the BMD HPC system; and (18) Consultancy to install, configure, provide training on storm surge and wave models as installed on HPC.

20. ***Sub-Component A1.1: Modernization of the surface, ocean and upper air monitoring networks:*** A priority activity for BMD is to recruit a Meteorological Systems and Services Integrator (MSSI) consultancy to support it on systems assessment, design of different aspects of the modernized network, forecasting and services, preparation of tender documents and technical support through the duration of the project. Such expertise is not adequately available at BMD. It will help BMD PIU both in technical aspects but also in all phases of the procurement process, including the preparation of complete bid documents, pre-bid meetings, bid evaluation review leading to contract award, evaluation of progress during the course of contracted work, and final acceptance of work. Some aspects of the observation and forecasting systems require detailed assessment and design; others can be procured with relatively quick upstream technical work. Moreover, while some tasks will need to be contracted out to other more specialized firms, the MSSI will support the PIU in the envisioning, procurement and integration of these activities. Substantial in country presence of the team leader will be essential for the success of this consultancy.

21. At present, BMD operates 35 synoptic stations, from which weather related data is manually observed and transmitted. Synoptic stations follow a common format and transmit weather data to the GTS at synoptic time to be used by other NMHSs and research institutions, and also in global weather forecast models. However, automatic recording and transmission of data is currently not possible under the existing manual system. This sub-Component will fund automation of the surface synoptic station network that will enable exceptional events such as extreme rainfall and wind events to be recorded automatically recorded and transmitted back to BMD with minimal risk of human error. All upgraded synoptic stations will report observation to the international community through GTS/WIS making this data available for use by NMSs/NMHSs around the world for assimilation in global and regional numerical weather prediction efforts. Data will also be available in real-time to national counterparts and the public in general. Automation is expected to improve data quality, temporal resolution and the timeliness of the information while also providing a richer data set. It will also enhance present weather observations and provide an improved historical record of weather events to be used by both the national and international community. This has a clear regional and global benefit, as this information will be used in global weather analysis and as input to global and regional weather forecast models.

22. Currently, the agro-meteorological (AgMet) community in Bangladesh only has the surface synoptic stations to help support their crop management decisions. This network is not dense enough to characterize micro-scale weather and climate information necessary for farmers. The project will thus support installation of 200 AWS stations that can collect data needed for preparing information, advisories and services for farmers in different agricultural zones and inform farm level decision-making. There are 487 upazilas (sub-district) in Bangladesh; of these, 47 upazilas will already contain an AWS station (35 synoptic stations being upgraded, and the lot of 12 being added). The 200 AWS AgMet stations are expected to be installed at DAE compounds. The exact number and sequencing of AgMet stations to be installed will be determined after further analysis and so the tender document will consist of two phases, the first phase for up to 106 AgMet stations at established Ag Extension offices and the remainder to be placed after BMD performs a study on network density requirements, physical layouts and locations within the DAE compounds. This has the potential to benefit the region in developing climate indicators that will help frame climate variability in Bangladesh and the region in general. However, this data will need to be freely shared to have this benefit.

23. Extreme rainfall events cause disruption to transportation and the general well-being of the urban community. For instance, water pumping plants require rainfall information in order to effectively plan for the removal of water where it has accumulated. However, at present, there are an insufficient number of rain gauges in the major urban areas. As such BMD is unable to provide effective information relating to extreme rainfall events to users such as Dhaka WASA. Sub-Component A1.1 will strengthen precipitation monitoring in four major urban areas that will receive a total of 65 new automatic rain gauges (ARGs) that report in real-time. Of these, 20 stations will be placed in Dhaka, 15 in Chittagong, 10 stations each in Khulna, Rajshahi and Sylhet. For Dhaka, these could be located on Dhaka/WASA premises. The locations of automatic rain gauges in Chittagong, Khulna and Rajshahi have to be decided. The need for installing additional rain-gauges will be determined based on assessment and design undertaken by the MSSI consultancy. Rain gauge stations will employ the mobile network GSM radio technology, with two SIM cards using two different network providers as available. This information will be primarily used for urban flooding modeling and input to Nowcasting and numerical forecasting systems. It is expected that the new rainfall data can be used to calibrate the radar-rainfall relationship so that the weather radars can be effectively used to provide Quantitative Precipitation Estimates (QPE) and short term (~< 60 minutes or more) Quantitative Precipitation Forecasts (QPF). Grant funding from JICA led to the acquisition and installation of 6 rainfall stations that report in real time. The maintenance of these 6 stations will be included as part of the goods and services to be provided to support the urban rainfall network. Upgrading the rain gauges will also help to calibrate the existing radars used by BMD. Proper calibration of the radar network to derive radar – rainfall estimation will in turn be very useful for hydrological forecasting (to be conducted by BWDB). This activity has the potential for regional and global benefits because it provides a signal of climate variability and the impact on urban areas. For this benefit to occur the data should be readily shareable to other countries (e.g. Mayanmar).

24. BMD operates a network of 5 S-Band radars that provide coverage of Bangladesh and surveillance out over the Bay of Bengal to detect the speed, movement, and intensity of approaching cyclones. The S-Band radar is ideally suited for long range reconnaissance, but in exchange for the long range of the radar, sensitivity to lightly precipitating or developing clouds is compromised. This is especially important in the vicinity of airports, where wind shear leading to turbulence can disrupt and cause harm to civil aviation. For this reason, 3 X/C-Band radars are required to observe rain and wind patterns over the three international airports of Dhaka, Chittagong, and Sylhet. These radars will also monitor rainfall over the three urban areas that are adjacent to the three airports and provide value to the urban rainfall detection and measurement cited earlier. It is expected that the data from the new three X/C-Band radars will be made available and displayed on both the Nowcasting and general weather workstations. Radars should be located sufficiently far enough away from the airport to effectively monitor runway approach and departure runways while keeping in mind the surveillance over the nearby urban areas. This procurement will include a provision to store the data in an open format on BMD, and will also include the integration of the legacy radar network data with the new radar network into a single open source (non-proprietary) database for use as BMD requires. This will include the developing a mosaic that will show both radar networks on the same display. This will have a clear regional and global benefit of assuring safeguards to civil aviation from weather related events at the international airports in Bangladesh.

25. While the new radar systems at the three international airports that support civil aviation and safe air navigation, they will not help with clear air wind shear events. To address the latter, Sub-Component A1.1 will support setting up an Aviation Weather Observation System (AWOS) that can be used to support civil aviation in all instances, including clear air wind shear events where radar is ineffective. AWOS will be installed at international airports at Dhaka, Chittagong, and Sylhet. The AWOS stations will include computer systems to collect and process the information and provide guidance and warning to flight controllers and other civil aviation staff as well as the international aviation community. This will have a clear regional and global benefit of assuring safeguards to civil aviation from weather related events at the international airports in Bangladesh.

26. Bangladesh's coastal areas are highly vulnerable to tropical cyclones associated with highly destructive storm surges. In order to improve the accuracy and lead time of its cyclone forecasts and develop capacity for storm surge forecasting, BMD needs to strengthen its marine information network and database. However, at present, BMD has no coastal observations of meteorology and oceanographic conditions in support of the severe risk prone coastal region where many lives have been lost due to storm surge and resulting inland inundation. The Bangladesh Inland Water and Transport Authority (BIWTA) operates 17 tide level gauges to support navigation on inland rivers, but these are not designed to focus on the dynamic effects of a cyclone on wave conditions, especially storm surge. Sub-Component A1.1 will support Coastal-Marine Automated Network (C-MAN) consisting of the installation of 40 coastal marine automatic stations placed along the Bangladesh coast line. The coastal surge stations automatically measure general state weather parameters (temperature, relative humidity, wind speed, wind direction, atmospheric pressure, and rainfall), and sea level, wave height, and wave period. They will be especially useful in detecting the impact of cyclones on storm coastal wave height and period. The stations will report through mobile network GSM data telecommunications, utilizing dual sim cards from different mobile network operators. The measurement of storm surge inundation is critical in characterizing the inundation from storm surges. It is expected that this data will be vital in calibrating and validating surge inundation models. It is envisioned that these 40 storm surge stations will use a single pole, and radar water level device. The stations will utilize the mobile network GSM Data transmission system to transmit data in real time. The storm surge station, as with all stations, should also log all data, holding a minimum of one year's worth of data. These stations can be operated with very low power consumption, so using a larger battery with semi-annual or annual battery changes may eliminate the need of a solar panel which is often target of theft and damage. These stations and equipment could be temporarily removed during periods where there is no threat of storm surge or inundation from inland flooding, and re-installed just prior to the season when coastal inundation generally occurs. The purpose of doing this is to minimize the opportunity to vandalize the equipment. This activity has the potential for regional benefits. The coastal monitoring network can help develop the regional long-term trends of storm surge. Also, the improved coastal observation systems can also benefit adjacent coastal communities in both India and Myanmar, provided the data is shared in real-time.

27. BMD does not have any Oceanographic buoy monitoring stations in the Bay of Bengal, an area where cyclones approach the coast of Bangladesh. Sub-Component A1.1 will support purchase and installation few buoy stations. The MSSI contractor will undertake an assessment of type of buoys needed, costs of operation and maintenance, prepare the tender and do site selection in consultation with BMD. The buoy network will be used for improved navigational safety and planned management of marine resources, directly contributing to reduce risks related to economic activities over maritime areas of Bangladesh. A buoy network would be established to monitor open sea conditions, including wave height and period and meteorological state parameters. The information will be used for issuing immediate advisories as well as input to storm surge forecast models. This activity has the potential for clear regional benefits and can be used to improve cyclone forecasting in the Bay of Bengal (BoB) countries including countries such as Bhutan that also experience cyclones but do not have the infrastructure or capacity to invest in forecasting this hazard.

28. A present, BMD does not have the capacity to undertake storm surge modeling and forecasting due to lack of high resolution DEMs or bathymetric data. With support from JICA, the Survey of Bangladesh is carrying out a DEM but the resolution is not sufficient for storm surge modeling. Moreover, there is no baseline bathymetric data for the 710 km coastline despite its extreme vulnerability to cyclone associated storm surges. To address this gap, Sub-Component A1.1 will support preparation of high resolution bathymetric survey. A combination of methods such as LIDAR, sonar will be considered for carrying out the survey. The data will publicly available so that it

can be used by various stakeholders. Improved bathymetric data once publicly shared will also have clear regional benefits to help improve storm surge modeling and forecasting in neighboring countries.

29. BMD operates 3 upper air stations that report a vertical profile of atmospheric conditions, including temperature, relative humidity, wind speed, wind direction, and atmospheric pressure heights. From this, dozens of derived parameters can be deduced. Data gathered by the upper air (radiosonde) stations are used to measure atmospheric parameters at all levels, and contribute to the international set of radiosonde data that is integrated into global and regional Numerical Weather Prediction (NWP) models and, in particular, would be used in running BMD's WRF and HWRF models. In addition to the three, one more station will be procured through IMD's STORM project. There are also a number of pibal stations in operation. The upper air stations are especially useful to and assimilated in global and regional Numerical Weather Prediction (NWP) models which in turn are used by BMD as well as the region. Radiosonde and pibal measurements require balloons filled with hydrogen to perform observations in the boundary layer as well as the upper atmosphere. The current operation of these measurements has been hampered by the lack of capacity to produce hydrogen gas. Sub-Component 1.1 will support purchase of 11 portable hydrogen gas generators to provide hydrogen gas to fill radiosonde and pibal balloons and to continue these measurements. The biggest challenge in maintaining upper air stations is relatively high recurrent cost as they require regular purchase of consumables including sondes and balloons. Recognizing the regional benefits of this activity, IMD, Delhi is already supporting BMD with 1 station for the Severe Thunderstorm, Observations and Regional Modeling (STORM) pilot program. Launching of more upper air balloons will allow the use of data from existing stations to be more routinely included in global weather analysis and as input to global and regional weather forecast models and thus has important regional benefits.

30. Upgrade of the existing equipment maintenance, repair and calibration facility at BMD: The existing BMD repair facilities are suitable for manual equipment. However, with the introduction of new automatic systems the existing calibration methods and equipment will need to be updated. Sub-Component A1.1 will support strengthening of BMD sensor maintenance, repair and calibration facility. This will include the acquisition of new temperature, relative humidity calibration systems, wind tunnel system, pressure calibration facility, solar radiation, and rainfall (tipping bucket) calibration system as well as portable calibration facility. This is key to maintaining the newly acquired equipment as part of this project and other bi-lateral activities. This facility will have direct consequences on the quality of all data BMD collects for national purposes, including information coming from synoptic stations shared with the regional and international community.

31. The modernization and expansion of BMD's observation network and improvement in forecasting and service delivery, will require significant improvements in its ICT capacity. Sub-Component A1.1 will support purchase of server(s) for data storage, quality control, product production, and analysis. It will also support purchase of office equipment (computers, printers, copiers, fax machines, and software) to support an efficient public weather service. ICT improvements will touch all BMD offices and allow the storage/retrieval of any data collected by BMD. Communication systems strengthening will include installation of highly reliable and dedicated high speed internet communications between the BMD offices of Dhaka, Rangpur, Sylhet, Barisal, Khulna, Rajshahi, and Chittagong. This will be required to improve services and the flow of information, forecasts, warnings and general communication within BMD. At present, BMD does not have sufficient bandwidth to receive data and information products that are issued by the Indian Meteorological Department (IMD) (such as tropical cyclone forecasts for the Bay of Bengal). Sub-Component A1.1 will also support expansion of BMD's bandwidth and GTS link and upgrade to the WMO Information System (WIS). This will be done in collaboration with national telecommunication companies and also regional meteorological agencies/WIS's Global Information System Centers (GISC) particularly IMD. This activity will have potential benefits to the region and international community, as the efficient movement and storage of information collected in Bangladesh will allow the information to be more readily shared to these communities.

32. ***Sub-Component A1.2: Improving infrastructure for Weather Forecasting:*** Currently BMD prepares forecasts through weather charts maps that are prepared manually and uses observation systems that are not tightly integrated. It uses computers to display products individually, making it difficult to assimilate information while taking precious time. This is not adequate to do forecasts for weather, extreme weather related events such as tropical cyclones and climate

prediction. As the meteorological observation system is modernized, there will be an abundance of information arriving at BMD which will require hardware and software tools to integrate the data to develop forecasts. To support this, Sub-Component A1.2 will support purchase of 7 weather workstations which will be located at BMD headquarters (4 workstations) and one each at the three international airports. The weather workstations will focus on providing a visual interface to data and products that the duty forecaster can use to help prepare forecasts. It is expected that workstations will be dedicated to given forecast activities, which is presently not the case. For instance, of the BMD weather workstations, one workstation will be dedicated to preparing short-mid range forecasts, another workstation to long range forecasts, another to help prepare marine forecasts, and another to prepare civil aviation forecasts. The decision as to the function of each weather workstation will be taken up by BMD in consultation with the MSSI. The workstations will perform Next Generation 4-D Forecast System and decision support. These workstations will be able to integrate the weather radar data, satellite data, and surface weather data, NWP model data, among other data sets as available at BMD. They will also facilitate the preparation of public weather forecasts, aviation forecasts, marine forecasts, severe weather forecast, cyclone forecasts, storm surge forecasts, urban weather forecasts and other forecasts of interest to BMD and other users. Quite often the formulation of weather forecast in a given country considers the forecasts being developed in adjacent countries. Thus, this activity has the potential for regional benefits in that forecasts developed by Bangladesh can be shared throughout the region, especially countries such as India, Myanmar, Nepal and Bhutan.

33. At present, BMD does not have the capacity to detect hazardous meteorological events such as extreme precipitation events in real time. To do so, Sub-Component A1.2 will support acquisition of five Nowcasting workstations which include software to assimilate radar data, surface observations, and satellite pictures among other products. Nowcasting workstations are specifically geared towards rapid processing and assimilation of real-time data and detection of hazardous meteorological events. The workstations will be located at the three international airports, Dhaka, Chittagong, and Sylhet, with one Nowcasting workstation at BMD headquarters and the BMD office in Rajshahi. The 5 workstations will have client software working with the server side software located at the BMD data center. The server side software will be the central collection point of all data used by the client software at the 5 locations. The server software will be able to display data from the newly acquired ARG's and AWS's, radar (new and legacy) data and radar derived products (i.e. Quantitative precipitation estimation (QPE), and Quantitative precipitation Forecasts (QPF)), satellite data, forecast maps, and the newly instituted Flash Flood Guidance (FFGS). The enhanced observational and assessment capabilities facilitated through the workstations are expected to improve civil aviation safety as well as extent the lead time for issuance of weather-hazard related emergency warnings to at risk sectors and vulnerable communities. This network will be one server based at BMD Dhaka, and five workstations that will work with the server in displaying data and annunciating hazardous conditions.

34. BMD currently provides 24 hour forecasts online and 72 hour forecasts in the form of Weather Research & Forecasting (WRF) model products. In order to provide longer term forecasts, and provide cyclone and climate forecasts, Numerical Weather Prediction will require strengthening. This improvement of technical capacity would require High Performance Computing (HPC) to run a series of models. BMD does not have this capacity at present. Sub-Component A1.2 will support purchase of a High Performance Computer that will need to be properly designed to accommodate the number of models, model runs per day over the domain and grid size to support the specific forecast activity. The High Performance Computing (HPC) facility will run a series of models, including but not limited to WRF ensemble forecasts, climate models, cyclone models, and storm surge forecast tools simultaneously. This will require an assessment of the models to be run, benchmarking of computer system and selection of the most effective HPC system. The MSI will undertake an assessment of the requirements for the HPC system and prepare tender documents. The HPC system would be used to provide improved guidance for the duty weather forecaster as well as for research activities, including testing a wide variety of meteorological models to help improve the quality of the services provided. NMS often use upstream country forecasts to help develop their own forecasts. Any improvements in numerical weather prediction in Bangladesh will have potential regional benefits as long as the Model Output Statistics (MOS) and forecasts are shared with the regional partners.

35. An important objective of this project is to improve the accuracy and lead time of weather related forecasts and services delivered. A forecast verification scheme (FVS) will help in quantifying the degree of improvement and will be supported through Sub-Component A1.2. Design of the

verification scheme will be done by the MSI contractor. Improvement to forecasts can be quantified with the use of a forecast verification system. As forecasters record their forecasts and the forecasts are later verified, they will know which forecasts where in error, and what the error is. If the forecasts have a certain bias, then the forecasters can use this knowledge to remove the bias. The first step is to record and verify the forecasts, which is the intent of this activity.

36. Currently, BMD does not currently store spatial data, such as raw radar data, satellite pictures, weather charts, and other such information. If this information was stored, BMD or researchers could use this information in studies that could be used to improve understanding of weather systems over Bangladesh and forecasts. To store this type of data and the historical record of meteorological data collected by it, BMD will require a database server of sufficient size. Some storage may need to be offline, in order to conserve costs, but all information will be saved for post analysis as needed. This will require the use of an existing server or a purchase of a new server as required, storage/retrieval software to store all of the spatial and forecast products. MSI contractor will write the TOR in consultation with BMD to identify all target data sources. Sub-Component A1.2 will support a consultancy on data digitization that will gather the data and products, digitize them and put them on the appropriate servers.

37. Once the new HPC is installed a consultancy to install all of the models will be required. A partial list of models includes WRF and HWRF. Additional models and ensemble models will be identified by the MSI consultancy, and will target climate, storm surge, and cyclone movement among other objectives. The installation of these models will require thorough training and documentation as part of the consultancy to install the models. This activity will include at a minimum Meteorological NWP, cyclone, climate and storm surge models and will have both national and regional benefits.

38. ***Sub-Component A2: Technical and institutional Capacity Strengthening, Regional Collaboration, Project Management, Monitoring & Evaluation (USD 9.51 million):*** The main objective of this component is to support technical capacity building of BMD, regional collaboration support project management, monitoring and evaluation. This includes the following:

> ***(a) Sub-Component A2.1: Technical and institutional Capacity Strengthening and Regional Collaboration which includes:*** (1) consultancy on training needs assessment, (2) training for BMD officials through a combination of in-house training, study tours, targeted training courses in collaboration with other meteorological agencies, twinning arrangements, (3) development of a legal and regulatory framework and data sharing policy for BMD, (4) consultancy to support refurbishment of BMD and Divisional offices; (5) refurbishment of BMD and divisional offices; (6) regional technical studies, and (7) support to scaling up ongoing regional pilot programs which include developing linkages to GEO and necessary downscaling of the FFGS.
>
> ***(b) Sub-Component A2.2: Project Management, Monitoring and Evaluation*** which will support (9) supporting PIU functions through hiring of technical experts and consultants, technical studies and monitoring and evaluation.

39. ***Sub-Component A2.1: Technical and institutional Capacity Strengthening and Regional Collaboration which includes:*** One of the most critical aspects of this challenging program is to strengthen the technical capacity of BMD. Further, BMD has not implemented a project of this scale before and in additional to technical training, needs training in project management and contract management at the beginning of the project. Lessons from other projects have shown that frontloading this type of training can be significantly beneficial to the PIU. Sub-Component A2.1 will therefore support training on project and contract management for BMD officials. It will help BMD PIU to effectively manage the numerous contractors that will be obtained during the course of this project. BMD modernization will introduce many new ways of conducting meteorological practices. Sub-Component A2.1 will support a consultancy on training needs assessment and development of a well thought out training plan. It will be based on an assessment of the current capacity of BMD staff, identification of training needs and involve development of a time-bound plan for areas of training, phasing, and modalities and institutions through which specific training will be provided. Training for BMD officials through a variety of means such as in-house training, short term study visits to other NHMSs, twinning arrangements, study tours, and other modalities such as distance learning will be included. Technical areas where BMD needs to build capacity include but are not limited to technical skills to support and operate observing networks, weather forecasting, climate modeling, sector

specific products development and many others. At present, there are no dedicated Departments of Meteorology or agro-meteorology within the University system in Bangladesh. This is a major gap. Modernization of the scale envisioned in the project can only be sustainable if there is a regular and strong cohort of professionals to undertake meteorology related research and operational work. This Sub-Component will support design and development of a Department of Meteorology at Dhaka university.

40. At present, BMD does not have a legal and regulatory framework that is geared towards service delivery. Sub-Component A2 will support development of a legal and regulatory framework for BMD operations, in line with other countries NMSs and in coordination with related laws in Bangladesh. Such a framework will strengthen BMD's mandate to provide authoritative meteorological alerts and warnings and help confirm its role as the institution with the responsibility to issue warnings of meteorological and oceanographic hazards. Regulation will also classify the responsibilities of other government agencies and organizations, which are affected by these hazards, ensuring more timely and effective responses that will help mitigate weather-related disasters. BMD does not have a data sharing policy and preparation of such a policy will also be supported through the Sub-Component A2. Open access to data sharing between organizations will make every organization that is involved in data sharing more effective, invite private sector actors to get involved and play a greater role in innovating in services and improve overall service delivery. A data sharing policy must be devised and implemented without hesitation. The data sharing policy will need to be negotiated between the various stakeholders. It will rely on open, non-proprietary, methods of data sharing where all partners can exchange data seamlessly and automatically. An example of this is the DCP Data Service (DDS) supported by the United States Weather Service. The DDS only includes the automatic exchange of data, the envisioned data sharing in Bangladesh will need to also include products.

41. Refurbishment of BMD headquarters and Divisional offices: BMD will expand office space to house the new data center, high performance computer, and forecast workstations among space requirements that will come with expanded services and service delivery. At present, the existing office space at BMD headquarters is insufficient for the above activities. Similarly, office space at the divisional offices will need to be improved and re-designed to provide functional workspace to the extent required by the staff and expanded service expected from the divisional offices. The office space will be designed by a consultancy that will also prepare the building specifications that will lead to office improvement at the 7 BMD offices targeted.

42. Roadmap and Scaling up Regional Collaboration: Sub-Component A2.1 will support technical studies including consultancy to develop a roadmap on regional collaboration. Based on consultations with regional and sub-regional partners, it will include assessment of areas where BMD is already collaborating with regional partners, areas where this collaboration can be further strengthened, areas where it needs support from regional partners and areas where it can provide support to others. Based on this, the Sub-Component will also support scaling up ongoing regional and sub-regional programs such as the STORM program, Severe Weather Forecasting Demonstration Project in the Bay of Bengal, the SASCOF process; improved collaboration with IMD to improve tropical cyclone forecasting in Bangladesh, improved forecasting for thunderstorms and others.

43. ***Sub-Component A2.2: Project Management, Monitoring and Evaluation:*** Sub-Component A2.2 will support project management activities, technical studies, participation in regional consultations, and monitoring and evaluation. At present, BMD does not have adequate capacity for managing project activities on a day to day basis. To support this, Sub-Component A2.2 will support hiring of consultants including a national project technical coordinator to steer the project, procurement consultant, financial management consultant, monitoring and evaluation consultant and communication consultant.

44. ***Sub-Component A3: Strengthening Weather Services, Early Warning Systems and Climate Service Delivery (USD 4.43 million):*** This sub-Component aims to strengthen BMD service deliver for weather services, disaster related early warning systems and climate services. It comprises of the following activities:

(a) Sub-Component A3.1: Weather and Disaster Early warning Services: which includes (1) Baseline survey to assess user needs, (2) consultancy to develop software, integrate and share weather and climate data, information and products within BMD and among BMD and stakeholders (such as BWDB, DDM) as an automated subscribed service; (3) consultancy to design and implement the Common Alerting Protocol (CAP) system (involving computers, software and end user facilities) in collaboration with the Department of Disaster Management, the BWDB and other end-users; (4) design and implement software (Data Factory) to provide automated product generation based on requirements from stakeholders.

(b) Sub-Component A3.2: Community Based Early Warning Services: which includes support to Community based early warning system for drought and extreme meteorological events in (north east districts):

(c) Sub-Component A3.3: Climate Services: which includes (1) Consultancy to install software, configure, and provide training on climate prediction model and seasonal prediction; (2) consultancy on divisional level climate services, (3) upgrade existing BMD webpage into a climate services portal; (4) public education and outreach.

45. ***Sub-Component A3.1: Weather and Disaster Early Warning services:*** Identifying the main users of BMD's services and assessing user needs is a first step to improving service delivery. While BMD provides services to the general public and other stakeholders, it has so far not undertaken any systematic assessment of user needs and priorities. The project will support initiation and institutionalization of this activity. Sub-Component A3.1 will support design and implementation of a baseline survey to assess user needs for weather and climate services. This will allow BMD to understand user needs, provide the basis for designing and developing user targeted services and make necessary improvements delivering those services. The user survey will also provide baseline information for monitoring and evaluation of project activities.

46. The preparation and timely delivery of timely products to users can be highly automated in a scenario where data is automatically collected and stored on systems. Sub-Component A3.1 will support a consultancy to design and program automated delivery of user services. It will be based on an assessment of stakeholder needs, the format and timing at which specific meteorological services are needed by users. Programs developed by this consultancy will integrate the information that the user requires and support automated delivery of services. The consultancy will support automation of user requests, programming the automatic assimilation of information, and delivering this information on a schedule. Sub-Component A3.1 will also support development of software to integrate and share data within BMD and among BMD and stakeholders. This is envisioned to be a data service that runs automatically that makes data available among stakeholders, and any agency subscribing to the service. The model for this service is the DCP Data Service (DDS), which is used by the National Oceanographic and Atmospheric Administration (NOAA), in the distribution of hydro-meteorological data to various sectors.

47. At present BMD does not have the capacity to produce standardized alerts and warnings. Sub-Component A3.1 will also support installation of a Common Alerting Protocol (CAP) which is an international standard that is used to send public alerts and warnings. It is a digital format for changing emergency alerts that allows a consistent alert message to be disseminated simultaneously over many different communication systems. As more systems are built or upgraded to CAP, a single alert can trigger a wide variety of public warning system, increasing the likelihood that intended recipients receive the alert by one or more communication pathways. The MSI will develop a contract language that will result in the set up for CAP for BMD, while coordinating these activities with first responders, such as local community leaders and DDM.

48. ***Sub-Component A3.2: Community Based Early Warning Services:*** This sub-component will support community level drought early warning systems in two of the most drought prone districts of Bangladesh, Rajshahi and Naogaon (to be confirmed). At present, residents of these districts do not receive any drought early warning services. Activities will focus on making drought early warning messages (developed by BMD) understandable to farmers and community members and will be carried out in collaboration with BWDB, Department of Disaster Management (DDM) and DAE. It will build on experience gained through the widely acclaimed Cyclone Preparedness Program (CPP) which is active in the coastal districts, has a large volunteer base and an excellent mechanism for

disseminating alerts and warnings to the communities in the context of tropical cyclones. The proposed community level activities will use a similar model and involve training, working with the disaster management committees at the district, upazila and community levels, building a volunteer base in the drought prone districts, developing and disseminating understandable messages and promoting drought preparedness amongst farmers, sharecroppers and local communities.

49. ***Sub-Component A3.3: Climate Services:*** At present, BMD's Climate Division mainly involves staff involved in digitizing data. The division does not have the capacity to run climate models, interpret and use climate model outputs, prepare climate products or provide climate services to specific sectors. Component A3.3 will support strengthening the capacity of BMD's Climate Services Division and enable it to gradually evolve into a climate forecast application research unit. A small group of BMD officials will focus on current and emerging methods of climate forecasting and provision of climate services. Sub-Component A3.3 will support consultancy to install, configure appropriate climate model and software on the HPC and train BMD officials, which is needed for preparing long term scenarios. The selection of climate model and prediction system will be undertaken by the MSI in consultation with BMD. The software will lead to seasonal forecasts as well as forecasts of 1, 3 and 6 months. The intended use of the model output will be as guidance to users that would be most interested in rainfall and temperature anomalies as well as likelihoods of extreme events such as droughts and floods where applicable. Seasonal forecasts would be used to enhance the guidance and technical assistance provided to communities interested in rainfall and temperature anomalies, such as the start of the rainy season, and temperature and rainfall outlooks, directly contributing to the protecting farmers' livelihoods and improving their food security situation. To the extent that climate forecasts and scenarios are shared at regional and international fora, they also have the potential to improve regional understanding of climate risks.

50. Sub-component A3.3 will also support development of a portal for climate data distribution. A consultancy will be commissioned by BMD to upgrade the existing BMD web portal into a full climate services and meteorological dissemination portal which will also help it to become more visible and easy to use. All of the observation data, products, and forecasts prepared by BMD will be automatically posted on the portal. Based on assessment done by MSI regarding divisional level user needs assessment for products, ICT, staff, training needed, development of climate products, tailored to specific sectors and to communities at the divisional level at Sylhet, Chittagong, Khulna, Barisal, Rajshahi, and Rangpur and supporting enhancing the capacity of these offices as climate centers. It will fund community outreach, education and training activities to improve the capacity and capabilities of the various sectors to utilize weather and climate data and information for decision making. This will also help these sectors to act as effective translators of BMD products and services to ensure that those who need the information can use it effectively.

51. Sub-Component A3.3 will support development of a National Framework for Climate Services (NFCS) in Bangladesh. This will draw on WMO guidance on Global Framework for Climate Services (GFCS) and be based on Bangladesh's own experience with providing services in the agriculture and other sectors as supported through this project. Development of the NFCS for Bangladesh will be supported through a consultancy under Sub-Component A3.3 and be prepared in the 4th year of project implementation. The National Framework for Climate Services will involve broad stakeholder engagement and provide a platform for the exchange of knowledge, know-how, and climate information needs among stakeholders in all climate sensitive sectors. It will also guide the priority activities of its National Climate Center. Essential for an effective climate service is the connection with the end users – communities and individuals, and ensuring that information is properly translated into an understandable form that can be used for everyday decisions by users.

52. **Component B: Strengthening Hydrological Information Services and Early Warning Systems (USD 35.65 million)**: The main objective of this component is to improve the provision of hydrological services in Bangladesh by strengthening hydrological observation, forecasting, and early warning systems. The component would be implemented by the BWDB and includes the following:

53. ***Sub-Component B1:*** **Strengthening Hydrological Observation Network and Forecasting (USD 21.92 million)** The main objective of this sub-Component is to modernize BWDB's hydrological monitoring, ICT systems and forecasting. This comprises of the following activities:

(a) Sub-Component B1.1: Strengthening Hydrological Monitoring and ICT systems: This will include (1) support for a Water Resources System Integrator (WSI) consultancy to assess, design, prepare technical documentation and support BWDB in the implementation of key project activities; (2) upgrading 308 manual water level stations to be equipped with automatic data collection and reporting in real-time; upgrade 257 rain gauges to automatic and real time; upgrade 10 existing climate stations operated by BWDB; and upgrade or establish 1100 groundwater stations and nests of various configurations to automatically report measurements; (3) purchase of 4 catamarans and 4 survey boats for coastal hydrographic survey and stream gauging; (4) purchase 10 vertical profiling ADCPs; (5) purchase of 20 water quality sondes for measuring salinity and total dissolved solids (TDS); (6) purchase 8 echosounders to support river gauging and river morphology measurements; and purchase of 2 survey grade echosounders; (7) 40 land based coastal storm surge inundation stations; (8) 15 handheld TDS meters (9) acquisition of 8 total stations (used for aiding river morphology surveys), 13 RTK-GPS, 6 DGPS beacon receiver, 4 first order digital leveling machine and 2 Sub bottom profiler 5-10m penetration capacity; (9) upgrade of the existing hydrological measurement equipment maintenance, repair and calibration facility at BWDB; and (15) upgrading BWDB ICT systems and communication systems including links with local offices.

(b) Sub-Component B1.2: Hydrological and Flood Forecasting: This includes (16) purchase of 4 Nowcasting workstations for short lead time events and development of flash flood forecasts for flash flood prone areas; (17) upgrade existing flood forecast models to cover coastal areas; (18) hardware and software for development of medium range (weeks up to a month) and long range (seasonal) forecasts and capacity for 24/7 flood forecasts during pre-monsoon, monsoon and post monsoon season as needed.

54. While BWDB has significant technical expertise, it needs the support of a hydrological Systems Integrator consultancy to perform analysis, ensure systems integration as the Hydrology Division modernizes, support preparation of technical documents and work with the BWDB PIU to efficiently guide project implementation. The consultancy will prepare tender documents in World Bank format for BWDB to review, and provide assistance in all facets of tender execution, including attending pre-bid meetings, providing technical assistance with selection, assist with equipment acceptance and acceptance testing, evaluate progress of various goods, works, and consultancy contracts.

55. BWDB's surface water level monitoring network is largely manual with observations that are taken only a few times per day. Much of the data is delivered by post, with some data received for data entry days/weeks after it is collected. The coastal area of Bangladesh is highly influenced by tides and approximately 40% of the river gauging stations are tidal and in the coastal area. The upgrade of these stations to automatic stations will result in a complete record of water level, and discharge in some cases, which will be used to more accurately characterize water level trends and capture peak values. 308 manual water level stations will be upgraded to automatically collect data and transmit it back to BWDB's data center. Installation of additional water level stations in hotspot areas will be determined based on further assessment and design carried by the WRSI consultancy. These stations will consist of non-contact measuring techniques to the extent possible using radar and ultrasonic water level sensors. There will be several categories of stations including bridge mount stations which are most desirable; pole mount stations (in the river bed); and stations that have the sensors cantilevered out over the water from the shoreline. The Mobile Network GSM data network will be used for these stations. The WRSI will be required to perform a survey to make sure communication is available at every site. Regardless of telemetry, all stations will be required to store at least one year of time tagged 15 minute water level measurements. The use of Iridium or VSAT is discouraged because of the high annual recurring cost of service.

56. Rain gauges are very important to understanding runoff from process. This is exemplified where flash floods occur due to locally heavy rainfall. The current manual nature of rain fall measurements does not allow the data to be used for fast developing flood events caused by high intensity, short duration rainfall events. Sub-Component B1.1 will support upgrading of BWDB's 257 rain gauges to measure rainfall automatically and deliver data in real-time. It will allow BWDB to be notified of very quick responding events and prepare near term forecasts for flash flood. The Mobile Network GSM Data system will be used for this network. All rain gauges and repeaters will be

located on BWDB land; otherwise private property should be sought whereby the landowner can assure the safety of the station from vandalism and/or theft.

57. BWDB currently manually operates 10 climate stations (located closer to the ground than typical meteorological AWS stations). This data is important for the determination of physical parameters that are used for flood models. Sub-Component B1.1 will support upgrade of these stations to collect and relay data automatically so that it can be integrated into flood models. Data transmission can occur over GSM/GPRS, as this data is not considered vital in real time.

58. In Bangladesh, groundwater is important both for drinking water supply and irrigation. Over 97% of all drinking water supply comes from groundwater. Groundwater fed irrigation also supports dry season cultivation helping Bangladesh to be food self-sufficient and secure. Some of the major challenges facing shallow groundwater resources including water quality issues and also decline of water storage in urban areas. Currently, BWDB already has a large ground water network comprising of over 1100 stations that are mostly manually operated. Data are collected by local contractors and sent to sub-divisional offices and eventually to Dhaka for storage and analysis. Modernizing will improve the quality and frequency of data and also improve the chain of custody of the data. To support improved monitoring and management of groundwater resources, Sub-Component B1.1 will support upgrading these stations and nests (group of boreholes) to automatically report measurements. Modernization will allow BWDB to have a better assessment of the country's ground water resource both in terms of quality and quantity measuring parameters like water level and salinity; the component will strengthen the monitoring network of stations (at varying depths) in the country including coastal districts and in urban areas. With a high population density, the pressure on water supply and water quality in Bangladesh will continue to increase and need to be monitored to assure a safe water supply. Further, Sub-Component B1.1will support purchase of 10 water quality sondes that will be used to measure salinity and total dissolved solids. The sondes will be portable and used along various reaches of the river. They will come with all accessories to perform measurements and calibration within the country. BWDB has manual in built calibration but there is no process of automatic data transmission.

59. Acoustic Doppler Current Profiling (ADCPs) are useful for instantly measuring discharge at any river cross-section and also to document changes in the river cross-section and channel morphology. Hydrology Division at present has 3 ADCPs. Sub-Component B1.1 will support purchase of 10 vertical profiling ADCPs to make discharge measurements along numerous cross sections of various rivers in Bangladesh. This equipment will be equipped with all of the accessories to effectively use the ADCP's in the Bangladesh environmental context. Sub-Component B1.1 will also support purchase of 4 catamarans and 4 survey boats to be acquired for coastal stream gauging. These boats will be relatively large boats able to navigate the larger rivers and coastal areas in Bangladesh during peak discharge periods. The sub-Component will also support purchase of 8 new echosounders and 2 new survey grade echosounders to improve mapping of channel bottom and morphology thus helping an improved understanding of water carrying capacity of the river channels.

60. Bangladesh is a country of constant land changes. The constant changes caused by sediment movement and land subsidence elevation have a dramatic impact on protection offered by embankments. The survey of land, especially in areas of structural flood control measures, is a constant process. In order to continue and expand surveying efforts Sub-Component B1.1 will support purchase of 12 RTK-GPD, 6 DGBS beacon receivers, 4 first order digital level machine and 2 sub-bottom profiler with 5-10 m of penetration capacity.

61. As BWDB acquires a wealth of automatic measurement systems, there will be a need to repair and calibrate these sensors. Sub-Component B1.1 will support upgrade of BWDB's calibration facilities which will include calibration area to be refurbished/established with new equipment to calibrate rain gauges and test data collection platforms and sensors. BWDB also operates a tow-tank to calibrate stream gauging equipment. The tow device will be automated so that the tow device can be operated remotely.

62. Strengthening BWDB's observation network, forecasting and hydrological services will require considerable upgrade of BWDB's ICT facilities. Sub-Component B1.1 will support the strengthening of connectivity within BWDB and also between the Dhaka offices and BWDB zonal offices. This funding will assure improved facilities for storing and visualizing data, computing, ensuring that all functions

have enough bandwidth to carry out communications and deliver services in a timely manner. Funding will also support establishing video conference facilities at all divisional offices and HQ. As assessment of the ICT needs and preparation of associated technical documentation for hydrology and flood forecasting will be undertaken by the HIS consultancy.

63. ***Sub-Component B1.2: Strengthening Infrastructure for Hydrological Forecasting:*** Despite the manual nature of its observation system, BWDB's FFWC has made significant strides in flood forecasting, currently doing 3 day flood forecasts on major rivers. However, the flood forecasts mainly focus on riverine flooding and FFWC's capacity to forecast rain-fed floods or flash floods in the river plains is limited. Further, in terms of geographic coverage, its flood models cover only three fourths of the country and FFWC does not have the capacity to forecast flooding or inundation in the coastal areas. Finally, FFWC can also extend the lead time of hydrological forecasts of value to users such as the agriculture community.

64. BWDB's capacity to integrate data from newly installed water level and rain-gauges, radar data provided to BWDB by BMD in near real-time, is at present limited. Sub-Component B1.2 will support purchase of 4 Nowcasting workstations including software to process and view all of this data. The software will allow BWDB to integrate BMDs radar data, satellite data while overlaying the rain gauge network and river gauging networks and will allow for extreme rainfall events to be quickly detected along with rapidly changing river conditions that can appear throughout the country or enter Bangladesh from India. The Nowcasting systems will be especially well suited in detecting short lead time events, that may have otherwise gone undetected in advance of causing harm to a given community.

65. The wealth of new automatically collected data in real-time will be used to add value to BWDB's flood/flash flood and drought forecast capabilities. It is anticipated that medium range, long range, and extended range river forecasts, and river outlooks can be further improved, especially in the 0-6 hour's Nowcasting time domain. With new data sources along the coastal region and in hotspot areas, models will be upgraded to utilize the real-time information in preparing early warning in the Nowcast time domain (0-6 hrs). Sub-Component B1.2 will also support model develop and calibration to support flood forecasting in the coastal region, and expand hydrological forecasting beyond flood forecasting.

66. ***Sub-Component B2: Institutional Capacity Strengthening, Project Management, Monitoring & Evaluation (USD 8.79 million):*** The main objective of this Sub-Component is to strengthen BWDB Hydrology Division's technical capacity, regional collaboration, project management, and monitoring and evaluation. This includes the following:

(a) Sub-Component B2.1: Technical and institutional Capacity Strengthening and Regional Collaboration which includes: (1) consultancy on training needs assessment, (2) training for BWDB officials through a combination of in-house training, study tours, targeted training courses in collaboration with other hydromet agencies, twinning arrangements, (3) development of data sharing policy for BWDB, (4) consultancy to support refurbishment of BWDB and Divisional offices; (5) refurbishment of BWDB and divisional offices; (6) regional technical studies and consultations, and (7) support to scaling up ongoing regional initiatives and programs.

(b) Sub-Component B2.2: Project Management, Monitoring and Evaluation which will support project management by supporting PIU and PCU functions through hiring of technical experts and consultants, technical studies and monitoring and evaluation.

67. ***Sub-Component B2.1: Technical and institutional Capacity Strengthening and Regional Collaboration:*** As with BMD, strengthening the technical capacity of the Hydrology Division officials in will be critical to long term sustainability of the project. Even though BWDB has extensive experience in working with the World Bank, its Hydrology Division has not implemented a project of this scale. Sub-Component B2.1 will support training on project and contract management for Hydrology Division officials which will be critical in supporting the BWDB PIU to effectively manage the numerous contractors that will be obtained during the course of this project. Modernization of hydrological information services will introduce many new ways of providing hydrological services. This will require the development of a well thought out training plan. Thus, Sub-Component B2.1 will support implementation of training needs assessment and development of a training plan. This

training plan will be based on an assessment of the current capacity of the Hydrology division staff, identification of training needs and development of a time-bound training plan. Sub-Component B2.1 will also support training for BWDB officials through a variety of means such as in-house training, short term study visits, study tours, and distance learning programs. Technical areas where BWDB needs to build capacity include but are not limited to technical skills to support observing networks, forecast models, especially using storm surge forecasts to predict inundation in storm surge prone areas along coast, database management, instrument maintenance and calibration and so forth.

68. At present BWDB does not have a data sharing policy that allows for real-time data to be shared with stakeholders. Developing a data sharing policy is a key to the overall success of the modernization program and will be supported through Sub-Component B2.1 in close coordination with Sub-Component A2.1 where a similar policy will be developed for meteorology. It will rely on open, non-proprietary, methods of data sharing where all partners can exchange data seamlessly and automatically. Sub-Component B2.1 will also support refurbishment of BWBD and Divisional offices. It will also support regional consultations on transboundary disaster risk management, technical studies and ICT systems to support improved disaster risk management, particularly relating to flooding on trans boundary rivers.

69. ***Sub-Component B2.2: Project Management, Monitoring and Evaluation:*** Sub-Component B2.2 will support project management activities, technical studies and monitoring and evaluation. Funding will be used to hire a project technical advisor, procurement consultant, financial management consultant, environment consultant, monitoring and evaluation and social and communication consultant. This Sub-Component will also provide support for project coordination activities undertaken by the PCU located at the BWDB.

70. ***Sub-Component B3: Strengthening Hydrological Services and Flood Early Warning Systems (USD 5.21 million):*** This sub-Component aims to strengthen BWDB service delivery for hydrological and flood forecasting services. It comprises of the following activities:

(a) Sub-Component B3.1: Hydrological and Flood Early warning Services: which includes (1) Baseline survey to assess user needs, (2) GIS center design, software & training; (3) software to share data within BWDB and with BWDB stakeholders, along with exchanging observation data in real-time with BMD (such as BWDB automatically sending BMD rainfall data, and BMD automatically sending BWDB rainfall data, QPE/QPF's, as an automated subscribed service etc. (4) product development; (5) installation of web-portal for sharing data and products with stakeholders; (6) implement software to provide automated product generation based on requirements from stakeholders; and (6) consultancy to design and implement the Common Alerting Protocol (CAP) system (involving computers, software and end user facilities) in collaboration with the Department of Disaster Management, the BWDB and other end-users;

(b) Sub-Component B3.2: Community Based Early Warning Services: which includes support to Cng systems for flash flooding in two districts in the north east of Bangladesh.

71. ***Sub-Component B3.1: Hydrological and Flood Early warning Services:*** While BWDB provides data and services to various users and stakeholders, at present, there is no systematic process in place to assess user needs for hydrological services. This is important in order to make necessary improvements and meet the growing needs of stakeholders for water resources and hazard related information and building to a more rich user-driven data, product, and service portfolio. Sub-Component B3.2 will support carrying out a baseline survey to assess user needs and satisfaction with hydrological and flooding early services. This information can then be used as a basis for designing and improving targeted services. The user survey will also provide baseline information for monitoring and evaluation of project activities.

72. As with BMD, Sub-Component B3.1 will support BWDB to strengthen its user orientation product development and service delivery. This will be done through support for GIS center, design, software and training, consultancies to develop hydrological information products, design and sharing of products and data through upgrading BWDB's existing web-portal. A GIS system is a proven way to look at many data sets together to provide decision support. A GIS center will be need to be designed, GIS software, products and data sets procured. This sub-Component will also support development of software to integrate and share data within BWDB and among BWDB and

stakeholders. This is envisioned to be a data service that runs automatically that makes data available among stakeholders, and any agency subscribing to the service. The model for this service is the DCP Data Service (DDS), which is used by NOAA in the distribution of hydro-meteorological data to various sectors. This will be developed jointly with BMD in a single tender with BMD and BWDB sharing costs. Sub-Component B3.1 will also support introduction and establishment of the Common Alerting Protocol (CAP), for the distribution and exchange of public warnings and emergencies. CAP allows warning messages to be consistently disseminated simultaneously over many warning systems to many applications. This activity should run in coordination with BMD's establishing of the CAP system. This sub-component will also support development of a decision support system for coastal inundation in Bangladesh.

73. ***Sub-Component B3.2: Community Based early warning systems for two flash flood prone north east districts:*** This sub-component will support community level early warning systems in two of the most flash flood prone districts of Bangladesh, Netrokona and Sunamganj (to be confirmed). At present, residents of these districts do not receive any early warnings for flash floods with sufficient lead time. Activities will be carried out in collaboration with BMD and the Department of Disaster Management (DDM). It will build on experience gained through the CPP program. Using a model similar to the CPP, the activity will involve mapping flood vulnerable communities, training, working with the disaster management committees at the district, upazila and community levels, building a volunteer base in the flash flood prone districts, developing and disseminating understandable messages and promoting flood preparedness amongst flood vulnerable communities.

74. **Component C. Agrometeorological Information Systems Development (USD 10.72 million):** The main objective of this component is to develop and deliver agro-meteorological services for farmers to support decision-making at the farm level. It has three sub-Components. These are:

75. ***Sub-Component C.1: Establishment of the Bangladesh Agrometeorological Information System (BAMIS) (US$ 2.06 million).*** This sub-component supports the establishment of BAMIS web portal, which will be dedicated to the provision of data, information, agrometeorological advisories and products such as crop and weather bulletins, drought and heat indices, climate-weather risk maps and services such as short and medium range weather forecasts and seasonal climate outlooks to stakeholders on the web. Specifically, this sub-component will support the following activities: (1) Setting up a Comprehensive web-portal for BAMIS at DAE; (2) BAMIS infrastructure, (3) development of upazila level agromet databases, (4) agromet data analysis and future scenario development, (5) development of advisories and (6) risk mapping of climate vulnerable communities.

76. Agriculture in Bangladesh occupies some three-quarters of the scarce land space of the country and supports the livelihoods of the majority of the population as some 67 percent of the population live in rural areas and over 43 percent of the country's total labor force engaged in agriculture. Crops, livestock, forestry, and fisheries contribute to 17 percent of the GDP. Despite the importance of the agriculture sector for the national economy, the contribution of agriculture to the country's economic output has declined over the past decade. The country is regularly hit by natural disasters that severely impact the economy, disproportionally affecting the infrastructure and agriculture sectors, as well as vulnerable groups.

77. The objective of this component is to provide improved agrometeorological services to farmers of Bangladesh in order to increase agricultural productivity and assist them in coping with weather and climate extremes. The component will support establishment of a science-based agro-meteorological information system to develop appropriate information and products, and deliver them through a number of dissemination mechanisms that will provide the agricultural sector with a decision support information system to mitigate climate-related agricultural production risks. The component will also support the strengthening of capacity at different levels to enable the development and effective delivery of climate information services to the agricultural sector.

78. Component C will be implemented by the Department of Agricultural Extension (DAE), with the support of the Agricultural Meteorology Division of the Bangladesh Meteorological Department (BMD). The main sub-components include: Sub-Component C1: Establishment of the Bangladesh Agrometeorological Information System (BAMIS); Sub-Component C2: Agricultural Disaster Risk

Management through Information dissemination; and (C3) Capacity Building, Project Management, Monitoring and Evaluation. A detailed description of each of these sub-components is given below.

79. Setting up a comprehensive web portal for BAMIS at DAE: The project will contract a consultancy to assess information and user needs and design BAMIS and procure necessary hardware, software, and other technological components to create and maintain an effective and sustainable BAMIS. These include an optical line between BMD and DAE, several high speed computers, monitors, high speed color printers, digital color scanners, plotters and a relational database management system (RDBMS), and suitable backup system, for archiving and disseminating agrometeorological data. Software such as ArcView 10 and ArcGIS Spatial Analyst software to facilitate the analysis and display of geospatial data and to aid in the preparation of agricultural weather products will be installed on the BAMIS computers. BMD will host the dedicated web-server for BAMIS.

80. Development of linkages to BAMIS through acquisition of infrastructure (software and hardware) at BMD. Development of agrometeorological products and their dissemination through BAMIS will carried out in close collaboration with the Agricultural Meteorology Division of BMD. The component will support acquisition of equipment (software and hardware, including a high speed server, computers and color laser printers) as well as the establishment of a dedicated fiber optic line between DAE and BMD to ensure high speed access to the RDBMS and web server.

81. Development of upazila level agrometeorological databases: There are 487 upazilas in the country where Automatic Weather Stations (AWS) (installed under component A) will provide real time data on all important weather variables. The project will also support the digitization of historical and current agricultural data on the land holdings, crops/cropping systems cultivated by farmers, average crop yields in different upazilas etc. (currently available as hard copy documents). Under the technical guidance of an International Agrometeorological Consultant, DAE, with BMD support, will integrate the AWS weather and agricultural data and compile agro-meteorological databases for the 487 upazilas, which will be located in the BAMIS at DAE. These agrometeorological databases will be used to conduct a variety of agrometeorological analyses and to generate information and products for use by the farming communities in different upazilas.

82. Agrometeorological data analysis and future scenario generation: The Project will support a technical consultancy on conducting agrometeorological data analyses, future scenario generation, including the use of crop models and downscaling the scenarios to block level. Currently BMD operates 12 agrometeorological stations (out of its 57 weather stations) with long term data for over 40 years for most of the stations. The consultancy will help DAE develop computations of climatological norms for rainfall and maximum & minimum air temperatures, rainfall probabilities, and combine them with the upazila databases to prepare crop suitability maps for different agroclimatic regions in the country. The consultant will guide DAE, with support from BARC and BMD, in developing agrometeorological products for decision support including selection of optimal planting dates based on expected climate conditions etc. The consultant will also provide assistance in training and capacity building of DAE, BARC and BMD staff on using agrometeorological data, generation of information on soil and crop management practices, and on using various crop models and tools.

83. Development of agrometeorological advisories and products for the farming communities: The project will support the procurement of a consultancy to guide DAE and BMD in the development of agrometeorological advisories and products and their timely delivery to farming communities to help the farmers better manage weather and climate risks. The consultancy will help DAE to use the agrometeorological databases, and develop agrometeorological advisories and products for use by farmers to make tactical decisions such as planting when adequate soil moisture is present or forecasted, harvesting before damaging extreme weather events such as heavy rainfall, hail storms etc., and implementing crop protection measures when risk of pests and diseases is elevated. It is important to highlight that some products such as the determination of best planting dates based on expected climate conditions require specific expertise and research and cannot be implemented without adequate capacity building (sub-component C.2).

84. Risk mapping of climate-vulnerable farming communities: Given the frequent incidence of weather and climate extreme events and the large impact they have on the agriculture sector, identifying the vulnerability of farming communities is critical. The component will support the

procurement of a consultancy in DAE to conduct agricultural disaster risk analysis based on weather and climate information, socio economic factors such as farmer land holdings and indebtedness, soils information, crops/cropping patterns etc. The analysis will be done at the agro-ecological zone level. Each climate risk can be identified by its natural characteristics, the nature of its impacts in different geographical areas, time of year it is most likely to occur and its severity etc., The consultant will guide the preparation of the climate risk vulnerability maps for all 487 upazilas to identify the areas at risk and vulnerable members of the community and train DAE and BMD in risk mapping. The component will also explore areas for collaboration with the students from appropriate Universities in this task.

85. ***Sub-component C.2 Training, Capacity Building, Project Management and Monitoring and Evaluation (US$ 5.41 million).*** This Sub-Component aims to strengthen agrometeorological capacity development, project management and monitoring and evaluation of project activities. It includes the following activities:

(a) Sub-Component C2.1 Provision of technical training to staff which includes training, participation in degree courses, study tours, (2) technical studies, (3) district and local level workshops for training farmers in portal tools, (4) support for JOWGRAM.

(b) **Sub-Component *C2.2 Project management, Monitoring and Evaluation.***

86. Sub-Component C2.1 will support provision of technical training to professional staff of DAE and BMD: This includes, organization of workshops/seminars at the BAMIS headquarters in agrometeorological data analysis and development of products and (b) organization of short term training and exposure visits to appropriate institutions and organizations abroad to promote a better understanding of the current methods and approaches in the development of agrometeorological advisories and products. Currently there are no personnel with post-graduate degrees in agrometeorology either in DAE or BMD. In order to enhance the long term capacity in agrometeorological research and applications in BMD and DAE, steps will be undertaken to depute staff for post-graduate degrees in agrometeorology. Given the diversity of weather and climate in different agroecological regions in the country and the range of crops and cropping systems which farmers cultivate, there are a number of critical weather, climate and agriculture issues on which advanced information will be needed to develop effective strategies to maintain agricultural productivity. Hence priority issues will be identified which require detailed technical studies and this component will support the recruitment of a Consultant to organize such technical studies. As DAE has a good network of offices in the 64 districts providing information to farmers, this network will be used for the organization of workshops at the regional and district levels for officials in the use of BAMIS Portal tools.

87. The vision for the Agrometeorological Information Systems in Bangladesh is an integrated system in which the meteorological community (BMD) and the agricultural community represented by DAE, and BARC work together to produce and disseminate climate and weather information relevant to agriculture thus enhancing climate resiliency and food security in the country. This requires close collaboration between the different agencies responsible for agrometeorological data collection and analysis, agricultural research and extension. Hence a Joint Working Group of on Agrometeorology (JOWOGRAM) will be established with the participation of experts from DAE, BMD and BARC and support will be provided for the effective functioning of the working group and for the implementation of the decisions taken by the group.

88. Sub-Component C2.2 will support costs associated with the PIU, operational costs related to DAE operations, additional technical studies, and activities associated with M&E, social outreach and other operational activities.

89. ***Sub-Component C.3: Agricultural Disaster Risk Management through agrometeorological information dissemination (US$ 3.25 million)***. This sub-component will support the awareness building of and dissemination to farmers of a variety of customized agrometeorological products and tools that will help them to better utilize weather and climate risk in their planning and cope with agricultural disaster risk. The activities include: (1)assessment of farmer's needs for weather and climate services; (2) installation of automatic rain gauges and

agrometeorological display boards at the Union Parishad locations; (3) establishment of kiosks, (4) development of mobile apps; (5) organization of roving seminars and (6) feedback from farmers.

90. This sub-component will support a consultancy to develop a baseline survey for a detailed assessment of farmer's needs for weather and climate services. Feedback from farmers will guide quality improvements in agrometeorological products and their dissemination mechanisms. Given the diversity of crops and cropping systems in the 64 districts around the country, the needs assessment will contribute to the development and dissemination of need-based advisories and products.

91. Installation of automatic rain gauges and agrometeorological display boards at the Union Parishad locations for provision of agrometeorological information to farmers. There are 4,051 Union Parishads and currently BMD has installed agrometeorological information display boards in eight Union Parishad offices. This sub-component will support DAE to procure and install agrometeorological information display boards and automatic rain gauges in the remaining 4043 Union Parishad locations. This will be done in collaboration with BMD as it has significant experience in already doing so. This activity is consistent with GoB's "Access to Information (a2i) Programme" which aims to deliver services at the citizen's doorsteps (a2i.pmo.gov.bd) through the Union Information Service Centers (UISC).

92. Establishment of agrometeorological kiosks in the 487 upazilas. The sub-component will also setup agrometeorological kiosks with data display screens, computers and printers in the Upazila Agricultural Offices to cater to the specific information needs of the farming community. The touch screen kiosks will provide one stop access to information needs of individual or group of farmers with minimum literacy standards. The kiosks allow users to navigate information on a number of aspects including current weather data, agrometeorological advisories, crop cultivation practices, agriculture inputs, crop diagnostic kit, management time table, farm machinery, market information etc.

93. Development and use of mobile and web-based applications for disseminating agrometeorological advisories through mobile phones and Internet: There has been a remarkable growth in the adoption of mobile devices among various communities in Bangladesh. This component will support a study by consultants to assess the various technical options for using mobile devices and apps with the objective of reaching a large number of farming communities in a cost effective and useful way. The component will support the procurement and adaptation of mobile apps to fit the Bangladesh context and the mechanism for implementing dissemination of agrometeorological advisory information through mobile devices. Farmers can use mobile Apps which can give them instant access to information and communication such as current weather, expected weather and the related impacts on crop growth and development and advice on controlling any emerging pests and diseases etc.

94. Organization of Roving Seminars for farmers to raise their awareness of weather and climate and improve their capacity to cope with agro-climatic risks: A key part of the project is the support provided by the component to raise the awareness of the farming communities regarding crop weather and climate, projected climate change and its impacts through the organization of Roving seminars. The component will also provide thermometers and rain gauges as needed to encourage decentralized collection and use of agromet information. These seminars would (a) help farmers better understand how weather and climate information can be used to improve decision making on their farms and (b) provide an opportunity to DAE and BMD to directly interact with farmers to describe the use of BAMIS decision support tools and solicit the feedback from farming communities to improve the tools. Direct interactions between farmers and agricultural weather information providers can help educate both groups about each other's services and requirements.

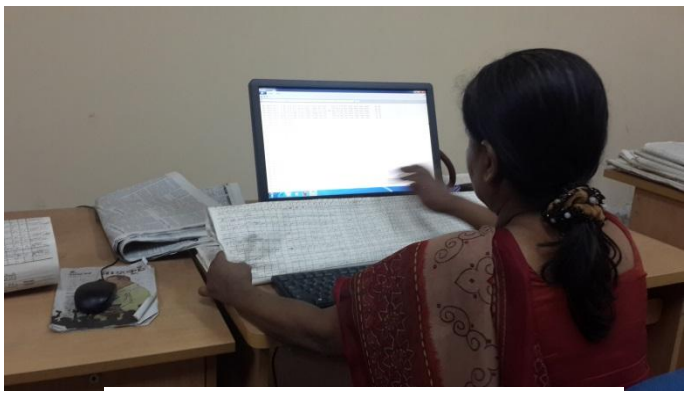
95. Feedback from farmers on the utility of the agrometeorological advisories and products. As the project implementation progresses, by the end of the first year, this component will support a study by consultants to obtain the feedback from farmers on the utility of the agrometeorological advisories and products which they have received during the year. This feedback assessment will be carried out at the end of each of the following four years in order to ensure that appropriate changes are made to improve the agrometeorological advisories and products to meet the needs of farmers. For instance, DAE with the technical support from BARI would use data from BMD and BWDB to develop tailored agromet advisories disseminated to farmers in various districts and Upazilas (through

a variety of user-accessible media) while new technologies such as Nowcasting would allow for accurate and specific early warning alerts to vulnerable communities.

96. **Component D. Contingent Emergency Response Component (US$ 0 Allocation):** Following an adverse natural or man-made event or that causes a major disaster, the Government may request the Bank to re-allocate project funds to this component (which presently carries a zero allocation) to support response and reconstruction. This component would allow the Government to request the Bank to reallocate project funds and designate them as IRM funds to be engaged to partially cover emergency response and recovery costs. This component could also be used to channel additional funds should they become available as a result of the emergency.

(A) (B)

(C) (D) (E)



(F)

Figure 2:1: Typical equipment for Component A, (A): Soil Thermometer at BMD, Dhaka (B):Calibration equipment (C) Automated Rain gauge, BMD, Khulna (D)Automated weather station, BMD, Khulna (E) High speed computers at BMD, Dhaka (F) Manual input of data

(A)

(B)

(C)

(D)

Figure 2:2: Typical equipment for Component B, (A): Water level sensor at Mongla river, (B): Water level sensor at Satkhira;(C) Real time data transfer equipment (D) Protection room housing equipment, Satkhira

2.3. Project Boundaries

97. The components and activities of the project will be implemented all over Bangladesh and also in the Bay of Bengal. Based on the available primary information and review of project documents the following tentative locations are being considered for the hydro-meteorological data collection network,

Component A:

(i) Upgrade 35 existing synoptic stations and installation of 440 AgMet automatic weather stations in the premises of Upazila Parishad offices across the country. These weather stations will require 9 sq. meters land;
(ii) Installation of 55 new automatic rain gauges (ARGs) in Dhaka, Chittagong and Khulna;
(iii) Installation of three C/X band Doppler Weather Radars to measure radar reflectivity to derive quantitative precipitation estimates (QPE) to support civil aviation and extreme urban rainfall events in nearby cities;
(iv) Installation of AWOS and other instrumentation to support civil aviation at the three international airports;
(v) Installation of Coastal-Marine Automated Network (C-MAN) comprised of 40 new coastal marine stations to detect wave height, wave period, and storm surge;
(vi) Design and installation of few buoy stations for measuring ocean temperature, current, wave dynamics, and other parameters;
(vii) Installation of 7 weather workstations (hardware and software) for preparing daily, short, medium and long range weather forecasts.

Component B:

(i) Upgrading 308 manual water level stations to be equipped with automatic data collection and reporting in real-time, these water level equipment will be installed in bridges and adjacent government owned land (water level measuring sensors) and in absence of bridges, on concrete columns placed in water of the rivers. In many places small 5m by 5m concrete sheds will need to be built to protect equipment;
(ii) Upgrade 257 rain gauges to automatic and real time;
(iii) Upgrade 10 existing climate stations operated by BWDB;
(iv) Upgrade or establish 1100 groundwater stations and nests of various configurations to automatically report measurements;
(v) 4 catamarans and 4 survey boats for stream gauging in different rivers across Bangladesh;
(vi) Purchase 10 vertical profiling ADCPs;
(vii) Purchase of 20 water quality sondes for measuring salinity and total dissolved solids (TDS);
(viii) Purchase 8 echosounders to support river gauging and river morphology measurements; purchase 2 survey grade echosounders;
(ix) 40 land based coastal storm surge inundation stations and 15 handheld TDS meters;
(x) Acquisition of 8 total stations (used for aiding river morphology surveys), 13 RTK-GPS, 6 DGPS beacon receiver, 4 first order digital leveling machine and 2 sub bottom profiler 5-10m penetration capacity.

Component C:

(i) Installation of 440 AgMet automatic weather stations in the premises of Upazila Parishad offices across the country. (installed under component A)
(ii) Installation of automatic rain gauges and agrometeorological display boards, establishment of kiosks at the Union Parishad,4051 locations.

3. Policy, Legal and Administrative Framework

98. This section identifies the relevant legislative, regulatory and policy requirements of the government of Bangladesh for the project. That is the applicable national laws, decrees, circulars, decisions, and national technical regulations and standards and also that sector specific regulations on environment. Also summarized in this section are the World Bank environmental and social safeguard policies. Furthermore, the implications of these policies on the project have been discussed and reviewed.

3.1. Environmental Conservation Act (1995) and Amendments

3.1.1. Bangladesh Environment Conservation Act (ECA), 1995

99. The Environmental Conservation Act (ECA) of 1995, with amendments in 2000, 2002 and 2010, is the main legislative framework relating to environmental protection in Bangladesh. This umbrella Act addresses conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution. It replaced the earlier Environment Pollution Control Ordinance of 1977, now repealed. This Act has established the Department of Environment (DoE), and empowers its Director General to take measures as he considers necessary which includes conducting inquiries, preventing probable accidents, advising the Government, coordinating with other authorities or agencies, and collecting and publishing information about environmental pollution. According to this act (Section 12), no industrial unit or project shall be established or undertaken without obtaining, in a manner prescribed by the accompanying Rules, an Environmental Clearance Certificate (ECC) from the Director General of DoE.

100. The main strategies of ECA '95 can be summarized as:

- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried out/initiated in the ecologically critical areas;
- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of the industries and other development activities' discharge permits;
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines.

101. A schedule attached to the Environment Conservation Rules 1997 categorizes projects as Green, Orange A, Orange B, and Red, and identifies for each category the level of environmental impact assessment required and other clearance application procedures and information. An appeal procedure is available for proponents who fail to obtain clearance. Failure to comply with any part of this Act may result in punishment to a maximum of three years imprisonment or a maximum fine of BDT 300,000 or both. The Department of Environment (DOE) executes the Act under the leadership of the DG.[1]

102. Bangladesh Environment Conservation Act (ECA), (Amendments) 2000: This amendment focuses on

- ascertaining responsibility for compensation in cases of damage to ecosystems;
- increased provision of punitive measures, both fines and imprisonment; and
- fixing authority on cognizance of offences.

103. Bangladesh Environment Conservation Act (ECA), (Amendments) 2002: The 2002 Amendment of the ECA elaborates on the following parts of the Act:

- restrictions on polluting automobiles;

[1]Government of Bangladesh. 1995. "The Bangladesh Environment Conservation Act, Act No. 1 of 1995" http://www.moef.gov.bd/html/laws/env_law/153-166.pdf

- restrictions on the sale and production of environmentally harmful items like polythene bags;
- assistance from law enforcement agencies for environmental actions; (iv) punitive measures; and
- authority for trials of environmental cases.

104. Bangladesh Environment Conservation Act (ECA), (Amendments) 2010: The ECA 1995 was amended in 2010, which provided clarification of defining wetlands as well as Ecologically Critical Areas and included many important environmental concerns such as conservation of wetlands, hill cutting, ship breaking, and hazardous waste disposal. This amendment empowered the government to enforce more penalties than before. Moreover, affected persons were given provision for putting objections or taking legal actions against the polluters or any entity creating nuisance to affected person.

Bangladesh Environment Conservation Rules, 1997

105. The Environment Conservation Rules, 1997 were issued by the Government of Bangladesh in exercise of the power conferred under the Environment Conservation Act (Section 20), 1995. These Rules defined categories of industries and projects and the types of environmental assessments each requires. There have been three amendments to these Rules, in February and August 2002, and in April 2003.

106. Under these Rules, the following aspects, among others, are covered:

- Declaration of ecologically critical areas
- Classification of industries and projects into four categories
- Procedures for issuing the Environmental Clearance Certificate (ECC)
- Determination of environmental standards.

107. According to Rule 7 of this Act, for the purpose of issuance of Environmental Clearance Certificate, the industrial units and projects shall, in consideration of their site and impact on the environment, be classified into the following four categories:-

(a) Green;
(b) Orange – A;
(c) Orange – B; and
(d) Red.

108. All existing industrial units and projects and proposed industrial units and projects, that are considered to be low polluting are categorized under "Green" and shall be granted Environmental Clearance.

109. The ECR'97 also contains the procedures for obtaining Environmental Clearance Certificates from the Department of Environment for different types of proposed units or projects. Any person or organization wishing to establish an industrial unit or project must obtain ECC from the Director General. The application for such certificate must be in the prescribed form (provided later in this chapter) together with the prescribed fees laid down in Schedule 13, through the deposit of a Treasury Chalan in favor of the Director General. Rule 8 prescribes the duration of validity of such certificate (3 years for green category and 1year for other categories) and compulsory requirement renewal of certificate at least 30 days before expiry of its validity.

Bangladesh Environment Court Act, 2010

110. Bangladesh Environment Court Act, 2010 has been enacted to resolve the disputes and establishing justice over environmental and social damage raised due to any development activities. The act allows government to take necessary legal action against any parties who creates environmental hazards/ damage to environmentally sensitive areas as well as human society.

a. Environmental Policies, Strategies and Plans

National Conservation Strategy, 1992

111. National Conservation Strategy (NCS) was drafted in late 1991 and submitted to the Government in early 1992. This was approved in principle. However the final approval of the document is yet to be made by the government.

National Environmental Policy, 1992

112. Bangladesh National Environmental Policy of 1992 is one of the key policy documents of the Government and sets out the basic framework for environmental action. The Environment Policy delineates the Department of Environment (DoE) as the approving agency for all such IEE/EIA's to be undertaken in the country. The policy addresses 15 sectors in all, in addition to providing directives on the legal framework and institutional arrangements. Marine environment and also science and technology are two of the key sectors covered in this policy.

113. The policy recognizes that, for immediate and long term solution of the problems concerning natural disaster, it is necessary that the issues are considered as an integral part of the overall program for protection and improvement of environment and sustainable resource management.

National Environmental Management Action Plan (NEMAP), 1995

114. The National Environmental Management Action Plan (NEMAP) is a wide ranging and multi-faceted plan, which builds on and extends the statements set out in the National Environmental Policy. NEMAP was developed to address issues and management requirements for the period 1995 to 2005 and set out the framework within which the recommendations of the National Conservation Strategy are to be implemented. NEMAP has the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce rate of environmental degradation;
- Improvement of the natural and built environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development; and
- Improvement in the quality of life of the people.

115. The plan also recommends the development of capabilities of different hazard forecasting and enhancement of coordination between different government agencies and also a comprehensive database for water resources systems.

Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009

116. The Bangladesh Climate Change Strategy and Action Plan 2009 is built on the following six pillars:

- Food security, social protection and health to ensure that the poorest and most vulnerable in society, including women and children, are protected from climate change and that all programs focus on the needs of this group for food security, safe housing, employment and access to basic services including health;
- Comprehensive disaster management to further strengthen the country's already proven disaster management system to deal with increasingly frequent and severe natural calamities;
- Infrastructure to ensure that existing assets are well maintained and fit-for-purpose and that urgently needed infrastructure is put in place to deal with the likely impact of climate change;
- Research and knowledge management to predict the likely scale and timing of climate change impacts on different sectors of the economy and socio-economic groups, to underpin future investment strategies and to ensure that Bangladesh is networked with the latest global thinking on science and best practices of climate change management;
- Mitigation and low carbon development to ensure low carbon development options and implement these as the country's economy grows over the coming decades and the demand for energy increases; and

- Capacity building and institutional strengthening to enhance the capacity of government ministries and agency, civil society and the private sector to meet the challenges of climate change and mainstream them as part of development action.

Coastal Zone Policy, 2005

117. The Coastal Zone Policy was initiated as a harmonized policy that transcends beyond sectoral perspectives. The policy provides general guidance so that the coastal people can pursue their livelihoods under secured conditions in a sustainable manner without impairing the integrity of the natural environment. The policy framework underscores sustainable management of natural resources with emphasis on conservation and enhancement of critical ecosystem- necessary measures will be taken to conserve and develop aquatic and terrestrial including all the ecosystems of importance identified by the Bangladesh National Conservation Strategy. The strategy recommends that steps be taken to support upgrading of technology and institutional strengthening for enhancing capacity to generate better data and more accurate long-term prediction and risk related to climate change. An Integrated Coastal Resources Database (ICRD) was also set up.

Coastal Development Strategy, 2006

118. Coastal Development Strategy is based on the Coastal Zone Policy has been approved by the Inter-Ministerial Steering Committee on Integrated Coastal Zone Management Plan (ICZMP) Project in 2006. The strategy takes into account the emerging trends: increasing urbanization, changing pattern of land use, declining land and water resources, unemployment and visible climate change impacts.

National 3R Strategy for Waste Management, 2010

119. The Department of Environment finalised this strategy in 2010 with the aim to reduce and manage environmental, social and economic impacts associated with disposal of waste. The strategy is based on principles of well-established environmental management and service rendering norms and in line with key strategies and policies of Bangladesh such as PRSP, National Sanitation Policy and Strategy, Industrial Policy, Agricultural Policy, Renewable Energy Policy as well CDM Strategy. While the national 3R goal for waste management is to achieve higher levels of waste reduction, reuse, and recycling and minimizing waste disposal on open dumps, rivers, flood plains and landfills by 2015 may seem ambitious and the challenges ahead may be multifaceted, there have been number of positive experiences in the recent past which provides useful lessons to build upon. According to the strategy the recycling of e-waste is required to be regulated due to presence of hazardous constituents in the components of waste electrical and electronic assemblies and recommends that the government should encourage e-waste recycling projects under public-private partnership mode. The National 3R Strategy broadly guides the relevant institutions e.g. local government bodies, industries, NGOs, trade bodies such as chamber of commerce and industries agencies to develop their own action plans for achieving National 3R goal in their respective areas.

b. Water Policies, Plans, and Legislation

National Water Policy, 1999

120. The National Water Policy, 1999, lays down the broad principles of development of water resources and their rational utilisation under these constraints. It conforms to internationally accepted principles of integrated water resources management, such as laid down in the Dublin-Rio statements. It aims to guide both public and private sector actions for ensuring optimal development and management of water that benefits both individuals and the society at large. Policy indications regarding such issues as overall basin-wide planning, water rights and allocation, public and private involvement, public investment, water supply and sanitation, fisheries, navigation, agriculture, industry and environment are incorporated in the Policy.

121. The Policy emphasises the need to give full consideration to environmental protection, restoration and enhancement measures consistent with National Environmental Management Action Plan (NEMAP) and the National Water Management Plan (NWMP). To address issues related to

harnessing and development of groundwater and the general management of water resources in an efficient and equitable manner the policy highlights the need to develop a state of knowledge and capability that will enable the country to design future water resources management through broad public participation.

National Water Management Plan, 2001 (Approvedin 2004)

122. The National Water Management Plan (NWMP) operationalizes the directives of the NWP. It is a "framework plan within which line agencies and other organizations are expected to plan and implement their own activities in a coordinated manner" in three phases – two of them now in the past (2000-5, 2006-10) and the third a perspective plan for 2011-25. NWMP has three central objectives, to be given equal importance:

- rational management and wise use of water;
- quality of life improved by equitable, safe, reliable access to water for production, health, and hygiene;
- Sufficient, timely, clean water for multi-purpose use and for preservation of aquatic ecosystems.

123. With regard to the main rivers, NWMP articulates the main aims as ensuring comprehensive structural and non-structural development and management for multipurpose use; integrating the needs of all users through comprehensive planning of river systems by the responsible agencies and working towards international river basin planning. Water Resources Planning Organization (WARPO) has been assigned to monitor the national water management plan. The major programs in the Plan have been organized under eight sub-sectoral clusters: i) Institutional Development, ii) Enabling Environment, iii) Main River, iv) Towns and Rural Areas, v) Major Cities; vi) Disaster Management; vii) Agriculture and Water Management, and viii) Environment and Aquatic Resources. Each cluster comprises of a number of individual programs, and a total of 84 sub-sectoral programs have been identified and presented in the investment portfolio, including program on development and management of water resources by the use of reliable data and targeted adaptive research.

Guidelines for Environmental Assessment of Water Management (Flood Control, Drainage and Irrigation) Projects (approved 2003, published 2005)

124. The 2003/2005 guidelines are an update of 1992 guidelines issued by Flood Plan Coordination Organization (FPCO) to govern assessment of Flood Action Plan (FAP) projects and programs. The document sets out the framework for environmental assessment of flood control, drainage, and irrigation projects in Bangladesh; it aims both to educate and to guide project planning. It primarily addresses project planning (project identification, pre-feasibility, feasibility), but does include information on the preparation of management recommendations for later project stages (design, construction, operation, monitoring, decommissioning). The guidelines emphasize the need for wider knowledge of measures and procedures such as EIA to prevent future environmental damage, in light of the "widespread and serious environmental damage done in the past by physical interventions affecting the water sector (largely before formal assessment procedures were developed)." The stated purpose is "not to prevent development, but to ensure that it proceeds with due regard for the environment."

Inland Water Transport Authority Ordinance, 1958

125. This ordinance sets up an authority for the development, maintenance and control of inland water transport and certain inland navigable waterways. The authority is mandated to perform functions including carrying out river conservancy work; river training for navigation purposes and aiding navigation; drawing up dredging program requirements and priorities for efficient navigable waterway maintenance, reviving dead or dying rivers, channels, and canals, and development of new navigation waterways.

National Water act, 2013

126. The National Water Act issued in 2013, is based on the National Water Policy, and provides the legal framework for development, management, extraction, distribution, usage, protection, and

conservation of water resources in Bangladesh. As per this Act, all forms of water (e.g., surface water, ground water, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people. Without prior permission issued by the Executive Committee, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor they will be allowed to build any structure that impede the natural flow of rivers and creeks. Act recognizes the significance for managing all forms of water resources in the context of natural flow of surface water and recharge of groundwater.

c. Agriculture and Land Use Policies and Legislation

National Agriculture Policy, 1999

127. Prepared in 1999 by the Ministry of Agriculture (MoA), the National Agriculture Policy is the first comprehensive document prepared by Ministry since the country's independence in 1971. NAP has an overall objective, 18 subsidiary objectives and 18 program areas. The goal of the Policy is to facilitate and accelerate technological transformation with a view to achieving self-sufficiency in food production and improving the nutritional status of the population. The Policy also aims to develop a contingency management system to combat natural disasters.

New Agricultural Extension Policy, 1996

128. The goal of the New Agricultural Extension Policy 1996 is to encourage national agricultural extension system agencies and partners to provide efficient and effective services that complement and reinforce each other, to increase the efficiency and productivity of Bangladesh agriculture. To achieve this goal, the Policy includes the following key components:

- extension support to all categories of farmer;
- efficient extension services;
- decentralization;
- demand-led extension;
- working with groups of all kinds;
- strengthened extension-research linkage;
- training of extension personnel;
- appropriate extension methodology;
- integrated extension support to farmers;
- coordinated extension activities; and
- integrated environmental support.

129. The National Task Force responsible for preparation of this Policy has also been charged with development of an Implementation Strategy that will establish effective mechanisms for collaboration and information exchange among extension agencies and among farmers and also effective linkages to support three-way information flow between farmers, extension agents, and research institute staff.

DAE Strategic Plan 1999- 2002

130. The Department of Agriculture (DAE) under the Ministry of Agriculture prepared the Strategic Plan (1999-2002), which presents a structure of objectives designed to further the implementation of the New Agricultural Extension Policy (NAEP). The Strategic Plan stipulates a total of 68 objectives to be attained under six strategic areas, i.e. extension approach development, development of partnership with government agencies, NGOs, research and education, mainstreaming gender, mainstreaming the environment, human resource management, and information system development. The overall goal of the Strategic Plan is to strengthen DAE capacity and promote partnership to facilitate wide range of services for the targeted farmers.

National Agriculture Extension Policy, 2015 (draft)

131. This document presents a revised National Agricultural Extension Policy (NAEP) which sets extension policy directions for transferring technologies to crop, fisheries and livestock sector development. The Policy concentrates on decentralized and demand-led extension to meet farmers'

needs, emphasizes on coordinated extension service delivery and encourages effective research-extension-farmer linkages. The NAEP is built on nine (9) key principles:

- Increasing production (horizontal and vertical) and productivity as a whole;
- Cost effective efficient decentralized demand responsive extension services;
- Targeting and mobilizing farmers group (FG) and their federations (FO);
- Bottom-up planning and implementation;
- Coordinated and integrated extension services through NAES;
- Development of agri-business and contract farming for export promotion;
- Adoption to climate change and development of specialized extension service for climatically distressed areas;
- Broad based extension support (in-time input support and subsidies, credit, price enhancement etc.); and
- Digitalized agricultural extension services (e-agriculture).

d. Biodiversity, Fisheries, Forestry, and Wildlife Policies and Legislation

National Fisheries Policy, 1998

132. The Ministry of Fisheries and Livestock prepared the National Fishery Policy in 1998 with the overall objective of developing the fisheries sector. The Policy 1998 recognizes that fish production has declined due to environmental imbalances, adverse environmental impact and improper implementation of fish culture and management programs. The policy suggests following actions:

- Biodiversity will be maintained in all natural water bodies and in marine environment
- Chemicals harmful to the environment will not be used in fish shrimp farms
- Environment friendly fish shrimp culture technology will be used
- Expand fisheries areas and integrate rice, fish and shrimp cultivation
- Control measures will be taken against activities that have a negative impact on fisheries resources and vice-versa
- Laws will be formulated to ban the disposal of any untreated industrial effluents into the water bodies.

National Livestock Development Policy, 2007

133. The National Livestock Development Policy (NLDP) has been prepared to address the key challenges and opportunity for a comprehensive sustainable development of the livestock sub-sector by creating an enabling policy framework.

National Forest Policy, 1994

134. The National Forestry Policy, 1994 is a revision of the National Forest Policy, 1977 in light of the National Forestry Master Plan. The major targets of the Policy are to conserve existing forest areas; bring approximately 20 per cent of the country's land area under the afforestation program; and increase reserve forest land by 10 per cent by the year 2015, through coordinated efforts of Government and non-governmental agencies, and active participation of the people.

135. The need of amendments of the existing forestry sector related laws and adoption of new laws for sectoral activities have been recognized as important conditions for achieving the policy goals and objectives. The Forest Policy also recognizes the importance of fulfilling the responsibilities and commitments under international multilateral environmental agreements.

Bangladesh Wildlife (Protection and Safety) Act, 2012

136. The Act provides for the conservation and safety of biodiversity, forest and wildlife of Bangladesh. The Act states that 'No person shall hunt any wild animal without a license or, as the case may be, obtaining a permit under this Act, or wilfully pick, uproot, destroy or collect any plant'

that is situated in a sanctuary or deemed to be endangered. The Act empowers the Government to create an eco-park, safari park, botanical garden, or breeding ground on any state-owned forest land, land or water-body.

e. Other Relevant Acts, Policies and Rules

National Information and Communication Technology (ICT) Policy, 2002

137. This Policy aims encourage in building an ICT-driven nation comprising of knowledge-based society. The policy focuses on development of a country-wide ICT-infrastructure to ensure access to information which will facilitate empowerment of people and enhance democratic values and norms for sustainable economic development. The infrastructure will be used for human resources development, governance, e-commerce, banking, public utility services and all sorts of on-line ICT-enabled services. Proper initiatives will be taken to utilize ICT systems in agro-based industries, agricultural research, and dissemination of agricultural technology, agri-business development to the farmers and preparation and maintenance of agricultural database. The policy also recommends that ICT be used to build capacity to fight against environmental degradation.

National Disaster Management Policy, 2012

138. The National Disaster Management Policy defines the national policy on disaster risk reduction and emergency response management, and describes the strategic policy framework, and national principles of disaster management in Bangladesh. The overall national objectives in this regard are:

to reduce the underlying risks by

- integrating disaster risk reduction approaches and climate change adaptation in all ongoing and future development plans, programmes and policies
- Enhancing professional skills and knowledge of key personnel on risk reduction, preparedness, warning and forecasting system, climate change risk reduction and post-disaster activities
- Strengthening mechanisms to build capacities for the Community and Institutions at all levels
- Community based Programming for risk reduction
- Promote and facilitate the incorporation of longer term disaster risk reduction due to climate change into disaster management
- Promote livelihood strategies and options for poor that incorporates disaster management and risk reduction practices
- Strengthen capacities for risk assessment for flood, cyclone, drought, river bank erosion, pest attacks, earthquake, epidemics , including assessment of climate change risk

to establish and strengthen the systems and procedures for effective response management through

- Creating a legal and institutional framework for effective response management
- Strengthening national capacity for response management with emphasis on preparedness and support to disaster management committees at district, upazila and union levels
- Improving the early warning and community alerting system
- Strengthening search and rescue capabilities of relevant agencies
- Introducing an effective response management coordination mechanism including a relief management logistic system to handle different levels of emergency response
- Establishing an electronic based information management system

Bangladesh Disaster Management Act

139. The Bangladesh Disaster Management Act forms the legislative basis for the protection of life and property and to manage long term risks from the effect of hazards both natural, technological and human induced, and to respond to and recover from a disaster event. It aimed at:

- Helping communities to:
    - ✓ mitigate the potential adverse effects of hazard events,
    - ✓ prepare for managing the effects of a disaster event,
    - ✓ effectively respond to and recover from a disaster or an emergency situation, and
    - ✓ adapt to adverse effects of climate change.
- Providing for effective disaster management for Bangladesh.
- Establishing an institutional framework for disaster management.
- Establishing risk reduction as a core element of disaster management.

Bangladesh National Building Code, 2006

140. The Bangladesh National Building Code (BNBC) clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety of the workmen. The BNBC also stipulates the general duties of the employer to the public as well as workers. According to this section, "All equipment and safeguards required for the construction work such as temporary stair, ladder, ramp, scaffold, hoist, run way, barricade, chute, lift shall be substantially constructed and erected so as not to create any unsafe situation for the workmen using them or the workmen and general public passing under, on or near them".

141. The Code also clarifies the issue of safety of workmen during construction and with relation to this, set out the details about the different safety tools of specified standard.

f. Implication of Government Policies on Project

142. The summary of relevant policies, strategies and legal instruments available in Bangladesh highlight the position of government on environmental considerations that is environmental issues needs to be considered along with project planning and implementation. The Environmental Conservation Act (ECA) '95 and Environmental Conservation Rules (ECR) 97 gives clear directions for environmental assessment needs and contains the procedures for obtaining Environmental Clearance Certificates from the Department of Environment for different types of proposed units or projects. A schedule attached to the Environment Conservation Rules 1997 categorizes projects as Green, Orange A, Orange B, and Red. According to these rules 'Assembling of scientific and mathematical instruments' are categorized under "Green" and shall be granted Environmental Clearance. Procedure for obtaining Environmental Clearance includes the following:

(i) general information about the project;
(ii) exact description of the raw materials and the manufactured product; and
(iii) no objection certificate from the local authority.

143. Most activities in the 'Bangladesh Weather and Climate Services Regional Project' thus fall under 'Green' category and according to the ECR 97, which means EIA and IEE are not required to obtain Environmental Clearance as per national policies and legislation.

144. However, although specific project location will be known during the implementation phase of the project, the project activities will be implemented nationwide, including the Bay of Bengal and within the ecological sensitive areas such as Sundarban. The following regulatory frameworks are applicable in these areas:

- Bangladesh Wildlife (Protection and Safety) Act, 2012: during installation of equipment no plants or trees within the ecologically sensitive areas can be uprooted or destroyed; and

- Environment Conservation Rules 1997: For obtaining Environmental Clearance from DoE and no-objection certificate from Department of Forests is needed.

145. A lot of equipment such as automated rain-gauges, computers, modems etc. will be used for this project that needs to be disposed of properly after equipment becomes unusable or damaged. But

there are no specific rules or procedures in Bangladesh regarding electronic waste recycling. But, DoE does have a strategy for the management of e-waste.

146. It is also important to highlight that the policy and legal framework described above emphasise that the need for collection of data and information and recommend that data collection be an integral element of development activities, decision making and monitoring of environmental impacts. Hence, this project actually supports GoB in the implementation of goals, strategies, policies and plans required for the environmental and socio-economic development of the country.

g. World Bank's Environmental Safeguard Policy

147. The World Bank has a number of Safeguard Policies to ensure that all possible impacts are considered and mitigation measures are identified prior to the implementation of any proposed project. These policies ensure that the quality of operations is uniform across different settings worldwide. The Bank requires environmental screening and classification for all investment projects proposed for Bank financing, to help ensure that they are environmentally and socially sound and sustainable. Screening and classification takes into account the natural environment (air, water, and land); human health and safety; social aspects; cultural property; and trans-boundary and global environmental aspects. Relevant World Bank environmental policies for this project include OP 4.01, Environmental Assessment; OP 4.04, Natural Habitats and OP 4.11, Physical Cultural Resources. The other environmental safeguard policies i.e., Pest Management and Dam Safety have also been briefly discussed.

OP 4.01 - Environmental Assessment

148. The Bank requires Environmental Assessment (EA) of projects proposed for Bank support to ensure that they are environmentally sound and sustainable, and thus to improve decision making. The EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. The EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The EA takes into account the natural environment (air, water and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples and physical cultural property) and transboundary and global environmental aspects.

OP 4.04 - Natural Habitats

149. The conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank supports, and expects borrowers to apply, a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. The Bank promotes and supports natural habitat conservation and improved land use by financing projects designed to integrate into national and regional development the conservation of natural habitats and the maintenance of ecological functions. Furthermore, the Bank promotes the rehabilitation of degraded natural habitats. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

OP 4.09 – Pest Management

150. Through this OP, the WB supports a strategy that promotes use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. Rural development and health sector projects have to avoid using harmful pesticides. Other pesticides can be used, but only as an element of an Integrated Pest Management Plan (IPMP) that emphasizes environmental and biological controls.

OP 4.11 - Physical Cultural Resources

151. This policy addresses physical cultural resources,[1] which are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above or below ground, or under water. Their cultural interest may be at the local, provincial or national level, or within the international community. Physical cultural resources are important as sources of valuable scientific and historical information, as assets for economic and social development, and as integral parts of a people's cultural identity and practices.

OP 4.37 - Safety of Dams

152. The Policy seeks to ensure that appropriate measures are taken and sufficient resources provided for the safety of dams the WB finances. However this OP is not relevant since the proposed Project does not involve construction of dams.This policy discusses measures to be taken for the construction of a new dam,[3] or projects that rely on the performance of an existing dam or a dam under construction (DUC): for example power stations or water supply systems that draw directly from a reservoir controlled by an existing dam or a DUC. The policy also recommends, where appropriate, as part of policy dialogue with the country, Bank staff discuss any measures necessary to strengthen the institutional, legislative, and regulatory frame-works for dam safety programs in the country.

h. Implication of World Bank Environmental Safeguard Policies

153. In general, the project is not expected to have significant environmental impact due to the nature of investments. However, the project may finance some infrastructure and install some equipment in environmentally sensitive areas. Special attention needs to be taken during site selection and installation of the equipment and associated facility, if any. Under this consideration, the proposed project has been classified as a category 'B' project, and only the Environmental Assessment policy (OP/BP 4.01) has been triggered. In order to address the policy, a framework approach has been adopted since the site specific interventions to be funded under the project are not known at this stage. The activities to be supported under the project will go through environmental screening process.

154. Application of two other environmental safeguard policies - Natural Habitats (OP/BP 4.04) and Physical Cultural Resources (OP/BP 4.11) –were considered during the project concept stage. However, the general assessment carried out during the project preparation confirmed that these policies will not be applicable for the project. The project will not have the potential to cause conversion of habitat and impair associated ecological functions. This is because the implementation will be limited to built-up areas in khas land (government owned fellow land) across the country. Similarly, the project will not support any major infrastructure or excavation, which likely to impact on physical cultural resources. However, the EMF has provision of screening of these impacts at sub-component level and will have suggested mitigation measures, if required.

155. In addition to the above environmental safeguard policies, the project will follow the access to information policy. According to World Bank's approach to the disclosure of information, transparency and sharing of knowledge, the public will have access to a broad range of information about project in preparation and implementation. The EMF, Social Assessment, Social Action Plan and RAP will be disclosed on BWDB website and also sent to WB InfoShop. Consultations have been held at community level and civil society level. The EMF will be translated in Bangla and placed in both English and Bangla on BWDB website and also in relevant offices in the project area.

4. Description of Baseline Environment

156. As mentioned earlier, the components and activities of the project will be implemented all over Bangladesh and also in the Bay of Bengal. However, component activities and locations are yet to be finalized. As result it is not possible to prepare any project specific environmental baseline. Alternatively, the EMF includes the generic environmental baseline for relevant component type and guideline for collection of information and data. The baseline information can be used in the screening matrix given in chapter 5 to identify and monitor probable impacts and identify mitigation measures.

157. The following activities are to be done to describe the baseline environment of the study area:

- **Determination of influence area:** Areas that will be directly impacted by the activities. These include ancillary facilities, temporary construction areas, borrow areas, access routes for transport of material and equipment.
- **Determination of physical components:** This information relates to the area-specific conditions pertaining to atmosphere and climate, topography, soil, hydrology and drainage, under physical environment; terrestrial ecology, aquatic ecology, biodiversity, National Conservation Site of Importance under biological environment; and demography, settlement pattern, land use and water use pattern, water supply and sanitation, fisheries industries, cultural and archeological resources under socio-economic environment.
- **Collection of primary and secondary data:** The environmental baseline condition in the component study area needs to be characterized using both primary and secondary data. Primary data can be collected by the PIU field team during visits to the study area, through rapid rural appraisal (RRA), focus group discussions (FGD), key informant interviews (KII) and public consultations. Secondary data can be collected from maps and databases.

158. Examples of baseline description for the following are given in Annex I:
- Water level monitoring station 107.2 on Gorai-Modhumoti river in Sarankhola Upazila of Bagerhat district; and
- Shoronkhola Upazila (sub-district) Office in Bagerhat district

a. Baseline Information for Component A

159. The activities and equipment of Component A will be primarily located or limited to built-up areas in khas land of DAE located in Upazila Offices. Each of the weather stations will require 9 sq. metres of land. A detailed baseline for each activity will include the following,

Influence Area

160. The influence area of the each of the installations will be limited to the walled premises of the khas land owned by DAE in Upazila offices or BMD offices.

Determination of physical components

161. Considering the influence area the following components need to be described in the description of the baseline environment:

Physical Environment:
- Climate (average precipitation, temperature, humidity)
- Topography and soil type
- Hydrology (groundwater levels)
- Land use and land cover

Ecological Environment:

- Bio-ecological zone
- Percentage of area under vegetation
- Type of trees

b. Baseline Information for Component B

162. The activities and equipment of Component B will be primarily located or limited to built-up areas in khas land of BWDB or bridges of Roads and Highways Department. Some of the monitoring stations may require 9 sq. meter of land. A detailed baseline for each activity will include the following,

Influence Area

163. There are primarily three types of installations. The influence area will vary accordingly based on the location of installations of equipment. The installations and associated influence area are:

- Water level monitoring equipment installed on concrete column in the river (in the absence of bridge), influence area will be the river. This implies only 5% of total BWDB installations.
- Water level monitoring and weather station on bridge with protection room housing equipment in BWDB premises, influence area will be the walled premises of BWDB.
- Water level monitoring and weather station on bridge with protection room housing equipment adjacent to bridge, influence area will be the khas land within 3m radius adjacent the structure.

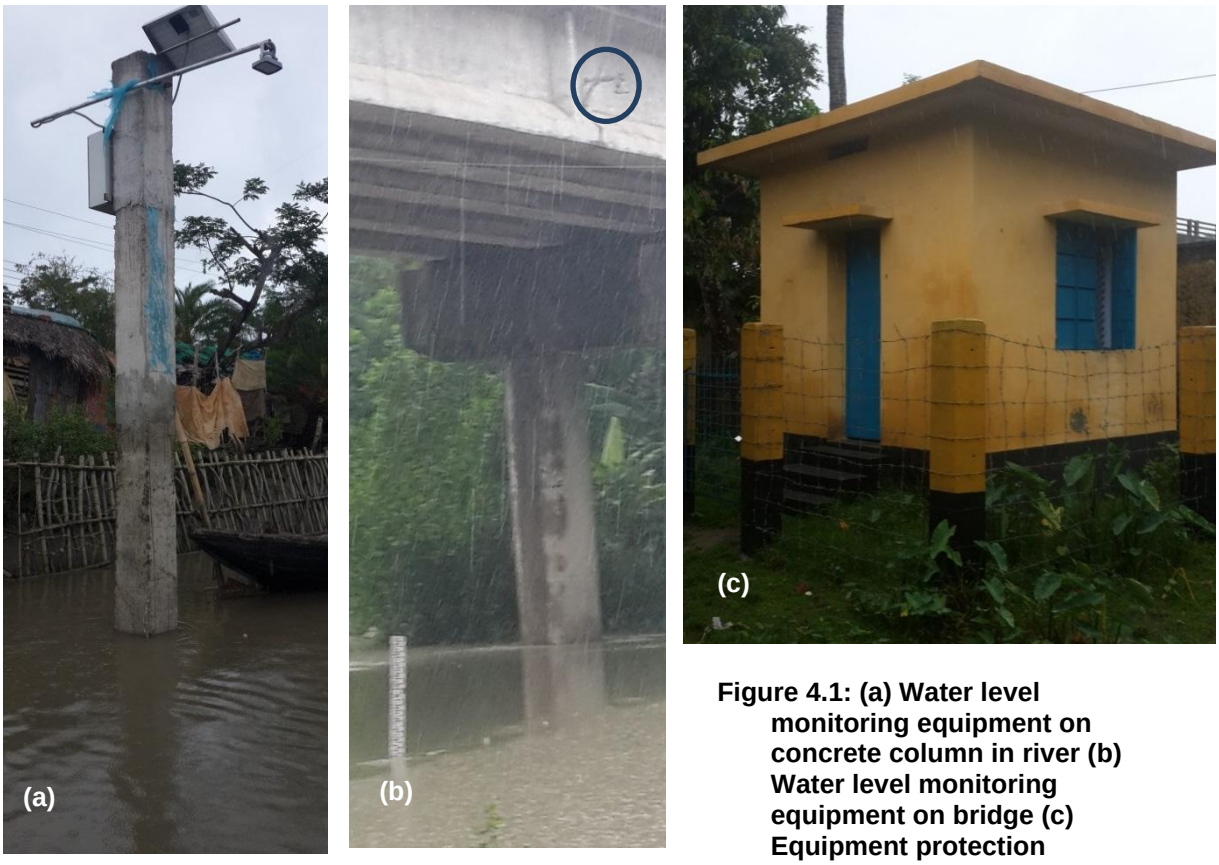


Figure 4.1: (a) Water level monitoring equipment on concrete column in river (b) Water level monitoring equipment on bridge (c) Equipment protection structure

Determination of physical components

164. Considering the influence area the following components need to be described in the description of the baseline environment-

Physical Environment:

- Climate (average precipitation, temperature, humidity)

- Topography and soil type
- Hydrology (discharge, tide, water levels)
- Land use and land cover

Ecological Environment:
- Bio-ecological zone
- Percentage of area under vegetation
- Type of trees
- Fisheries and aquatic biodiversity

c. Baseline Information for Component C

165. The activities and equipment of Component A will be primarily located or limited to built-up areas in khas land of DAE located in Upazila Offices and Union Parishad offices. Each of the weather stations will require 9 sq. meter of land. A detailed baseline

Influence Area
166. The influence area of the each of the installations will be limited to the walled premises of the khas land owned by DAE in Upazila offices.

Determination of physical components
167. Considering the influence area the following components need to be described in the description of the baseline environment:

Physical Environment:
- Climate (average precipitation, temperature, humidity)
- Topography and soil type
- Hydrology (groundwater levels)
- Land use and land cover

Ecological Environment:
- Bio-ecological zone
- Percentage of area under vegetation
- Type of trees

5. Potential Project Impacts and Mitigation Measures

168. The environmental impacts identified at this stage are preliminary in nature and will need to be further elaborated specifically and potential for occurrence has to be ascertained during specific interventions or installations design and implementation when locations will be finalized and details of each installation of equipment or physical intervention will be known. However, most of the activities of this project are unlikely to have severe environmental implications. But, there are possibilities of a few likelihood adverse environmental and social impacts due to particular activities like: installation of instruments for automatic weather system and disposal of equipment. Most of the adverse impacts identified are reversible in nature can be relieved by mitigation measures. Occupational health and safety during installation of the equipment has also provided attention.

Screening Matrix for Environment Assessment

169. All the major environmental parameters covering ecological, physical and human interest related aspects need to be considered in identifying the potential impacts during different phases of the project. Environmental screening is essential to gather information on baseline status and potential environmental impacts of the project interventions. Environmental screening identifies the consequence of the proposed projects in broader sense based on similar project experiences, stakeholder's perceptions and expert judgment, without having very much detailed investigation. Also critical issues are identified through the screening which needs detailed investigation. Based on the extent of environmental impact obtained from the environmental screening, the decision for further environment impact assessment will be taken.

170. The Environmental Screening will be carried out in two stages. These are: (i) Eligibility Screening; and (ii) Impact Screening. The eligibility screening will be carried out by a simple checklists (Table 5.1). This will provide information whether the proposed interventions will be eligible for funding under the project. The impact screening will be carried out with the help of matrix or checklists of the environmental parameters identified in Baseline Description for each of the major components during planning phase have been presented in Table 5.2. In the impact checklist, the magnitude of environmental impacts has been classified as none, low, moderate and severe. Long-term and short-term impacts (identified as L and S, respectively) as well as reversible and irreversible (identified as R and I, respectively) have also been identified in the checklist. This checklist needs to be completed for each of the locations for the different components of the project during pre-installation/ planning, decommissioning, construction, operation and dismantlement. The following table needs to be filled in based on expert judgment and FGD by officials and field technicians from implementation agencies. Discussion with communities living around the installation area needs to be carried in filling the checklist.

Table 5.1: Environmental Screening using Checklist

Screening Questions	Yes/No	Remarks, (If yes?)
1. Would the proposed intervention deems to be highly risky or contentious?		If yes, sub-project is not eligible for funding.
2. Would the proposed intervention involve serious, multi-dimensional and generally interrelated potential social and/or environmental impacts?		If yes, the sub-project is not eligible for funding.
3. Would the proposed intervention have potential impact on natural parks, wildlife sanctuary, land of national historical-cultural monument, world heritage site, critical natural habitat, protected area of natural habitat, and would lead to significant loss or conversion of that habitat, natural forest, natural park or reserve?		If yes, the sub-project is not eligible for funding.
4. Would the proposed intervention displace, disfigure or render inaccessible any structure or site of great cultural or historical value to the country, to an ethnic group or to the local community?		If yes, then the sub-project is not eligible for funding.
5. Would there any territorial dispute on the proposed location and its ancillary aspects and related activities?		If yes, then the subproject is not eligible for funding.

Table 5.2: Environmental Impact Screening using Checklist

Screening Criteria/ Environmental Parameters	Environmental Assessment				
	Positive Impact	No Impact	Adverse Impact		
			Low	Moderate	Severe
Does the project site and activities fall within/ and/ or will impact the following environmentally sensitive areas?					
Protected areas					
Wetland					
Reserve forest					
National parks					
Buffer zone of protected areas					
Special area for protecting biodiversity					
Near cultural heritage sites					
Areas with rare/ endangered flora/ fauna					
Will there be any minor constructions which will have					
1. Ecological					
Fisheries					
Aquaculture					
Eutrophication					
Wetland					
Bushes/ trees					
Animals					
Species diversity					
Endangered species					
2. Physical-chemical					
Erosion and siltation					
Flooding					
Drainage congestion					
Air pollution					
Noise pollution					
Solid waste					
Chemical waste					
Water pollution					
Disaster management					
3. Human interest related					
Loss of agricultural land					
Health					
Navigation					
4. Health and safety					
				Yes	No
Access to site is safe and easy (example tall columns, sea) for installation team and inspection staff					
Hazardous/dangerous substances used					

Impact Assessment

171. The component A (**Strengthening Meteorological Information Services)** and Component C (**Agro-meteorological Information Systems Development)** are interlinked. The discussion of component A and C are provided below. It may be noted these are the potential impacts and all installation of equipment or physical intervention at any site may not have these impacts.

Adverse Environmental Impacts

- ◊ **Vegetation removal:** The equipment and necessary hardware will be installed in the compounds of Upazila Parishad offices, Union Parishad offices or BMD office premises across the country. These weather stations will require 5m by 5m land, which means trees or plants may need to be removed. The existing stations are not defined clearly in terms of locations, lands. The precise scale of impact in each case will be assessed during the implementation of the sub-components, and appropriate mitigations, where necessary, will be implemented.

- ◊ **Radio-frequency emissions from equipment:** Low-powered, intermittent, or inaccessible transmitters and facilities are normally "categorically excluded" from the requirement for routine evaluation for radio-frequency exposure. These exclusions are based on calculations and measurement data indicating that such transmitting stations or devices are unlikely to cause exposures in excess of any recommended limits under normal conditions. Measurements have shown that ground-level power densities due to microwave directional antennas are normally a thousand times or more below recommended safety limits (Cleveland and Ulcek, 1999).

- ◊ **Electronic waste:** Dry-cell batteries are commonly used for power supply for operation of hydrological and meteorological sensors in automated stations. Such batteries can affect human health and environment if they are not disposed properly. The devices such as batteries, thermometer, barometer, weather balloons, solar panels, transducers and computer related electronics are e-wastes that may contain mercury, lead, cadmium, nickel, zinc, lithium and compounds such as Manganese dioxide, Potassium hydroxide, Sodium hydroxide and Ammonium chloride. Disposal or end-of-life management of these equipment needs to be done carefully. Leaching of these chemicals into soil or water or into air affect the environment, wildlife and human health, or the staff/workers may come in direct contact.

- ◊ **Scouring of benthic habitat:** Few buoy stations will installed in the Bay of Bengal. Studies show that depending on the scope of chain, tidal range, and environmental forces where the buoy is located, benthic habitat can be scoured by the buoy chain and anchor. Furthermore, the laying down and picking up of sinkers and chain associated with floating or anchored buoy establishment, disestablishment, and maintenance can temporarily increase turbulence, turbidity, and sedimentation in their vicinities. Additionally, coral and seagrass species through direct contact with equipment can cause coral fragmentation, overturning, and abrasion. Disturbances of seabed biomass hinder organic matter production and nutrient recycling, and destabilize the sediment substrate, which are detrimental to seagrass regrowth (L. Slivinski, 2015). This is applicable for component A only. Further information about ecological environment of Bay of Bengal is given in ANNEX II.

- ◊ **Safety Issues:** The installation and inspection of buoys in the sea could be hazardous and cause risk to installation team and inspection team, especially during rough weather.

- ◊ **Damage from lightning:** Tall electrical equipment and wiring attracts lightning during thunderstorms and can cause harm to equipment, buildings and even indoor equipment and people near the structures.

Positive Environmental Impacts

- ◊ **Promote scientific understandings:** Better observational data and data access are necessary to improve knowledge of ongoing changes, to enhance model performance, and facilitate adaptive management of natural resources especially under impacts of climate change. The outcome of this project will help in selecting response measures to climate

change; help in designing development plan; use in developing a coordinated monitoring mechanism in the country.

◊ **Improved disaster management:** A strong and robust hydrometeorology monitoring network, forecasting and dissemination of forecasts will facilitate detection and attribution of present-day hydrological changes; in particular, changes in water resources and in the occurrence of extreme events.

Mitigation measures

Detailed mitigation measures are discussed in Chapter 6 and also Environmental Code of Annex III.

◊ Clearing natural vegetation will be avoided and equipment will be installed in a natural clearing. The removed trees or plants should be replaced with new plantation at appropriate locations, Where-ever possible the trees and plants should be replaced by at least two samplings of same species. However, local officials can be consulted to finalize the plantation program. The genetic variety in trees as well as other species needs to be ensured. Reduce monocultures, avoid exotic tree species particularly numerous invasive aliens from plantations. Local varieties of trees should be planted as much as possible.

◊ The lakes, water bodies and lowlands must not be used for disposal of any waste or debris.

◊ Solid waste and electronic waste should be properly disposed. The options include: storage, incineration, municipal solid waste landfill, recycling and hazardous waste process. Develop waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris etc.) prior to commencing of installation and submit for approval. Organize disposal of all wastes generated during construction in an environmentally acceptable manner. This will include consideration of the nature and location of disposal site, so as to cause less environmental impact. Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. Segregate and reuse or recycle all the wastes, wherever practical. Prohibit burning of solid waste. Collect and transport non-hazardous wastes to Central offices of BMD.

◊ Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process. Provide refuse containers at each worksite. Request suppliers to minimize packaging where practicable.

◊ Place a high emphasis on good housekeeping practices. That is maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all wastes before transportation and final disposal.

◊ Equipment will not be repaired in the field. But rather in BMD laboratories. Where ever possible prefabrication in built up areas to avoid damage to vegetation.

◊ Buoys with environmental friendly anchoring and mooring options need to be installed to reduce impact area of the seafloor. Installations should not be located near coral reefs or sea grass areas.

◊ Adequate lightning safety measures should be taken to equip the weather stations with surge protectors to protect appliances and equipment. Precautionary steps during thunder storms should to be taken, live connections for computers and equipment should be turned off and personnel should not be using computers during thunderstorms.

◊ Implement suitable safety standards for all workers and site visitors, with sufficient provisions to comply with international standards (e.g. International Labor Office guideline on ‘Safety and Health in Construction; World Bank Group’s ‘Environmental Health and Safety Guidelines’) and contractor’s own safety standards, in addition to complying with national standards.

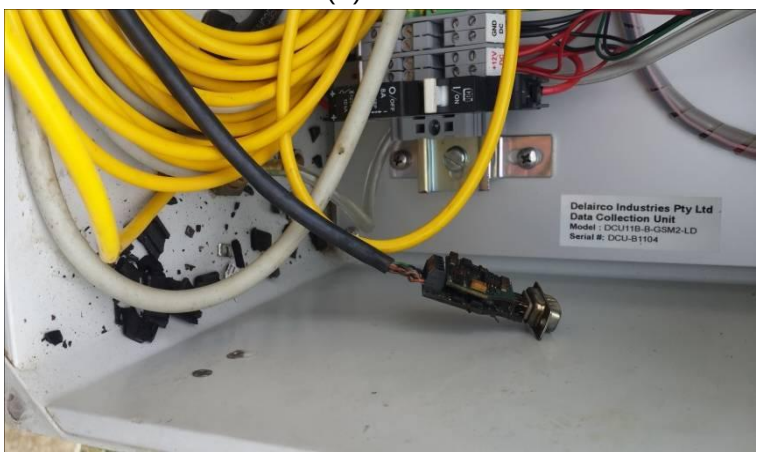
◊ Adequate safety measures should be taken by staff, during travel on boats and vessels during buoy installation and inspection. Vessels must be maintained regularly. Life jackets have to

be used by crew and crew has to be trained in life-saving techniques. Only trained professionals will install and inspect buoy. There should be no travel during stormy weather;

◊ Ensure the riverine transports, vessels and ships are well maintained and do not have oil leakage to contaminate river water. Contain oil immediately on river in case of accidental spillage from vessels and ships and in this regard, make an emergency oil spill containment plan to be supported with enough equipment, materials and human resources.

(A)

(B)



(C)

(D)

Figure 5.1: (A): Manual barometer (mercury), (B): Automatic barometer (C) Damaged equipment in Automatic Weather Station, BMD, Khulna due to lightning (D) Land available for installation of Automated Weather Station at typical Upazila Parishad premises

Component B: Strengthening Hydrological Information Services and Early Warning Systems

172. The following are the potential impacts and all the interventions may not have these impacts.

Adverse Environmental Impacts

◊ **Vegetation removal:** The different equipment and necessary hardware will be installed in BWDB monitoring stations (groundwater monitoring and rain gauges), bridges and adjacent government owned land (water level measuring sensors) and in absence of bridges, on concrete columns placed in water of the rivers. Concrete columns represents only 5% of total installations. In many places small 5m by 5mconcrete sheds will need to be built to protect equipment, which means trees or plants may need to be removed.

Most importantly, few water level sensors may be installed in ecological critical areas and interior of the Sundarban. Again, the planned stations are not defined clearly in terms of locations, lands. The precise scale of impact in each case will be assessed during the implementation of the sub-components, and appropriate mitigations, where necessary, will be implemented.

◊ **Water pollution and disturbance to land ecosystems:** Limited pollution of water sources with regular mobility of office staff observers and gauge readers in and around the stations and during measurements using echo-sounder, Acoustic Doppler Current Profiler (ADCP), sub-bottom profiler.

◊ **Radio-frequency emissions from equipment:** Low-powered, intermittent, or inaccessible transmitters and facilities are normally "categorically excluded" from the requirement for routine evaluation for radio-frequency exposure. These exclusions are based on calculations and measurement data indicating that such transmitting stations or devices are unlikely to cause exposures in excess of any recommended limits under normal conditions. Measurements have shown that ground-level power densities due to microwave directional antennas are normally a thousand times or more below recommended safety limits (Cleveland and Ulcek, 1999).

◊ **Hazardous and e-wastes:** Dry-cell batteries are commonly used for power supply for operation of hydrological and meteorological sensors in automated stations. Such batteries can affect human health and environment if they are not disposed properly. The devices such as batteries, thermometer, barometer, weather balloons and a computer related electronics are e-wastes that may contain mercury, lead, cadmium, nickel, zinc, lithium and compounds such as Manganese dioxide, Potassium hydroxide, Sodium hydroxide and Ammonium chloride. Disposal or end-of-life disposal of these equipment needs to be done carefully. Leaching of these chemicals into soil or water or into air affect the environment, wildlife and human health, or the staff/workers may come in direct contact with them.

◊ **Safety Issues:** Many of the instruments will be installed on bridges or concrete pillars. Access to these installation sites could be unsafe during installation and inspection of buoys.

Positive Environmental Impacts

◊ **Promote scientific understandings:** Better observational data and data access are necessary to improve knowledge of hydro-meteorological processes. The main benefits of this project will be improved reliability of data, improved understanding of floods and droughts, improved prediction of riverbed thalweg movement line which will help to understand morphological changes in river.

◊ **Improved disaster management:** A strong and robust hydrometeorology monitoring network, forecasting and dissemination of forecasts will facilitate detection and attribution of present-day hydrological changes; in particular, changes in water resources and in the occurrence of extreme events. The main benefits will be, improved reliability of flood forecasting data, increased frequency of flood forecasting data, drought forecasting, salinity intrusion forecasting, forecasting of groundwater availability and improved forecasting of morphological changes in river.

Mitigation measures

Detailed mitigation measures are discussed in Chapter 6 and Annex III.

- ◊ In Reserved Forest or Ecologically Critical Areas equipment will be installed in government office premises wherever possible, in case this is not possible, equipment needs to be installed in natural clearing.

- ◊ Clearing natural vegetation will be avoided and equipment will be installed in a natural clearing. The removed trees or plants should be replaced with new plantation at appropriate locations, Where-ever possible the trees and plants should be replaced by at least two samplings of same species. However, local officials can be consulted to finalize the plantation program. The genetic variety in trees as well as other species needs to be ensured. Reduce monocultures, avoid exotic tree species particularly numerous invasive aliens from plantations. Local varieties of trees should be planted as much as possible

- ◊ The lakes, water bodies and lowlands must not be used for disposal of any waste or debris.

- ◊ Solid waste and electronic waste should be properly disposed. Develop waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris etc.) prior to commencing of installation and submit for approval. Organize disposal of all wastes generated during construction in an environmentally acceptable manner. This will include consideration of the nature and location of disposal site, so as to cause less environmental impact.

- ◊ Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. Segregate and reuse or recycle all the wastes, wherever practical. Prohibit burning of solid waste. Collect and transport non-hazardous wastes to Central offices of BWDB.

- ◊ Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process. Provide refuse containers at each worksite. Request suppliers to minimize packaging where practicable.

- ◊ Place a high emphasis on good housekeeping practices. That is maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all wastes before transportation and final disposal.

- ◊ Equipment will not be repaired in the field. But rather in BWDB laboratories. Where ever possible prefabrication in built up areas to avoid damage to vegetation.

- ◊ Concrete pillars placed in water or installations on bridges need adequate access facilities (example ladders, steps) to improve access, thereby increasing safety during inspection.

- ◊ During measurement of discharge and bed profiling using catamarans, echo-sounder, Acoustic Doppler Current Profiler (ADCP), sub-bottom profiler surveyors need to be careful not to throw anything in water and prevent leakages of oil from boats and catamarans. Not carrying out in-situ monitoring activities in one place in long, contiguous stretches at a time. Motor boat speed will be limited to 15 km/h in accordance with best international practices.

- ◊ Implement suitable safety standards for all workers and site visitors, with sufficient provisions to comply with international standards (e.g. International Labor Office guideline on ‘Safety and Health in Construction; World Bank Group’s ‘Environmental Health and Safety Guidelines’) and contractor’s own safety standards, in addition to complying with national standards.

- ◊ Ensure the riverine transports, vessels and ships are well maintained and do not have oil leakage to contaminate river water. Contain oil immediately on river in case of accidental spillage from vessels and ships and in this regard, make an emergency oil spill containment plan to be supported with enough equipment, materials and human resources.

6. Environmental Management Framework

173. The Environmental Management Framework (EMF) is proposed as a decision making tool to manage adverse impacts of project interventions on the environment and people of the project area and ensures that activities implemented under this project are environmentally sound.

174. The EMF recognizes the need for an early environmental and social assessment, during planning stage of activities at the field level which will help in identifying any adverse impact and support in planning and implementing mitigation measures. These mitigation measures are to be mainstreamed throughout the implementation phase. The framework has been prepared taking into consideration of the GoB regulatory framework and WB safeguard policy. This is not an attempt to predict the specific impacts of projects or activities, but rather to minimize the overall potential change to the natural environment whilst implementing projects. One purpose of the EMF is also to record the procedure and methodology for management of mitigation identified for each negative impacts of the Project. It will help the management in delineating the responsibility of various participants and stakeholders involved in planning, implementation and operation of the project.

175. Using the major steps outlined below, this section of the EMF describes the process for ensuring that environmental and social concerns are adequately addressed through the institutional arrangements and procedures used by the project for managing the identification, preparation, approval, and implementation of Components. The major steps are:

- ◊ Screening and Impact Assessment
- ◊ Review, Approval, and Disclosure of Component Safeguard Instruments
- ◊ Implementation, Supervision, Monitoring, and Reporting

176. A schematic diagram showing the Environmental Assessment Framework is shown in Figure 6.1. Each of the components are further discussed in detail in the different sections of this chapter.

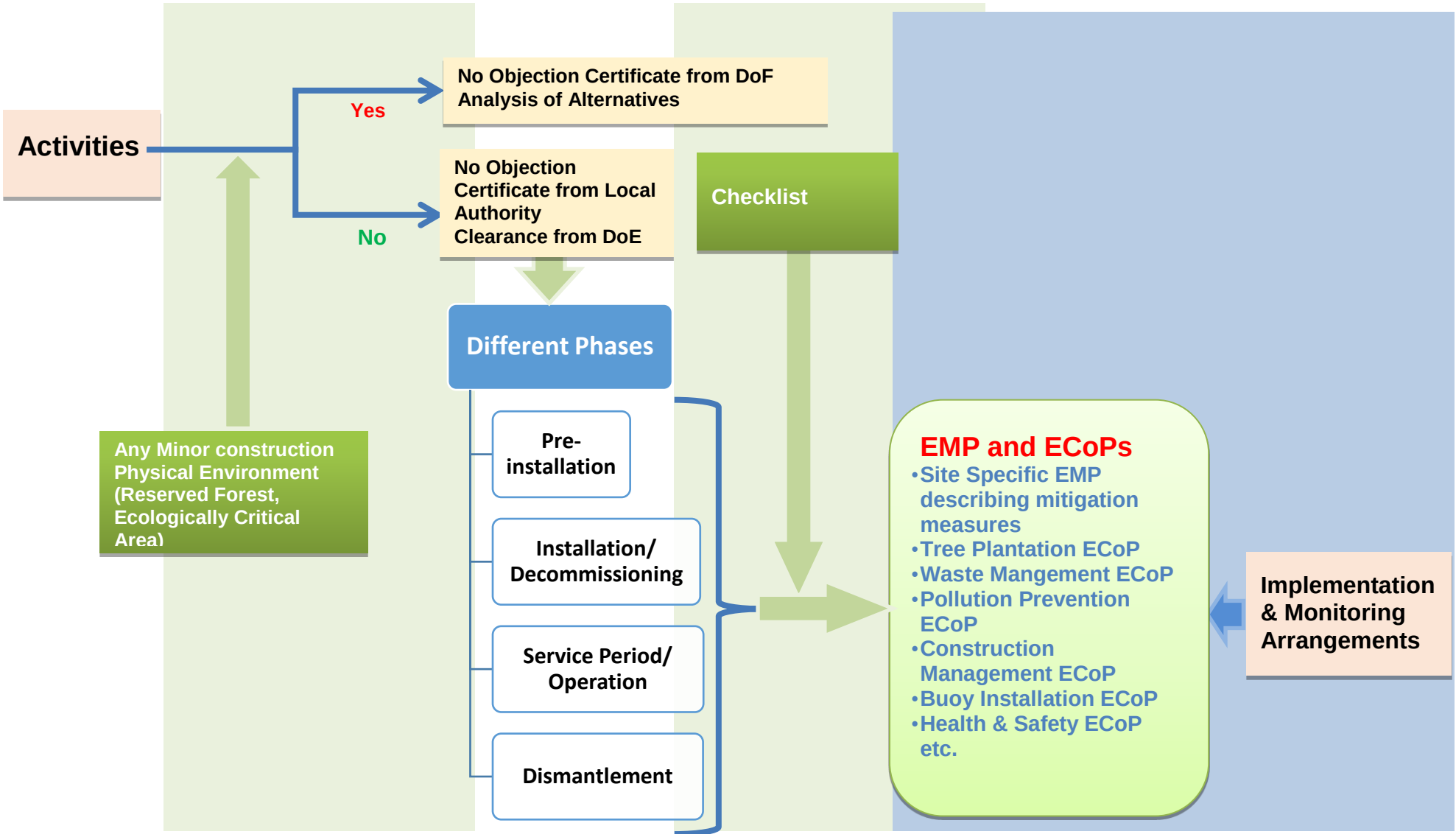


Figure 6.1.Environmental Management Framework

Screening and Impact Assessment

177. Key steps in Component preparation during project implementation are screening and impact assessment. The screening often includes two steps: eligibility screening and impact screening for assessment of potential impacts, policies triggered and instruments to be prepared.

178. The purpose of eligibility screening is to avoid adverse social and environmental impacts that cannot be adequately mitigated by project or that are prohibited by a World Bank policy, or by international conventions. Typical safeguard actions to be taken during the EMF process are illustrated in the flow chart in Figure 6.2.

179. In general, impact screening process identifies what levels of environmental assessment are required for the interventions and categorizes the interventions into A, B and C (explanations given in Table 5.2). The purpose of the screening is to get relevant concerns addressed at an early stage. It ensures proper designs with adequate considerations mitigate environmental and social impacts. Furthermore, it enhances opportunities for proper budgeting. Environmental and social impacts of each sub-component of the project will vary in their extent, magnitude and duration as per the nature and scale of each installation of equipment or physical intervention and location chosen.

180. If any of the intervention is expected to have contentious and multidimensional interrelated environmental issues and have significant and irreversible negative impact, than the interventions should be deemed ineligible for financing under the project. But as mentioned before, the project is not expected to have significant environmental impact due to the nature of investments. Only the activities categorized as ‘B’ or ‘C’ will be eligible for funding under the project.

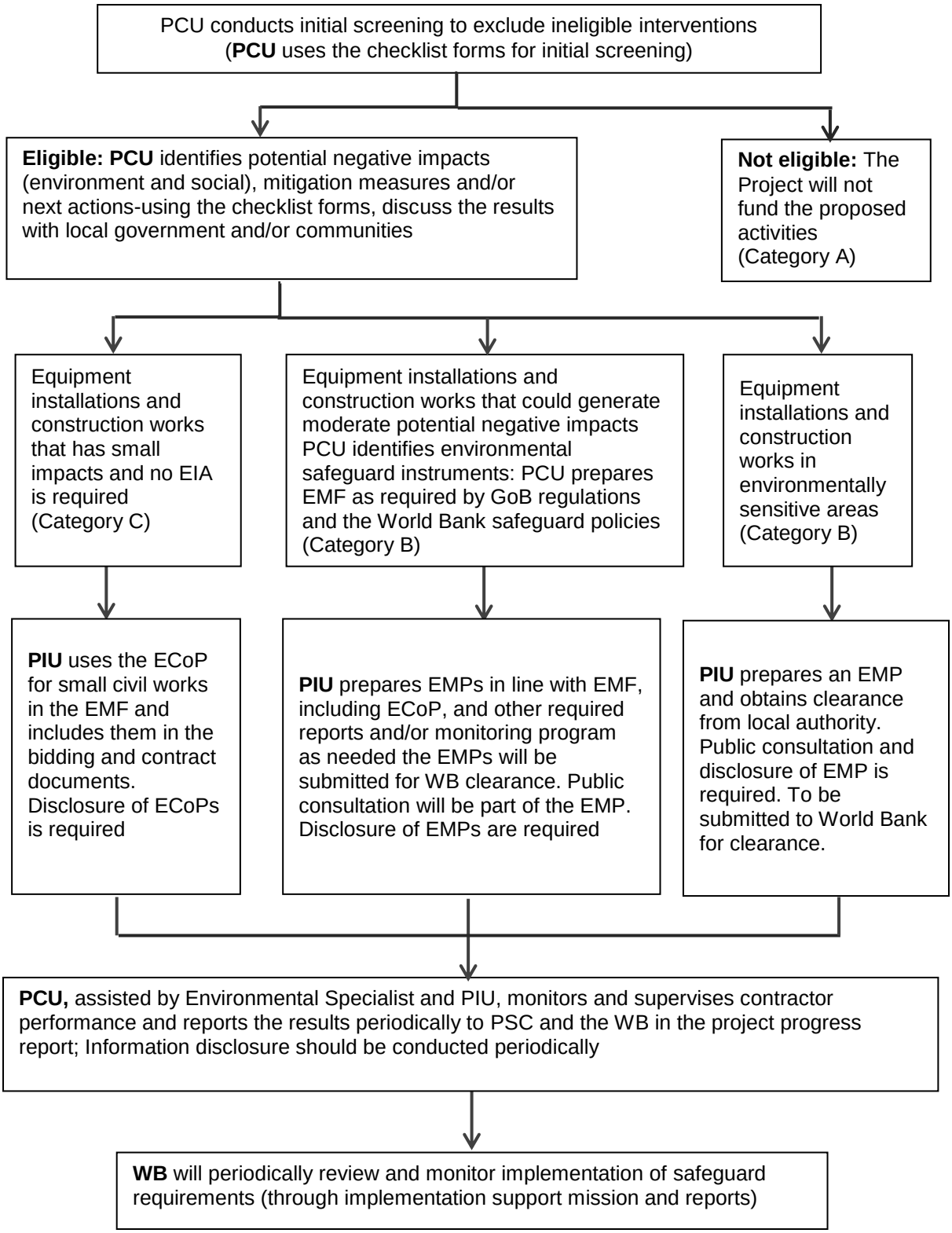


Figure 6.2: Schematic Flowchart for Safeguard Actions for project components

181. Based on discussions in previous chapters it can be concluded that the project is not expected to have significant environmental impact due to the nature of investments. However, the project may finance some infrastructure and install some equipment in environmentally sensitive areas, thus technical screening is needed.

182. The technical environmental screening of each proposed component is to determine the appropriate extent and type of environmental assessment (EA). The outcome of this screening is used to classify the interventions into one of three categories, depending on the type, location, sensitivity, and scale of the project component and the nature and magnitude of its potential environmental impacts (World Bank OP 4.01).

Table 6.1: Environmental and Social Screening Criteria

Category	Screening Criteria
Category A (if High)	An intervention will be Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. An EIA is carried out for this type of activities as per ECA 1995 of GoB. No subproject under this project is likely to have significant environmental impact. If any subproject is identified with significant environmental impacts, it will not be supported under the project.
Category B (If medium)	An intervention is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas - including wetlands, forests, grasslands, and other natural habitats - are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigation measures can be designed more readily than for Category A projects.
Category C (If Low)	An intervention is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.

183. The checklist will be used to screen the components and activities of this project. The checklist (Table 5.1) will be used during eligibility and checklist (Table 5.2) will be used in impact screening.The checklists will be filled in based on expert judgment (Environmental Specialist and trained PIU officials) and FGD with officials and field technicians from implementation agencies and communities living around the installation area.

184. In the checklist, the magnitude of environmental impacts needs to be classified as none, low, moderate and severe. Long-term and short-term impacts (identified as L and S, respectively) as well as reversible and irreversible (identified as R and I, respectively) also need to be identified in the checklist. This checklist needs to be completed for each of the locations for the different components of the project based on participation and consultation with beneficiaries/local communities. The checklist needs to be completed on the basis of the threshold values highlighted in safeguard policies of WB and environmental policies of GoB, which are:

- ◊ potential risks to natural habitats and forests,
- ◊ pollution risks including land, water and air,
- ◊ human health and occupational safety,
- ◊ land slope stability, and
- ◊ built artifact or heritage

185. Each intervention of the project will go through environmental and social screening in order to identify relevant environmental and social concerns. The screenings are also helpful to suggest if any further investigation and assessment is necessary. Once the proposed interventions are screened against all these criteria they will be categorized as indicated in the Table 5.2 and as per the nature and magnitude of impacts. Key potential negative impacts on the environment and local community will be screened during planning and implementation phases. Interventions with medium and high impacts will need to develop and implement mitigation measures, monitoring programs, and adequate institutional capacity on safeguards and this will be used as the basis for preparation of EMPs for intervention. Data collection, field survey, and consultation with local communities and affected population will be carried out. If a component is required by the government's EIA regulations, appropriate actions and documents will be prepared accordingly. A detailed Mitigation and Compliance Monitoring Plan given in Table 7.2 shows the mitigation actions of the identified impacts and key performance indicators of the mitigation measures.

6.1.1 Analysis of Alternatives

186. The Bangladesh Weather and Climate Services Regional project will support modernization of the country's weather, water and climate information infrastructure strengthening both the supply of hydro-meteorological data, information and services and delivery to sectors and communities. It will do so by modernizing meteorological and hydrological monitoring systems, forecasting, strengthening sector specific information services and targeted community based hazard early warning activities in selected districts. Thus the project will play an important role in providing reliable data and information on trends and condition of water resources; climate and flow regimes; water use and development practices and will provide the backbone for sound decision making and effective water resources management.

187. In general, the project is not expected to have significant environmental impact due to the nature of investments. However, the project may finance some infrastructure and install some equipment in environmentally sensitive areas. Various alternatives need to be considered in siting and design of the project components in environmentally sensitive areas. The analysis of these alternatives should be based on the following considerations:

- With or without the project activities in environmentally sensitive areas;
- Analysis criteria to include environmental, technical/design and economic options (Table 6.2);
- Network in environmentally sensitive areas should be basic with equipment installed in already built up areas or khas land;
- Network should be focussed on optimum locations and data and information should be based on primary data collection in upstream/ downstream region outside of environmentally sensitive areas combined with modelling activities and satellite information.

Table 6.2: Criteria for evaluation of alternatives

Main Criteria	Sub Criteria
Technical Aspects	• Robustness, constructability, • degree of protection, • maintenance requirements, • history of performance
Financial Aspects	• Construction cost and • maintenance cost
Environmental Aspects	• Project footprints, • material requirements, Impact on river flows and channels, • Impact on aquatic and terrestrial habitats, • impact on fish and fish migration • safety

6.1.2 Environmental Management Plan (EMP)

188. A project's EMP consists of a set of mitigation, monitoring, and institutional measures to be taken during implementation and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. The plan also includes the actions needed to implement these measures. EMPs are essential elements of EIA reports for Category A projects; however, for many Category B projects, the EA may result in a management plan only. For this particular project, EMPs will be required if equipment installations and construction works are conducted in environmentally sensitive areas. The EMP to be prepared should include the analysis of impacts on the sensitive areas and mitigation measures commensurate with the magnitude of impacts. To prepare a management plan, the PIUs needs to identify a set of responses to potential adverse impacts; (b) determine requirements for ensuring that those responses are made effectively and in a timely manner; and (c) describe the means for meeting those requirements.

6.1.3 Environmental Code of Practice (ECoPs)

189. The environmental codes of practice (ECoPs) are generic, non site-specific guidelines. The ECoPs consist of environmental management guidelines and practices to be followed by the PIU and contractors for sustainable management of all environmental issues. ECoP will consist of routine systematic checking that all mitigations are effectively implemented during the relevant periods of the project. Detailed ECoPs are shown Annex III.

- ✓ Tree Plantation ECoP
- ✓ Pollution Prevention ECoP
- ✓ Waste Management ECoP
- ✓ Construction Management ECoP
- ✓ Buoy installation ECoP
- ✓ Health and Safety ECoP

6.1.4 Disclosure of Safeguard Instruments

190. All the activities of the project that is during planning and equipment installation will be disclosed locally in a timely manner, before approval of the Components, in an accessible place and in a form and language understandable to key stakeholders. During disclosure the following information needs to be shared:

- Main objectives, activities and outcomes of the project
- Any environmental impacts (positive and negative)
- Mitigation measures to be taken
- Environmental Management Framework

7. Implementation Arrangements

191. The Environmental Management Framework (EMF) implementation requires an organization support structure in the form of organizational requirements, training needs and plan, and information management system. The Government of Bangladesh (GoB) is responsible for overall project management and coordination through its Ministry of Defense (MoD), Ministry of Water Resources (MoWR), and Ministry of Agriculture (MoA). The purpose of project management is to ensure (i) Project Oversight and Policy Direction, (ii) Project Coordination and Management, and (iii) Project Implementation.

192. To carry out the above functions, (i) a Project Steering Committee (PSC) and (ii) three Project Implementation Units (PIUs) each at BMD, BWDB and DAE will be established. To facilitate coordination between the three PIUs during implementation, the PSC will set up a Project Coordination Unit (PCU) andthe PCU will have an Environment Specialist for the duration of the project.

a. Project Level

193. A central Project Steering Committee (PSC) will take the lead in overseeing and monitoring of the implementation of components and this unit will periodically supervise and monitor the safeguard implementation performance and include the progress/results in the Project Progress Report. The PSC will provide an apex platform/forum for overall guidance, policy advice/decision, and coordination of project activities addressing inter-agency issues that may arise during project implementation.

194. The PSC will be convened by the Secretary of the MoD. The PSC will include the Secretaries, or their representatives from the Finance Divisions, Ministry of Water Resources, Ministry of Agriculture, & Ministry of Disaster Management and Relief and any relevant Government Stakeholders. Secretariat support will be provided by the Project Coordination Unit (PCU) office at BWDB. The PSC will oversee:

(a) The overall compliance with measures agreed with the World Bank on the basis of the findings and results of the screening and EA; and
(b) The findings of monitoring programs and need for corrective measures.

195. For more regular project monitoring, BWDB Head Office will create a Project Coordination Unit (PCU) headed by a Project Coordinator (PC) who will be the Chief Planning of the BWDB. This office will serve as the secretariat to the PSC. The PCU will appoint an Environmental Specialist who will be responsible for effective and timely implementation of safeguard activities, monitoring of the environmental impacts of components throughout the project period and environmental enhancement of project activities. The PCU will be fully connected with the PIUs and will report to the PSC.

196. The Environmental Specialist will provide support to the PIUs throughout the EA process with advice, training, dissemination of good practice, and operational support. The Environmental Specialist will review all the screening report, EMFs, monitoring reports etc. prepared by implementing agencies. The TOR of the Environmental Specialist is given in Annex V.

b. Component Level

197. Each implementing agency will establish their own Project Implementation Unit (PIU), which will be responsible for ensuring effective implementation of safeguard measures in close consultation with local authorities and local communities. Each PIU will assign at least one full time staff as the safeguard focal person to be responsible for forging effective implementation of safeguard activities. PIU-BMD and PIU-DAE will assign one additional staff each for training purposes and to ensure continuity in case of transfer of assigned focal person. The PIU will be responsible for incorporating environmental considerations in bidding and contractual documents. During implementation, the PIU will assign local officials for monitor environmental issues. The results will be part of the component progress report and the safeguard focal point will be responsible for ensuring proper documentation of safeguard activities.

198. PIUs will be actively involved in disseminating information on to beneficiaries about the key project components, sub-components, activities, stakeholder involvement, contribution of the project and project implementation process. Professional support will be provided to PIU through BMD, BWDB and DAE. The organizational flowchart is shown in figure 7.1.

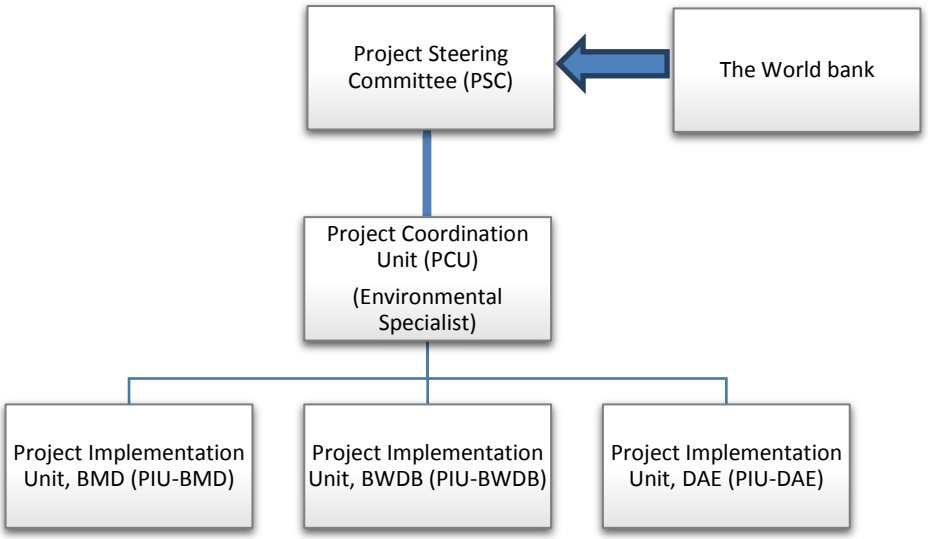


Figure 7.1: Implementation Arrangement

199. In summary, an Environmental Specialist, part of the PCU will be responsible for effective and timely implementation of safeguard activities, monitoring of the environmental impacts of components throughout the project period and environmental enhancement of project activities. Each PIU will have at least one Environment Focal Point who will be responsible for forging effective implementation of safeguard activities. PIU-BMD and PIU-DAE will assign one additional staff each for training purposes and to ensure continuity in case of transfer of assigned focal person. The PSC will ensure coordination between the three implementing agencies. The Table 7.1 provides roles and responsibilities of different stakeholders of the project implementation team.

Table 7.1: Roles and responsibilities of project implementation team

Responsible Unit	Major Activities	Output	Action Time Frame
Project Steering Committee (PSC)	• Guide overall Environmental Performance of the project	• Ensure overall environmental compliance of the project	Throughout project life cycle
Environmental Specialist, Project Coordination Unit (PCU)	• Capacity development of PIU and professionals of implementing agencies • Review all the screening report, EMPs, monitoring reports prepared by three agencies • Monitor key activities and track performance.	• Quality assurance • Project level environmental report • Instructions to PIU and contractor • Support for necessary no-	Throughout project life cycle

Responsible Unit	Major Activities	Output	Action Time Frame
	• Identify and correct problems. • Keep adequate records of EA performance. • Conduct periodic environmental management system audits	objection clearance	
Environment Focal Person, Project Implementation Units (PIU)	• Environmental Screening • Preparation of EMP, if needed • Costing of EMP implementation • Community relations • Ensure inclusion of environmental clauses in technical specifications • Implementation of mitigation measures • Environmental performance of equipment • Support implementation of ECoPs	• Component level Annual Environmental Reports • Obtain no-objection certificate	Once a month but responsibility runs throughout the project life cycle
Contractors	• Environmental performance of equipment and plants. • Implementation of relevant mitigation measures.	• Maintenance records • Trained workers • Mitigating actions	On-going responsibility throughout installation phase.

200. A detailed Mitigation and Compliance Monitoring Plan given in Table 7.2 shows the mitigation actions (based on ECoPs, responsibility for execution and mitigation, key performance indicator and cost allocation.

Table 7.2: Mitigation and Compliance Monitoring Plan

Environmental Impact/Issue	Mitigation Actions	Responsibility		Key Performance Indicator	Cost Allocation
		Execution	Monitoring		
Vegetation removal	Clearing natural vegetation will be avoided as far as possible. Equipment will be established in a natural clearing, to the extent possible. Any loss or damage to vegetation will be compensated in accordance with Tree Plantation Plan In Reserved Forest or Ecologically Critical Areas equipment will be installed in government office premises wherever possible, in case this is not possible, equipment needs to be installed in natural clearing Complete record will be maintained for any tree cutting. Tree Plantation ECoP	Contractor	PIU (BMD, BWDB, DAE)	Number of any non-compliance reports Number of tree felled Area of vegetation restored	Included in contractors' costs
Radio-frequency emissions from equipment	Equipment with adequate safety standards can only be procured Storage, handling and installation of equipment will follow standard safety instructions given by manufacturer.	Procurement Committee and PCU	PIU (BMD, BWDB, DAE)	Monitoring in accordance with Ground Water Monitoring Program. No breaches of Material Safety Data Sheet (MSDS) for hazardous substances.	Included in cost of equipment
Electronic and chemical waste	Waste Management ECoP A Waste Management Plan will be prepared and approval obtained from PSC.	PIU (BMD, BWDB, DAE)	Environmental Specialist	Approved Plan Plan itself will outline appropriate KPIs for its implementation.	Included in O&M costs

Environmental Impact/Issue	Mitigation Actions	Responsibility		Key Performance Indicator	Cost Allocation
		Execution	Monitoring		
Scouring of benthic habitat	Buoy Installation ECoP Environmental friendly anchoring and mooring options need to be installed to reduce impact area of the seafloor. Installations should not be located near coral reefs or sea grass areas.	Contractor	Environmental Specialist, PIU (BMD), PCU	Reduced disturbance in sea floor	Included in contractors' costs
Damage from lightning	Adequate lightning safety measures will be taken to equip the weather stations with surge protectors to protect appliances. Precautionary steps during thunder storms will be taken, live connections for computers and equipment should be turned off and personnel should not be using computers during thunderstorms.	Contractor	PIU (BMD, BWDB, DAE)	No. of equipment damaged from lightning	Included in contractors' costs
Health and safety	Concrete pillars placed in water need adequate facilities (example ladders, steps) to improve access; Motor boat speed will be limited to 15 km/h in accordance with best international practices; Place a high emphasis on good housekeeping practices. That is maintain all construction sites in a cleaner, tidy and safe condition Vessels must be maintained regularly. Life jackets have to be used by crew and crew has to be trained in life-saving techniques. Only trained professionals will install and inspect buoy. There should be no travel during stormy weather	Contractor	PIU (BMD, BWDB, DAE)	Occurrence of accidents	Included in O&M costs
Water pollution and disturbance to land	The lakes, water bodies and lowlands must not be used for disposal of any waste or debris.	Field team of PIU	Environmental Specialist, PIU	Number of non-compliance reports.	Included in contractors'

Environmental Impact/Issue	Mitigation Actions	Responsibility		Key Performance Indicator	Cost Allocation
		Execution	Monitoring		
ecosystem	Equipment will not be repaired in the field, repairs will take place in BMD and BWDB laboratories. Concrete pillars placed in water need adequate facilities (example ladders, steps) to improve access, thereby increasing safety during inspection. During measurement in canals, rivers, surveyors need to be careful not to throw anything in water and prevent leakages of oil from boats and catamarans. In-situ monitoring activities will not be continued in one place in long, contiguous stretches at a time. Motor boat speed will be limited to 15 km/h in accordance with best international practices. Construction materials will be stored, used and handled appropriately.			Number of community complaints.	costs

c. Special Environmental Clauses (SECs) included in the Technical Specification

201. An Environmental Assessment highlights the major possible impacts and lists mitigation measures to be implemented. Some of those measures, but not all, are directly related to the construction and installation works of the project. These measures and precautions are to be implemented in the frame of worksites management. When evaluating bid proposals Procurement Committee needs to look at the approach the contractor will use to for environmental management during construction, its previous experiences, and the cost for environmental mitigation. Each contractor will be required to work with the PIU to ensure implementation of mitigation measures. The construction contracts will have Special Environmental Clauses (SECs) to bind the contractors for the above obligations, these are:

- The bidder will be responsible for communicating with and training of its staff in the environmental/social aspects. The contractor will develop the various plans directed towards health, safety, the environment and social issues (discussed in Chapter4 and 5), and get them approved by the PSC before the commencement of the physical works on site.
- The bidder should demonstrate that is has the key personal as permanent staff for at least two (2) years that have expertise in designing and monitoring environmental impacts and implement mitigation measures and health and safety experience in field activities.
- The bidder should demonstrate experience of one (1) construction contract over the last five (5) years in which the environmental impact mitigation knowledge transfer to a local partner or capacity building of the Employer's country staff was carried out satisfactorily.
- The Contractor should institute a program of self-monitoring and enforcement via standard international quality assurance procedures for monitoring the Project Impact, as described in EMF. The self-monitoring and enforcement program shall be in accordance with the associated quality assurance procedures which shall be included in the Contactor's Site Environmental Management Plan.
- The Contractor should, wherever possible, locally recruit the available workforce and shall provide appropriate training as necessary. The Contractor shall consider all aspects of workforce
- The Contractor should, wherever possible, locally recruit the available workforce and shall provide appropriate training as necessary. The Contractor shall consider all aspects of workforce
- The bidder should have available in-house policies and procedures acceptable to the PSC for worksite management.
- The contractor will be required to follow the ECoPs (appropriate ECoPs to be added in the Annex) and specific EMP (to be added in Annex).
    - ◊ Tree Plantation ECoP
    - ◊ Pollution Prevention ECoP
    - ◊ Waste Management ECoP
    - ◊ Construction Management ECoP
    - ◊ Health and safety ECoP
    - ◊ Buoy Installation ECoP

8. Capacity Building, Training and Technical Assistance

202. The effectiveness of the Environmental Management Framework and implementation depends considerably on the understanding and preparedness of project staff and in particular their Environmental Team. It is important that the project authority to sensitize the team on management of environmental issues. This EMF provides guidance, and encourages them to build requisite capacities.

203. One of the most critical aspects of this project is to strengthen the technical capacity of the three implementing agencies. The capacity building program will be based on an assessment of the current capacity of staff, identification of training needs and involve development of a time-bound plan for areas of training, phasing, and modalities and institutions through which specific training will be provided. The capacity building program should also provide an opportunity for integrating environmental issues into the different policies, projects and activities of BMD, BWDB and DAE. Inter-sectoral coordination in dealing with cross-cutting issues like environment is a major lacking in Bangladesh. While many of the policies and sectoral regulations in Bangladesh have incorporated environmental issues into their regulatory framework, there is lack of directions for cooperation, coherence and coordination within the different agencies. Additionally inadequate capacity and structural reforms means environmental issues are not treated with appropriate urgency and priority and thus create inconsistencies. Present capacities of the three agencies with respect to environmental assessment are summarized in Table 8.1.

Table 8.1: Capacity to incorporate environmental assessment

Implementation Agency	Activities related to EA	Gaps
Bangladesh Meteorological Department (BMD)	BMD has no prior experience of implementation of EA	No dedicated person or cell for EA or environmental issues
Bangladesh Water Development Board (BWDB)	Many BWDB projects fall under Red Category and therefore detailed EIA and IEE is done by independent consultants/ consulting farms	No dedicated person or cell for EA or environmental issues Activities related to EIA and IEE done project-wise and on an adhoc basis EA monitoring and implementation is absent A number of professionals have received training on EIA and environmental issues but there is no scope of structural reformation and continuity to sustain the capacity gained from training
Department of Agricultural Extension (DAE)	DAE projects fall under Green Category and therefore DAE has no prior experience of implementation of EA	No dedicated person or cell for EA or environmental issues

204. Table 8.1 shows that BMD, BWDB and DAE have little to no experience in working with EA and environmental issues. Capacity building for environmental safeguard management and also supporting a wide and deep base of technical knowledge on environmental issues will need to be carried out at all tiers of the project, including PCU, PIU (BMD, BWDB, DAE), Field Team and contractors). The various aspects that need to be covered under the capacity building will include general environmental awareness with focus on the following:

- Principles and policies for (natural) environmental mitigation in development projects;

- Legal and institutional aspects; project mandates;
- Probable environmental impacts from project;
- The EMF consisting of
    - The environmental designs and implementation plans;
    - Mitigation activities
    - Monitoring, evaluation and reporting methods and mechanisms and,
    - Inter-sectoral and inter-agency collaboration, etc.

205. Capacity building will include training of IT personnel, forecasters and middle management officials. Technicians and engineers in the headquarters and field offices should also undergo training to enhance their knowledge and skills in the operation and maintenance of modern equipment. The following should be considered:

- ◊ Post-training utilization of the trainees and application of knowledge acquired during training activities should be ensured by the management of the agencies. Dependable follow-up measures and structural reformation need be in place to ensure sustainability and effective application.
- ◊ A pool of officers having aptitude, commitment, competence and adaptability need to be identified within each agency to act as trainers and retain the knowledge acquired.
- ◊ Capacity building programs will need to be prioritized and frontloaded for all the implementing agencies. A systematic needs assessment needs to be carried out periodically throughout the project.
- ◊ Encourage decentralization of the training services to ensure optimal utilization of facilities and resources in the regional offices.
- ◊ Incentives should be given to busy personal to attend the training courses by giving due importance during performance appraisal and career advancement.
- ◊ Mid and junior level officers should be given preference to ensure continuity.
- ◊ Where ever possible capacity building activities for EIA and environmental issues should held in tandem with other capacity building activities of the project

206. Table 8.2 provides a summary of various aspects of the environmental trainings to be conducted. The PCU will update the plan during the Project implementation in consultation with the World Bank. During the implementation phase of the project, these trainings will continue to be conducted and coordinated by Environmental Specialist and PIU staff for all relevant O&M personnel and community.

Table 8.2: Environmental Trainings

Participants	Contents	Responsibility	Schedule	Type of program
Bangladesh Meteorological Department (BMD)				
Central and Divisional Officers	General environmental and socioeconomic awareness; Principles and policies for (natural) environmental mitigation in development projects; Legal and institutional aspects; Project mandates; Environmental sensitivity of the project influence area Probable environmental impacts from project; Key findings of the EMF; Mitigation measures; ECoPs listed in the EMF	Environmental Specialist with selected national/ international trainers	During planning stage of project	Long term (5 days with 1 day fieldwork)
Lab Technicians	General environmental and socioeconomic awareness; Environmental sensitivity of the project influence area Probable environmental impacts from project; Key findings of the EMF; Mitigation measures; ECoPs listed in the EMF	Environmental Specialist with selected national trainers and trained Central BMD officers	During planning stage of project (To be repeated as needed.)	Medium term (3 days)
Bangladesh Water Development Board (BWDB)				
Director to Sub Assistant level officers primarily in Hydrology, O&M and Planning divisions	General environmental and socioeconomic awareness; Principles and policies for (natural) environmental mitigation in development projects; Legal and institutional aspects; Project mandates; Environmental sensitivity of the project influence area	Environmental Specialist with selected national/ international trainers	During planning stage of project	Long term (5 days with 1 day fieldwork)

Participants	Contents	Responsibility	Schedule	Type of program
	Probable environmental impacts from project; Key findings of the EMF; Mitigation measures; ECoPs listed in the EMF			
Field staff from Hydrology and O&M Divisions in the relevant districts	General environmental and socioeconomic awareness; Environmental sensitivity of the project influence area Probable environmental impacts from project; Key findings of the EMF; Mitigation measures; ECoPs listed in the EMF	Environmental Specialist with selected national trainers and trained BWDB officers	During planning stage of project (To be repeated as needed.)	Medium term (3 days)
Drivers; boat/launch crew	Road/waterway safety; Defensive driving/sailing; Waste disposal	Trained BWDB officers	Before and during the field operations. (To be repeated as needed.)	Short term (1 day)
Department of Agricultural Extension (DAE)				
Central and Divisional Officers	General environmental and socioeconomic awareness; Principles and policies for (natural) environmental mitigation in development projects; Legal and institutional aspects; Project mandates; Environmental sensitivity of the project influence area Probable environmental impacts from project; Key findings of the EMF; Mitigation measures; ECoPs listed in the EMF	Environmental Specialist with selected national/ international trainers	Prior to the start of the field activities. (To be repeated as needed.)	Long term (5 days with 1 day fieldwork)
Upazila officers	General environmental and socioeconomic awareness; Environmental sensitivity of the project influence area	Environmental Specialist with	During planning stage of project	Medium term (3 days)

Participants	Contents	Responsibility	Schedule	Type of program
	Probable environmental impacts from project; Key findings of the EMF; Mitigation measures; ECoPs listed in the EMF	selected national trainers and trained DAE officers	(To be repeated as needed.)	
Sub Assistant Agricultural Officers at Union level	General environmental and socioeconomic awareness; Environmental sensitivity of the project influence area Probable environmental impacts from project; Key findings of the EMF; Mitigation measures; ECoPs listed in the EMF	Environmental Specialist with selected national trainers and trained Central DAE officers	During planning stage of project (To be repeated as needed.)	Short term (1 day)
General				
Focal Person from PIU-BMD (2 person), PIU-BWDB (1 person) and PIU-DAE (2 person)	Training of trainers	Environmental Specialist with selected national trainers	During planning stage of project	Short term (10 days)
Contractors and installation crew	General environmental and socioeconomic awareness; Environmental sensitivity of the project area; Key findings of the EMF; Mitigation measures; ECoPs listed in the EMF	Environmental Specialist with selected national trainers and trained Central DAE officers	During implementation stage of project	Short term (1 day)

9. Environmental Management and Monitoring Cost

207. The cost of overall environmental and social management includes waste management, dissemination, and impact compliance and evaluation and capacity building and is estimated to be **USD 0.62 million** over the project period. The breakdown of estimated costs is given in **Table 9.1**.

Table 9.1: Cost Estimates for Environmental Management and Monitoring

Sl	Activities	Total	Amount included in BMD budget	Amount included in BWDB budget	Amount included in DAE budget	Remarks
		USD	USD	USD	USD	
1	Baseline information, development of conservation plans and monitoring during instrument installation, construction and operation	-				
2	Implementation of conservation plans and ECoPs Tree plantation Waste Management (Dry Cell Management and E-waste Management)	 50,000 200,000	 20,000 75,000	 20,000 75,000	 10,000 75,000	Purchase of saplings Collection &transportation to central offices
3	Environmental Specialist	120,000		120,000		contract for 5 years
5	Stakeholder consultations	Included in social plan				
6	Capacity building and institutional strengthening	250,000	100,000	50000	100,000	Includes all levels of staff training
Total		620,000	195,000	265,000	160,000	

References:

Bangladesh Bureau of Statistics (BBS) and Statistics and Informatics Division (SID), Ministry of Planning Government of the People's Republic of Bangladesh. 2011. “District statistics. Bagerhat.” http://www.bbs.gov.bd/WebTestApplication/userfiles/Image/District%20Statistics/Bagerhat.pdf

Cleveland, R. F and J. L. Ulcek, 1999. Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields Office of Engineering and Technology Federal Communications Commission Washington, D. August 1999

Department of Fisheries,Ministry of Fisheries and Livestock,Bangladesh.2012-2013."Fisheries Statistical Yearbook of Bangladesh."

Government of Bangladesh. 1995. “The Bangladesh Environment Conservation Act, Act No. 1 of 1995” http://www.moef.gov.bd/html/laws/env_law/153-166.pdf

Government of Bangladesh. 1997. Environment Conservation Rules, 1997, as Amended 2002 and 2003. http://www.doe-bd.org/2nd_part/179-226.pdf

Government of Bangladesh. 2008. “Bangladesh Climate Change Strategy and Action Plan.” http://www.moef.gov.bd/climate_change_strategy2009.pdf

Government of Bangladesh. 1958. “Inland Water Transport Authority Ordinance.” http://bdlaws.minlaw.gov.bd/pdf/282___.pdf

Government of Bangladesh. 2012. “Wild Life (Protection and Safety) Act 2012 [in Bangla].” http://www.bforest.gov.bd/images/test/wildlife%20act.pdf

Government of Bangladesh. “Bangladesh Wild Life (Preservation) Order (1973).” http://bdlaws.minlaw.gov.bd/print_sections_all.php?id=452

Government of Bangladesh. 1950. “Protection and Conservation of Fish Act, 1950.” http://bdlaws.minlaw.gov.bd/pdf/233___.pdf

HuqS.M. I. and A.F.M. ManzurulHoque.“Land and Soil Resources Database for Grass - Root Agricultural Development in Bangladesh.” http://www.fao.org/fileadmin/user_upload/GSP/docs/Presentation_china_feb2012/Hoque.pdf

Institute of Water and Flood Management (IWFM), Bangladesh University of Engineering and Technology. 2012. “Spatial and Temporal Distribution of Temperature, Rainfall, Sunshine and Humidity in context of crop agriculture.”http://www.slideshare.net/tauhidulislam50115/29-report spatialtemporaldistributionoftemperaturecropagriculturefull

Slivinski, L. 2015.Environmentally Friendly Aids to Navigation Buoy Moorings. Masters project submitted in partial fulfillment of the requirements for the Master of Environmental Management degree in the Nicholas School of the Environment of Duke University. Dr. Cindy Van Dover, Adviser May 24, 2015

Macauley M, Palmer K, Shih J., Cline S, and H Holsinger. 2001. Modeling the Costs and Environmental Benefits of Disposal Options for End-of-Life Electronic Equipment: The Case of Used Computer Monitors. Discussion Paper 01–27. http://www.rff.org/documents/rff-dp-01-27.pdf Accessed on 5 March 2015

Ministry of Water Resources. 1999. “National Water Policy”. Government of Bangladesh.

Naser, N. M. .2014. ”Fisheries and Environmental Challenges of Gorai and Modhumoti River System”.http://www.slideshare.net/CPWF/fisheries-and-the-environmental-challenges-of-the-goraimadhumati-river-system

Rahman M.R. and M. Asaduzzaman (undated). “Ecology of Sundarban Bangladesh.”http://www.banglajol.info/index.php/JSF/article/view/14618

Water Resources Planning Organization (WARPO). 2001. “National Water Management Plan”. Ministry of Water Resources, Government of Bangladesh. http://www.warpo.gov.bd/nwmp.html

Water Resources Planning Organization.(WARPO). 2005. “Guidelines for Environmental Assessment of Water Management (Flood Control, Drainage and Irrigation) Projects”. Dhaka, Bangladesh: National Water Management Plan Project, Ministry of Water Resources, Government of the People’s Republic of Bangladesh.

ANNEX I

Examples of baseline description for the following are given in this section. It should be noted that both are situated in the same upazila, thus all information related to physical and ecological components will remain the same. Only the influence area will change.

- Water level monitoring station 107.2 on Gorai-Modhumoti river in Sarankhola Upazila of Bagerhat district
- Shoronkhola Upazila Office in Bagerhat,district

Environmental Baseline

Water level monitoring station 107.2 on Gorai-Modhumotiriver in SarankholaUpazila of Bagerhat district. The water level station has been equipped with automatic data collection and reporting in real-time system. The water level monitoring equipment has been installed on the Rayenda Bridge over the Gorai-Madhumati river and data collection and reporting equipment are housed in 25 the adjacent BWDB premises (Figure A1).

Figure A1: Water level monitoring station 107.2 on Gorai-Modhumotiriver, SarankholaUpazila, Bagerhat

Influence Area

The influence area of the of the installations will be limited to the river (for the water level equipment) and walled premises of the 2.4 acres khas land owned by BWDB (for the equipment shed).

FigureA2: Rayenda bridge over Gorai-Modhumoti River and BWDB office location

Shoronkhola Upazila Office in Bagerhat, district

The activities and equipment of Component A will be primarily located or limited to built-up areas in khas land of DAE located in Upazila Offices. Each of the weather stations will require 9 sq. meters of land.

Influence Area

The influence area of the of the installations will be limited to the walled premises of the 10 acres khas land owned by Upazila office.

Figure A3: Shoronkhola upazila office

Description of the physical environment

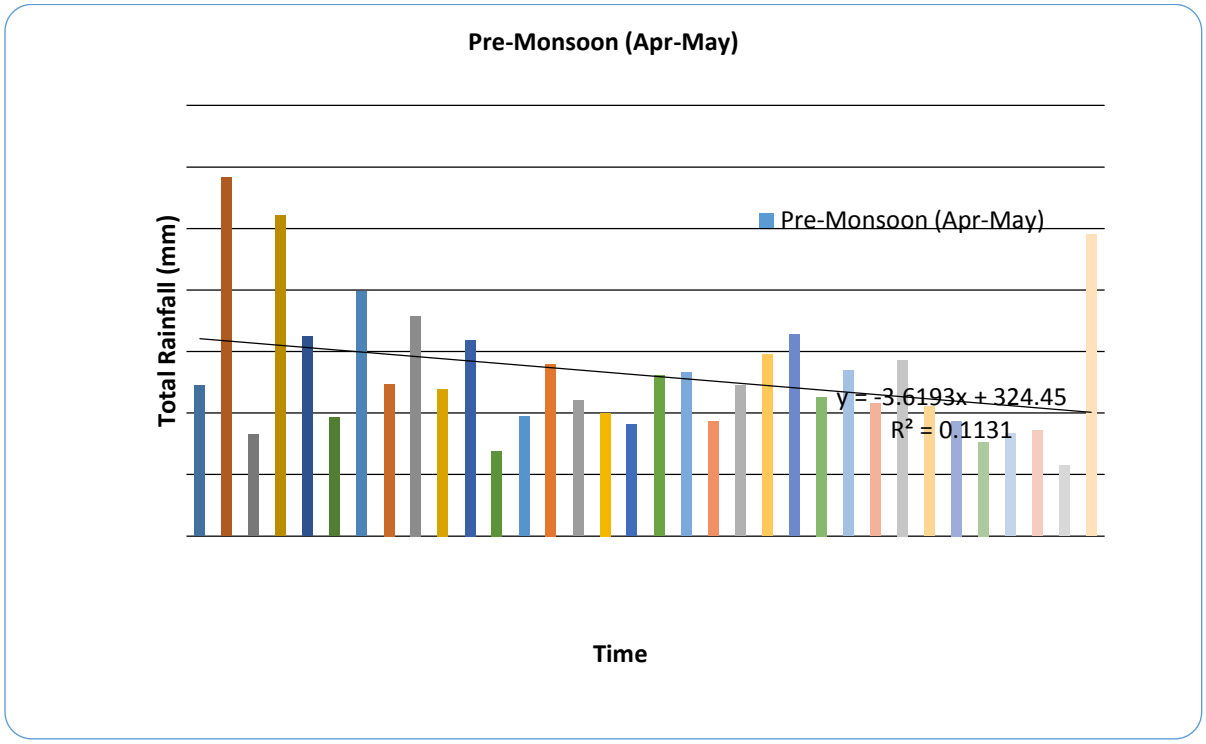
Climate

The Project area lies in the south west part of Bangladesh, where the climate is tropical in nature with three seasons namely summer/pre-monsoon from March to May, monsoon from June to October, and winter season from November to February. The rainy season is hot and humid with about 88 percent of the annual rainfall in the area. The winter is predominately cool and dry. The summer is hot and dry interrupted by occasional heavy rainfall. Monsoon starts in the month of June and recedes in late October. Data on metrological parameters have been accumulated from different secondary sources

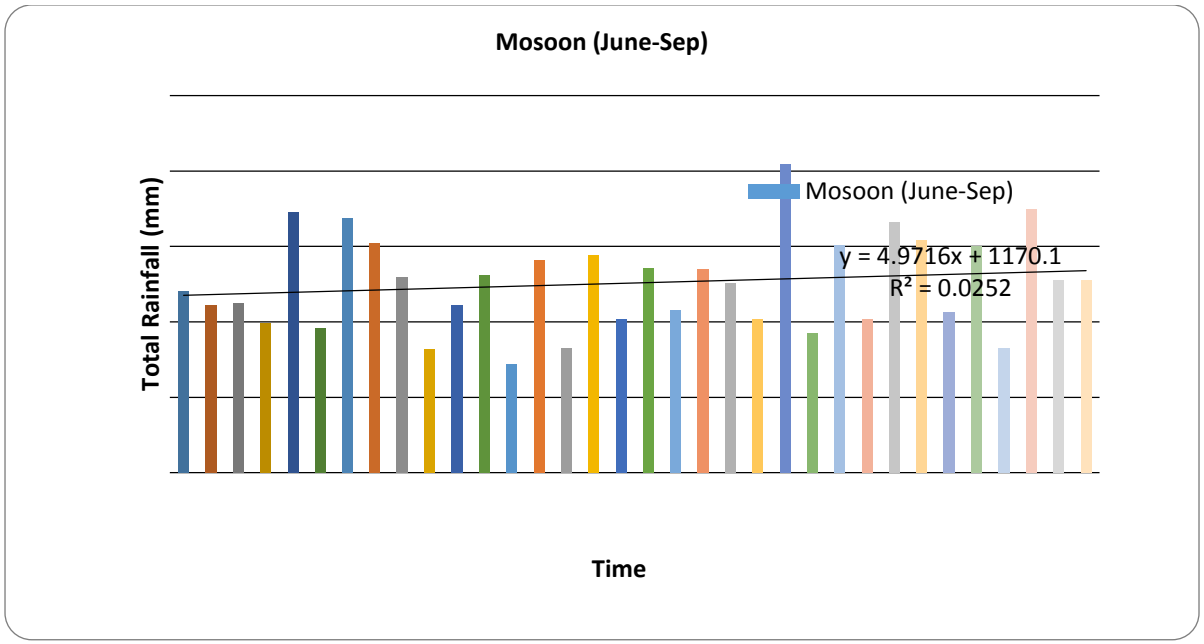
(Bangladesh Meteorological Department - BMD) and synchronized at district level for Khulna. Summary of the analysis of metrological parameters are given in the following sections.

Rainfall

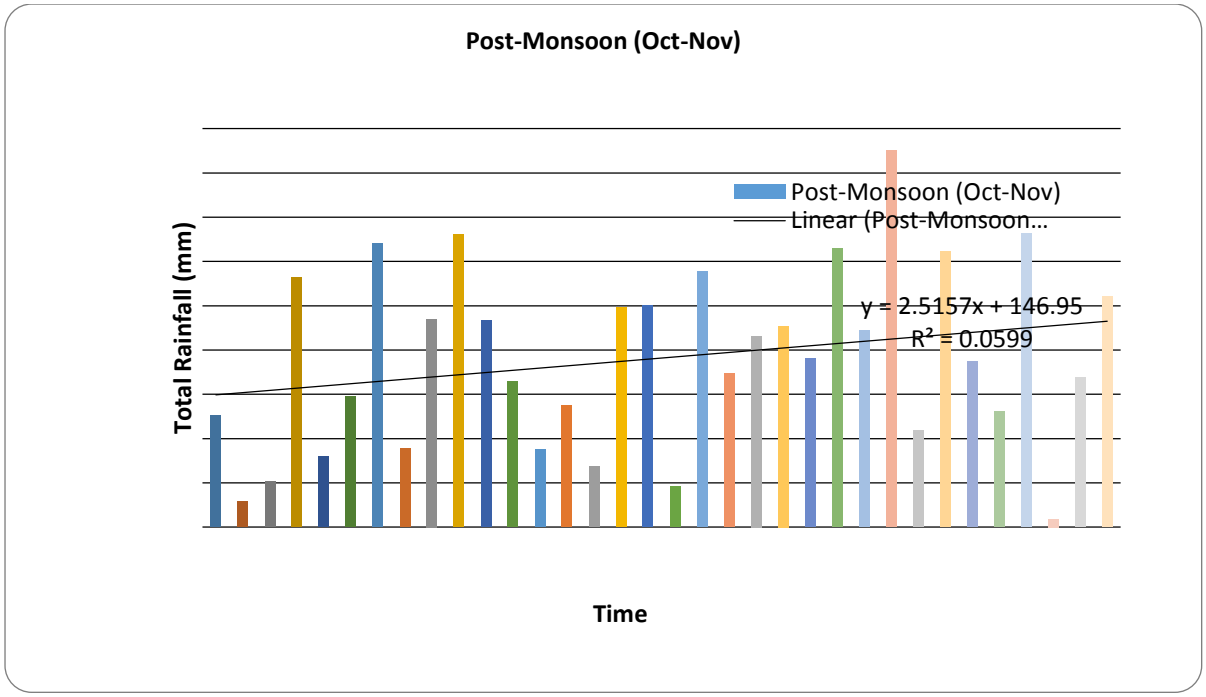
The mean annual rainfall in the region with 80% in probability varies from about 2000mm in the eastside and1600mm. The rainy season is June to September and October to February winter. Eighty to eighty five percent of annual rainfall occurs during the monsoon season from May to September.



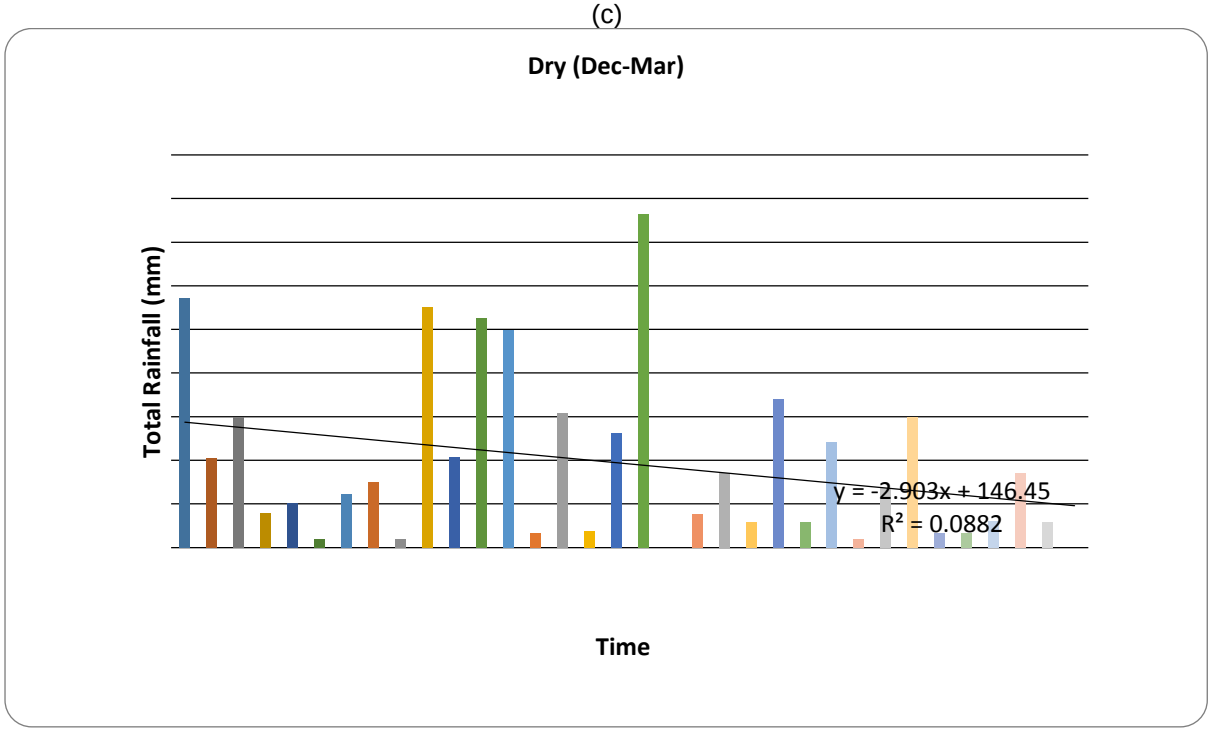
(a)



(b)



(c)



(d)

Figure A4: Trend analysis of Rainfall during (a) Pre-Monsoon (b)Monsoon (c) Post-Monsoon and (d) Dry season for Khulna Station (Source: BMD)

Temperature

The meteorological data of the area measured at Mongla station shows that the monthly maximum temperature varies from 28ºC to 34ºC. Maximum temperature occurs in the month of April and is around 34ºC and average temperature during monsoon is about 26º C. Monthly minimum temperature ranges from 9ºC to 23ºC and the minimum temperature (December to February) is around 9ºC to 11ºC.

Humidity

The annual relative humidity varies from 70-80%. June to October is the month of high humidity and lowest on February. (According to the District statistics, Bagerhat,2011)

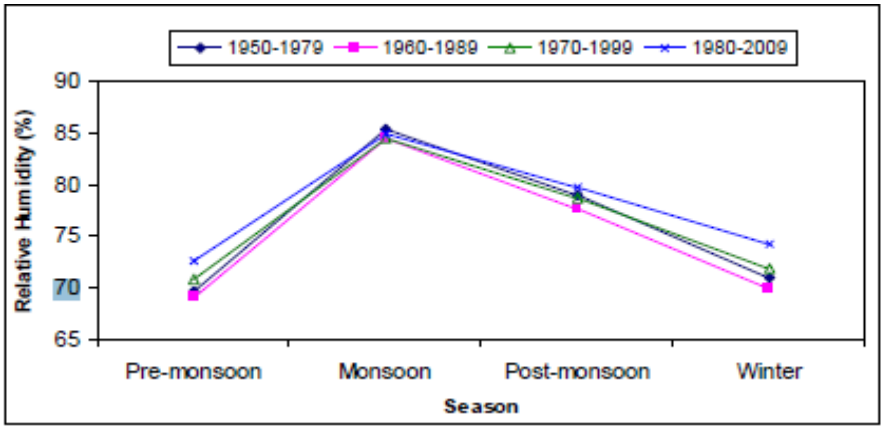
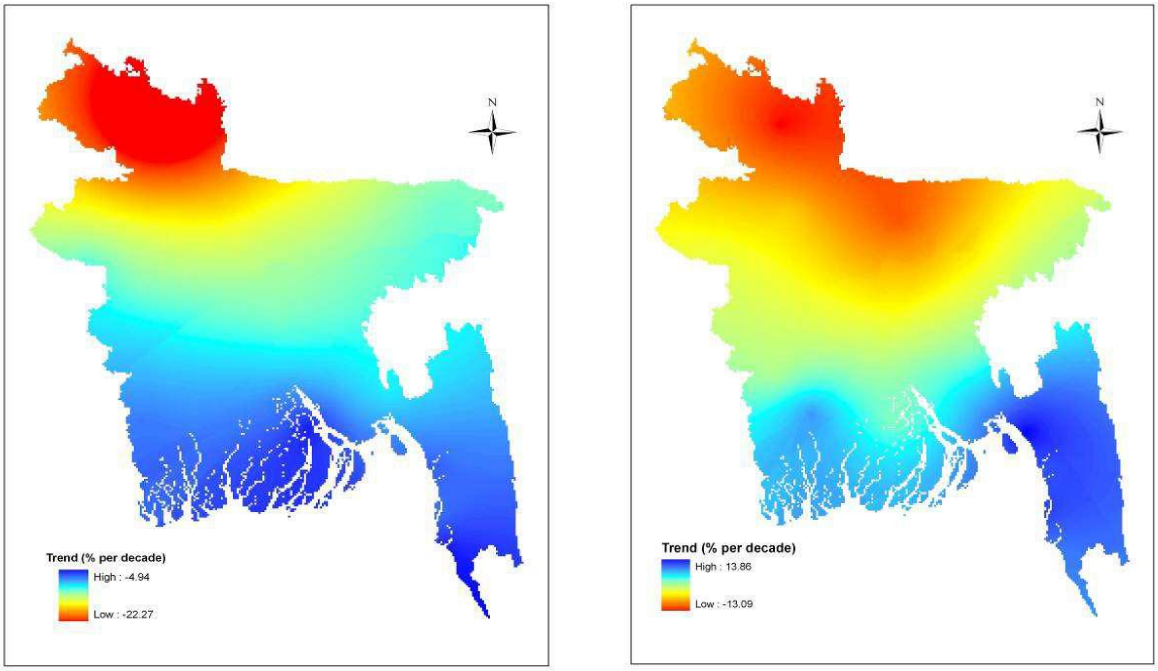


Figure A5: All-Bangladesh normal humidity during different seasons (Source:IWFM)

Sunshine hour

The daily sunshine hour varies from 3.5-8 hrs in whole year. November to April is the month of maximum duration of sunshine hour and the month of lowest on June.



(a) (b)

Figure A6: Spatial distribution of the trends in sunshine duration (% per decade) during (a) January and (b) June.(Source:IWFM)

Wind

The south-westerly monsoon starts from about middle of March, and records about the end of September. The monsoon winds blow from the south with sustained force from March to October. The prevailing winds are from the north and northeast in January. February is calm month with foggy mornings.

Soil salinity

The soil has very low to very high saline content in the dry season (2 - 24.4 ds/m) and soil pH ranges from 6.5-7.0 (Field Survey, 2009-2010 of Environmental Impact Assessment of Polder 35/1). Soil Salinity in April-May remains between 5.2 to 16mmhos/Cm in most parts Sharankhola in dry season and during rain 0.65 to 8.97mmhos/cm. Peak salinity level occurs in March-May and drops gradually in the soil and abruptly in water after June. The fertility level is generally high with medium to high.

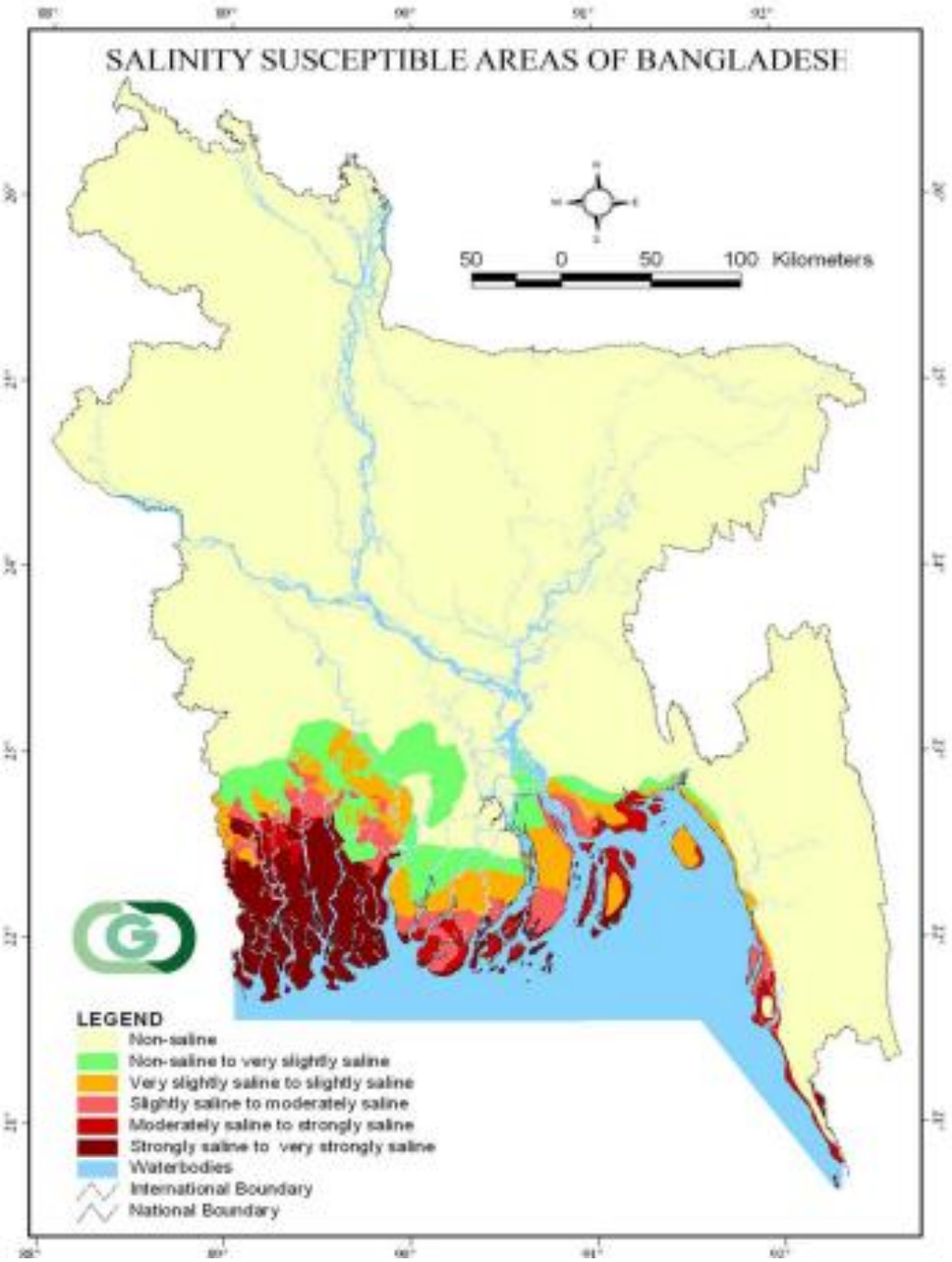


Figure A7: Saline Susceptible area of Bangladesh

Topography and soil type

Physiography

The three broad physiographic units belonging to three distinct geological ages:

A. Tertiary hills occupying 12%area

B. Pleistocene terraces covering 8% area and

C. Recent floodplains spreading about 80% area of the country.

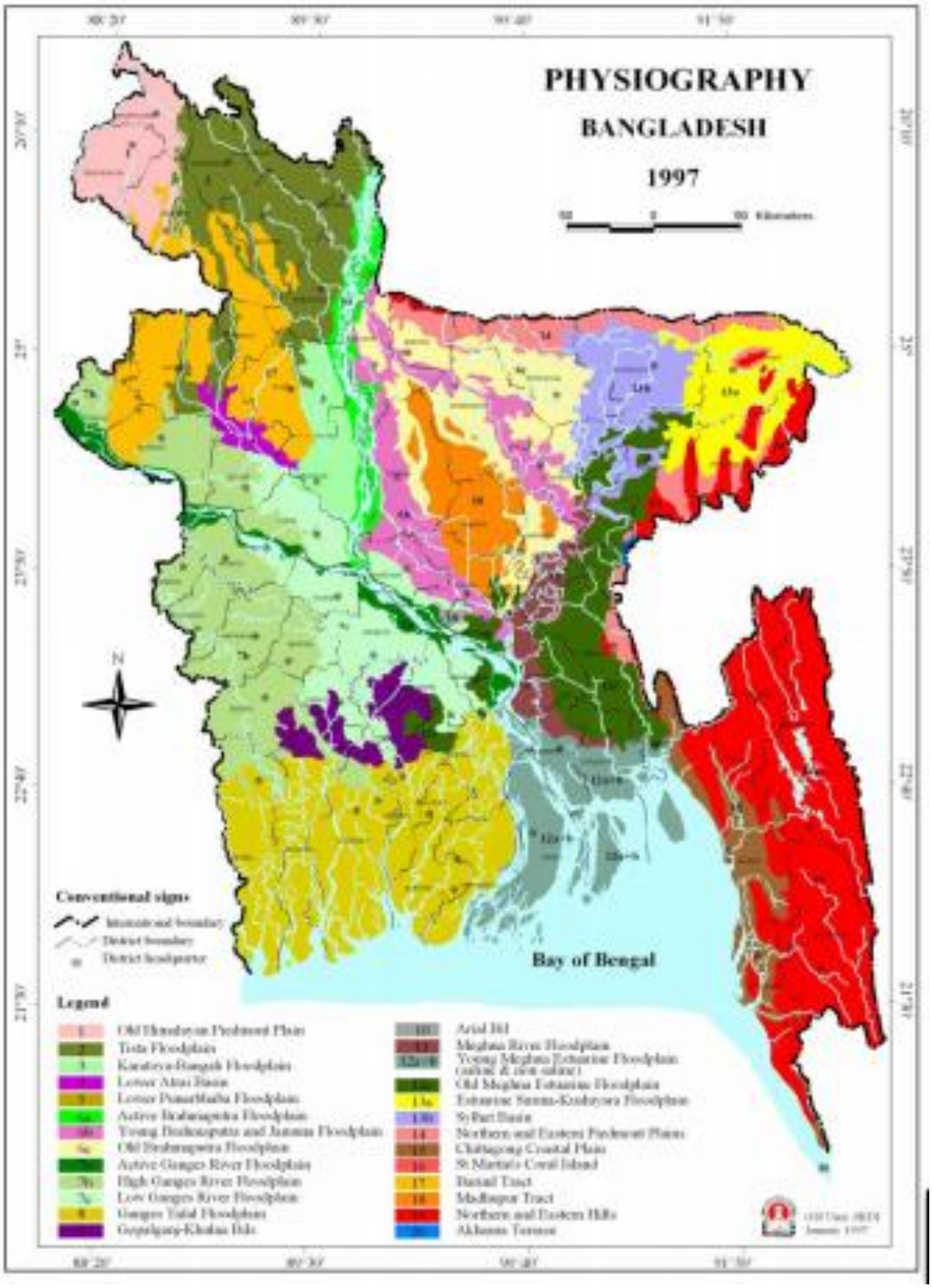


Figure A8: Physiography of Bangladesh *(source: S.M. Imamul Huq and A.F.M. Manzurul Hoque."Land and Soil Resources Database for Grass ‐Root Agricultural Development in Bangladesh.")*

The project area belongs to category C and within Ganges Tidal Floodplain.

Again, Bangladesh is considered to have 7 types of soil tract considering type of soil. Sharankhola is under the coastal saline tract.

Table A1: The Seven soil tracts of Bangladesh

No.	Soil Tracts	Area Sq. Km. (estimated)	Typical Soil Series**
1	**Madhupur Tract**	**10,000**	**Tejgaon**
2	**Barind Tract**	**13,000**	**Amnura**
3	**Tista Silt**	**16,000**	**Gangachara**
4	**Brahmaputra Alluvium**	**40,000**	**Ghatail**
5	**Gangetic Alluvium**	**27,000**	**Sara**
6	**Coastal Saline Tract**	**20,000**	**Barisal**
7	**Chittagong Hill Tract**	**15,000**	**Kaptai**

*Islam and Islam (1956), **SRDI (1965-1976)

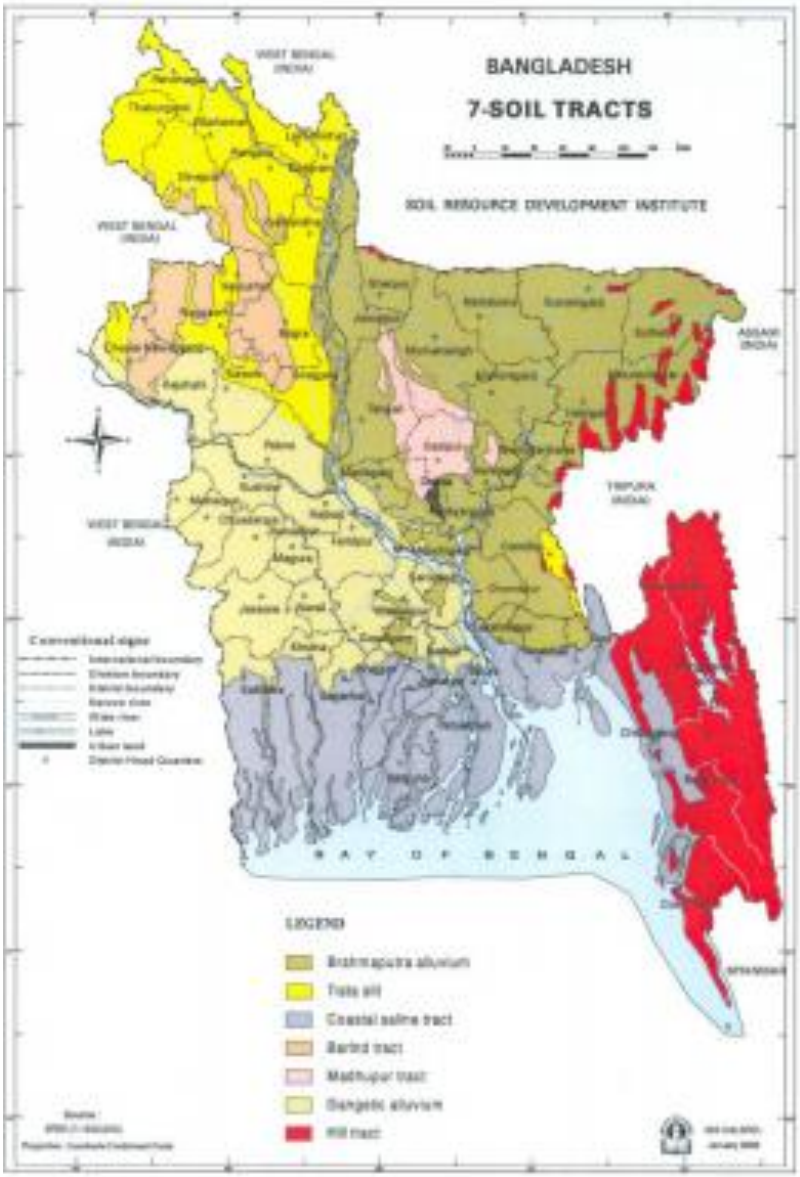


Figure A9: 7-soil tracts of Bangladesh *(source: S.M. ImamulHuq and A.F.M. ManzurulHoque."Land and Soil Resources Database for Grass‐Root Agricultural Development in Bangladesh.")*

Hydrology

The Gorai-Modhumoti River which is locally known as Rayendakhal is a tidal river and falls into the Baleshwar river.Gorai is the tributary river of Padma at Kushtia and continued as Madhumati, kacha and Baleswar River. Baleshwar is the eastern border of Sunderban. Thus the Gorai-Madhumati River is supplying freshwater to the Sunderban. This river system is 372 km long (Gorai is 89 km long, Madhumati is 137 km long and Baleshwar is 146 km long).

The tidal inundation sweeps over the area twice a day and tidal current changing its direction after every six hours. The maximum rise and fall occurs during the spring tides in March and April. The effect of the tide is far into the interior and the rise and fall tends to be content throughout the year and varies only with the phases of the moon.

Figure A10: Gorai-Modhumoti river in google earth



Figure A11:Gorai-Modhumoti river

Water Quality

Water quality parameter measurement is the important measurement for analyzing the quality of surface water. Different type of parameter like water level, temperature, P^H , Dissolved oxygen (DO),total suspended solids (TSS), Electrical Conductivity (EC), Total Dissolved Solids (TDS), Hardness as $CaCO_3$, tidal influence etc. can be the indicator of the certain situation of the river. Here a table is stated which shows the water quality of Gorai-Madhumati River system based on a study of 2011-2012 and 2014.

Table A2: Water Quality of Gorai-Madhumati River system.

Parameter	**Gorai River**		**Madhumati River**	
	Pre-monsoon	**Post-monsoon**	**Pre-monsoon**	**Post-monsoon**
Water Depth(m)	1-1.5	1-1.5	2-3	3-3.5
Temperature (T^0C)	32-33.5	19-22	31-33	18-22
P^H	7.6-7.9	7.2-7.8	7.7-7.8	7.6-7.9

Parameter	Gorai River		Madhumati River	
	Pre-monsoon	**Post-monsoon**	**Pre-monsoon**	**Post-monsoon**
Dissolved Oxygen (mg/l)	5.8-7.7	6.0-7.6	6.6	6.9
Total Suspended solid (mg/l)	0.9-2.5	0.9-3.0	1.2	2.1
Electric Conductivity (µ S/cm)	219-278	208-264	449	334
Total Dissolved Solid (mg/l)	140-178	133-169	----	-----
Hardness (mg/l) as $CaCO_3$	112-158	114-148	170	188
Tidal Influence	None	None	Presence	Presence

(CEGIS Study based on 2011-2012 and 2014)

Salinity Intrusion

In south-west Bangladesh thus salinity intrusion has increased gradually. This increase in salinity has been attributed to the decrease of freshwater discharge in the rivers during monsoon the salinity levels are very low because of the increased amount of freshwater in the water bodies. The level of salinity starts increasing from January due to the reduction of upland discharge and reaches the peak in April and then starts decreasing again. In the dry season, the overall salinity levels both in soil and surface water are high.

Cyclones and Storms

Several cyclones may also occur in October and November. Cyclones are accompanied by tidal surge and autumnal storm. The frequency appears to be increasing during the 20th century from 1 in 3 years in 1950 to 1 in 2 years now. The storms and tidal surge can cause several damage to forest, agricultural crops, fishery and human settlements.

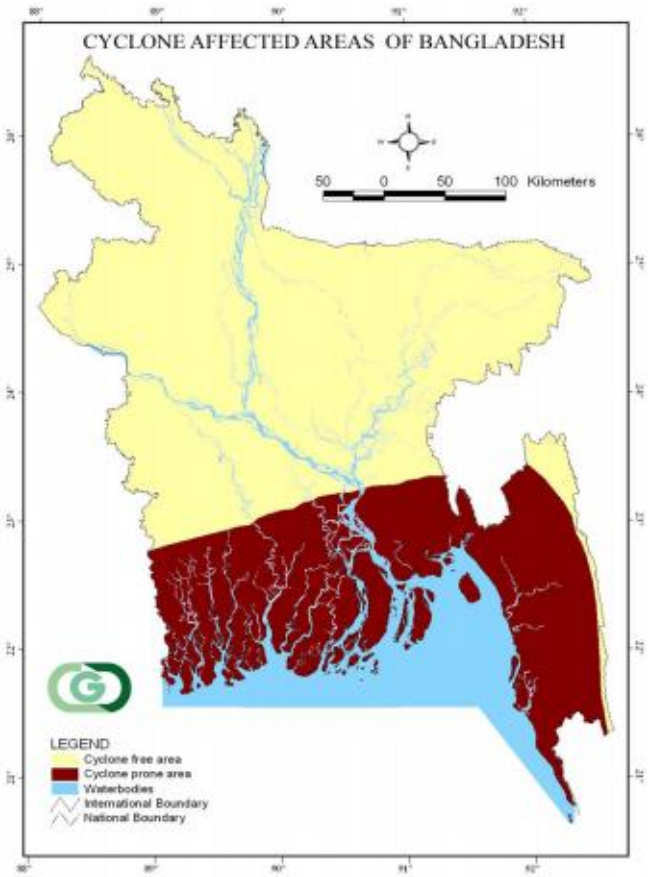


Figure A12: Cyclone affected Area of Bangladesh *(source:Huq and Hoque."Land and Soil Resources Database for Grass‐Root Agricultural Development in Bangladesh.")*

Ecological Environment:
Percentage of area under vegetation: Almost 48.9% area of BWDB compound is covered under vegetation like different type of fruit trees, timber trees, bush and shrubs etc.

Type of trees:
Different types of fruit tree like Mango, Jackfruit, Coconut Palm, Amra and Guava can be found in BWDB compound. Different types of wooden tree like Tikchambal and Mehegoni and also shrubs like Lemon etc can be found within the compound.

Figure A13: Fruit trees

Figure A14: Timber trees

Figure A15: Fruit and Timber trees

Fisheries and Aquatic Biodiversity:
Current fish production in Bagerhat district which includes Sharankhola is almost 1,00,000 metric ton. Table 1: shows the current fish production status in Bagerhat district, data has been collected from Department of Fisheries.

Table A3: Fish Production in Bagerhat*(Unit: Metric Ton)*

River	4762
Sundarban	13605
Beel	17
Flood plain	7608
Pond	13143
Seasonal cultured water body	3848
Boar	0
Shrimp/ Prawn Farm	56796.50
Total	**99779.50**

Source: "Fisheries Statistical Yearbook of Bangladesh 2012-2013."

Table : Annual Fish Production of Beel(*Production in Metric Ton)*

Production from Natural Source	Area	42
	Catch	14
Production under Beel Nursery Program	Area	6
	Catch	3
Total	Area	48
	Catch	17

Source: "Fisheries Statistical Yearbook of Bangladesh 2012-2013."

Table: Annual Fish catch in Flood Plain (2012-2013)

BAGERHAT		
Subsistence Fisheries	No. of Subsistence Household (.000)	213
	Average Catch per Household (kg)	35.22
	Total Estimated Catch (MT) A	7502
Fry Released Program	Area (Ha)	390
	No of Fry Released (Lakh)	0.54
	Prod.(MT) B	106
Haor	Area (Ha)	
	Prod.(MT) C	
Total Production (MT) (A+B+C)		7608

Source: "Fisheries Statistical Yearbook of Bangladesh 2012-2013."

Table A4: Annual Fish Production Of Pond (*Production in Metric Ton) 2012-2013*

BAGERHAT		
Extensive < 1.5 MT/Ha	Area	2366
	Pond	2511
Semi-Intensive 1.5 – 4.0 MT/Ha	Area	2841
	Pond	9978
Intensive 4.0>-10.0 MT/HA	Area	153
	Pond	652

	Pond	
Derelict	Area	8
	Pond	2
Total	Area	5368
	Pond	13143
	MT/Ha	2.448

Source: "Fisheries Statistical Yearbook of Bangladesh 2012-2013."

Aquatic species:
Various types of aquatic species are found in the Gorai and Madhumati river like Cypriniformes,Perciformes,Tetraodonformes,Silouriformes,Beloniformes,Channiformes,Synbranchformes, Decapoda,Molluska etc. There are 37 and 65 types of aquatic species are found from a study in Gorai and Madhumati river respectively.

Table A5: Aquatic Species in Gorai-Madhumati River

Aquatic Species in Gorai and Madhumati River	**Gorai river**	**Madhumati River**
Cypriniformes	10	14
Perciformes	4	13
TetraodonHformes	1	1
Siluriformes	8	15
Beloniformes	1	2
Channiformes	2	3
Clupeiformes	6	6
Synbranchi forms	1	1
Decapoda	1	3
Molluska	3	4
Aquatic mammals	0	2
Total aquatic species	37	65

(Source: Naser,.2014)

- Shoronkhola Upazila Office in Bagerhat, district

ANNEX II

Ecological Environment in the Bay of Bengal

The Bay of Bengal is regarded as the 64th large marine ecosystems (known as BOBLME, Bay of Bengal Large Marine Ecosystems) in the world. It measured as moderately productive (Class II) type of LME, that is, 150 to 300 g of carbon is produced per square meter per year located at 6°N and 80° E to 22°N and 80° 94°E (Mohapatro et al, 2011). Bay of Bengal supports a wide range of habitats, including extensive tracts of mangroves (12 percent of the world's mangroves), coral reefs (eight percent of the world's coral reefs) and seagrass beds. It is an area of high biodiversity, with a large number of endangered and vulnerable species. These natural resources are of considerable social and economic importance to the countries that border the Bay of Bengal. Activities such as fishing, marine farming, tourism and shipping contribute to food security, employment and national economies (BOBLME, 2004).

Coral Reefs

The distribution of reefs is very uneven around the region. Bangladesh has only one reef, although of interesting structure. Shallow reefs along the east coast of India are limited to the Gulf of Mannar and the Andaman and Nicobar Islands. Fringing reefs are extensive on the south east coast of Myanmar, extending further south into Thailand. Coral reefs are also found around the islands straddling the Thai-Malaysian border and continue south around Langkawi, Extensive reefs are found along the Straits of Malacca, Aceh and West Sumatra. Important reefs fringe the coast of Sri Lanka, while the Maldives is an atoll nation.

St. Martin's Island is the lone shallow reef in Bangladesh, located in the far southeast corner. The island covers an area on only 8 km^2, yet it is home to 6,000 inhabitants, who depend on fishing. The fisherfolk migrated from the mainland. The dominant species in the catches are not reef fish, consisting of clupeids, catfish, ribbonfish, perches and croakers. St. Martin's has scientific interest because of its geology and unique algal mat coral association. The island is seriously threatened by coral mining and collection for the tourist trade. Uncontrolled waste disposal and lack of sewage treatment are major sources of pollution. Poor land management and pesticides use on the mainland contaminate the waters around the island. The island is promoted as a tourist destination, encouraging coral and shell collection by the inhabitants of the island.

Seagrass

Very little is known about seagrass abundance and distribution in the tropical Indo-Pacific region. Few regional maps exist and there is little information about the great biological diversity living within them. The BOBLME region has the highest number of seagrass species. In a global review of seagrasses, it is shown there is a huge global loss of seagrasses, but not specifically to the BOBLME region. There is a pressing need to acquire more data on seagrass extent in this important region to aid in evaluating the status of seagrasses (BOBLME, 2004).

References:

Mahapatro D, Panigrahy R. C., Naik S., Pati S. K. and R. N. Samal. (2011). Macrobenthos of shelf zone off Dhamara estuary, Bay of Bengal. Journal of Oceanography and Marine Science Vol. 2(2), pp. 32-42, February 2011. Available online at http://www.academicjournals.org/Joms ISSN 2141-2294 ©2011 Academic Journals

Sustainable Management of the Bay of Bengal Large Marine Ecosystem (BOBLME). 2004. Gcp/ Ras/ 179/ Wbg Review Of The Status Of Shared/ Common Marine Living Resource Stocks And Of Stock Assessment Capability In The Boblme Region March 2004 G. L. Preston Gillett, Preston & Associates Inc.

ANNEX III

ECoP1: Tree Plantation ECoP

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Vegetation clearance	Local flora are important habitats for birds, provide fruit harvest, timber/fire wood, protect soil from erosion and overall keep the natural balance for human-living. As such damage to flora has wide range of adverse environmental impacts.	The Contractor shall • Minimize disturbance to surrounding vegetation. • Get approval from supervision consultant for clearance of vegetation. • Make selective and careful pruning of trees where possible to reduce need of tree removal. • Control noxious weeds by disposing of at designated dump site or burn on site. • Clear only the vegetation that needs to be cleared in accordance with the engineering plans and designs. These measures are applicable to both the construction areas as well as to any associated activities such as sites for stockpiles, disposal of fill. • Minimize the length of time the ground is exposed or excavation left open by clearing and re-vegetate the area at the earliest practically possible. • Ensure excavation works occur progressively and re-vegetation done at the earliest. • Provide adequate knowledge to the workers regarding nature protection and the need of avoid felling trees during construction • The genetic variety in trees as well as other species needs to be ensured. Reduce monocultures, avoid exotic tree species particularly numerous invasive aliens from plantations. Local varieties of trees should be planted as much as possible; • Trees and plants will be re-planted as per World Meteorological Organization (WMO) guidelines to ensure standard of measurements; • Since the planting program will not continue for years, the seedlings may be procured from sources such as Forest Department Nurseries or Private Nurseries. It is expected that the quality of the seedlings from FD nurseries will be better. For better success, at least 1 meter tall seedlings in 25cm x 15cm poly-bags, of about 1.5 years of age, are to be used. The best mode of transporting seedlings is either by 'head load' or 'boat'.

ECoP2: Pollution Prevention ECoP

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Hazardous material and Waste	Water pollution from the storage, handling and disposal of hazardous materials and general construction waste, and accidental spillage	The Contractor shall • Follow the management guidelines proposed in ECP 3: Waste Management • Minimize the generation of spoils, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways or storm water systems.
Discharge from construction sites	Construction activities, sewerages from construction sites and work camps may affect the surface water quality. The construction works will modify groundcover and topography, changing the surface water drainage patterns of the area.	The Contractor shall • Prevent all solid and liquid wastes entering waterways by collecting spoils, oils, chemicals, bitumen spray waste and wastewaters from brick, concrete and asphalt cutting where possible and transport to an approved waste disposal site or recycling depot.
Regular movement of office staff observers and gauge readers in and around the stations and during measurements using echo-sounder, Acoustic Doppler Current Profiler (ADCP), sub-bottom profiler	Limited pollution of water sources	The Contractor shall • Ensure that equipment is not be repaired in the field. But rather in BMD and BWDB laboratories. • During measurement of discharge and bed profiling using catamarans, echo-sounder, Acoustic Doppler Current Profiler (ADCP), sub-bottom profiler surveyors need to be careful not to throw anything in water and prevent leakages of oil from boats and catamarans. • Not carrying out in-situ monitoring activities in one place in long, contiguous stretches at a time. • Motor boat speed will be limited to 15 km/h in accordance with best international practices. • Ensure the riverine transports, vessels and ships are well maintained and do not have oil leakage to contaminate river water. Contain oil immediately on river in case of accidental spillage from vessels and ships and in this regard, make an emergency oil spill containment plan to be supported with enough equipment, materials and human resources.
Drinking water	Untreated surface water is not suitable for drinking purposes due to presence of suspended solids and ecoli.	The Contractor Shall • Provide drinking water that meets National and WHO Drinking Water standards.

ECoP 3: Waste Management ECoP

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
General Waste	Soil and water pollution from the improper management of wastes and excess materials from the construction sites.	The Contractor shall • Organize disposal of all wastes generated during construction in the designated disposal sites approved by the Project authority and develop waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris etc.) prior to commencing of installation and submit to PSC for approval. • Organize disposal of all wastes generated during construction in an environmentally acceptable manner. This will include consideration of the nature and location of disposal site, so as to cause less environmental impact. • Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. • Segregate all wastes, wherever practical. • Vehicles transporting solid waste shall be totally confined within an enclosed vehicle or is fully covered with a tarp to prevent spilling waste along the route. • Tarp must be undamaged (not torn or frayed) properly secured to the body of the vehicle or trailer with ropes, chains, straps, or cords so that no waste is exposed. The edges of the tarps shall extend 12 inches over the permanent sides and back of the open top vehicle or trailer and must be secured to the permanent vehicle. All loads must be tarped from the point of origin of the waste to the tipping area of the final disposal/landfill. • Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process. • Provide refuse containers at each worksite. • Request suppliers to minimize packaging where practicable. • Place a high emphasis on good housekeeping practices. • Maintain all construction sites clean, tidy and safe and provide and maintain appropriate facilities as temporary storage of all wastes before transporting to final disposal. • Collect and transport non-hazardous wastes to Central offices of BMD and BWDB. • Collect and transport non-hazardous wastes to Central offices of BMD and BWDB. • Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Provide refuse containers at each worksite. • Request suppliers to minimize packaging where practicable.
Fuels and hazardous goods.	Materials used in construction have a potential to be a source of contamination. Improper storage and handling of fuels, lubricants, chemicals, hazardous goods/materials on-site, wash down of plant and equipment, and potential spills may harm the environment or health of construction workers.	The PIU and Contractor shall • Collect chemical wastes in 200 liter drums (or similar sealed container), appropriately labeled for safe transport to an approved chemical waste depot. • Store, transport and handle all chemicals avoiding potential environmental pollution. • Store all hazardous wastes appropriately in raised areas away from water courses. • Make available Material Safety Data Sheets (MSDS) for hazardous materials on-site during construction. • Store hazardous materials above flood plain level. • Put containers and drums in temporary storages in clearly marked areas, where they will not be run over by vehicles or heavy machinery. The area shall preferably slope or drain to a safe collection area in the event of a spill. • Avoid the use of material with greater potential for contamination by substituting them with more environmentally friendly materials.

ECoP 4: Construction Management ECoP

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities and material stockpiles	The impact of soil erosion are (i) Increased run off and sedimentation causing a greater flood hazard to the downstream and silt accumulation and (ii) destruction of aquatic environment by erosion and/or deposition of sediment damaging the spawning grounds of fish	The contractor shall ensure, • The construction camp site is accepted by the local authority; • Avoid work within the drip-line of trees to prevent damage to the tree roots and compacting the soil; • Minimize the length of time the ground is exposed or excavation left open by clearing and re-vegetate the area at the earliest practically possible; • Excavation works occur progressively and re-vegetation done at the earliest; • Where ever possible prefabrication should be done so not cause too much disturbance in the field; • Place a high emphasis on good housekeeping practices. That is maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all wastes before transportation and final disposal.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Wash out ready-mix concrete agitators and concrete handling equipment at washing facilities off site or into approved bunded areas on site. Ensure that tires of construction vehicles are cleaned. This should be done in every exit of each construction vehicle to ensure the local roads are kept clean. Locate stockpiles away from drainage lines. • Remove debris from drainage paths and sediment control structures. • Cover the loose sediments of construction material and water them if required. • Divert natural runoff around construction areas prior to any site disturbance. • Install protective measures on site prior to construction, for example, sediment traps. • Install 'cut off drains' on large cut/fill batter slopes to control water runoff speed and hence erosion. • Observe the performance of drainage structures and erosion controls during rain and modify as required.
Clearing of construction sites	Cleared areas and slopes are susceptible for erosion of top soils, which affects the growth of vegetation and causes ecological imbalance.	The Contractor shall • Reinstate and protect cleared areas as soon as possible. • Cover unused area of disturbed or exposed surfaces immediately with mulch/grass turf/tree plantations.
Soil erosion and siltation	Soil erosion and dust from the material stockpiles will increase the sediment and contaminant loading of surface water bodies.	The Contractor shall • Stabilize the cleared areas not used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion. • Water the material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds).

ECoP 5: Buoy Installation ECoP

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Installation of few buoy stations for measuring ocean temperature, current, wave	Depending on the scope of chain, tidal range, and environmental forces where the buoy is located, benthic habitat can be scoured by the buoy chain and anchor.	The Contractor shall • Minimize disturbance to surrounding vegetation. • Buoys with environmental friendly anchoring and mooring options will be installed to reduce impact area of the seafloor; • Helix, manta, and pin anchors with customizable elastic mooring components should be considered

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
dynamics, and other parameters	The laying down and picking up of sinkers and chain associated with floating or anchored buoy establishment, disestablishment, and maintenance can temporarily increase turbulence, turbidity, and sedimentation in their vicinities.	as they impact a smaller area of the seafloor. • Installations should not be located near coral reefs or sea grass areas. This includes at least a buffer zone of100m radius to minimize impact on critical habitat; • Support for restoration or recovery efforts for the area of seagrass habitat that has been impacted; • Designated Mooring Areas (DMAs), need to be identified based on advice from marine experts and other relevant agencies.

ECoP 6: Health and Safety ECoP

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Best practices	Many of the instruments will be installed on bridges or concrete pillars. Access to these installation sites could be unsafe during installation and inspection of buoys.	The Contractor shall • Implement suitable safety standards for all workers and site visitors, with sufficient provisions to comply with international standards (e.g. International Labor Office guideline on 'Safety and Health in Construction; World Bank Group's 'Environmental Health and Safety Guidelines') and contractor's own safety standards, in addition to complying with national standards. • Provide the workers with a safe and healthy work environment, taking into account inherent risks in its particular construction activity and specific classes of hazards in the work areas. • Ensure adequate safety measures are taken by staff, during travel on boats and vessels during buoy installation and inspection. Vessels must be maintained regularly. Life jackets have to be used by crew and crew has to be trained in life-saving techniques. Only trained professionals will install and inspect buoy. There should be no travel during stormy weather • Provide adequate access to concrete pillars placed in water or installations on bridges. (example ladders, steps) to improve access, thereby increasing safety during inspection.

Annex IV

The consultant made a reconnaissance field visit to examine possible installation locations and installed equipment during 20-23 June. The locations were decided based on discussion with the Project Implementing Agencies that is BMD, BWDB and DAE, Details of this reconnaissance visit is given below.

Date : 21 June 2015
Place visited: Bangladesh Meteorological Department, Khulna Division Office
Water level Station 244 on Rupsha-Pashurriver, Mongla,
Water level Station 254 on Satkhira Bridge, Satkhira
Groundwater level station KH01, Satkhira BWDB Guest House
DAE office, SatkhiraSadarUpazila Office, Satkhira

Date : 22 June 2015
Place visited: Water level Station 107.2 at Rayenda, Bagerhat,
DAE office, SharankholaUpazila Office, Bagerhat

Issues discussed with community stakeholders:
The checklist used for consultation includes the following issues:

1. Knowledge of the participants and attitude of people towards the proposed project interventions.
    - Do you know what the instrument is?
    - Did see the equipment being installed?
    - When was it installed?
2. Perception of local people about problems regarding the equipment and suggestions for solution of the perceived problems considering:
    - Could there be any environmental problems related to the installation of the equipment
    - Is it creating any problems in this area?
3. Suggestions on enhancement (positive impacts) and mitigation (negative impacts) measures of the project.
    - What do you think the benefits of this project will be?
    - Do you listen to the radio for weather information?
    - Do you take decisions based on the weather information?

Issues discussed with field staff:
The checklist used for consultation includes the following issues:

1. Knowledge of the participants and attitude of people towards the proposed project interventions.
    - Do you know what the instrument is?
    - When was it installed?
    - Have you received any objections/ complaints from local communities regarding the equipment?
    - How did you monitor water levels before?
    - How did you send data to data processing units? What was the frequency?
2. Suggestions on enhancement (positive impacts) and mitigation (negative impacts) measures of the project.
    - What do you think the benefits of this project will be?
    - Do you listen to the radio for weather information?

- Do you take decisions based on the weather information?

Issues discussed with Upazila Nirbahi Officers and Agricultural Extension Officers:
The checklist used for consultation includes the following issues:

1. Knowledge of the participants regarding the proposed project interventions.
    - Do you know about meteorological data monitoring instruments?
    - Have you used hydro-meteorological forecasts for decision making?
2. Regarding installations in Upazila Office premises
    - Is there enough space in the premises?
    - Will it create any problems?
3. Suggestions on enhancement (positive impacts) and mitigation (negative impacts) measures of the project.
    - What do you think the benefits of this project will be?

Summary of Consultations

Parties Consulted	**Project Appreciation**	**Project Concerns**
Communities	Equipment installation has not caused problems Increased access to hydro-meteorological information will be beneficial to locals Future decision-making may take into consideration – hydro-meteorological information	No perceived problems
Field Technicians (SO, field technicians)	Equipment installation has not caused problems No complaints received Water level is still being monitored manually	Concrete pillars placed in water need adequate facilities (example ladders, steps) to improve access, thereby increasing safety during inspection.
Upazila Nirbahi Officers and Agricultural Extension Officers	There is enough space in premises, however formal approval needs to be given through proper channel Integrated Crop Clubs use rainwater monitoring equipment and use the data to make decisions	Installation of equipment on building may cause problems

Consultation Workshop
On
'Bangladesh Weather and Climate Services Regional Project'
Date: 25 November 2015
Venue: BWDB conference Room, Dhaka

A consultation workshop to discuss the 'Bangladesh Weather and Climate Services Regional Project' and the draft Environmental Workshop report was held on 25 November 2015 at BWDB Conference Room, WAPDA Bhaban (2nd floor), Motijheel C/A, Dhaka. Around 69 participants from relevant government agencies and NGOs were present as well as officials from BMD, BWDB and DAE. This was the second round of consultations for the formulation of the EMP and a presentation was done on the EMP. This was followed by an open discussion so that participants could provide their feedback.

The objectives of this consultation were,

(i) Disclosure of the draft report contents, including the proposed EMP and ECoPs;
(ii) Consultation with stakeholders on the results of the assessment; and
(iii) Discussion of stakeholder participation in environmental management activities during construction and implementation.

Figure A16: Consultation workshop on EMF

Open Discussion

Questions with corresponding responses and suggestions are given below:

Participants whoraised questions	Questions	Response
Md. Arif, Bangladesh Unnayan Parishad	1.Though this project is now considered a high tech project and category B,according to the World Bank impact standerd, how will the effect and hazard caused by the electronic waste after implementation be checked?	- The EMF has addressed this issue in the waste management ECoP. The PCU and PIUs are have to implement the ECoP. planning is maintained properly and implemented stratigically, then it will be possible to execute the project work

Participants whoraised questions	Questions	Response
		successfully and the hazardous effect can be avoided easily. -In our country, use of mercury should be reduced in meteorological measurement which has negative impact in nature. If instrument will be mercury free, then electronical pollution will be less.
Mr. Abdul Alim, ActionAid Bangladesh	2.Why is the funding in loan form? Why it is not in form of grant? Because this type of investment is very important for GoB. It can be easily merged with the program activity of Climate Change Trust Fund. The project team explore this option.	Has not been explored yet.
	3.Will it cover Barind tract? Because Barind tract is one of the vulnerable area where, ground water is declining at high level. It will be necessary to ensure the generation of standerd data which will be key findings of this project.	Yes, it will cover the Barind tract.
	4.As instrument installation will cover upazilla and selective union, how long will it take the information to reach the farmer so that he will get the benefit?	Data generation and analysed result will be provided within 3-4 hours and it will be as open source for all.
	5. What is the dissemination policy of this information?	BAMIS web portal will be used for dissemination of all data generated by project.

Participants Provided Suggestions In Open Discussion	
M. Rafiqur Sazzad (Executive Engineer, BWDB)	For strengthening the hydrological unit of Bangladesh Water Development Board (BWDB), proper procurement is needed. Skilled manpower needed for the sustainability of this type of approach. Capacity building should be introduced for the sustainability and long term durability of the project.
BMD personnel	-Funding and communication should be under consideration for this project. -Wireless system should be inaugurated for this purpose. Existing communication system will upgraded and modern technological system should be introduced.
Mr. Abdul Alim	-Flood forcasting and other system should be community based because it will be more helpful and cost effective. Ansar-VDP can be used for flood early warning system dissemination. -Rainfall forcasting should be areawise as it will be more helpful to fillup the gap and uncertainity of the generated data. - Salinity forcasting considering both soil salinity and surface water salinity should be considered as one the key point, if possible.
Mr. Shaikh Mohammad Jobayed Hosain, Senior Assistant Chief of Planning (Ministry of Defense)	-It is a highly automated project with high risk because infrastructure is not viable. Some area and infrastructure should be selected for the piloting program. If it provide positive output then the program activity should be accelerated. -Ownership, co-ordination mechanism should be same for all. -Skill people should be procured by the BMD,BWDB and DAE. -As Department of Agricultural Extension (DAE) has experience in this activity, so DAE should be in part of coordination lead. -Participation of the civil society will be necessary. Farmers should be the primary stakeholder. So, their concern about this project is important.
Sohel Masud (Institute of Water	-Technical sustainability might be an issue. Project should consider manual as well as automated data -Dissimination of data through data logger, so that where there is no station, data is still

Modelling)	available.

Annex V

Terms of Reference for Environmental Specialist

Background

The Bangladesh Weather and Climate Services Regional project will support modernization of the country's weather, water and climate information infrastructure strengthening both the supply of hydro-meteorological data, information and services and delivery to sectors and communities. It will do so by modernizing meteorological and hydrological monitoring systems, forecasting, strengthening sector specific information services and targeted community based hazard early warning activities in selected districts. An Environmental Management Framework (EMF) prepared in June-September 2015, provides general policies, guidelines, and procedures to be integrated into the design and implementation of all components under the proposed project.

The Bangladesh Weather and Climate Services Regional project has 3 implementing agencies: the Bangladesh Meteorological Department (BMD), the Bangladesh Water Development Board (BWDB) and the Department of Agricultural Extension (DAE). A Project Steering Committee (PSC) convened by the Secretary of the MoWR will ensure (i) Project Oversight and Policy Direction, (ii) Project Coordination and Management, and (iii) Project Implementation. For more regular project monitoring, BWDB Head Office will create a Project Coordination Unit (PCU) headed by a Project Coordinator (PC). Its office will serve as the secretariat to the PSC. The PCU will appoint an Environmental Specialist who will be responsible for The PCU will be fully connected with the Project Implementation Units (PIU) at the agency level and will report to the PSC.

The Environmental Specialist will work with PCU in implementing the EMF for all three components. The EMF aims to: (i) establish clear procedures and methodologies for the environmental and social planning respectively, review, approval and implementation of sub-components to be financed under the project; (ii) specify appropriate roles and responsibilities, and outline the necessary reporting procedures, for managing and monitoring environmental and social concerns related to sub-components; (iii) determine the training, capacity building and technical assistance needed to successfully implement the provisions of the EMF; (iv) establish the project funding required to implement the EMF requirements.

Objectives

The engagement of the environmental specialist is to ensure effective and timely implementation of environmental safeguard activities, monitoring of the environmental impacts of components throughout the project period and environmental enhancement of project activities.

Scope of Services

The scope of service of the environmental specialist:

- Review and identify the considerations and processes for timely implementation of environmental safeguard activities based on recommendations of the EMF and compliant with Bangladesh Environmental Conservation Act, 1995 and the guidelines of the World Bank;
- Prepare environmental check list for different activities of the project which will be the key tool to assess the potential risk and environmental sustainability and to determine required actions for each intervention;
- Develop deliver tailored training programmes for the implementing agencies on use of the environmental checklist and the environmental guidelines and safeguard procedures, the training programme will based on recommendations of the EMF and wherever necessary

national and international training institutes/ personal will be used. The consultant has to monitor training activities to ensure environmental enhancement is achieved;

- Review existing interventions in the EMF and periodically update and revise EMF based on new regulations (if any) of Bangladesh Government. Revisions to safeguard management plans, monitoring requirements and reporting have to be agreed by PCU.
- Extensive consultation with stakeholders including the implementing agencies, local government and communities to understand their views and requirements.
- Review all the screening report, EMFs, monitoring reports etc. prepared by implementing agencies.
- Devise and implement monitoring plan for EMP
- Prepare timely environmental assessment report or review of environmental assessment report prepared PIU;
- Incorporation of EMPs in the bidding and contractual documents;
- Monitoring and supervision of EMP implementation by the contractor, the construction supervision engineer, and the PIU;
- Monitor status and compliance with mitigation measures in the EMP; and any challenges in safeguard implementation, solutions, and lessons learned.
- Pay special attention to issues of non-compliance. In case of any noncompliance or unresolved safeguards issues propose additional measures with PCU and World Bank.
- Visit components and activities with significant potential environmental issues.

Time Period

The environmental specialist shall be engaged for project duration depending upon his/her performance evaluated after 6 months.

Qualification and Experience

The environmental specialist should have at least Masters Degree in Environmental Science or Environmental Engineering. The environmental specialist must have at least 10years of working experience of which 5 years in the field of environmental activities as consultant or working in an institution which deals with environmental concern. The environmental specialist must be aware of the environmental rules and regulations of Bangladesh and the World Bank and must have completed, or involved in the preparation of, environmental impact study of at least two projects in Bangladesh.