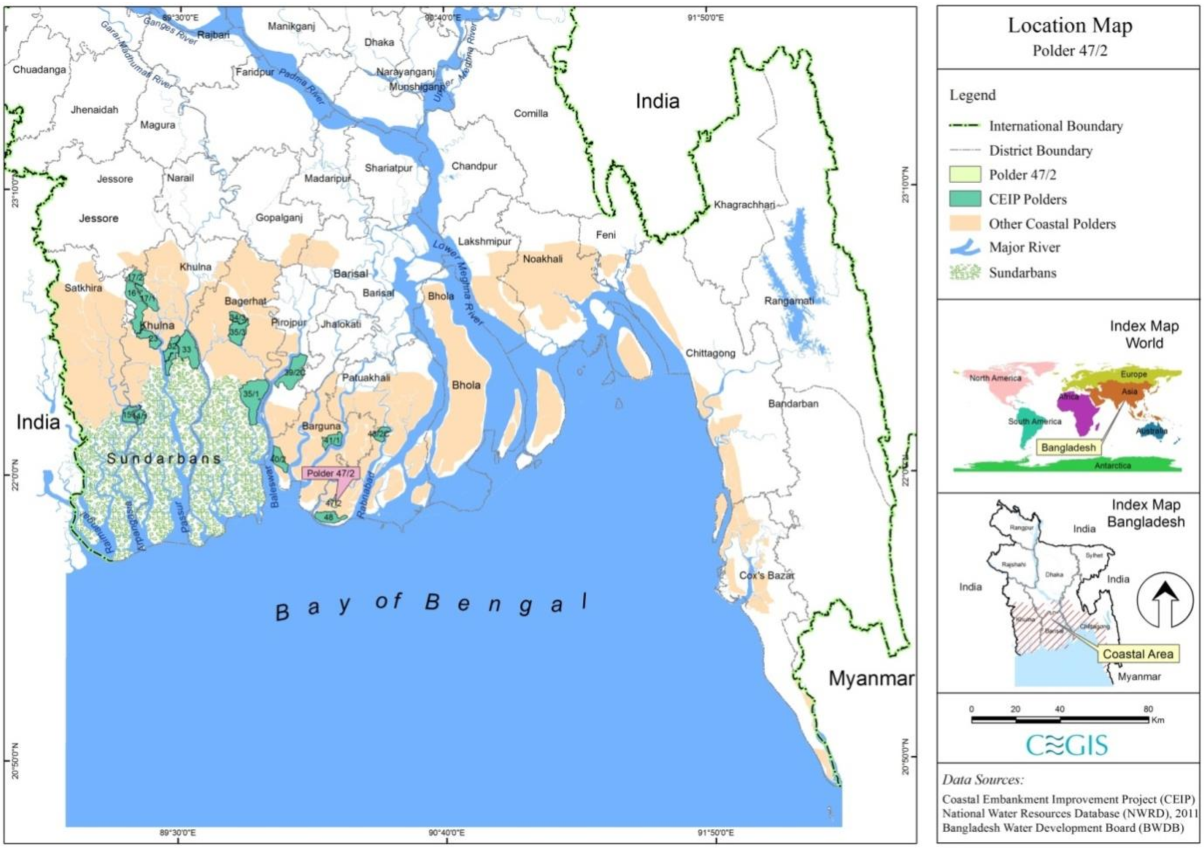
Final Report

Government of the People's Republic of Bangladesh
Ministry of Water Resources
Bangladesh Water Development Board

COASTAL EMBANKMENT IMPROVEMENT PROJECT, PHASE-1 (CEIP-1)



Consultancy Services for Detailed Design, Construction Supervision and Project Management Support

ENVIRONMENTAL IMPACT ASSESSMENT POLDER- 47/2 FOR PACKAGE-2

February 2017

Study Team

A multidisciplinary team from Center for Environmental and Geographic Information Services (CEGIS) conducted the EIA study. The study team comprised of the following professionals:

Sl. No.	Position	Incumbent
1	Water Resources Engineer/Team Leader	Mr. Md. Sarfaraz Wahed
2	River Morphologist	Mr. Pintu Kanungoe
3	Environmental Specialist	Mr. Kazi Kamrull Hassan
4	Socio-economist	Dr. Dilruba Ahmed
5	Soil & Agriculture Specialist	Dr. Anil Chandra Aich
6	Fishery Specialist	Dr. Ashraful Alam
7	Ecologist	Mr. Ashoke Kumar Das
8	GIS/RS Specialist	Ms. Pia Afreena Huq
9	Junior Professional (Water Resources Engineering)	Mr. Fahad Khan Khadim
10	Junior Professional (Morphology)	Mr. Sudipta Kumar Hore
11	Junior Professional (Fishery)	Mr. Md. Ashraful Alom
12	Junior Professional (Ecology)	Mr. Md. Sharif Hossain Sourav
13	Junior Professional (Forestry)	Mr. Md. Mizanur Rahman
14	Junior Professional (Sociology)	Mr. Mobasher Bin Ansari
15	GIS/RS Analyst	Mr. Md. Saidur Rahman
16	GIS/RS Analyst	Mr. Hassan Imam Tawfique
17	Enumerator	Mr. Md. Azizur Rahman
18	Enumerator	Mr. Muhammad Shahidur Rahman

Acknowledgement

The Center for Environmental and Geographic Information Services (CEGIS) has been entrusted with the responsibility of conducting the Environmental Impact Assessment (EIA) Study for Coastal Embankment Improvement Programme (CEIP) as a sub-consultant. CEGIS is indebted to the DCSC of CEIP-1 under Bangladesh Water Development Board (BWDB) for assigning the task of conducting the environmental assessment study of coastal polders to CEGIS.

The multi-disciplinary team formed by CEGIS for conducting the environmental and social baseline survey of the CEIP-1 remembers with gratitude the guidance and support it received from Mr. Md. Sarafat Hossain Khan, Additional Chief Engineer and Project Director, CEIP-1, BWDB and other officials of his office, while conducting the study particularly during baseline survey on coastal Polder-47/2. CEGIS is thankful to DevConsultant Ltd. for their co-operation at every stage of the study. The study team is also grateful to Engineer Md. Waji Ullah, Executive Director, CEGIS without whose continuous guidance, inspiration and support it was impossible to complete the study smoothly.

CEGIS is grateful to Mr. Harrie Laboyrie, Team Leader and Mr. Md. Habibur Rahman, Deputy Team Leader of CEIP for their direction, guidance and support with necessary data and documents on the Polder-47/2 to the EIA study team. CEGIS also thanks all other staffs of CEIP for providing relevant documents during preparation of this report.

CEGIS gratefully acknowledges the support received from the Chief Engineer of Southern Zone; Superintending Engineer, Patuakhali WD Circle; and Executive Engineer Patuakhali WD Division, with all other officials of his office for providing necessary information and cooperation to the study team during field visits.

The EIA study of the CEIP has been made easier for the active participation of the community of Polder- 47/2 during field survey and public consultation meetings.

Table of content

List of Tables

List of Figures

List of Maps

List of Pictures

Abbreviations and Acronyms

ADP	Annual Development Plan
AEO	Assistant Extension Officer
AP	Affected Person
ASA	Association for Social Advancement
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorology Department
BP	Bank Procedure
BRDB	Bangladesh Rural Development Board
BRAC	Bangladesh Rural Advancement Centre
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CBOs	Community Based Organizations
CCP	Chittagong Coastal Plain
CDS	Coastal Development Strategy
CDP	Coastal Development Partner
CEGIS	Center for Environmental and Geographic Information Services
CEIP	Coastal Embankment Improvement Program
CEIP-I	Coastal Embankment Improvement Project, Phase I
CERP	Coastal Embankment Rehabilitation Project
CMG	Canal Maintenance Group
CES	Consulting Engineering Services
CAFOD	Catholic Fund for Overseas Development
CS	Construction Supervision
CLAC	Central Land Allocation Committee
CZPo	Coastal Zone Policy
DAE	Department of Agricultural Extension
DC	Deputy Commissioner
DCSC	Design & Construction Supervision Consultants
DCEO	Deputy Chief Extension Officer
DD	Deputy Director

DCSC	Design and Construction Supervision Consultant
DEA	Department of Agricultural Extension
DEM	Digital Elevation Map
DOE	Department of Environment
DOF	Department of Fisheries
DPHE	Department of Public Health Engineering
DPM	Design Planning & Management Consultants
DTW	Deep Tubewell
DWM	Directorate of Water Management
EA	Environment Assessment
EAP	Environmental Action Plan
EC	Executive Committee
ECA	Environment Conservation Act
ECC	Environmental Clearance Certificate
ECoP	Environmental Code of Practice
ECR	Environment Conservation Rules
ECRRP	Emergency 2007 Cyclone Recovery and Restoration project
EDS	Environmental Data Sheet
EIA	Environmental Impact Assessment
EMG	Embankment Maintenance Group
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EO	Extension officer
ES	Environmental Supervisor
ESBN	Estuarine Set Bag Net
ESC	Environmental Social and Communication Unit
ESCU	Environmental, Social and Communication Unit
FAO	Food and Agriculture Organization
FD	Forest Department
FG	Functional Group
FGD	Focus group Discussion
FRSS	Fisheries Resources Survey System
FWIP	Future-with-Project
FWOP	Future-without-Project
GIS	Geographical Information System

GO	Government Organization
GOB	Government of Bangladesh
GRC	Grievance Redress Committee (GRC)
GPWM	Guidelines for Participatory Water Management
GTPE	Ganges Tidal Plain East
GTPW	Ganges Tidal Plain West
Ha	Hectare
HTW	Hand Tubewell
HYV	High Yielding Variety
ICZM	Integrated Coastal Zone Management
ICZMP	Integrated Coastal Zone Management Plan
IDA	International Development Association (World Bank)
IEE	Initial Environmental Examination
IESCs	Important Environmental and Social Components
FIDIC	International Federation of Consulting Engineers
ILO	International Labour Organization
IPOE	Independent Panel of Expert
IPCC	Intergovernmental Panel on Climate Change
IS	Institutional Survey
IUCN	International Union for Conservation of Nature
IWM	Institute of Water Modelling
KCC	Khulna City Corporation
KII	Key Informant Interview
KJDRP	Khulna-Jessore Drainage Rehabilitation Project
KMC	Knowledge Management Consultants Limited
LCB	Local Competitive Bidding
LCS	Landless Contracting Society
LGI	Local Government Institution
LLP	Low Lift Pump
MC	Main Consultant (for CEIP-I Feasibility study)
MDP	Meghna Deltaic Plain
MOEF	Ministry of Environment and Forest
MOL	Ministry of Land
MOWR	Ministry of Water Resources
MP	Muriate of Potash

MSDS	Project Management Data Sheets
MSL	Mean Sea Level
NCA	Net Cultivated Area
NCR	Non-Compliance Report
NGO	Non-Governmental Organization
NOC	No Objection Certificate
N,P,K	Nitrogen, Phosphorous, Potassium
NWRD	National Water Resources Database
OMD	Operation and Maintenance Group
O&M	Operation and Maintenance
PAP	Project Affected Person
PCM	Public Consultation Meeting
PCD	Project Concept Document
PD	Project Director
PIC	Project Implementation Committee
PID	Project Information Document
PIO	Project Implementation Office
PL	Post Larva (fish seed)
PMU	Project Management Unit
PPE	Personnel Protective Equipment
PRA	Participatory Rural Appraisal
PSC	Project Steering Committee
PWD	Power Works Department
PRSP	Poverty Reduction Strategy Paper
RAP	Resettlement Action Plan
RCB	Reinforced Concrete Box
RCC	Reinforced Concrete Cement
RL	Reduced Levels
RRA	Rapid Rural appraisal
SAEO	Sub-Assistant Extension Officer
SDE	Sub-Division Engineer
SEA	Strategic Environmental Assessment
SEO	Secondary Education Office
SLR	Sea Level Rise
SMG	Structure Maintenance Group

SO	Sectional Officer
SRDI	Soils Resources Development Institute
SSO	Social Service Office
STW	Shallow Tubewell
TAO	Thana Agriculture Officer
TDS	Total Dissolved Solids
TOR	Terms of Reference
TPV	Third Party Validation
TSP	Triple Superphosphate
UFO	Upazila Fisheries Office
UNDP	United Nations Development Program
UZ	Upazila
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding
WA	Work Assistant
WAO	Women Affairs Office
WARPO	Water Resources Planning Organization
WMA	Water Management Association
WMF	Water Management Federation
WMG	Water Management Group
WMIP	Water Management Improvement Project
WB	World Bank
WMO	Water Management Organization
YDD	Youth Development Department

Glossary

Aila: Major Cyclone, which hit Bangladesh coast on May 25, 2009

Aman: Group of rice varieties grown in the monsoon season and harvested in the post-monsoon season. This is generally transplanted at the beginning of monsoon from July-August and harvested in November-Dec. Mostly rain-fed, supplemental irrigation needed in places during dry spell.

Aus: Group of rice varieties sown in the pre-monsoon season and harvested in the monsoon season. These are broadcasted/transplanted during March-April and harvested during June-July. Generally rain-fed, irrigation needed for HYV T. Aus.

B Aus: When preceding a crop means broadcast (B. Aus)

Bagda: Shrimp (*Penaeus monodon),* brackish/slightly saline water species.

Bazar: Market

Beel: A saucer-shaped natural depression, which generally retains water throughout the year and in some cases seasonally connected to the river system.

Boro: A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January and harvested before the onset of monsoon in April- May.

Golda: Prawn *(Macrobrachium rosenbergii*), non-saline/fresh water species

Gher: Farm lands converted into ponds with low dykes and used for cultivation of shrimp/prawn/fish.

Haat: Market place where market exchanges are carried out either once, twice or thrice a week, however not every day.

Haor: A back swamp or bowl-shaped depression located between the natural levees of rivers and comprises of a number of *beel*s.

Jhupri: Very small shed for living, made of locally available materials (thatched). One type of houses used by very poor community members.

Kutcha: A house made of locally available materials with earthen floor, commonly used in the rural areas.

Khal: A drainage channel usually small, sometimes man-made. The channel through which the water flows. These may or may not be perennial.

Kharif: Pre-monsoon and monsoon growing season. Cropping season linked to monsoon between March-October, often divided into kharif-1 (March-June) and kharif-2 (July-October).

Khas land: Land holding by the Government

Kutcha Toilet: The earthen made latrine consist of a hole without cover.

Perennial Khal: Khal, where water is available all the year round.

Rabi: Dry agricultural crop growing season; mainly used for the cool winter season between November and February.

Red Category: The "Red" category projects/industries are those likely to produce some adverse environmental impacts but considered to be overly significant and that the impacts can be mitigated with residual adverse impacts.

Ring Slab: The simple pit latrine consists of a hole in the ground (which may be wholly or partially lined) covered by a squatting slab or seat where the user defecates. The defecation hole may be provided with a cover or plug to prevent the entrance of flies or egress of odor while the pit is not being used.

Seasonal Khal: Khals, where water is not available all the year round.

Sidr: Major Cyclone, which hit Bangladesh coast on November 15, 2007.

T. *Aman*: When preceding a crop means transplanted (T. Aman).

Upazila: Upazila is an administrative subdivision of a district.

Water sealed: A water sealed latrine is simply a pit latrine that has a water barrier to prevent odors. These latrines are simply pits dug in the ground in which human waste is deposited. A water sealed latrine has a bowl fixture that has a set amount of water retained in it. It is operated on the pour to flush system. These types of latrines can be connected to a septic tank system.

Conversion Units

1 m^2	= 10.77 ft^2
1 Decimal	= 435.60 ft^2
1 Decimal	= 40.47 m^2
1 Katha	= 1.653 Decimal
1 Bigha	= 33 Decimal (The size of Bigha changes in some locations)
1 Bigha	= 20 Katha
1 Acre	= 100 Decimal
1 Acre	= 4,046.825 sq. meter
1 Hectare	= 247 Decimal
1 Hectare	= 10,000 sq. meter
1 Hectare	= 2.47 Acre
1 Metric ton	= 1,000 Kilogram
1 Kilometer	= 1000 Meter
1 Meter	= 1,000 Millimeter
1 Inch	= 25.4 Millimeter
1 Foot	0.3048 Meter
1 Million cubic meter	= 1,000,000 Cubic meter

Executive Summary

The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase- 1 (CEIP-1), under which seventeen polders will be rehabilitated and improved in the coastal area of the country. The GoB has obtained financial assistance from the World Bank (WB) for this Project. In accordance with the national regulatory requirements and WB safeguard policies, Environmental Impact Assessments (EIAs) of four polders have already been carried out in the first package. This document presents the EIA report of Polder 47/2, which is one of the six polders of Package- 2.

Background

The coastal zone in southern Bangladesh adjoining the Bay of Bengal is characterized by a delicately balanced natural morphology of an evolving flat delta subject to very high tides and frequent cyclones coming in from the Bay of Bengal encountering very large sediment inflows from upstream. The coastal zone, in the past, in its natural state, used to face inundation by high tides, salinity intrusion, cyclonic storms and associated tidal surges. In 1960s, polderization started in the coastal areas to convert this area into permanent agricultural lands. The polders in this area are enclosed on all sides by dykes or embankments, separating the land from the main river system and offering protection against tidal floods, salinity intrusion and sedimentation. These polders are equipped with in- and outlet sluice gates to control the water inside the embanked area.

The polders were originally designed without proper attention to storm surges. However, recent cyclones caused substantial damage to the embankments, which threatened the overall integrity of the coastal polders. In addition to breaching of the embankment due to cyclones, siltation of peripheral rivers surrounding the embankment caused coastal polders to suffer from water logging**,** which lead to large scale environmental, social and economic degradation. Poor maintenance and inadequate management of the polders have also contributed to internal drainage congestion and heavy external siltation. As a result, soil fertility and good agriculture production in some areas are declining because of water logging and salinity increase inside the polders.

The above reasons have led the Government to re-focus its strategy on the coastal area from not only to protect against high tides, but also to provide protection against frequent storm surges. The long-term objective of the Government is to increase the resilience of the entire coastal population to tidal flooding as well as other natural disasters by upgrading the entire embankment system. With an existing network of nearly 5,700 km long embankments in 139 polders, the magnitude of such an initiative is daunting and requires prudent planning. Hence, a multi-phased approach of embankment improvement and rehabilitation is adopted over a period of 15 to 20 years. The proposed CEIP-1 is the first phase of this long-term programmatic approach.

Location and Synopsis of Rehabilitation Work

The location of Polder 47/2 is in Kalapara Upazila under Patuakhali district of Bangladesh. The gross area of the polder is 2,065 hectares (ha) of which net cultivate area is 1,850 ha. The project aims to enhance protection against natural disasters, increase resilience during and after such disasters and improve agricultural production by reducing water management problems.

Rehabilitation works planned in Polder 47/2 under CEIP-1 are: Re-sectioning of embankment (17.49km); replacing 4 drainage sluices; replacing and repairing 5 flushing sluice; re-excavation of drainage channels (11.46 km); bank protection (0.52 km) and afforestation on the foreshore areas (3.43 ha). Other components include implementation of a social action plan as well as an environmental management plan. Project implementation includes supervision, monitoring and evaluation of project impacts; project management, technical assistance, trainings, technical studies; and contingent emergency response.

The Bangladesh Water Development Board (BWDB) is the implementing agency of this Project.

Regulatory and Policy Framework

The Bangladesh Environment Conservation Act, 1995 (amended in 2002), requires that all development projects shall obtain environmental clearance from the Department of Environment (DoE), Ministry of Environment and Forest (MoEF). Similarly, the World Bank's environmental safeguard policies require an environmental assessment, which needs to be carried out for projects being considered by its financing. The present EIA Report fulfils both these requirements.

The construction, reconstruction, expansion of polders and flood control embankment is categorized as Red in accordance with the DoE‘s classification and According to the World Bank safeguard policies, the project has been classified as Category A. The Environmental Impact Assessment (EIA) study has been conducted and an Environmental Management Plan (EMP) and a Resettlement Action Plan (RAP) have been prepared as per GoB regulations and World Bank Policies.

Environmental Baseline and Existing Conditions

Polder 47/2 lies at flat agro-ecological zone of the Ganges Floodplain and saline tidal flood plain. The entire Polder area (100% of NCA) is covered with clay loam soil texture.

The total cropped area is 2,870 ha of which rice occupies 2,260 ha and the rest 610 ha is covered by non-rice crops. The rice and non-rice cropped area are 79% and 21% of the total cropped area, respectively. Among the rice crops, T. Aus (Local), T. Aus (HYV), T. Aman (Local), T. Aman (HYV) and Boro (HYV) are commonly grown in the polder area.

Most of the canals have silted up due to increased siltation. Local people opined that there are around 60 km drainage khals (water channel) inside the polder. The present condition of some of the internal drainage khals is undesirable. Over the years, lack of maintenance, siltation, topsoil erosion and other land filling activities have resulted in gradual decrease of water courses within the polder. In recent field observations, it was found that Rosulpur Khal and Kichikata branch khal 2, which are connected to the Charpara River at the periphery of the polder, all of them have been silted up causing frequent floods during the monsoon period.

From spatial analyses using the satellite imageries of different time frame (1988, 2003 and 2014), it has been found that riverbank erosion is active and it creates severe problems. Erosion engulfs local people's land, homes and has become an environmental and social hazard. During field investigation, two erosion hotspots have been found mainly in northwestern part along the Sonatala River. The riverside slope of the embankment at Ch. 1+700 km to Ch. 2+700 km at Payerpur village and Ch. 6+000 km to Ch. 7+000 km at Fulbunia village has been damaged due to severe wave action of the Baraitala and Sonatala Rivers, respectively.

The soil salinity levels are 1.01 to 7.57 (ds/m) in the top soil (depth of 0-15 cm) in all agricultural land showing the agricultural land is considered as ranging from being non-saline to slightly saline.

The Polder-47/2 area is situated in tidal part of the Ganges Floodplain. No Ecologically Critical Area (ECA) or designated protected area is located within or near the polder area. The area is tidal in nature. A good number of mangrove and bushy vegetation are found along the marginal lands of canals shoreline. The most dominant mangrove species are Gewa (*Excoecaria* *agallocha*), Kakra (*Bruguiera gymnorrhiza*), Ora (*Sonneratia caseoloaris*), Golpata (*Nipa fruticans*) and Hargoza (*Acanthus illicifolius*).

Fish habitats cover an area of 1,476 ha of which 1466ha is capture fish habitats (including external rivers and internal canals). Aquaculture practice is expanding gradually in the polder area. Various types of fish culture systems have been adopted by the local people including mono-, poly-, and mix-culture. Exclusively poly-culture practice has been adopted by the local people. The estimated area under fish culture is 10 ha. The estimated total fish production of the Polder area is 168MT. The main part of the fish production (about 93%) is coming from capture fisheries while the rest of the production (about 7%) is coming from culture fisheries habitats.

The Polder area is the home of 11,532 people belonging to 3,188 households. Of the total population; 5,575 (48.3%) are male where females are 5975 (51.7%). The average household size is 3.6, which is lower than the national average of 4.50. The average population density is 449 per square kilometer, which is lower than the national average (1,055). Literacy rate, based on a definition “ability to write a letter in any language” is 50.9%, where for male it is 51.2% and for female 50.6%. Out of the total population of 10,921, 1,498 (13.7%) are economically active, which include 511 (34%) employed, 22 (1.5%) are looking for work, and 617 (41.19%) engaged in household work.. There is no electricity facility in the polder area. The coverage of solar is found nominal. Due to the low coverage in supply of electricity, the polder area has less socio-economic development activity. Most of the houses are *Kutcha* (88.5%) while 0.8 % houses are semi-pucka and 10.4% percent house is still *Jhupri*. 72% of the households use sanitary latrines, where 21.2% is water-sealed and non water-sealed sanitary latrine is 50.8%. About 24.7% use non-sanitary latrines and 3.2% households have no sanitation facilities neither owned nor on shared basis.

Potential Impacts and their Mitigation

Pre-construction phase

The potential environmental and social impacts during the pre-construction phase are mainly associated with acquisition of land for the construction of retired embankments. Land acquisition will affect homesteads, agricultural and orchards etc. About 2.31 hectares of land will be acquired. A total 16,928 number of trees are to be cut for re-sectioning of embankment and construction of structures. Moreover, about 15 Common Properties will be affected in Polder 47/2.

During-construction phase

The potential impacts during the construction phase include air pollution, noise pollution, degradation of landscape, soil erosion, increased siltation in water bodies, loss of agriculture, damage to fish and other aquatic fauna, impediments to land traffic and navigation, and safety & health hazards. The key construction activities that are likely to cause these environmental and social impacts include establishment of labor camps, transportation of equipment and material, material borrowing, excavation, embankment raising, dismantling, repair and construction of regulators, re-excavation of water channels, and associated waste disposal. Piling of excavated spoils may also damage the vegetation if not handled properly. Construction activities may temporarily disturb terrestrial fauna remaining in the polders such as monitors, jackals, lizards and snakes. Fish migration between the outside rivers and internal khals is likely to be affected temporarily during re-excavation of khals. Besides, fish migration within the Polder between khals and low-lying areas may be affected as well during replacement of drainage structures.

The construction activities along the embankments will also cause temporary disturbance in the movement of local people. Mobilization of equipment, machinery, material and manpower will be transported to the Polder resulting additional traffic on roads and in waterways.

Project operation phase

The Project after implementation would provide substantial benefits including protection against natural disasters such as tidal surge, river erosion, flooding and also arrest salinity intrusion. Besides, drainage congestion will be significantly reduced. This will increase the area under cultivation, lead to an increase in crop production, and create opportunity for employment generation. The cropped area would be about 4,000 ha of which rice cropped area would about 1,902 ha and non-rice cropped area would about 2,098 ha. An estimated additional 2,082 tons of rice and 13,246 tons of non-rice would be produced in the With-Project situation compared to the Without-Project situation.

Due to the expected expansion of agricultural production, an estimated 26,646 kg of chemical fertilizers and 505kg of pesticides would be required extra in future. Runoff from agriculture with increased loads of fertilizers and pesticides might potentially pollute the water bodies and even drinking water sources thus causing health hazards to the communities. The increase in runoff from the cropped areas may potentially pollute water bodies and reduce fish production.

Analysis of Alternatives

Several alternatives were considered during the design phase of the Project. These include ‘No-Project’ alternative and ‘with project’ alternatives.

In the present situation, Polder 47/2 is extremely vulnerable to cyclones, storm surges, wave action, and climate change effects, and the Polder is not in a state to provide required services, particularly protection against tidal inundation, efficient drainage, and minimizing the impact of cyclonic surges. The Polder area is vulnerable to salinity intrusion. Due to high salinity and scarcity of ground water during the periods of low rainfall, the farmers are facing crisis from January to April (salinity intrusion) and May to August (flooding). The silted water channels are resulting into declining fisheries, local farmers and labour will remain financially stressed, livelihood opportunities will remain limited, and local people will migrate outside the Polder for employment and increasing environmental pollution. The proposed interventions under CEIP-1 have been designed to address the above problems in the Polder. If these interventions are not undertaken, the present poor state of the Polder will continue, and therefore the ‘no-project’ alternative is not a recommended option.

Several with project alternatives were considered to address each of the problems being faced in the Polder. These included alternatives for embankment strengthening, riverbank protection works, protection of embankment slopes, replacement of drainage sluices, rehabilitation of flushing sluices, addressing water logging and drainage congestion.

Climate Change Impact

Climate of the study area is typical monsoon considering three seasons: Summer (pre-monsoon) – March to May; Rainy season (monsoon) – June to October; and winter season – November to February. The temporal plots of the annual and seasonal precipitation of Polder 47/2 have been drawn to investigate the nature of inter-annual fluctuations. The linear regression lines have also been shown on the graphs. The temporal variations and the trends of seasonal precipitations for winter, pre-monsoon, monsoon and post-monsoon and the annual precipitation are obtained during the period 1976-2005. It is found that all seasons show decreasing trends except in monsoon season. The rate of decreasing trends in the annual precipitation, pre-monsoon, post-monsoon and winter seasons are observed at -3.92 mm/year, -6.049 mm/year, -0.86 mm/year, and -0.83 mm/year respectively during the same period, which are not statistically significant. Monsoon season rainfall over the Polder area shows an increasing trend at the rate of 3.82 mm/year, which is not statistically significant for the same period.

Cumulative and Reciprocal Impacts

The Polder-47/2 is surrounded by a number of rivers. The existing crest levels of the polder ranges from 4.10 to 4.20 mPWD. The re-sectioning works proposed would increase its crest level up to 4.5 to 5.0 mPWD with a view to protect the polder from cyclonic surges and tidal flooding, Polder- 48 is located near this polder, where interventions similar to the ones proposed for Polder 47/2 are considered. It may be mentioned that these Polder 47/2 and 48 have co-exists since their construction in the 1960'ties. However, there will be no impact in terms of hydro-morphology, socio-economic and biological resources of the Polder-47/2. As such, there will be no additional impact due to rehabilitation of these two polder in one each other's. Nonetheless, the proposed protective measures of Polder-47/2 protect it against surge level; it may divert storm surges and cause a great threat to the surrounding polders, i.e. 46 and 47/1.

Environmental Management Plan

The environmental management plan (EMP) provides the implementation mechanism for the mitigation measures identified during the present EIA. A comprehensive EMP, which focuses on managing construction and post-construction (Operation) phases-related impacts, should suffice in managing the potential construction and operation phase impacts. The EMP will be attached with the Bidding Document. The environmental management budget will be included in the BoQ. Since most of the contractors do not have a clear understanding on the need of environmental management, some tend to quote very low price for implementation of the EMP and are eventually not able to implement EMP as per design due to lack of resources and expertise. To avoid this problem, a Fixed Budget will be assigned for EMP implementation. Included in the budget there is provision for training of the contractor on environmental issues. The total cost of EMP implementation for Polder- 47/2 has been estimated as BDT 7.93 million. The contractor needs to submit a Construction Environmental Action Plan (CEAP) based on the EIA and EMP in line with the construction schedule and applicable national as well as World Bang guidelines. The CEAP needs to be reviewed by the supervision consultant and cleared by BWDB and World Bank.

Extensive environmental monitoring will be required as per World Bank guidelines. The monitoring program will have the purpose to evaluate: (i) the extent and severity of the environmental impacts against the predicted impacts and baseline; (ii) the implementation and performance of the environmental protection and mitigation measures and compliance with pertinent rules and regulations; (iii) any trends in impacts; and (iv) overall effectiveness of the project environmental protection and mitigation measures. The monitoring plan is included in the EMP. The EMP stipulates the registration of monitoring results in suitable database and regular reporting of results.

Institutional Responsibility and Report Requirement

The contractor is responsible for implementing the EMP during the construction phase whereas the Project Supervision Consultant is primarily responsible for supervising the implementation of the EMP. The environment specialist to be employed by BWDB will conduct field inspections and surveys on a regular basis. The environment specialist will report to the Senior Environment Specialist at Head Quarter. The M&E consultant will be responsible for independent monitoring the implementation of the EMP, and external monitoring and evaluation. DoE will be consulted if any complicated issues arise during construction and/or operation stages. BWDB will apply for annual site clearance from DoE. WMOs will be trained to ensure adequate water and environmental management practices are followed during project operation. The Environmental Management Unit of BWDB, strengthened through CEIP-1, will ensure and oversee the environmental management during project operation.

BWDB will prepare the Half Yearly Progress Report on environmental management during construction phase and will share this with the World Bank for review. Contributing development partners (if any) may join the field visits to understand the environmental compliance of the project. In addition, the effectiveness of screening, monitoring and implementation of the EMP will be carried out by a third party monitoring firm along with the project component activity monitoring quarterly/bi-annually/annually. The Annual Environmental Audit Report prepared by the third party monitoring firm will be shared with the safeguards secretariat.

The Environmental, Social and Communication Unit (ESCU) are to be established to provide co-ordination, technical support and services during the environmental screening and preparation of EA, and implementation of the environmental mitigating measures. At least one of the two environmental specialists must be on board. The specialists will prepare subproject specific environment screening/assessment report with EMP, supervise the implementation of EMP and support capacity building of the field level staff of BWDB and contractor. The ESCU will review the EMF and ensure quality of the environmental screening/assessment with EMP.

Stakeholder Consultation,Participation and **Disclosure**

During the study period, public consultation meetings were organized with the participation of local people, representatives of local government and BWDB and other stakeholders. Local people showed interest in the rehabilitation of the project for their existence. They had no objection from their side to implement the project, rather were found them ready to help the implementing agency spontaneously. Two Public consultations (at Dablugonj union Auditorium and Kalapara Upazila Auditorium) and three focus group discussion meetings (at Maherpur, Fulbunia and Thankhuli villages) were held to collect stakeholder perception on the proposed interventions considering EMP measures.

1 Introduction

The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase 1 (CEIP-1) (In the following referred to as the ‘project’), under which seventeen polders will be rehabilitated and improved in the coastal area of the country under three packages. The GoB has obtained financial assistance from the World Bank (WB) for this project. It is to be mentioned here that the Site Clearance of all the 17 (seventeen) polders had been obtained from the Department of Environment (DoE), Bangladesh on the basis of the Initial Environmental Examination (IEE) reports completed earlier. Polders 43/2C, 47/2, 48, 40/2, 41/1 and 39/2C are included in package two; whereas, polders 14/1, 15, 16, 17/1, 17/2, 23 and 34/3 are included in Package-3. For the location of the polders, refer Map 1.1. In accordance with the national regulatory requirements and WB safeguard policies, Environmental Impact Assessment (EIA) of Package-2 of six polders have also been carried out. This document presents the EIA report of Polder 47/2.

1.1 Background

1. In the 1960s, polderization started in the coastal zone of the country to convert this area into permanent agricultural lands (refer Map 1.1 for coastal polders) to increase the agriculture production. The polders in this area are enclosed on all sides by dykes or embankments, separating the land from the main river system and offering protection against tidal floods, salinity and sedimentation. Without embankments, the coastal communities would be exposed to diurnal tidal flooding. The poldered lands are slightly higher than sea level. These polders are equipped with inlet and outlet sluice gates to control the water inside the embanked area.

2. The polders in this area are enclosed on all sides by dykes or embankments, separating the land from the main river system and offering protection against tidal floods, salinity intrusion and sedimentation. The poldered lands are slightly higher than the sea level. The polders were designed to keep the land safe from daily tide to allow agriculture activities. Without embankments, the coastal communities would be exposed to diurnal tidal flooding. These polders are equipped with inlet and outlet sluice gates to control water inside the embanked area.

3. The coastal embankment system of Bangladesh was originally designed without attention to storm surges. Recent cyclones have substantially damaged the embankments and threatened the integrity of the coastal polders. In addition to breaching due to cyclones, siltation of peripheral rivers surrounding the embankments, have caused failures of the drainage systems, creating water logging inside the polders. This has led to large-scale environmental, social and economic degradation. Poor maintenance and inadequate management of the polders have also contributed to internal drainage congestion and heavy internal siltation, which comes, from connected river and for top soil erosion. Soil fertility and agriculture production are declining in water-logged areas. Other areas suffer from salinity increase due to incursion of seawater into the polders.

4. The above reasons have led the Government of Bangladesh (GoB) to readjust its strategy on the coastal area from only ensuring protections against high tides to providing protection against frequent storm surges as well. The long-term objective of the GoB is to increase the resilience of the entire coastal population from tidal flooding as well as natural disasters by upgrading the entire embankment system. With an existing network of nearly 5,700 km long embankments in 139 polders, the magnitude of such a project is daunting and requires prudent planning. Hence, a multi-phased programmatic approach of embankment

improvement and rehabilitation is adopted over a period of 15 to 20 years. The proposed CEIP-1 is the first phase of this long-term program.

1.2 Project Overview

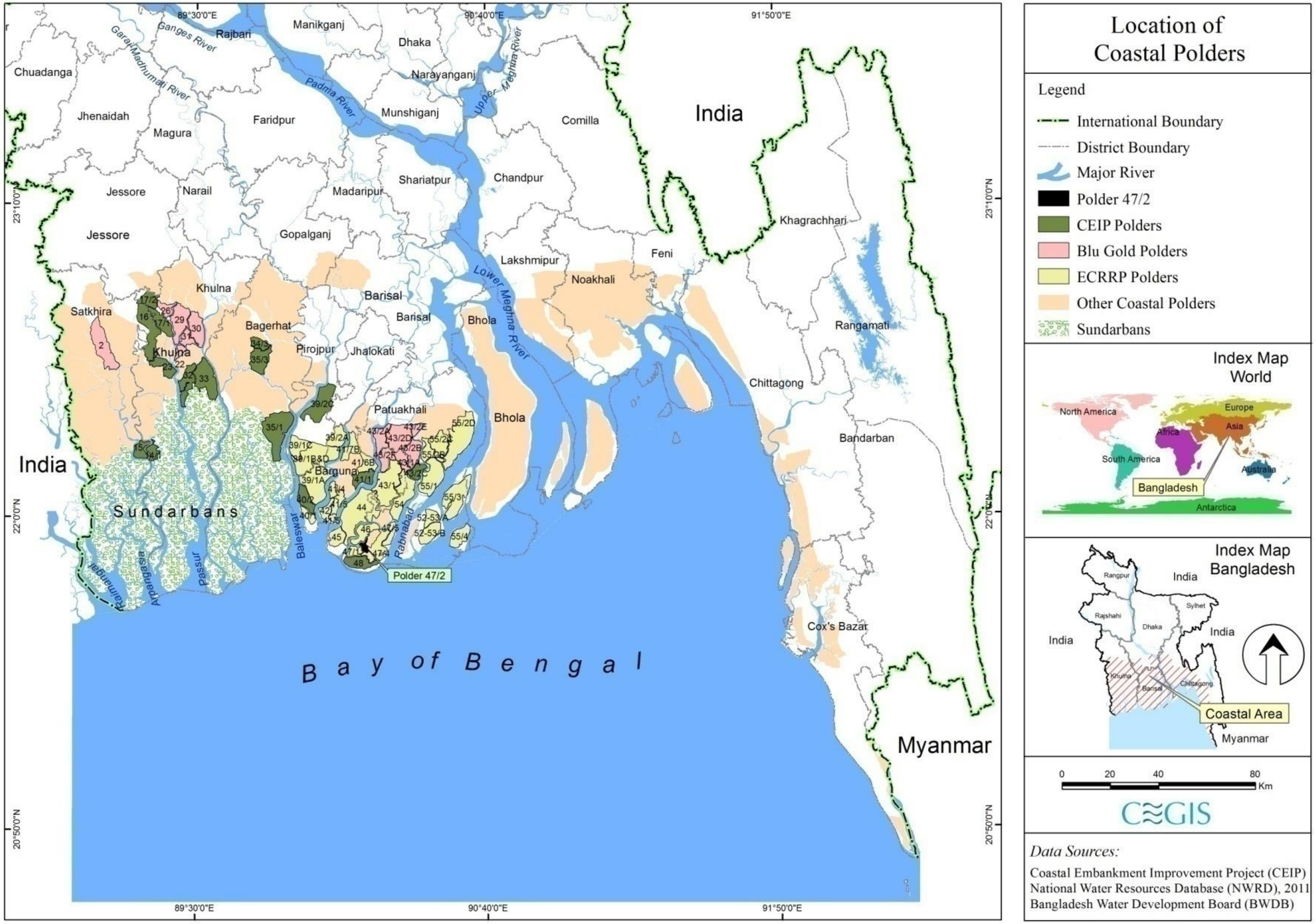
5. Polder-47/2 is located in Kalapara Upazila under Patuakhali District of Barisal Division (Map 1.2). The Polder covers a gross area of 2,065 hectare (ha) with net cultivable area of 1,850 ha. The overall cropping intensity is around 189% (which is near to the national average of 191%) giving a total cropped area of 3,492 ha. The Project aims to enhance protection against natural disasters, increase resilience during and after such disasters, and improve agricultural production by reducing drainage congestion, thereby facilitate an increase in cropping intensity. To meet these objectives, the following key improvements have been planned:

- Re-sectioning of embankment : 17.49 km
- Replacing of drainage sluice : 4 nos.
- Replacing and Repairing of flushing sluice : 5 nos.
- Re-excavation of drainage channel :11.46 km
- Bank revetment :0.52 km
- Afforestation on the foreshore and slope areas : 9.73 ha

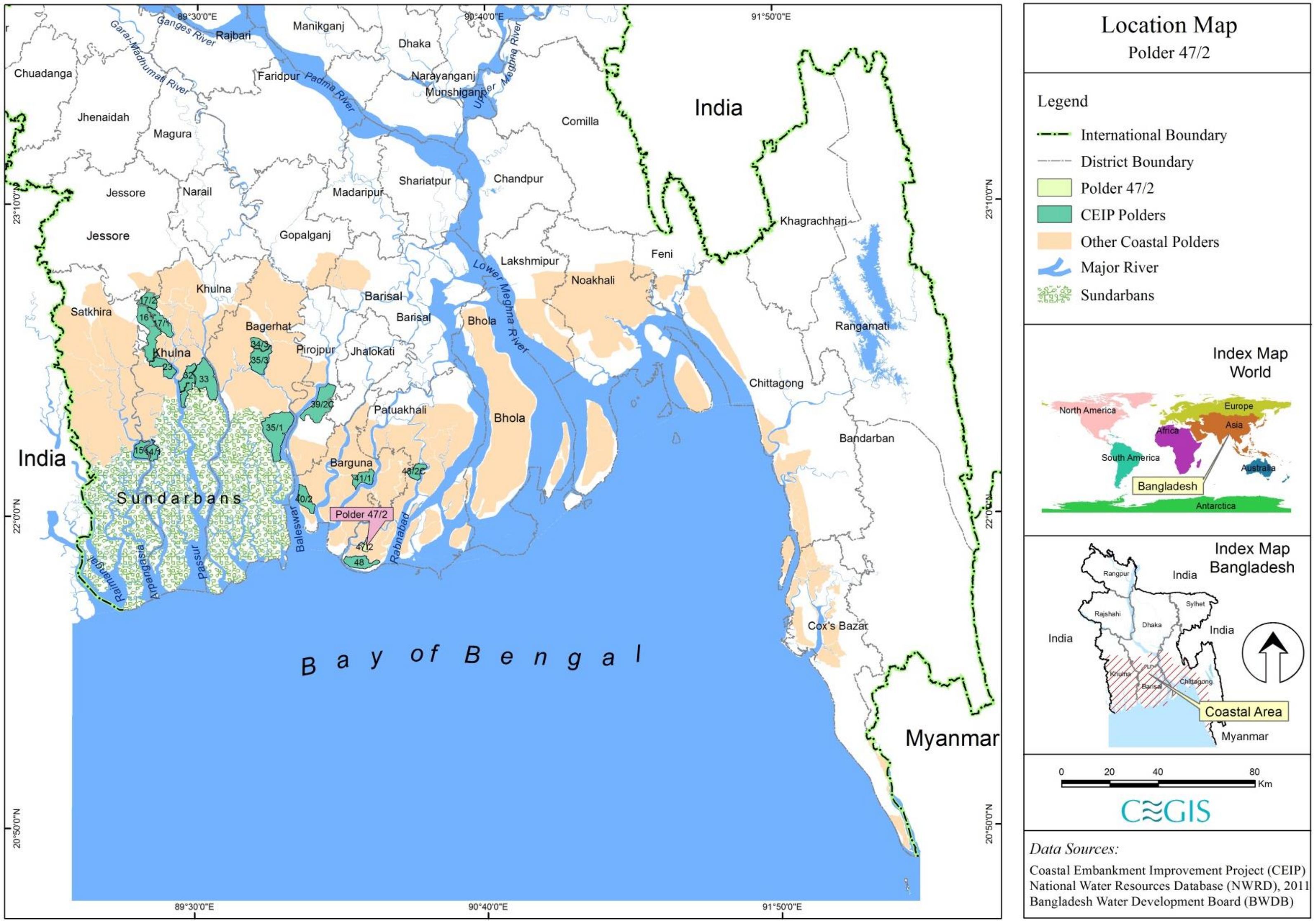
6. Other components of the CEIP-1 will include implementation of a social action plan and environmental management plan; supervision, monitoring and evaluation of project impacts; project management, technical assistance, trainings, and technical studies; and contingent emergency response. Detailed information of the Project is presented in the project description chapter of the report.

1.3 Regulatory and Policy Framework

7. The Bangladesh Environment Conservation Act, 1995 (amended in 2002), requires that all development and old developed projects shall obtain environmental clearance from the Department of Environment (DoE), Ministry of Environment and Forest (MoEF). Similarly, the World Bank's environmental safeguard policies require an environmental assessment to be carried out for projects being considered for its financing. The present EIA fulfils both of these requirements.



Map 1.1: Location of Coastal Polders



Map 1.2: Location of Polder- 47/2

1.4 Objectives of the Study

8. The objective of the EIA study for Polder-47/2 is to identify and assess the potential environmental impacts of the proposed project interventions, evaluate alternatives, and design appropriate mitigation, management, and monitoring measures to be addressed in the Environmental Management Plan (EMP)[1]. In compliance with the national regulatory and WB environmental policies and guidelines (for further details refer to Chapter 3).

9. The specific objectives of the EIA study are to:

- Comply with the national regulatory and WB policy frameworks (further discussed later in the document);
- Determine and describe the existing environmental and social settings of the Project area (the Project area is defined as the entire area inside the polder, project influence area outside the polder i.e. the embankments, borrow pits and spoil disposal areas if located outside the polder; earth collection areas if located outside the polder and access routes to the polder);
- Identify and assess the potential environmental and social impacts of the Project;
- Identify mitigation measures to minimize the negative impacts and enhancement measure to enhance the positive impacts; and
- Prepare an EMP including a detailed monitoring plan.

1.5 Scope of work

10. The scope of works of the present EIA study for Polder- 47/2 includes the following:

i. Carry out detailed field investigation of required parameters of the environmental and social baseline, especially on critical issues.

ii. Determine the potential impacts due to the project through identification, analysis and evaluation of sensitive areas (natural habitats; sites of historic, cultural and conservation importance), settlements and villages/agricultural areas or any other identified Important Environmental and Social Component (IESCs).

iii. Determine the cumulative environmental impacts of the project that may occur inside and outside the project area.

iv. Distinguish between significant positive and negative impacts, direct and indirect impacts, immediate and long-term impacts, and unavoidable or irreversible impacts.

v. Identify feasible and cost effective mitigation measures for each impact predicted as above to reduce potentially significant adverse environmental impacts to acceptable levels.

vi. Determine the capital and recurrent costs of the measures, and institutional, training and monitoring requirements to effectively implement these measures. The consultant is required to identify all significant changes likely to be generated by the project activities. These would include, but not be limited to, changes in the coastal erosion and accretion due to alteration of tidal currents, changing of fish migration routes, destruction of local habitats, and water logging.

[1]WB Operation Policy 4.01. 2011 Revision

vii. Consult with modeling consultants to establish conformity of the impact assessment with existing and ongoing mathematical model due to climate change developed by a number of reputed organizations. The developed models may be available from the main consultant and implementing agency;

viii. Prepare (a) an estimate of economic costs of the environment damage and economic benefits, where possible, from the direct positive impacts that the project is likely to cause, and (b) an estimate of financial costs on the mitigation and enhancement measures that the project is likely to require, and financial benefits, if any; the damage/ cost and benefits should be estimated in monetary value where possible, otherwise describe in qualitative terms.

ix. Describe alternatives that were examined in course of developing the proposed project and identify other alternatives that could achieve the same objectives. The concept of alternatives extends specifically to the site and design, technology selection, rehabilitation/construction techniques and phasing, and operating and maintenance procedures. Compare alternatives in terms of potential environmental impacts, vulnerability, reliability, suitability under local conditions, and institutional, training, and monitoring requirements. When describing the impacts, indicate which are irreversible or unavoidable and which may be mitigated. To the extent possible, quantify the costs and benefits of each alternative, incorporating the estimated costs of any mitigating measures. Include the alternative of not constructing the project to demonstrate environmental conditions without it.

x. Identify the specific reciprocal impact of climate change on polder. Check the suggested polder height with respect to the SLR and high tide. The sub consultant will ensure that the design will minimize the negative impact on the environment due to polder rehabilitation activities. For example, adequate fish pass should be provided to ensure free movement of fish or drainage facility should be provided to avoid water logging in the surrounding area.

xi. Prepare detailed Environmental Management Plans along with respective EIA separately to monitor the implementation of mitigation measures and the impacts of the project of other inputs (such as training and institutional strengthening) needed to conduct during construction and operation. Include an estimate of capital and operating cost in the plan and a description of other inputs (such as training and institutional strengthening) needed to implement the plan.

xii. Ensure to address occupational health and safety for the construction workers in the EMP;

xiii. Develop environmental monitoring format for regular monitoring of the project /during pre-construction, construction and operational stages; and

xiv. Prepare the EIA report.

1.6 Structure of the Report

Chapter 1 (Introduction) describes the background of the project, objectives of the study, scope of works with a list of EIA study team.

Chapter 2 (Approach and Methodology) presents the detailed approach and procedure adopted to conduct the EIA study. The Chapter also describes data sources and methodology of data collection, processing and impact assessment.

Chapter 3 (Policy, Legal and Administrative Framework) reviews the national legislative, regulatory and policy framework relevant with the EIA study. The Chapter also includes a discussion on the WB safeguard policies and their applicability for the Project.

Chapter 4 (Description of the Project) provides the simplified description of the project and its phases, key activities under three phase, labour, equipment, and material requirements, implementation arrangements, implementation schedule, and other related aspects.

Chapter 5 (Environmental Baseline and Existing Conditions) describes the existing environmental and social settings in respect of ***Physical Environment, Biological Environment and Socio-cultural environment*** aspects of the project area.

Chapter 6 (Anticipated Environmental Impacts and Mitigation Measures) identifies the environmental impacts that may potentially be caused by the project in various phases, and also proposes appropriate mitigation measures to avoid, offset, reduce, or compensate these impacts.

Chapter 7 (Analysis of Alternatives) discusses various alternatives considered during feasibility and design stage of the project, and their environmental and social considerations.

Chapter 8 (Climate Change Impact): discusses the climate change aspects from local perspectives and the likely impacts on the project area and its surroundings.

Chapter 9 (Cumulative and Reciprocal Impacts) presents analysis of cumulative impacts of the proposed Project and other projects in the area. In addition, induced impacts are also covered in the chapter.

Chapter 10 (Environmental Management Plan) includes an estimate of the impacts and costs of the mitigation measures, a detailed EMP with proposed work programs, budget estimates, schedules, staffing and training requirements and other necessary support services to implement the mitigation measures, phase wise monitoring, etc. Besides, the EMP specifies the implementation arrangements for the mitigation measures identified during the EIA study.

Chapter 11 (Stakeholders and Disclosure Consultation and Participation) provides details of the consultations held with the stakeholders at the project site and framework for consultations to be carried out during construction phase. The Chapter also includes the disclosure requirements for the EIA.

2 Approach and Methodology

11. This Chapter presents the detailed approach and methodology followed to conduct the EIA study. The Chapter also described the data sources and methodology of data collection, processing and approach used in the impact assessment.

2.1 Overall Approach

12. The EIA study for the rehabilitation of Polder-47/2 has been carried out following the approved Terms of References (ToR) of DoE dated 05/06/2013 and the Environmental Management Framework (EMF) for CEIP-1. The overall approach of the study is shown in **Figure 2.1** below:

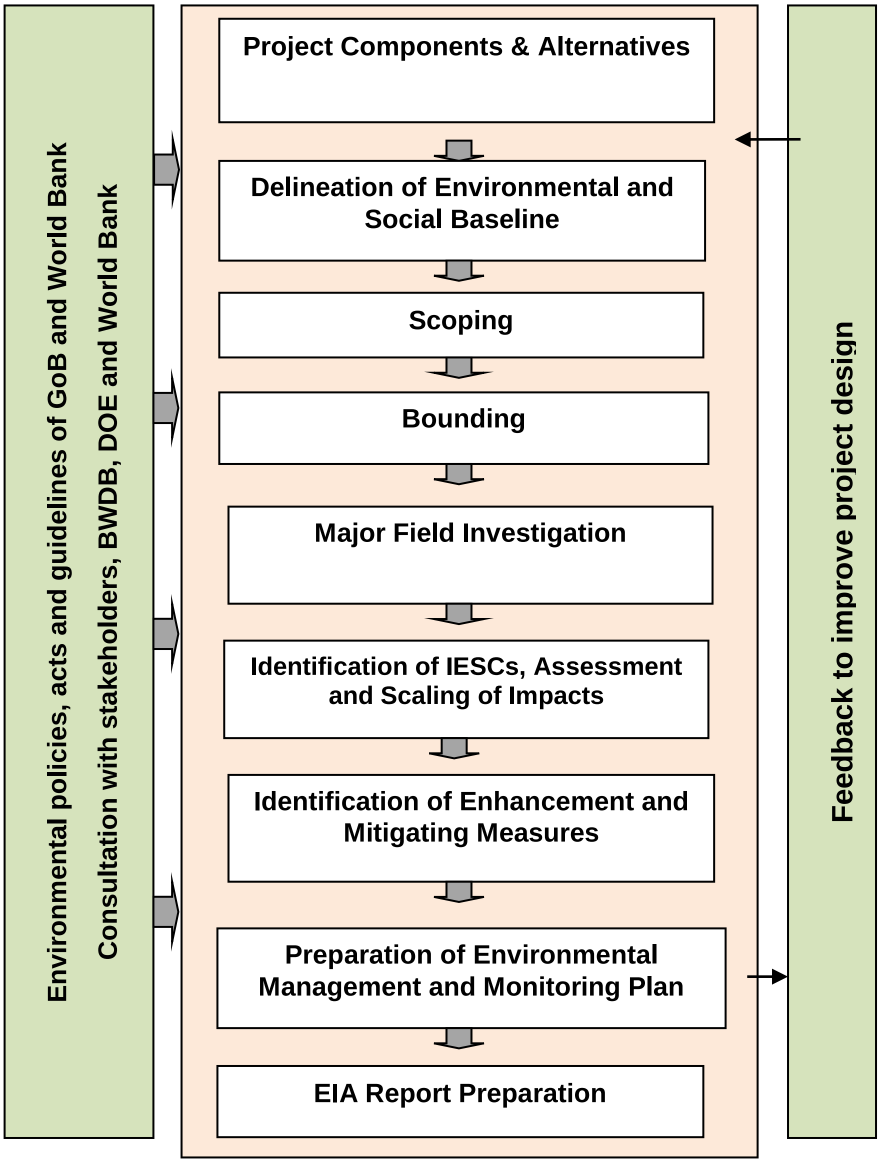


Figure 2.1: Overall approach of the EIA study

2.2 Methodology

13. The detailed methodology followed for the EIA study is described below.

2.2.1 Project Area of Influence

14. At the beginning of the study, the Project area of influence was broadly demarcated. This included the area inside the polder where most of the Project interventions would take place, the area immediately outside the polder embankments (this area could be used for staging of construction works, material stockpiling, and/or earth borrowing), access routes for the polder, borrow as well as spoil disposal areas if located outside the polder, and labor camps/contractor facilities if located outside the polder. The area of influence is bounded by Sonatala River to the north and west, Baraitala River to the south and southwest and Charpara River to the north and North West. It is noted that project area includes polder area whereas study area includes both project area and peripheral rivers.

2.2.2 Analysis of the Project Design and Description

15. Detailed information on the Polder 47/2 including objective, nature and location of proposed and existing interventions, construction works, and other related aspects was obtained from the DCSC of CEIP-1.

16. The Water Resources Engineer of the EIA study team interpreted this information for the multi-disciplinary team members for assessing the potential environmental and social impacts of the proposed interventions.

17. Since the location of most of the project interventions are already fixed, alternative design options of the interventions were analyzed considering environmental, social, and technological criteria to identify suitable alternatives and appropriate mitigation measures for negative environmental impacts. Figure 2.2 shows the different aspects to be addressed in the Project Design and Description step of the EIA studies.

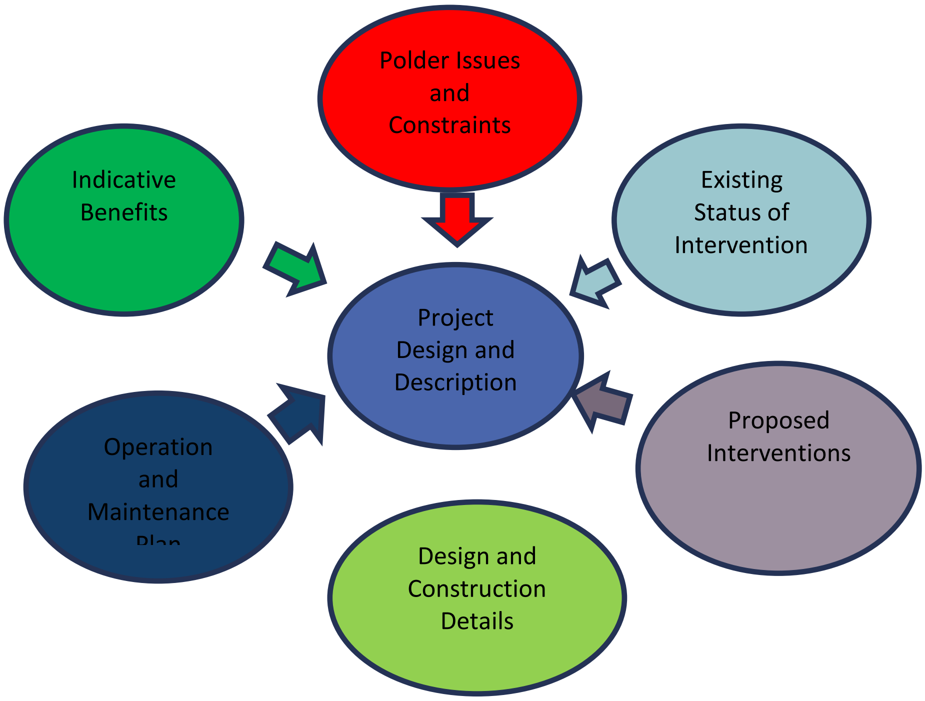


Figure 2.2: Aspects to be addressed in the Project Design and Description

2.2.3 Analysis of the Project Components and Alternatives

18. Analysis of site alternatives were not considered relevant as the Project mostly entails outright rehabilitation works of infrastructure where their spatial domains are already fixed. However, the possible alternatives of proposed interventions were analyzed on a qualitative basis, considering their environmental, social, technical and economic suitability. This would rationalize the selected interventions, and identify pathways for better design alternatives, if available. Figure 2.2 outlines the approach followed in the alternative analysis.

19. During the suitability assessment process, all design alternates or alternatives in project interventions were compared to the 'without-project' option, which would be generated by projecting the baseline situation for the entire project life, within the Future-Without-Project (FWOP) scenario. Moreover, different possible construction alternatives related to project implementation such as, the materials to be used, workforce procurement sources, locations of stockyards, sources for material procurement, transportation routes, modes of material and manpower mobilization, scheduling etc., were analyzed during the study.

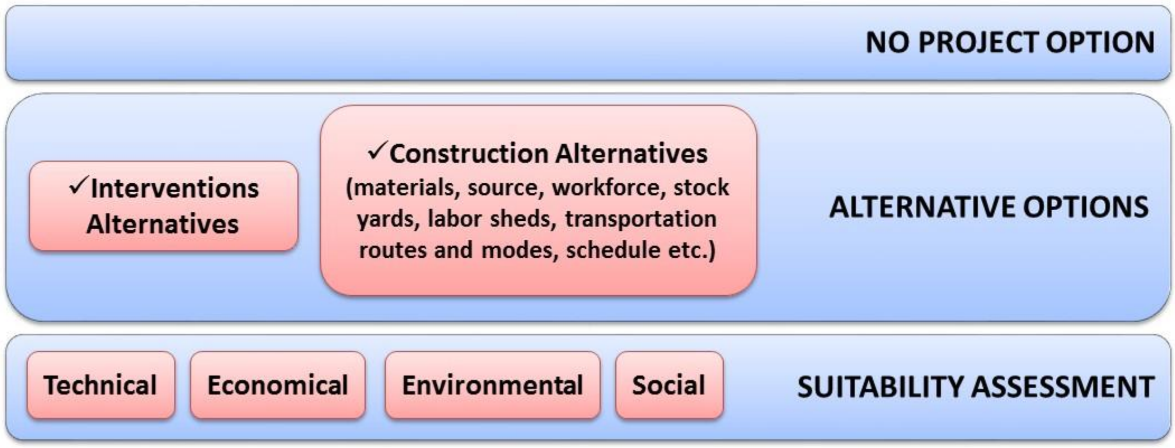


Figure 2.3: Concept of Alternative analysis to be used in the EIA study

2.2.4 Data Collection for Environmental Baseline

20. A reconnaissance field visit was conducted in the polder area to identify the existing environmental settings of the polder area. Subsequent to this, Rapid Rural Appraisals (RRAs), Participatory Rural Appraisals (PRAs), Focused Group Discussions (FGDs) and interviews with key informants were followed to collect data and information on the environmental and social aspects of the polder area. Local knowledgeable persons including community representatives, traders, teachers, farmers, fishermen and political leaders were interviewed individually to reflect upon the problems regarding the polder. They were also requested to highlight possible solutions that the project should bring about as per their indigenous knowledge and experiences.

21. The baseline condition of the polder area was determined according to the information collected from secondary and primary data sources through literature review, field investigations and consultations with different stakeholders. The baseline settings were established with respect to the physical, biological and socio-cultural environment conditions including identification of problems in respect of the proposed project sites and adjoining area. A checklist was developed (Attached in Appendix A) and approved by the Detailed Design, Construction Supervision and Project Management Support Consultant (DCSC) and used to register the information obtained from different stakeholders.

Physical Environment

22. Field visits at different stages of the study were arranged to the polder area and primary data on water resource components were collected. Local knowledgeable persons and community representatives were also interviewed. During field visits, the multidisciplinary EIA study team members made observations pertaining to their individual areas of expertise.

Water Resources and Metereology

23. Water resource data related to river hydrology and morphology, surface and ground water availability, drainage pattern, ground and surface water quality and water use were collected from secondary sources. Primary data on water, water quality, drainage pattern and salinity were collected and analysed. Observations by the professionals of the multi-disciplinary team were backed up by feedback from the local people. Major river systems were identified for hydrological and morphological investigation through historical and current image data collection and analysis. Specific areas or points of interest were selected for collecting data on special hydrological and morphological aspects, water availability, drainage pattern, water quality (surface and ground water), tidal flood, risk of erosion and sedimentation.

24. Meteorological data such as temperature, rainfall, evapo-transpiration, wind speed and humidity were collected from the National Water Resources Database (NWRD) of Water Resources Planning Organization (WARPO), and subsequently analyses as baseline information. The NWRD contains long series of temporal data showing daily values for meteorological stations maintained by the Bangladesh Meteorological Department (BMD). Moreover, these parameters have been used in Model study by IWM for storm surges analysis.

25. The topographical and geological data were collected from Geological Survey of Bangladesh and NWRD.

Land Resources

26. The agro-ecological region of the project area was identified using secondary sources including Food and Agriculture Organization (FAO) and United Nations Development Program (UNDP) information. The land type and soil texture data was collected from Upazila[2] Land and Soil Resources Utilization Guide of Soils Resources Development Institute (SRDI). The secondary data of these parameters was verified at field level through physical observations as well as consultations with the local people and officials of the Department of Agriculture Extension (DAE) during field visit.

Biological Environment

Agricultural Resources

27. Land use information was prepared from satellite image classification with field verification. Data on agricultural resources, which included existing cropping patterns, crop variety, crop calendar, crop yield, crop damage, and agricultural input used, were collected from both secondary and primary sources. Agriculture data was collected through extensive field surveys with the help of questionnaires and consultations with local people and concerned agricultural officials. Agricultural resources data were also collected from secondary sources from the DAE.

[2] Upazila is an administrative subdivision of a district.

Ecological Resources

28. The ecological component of the EIA study focused on terrestrial and riverine ecology including flora, birds, reptiles, amphibians, mammals, and migratory birds. The field activities included collection of ecosystem and habitat information, sensitive habitat identification, identifying ecological changes and potential ecological impact. The land use information on different ecosystem was generated through analysis of recent satellite imagery.

29. Field investigation methods included physical observation; transect walk, habitat survey and consultations with local people. Public consultation meetings were carried out through FGD and Key Informants Interview (KII) methods. Inventory of common flora and fauna was developed based on field surveys and from the database of the International Union for Conservation of Nature (IUCN).

Fish and Fisheries

30. Primary data were collected from the fishermen community, fishermen households and local key informants while secondary data were collected from Upazila Fisheries Offices (UFOs) during field visits.

31. Fish habitat classification was made on the basis of physical existence and was categorized into capture and culture fish habitats. The capture fish habitats included rivers, khals, and tidal floodplains, burrow pits, and beels. The culture fish habitats included homestead culture fishponds, commercial fish farms and shrimp ghers.

32. Information on post-harvest activities, forward and backward linkages, fishermen livelihood information, fisheries management issues, potential fish recruitment, fish culture infrastructure and fishermen vulnerability were also collected.

33. Secondary information from UFOs and literature were blended with primary data from individual habitats to estimate fish production.

Livestock Resources

34. Data on the present status of livestock (cow/bullock, buffalo, goat and sheep) and poultry (duck and chicken) in the polder area was collected during field survey in consultation with the local people through Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA). Livestock resources data were also collected from secondary sources from Upazila Livestock Office.

Socio-cultural Environment

35. The steps followed for collecting socio-cultural data are as follows:

- Data was collected from Bangladesh Bureau of Statistics (BBS), 2011.The relevant literatures from BWDB and main consultant was also reviewed;
- Reconnaissance field visit and discussions with BWDB officials and local stakeholders were for primary data collection;
- PRA /RRA, FGDs, KII were carried out for primary data collection;
- Institutional surveys were conducted for primary data collection at district and upazila level.

36. Demographic information, such as population, occupation and employment, literacy rate, drinking water, sanitation, and electricity facilities were collected from secondary sources. Data on income, expenditure, land ownership pattern, self-assessed poverty status, migration, social overhead capitals and quality of life, disasters, conflicts of the study area, information on Non-governmental Organizations (NGOs), cultural and heritage features of the project area were collected mainly from primary sources through PRA and FGDs and public consultations.

2.2.5 Climate Change

37. Climate change is caused by several factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have also been identified as significant causes of recent climate change, often referred to as global warming. In Bangladesh, climate change is an extremely crucial issue, and according to Germanwatch Global Climate Risk Index, the country ranks first as the most vulnerable nation, to be highly impacted in the coming decades. In the coastal areas, the consequences of climate change are more staggering. Climate change directly contributes to changes in temperature and precipitation, which eventually is considered to lead to sea level rise and increased tidal flooding. Climate change also affects the frequencies and intensities of cyclonic storm surge events. Increase in salinity intrusion, river erosion, drainage congestion and water logging are other associated impacts of climate change. Consequently, it is important to consider the potential environment and socio-economic impacts in a Climate Change perspective. Figure 2.4 below shows a process diagram of possible climate change impacts in the coastal areas of Bangladesh.

38. Following the development of the Environmental and Social baseline condition, analysis was made to underscore the major climate change issues in the polders.

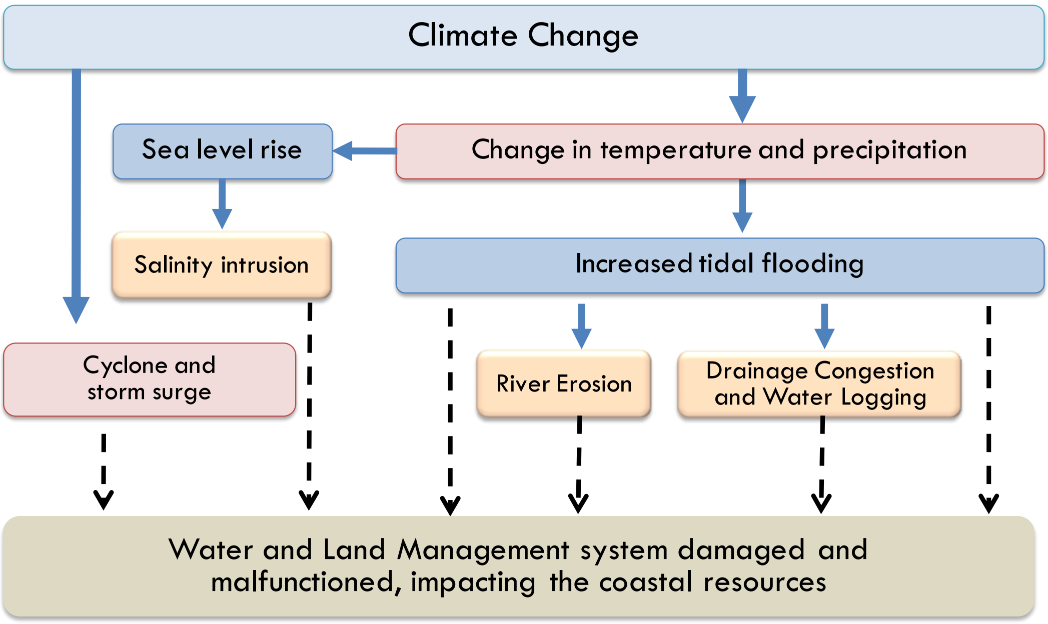


Figure 2.4: Typical diagram of climate change impacts in coastal areas

39. During field level consultations, the major regional and local issues in connection with climate change and variability were identified. Besides, data on different meteorological parameters such as rainfall, temperature, sunshine hours, humidity and wind speed were collected from the adjacent weather stations of Bangladesh Meteorological Department (BMD). The historical variations of the information were used to develop an understanding of climate science for the polders. Afterwards, the qualitative field findings were compared with the analyzed historic information on climate science, from which the regional and local climate change vulnerability may be inferred. Moreover, intensive reviews of existing literatures and national reports were made to validate the identified climate change the issues and concerns.

2.2.6 Scoping

40. A structured scoping process in two stages was followed for identifying the IESCs, which would potentially be impacted by the proposed Project. In the first stage, a preliminary list of the components, which could be impacted by the Project, was prepared. In the second stage, village scoping sessions were held where opinions of the stakeholders were obtained on their perception about the environmental and social components, which could be impacted by the project interventions. With the help of the professional judgments of the multidisciplinary EIA team as well as the opinions of the stakeholders, the preliminary list of the important environmental and social components was finalized.

2.2.7 Assessment and Scaling of Impacts

41. At this stage, attempts were made to assess the impacts of the proposed interventions of the polder quantitatively. Alternatively, impacts were assessed qualitatively when quantification was not feasible. The impacts of proposed interventions, considering the climate-change scenario for 2050, were estimated on the basis of differences between the future-without-project (FWOP) condition and the future-with-project (FWIP) condition. The future-without-project (FWOP) conditions were generated through trend analysis and consultations with the local people. This reflected conditions of IESCs in absence of the proposed interventions under the polder area. Changes expected to be brought about due to proposed interventions under the Project were assessed to generate the Future-with-Project (FWIP) condition. Comparison and projection methods were used for impact prediction.

42. Cumulative impact assessment of a certain Polder is a two-way approach. Initially, the impact due to improvement/development works of Polder has been assessed (e.g. drainage improvement due to re-excavation of khals inside the polder). In this regard, some parameters i.e. existing and design crest level of the embankment; hydrological condition, geographical position of polders etc. have been considered to quantify the impact assessment. Finally, the impacts for development works of other adjacent polders have been considered for cumulative impact assessment.

43. Drainage modelling of the coastal polder has been carried out by IWM to find out the design parameters for drainage canal systems, drainage regulator, river bank, slope protection works. Climate resilient coastal embankment crest level has been design considering the combined effects of cyclone storm surge effects and cyclone induced wind wave. The model has been developed and simulated considering climate change condition. The impact of proposed interventions on drainage, flooding, river dynamics has also been analyzed through modeling. The model results have been utilized in the EIA study.

Methodology

44. The assessment of effects and identification of residual impacts takes account of any incorporated mitigation measures adopted due to any potential impact of project activities, and will be largely dependent on the extent and duration of change, the number of people or size of the resource affected (receptor) and their sensitivity to the change. Potential impacts can be both negative and positive (beneficial), and the methodology defined below was applied to define both beneficial and adverse potential impacts.

45. The criteria to determine significance are generally specific for each environmental and social aspect/receptor. Generally, the magnitude of each potential impact is defined along with the sensitivity of the receptor.

Magnitude

46. The assessment of magnitude has been undertaken in two steps. Firstly, the key issues associated with the Project are categorized as beneficial or adverse. Secondly, potential impacts have been categorized as major, moderate, minor or negligible based on consideration of the parameters such as:

- Duration of the potential impact;
- Spatial extent of the potential impact;
- Reversibility;
- Likelihood; and
- Legal standards and established professional criteria.

47. The magnitude of potential impacts of the Project has generally been identified according to the categories outlined in Table 2.1.

Table 2.1: Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Negligible/Nil
Duration of potential impact	Long term (more than 15 years)	Medium Term Lifespan of the project (5 to 15 years)	Less than project lifespan	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and established professional criteria	Breaches national standards and or international guidelines/obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Sensitivity

48. The sensitivity of a receptor has been determined based on review of the absorption capacity of the receptor (including proximity / numbers / vulnerability) and presence of features on the site or the surrounding area. Criteria for determining receptor sensitivity of the Project's potential impacts are outlined in Table 2.2.

Table 2.2: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very High	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
High	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Medium	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low / Negligible	Vulnerable receptor with good capacity to absorb proposed changes or/and good opportunities for mitigation

Assigning Significance

49. Following the assessment of magnitude and sensitivity of the receptor the significance of each potential impact was established using the potential impact significance matrix shown in Table 2.3 below:

Table 2.3: Assessment of Potential Impact Significance

Magnitude of Potential impact	Sensitivity of Receptors			
	Very High	High	Medium	Low / Negligible
Major	Critical	Major	Moderate	Negligible
Moderate	Major	Major	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Mitigation Measures

50. Subsequent to the impact assessment discussed above, appropriate mitigation measures have been proposed to avoid, offset, mitigate/reduce, or compensate for the identified impacts. Generally, impacts having moderate to critical consequence significance per the Table2.3 require appropriate avoidance/ mitigation/compensatory measures to reduce the significance. Impacts having low to negligible significance are considered not to need any mitigation measures.

51. Generally, preference is given to the avoidance of the impact with the help of options available for nature, siting, timing, method/procedure, or scale of any Project activity. If avoidance is not possible, appropriate mitigation and control measures are proposed to reduce the consequence significance of the predicted impact, where feasible. Finally, if impact reduction is not possible, compensatory measures are proposed.

Assessment of Residual Impacts

52. The final step in the impact assessment process is to determine the significance of the residual impacts, which would be experienced even after implementing the mitigation/compensatory measures. Ideally, all of the residual impacts should be of negligible to low significance. No residual impacts having major or critical significance are generally acceptable.

Identification of Enhancement Measures

53. Wherever feasible, enhancement interventions, that may increase the positive benefits of the Project should be identified and included in the Project design/implementation. Identification of enhancement measures have been based on experience from implementation of similar projects, applying expert judgment and from consultation with stakeholders.

2.2.8 Preparation of Environmental Management and Monitoring Plan

54. An environmental management plan (EMP) for the proposed Project was prepared comprising the mitigation/ enhancement measures with institutional responsibilities, environmental monitoring plan, training and capacity building plan and reporting and documentation protocols (Refer Chapter 10).

2.2.9 EIA Report Preparation

55. At the end of the study, the present report was prepared incorporating all the findings of the EIA.

3 Policy, Legislative and Regulatory Framework

56. This chapter presents a review of the national policy, legal and regulatory framework relevant to the environmental and social aspects of the project. Also reviewed the WB environmental and social safeguard policies and guidelines in the chapter.

3.1 Relevant National Policies, Strategies and Plans

3.1.1 National Environment Policy, 1992

57. The National Environment Policy (NEP) is one of the key policy documents of the Government. The policy addresses 15 sectors in all, in addition to providing directives on the legal framework and institutional arrangements. Coastal and marine environment is one of the key sectors covered in this policy. The policy declarations that have particular bearing on the Integrated Coastal Zone Management (ICZM) are listed below:

- Sustainable use of coastal and marine resources and preservation of coastal ecosystem
- Prevention of national and international activities causing pollution in coastal and marine environment
- Strengthening research in protection and development of coastal and marine resources and environment
- Exploration of coastal and marine fisheries to a maximum sustainable limit

58. Regarding water resource development, flood control and irrigation sector, the policy seeks to:

- ensure environmentally-sound utilization of all water resources;
- ensure that water development activities and irrigation networks do not create adverse environmental impact;
- ensure that all steps are taken for flood control, including construction of embankments, dredging of rivers, digging of canals, etc, be environmentally sound at local, zonal and national levels;
- ensure mitigation measures of adverse environmental impact of completed water resources development and flood control projects;
- keep the rivers, canals, ponds, lakes, haors, baors and all other water bodies and water resources free from pollution;
- ensure sustainable, long-term, environmentally sound and scientific exploitation and management of the underground and surface water resources; and
- conduct environmental impact assessment before undertaking projects for water resources development and management.

59. The Policy is applicable to the Package-2 under CEIP-1 and the proposed interventions are required to comply with all the policy directives emphasizing particularly on reducing adverse environmental impacts. The EIA studies of the coastal polders are required to clearly address the potential impacts and propose mitigation measures.

3.1.2 National Environment Management Action Plan, 1995

60. The National Environment Management Action Plan (NEMAP, 1995) identifies the main national environmental issues, including those related to the water sector. The main water related national concerns include flood damage, riverbank erosion, environmental degradation of water bodies, increased water pollution, shortage of irrigation water and drainage congestion; various specific regional concerns are also identified.

3.1.3 National Water Policy, 1999

61. Endorsed by the GoB in 1999, the National Water Policy (NWP) aims to provide guidance to the major players in water sector for ensuring optimal development and management of water. According to the policy, all agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation, and maintenance) are required to enhance environmental amenities and ensure that environmental resources are protected and restored in executing their tasks.

62. The policy has several clauses related to water resource development projects for ensuring environmental protection. Some of the relevant clauses are:

- Clause 4.5b: Planning and feasibility studies of all projects will follow the Guidelines for Project Assessment, the Guidelines for People's Participation (GPP), the Guidelines for Environmental Impact Assessment, and all other instructions that may be issued from time to time by the Government.
- Clause 4.9b: Measures will be taken to minimize disruption to the natural aquatic environment in streams and water channels.
- Clause 4.9e: Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding.
- Clause 4.10a: Water development projects should cause minimal disruption to navigation and, where necessary, adequate mitigation measures should be taken.
- Clause 4.12a: 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).
- Clause 4.12b: Adhere to a formal environment impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects, in each water resources development project or rehabilitation program of size and scope specified by the Government from time to time.
- Clause 4.12c: Ensure adequate upland flow in water channels to preserve the coastal estuary ecosystem threatened by intrusion of salinity from the sea.
- Clause 4.13b: Only those water related projects will be taken up for execution that will not interfere with aquatic characteristics of those water bodies.

63. Most of the above clauses will be applicable to the Package- 2 under CEIP-1. The Project design and present EIA study will be required to comply with these requirements.

3.1.4 National Water Management Plan, 2001 (Approved in 2004)

64. The National Water Management Plan (NWMP) 2001, approved by the National Water Resources Council in 2004, envisions establishing an integrated development, management and use of water resources in Bangladesh over a period of 25 years. 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. Most of the programs are likely to be implemented in coastal areas.

65. The CEIP-1 has been designed in line with this Plan and addresses its key objectives for the water resource management in the coastal areas.

3.1.5 Coastal Zone Policy, 2005

66. The Government has formulated the Coastal Zone Policy that provides a general guidance to all concerned for the management and development of the coastal zone in a manner so that the coastal people are able to pursue their life and livelihoods within secure and conducive environment.

67. The coast of Bangladesh is known as a zone of vulnerabilities as well as opportunities. It is prone to natural disasters like cyclone, storm surge and flood. In this regard, for reducing risk, the policy emphasizes the improvement of coastal polders and seeks to enhance safety measures by combining cyclone shelters, multi-purpose embankments, road system and disaster warning system.

68. The CEIP-1 addresses some aspects of this Policy particularly those relating to the polder improvements.

3.1.6 Coastal Development Strategy, 2006

69. The Coastal Development Strategy (CDS) focuses on the implementation of the coastal zone policy. The CDS was approved at the second meeting of the Inter-Ministerial Steering Committee on ICZMP held on 13 February 2006. Nine strategic priorities, evolved through a consultation process, guide interventions and investments in the coastal zone:

- ensuring fresh and safe water availability
- safety from man-made and natural hazards
- optimizing use of coastal lands
- promoting economic growth emphasizing non-farm rural employment
- sustainable management of natural resources: exploiting untapped and less explored opportunities
- improving livelihood conditions of people especially women
- environmental conservation
- empowerment through knowledge management
- creating an enabling institutional environment

70. The proposed interventions under CEIP-1 are in line with this strategy and support most of the above listed priorities.

3.1.7 National Land Use Policy (MoL, 2001)

71. The National Land Use Policy (NLUP), enacted in 2001, aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities. The NLUP urges that increasing the land area of the country may not be possible through artificial land reclamation processes, which are cost-effective only in the long run. Therefore, land use planning should be based on the existing and available land resources. The policy suggests establishing land data banks where, among others, information on accreted riverine and coastal chars will be maintained. Among the 28 policy statements of NLUP, the following are relevant to coastal area:

- forests declared by the Ministry of Environment and Forests will remain as forest lands;
- reclassification of forest lands will be prevented; and
- effective green belts will be created all along the coast.

72. CEIP-1 is designed in accordance with this Policy and will comply with the above listed requirements.

3.1.8 National Agriculture Policy, 1999

73. The overall objective of the National Agriculture Policy is to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable food security system for all. Although the policy does not emphasize the coastal zone separately, all specific objectives are applicable to the development of coastal zone agriculture. The policy particularly stressed on minor irrigation capturing tidal water in reservoirs in coastal areas and research on the development of improved varieties and technologies for cultivation in coastal, hilly, water-logged and salinity affected areas. The policy also recognizes that adequate measures should be taken to reduce water-logging, salinity and provide irrigation facilities for crop production.

74. The proposed CEIP-1 is expected to contribute to achieve the objectives of the agriculture policy.

3.1.9 National Fisheries Policy, 1996

75. The National Fisheries Policy (NFP), 1996 recognizes that fish production has declined due to environmental imbalances, adverse environmental impact and improper implementation of fish culture and management programs. The policy particularly focuses on coastal shrimp, aquaculture and marine fisheries development.

76. The policy suggests following actions:

- Shrimp and fish culture will not be expanded to the areas which could damage mangrove forest in the coastal region
- 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.

77. The CEIP-1 integrates the guidelines of NFP in design and implementing the proposed interventions.

3.1.10 National Forest Policy, 1994

78. The Forest Policy, 1994 recognizes the importance of biodiversity for environmental sustenance. The policy is explicitly mentioned that habitats for the wildlife and vegetation will be conserved through afforestation and by bringing forest lands under Protected Areas. The policy targets to bring 20% of the total land area of the country under forest cover, and at least 10% of which under protected areas by 2015. It also declared that measures will be taken to improve degraded forests. The Policy, at the same time, advocated social forestry, which includes agro forestry, woodlot plantations, and strip plantations in vacant public and private lands of the country. Afforestation could directly contribute to climate change mitigation efforts and efforts to improve forest quality and add to forest resilience.

3.1.11 National Livestock Development Policy, 2007

79. The National Livestock Development Policy (NLDP) has been prepared to address the key challenges and opportunity for a comprehensive sustainable development of the

livestock subsector by creating an enabling policy framework. Among 60 or more policy statements, the following two policy statements address the coastal zone:

- Specific areas will be identified to implement programs for fattening of cattle and livestock. For this purpose, the Chittagong Hill Tracts, the coastal areas and the islands will be included under the fattening of livestock and cattle program.
- Special programs will be taken up for the production of grass in the Chittagong Hill-tracts and the coastal areas.

80. As livestock is one of the key assets in coastal livelihoods and protection of livestock from cyclones and tidal surges should be emphasized along with security of human life. The proposed CEIP-1 interventions will contribute to the safety of livestock and thus increase livestock productivity in coastal areas.

3.2 National Environmental Laws

81. The key national laws relevant to environmental management are briefly discussed below.

3.2.1 Bangladesh Water Act , 2013

82. The Water Act 2013 is based on the National Water Policy, and designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh.

83. 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. The private landowners will be able to use the surface water inside their property for all purposes in accordance with the Act. A worthwhile initiative is the requirement for permits/licenses for large scale water withdrawal by individuals and organizations beyond domestic use. 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.

3.2.2 National River Protection Commission , 2013

84. The National River Protection Commission Act helps the government take legal action to protect rivers from encroachment, pollution and unscrupulous use of rivers as well as other water bodies. The Act will help prevent building infrastructures by encroaching rivers through a National River Protection Commission.

85. This Act, consisting of 4 Chapters, creates the National River Protection Commission. It establishes composition, duties and responsibilities of the above mentioned Commission, entitled to: manage and control water and environmental pollution, caused by industrial pollution of rivers, construction of illegal structures and to prevent irregularities and restore the normal flow of the river, to control flood and drainage; hydrology, the use of surface and ground water; and to examine the equipment.

86. The Commission is formed with a chairman and four experts on river, environment, river survey and law (human rights) under the act for a three-year term. As per the Act, the Commission works for creating public awareness for protecting rivers, conducting researches on river protection, ensuring river management, and taking up both short- and long-term plans for protection of rivers.

3.2.3 Bangladesh Environment Conservation Act (ECA), 1995 and all its subsequent amendments

87. The Environmental Conservation Act (ECA) of 1995 is the main legislative framework relating to environmental protection in Bangladesh. This umbrella Act includes laws for conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution. 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.

88. In accordance with this Act, the CEIP-1 will need to be cleared by DoE before commencing the project following procedures given in the Environment Conservation Rules (ECR) 1997 (discussed below). In addition, the Ecologically Critical Areas in coastal zone, defined by DoE under this act, will be considered while planning and designing of the CEIP-1 project interventions.

89. The present EIA has been carried out in compliance with this Act.

Bangladesh Environment Conservation Act (ECA), (Amendments), 2010

90. 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.

3.2.4 Bangladesh Environment Conservation Rules (ECR), 1997

91. 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. 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
- Determination of environmental standards.

92. The Rule 3 defines the factors to be considered in declaring an area 'ecologically critical area' (ECA) as per Section 5 of ECA95. It empowers the Government to declare an area 'ECA', if it is satisfied that the ecosystem of the area has reached or is threatened to reach a critical state or condition due to environmental degradation. The Government is also empowered to specify which of the operations or processes shall not be carried out or shall not be initiated in the ecologically critical area. Under this mandate, MoEF has declared the Sundarbans, Cox's Bazar - Teknaf Sea Beach, Saint Martin's Island, Sonadia Island, Hakaluki Haor, Tanguar Haor, Marzat Baor and Gulshan - Baridhara Lake as ECA and prohibited certain activities in those areas. Beside these, the government of Bangladesh declared four rivers around Dhaka: the Buriganga River, Turag River, Shitalakha River and Balu River as ECA in 2009. Recently the thirteenth ECA - Jaflong-Dauki River, Sylhet was declared in 2015.

93. Rule 7 classifies projects into four categories depending on environmental impact and location for the purpose of issuance of ECC. These categories are: Green, Orange A, Orange B, and Red.

94. All existing and proposed projects, that are considered to be low polluting are categorized under "Green" and shall be granted Environmental Clearance. For proposed projects falling in the Orange-A, Orange-B and Red Categories, firstly a site clearance certificate and thereafter an environmental clearance certificate will be required. A detailed description of these four categories of projects has been given in Schedule-1 of ECR'97. Apart from the general requirements, for every Red category proposed project, the application must be accompanied with feasibility report, Initial Environmental Examination (IEE), and an Environmental Impact Assessment (EIA) based on approved ToR by DoE, as well as an Environmental Management Plan (EMP). As per ECR’97, water resources development projects, such as the present CEIP-1 is considered as category ‘Red’, since it will involve construction/maintenance of embankment, re-excavation of water channels along with various other physical interventions.

95. The ECR'97 describes the procedures for obtaining the ECC from the DoE for different types of proposed projects. Any person or organization wishing to establish a project must obtain an ECC from the Director General, DoE. The application for such certificate must be in the prescribed form together with the prescribed fees laid down in Schedule 13, through the deposit of a Treasury Chalan in favour of the DG, DoE. The fees for clearance certificates have been revised in 2010. Rule 8 prescribes the duration of validity of such certificate (three years for green category and one year for other categories) and compulsory requirement for renewal of certificate at least 30 days before expiry of its validity.

3.2.5 Bangladesh Environment Court Act, 2010

96. 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. This Act allows government to take necessary legal action against any parties that create environmental hazards/ damage to environmentally sensitive areas as well as human society. According to this Act, government can take legal actions if any environmental problem occurs due to CEIP-1 interventions.

3.2.6 The Forest Act, 1927 & Amendment Act 2000

97. According to the Act the Government (Forest Department) can prohibit certain activities in the declared Reserved Forest area such as any intervention kindles, keeps or carries any fire; trespasses or pastures cattle, or permits cattle to trespass; causes any damage by negligence in felling any tree or cutting or dragging any timber etc.

“26. Acts prohibited in such forests. -

(1) Any person who, in a reserved forest-

(a) Kindles, keeps or carries any fire except at such seasons as the Forest-Officer may notify in this behalf;

(b) Trespasses or pastures cattle, or permits cattle to trespass;

(c) Causes any damage by negligence in felling any tree or cutting or dragging any timber;

(d) Quarries stone, burns lime or charcoal, or collects, subjects to any manufacturing process, or removes any forest produce other than timber; or who enters a reserved forest with firearms without prior permission from the Divisional Forest Officer concerned, shall be punishable with imprisonment for a term which may extend to six months and shall also be liable to fine which may extend to two thousand taka, in addition to such compensation for damage done to the forest as the convicting Court may direct to be paid.”

98. The proposed intervention should not carry out any such activities that may cause damage or adversely impact on the natural resources including wildlife of the Sundarbans Reserve Forest.

3.2.7 Standing Orders on Disaster, 2010

99. The Standing Orders on Disaster is designed to enhance capacity at all tiers of government administrative and social structures for coping with and recovering from disasters. The document contains guidelines for construction, management, maintenance and use of cyclone shelters. According to the guideline, geographical information system (GIS) technology will be applied at the planning stage to select the location of cyclone shelter considering habitation, communication facilities, and distance from the nearest cyclone centre. The advice of the concerned District Committee is to be obtained before final decision. The cyclone shelters should have easier communication facilities so that in times of distress delay does not occur to go there. For this reason, the road communication from the cyclone shelters should not only link up with city or main road but also with neighbouring village areas. Provision of emergency water, food and sanitation and shelter space for livestock during period should also be kept in view for future construction of shelters.

100. Improvement of coastal polders under CEIP-1 will reduce disaster risk in terms of protection of lives and livelihoods reducing damage of houses and other infrastructure, with provision of better communication facilities in the coastal areas, which is crucial for emergency response to disasters.

3.2.8 National Adaptation Programme of Action (NAPA)

101. In 2005, the Ministry of Environment and Forest (MoEF) prepared the National Adaptation Program of Action (NAPA) for Bangladesh. The basic approach for the NAPA preparation was in accordance with the sustainable development goals and objectives of the country where it has recognized the necessity of addressing climate change and environmental issues and natural resource management. The NAPA is the beginning of a long journey to address adverse impacts of climate change including variability and extreme events and to promote sustainable development of the country. There are 15 adaptation strategies suggested to address adverse effects of climate change. Among the 15 adaptation strategies, the following strategies address the coastal region for reducing climate change induced vulnerability.

- Reduction of climate change hazards through coastal afforestation with community participation.
- Providing drinking water to coastal communities to combat enhanced salinity due to sea level rise.
- Construction of flood shelter, and information and assistance centre to cope with enhanced recurrent floods in major floodplains
- Promotion of research on drought, flood and saline tolerant varieties of crops to facilitate adaptation in future.
- Promoting adaptation to coastal crop agriculture to combat increased salinity.
- Promoting adaptation to coastal fisheries through culture of salt tolerant fish special in coastal areas of Bangladesh.

102. The CEIP-1 broadly contributes toward achieving the aims and objectives of the NAPA.

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

103. The Government of Bangladesh has prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009. The BCCSAP is built on six pillars: (i) food security, social safety and health; (ii) comprehensive disaster management; (iii) infrastructure; (iv) research and knowledge management; (v) mitigation and low carbon development; and (vi) capacity building. Five programs have been suggested related to improvement of the water management infrastructures in coastal areas of Bangladesh under pillar 3 (Infrastructure) of BCCSAP, including:

- Repair and maintenance of existing flood embankments
- Repair and maintenance of existing coastal polders
- Improvement of urban drainage
- Planning, design and construction of river training works
- Planning, design and implementation of resuscitation of the network of rivers and khals through dredging and de-siltation work.

104. CEIP-1 is relevant to the above-mentioned programs and will contribute towards achieving the objective of other pillars of the BCCSAP, such as (i), (ii), (iii) and (iv).

3.2.10 The East Bengal State Acquisition and Tenancy Act, 1950 (Revised 1994)

105. The State Acquisition and Tenancy Act (Sections 86 and 87) also define the ownership and use right of alluvium (payosti or reformation in situ or original site) and diluvion land (nadi sikosti) in the country. In legal terms, eroded lands (sikosti) inside the alluvion-diluvion (AD) line (i.e. including submerged land or underwater land) are considered khas land once declared by concerned Deputy Commissioner (DC) demarcating the AD Line.[3]

3.2.11 Constitutional Right of the Tribal Peoples Rights

106. The Constitution of Bangladesh does not mention the existence of cultural and ethnic minorities in Bangladesh. The only protective provision for the ethnic minorities that the policy makers often refer to in the context is Article 28 (4) which states that: Nothing shall prevent the state from making special provision in favour of women and children or for the advancement of any backward section of the citizens. The above provision is an ambiguous one and it does not define who or what constitutes "backward". However, the Government recognizes existence of “tribal peoples” and the need for special attention and in general; tribal people are essentially viewed as backward, poor and socio-economically & culturally inferior. Towards this end, a special program was initiated in 1996-97 by the Prime Minister’s Secretariat aimed at improving the socio-economic situation of the indigenous people of Bangladesh, resident outside the Chittagong Hill Tracts.

3.2.12 Ethnic Minority Rights in PRSP 2005

107. Relevant strategic suggestions in the Poverty Reduction Strategy Paper (PRSP) 2005 to preserve the cultural, social and economic identity and interests of the ethnic populations in and outside CHT are as follows:

[3] The Assistant Commissioner of Lands (AC Land) in respective districts demarcates the AD Line each year in areas where rivers frequently erode their banks. According to law, if the land classified by an AD Line re-appears within 30 years from the date of erosion, the original owner(s) can claim the land. The original private owners cannot claim any eroded land if developed by the government through land filling for use in public purpose.

- Effective recognition of ethnic minority communities and their specific needs in all relevant government policies and programs towards improving the socio-economic conditions of these communities.
- Proper actions for protecting the rights of ethnic minority people, particularly their rights to land and forests.
- Transfer of land administration in CHT to the hill districts councils in accordance with the 'Hill District Councils Acts of 1989'.
- Provide education to ethnic minority people with a curriculum that allows learning in their own language at the primary level.
- Strengthen their competence in job markets through affirmative actions at higher levels of education and skill training to promote their inclusion in mainstream economic life.
- Scale-up efforts to provide health care, clean water and sanitation facilities to ethnic minority areas in general and to the more disadvantaged groups among them in particular.
- Increase and utilize property the fund available in the Prime Minister's office for the development of the ethnic minority people of the plain lands.
- Provide wider access to electrification and telecommunications for ethnic minority communities, particularly in the Hill Tracts.

3.2.13 Acquisition and Requisition of Immovable Property Ordinance, 1982

108. The principal legal instrument governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable Property Ordinance, 1982(Ordinance II of 1982 with amendments up to 1994) and other land laws and administrative manuals relevant to land administration in Bangladesh. According to the Ordinance, whenever it appears to the GoB that any property in any locality is needed or is likely to be needed for any public purpose or in the public interest, the Government can acquire the land provided that the property is not used by the public for the purpose of religious worship, graveyard and cremation ground. The 1982 Ordinance requires that compensation be paid for (i) land and assets permanently acquired (including standing crops, trees, houses); and (ii) any other damages caused by such acquisition. The DC determines (a) market value of acquired assets on the date of notice of acquisition (based on the registered value of similar property bought and/or sold in the area over the preceding 12 months), and (b) 50% premium on the assessed value (other than crops) due to compulsory acquisition. The 1994 amendment made provisions for payment of crop compensation to tenant cultivators. Given that people devalue land during title transfer to minimize tax payment, compensation for land paid by DC including premium largely remains less than the actual market price.

109. The Ordinance, however, is not adequate to deal with the adverse impacts associated with land acquisition and involuntary displacement. Land is acquired under this ordinance but its provisions do not fully satisfy the requirements of the WB's OP 4.12 on Involuntary Resettlement. There is no other policy in Bangladesh to complement the acquisition law in ways to assess, mitigate and monitor the adverse impacts that the affected persons may suffer. The law does not cover project-affected persons without title or ownership record, such as informal settler/squatters, occupiers, and informal tenants and lease-holders (without registration document) and does not ensure replacement value of the property acquired. The Ordinance has no provisions for resettlement of the affected households/businesses or any assistance for restoration of livelihoods of the affected persons. As a result, land acquisition potentially diminishes productive base of affected farm families and infringe impoverishment risks to those physically or economically displaced due to undertaking of infrastructure projects.

110. As the legal framework falls short of the provisions of the World Bank OP 4.12 on Involuntary Resettlement, the project proposes added mechanisms to meet the Bank's requirements:

- Avoid or minimize resettlement: The law only implicitly discourages unnecessary acquisition, as lands acquired for one purpose cannot be used for a different purpose. However, there are no mechanisms to monitor if this condition is actually adhered to.
- Eligibility for compensation: The law stipulates compensation only for the persons who appear in the land administration records as the owners. It does not recognize the rights of those, such as squatters, who do not possess legal title to the lands they live in or make a living from.
- Compensation: The law provides compensation for lands and other objects built and grown on them (structures, trees and orchards, crops and any other developments like ponds, built amenities, etc.). No provisions are there to assess and restore lost income stream or income sources that acquisition causes to the affected persons, be they legal titleholders or others like squatters, tenants and employees of affected businesses.
- Compensation standards: Although the law stipulates 'market prices' of the acquired lands as the just compensation, the legal assessment method almost always results in prices that are far below the actual market prices[4]. Certain pricing standards, which are regarded as unrealistic, are used to assess other losses like structures and various built amenities, trees, crops and the like.
- Relocation of households and other establishments: No legal obligation is there to relocate, or assist with relocation of, those whose homesteads have been acquired or whose place of residence or livelihoods has been affected. Such persons/households, be they titleholders or squatters, are left on their own.
- Ensuring payment of compensation: Lands are legally acquired and handed over to the project execution agency as soon as the acquisition authority identifies the owners (or 'awardees'), by examining the records, and sends a legal notice advising them to claim the compensation (or 'awards'). It is the obligation of the affected landowners to prove, by producing an array of documents that the acquired lands legally belong to them. As gathering these documents is a long, expensive and cumbersome process, many landowners may remain unable to claim their awards[5.]
- Socioeconomic rehabilitation: The law shows no concern whatsoever about the long-term socioeconomic changes the affected persons and households might undergo in the post-acquisition period. There is no provision in the law except compensation for ensure economic rehabilitation and social reintegration of the displaced persons.
- The Ministry of Land (MoL) is authorized to deal with land acquisition. The MoL delegates some of its authority to the Commissioner at Divisional level and to the

4 According to the law, the 'market price' is calculated by averaging the sales prices recorded in the previousone year, in terms of land characteristics by land administration units or *mauzas*. But it is a widely acceptedfact that prices determined as such hardly reflect the true market value of the lands. As the sale/acquisitionprices are grossly under-reported to evade on sale taxes, assessment of legal compensation almost always fallfar too short of the real market prices.

5 In the present land administration system, which is widely accepted as antiquated, land transactions, especially in the rural areas, often remain incomplete. Even after the sale/purchase deeds are legally executed, the sellers continue to remain as owners in the legal records until mutations are completed. As the transaction process is cumbersome and involves costs beyond those mandated by the law, and the practice that lands can be used with the deeds alone, most land transactions do not follow the process beyond deed execution. Many land purchasers are even not aware of the mutation or its significance.

Deputy Commissioner at the District level. The Deputy Commissioners (DCs) are empowered by the MOL to process land acquisition under the Ordinance and pay compensation to the legal owners of the acquired property. *Khas* (government owned land) lands should be acquired first when a project requires both *khas* and private land. If a project requires only *khas* land, the land will be transferred through an inter-ministerial meeting following the acquisition proposal submitted to DC or MoL as the case may be. The DC is empowered to acquire a maximum of 50 standard *bigha* (6.75 ha) of land without any litigation where the Divisional Commissioner is involved for approval. Acquisition of land more than 50 standard *bigha* is approved from the central land allocation committee (CLAC) headed by the chief executive of the Government of Bangladesh proposed by the MoL.

- The landowner needs to establish ownership by producing record-of-rights in order to be eligible for compensation under the law. The record of rights prepared under Section 143 or 144 of the State Acquisition and Tenancy Act 1950 (revised 1994) are not always updated and as a result, legal landowners have faced difficulties trying to "prove" ownership. The affected person (AP) has also to produce rent receipt or receipt of land development tax, but this does not assist in some situations as a person is exempted from payment of rent if the area of land is less than 25 *bighas* (3.37 ha).

111. These shortfalls in the legal provisions have been widely recognized as not fulfilling the requirements of the OP 4.12, ever since Bangladesh started to address resettlement issues in the Bank-financed projects in the early 1990s starting with the Jamuna Multipurpose Bridge Project. All infrastructure agencies in Bangladesh using finance from international development financing institutions like the World Bank, the ADB, JICA, and DFID are now undertaking resettlement of project affected persons as an integral part of development projects.

3.2.14 The Embankment and Drainage Act 1952

112. The Embankment and Drainage Act consolidates laws relating to embankment and drainage and as a result make better provisions for the construction, maintenance, management, removal and control of embankments and watercourses or better drainage of lands and for their protection from floods, erosion or other damage by water.

113. According to the Section 4 (1) every embankment, watercourse and embanked tow-path maintained by the Government or the Authority, and all land, earth, pathways, gates, berms and hedges belonging to or forming part of, or standing on, any such embankment or water-course shall vest in the Government or the Authority, as the case may be.

114. The section 56 (1) states that, persons will be subject to penalty (Taka 500 or imprisonment if s/he erects, or causes or wilfully permits to be erected, any new embankment, or any existing embankment, or obstructs or diverts, or causes or wilfully permits to be obstructed or diverted, any water course. This section could be applied to the person causing damage to the protective works.

3.2.15 Bangladesh Labour Act, 2006 (XLII of 2006)

According to Labour Act, 2006, the following labour related issues are covered in the course of implementation of CEIP-1:

- Serious bodily injury
- Condition of employment
- Payment of wages
- Stoppage of work

- Death benefit
- Prohibition of employment of children and adolescent
- Cleanliness
- Dust and fume
- Disposal of waste and effluents
- Drinking water
- Latrines and urinals
- First aid appliance
- Weekly hours

115. The above relevant by-laws deals with occupational rights and safety of factory workers; provision of comfortable work environment and reasonable working conditions need to be fulfilled during implementation of rehabilitation of the polders of CEIP-1.

3.2.16 Other Relevant Acts

116. There are a number of other laws and regulations applicable, which are relevant for the project. These are presented in the **Table 3.1** below.

Table 3.1: Laws and Acts

Act/Law/Ordinance	Brief Description of Laws and Acts	Responsible Agencies
The Vehicle Act (1927) and the Motor Vehicles Ordinance (1983)	Provides rules for exhaust emission, air and noise pollution and road and traffic safety	Road Authority
Rules for Removal of Wrecks and Obstructions in inland Navigable Water Ways (1973)	Rules for removal of wrecks and obstructions	BWTA
The Water Supply and Sanitation Act (1996)	Regulates the management and control of water supply and sanitation in urban areas.	MoLG, RD&C
The Ground Water Management Ordinance (1985)	Describes the management of ground water resources and licensing of tube wells	Upazila Parishad
The Private Forests Ordinance (1959)	Deals with the conservation of private forests and afforestation of wastelands.	MoEF
The Protection and Conservation of Fish Act (1950)	Deals with the protection/conservation of fishes in Government owned water bodies	DoF
The Embankment and Drainage Act (1952)	Describes the protection of embankments and drainage facilities	MoWR
The Antiquities Act (1968)	Describes the preservation of cultural heritage, historic monuments and protected sites	DoArch
Acquisition and Requisition of Immovable Property Ordinance (1982)	Describes procedures and provides guidelines to acquisition and requisition of land	MoL

3.3 Guidelines for Participatory Water Management

3.3.1 Guideline for Particiatory Water Management 2014

117. The Guidelines for Participatory Water Management 2014 were prepared under "Bangladesh Water Development Board Act 2000". The Rules relate to formation and functions of water management organizations (WMOs) in water resources projects.

The Guidelines for Participatory Water Management (GPWM) in Bangladesh provides the following:

- Participation is an important voluntary process in which local stakeholders influence policy formulation, alternative plans/designs, investment choices and management decisions affecting their communities and establish the sense of ownership.
- Give the local stakeholders a decisive voice at all stages of water management.
- Participation of local stakeholders to prepare production plans on agriculture, fishery, forestry and livestock development and environmental management plan based on the feasibility study by the implementing agencies.
- According to this rule, every water management group shall will form cluster groups including landless men and women of the project area for infrastructure development or maintenance related activities of which 30 percent will be women.

3.4 International Treaties Signed by GoB

118. Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, including the Ramsar Convention, the Convention on the Conservation of Migratory Species of Wild Animals (CMS), the Rio de Janeiro Convention on Biological Diversity (CBD) conservation and the Kyoto protocol on climate change. An overview of the relevant international treaties and conventions signed by GoB is shown in Table 3.2 below:

Table 3.2: Treaty or Convention and Responsible Agency

Treaty	Year	Brief Description of Treaty and Convention	Relevant Departments
Protection of Birds (Paris)	1950	Protection of birds in wild state	DoE/DoF
Ramsar Convention	1971	Protection of wetlands	DoE/DoF
Protocol Waterfowl Habitat	1982	Amendment of Ramsar Convention to protect specific habitats for waterfowl	DoE/DoF
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural monuments	DoA
CITES (Washington Convention)	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	DoE/DoF
Bonn Convention	1979	Conservation of migratory species of wild animals	DoE/DoF
Prevention and Control of Occupational Hazards	1974	Protect workers against occupational exposure to carcinogenic substances and agents	MoH
Occupational hazards due to air pollution, noise &vibration (Geneva)	1977	Protect workers against occupational hazards in the working environment	MoH
Occupational safety and health in working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	MoH
Occupational Health Services	1985	To promote a safe and healthy working environment	MoH
Convention on oil pollution damage (Brussels)	1969	Civil liability on oil pollution damage from ships	DoE/MoS
Civil liability on transport of dangerous goods (Geneva)	1989	Safe methods for transport of dangerous goods by road, railway and inland vessels	MoC
Safety in use of chemicals during work	1990	Occupational safety of use of chemicals in the work place	DoE
Convention on oil pollution	1990	Legal framework and preparedness for control of oil pollution	DoE/MoS
Vienna Convention	1985	Protection of the ozone layer	DoE
London Protocol	1990	Control of global emissions that deplete ozone layer	DoE
UN framework convention on climate change (Rio de Janeiro)	1992	Regulation of greenhouse gases emissions	DoE
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of bio-diversity, sustainable use of its components and access to genetic resources	DoE
International Convention on Climate Changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases	DoE

Treaty	Year	Brief Description of Treaty and Convention	Relevant Departments
Protocol on biological safety (Cartagena protocol)	2000	Biological safety in transport and use of genetically modified organisms	DoE

3.5 The Constitusion

119. Article 18A of the Constitution of the People's Republic of Bangladesh very clearly states: “The State shall endeavour to protect and improve the environment and to preserve and safeguard the natural resources, bio-diversity, wetlands, forests and wild life for the present and future citizens."

120. This provision justifies that the state has been given responsibility to protect and improve the environment.

3.6 Implication of GoB Polices, Acts and Rules on CEIP and their Classification

121. The environmental legislative basis for approval of the CEIP-1 project is the Environmental Conservation Act 1995 (ECA'95) and the Environmental Conservation Rules 1997 (ECR'97). DoE), under MoEF is the regulatory body responsible for enforcing the ECA'95 and ECR'97. According to the Rule 7 (1) of the Environmental Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every project, in consideration of their site and impact on the environment, will be classified into the four categories and they are: Category I (green), Category II (Orange-A), Category III (Orange B) and Category IV (Red). According to the categorization, all construction/reconstruction/expansion of flood control embankment/polder/dykes etc falls under Red Category. Therefore, the CEIP-1 Project intervention in Polder-47/2falls under the ‘Red’ category.

122. It is the responsibility of the proponent to conduct an EIA of the development proposal. The responsibility to review EIAs for the purpose of issuing Environmental Clearance Certificate (ECC) rests on DoE. The procedures for “Red” Category include submission of:

- An Initial Environmental Examination (IEE)
- An Environmental Impact Assessment (EIA)
- An Environmental Management Plan (EMP)

123. Environment clearance has to be obtained by the respective implementing agency or project proponent (private sector) from DoE. The environmental clearance procedure for Red Category projects can be summarized as follows:

124. Application to DoE →Obtaining Site Clearance →Applying for Environmental Clearance →Obtaining Environmental Clearance → Clearance Subject to annual renewal.

3.7 Detailed Steps of In Country Environmental Clearance Procedure

125. Legislative bases for EIA in Bangladesh are the Environmental Conservation Act 1995 (ECA'95) and the Environmental Conservation Rules 1997 (ECR'97). Department

126. Environment (DoE), under the Ministry of Environment and Forest (MoEF), is the regulatory body responsible for enforcing the ECA'95 and ECR'97. According to the Environment Conservation Act 1995, no industrial unit or project will be established or undertaken without obtaining, in the manner prescribed by the Environment Conservation Rules 1997, an Environmental Clearance Certificate from the Director General. Therefore, every development projects/industries, which are specified under the Schedule 1 of the Environmental Conservation Rules 1997, require obtaining site clearance and environmental clearance from DoE. For ‘Red’ category, it is mandatory to carry out an EIA including an

EMP and where necessary develop a Resettlement Plan for getting environmental clearance from DoE. The application procedure for obtaining site clearance and environmental clearance for the sub-projects of Red category is shown in Figure 3.1.

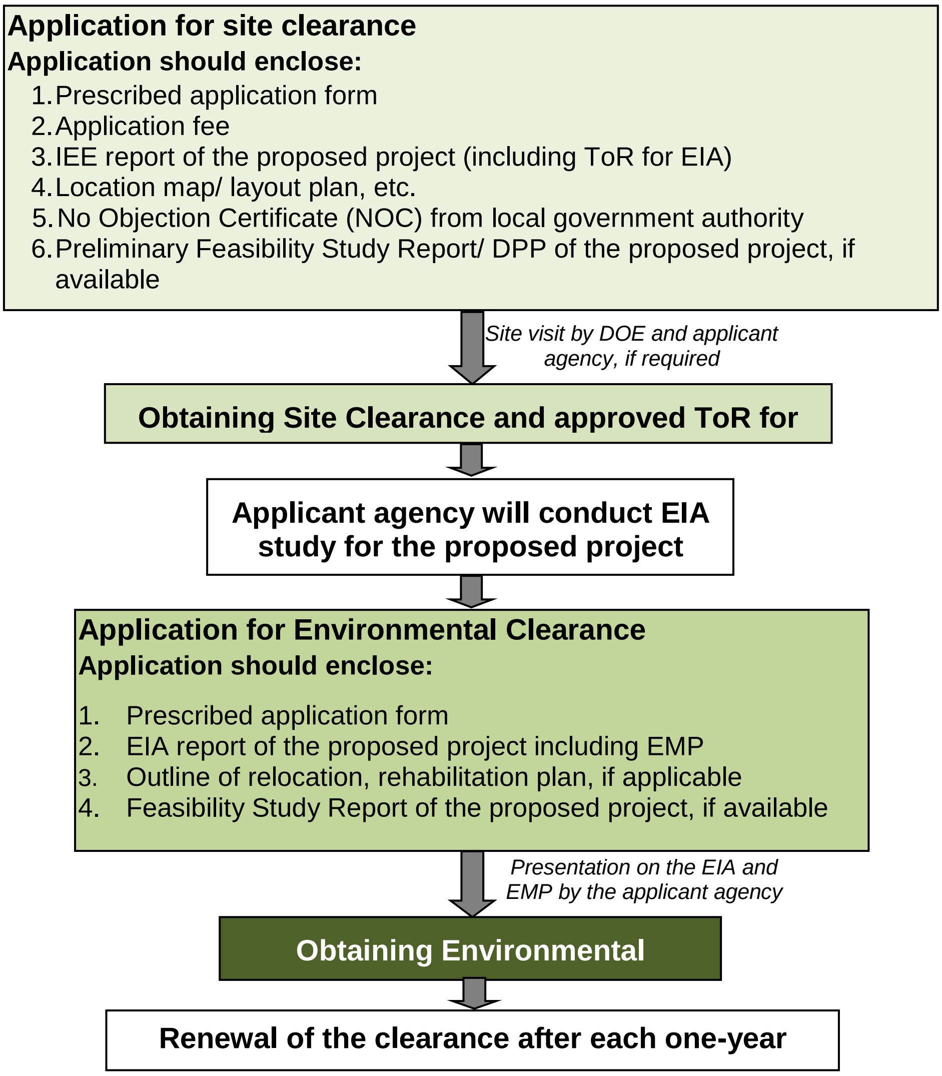


Figure 3.1: Process of obtaining Clearance certificate from DoE

3.8 World Bank's Environmental Safeguard Policies

127. Developers seeking financing from the WB are required to comply with the applicable environmental and social safeguards, operational policies (OPs) and Bank Procedures (BPs). A summary of the relevant safeguards policies considered for the Project is provided below:

3.8.1 Environmental Assessment (OP 4.01)

128. **EA requirement**. The World 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 Bank Policy OP 4.01 considers that EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. 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. EA takes into account the natural environment (air, water and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples and physical cultural resources); and trans-boundary and global environmental aspects. The Bank Policy also envisages that the borrower Government is responsible for carrying out the EA and the Bank advises the borrower on the Bank's EA requirements.

129. The present EIA has been carried out in compliance with this OP.

130. **EA classification**. The World Bank classifies the proposed project into one of the four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. These categories are defined below:

131. ***Category A:*** A proposed project is classified as 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.

132. ***Category B:*** A proposed project 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.

133. ***Category C:*** A proposed project 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.

134. ***Category F***: A proposed project is classified as Category F if it involves investment of Bank funds through a financial intermediary, in subprojects that may result in adverse environmental impacts.

135. The proposed CEIP-1 has been classified as Category A, since some of the potential impacts are likely to be significant and diverse.

3.8.2 Natural Habitats (OP 4.04)

136. The Policy describes the conservation of natural habitats, like other measures that protect and enhance the environment, to be 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 also 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.

137. The WBOP 4.04 is triggered for the proposed Project. However, the proposed activities will be undertaken in an area where natural habitat has already been modified to farm land and built-up area. Furthermore, appropriate control measures have been incorporated in the environmental management plan (EMP) (provided later in the document) to prevent any potential impacts of the Project on the nearby foreshore area.

3.8.3 Water Resources Management (OP 4.07)

138. Through this Policy, the Bank seeks to support operations that provide potable water, sanitation facilities, flood control, and water for productive activities in a manner that is economically viable, environmentally sustainable, and socially equitable. The Bank assists

borrowers in many priority areas, among which developing a comprehensive framework for designing water resource investments, policies, and institutions is very important. Within this framework, when the borrower develops and allocates water resources, it considers cross-sectoral impacts in a regional setting (e.g., a river basin). Restoring and preserving aquatic ecosystems and guarding against overexploitation of groundwater resources are also given priority to the provision of adequate water and sanitation services for the poor. Furthermore, special attentions are needed by the borrowers to avoid the water logging and salinity problems associated with irrigation investments by (i) monitoring water tables and implementing drainage networks where necessary, and (ii) adopting best management practices to control water pollution.

139. The proposed Project seeks to address several of the Policy objectives particularly those relating to flood control and water resource management for productive activities.

3.8.4 Physical Cultural Resources (OP 4.11)

140. The World Bank's general policy regarding cultural properties is to assist in their preservation, and to seek to avoid their elimination. The specific aspects of the Policy are given below. [6]

- The Bank normally declines to finance projects that will significantly damage non-replicable cultural property, and will assist only those projects that are sited or designed so as to prevent such damage.
- The Bank will assist in the protection and enhancement of cultural properties encountered in Bank-financed projects, rather than leaving that protection to chance. In some cases, the project is best relocated in order that sites and structures can be preserved, studied, and restored intact in situ. In other cases, structures can be relocated, preserved, studied, and restored on alternate sites. Often, scientific study, selective salvage, and museum preservation before destruction is all that is necessary. Most such projects should include the training and strengthening of institutions entrusted with safeguarding a nation's cultural patrimony. Such activities should be directly included in the scope of the project, rather than being postponed for some possible future action, and the costs are to be internalized in computing overall project costs.
- Deviations from this policy may be justified only where expected project benefits are great, and the loss of or damage to cultural property is judged by competent authorities to be unavoidable, minor, or otherwise acceptable. Specific details of the justification should be discussed in project documents.
- This policy pertains to any project in which the Bank is involved, irrespective of whether the Bank is itself financing the part of the project that may affect cultural property.

141. This OP is not triggered since no cultural or archaeological resources are known to exist in the vicinity of the Project nor have any such resources been identified during field investigations. However, 'chance find' procedures will be implemented in the EMP.

3.8.5 Forestry (OP 4.36)

142. This Policy recognizes the need to reduce deforestation and promote sustainable forest conservation and management in reducing poverty. The Bank believes that forests are very much essential for poverty reduction and sustainable development irrespective of their location in the world. The Bank assists borrowers with forest restoration activities that

[6] Excerpts from the OPN 11.03. WB Operational Manual. September 1986.

maintain or enhance biodiversity and ecosystem functionality. The Bank also assists borrowers with the establishment and sustainable management of environmentally appropriate, socially beneficial, and economically viable forest plantations to help meet growing demands for forest goods and services. The Bank does not finance projects that, in its opinion, would involve significant conversion or degradation of critical forest areas or related critical natural habitats. Furthermore, the Bank does not finance projects that contravene applicable international environmental agreements.

143. Though this OP is triggered during the concept development stage, the proposed Project is not located in any forested area and will therefore not have any direct impact on forests.

3.8.6 Projects on International Waterways (OP 7.50)

144. Projects on international waterways may affect the relations between the WB and its borrowers and between riparian states. Therefore, the Bank attaches great importance to the riparian states making appropriate agreements or arrangements for the entire waterway, or parts thereof, and stands ready to assist in this regard. A borrower must notify other riparian states of planned projects that could affect water quality or quantity, sufficiently far in advance to allow them to review the plans and raise any concerns or objections.

3.8.7 Pest Management (OP 4.09)

145. 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.

3.8.8 Indigenous Peoples (OP 4.10)

146. For purposes of this Policy, the term ‘Indigenous Peoples’ is used in a generic sense to refer to a distinct, vulnerable, social and cultural group possessing the following characteristics in varying degrees:[7]

- self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
- collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and
- an indigenous language, often different from the official language of the country or region.

147. The OP defines the process to be followed if the project affects the indigenous people.

148. No indigenous people - with a social and cultural identity distinct from the dominant society that makes them vulnerable to being disadvantaged in the development process – are known to exist in the Project area. Therefore this OP is not triggered.

149. However if such groups are identified during the Project implementation, the proponents will develop an Indigenous People Development Plan, in compliance with the OP and get it approved by the Bank.

[7] Excerpts from the OP 4.10. WB Operational Manual. July 2005.

3.8.9 Involuntary Resettlement (OP 4.12)

150. The WB's experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks: production systems are dismantled; people face impoverishment when their productive assets or income sources are lost; people are relocated to environments where their productive skills may be less applicable and the competition for resources greater; community institutions and social networks are weakened; kin groups are dispersed; and cultural identity, traditional authority, and the potential for mutual help are diminished or lost. This policy includes safeguards to address and mitigate these impoverishment risks.[8]

151. The overall objectives of the Policy are given below:

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.
- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

152. Since the proposed Project will involve land acquisition as well as displacement of houses and other assets, a Resettlement Action Plan (RAP) has been prepared, under a separate cover, in accordance with this Policy.

3.8.10 Projects in Disputed Areas (OP 7.60)

153. Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighbouring countries. In order not to prejudice the position of either the Bank or the countries concerned, any dispute over an area in which a proposed project is located is dealt with at the earliest possible stage.

154. The Bank may proceed with a project in a disputed area if the governments concerned agree that, pending the settlement of the dispute, the project proposed for country A should go forward without prejudice to the claims of country B. [9]

155. This OP is not triggered since no part of the Project area is located in any disputed territory.

3.8.11 Safety of Dams (OP 4.37)

156. 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.

8 Excerpts from WB OP 4.12. WB Operational Manual. December 2001.

9 Excerpts from the OP 7.60. WB Operational Manual. November 1994.

3.8.12 Public Disclosure of Information (BP 17.50)

157. This BP deals with the World Bank policy on disclosure of information. It is a mandatory procedure to be followed by the borrower and Bank and supports public access to information on environmental and social aspects of projects.

158. Once finalized, the EIA report will be disclosed to the public and will also be available on the official website of the BWDB. EIA will also be sent to the WB InfoShop.

3.8.13 Environment, Health and Safety Guidelines

159. The Environment, Health, and Safety (EHS)[10] Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities or project by existing technology at reasonable costs. These Guidelines will be applicable to the Project.

3.9 Implications of WB Policies on CEIP

160. The project interventions for Polder-47/2 fall under Category A, due to the complexity of environmental issues associated with project activities involving major civil works by reconstruction and rehabilitation of the coastal embankment to protect against tidal flooding and storm surges. Since the coastal area is of high ecological sensitivity and vulnerability, certain negative environmental impacts may occur during the implementation and operational phase on overall polder system. There may be localized impact on the natural habitats especially on the fish spawning site and protected areas, during the implementation of the civil works.

161. The environment assessment (OP/BP 4.01), natural habitats (OP/BP 4.04) and forests (OP/BP 4.36) policy have been triggered for the proposed operation. Although no direct impacts on physical cultural resources are expected, screening mechanism incorporated into the EA process will identify subprojects with archaeological, paleontological, historical, religious, or unique natural values, chance and find procedure will be followed to address physical cultural resources (OP/BP 4.11). The interventions under the proposed Project may result in an increased availability of irrigation water through cleaning and excavation of watercourses in the Polder. This increased water availability can in turn potentially increase the usage of chemical fertilizers and pesticides. During regular environment monitoring during operational phase if the water and soil pollution is observed, the proponent will be responsible for preparing Pest Management Plan with prior approval from Bank. No Project activities are to be carried out in the rivers except some transportation. However, this will not have any effect whatsoever on the upper riparian water usage or availability. Hence, International Waterways (OP 7.5) is not expected to be triggered.

[10] Environmental, Health and Safety Guidelines. IFC/WB Group, April 30, 2007.

4 Description of the Project

162. The project activities, construction methodology, construction schedule, and the institutional arrangements for implementation of the Project are described in this chapter.

4.1 Project Background

163. The Bangladesh low-lying Delta is formed by the interaction of the very large summer discharges of both water and sediment from the Ganges, Brahmaputra (Jamuna) and Meghna Basins with tides in the Bay of Bengal, which can vary in range from 3 m in the west to nearly 6 m in the northeastern corner of the Bay near Sandwip.

164. The Coastal Zone of Bangladesh has been defined as the area within which the rivers flows are influenced by the tide. Given the high tidal range and the very low river gradients, the tide reaches very far landwards, particularly in the dry season. If the upstream freshwater inflows are reduced in the dry season, salinity can also intrude very far upstream within the river system, which comprises a number of very large estuaries.

Coastal Embankment Project

165. The Coastal Embankment Project (CEP) was initiated in the 1960s to reclaim or protect areas in the coastal zone that lay below the highest tide levels for periodic inundation by saline water. These lands could now be used for agriculture by providing drainage structures capable of evacuating excess water during low tide. This system worked well for many years and 1.2 million hectares came under protection the embankment system bringing immense benefits.

166. However, there have been unintended consequences of this project. The very act of preventing the high tides from spreading over the land and confining them within the river channels initially increased the tidal range by about 30 per cent, which might have had an immediate beneficial impact on drainage. However, the reduction of upstream and overbank storage also decreased the tidal cubature (i.e., the volume of water displaced during a tidal cycle).

167. The reduction in cubature induced sedimentation or more correctly a reduction in cross sectional areas of the rivers of all types – the large rivers such as the Pussur which have sandy bottoms and clay/silt banks and the smaller rivers which have an excess of silt and clay. The consequent choking of smaller rivers resulted in drainage congestion within some internal polders, and navigation problems in some.

168. The embankment system was designed originally to keep out the highest tides, without any consideration of possible storm surges. Recent cyclonic storm damages and the anticipation of worse future situations because of climate change, has caused this strategy to be revised. Additional problems have also been identified – the direct impact of sea level rise on salinity intrusion into the coastal zone as well as on polder drainage.

The CEIP Initiative

169. It is well recognized that infrastructural interventions in the coastal areas by embankments and cyclone shelters have significantly reduced its vulnerability to natural disasters at least partially and thus the poor people have some assurance of safety to their lives and crops. However, some effectiveness of the infrastructures in most cases has been compromised through poor and inadequate maintenance and sometimes by shifting the embankments towards country sides. With the occurrence of the frequent storms in the

recent period, the Coastal Embankment Systems (CES) has weakened and calls for systematic restoration and upgrading.

170. After cyclone Sidr struck the coastal area causing severe damage to the infrastructure, lives and properties of the coastal belt, GOB obtained an IDA/credit for Emergency Cyclone Recovery and Restoration Project (ECRRP, 2007) and proceeds from this credit would be used to meet the expenses for preparation of the proposed Coastal Embankment Improvement Project-Phase-1 (CEIP-1).

171. It had been apprehended that undertaking the rehabilitation of coastal embankment system under one or two localized projects would not bring any convincing change in such a vast area. To resolve this multi-dimensional problem a strategic approach in the name of Coastal Embankment Improvement Programme (CEIP) was felt necessary. It incorporates a longer-term perspective in a programme spread over a period of 15-20 years, composed of at least 3-4 sub-phases.

172. The Polder- 47/2 is one of the polders to be rehabilitated under the CEIP-1.

4.2 Overview of Polder- 47/2

173. The polder is located in the Dablugonj union of Kalapara Upazila under Patuakhali District. The polder is bounded by Sonatola and Baraitala Rivers to the West; Charpara and Baraitala River to the East; Baraitala River to the south and Sonatala and Charpara Rivers to the North. Polder- 47/2 was conceived in the year of 1960Under Coastal Embankment Project (CEP). Construction of the polder was started in 1961-62 and completed in 1965-66 comprising an area of 2,065 ha.

174. The original concept for construction of this polder was to protect the agricultural lands from saline water intrusion and to reduce sufferings of the coastal dwellers caused due to tidal inundation from the sea and river. At present, the embankment of the polder is under threat to storm surge, river erosion and increasing risks brought about by the climate change. This is one of the 17 polders, selected for feasibility study under CEIP-1. The summary of the existing water management infrastructures are in Table 4.1 below:

Table 4.1: Summary of existing water management infrastructures

Type	Specification
Total length of Embankment	17.49 km
Total number of Drainage Sluices	4nos
Total number of Flushing Sluices	6 nos
Drainage Khal (Water Channel)	60 Km

Source: DCSC Design Team, CEIP, 2015

4.3 Objective of the Project

175. The main objective of the Project is to increase the resilience of coastal population from natural disasters and climate change. Specifically, the Project aims at (a) reducing the loss of assets, crops and livestock during natural disasters; (b) reducing the time of recovery after natural disasters such as cyclones; (c) improving agricultural production by reducing saline water intrusion which is expected to worsen due to climate change; and (d) improving GoB’s capacity to respond promptly and effectively to an eligible crisis or emergency.

4.4 Water Management Problems and Issues in the Polder

176. To provide a save guard against high tide was the main consideration of the polder where storm surges were not considered. A number of segments of the embankment of the

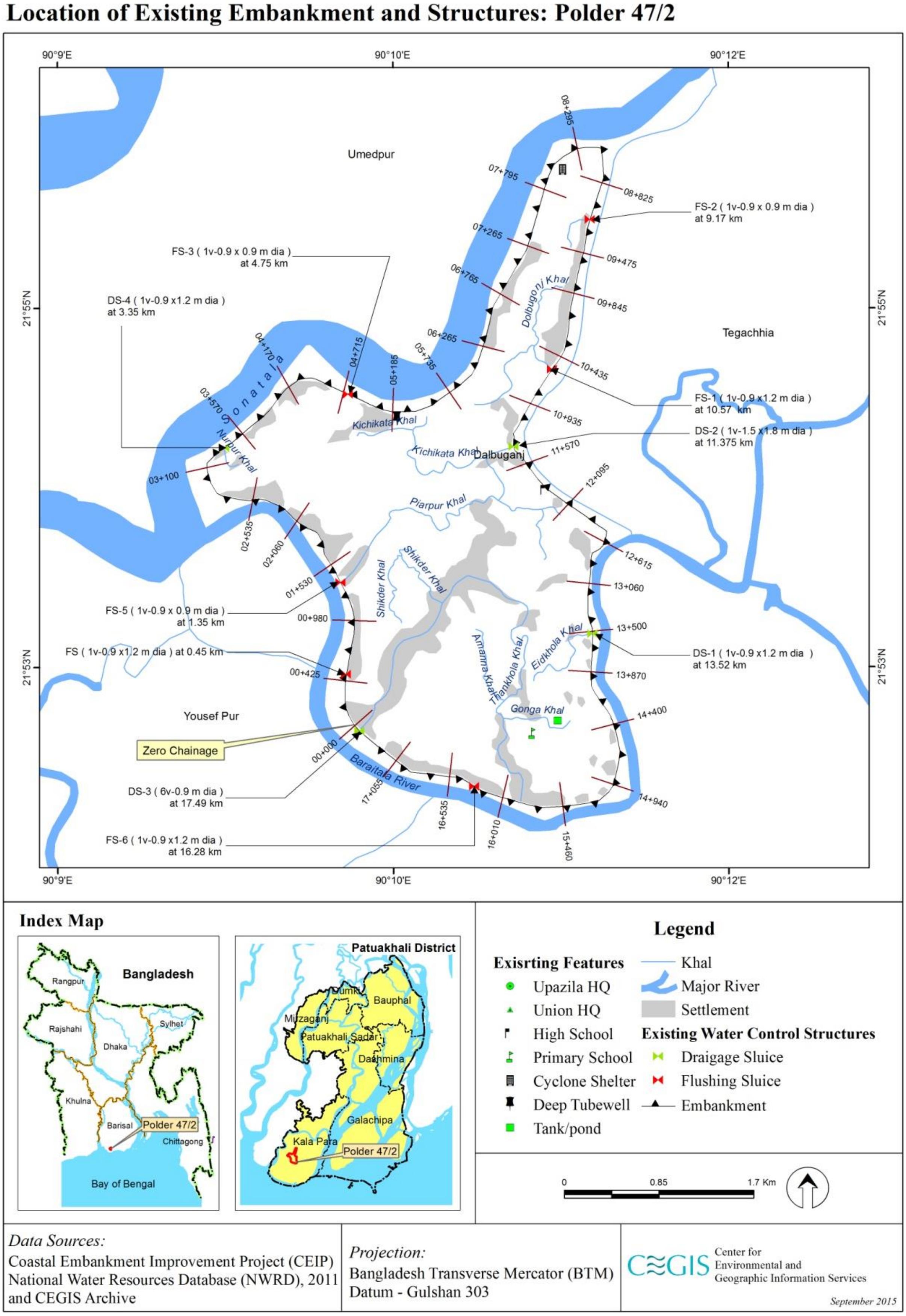
Polder have been damaged by recent storm surges, cyclones i.e. Sidr, Aila etc. and have put the coastal polders to a threat. Breaches occurred in some weak sections of embankment and the polder area was inundated by about 1m of water during SIDR. It is reported that 5 people died and some people were injured during Sidr. In addition, breaching of the embankments due to cyclones caused siltation in the peripheral rivers surrounding the embankments and caused the coastal polders to suffer from water logging; leading to large scale environmental, social and economic degradation. Poor maintenance and inadequate management of the polders have also contributed to internal drainage congestion and heavy external siltation. As a result, soil fertility and good agriculture production are declining because of water logging and intrusion of saline water inside the polders.

177. The riverside slopes in some segments of embankment has been severely damaged by river erosion and wave action. The entire length of the embankment is under-sectioned with respect to its original design. The new CEIP Design Crest levels would require re-sectioning of the entire embankment. Many of the hydraulic structures are in dilapidated condition. The concrete surfaces of the structures have been deteriorated due to lack of maintenance as well as exposure to salinity. Most of the gates of the structures have been lost and loose aprons have been damaged. There are 4 drainage sluices, which need to be replaced. There are 6 Flushing Inlets out of which 3 are repairable and 3 are to be replaced.

178. Currently, about 15-20% of the polder area is facing problems of salinity primarily because of ineffective water control structures and siltation of water channels. This situation is further compounded by unavailability of suitable ground water at shallow depth from April to May.

179. The capacity of Charpara River has been reduced which is mainly responsible to convey drainage water. Last year a new cross dam has been constructed by BWDB in the southern portion (Payerpur village) of the polder area. According to local people and field visit, it seems that the cross dam caused water logging in surrounding areas.

180. There is local demand for storage of sweet water in the internal canal system for cultivating *robi-crops* when the river water becomes saline. Therefore, structures are required to be constructed with provision of flushing and drainage. The internal drainage channels have been silted up and needs to be re-excavated for smooth drainage. An Index Map 4.1 shows the existing alignment of the embankment along with the locations of the drainage and flushing sluices, and drainage channels of the Polder-47/2.



Map 4.1: Location of Existing Embankment and Structures of Polder- 47/2

181. Based on local opinions clustered during the major field investigation carried out in June 2015, the study team identified the following key water management problems and issues in Polder- 47/2.

a) Lack of timely repair and maintenance of water control structures and embankments;
b) Inadequate budget allocation and its inefficient use;
c) Recent cyclones and storm surges, particularly the recent cyclones of 2007 (Sida) and 2009 (Aila);
d) High rate of siltation in peripheral khals (eastern portion) which hinders natural overland drainage;
e) Inadequate plantation in the foreshore and lack of coastal green belt; and
f) Absence of functional community organizations for operation and co-management of the polder system.

4.5 Present Status of Water Management Infrastructures

182. To ensure sustainable management, optimal use and equitable sharing of water resources and Water Management Infrastructures are seemed as physical interventions that are the key features of intervention work. There are some typical water management infrastructures such as peripheral embankments, drainage and flushing sluices, drainage khals, etc., in Polder-47/2. Based on field investigation carried out in June 2015, supplemented with the information received from CEIP consultants, the study team gathered the following information regarding the status of existing infrastructure.

4.5.1 Embankment

183. The embankment from Ch. 00 + 000 to Ch. 17+055 will be newly constructed. Bank revetment with backing of embankment will be provided from km 1.7 to km 2.7 and km. 6.0 to km 7.0. No bank protection work is needed in the polder area. The polder is surrounded by Baraitala and Sonatala Rivers at south-west and north-west portion of the polder respectively. Presently, a significant portion of the polder is directly vulnerable to cyclones and storms surge from the Bay of Bengal, which may enter through the large Baleswar estuary. Many reaches of the embankment have been damaged due to Sidr and Aila, especially along Khaprabhanga Union.

184. Almost the entire length of the peripheral embankment during field observation was found as unpaved, which hampers communication during wet seasons. There is a paved portion along the polder from Jamalpur to internal locations, which is predominantly used for vehicular movement (motorcycle, van etc). A couple of erosion hotspots have also been observed during field investigation in Jamalpur and Rosulpur village (adjacent to Charpara River).

Picture 4.1: Embankment at Ch. km 13.80 to km 14.40 (Dablugonj)

Picture 4.2: Revetment Ch. km 6.0 to 7.0 (Rosulpur)

Picture 4.3: Revetment Ch. km 1.7 to 2.7 (Fulbaria)

4.5.2 Water Control Structures

185. There are 4 Drainage Sluices and 6 Flushing Sluices within Polder-47/2. Most of them are in dis-repair and have to be replaced. Their non-operational condition creates drainage congestion along with obstacles to water supply from river. The concrete surface of the structures has deteriorated due to prolonged exposure to salt water. A number of gates have been corroded and the loose aprons have been damaged as well. Some of the sluices were found with no gate.

186. Most of the drainage and Flushing structures are beyond repair and some are to be replaced by new ones with provisions for both flushing and drainage, which will last long and achieve project objectives. Local people opined that sweet water retention is ensured within internal canal system for cultivating Rabi-crops though saline water intrusion is not a severe problem in this area. **Table 4.2** below provides a detail understanding of the existing drainage and flushing sluices in the Polder and addresses the need for future works.

Table 4.2: Status of existing water control structures

Sl.	Structure	Chainage	Type and Size	Observations	Rehabilitation Needs
Drainage Sluice					
1	D/S - 1	Ch. 13+520	RCB (1vent-0.9mx1.2m)	• Loose aprons have been damaged • The gate has been lost. • The sluice is known to be underventage	Needs to be replaced
2	D/S - 2	Ch. 11+375	RCB (1vent-1.5mx1.8)	• Dilapidated condition. • Loose aprons and gate have been damaged.	Needs to be replaced
3	D/S - 3	Ch. 17+490	RCP (6vent-0.9m dia)	• Bad condition. • Loose aprons and gates have been damaged.	Needs to be replaced
4	D/S - 4	Ch. 3+350	RCB (1vent-0.9mx1.2m)	• Loose aprons have been damaged • Concrete surface is in very bad condition.	Needs to be replaced
Flushing Sluice					
1	F/S - 1	Ch. 10+570	RCB (1vent-0.9mx1.2m)	• Loose aprons are damaged • Gate has been lost; • The structure is in deplorable condition.	Needs to be replaced
2	F/S - 2	Ch. 9+175	RCB (1vent-0.9mx0.9m)	• Loose aprons have been damaged; • Gates have been lost	Needs to be repaired
3	F/S - 3	Ch. 4+750	RCB (1vent-0.9mx0.9m)	• U/S loose aprons have been damaged; • Gates have been lost.	Needs to be demolished
4	F/S-4	Ch. 3+350	RCB (1vent-0.9mx1.2m)	• Loose aprons have been damaged • Concrete surface is in very bad condition.	Needs to be replaced
5	F/S - 5	Ch. 1+350	RCB (1vent-0.9mx0.9m)	• Functioning well; • Loose aprons have partially been damaged; • Gates have been lost.	Needs to be repaired
6	F/S - 6	Ch. 16+280	RCB (1vent-0.9mx1.2m)	• Concrete surface of the sluice is severely deteriorated; • Reinforcement has been exposed; • Loose aprons have been damaged and gate has been lost.	Needs to be replaced

Source: DCSC Design Team, 2015; Note: F/S = Flushing Sluice, D/S = Drainage Sluice, RCP = Reinforced Concrete Pipe, RCB = Reinforced Concrete Box.

Picture 4.4: Deteriorated condition of D/S-4 (Nurpur)

Picture 4.5: Deteriorated condition of F/S-1 (Rosulpur)

Picture 4.6: Damaged Structure F/S-6 (Fullbaria village)

4.5.3 Drainage Khals

187. At present, there are drainage *khals* (water channel) having a length of 60km inside the polder. The present condition of some of the internal drainage khals is undesirable. Over the years, lack of maintenance, siltation, topsoil erosion and other land filling activities have resulted in gradual decrease of water courses within the polder. In recent field observations, it was found that Rosulpur Khal (North-East portion) and Kichikata branch khal 2 (Northern portion) have been silted up which causes frequent flood during monsoon period.

4.6 Proposed Rehabilitation Activities

188. The proposed interventions in Polder-47/2 under CEIP-1 are listed in Table 4.3. It is mentionable that drainage modelling of the coastal polder has been carried out by IWM to find out the design parameters for drainage cannel systems, drainage regulator, river bank, slope protection works. Climate resilient coastal embankment crest level has been design considering the combined effects of cyclone storm surge effects and cyclone induced wind wave. The model has been developed and simulated considering climate change condition considering with and without interventions (IWM, 2016). The interventions have further been detailed in the following sections:

Table 4.3: List of Proposed Interventions in Polder- 47/2

Type of Work	Specification
Re sectioning of embankment (Design slope -R/S 1:3 and C/S 1:2)	17.49 km
Replacement of Drainage Sluices	04 nos.
Replacement of Flushing Sluices (	05 nos.
Re-excavation of drainage channels	11.46 km
Bank Protection	0.52 Km
Afforestation	3.43ha

Source: DCSC Design Team, 2015

189. Map 4.2 and Map 4.3 (Part-1 to Part-4) shows the location of the proposed interventions of the Polder-47/2 under CEIP-1. However, the proposed intervention will take place in a system that was modified in the past, that is not working properly well and that the social and physical environment is being affected. Therefore, the proposed project will absorb those liabilities.

190. To implement the aforementioned project interventions, the following phase-wise activities are to be carried out (Figure 4.1). The activities under each intervention have further been discussed and specified in the following sections:

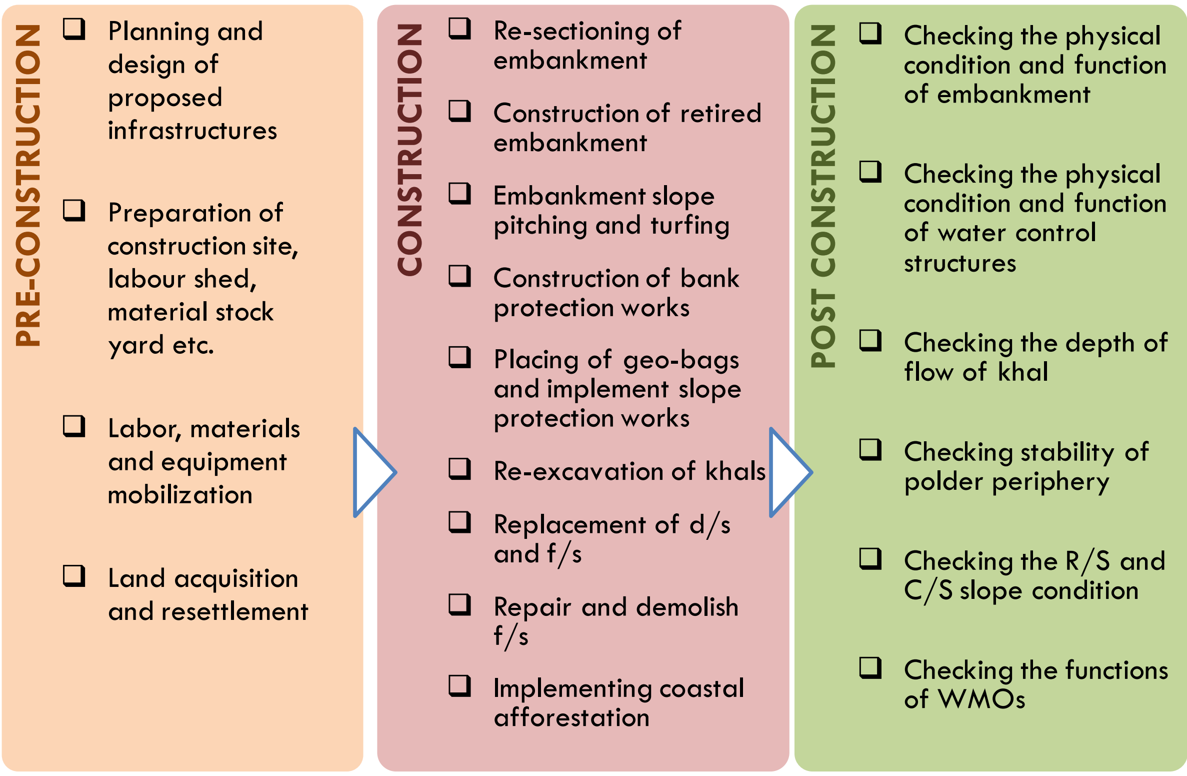


Figure 4.1: List of activities in Polder- 47/2 at different project phases

4.6.1 Works on Embankment

191. The proposed intervention of Polder-47/2 includes re-sectioning of the entire length i.e. of 17.49 km of the embankment with mechanical compaction as per CEIP design. The crest level and side slopes of the polder are also redesigned. The crest level has been proposed to increase up to 5.00m PWD. The side slopes will be 1:3 and 1:2 at riverside (R/S) and land-side (C/S), respectively.

Description of construction activities

192. The construction of the embankment will be carried out with the soil/earth obtained either from drain/canal re-excavation or from burrow pits, or from other sources, approved by the Engineer-in-charge. The earth fill materials will be graded, homogenous and free from logs, stumps, roots, rubbish or any other ingredient, organic/ vegetable matter.

193. Labor sheds construction with proper sanitation and other required facilities should be planned before the commencement of construction activities of the embankment works. A suitable site shall be selected and prepared by cleaning bushes, weeds, trees, etc. Alignment of the embankments has to be fixed with adequate base width. Base stripping and removal of trees, weeds etc. will be done as per the instruction of the Engineer-in-charge. The tools required for the construction of embankments will be procured during this period. After validating the final design, excavated of soil/carried earth will be dumped in layers in the selected area. At the same time, each layer (of 1.5 feet) of dumped soil will have to be compacted by a compactor. The sloping and shaping of embankment will be made after proper compaction in layers. The required turfing with grass will then be provided on the slope of the embankment. Watering and fertilizers will also be provided as per the instructions in the EMP.

4.6.2 Construction (Replacing) or Repairing of Drainage Sluices

194. All four existing Drainage Sluices need to be constructed under the proposed intervention of the Polder. The summary of design information of the proposed works in these drainage sluices are given in Table 4.4.

Table 4.4: Detail of Works in Drainage Sluices

Sl No.	Name of drainage sluices	Chainage (at km)	Khal Name	Name of outfall river	Length of Khals (Km)	Lowest Tide level (m. PWD)	Lowest elevation of basin (m. PWD)	Existing Sill Level (m. PWD)	Proposed Sill level (m. PWD)	Remarks
01	DS-1 RCB (1vent-1.5m x 1.8m)	13+520	Eid Khola Khal	Baraitala River	0.75	-1.095	0.7	-0.560	-0.50	Replacement by RCB (1vent-1.5mx1.8m) is proposed
02	DS-2 RCB (1vent-1.5m x 1.8m)	11+370	Kichikata Khal	Charpara River		-1.095	0.7	-1.430	-0.50	Replacement of the structure is proposed
03	DS-3 RCP(6vent-0.90m dia)	17+190	Than khola Khal	Baraitala River	5.00	-1.095	0.7	-0.070	-0.50	Replacement of the structure is proposed
04	D/S – 4 RCB (1vent-0.9mx1.2 m)	3+350								Replacement of the structure is proposed

Source: CEIP-I Design Study Finding

<u>Description of construction activities</u>

195. During pre-construction phase of the Drainage Sluices, construction of labor shed with sanitation and other facilities should be completed. During this period, required construction materials (sand, cement, wood, shuttering materials, etc.) will be procured by the contractor as per tender schedule. Before starting the construction of Drainage Sluices, ring bundhs and diversion channels will have to be constructed on the selected and prepared site as per instruction of the Engineer-in-charge. After that, the foundation treatment required for the structure will be carried out. CC and RCC works along with cutting, bending and binding of rods will then be performed as per specification. CC blocks will be prepared and placed as and where required as per design. After construction of approach roads, fitting and fixing of gates and hoisting device will be carried out. Gates will be properly painted. The intake and outfall of the gates will be constructed as per design. The CC blocks will be made for river training works and pitching works will then be conducted.

4.6.3 Replacement or Construction of Flushing Sluice

196. Five Flushing Sluices in the polder, FS-1, FS-2, FS-4 and FS-6 are recommended for replacement while FS-3 will be demolished. Moreover, a new Flushing Sluice namely FS-5 will be constructed at Ch. 1+600. A detailed description of the Flushing Sluices is given in **Table 4.5 and Map 4.2.**

Table 4.5: Detail of Works in Flushing Sluices

Sl.	Name of Structure	Chainage	Structure Type and Size	Proposed works
1	F/S - 1	Ch. 10+570	RCB (1vent-0.9mx1.2m)	Replacement is proposed
2	F/S - 2	Ch. 9+175	RCB (1vent-0.9mx0.9m)	Replacement is proposed
3	F/S - 4	Ch. 3+350	RCB (1vent-0.9mx0.9m)	Replacement is proposed
4	F/S - 5	Ch. 1+600	RCB (1vent-0.9mx1.2m)	New proposed
5	F/S - 6	Ch. 16+280	RCB (1vent-0.9mx1.2m)	Replacement is proposed

Source: CEIP-I Design Study Finding

<u>Description of construction activities</u>

197. Before starting the construction activities of flushing sluices, a labor shed will be constructed by provision of sanitation, safe drinking water and other facilities. The required construction materials (sand, cement, wood, shuttering materials etc.) will be procured simultaneously. A suitable site for the structure will then be selected and prepared accordingly. Diversion channels will be developed before starting the construction works. After that, the foundation treatment required for Flushing Sluices will be carried out. RCC works and pipes along with allied construction and fittings will then be made along with construction of collar joints as and where required would also be completed. After few days of construction, gates will be installed at the upstream end of each Flushing Sluice. After completion of all construction activities, the embankments will be constructed and turfed with grass. Finally, a channel will be excavated through lead cut and tail cut to divert the flow through the flushing gates.

4.6.4 Re-excavation of Drainage Khals

Seven (7) drainage channels with a total length of 11.46 km will be re-excavated to ease water flow and reduce drainage congestion. An estimated volume of 0.0128 million cubic meters of soil/silt will be excavated. The excavated soil will be used for strengthening the khal banks. Local people may be encouraged to take earth from the spoils, as well. The spoil may be used for raising the plinth level of their earthen kacha houses as well as individual house yards. If the excavated materials are found suitable, the Contractor can use the materials for construction of embankments upon prior approval by the DCSC. The water channels to be re-excavated under the project are listed in Table 4.6. Figure 4.1 below shows the conceptual layouts of proposed dumping technique. Compartmental dumping spots will be created along the sides of the excavated khals, allowing any runoff from de-watering of the spoils and from precipitation to drain into the excavated khals.

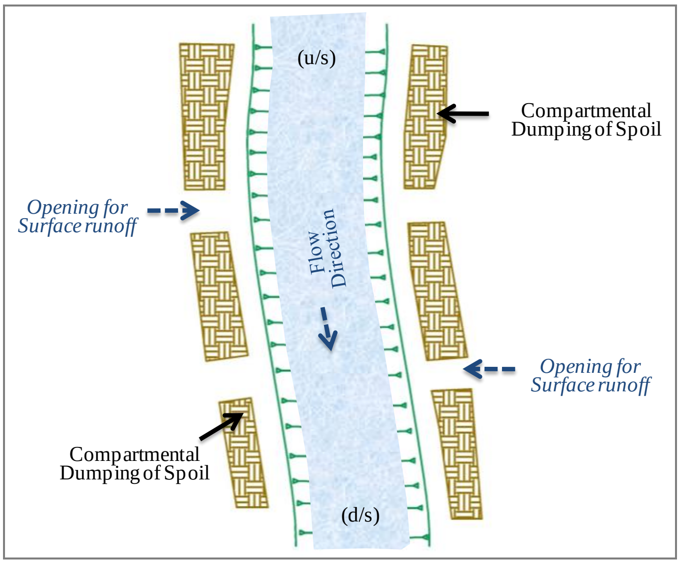


Figure 4-1: Plan form of a typical khal to be re-excavated

Table 4.6: Channels to be Re-excavated

	Name of Khal (Channel)	Length (km)	Chainage (km)
1	Eid khola khal	0.75	13.50
2	Kichikata khal	1.70	11.375
3	Thankhola khal	5.00	17.19
4	Piarpur khal	2.00	1.60
5	Dalbuganj khal	1.33	10.57
6	Rasulpur khal	0.44	9.17
7	Nurpur khal	0.24	4.75

Source: CEIP-I Design Study Team,2015

Description of construction activities

198. At first, the required tools will have to be procured for re-excavation of the drainage channels. A schematic diagram showing centerline and layout plan of the excavation will be prepared showing the design depth, width of excavation and disposal sites. The entire channel will then be divided into a number of reaches. The excavation will start from the upstream of the channel. Cross dams are to be provided at the starting and end locations of the excavation. The plan for the excavation will have to be approved by the DCSC before excavation starts. Both manually and mechanically (excavator) methods will be used for excavation of drainage khals. No dredging operation will be carried to removal of sedimentation from the khals. The excavated soil/sludge will be disposed into the approved disposal sites. After completing excavation of one reach, the next reach downstream would be excavated using the same procedures.

4.6.5 Bank Protection Work

199. Bank protection work will be carried out at a stretch of 0.52 km from Ch 6.170 to Ch 6.690 (Refer Map 4.2).

Description of construction activities

200. The construction activities involved for the bank protection and slope protection works are: construction of labor shed, creation of sanitation facility and procurement of construction materials (sand, cement, wood, shuttering materials etc.). The slope of the river bank will be developed first with earth as per design. At the same time, the required CC blocks will be casted or manufactured and guard walls will be constructed. After completion of preparation of CC blocks, Geo-textile bags will be placed along the slope and CC blocks will be placed on it. A launching apron will be prepared with CC blocks along with dumping of CC blocks in assorted form completed up to the toe of the river banks. Finally, turfing will be made on the slope or crest of the embankment. Proper drainage provision will be kept to avoid formation of any rain cuts due to surface run off. All these activities will be completed as per design and specification under the guidance of the Engineer-in-charge. For River Bank Protection and Embankment Protection Works CC Blocks of various sizes will be used to control river erosion activities. Their estimated quantity with sizes of CC blocks are given in the following table:

Table 4.6a: Quantity of CC Blocks for River Bank and Slope Protection Works

Work	Size (mm)		
	400x400x300	400x400x400	300x300x300
River Bank Protection	27,950	162,141	256,222
Embankment Slope Protection	432,853	227,376	125,926
Total =	460,803	389,517	382,148

Source: CEIP-1 Design Study Team

4.6.6 Afforestation

201. Afforestation on the foreshore area by plantation of mangrove species is proposed under the interventions. The areas selected for afforestation in Polder-47/2 are shown in detail in Map 4.2 and details in Table 4.7. A total of 16,928 nos of trees will need to be cut from the RoW (Source RAP Report). About 17.55 km of embankment slope with 6.3 ha area is available for afforestation of this polder. In addition, about 3.43 ha of foreshore area will be planted with different mangrove species (Source: Final Interim Report on Additional Tasks Assigned, Volume-III: Afforestation Report, page: III-19).

202. The afforestation regulations (policy) enunciated by the BWDB on June 01, 1998 may be followed. Afforestation plan have been finalized after reviewing previous studies on foreshore afforestation, consultation with Forest Department and field verification for suitable species selection.

203. For the Slope Plantation, the lower one third of the slope may be planted with deep-rooted tree species, the mid one third may be planted with shallow rooted medium size tree species and the upper one third may be planted with species that have very small root system. Keeping this in view, the lower row along the slope will be planted with *Tamarindus indica* (Tetul) & *Acacia nilotica* (Babla) at a spacing of 2M (6 ft) apart. The upper row will be at a distance of 6 to 8 feet i.e. 2 to 3M from the lower row. The upper row will be planted with *Borassus flabellifer* (Tal), *Cocos nucifera* (Narikal) and *Phoenix sylvestris* (Khajur) at a

spacing of 2 M (6 feet) apart, but staggered with the lower row plants. The *Tamarindus indica* (Tatul) and *Acacia nilotica* (Babla) seedlings will be raised in 10” X 6” poly bags. Before plantation, a temporary nursery will be established in the polder area to ensure the availability of seedlings. Nursery costing has been shown separately in Feasibility Report. The *Borasus flabellifer* (Tal), *Cocos nucifera* (Narikal) and *Phoenix sylvestris* (Khajur) seedlings will be purchased from nurseries. Planting of 2,500 seedlings will make one Hector Plantation. An estimated 15,750 nos of saplings will be planted along the 6.3 ha area of embankment slope.

204. The available foreshore area of the polder will be planted with suitable mangrove species. Keora (*Sonneratia apetala*), Baen (*Avicennia officinalis*), Chaila/Ora (*Sonneratiacaseolaris*), Kankra (*Bruguiera gymnorhiza*), Gewa (*Excoecaria agallocha*), Bhola (*Hibiscus tiliaceous*) and Golpata (*Nypa fruticans*) has been selected as the suitable species for this polder. Average distance between two saplings will be 1.5 m. accordingly; more than 15,243 mangrove saplings will be planted in 3.43 ha of available foreshore area. A typical cross section of embankment slope and foreshore afforestation is shown in Figure 4.2.

Table 4.7: Detail works of afforestation

Sl	Description	Chainage (km)	Length (km)	Total Afforested area (ha)
1	Slope Plantation		17.55	6.30
2	Foreshore Afforestation including Golpata Plantation	03.00 km to 06.00 km ,	3.00	3.43
		07.00 km to 07.500 km ,	0.50	
		09.00 km to 11.50 km ,	2.50	
		12.00 km to 17.00 km.	5.00	
	Total		28.55	

Source: Feasibility Report of CEIP, Volume III: Afforestation Report, September 2013;
Final Report, Volume-V, Landuse Reports, Part C: 1. Forestry, Table: 5.1, Page: V-C-1-22

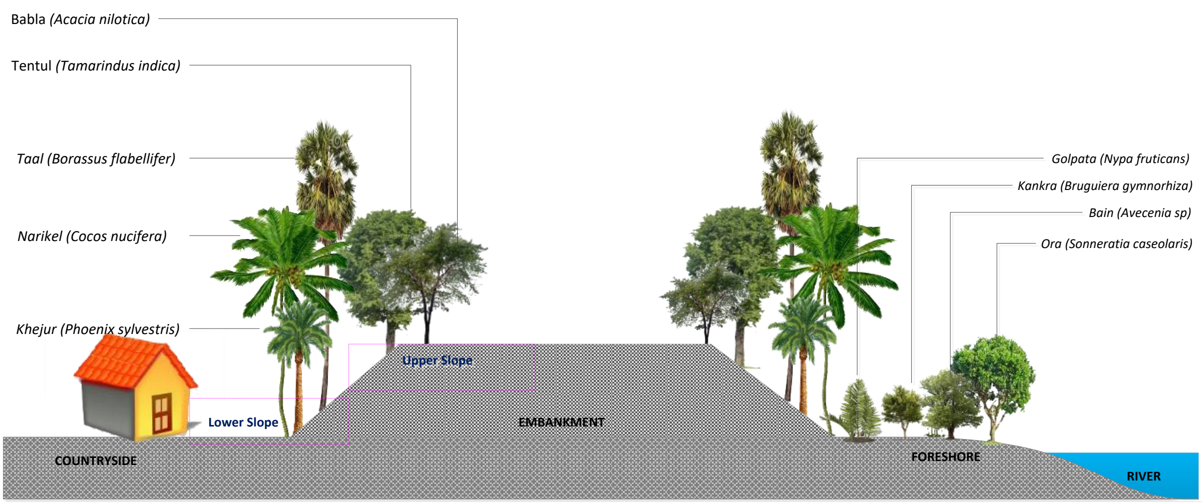


Figure 4-2: Typical cross section of Embankment slope and Foreshore Afforestation

205. Moreover, to compensate the tree cutting as well as enhance plantation, here is suggested to distribute timber, medicinal and fruit yielding tree sapling to planted in each the household and other available areas (i.e. institutional ground, graveyards, roadsides etc). To achieve the motto “planting 3 trees for cutting 1 tree”, it would be needed more than 19,800 no of additional sapling plantation.

Detail Plantation establishment Matrix is presented in following Table:

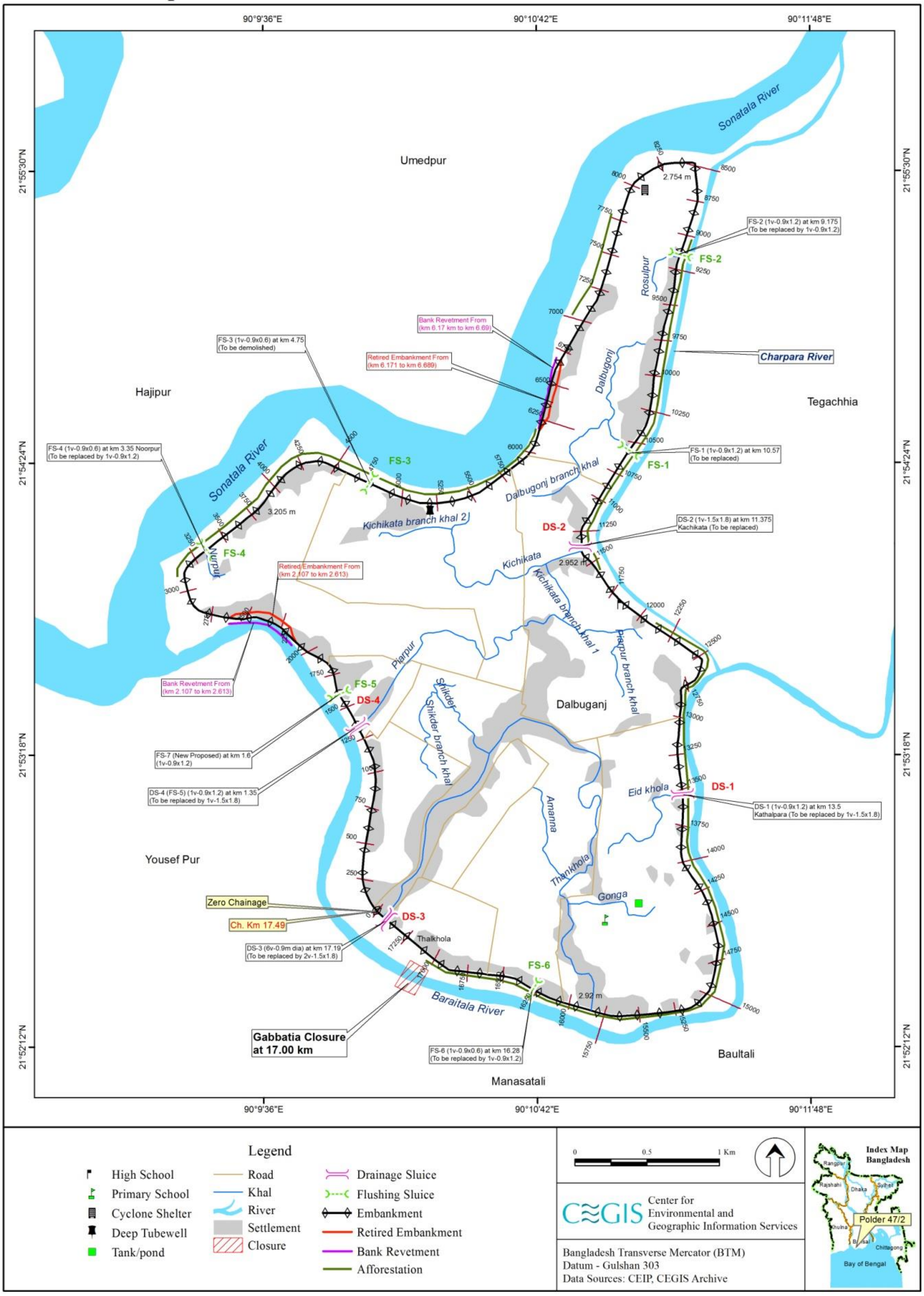
Table 4.8: Detail Information on Plantation Program

Item of works	Time schedule for the given type				
	Golpata (Nypa) Plantation	Chailla, Kankra, Gewa Plantation	Keora Baen Plantation	Embankment Slope Plantation	Additional Plantatation
Selection of site, survey the site and prepare plantation site map.	March	January	February and March	February	February and March
Cleaning of unwanted growths by cutting them off.	May 3rd week.	April 4th week immediately before planting.	One week before the planting day. May be in the 1st week of May.	April 1st week.	-
Pit making	n.a.	March 2nd week.	n. a.	April 1st week.	-
Application of Compost	n.a.	March 4th week.	n. a.	April 3rd week.	-
Stacking	May 3rd week.	April 1st week.	n. a.	April 3rd week.	
Bring seedlings from the nursery to plantation site.	June 1st week.	April 3rd week.	On the day of planting during 1st or 2nd week of May.	April 4th week.	
Planting of seedlings.	June 1st week. Immediately after bringing seedlings from the nursery.	April 4th week.	May be 1st or 2nd week of May.	Immediately after bringing the seedlings.	
Fixing of red flags indicating planting sites to avoid fishing.	May 4th week.	n. a.	n. a.	n. a.	
Application of fertilizers.	n. a.	After of week of planting the seedling.	n. a.	After of week of planting.	
First weeding	August 1st week	May 4th week	May 4th week. 1st year.	May 2nd week, 1st year, to be done by the watcher free of charges.	
Second weeding	November 1st week	June 3rd week	June 1st week. 1st year.	July 1st week, 1st year, to be done by the watcher free of charges.	
Third weeding	May 1st week next year	July 2nd week	June 4th week. 1st year.	May 1st week, 2nd year, to be done by the watcher free of charges.	
Fourth weeding	n.a.	August 4th week.	May 1st week. 2nd year.	August 1st week, 2nd year, to be done by	

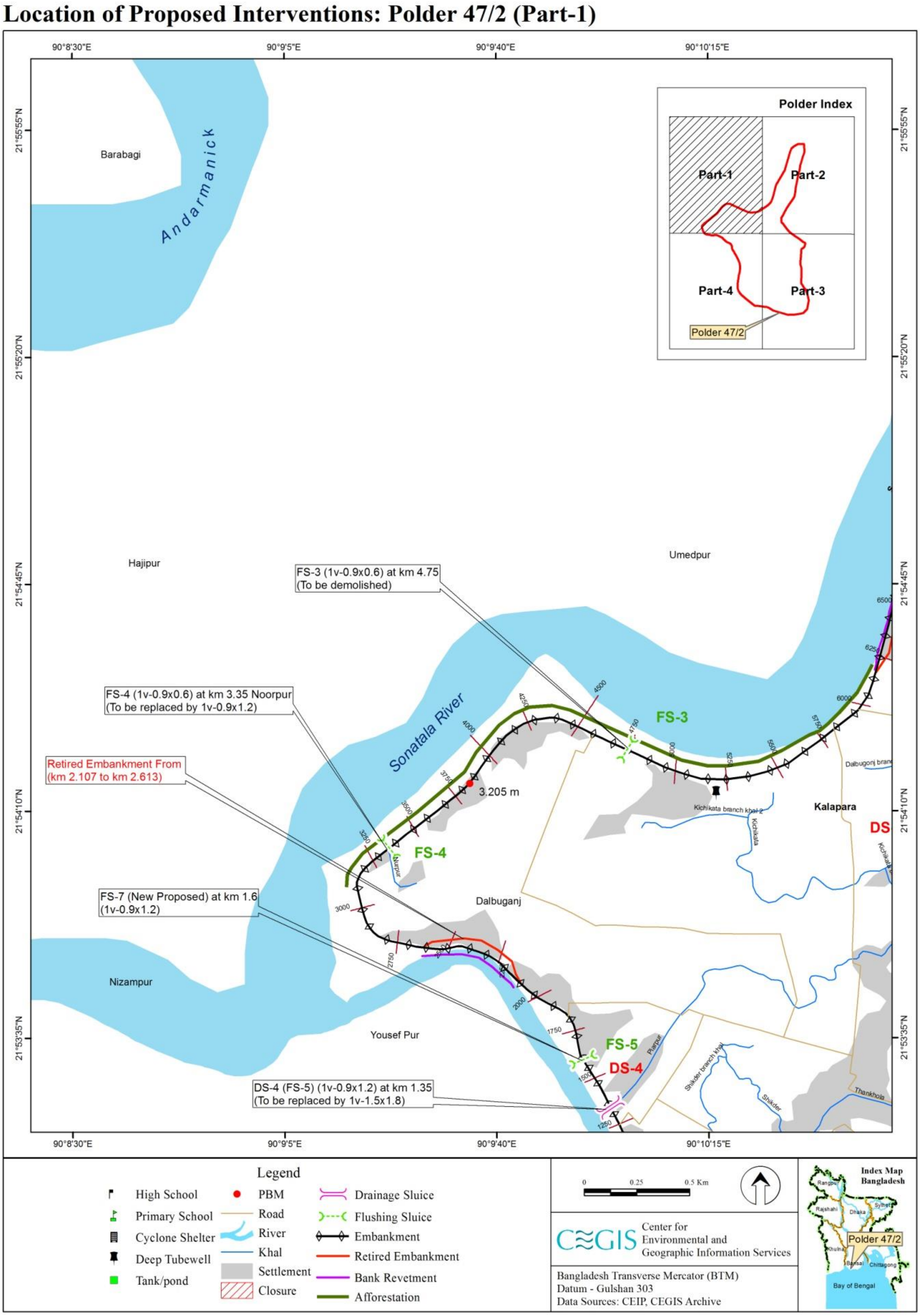
Item of works	Time schedule for the given type				
	Golpata (Nypa) Plantation	**Chailla, Kankra, Gewa Plantation**	**Keora Baen Plantation**	**Embankment Slope Plantation**	**Additional Plantatation**
				the watcher free of charges.	
Sapling Distribution	-	-	-		July, last week
Fifth weeding with light pruning if necessary.	n. a.	April 1st week next year.	October 1st week. 2nd year.	n. a.	
Sixth weeding (Climber cutting)	n. a.	June 1st week next year.	n. a.	n. a.	
Seventh weeding (Climber cutting)	n. a.	August 1st week. Next year.	n. a.	n. a.	
Pruning.	n. a.	n. a.	n. a.	n. a.	
Watching	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	

Source: Feasibility Report of CEIP, Volume III: Afforestation Report, September, 2013

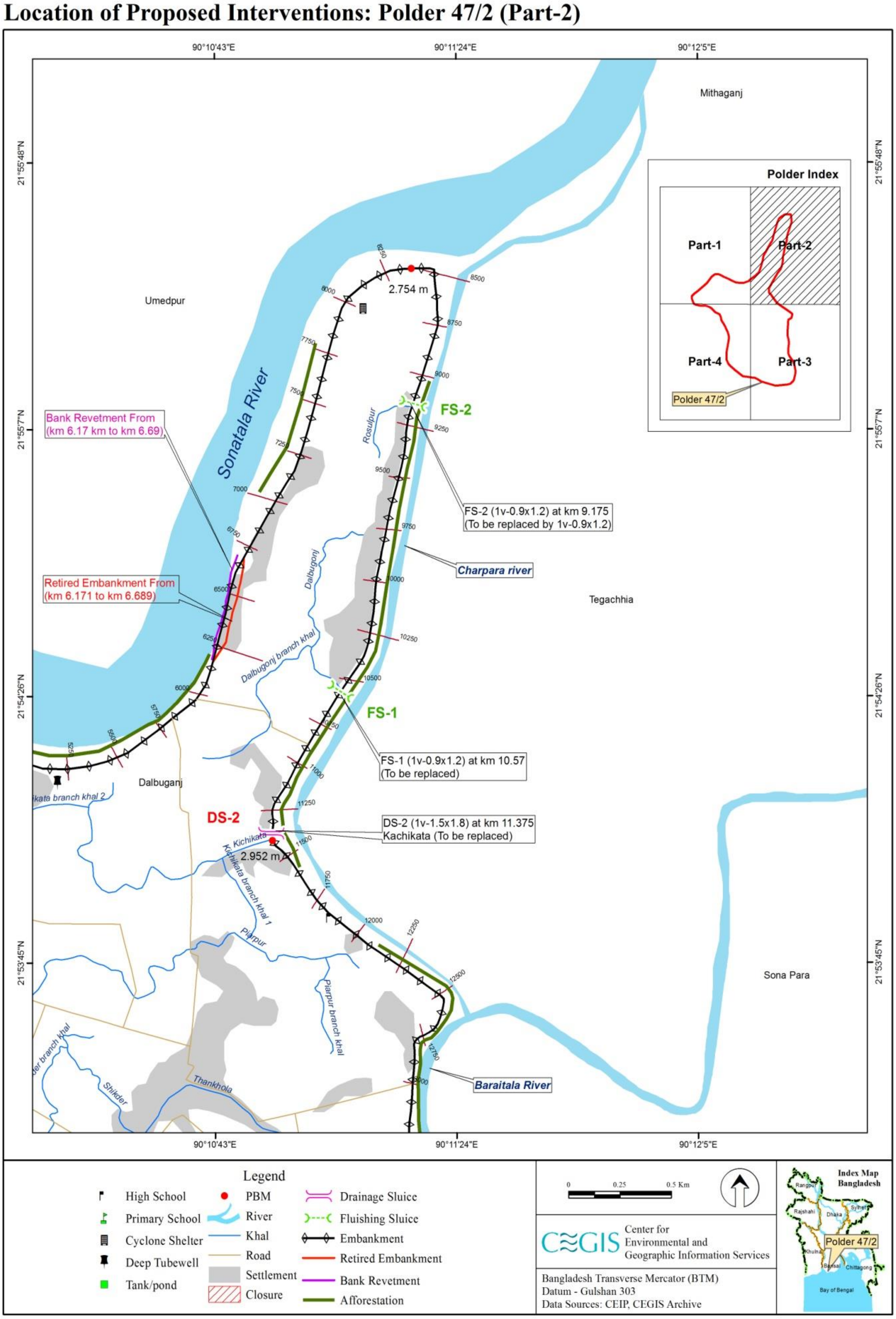
Location of Proposed Interventions: Polder 47/2



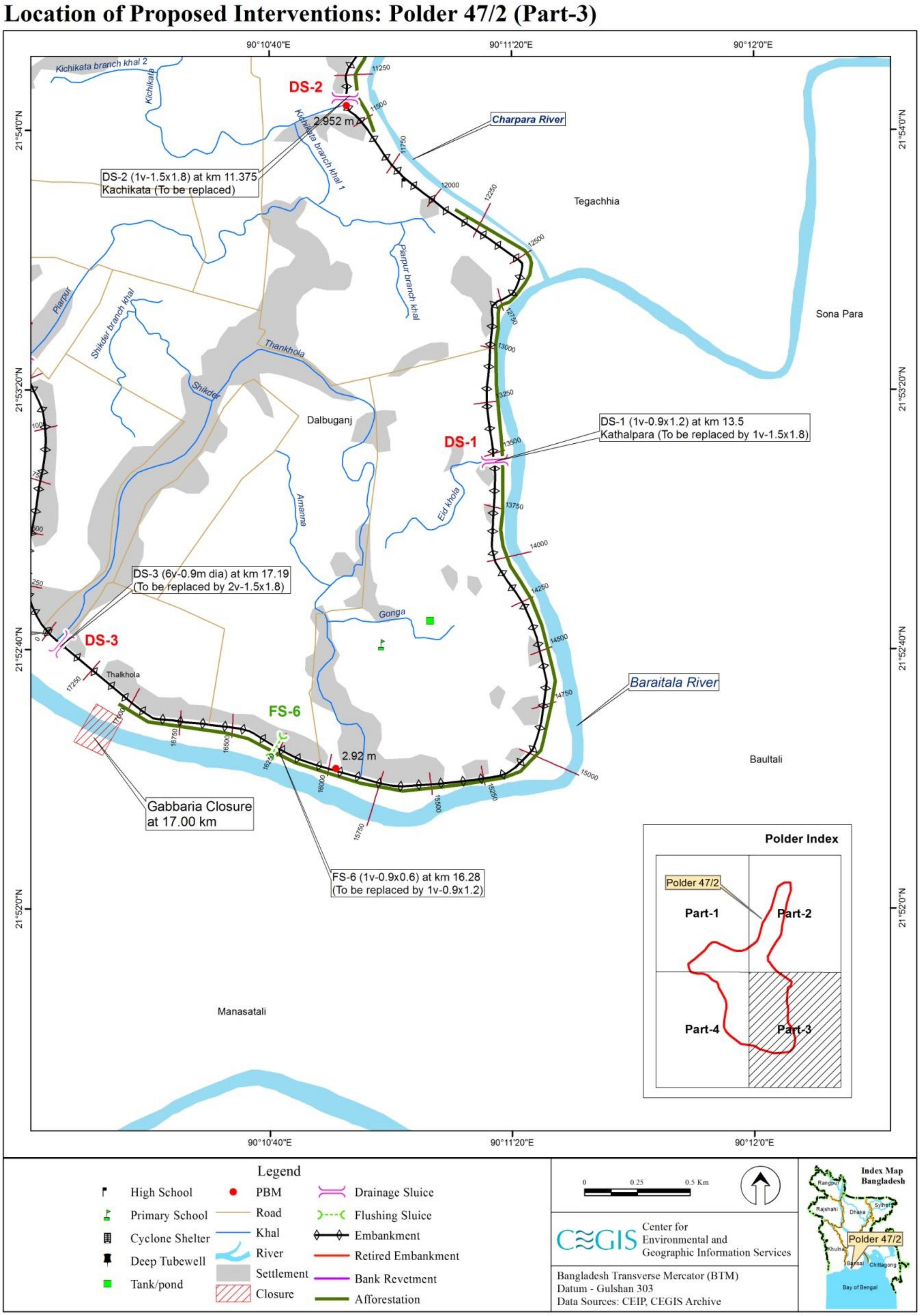
Map 4.2: Map showing the locations of proposed interventions



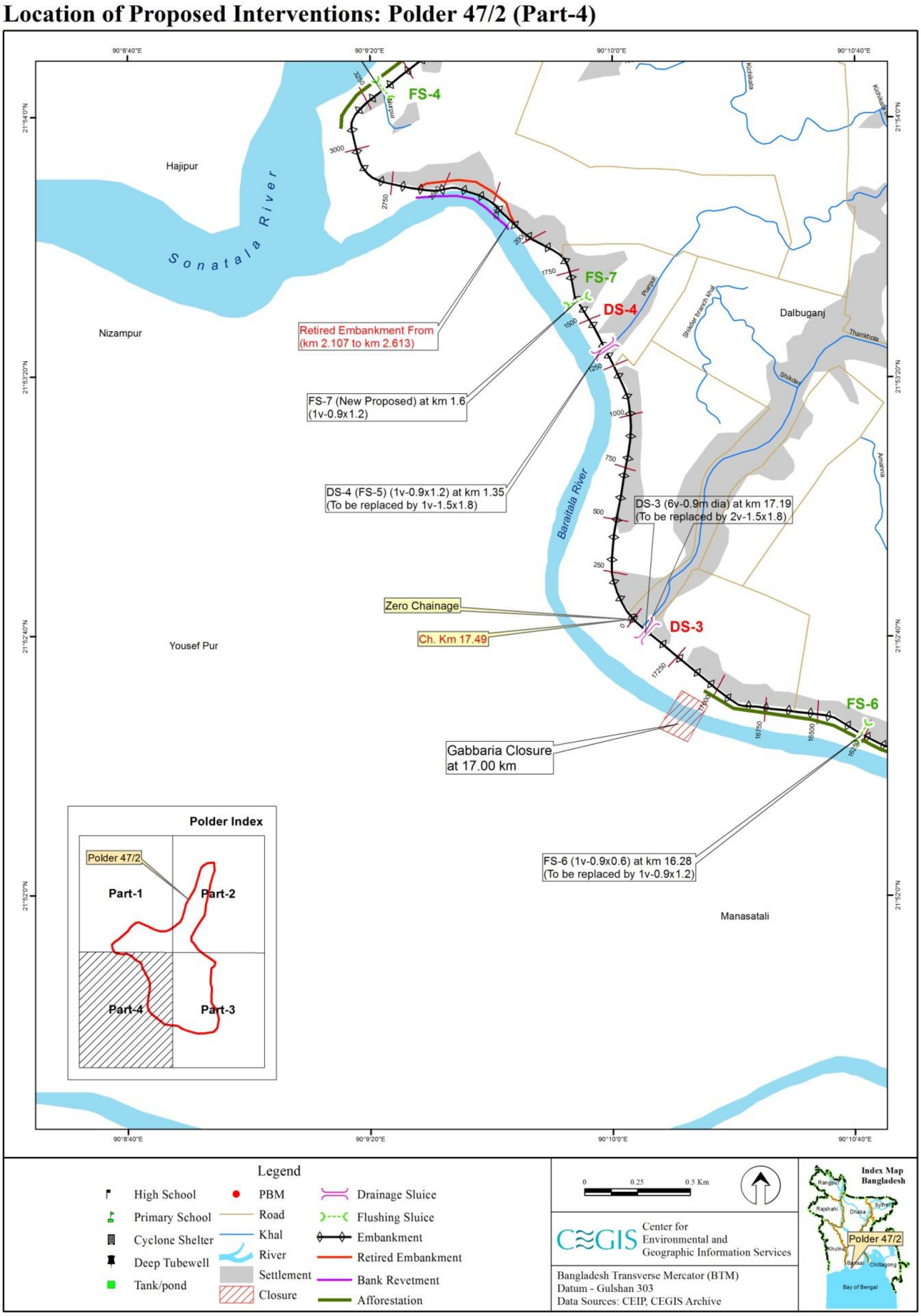
Map 4.3 (Part 1): Map showing the locations of proposed interventions



Map 4.3 (Part 2): Map showing the locations of proposed interventions



Map 4.3 (Part 3): Map showing the locations of proposed interventions



Map 4.3 (Part 4): Map showing the locations of proposed interventions

4.7 Construction Details

4.7.1 Construction Schedule

206. The construction works in Polder- 47/2 under the CEIP-1 are expected to be completed in four years. The construction schedule is presented in Table 1 in Appendix 1.

4.7.2 Construction Manpower Requirement

207. Technical and nontechnical manpower will be required for the construction works. The manpower will include engineers, technicians, supervisors, surveyors, mechanics, foremen, machinery operators, drivers, and un-skilled laborers. Around 60 to 70%of the laborers will be engaged from the local area and the rest will come from outside of the Polder area. The estimated manpower requirement is presented in Table 4.9.

Table 4.9: Required manpower for construction

Sl. No.	Required Manpower	Number
1	Engineer	1
2	Machinery operator	20
3	Mechanics	1
4	Surveyor	1
5	Skill labour (Person-day)	4,000
6	Un-skill labour (Person-day)	40,085

Source: Engineering & Procurement Team of CEIP-1, 2015

4.7.3 Construction Material

208. The construction materials required for re-sectioning of the embankment, drainage sluices, flushing sluices and bank protection work will include soil, cement, steel, and sand. The estimated quantities of these materials are presented in **Table 4.10**.

Table 4.10: Details of Construction materials

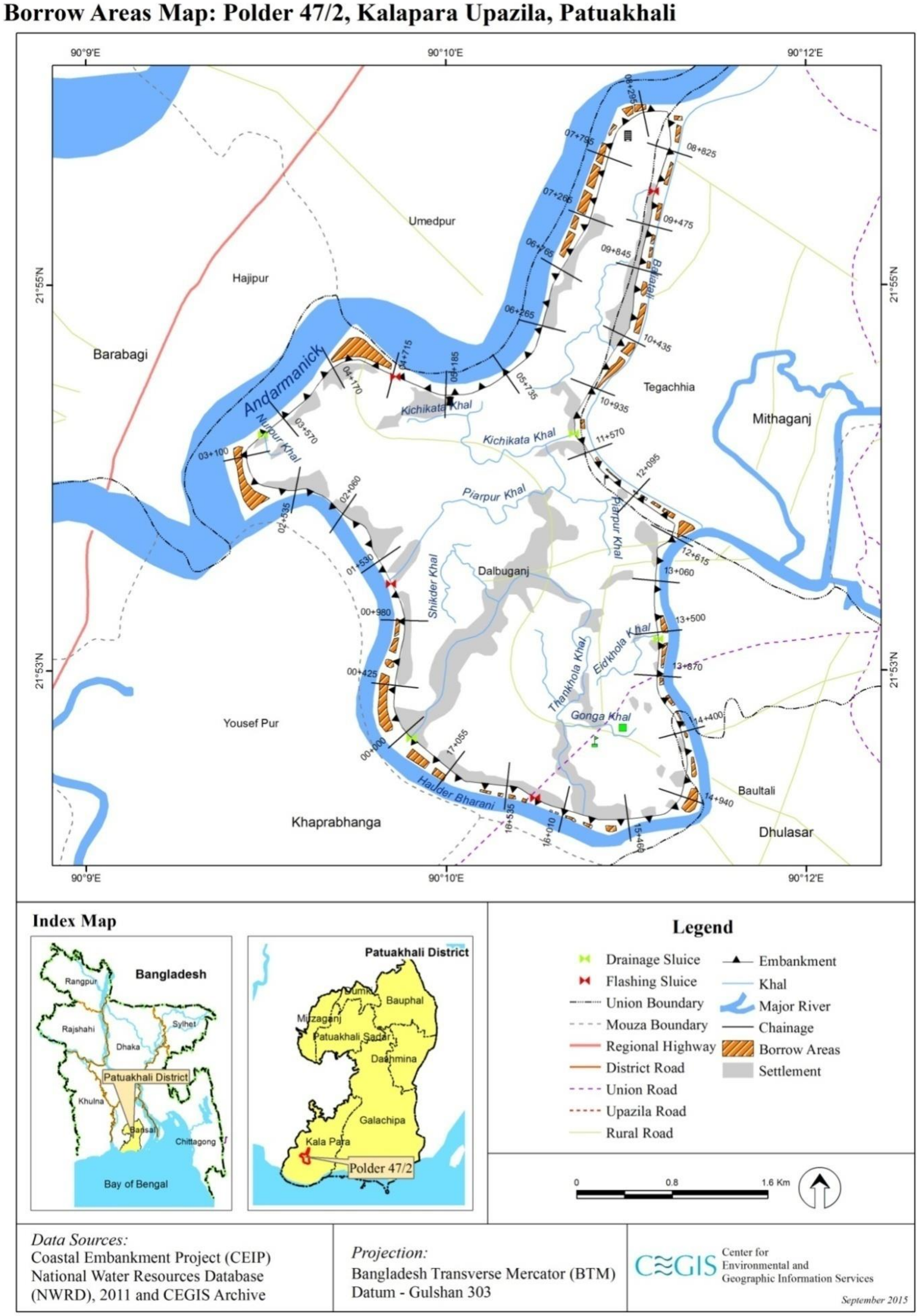
Sl. No.	Description	Quantity	Sources
Re-sectioning and retired embankment			
1	Earth work	600,000 m^3	Borrow pits, dredging spoils from re-excavation of drainage channels
Construction of sluices and flushing inlets			
2	Cement	40,000 bag	To be procured from local market
3	Sand	2,000 m^3	To be procured from Patuakhali/Sylhet
4	Stone	3,000 m^3	To be procured from Patuakhali
5	Steel	700 Ton	To be procured from Patuakhali
Bank protection			
6	CC Blocks	0	

Source: Engineering & Procurement Team of CEIP-1

Earth from borrow area

209. The earth for rehabilitation of the embankment will be collected mainly from the offshore borrow areas of Polder-47/2.The EIA team of CEGIS has identified the available borrow areas during field investigation considering the minimum set back distance of 15 m from the toe of the embankment. The required earth for of the embankment could be obtained from the identified borrows areas. The depth of the borrow areas shall not be more than 1.5 m to be designed by Main-Consultant) which does not cause any impact on geo-morphological and topographyaz. However, necessary approval has to be obtained in this regard.. The borrow pit area have been selected based on khas land, fallow and tree less land which does not change the topography of this area. During excavation of borro pits, a

separate walk way will be kept for the movement of workers and pedestrians. In the coastal area, on an average, roughly 5 to 10 inches sedimentation takes place in most of the major khals and the surrounding rivers each year. Therefore, it is expected that the pit area will be restored within 5 to 10 years after excavation. The identified borrow areas for earthwork of the embankment is shown in Map 4.4.



Map 4.4: Map showing the available Borrow area of the Polder-47/2

4.7.4 Construction Machinery

210. Different types of construction machinery and equipment will be needed for the construction activities in the polder. A tentative list of these machinery and equipment is presented in Table 4.11 below:

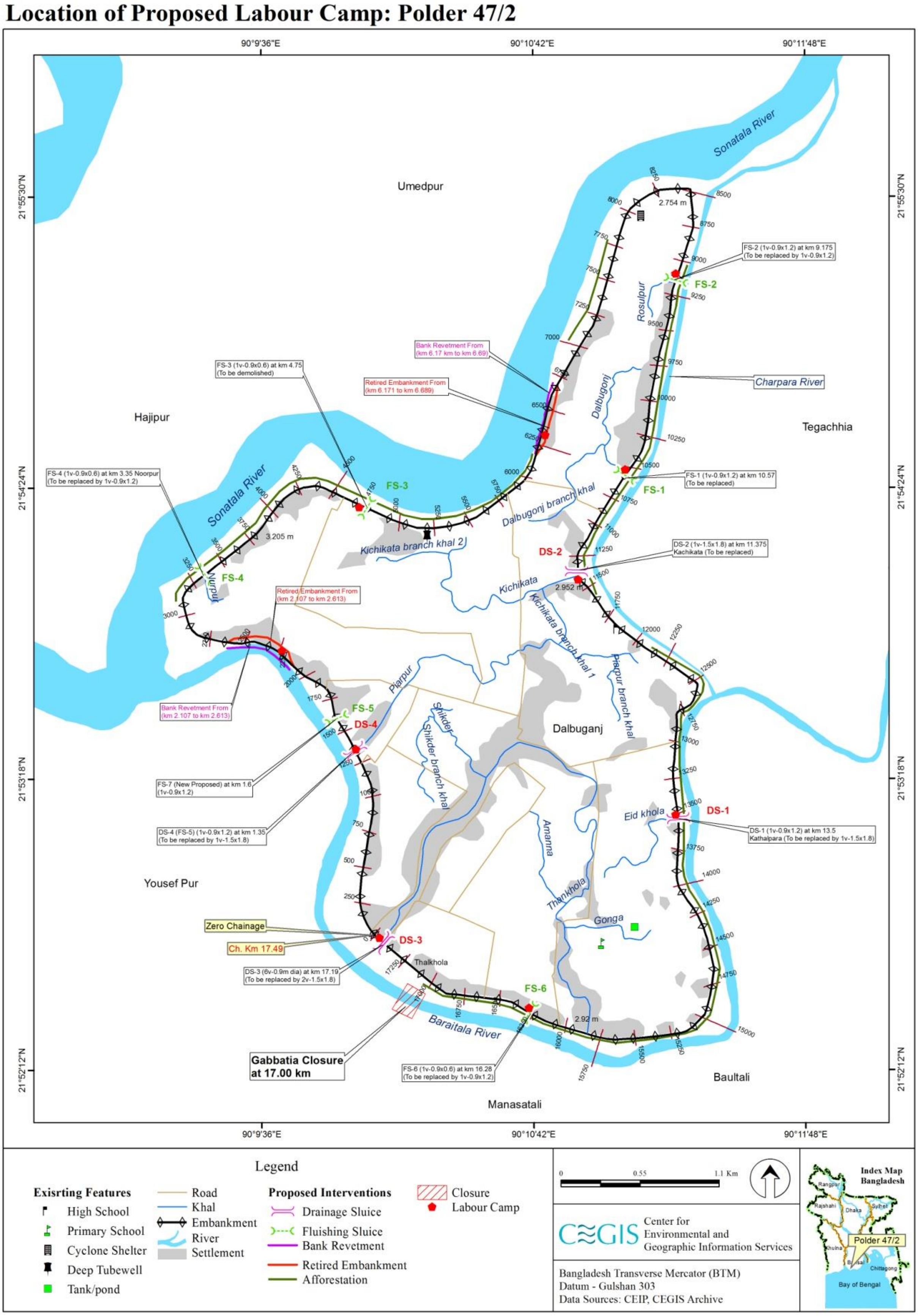
Table 4.11: List of construction equipment and machinery

Sl	Description	Quantity (number)
1	Bulldozer	2
2	Dump- truck	8
3	Pay Loader	2
4	Excavator	20
5	Barge	1
6	Engine Boat	6
7	Vibrator	2
8	Compactor	7
9	Mixture Machine	7
10	Mixing-Plant	1
11	Truck	6
12	Tractor	5
13	Generator	9
14	Levelling Instrument	3
15	De-watering System	1
16	Low lift pump	12

Source: Engineering and Procurement Team of CEIP-1

4.7.5 Construction of Labour Camps/sheds

211. A total of 10 camps/sheds for labor will be established during construction period. Out of the total camp, 6 camps are for sluice and flushing inlets works, one camp is for bank protection works, three camps for embankment works. The Contractor will select the location of the camps through consultation with the local union parishad chairman and the local community, and after obtaining permission from the DCSC. The planned location of construction camps are shown in Map 4.5.



Map 4.5: Map showing the locations of proposed labour camps

4.8 Project Implementation Arrangements

212. **Overall Project Management**. The Government of Bangladesh has the overall responsibility for project management and coordination through its Ministry of Water Resources. A Project Steering Committee (PSC) would provide the forum for overall guidance, policy advice and coordination of the project activities and for addressing inter-agency issues. The BWDB will act as the *Project Implementing Agency* and implement the project through a Project Management Unit (PMU).

213. **Project Steering Committee (PSC)**. The PSC would be chaired by the Secretary of Water Resources and will include the Secretaries of Finance, Agriculture, Environment, Public Health Engineering, Forestry and Wildlife, and the Chief Executive officer of selected NGOs, and representatives of the local/district administration as its members. The PSC will oversee the project and provide policy-level guidance and inter-agency coordination for the project. The Project Director of the PMU will act as the secretary of the PSC.

214. **Project Management Unit (PMU).** The BWDB will set up a PMU to oversee the development and management of the Project. It will be led by a Project Director appointed by the BWDB who will have the rank of Chief Engineer, and will directly report to the Director General (DG). The PMU will have a central project office located at the headquarters of the BWDB in Dhaka. The PMU will have 3 subordinate units: (i) Engineering Unit; (ii) Procurement and Finance Unit; and (iii) Social, Environment and Communication Unit. In addition to the central unit in Dhaka, three *Field Level Offices* will be set up, each headed by an Executive Engineer, recruited by the project. The Field Offices will be located in each of the three main project districts, namely Khulna, Patuakhali/ Barguna and Bagerhat.

215. **The Engineering Unit** will oversee the work of the consultants on design and construction supervision matters. A Deputy Project Director will head the *Engineering Unit* and spend about half of his/her time at site to provide coordination between the PMU, the supervising consultant and the three field offices. In addition to the Deputy Project Director, the unit will also include two Executive Engineers and two Assistant Engineers.

216. **The Procurement and Finance Unit** will be responsible for the entire procurement and financial management process of the Project. It will also be responsible for monitoring project progress, to liaise with the Bank and to prepare annual programs, implementation reporting, updating all procurement reporting documents, and financial management reporting. The procurement staff would consist of a Senior Procurement Specialist and one Procurement Specialist. The finance staff would consist of one Deputy Director, Finance, two Accountants and three support staffs.

217. **The Social, Environment and Communication Unit** will supervise compliance with the Environmental Management Plan and Social Action Program. This unit, together with the engineering unit will implement the communication strategy. This unit will include a Senior Environmental Specialist, a Senior Social Specialist, a Senior Forestry Specialist, a Revenue Staff and a Communication Specialist.

218. **Each Field Offices** will be staffed with one Project Manager/Executive Engineer (XEN), two Sub-Divisional Engineers (SDEs) and two Assistant Engineers (AEs). In addition, an Environmental Specialist, a Social Specialist and a Revenue Staff will work across all the three field offices.

219. The PMU will be supported by the following consultancy services:

- An experienced NGO will be mobilized by the PMU to implement the social afforestation recommended in the EMP, the Social Action Plan including mobilization of Water Management Organization, the RAP and the EMP.
- A *Design and Construction Supervision Consultant (DCSC)* that will assist the PMU in preparing the detail design of the remaining polders and supervise all the construction. For civil works contracts, the Project Director will serve as the

Employer, and the DCSC will serve as the *Engineer* for construction supervision. At the site, a *Resident Engineer*, appointed by the consultant, with a team of specialists and inspectors will supervise the Contractor.

- A Third Party Monitoring and Evaluation Consultant will provide support in monitoring project impacts and supervise the implementation of the EMP/RAP and report to the PMU.
- A Procurement Panel will be appointed by the BWDB to oversee the procurement process of large value contracts subject to prior review under the Project. The panel will consist of two international/expatriate specialists and one national specialist.

220. *An Independent Panel of Experts (IPOE)* will be appointed by the BWDB to act as an independent "peer reviewer" and undertake quality control functions of various technical outputs. The Panel will consist of 5 renowned experts in the fields of morphology/ river engineering; tidal river management/ sedimentation, geotechnics, sociology and environment.

This institutional arrangement is effective and are being followed in Package -1 of CEIP-1

4.9 Water Management and Operational Plan

4.9.1 Introduction

221. The coastal polders, surrounded by embankments in the coastal region, protect the lives and properties of people and agricultural lands with crops from tidal inundation; saline water intrusion; storms and cyclonic surges thereby releasing a large extent of land for permanent agriculture as well as congenial living condition.

222. The polders have been playing vital role in safeguarding the coastal area; ensuring and increasing agricultural production; improving livelihoods of the people; and mitigating environmental damages. However, these are vulnerable to storm surges; high tides; annual floods; land erosion and drainage congestion. In many cases, the structures as built have not been found adequate to cope with the diversified needs of the local people. Changes in the land use pattern of the area have also created water management conflicts and new dimensional needs asking the structures to allow water to flow in both directions. So maintenance of the polder system with embankments and structural elements built over there has permanently become important. The Government of Bangladesh either with assistances from international donors and lending agencies or out of its own resources has been spending money almost in a regular basis to keep the polders in good working condition eventually to save the coastal people. The Coastal Embankment Improvement Program (CEIP) is one of the latest initiatives to address a systematic restoration and upgrading of polder systems in the coastal region. Under this long term phased program of polders improvement, Operation and Maintenance issues with special reference to Local Government Institutions (LGIs) as well as local stakeholders participation and need based budgeting will continue to remain at the apex.

4.9.2 Approach and Methodology

(a) Approach

225. There is no denying of the fact that the Operation and Maintenance (O&M) of large-scale water resources projects in Bangladesh are chronically under-financed. BWDB field offices have a common complaint that they are always provided with poor fund which are not only inadequate to cover the exact requirement of major preventive maintenance works; but in most cases so meager compared to the total needs even no minor maintenance work is possible to be undertaken. Thus for the years together vital works of

preventive maintenance are deferred and eventually pushed down to expensive rehabilitation measures. Several studies for O&M of BWDP sub-projects and polders have addressed this issue quite in depth and many suggestions have been put forward. The most relevant to the current assignment i.e. *"Guidelines for O&M Planning and Budgeting, August 2001; CERP-II"* has been consulted very carefully. Moreover, the Consultants discussed all the pros and cons of polders' O&M issues with BWDB's field staffs and local stakeholders to suggest this approach for polder O&M planning, which is summarized as below:

Community Participation in Operation and Preventive Maintenance

226. Polders need to be taken care of its every day wear and tear quite effectively. Past experiences show that preventive maintenance of polders (embankments, structures, canals etc.) through community participation is successful if necessary supervision and guidance are ensured from BWDB's end. To make participation worth and meaningful, stakeholders should be allowed to ventilate their opinion right from the planning process to actual implementation stages. However, the success depends on the active participation of the local stakeholders. Above all, institutionalization is most importantly considered in this kind of local participation. There should have some cohesive forces to unite the people together, which can be ensured through building of institutions. When there is a common platform to think on any particular issue leading to some common interests and are tied with some goals to achieve in the long run, the united people can work effectively and produce the desired results.

227. For effective and meaningful community participation, the following remarks are important.

- ***Firstly,*** a formal institutionalization process should be undertaken to organize the local stakeholders in a common platform, i.e. Water Management Organizations (WMOs).
- ***Secondly***, all potential beneficiaries who intend to take part or are motivated to take part in O&M activities should make their ways to do so only through WMOs. Without formal institutionalization of WMOs, no direct monetary benefits or usufractuary rights will be allowed to any of the functional groups.
- ***Thirdly***, the advantages allowed to any of the groups under WMOs should not be treated as the permanent arrangement but a simple performance based contract. Direct monetary assistances on a regular basis make people crazy and idle; they start behaving oppositely when such benefits are restrained. The members of the functional groups under WMOs will be clearly informed at the beginning that the contracts are not *perpetual* rather *performance based* and will be renewed after certain period.

<u>Annual Evaluation of the O&M activities done by WMOs</u>

228. There should be some accountability on the part of the Water Management Groups (WMGs) involved in the O&M activities. Therefore, assessment needs to be done ***twice in a year***; once at the beginning when the polders will be jointly supervised to record the prevailing conditions of the infrastructures, i.e. more specifically the requirement of probable preventive works will be listed; and finally at the end of the year another joint verification will be made to ascertain the real accomplishment of the maintenance works by the functional groups (EMGs, CMGs, LCSs & SMGs) working under WMGs.

229. It is wiser to remove them who will be found worthless and ineffective in accomplishing their duties. Continuous guidance and monitoring the performance of WMGs vis-a-vis the functional groups by BWDB field staffs will make them more accountable and eventually some improvements will be apparent in the preventive maintenance program. The Local Government Institutions (LGIs) i.e. Union Parishad leaders / representatives (i.e. the

Ward Members) may be involved for active support and cooperation during the process of this joint verification and assessment.

Prioritization of Maintenance Works

230. In case of any shortfall in funding, the large and expensive repair works on embankments; structures and protective works (major periodic maintenance and rehabilitation) will be considered a lesser priority. Implementation of this type of major periodic maintenance/rehabilitation works should be separately addressed through other sources of fund instead of the preventive O&M fund. This will release pressure on cost effective and minor periodic maintenance. If the preventive and minor periodic maintenance works are given adequate priority with regular and timely accomplishment, the need for rehabilitation measures will decline over time.

Interaction with Local Government Institutions and Stakeholders

231. Field staffs of BWDB should work more closely with the leaders of Union Parishads and Community Groups in the field. Local stakeholders' participation will meaningful and effective if the Local Government Institutions (LGIs) are involved in the Operation and Maintenance stages through Water Management Groups vis-a-vis the functional groups or community-based organizations. Meetings with local stakeholders will have to be organized at the field level as and when required; comments and opinions of the local stakeholders (including members of the WMGs i.e. functional groups in particular) received from these meetings should be taken into account with due importance.

232. In addition to the annual joint supervisions for field assessment of the polder infrastructures, Field Supervisory Staffs of BWDB are to carry out regular periodic "Field Checks" of the embankment and structures. In all such events, the local Union Parishad leaders preferably the concerned Ward Member are to be invited to take part. Furthermore, in cases of annual evaluation of the performances of functional groups (EMGs, CMGs, LCSs and SMGs) it is advisable to take up the issues with the Union Parishad Chairman as a fixed agenda.

Engaging NGOs in operation and Preventive Maintenance

233. The employment of the NGOs to a limited scale would have better impacts in actual Operation and Maintenance of polders. The role of NGOs should be limited to the identification and selection of local beneficiaries; formation of Functional Groups from the beneficiaries identified; institutionalizing them as the polder community; and training. BWDB's Sub-Divisions will directly supervise the activities of the NGOs or in other words, the NGOs will be directly responsible to the concerned Sub- Division for their performances even though the employment and contract negotiations would have to be completed by the Divisional Office.

4.9.3 Methodology

Meetings with Local Stakeholders at site

234. It is required that consultative meetings on identified interventions should be organized with stakeholders for their public commitment. Discussions in these meetings may lead to bring in some changes and modifications compatible with the local needs. The CEIP-1 Consultants will also have similar opportunities to help and assist the concerned Division Offices so that meetings with local stakeholders are held at projects sites seeking their opinion on the functional aspects of interventions as well as support / cooperation in the implementation.

Priority of Maintenance Works and preparation of Work Authorization

235. The most important step of O&M planning is the prioritization of the proposed works especially when there is anticipated shortfall in funding. The list of maintenance works normally considered necessary to be undertaken in a polder for a particular period may be

large; but depending to the available fund for *O&M*, many items of the list have to be curtailed. The list thus becomes short and shorter based on priority. The criterion for prioritization or "Budget Cuts" should be applied quite judiciously, i.e. coming down from the items of major periodic maintenance to the items of minor periodic maintenance. Preventive maintenance works should be left untouched (Figure4.3) because adequate preventive and minor periodic maintenance push down the need of rehabilitation; infrastructure remains in good condition.

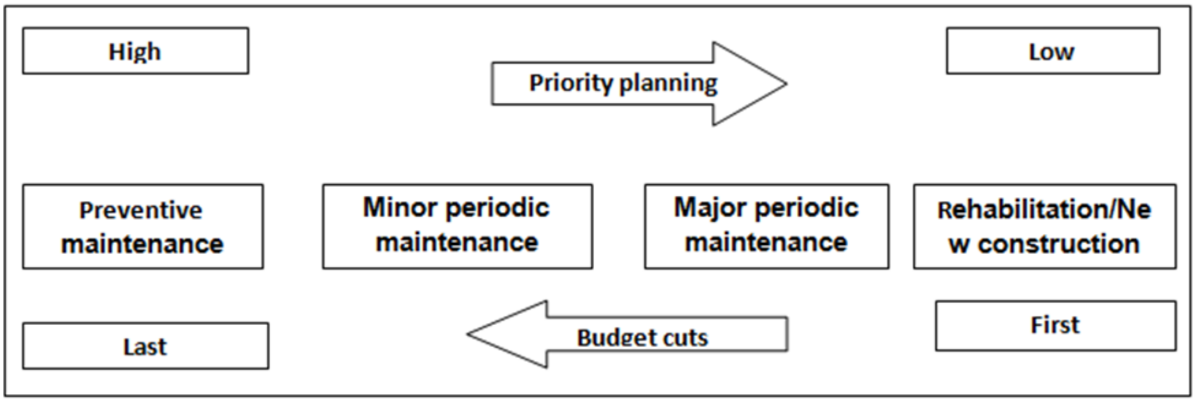


Figure 4-3: Priority Budgeting for O&M

236. It is very hard to prescribe any standard criterion for prioritization of works because the socio-economic dimensions for each polder vary widely. So, the actual selection of work items for prioritization should be made very carefully and for each polder separately.

4.9.4 Operation Plan

237. The operational plan involves setting out the schedule of activities related to operation of gates of structures by the users' organization to control water levels best suited to water management and agricultural needs. In the coastal polders, operation of gates mainly focuses on protecting the saline water out of the polder during high tides and allowing drainage of excess water from inside the polder during low tides to minimize the depth of flooding but storing enough water on the paddy fields. The trend however changes in the dry season where the operational plan aims in storing as much water in the canal networks as possible by closing the gates. The water thus stored should have the basis of a balancing mechanism among all categories of user viz. paddy growers; salt producers (if there is any); shrimp producers (also including other fish culture practices); and also domestic users. Operation of structures should therefore be an organizational, low cost activity requiring quick communication with the beneficiaries and with project staffs at the lowest level.

4.10 Operational Activities

238. The operational plan provides the framework upon which canal water levels (also referred to as operation target) and day-to-day structure operation will be based. More specifically, the operational plan for the CEIP polders can be thought of as a hub for the following operational activities:

- *Operation of drainage regulators;*
- *Operation of flushing sluices/irrigation inlets; and*
- *Operation of privately owned Low Lift Pumps (LLPs)*

239. Besides, some other activities may also be conceived in the context of varying polder conditions. The following activities are within the purview of operational plan:

4.10.1 Regulation of gates

240. In the past BWDB employed the Gate Operators from its own; but due to budget cuts this position has been discontinued. Currently the responsibilities of gate operation are given to beneficiaries in the polders where agricultural activities are of main concern. Standard procedures have been developed under different projects but are hardly followed as common practices.

241. The picture in other polders where only FCD activities exist is different; institutional set up for the users' organizations is yet to be built and introduced. This particular issue will be discussed in detail in the following section to address Beneficiaries Participation in coastal polders.

242. The gates of each drainage sluice / regulator must be operated following certain fixed rules regarding timings. BWDB O&M section in consultation with the beneficiaries' organizations, DWM staffs and DAE field staffs will ensure operation of the gates in conformity with operational timing based on actual water management and agricultural needs.

243. Flap Gates of regulators should remain in place at all times except during maintenance and flushing. During pre-monsoon period, the vertical lift gates of each regulator should remain closed for retention of water for irrigating Aus crops by LLPs. During monsoon (*July to September)*, the vertical lift gates should normally remain closed; but may be opened to regulate the water levels inside the polder and should not be allowed to exceed the stated maximum permissible level for safety reasons. In order to achieve this, discharges into the river should commence (river levels permitting soon after this level is attained. This type of water management decisions should be taken after due consideration of daily rainfall, river stages, water levels inside the polder, gate opening schedules. However, the frequency and type of this decision making process will vary with the seasonal conditions.

244. During post monsoon season (*October to November*), the vertical lift gates will be operated to retain water in the drainage canals without overtopping the canal banks and increasing the soil moisture level for cultivation. In all these cases, there should be enough consultation with the beneficiaries' organizations because agricultural practices, crop varieties; and cropping pattern changes with over time.

245. Operation of Flushing Sluices and Pipe Inlets should also have similar practices with maximum involvement of beneficiaries' organizations. The O&M section and DWM staffs of BWDB will assist them in the water management of command areas inside the polders. A gate operation plan in Bengali is provided in **Appendix-12.**

4.10.2 Frequent Watching of Embankments

246. This is a typical monitoring activity to be carried out by the BWDB O&M Staffs. It is intended mainly to detect weak sections, gullies, slips, sign of squatter settlements, and cultivation of perennial cash crops, cuts in the embankments to accommodate homesteads, embankment subsidence and erosion and / or settlement of protection works.

4.10.3 Regular Checking of Structures

247. This is also a typical monitoring activity to be carried out by BWDB's O&M field staffs to detect slips at abutments, damage of protective works and wing walls, and periodic damage to flap gates and fall boards etc. The functional groups under WMGs in the polders will assist the O&M Section Office of BWDB to identify and report the damages for rectification.

4.10.4 Condition survey (of embankment & structures) and Engineering survey

248. The survey data obtained by the O&M field staffs of BWDB are used for estimating the required maintenance works. Physical condition of embankments and structures are investigated through field surveys once in a year. This is specially required to prepare the details for carrying out periodic maintenance works.

4.10.5 Supervision of preventive maintenance works

249. Preventive maintenance works are performed by community-based functional groups (e.g. EMGs, SMGs, and CMGs) as and when required round the year. The works are the most simple, cheap and cost effective maintenance works and are implemented more or less continuously. The field staffs of O&M section of BWDB supervise all preventive maintenance works.

4.11 Planning of Operation

250. The objective of structures operation is to maintain control over water levels in the polder channels to ensure integrated water management. This means that the operation of water management structures should be directly linked to agricultural requirements and on-farm water management conditions keeping the eyes open on the requirements of other users like fisher folk community, navigators/boatmen, salt growers (if applicable) and general water users for domestic purpose. So in the planning of operation, the demands of all categories of beneficiaries should be taken into account for achieving perfect integrated water management. Participation of beneficiaries at all levels of planning is essential.

251. The decision making process involved in structure operation is shown in Figure 4.5. This illustrates schematically the procedural steps necessary to translate water management needs into actual structure operation. The water management plan drawn over a season provide the framework upon which water levels in the drainage channels i.e. operation targets and day-to-day structure operation needs will be based. However, actual field water levels may diverge from the water management targets due to some unpredictable factors like rainfall or other causes. During the cropping season, monthly, weekly or daily operational adjustments will be required. Routine monitoring of water management and hydrological conditions will supply data that together with the water management plan, will dictate the need of adjusting the operational measures.

252. Participation of beneficiaries vis-a-vis the farming community is essential in establishing the seasonal or long-term water management plan. This however, reduces to a somewhat lesser extent in setting up the weekly operation targets. Although the daily structure operation is largely an activity of the responsible O&M authority like BWDB's Section Office, it can be shifted to the WMG if they are provided with adequate training and management capabilities.

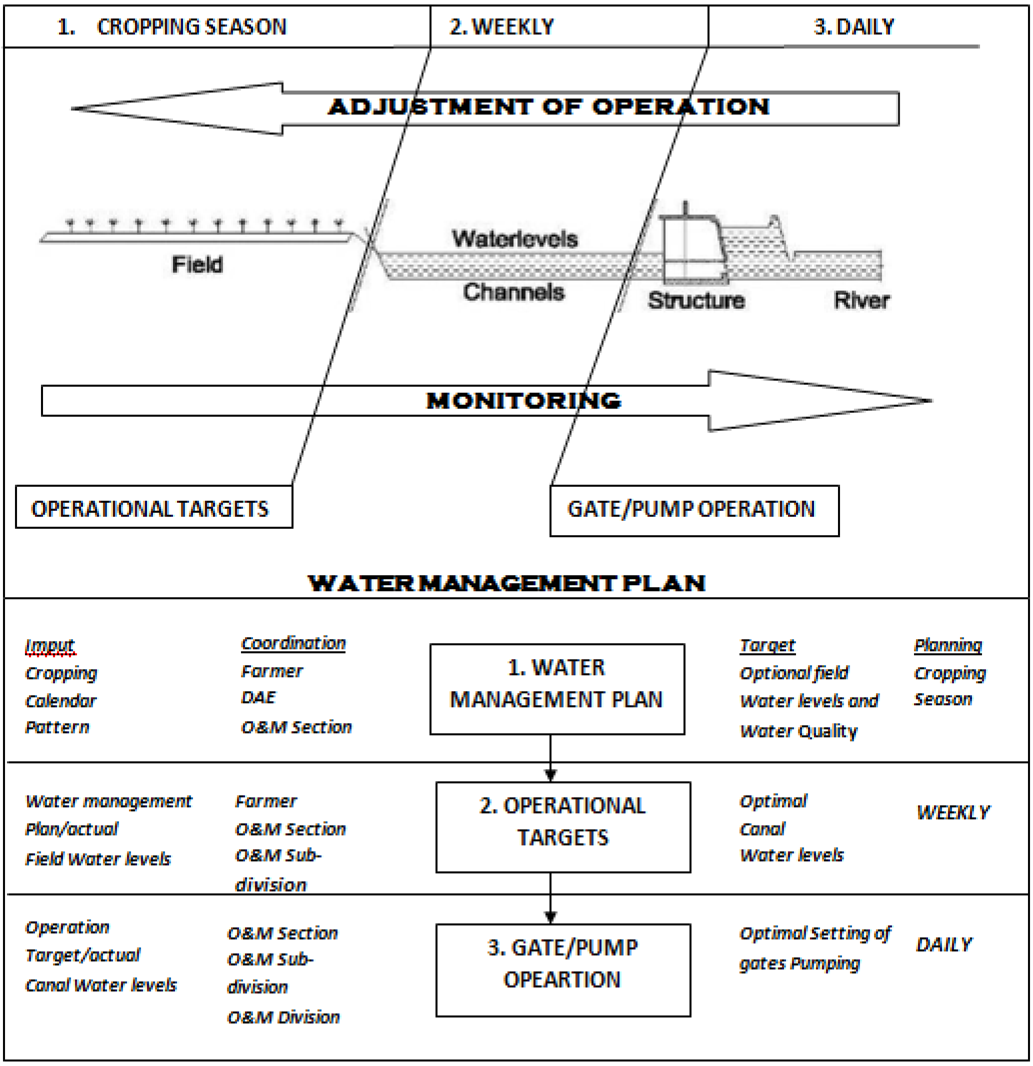


Figure 4-4: Decision making in operation

(a) Seasonal Water Management Plan (WP Plan)

253. In coastal polders both the drainage and water conservation requirements are equally important; in the wet season drainage will get priority while in the dry season, conservation of sweet water inside the polder becomes the predominant factor. The seasonal water management plan must therefore emerge covering the polder as a whole and on the basis of the requirements of all water users. The plan will have to be prepared jointly by the BWDB's O&M offices, the leaders of WMGs / WMAs, and DWM of BWDB. Draft water management plans will be drawn up to the user level i.e. at WMGs (Figure 4.6, Planning Procedure); these will be combined into water management plans at WMA (Sub-Division level). In large polders the plans will be compiled by the Executive Engineer (in support and cooperation of the WMF- if exists) and DWM to produce the final WM plan. This needs to be prepared well ahead of the cropping season so that critical farm operation (e.g. seed bed preparation, shrimp or salt production requirements) can be carried out in line with the plan.

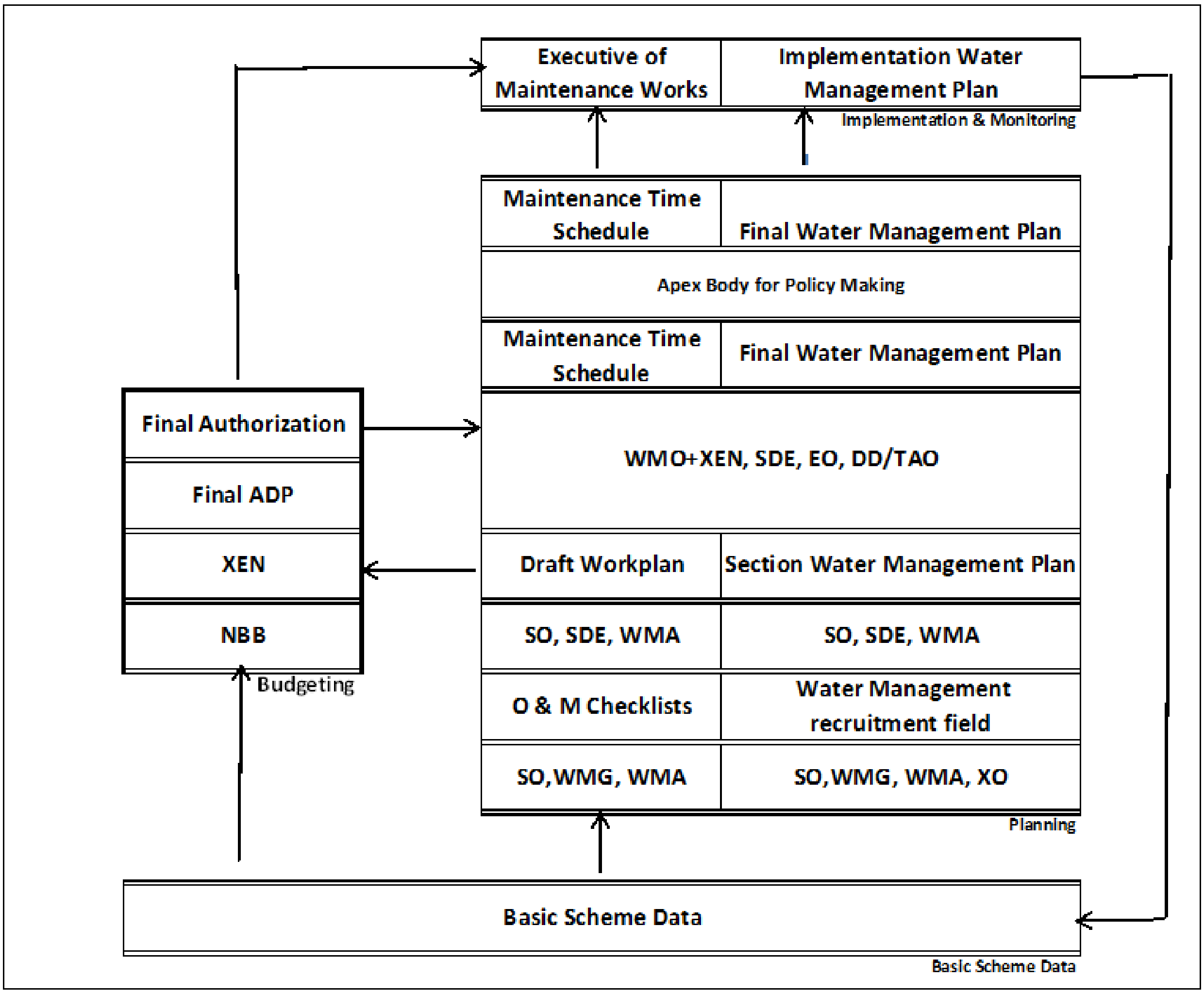


Figure 4-5: Standard Planning Procedure

Note
DD Deputy Director
TAO Thana Agriculture Officer
BS Block Supervisor
For other Abbreviations, see FIG: Relationship between WMGs and LGIs

254. Inputs required for the WM plan includes information on crop calendars and cropping pattern to be formulated by the farmers in consultation with agricultural extension services, DWM and BWDB's O&M staffs. Together with information on the system (Basic polder data, O&M guidelines, Design details, etc.) and status of the system (Monitoring data, O&M checklists, Maintenance work plans, and Maintenance time schedules) this will enable in drawing up of a detailed water management plan. In large polders, there will be water management computer model to use as an important tool in the planning process. The models can be used to compute several water management scenarios and the effects of certain measures (e.g. extra regulators, early drainage or flushing etc.) can be simulated. The model can also be used to develop weekly operation targets and may become a very useful tool in the day-to-day management of large polders. Specially trained staff will be required for such advanced calculation.

255. In fact the WM Plan is a formal agreement between the BWDB's O&M offices and the water users' platforms (WMG or WMA) ensuring that operational services are provided. Once the WM Plan is finalized, information can be passed on to other agencies through the apex body of the beneficiaries so that necessary adjustments can be made to accommodate other national programs, work plans, etc.

Weekly Operation Targets:

256. In the coastal polders water levels in the drainage channels can be manipulated easily because the mode of operation is in line with the FCD system; and the water levels inside a Beel is much more dependent on rainfalls. The parameters in the seasonal WM plan, viz. water levels in the channels and discharges will be compared with the actual field conditions, operation targets etc. on weekly basis to eventually arrive at the weekly operation targets setting. The system users in close contact with O&M staffs of BWDB can set the weekly operation targets to maintain the desired field conditions.

Day-to Day operation:

257. Daily structure operation requirements involve manipulation of gates or pumps to maintain water levels in the channels as laid down in the operation target. Actual structure operation is also implemented and adjusted on a daily basis by the O&M staffs of BWDB. For each polder, the operational practices so developed will have to be documented and kept in proper records for use by the WMGs / WMAs.

4.11.1 Maintenance Works

258. Maintenance of embankments and structures is the most important item of activities in the coastal polders. It is necessary and cannot be avoided because it helps in preserving the infrastructure in good and functional condition; protects investments; and prevents high rehabilitation costs. Since this is included in the day-to-day tasks schedule and needs continuous efforts, maintenance of coastal polders put emphasis on simple and cost effective community-based interventions.

259. In the coastal polders, the works, which only directly serve water management, should be regularly maintained. These activities are divided into:

I. Preventive or Routine Maintenance;
II. Periodic Maintenance;
   - Minor Periodic Maintenance
   - Major Periodic Maintenance
III. Emergency Maintenance;

4.12 Preventive or Routine Maintenance

260. The objective of preventive maintenance is to keep the overall polder *system* including all its *elements* in good functional order thereby reducing the need of periodic maintenance eventually avoiding high rehabilitation costs. The works are simple, cheap and cost effective and can be implemented through community-based functional groups such as EMGs, CMGs, and SMGs. Preventive maintenance is carried out throughout the year, almost continuously or as and when required. The works are noted below:

- All activities related to vegetative covers on embankment i.e. new (or re-) planting; enrichment planting; and maintenance of vegetation by EMGs and/or EPGs;
- Small earthworks on the embankment by EMGs;
- Cleaning, greasing, and painting of structures by SMGs;
- Cleaning Khals and Outfall Drains from aquatic weeds and floating debris, and removing of silt in wet condition by CMGs.

261. The preventive maintenance interventions have been spelled out precisely in Table 4.12 below:

4.13 Periodic Maintenance

262. Periodic Maintenance intends to bring the components of the hydraulic infrastructure back to its design standard. The works are more expensive than preventive maintenance and are implemented by LCBs, LCSs, and PICs (food for works). Periodic maintenance has the character to repair works and is identified during the field assessment at (more or less) regular intervals.

263. The most important distinguishing characteristic of minor periodic maintenance works is that it is more community based and often implemented by LCSs while major periodic maintenance works are generally carried out through competitive bidding (LCBs). However, in case of earth works at least 25% of the works should be allotted to LCSs. Both these types of periodic maintenance are summarized as under:

Minor Periodic Maintenance Works:

- Minor earth works on the embankments by LCSs i.e. shaping and minor fillings including repair of access ramps;
- Minor repair of protective works by LCSs, i.e. re-positioning of the displaced blocks;
- Minor repair of structures by LCSs, i.e. small patching of brick works, replacing rubber seals, etc.; and
- Re-excavation of Khals and removal of earthen cross dams by LCSs and / or PICs;

Major Periodic Maintenance Works:

- Major earth works by LCBs / LCSs, i.e. re-sectioning of embankments including turfing;
- Major repair of structures by LCBs, i.e. repair or replacement of metal works/hinges, lifting mechanisms, gates, block works, head / wing walls etc.;
- Re-excavation of Khals by LCSs / PICs.

264. The periodic maintenance interventions have been spelled out precisely in Table 4.12 below**:**

4.14 Emergency Maintenance

265. Emergency works cover unforeseen interventions that require immediate actions to protect the polder as a whole or a part thereof from the adverse effects of flooding or uncontrolled saline intrusion, etc., associated with damage of lives and properties. This type of work requiring immediate attention includes the closure of an embankment breach, the repair and replacement of flap gates, or the construction of cross dams over canals if structure fails. As the title implies planning of these kinds of works is not possible. Table 4.12 indicates each type of emergency maintenance works.

Table 4.12: Types and Classification of Maintenance Works

Sl. No	Description of Maintenance Works	Implementation Mode									
		Classification by Type of Maintenance			Community Based Functional Groups under WMOs						LCB
		I	II	III	EM G	ES	CM G	SM G	LC S	PI C	
	Embankment										
1	Incidental earth works: Minor fillings of rills; ghogs; rodent holes at crest and/or slope	√			√	√					
2	New or additional planting of trees and/or shrubs on embankment or toe	√			√	√					
3	Maintenance of embankment vegetation: Patrolling and protecting young plants against browsing, protecting turfs/ grass/ shrubs against overgrazing and indiscriminate trampling by cattle, upkeep of paths to facilitate inspection of trees, clearing around trees, application of fertilizer, harvesting of produce from trees, replanting and replacement of diseased/	√			√	√					
4	Minor earth works: Shaping or minor fillings of crest and slope but not re-sectioning so as to bring it back in a shape that allows ESs to settle and trees to be planted.		√						√		
5	Major earthworks: Re-sectioning or filling of crest and/ or slope including turfs to bring it back to its design level.		√						√	√	
6	Repair of damaged access ramp, construction of small partition dyke		√			√			√		
7	Emergency closing of breached section			√					√		√
	Structure										
8	Cleaning and greasing of moving and/or sliding parts and seal	√						√	√		
9	Removing silt and debris (water hyacinth, aquatic weeds and others) near intake	√							√		
10	Checking and tightening nuts and bolts	√						√	√		
11	Brushing cheeped or loose paint rust on metal parts; and painting	√						√	√		
12	Patching minor damages or minor brick		√								√
13	Replacing rubber seal of gate, positioning		√					√			√
14	Repairing or replacing damaged metal works /hinges, lifting devices for flap or Vertical sliding gates		√					√			√
15	Repair defective block works(aprons)		√								√
16	Replacing stop logs, flap gate and vertical lift gates		√	√							√
17	Repair head walls, wing walls, aprons		√								√
18	**Protective Works** Re-positioning/replacing of incidentally displaced blocks/ boulders /concrete frames, small repair to sand/gravel filter		√								√

Sl. No	**Description of Maintenance Works**	**Implementation Mode**									
		Classification by Type of Maintenance			**Community Based Functional Groups under WMOs**						**LCB**
		I	**II**	**III**	**EM G**	**ES**	**CM G**	**SM G**	**LC S**	**PI C**	
19	**Channels** Cleaning khal and outfall drains and de- silting outfall drains	√					√				
20	Re-excavation of khal		√						√		
21	Removing cross-dams (used as access roads, flashing bunds or water retention)		√			√					

Notes: *Maintenance Class; I- Preventive or routine maintenance; II-periodic Maintenance; III-Emergency Maintenance*.

4.15 Planning of Maintenance

266. As already stated, maintenance activities in BWDB polders are conceived in three distinct categories i.e. Preventive Maintenance; Periodic Maintenance; and Emergency Maintenance. Preventive maintenance requires little annual planning because Embankment Maintenance Groups and Canal Maintenance Groups go ahead in a continuous process. Emergency maintenance cannot be planned as this will be dependent on unexpected conditions and can hardly be foreseen. So the maintenance planning centers on periodic maintenance. The selection of items to be maintained and repaired, and the ranking of the works, is the recurrent activities in maintenance planning. This selection depends on the project inventory; the O&M checklists filled in by the farmers under the guidance of the Section Officer; and monitoring data produced by BWDB. A clear dichotomy is apparent here; monitoring focuses on the elements of the infrastructure while the O&M checklists help identify the water management bottlenecks and support the system approach. Another important issue in the maintenance planning is the timing of maintenance, i.e. when certain works need to be carried out without hampering water management, and if it does hamper in any area, all these should be reflected in the water management plan. This concerns mainly the periodic maintenance works. A third planning activity is a part of the implementation phase and concerns the drawing up of physical work plans prior to the start of the works; this is in fact an activity between the contractor and the O&M Offices. The O&M field staff should see that these physical work plans follow the maintenance schedule shown in Figure 4.6.

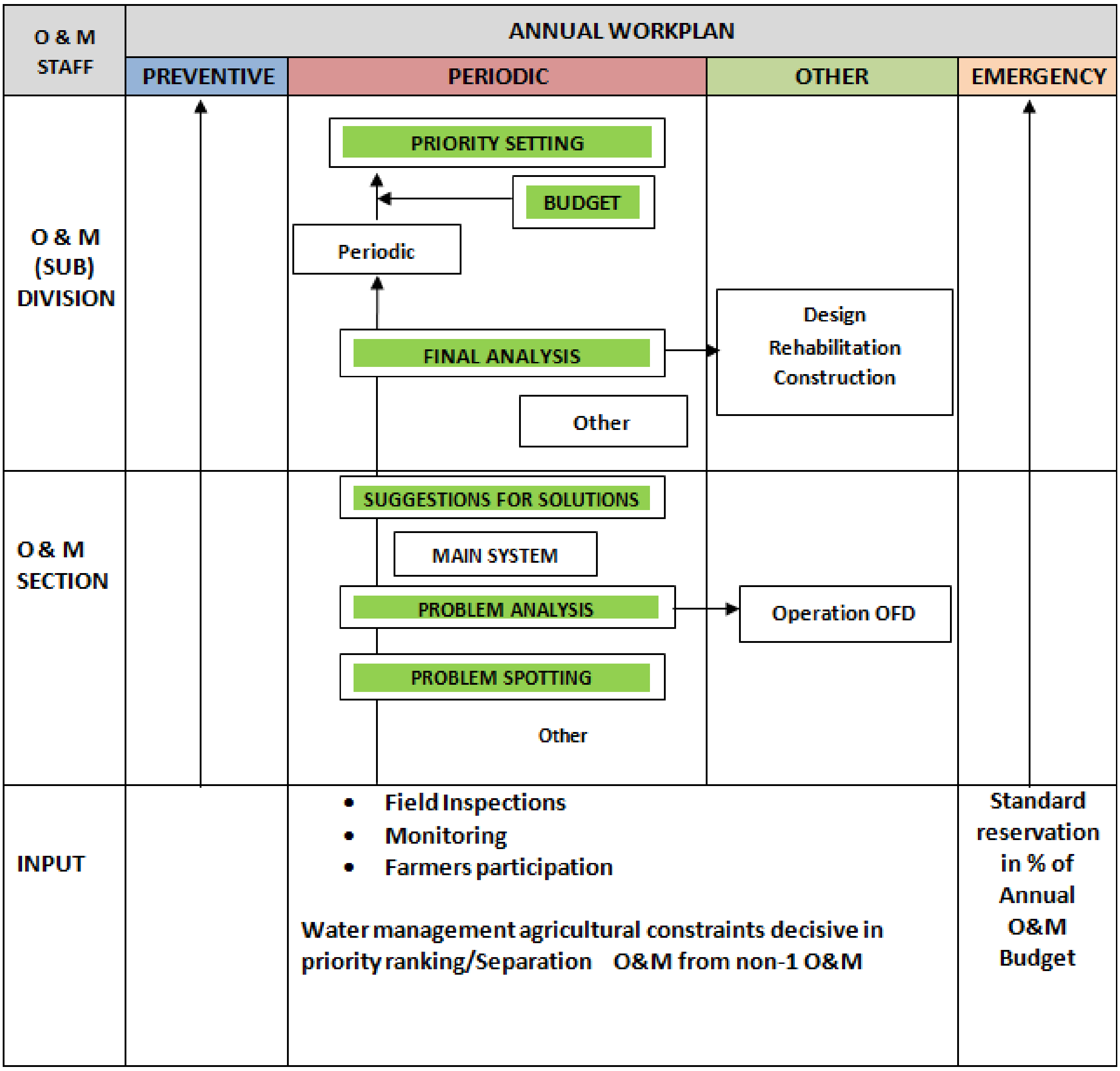


Figure 4-6: Decision Making in Maintenance

267. Before any planning of maintenance, there should have the separation between O&M and non-O&M works. Only that part of infrastructure that is related to water management should be included in the O&M works. All preventive maintenance works are the part of O&M works; but under periodic maintenance there may have the choice of prioritizing between O&M and non-O&M works. A considerable part of the annual planning process will be centered on the selection of works to be included under periodic maintenance.

4.15.1 Rehabilitation Works

268. Rehabilitation works are termed as the big repair or replacement types of maintenance works when normal repair and maintenance works are not considered sufficient to bring the polder infrastructure back to its original functioning state. From a different but commonly accepted view point the *Rehabilitation* is defined as the "*restoration of deteriorated facilities and infrastructure within the completed systems to their original functional condition*." Deterioration of structures and other polder elements usually occur due to normal wear and tear over time if the regular maintenance works are not done adequately and in time. The tendency to defer normally required maintenance needs often give rise to rehabilitation. Rehabilitation works include the following:

- Construction of new or retired embankment, closing of breach (not emergent);
- All new protective works (CC blocks/boulders), big repair, remodelling at large scale, replacement of blocks/boulders/concrete frames, substantial fillings of sand /gravel bed and major renovation to geo-textile;
- Big repair or replacing of lifting mechanisms for flap gates / vertical slide gates;
- Big repair of block works (aprons);
- Replacing stop logs, flap gates or vertical sliding gates for large structures;
- Repair head walls, wing walls and aprons of large structures etc.; and
- Excavation of new Khals.

Table 4.13 below depicts the Type of Rehabilitation works.

Table 4.13: Type of Rehabilitation Works

Sl. No.	Description of Maintenance Works	Implementation Mode						
		Community Based Functional Groups under WMOs						LCB
1	**Embankment** Construction of new or retired embankment, closing of breach(not emergent);					√		√
2	**Structures** Big repair for replacing and uplifting flap gates or vertical slide gates;							√
3	New protective works (CCblocks/boulders), big repair of block works (aprons);							√
4	Repair of headwalls/wing walls/aprons							√
5	**Protective works** Big repair, remodelling at large scale, replacement of blocks/ boulders/concrete frames, substantial fillings of sand/gravel bed and major renovation to geo-textile;							√
6	**Channels** Excavation of new Khals					√	√	√

Source: Engineering Team of DCSC

Note EMG- Embankment Maintenance Group; ES- Embankment Settler; CMG-Canal Maintenance Group; Landless Contracting Society; PIC- Project Implementation Committee; LCB- Local Competitive Bidding

4.15.2 Local Participation in O&M and Water Management

269. Local stakeholders' participation in the development and maintenance of water resources sub-projects / polders is a much-talked issue. This is looked upon more seriously in FCD and / or FCDI interventions of BWDB because chronically most of these sub-projects vis-a- vis coastal polders have been showing poor performances in terms of water management and agricultural crop production mainly due to inadequate Operation and Maintenance (O&M). The potentials in many cases remain under-utilized; neither the beneficiaries nor the local government institutions find effective ways and means to get themselves involved in O&M and water management issues. In the past standard procedures were prescribed in some of the study reports under different projects but instances are few where these are commonly followed to achieve substantial results. Until now the provisions of local level participation in the National Water Policy and in the Guidelines for Participatory Water Management that stressed the need for organizing the

local stakeholders by themselves with LGIs (i.e., Union Parishad at the grass-root level) playing the roles of coordinating agencies could not succeed in drainage sub-projects for the benefit is not tangible. The challenge of shifting the responsibilities of O&M to beneficiaries' organizations in drainage sub-projects especially in coastal polders thus remains as a big question as yet.

4.16 Institutions for Participation

270. Efforts made in the past to unite the local stakeholders for system operation and maintenance vis-a-vis water management activities in large water resource projects was hardly successful although it was felt that the organizations of beneficiaries/local stakeholders are the driving force.

271. To suggest any pattern of organization for ensuring beneficiaries' participation in water management and O&M responsibilities, i.e. more specifically organizing the beneficiaries for participation in water management and O&M in the coastal polders, past experiences may be considered as the starting point. Looking at the evolution of beneficiaries' participation mechanism in BWDB's subprojects *The Guidelines for Participatory Water Management (MoWR 2001)* usually known as GPWM is regarded as the effective tool for building Water Management Organizations (WMOs). The guidelines provide the basis for all institutional arrangements relating to participatory arrangement. Till 1995, BWDB had been organizing its WMOs on a two-tier basis. This approach changed to three tiers with the introduction of the previous Guidelines for Beneficiaries Participation and this hierarchy persists with the GPWM also. The GPWM has outlined a three tier organizational structure comprising Water Management Groups (WMG) at the lowest level, Water Management Associations (WMA) at the mid-tier and Water Management Federation (WMF) at the apex. The combination of groups, associations and federations in a particular sub-project is together termed as the Water Management Organization (WMO).

4.16.1 Current status of Participation in CEIP Polders

272. At present, there exist no beneficiaries' organizations in any of the 17 polders selected for improvement under CEIP. Soon after completion of the civil construction works in late sixties or early seventies, the polders were handed over to the local beneficiaries through formation of *Sluice Committees* and *Polder Committees* as per norms prevailing at that time. The polders had to face a series of devastating catastrophes since their commissioning and after each of those occurrences maintenance issues vis-a-vis major rehabilitation works got the priority attention leaving aside the system operational needs and local stakeholders' perception to it. In fact, since early nineties beneficiaries' participation in large water resource projects including coastal polders had been considered with importance.

273. However, the approach to beneficiaries' involvement in operation and maintenance and /or water management in coastal polders has narrowly focused on either combating natural disasters like floods and cyclones or attaining self-sufficiency in food production under any massive program of agricultural development. The National Water Policy (NWPo) released in 1999 emphasized the need for integrated water resources management in an equitable manner among all users.

274. Although there are experiences of forming WMOs in some of the irrigation sub-projects of BWDB; but the coastal polders did not have any initiative to form the WMOs following GPWM provisions. The scopes were very little in the CERP/PWP polders to build up institutions for Water Management /O&M because the project did not provide for sufficient manpower among BWDB and /or TA team could not support the beneficiaries' organization building tasks. They simply suggested establishing WMOs (Water Management Organizations) with the help of NGOs. In some of the PWP polders, maintenance of embankments and biological protective measures through organizing CBOs were put on trial by NGOs.

275. The main difficulties that still persist in the formation of WMOs in the coastal polders are with the registration of primary level organizations i.e. Water Management Groups (WMGs) at the lowest tier. The polders are FCD type of sub-projects dealing with salinity prevention and drainage as the major activities; benefits accrued to the local stakeholders are not tangible enough. For the WMOs of FCDI sub-projects, registration at the levels of WMGs and WMAs are allowed under the Cooperative Legal Framework and for the WMOs of FCD sub-projects/polders, this has been left open to the choice of beneficiaries (Huda, Shamsul ATM 2006). They can either opt for registration as the Cooperative Societies like those in the FCDI sub-projects or get registered with the BWDB. In case of BWDB's registration, it is required to frame rules under BWDB Act 2000. The issue of introducing GPWM provisions in the formation of WMOs as well as registration in the coastal polders is still unresolved. Afterwards, the polders faced at least two severe cyclonic storms "Sidr" and 'Aila'.

4.16.2 Institutional framework for Participation

276. The whole set of activities of beneficiaries' participation in O&M and water management in coastal polders has been conceived to have a definitive framework for institution building discussed here under:

277. As per GPWM provisions, local stakeholders belonging to the polder community may be brought under three tiers of organization or as applicable, namely - *Water Management Groups (WMGs) at* the lowest tier; Water *Management Associations (WMAs)* at the mid-tier; and *Water Management Federations (WMFs)* at the apex level.

Box-1 below depicts the setting out pattern, size and hierarchy of WMOs.

For sub-projects /polders up `to 1000 ha;

There may be one or two levels of WMOs as indicated below:

WMG at the lowest level for each smallest hydrological unit or social unit (Para/village); and WMA at the apex level

For sub-projects /polders from 1000 ha to5000 ha;

WMOs for such polders may consist of two or three levels as indicated below:

- WMG at the lowest level for each smallest hydrological unit or social unit (Para / village);
- WMA either at the mid-level for each sub-system* of the polder or at the apex level; and
- If necessary, WMF at the apex level of the polder in case WMA is formed at the mid-level

For sub-projects /polders above 5000 ha;

There will have the following three tiers of WMOs:

- WMG at the lowest level for each smallest hydrological unit or social unit (Para/ village);
- WMA at the mid-level for each sub-system of the polder; and
- WMF at the apex level of the polder

Source: Adopted from GPWM, 2001

Water Management Groups (WMGs):

278. This organization, at the grass-root level will provide the platform for all those who live inside or in close vicinity of the polder and will be treated as the primary society. The entire command area of the sub-project/polder will be sub-divided into few Units preferably on the basis of hydrological consideration and each of these Units will have one WMG. The size of the units may vary depending on the land topography, actual alignment of the existing roads, canals or embankment, and location of structure, turn-outs or even the field channels. Preferably, the size of such hydrological Units should vary within the range of 500 ha to 1500 ha. The areas of the Units so demarcated usually comprise 2 or

3 villages and part thereof. One WMG may therefore include several hundreds to a few thousands as its primary members.

279. A complete household list prepared will be scrutinized to find out the actual numbers of beneficiary. By virtue of their staying in the Units or having land holdings inside the sub-project /polder areas each of the household chiefs will qualify for becoming the Primary Member.

280. The enlisted members will have the right to vote for electing the members of Executive Committee including office bearers. The general body of the WMG comprising of all enrolled Primary Members will assemble to elect the 12-member Executive Committee (EC) through a standard franchise procedure. The elected EC will be treated as the legal management body of the WMG concerned.

281. The WMG should be allowed to function as a primary cooperative society. The individuals enrolled as the primary member will join and cling to the society if they find it beneficial for themselves. WMGs are the building blocks in a polder (large water resource scheme/sub-project) and need to be established on a firm foot-hold. These will be led to success for the eventual sustained growth and effective local participation in water management and O&M.

Water Management Association (WMA):

282. The numbers of WMGs functioning in a Polder/Sub-project will form a Water Management Association as a coordinating body at the mid- level of the polder/ sub-project. The WMGs are the grass-root people who would be directly involved in water management while the WMAs will provide necessary coordination at the mid-level. The WMAs are chosen as the point of formal interface between BWDB and WMGs. This is the level where formal agreements relating to respective duties and obligations of the water sector agency (BWDB) and primary societies i.e. WMGs are reached and signed. For this reason, this level needs to have a legal status and hence the question of registration arises.

283. A coastal polder may have one or more WMA depending on the numbers of WMGs organized. For the polders falling within the category of 5000 ha to 10,000 ha, the numbers of WMAs should not be more than 2 - each comprising at least 2 WMGs. The EC members of the constituent WMGs will exercise their franchise to elect the 6-member Management Committee (MC) of the WMA from among them. Each of the organizations has specific responsibilities to perform; these are summarized in a table below:

Water Management Federation (WMF):

284. This is conceived as the supervisory type of organization functioning at the apex level of the hierarchy and is needed to establish linkages with other higher-level organizations for support and mobilization of resources. The WMFs may exist on the basis of actual functioning strength of WMGs and WMAs. Usually in a district or in a bigger hydrological basin comprising of several districts may have one or more federating bodies functioning at the top level of the hierarchy. The office bearers of the WMF, the 5-member body will be selected from among the MC members of WMAs. Important personalities in the area like Member of Parliament or local leader may be nominated as the chair-person of the WMF and other members (not exceeding 04 nos.) may come from the WMAs by virtue of their importance in controlling the numbers of WMGs etc.

Moreover, the duties and responsibilities of WMOs at different tiers are shown in Table 4.14.

Table 4.14: Duties and Responsibilities of WMOs at different tiers

Water Management Group (WMG)	Water ManagementAssociation (WMA)	Water ManagementFederation (WMF)
• Initiation of Stakeholders activities through preliminary discussions, meetings and motivational	• Preparation of budgets and participation in overall activities	• Liaison with the implementing agency

Water Management Group (WMG)	Water ManagementAssociation (WMA)	Water ManagementFederation (WMF)
exercises		
• Drafting the working procedures and process of interaction	• Liaison with implementing agencies, NGOs, CBOs and LGIs • Resolution of conflicts (both inter and intra) of WMGs	• Oversight of the WMAs • Mobilization of efforts to enforce the rules and procedures of water management
• Preparation and preservation of documents/reports etc.	• Signing of management transfer agreements on behalf of the WMGs with implementing agencies or LGIs as appropriate	• Coordination of stakeholders 'activities in water management
• Participation throughout the project cycle	• Formal representation of the beneficiaries and project affected people on all issues related to water management	• Formal representation of the beneficiaries and project affected people on all issues related to water management
• Preparation of annual crop production as well as O&M plans	• Preparation of annual crop production/ O&M plans and/or collate the plans emanating from the WMGs	• Preparation of annual crop production/ O&M plans and/or collate the plans emanating from the WMAs
• Mobilization of local resources and collection of members' contribution towards and recurring costs	• Collection of beneficiary contribution towards investment and operation costs and collection of consolidated contributions from WMGs as appropriate	• Collection, where applicable, of beneficiary contribution towards polder level operation and maintenance
• Maintenance of accounts	• Supervision and guidance to WMGs on maintaining the accounts	• Financial oversight
• Work with implementing agencies, NGOs, CBOs and LGIs	• Participation in the supervision of sub- project implementation to ensure that the works are as per design and agreement	• Observation of sub- project's /polder's construction to ensure compliance with design and agreement
• Progressive sharing of water management responsibilities	• Operation and maintenance of works in accordance with any leasing agreement	• On its completion, leasing out the polder/sub-project level infrastructure from the implementing agency and oversee the operation / maintenance as per terms of the lease.
• Resolution of conflicts, election of office bearers, exploration of additional water based economic activities/ IGAs for the WMGs or its members	• Assistances in organizing training courses for WMG members and general capacity building initiatives with Government or NGOs for different types of stakeholders	• Coordination of WMA's activities in organizing training courses for WMG members and general capacity building initiatives with Government or NGOs for different types of stakeholders

4.16.3 Participation of Community Based Organizations

285. Community Based Organizations often termed as CBOs can also play a vital role in maintenance activities. The experiences of CERP described hereunder would form an example that can be subsequently used in the actual application of local stakeholders' participation strategies. *While engaging any of the functional groups of these CBOs in CEIP polders, care should be taken to twist and turn the methodologies slightly in some of the aspects as per local situation and project provisions so that it really fits in.* In CEIP, the CBOs are conceived to have been included in the Water Management Groups (WMGs) as Functional Groups (FGs). The FGs have the scope of working in the polder O&M under the

purview of WMG. So in this report herein after the terminology of CBO has been replaced with FG. Following CBOs have been recommended for the polders under CEIP.

- ES-Embankment Settler

286. ESs is families selected from squatters and project affected persons who do not have any land or lost it by land acquisition. They can be organized in functional groups for taking part in preventive maintenance of the embankments in specified reach (appx. 0.5 ha) where they are allowed to settle on the toe of the embankment. The maintenance activities include small earthworks, new plantation, re-plantation or enrichment in planting and maintenance of vegetation cover. ESs may be engaged in embankment maintenance activities through a contract agreement for a certain period. Unlike CERP, they will simply enjoy the settlement facility and usufractuary rights of the plantation on embankment slopes and toes.

- EMG - Embankment Maintenance Group

287. EMGs are the groups formed from the destitute women (maximum 10 members per group) selected from landless families, who are responsible for preventive earthwork maintenance of a specified reach of embankment including grass turfs lying. They are the laborers paid on a daily basis. Responsibilities and mode of payment are same as those already in practice in BWDB polders /sub-projects.

- LCS – Landless Contracting Society

288. LCSs are the groups selected from landless people consisting of nearly 60 members or more per group (as the case may be). They are responsible for earthworks only up to a limit of Tk. 3.00 lacs in a single contract; they may be awarded a second contract based on their performances. These groups are entitled to have the facility of doing 25% of the total earthworks needed in a Division per year. LCSs are enlisted as D-class contractor. They are awarded the works as per scheduled rates of BWDB and need not to compete with contractors in an open bidding. LCSs are also needed to sign a contract document before start of the assigned job. This has become a popular means of executing earthworks especially in case of emergency needs because they can start work immediately.

- CMG – Canal Maintenance Group

289. CMGs are the groups consisting of 10 members selected from landless people; they will be responsible for preventive maintenance of canals inside the polder and outfall drains. Activities include the removal of floating debris, aquatic weeds and water hyacinths; and to some extent disposal of silt deposits in wet condition. CMGs are paid on a daily basis and not based on volumes of actual works done.

4.16.4 Roles of NGOs in participation

290. Over the last few decades there has been a tremendous growth of non-government organizations popularly termed as NGOs taking part in various development activities at the grass-root level. For the purpose of re-structuring or in some cases re-orienting the water management organizations in the coastal polders, the services of experienced NGOs would prove worth enough. Besides, they can also work with the CBOs in accomplishing maintenance activities of the embankments. These are discussed in the following sub-sections:

- Organizing the WMOs

291. It is presumed that the Sluice Committees and Polder Committees formed in the past are almost defunct. To organize the local stakeholders to form the WMOs, NGOs may be engaged who are experienced enough to identify and organize the target beneficiaries under a fixed ToR. Not only formation of various groups, their capacity development and integration of local resources towards sustained growth may also be looked upon by the NGOs.

- Ensuring CBOs involvement in Preventive Maintenance

292. The NGOs with proven track records of experiences to work among the coastal people may provide their services in organizing the appropriate groups of functionaries so that preventive maintenance of embankments and critical toe protection works with biological means, i.e. vegetative cover, plantation on foreshore lands, etc., measures can be successfully undertaken. Especially the EMGs, CMGs, SMGs, LCSs, etc. under the guidance and supervision of NGOs can effectively prove worth in the preventive maintenance of embankments, structures, and canals in the polder system.

293. Capacity Development of WMOs

294. WMOs, in their current forms in the coastal polders will be quite new at many places. It would not be sufficient to just organize the local stakeholders to form WMGs, WMAs or WMFs. It is at the same time more important that these organizations would work effectively and rise on firm foot-holds to become sustainable. Therefore, the capacity development initiatives for the individuals as well as for these organizations are inevitable. Addressing the issues of capital building, integration of sufficient resources across the community, implementation of IGA activities and skills development programs should be best looked into by the experienced NGOs.

- New Plantation and Re-enforcing the Vegetative Covers

295. Embankment protection with vegetative covers and successful plantation on the berms and foreshore lands are quite technical and usually not within the capabilities of the functional groups; this needs some technical backstopping and guidance. The experiences of CERP and CDSP indicate that services of qualified NGOs are a pre-requisite in planned gardening; especially in species selection, raise of seedlings, ideal plantation, fencing and overall nursing for a certain periods can best be handled by the NGOs. Employing experienced NGOs would be effective in organizing the classified WMOs noted above and providing necessary assistance in successful plantation.

4.16.5 Relationship with LGIs and Local Administration

296. At the lowest tier of administration, the Local Government Institutions (LGIs) in Bangladesh have a very good record of existence and performance among the local community. It also becomes the inevitable part of development activities. It would not be appropriate to introduce WMOs to function in coastal polders in an isolated way. LGIs should be involved in water management, operation, and maintenance activities of the polders. Following sections will depict the fields of cooperation and coexistence of WMOs with the LGIs and local administration system.

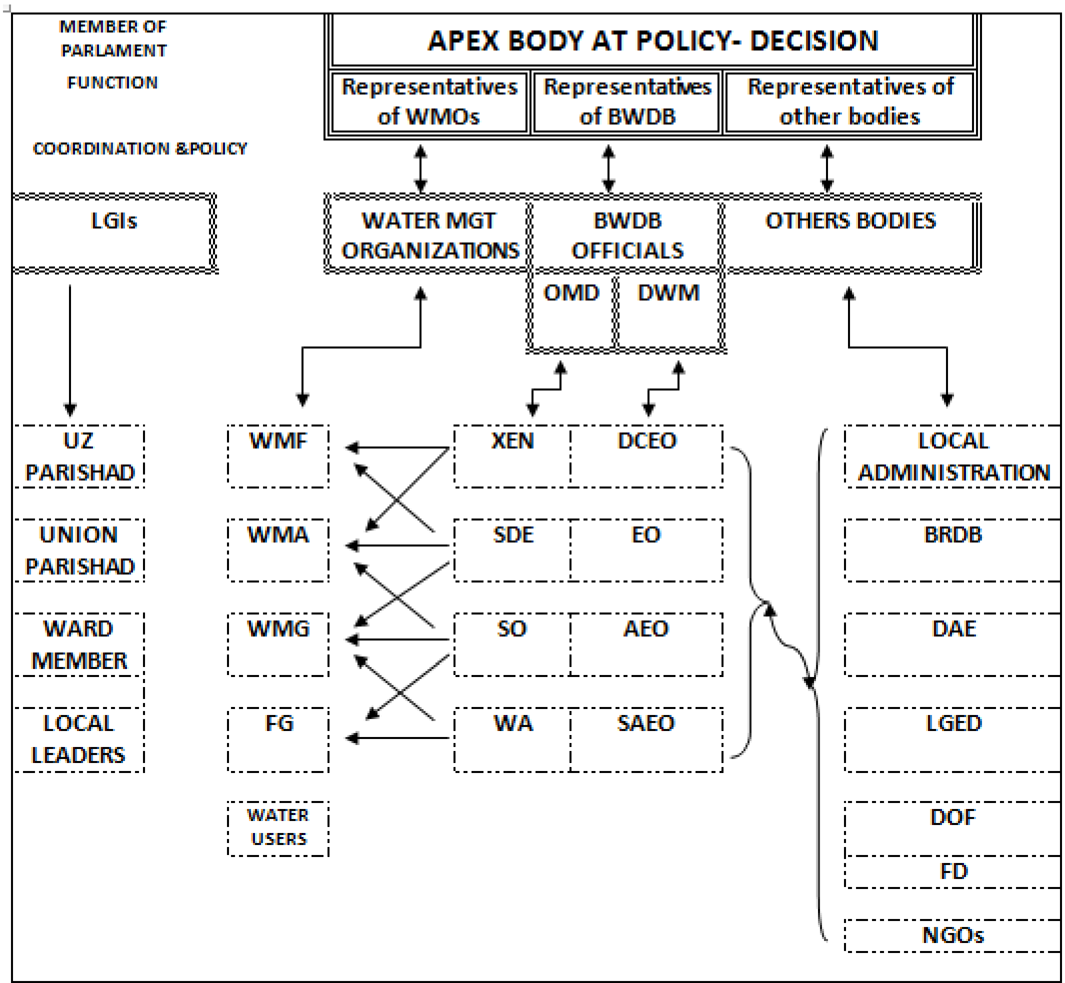
- Cooperation of LGIs

297. Coastal polders having the characteristics of FCD type of sub-project yield benefits not so tangible to the local stakeholders. They rather consider the prevention of flood control/ salinity intrusion and drainage facilities as a public good done by the government. Therefore, to get the polder community taking part in operation and maintenance of the polder infrastructure and water management activities is not straight forward like that in the irrigation or FCDI types of subprojects.

298. Apart from the farm families living inside the polder, the embankment settlers; landless section; local minorities; and people of other trades like fishermen, boatmen etc. behave differently and their perceptions towards the polder infrastructure are also diverse in nature. However, the local leaders like UP Chairmen, Ward Members and village leaders have decent acceptability among the local community. It is therefore, required that the LGIs should have specific roles in WMOs; especially the Ward Members will be given the responsibilities to coordinate the formation of WMGs and different functional groups like EMGs, CMGs, SMGs, and also LCSs. Besides, they will also take part in the process of participatory planning and implementation of maintenance activities. Especially at the stage

of implementing preventive and minor periodic maintenance works, there should have the provision of LGIs' intervention in conflict resolution and ensuring peaceful co-existence of all groups / sub-groups within the WMGs /WMAs.

299. The LGIs will act as the interface between the WMOs and BWDB's O&M Section; a lateral relationship will prevail among them. It is required that in the process of consolidation of WMOs institutional setting towards sustained growth, LGIs (i.e. Union Parishads) will patronize and extend necessary cooperation. The UP Chairman / Ward Members can play a vital role in some of the important aspects of WMOs' sustainability especially to form Own Capital; manage Community Development Fund; undertake Capacity Building initiatives; launch out Members' Welfare / Charity program, Skills Development training etc. In all these affairs, the LGIs roles should be in the form of oversight and advisory capacity; but the issues of Conflict Resolution in both the 'intra' and 'inter' organizations shall have to be dealt with by the LGIs as mandatory provisions. The whole affairs of WMOs' relationship with LGIs are depicted in the figure below (Figure 4.7):



AEO	Assit. Extension Officer	**SDE**	Sub-Division Engineer
BRDB	Bangladesh Rural Development Board	**SO**	Sectional Officer
DEA	Department of Agricultural Extension	**WA**	Work Assistant
DCEO	Deputy Chief Extension Officer	**WMA**	Water Mgt. Association
DWM	Directorate of Water Management	**WMG**	Water Mgt. Group
DOF	Department of Fisheries	**FG**	Functional Group
EO	Extension Officer	**UZ**	Upozila
SAEO	Sub- Assit. Extension Officer	**NGOs**	Non-Government Organizations
FD	Forestry Department	**OMD**	Operation and Maintenance Division
WMF	Water Mgt. Federation	**LGIs**	Local Government Institutions
LGED	Local Government Engineering Department		

Figure 4-7 : Inter-relationship between WMOs and the LGIs

Support from Local Administration

300. From the viewpoint of geographical location, the coastal polders are situated at distant places and in the islands away from the administrative headquarters of the district and/or upazila and often quite difficult to reach. The people living there have to meet many adversities, which normally the people in other areas do not have to come across at all. In that consideration, they always deserve special and usually a preferential treatment from the administrative authorities. However, in the real life situation things happen more or less contrary to the expectations of the inhabitants of remote polders. The Water Management Organizations (WMOs) and BWDB's O&M section in particular should trigger some of the key points in the whole affairs of local participation to get the local administration more attentive and involved. These are as under:

Participation in the Union Parishad and Upazila Parishad Review Meetings

301. Government of Bangladesh has of late reorganized the local government pattern to put more emphasis on undertaking various development initiatives for the rural people. The Upazila Parishad and Union Parishad received more attention in this process. In fact, these are the two important forums to discuss and review periodically the progress of activities, problems and bottlenecks in development works going on under different departments/agencies. Executive Committee members of WMOs and BWDB's field officers at respective level will simply liaise with the coordinating offices of LGIs i.e. Union Parishad and Upazila Parishad and ensure the inclusion of their problems and prospects in the agenda of discussion. Through active participation in such meetings at regular intervals WMOs can keep the administration abreast of their concerns; the approach would be simply- "*get yourself focused for your sake*".

Creating opportunities for the Administration People to get involved in WMOs' affairs:

302. This is also an important technique to make things attractive for the common people. The WMOs should try to draw in elected representatives / local leaders and administrative stalwarts on special occasions in their programs / ceremonies. In this process, they feel honoured and take the privilege to go into details of the facts. Having more insight of the affairs and issues they put themselves in the position of advocacy among the local beneficiaries and related concerns. Inviting the Administration People in different occasions and showing due respect to them by WMOs would prove worth to earn cordial support and help of the local administration in getting things moved across the hurdles.

4.17 Project Cost

303. The implementation cost of the project has been estimated as Tk. 483,363,469/ (Taka forty eight crore thirty three lac sixty three thousand four hundred sixty nine only.

4.18 Need of Resettlement Action Plan (RAP)

304. The interventions proposed in Polder- 47/2 do not include any major type of works to be carried out in new alignments. All Drainage or Flushing Sluices proposed to be replaced will be re-constructed on the existing alignment. Also for the embankment re-sectioning works, the existing alignment is to be used for the additional set back distance. Moreover, there is no such intervention of construction of retired embankments. It can therefore be concluded that no major resettlement may occur during project implementation. However, some minor resettlements may be needed as some households still exist over or are located adjacent to the polder periphery, which may be displaced during construction works. In this connection, a detail RAP investigation is required, which is being conducted by the consultants.

4.19 No Objection Certificate

305. Polder-47/2 is located in the Kalapara upazila under Patuakhali district, covering Dablugonj union. No archaeological sites or cultural heritages are known to exist in these unions, which might affect the interventions proposed for rehabilitation of the polder. Furthermore, there will be no problems of land acquisition or displacement of people since rehabilitation will be made on the existing infrastructures. This has been addressed in the No Objection Certificates (NOCs) collected from the union chairmen, which are attached in Appendix 2.

5 Environmental Baseline and Existing Conditions

306. Baseline data on physical, biological and socio-economic environment of the project influence area has been collected first from secondary sources followed by primary data collection from the polder area.

5.1 Physical Environment

5.1.1 Geology

307. Polder 47/2 is situated in a low-lying coastal region and is composed of Tidal Deltaic sediments deposited subaqueously in a permanent body of water where tidal waves and currents aid in the transportation and deposition. Typically, a low-lying deltaic environment comprises of soft sediments, and these regions are quite dynamic and changes in coastal geomorphology are quite rapid, e.g. impacted cyclones.

5.1.2 Topography

308. The study area is located in the southern hydrological zone of Bangladesh with a flat landscape and low topography. The elevations are more or less similar, with a very minor downward sloping from north to south. The area is interspersed with network of rivers and khals. Land elevation of the study area varies from 1.24 to 2.46, mPWD. From the Digital Elevation Model it is found that around 81% of the land of area have an elevation between 1.24 to 1.84 m above MSL, whereas 19% of have elevations between 1.84 to 2.46mPWD. The area elevation storage curve is shown in Figure 5.1 and the Digital Elevation Model of the study area is shown in Map 5.1.

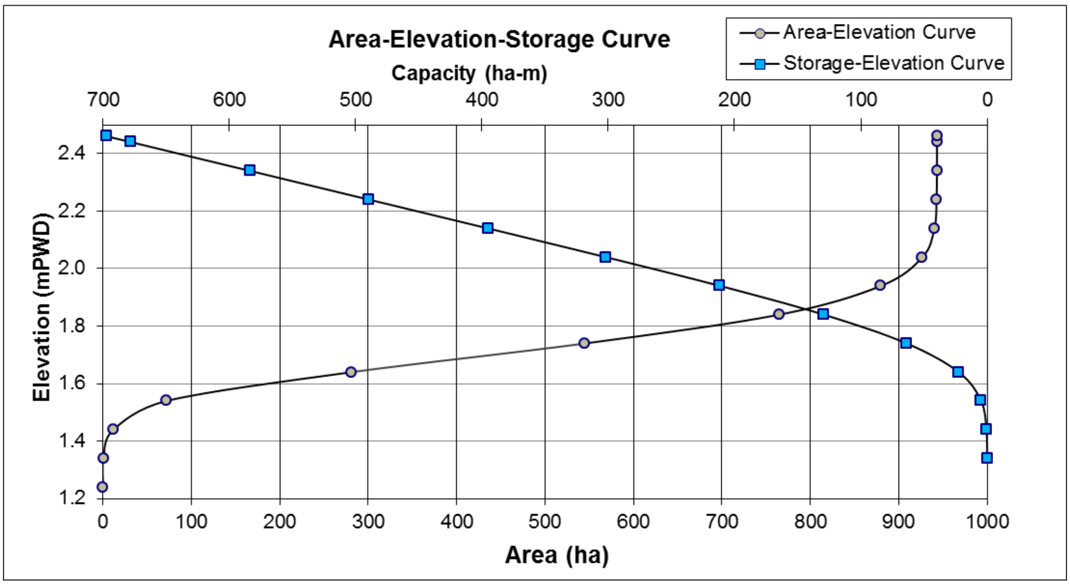
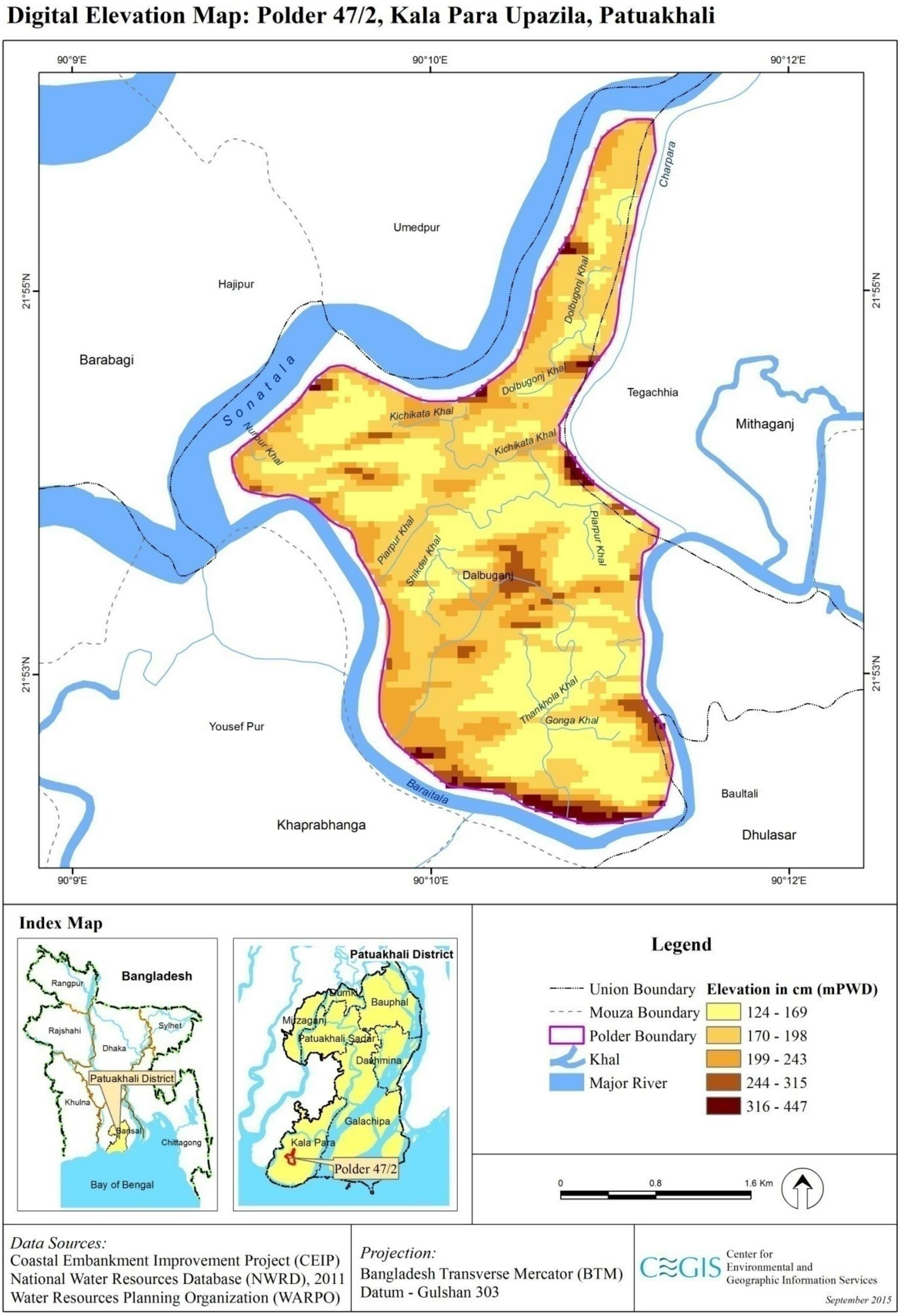


Figure 5.1: Area–Elevation-Storages curve of Polder- 47/2



Map 5.1: Digital Elevation Model of the Polder

5.1.3 Seismicity

309. Bangladesh is one of the seismically active regions of the world, experienced numerous earthquakes in the past 200 years. According to the seismic zoning map of Bangladesh provided by BNBC (Bangladesh National Building Code 1993) the Polder 47/2 is under Zone I with design Peak Ground Acceleration (PGA) value of 0.075g. This level of acceleration may be considered as a more or less seismically quiet zone. However, the BNBC adopted a new code in 2010 after Bangladesh experienced several shock wave of higher intensity. This proposed seismic zoning map is based on PGA values for a return period of 2475 years. The country is divided into three seismic zones with zone coefficient Z equal to 0.12 (Zone 1), 0.2 (Zone 2), 0.28 (Zone 3) and 0.36 (Zone 4).

310. In the newly adopted code of BNBC 2010[11], it is observed that the Project area lies in the Seismic Zone I (seismic coefficient 0.12 g). This zone has the low vulnerability for earthquake in Bangladesh and the polder is relatively safer (seismically quiet) side. Map 5.2 shows the seismic zone map of the study area.

[11] Sarraz A., Ali M. K., Das D. C., 2015; Seismic Vulnerability Assessment of Existing Buildings Stocks at Chandgaon in Chittagong city, Bangladesh, American Journal of Civil Engineering 2015; 3(1): 1-8, retrieved from http://www.sciencepublishinggroup.com/j/ajce

Map 5.2: Map showing the location of Polder in earthquake zone of Bangladesh

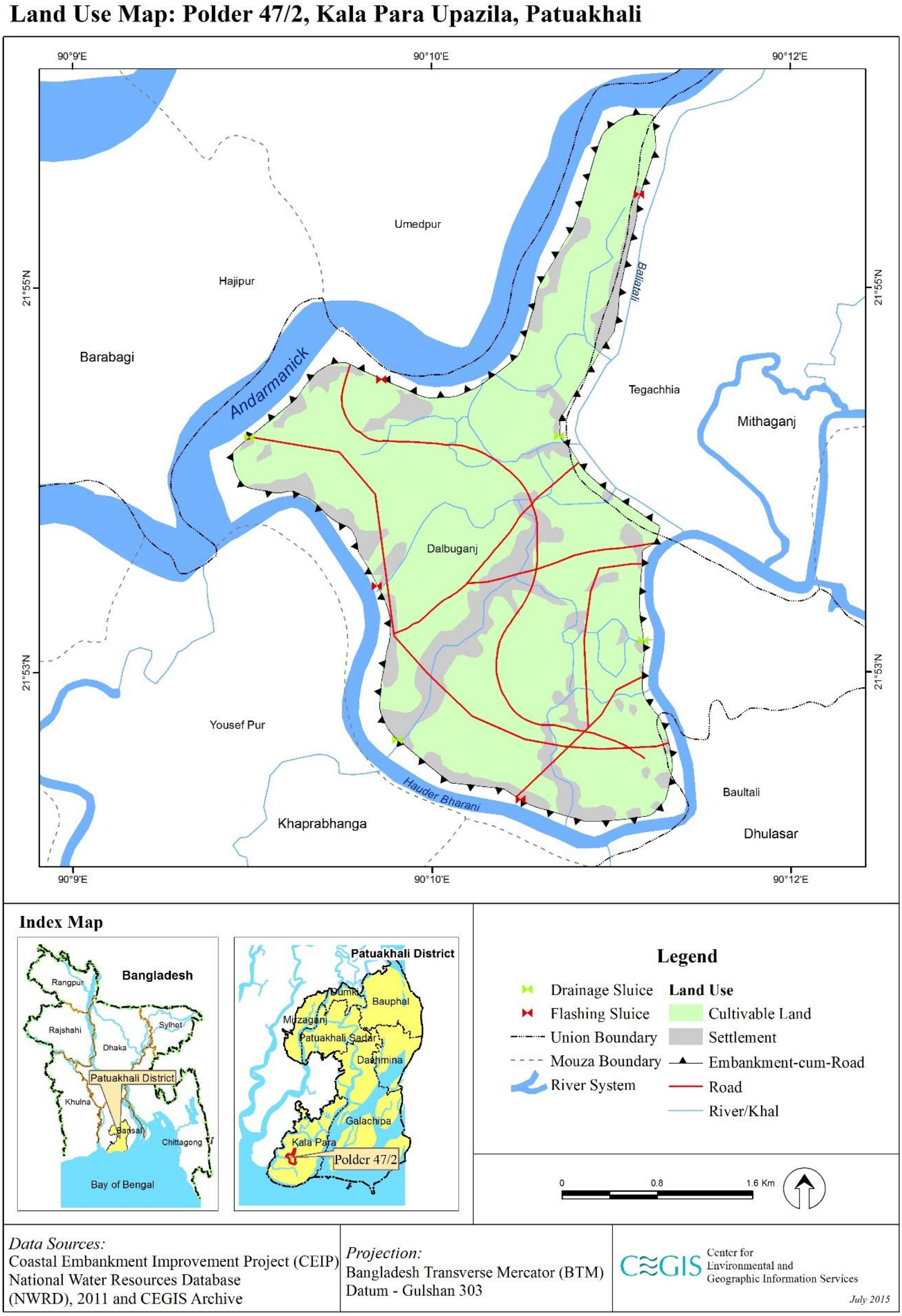
5.1.4 Land use

311. The gross area of Polder-47/2 is about 2,065 ha of which 1,850 ha is net cultivable area (NCA). The NCA is about 90% of the gross area. The coverage of settlements and water bodies are 185 ha (10%) of the gross area. Detailed present land use of the polder area is presented in Table 5.1 and Map 5.3.

Table 5.1: Detailed present land use in the Polder area

Land use	Area (ha)	% of area
Net cultivable area (NCA)	1,850	90
Single crop	570	30.8
Double crop	905	48.92
Triple crop	371	20.0
Fallow	5	0.29
Others (settlement and water bodies)	185	10
Total gross area	**2,065**	**100**

Sources: Feasibility report (Agriculture), CEIP, 2012 and field information, 2015



Map 5.3: Present Land use of the Polder area

5.1.5 Soil Properties

(a) Agro-Ecological Zones (AEZs)

312. The Polder area is covered by one AEZ namely Ganges Tidal Floodplain (AEZ-13). The location of the Polder area is shown in Map 5.4.

313. The entire Polder- 47/2 area is under AEZ-13 zone. This region occupies an extensive area of tidal floodplain land in the south-west of the country. The greater part of this region has smooth relief having large area of salinity. There is general pattern of grey, slightly calcareous, heavy soils on river banks and grey to dark grey, non calcareous, heavy silty clays in the extensive basins. Non-calcareous Grey Floodplain soil is the major component of General Soil Types. Acid Sulphate soils also occupy significant part of the area where it is very strongly acidic during dry season. In general, most of the top soil are acidic and sub-soils are neutral to slightly alkaline. General fertility level is high with low to medium organic matter content and very high CEC and K status. There are limitations of high exchangeable Na and low Ca/Mg ratio. The Zn status is low to medium and the B and S status is medium to optimum. Physio-chemical properties of soils of AEZ-13 are presented in table below Table 5.2:

Table 5.2: Physio-chemical properties of soils of AEZ-13

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Medium highland	4.5-8.4	L-M	L	VL-L	M-Opt	M-Opt	Opt-H	M-Opt	L-M	M-Opt	Opt

Source: Fertilizer Recommendation Guide; BARC, 2012; Note-OM=Organic matter; VL=Very low; L=Low; M=Medium; Opt=Optimum; H=High

Map 5.4: Agro-ecological zone of the Polder area

(b) Land types

314. Land type classifications are based on depth of inundation during monsoon season due to normal flooding on agricultural land. The land type is very important for utilization of lands for crop production. In terms of depth of flooding, the following classes of land type are recognized by the Master Plan Organization (MPO).

315. Around 37%, 43%, 18% and 2% of the net cultivable area (NCA) of the polder area (Polder 47/2) fall under flood free land/high land, high land, medium high land and medium low land respectively. The distribution of land types under polder 47/2 is presented in Table 5.3.

Table 5.3: Distribution of land type in the Polder area

Land Type	Description	Flooding depth(meter)	Flooding characteristics	Area(Ha)	% of NCA
FF	High land	(<0)	Non-flooded to intermittent	820	44.3
F_0	High land	(0.0-0.3m)	Non-flooded to intermittent	623	33.7
F_1	Medium Highland	(0.3-0.90m)	Seasonal	403	21.8
F_2	Medium Low Land	(0.90-1.80m)	Seasonal	5	0.3
F_3	Low land	(1.80-3.60m)	Seasonal, but remains wet in early dry season	0	0
F_4	Very Lowland	(>3.60m)	Seasonal, but remains wet in most of the dry season	0	0
Total				**1,850**	**100**

Source: IWM, 2015

(c) Soil texture

316. Soil texture comprise relative proportions of sand, silt and clay. It is very important for soil characteristic that guides crop selection, crop production and field management. The entire Polder area (100% of NCA) is covered with Clay Loam soil texture.

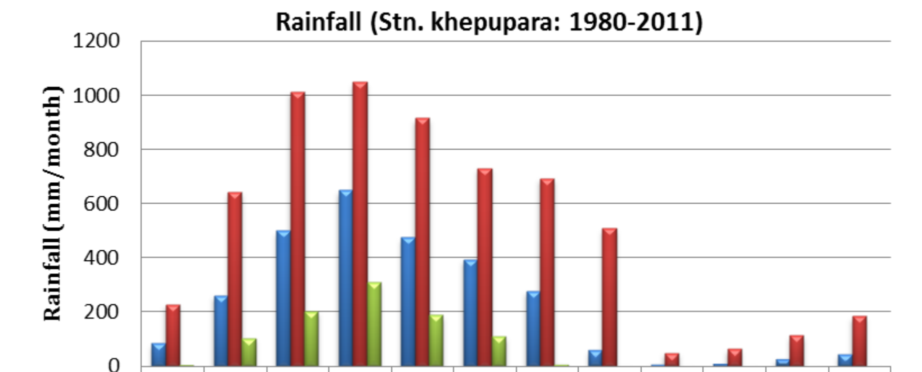
5.1.6 Climate

317. The study area lies in the south-eastern region of Bangladesh and has a typical monsoon climate that is characterized by four seasons: the winter from about December to March, the pre monsoon lasting from April to May, the monsoon from June to September and the post monsoon from October to November. Meteorological data for last 31 years has been collected BMD station in Khepupara and analyzed to get the overall conditions of the study area. Khepupara station is situated at about 11.0 km northward of Polder- 47/2. Summary of the analysis of climatic parameter are given in following sections:

a. Rainfall

318. The average annual rainfall of this area is about 2,788 mm of which around 72% (2018 mm) mainly concentrated during monsoon season which last from June until the end of September. Besides, about 12.4% (345 mm) and 12.1% (336 mm) of total annual rainfall occur during pre-monsoon and post-monsoon respectively. The period from December to

March is significantly dry with less than 3% of the annual total. The pre-monsoon period is associated with local tornado and sometimes with cyclonic storms due to depressions in the Bay of Bengal. The hyetograph shows that the average highest and lowest values of rainfall are usually observed during the months of July (650 mm) and December (8 mm) respectively. Figure 5.2 shows the Average Monthly Rainfall of Khepupara BMD station.



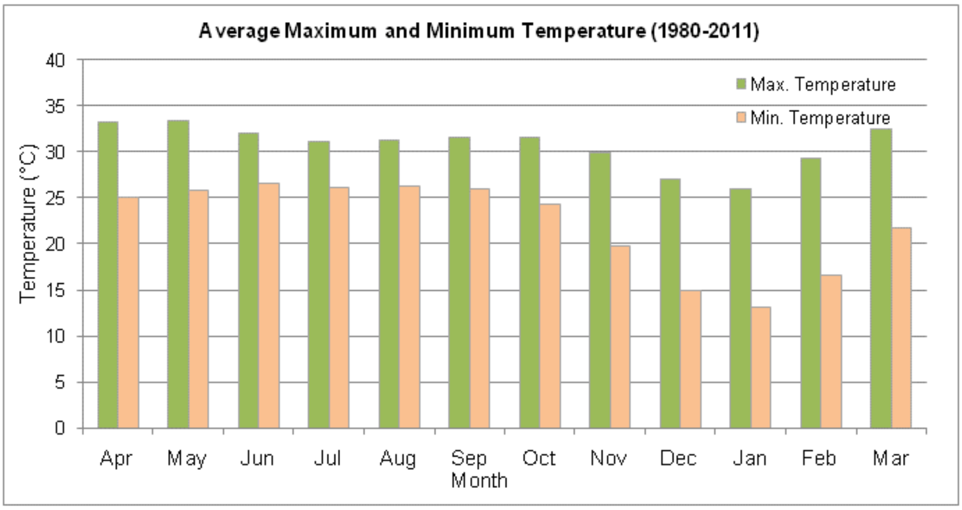
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	feb	Mar
Average	85	260	501	650	474	393	278	58	8	10	25	46
Max	228	643	1014	1049	915	730	693	508	49	63	113	184
Min	5	103	202	308	189	109	8	0	0	0	0	0

Source: BMD, 2011

Figure 5.2: Average Monthly Rainfall

b. Temperature

319. The normal average winter temperature ranges from a minimum of 13°C to a maximum of 26°C. The winter season receives a negligible amount of rainfall and is characterized by low temperature, low humidity and high solar radiation. The summer starts from April through May with a mean temperature of about 34°C. The hot summer (pre-monsoon) receives some rainfall in occasional heavy thunderstorms and hailstorms. The summer is characterized by its high temperature and evaporation rates due to extensive cloud cover. The monsoon season begins in June and continues up to September with maximum temperature usually around 32°C with high humidity and low solar radiation. The results of monthly average, maximum and minimum temperature variations of the Polder 47/2 are shown in Figure 5.3.

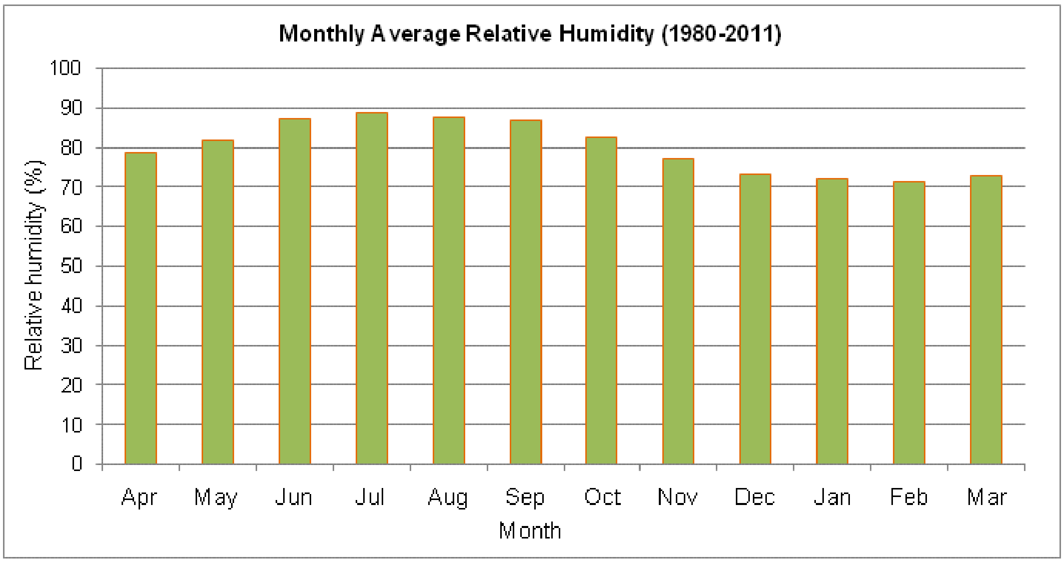


Source: BMD, 2011

Figure 5.3: Average Maximum and Minimum Temperature

c. *Relative* Humidity

320. Variation of monthly relative humidity, as recorded by the Khepupara BMD station (1978~2011) is shown in Figure 5.4. A significant fluctuation has been observed as relative humidity values start to increase from April (start of summer) due to increase in atmospheric water vapours coupled with temperature rise. Relative humidity rises above 89% in monsoon (June to September), and starts decreasing from post monsoon season following the monsoon rainfall. In the coastal areas, relative humidity values are usually higher than the other parts of the country. This is because of having a greater extent of water bodies, leading to increased evaporation.

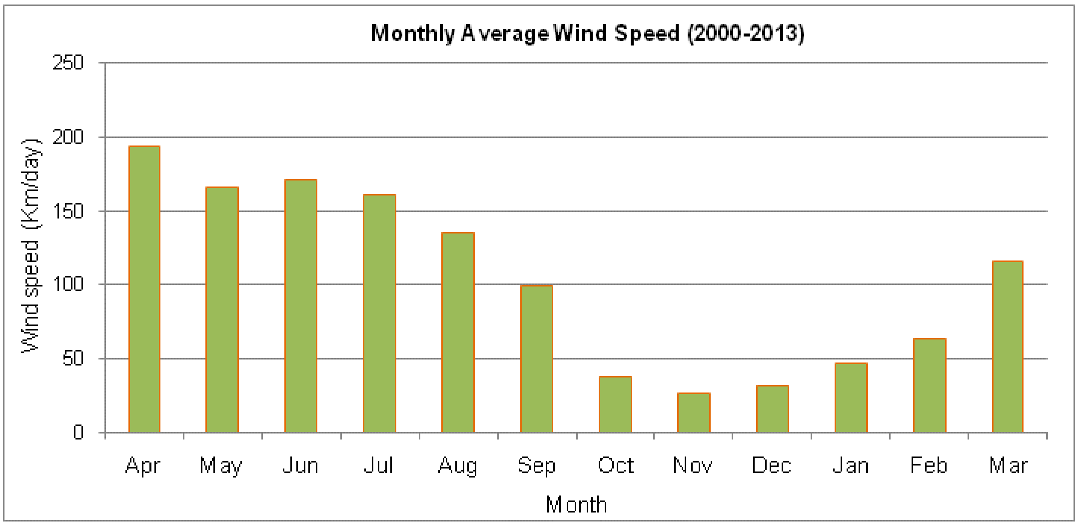


Source: BMD, 2011

Figure 5.4: Monthly Average Relative Humidity

d. Wind Speed

321. Historical data on wind speed for the last 25 years (1973-2013) has been collected from the BMD station at Patuakhali. Wind speed is the highest in April (around 195 km/day) and the lowest in December (around 27 km/day). During cyclone Sidr (2007) and Aila (2009), 1 minute sustained wind speeds were recorded as 260 kph and 120 kph respectively. SIDR caused more damage due to its high wind speed. Figure 5.5 shows the monthly wind speed of the study area.



Source: BMD, 2013

Figure 5.5: Variation of Monthly Average Wind Speed

e. Sunshine Hours

322. The average sunshine hour data has also been collected from Patuakhali BMD station (1989-2010). **Figure 5.6** shows that, the daily average sunshine hours are higher than 6 hours from October to May, but due to increased extent of cloud cover in monsoon (June to September) the values dropped below 4 hours.

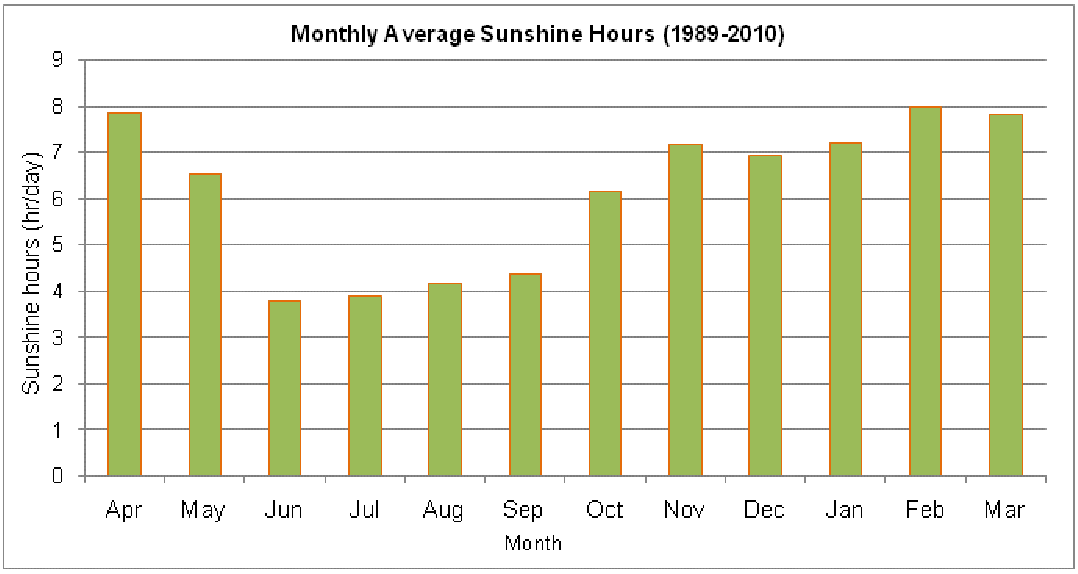


Figure 5.6: Monthly Variation of Average Sunshine Hours

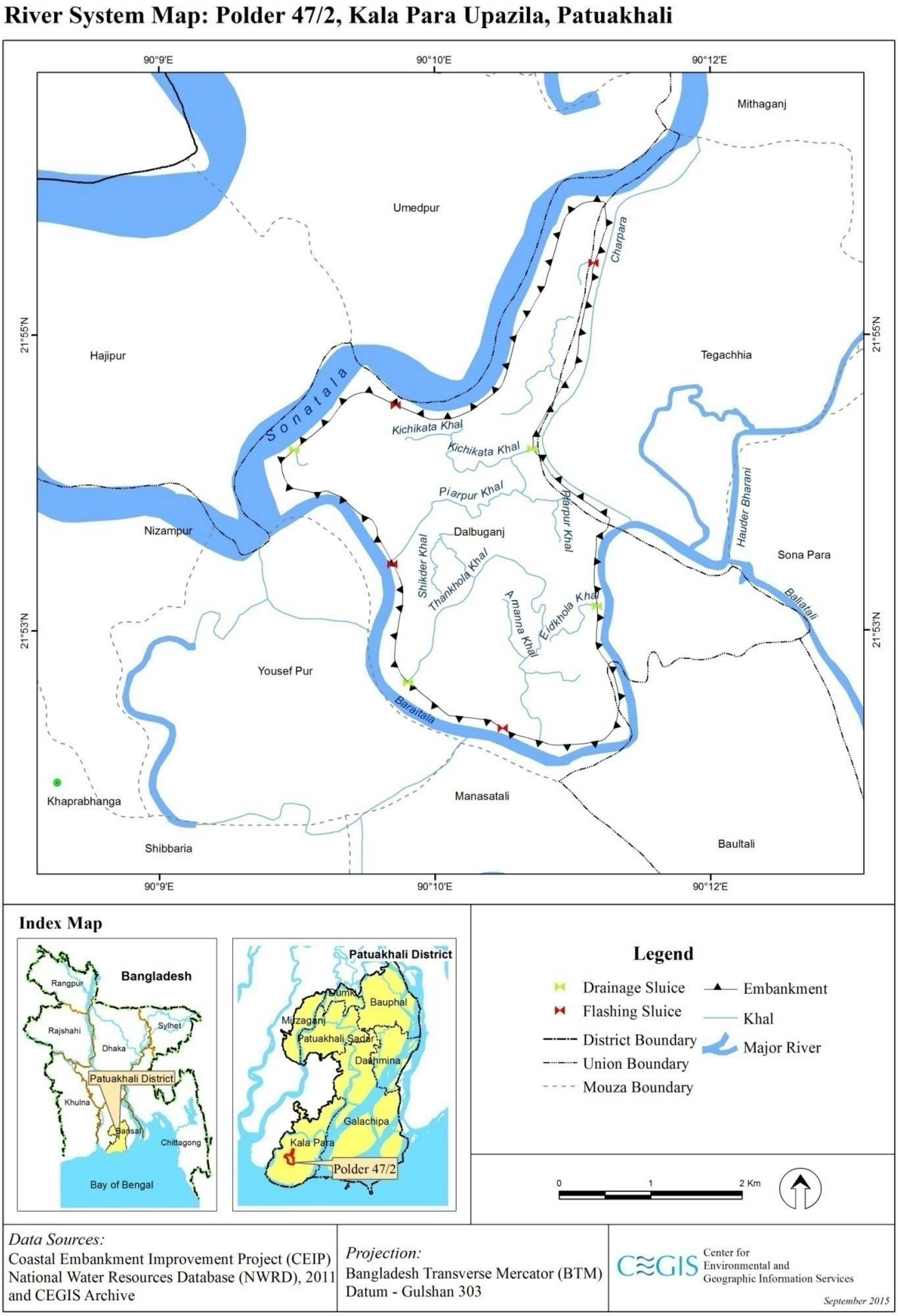
5.1.7 Water Resources System

323. The existing water resources system of the polder area depend on the surrounding ecosystem. It is the source of water supply, and plays an indispensable role in attenuating and regulating drainage, recharge into the aquifer, and maintaining the environment for aquatic habitats.

- **Major Rivers and Khals**

324. The Polder-47/2 is nearly 10 km away from the Bay of Bengal and undergoes diurnal tidal influence. The polder is surrounded by Sonatala River to the north and west; Baraitala River to the south and south-west and Charpara river to the north and north-east.

325. The main river of the study area is Sonatala River and is directly fed by the oceanic tides. The offtake of the Sonatala River is Andarmanick at Madhukhali mauza under Mithaganj union and drains into the same river; Andarmanick at Nizampur mauza under Mohipur union. The river is perennial in nature. The length of the Sonatala River is approximately 22.0 km with width of minimum 200 m, maximum 375 m and average 300 m. It is a tidal river and the maximum average variation of water level is 2.3 m between high tide and low tide. The offtake and outfall of the Baraitala River is from Sonatala River and is also tidal river. The river system of the area is shown in Map 5.5.



Map 5.5: Major River System of the Polder area

Picture 5.1: Sonatala River at DS-4 Regulator

Picture 5.2: Baraitala River at Thankhola Bazar Regulator (DS-3)

- **Hydrological Connectivity**

326. The water resources system of the polder area is mainly governed by the Andarmanick River, which feeds the peripheral Sonatala River and Baraitala River. In addition, there are numerous khals inside the polder area namely *Kachikata khal, Dalbuganj khal, Rasulpur khal, Nurpur khal, Piarpur khal, Thankhola khal, Eidkhola khal* and also some branch khals. These khals have tidal effects which flow from north to south and control the main drainage system and provide supplementary irrigation during the monsoon. The internal water courses of the polder facilitate the flow circulation inside the polder. During high tide, the flow direction of the khals is from Sonatala and Baraitala River to khals inside polder whereas at low tide period, tidal water recedes through the peripheral water courses and reaches the Bay of Bengal.

327. During rainy season, these khals are used to drain out the access water from the polder. However, in recent years, most of the khals have been silted up due to increased siltation because of the damaged sluice gates at the khal openings leading the siltation process. This also hampers the flow circulation inside the polder area.

Picture 5.3: Charpara River at Jamalpur village near DS-2 Regulator

Picture 5.4: Kachikata khal at DS-2 Regulator

Picture 5.5: Dabluganj khal at C/S of FS-1 Regulator

Picture 5.6: Nurpur khal at C/S of DS-4 Regulator

Picture 5.7: Eidkhola khal at C/S of DS-1 Regulator

Picture 5.8: Thankhola khal near DS-3 Regulator

5.1.8 Hydrological Setting

a. Surface Water Levels

328. The surface water level is an important issue of water resources. The available surface water level data of BWDB tidal water level station at Khepupara (Station ID-220: Andarmanick River) was collected for the period of 1959 to 1987 (Figure 5.7). The Khepupara station is situated at the offtake of Sonatala River, which is at a distance of 8.5 km northeast from the polder. Figure 5.6 shows that water level during high tide which ranges from +0.75m,PWD to +1.69mPWD, whereas low tidal water level ranges from (-)1.12m, PWD to (-)0.54mPWD.

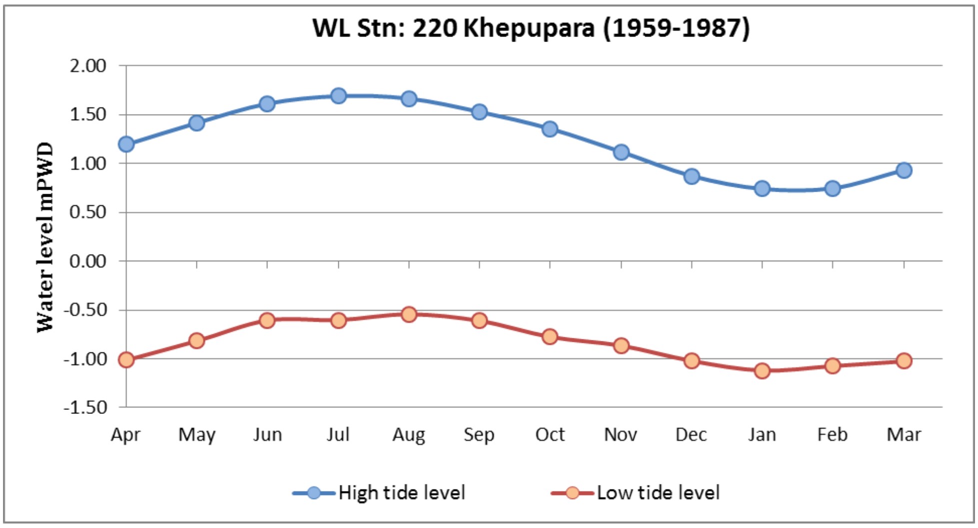


Figure 5.7: Surface Water Level of Andarmanick River at Khepupara

b. Groundwater Table

329. As other parts of the country, the study area also receives sufficient amount of rainfall and the available groundwater, used by hand pumps for drinking and domestic purposes. The monthly variation in ground water level from the year 1977 to 2013 has been analyzed from the nearest BWDB ground water observation well PAT002 (Well ID: 17857001) at Amtali Upazila. The variation pattern for PAT002 station the GWT are fairly low, with lowest and highest values found in September and March respectively. The monthly variation of average ground water level at Amtali Upazila is shown in Figure 5.8**.**

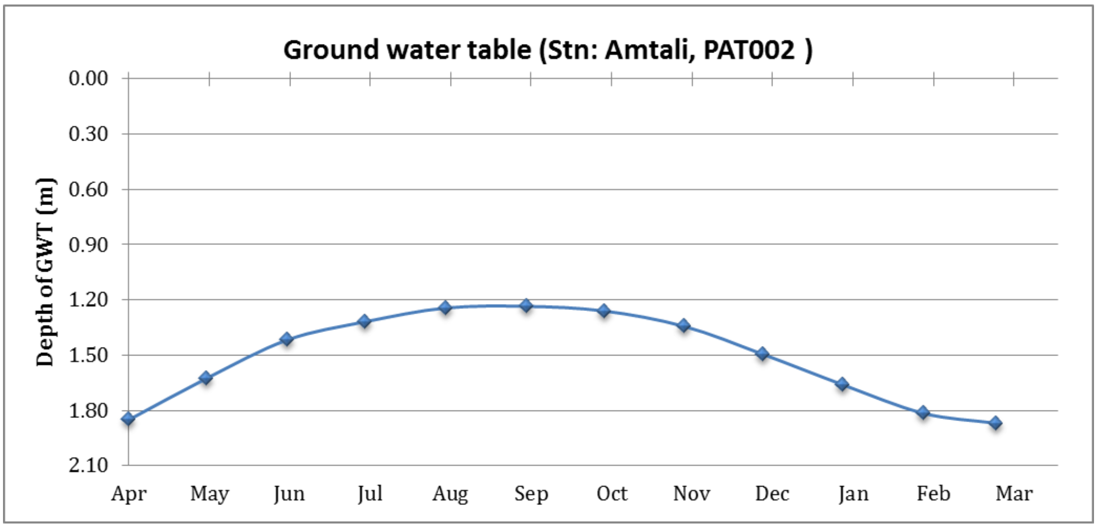


Figure 5-8: Average Monthly Variations of GWT

330. The Ground Water Table (GWT) measured at the aforementioned location at ten year intervals are shown in Table 5.4**.** Values are analysed for the months of March (considering as dry period) and September (considering as wet period). In the dry season, increased dependency of the local people on ground water lowers the GWT. During monsoon, the higher availability of surface water leads to higher recharge of ground water sources.

Table 5.4: Ground Water Tables (GWT) shown at ten-year intervals

New ID	Location	1980		1990		2000		2010	
		Mar	Sep	Mar	Sep	Mar	Sep	Mar	Sep
		Depth in Meter from the ground surface							
PAT002	Amtali	2.51	1.48	2.00	1.36	1.41	0.98	1.61	1.54

Source: National Water Resources Database (NWRD), 2010

331. Analyses have also been made to understand the long-term annual variations of GWT from 1977 to 2013 for PAT002 station, for the month of March (driest period) and September (wettest period). The values are presented in Figures 5.9 and 5.10. A mild increasing trend of annual GWT variation is observed in both cases. The figures show that the ground water table during both March and September is increasing gradually.

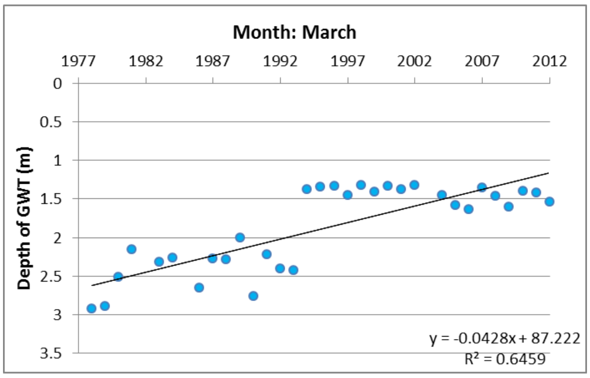


Figure 5.9: Variation of GWT at PAT002 in March (1977-2013)

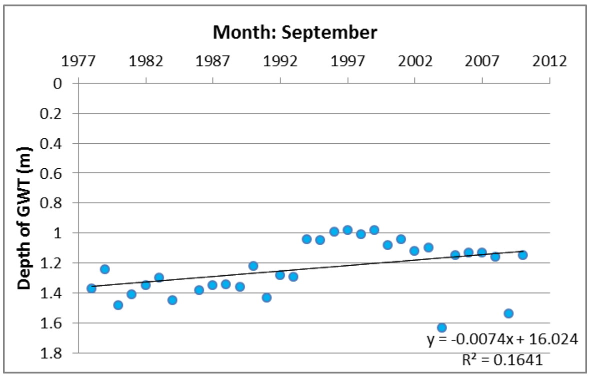


Figure 5.10: Variation of GWT at PAT002 in September (1977-2013)

Source: Bangladesh Water Development Board, 2014

Aquifer System

332. The aquifer system in Bangladesh is categorized mainly in three groups, which are; a) the upper aquifer or composite aquifer, b) the main aquifer, and c) deeper aquifer. However, the study area (e.g. Polder-47/2) has fallen under coastal area, which is the deeper aquifer of the country. The brief characteristics of this aquifer system is described below:

333. The deeper aquifer: The deeper unit is separated from the overlying main aquifer by one or more clay layers of varied thickness and extent. Deep aquifers are generally based on depth and in some areas, the aquifers in which water have neither access vertically upward nor downward but flows very slowly along the dips and slopes of the aquifers (Figure 5.11). This water bearing zone comprises of medium to coarse sand in places inter bedded with fine sand, silt and clay. At present water is being exploited in limited quantity from the water bearing formations deeper than 150-200 m of coastal zone. Large-scale extraction is not encouraged in the coastal areas for having every possibility of seawater intrusion or leakage from the upper aquifer (Sattar, M.A. 1993). The characteristics of the main aquifers of the country including the coastal zone where the study area is situated are presented in Table 5.5. From the Table 5.5 it is observed that the lithology of the coastal aquifer is grey medium to coarse sands, mostly confined to semi-confined in nature and with transmissivity rate of 1,000-3,000 m^2/day (Figure 5.12).

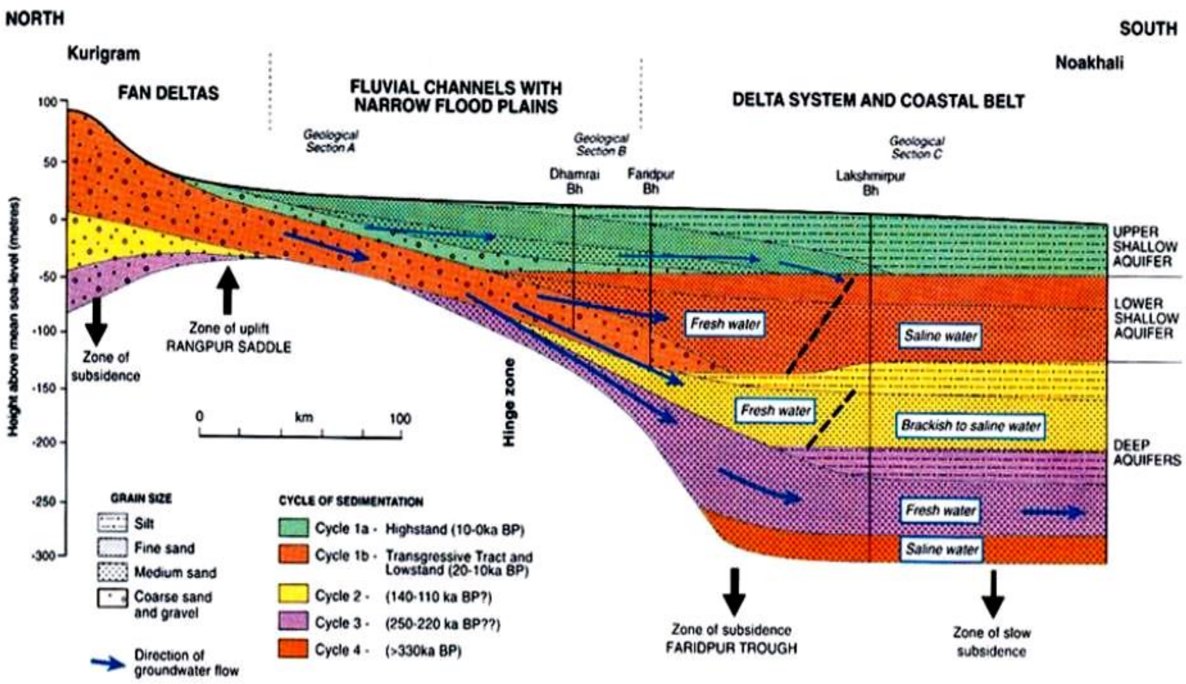


Figure 5.11: Hydrogeological Cross Section from North to South across Bangladesh

Table 5.5: The Main aquifers in Bangladesh, their lithology, relative ages and transmissivities

Aquifer	Lithology	Age	Transmissivity (m^2per day)
Brahmaputra-Teesta Fan and Brahmaputra basal gravels	Grey coarse sand, gravel and cobbles	Late Pleistocene and Holocene	3,500-7,000
Ganges, Lower Brahmaputra and Meghna main channels	Grey coarse to medium sands and gravel	Late Pleistocene and Holocene	3,000-5,000
Deeper cyclic aquifers of main delta and coastal areas	Grey medium to coarse sands	Early to mid Pleistocene	1,000-3,000
Old Brahmaputra and Chandina fluvial aquifers and fine silts of the Sylhet basin	Red-brown medium to fine grained weathered sands	Early to mid Pleistocene (DupiTila)	300-3,000
Madhupur and Barind Tract weathered fluvial aquifers beneath surface clay residuum	Red-brown to grey medium to coarse sands and inter-bedded clays	Early to mid Pleistocene (DupiTila)	500-3,000

Source: Ground Water Survey, The Hydrological Conditions of Bangladesh, UNDP, 1982, DP/UN/BGD-74-0091

334. Further, the lithology of coastal aquifer is presented in Figure 5.12 below.

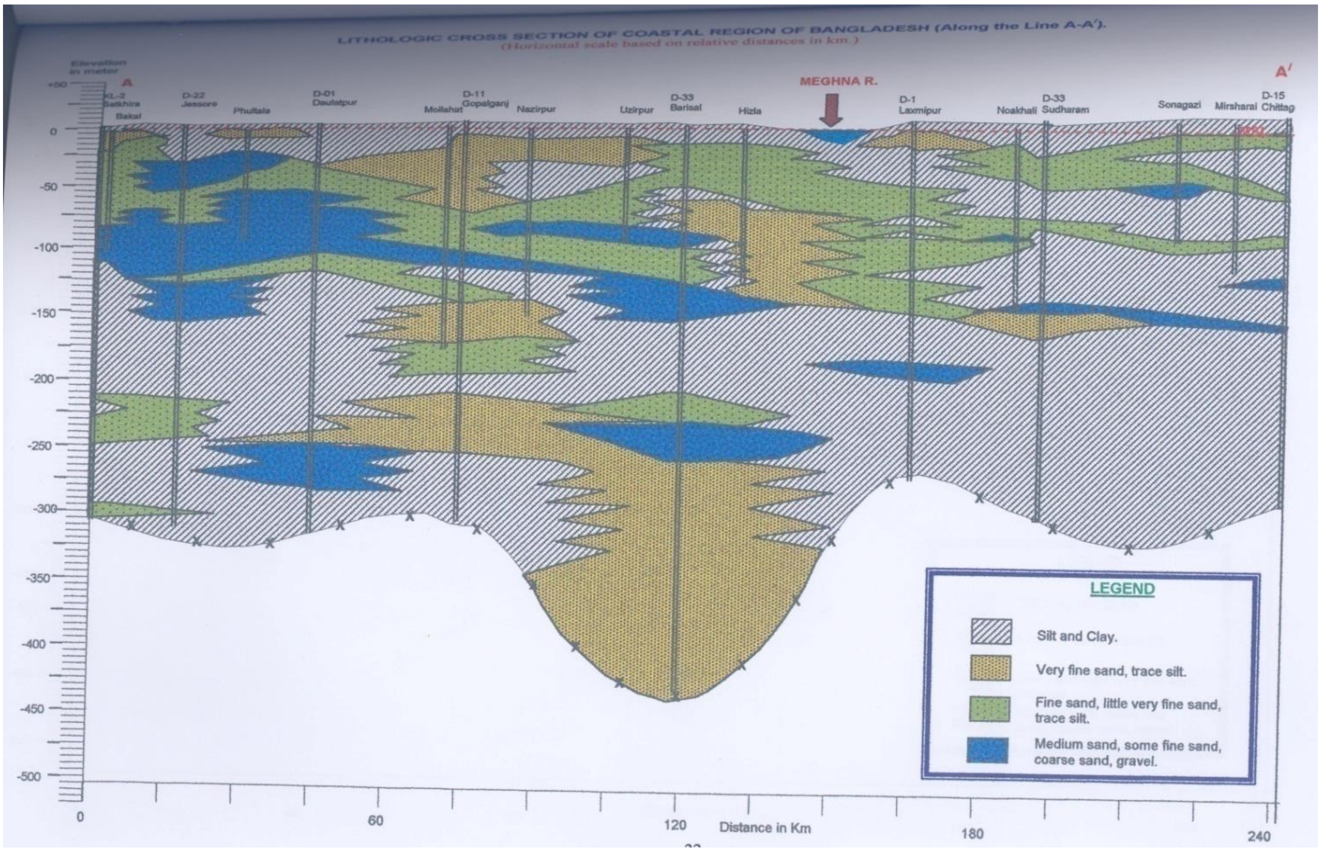
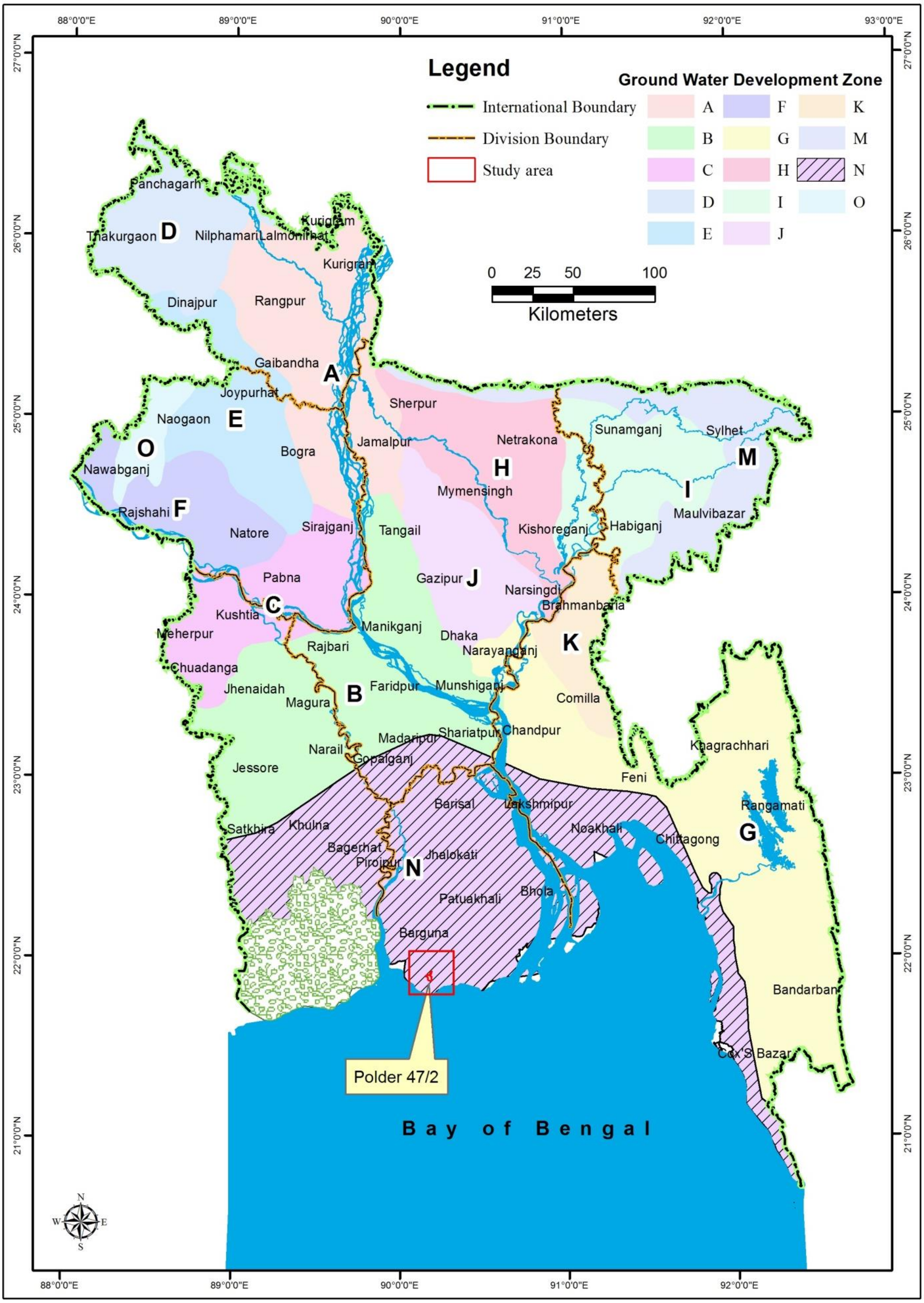


Figure 5.12: Lithological Cross-section of the coastal aquifer

335. Furthermore, based on the lithology and other characteristics of the aquifer the entire country has been divided into 15 potential groundwater development zones (Map 5.6). The study area has fallen under zone N (Table 5.6) which has been characterized as Floodplains of GBM with brackish & saline water problems.



Map 5.6: Potential groundwater development zones

Table 5.6: Summarized Description of the Groundwater Development Zones in Bangladesh

Zone	Area	Lithology	Aquifer characters	Remarks
A	Rangpur, parts of Bogra&Jamalpur	Coarse sediments	T= 1000 to 7000 sq. m/day	Highest transmissivity
B	South-central part of the country	Clay, silt in the upper part	T=3500 sq.m/day	Potential for deep wells
C	Kushtia and most of Pabna	Floodplain of the Ganges (sand, silt, clay)	2-3 cusec for deep wells	---
D	Most northwestern region (Dinajpur)	Coarse detrital piedmont deposits, top silt clay	T= high	Suitable for groundwater development
E	Bogra and Rajshahi	Older alluvial clay	1-2 cusec for deep wells	---
F	Southern and western parts of Rajshahi	Same as zone C	---	Lowest recharge
G	Southwestern section of Comilla& northern part of Noakhali	Floodplain deposits of the Meghna	2 cusec for deep wells	Suitable for deep wells
H	Most of Mymensingh, eastern Jamalpur & a small part of NW Dhaka	Floodplain deposit of the Old Brahmaputra	2 cusec for deep wells	Suitable for deep wells; high recharge
I	Plains of Sylhet district	Top part silt & clay	One cusec for deep wells	High rainfall, high recharge
J	Parts of Dhaka, Tangail & Mymensingh	Top part Madhupur Clay	1-2 cusec (200 mm recharge /Year)	Suitable for deep wells
K	Eastern part of Comilla	Estuarine silt	2 cusec	Suitable for deep wells
L	Chittagong & Noakhali	Piedmont deposits & estuarine deposits	T= 40 m^2/day	Not favourable for extensive withdrawal
M	Hilly areas of Sylhet& Mymensingh& Ctg. Hill Tracts	Tertiary sediments	Low transmissivity	Not favourable for extensive withdrawal
N	Coastal areas of Barishal, Patuakhali , most of Khulna, Noakhali & Chittagong	Floodplains of GBM	1,000-3,000m^2/day	Brackish & saline water problems
O	Western Rajshahi district	Thick Madhupur clay on the top part with thin sand layers	---	Limited scope for development

Source: Ground Water Survey, The hydrological conditions of Bangladesh, UNDP, 1982, DP/UN/BGD-74-0091

336. The term salinity intrusion specially describes the situation where seawater displaces or mixes with freshwater within an aquifer in response to change in the hydro- geological environment. Salinity intrusion occurs as a result of seawater encroachment into the coastal aquifer. If groundwater gradients are reduced, (it may happen in coastal aquifer where excess pumping has disrupted the hydraulic equilibrium), the outflow of freshwater is reduced and denser saline water may displace the fresh water within the aquifer. Seawater intrusion mechanism and lateral intrusion mechanism of coastal aquifer are shown in Figure 5.13 and Figure 5.14 below:

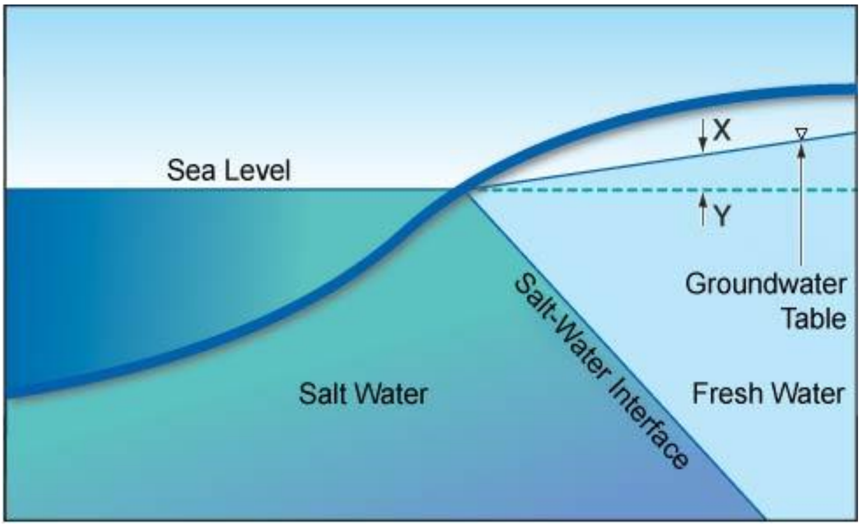


Figure 5.13: Seawater intrusion mechanism for homogeneous and unconfined coastal aquifer

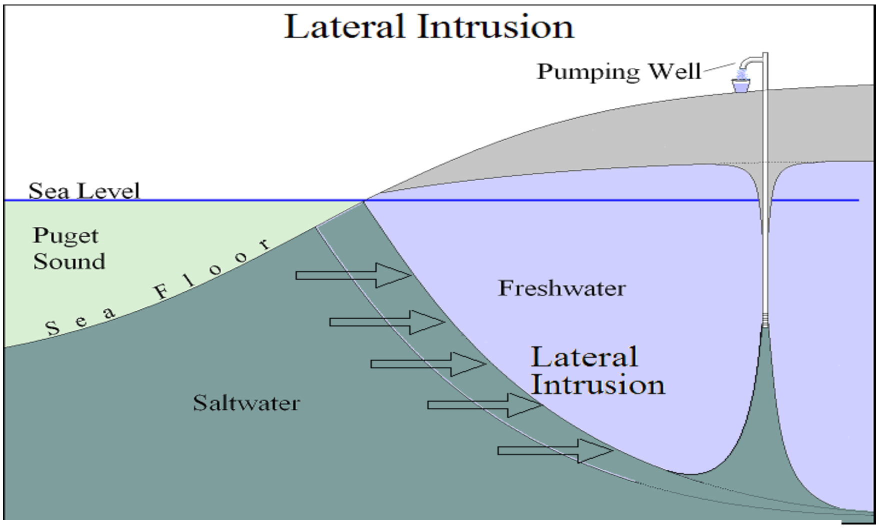


Figure 5.14: Lateral intrusion mechanism of coastal aquifer

337. The mechanism of saltwater intrusion is related with water table and saltwater interface. If the water table (fresh water) in a coastal aquifer is lowered then the salt-water interface will rise. However, the saltwater intrusion into coastal aquifers is caused by two process are:

- Lateral encroachment from the ocean due to excessive water withdrawals from coastal aquifers, or
- Upward movement from deeper saline zones due to upconing near coastal discharge/pumping wells.

5.1.9 Water Resources Issues and Functions

338. Salinity and drainage congestion and water logging are major problems in Polder 47/2. It is evident from the field visit and consultation with local people that the polder encounter various problems like sedimentation, erosion, tidal and storm surges flooding, and obstruction of navigation.

a. Salinity

339. Salinity intrusion is one of the major problems in the polder area. Low salinity in the surface water is found in the polder area during monsoon. However, during the dry season (December to March), increased salinity is observed in the surface water. The entrance of tidal water during high tide through unprotected and deteriorated water control structures, into *Kachikatakhal, Dalbuganjkhal, Rasulpurkhal, Eidkholakhal, Thankholakhal* results to some extent in saline water intrusion to some extent. The river water become saline in the month of February and continue until May and salinity level lowers down during monsoon. The local people has a demand for storage of sweet water in the internal canals system for cultivating Robi-crops when the river water is saline.

340. Entrance of saline water in unprotected areas results in major constraints to agricultural development. Surface water becomes un-suitable for irrigation during the dry season, because of the high salinity content.

b. Drainage Congestion and Water Logging

341. Drainage congestion has been identified as the major problem inside the polder area and its intensity varies from place to place. *Kachikatakhal, Dalbuganjkhal, Rasulpurkhal, Eidkholakhal* inside the polder, which are directly connected to the peripheral rivers, suffer from tremendous drainage congestion. About 84% (2,354 mm) of total annual rainfall occurs during monsoon and post-monsoon periods. As a result, these internal khals cannot cope with the increased rainfall occurrences, leading to moderate to severe drainage congestion. Local people opined that, around 247 ha (26% of total polder area) suffers from *severe drainage congestion*[12] problems. From field investigation during June 2015 and using Digital Elevation Model (DEM); the Mauza wise drainage congested area found are shown in Table 5.7.

Table 5.7: Drainage Congestion of the Polder Area

SL No	Union name	Village name	Affected area (ha)
1	Dalbuganj	Rasulpur	36
2		Dalbuganj	90
3		Meherpur	86
4		Payerpur	35
		Total	**247**

Source: Field Survey, June, 2015

342. Such drainage congestion mostly affects the agriculture sector. The reduced drainage capacity of the khals causes rainwater to inundate the agricultural fields for a period of 7 to 10 days, and affects the Kharif-II crops.

343. The main reason for drainage congestion problems is of two-fold; decrease of the conveyance capacity of khals due to sedimentation and occurrence of heavy rainfall during monsoon. The main drainage dynamic of the polder is mainly governed by four (04) drainage sluices associated with other internal khals. At present, the internal khals are silted up because of the damaged sluice gates at the khal openings. Some of the gates (*Kachikatakhal, Dalbuganjkhal, Rasulpurkhal, Eidkholakhal, Thankholakhal, etc*.) became non-functional due to poor maintenance, leading to siltation adjacent to the khal openings. The rate of sedimentation on riverbed and bank side deposition is increasing day by day and the cumulative sedimentation causes rise in bed level of the internal khals. Since the khals

[12]Severe Drainage Congestion has been defined as the water courses which have extremely low conveyance capacity and usually take one week or more to properly drain out rainwater.

are deposited with silt, water conveyance capacity has decreased; as a result, effective drainage from the polder area is not possible.

344. BWBD has constructed a closure dam on Baraitala River last year (2014) to protect the area from riverbank erosion.

345. Local people opined that, no prolonged water logging situation exists inside the polder, however, minor rain fed inundation exists in some areas as already discussed above.

Picture 5.9: Drainage congestion at Rasulpur village

Picture 5.10: Drainage congestion at Dalbuganj village

Picture 5.11: Drainage congestion at Meherpur village

Picture 5.12: Drainage congestion at Dalbuganj village

c. Tidal and Storm Surge Flooding

346. Tropical cyclones and tidal flooding are threat to the polder areas. During the devastating cyclone Sidr (2007), the polder area was inundated damaging the crops and properties by overtopping of wave action. The Sidr (2007) directly hit the polder and affected about 60% (570 ha) of the total area. During this cyclone, surge water entered the polder area by overtopping (about 0.6-1.0 feet water on embankment) the bank of *Sonatala* River and *Baraitala* River and damaged many segments of the flood control embankment. At that time, the water level on the project site from the ground was 2-3 feet. As a result, the embankment was further damaged and aggravated with time due to weathering and regular tidal wave action. At present, the entire embankment is under sectioned in respect of the design section and thus, about 30% of the polder area is under intense threat of cyclone surges, tidal wave action and river erosion.

347. Tidal flooding is very common in the project area. At present, almost every year tidal flooding occurs inside the Polder and inundates about20 to 25 % of the total polder area. *Payerpur, Meherpur, Dalbuganj* and southern part of *Rasulpur* villages are mainly affected by tidal flooding. The main reasons for flooding are heavy rainfall, tidal water intrusion by the damaged gates, storm surge, water level rise etc.

d. Navigation

348. The peripheral rivers and Khals (Sonatala and Baraitala) of Polder-47/2 are used for waterway communication. Small trawlers carrying passengers and sand are frequently found to navigate through the rivers. However, very little navigation takes place inside the polder as only small fishing boats are found to navigate through the internal khals.

e. Water Use

349. The standard value of average daily demand of water for domestic and drinking purposes in rural areas is considered as 50 lpc (Ahmed and Rahman, 2010). However, the actual status of drinking water in some of the coastal polders is very poor. During field survey in Polder-47/2, it was found that the average daily domestic use of water was around 40lpc. The study found that around 245 m^3 of water is consumed daily by the total number of 6,125 people living in the polder. Local people opined that they prefer Deep Tube Wells (DTWs) as drinking water sources to meet up their daily needs. The use of shallow tubewells is only confined for domestic purposes. This is because the shallow subsurface layers contain minor salinity (upto 2 ppt), making it unfavourable for drinking water use. Overall, water availability in Polder-47/2 is not a major concern as the local people opined that they have sufficient surface and groundwater sources to meet up their daily needs for drinking and domestic purposes.

5.1.10 River morphology and dynamics

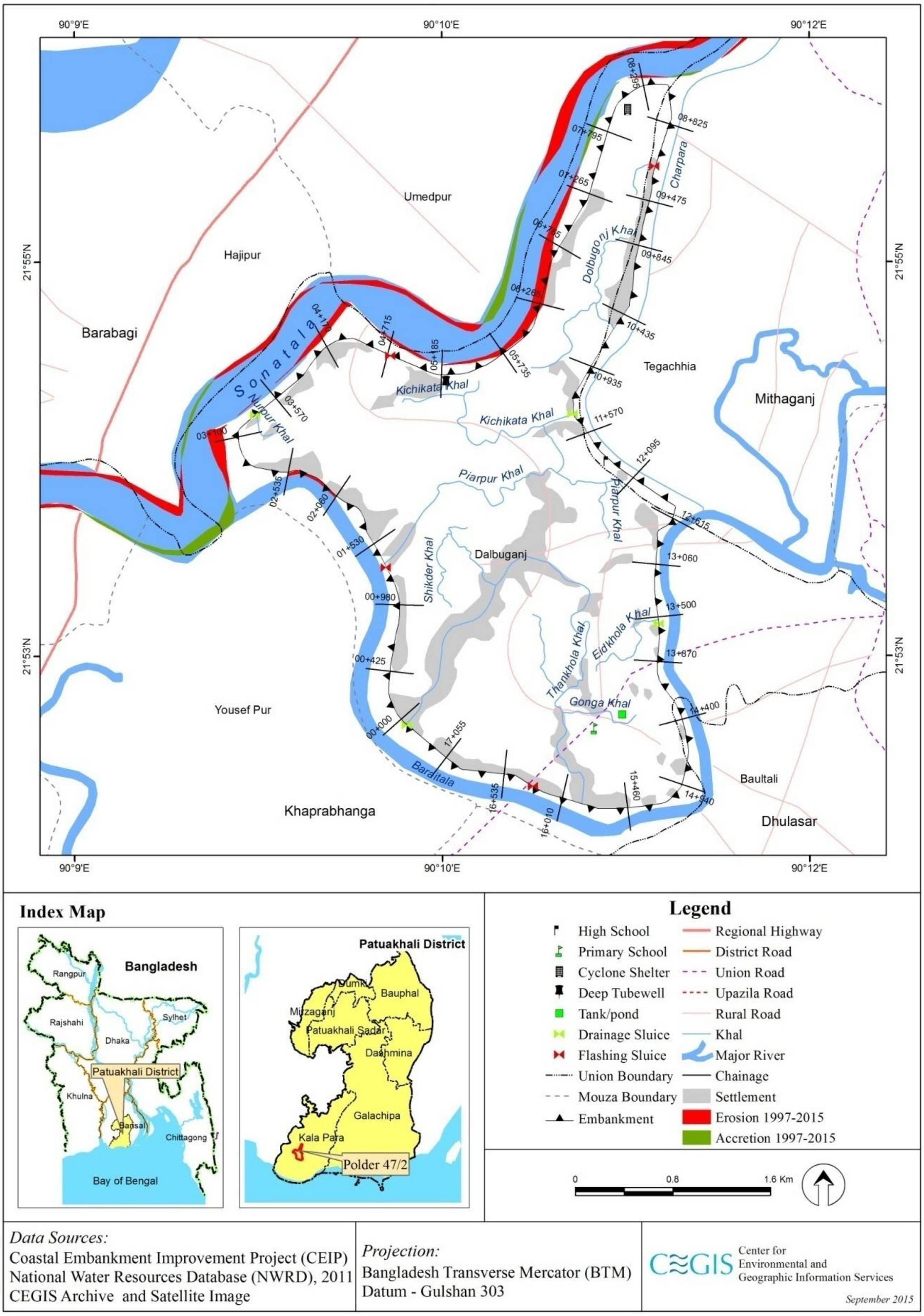
Historical Erosion-Accretion Analysis along Sonatala River

350. Historical satellite images for the year 1997 and 2015 were analyzed to understand the historical erosion-accretion of the adjacent river of the Polder-47/2. The raw Landsat TM images were geo-referenced into Bangladesh Traverse Mercator (BTM) projection system with respect to the mosaic of Landsat TM images of 1997. These images were then co-registered with each other. Bankline delineation was done from the satellite images and by superimposing the banklines of two different years erosion/accretion was assessed. The 11 km reach around the Sonatala River has been considered during the erosion-accretion analysis. From the analysis, it has been found that erosion was 65.13 hectares at the rate of 3.62 hectares per year while accretion was 13.03 hectares at the rate of 0.72 hectares per year during the specified period in Kalapara upazila of Patuakhali district around the polder. The amount of erosion is comparatively higher than that of the accretions in this reach (Map 5.7).

351. River bank erosion is active and creates severe problem in this area. Erosion engulfed local people's land, homes and has become an environmental and social hazard. During field investigation, two erosion hotspots have been found mainly in the north-western part along Sonatala River. The riverside slope of embankment at Ch. 1+700 km to Ch. 2+700 km at Payerpur village (Picture 5.13) and Ch. 6+000 km to Ch. 7+000 km at Fulbunia village (Picture 5.14) has been damaged due to severe wave action of the Sonatala River.

352. At Payerpur, embankment is under threat of severe bank erosion. Local people informed that, the location is unstable and is being eroding since last 5~7 years. A total of about 200 m embankment has been breached (On: 23 June, 2015) due to heavy rainfall and severe wave action of Sonatala River.

Erosion and Acceration (1997-2015) Map: Polder 47/2, Kala Para Upazila, Patuakhali



Map 5.7: Erosion-Accretion along the Sonatala River

353. The other erosion hotspot at Fulbunia village was inspected as well. Similar erosion features and morphological instability were observed in that area but the length of erosion is more than that of the Payerpur village. About 450 m length of flood control embankment has been breached by severe wave action of Baraitala River. Local people opined that more tidal

water may intrude inside the polder through this breach, and as a natural process severe river erosion may occur in the coming years.

354. Flood control embankment, drainage and flushing infrastructure, settlement (about 250-300 homestead), agricultural lands (300 – 350 ha) and other natural resources will remain exposed to river erosion. To protect these areas bank revetment with backing of embankment is needed.


Picture 5.13: River bank erosion at Payerpur Ch. 2+550 km (21°53’51.6” N; 90°9’26.3” E, Date: 23 July 2015)


Picture 5.14: River bank erosion at Fulbunia Ch. 6+265 km (21°54’43.1” N; 90°10’34.9” E, Date: 23 July 2015)

355. Sedimentation is another problem in the polder area. In the tidal rivers, suspended sediments are mainly composed of silt and clay. The main drainage outfall of the polder, i.e., the periphery rivers are severely silted up due to malfunctioning of water control structures. Sedimentation in most of the internal khals namely *Kachikata khal, Dalbuganj khal, Rasulpur khal, Eidkhola khal, Thankhola khal* in the polder has taken places for having no maintenance from the completion of the polder and malfunctioning of the structures causes rise of bed level reducing of the conveyance capacity of the khals. In the polder area, on an average, roughly 5 to 7 inches sedimentation took place in most of the major khals and the surrounding rivers each year.

5.1.11 Environmental quality and pollution

a. Water quality

356. Five major water quality parameters (pH, TDS, Temperature, DO and Salinity) were measured at site in June 2015, from five different sampling locations of the polder. One of the five samples was collected from a Deep Tube Well (DTW) at *Meherpur* Primary school. The other four samples were collected from different surface water sources (two from the outer side of the polder and two from the inner side the polder). The results of the in-situ water quality measurements in wet season are shown in Table 5.8 below.

Table 5.8: Water quality in different locations (wet season)

Location	Sampling Water Source	GPS readings	pH	TDS (ppm)	Temp. (ºC)	DO (mg/l)	Salinity (ppt)
Sonatala river at Nurpur Village near DS-4	Sonatala, outside the polder	21°54’10.5”N 90°09'11.8”E	7.8	925	27.9	6.2	5.0
Mirpur village near DS-3	Inside the polder	21°52’51.8”N 90°09'59.9”E	7.3	350	27.5	4.3	3.0
Dalbuganj village	Inside the polder	21°53’50.3”N 90°10'28.9”E	7.5	415	27.1	4.7	3.0
Charpara khal near DS-2	Outside polder	21°54’08.5”N 90°10'46.2”E	7.6	545	28.6	4.9	4.0
Meherpur primary school	Deep Tube Well, inside the polder	21°52’25.0”N 90°10'40.2”E	7.5	170	25.3	4.3	0.0
DoE Standard Value(Bangladesh)			***6.0-9.0***	***2100***	***20-30***	***4.5-8.0***	***-***

Source: CEGIS field survey & Laboratory.tests June 2015

357. During the wet season, the pH values were higher than the neutral value (pH=7), ranging from 7.3 to 7.8, which means that the water in these locations are slightly alkaline.. However, pH values observed are within the DoE standard values at all locations. Values of TDS were found moderate inside the polder, but were slightly higher outside the polder. However, all measured TDS values were within the DoE standard value. The higher values outside the polder is caused by increased sediment load carried by the peripheral rivers, which, to some extent, is slightly prevented from entering into polder by the damaged water control structures. Values of DO were mostly found close to the standard values set by DoE for both irrigation (5 to 6 mg/l) and fishing (5 mg/l).Temperature values varied within a typical range for different locations as samplings were made in different parts of the day.

358. Almost all the surface water samples from inside and outside of the polder were found of having low to moderately saline concentrations. Sample collected from Sonatala River was found moderately saline (5 ppt). There are some khals *(Kachikata khal, Dalbuganj khal, Rasulpur khal, khal, Thankhola khal),* where tidal water enters because of damaged gates. Salinity concentrations at Dabluganj, Mirpur and Meherpur villages (inside polder) were found as 3 ppt, which is almost similar to those of the outside polder. One deep tube-well was also tested at Meherpur primary school and found to have zero salinity.

359. In addition, surface water quality has also been measured in dry season (February, 2016). Table 5.9 shows the water quality in dry season of the same parameters of surface water.

Table 5.9: Water quality in different locations (dry season)

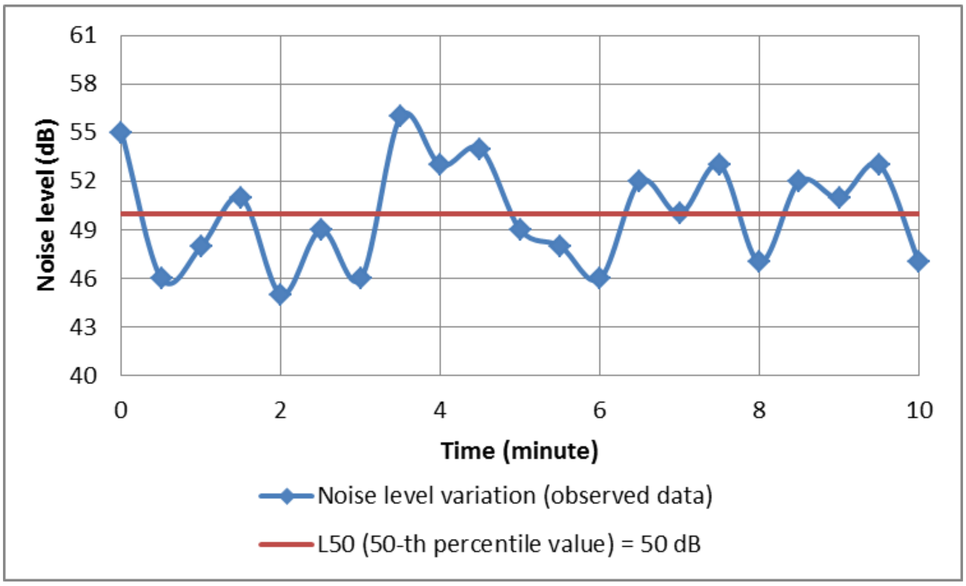
Source of surface water	Location	GPS point	Water quality parameter				
			pH	TDS (ppm)	Temp(°C)	DO (mg/L)	Salinity (ppt)
Sonatola River	Fultola bazar	21°54'24.99"N 90°10'23.06"E	8.1	1	22.9	8.5	10
Kachikata khal	Kachikata, Jamalpur (U/S of DS-2)	21°54'6.65"N 90°10'41.70"E	8.4	921	26.0	5.5	0
Charpara khal	Kachikata, Jamalpur (D/S of DS-2)	21°54'7.12"N 90°10'43.17"E	8.0	1	26.1	5.8	8
Eidkhola khal	Kathalpara (U/S of DS-1)	21°53'12.10"N 90°11'6.46"E	8.5	1137	26.5	5.4	0
Baraitala River	Kathalpara (D/S of DS-1)	21°53'12.26"N 90°11'7.74"E	8.4	1	26.2	6.4	8
Thankhola khal	Mirpur at DS-3	21°52'44.66"N 90° 9'55.34"E	8.1	1	25.3	3.8	9
Tubewell	51 no. Mohipur Govt. Primary school	21°52'24.79"N 90°10'40.82"E	8.6	1065	27.2	2.7	0
DoE Standard Value(Bangladesh)			***6.0-9.0***	***2100***	***20-30***	***4.5-8.0***	***-***

Source: CEGIS field survey&Lab.test, February, 2016

360. The pH value is higher than neutral scale (pH=7), which means the water in these locations was alkaline yet. Values of TDS in dry season were found to be very low except in Kachikata khal, Eidkhola khal and in the tubewell with variations from 921 to 1137 ppm. Values of DO were mostly found to be slightly above the standards set by DoE. Salinity in of the surface water during the dry season was found to be slightly higher than measured in wet season. However, according to local people, salinity of both surface and ground water become higher during April and May compared to the salinity level in in February.

b. Noise quality

361. During the field survey, sound levels were measured at Jamalpur village (Figure 5.15) near DS-2 with 10-minute sampling periods. L_{50} (50-th percentile value) value was computed with the observed sound levels. For a normal time series distribution of sound levels, L_{50} is assumed to be equal to Leq, which is the Equivalent Noise Level. In the study area the L_{50} value was found as 50 dB, which is equivalent to the standard Leq. value for residential zone, set by ECR 1997 (50 dB).



Source: CEGIS field survey, June 2015

Figure 5-15: Variation of sound levels for 10 minute sampling period at Jamalpur village near DS-2 (21º54'4.0''N and 90º10'29.0''E)

N.B.: All values were collected during daytime

c. Soil quality

Soil sample were collected from three locations at three depths (0-15 cm, 15-30 cm and 30-45 cm) inside the Polder area on 23rd June, 2015. Collected soil samples were handed over to Soil Resource Development Institute (SRDI), Dhaka for analyzing the same. Soil quality data based on fertility are presented in Table 5.10 and the standard of chemical properties of soil is also presented in appendix-3

Table 5.10: Chemical properties of soil on agriculture land

Location (Mouza / Village)	GPS reading	Land use	Depth (cm)	EC (ds/m)	pH	OM	N	K	P	S	Zn	Pesticide residue
						%			μg/g			
Mirpur	21°49' 5.7'' N 90°06' 45.1''E	Fallow-Lt. Aman-Pulse	0-15	9.14	7.5	1.10	0.06	0.20	5.49	41.93	0.38	-
Pearpur	21°53'47.9'' N 90°09' 32.7''E	Lt. Aus-HYV Aman-Pulses	0-15	4.6	7.7	0.74	0.04	0.37	6.31	78.18	0.57	-
Fulbuniar	21°54'23.3'' N 90°09' 49.9''E	Fallow-Lt. Aman-Potato	0-15	2.29	7.1	0.86	0.05	0.21	6.63	35.50	0.56	-

Sources: SRDI and BARI Laboratory test, August; 2015

362. The soil salinity levels are 2.29 to 9.14 (ds/m) in the top soil (depth of 0-15 cm) in all agricultural land. This indicates that the soil of the respective agricultural land is non-saline to slightly saline. The pH levels are observed from 7.1 to 7.7. The soils are slightly alkaline, however with pH values within acceptable limits. The Organic Matter (OM %) contents range from 0.74 to 1.10 , which corresponds to very low to low organic contents (≤1.0-1.7%) (BARC, 2012). In the case of Nitrogen (N) level, it was found to range from 0.04% to 0.06%, which are considered to be a very low nutrient content.

363. Potassium (K) contents were found within a range of 0.20 to 0.37 (meq/100g) in all the locations. The K contents are between medium and optimal. The concentration of Phosphorus (P) was within a range of 5.49 to 6.63 (μg/g) , which is considered as a low P content. The Sulphur (S) contents were found within a range of 35.50 to 78.18 (μg/g), which are considered as optimum to a very high S content.

364. The Zinc (Zn) levels are within the range of 0.38 to 0.57(μg/g) in all locations, which are considered to be very low to low.

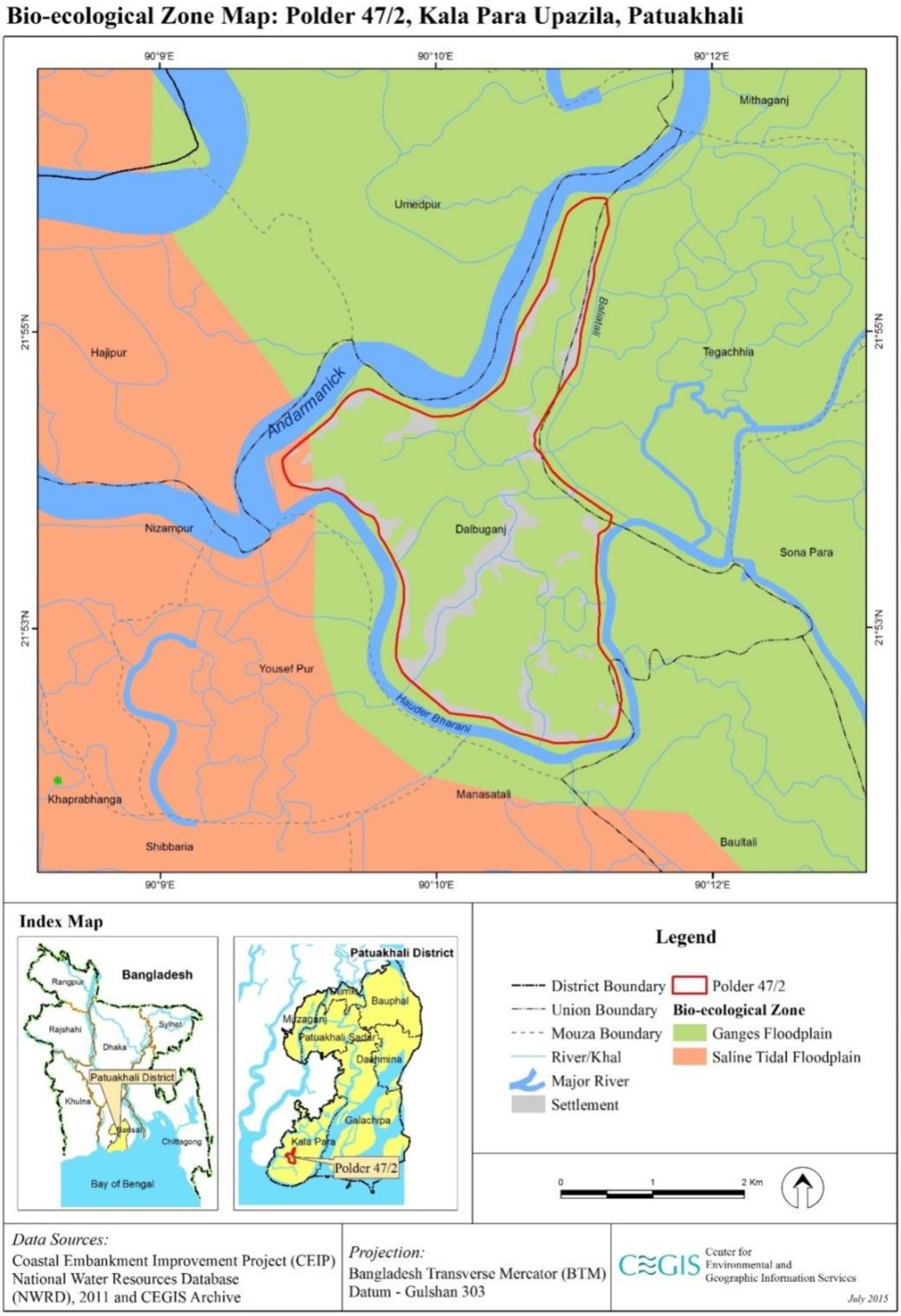
365. The analyzed results show that no pesticide (Furadan) exists in the soil samples.

5.2 Biological Environment

366. The study area supports different type of habitat with different species of flora and fauna. Ecosystems of the study area can be divided into major categories: terrestrial ecosystem, mangrove ecosystem and aquatic ecosystem The study was carried out under line transect walk literature review, and peoples' interviews to survey both on flora and fauna. A detail on methodology is presented in the section 2.2.4.

5.2.1 Bio-ecological zones

367. The area of Polder-47/2 encompasses one bio-ecological zones out of 25 zones, namely the Ganges Floodplain but Saline tidal flood plain has touched a corner of the polder (Map 5.8) (Nishat et.al. 2002).These Bio-ecological zones have been identified by IUCN-The World Conservation Union -Bangladesh.



Map 5.8: Location of Polder in Bio-ecological Zone of Bangladesh

5.2.2 Terrestrial Ecosystem

a. Terrestrial Flora

368. There is no natural/reserved forest within or adjacent to the Polder-47/2. The terrestrial ecosystem contains all the flora and fauna found only on landforms. In the polder area; the major terrestrial ecosystems are classified into three groups;

- Settlement/Homesteads
- Crop fields
- Road

Settlement/Homestead vegetation

369. Homestead vegetation includes most of the plant in terms of diversity and population (Picture 5.15). Most of the homestead vegetation are man-made and are usually planted for household benefits. Rest of the vegetation is considered as self-propagating. Settlement vegetation is dominated by Narikel (*Cocos nucifera*), Taal (*Borassus flabeliffer*), Khejur (*Phoenix sylvestris*),Mango (*Mangifera indica*), Boroi (*Zizyphus mauritiana*), Supari (*Areca catechu*), Bansh (*Bambusa Spp.),* Chambol (*Albizia richardiana*), Mahogoni (*Swietenia mahogoni*) Akashmoni *(Acacia auriculiformes)*and Raintree (*Samanea saman*).Table 5.11 provides a list of the major tree species within the homestead vegetation in the polder area. Settlement vegetation is also providing shelter for various terrestrial fauna. The density of herbs and shrubs is moderate. Almost all tree species present on homestead platforms are sensitive to flood water. Tidal flood creates drainage congestion inside the polder, which severely impact on homestead vegetation. Except one or two species, all herbs and shrubs are sensitive to flooding.

Table 5.11: Major trees species within the homestead area

Tree species name	Family name	Local Status	Saline susceptibility	Habit	Utilization	Ecological Value
Supari (Areca catechu)	Palmae	VC	2	Monocot	Fruit and Thatching	3
Narikel (Cocos nucifera)	Palmae	VC	3	Tall monocot	Fruit and Thatching	1,2
Khejur (Phoneix sylvestirs)	Palmae	VC	3	Monocot	Fruit	1,2
Tal (Boassus flabelifer)	Palmae	VC	2	Tall monocot	Fruit and thatching	1,2
Bash (Bamboosa sp.)	Gramineae	C	1	CL	Thatching	1,2,3
Babla (Acacia nilotica)	Fabaceae	VC	3	T	Timber, fuel wood and fruit	1,2,3
Khai Babla (Pithecolobium dulce)	Mimosaceae	VC	2	T	Timber, fuel wood and fruit	1,2,3
Nim (Azadirachta indica)	Meliaceae	VC	2	T	Timber and fuel wood	2
Sirish (Albizia lebbeck)	Leguminosae	VC	2		Timber and fuel wood	2
Mahogany (Swietenia mahagoni)	Meliaceae	VC	2	T	Timber and medicine	2

Tree species name	Family name	Local Status	Saline susceptibility	Habit	Utilization	Ecological Value
Chambol (Albizia richardiana)	Leguminosae	VC	2	T	Timber and fuel wood	2
Raintree (Samanea saman)	Leguminosae	VC	2	T	Timber and fuel wood	2
Akashmoni (Acacia auriculiformis)	Mimosaceae	VC	2	T	Timber and fuel wood	3
Bot (Ficus benghalensis)	Moraceae	C	1	T	Timber	1,2,3
Safeda (Manilkara zapota)	Zapotaceae	VC	2	T	Fruit	1
Tetul (Temarindus indica)	Leguminosae	VC	2	T	Timber and Fruit	2
Payra (Psitium guajava)	Myrtaceae	VC	2	T	Fruit	2
Aam(Mangifera indica)	Anacardiaceae	C	1	T	Fruit and timber	1,2
Jam (Syzygium sp)	Myrtaceae	C	1	T	Fruit and timber	1,2
Kola (Musa sp)	Musaceae	C	2	H	Fruit	1,2,3
Gab (Diospyros perigrina)	Ebenaceae	C	2	T	Fruit and fuel wood	1,2
Boroi (Zizyphus sp)	Rhamnaceae	VC	2	T	Fruit and fuel wood	2
Jambura (Citrus fistula)	Rutaceae	C	1	T	Fruit	2
Dumur(Ficus religiosa)	Moraceae	C	2	S	Fruit , Fuel wood	2,3
Bel (Aglemarmelos)	Rutaceae	R	1	T	Fruit and Medicine	2
Kathal (Artocarpus heterophyllus)	Moraceae	O	1	T	Timber and fruit	1,2
Sezi (Euphorbia antiquoram)	Euphorbiaceae	VC	3	S	Fencing and Medicine	1,2,3
Jiga (Lennea coromandelica)	Anacardiaceae	VC	2	S	Fencing	2,3

Sources: CEGIS Field Survey, 2015

Note: Local Stratus: C= Common, VC = Very Common, O = Occasionally, R= Rare

Habitats: T= tree, H= Herb, S= Shrub, V=Vine; VC= Very Common, C= common, UC= Uncommon CL=Clump

Saline Susceptibility: 1 = Highly Susceptible, 2 = Moderately Susceptible, 3 = Slightly Susceptible, 4 = Resistant

Ecological Value: 1 = For Wildlife, 2 = For Avifauna, 3 = For micro-Ecosystems

370. No Ecologically Critical Area (ECA) or designated protected area is located within or near the polder area.

Picture 5.15: View of homestead vegetation in the Polder- 47/2

Crop field vegetation

371. Crops and cropping patterns, practiced in the polder have been discussed in the agricultural section of this report. Crop field vegetation is also a good shelter for different types of terrestrial fauna.

372. Part of the crop fields (Picture 5.16) are being seasonal (March-June) and remain fallow for 3-4 months of a year. During this period, the fallow land is covered by naturally regenerating vegetation. Durba (*Cynodon*sp.*)* is prevalent with *Echinocola, Brachiara, Digiteria, Hemarthrira, Cyperus* and *Paspalum* sp. The seasonal fallow lands have important role in the ecosystem and functioning as they support grazing for cattle, feeding and breeding habitats of many arthropods, reptiles and avifauna.

Picture 5.16: Crop field vegetation affected by drainage congestion

Embankment /Roadside vegetation

373. Major species found along the village road (Picture 5.17 and 18) are: Sirish (*Albizia odoratissima),* Babla *(Acacia nilotica),* Tal *(Boassus flabelifer),* Narikel (*Coccos nucifera*), Suparee (*Areca catechu*), Khejur (*Phoenix sylvestris*), etc. The roads, which passed between the homesteads, were mostly planted with Jiga *(Lennea coromandelica)* and Khejur as these serve for fencing as well as peripheral plants. Basak (*Justica adhatodal*), Akand (*Calotropis procera*), Vaant (*Clerodendron viscossum*), Cactus/sezi *(Euphorbia grandialata)*

and Hatisur (*Heliotropium indicum)* are common wild shrubs and herbs sighted along most of the roadsides.

374. Riverside embankment is exclusively dominated by Shisu *(Dalbergia sisoo),* Rendi Koroi *(Albizzia lebbek),* Babla *(Acacia Arabica),* Sirish (*Albizia odoratissima),* and Mahogoni (*Swietenia macrophylla).* These plants are mostly planted by villagers for timber and fuel wood. Basak (*Justica adhatodal*), Cactus/Seji *(Euphorbia* spp*.*) and Durba Ghash (*Cynodon dactylon*) are common wild shrubs and herbs sighted along most of the embankment side. Vegetation of this type supports good habitats for local avifauna and other small-sized wildlife like lizards, mongoose, etc.

375. Table 5.12 provides a list of major tree species within the embankment/ roadside vegetation in the polder area.

Table 5.12: List of plant species found in the embankment/roadside of the polder area

Local/English Name	Scientific Name	Use	Abundance
Akasmoni	*Acacia auriculiformis*	Timber and Fuel wood	H
Babla	*Acacia nilotica*	Timber and Fuel wood	H
Chambul/Raj koroi	*Albizia richardiana*	Timber	H
Tal	*Boassus flabellifer*	Fruit and HH use	H
Narikel/Coconut	*Cocos nucifera*	Fruit and Fuel wood	H
Sisoo	*Dalbergia sissoo*	Timber and Fuel wood	M
Jiga	*Lennea coromandelica*	Fencing	M
Khejur /Date Palm	*Phoenix sylvestris*	Fruit and Fuel wood	M
Khoiya Babla	*Pithocelobium dulci*	Fruit and Fuel wood	M
Raintree	*Samanea saman*	Timber and Fuel wood	H
Mahogoni	*Swietenia macrophylla*	Timber and Fuel wood	M
Kola	*Musa sp*	Fruit	h

Source: CEGIS and KMC field survey, June 2015; (Note: Abundance Code, H= High, M= Medium, L= Low)

Picture 5.17: View of village road side vegetation

Picture 5.18: View of embankment side vegetation

b. Terrestrial fauna

376. The coastal area supports vast habitats for migratory birds those usually roam along the foreshore charland during winter. This polder have tiny amount of foreshore area. For this reason, this polderdoes not support significant population of migratory birds. Among the local faunal communities, the terrestrial faunal information of the polder area has been summarized below considering the public opinion and field observation in June 2015

377. Amphibians, though are not emphasized like birds and mammals but they play an important role to the ecosystem. Amphibians are considered as good ecological indicators. Due to high degree of sensitivity at every stage of their life, they respond to very slight changes to the environment. These responses indicate habitat fragmentation, ecosystem stress, impact of pesticides and various anthropogenic pressures. Available species are Common Toad (*Duttaphrynus melanostictus*), Bullfrog (*Hoplobtrachus tigerinus*), Jerdon's Bullfrog (*Hoplobatrchus crassus*) and Cricket Frog (*Fejervarya limnocharis*).

378. Reptiles commonly found within or adjacent to the polder area are House Lizard (*Hemidactylus brokii*), Common Garden Lizard (*Calotes versicolor*), Spotted House Lizard (*Hemidactylus frenatus*), Brahminy Skink (*Eutropis carinatus*), Ring Lizard (*Varanus salvator*), Checkered Keelback (*Xenochrophis piscator*), Common Smooth Water-snake (*Enhydris enhydris*). Brahminy River Turtle (*Hardella thurjii*), Asian Giant Softshell Turtle (*Pelochelys cantorii*) and Leatherback Sea Turtle (*Dermochelys coriacea*) were also noted during the survey.

379. Birds observed in their natural habitats and tidal floodplains are Black Drongo (*Dicrurus macrocercus*), Common Myna *(Acridotheres tristis*), Red-vented Bulbul (*Pycnonotus cafer*), Asian Pied Starling (*Sturnus contra),* Spotted Dove (*Streptopelia chinensis*), Common Tailor Bird (*Orthotomus sutorious*), Oriental Magpie Robin (*Copsychus saularis*)*,* House Sparrow (*Passer domesticus*), Black Kite (*Milvus migrans*), Less frequent birds seen at the project site area: Asian Koel (*Eudynamys scolopaceus*), White-bellied Sea Eagle (*Halieetus leucogaster*) and Black-hooded Oriole (*Oriolus chinensis*)*.*

380. The mammals are scarce throughout the polder area. Available species are House Rat *(Rattus rattus)*, House Mouse *(Mus musculus)*, Common Mongoose (*Herpestes edwardsi*). Jackal (*Canis aureus*), Jungle Cat (*Felis chaus*), Indian Flying Fox (*Pteropus giganteus*) are found in the polder area. The status of all faunal specis are presented in the following table:

Table 12-a: List of Major Faunal species in Polder area and their status

Class	Common Name	Local Status	IUCN-Bangladesh Status (2015)	CITES (2016)
Amphibia	Common Toad	VC	-	-
	Bullfrog	C	-	-
	Jerdon's Bullfrog	C	-	-
	Cricket Frog	C	LC	-
Reptilia	House Lizard	C	-	-
	Common Garden Lizard	C	-	-
	Brahminy Skink	UC	LC	-
	Ring Lizard	UC	VU	-
	Checkered Keelback	UC	LC	-
	Common Smooth Water-snake	UC	LC	-
	Brahminy River Turtle	Rare	EN	-
	Asian Giant Softshell Turtle	UC	CR	-
	Leatherback Sea Turtle	Rare	CR	-

Class	Common Name	Local Status	IUCN-Bangladesh Status (2015)	CITES (2016)
Aves	Black Drongo	VC	-	-
	Common Myna	C	-	-
	Red-vented Bulbul	C	-	-
	Asian Pied Starling	C	-	-
	Spotted Dove	C	-	-
	Common Tailor Bird	C	-	-
	Oriental Magpie Robin	VC	-	-
	House Sparrow	C	-	-
	Black Kite	UC	LC	-
	Asian Koel	UC	LC	-
	White-bellied Sea Eagle	Rare	LC	-
	Black-hooded Oriole	UC	LC	-
Mammalia	House Rat	C	-	-
	House Mouse	C	-	-
	Common Mongoose	UC	LC	Appendix III
	Jackal	C	LC	Appendix III
	Jungle Cat	UC	NT	-
	Indian Flying Fox	C	LC	-

Note: Local Status: VC-very common, C-common, UC-Uncomon;
IUCN-Bangladesh Status: LC-Least Concer, NT- Near threatened , EN-Endangered, VU-Vulnerable

5.2.3 Aquatic ecosystem

381. The polder area is encircled by three rivers namely *Sonatala, Baraitala and Charpara*. Inner portion of the polder is crisscrossed by many canals, some fishponds also exist. Most of the polder area is used as agricultural land and are submerged during monsoon when the total area converts into a seasonal wetland.

382. The aquatic ecosystem is classified into two categories on the basis of duration of stagnation by water such as seasonal and perennial wetlands.

Seasonal wetland

383. The seasonal wetlands are inundated for a short duration of 4-6 months. The seasonal wetlands provide nourishment to aquatic fauna through flourishing aquatic vegetation. Canals, tidal floodplains and ditches are considered as seasonal wetlands.

Perennial wetland

384. The other type of wetland is perennial which contain water throughout the year. Rivers and homestead ponds are considered under this category.

385. The baseline information on aquatic biota has been described into two groups: flora and fauna.

a. Aquatic flora

386. Floral composition of the aquatic ecosystem is rich with different types of species in the polder area. Available species observed during the survey are described in the following sections.

387. Canals are abounded with free floating and rooted floating hydrophytes like Water Hyacinth (*Eicchornia crassipes*), Water Lettuce (*Pistia sp*), Water Fern (*Azolla sp, Salvinia sp*,), Helencha (*Enhydra flactuans*), Kutipana (*Azolla*sp.), Khudipana (*Lemna* sp.), etc.

388. Submerged plants are prevalent in the polder area, both in perennial and seasonal wetland. Almost all of these plants are closely related families like Aponogetonaceae, Hydrocharitaceae and Potamogetonacea. These plants start growing with the rise of water level and persist as long as water is present. *Hydrilla verticillata* are most common in this vegetation type.

389. Sedges and meadows plants are the amphibian species. This type of vegetation has the highest species diversity and one of the most important wetland's plant communities in the polder area. They commonly include Panikola (*Ottelia alismoides),* Jhangi (*Ceratophyllum desmersum*), Dhol kolmi (*Ipomoea aquatica*) and Kochu *(Colocasia* sp.).

390. Mangrove vegetation: Mangrove vegetation (Picture 5.19) is found scattered, growing along the riverbanks or in the char lands on the coast side. Common species are Kewra *(Sonneratia apetala),* Golpata *(Nipa fruticans),* Hargoza *(Acanthus ilicifolius)*, Gewa (*Excoecharia agallocha*), Ora (*Sonneratia caseolaris*) and Bain *(Avicennia officinalis*). Golpata is found in sporadic patches in the entire polder area.

Picture 5.19: Bush of Golpata (*Nypa fruticans*) found in some of the brackish shallow ditches inside the polder

b. Aquatic fauna

391. The life cycle of aquatic fauna is dependent on seasonal variation as well as inundation depth and availability of water in all types of wetlands. Naturally, wetlands provide food and shelter to the aquatic fauna. A brief description of aquatic fauna is presented below:

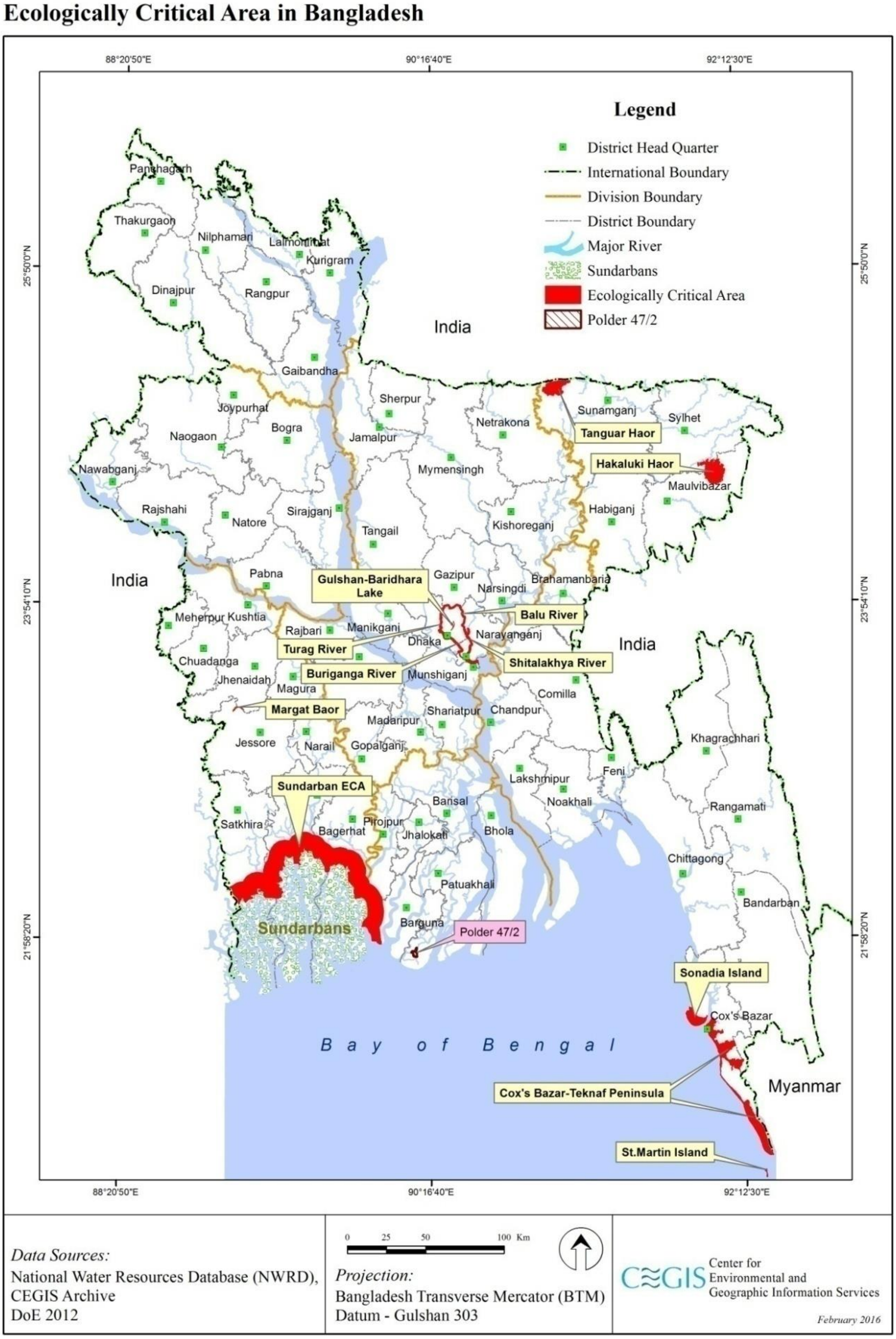
392. Among fauna, Indian Bullfrog (*Hoplobatrachus tigerinus*), Indian Cricket Frog (*Limnonectes limnocharis*), Skipper Frog (*Euphlictis cyanophlyctis*), Checkered Keelback (*Xenocrophis piscator*), Little Egret (*Egretta grazetta*), Great Egret (*Casmerodius albus*), Indian Pond Heron (*Ardeola grayii*), Common Snipe (*Gallinago gallinago*) and Pin-tailed Snipe (*Gallinago stenura*) are occasionally found in the polder area. Gangetic River Dolphin (*Platanista gangetica*) inhabits the nearby river systems. Migratory birds like Eurasian Wigeon (*Anas penelope*) also visit the wetlands within the polder and in adjacent areas.

5.2.4 Protected areas

393. The Department of Environment in 1999 circulated not to propose any development projects within 10 Km of any ECAs. The polder is not situated within or nearby any restricted area. Polder-47/2 is located at a distance of 19 km from the Sundarban ECA (Map 5.9)

5.2.5 Importance of polderization for the existing ecosystems and occurrence of indicator species

394. Peripheral embankments of the polder protect against tital flooding, saline water intrusion and the sluices act as drainage controller. The land of the polder supports different types of ecosystems. Homesteads and cropfields are dominated by fresh water loving plant species whereas khal banks and river foreshores are dominated by saline water loving mangrove plant species. Hargoza (*Acanthus illicifolius*), Kewra (*Sonneratia appetala*), and Ora (*Sonneratia caseolaris*) indicate the saline water conditions and soil salinity of khal banks and foreshore areas of the polder. Existence of these plants inside the polder area is an indication of soil and water salinity. On the other hand, fresh water shells (bivalves) indicate a fresh water environment and are found in most of the homestead ponds and stagnant parts of the khals inside the polder. Bivalve species are sensitive to water salinity. So, any significant change of these plant and animal populations indicate a change of water salinity due to malfunctioning of water control structures like sluices.



Map 5.9: Location of Polder- 47/2 from the Sundarban ECA of Bangladesh

5.2.6 Ecosystem services

a. Output of ecosystem services

395. Ecosystem services (Table 5.13) are the benefits which people obtain from ecosystems. These include provisioning both goods (tangible benefits) and services (intangible benefits).

396. Homestead vegetation is very important for fruit production in the polder area. Banana (*Musa*spp), Mango (*Mangifera indica*), Payara (*Psidium guajava)*, Narikel (*Cocos nucifera*), Supari (*Areca catechu*), etc., and various types of fruit species are also a major output from homestead vegetation. Timber for house and furniture are provided from homestead's timber trees. Homestead vegetation also provide important habitat of wildlife like bamboo grove, scrub jungle etc., which are habitats for birds, reptiles and small mammals. Total amount of fish production is included in fisheries section of this report. Aquatic plants and microorganisms are important for fishes and also have role to maintain balance of the ecosystem of a wetland.

397. On the other hand, ecosystem "services" includes maintaining of hydrological cycles, regulating climate, shelterbelt, cleaning water and air, maintaining the gaseous composition of the atmosphere, pollinating crops and other important plants, generating and maintaining soils, storing and cycling essential nutrients, absorbing and detoxifying pollutants; providing aesthetic beauty and recreation.

398. The Table 5.13 below presents the provided services from different common plants of the polder areas.

Table 5.13: The ecosystem product and its services within the polder area

Goods/Services/Purpose	Source	Plants Parts used
Food	Supari *(Areca catechu),* Narikel *(Cocos nucifera)* ,Aam *(Mangifera indica),* Kola (*Musa sp),* Safeda *(Manilkara zapota),* Payara (*Psidium guajava)*, etc	Fruit
	Helencha (*Enhydra fluctuans)* and Dholkolmi (*Ipomoea aquatica*)	Leaf and stem
Fodder	Kochuripana, (*Eichhornia crassipe*), etc.	Leaf and stem
Wood, timber	Aam *(Mangifera indica),* Bot *(Ficus benghalensis),* Babla *(Acacia nilotica),* Mahogany (*Swietenia mahagoni),* Chambul/Rajkoroi (*Albizia richardiana)*	Trunk
Medicine	Mahogany (*Swietenia mahagoni),* Tulshi *(Ocimum americanum),* Sezi *(Euphorbia antiquoram),* Bel *(Aglemarmelos),* Nim *(Azadirachta indica)*	Roots, Leaf, Stem
Thatching and mat making	*Cyperus platystylis*, Supari *(Areca catechu),*Narikel *(Cocos nucifera),* Bash (*Bamboosa* sp.), Bel *(Aeglemarmelos),* Tal *(Borassus flabelifer)* and Hogla (*Typha elephantalis*),	Thatching and fencing for huts and as protective screen in homestead.
Fuel	Babla *(Acacia nilotica)*, Akashmoni *(Acacia auriculiformis),* Boroi *(Zizyphus sp)* ,Gab *(Diospyros perigrina), Thespicia populina*	Branches, Leaves

Goods/Services/Purpose	Source	Plants Parts used
Biofertilizer/Guano	Kochuripana,	As compost,
Hydroponics	Kochuripana to make baira (floating platforms)	to grow seedlings and vegetables
Bio-gas	Kochiripana, Khudipana (*Lemna* and *Spirodelaspp.*) and other aquatic plants.	All parts of the pant
Erosion Protection	Dholkolmi *(Ipomoea fistulosa)*, Chaila gash *(Hemarthria protensa)*	Against wave action, erosion and storm

Sources: Field Survey, June 2015

b. Present threats on ecosystem

399. Tidal flooding, drainage congestion, saline problem and riverbank erosion are the main threats for ecosystem sustainability of the polder area.

400. Most of the wetlands, especially khals were found to have silted up. Non-functioning of water control structures causes insufficient drainage, which creates drainage congestion. Therefore, poor drainage systems is the main problem, which severely impacts the surrounding vegetation specially, cropland vegetation.

401. Besides, due to heavy rainfall, water overflows on surrounding land of the polder. In addition, overall homestead, cropland, roadside vegetation are also damaged and are at risk of tidal flood during rainy season.

402. Embankment breaches due to river bank erosion every year. The embankment cannot protect the poldered area from flood and cause floodwater inundation, which adversely impacts the surrounding vegetation. Consequently, faunal population and diversity also decreases due to habitat destruction.

403. Intrusion of saline water in the dry season creates stress for vegetation and its succession.

404. Pests and diseases infestation along with improper homestead space utilization planning are also a problems. Nevertheless, hunting of birds and resident wildlife is also a threat resulting in disappearance of wildlife day by day. Consequently, faunal population and diversity is also decreasing due to flood, cyclone and various human activities.

405. Local farmers reported that mammal population is very low in the polder area. Big mammals have already disappeared, as natural vegetated areas have reduced in addition to different human activities.

406. Several species listed in the IUCN *Red Data Book* occur within the polder area is given Table 5.14 below:

Table 5.14: List of Threatened Species

Local/Common name	Scientific name	Local status	IUCN status	Cause of threat
Pati Shial/Golden Jackal	*Canis aureus*	Rare	Vulnerable	Hunt and habitat loss
Gui Sap/Bengal Monitor	*Varanus bengalensis*	Moderate	Vulnerable	Hunt and habitat loss
Kal Keotey/ Common Krait	*Bungarus caeruleus*	Common	Endangered	Hunt and habitat loss

Source: CEGIS Field survey, June 2015 and Red Data Book of IUCN Bangladesh.

5.2.7 Fish Habitats

407. Fish habitat (Picture 5.20) in this polder area is mainly classified into two types, such as, open water or capture fisheries and culture fisheries. Distribution of the fish habitats within the Polder area is shown in Figure 5.16.

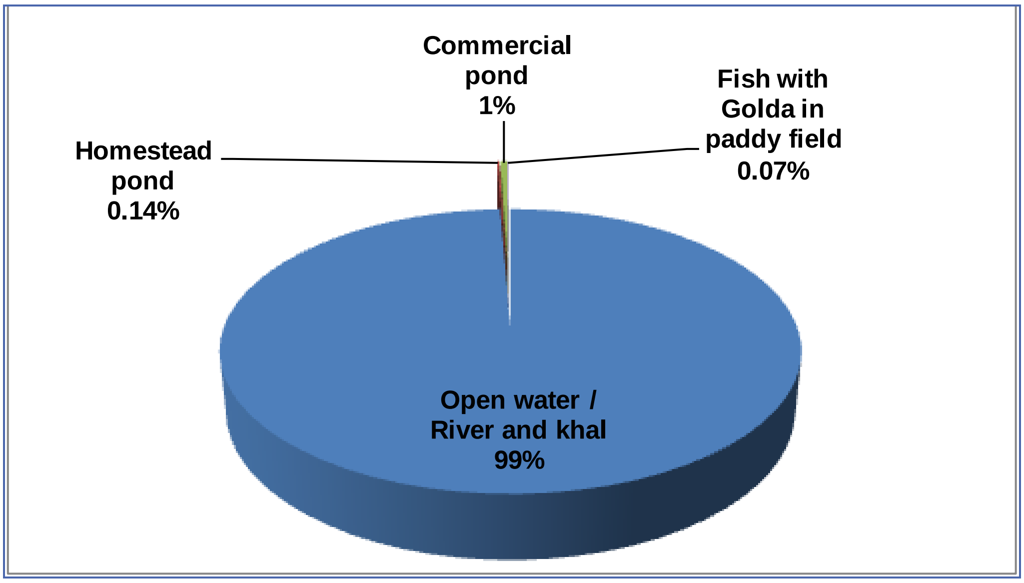


Figure 5.16: Distribution of fish habitat in the polder area

Capture fisheries

408. Fish habitat (including external rivers) in the Polder area is 1,476 ha of which 1,466 ha is capture fish habitat of the Polder area (Table 5.15).

Table 5.15: Fish habitat status of the project area

Sl	Fisheries type	Habitat type	Area (ha)
1	Capture	Open water / River and khal	1,466
		Sub Total	***1,466***
2	Culture	Homestead pond	02
3		Commercial pond	07
4		Fish with Golda in paddy field	01
		Sub total	***10***
		Total	**1,476**

Source: Draft Final of Fisheries Report (from main consultant), 2012

DS-1: Eidkhola Khal

DS-2: Kichikata Khal

DS-3 (Inside): Thankola Khal

BR-Ch 1.7-2.7: Baraitala River

Picture 5.20: Major capture fish habitat in the polder area

409. The project area consists of a number of seasonal and perennial canals/khals. Among which some habitats are breeding ground, some are spawning ground and some are nursery ground. Moreover, all of these are used as the feeding ground. However, depths of seasonal canals of the project area are reduced with time and getting insufficient to shelter fish juveniles as these are getting silted up. Local people reported that siltation rate in the internal fish habitats in the project area is 2-3 cm per year. The following table shows the habitat use of the identified khals with the associated interventions (Table 5.16).

Table 5.16: Habitat use of different identified khals by different age class of different fish species

Sl	Intervention*	Habitat	Age Class
1	BR_Ch1.7-2.7	Baraitala River	Fry, Age-1 Juvenile, Young and Adult
2	BR_Ch6-7		Fry
3	DS-1	Eidkhola Khal	Age-1 Juvenile, Young and Adult
4	DS-2	Kichikata Khal	Age-1 Juvenile, Young, Adult and Brood
5	DS-3	Thankola Khal	Fry, Age-1 Juvenile, Young, Adult and Brood

Source: CEGIS field survey (KII with professional fishermen), June2015.

*BR: Bank Revetment; DS: Drainage Sluice

410. Moreover, through investigating habitat use of different age classes of different fish species, the identified khals have further been clustered as the breeding ground (BG), spawning ground (SG), nursery ground (NG) and feeding ground (FG) as shown in Figure 5.17.

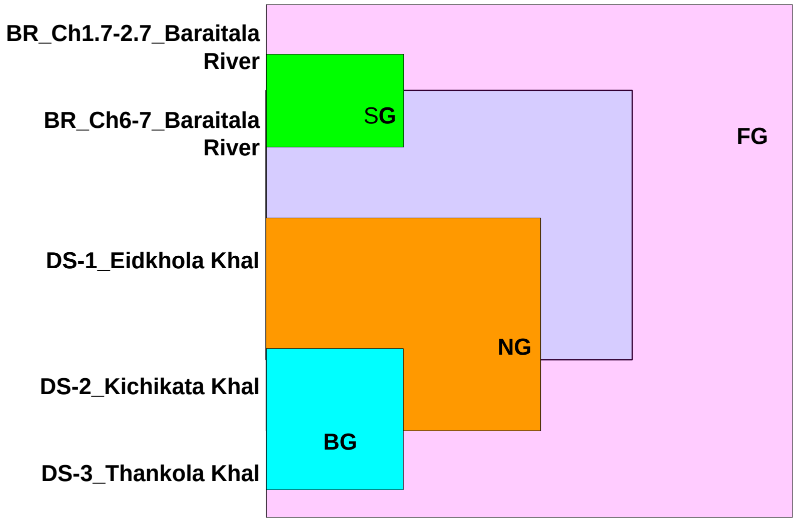


Figure 5.17: Habitat classification of Intervention-specific fish habitat

Note: BG: Breeding Ground; SG: Spawning Ground; NG: Nursery Ground and FG: Feeding Ground
Source: CEGIS field survey, 2015

Culture fisheries

411. Aquaculture practice (Picture 5.21) is expanding gradually in the polder area. Various types of fish culture systems are adopted by the local people including mono-, poly-, and mix-culture. Depth of water level of culture fish pond ranges from 1 meter to 1.5 meter. Exclusively poly-culture practice is adopted by the local people. Estimated area under culture habitat only is 10 ha. Most of which are extensive culture in practice (Picture 5.2)

Picture 5.21: Commercial fish pond in the project area

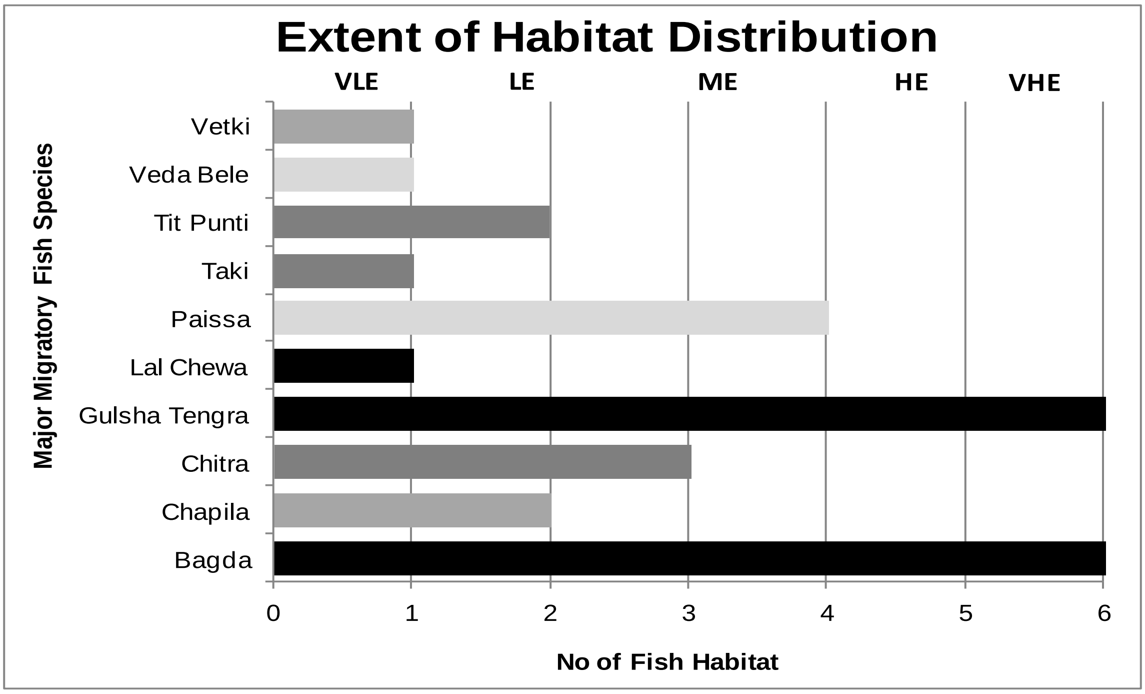
5.2.8 Fish migration

412. Fish is highly influenced by environmental factors, such as, water temperature, rainfall, water quality, etc. Moreover, these interactions are species specific. The various physiological condition needs appropriate environment. To meet up various biological purposes, like feeding, breeding, spawning, etc., fish normally migrate from one habitat to other suitable habitat.

413. Overall fish migration status is poor in the polder area. It has been found that only two species, *Gulsha Tengra and Bagda* are mainly well distributed in the internal khals. On the other hand, *Vetki, Veda Bele, Lal Chewa*, and *Taki* have restricted distribution (Figure

5.18). It, nevertheless, has been reported by the local people that peripheral rivers along with internal rivers and khals of the project area have been silted up naturally and structures on the khals caused the reduction of the length of successive migration routes.

414. It is noted that fish migration is impeded by the malfunctioning of the polder, sluices, etc. Once when the polders and the sluices were functioning well fisheries activities were there and some people were dependent on it for carrying their livelihood. After bad functioning of the polders and sluices fisheries activities reduced substantially.



Source: Data from Catch Assessment by Field Survey, CEGIS, 2015

Figure 5.18: Extent of habitat distribution of major migratory fish species in the project area

Note: VLE: Very Low Extent; LE: Low Extent; ME: Moderate Extent; HE: High Extent and VHE: Very High Extent

415. Both the fresh and saline water fishes migrate from river to the project area through open and regulated khals for meeting their various purposes. Many fish species migrate horizontally to these water bodies as part of their life cycle. It has been found that migration pattern in respect of purpose and timing of migration varies with different water bodies controlled by different water control structures. It has also been stated from the local fishermen some major species, like *Puntius ticto*, have been changing their migration pattern through decreasing their purposes after establishing water control structures. It results in decreasing fishing at the associate khals. The following table shows the migration period of some major fish species (Table 5.17):

Table 5.17: The purpose and timing of migration for some major migratory fish species

Sl	Fish Species	Habitat	Purpose	Timing
1	Bagda	Baraitala River	Nursing	All the Year Round
2		Thankola Khal		
3	Chapila	Kichikata Khal	Feeding	Ashar-Aswin(Mid-June to mid-October)
4	Chitra	Baraitala River	Nursing	Ashar-Aswin(Mid-June to mid-

Sl	Fish Species	Habitat	Purpose	Timing
5		Eidkhola Khal		October)
6		Kichikata Khal		
7	Gulsha Tengra	Baraitala River	Feeding	All the Year Round
8		Eidkhola Khal		
9		Kichikata Khal		
10			Spawning	Ashar-Aswin (Mid-June to mid-October)
11		Thankola Khal		
12	Lal Chewa	Thankola Khal	Spawning	Ashar-Aswin (Mid-June to mid-October)
13	Paissa	Baraitala River	Nursing	Ashar-Aswin (Mid-June to mid-October)
14		Eidkhola Khal		
15		Kichikata Khal		
16		Thankola Khal	Nursing and Spawning	All the Year Round
17	Taki	Thankola Khal	Nursing	All the Year Round
18	Tit Punti	Kichikata Khal	Spawning	Ashar-Aswin(Mid-June to mid-October)
19		Thankola Khal		
20	Vadrakatali Chingri	Baraitala River	Breeding	Falgun-Joistha (Mid-February to mid-June)
21	Veda Bele	Kichikata Khal	Nursing	Ashar-Aswin(Mid-June to mid-October)
22	Vetki	Eidkhola Khal		

Source: CEGIS field visit (KII with Professional Fishermen having minimum 20 years experiences), 2015

5.2.9 Fish biodiversity and composition

416. The project area is very poor to moderate in fish biodiversity (Picture 5.22) as the biodiversity of fishes shows a declining trend over the years. Runoff pollutants, agrochemicals and pesticides coming from paddy fields, obstruction in fish migration routes, morphological changes of internal khals, siltation of fish habitats, shrinking of spawning and feeding grounds and expansion of both culture fishery and *rice* cultivation are responsible for the steady decline of fish abundance and biodiversity.

Picture 5.22: Fish catch of the Polder area

417. The Polder area comprises an assemblage of both fresh and brackish water fish species (Picture5.22). The available fish species are *bagda and golda chingree, bele, gulsha tengra, poma, motka chingree, vetki, tit puti, veda bele*, etc (Table 5.18).

Table 5.18: Available fish biodiversity of the project area

Sl. No.	Group/ Guild	Local Name	Species Name	Fish Habitat	
				River and Khal	Pond
1	Minnows, Rasboras and Barbs	Punti	*Puntius spp.*	P	P
		Mola	*Amblypharyngodon mola*	P	P
		Gutum	*Lepidocephalus guntea*	P	A
2	Climbing perch	Koi	*Anabas testudineus*	A	P
		Kholisa	*Colisa fasciatus*	P	A
3	Small catfish (mostly commercially important)	Magur	*Clarias batrachus*	P	P
		Singi	*Heteropneustes fossilis*	P	P
		Tengra	*Mystus tengara*	P	A
		Gulsa Tengra	*Mystus cavasius*	P	A
4	Major carps (include four species and orderly)	Rui	*Labeo rohita*	P	P
		Catla	*Catla catla*	P	P
		Mrigel	*Cirrhinus cirrhosus*	P	P
5	Large catfish (six species and orderly)	Boal	*Wallago attu*	P	A
		Pangas	*Pangasius pangasius*	P	A
		Thai Pangas	*Pangasius hypophthalmus*	A	P
6	Herring (Highly valued)	Ilish	*Tenualosa ilisha*	P	A
7	Snakeheads	Shol	*Channa striatus*	P	A
		Gazar	*C. marulius*	P	A
		Taki	*C. punctatus*	P	P
		Cheng	*C. orientalis*	P	A
8	Knife fishes	Foli	*N. notopterus*	P	A
9	Needle fishes	Kaikka	*Xenentodon cutcutia*	P	A
10	Anchovies and Sardines	Phasa	*Setipinna phasa*	P	A
		Kachki	*Corica soborna*	P	A
		Chapila	*Gudusia chapra*	P	A
11	Spiny eels	Baim	*Mastacembelus aculeatus*	P	A
12	Mud perch	Bheda	*Nandus nandus*	P	A

Sl. No.	Group/ Guild	Local Name	Species Name	Fish Habitat	
				River and Khal	Pond
13	Glass fishes	Chanda	*Chanda spp.*	P	A
14	Prawns	Golda chingri	*Macrobrachium rosenbergii*	P	P
		Gura chingri	*Leander styliferus*	P	P
15	Exotic introductions (Five carps, two cichlids and one barb)	Silver carp	*Hypophthalmichthys molitrix*	A	P
		Mirror carp	*Cyprinus carpio var. specularis*	A	P
		Grass carp	*Ctenopharyngodon idella*	A	P
		Thai barb	*Barbodes gonionotus*	A	P
		Tilapia	*Oreochromis mossambicus*	A	P
		Nilotica	*O. niloticus*	A	P

Source: FAP 6 and Field observation; Note: A=Absent and P=Present

418. Different fish species have different habitat preferences and having different sensitivities to the physical condition of the area. The larger catfishes like *Wallago attu*, *Pangasisus pangasius*, etc, prefer deeper water having connectivity with the large river and drainage canal (particularly for *Wallago attu*). These are sensitive to warm water and shallow water habitat. They breed when they get new water in the next season. If sluices do not function properly then the large catfish population will be declined.

419. Smaller catfishes (*Clarius batrachus, heteroneustes fossilis, Mystus tengara,* etc.) prefer shallower habitat. They usually breed in the ditches and burrow pit. Snakeheads also inhabit in the drainage canal and in the pond.

420. Different type of benthos are found in the khal (Canal). The roles of benthic macroinvertebrates in cycling nutrients and controlling nutrient outflows from ecosystems. It is rpoerted that these benthos are used as food of many fishes and play an important role in fish production. Large benthic animals (those readily visible without the use of a microscope) are collectively referred to as macro zoo benthos or macro invertebrates. Representatives include clams, snails, worms, amphipods, crayfish, and the larvae of many aquatic insects (e.g., dragonflies, mayflies, stoneflies, caddis flies, chironomid midges, and black flies).

Major Indicative Species

421. Major indicative species has been identified during the investigation period of June, 2015 by assessing evenness and fish richness in the fish composition. Evenness and richness have been analyzed through applying Shannon-Weiner Diversity Index and Sympson’s Index respectively. Table 5-19 describes the fish biodiversity status of the area, It has been done based on the regularly caught major fish species. It is seen that Baraitala River has high species dominance while in the Kichikata Khal the species dominance is moderate. Though water quality mentioned in the Table 5-8, the parameters are showing well within the permissible limit but timely availability of water due to malfunctioning of the polders and sluices is scarce. For this reason, species diversity is considered poor to moderate. It has also been found that the Eidkhola Khal is rich in Gulsha Tengra, Horina and Motka Chingree, the Kichikata Khal in Horina Chingree, Veda Bele, Tit Punti, Gulsha Tengra and Chapila, and the Taltola khal in Horina Chingree, Gulsha Tengra and Bagda.

Table 5.19: Species evenness and richness in four major intervention specific fish habitats

Sl	Site	Species No	Dominated Fish Number**	SI*	SWDI**
1	Baraitala River	7	2	0.53	0.47
2	Eidkhola Khal	6	3	0.64	0.70
3	Kichikata Khal	7	4	0.72	0.76

Sl	Site	Species No	Dominated Fish Number**	SI*	SWDI**
4	Thankola Khal	7	3	0.71	0.75

Source: Catch Assessment Survey, CEGIS, 2015
**SI: Symption's Index (used for analyzing species richness)*
***SWDI: Shannon-Weiner Diversity Index (used for species evenness)*

422. It is being revealed from the above investigation that Gulsha Tengra, Tit Punti, Chapila, Bagda, Golda and Horina Chingri are the major indicative fish species in the polder area. Among these fishes, Gulsha Tengra is known as the major predator species which have a significant role in controlling fish community structure in the waterbodies.

5.3 Human and Economic Development

5.3.1 Fish production

423. Estimated total fish production of the Polder area (including external river) is 168MT. Bulk of the fish production (about 93%) is coming from capture fisheries while the rest of the production (about 7%) is coming from culture fisheries habitats (Table 5.20).

Table 5.20: Fish production in the Polder area

Sl.	Fisheries type	Habitat type	Production (Ton)
1	Capture	Open water / River and khal	157
		Sub Total	***157***
2	Culture	Homestead pond	1
3		Commercial pond	09
4		Fish with Golda in paddy field	01
		Sub total	***11***
		Total	**168**

Source: Draft Final of Fisheries Report (from DCSC), FRSS and Catch Assessment Survey, CEGIS (2015)

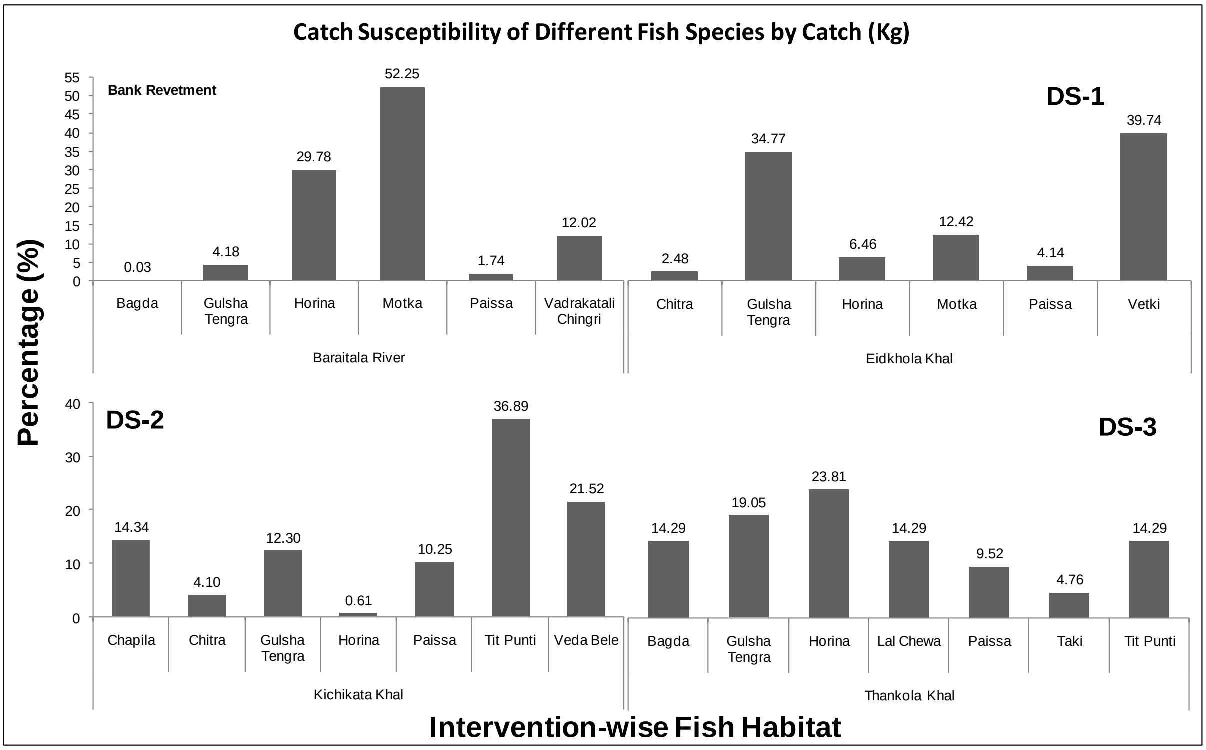
424. The highest catch has been observed in the drainage sluice associated with Eidkhola Khal, and lowest catch in the drainage sluice associated Kichikata Khal (Table 5.21). However, highest minimum productivity level has been reported in case of newly proposed drainage sluice associated Thankola Khal. These indicate that fish production function is highly seasonal. According to the consultation with local fishermen, fish traders and local fisheries officials, fish production is directly linked with the livelihood of the dependent fishermen community of the area. If production declines due to bad functioning of the polders and sluices, the livelihood of the area will be affected and the economy of the area as well.

Table 5.21: Minimum catch ability and productivity per haul in the intervention associate fish habitat

Sl	Intervention	Minimum Catch ability (kg/Year)	Minimum Productivity per haul (Kg/hl)
1	Baraitala River	43	299
2	Eidkhola Khal	254	0.03
3	Kichikata Khal	38	0.01
4	Thankola Khal	108	10,800

Source: CEGIS field visit, 2015

425. Catch susceptibility of different fish species varies with the use of fishing gears fishing in the intervention located khals. The following figure shows the matrix of fish susceptibility to fishing at different intervention specific fish habitat (Figure 5.19).



Source: Catch Assessment Survey, CEGIS (2015)

Figure 5.19: Catch susceptibility of different fish species (by Weight) in the intervention specific fish habitats

5.3.2 Fishing efforts

Fishing Season

426. Capture fishing is the major fishery of the polder area. Fishing in khals raises higher from the month of May and continues up to October. Rest of the time they are mainly engaged in other fisheries activities (like fish traders). The seasonality of major fishing is furnished in the Table 5.22.

Table 5.22: Fishing seasonality of the project area

Type of gear	Seasons											
	Pre-monsoon		Monsoon flood season				Post-monsoon		Dry Season			
	Months											
	Apr–May	May–Jun	Jun–Jul	Jul–Aug	Aug–Sep	Sep–Oct	Oct–Nov	Nov–Dec	Dec–Jan	Jan–Feb	Feb–Mar	Mar–Apr
	Boishakh	Jaishtha	Ashar	Srabon	Bhadra	Ashyin	Kartik	Agrahayan	Pause	Magh	Falgun	Chatra
Badha Jal	Low	Medium	High	High	High	Medium	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence
Current Jal	No occurrence	No occurrence / Medium	High	High	High	Medium / No occurrence	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence
Jhaki Jal	Medium	Medium / High	High	High	High	High	Medium	Medium	Medium	Medium	Medium	Medium
Muia Jal	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Net Jal	Low	Low	Medium	High	High	High	Medium	Low	Low / No occurrence	No occurrence	No occurrence	No occurrence
Savar Net	Low	Low	Medium	High	High	High	Medium	Low	Low / No occurrence	No occurrence	No occurrence	No occurrence

Legend: High | Medium | Low | No occurrence

Source: CEGIS field investigation, 2015

Fishing Gear and Crafts

427. The commercial fishermen usually catch fish in the nearby river and connecting khals using country boat and dingi boats. Six types of nets/gears (Picture 5.23) have been

observed to be used for fishing in the polder area (Table 5.4). These are: (1) Jhaki jal, (2) Net jal, (3) Current jal, (4) Muia jal, (5) Badha/Sluice jal[13] and (6) Savar Net. Only 20 to 25% of fishermen have fishing boats and around 70% fishermen have fishing gears/nets. Among these gears, Badha/Sluice jal is the mostly used especially for fishing in the intervention location by creating bundh the mouth of drainage channel (Table 5.23 and Picture 5.22)

Table 5.23: Major gears used in the intervention specific fish habitat in the project area

Sl	Habitat	TI_Gear	Haul Duration (hr/haul)	Haul No	Operated Person (N)	Month/Year
1	▪ Baraitala River	Muia Jal	0.3	10	2	12
2		Net Jal	6	1	1	9
3		Savar Net	1	20	1	9
4	▪ Eidkhola Khal	Current Jal	2	1	1	4
5		Jhaki Jal	1	25	1	12
6	▪ Kichikata Khal	Badha Jal	6	1	1	6
7		Jaki Jal	1	50	1	12
8	▪ Thankola Khal	Jhaki Jal	2	100	1	12

Source: CEGIS field visit, 2015

Savar Net

Current Jal

Jhaki Jal

Net/Masari Jal

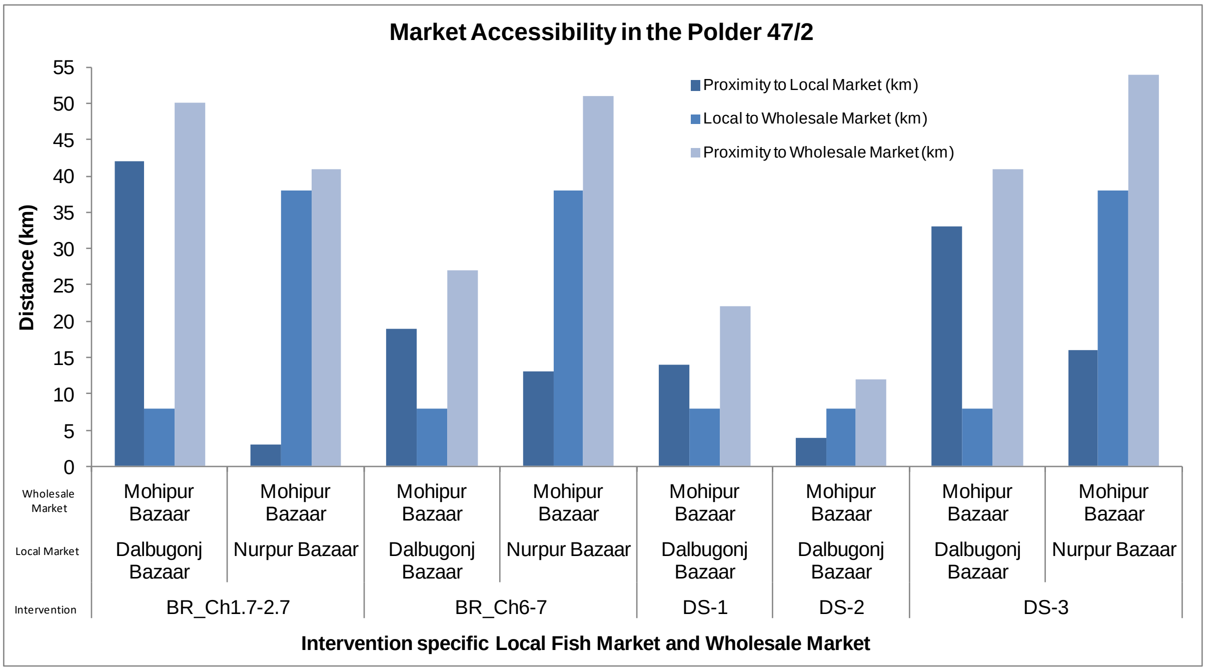
Source: CEGIS field visit, 2015

Picture 5.23: Major fishing gears in the polder area

[13]Badha/Sluice Jal: This net is being fixed with sluice gates

5.3.3 Fish Marketing –Post harvest facilities and damage

428. Market accessibility (Figure 5.20) is very poor in this polder area due to the low proximity (inversely related to distance between two supply chains) to local fish market, lack of specific wholesale fish market, poor infrastructure (road), limited transportation vehicles and vessels. The local fishermen sell the bulk of their catch directly to the local fish market. Lowest proximity to local fish market has been observed in case of Bank Revetment from Ch 1.7-2.7 where the fishermen transport their fish by engine boat (Figure 5.20).Fishes are directly sold from the local fish market to the nearby *Mohipur* Bazaar wholesale fish market. Moreover, the fishermen directly sell their fish to the wholesale market in *Mohipur* Bazaar. No structured fish landing centers are found in the area. No Ice factories are observed in the polder area.



Source: Market Survey, CEGIS (2015)

Figure 5.20: Market accessibility in view of proximity to local fish markets and wholesale fish markets

5.3.4 Fisher Lifestyle

429. The average daily income of professional fishermen, part-time fishermen and subsistence fishermen are Tk. 250 to 400 Tk.200 to 300 and Tk. 100 to 150 respectively. Consequently, they are changing their occupation. People involved in fish culture is mostly practicing traditional culture methods.

5.3.5 Fisheries Management

430. Fishermen Community Based Organizations (FCBOs) is absent in the project area. Department of Fisheries (DoF) has limited activity for fisheries resource conservation and management in this region. Some NGOs are working but they are very much limited in micro credit (ASA, BRAC, Sushilan, etc.) rather than extension services and aquaculture training. Enforcement of fisheries regulation is very weak.

5.3.6 Farming Practices

431. Farming practices largely depend on the cropping seasons. There are three cropping seasons in a year in the polder area. They are Kharif-I, Kharif-II and Rabi seasons. The

Kharif-I start from March and ends in June. This season is characterized by the uncertainty of weather of alternating dry and wet spells. T. Aus (Local), T. Aus (HYV) and summer Vegetables are grown in this season. The Kharif–II starts from July and ends in October. This season comprises wet and cloudy environment and heavy rainfall but uneven distribution, low solar radiation, high temperature and humidity. T. Aman (Local), T. Aman (HYV) are grown in the Kharif -II season. The Rabi season starts from November and ends in February. During this season, crops are favoured with high solar radiation, low humidity and temperature, but lack of adequate soil moisture depresses the crop yield. Wide ranges of crops are grown in this season. Orchard, Potato, Spices, Oil seeds crop, Pulses, Vegetables and Boro rice are practiced in this season. Boro (HYV) is grown in limited area under irrigated condition with the help of low lift pumps (LLPs).

5.3.7 Present Cropping Patterns and Intensity

432. The dominant cropping pattern in the flood free high land is T. Aus (Local) -Fallow–W. Vegetables and T. Aus (HYV) - T. Aman (Local) –Chilli, which occupies about 20.6% and 11.8% of the NCA, respectively. In the medium high land, dominant cropping pattern is Fallow- T. Aman (HYV) -Pulses which occupy about 10.2% of the NCA. Detailed cropping patterns along with land type are presented in Table 5.24. The overall cropping intensity in the Polder area is 189%.

Table 5.24: Detailed cropping patterns by land type in the Polder area

Land type	Kharif-i (March-June)	Kharif-ii (July-October)	Rabi (Nov-February)	Area (ha)	% of NCA
High land(FF)	Orchard	Orchard	Orchard	69	3.7
	S. Vegetables	Fallow	Pulses	152	8.2
	T. Aus (HYV)	T. Aman (Local)	Chilli	218	11.8
	T. Aus (Local)	Fallow	W. Vegetables	381	20.6
Sub-total				**820**	**44.3**
High land(F0)	T. Aus (Local)	T. Aman (Local)	Spices	76	4.1
	T. Aus (Local)	T. Aman (Local)	Potato	76	4.1
	Fallow	T.Aman(Local)	Fallow	180	9.7
	Fallow	T. Aman (HYV)	Fallow	291	15.7
	Sub-total			**623**	**33.7**
Medium high land(F1)	T. Aus (HYV)	Fallow	Oil seeds	89	4.8
	T. Aus(Local)	Fallow	Boro(HYV)	95	5.12
	Fallow	T. Aman (Local)	Fallow	31	1.7
	Fallow	T.Aman(HYV)	Pulses	189	10.2
Sub-total				**403**	**21.8**
Medium Low land	Fallow	Fallow	Fallow	5	0.29
Sub-total				**5**	**0.29**
Grand total				**1,850**	**100**

Source: DCSC and field investigation, 2015

Picture 5.24: View of T. Aus rice field in the Polder area

Picture 5.25: View of summer vegetables (pit crop) in the polder area

5.3.8 Cropped Area and Production

433. Detailed cropped area, crop production and yield rate are presented in Table 5.25

Cropped Area

434. Total cropped area is 3,492 ha of which rice occupied 2,090 ha and the rest 1,402 ha is covered by non-rice crops. The rice and non-rice cropped area are 60% and 40% of the total cropped area respectively. Among the rice crops, T. Aus (Local), T. Aus (HYV), T. Aman (Local), T. Aman (HYV) and Boro (HYV) are commonly grown in the polder area (Table 5.23).

Crop Production

435. Total crop production is 14,573 metric tons of which rice production is 4,099 metric tons (Table 5.25) and non-rice production is 10,475 metric tons. Among the rice crops the contributions of T. Aus (Local), T. Aus (HYV), T. Aman (Local), T. Aman (HYV) and Boro (HYV) are about 24%, 20%, 21%,29% and 5% respectively, Details of which are presented in Table 5.25.

Table 5.25: Present cropped area, yield and production of the Polder area

Name of crops	Present cropped area, yield(metric ton/ha) and production			% of contribution
	Cropped area (ha)	Yield(metric ton/ha)	Production (metric ton)	
T.Aus(Local)	628	1.57*	986*	24
T.Aus(HYV)	307	2.7*	830*	20
T.Aman(Local)	581	1.5*	871*	21
T.Aman(HYV)	479	2.5*	1198*	29
Boro(HYV)	95	2.25*	213*	5
Total rice	**2,090**	**0**	**4099***	**100**
Chilli	218	1.25	273	3
Pulses	340	1.5	511	5
Potato	76	14	1070	10
Orchard	69	10.5	723	7
S. Vegetables	152	12	1820	17
W. Vegetables	381	15	5717	55
Spices	76	3.25	247	2
Oilseeds	89	1.3	115	1

Name of crops	Present cropped area, yield(metric ton/ha) and production			% of contribution
	Cropped area (ha)	Yield(metric ton/ha)	Production (metric ton)	
Total non-rice	**1402**	**0**	**10,475**	**100**
Total	**3,492**	0	**14,573**	**0**

*Source: DCSC and field information, 2012; *Indicates cleaned rice*

5.3.9 Crop Damage

436. The crop damage due to various means of the Polder area during 2007-2011 is presented in Table 5.24. About 80% &100% field crops (T. Aman (HYV) and Vegetables crops) were damaged in the year 2007 by natural calamities (Sidr). About 40% field crops (Vegetables and Watermelon) were damaged by Aila in the year 2009. In 2008, about 30% to 40% of the field crops (T. Aman, Vegetables) were damaged due to heavy rainfall. Farmers reported that 20% T. Aman and Vegetables crop were damaged by draught or water logging in the year 2010. 15 to 20% of Vegetables, T.Aman and fruit crops were lost due to pest infestation in the year 2011. About 25% and 20%of Pulses and Spices were damaged respectively by MOHASEN in the year 2013. Detailed crop damage is presented in Table 5.26.

Table 5.26: Crop area damaged by different means and losses during 2007-2011 and 2013

Sl No.	Crops	Damage (%)	Year	Reason of damage
1	T. Aman(HYV)	80	2007	Sidr
	Vegetables	100	2007	Sidr
	Pulses	100	2007	Sidr
2	T. Aman	30	2008	Heavy rainfall
	Vegetables	40	2008	Heavy rainfall
3	Vegetables	40	2009	Aila
	Water melon	30	2009	Aila
4	T.Aman	20	2009	Water logging
	Vegetables/Fruits	15	2010	Pests
5	T. Aman	20	2011	Pests
	Vegetables	15	2011	Pests
	Fruits	20	2011	Pests
6	Pulses	25	2013	Mohasen
	Spices	20	2013	Mohasen

Source: DCSC and field information, 2012 and June 2015

5.3.10 Agricultural Inputs

Seeds

437. The role of seeds is very important for growing crops. Selection of seeds has to be made carefully. Seeds having more than 85% germination rate, free from disease infestation and high yield potential need to be considered. The quality seeds of different vegetables are not available in the market. Most of the farmers used their own seeds in case of local variety such as T.Aus and T.Aman. The quality of seeds of private dealer is poor and market prices are very high.

Fertilizer

438. The rate of use of fertilizer per hectare varies considerably from farmer to farmer depending on soil fertility, crop cultivars, cropping pattern and financial ability. Not all kind of chemical fertilizers are available in the local dealer shop but the prices are very high. The

Polder farmers use chemical fertilizers such as Urea, TSP, MP and Gypsum in different crops. Farmers use no organic manure or compost (Table 5.27).

Table 5.27: Present level of crop production input used within Polder 47/2

Crop Name	Seeds used/ (Kg/ha)	Fertilizer (Kg/ha)					Irrigation cost (Tk./ha)	Pesticide (Tk./ha)	Percent farmers using Power tiller	Cost power tiller (Tk./ha)
		Urea	TSP	MP	Gypsum	Zinc				
T. Aus (Local)	40	110	50	30	-	-	-	1500	80	3000
T. Aus (HYV)	35	130	70	50	-	-	-	1500	80	3000
T. Aman (Local)	38	70	40	30	-	-	-	1000	80	3000
T. Aman (HYV)	30	130	70	50	-	-	-	1200	80	3000
Boro (HYV)	40	182	100	100	-	-	3500	2000	80	3000
Chilli	1-1.5	150	100	80	40	-	1000	2500	80	3000
Pulses	25	40	30	30	-	-	-	1000	80	3000
Potatoes	1500	175	90	35	55	6	1000	2000	80	3000
Spices	10	100	80	60	70	-	200	1500	80	3000
Orchard	100-110 sapling	1.5 kg/tree/yr	0.22 kg/tree/yr	0.25 kg/tree/yr	0.13 kg/tree/yr	-	1000	1000	80	3000
Oil seeds	10	75	80	50	40	-	-	500	80	3000
S. Vegetables	4	160	80	60	30	-	-	2000	80	3000
W. Vegetables	5	160	80	60	30	-	1000	2000	80	3000

Sources: Feasibility report (Agriculture), DCSC and field information; 2012

Pesticides

439. The use of pesticides depends on the degree of pest infestation. According to feasibility report, all farmers (100%) applied pesticides in all crops such as T.Aus (Local), T.Aus (HYV), T.Aman (Local), T.Aman (HYV), Boro (HYV), Chillies, Potatoes, summer and winter Vegetables and spices. It was observed that some farmers use pesticides in some crops such as T. Aman (HYV), Boro (HYV), winter Vegetables, spices and Chillies. Local farmer reported that they are using different types of pesticides such as Furadan 3G (Carbofuran), Karate (Landacyhalothrin), Virtako 40WG (Diazinon), Rovral (Iprodion) and Theovit powder (Mancogeb) etc. to prevent pest infestation in crop field.

Labor

440. Most of the practices for crop production in the study area are manually. So, agricultural labor is considered as one of the essential inputs for crop production. The labor requirement is not equal throughout the year. The number of labor requirement varies from crop to crop. The average labor used in the Polder area is presented in Table 5.28.

Table 5.28: Average labor used in the Polder area

Sl. No.	Crop name	Labor(No/ha)
1	T. Aus (Local)	150
2	T. Aus (HYV)	160
3	T. Aman (Local)	160
4	T. Aman (HYV)	170
5	Boro (HYV)	180
6	Orchard	140

Sl. No.	Crop name	Labor(No/ha)
7	Chilli	170
8	Pulses	120
9	Potatoes	200
10	S. Vegetables	160
11	W. Vegetables	160
12	Spices	140
13	Oilseeds	120

Source: CEGIS Assessment from field information, 2015

Irrigation

441. Irrigation coverage of the study area is about 5% of the NCA during the dry season. Surface water is being used for irrigation. Rivers (Sonatola, Baraitola), Khals (Pear pur and Mirpur) and beel are the main sources of surface water irrigation. Low Lift Pumps (LLPs) and small types of irrigation equipment, traditional mode like sewing baskets, are used for lifting the irrigation water. However, the availability of irrigation water has been declining due to siltation of the river, beels and khals. T. Aus (Local), T .Aus (HYV), T. Aman (Local) and T. Aman (HYV) are cultivated under rain-fed condition.

5.3.11 Livestock and Poultry

442. Livestock and poultry, being an essential element of integrated farming system, play important role in the economy of Polder-47/2. Livestock provide significant draft power for cultivation, threshing and crushing of oil seeds; cow dung as a source of manure and fuel; a ready source of funds and meat, milk and eggs for human consumption. Most of the households raise poultry and livestock (Picture 5.26 and 5.27), a practice that significantly reduce poverty through generating income and employment. The number of livestock and poultry in the Polder area are presented in Table 5.29.

Table 5.29: Number of Livestock and Poultry of the Polder Area

Name of Livestock/poultry	Present number
Cow/Bullock	11,850
Buffalo	420
Goat	6,500
Sheep	510
Duck	13,370
Chicken	5,025
Total	**37,675**

Sources: Feasibility report (Agriculture)-2012, DCSC and field information, CEGIS

443. According to farmers (field visit, June 2015), only one poultry farm is found in the Polder area. Average number of poultry (chicken) in this farm is ranging from 250-300. The overall farm management is good but food and fodder crisis are being appeared in rainy season due to shortage in the market.

444. The owners of the livestock population are facing problems in respect of non-availability of fodder and feeds during the months of July to November due to unavailability of grazing land. Rice straw is the main fodder. Oil cake, bran, Grass, etc. are other common fodders in this Polder area. Shortage of grazing areas throughout the year aggravates the feed problem to the animal population. The poultry population at family level survives by

scavenging and generally, no feed supplements are provided. However, at times kitchen waste becomes feed for the poultry.

Picture 5.26: Livestock (cow) in the Polder area

Picture 5.27: Poultry (duck) in the Polder area

445. Productions of livestock and poultry are mainly constrained due to diseases and death of the population. Outbreak of disease is causing a considerable economic loss in livestock farming. Every year livestock population is affected by different diseases. Major livestock diseases are Foot and Mouth Disease (FMD), Gola fula, Black leg (Badla), Diarrhoea and Goat Peste Des Petits Ruminants (PPR). Major poultry diseases are Ranikhet (New castle), Cholera, Fowl pox and Duck plague. However, some diseases are spreading round the year. During monsoon season, the soggy condition of the animal shelter promotes various kinds of diseases to the bullocks and cows.

5.4 Socio-cultural Environment

446. Baseline on the state of socio-economic environment is sketched out for the entire polder. The polder covers only one union named DIlbuganj of Kalapara Upazila under Patuakhali district.

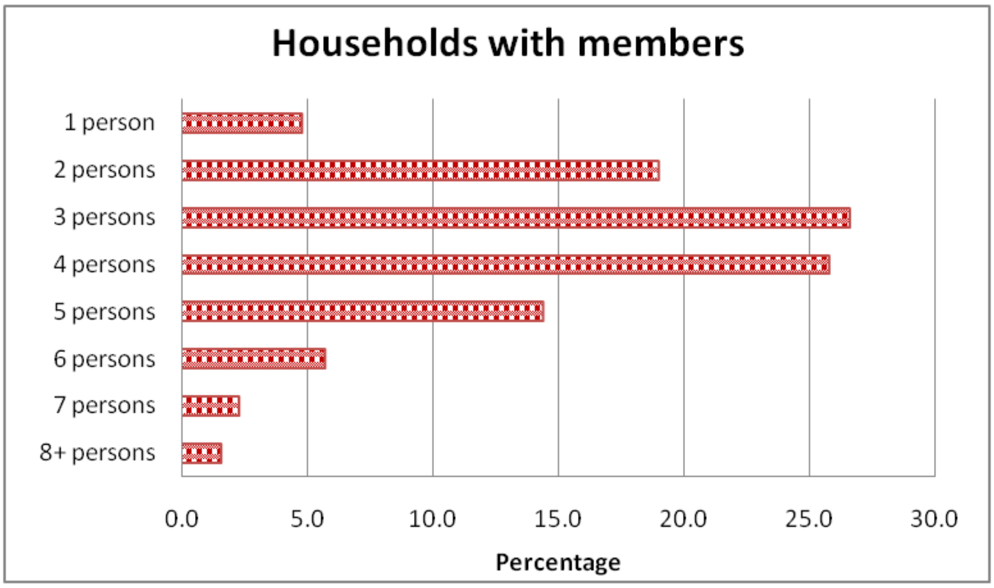
5.4.1 Demography

447. There are 11,532 population comprising of 3,188 households in the study area. Of the total population, 5,575 (48.3%) are male and are 5,975 (51.7%) females. The average household size is 3.6, which is lower to the national average of 4.50 [BBS, (HIES) 2010[14]]. The average population density is 449 per square kilometer, which is lower than that of national average (1,055) (Housing and Population Census, BBS, 2011, CEGIS estimation, 2015[15]).

448. The Figure 5.21 shows that the household with 3 persons are maximum; 26.6% belongs to this category where households with 8+ persons are the minimum (1.6%). Though average household size is 3.6, yet 50.3% households have 3 or less than three members.

[14] HIES 2010 refers to Household Income and Expenditure Survey conducted by the Bangladesh Bureau of Statistics (BBS) in 2010.

[15] This estimation is based on BBS, 2011 Census data and 1.37 linear national growth rate.



Source: Housing and Population Census, BBS, 2011

Figure 5.21: Distribution of households comprising member in each

Age Structure

449. According to the age structure there are 23.3% population belongs to the age category of 30-49 years. On the other hand, the lowest 2.9% population belongs within the range of 60 to 64 years category. Age groups of 0-14 years is defined as children, 15 to 24 years as early working age, 25 to 54 years as prime working age, 55 to 64 years as mature working age and 65 years and over as elderly people (source: World Fact Book, CIA[16]).

450. According to the international standards, the "economically active population" comprises all persons of either sex who furnish the supply of labour for production of goods and services as defined by the United Nations systems of national accounts and balances, during a specified time reference period (Ralf Hussmanns et. al, 1992[17]). This definition is adopted by the International Labour Organization (ILO) and categorized the population of 15 to 64 years category as labour force whereas the populations below 14 years and above 65 years are considered as dependent.

451. The analysis of the population data shows that almost 56.7% population are in labour force category who are within 15 to 64 years and are economically active. On the other hand, there are 43.3% population who are defined as economically inactive comprising of the elderly people (5.9%) and children (37.4%) (Figure 5.22**)**.

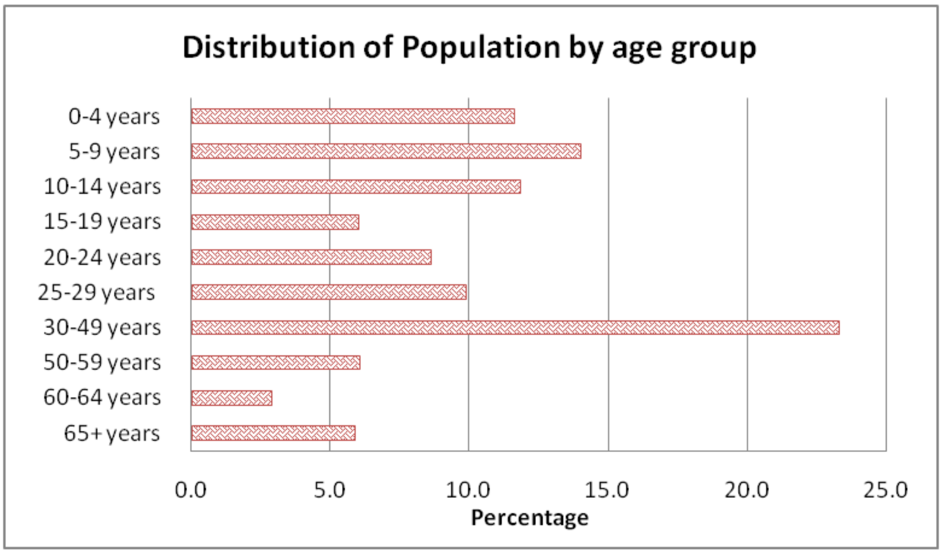
452. The estimates of the total dependency ratio[18]shows it to be as 86, in which child dependency ratio is 45 and aged dependency ratio is 10. It is shown that total 86 persons are dependent on 100 labour forces in which 45 are children and 10 are elderly people.

[16] Retrieved on 19/3/2015 from https://www.cia.gov/library/publications/the-world-factbook/docs/notesanddefs.html

[17]Ralf Hussmanns et. al, 1992; *Surveys of economically active population, employment, unemployment and underemployment;*International Labour Office, Geneva.

[18] Total dependency ratio= $\frac{number\ of\ people\ aged\ 0-14\ \&\ those\ 65\ and\ above}{number\ of\ people\ aged\ 15-64} \times 100$

Child dependency ratio= $\frac{number\ of\ people\ aged\ 0-14}{number\ of\ people\ aged\ 15-64} \times 100$



Source: Housing and Population Census, BBS, 2011

Figure 5.22: Age structure of the studied population

5.4.2 Education

453. There are 5 government primary schools, a registered high school, an Ebtedayee Madrasha and a Dakhil Madrasah[19] (Picture 5.28) in the study area with no college in the study area. Access to education is limited in this locality because of improper communication system, poverty, lack of health care and nutrition services etc.

454. School attendance rate (Figure 5.23) is measured by BBS from 3 years to 29 years by six clusters of age groups. 3 to 5 years is defined as pre-school attendance, 6 to 10 as primary, 11 to 19 years as secondary and higher secondary and finally 20 to 29 years as higher as well advanced level attendance at educational institutions. Comparative scenario of attending and not attending rate shows that net attendance rate is highest (20.1%) at primary level after which the rate starts reducing gradually. The secondary level shows the doorsill point from which no attending rate moves upward and attending rate starts sliding. This trend is same for higher as well as advanced level of studies.

Picture 5.28: Educational institutions in the polder area

Aged dependency ratio= $\frac{\text{number of people aged 65 and above}}{\text{number of people aged 15–64}} \times 100$

[19]CEGIS field visit, 2015

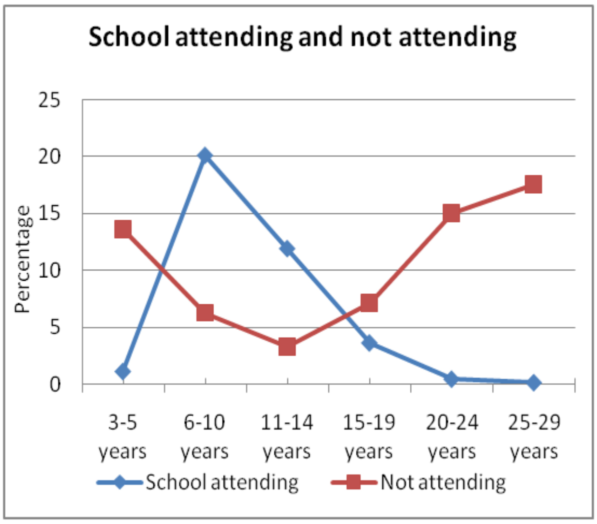


Figure 5.23: Portrayal of school attending and not attending rate in terms of age groups

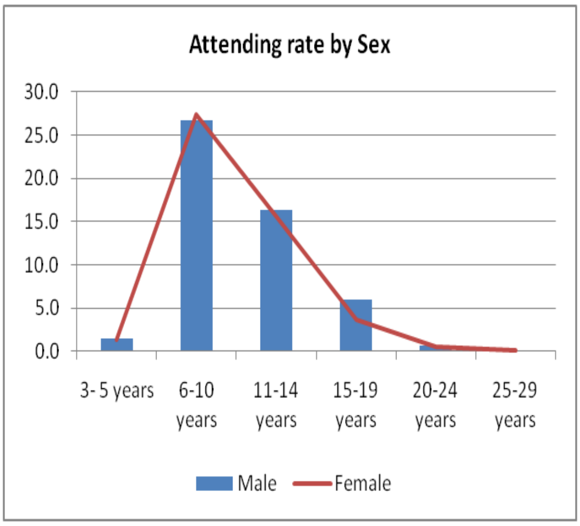
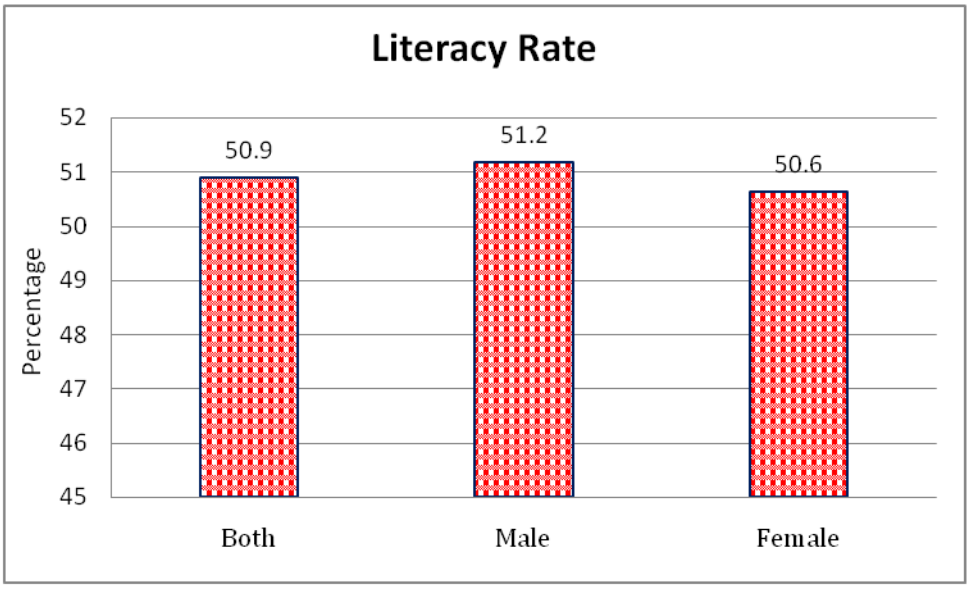


Figure 5.24: Comparative picture of male-female attendance rate

Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

455. Female attendance rate (27.3%) in the study area is comparatively higher than that of males (26.7%) at primary school (Figure 5.24). Field findings confirm that female attendance at this stage is higher because of existing scholarship program, and the parents also consider this basic schooling as an investment for securing a good marriage of their female child. It has also been observed and the data collected confirms that after completion of primary education, most of the girls get married and therefore the attendance rate gradually starts reducing. However, male attendance rate also starts decreasing due to their involvement in income generating activities. Field findings also proved that impoverishment of local people pushed them toward livelihood harnessing at their early age.

456. Literacy rate (Figure 5.25), based on the definition "ability to write a letter in any language" is 50.9%, where for male it accounts to 51.2% and for female 50.6%. The rate of literacy reported above is for population of 7 years and over ages.



Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

Figure 5.25: Literacy rate among the studied population

5.4.3 Public Health

Prevalence of Diseases

457. It is found from the field that waterborne diseases, coldness, fever, respiratory and skin diseases are the main diseases throughout the study area. The prevalence is due to drainage congestion in the study area. Field data confirms that water in the polder area remains stagnant in linked canals and ditches round the years, which spread bad fragrance leading to air pollution. It eventually increases respiratory diseases particularly to children. Local people often use this stagnant water. It eventually leads them to skin disease as this water has already been contaminated.

458. However, during wet season waterborne diseases and coldness are very common. Water congestion takes acute form during this period as high tide pushes water inside the polder area and heavy rainfall adds extra water. Most of the internal roads networks, courtyard and in some cases kitchens are flooded for at least 6 hours a day (time of high tide). This dampens the floor of the houses that increases coldness.

Access to Health Services

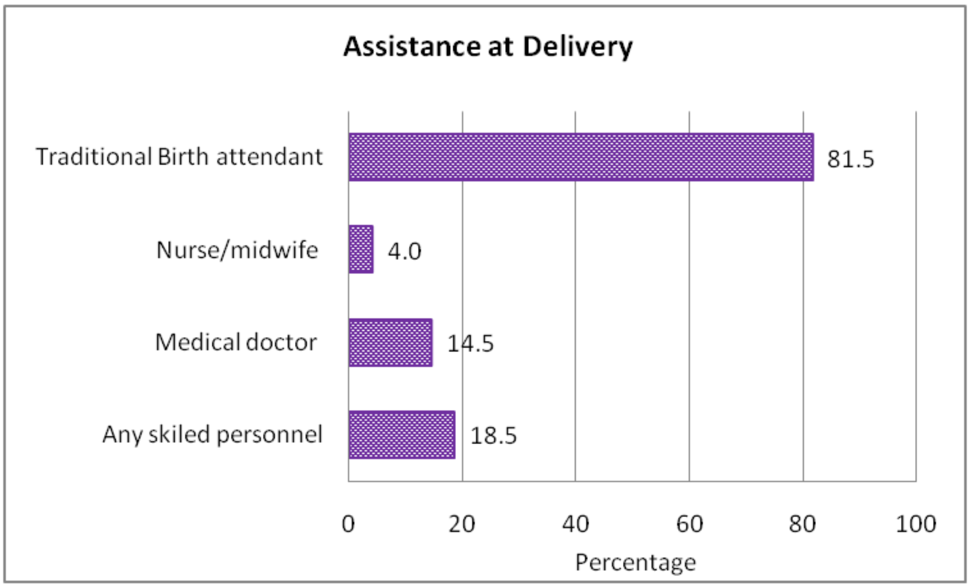
459. Access to health services and facilities refer to the availability and adequacy of supply, affordability, physical accessibility and socio-cultural acceptability. Field data shows that there is no community clinic in the study area. Therefore, they have to receive health services from peripheral Khaprabhanga Union Health Complexes (7km away), Upazila Health Complex (UHC) (12 km away) located at Kolapara Upazila.

460. Field data shows that the existing services are almost inaccessible to local people therefore, a substantial number of populations tend to receive services from the local chemists and/or “village doctors” either self-educated or locally trained who have some basic knowledge about health and medicines. Such inaccessibility exacerbated due to poor communication network and lack of services and facilities.

Child and Mothers’ Health

461. Infant mortality rate (IMR) in the Upazila covered by the study area is 44. IMR is defined as the number of deaths of infants under one year old exact per 1,000 live births. On the other hand, the less than five mortality rate (U5MR) is 55; it also indicates the number of deaths of infants under five years old per 1,000 live births. This rate is comparatively lower than that of national average, which is 49 for IMR and 64 for U5MR (source: Progoti Pathey, MICS, 2009). Although this scenario represents the entire Upazila, it is very common for Dalbuganj Union. The child mortality is due to malnutrition, having scarcity of trained attendants at delivery, and more importantly lack of health services due to poor communication facilities.

462. It is found in the entire Upazila that about 57.60% women aged between 15 and 49 years with a birth in 2 years preceding the survey can breastfeed their baby within one hour of birth and about 90.50% can breastfeed within one day of birth. The following figure shows that the highest percentage (81.5%) of delivery was assisted by traditional birth attendant, about 4% by nurse /midwife, and 14.5% by professional doctor (Figure 5.26). It is found in the study area that only 18.5% of delivery was assisted by means of skilled personnel. This scenario is common for the entire study area.



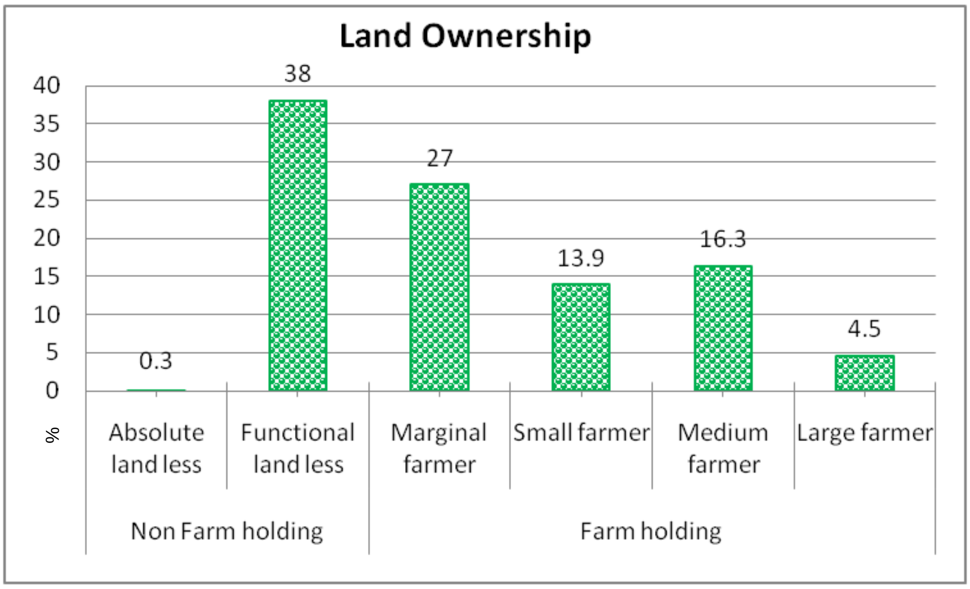
Source: Progotir Pathey, MICS, 2009

Figure 5.26: Percentage of women aged 15-49 with a birth by type of personnel assisting with the delivery

5.4.4 Ownership and utilization of land

463. The Census of Agriculture, 2008 conducted by BBS classified land holdings into two broad categories- one as farm-holdings and the other as non-farm holdings. The farm holding is defined as being an agricultural production unit having cultivated land equal to or more than 0.05 acre. Conversely, non-farm holding includes landless households and households having lands up to 0.04 acre (Figure 5.27). The study area shows that out of total holdings 72.4% is farm-holder and the rest 27.6% is non-farm holders.

464. According to BBS 2008 data on land holding distributions, in the study area 0.3% households are absolute landless i.e. they have no lands either homesteads or cultivated. 38% households belong to functional landless category, who have land upto 0.04 acres.



Source: The Census of Agriculture, 2008, BBS

Figure 5.27: Households by land holdings

465. On the other hand, farm holding distribution shows that 27% households belong to marginal farmers (0.05 to 0.99 acre), 13.9% belong to small farmer (1.00 to 2.49 acre), 16.3% belong to medium farmer (2.5 to 7.49 acre) and rest 4.5% belong to large farmer (7.5+ acre) categories. It is found that land fragmentation decreases the holding size therefore; large and medium farmers are gradually being turned into marginal farmers.

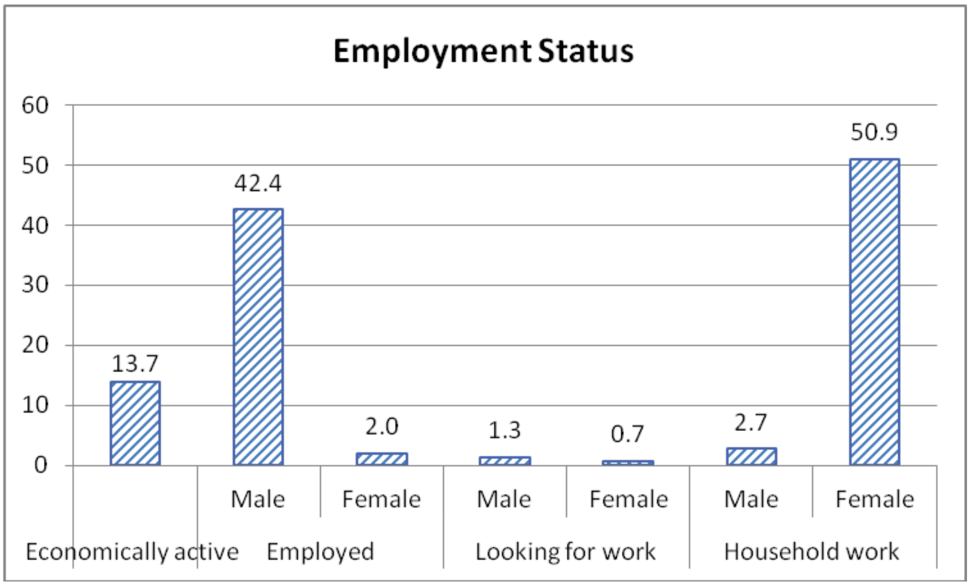
466. The entire land holdings can be categorized into three groups such as “owned land”, “land given to others” and “land taken from others”. It is found in the study area that about 60.8% holdings are under owned category; which means the land owned by holder including members of his/her family having a title to the land with right to determine nature and extent of its use and to transfer the same. On the other hand, about 15.4% of the holdings are found to be given by the owners to others in terms of lease and/or rent for a limited time on payment either in cash of kind or both. About 23.8% of the holdings are found to be taken by the farmers from others in terms of share-cropping and/or lease on other terms (BBS, 2008).

467. Field findings confirm that the “land given to others” and “land taken from others” takes into two form: one is *adha-bhaga* (distributing crops into half between land owners and farmers), and another is *kot-kawla* (leasing land on payment in cash). In *adha-bhaga* category, the land owner gives land to the farmers. Conversely, farmers cultivate land with all input supplies except seeds. The cost of seed in this condition is shared by both the farmers and land owners. After harvesting, crops are distributed equally between the farmers and land owners. However, in *kot-kawla* system the land owners gives land to others with taka 1800 to 2400 per decimals. The land takers cultivate lands until the land owners repaid his/her paid amount.

5.4.5 Occupations and Livelihoods

468. Out of total 10,921 population, 1,498 (13.7%) are economically active (aged 7+ and at present not attending school) of which 665 (44.4%) are employed, 30 (2.0%) are looking for work, and 803 (53.6%) are engaged in household works (Figure 5.28). The economically active population includes those who are aged 7 and over and not attending school at reference period of Housing and Population Census, 2011. Therefore, the definition include employed, looking for work and household work categories and exclude the children below 7 years, attending school population, physically challenged and elderly people who are not engaged in income generation works at reference period. Here, the household works particularly for women participation is accounted in terms of household activities as well as alternative income generation such as livestock rearing, poultry farming etc.

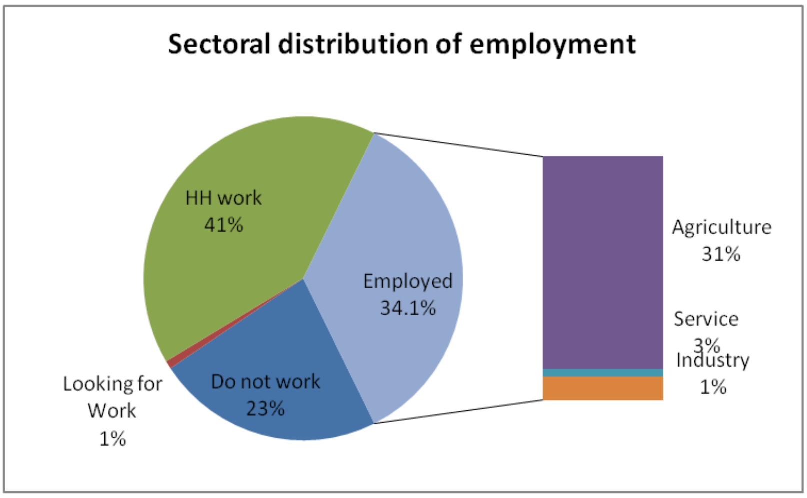
469. The education status confirms that whereas not attending males are engaged in employment, females are getting married and in turn, contributed to the highest participation in household works (39.1%). Therefore, women participation in direct income generating activities (employed category) is very negligible (1.5%). The employed category also includes child labour as it was accounted from 7 years old population. Therefore, non-attending children aged between 7 to 15 years were included in this category, which is documented in section 5.5.2.



Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

Figure 5.28: Employment status among the studied population

470. Distribution of employed population at reference period of the 2011 census shows that 31% are engaged in agricultural activities, 3% in service and only one percent is engaged in industry sector. Agricultural activities broadly include crop farming, fishery, livestock, and poultry farming. It is found that the study area is agrarian based as it provides mainstay of livelihood. Males are the main group dominating this sector. On the other hand, females are mainly involved in service sector for income generation (Figure 5.29).



Source: Housing and Population Census, BBS, 2011

Figure 5.29: Sex-wise contribution to sectoral activities

5.4.6 Labor Market

471. The employment[20] rate[21] in the study area is 34.1 whereas the unemployment rate[22] is 65.9. It is evident that more than half of the total economically active population is still

[20] The ILO defines employed persons of those who, (1) do any work at all as paid employees, work in their own business or profession or on their own farm, or work 15 hours or more as unpaid workers in a family-operated enterprise; and (2) all those who do not work but had jobs or businesses from which they were temporarily absent due to illness, bad weather, vacation, childcare problems, labor dispute, maternity or paternity leave, or other

unemployed. Most of the unemployment populations are females who are solely involved in household work, and only 0.5% populations are looking for works.

472. Data confirms that agriculture is the main sectors, generating employment for the local people. In the agricultural sector, almost all labourers come from the local villages. Out-migration from study area is very high (30%) during the months from January to April. These out-migrated people are generally engaged as rickshaw puller, mason, non-farm laborers and shoe factory worker etc. Seasonal out-migrants often go to Dhaka, Khulna, Barisal, and Chittagong districts for better employment. The employment opportunity in the study area is very limited. Therefore, the seasonal in-migration is insignificant.

5.4.7 Standard of Living

473. Standard of living indicates the level of wealth, comfort, material goods and necessities available to the studied population. This section defines it narrowly and necessarily includes people's access to electricity, sanitation facilities, safe drinking water availability, housing condition and fuel consumption.

474. There is no electricity facility in the polder area. As a result, the polder area has less socio-economic development activity. The coverage of solar is found nominal in the entire study area.

475. It is found that most of the houses are *Kutcha* (88.5%) where only 0.8 % houses are *Semi*-*Pucca* and 10.4% percent houses are still J*hupris (Figure 5.30)*. Field data confirms that prevalence of extreme poverty push them to live in K*utcha* houses (**Figure 5.30**).

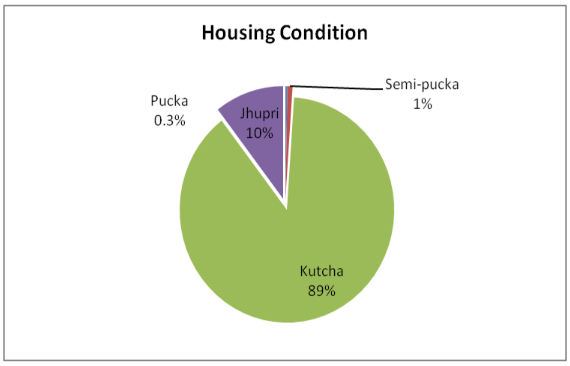


Figure 5.30: Housing condition in the study area

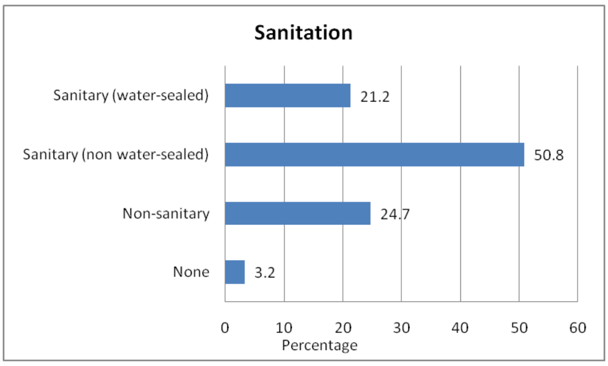


Figure 5.31: Distribution of households by sanitation facilities

Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

476. 72% of the households in the study area use sanitary latrines, where water-sealed sanitary latrine is 21.2% and non water-sealed sanitary latrine is 50.8%. Almost 24.7% use non-sanitary latrines and still 3.2% households have no sanitation facilities either owned or on shared basis. Field findings confirmed that non-sanitary latrines are predominant among kutcha houses. (**Figure 5.31**)

477. Tube-well is the main source of drinking water throughout the study area. However, some households depend on open water bodies as sources of drinking water and they are very negligible. These houholds are basically the poorest and have no access to tube-wells

family or personal obligations — whether or not they were paid by their employers for the time off and whether or not they were seeking other jobs.

[21]Employment Rate = $\frac{EmployedPopulation}{Totallabourforce} X\ 100$

[22] Unemployment Rate= 100-Employment Rate

478. Fire wood and husk of paddy are the only source of fuel consumption in the entire study area. People collect firewood from the neaest places and use them round the year. They also stored chips during crop harvesting time for cooking in wet season. Poor people who cannot afford usually collect leaves from neighbours' garden and also collect husk from the paddy field.

5.4.8 Poverty

479. Poverty for the study area has been measured following the Multidimensional Poverty Index (MPI) method. The process is intended to identify multiple deprivations at the household level in three broad dimensions such as education, health and standard of living. The total 10 standard indicators along with threshold are described by Alkire and Santos, 2010[23]. Of them, total 8 indicators were selected to be analyzed for this study based on data availability and accordingly adapted to the prescribed methodology (detail methodology is in Appendix 4). The indicator and the thresholds for defining poverty are presented in the following table (Table 5.30).

Table 5.30: Indicators thresholds along with data sources for MPI calculation

Dimensions	Indicators	Definitions/threshold	Data sources
Education	School attainment	No household member has completed at least six years of schooling.	Housing and Population Census, 2011, BBS
	School attendance	A school-age child (up to grade 8) is not attending school.	Housing and Population Census, 2011, BBS
Health	Child mortality	A child has died in the household within the five years prior to the survey	Progothir Pathey, MICS, 2009, BBS
Standard of living	Electricity	Not having access to electricity	Housing and Population Census, 2011, BBS
	Drinking water	Not having access to clean drinking water or if the source of clean dirking water is located more than 30 minutes away by walking	Housing and Population Census, 2011, BBS
	Sanitation	Not having access to improved sanitation or if improved, it is shared	Housing and Population Census, 2011, BBS
	Cooking fuel	Using "dirty" cooking fuel (dung, wood or charcoal)	Field investigation, CEGIS, 2015
	Housing	Having a home with dirt floor	Housing and Population Census, 2011, BBS

480. Analysing the poverty status, it is found that about 32% households are multidimensional poor (index value 0.32 out of 1= **MPI**). About 67% populations are living in these poor households (poverty head count=**H**) and on average 47% poor people are deprived of any indicator (intensity of deprivation=**A**). Table 5.31 is shown the state of multidimensional poverty.

[23] Retrieved from http://hdr.undp.org/sites/default/files/hdr14_technical_notes.pdf

Table 5.31: State of Multidimensional poverty

Dimensions	Indicators	Deprivation per indicator (%)	Contribution of deprivation in dimension to overall poverty (%)
Education	School attainment	22	22.9
	School attendance	67	
Health	Child mortality	6	6.2
Standard of living	Electricity	100	70.9
	Drinking water	2	
	Sanitation	79	
	Cooking fuel	98	
	Housing	99	

Source: CEGIS calculation, July 2015

481. Illustrating contribution of deprivation in dimension to the overall poverty, the highest deprivation (70.9%) is found in the standard of living dimension as 79% populations have no access to improved sanitation facility (water-seal sanitation), 99% are living on dirt floored households (considering kutcha and jhupri), 98% are using dirt fuel (considering all types of traditional fuel), 100% households have no grid electricity coverage and 2% households still collect drinking water from unsafe sources (ponds, river etc.).

482. The second highest deprivation is found in standard of living dimension (22.9%) as education dimension. Considering two dimension it is found that 22% household members have not completed at least six years of schooling, and 67% school-age children (up to grade 8) are not attending school.

483. In case of health dimension, only one indicator (child mortality) is considered as nutrition data, which is not available. It contributes 6.2% in overall poverty as 6% children are found to be dead in the households within the five years prior to the survey (considering both IMR and U5MR) (Table 5.31).

5.4.9 Institutions and infrastructure

Market

484. There are three (03) local markets in the polder area which are located on BWDB flood control embankment includes *Thankhola* Bazar (Ch. 0.04 km), *Fulbunia* Bazar (Ch. 5.84 km) and *Dalbuganj* Bazar (Ch. 13.10 km).These markets play important role providing source of livelihood of the Polder inhabitants as well as meeting the daily needs of the people. However, some peripheral markets are found namely Khaprabhanga Bazar (7 km away) and Kolapara Bazar (12 km away from the polder area).

Transport Network

485. There is no national/regional or even local waterway routes available in the polder area. However, some peripheral waterways namely Fulbunia launch ghat (1 km) on Nilgonj river, Budbaria (3 km) and Thankhola ferry ghat (3 km). Moreover, there is also no major road network in the polder area.

5.4.10 Vulnerability

486. The polder area is vulnerable to natural disaster notably with cyclonic storm, storm surges, tidal flooding, heavy rainfall and erosion. In some areas, embankments are vulnerable and supposed to be eroded within short time. Tidal flood water enters into the

polder as there is no functional gate of any drainage and flushing sluices. This water coincides with heavy rain water and in turn, makes drainage congestion which eventually floods internal road networks, homesteads, playground and educational institutions. Being a coastal area, the cyclonic storm is very common in the study area. Substantial aftermath took place with very severe cyclonic storm namely Sidr, of which, human and non-human asset loss is mentionable.

5.4.11 Social structure

487. Agrarian social relation more or less existed in the study area, as agriculture is the predominant mode of production. Although power structure was operated centering the land ownership in earlier time, the trend is now changing.

488. In social relation, males are considered as the main livelihood earner whereas females are usually confined to household chores. In agriculture sector, females' contribution is supplementary aiming to aid their male partner in preparation of raw paddy to rice. Furthermore, kitchen garden is the main task done by women. In decision making both in society and family, males are the main contributors. Peoples reported that as the female literacy rate is gradually increasing, they are now contributing, although trivial, in household income particularly in service sector such as teaching, factory worker etc.

5.4.12 Cultural heritage/sites

489. There is no cultural sites inside and outside the polder area.

6 Environmental Impacts and Mitigation Measures

6.1 Preamble

490. This Chapter identifies the environmental and social impacts, which may potentially occur in various Project phases, and proposes appropriate mitigation measures to avoid, offset, reduce or compensate these impacts. Potential Interventions which may cause potential environmental impacts during pre-construction, construction and post-construction stages have been identified in Chapter 4. The project influenced area has been identified in Article 2.2.1 of Chapter 2. The following detailed investigations have been carried out to assess the magnitude of these impacts:

- Census survey to assess the extent of land acquisition and resettlement, loss of vegetation, occupation, income and poverty levels of the affected households, etc;
- Polder drainage model developed using the existing calibrated and validated Southwest Regional Model as base model has been used to understand the impact of project intervention to improve the existing drainage system and impact of climate change considering 5th assessment report of IPCC with the existing drainage system and with modified drainage system;
- Environmental quality baseline monitoring of air, noise, surface water, groundwater and soil;
- Ecological surveys comprising vegetation, wildlife and fisheries covering both mainland and offshore area;
- Surveys comprising of socioeconomic status and environmental settings in and surrounding polder
- Expert consultations focus group discussions, and public consultations.

491. It is noted that the impact of proposed interventions on drainage, flooding, river dynamics has also been analyzed through modeling conducted by IWM 2016.

6.2 Impact Screening

492. As a part of the environmental impact assessment process, a screening matrix was used customized specifically to the proposed Project, focusing the potential environmental impacts during design, construction and operation phases. The matrix examined the interaction of project activities with various important components of the environment. The impacts were broadly classified as physical, biological and social, and each of these broad categories were further divided into different aspects. The potential impacts thus predicted were characterized as follows:

- Highly negative (adverse) impact;
- moderately negative impact;
- Insignificant impact;
- Moderately positive impact.
- Highly positive (beneficial) impact;

The matrix is provided in Table 6.1. The negative impacts predicted in this manner were the ‘unmitigated’ impacts. Appropriate mitigation measures have been recommended as part of this EIA study, thus reducing the occurrence possibility and severity of the potentially adverse impacts. The potentially negative impacts identified through this process are discussed in the subsequent sections.

Table 6.1: Environmental Screening Matrix (Unmitigated)

	Physical					Biological		Social and Socioeconomic													
Project Phases and Activities	**Soil Erosion/Contamination**	**Air Quality**	**Surface Water Quality**	**Groundwater Quality**	**Water Availability and Consumption**	**Natural Vegetation**	**Aquatic Fauna**	**Resettlement**	**Blocked Access Routes**	**Noise and Vibration**	**Impacts on Agriculture and grazing**	**Impacts on Fisheries**	**Flooding**	**Vehicular Traffic**	**Safety Hazard**	**Damage to Infrastructure**	**Public Health**	**Aesthetic Value**	**Gender and Cultural Issues**	**Employment Opportunities**
Design Phase and Pre-Construction Phase																				
Land Acquisition	0	0	0	0	0	0	0	HN	0	0	0	0	0	0	0	0	0	0	0	0
Contractor Mobilization	MN	MN	MN	0	0	MN	MN	0	MN	MN	MN	MN	0	HN	HN	HN	MN	0	MN	MP
Construction Camp Establishment	MN	MN	MN	0	0	MN	MN	MN	MN	MN	MN	MN	0	MN	HN	MN	MN	MN	MN	MP
Construction Phase																				
Equipment / Material Transportation	MN	MN	MN	0	0	0	0	0	MN	MN	MN	MN	0	MN	HN	MN	MN	0	MN	MP
Operation of Construction Camp	HN	MN	HN	MN	MN	0	MN	0	MN	MN	0	MN	0	MN	HN	MN	HN	0	MN	MP
Site Clearance	MN	MN	MN	0	0	MN	MN	0	MN	MN	MN	MN	0	MN	HN	MN	MN	MN	MN	HP
Borrow and disposal area management	HN	MN	HN	0	0	MN	MN	0	MN	MN	HN	MN	MN	MN	HN	MN	HN	MN	MN	HP
Excavations of water channels	MN	MN	HN	0	0	MN	HN	0	MN	MN	0	HN	MN	MN	HN	MN	MN	MN	MN	HP
Re-sectioning of Embankments	HN	MN	MN	0	0	MN	0	0	HN	MN	MN	0	MN	MN	HN	MN	MN	MN	MN	HP
Installation/replacement/repair of Regulators	HN	MN	MN	0	0	0	MN	0	HN	MN	0	MN	HN	MN	HN	MN	MN	MN	MN	HP
Demobilization	MN	MN	MN	0	0	MN	MN	0	MN	MN	MN	MN	0	HN	HN	HN	MN	0	MN	MP
Operation Phase																				
Operation of Regulators	MN	0	HN	0	MN	0	MN	0	0	0	HN	HN	HN	0	0	0	0	0	0	MP
Repair and Maintenance	MN	0	MN	0	0	0	MN	0	MN	MN	HN	HN	HN	MN	MN	0	0	0	0	MP
Monitoring	0	0	0	0	0	0	0	0	0	0	0	0	0	MN	0	0	0	0	0	MP

Key:- HN: High negative impact; MN: Moderate negative impact; 0: Insignificant/negligible impact; HP: High positive impact; MP: Moderate positive impact

6.3 Impacts during Pre-construction Phase

493. Site development involves the following activities:

- Mobilization of construction equipment, materials and vehicles;
- Clearing of sites;
- Collection of earth materials from borrow pits, re-excavated khals and dredge spoils;
- Construction of civil amenities and development, and
- Establishment of temporary construction yards and labor sheds with sanitation and safe drinking water facilities.

494. The activities will cause the following environmental impacts

6.3.1 Damages of properties due to Project Intervention and Land Acquisition

Impact

495. About 2.31 hectares of land will be acquired for development work specifically for construction retired embankment. In this case, the detail of the land acquisition plan, process and cost including the list of the PAPs are incorporated in the RAP report prepared by Planning and Design Consultants. During distribution of compensation, conflict may arise due to absence of proper legal document in connection with the ownership of land. Moreover, a number of primary and secondary structures, common properties as well as many trees will be affected by the proposed activities. The social network e.g somiti and club will be affected but there activity is of minor sclae. Therefore, the structure of the club will be re-located and their activies will be hampered temporarily. Moreover, the project interventions in Polder 47/2 will affect 51 number of shops from which 46 shops are operating their business by themselves while 5 shops are running their business as tenants. As a result, a total of 51 hosehold will loss their bussines and their daily imcome of the shop owner will decline. The details of these damages in Polder-47/2 are presented in Tables 6.2 to 6.6.

Table 6.2: Land to be acquired in Polder- 47/2

Type of land use	Quantity (ha)
Homestead	1.15
Vita/ Highland	0.23
Crop land	0.36
Orchard/ Forest land	0.23
Total	2.31

Source: RAP report prepared by KMC, 2016

Table 6.3: Primary Structures (in sq ft) to be affected in Polder-47/2

Sl. No	Description	Quantity
1	Pucca	645
2	Semi-pucca	635
3	Tin	29551
4	Kutcha	7273
5	Thatched	8187
	Total	46,291

Source: RAP report prepared by KMC, 2016

Table 6.4: Secondary Structures to be Affected in Polder-47/2

Sl. No	Description	Quantity
1	Pucca Floor (sft.)	30
2	Meherab(sft)	160
3	Under construction sft	54.18
4	Boundary wall (rft.)	138
5	Bench (rft.)	21.5
6	Grave (rft.)	283
7	Stairs of House (rft.)	24
8	Pucca Latrine (No.)	4
9	Slab Latrine (No.)	62
10	Katcha Latrine(No.)	2
11	Tube Well (No.)	2
12	Pillar (No)	2
13	Urinal Place (No.)	2
14	Septic Tank (Cft.)	120.96

Source: RAP report prepared by KMC, 2016

Table 6.5: Trees to be Affected in Polder-47/2

Types	Big	Medium	Small	Plant	Total
Fruit trees	1050	1079	1617	460	4,206
Timbers trees	1264	3499	2994	1471	9,228
Medicinal	39	349	858	732	1,978
Banana	231	261	126	132	750
Bamboo	536	72	148	10	766
Totals	3120	5260	5743	2805	16,928

Source: RAP report prepared by KMC, 2016

Table 6.6: Common Properties to be Affected in Polder-47/2

Description	Quantity
School/Pathshala	1
Govt. Office	2
Mosque	5
Madrashs	1
Somiti	1
Club	2
Tubewell	1
Public Toilet	2
Total	15

Source: RAP report prepared by KMC, 2016

496. The significance of this potential unmitigated impact has been assessed as **Major** on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

497. The following mitigation measures are to be undertaken to address the above concerns:

498. A Resettlement Action Plan (RAP) is prepared in accordance with the national laws and WB OP 4.12. Salient features of the RAP includes: the affected households to be compensated for their loss of land, structures, trees, ponds and others; squatters and tenants are to be paid compensation for the loss of their structures and livelihood; sanitation facilities to be provided for each displaced household in the Polder area since about 68 latrines and 2 tubewells will be displaced during construction works; and community based drinking water facilities are to be constructed.

- Compensation will be made prior to construction in accordance with RAP.
- Contractor will maintain liaison with communities.
- Grievance Redress Mechanism (GRM) will be established.
- Follow 'Find Chance' procedures for common property resources.
- Follow the social networks to resettle the affected households due to project implementation.

Residual Impacts

499. The impacts associated with the involuntary resettlement are likely to be addressed with the help of the above mitigation measures, and the significance of residual impact will be **Low**.

6.3.2 Preparation of facilities for contractor(s) and labor force

Impact

500. The activities that take place for construction of camp and labor shed development are land cleaning, levelling of site and construction of temporary buildings. During site development activities, the polder may potentially affected by air and water contamination, noise generation, safety hazards, hindrance to local communities and other relevant impacts. Mostly, all labor force facilities and sheds will be implemented along the periphery peripheral of the embankment which may create disturbance (communication problem and create noise) for the nearest five (05) schools and *Madrasha*.

501. The significance of this unmitigated impact has been assessed as **Moderate** on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

502. The following mitigation measures are to be implemented to address the above concerns:

- Contractor will prepare site establishment plan and obtain approval from the DCSC
- Approval for location of temporary facilities will be obtained from the DCSC;
- Deforestation will be minimized as far as possible during site facilities development;
- Photographic record will be maintained to keep the pre-construction condition of the area;
- Site facilities will be established at a safe distance from communities;
- Contractor will prepare and implement pollution control and waste management plans;
- No untreated wastes shall be released on the ground or in water;
- Exhaust emissions from vehicles and equipment will comply with standards;

- Vehicles, generators and equipment will be properly tuned;
- Water will be sprinkled as and where needed to suppress dust emissions;
- Speed limits will be enforced for vehicles on earthen tracks during school time (8:00am to 1:00 pm);
- Vehicles and machinery will have proper mufflers and silencers; and
- Liaison will be maintained with the local school communities.

Residual Impacts

503. The impacts associated with the establishment and construction of site facilities are likely to be addressed with the help of the above mitigation measures, and the significance of residual impact is considered to be Low.

6.3.3 Increased Vehicular Traffic during Mobilization

Impact

504. During mobilization of equipment, machineries, materials and manpower will be transported to the Polder resulting additional traffic on roads and in waterways. This traffic may potentially cause traffic congestion particularly on the peripheral road cum embankment. This increased traffic may affect movement of students and guardians of five (05) schools and *Madrasha* including *Payerpur* primary school (Ch. 1.78 km), *Nurpur Madrasha* (Ch. 4.47 km), *Fulbunia* primary school (Ch. 5.10 km), *Rasulpur* primary school (Ch. 10.41 km) and *Meherpur* primary school (Ch. 15.96 km) which are located within 100 to 150 m of the embankment. Besides, three (03) local markets on BWDB embankment; *Thankhola* Bazar (Ch. 0.04 km), *Fulbunia* Bazar (Ch. 5.84 km) and *Dalbuganj* Bazar (Ch. 13.10 km) will face traffic congestion.

505. The significance of this potential unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

506. The following mitigation measures are to be implemented to address the above concerns:

- The contractor will construct a temporary terminal/*Ghat* at Nurpur village (Ch. 3+100 km of Embankment) to carry construction material through waterway from Hazipur Ferry Ghat to the Polder area which will be cost effective;
- Contractor to prepare and implements a traffic management plan for vehicular movements.
- The TMP will be shared with the communities and will be finalized after obtaining their consent;
- Ensure minimal hindrance to local communities and commuters; and
- Regularly liaise with local communities and concerned authorities.

Residual Impacts

507. The impacts associated with establishing the site facilities are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be Low.

6.3.4 Change of land use

Impact

508. Land would be needed to establish temporary facilities including construction camp (labor shed) and borrow pit. It is estimated that about 10 labor sheds would be constructed to establish temporary facilities for the rehabilitation works. All the labor sheds would be constructed in the requisite land. It is mentioned here that land will not be changed because this land will be used for construction of labour camps as a temporary facilities and it would be brought back to original use.

509. The use of borrow pits area are majorly fallow during dry season. In wet season, these borrow pit areas is used scattered for seedbed or grazing of livestock by the dwellers of the polder.

510. The significance of this potential unmitigated impact has been assessed as Low on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

511. The following mitigation measures are to be implemented to address the above concerns:

- Establish all the construction camps within the area owned by BWDB;
- if private land is required on temporary basis, which instructions should be specified in the tender documents with compensation;
- Construct labor shed/camp at government khas land; and
- Avoid impacts on local stakeholders.

Residual Impacts

512. The impacts associated with changes in land use are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact is to be considered Low**.**

6.3.5 Cutting of Trees for construction of structures

Impact

513. A total 16,928 number of trees of different species and varying sizes are to be cut for re-sectioning of embankment, construction of structures, establishment of temporary labour camps and other temporary facilities in Polder 47/2. In addition, material stockpiling, material borrowing, and waste disposal can potentially affect the natural vegetation and trees. The details of the species composition is provided in the RAP Report.

Mitigation Measures

514. The following mitigation measures are to be implemented to address the above concerns:

515. Make early notification to the proper authorities (i.e. Forest Department) about tree felling;

516. Avoid vegetation damage as much as possible to select the sites for labour shed and material stock by using nearby fallow lands or barren homestead yards;

517. Ensure proper implementation of afforestation on available land, primarily on embankments with local floral species after completion of construction works.

518. Give proper compensation to the tree owners against tree felling specially for fruit yielding trees; and

519. Implement tree plantation at the damaged sites after completion of the construction works.

Residual Impacts

520. The impacts associated with establishing the site facilities are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be Moderate.

6.4 Impacts during Construction Phase

521. Reconstruction and rehabilitation of flood control embankment and water control structures will involve the following tasks during construction phase:

- Mobilization of equipment, construction materials and vehicles;
- Placement and compaction of earth for flood control embankment/sea dyke;
- Re-excavation of canals;
- New construction/replacement of water control structures; and
- Disposal of canal excavated wastes.

6.4.1 Hindrance for pedestrians and vehicles movement during re-sectioning of embankment

Impact

522. Three (03) local markets are located on BWDB flood control embankment includes *Thankhola* Bazar (Ch. 0.04 km), *Fulbunia* Bazar (Ch. 5.84 km) and *Dalbuganj* Bazar (Ch. 13.10 km).These markets play important role providing source of livelihood of the Polder inhabitants as well as meeting the daily needs of the people. During marketing hours, all the stakeholders use the embankment as road for carrying their goods for buying and selling and other purposes. Construction activities like re-sectioning of embankment, replacement/dismantled of hydraulic structure along the embankments are likely to disrupt the markets and other relevant activities. Besides, construction activities will also cause temporary disturbance in the movement of local people because of the internal roadways are not sufficient enough to provide alternate means of transportation. Local people will suffer due to their limited roadway movements. This will affect their economy and earning options as well.

523. The significance of this potential unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

524. The following mitigation measures are to be implemented to address the above concerns:

- The embankment works will be carried out in segment wise and soil will be placed linearly one on half of the embankment, leaving the other half to be used as public transportation. When the works of the first half are completed, it will be opened for local traffic and the works will be undertaken on the other half of the embankment will be undertaken;
- Work schedule will be finalized in coordination and consultation with local representatives (Union Parishad Chairman & members) and communities;

- Alternative road can be used. Otherwise it should be constructed by the contractor;
- The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes;
- Earth work for re-sectioning of embankment during hat day can be shorted for essay movement of local people; and
- Water way can be used especially along the *Sonatala* during construction period.

Residual Impacts

525. The impacts on pedestrians and vehicles movement are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be Low**.**

6.4.2 Generate Noise and Vibration

Impact

526. The construction activities particularly demolition of existing water control structures, excavation, compaction, operation of construction machinery and vehicular traffic will generate noise and vibration which are likely to affect the nearby communities. In addition, campsites may also generate noise. Increased noise levels may cause disturbance, nuisance and even health hazards to the nearby communities as well as to the construction workers. In particular, the settlements near the working areas will be exposed to noise and vibration generated by the Project activities. Therefore, sensitive receptors including five schools and Madrasha which are located within 100 to 150 m of embankment are likely to be more severely affected by noise. The students of these schools may be faced serious noise and vibration problem during school time. Table 6.7 shows the noise level to be expected from the equipment. According to ECR'97 60 dBA is applicable for mixed area in Bangladesh.

Table 6.7: Noise level of different construction equipment and machineries

	Equipment	Noise Level (7m away (dBA)
1	Bull-dozer	85
2	Excavator	80
3	Compactor	85
4	Concrete Mixer	85
5	Generator	81
6	Scraper	86

Source: Engineering and Procurement Team of CEIP-I

Mitigation Measures

527. The following mitigation measures are to be implemented to address the above concerns:

528. The following mitigation measures are to be undertaken to address the above concerns:

- The Contractor will prepare site specific pollution control plans for noise control for each construction site as well as a traffic management plan to be implemented upon approval by the DSC Consultant and PMU, for:
- The regulators will not be demolished during school time (8 am to 1 pm) particularly near the schools;
- Restrict/limit construction activities during the day time;
- Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards;
- Vehicles and machinery will have proper mufflers and silencers;

- Provision of noise barriers at schools and other sensitive receptors should be assured, as needed;
- Provision of PPE (ear muffs and plugs) to labor;
- Construction crew will be instructed to use the equipment properly, to minimize noise levels;
- Camps will be located at a safe distance from communities; and
- Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.

Residual Impacts

529. The impacts associated with noise and vibrations are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be Low**.**

6.4.3 Soil and water contamination due to wastes

Impact

530. Construction materials, demolished debris, fuel both from transportation vessel and construction machineries (piling machine, pump etc.) may degrade the soil and water quality. The construction workers will generate domestic solid waste and wastewater including sewage. The amount of domestic wastewater generated by the construction workers is assumed to be equal to the amount of water usage. Oily water, waste oils, oily rags and other similar wastes will be generated from workshop. The stores and warehouse will generate solid waste such as empty cement bags, cardboards and wooden crates. Improper disposal of these waste streams can potentially contaminate the soils and water resources of the area. Soil and water contamination can potentially have negative impacts on the local community, natural vegetation, agriculture and biological resources of the area including aquatic flora and fauna. Borrowing material from the river banks may potentially cause increased turbidity in the rivers. Furthermore, release of effluents, soil and/or sand in water bodies may increase water turbidity, which would prevent sunlight to enter into the water that is necessary for promoting photosynthesis of aquatic plants.

531. The significance of this potential unmitigated impact has been assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

532. The following measures are to be implemented by contractor to address the above concerns:

- Contractor will prepare and implement site-specific pollution control plan and a Standard operation plan and procedures for handling pollution spills, and management of fuels and hazardous wastes for implementation upon approval by the DSC Consultant and PMU.;
- Workshops will have oil separators/sumps to avoid release of oily water;
- Avoid repairing of vehicles and machinery in the field;
- Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination;
- Dispose contaminated soil appropriately ensuring that it does not contaminate water bodies or affect drinking water sources;
- Contractor will ensure that there is no leakage, spillage or release of fuel, oil or any other affluent/waste on the ground or in the water from its construction machinery,

vehicles, boats, launches, and barges. Contractor will regularly monitor the condition of its fleet;

- Material borrowing from the river banks will be carried out sufficiently away from the water line, minimizing the possibility of loose soil to wash away in the river;
- Contractor will locate camps for away from communities and drinking water sources;
- Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal);
- Release untreated wastes on ground or in water;
- Recycle spoil and excavated material where possible;
- Dispose spoil at designated areas with community consent; and
- Construction material, demolished debris and excavated soil/silt will not be allowed to enter the water bodies.

Residual Impacts

533. The impacts associated with soil and water contamination are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be Low**.**

6.4.4 Increased Sedimentation

Impact

534. Borrowing material from the river banks may potentially cause increased sediments in the rivers. Similarly, excavation of water channels (0.12Mm^3) if carried out in water can potentially increase their sediment load. Excavated material from the channels if left along their banks may again enter the water thus increasing their sediment load. In addition, construction material, loose earth/soil, demolition debris, and other materials may enter the river or other water bodies causing increased sediments. Run off from construction sites, camps, and other temporary facilities may enter water bodies increasing their sediment load.

535. The significance of this potential unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity (Table 6.1).

Mitigation Measures

536. The following mitigation measures are to be implemented to address the above concerns:

- Contractor will protect untreated embankment slopes;
- Contractor will excavate channels after dewatering them in case of manual excavtion;
- Contractor will not leave excavated earth and silt on channel banks;
- Contractor will implement measures to protect channels from run-off from working areas and camps; and
- Contractor will obtain borrowing material from river banks in such a manner so that there is no increase of siltation in rivers, and will not leave loose soil after excavation.

Residual Impacts

537. The impacts associated with sedimentation are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Low.

6.4.5 Damage of agriculture crop production

Impact

538. During collection of earth from the borrow pit areas no agriculture land would be impacted in the Polder area as all spoil earth would be collected from offshore area through manual excavation and from river bed of *Sonatala* River and *Baraitala* River as well as Nurpur, *Pearpur*, *Mirpur* and *Rasulpur* khals etc. through dredging.

539. In addition, construction activities, movement of construction machinery, project related vehicular traffic, material borrowing, material stockpiling, waste disposal or camp establishment might damage crops or affect the cultivated land.

540. The significance of this potential unmitigated impact has been assessed as Low on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

541. The following mitigation measures are to be implemented to address the above concerns:

- Compensation to be made for any crop damage;
- Contractor should avoid cultivation fields during construction;
- Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps;
- Contractor should ensure that no vehicular movements take place inside cultivation fields;
- Contractor should ensure that no material is dumped inside the cultivation fields; and
- Contractor should maintain liaison with communities.

Residual Impacts

542. The impacts associated with loss of agriculture are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact would be Low.

6.4.6 Disturbance of Irrigation Water Conveyance

Impact

543. Construction activities particularly for regulators and water channels can potentially disrupt the crop irrigation during both wet and dry season thus negatively affecting cultivation. The works on sluices can cut off the incoming water from the river, while the excavation works in water channels can affect water conveyance through them.

544. The significance of this potential unmitigated impact has been assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

545. The following measures are to be implemented to address the above concerns:

- Contractor would construct diversion channels; before construction/ replacement / demolished of each regulator;
- Sequence of work for the regulators and in the water channels would be carefully planned to avoid irrigation disruption;
- Contractor would ensure no negative impacts on irrigation;

- Contractor would maintain liaison with farmers communities; and
- Contractor would work during dry season.

Residual Impacts:

546. The impacts associated with disruption of irrigation are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact would be Low.

6.4.7 Destroy the Feeding, Nursery and Spawning Ground of Fish Habitat

Impact

547. The bank side of the *Baraitala* River has been found as the feeding, nursery and spawning ground, especially for *Paissa, Gulsha Tengra, Bagda*, etc (Table 6.8). It is supposed that due to the activities of bank revetment and slope protection (earth work) the feeding, nursery and even spawning ground of these fish species will somewhat be destroyed (if in the dry season) or fully disturbed (if in the rainy season). Consequently, fish catch at that location will be declined as well as earning of fihsermen will be decreased through decreasing accessibility to fishing ground in respect of catchability as a result of the fish behaviour due to losing feeding, nursery and spawning ground (Hilborn and Walters, 1992).

Table 6.8: Use of bank side of Lohalia River by some major fish species

Sl	Intervention*	Habitat	Age Class
1	BR_Ch1.7-2.7	Baraitala River	Nursery, Feeding and Spawning Ground
2	BR_Ch6-7		Nursery Ground

Source: CEGIS Field Survey, 2015

Mitigation Measures

548. The following mitigation measures are to be implemented to address the above concerns:

- Earth work should be conducted during the dry season (December-January);
- Sequence of work at the bank side of *Baraitala* River will be carefully planned to minimize impacts on spawning and subsequently nursery ground of fish; and
- Contractor will maintain liaison with experienced fishermen.

Residual Impacts

549. The impacts on spawning and nursery ground are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be Low.

6.4.8 Change in Migration Behaviour

Impact

550. Three (3) drainage sluice gates are proposed to be replaced by new ones which are used to regulate the water availability and water quality of associated khals. These khals have been found to be used as the feeding, nursing, spawning and even breeding ground by different fish species in different seasons (Table 6.9). It is supposed that due to the activities of replacement of these sluice gates, the habitat of about 1 km around the sluice gates (500 m

upstream and 500 m downstream) migration behaviour of the following fish species towards feeding, nursing, spawning and breeding might somewhat be hindered (if in the dry season) or fully hampered (if in the rainy season). On the other hand, due to non-functioning of existing regulators adverse impact has been noticed like salt water intrusion, sedimentation, drainage congestation, loss of irrigated area etc. As a result of new construction of infrastructures/regulators , these problems will be removed.

Table 6.9: Migration purpose and time by some major fish species

Sl	Fish Species	Habitat	Purpose	Timing
1	Bagda	Thankola Khal	Nursing	All the year round
2	Chapila	Kichikata Khal	Feeding	Ashar-Aswin
3	Chitra	Eidkhola Khal	Nursing	Ashar-Aswin
4		Kichikata Khal		
5	Gulsha Tengra	Eidkhola Khal	Feeding	All the Year Round
6		Kichikata Khal		
7			Spawning	Ashar-Aswin
8		Thankola Khal		
9	Lal Chewa	Thankola Khal	Spawning	Ashar-Aswin
10	Paissa	Eidkhola Khal	Nursing	Ashar-Aswin
11		Kichikata Khal		
12		Thankola Khal	Nursing and Spawning	All the Year Round
13	Taki	Thankola Khal	Nursing	All the Year Round
14	Tit Punti	Kichikata Khal	Spawning	Ashar-Aswin
15		Thankola Khal		
16	Veda Bele	Kichikata Khal	Nursing	Ashar-Aswin
17	Vetki	Eidkhola Khal		

Source: CEGIS Field Survey, 2015

Mitigation Measures

551. The following mitigation measures are to be implemented to address the above concerns:

- Replacement should be conducted during dry season (December-January and the contractor should be asked to take step accordingly);
- Sluice gate operation committee will operate the gate for fish migration during May to July; and
- Contractor might maintain liaison with experienced fishermen.

Residual Impacts

552. The impacts on migration for spawning and breeding are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be Low.

6.4.9 Damage of Benthic Fauna

Impact

553. Benthic communities play important role in food chain not only for lentic (standing water) but also for lotic (flowing) water bodies. Construction activities including re-excavation and Installation/replacement/repair of Regulators of three *khals* can potentially impact the benthic

communities of the water bodies. Most of the construction activities will be implemented during dry season, when the benthic fauna would be more vulnerable (Table 6.10).

Table 6.10: Major benthic composition of Lohalia River and its tributary khals in the project area

Sl	Major Group	Major Class/Order	Major Species
1	Phytoplankton	Cyanophyceae	*Anabaena fuellebornii*
2		Chlorophyceae	*Chlorella vulgaris*
3		Bacillariophyceae	*Chaetoceros pendulus*
4		Xanthophyceae	*Centritractus belanophorus*
5		Dinophyceae	*Ceratium dens*
6	Zooplankton	Protozoa	*Favella taraikaensis*
7		Cladocera	*Evadne tergestina*
8		Copepoda	*Calanus helgolandicus*
9		Rotifera	*Brachionus angularis*
10	Benthos	Coleoptera	*Corixa semistriata*
11		Crustacea	*Bathynella natans*
12		Diptera	*Ablabesmyia mallochi*
13		Ephemeroptera	*Acentrella alachua*
14		Gastropoda	*Amnicola taylori*
15		Hemiptera	*Belostoma* sp.
16		Megaloptera	*Corydalus cornutus*
17		Odonata	*Limnodrilus hoffmeisteri*
18		Oligochaeta	*Limnodrilus hoffmeisteri*
19		Bivalvia	*Corbicula fluminea*
20		Plecoptera	*Eccoptura xanthenes*
21		Trichoptera	*Brachycentrus lateralis*

Source: CEGIS data base, 2014

Mitigation Measures

554. The following mitigation measures are to be implemented to address the above concerns:

555. The Contractor will prepare site-specific plans for pollution control and for standard operation and procedures for handling pollution spills to be implemented upon approval by the DSC Consultant and PMU.

556. Contractor will carry out *khal* excavation in segments thus minimizing impacts on benthic fauna

Residual Impacts:

557. The Project's impacts on benthic fauna will be somewhat reduced with the help of the above mitigation measures. After the construction phase, these resources are likely to fully recover gradually. The significance of the residual impacts has therefore been assessed as Low.

6.4.10 Stock Susceptibility to Catch

Impact

558. Re-excavations of water channels and Installation/replacement/repair of Regulators are two major activities in the proposed interventions in Polder 47/2. It is expected that fishing activities would be exponentially increased during these two activities through increasing catchability and accessibility to fishing as a result of improving natural environmental factors

(water flow, velocity, etc.) (F. A. Sánchez, 1995). Moreover, improving environmental flow in that locations, different stock will be facilitated to migrate. Both of these would turn in increase the stock susceptibility to fishing in that location.

Mitigation Measures

559. The following mitigation measures are to be implemented to address the above concerns:

- Replacement should be carried out during the dry season (December-January); and
- Close monitoring should be made during the construction by the local commercial fishermen under the supervision of DoF so that, allowable biological catch can be ensured.

Residual Impacts

560. The impact on stock susceptibility is likely to be adequately addressed with the help of the above mitigation measures, and the significance of residual impact will be Low.

6.4.11 Cutting of Herbs and Surbs

Impact

561. All the existing tiny vegetation would be damaged at the both slopes of the Embankment during re-sectioning work. Most of the plant species at the proposed sites are seasonally grown and life span is not more than one years. Therefore, it is expected that the damaged sites will be recovered within 1 to 2 years by natural regeneration of herbs and shrubs. Existing big trees at the embankment slopes will not be cut in most of the cases. For this reason, this negative impact is temporary and recoverable.

Mitigation Measures

562. The following mitigation measures are to be implemented to address the above concerns:

563. Use low vegetative land for labour and construction vehicle movement. The following mitigation measure is being suggested to address the above concerns:

564. Aware labours about plant conservation

565. Collect soil from barren land as much as possible; and

566. Proper turfing should be made at embankment slopes with local grasses (i.e. Durba *(Cynodon dactylon),* Mutha*(Cyperus sp)* and ensure regular monitoring of turf grasses till they are matured

Residual Impacts

567. With the help of the above mitigation measures, the impacts associated with re-section of embankment will be Low.

6.4.12 Coastal afforestation

Impacts

568. In the foreshore area, the existing undergrowth vegetation would be damaged due to movement of labour during plantation. Incautious disposal of sapling’s poly bags may cause deterioration of soil quality. There may be a risk to outbreak of plant diseases to the other existing plants from the planted disease affected saplings. Water flow in creeks and strips of

planted area may interrupt for aggregation of plant or plant shoots. Inadequate distance between two saplings may hinder proper growth and caused disease outbreak.

Mitigation Measures

569. The following mitigation measures are to be implemented to address the above concerns:

- Aware labours about plant conservation who will be engaged for afforestation activities
- All kinds of polyethylene bags and plastic ropes should be piled up in a pit for dumping or burning in a proper way;
- Care should be taken for physical and biological control of plant disease while nursery raising and sapling plantation (i.e.: using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers) ;
- Pre consultation with Forest Department and other related non-government organizations for selecting of suitable species for plantation and spacing of the saplings;
- Develop a pest management plan for the holistic afforestation; and
- Collect saplings from nearer natural and local source as much as possible.

Residual Impacts:

570. The impacts associated with coastal afforestation are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact would be Low.

6.4.13 Communication

Impact

571. A number of local people use this embankment as road for carrying their goods for buying and selling along with other purposes. The construction activities along the embankments will also cause temporary disturbance in the movement of local people. The internal roadways are not sufficient enough to provide alternate means of transportation. Mobilization of equipment, machinery, material and manpower will be transported to the Polder resulting additional traffic on roads and in waterways.

572. Road communication system will be deteriorated during construction period, it may create disturbance in local road communication during this phase. Therefore, suffering of people will emerge temporary among the local people.

Mitigation Measures

573. The following mitigation measures are to be implemented to address the above concerns:

574. The Contractor will prepare site specific traffic management plans as well as Spoil management and disposal plans to be implemented upon approval by the DSC Consultant and PMU, for:

575. The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes.

576. Temporary arrangement of boat for navigation, and need to construct alternative way such as temporary footpath for road communication

577. The embankment works will be carried out segment wise and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. The works of the first

half when completed, it will be opened for local traffic while the works of the other half will be undertaken.

578. Work schedule will be finalized in coordination and consultation with local representatives and communities.

579. Local routes will not be blocked as far as possible. If unavoidable, alternative routes will be identified in consultation with local community.

580. A GRM will be put in place.

Residual

581. The impacts on communication are likely to be adequately addressed with the help of the above mitigation measures and the significance of residual impact will be Low.

6.4.14 Safety and Public Health Hazards

Impact

582. The area is prone to cyclones and storm surges. Although the works will be carried out during the dry season, a certain level of safety hazards still exists for the construction staff.

583. The construction activities will involve operation of heavy construction machinery, vehicular traffic, excavation and filling operations. These activities may pose some safety hazards to the local population as well as for the construction workers. The fuel storage at the campsites may also pose safety hazards for the construction staff as well as to surrounding population.

584. Inappropriate waste disposal at the camps and construction sites, and air quality deterioration caused by the Project's vehicular traffic and construction activities potentially pose health hazards to the construction staff and nearby population. Unhygienic condition and unavailability of safe drinking water for the construction staff will expose them to health risks. In addition, influx of construction staff can potentially expose the nearby population to communicable diseases.

585. The significance of the potential impacts are assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

586. The following mitigation measures are to be implemented to address the above concerns:

- Liaison will be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets will be kept in all the labor camps for obtaining weather information.
- The contractors will prepare site specific Camp management plans, an Occupational health and safety plan including training programs as well as an Emergency response plan with early warning system and training programmes to be approved by the DSC Consultant and PMU. The Plan will also include awareness raising and prevention measures, particularly against communicable diseases such as hepatitis B and C, and HIV/AIDS. Besides:
- All temporary facilities including labor camps will meet minimum safety, hygiene and sanitation requirements (safe drinking water, proper sewage disposal, solid waste management, general cleanliness, protection against disease vectors, and protection against weather elements, firefighting, and other similar essential services).

- All workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.
- The construction sites will have protective fencing to avoid any unauthorized entry, where appropriate and possible.
- Health screening of employees would be a Contractor obligation prior to labourers working on site and living in the temporary accommodation facilities. The health screening would entail normal review of physical fitness and also include a review of appropriate vaccinations. Workers would be given vaccinations as and when required.
- All site staff will undergo screening against communicable diseases. Communicable disease careers will not be employed at the working site.
- All employees need to carry out induction health and safety training prior to commencement of work. Training would include the provision of appropriate written or visual materials to reinforce learning. Where illiteracy levels are high, OHS issues need to be covered more frequently than normal in toolbox talks.
- Public awareness training and workshops on safety and health risks will be conducted for local communities prior to and during construction operations.
- Observing statutory requirements relating to minimum age for employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activities. The construction contractor(s) would not hire people under the age of 18 on permanent contracts but would include short training activities for youth to the extent possible.
- Ensure the acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work;
- Ensure that no workers are charged fees to gain employment on the Project.
- Ensure rigorous standards for occupational health and safety are in place.
- Contractor will establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.
- The contractor will adopt a Human Resource Policy appropriate to the size and workforce, which indicates the approach for management employees (this could be part requested in the tender process).
- Produce job descriptions and provide written contracts and other information that outline the working conditions and terms of employment, including the full range of benefits;
- Provide health insurance for employees for the duration of their contracts;
- Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts;
- Employ a community liaison officer (this could be full time or part of another post's responsibilities);
- Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training;
- Report regularly on the labor force profile, including gender, and location source of workers;

- Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase;
- Organize a training program and keep training registers for construction workers;
- Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system, which provide workers with a safe and healthy working environment taking into account the inherent risks for this type of project.
- Availability of safe drinking water will be ensured for the construction staff.
- First aid boxes will be made available at each construction site. Emergency phone numbers (including hospitals, Fire Department, and Police) will be displayed at key locations within the site. Each site will have an ambulance facility.
- Firefighting equipment will be made available at the camps and worksites.
- The camp staff will be trained for safety against firefighting.
- All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel.
- Waste management plan to be prepared and implemented in accordance with international best practice.
- Liaison with the community will be maintained.

Residual

587. The impacts associated with safety and health hazards are likely to be mostly addressed with the help of above mitigation measures and the significance of residual impact will be Medium.

6.4.15 Cultural heritage

588. There will be no impact on cultural heritage as there is no cultural heritage in the polder,

6.5 Impacts during Post-construction Phase

6.5.1 Increased fertilizer and pesticide uses, and reduced soil fertility

Impact

589. At present, about 95 ha and 307 ha of land are under Boro and Aus rice cultivation. Respectively. Presently, 113040 kg of chemical fertilizers and 2279 kg are required for pesticides for cultivation Boro and Aus. According to the initial estimates, about 1.98 Mm^3 of water would be available from the internal canal system, after the completion of the proposed Project. This would allow expansion of area under irrigated cultivation of Boro and Aus varieties of rice to about 105 ha of which Boro and Aus area are 3 ha and 102 ha respectively. This expansion of irrigated cultivation is likely to result in decreased soil fertility and increased use of chemical inputs including fertilizers and pesticides. Due to expansion of Boro and Aus cultivation, additional about 26,646 kg of chemical fertilizers and 505kg would be required for pesticide purchase in future (Table 6.11) due to expantion of HYV crop area. Runoff from such cultivation fields might potentially pollute the water bodies and even drinking water sources thus causing health hazards to the communities.

Table 6.11: Impact on area (ha) fertilizers (kg) and pesticides (kg/ml) required in present and future situation

Crop name	Present cultivate area(ha)	Fertilizer required (kg/ha)	Granular pesticides required kg/ha	Liquid pesticide required ml/ha	Total Fertilizer required (kg)	Total granular pesticides required(kg)	Total liquid pesticides required (ml)	Future cultivated area(ha)	Increased area(ha)	Total future fertilizer required (kg)	Total future granular Pesticides (kg)	Total future liquid pesticides required (ml)	Impact		
													Fertilizers (kg)	Pesticides (kg)	Pesticides (ml)
HYV Aus	307	250	4	700	76,750	1,228	214,900	409	102	102,250	836	71,400	25,500	(392)	143,500
HYV Boro	95	382	8	800	36,290	760	76,000	98	3	37,436	864	2,400	1,146	104	73,600
Total	**402**	**632**	**12**	**1,500**	**113,040**	**1,988**	**290,900**	**507**	**105**	**139,686**	**1,700**	**73,800**	**26,646**	**(288)**	**217,100**

Sources: Feasibility report (Agriculture), CEIP and field information; 2012 and June, 2015

590. The significance of this potential unmitigated impact has been assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

591. The following mitigation measures would be implemented to address the above concerns:

- Capacity building and awareness raising of the farmers would be carried out to practice Integrated Pest Management (IPM) and Integrated Crop Management (ICM) in order to minimize usage of chemical inputs.
- Farmers group would have close contact with DAE for adoption of various measures of IPM/ICM.
- Farmers would be encouraged to use organic manure to increase soil fertility while avoiding water contamination. and
- Farmers would be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.
- Follow the Fertilizer and Pesticides Management Guideline (Appendix-10)

Residual Impacts:

592. With the help of above mitigation measures, the impacts associated with usage of increased level of chemical inputs are likely to be somewhat addressed and the significance of residual impact will be Moderate.

6.5.2 Reduced Fish Migration Time and Extent

Impact

593. Drainage sluice gates are designed to control water for improvement of drainage system of the polder area. Sluice gates are mainly operated in order to meet up the drainage purpose. Thus, it would hamper the migration behaviour of fish species. Moreover, the extent of Bagda, Chapila, Chitra, Lal Chewa, Veda Bele, etc. would be very restricted with the replacement of the proposed drainage sluices (Table 6.12).

Table 6.12: Future scenarios of migration towards different fish habitat by some major fish species

<table>
<tr><th>Sl</th><th>Fish Species</th><th>Habitat</th><th>Remarks of Future Scenarios</th></tr>
<tr><td>1</td><td>Bagda</td><td>Thankola Khal</td><td rowspan="4">Will be shifted</td></tr>
<tr><td>2</td><td>Chapila</td><td>Kichikata Khal</td></tr>
<tr><td>3</td><td rowspan="2">Chitra</td><td>Eidkhola Khal</td></tr>
<tr><td>4</td><td>Kichikata Khal</td></tr>
<tr><td>5</td><td rowspan="4">Gulsha Tengra</td><td>Eidkhola Khal</td><td rowspan="2">Not Changed</td></tr>
<tr><td>6</td><td rowspan="2">Kichikata Khal</td></tr>
<tr><td>7</td><td rowspan="5">Will be shifted</td></tr>
<tr><td>8</td><td>Thankola Khal</td></tr>
<tr><td>9</td><td>Lal Chewa</td><td>Thankola Khal</td></tr>
<tr><td>10</td><td rowspan="3">Paissa</td><td>Eidkhola Khal</td></tr>
<tr><td>11</td><td>Kichikata Khal</td></tr>
<tr><td>12</td><td>Thankola Khal</td><td>Not Changed</td></tr>
</table>

Sl	Fish Species	Habitat	Remarks of Future Scenarios
13	Taki	Thankola Khal	
14	Tit Punti	Kichikata Khal	Will be shifted
15		Thankola Khal	
16	Veda Bele	Kichikata Khal	
17	Vetki	Eidkhola Khal	

Source: CEGIS Field Survey, 2015

Mitigation Measures

594. The following mitigation measures will be implemented to address the above concerns:

- WMO groups with representatives of fishermen will be established for management of the sluice gates and trained in proper water management, including fish friendly operation allowing fish migration at critical periods. Core commercial fishermen having more than 20 years' experience should be appointed in WMOS for Operation and Maintenance of sluice gate. A gate operation manual will be prepared and provided to the WMOs. The Manual should be translated into Bangla and the WMOs trained for properly management of the structures[24].
- Provide training to WMOs
- Besides, there are options for:
- Fish sanctuary could be established in the perennial Khal with the co-management of the local fisheries office and the local people. In this regard, local people can be trained up on the sanctuary issue. The Fisheries Department can be involved in this process. Water management organization will be given responsibility of awareness building program to the local people. Identified water bodies (deep portion) should be marked as the sanctuary with the presence of red flags surrounding the sanctuaries during operation phase.
- BWDB with collaboration of DoF is expected to provide training and introduce net pen, cage culture

Residual Impacts

595. With the help of above mitigation measures, the impacts on migration status are likely to be adequately addressed and the significance of residual impact will be Low.

6.5.3 Increased Stock Susceptibility of Fish to Catch

Impact

596. Fishing activities are highly confined around the sluice gates of the khals using Badha/Sluice Jal and Jhaki Jal. It is expected that installation of sluice gates will result in increasing stock susceptibility to fishing more than that of the present situation (**Table 6.13**).

[24]The "Wet land Biodiversity Rehabilation Project" of Department of Fisheries already successfully implemented 5 Sluice gate management and operation committee through WMA. Based on this result a guidelines prepared on how to operate and manage sluice gate in eco-friendly manner was already submitted by Department of Fisheries to the concerned Ministry for approval (source DoF).

Longer term monitoring of fish catch assessment in canal and river is required to identify the real impact from the hydraulic structure operation activities.

Table 6.13: Future scenarios of stock susceptibility to catch of some major fish identified in the field survey

REMARKS OF FUTURE SCENARIOS	FISH SPECIES
Very Slightly Increased	Gulsha Tengra, Paissa and Horina Chingri
Slightly Increased	Chitra
Increased	Tit Punti, Bagda and Motka Chingri
Highly Increased	Chapila, Lal Chewa, Taki, Veda Bele and Vetki

Source: CEGIS Field Survey, 2015

Mitigation Measures

597. The following mitigation measures will be implemented to address the above concerns:

- Awareness building program should be promoted to commercial and subsistence fishermen around the sluice gate
- Monitoring cell should be formed to monitor the fishing activities and allow the allowable biological catch.

Residual Impacts

598. With the help of above mitigation measures, the impacts on stock susceptibility to catch are likely to be adequately addressed and the significance of residual impact will be Low.

6.6 Positive Impact of the Project

6.6.1 Change of land type

599. Land type will be changed but land use will not be changed. Such change is related to the crop productivity. Soil productivity will also be changed which would increase cropping intensity as well.

600. Presently, maximum (44.3%) study area is under FF land type of the NCA which is followed by F_0 (33.7%), F_1 (21.8%) and F_2 (0.3%) land type (Table 6.14). As per proposed plan, drainage congestion will be significantly reduced due to re-excavation of internal khals of the polder area. Land type might be changed if the project is implemented. F_0 land type would convert to FF land type. F_0, F_1 and F_2 land type area reduced 6.07%, 13.96% and0.28% respectively. According to Institute of Water Modelling (IWM), around 20.26% would be under FF land type, which is followed by F_0, F_1 and F_2 land type, respectively.

Table 6.14: Changing land type of the Polder area

Land type	Baseline/FWOP		FWIP		Impact (FWIP-FWOP)
	Area (ha)	% of NCA	Area (ha)	% of NCA	
FF (<0)	820	44.3	1195	64.56	20.26
F_0(0.0-0.30m)	623	33.7	511	27.58	-6.07
F_1(0.3-0.90m)	402	21.8	144	7.80	-13.96
F_2(0.90-1.80m)	5	0.3	0	0	-0.28

Land type	Baseline/FWOP		FWIP		Impact (FWIP-FWOP)
	Area (ha)	% of NCA	Area (ha)	% of NCA	
F_3(1.80-3.60m)	0	0	0	0	0
F_4(>3.60m)	0	0	0	0	0
Total	**1,850**	**100**	**1,850**	**100**	**0**

Source: IWM, 2015

6.6.2 Change of cropping pattern and intensity

Impact

601. Presently, cropping intensity of the polder area is 189%. According to the proposed intervention, the polder would be protected from tidal and monsoon flooding and would remove drainage congestion in the polder area. Besides, drainage congestion will be significantly reduced due to re-excavation of internal khals of the polder area as per proposed plan. Due to improved situation, farmers of the respective areas would encourage to cultivate more crops in their lands. Thus, it is expected that cropping intensity would be 216% in the polder area in future scenario (Table 6.15). Therefore, cropping intensity of the polder area would be increased by around 27% from the base situation.

Table 6.15: Cropping pattern of the Polder area

Land type	Kharif-I	Kharif-II	Rabi	Area (ha)	% of NCA
	(March-June)	(July-October)	(Nov-February)		
High land(FF)	Orchard	Orchard	Orchard	152	8.2
	S. Vegetables	Fallow	Oilseeds	290	15.7
	T. Aus (HYV)	T. Aman (Local)	Chilli	340	18.4
	S. Vegetables	T. Aman (HYV)	W. Vegetables	413	22.3
	Sub-total			**1,195**	**64.6**
High land(F0)	T. Aus (Local)	T. Aman (Local)	Pulses	68	3.7
	Fallow	T.Aman(HYV)	Fallow	344	18.6
	Fallow	T. Aman (HYV)	Potato	98	5.3
	Sub-total			**511**	**27.6**
Medium high land(F1)	T. Aus (HYV)	Fallow	Boro(HYV)	98	5.3
	Fallow	T. Aman (HYV)	Spices	17	0.9
	Fallow	T. Aman (HYV)	Pulses	17	0.9
	Fallow	T.Aman(HYV)	Fallow	0	0.7
	Sub-total			**131**	**7.8**
Grand total				**1,850**	**100**

Source: CEGIS Assessment based on field information July, 2015

6.6.3 Increased Crop production

Impact

602. The cropped area would be changed if the project is implemented. The cropped area would be about 4,000 ha. of which rice cropped area would about 1,902 ha. and non-rice

cropped area would about 2,098 ha. The crop production might be boosted up significantly under the FWIP condition. The total crop production would be about 29,901 tons of which rice would be about 6,180 tons and non-rice would be about 23,721 tons. Rice production would be increased mainly due to protection of agricultural land from river bank erosion, construction of structure and repair/replaced of structure which adoption of modern technology in crop production, change in cropping pattern etc. Rice production would be increased due to expansion of T. Aus (HYV), T. Aman (HYV), Boro (HYV); in addition, area and production of Orchard, Summer vegetables and Winter vegetables will also increase. Additional 2,082 tons of rice and 13,246 tons of non-rice would be produced in FWIP over FWOP (Table 6.16).

Table 6.16: Impact on crop production and land use in the Polder area

Name of crops	Baseline/FWOP			FWIP			Impact (FWIP-FWOP)
	Cropped area (ha)	Yield (ton/ha)	Production (metric ton)	Cropped area (ha)	Yield (ton/ha)	Production (metric ton)	
T.Aus (Local)	628	1.6	986	68	1.8	123	(863)
T.Aus (HYV)	307	2.7	830	438	3.5	1,535	705
T.Aman (Local)	581	1.5	871	409	2.5	1,022	151
T.Aman (HYV)	479	2.5	1198	888	3.5	3,108	1,910
Boro (HYV)	95	2.3	213	98	4	392	179
Total rice	**2,090**	**0.0**	**4,099**	**1,902**	0	**6,180**	**2,082**
Chilli	218	1.3	273	340	1.6	545	272
Pulses	340	1.5	511	85	2	170	(340)
Potato	76	14.0	1,070	98	20	1,961	891
Orchard	69	10.5	723	152	10.5	1,593	870
S. Vegetables	152	12.0	1,820	703	15	10,545	8,725
W. Vegetables	381	15.0	5,717	413	20	8,251	2,535
Spices	76	3.3	247	17	4.5	75	(172)
Oilseeds	89	1.3	115	290	2	581	465
Total non-rice	**1,402**	**0.0**	**10,475**	**2,098**		**23,721**	**13,246**
Total	**3,492**	**0.0**	**14,573**	**4,000**		**29,901**	**15,327**

Source: Source: CEGIS Assessment based on field information July, 2015

Enhancement Measures

603. The following mitigation measures would be implemented to address the above concerns:

- Irrigation should be provided in optimum level with minimum conveyance loss.
- Involvement of WMOs in project activities would enhance crop production.
- Introduction of HYV/Hybrid crop cultivars along with crop diversification need to be practiced.

6.6.4 Enhanced Species Evenness

Impact

604. It is observed that previously more than 100 freshwater and brackish fish species were available in the Polder area. Moreover, it has been found that species richness of species composition varies with different khals. The water of which is regulated by different sizes of drainage sluice. It, therefore, is suspected that species evenness of these khals would be improved with the improved water resource condition (described in water resource section). The future changing scenarios are given in the following table (Table 6.17):

Table 6.17: Future scenarios of Species evenness

Sl	Site	Remarks of Species Evenness
1	Baraitala River	Increased
2	Eidkhola Khal	Slightly Increased
3	Kichikata Khal	
4	Thankola Khal	

Source: FGD and KII, CEGIS, 2015

6.6.5 Increased Fish Production

Impact

605. The experiences in wetland co-management, the MACH project, with khal re-excavation shows that khal re-excavation has been improving the conveyance capacity of fish habitat (khals) resulting in improving habitat condition (Thompson, P., Chowdhury S.N., 2007). It has been found that habitat conditions (area, water availability and water quality, fishing activities, stock susceptibility to fishing and proximity to market) are highly influential parameters to enhance fish production in the khals controlled by different drainage sluice. It is expected that fish production from water bodies (river and khals) would be slightly improved with the future improvement of drainage sluice. Moreover, bank revetment and slope protection would strengthen the tendency of practicing Gher (Bagda and Golda), homestead pond and improved fish culture in the polder area (Table 6.18).

Table 6.18: Future scenarios of Fish production

Sl. No.	Fishery category	Habitat type	Production (Ton)	Change (%)
1	Capture	Water bodies	157	-
		Total	**157**	**-**
2	Culture	Bagda/Golda Gher	1.1	10
3		Fish pond (Homestead)	9.45	5
4		Fish with Golda in Paddy Field	1.15	15
		Total	11.7	30
		Grand Total	**168.7**	**30**

Source: CEGIS estimation, July2015

6.6.6 Afforestation

606. Afforestation will mitigate negative impacts associated with tree felling. Consequently, foreshore afforestation will enhance the mangrove vegetation coverage

surrounding the polder that is expected to protect embankment from tidal surge, reduce erosion of foreshore land and provide habitats especially for local avifauna and fishes.

6.6.7 Employment Generation

607. The construction work will generate a substantial employment over its construction period to local people and other associated professionals. On the other hand, during construction period, earthwork of embankment and constructing structure will create temporary employment opportunities for labours. The employment generation represents the different way of livelihood by which people can generate their income and improve their living standard.

6.6.8 Gender Promotion

572. Construction work requires various types of skilled and unskilled labours, of which a portion is female. The female workers are often distressed or, and do not have any other source of income. Therefore, the substantial increased job opportunities for women in the construction works and especially in the agricultural sector during the operation phase is significantly positive.

573. Overall, the Project is considered to provide a Medium to High positive impact on the gender situation

6.6.9 Seasonal out-migration

574. The seasonal out migration of day labourers from this polder area to other areas is expected to decline due to creation of local employment opportunities in the agriculture and other sectors, respectively.

575. Overall, the Project is considered to provide a Medium positive impact by reducing out-migration

6.6.10 Education

608. During wet season, road networks and surroundings of many educational institutions become inundated. Both students and teachers are usually reluctant to attend the schools then. It eventually interrupts the standard of education and in some cases, it instigates the dropout rate. If the project is implemented, inundation problem will be solved; therefore, status of education will be improved.

6.6.11 Livelihood improvement

609. Agriculture is the main source of livelihood in the study area. Drainage congestion interrupts the production. Furthermore, there is a chance of crop damage if the embankment is broken. If the project is implemented, these problems will be solved and livelihood for local people will be improved. Additionally, production will be increased if irrigation facilities are enhanced by the construction of flushing sluices.

6.7 Risk Assessment

6.7.1 Function and Funding of Water Management Groups and Associations

Risk

610. The polder 47/2 was built in 1962. The polder was designed to keep the land safe from regular tides to increase the agriculture production. Though the polderization has helped grow more food, also created some environmental and social problems because

there is no active water management association for operation and maintenance of the polder. It is worth noting that the polder gradually got dilapidated due to lack of necessary O & M budget, absence of Water Management Groups and Associations (WMG/WMA) and inadequate staff of BWDB.

Mitigation Measures

- Water Management Groups and Associations should be properly formed and trained to identify the problems and take appropriate measures, including adequate operation of structures . This would help develop ownership of the WMGS/WMA for realization of benefits from the polder without hampering the hydrological and environmental settings of the polder.
- Allocate sufficient budget and Manpower for O&M of BWDB

6.7.2 Risk of Embankment Failure

Risk

611. Rain cuts, wave action, tidal surge and public cuts are the major causes of embankment breaching of the coastal region. Lack of regular maintenance has created weak point at the sensitive locations of the embankment where the set back is less than 15m to 25m. Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously have accelerated the risk of embankment failure. The southern part at Payerpur(Ch. 1.70 km to Ch. 2.70 km) and western part at Fulbunia(Ch. 6.0 km to 7.0 km) of flood control embankment along the bank of Sonatala River is more susceptible to breaches in future due to storm surge and counter circulation of the cyclone of the Bay of Bengal.

612. The significance of this potential unmitigated impact has been assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

613. The following mitigation measures are to be implemented to address the above concerns:

- Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the southern and western side of the Polder will be ensured. This monitoring will particularly be carried out before and after monsoon season.
- Available cyclone and flood shelter will be prepared as a contingency measure during emergency situation.
- WMG will develop fund for such emergency situation. and
- Structural measures like geo bag and sand bag will be kept in the Upazila office for emergency need.

Residual Impacts

614. The impacts associated with risk of embankment failure are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be Low.

6.7.3 Drainage congestion and Increased Sedimentation in inlet of water control structures

Impact

615. Due to construction of closer dam on Baraitala River, the natural drainage system has been disrupted i.e. flow direction from south to north is permanently closed. Thus, Charpara khal became the prominent drainage channel throughout this area. Consequently, the total catchment area of Charpara khal is about 600 ha (DS-1, DS-2, FS-1, FS-2 and FS-6 is 500 ha and Charpara itself 100 ha; source: *model study*). Whereas, the conveyance capacity of the Charpara khal is insufficient and needs re-excavation with widen the sections whichsections, which is not considered in the Feasibility study and Detail Design. If the proposed re-excavation work along the Charpara khal (5.40 km) and replacement of all hydraulic structures with adequate vent size is not implemented properly, the problem will worsen in future as well as aforesaid regulators will not function up to expected level.

616. The proposed implementation work may improve the drainage congestion problem and rainwater would be drained out properly during monsoon and regular tide. However, drainage congestion is a recurring problem and silt deposition in the rivers outside and water channels inside the Polder is likely to continue which may cause sedimentation at inlet of water control structure. Consequencly, drainage congestation may occure particularly, the low-lying areas of the polder in the future.

617. The significance of this potential unmitigated impact has been as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

618. The following mitigation measures are to be implemented to address the above concerns:

- Remove closure or construct bridge on the closure
- Re-excavation of Charpara khal (5.40 km) will have to be implemented.
- An ongoing program of de-silting of water channels will be considered with full community involvement and participation of WMGs.
- The local government (Union parishad) will be authorized to monitor the development activities.

Residual Impacts

619. The impacts associated with drainage congestion are likely to be mostly addressed with the help of above mitigation measures, and the significance of residual impact will be Moderate**.**

6.7.4 Impact of Salinity Intrusion

Impact

620. The proposed project has been designed to protect salinity intrusion through construction and repairing of sluices as well as re-sectioning of embankment. According to experiences from other coastal polders, mal-operation and leakage of regulators may occur and will result in salinity intrusion during the dry season causing severe damage to the soil, water resources, and crops. If the regulators are not monitored and operated by the BWDB

after project completion then salinity intrusion due to leakage of regulators constitutes a risk in future.

621. The significance of this potential unmitigated impact has been assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation Measures

622. The following mitigation measures are to be implemented to address the above concerns:

- Regular monitoring and careful maintenance of the water control structures will have to be ensured.
- Standard operating procedures will have to be prepared and implemented for the water control structures. These procedures will be translated in Bangle as well.
- Involve WMOs in gate operation and strengthen WMO's capacity building through training

Residual Impacts

623. The impacts associated with salinity intrusion are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be Low.

624. Moreover, the coastal Polder 47/2 built in 1962. The polder was designed to keep the land safe from regular tides to increase the agriculture production. Though the polderization has helped to grow more food, also created some environmental and social problems.

- There is no water users association for operation and maintenance of the polder. It is felt that a water user association should have been formed which could appreciate the problems of the polder, thereby manage and develop ownership for realization of benefits from the polder without hampering the hydrological and environmental settings of the polder.
- It is worth noting that the polder gradually got dilapidated due to lack of necessary O&M budget and absence of Water Management Association (WMA).

6.8 Summary of Assessed Impacts

625. A summary of these impacts and their significance discussed in the sections above is presented in table 6.19.

Table 6.19: Significance of Environmental Negative Impacts

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
A. Pre-construction Phase								
Damages of properties due to Project Intervention and Land Acquisition	Long term	Local	Irreversible	Certain	High	Major	• RAP to be prepared • Compensation to be paid prior to construction in accordance with RAP • Maintain liaison with communities. • Grievance Redress Mechanism (GRM) in place	Moderate
Impacts associated with construction of temporary facilities	Short term	Local	Reversible (after construction phase)	Certain	Medium	Moderate	• Contractor will prepare site establishment plan and obtain approval from the DCSC. • Approval from DCSC will be obtained for the location of temporary facilities. • Deforestation will be minimized as far as possible during site facilities development. • Photographic record will be maintained to keep the pre-construction condition of the area. • Site facilities will be established at a safe distance from communities • Contractor will prepare and implement pollution control and waste management plans • No untreated wastes shall be released on the ground or in water	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							• Exhaust emissions from vehicles and equipment will comply with standards • Vehicles, generators, and equipment will be properly tuned. • Water will be sprinkled as and where needed to suppress dust emissions • Speed limits will be enforced for vehicles on earthen tracks • Vehicles and machinery will have proper mufflers and silencers • Liaison will be maintained with the communities.	
Increased Vehicular traffic during Mobilization	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Moderate	• The contractor will construct a temporary terminal/Ghat at Nurpur village (Ch. 3+100 km of Embankment) to carry construction materials through waterway from Hazipur Ferry Ghat to the Polder area which will be cost effective • The contractor will prepare a traffic management plan (TMP) and obtain approval from the DCSC consultant. The TMP will be shared with the communities and will be finalized after obtaining their consent. • Ensure minimal hindrance to local communities and commuters. • Liaise with local communities and concerned authorities	Low
Changes in land use (preparation of	Short term	Local	Reversible (after construction	Certain	Low to Medium	Low	• Establish all these facilities within the areas owned by BWDB. • Pay compensation/rent if private property is acquired on temporary	Very low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
construction facilities, borrow areas, others)			phase)				basis. • Construct laboursherd /camp at government khas land. • Avoid impacts on communities.	
Clearances of vegetation	Sort term	Local	Reversible (after construction phase)	Certain	Low to Medium	Low	• Make early notification to the proper authorities (i.e.: Forest Department) about tree felling. • Avoid vegetation damage as much as possible to select the sites for labour shed and material stock by using nearby fallow lands or barren homestead yards • Give proper compensation to the tree owners against tree felling specially for fruit yielding trees • Implement tree plantation at the damaged sites after completion of the construction works	Low
B. Construction Phase								
Hindrance for Pedestrian and Vehicle Movement	Short term	Local	Reversible	Likely	Medium	Moderate	• The embankment works will be carried out in segment wise and soil will be placed linearly one on half of the embankment, leaving the other half to be used as public transportation. When the works of the first half are completed, it will be opened for local traffic and the works will be undertaken on the other half of the embankment will be undertaken; • Work schedule will be finalized in coordination and consultation with local representatives (Union Parishad Chairman & members) and	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							communities; • Alternative road can be used. Otherwise it should be constructed by the contractor; • The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes; • Earth work for re-sectioning of embankment during hat day can be shorted for essay movement of local people; and • Water way can be used especially along the Sonatala during construction period.	
Generate noise and vibration	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Moderate	• The regulators will not be demolished during school time (8 am to 1 pm) particularly near the schools; • Restrict/limit construction activities during the day time; • Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards; • Vehicles and machinery will have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors should be assured, as needed; • Provision of PPE (ear muffs and plugs) to labor; • Construction crew will be instructed to use the equipment properly, to minimize noise levels;	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							• Camps will be located at a safe distance from communities; and • Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.	
Soil and water contamination due to wastes	Short term	Local	Reversible (after construction phase)	Certain	High	Major	• Prepare and implement pollution control plan; • Workshops will have oil separators/sumps to avoid release of oily water; • Avoid repairing of vehicles and machinery in the field; • Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination; • Dispose contaminated soil appropriately ensuring that it does not contaminate water bodies or affect drinking water sources; • Contractor will ensure that there is no leakage, spillage or release of fuel, oil or any other affluent/waste on the ground or in the water from its construction machinery, vehicles, boats, launches, and barges. Contractor will regularly monitor the condition of its fleet; • Material borrowing from the river banks will be carried out sufficiently away from the water line, minimizing the possibility of loose soil to wash away in the river;	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							• Contractor will locate camps for away from communities and drinking water sources; • Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal); • Release untreated wastes on ground or in water; • Recycle spoil and excavated material where possible; • Dispose spoil at designated areas with community consent; and • Construction material, demolished debris and excavated soil/silt will not be allowed to enter the water bodies.	
Sedimentation	Short term	May extend beyond Polder	Mostly Irreversible	Likely	High	Moderate	• Small scale Tidal River Management (TRM) will be implemented where appropriate; • Contractor will protect untreated embankment slopes; • Contractor will excavate channels after dewatering them; • Contractor will not leave excavated earth and silt on channel banks; • Contractor will implement measures to protect channels from run-off from working areas and camps; and • Contractor will obtain borrowing material from river banks in such a manner so that there is no increase of siltation in rivers, and will not leave loose soil after excavation.	Low
Effects on	Short	Local	Reversible	Likely	Minor	Low	• Compensation to be made for any	Negligible

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
agriculture crop production	term						crop damage; • Contractor should avoid cultivation fields during construction; • Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps; • Contractor should ensure that no vehicular movements take place inside cultivation fields; • Contractor should ensure that no material is dumped inside the cultivation fields; and • Contractor should maintain liaison with communities.	
Disturbance of irrigation water conveyance	Short term	Local	Reversible	Likely	High	Major	• Contractor would construct diversion channels before construction/replacement/demolished of each regulator; • Sequence of work for the regulators and in the water channels would be carefully planned to avoid irrigation disruption; • Contractor would ensure no negative impacts on irrigation; • Contractor would maintain liaison with farmers communities; and • Contractor would work during dry season.	Low
Impacts on Feeding and Spawning Ground of Fish	Short term	Local	Reversible	Likely	Medium	Major	• Earth work should be conducted during the dry season (December-January) • Sequence of work at the bank side of Baraitala River will be carefully	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
Habitat							planned to minimize impacts on spawning and subsequently nursery ground of fish. • Contractor will maintain liaison with experienced fishermen.	
Change in Migration Behaviour	Short term	Local	Reversible	Likely	Medium	Major	• Repair of drainage and flushing sluices should be conducted during the dry season (December-January). • Contractor might maintain liaison with experienced fishermen during construction works.	Medium
Damage of benthic communities	Short term	Local	Reversible (in medium to long term)	Likely	Medium	Moderate	• Do not release untreated wastes on soil or in water. • Carry out khal excavation in segment thus minimizing impacts on benthic fauna.	Low to medium
Increased Stock Susceptibility of Fish to Catch	Short term	Local	Reversible	Likely	High	High	• Replacement should be carried out during the dry season (December-January); and • Close monitoring should be made during the construction by the local commercial fishermen under the supervision of DoF so that allowable biological catch can be ensured.	Medium
Cutting of Herbs and Surbs	Short term	Local	Reversible (after construction phase)	Occasional	Medium to high	Moderate	• Collect soil from barren land as much as possible; and • Proper turfing should be made at embankment slopes with local grasses (i.e. Durba (Cynodon dactylon), Mutha (Cyperus sp) and ensure regular monitoring of turf grasses till they are matured	
Interrupt	Short	Local	Reversible	Positive	Medium to	Medium	• Temporary arrangement of boat for	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
communication	term		(after construction phase)		high		navigation, and need to construct alternative way such as temporary footpath for road communication. • The embankment works will be carried out in section wise and soil will be placed and lined-up on half of the embankment, leaving the other half for the use of vehicles. • Work schedule will be finalized in coordination and consultation with local representatives and communities. • Water way can be used especially along the river during construction period • Earthwork for re-sectioning of embankment can be shortened for easy movement of local people. • All works are to be conducted in presence of Union Parishad Chairman and members. and • Project Implementation Officer (PIO) will be informed during construction and finishing of earth works of embankment.	
C. Post Construction Phase								
Risk of embankment failure	Long term	Local	Reversible	Unlikely	High	Major	• Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the southern and western side of the Polder will be ensured. This monitoring will particularly be carried out before and	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							after monsoon season. • Available cyclone and flood shelter will be prepared as a contingency measure during emergency. • WMG will develop a fund for this kind of emergency need. • Structural measures like geo bag and sand bag will be kept in the Upazila office for emergency.	
Tidal flooding	Long term	Local	Reversible	Likely	High	Major	• Bank revetment with backing of embankment work along the Sonatala and Baraitala River should be constructed to protect tidal flooding during high tide and natural calamities. • Regular monitoring of seepage of surface waters from peripheral river through the regulators will be checked during dry seasons and necessary steps will be taken to check seepage, if any. • Afforestation program will be taken at both side of the embankment, which will help to strengthen the embankment.	Low
Drainage congestion and increased sedimentation in khals	Long term	Local	Reversible	Likely	High	Major	• Re-excavation of Charpara khal (5.40 km) will be implemented. • An ongoing program of de-silting of water channels will be considered with full community involvement and participation of WMGs. • Proper land zoning plan will be prepared in the Polder for controlling	Moderate

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							unplanned development works. For this purpose, further research should be taken by the SRDI or Agriculture Extension Office and LGED of Bangladesh. • The local government (union parishad) will be authorized to monitor the development activities. • Prepare Bangla manual for sluice gate operation and provide training to WMOs; • Reduce conflicts between farmers and fishermen. • Implement small-scale tidal river management (TRM).	
Salinity intrusion	Long term	Local	Reversible	Likely	High	Major	• Regular monitoring and careful maintenance of the water control structures will be ensured. • Standard operating procedures will be prepared and implemented for the water control structures. These procedures will be translated in Bangle as well. • Capacity building of WMOs will be carried out.	Low
Soil and water contamination (increased use of chemical inputs) and reduced soil fertility)	Long term	Local	Reversible	Likely	High	Major	• Using IPM/ICM method for reducing pesticide use; • Leguminous crop cultivation. • Crop rotation should be followed. • Awareness raising of communities	Moderate

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
Reduced Fish Migration Time and Extent	Long term	Local	Not reversible	Likely	Medium	Moderate	• Proper sluice gate operation allowing fish migration in time. • Core commercial fishermen having more than 20 years' experience should be appointed in Operation and Maintenance of sluice gate. • Provide training to WMOs	Low
Increased Stock Susceptibility of Fish to Catch	Long term	Local	Reversible	Likely	Medium	Moderate	• Awareness building program should be promoted to commercial and subsistence fishermen around the sluice gate. • Monitoring cell should be formed to monitor the fishing activities allow the allowable biological catch.	Low

7 Analysis of Project Alternatives

7.1 Overview

626. This chapter presents an analysis of various alternatives considered during the Project feasibility and design stage including the 'no project' alternative. To the extent possible, environmental and social issues of these alternatives have been considered

7.2 'No Project' Alternative

627. The 'No-Project' option analysis provides a clear view of the existing situation of the Polder and helps understand the need of the proposed interventions under CEIP-I. At present the people in polder is extremely vulnerable to cyclones, storm surges, wave action, and climate change effects, as described in Chapter 8. Furthermore, this Polder is not in a state of providing desired services i.e. protection against tidal inundation, efficient drainage and minimizing the impact of cyclonic surges. The Polder area is vulnerable to salinity intrusion and partly to localised water logging. The silted water channels are resulting into limited navigation in these waterways, declining fisheries and increasing environmental pollution.

628. The proposed interventions for Polder- 47/2 under CEIP-1 are aimed to eliminate the major problems described above. To highlight present state and various aspects of the Polder and to realize the importance of the proposed interventions under the Project, the 'no project' and 'with project' scenarios are compared in Table 7.1

629. Section 6.6 provides a detailed assessment of the high positive impacts of the Project that is considered to improve the security and socio-economic conditions for all strata in polder 47/2

630. Following Table 7.1 shows the consequences if no intervention is initiated in comparison with the proposed project intervention.

Table 7.1: Comparison of 'No Project' and 'With Project' Scenarios

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
1.Re-sectioning of embankments (35.58 km) and design crest level (6.00 m, PWD and 5.00 m, PWD)	At a certain number of points, the embankments will be further deteriorated and dropped below the design level. Therefore, cyclones, rise in surge heights due to global warming, and tidal actions will inundate the Polder, causing severe damage to the lives and property of local people.	Re-sectioned embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, reduction in loss of lives and assets caused by the natural disasters.
	Because of submergence of the embankments during monsoon, transportation system would further deteriorate inside the Polder, and sufferings of local people would further increase.	Re-sectioned embankments will provide enhanced protection to Polder, facilitating transportation within the Polder even during monsoon.
	Reduction of agricultural area, crisis situation for farmers from January to	Re-sectioned embankments providing support to Polder

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
	April (salinity intrusion) and May to August (flooding).	facilitate enhanced agriculture activities and increased area for cultivation, thus increasing agriculture output.
	Continued silt deposition inside the Polder due to cyclonic surges and floods would increase and cause water logging, drainage congestion and other associated problems.	Decreased silt deposition in the Polder will result into improved drainage and navigation in internal lakes/khals, increased usage of surface water for irrigation, and reduced water logging problem.
	Local farmers and labor will remain financially stressed. Livelihood opportunities will remain limited, and local people will migrate outside the Polder for employment.	Enhanced agricultural activity will increase the demand for farm workers. Local people can engage themselves in the construction works inside the Polder. Improve earnings of local people during the construction phase of the project.
Bank revetment (300 m)	River bank erosion would further deteriorate the embankments and land resources would be damaged/ lost.	Bank revetment will provide enhanced protection against erosion by wave action, storm surges and currents, and will result into preservation of Polder and its land/agriculture resources.
	Further subsidence of the embankments and further damage to transportation routes.	The bank revetment will protect the embankments and facilitate transportation within the Polder.
Slope protection of Embankment (1.00 km)	Continued weakening of embankments; continuous subsidence of embankments due to traffic load and wave action; land resources would continue to be damaged.	Slope protection works will strengthen the embankments and protect them against subsidence, wave action, and wear and tear.
Replacement of drainage sluices with drainage-cum-flushing sluices.	Continued use of the existing drainage sluices for both flushing and drainage would cause further damage to these structures. As a result, water logging and drainage congestion would be increased due to malfunctioning of the sluices.	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
Replacement of the existing flushing sluices	No dry season agriculture practice will be possible. Shrimp culture during January to May, as sweet water cannot be used in the periods of low rainfall.	Replaced flushing sluices will facilitate better agriculture practices, increased dry season rice cropping, and reduced shrimp culture - thus benefiting the poor farmers.
Construction of new flushing sluices	Cultivable lands will be decreased in future.	New flushing sluices will facilitate increased surface water, better control on irrigation during periods of low rainfall and increased agricultural production.

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
Afforestation (30 ha)	Wind and wave action during cyclones would cause severe damage.	Effects of cyclone surge, wave action and gusty wind could be mitigated to a certain extent, reducing the loss of lives and assets.
Re excavation of Drainage Channels (36.7 km)	Depth of water would be further decreased, and drainage congestion and water logging would be further increased.	Depth of water bodies will increase, water logging and drainage congestion will decrease and fish habitats will increase.

7.3 'Site selection alternative

631. The 'With project alternative' part concentrates upon the proposed intervention under CEIP-1 as per demand of Polder- 47/2 by discussing the possible consequences within it

7.4 ' With project'Alternatives:

7.4.1 Site selection alternative:

632. No site alternative is to be considered, because it is a rehabilitation project. However, a comprehensive multi-criteria analysis was conducted to prioritize the polder rehabilitation under CEIP-1. The analysis results are presented in Appendix 3.

7.5 Technical Alternatives

633. The technical possibilities and alternatives for addressing the issues related to the status of the Polder and living conditions for its inhabitants were considered. These have pertained to strengthening the polder embankment, protection of river banks, protection of embankment slope, improving the sluices and their performance, and reducing drainage congestion and water logging. These technical alternatives are discussed in **Table 7.2** below.

Table 7.2: Technical Alternatives for Polder 47/2

Proposed Interventions	Alternative Options	Consequence
Strengthening of the existing embankment	No change in alignment and no re-sectioning/repairing of the existing embankment	The present vulnerable situation of the embankment and thus the entire polder will continue (similar to the 'No Project' scenario discussed in earlier).
	Retirement/relocation of the existing embankment, as and where required	Partial achievements of the Project objectives.
	Backing/minor inward shifting of embankment with slope protection	Same as above.
	Constructing new embankments (selected option for 34km embankment east and south)	New embankments will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, reduction in loss of lives and assets caused by the natural disasters.

Proposed Interventions	Alternative Options	Consequence
	Re-sectioning of existing embankment with new design heights (selected option). (Selected option for 10.8km existing embankment).	Higher and wide embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, will reduce the loss of lives and assets caused by the natural disasters.
River bank protection works	No change in the existing embankment	River bank erosion would further deteriorate the embankments and land resources would be damaged/lost (similar to the 'no project' scenario discussed in earlier).
	Retirement of embankment	Partial achievements of the Project objectives; decrease the Polder area; and erosion of the river bank will be continued.
	Bank Revetment for 3.5 km (selected option)	Bank revetment will provide enhanced protection against erosion by wave action, storm surges and currents, and will result in preservation of the polder and its land and agriculture resources.
Protection of embankment slope (against wave action)	No change in the existing embankment	The embankments will be more weakened; continuous subsidence of embankments due to traffic load and wave action will be continued; land resources would continue to be damaged/ lost (similar to the 'no project' scenario discussed in earlier).
	Slope protection (selected option for 4.0km)	Slope protection works will strengthen the embankments and protect them against subsidence, wave action, and wear and tear.
	Foreshore plantation (selected option 39 km embankment)	Effects of cyclone surge, wave action and wind could be mitigated to some extent, and reduce the loss of lives and assets.
Replacement of drainage sluices	No change in the existing structures	Use of the existing drainage sluices will be continued for both flushing and drainage, which would cause further damage to these structures. As a result, water logging and drainage congestion would be increased due to malfunctioning of the sluices (similar to the 'no project' scenario discussed in earlier).
	Repairing of structures (possible where there is no need of re-sizing) (selected option for some structures)	For sluices, which are beyond any repair, this option would be similar to the 'no project' scenario described above.
	Replacement of existing Drainage Sluice with Drainage-cum-flushing sluice (selected option for some of the sluices depending upon need)	Drainage-cum-flushing sluices will be more efficient and will make the polder area rice production as sweet water can be stored and used later in the dry season for irrigation.
	Regulators with provision for appropriate passages for fish and small boats.	In addition to the above advantage, the structures will facilitate fish migration and navigation through them. The cost of such structure is likely to be high.

Proposed Interventions	Alternative Options	Consequence
Rehabilitation of flushing sluices	No change in the existing structure	No dry season agriculture practice will be possible. There will be Shrimp culture from January to May, as sweet water cannot be used in the period for low rainfall (similar to the 'no project' scenario discussed in earlier).
	Repair of the existing structures	For sluices, which are beyond any repair, this option would be similar to the 'no project' scenario described above.
	Replacement of the existing Flushing Sluices (selected option)	Replacement of flushing sluices will facilitate better agriculture practices, increase dry season rice cropping, and reduce shrimp culture - thus benefiting the poor farmers.
Constructing new water drainage structure	Not constructing any Flushing Sluices	Cultivable lands and irrigable lands will continue to decrease (similar to the 'no project' scenario discussed in earlier).
	Construction of drainage cum flushing (selected option in certain cases)	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
	Construction of new Flushing Sluices (selected option in certain cases)	New flushing sluices will facilitate the availability of surface water, better control on irrigation during periods of low rainfall and increase agricultural production.
	Providing closure dam (selected option in a few locations)	Providing closure dam would restrict the entry of silt and saline water into the internal rivers. In the same time, it will increase the level of water in the channel to facilitate better irrigation.
Reducing water logging and drainage congestion	No action is taken.	Depth of water bodies would further decrease, and drainage congestion and water logging will further increase (similar to the 'no project' scenario discussed in earlier).
	Channel re-excavation (selected option)	Depth of water bodies will increase, water logging and drainage congestion will decrease and fish habitats will increase.

7.5.1 Technical, Financial, Economic, Environmental, and Social Considerations of Selected Options

634. An attempt has been made to evaluate the technical, financial, economic, environmental, and social considerations of the selected options discussed above. This evaluation is presented in Table 7.3 below:

Table 7.3: Technical, Economic, Environmental and Social Considerations

Intervention	Considerations			
	Technical	**Financial/Economic**	**Environmental**	**Social**
Re-sectioning, embankment with new design heights	Better protection against cyclone surges and water level rise	Financial savings from reduced damages caused by the floods	Improved surface water quality; improved natural vegetation	Reduced loss of lives and assets, which would bring poverty reduction; increased employment opportunities for local people.
	Protection to river bank erosion	Financial savings as the embankments will provide good road transportation routes.	Reduced traffic congestion inside the polder because of improved embankments, which will facilitate vehicular traffic	Reduction of loss of assets which would bring poverty reduction
	Prevention of salinity intrusion in the polder	Improved earning of local people during construction		Improved cropping particularly for small farmers thus alleviating poverty.
		Improved cropping pattern and boosting the local economy		
Bank revetment, slope protection	Enhanced embankment protection against tidal wave action of rivers, provide erosion protection	Financial savings from reduced damages caused by the floods; increased life span for the infrastructure and associated water control structures; improved earnings of local people through employment during bank revetment works and slope protection works.	Improved embankment stability; reduced soil erosion; and provide good means of transportation	Reduced loss of lives and assets, which would bring poverty reduction; increased employment opportunities for local people.
Replacement of existing drainage sluice with drainage-cum-flushing sluice and construction of new flushing sluices where needed	Better functional performance in both flushing and drainage; achieving the objectives of Polder and CEIP-I	Financial savings against damages due to water logging, drainage congestion, and salinity intrusion.	Removal of inactive sluices would improve the drainage characteristics	Better agriculture practice could be achieved which would improve cropping pattern, enhance local earnings, and reduce poverty.
		Agricultural production will be boosted as dry season rice cropping	Water logging, drainage congestion would be reduced.	

Intervention	Considerations			
	Technical	Financial/Economic	Environmental	Social
		would increase		
Channel re-excavation	Reduce water logging and drainage congestion	Enhanced agriculture output; the dredged soil can later be used in construction works and will save construction cost	Increase navigability of water ways and fish habitats would improve, the ecosystem will be enhanced	Increase in cultivable area, increased availability of irrigation water thus increased farm income for local community; increased farm labor opportunities.

7.5.2 Alternatives during Construction

635. Material stockpiling, material sourcing, manpower supply, required transportation etc. are the key factors of construction site whereas alternative options can be analyzed. A discussion upon alternatives of the abovementioned factors is made consecutively.

7.5.3 Material Storage

636. Seemingly, two alternative options can be considered for material storage 1) Inside the Polder; and 2) Outside the Polder. However, storage inside this polder is inappropriate due to lack of sufficient and suitable space.

637. The required materials would be collected and transported from their respective sources to the Polder and then would be stored in the stockyard to be used during construction phase. The location of the stockyard will be identified at a flood and erosion safe place outside the polder.

7.5.4 Material Sources

638. The sources from which the construction materials will be collected have been discussed below..

Soil for Embankments

639. For retirement, re-sectioning, and construction of new embankments, about 126 thousand cubic meters of soil will be required. The following options are available for sourcing this material:

- Soil can be obtained from borrow pits along the river bank just outside the embankments, provided the soil quality is appropriate for this purpose. This is a feasible options with some benefits since it will minimize soil transportation needs, minimize related to material transportation and having minimum environmental and social impacts related to excavation and transportation. However, as BWDB does not own any land sites for borrow pits, these have to be obtained from the owners and compensation provided.
- Part of the required material can be obtained from the re-excavation of the water channels within the Polder, provided the quality of this material is technically acceptable. About 128 thousand cubic meters of earth will be obtained from re-

excavation of channels during implementation of rehabilitation works inside the Polder. This option minimize the cost of excavation for the borrow material, though the cost of transportation to work site will be slightly more than the first option, This is the preferred option from an environmental point of view, as it will reduce the need for sourcing material from borrow pits or river bed material.

- If the riverbed material is, suitable having the required material quality, dredged material can be used for embankment construction as well. From an environmental point of view, this is the second preferred option, as there will be no terrestrial impact, while the aquatic impact will be very temporary and localised to the riverbed. Any dredged material will rapidly be replaced due to the high sediment transport capacity in the rivers in the polder region. Transport of the dredged material can take place directly at the embankment construction site, requiring minimal land transport. However, sites for de-watering the dredged material will be required. The use of dredged material is considered the preferred option from an environmental point of view.

640. As per the Project design, the final decision regarding the material source will depend on the material quality, either dredged from rivers, from re-excavations of khals or from borrow pits, as well as the availability of the latter two. The Contractor will carry out tests of the material quality from various sources, provide a plan for obtaining the required amounts of suitable quality and obtain approval from the DSC Consultant before starting obtaining the material.

Sand

641. Sand would be needed for embankment improvement works, concreting works, and for manufacturing concrete blocks for slope protection. Two broad options are available to source this material as discussed below:

642. Sand could be procured from markets. This would entail consistent quality and assured supply; however, it would also entail increased transportation cost and associated environmental and social impacts including traffic congestion and air pollution.

- The second option is to obtain sand from the riverbeds. This would reduce the transportation needs along with the associated costs and environmental as well as social impacts. However, quality of this sand may not be consistent and this sand may need to be washed before use.

643. As per the Project design, the final decision regarding the sand source will depend on the material quality, either acquired on the market or dredged from rivers. The Contractor will carry out tests of the material quality from various sources, provide a plan for obtaining the required amounts of suitable quality and obtain approval from the DSC Consultant before starting obtaining the sand.

7.5.5 Alternatives for Workforce Procurement

644. Two alternative options are available for sourcing the manpower for the construction works. These are discussed below.

645. Employing the bulk of the manpower from outside the polder. This will entail requirement of larger labor camps, need for labor transportation causing traffic congestion and air pollution, and possible resistance and resentment from the local community.

- Employing manpower from within or in the vicinity of the polder and only bringing more skilled and technical manpower from outside. This option will entail reduced labor camp sizes, decreased transportation needs and reduced environmental and social problems related to outside workers. This option will also offer employment opportunities for the local community thus increasing their economic condition and also increasing the local ownership and acceptance of the project. In view of these advantages, this is the preferred option for manpower sourcing.

7.5.6 Alternatives for Mode of Transportation

646. Generally, trucks are used to transport all the construction materials to main stockyard by road. The materials will be carried from the main stockyard to the worksite mainly by river or by road in some cases. The condition of roads inside the polder is not suitable for larger vehicles i.e. dump truck, trolley, excavator etc. Therefore carrying of earth and other construction materials will be done by small carts, non-motorized vehicles, manual labor etc. while using roadways; small boats and trawlers in waterways.

647. Sonatala River is flowing north--west of Polder 47/2. It remains navigable throughout the year and can be used for transferring construction equipment and materials by larger vessels. To the east and south, the polder is surrounded by more narrow and shallow rivers, not suitable for larger vessels. Transport of construction materials by waterway is the preferred solution. The Barisal-Kuakata Main road is 3 km from the Polder. However, the connecting earthen road is narrow and not suitable for heavy traffic.

8 Climate Change Impact

648. Bangladesh is one of the most climate-vulnerable countries in the world due to its geophysical location and hydro-geological and socio-economical characters. Bangladesh experiences tropical cyclones, storm surges, floods, riverbank erosion, droughts and many other natural disasters. The risk of climate change is accelerating the duration, magnitude and frequency of these natural hazards and making communities more vulnerable. Natural disasters cause a severe effect on different sectors like agriculture, fisheries, livestock, forest and ecosystem, infrastructure etc. It is predicted that climate change in future will bring more changes in temperature, characteristics of rainfall and natural hazards, which will have significant implication on the physical, social and economic systems. Studies and assessments on impacts, vulnerabilities and adaptation to climate change and sea level rise for Bangladesh clearly demonstrate that Bangladesh is one of the most climate vulnerable countries in the world. Rainfall is predicted to become higher and more erratic.

649. Sea level rise has various impacts on Bangladesh, a coastal country facing a 710 km long coast to the Bay of Bengal. It already has affected Bangladesh by land erosion, salinity intrusion and loss in biodiversity. Its potential threats are coming even strongly in the future. Sea level rise will cause riverbank erosion, salinity intrusion, flood, damage to infrastructures, crop failure, fisheries destruction, loss of biodiversity, etc. along this coast. Overall impacts of climate change on Bangladesh would be significant. It was found that the population living in the coastal area is more vulnerable than the population in other areas (Alam and Laurel, 2005). Coastal resources upon which the most people are dependent and are likely to be severely affected due to climate variability and change. It is predicted that for 45 cm rise of sea level may inundate 10-15% of the land by the year 2050 resulting over 35 million climate refugees from the coastal districts.

8.1 Climate change projection

8.1.1 Projection of rainfall over Polder- 47/2 area

650. Regional Climate Downscaling (RCD) has an important role to play by providing projections with much detail and more accurate representation of localized extreme events than the General Circulation Models. South Asia Coordinated Regional climate Downscaling Experiment (CORDEX) domain data (resolution 50 km) is available at the Centre for Climate Change Research (CCCR), IITM, India. The CCCR is recognized by the World Climate Research Programme (WCRP) and is responsible for generating downscaling model data over the South Asia CORDEX domain. These data has been used to generate the future scenarios for rainfall and temperature over Bangladesh using the RCP4.5 data set. The RCM model outputs were analyzed to find out seasonal and annual rainfall and monthly temperature over Polder area. The base line for 1990 is representative for the mean average in the period 1981-2000. The year 2030 mean average precipitation/temperature represents the period 2021-2040 and year 2050 mean average precipitation/temperature represents the period of 2041-2060.The RCP4.5 projections are given below:

8.1.2 Rainfall projections for RCP4.5 scenario:

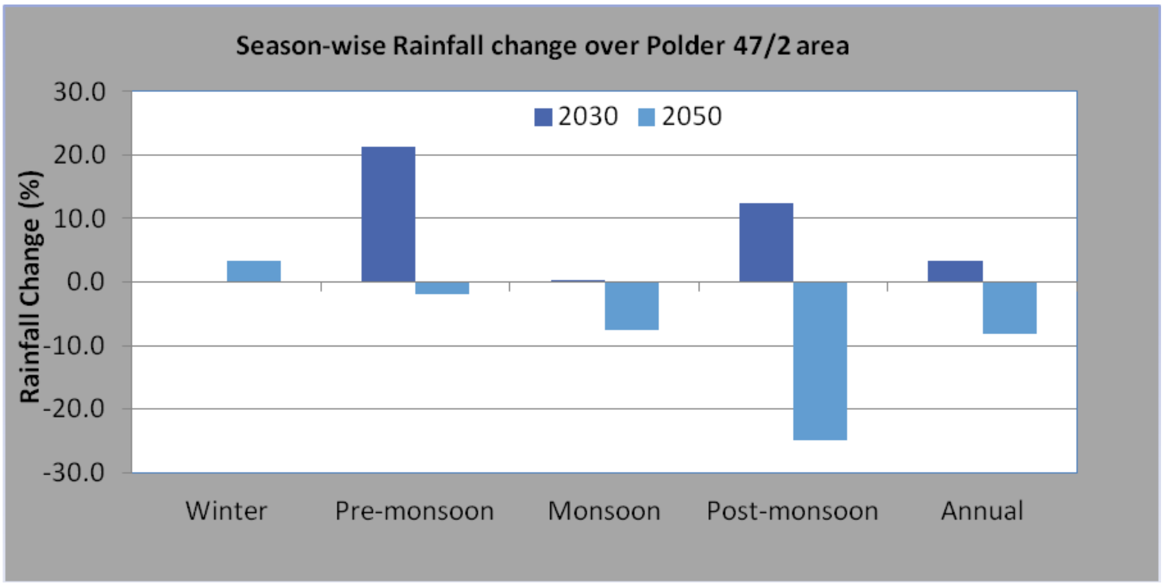


Figure 8.1: Change of seasonal rainfall (%) over Polder 47/2 area for the year 2030 and 2050, respectively

Year-2030: The change of rainfall for 2030 is found to be 0.1, 21.3, 0.4 and 12.5 for winter, pre-monsoon, monsoon, post-monsoon, respectively (Figure 8.1). On average, the projected change in annual rainfall over Polder 47/2 is 3.3% for the year 2030.

Year-2050: The projected changes in rainfall for 2050 are 3.3, -1.9, -7.5 and -24.9 % for winter, pre-monsoon, monsoon and post-monsoon, respectively (Figure 8.1). On an average, the protected change in annual rainfall change over the Polder 47/2 is minus 8.2% for the year 2050.

8.1.3 Maximum temperature projections over Polder 47/2 area for RCP4.5 scenario

Year-2030: The maximum surface air temperature is predicted to increase by 0.2 - 1.2°C with the highest increase during the winter season for 2030.

Year-2050: The maximum surface air temperature may be changed in 2050 by 0.9 - 1.9° C. On an average, the maximum surface air temperature is estimated to be increased by 1.4°C for 2050 (Table 8.1).

8.1.4 Minimum temperature projections over Polder 47/2 area for RCP4.5 scenario

Year-2030: The minimum surface air temperature may change in 2030 by 0.6-2.1° C with highest increase during winter season.

Year-2050: The minimum surface air temperature is predicted to increase 1.3-2.6° C for the period 2050 with highest increase in winter season (Table 8.1).

Table 8.1: The change of maximum and minimum surface air temperature over Polder 47/2 area for the year 2030 and 2050.

Scenario	Base line	Maximum Temperature Change(ºC)												
		Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RCP4.5	1990 (1981-2000)	2030	1.1	0.9	0.4	0.3	0.2	0.8	0.5	0.7	0.7	0.6	1.2	1.0
		2050	1.9	1.7	1.8	1.5	0.9	1.4	1.3	1.5	1.3	0.9	1.4	1.5
Minimum Temperature Change(ºC)														
RCP4.5	1990 (1981-2000)	2030	2.1	0.9	1.4	0.6	0.7	0.9	0.7	0.9	1.1	1.0	1.7	2.1
		2050	2.6	2.4	2.5	1.8	1.3	1.5	1.3	1.5	1.5	1.3	1.4	1.7

Source: IITM, 2014. http://cccr.tropmet.res.in/cordex/files/downloads.jsp

8.1.5 Projection of sea level rise

651. According to IPCC AR5 Working Group 1 report, the Observed and projected relative sea level change in Bay of Bengal is presented in figure 8.2 (Figure source: IPCC AR5 Working Group 1 report). The figure shows the observed in situ relative sea level records from tide gauges (since 1970) in yellow, and the satellite record (since 1993) as purple lines. The projected range from 21 CMIP5 RCP4.5 scenario runs (90% confidence) is shown by the shaded region for the period 2006–2100, with the bold line showing the ensemble mean. The vertical bars at the right side represent the ensemble mean and ensemble spread (5 to 95%) of the likely(medium confidence) sea level change at the year 2100 inferred from RCPs 2.6 (dark blue), 4.5 (light blue), 6.0 (yellow) and 8.5 (red). According to this figure, the sea level rise in Bay of Bengal for RCP 4.5 ranges between 0.25 to 0.72 m by 2100. The average sea level rise for 2030, 2050 and 2100 are 0.12, 0.21 and 0.5 m with respect to 1986-2005 sea level. In RCP 8.5 scenario, the sea level rise is 0.62 m by 2100.

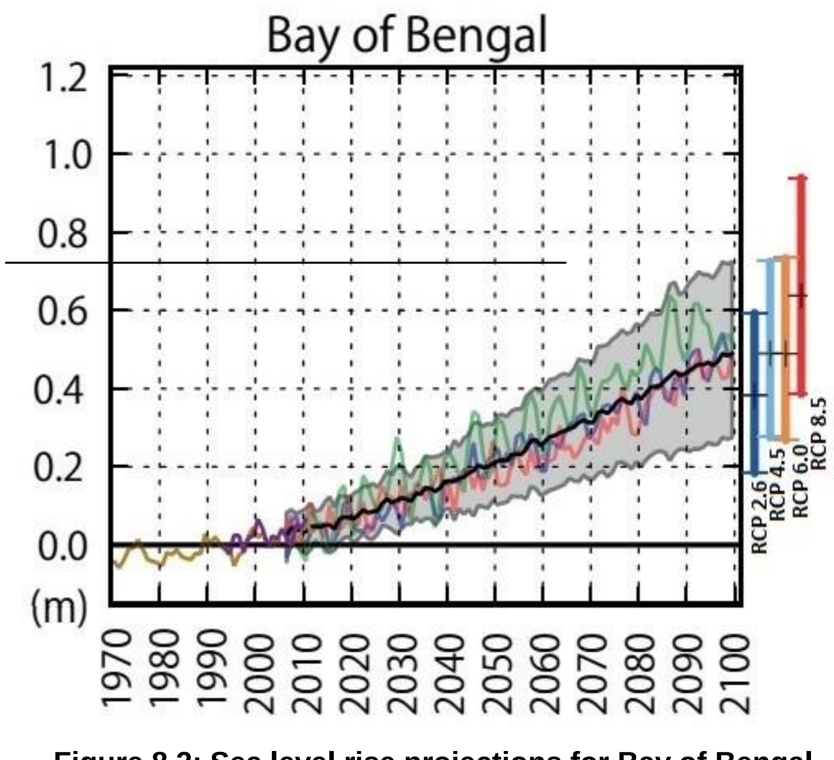


Figure 8.2: Sea level rise projections for Bay of Bengal

8.1.6 Projection of cyclonic storms

652. The available scientific evidence indicates that increased sea-surface temperature with climate change will intensify cyclone activity in the tropics and heighten storm surges (IWTC 2006; IPCC 2007; Hansen and Sato 2011). IPCC further indicates that future cyclonic storm surges and related coastal floods in Bangladesh will likely become more severe as future tropical cyclones increase in intensity (IPCC 2007). Records indicate that the greatest damage during cyclones has resulted from the inundation caused by cyclone-induced storm surges. Though time-series records of storm-surge height are scarce, existing literature indicates a 1.5 m to 9 m height range during various severe cyclones.

653. According to a World Bank study (World Bank, 2010), it is estimated that a 10-year-return period cyclone in a changing climate (2050) will be more intense and cover 43 percent of the coastal zone of Bangladesh, 17 percent more than the current coverage. To approximate cyclones and related storm surges in a changing climate, this analysis considered a SLR of 27 cm (UK DEFRA, 2007), increased wind speed of 10% (Nicholls et al., 2003), and landfall during high tide to approximate cyclones in a changing climate by 2050. The results show a 69% increase in area inundated by 3 m or more depth. Figure 8.3 shows the inundation risk map for 2050 under climate change.

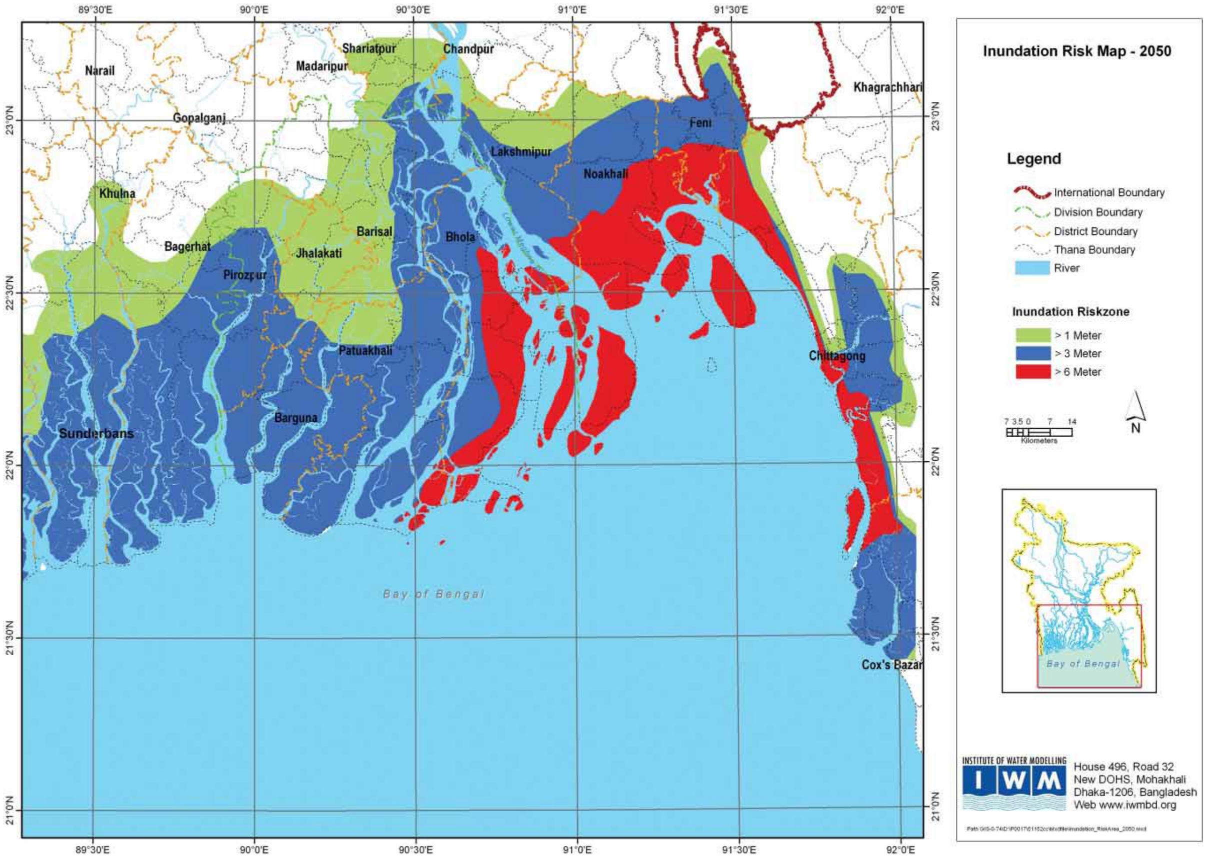


Figure 8.3: Storm surge High-risk area by 2050 under climate change

9 Cumulative and Reciprocal Impacts

9.1 General

654. Chapter 9 presents the analysis of cumulative and reciprocal impacts of the proposed Project and other projects in the area..

9.2 Cumulative Impacts of all CEIP interventions on Polder- 47/2

655. As shown in Map 4.1, Polder- 47/2 is surrounded by a number of rivers and lakes/khals. The Sonatala and the Baraitala Rivers are flowing along North-western and southern portion of the polder, respectively. The existing crest levels of the polder ranges from 4.10 to 4.20 mPWD. Re-sectioning works are proposed in the polder under CEIP, which would increase its crest level up to 4.01 to 4.21 mPWD. This intervention would reduce storm surge to enter into the polder. Under CEIP project, Polder 48 is located near to this polder, which has some proposed interventions. Polder 48 is located at the vicinity of Bay of Bengal whose existing crest level ranges from 4.88 to 6.00 mPWD. It is a great safeguard to this region against seasonal storm surges and flooding. Moreover, the predicted water level, storm surge level (IWM; table 9.2, 9.3) may be a threat to Polder- 47/2. However, during cyclonic events, storm water would not be able to enter Polder 48 because of its re-sectioned embankments, diverted river water may actually generate increased hydraulic pressure on the embankments of Polder -47/2.

656. The overall developments of Polder- 48 would lead to the increased labor attraction towards Polder- 47/2; the economic status of the people living in Polder- 47/2 may improve.

9.3 Synopsis of projects around Polder- 47/2

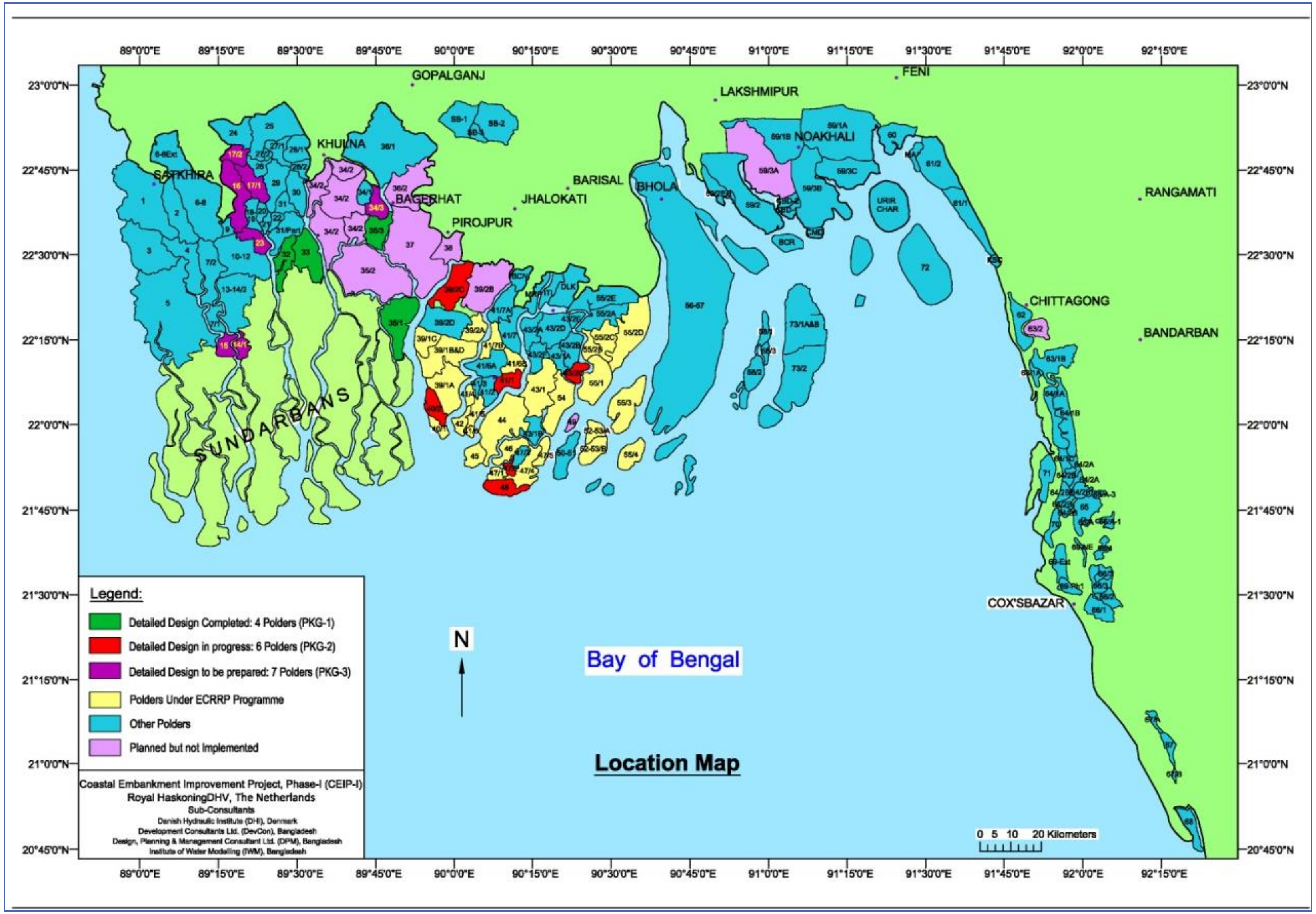
657. Other than CEIP interventions, there are some other development projects nearby Polder 47/2, implemented locally or regionally (Map 9.1). Activities of these projects may generate cumulative impacts on the polder in future. Table 9.1 below shows a list of various projects in relevance with Polder 48, undertaken by different line agencies in Patuakhali and Barguna districts.

Table 9.1: List of water management projects

AGENCY	PROJECT NAME	DURATION	LOCATION	SENSITIVITY
National				
MoDMR	Comprehensive Disaster Management Program (CDMP), Phase II	2010- ongoing	Entire country (40 districts including Patuakhali with direct interventions)	Low
BWDB	Projects under Climate Change Trust Fund	2013-ongoing	Entire country	Low
	Capital Dredging of River system of Bangladesh	2012-ongoing	Entire country	Low
	Water Management Improvement Project (WMIP)	2008-ongoing	Entire country	Low
Regional				
DMB, BWDB,	Emergency 2007 Cyclone Recovery	2008- ongoing	Coastal Zone	Moderate

AGENCY	PROJECT NAME	DURATION	LOCATION	SENSITIVITY
LGED	and Restoration Project (ECRRP)			
BWDB	Blue Gold Program	2013- ongoing	Coastal zone	Moderate
	Coastal Embankment Rehabilitation Project (CERP)	1995-2004	Coastal zone	Negligible
Local				
LGED	Rural Development Project-16: Infrastructure (Phase-II)	1999-2004	Patuakhali and Barguna	Negligible
	Participatory Small Scale Water Resources Sector Project	First (1996-2007) and Second (2010-ongoing)	Barisal, Jhalokathi, Patuakhali etc.	Negligible
DPHE	Water Supply, Sanitation, Drainage and Waste Disposal Project	1996-2007	Patuakhali and Barguna	Negligible

658. The projects (listed in Table 9.1) which have or may have moderate sensitivities on some of the environmental or social components of Polder- 47/2 are briefly discussed in the following sections.



Map 9.1: Locations of polders under CEIP-1

9.3.1 Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)

659. In order to facilitate the recovery of damage to livelihoods and infrastructure caused by Cyclone SIDR and to build a long-term preparedness through a strengthened disaster risk management, GoB implemented a project under the caption of 'Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)' in a total number of 13 districts (Barguna, Bagerhat, Barisal, Khulna, Bhola, Pirojpur, Jhalokati, Noakhali, Feni, Chittagong, Patuakhali, Sathkhira, Laksmipur) of Bangladesh.

660. A major component of the activities of this project is rehabilitation of embankments and among the 35 polders considered for rehabilitation under the project, Polders 46, 47/1 and 47/4 are located near Polder- 47/2, along the downstream of Sonatala and Baraitala River (Map 10.1). The design crest levels of these polders are: 4.88 to 5.18 mPWD for Polder 46, 4.88 to 6.10 mPWD for Polder- 47/1 and 47/4. All these polders will tend to divert the flow of Sonatala and Baraitala River further upstream and may transfer storm surge inundation risks. There may also be flood plain sedimentation along the river, as a significant portion of tidal water would be prevented from entering those polders, which may reduce the depth of flow of Sonatala and Baraitala River in future. Due to the reduced depth, river erosion probabilities in Polder- 47/2 may increase.

9.3.2 Cumulative Impacts of all Blue Gold interventions

661. A total number of 12 polders in Satkhira, Khulna and Patuakhali districts have been selected for implementation of the program in the first phase. Among these, polder 47/3 is adjacent to Polder- 47/2 and therefore, may generate some impacts in future. The existing crest level of Polder 47/3 is 4.00 mPWD. Re-sectioning works are carried out along the periphery of these polders up to the design elevation of 4.88 mPWD.

662. There would be more floodplain sedimentation adjacent to the upstream polders. This may result increase in sedimentation along the Sonatala river system. With reduced river, sections along the upstream, tidal flow velocity might increase in the downstream which would create more pressure along the peripheral embankment of Polder- 47/2. Furthermore, repairing of existing water control structures of Polder- 47/3 under Blue Gold program would ensure reduction of dry season flow towards the Polder- 47/2. As such, surface water salinity, surrounding the Upper Sonatala Rivers may increase, which might affect the existing river ecosystem, as well as the multifaceted surface water use of Polder-47/2. Moreover, if any bank protection works are carried out in future in the aforementioned Polder-47/3, the morphological behaviour of Sonatala Rivers may be changed. This might increase risk of river erosion in Polder 47/2.

9.3.3 Projects under Climate Change Trust Fund (CCTF)

663. Considering Bangladesh's vulnerability to climate change, GoB decided to finance climate change adaptation initiatives from its own revenue budget as Climate Change Trust Fund (CCTF), for implementing more projects on climate change adaptation and mitigation. Up until now feasibility level, investigations have been completed for a total number of 30 projects of BWDB, some of which are being implemented throughout the country. The second phase of CCTF is in the pipeline for implementation, with a number of newly proposed projects. Among all the CCTF projects, the geographic extent of one scheme (Re-excavation of Khals in Kalapara and Rangabali Upazila in Patuakhali District for Retention of Rain water to increase Agricultural Production and Removal of drainage Congestion) lies near Polder-47/2. The interventions proposed under the project are localized adjacent to the polder and will not have any large-scale impacts on Polder- 47/2. However, there may still be some social impacts regarding labor harnessing, employment opportunities etc.

9.4 Reciprocal Impacts of Climate Change and Polder Improvement

664. Reciprocal impacts of Climate Change and Polder improvement refers to the impacts occurred on polder due to climate change and vice versa. IWM used hydrodynamic models (MIKE 21) and analyzed the existing meteorological situation of the polder area. They have evaluated the physical changes in the relative polders, which may occur due to climate change. All data used in the model setup and calibration (including topography, soil maps, land use maps, and weather data, river network and cross-section, water level, discharge and salinity) were obtained from different sources. For Drainage Model, Rainfall Runoff Model and Water Flow Model IWM has used SWRM, NAM, Water Flow Model respectively.

665. In order to evaluate the reciprocal impacts of Climate Change and Polder improvement of Polder- 47/2, both quantitative assessments and qualitative judgments have been made out. Two separate hydrological and hydrodynamic models have been setup and simulated using input data from climate and hydro-meteorology to assess the impact of climate change on some sensitive issues of the polder namely, water availability, flood security etc.

9.4.1 Impact of Increased Water Level

666. The rise in sea water level will affect the increase of the river water level outside of the polder area. The rainfall during the monsoon will be increased due to climate change, which will result in an increase in extreme flow during monsoon that will ultimately result in an increase in water levels. To understand the impact of climate change, model simulations have been carried out for Polder- 47/2 to evaluate water level using climate change scenarios for the year 2050s (Table 9.2).

Table 9.2: Water level of Peripheral river/canal of Polder- 47/2

Sampling point	Name of khal on which sluice is located	Chainage along the embankment (sluice location)	Water level (mpwd)
115	Baraitala River	0+000	3.45
116	Sonatala River	5+370	3.46
117	Charpara River	13+600	3.46

Source: IWM, 2016

667. From the table, it has observed that the existing crest level (4.20 mPWD) of the embankment of Polder- 47/2 is moderately higher than the predicted (25-year) water levels due to climate change of the surrounding water bodies/khals. Tidal water may not affect the Polder- 47/2 during monsoon period. The expected Climate Change induced increase in water levels have been incorporated into the design of embankments and structures.

668. Due to design crest level of polder the adjacent areas which are not protected (Khepupara, Tegasi etc.) may be inundated and will be severely affected by cyclones storms in future.

9.4.2 Impact of Storm Surge Level

669. Storm surge model (IWM) simulation results have been used in determining storm surge level for different return periods. The projection of storm surge level in the three locations of the Polder- 47/2 considering with and without Climate Change are presented in Table 9.3. It is observed that in the 25 year return period surge levels with climate change will increase by 15% compared to the surge levels without climate change. For a 50-year return period the surge levels are predicted to increase by around 13%. The impact of increased storm surge levels is incorporated in the design of the embankments for Polder-

47/2. Even with this expected increase in storm surge leveles, the design crest level of 4.5mPWD is sufficient to protect Polder 47/2 against overtopping.

Table 9.3: Storm surge level for different return period with and without climate change

Polder Name and Location Name	Location No.	Design Crest level (mPWD)	Surge Level (mPWD) in different Return Period (years) without Climate Change					Surge Level (mPWD) in different Return Period (years) with Climate Change (AR4)		
			Sidr	Aila	10	25	50	10	25	50
Kalapara, Hauder Bharani	115	4.50	3.8	2.5	2.40	3.10	3.62	2.88	3.57	4.08
Kalapara, Hauder Bharani	116	4.50	3.93	2.5	2.45	3.30	3.94	2.87	3.54	4.04
Kalapara, Hauder Bharani	117	4.50	4.09	2.52	2.47	3.19	3.72	2.95	3.65	4.18

Source: IWM, 2016

9.4.3 Impact of Wave Height due to Climate Change

670. The significant wave heights during cyclonic conditions for different return periods with climate change effect around the Polder 47/2 are presented in the Table 9.4.

Table 9.4: Wave height (m) for different return period with climate change condition

Station No.	Polder no. and location	Significance wave Height (m) in Different Return Period (Years) with Climate Change					
		Sidr	Aila	10	25	50	100
53	47/2; Kalapara, Tentulia	4.01	1.87	2.53	3.63	4.36	5.05

Source: IWM, 2015

671. From the above table, it is predicted that wave heights increase for short duration return periods (i.e. 10 to 25 year return period) by up to 43% whereas for the long duration return periods (>25 years) wave heights are predicted to increase by up to 20%. The highest waves are found in the Sonatala River. Here the design crest level is 5.00 mPWD, sufficient to contain the projected 50-year return period wave height.

9.4.4 Climate Change Resilience Developed in Polder-47/2

672. During field investigations, it was found that the local people are mostly aware of the climate change consequences and events. In recent years they are the victims of climate change induced natural disasters, frequently hitting them and causing massive loss of lives and properties. The initiatives already undertaken through different interventions by programs other than CEIP-1, the insight of climate resilience has been developed within the polder habitants. Through the community mobilization in CEIP program, local people have become more active towards building a climate resilient society. They are now driven by the concept of climate smart village. Most of the people who are able to afford are now re-building their houses and infrastructures on a relatively higher level. Local people claimed that they would use the excavated spoil from the internal khals for their household purpose if available. This will allow them to have their house and other infrastructures on a re-built higher land. The local farmers are now more concerned about climate change issues as well. They regularly follow and take part in the knowledge development and capacity building programs organized by CEIP, which they believe enhanced their understanding and preparedness on flood and disaster management.

10 Environmental Management Plan

673. This chapter presents the Environmental Management Plan (EMP) for the rehabilitation activities in the Polder- 47/2. The EMP essentially provides the implementation mechanism for the environmental and social mitigation measures discussed in Chapter 6.

10.1 Objectives of EMP

674. The basic objective of the EMP is to manage, prevent and mitigate potentially adverse impacts of Project interventions. The specific objectives of the EMP are to:

- Facilitate the implementation of the environmental and social mitigation measures identified during the present EIA and discussed in Chapter 6.
- Assign responsibilities for project proponent, contractors, consultants and other members of the Project team for the environmental and social management of the Project;
- Define a monitoring mechanism and identify monitoring parameters to ensure effective implementation of the mitigation measures; and
- Assess environmental training requirements for different stakeholders at various levels.
- Describe communication and documentation requirements.

> The EMP should be included in all the bid documents of Polder- 47/2 and will become a part of the civil works contract. The strict implementation of the EMP and project management's strict enforcement of the adequate construction practices and standards will greatly reduce the negative impacts of the Project.

10.2 EMP Components

675. The EMP components are listed below:

- Institutional Arrangement
- Mitigation Measures and Plan
- Monitoring Plan
- Documentation and reporting
- Contractual arrangements for EMP implementation
- EMP implementation cost
- Capacity building
- Grievance redress mechanism

676. These components are discussed in Sections below:

10.3 Institutional Arrangement

677. Clearly defined and functional institutional arrangements are essential for ensuring effective and sustainable implementation of the EMP, particularly the mitigation measures identified in the EIA. An Organogram showing the institutional setup of CEIP-1 including organisation for implementation and monitoring of the EMP is shown in Figure 10.1.

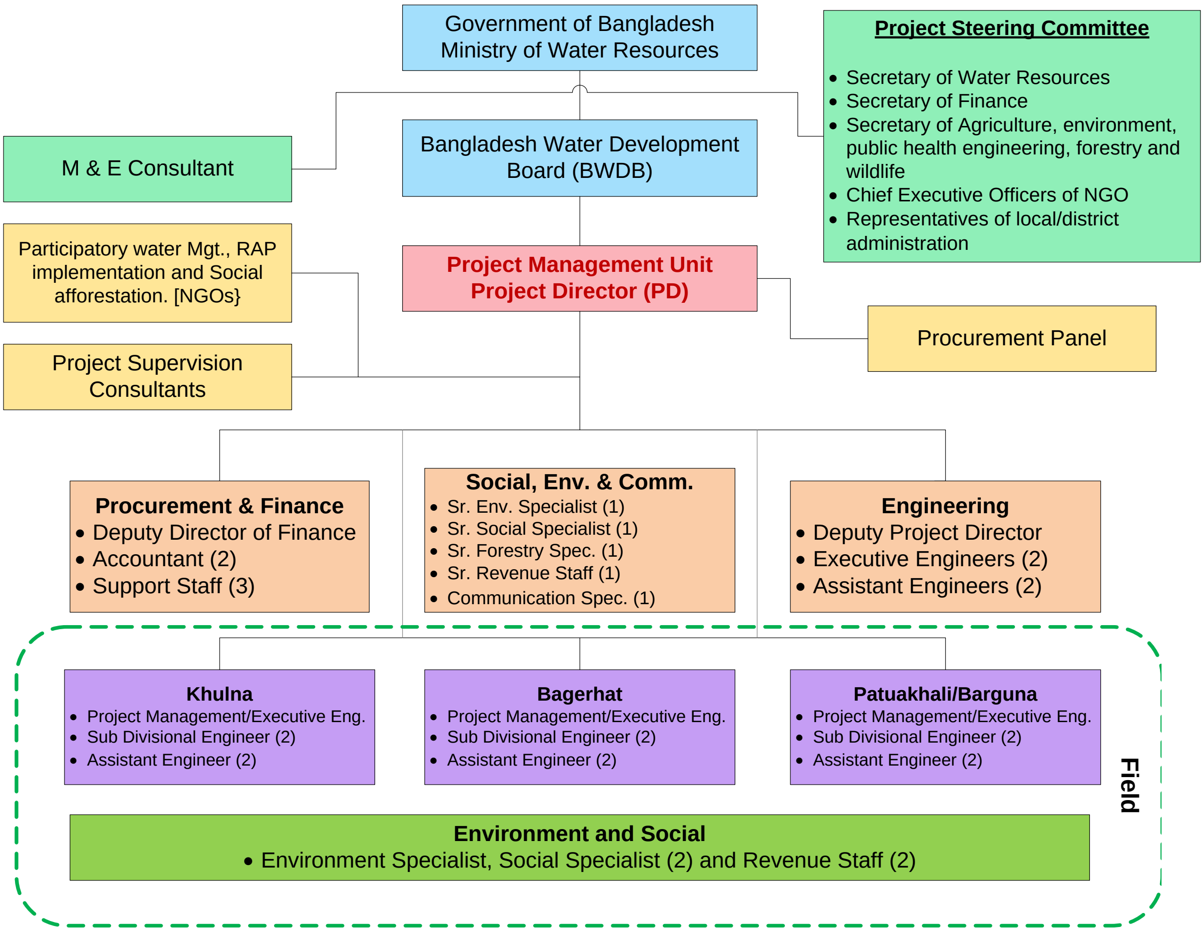


Figure 10.1: Organogram showing the institutional setup for CEIP-I

678. The institutional arrangements proposed to implement the EMP of Polder-47/2 are described in detail below:

10.3.1 Overall Responsibility

679. The overall responsibility of EMP implementation and fulfilling other environmental obligations during the Project rests with the Project Director (PD). For this purpose, the PD will be supported by Environmental and Social staff of the PMU, DCSC and Contractors.

10.3.2 Construction Phase

a. <u>Environment and Social Staff in PMU</u>

680. As described in Section 4.8, the BWDB will set up the PMU to manage the Project implementation. The PMU will be led by the Project Director (PD). To manage and oversee the environmental and social aspects of the Project, the PMU will have an Environment, Social, and Communication (ESCU). The Unit will supervise compliance with and implementation of the EMP. The Unit will include a Senior Environmental Specialist. One environment specialist will be posted at the field level to support all three divisions. The ESCU will maintain liaison with WB safeguards team, regulatory agencies and other stakeholders during the Project implementation. The ESCU will also coordinate with the environmental staff of the DCSC In order to manage the EA process and EMP implementation effectively; the ESCU will be established and made operational before

awarding the contract to Contractor. BWDB will update the EIA report, if necessary. The Mode of EMP implementation is shown in the figure-10.2 as follows:

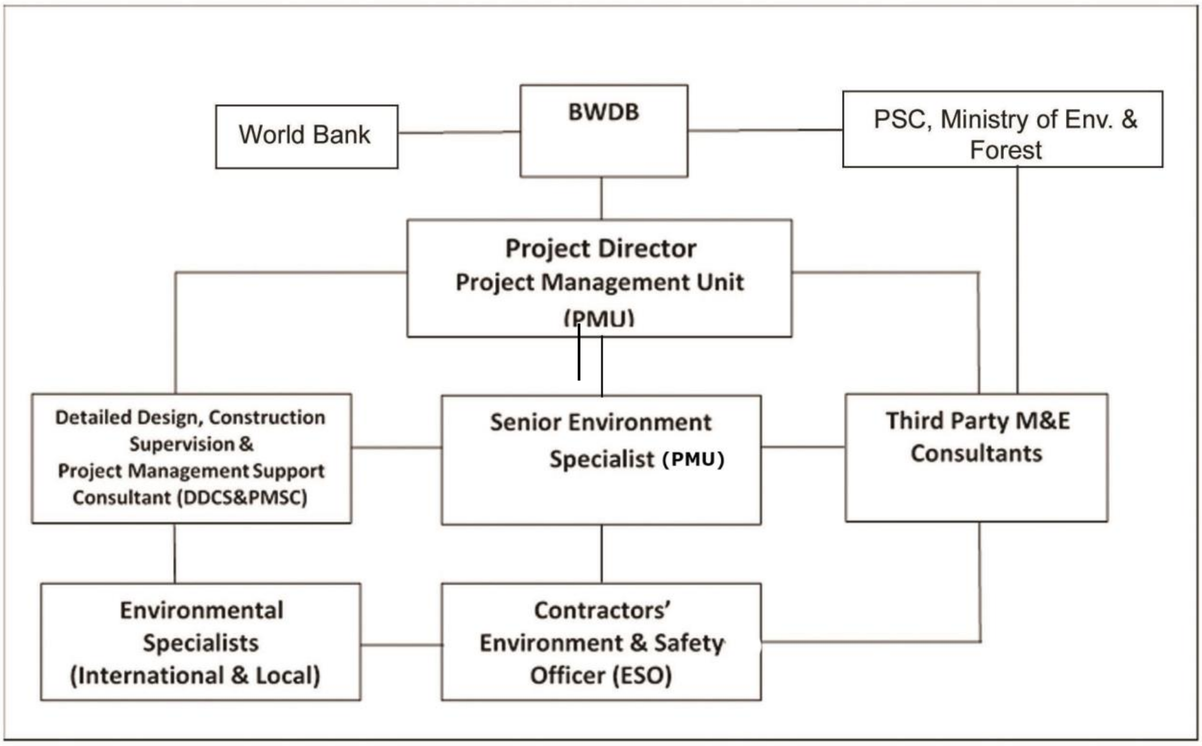


Figure 10.2: Organogram for Mode of EMP Implementation

b. Environment and Social Staff with DCSC

681. The DCSC will be responsible for overall supervision of polder rehabilitation related activities. The DCSC will ensure quality control and report to the PD. The DCSC will also assist the ESCU for ensuring environmental compliance and monitoring of progress including EMP and/or ECoP implementation. The DCSC will supervise the contractors, ensuring design compliance and quality of works. For supervising the EMP implementation, DCSC will have dedicated and adequately qualified and experienced environmental staff including field-based environmental monitors (EMs). The DCSC will supervise and monitor contractors to ensure compliance with the EMP. The DCSC consultants' environmental staff will maintain coordination with the ESCU for the effective implementation of EMP and other environmental commitments and obligations of the Project.

c. Contractor's Environment Supervisors

682. The construction contractors will have an adequate number of dedicated, properly qualified and experienced, site-based Environment Supervisors (ESs) at the construction sites. The ESs will be responsible to implement various aspects of the EMP particularly the mitigation measures to ensure that the environmental impacts of the construction works remain within acceptable limits. The EMs will maintain coordination with the DCSC at the site level. The ESs will also be responsible to conduct environmental trainings for the construction crew.

10.3.3 Post-construction Phase

683. The BWDB monitoring unit has postings of 4 Assistant Chiefs and 2 Deputy Chiefs to oversee the overall environmental compliance of BWDB implemented projects. Under CEIP, the ESCU will provide training to the BWDB people responsible for monitoring of environmental compliance. Thus, a smooth transition to BWDB will happen to ensure environmental compliance during the O&M after the project completion. These staff will be responsible to manage the environmental aspects of the operation and maintenance of polder, its water control structures, and other relevant issues such as protection of key environmental resources of the older and maintain fish migration. Water Management Organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (Nov 2000) and involve the beneficiary communities. WMOs will be trained by BWDB to ensure environmental management during project operation. The Environmental Management Unit of BWDB will ensure and oversee the environmental management during project implementation and operation. The Water Management Organization will also be trained and involved in EMP implementation during the operation phase.

10.4 Mitigation Measures and Plan

684. Mitigation is an integral part of impact evaluation. Where mitigation is deemed appropriate, a proponent should strive to act upon effects, in the following order of priority, to:

- Eliminate or avoid adverse impacts, where reasonably achievable.
- Reduce adverse impacts to the lowest reasonably achievable level.
- Regulate adverse impacts to an acceptable level, or to an acceptable time period.
- Create other beneficial impacts to partially or fully substitute for, or counter-balance, adverse effects.

685. Project specific construction environmental management plans will be prepared by the Contractor and implemented upon approval by the DSC consultant and the PMU. These plans will specify precautions and mitigation measures for construction activities. Good Environmental Construction guidelines have been compiled in Appendix 10 of Environmental Management Framework..

686. Impacts identified as severe in consequence category and or likelihood category will be further analyzed to identify additional mitigation measures that are potentially available to eliminate or reduce the predicted level of impact. Potential mitigation measures will include,

- habitat compensation program
- species specific management program
- engineering design solutions
- alternative approaches and methods to achieving an activity‘s objective
- stakeholders participation in finalizing mitigation measures
- construction practice, including labor welfare measures.
- operational control procedures
- management systems

687. Based on the past experience, a generic Mitigation/Compensation Measures Guideline for the EMP has been developed and is presented in Table 10.1 below for reference. This has been used as a reference material for comprehending the scope of the EMP. Table 10.1 will be used in conjunction with the implementation of the polder specific mitigation measure stated in Chapter 6.

Table 10.1: Generic Mitigation/Compensation Measures/Guideline

Parameter/Activities	**Mitigation/Compensation Measure/Guideline**
ECoP 1: Soil/ Land Management	
Sources of Material for Earthwork	• During design, the segment wise soil requirement and location of the sources of soil for earthwork for each polder construction/rehabilitation should be identified. • Selection of Borrow pit areas or soil borrowing areas for earthen material collection. • No objection from land owner/Revenue authorities as applicable • Contractor shall ensure that borrow materials used for embankment filling is free of pollutants • Disposal of excess soil should be done at site with no objection from DoE and local authority
Borrowing of Earth	Selection of Borrowing Area Borrowing of soil from close to the toe line on any part of the embankment is prohibited. Earth available from dredging as per design, may be used as embankment material (if necessary and applicable), subject to approval of the Engineer, with respect to acceptability of material. Borrowing to be avoided from the following areas: • Lands close to toe line and within 0.5 km from toe line. • Irrigated agricultural lands (In case of necessity for borrowing from such lands, the topsoil shall be preserved in stockpiles). • Grazing land. • Lands within 1km of settlements. • Environmentally sensitive areas such as reserve forests, protected forests, sanctuary, wetlands. A distance of at least 500 m should be maintained from such areas. • Unstable side-hills. • Water-bodies (only if permitted by the local authority, and with specific pre-approved redevelopment plans by the concerned authority and engineer-in-charge) • Streams and seepage areas. • Areas supporting rare plant/ animal species. **Documentation of Borrow Pit** The contractor must ensure that following data base must be documented for each identified borrowing areas before commencing the borrowing activity that provide the basis of the redevelopment plan. • Chainage along with offset distance; • Area (Sq.m); • Photograph and plan of the borrowing area from all sides; • Type of access/width/kutcha/pucca etc. from the roadway; • Soil type, Slope/drainage characteristics; • Water table of the area from the nearest well, etc; • Existing land use, for example barren / agricultural /grazing land; • Location/name/population of the nearest settlement from borrow area; • Quantity excavated (likely and actual) and its use; • Copy of agreement with owner/government; and • Community facility in the vicinity of borrow pit. • Rehabilitation certificate from the landowner along with at least four

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	photograph of the rehabilitated site from different angles.
Excavation operation and Management of Excavated Material	To minimize the adverse impact during excavation of material following measures are required to be undertaken: • Adequate drainage system shall be provided to the excavated area • At the stockpiling locations, the Contractor shall construct sediment barriers to prevent the removal of excavated material due to runoff. • The followings precautions shall be undertaken during quarry operations. • Overburden shall be removed. • During excavation, slopes shall be flatter than 20 degrees to prevent sliding. • In case of blasting, the procedure and safety measures shall be taken as per DoE guidelines. • The Contractor shall ensure that all workers related safety measures are taken. • The Contractor shall ensure maintenance of crushers regularly as per manufacturer‘s recommendation. • During transportation of the material, measures shall be taken to minimize the generation of dust and to prevent accidents.
Handling Dredged Material from River Dredging	• Deposition of dredged material should be far away from the channel edge to limit damage to streamside habitats. This also allows a degree of flooding to occur on the floodplain, thereby creating opportunities for wet grassland, scrub/wet woodland, wetlands and seasonally grazed rough grass. • Apply biotechnical engineering where possible, for example geotextiles, may be used to stabilize the material and aid re-colonization • Other possibilities include: drying and spreading the spoil over the adjacent land, which can improve soil fertility in some cases, and also to other important flora and habitats; excavating a trench and in filling it with spoil, thus minimizing disturbance to agriculture and the local environment; dumping off-site is possible but expensive, using spoil to create artificial wetlands.
ECoP 2: Water Resource & Hydrology Management	
Hazardous Waste Management	• The contractor will minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes).
Ponding of water/water logging	• Ponding of water should not be allowed especially near the waste storage areas and construction camps • Discard all storage containers capable of storing of water, after use or store them in inverted positions. • Reinstate relief and landscape • Monitor drainage pattern after high down pouring and recession flood • Connect water pockets to the nearest drainage structures/canals
Soil Erosion and siltation	The Contractor shall • Water the material stockpiles, access roads and bare soils as and when required basis to minimize dust emissions. Increase the watering frequency during periods of high risk (e.g. high winds) • All working sites (except permanently occupied by the road and supporting facilities) should be reinstated to its initial conditions (relief, topsoil, vegetation cover) • Ensure that roads used by construction vehicles are swept regularly to remove sediment.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Dredging	• Disturbance can be minimized if mechanical excavators work from a particular bank. If the channel is too wide, the digger must work within the channel. Disruption can be minimized by diverting the river down one side of the channel and dredging the other side while it is 'dry'. Smaller plant equipment generally limits the level of impact on bank-side and in-stream habitats.
Construction activities in water bodies	• Protect water bodies from sediment loads by silt screen or bubble curtains or other barrier. • Do not discharge cement and water used for curing cement concrete directly into water courses and drainage inlets • Monitor the water quality in the runoff from the site or areas affected by dredge plumes, and improve work practices as necessary.
ECoP 3: Air Management	
Construction vehicular traffic	The Contractor should • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner • Cover haul vehicles carrying dusty materials (cement, borrow and quarry) moving between outside and the construction site • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions • Control the movement of construction traffic • Water construction materials prior to loading and transportation • Service all vehicles regularly to minimize emissions • Materials will be transported to site in off peak hours.
Construction activities	• Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust • Increase the watering frequency during periods of high risk (e.g. high winds) • Stored materials such as excavated earth, dredged soil, gravel and sand shall be covered and confined to avoid their being wind-drifted • Minimize the extent and period of exposure of the bare surfaces • Reschedule earthwork activities or vegetation clearing activities, where practical, if necessary to avoid during periods of high wind and if visible dust is blowing off-site • Restore disturbed areas/side of the embankment as soon as practicable by plantation/vegetation/grass-turfing • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations. • Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems.
Odor from Construction labor Camps	• Construction worker's camp shall be located at least 500 m away from the nearest habitation • The waste disposal and sewerage system for the camp shall be properly designed, built and operated so that, no odor is generated.
ECoP 4: Agriculture Management	
Loss of Top Soil	• Soil from fallow lands/ non-agricultural lands should be used in earthwork in embankments • Collect/strip top soil before earth filling and store and reuse it for final

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	surfacing of embankment top and tree plantation/afforestation. • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m • Remove unwanted materials from top soil like grass, roots of trees and similar others • The soil are to stockpiled with side in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil • Locate topsoil stockpiles in areas outside the drainage lines and protect from erosion • Spread the topsoil to maintain the physio-chemical and biological activity of the soil. • The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites • Topsoil stockpiles will be monitored and corrective measure are to be undertaken any adverse condition is observed and the actions will include: • Anaerobic conditions-turning the stockpile or creating ventilation holes through the stockpile; • Erosion – temporary protective silt fencing will be erected;
Soil salinity	• Use of duckweed will remove soil salinity • Flushing with pre-monsoon rainwater will reduce soil salinity. • Saline tolerant crops need to be practiced. • Environmentally and socially responsive shrimp farming e.g. shrimp-rice farming system is encouraged. • Increase of upland discharge of fresh water will push back ingress of saline water from the sea • Green manure application to be promoted • Ground water abstraction for shrimp farming should be avoided.
ECoP 5: Noise Management	
Construction vehicular traffic	• Maintain all vehicles in order to keep it in good working order in accordance with manufacturer's maintenance procedures • Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise at the work site.
Construction machinery	• Appropriately locate all noise generating activities to avoid noise pollution to local residents • Maintain all equipment in order to keep it in good working order in accordance with manufactures maintenance procedures.
Construction activity	• Notify adjacent landholders/Schools prior to any typical noise events during of daylight hours • Employ best available work practices on-site to minimize occupational noise levels • Install temporary noise control barriers where appropriate • Plan activities on site and deliveries to and from site to minimize impact • Monitor and analyze noise and vibration results and adjust construction practices as required • Avoid working during 09:00pm to 06:00 am within 500m from the existing residences.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
ECoP 6: Ecology Management	
Flora	
Vegetation Clearance	• Tree felling should be performed upon preliminary notification to the relevant authority (Divisional Forest Office, DoE) • Preparation of maps in GIS format, cadastral description of trees to be felled, marking, and supervision of Forest Department are necessary elements of the procedure • Provide adequate knowledge to the workers regarding natural protection and the need of avoiding felling trees during construction • Fruit and timber trees owned by local population will be compensated at their replacement cost according to market prices.
Plant Management	• Tree seedlings are planted in a way that minimizes damage to the soil, while facilitating seedling survival. Appropriate tree seedling species are selected for maintaining long-term productivity. • Focus on tree species suitable for site condition. • Prevent unreasonable species resulting in slow growth, less water and soil conservation and pest or disease outbreaks. • Local species as planting materials, since natural selection and succession are most suitable for local climates and natural conditions. • Ensure avoid single species or clone monoculture. • Choose suitable species for berm, turfing and side.
Planting	• Leave set back requirements around streams, restricted areas e.g. native vegetation, protected riparian strips, historic and heritage sites, research areas • For nursery raising, physical and biological controls are practiced to control the pests and diseases in the nurseries • Not to plant spread-prone species on sites where there is a high risk of uncontrollable wilding spread beyond the boundaries of the plantation • Consider appropriate species, patterns and layout when planting areas with high visual values and/or with important recreational values.
Polypropylene Bags Handling	• Make a Borrow Pit at each site for collection of poly bags • Collect all bags at the pits after plantation • If feasible, inform private sector to collect those bag for recycling.
Pest Management to Nursery	• During outbreak of any deadly plant disease, develop a plan to manage pest in coordination with neighbours by identifying existing pests and diseases and the risks for the introduction of new pests and diseases. • Share the plan with Bank before application.
Water Management	• Install temporary sediment basins, where appropriate, to capture sediment-laden run-off from nursery • Divert runoff from undisturbed areas around the harvesting site • Stockpile of fertilizer or agro-chemical away from drainage lines • Prevent all solid and liquid wastes entering waterways by collecting solid waste, oils, chemicals, fertilizer waste and transport to an approved waste disposal site.
Fauna	
Construction works in the surrounding lands	• Pre-entry survey and prevention of damage to fauna prior to start up • Limit the construction works within the designated sites allocated to the contractors • Not be permitted to destruct active nests or eggs of resident birds • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	illegal poaching.
ECoP 7: Fisheries Management	
Construction works in the rivers and on the surrounding lands	• Critical breeding areas of major fish species should be identified and declared as sanctuaries • Creation of small lagoons and pools that may trap the fishes will be avoided • Creation of artificial waterfalls and other barriers for migration will be avoided • Natural river channel will be reinstated after completion of construction works.
Hydraulic Structure	• Sufficient free flow will have to be guaranteed in the design and construction work to ensure free passage of migrating fishes. • Hydraulic structures to be operated considering fish migration and spawning time • An area specific hydraulic structure operation guideline should be developed.
Dredging	• Ensure that the dredging activity will create minimum sediment load in the water • Avoid dredging during spawning period of fish.
ECoP 8: Socio-Economic Management	
Construction Camp Management	
Siting and Location of construction Camps (MRDI, 2011)	• Locate the construction camps at areas, which are acceptable from environmental, cultural or social point of view. • Consider the location of construction camps away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • BWDB should endorse detailed layout plan for the development of the construction camp submitted by the contractor. The plan should indicate the definite locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters.
Construction Camp Facilities	The following facilities should be provided by the contractor • Adequate housing for all workers • Safe and reliable water supply • Hygienic sanitary facilities and sewerage system. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities • Provide in-house community/common entertainment facilities, dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Solid Waste Management	• Ensure proper collection and disposal of solid wastes within the construction camps • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. • Establish waste collection, transportation and disposal systems with the

Parameter/Activities	**Mitigation/Compensation Measure/Guideline**
	manpower and equipment/vehicles needed. • Do not establish site-specific landfill sites. All solid wastes will have to be collected and removed from the work camps and disposed in approved disposal sites.
Fuel supplies for cooking and heating purposes	• Provide fuel to the construction camps for their domestic purpose, in order to discourage them to use fuel wood or other biomass. • Conduct awareness campaigns to educate workers to protect the biodiversity and wildlife of the project area, and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	• Provide adequate health care facilities within construction sites • Provide first aid facility round the clock. Maintain stock of medicines in the facility • Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outer areas • Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work • Provide HIV awareness programming, including STI (sexually transmitted infections) • And HIV information, education and communication for all workers on regular basis • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Regular mosquito repellent sprays during monsoon. • Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. • Place display boards at strategic locations within the camps containing messages on best hygienic practices.
Payment of Wages	• The payment of wages should be as per the Minimum Wages Act, Department of Labor, and Government of Bangladesh for both male and female workers. • Display boards showing of the minimum wages at camps and major construction sites should be done in local languages at the construction and labor campsites. • Wages should be paid to the laborers only in the presence of BWDB staff; • Contractor is required to maintain register for payment of labor wages with entry of every labor working for him. Also, he has to produce it for verification if required and when asked by the Engineer, EMU and/or the concerned BWDB staff/Engineer‘s representative.
Rehabilitation of Labor and Construction Camp	After completion of construction, all construction camp facilities shall be dismantled and removed from the site. The site shall be restored to a condition in no way inferior to the condition prior to commencement of the works. The activities to be carried out for site rehabilitation after completion of construction include: • Oil and fuel contaminated soil shall be removed and transported and buried in waste disposal areas. • Soak pits, septic tanks shall be covered and effectively sealed off. • Debris (rejected material) should be disposed of suitably. • Underground water tank in a barren/non-agricultural land can be covered. However, in an agricultural land, the tank shall be removed.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• If the construction campsite is on an agricultural land, preserve top soil and good earth can be spread back for a minimum 30cm for faster rejuvenation of the land. • Proper documentation of rehabilitation site is necessary. • This shall include the following: • Photograph of rehabilitated site; • Land owner consent letter for satisfaction in measures taken for rehabilitation of site; and • Undertaking from contractor; • In cases, where the construction camps site is located on a private land holding, the contractor would still have to restore the campsite as per this guideline. The rehabilitation is mandatory and should be include in the agreement with the landowner by the contractor. In addition, he would have to obtain a certificate for satisfaction from the landowner.
Damage and Loss of Cultural Properties	
Conservation of Religious Structures and Shrines	• Necessary and adequate care shall be taken to minimize impact on cultural properties which includes cultural sites and remains, places of worship including temples, mosques, churches and shrines, etc., graveyards, monuments and any other important structures as identified during design and all properties / sites / remains notified. No work shall spill over to these properties and premises. The design options for cultural property relocation and enhancement need to be prepared. • All conservation and protection measures will be taken up as per design. Access to such properties from the road shall be maintained clear and clean.
	• During earth excavation, if any property is unearthed and seems to be culturally significant or likely to have archaeological significance, the same shall be intimated to the Engineer. Work shall be suspended until further orders from the PD. The Archaeological Department shall be intimated of the same findings and the Engineer shall carry out a join inspection with the department. Actions as appropriate shall be intimated to the Contractor along with the probable date for resuming the work. • All fossils, coins, articles of value of antiquity and structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government, and shall be dealt with as per provisions of the relevant legislation.
Worker's Accident Risk	
Risk from Operations	• The Contractor is required to comply with all the precautions as required for the safety of the workmen as per the International Labor Organization (ILO) convention. The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, books, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and outlet.
Risk from Electrical Equipment	• Adequate precautions will be taken to prevent danger from electrical equipment. No materials on any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Bangladesh Standards (BS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per BS provisions and to the satisfaction of the Engineer.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Risk from Hazardous Activity	• All workers employed on mixing material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals.
Malarial Risk	• The Contractor shall, at his own cost, conform to all anti-malarial instructions given to him by the Engineer and the EMU, including filling up any borrow pits, which may have been dug by him.
Disruption to Users	
Loss of Access	• At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock. Works that affect the use of existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the Engineer. • The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, and any other access footpaths to or of properties whether public or private.
Traffic Management	• Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night. • The temporary traffic detours in settlement areas shall be kept free of dust by frequent application of water
Traffic Control and Safety	• The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the cross section.

10.5 Chance- Find Procedures for Physical Cultural Property

688. The Contractor will be responsible for familiarizing themselves with the following “Chance Finds Procedures” in case culturally valuable materials are uncovered during excavation or any project activities as per Antiquities Act, 1968, including:

- Stop work immediately following the discovery of any materials with possible archaeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;
- Protect artefacts as well as possible using plastic covers, and implement measures to stabilize the area, if necessary, to properly protect artefacts;
- Prevent and penalize any unauthorized access to the artefacts; and
- Restart construction works only upon the authorization of the relevant authorities (e.g. Upazila Nirbahi Officer, Deputy Commissioner and Department of Archaeology).

10.6 Monitoring Plan

689. Extensive monitoring of the environmental concerns of the CEIP project will be required as per World Bank guideline. The monitoring program will help to evaluate: (i) the extent and severity of the environmental impacts against the predicted impacts and baseline; (ii) the performance of the environmental protection measures or compliance with pertinent rules and regulations; (iii) trends in impacts; and (iv) overall effectiveness of the project environmental protection measures. The monitoring plans should be included in the EMP for

specific sub-projects. Moreover, for all type of monitoring, a comprehensive database of the polder specific Environmental Impact and Monitoring information should be created, which will help to evaluate the impacts easily.

690. The Monitoring activities during design/preconstruction period are:

i. checking the contractor's bidding documents, particularly to ensure that all necessary environmental requirements have been included; and

ii. Checking that the contract documents' (Construction Environmental Action Plan) references to environmental mitigation measures requirements have been incorporated as part of contractor's assignment and making sure that any advance works are carried out in good time.

691. Construction environmental monitoring is a function of supervision, and the essential purpose is to ensure adherence to the EMP. The monitoring is a daily process, which ensures that departures from the EMP are avoided or quickly rectified, or that any unforeseen impacts are quickly discovered and remedied.

692. Post project monitoring evaluation will be carried to evaluate the impacts of the Project during first three (3) years of operation of the Project. Regular monitoring of the condition of the embankment, drainage structures and slope protection structures and afforestation are important from an environmental management point of view. In addition to this activity, information on the locations, type and consequences of flooding, erosion, flora and fauna mortality, availability of fish, occupational shift, migration is required. Recommended air, noise and water quality monitoring, greening and landscaping and community feedback are also included in the Monitoring Plan. The monitoring plan and details of monitoring locations for environmental condition indicators of the project during the construction and operation stage are presented in Table 10.2 and Table 10.3.

Table 10.2: Environmental Monitoring Plan during Construction and Operation of Rehabilitation and Improvement of Polder System

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
During Construction					
Sources of Material	Work Site	Possession of official approval or valid operating license of suppliers of materials (Cement, soil).	Before the agreement for the supply of material is finalized.	Contractor	DCSC, M&E Consultant, BWDB
Operation of borrow pit site	Borrow pit/site	Visual inspection of borrow pit site and ensuring operational health and safety	monthly	Contractor	DCSC M&E Consultant, BWDB
Top Soil	Storage area	Top soil of 0.15 m depth will be excavated and stored properly	Beginning of earthwork	Contractor	DCSC BWDB
	Storage area	The stored top soils will be used as cladding material over the filled lands	Immediately after filling and compaction of earth materials	Contractor	DCSC, BWDB
	Work Site	Some of the top soil are placed on top and berm of embankment for turfing and plantation	At the end of filling activity	Contractor	DCSC, BWDB
Workers; Health Safety	Workers' camp site/ work site	Use of PPE by workers, provision of safe drinking water, sanitation and first aid facilities and	Daily	Contractor/workers	DCSC,BWDB
Erosion	Side slopes of the embankments and material storage sites	Visual inspection of erosion prevention measures and occurrence of erosion	At the end of filling activity	Contractor	DCSC, M&E Consultant, BWDB
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	DCSC, BWDB
Traffic safety	Construction area	Visual inspection to observe whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DCSC, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Daily	Contractor	DCSC, BWDB
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DCSC
Air Quality (PM_{10}, $PM_{2.5}$)	Close to School/ Madrasha, Hospital &Villages	Air quality monitoring	Yearly	Contractor through a nationally reputed laboratory	DCSC, M&E Consultant, BWDB
Noise	Construction sites	Visual inspection to ensure good standard equipment are in use	Weekly	Contractor	DCSC, M&E Consultant, BWDB
	Construction sites	Ensure restriction of work between 09:00 p.m.-6:00 a.m. close to School/ Madrasha, Hospital & Villages	Weekly	Contractor	DCSC, M&E Consultant, BWDB
Physical and chemical qualities of soil (soil texture, N.P.K organic matter, pH, salinity etc)	Construction sites	Soil sample collection and laboratory analysis	Yearly	Contractor	DCSC, M&E Consultant, BWDB
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample from the river of each polder	Sampling and analysis of surface water quality	Yearly	Contractor through a nationally reputed laboratory	DCSC, M&E Consultant, BWDB
Drinking Water Quality (Arsenic, Iron, TDS, Turbidity, pH, FC, as of groundwater etc)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality	yearly	Contractor through a nationally reputed laboratory	DCSC, M&E Consultant, BWDB
Sanitation	Construction camp/site	Visual Inspection	Weekly	Contractor	DCSC, M&E Consultant, BWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid waste and other	Weekly	Contractor	DCSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
		depositions at designated site			
Flora and Fauna	Project area	Survey and comparison with baseline environment	Yearly	Contractor through nationally reputed institute	DCSC, M&E Consultant, BWDB
Cultural and archaeological Sites	At all work sties	Visual observation for chance finding	Daily	Contractor	DCSC, M&E Consultant, BWDB
Reinstatement of Work Sites	All Work Sites	Visual Inspection	After completion of all works	Contractor	DCSC, M&E Consultant, BWDB
Safety of workers Monitoring and reporting accidents	At work sites	Use of Personal Protective equipment (PPE) like	Monthly	Contractor	DCSC, M&E Consultant, BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample on each river of each polder	Sampling and analysis of surface water quality	Yearly	BWDB through a nationally reputed laboratory	M&E Consultant
Air Quality (Dust PM_{10}, $PM_{2.5}$)	At the baseline monitoring site	24 hours Air quality monitoring	Yearly	BWDB through a nationally reputed laboratory	M&E Consultant
Flora and Fauna specially fisheries	In the project area	Detail species assessment and compare with baseline	Yearly	BWDB through a nationally reputed institution	M&E Consultant
Agriculture	In the project area	Compare the production with the baseline	Yearly	BWDB through a nationally reputed institution	M&E Consultant
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant

Table 10.3: Environmental Monitoring Plan during Construction and Operation of Afforestation

Parameter	Locations	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
During implementation					
Plant species selection	Nursery	Visual inspection. Type and variety of plant species to be planted for turfing on the top of embankment and foreshore	Before plantation	Contractor	DCSC and M&E Consultants, BWDB
Waste Management	Afforestation sites and Nursery	Visual inspection of collection, transportation and disposal of poly bags, debris and is deposited at designated site	Weekly	Contractor through nationally recognized institute	DCSC and M&E Consultants, BWDB

10.6.1 Qualitative Spot Checking Indicators

693. Moreover, a rapid environmental monitoring will be carried out as per the following checklist in terms of visual judgment during field visit as a control of the implementation of the Environmental Mitigation plan. Table 10.4 can be followed during the construction phase.

Table 10.4: Spot Checking Indicator

Parameter	Visual Judgment			
	Poor	Moderate	Satisfactory	Comments
Workers Safety				
Camp Site Management				
Plant Site Management				
Borrow Area Management				
Top Soil Prevention				
Waste Management				
Occupational Health and Safety				
Stockpiling of construction materials				
Reporting and Documentation				

10.7 Third Party (M&E Consultants) Validation

694. BWDB will engage independent consultants to conduct a third party validation (TPV) of the EMP implementation on yearly basis during the construction phase. During the TPV, the consultants will review the implementation and effectiveness of various EMP activities including mitigation measures, environmental monitoring, trainings, and documentation. The consultants will also identify gaps and non-compliances in EMP implementation and propose actions for their remedy.

10.8 Documentation, Record keeping and Reporting

10.8.1 Record Keeping

695. Proper arrangements are necessary for recording, disseminating and responding to information, which emerges, from the various environmental monitoring and management programs. They are also necessary for rendering the environmental management system “auditable”. However, the primary focus must remain on the pragmatic control of pollution, not the creation of complex bureaucratic procedures. BWDB will maintain database of the polder specific Environmental Impact and Monitoring information for keeping all type of monitoring record. The ESCU will assist BWDB for keeping those records initially. The trained BWDB staff will take the responsibility of record keeping and monitoring during operation phase.

10.8.2 Monitoring Records

<u>Quantitative Physical Monitoring</u>

696. The objective of quantitative physical monitoring is to ensure that the mitigation measures designed to prevent, reduce and where possible offset any significant adverse impacts on the environment are being implemented throughout the Project lifecycle. DCSC will regularly monitor and provide information to ESCU for updating the database. DCSC will provide the following information bi-weekly to ESCU, if not urgent.

- Sampling points;
- Dates and times of sample collection;
- Test results;
- Control limits;
- “Action limits” (circa 80 percent of the control limits) at which steps must be taken to prevent the impending breach of the control limit; and
- Any breaches of the control limits, including explanations if available.

697. The monitoring data would be continually processed as it is received, to avoid a build-up of unprocessed data.

<u>General Site Inspections and Monitoring</u>

698. A Site Inspection Checklist for recording the findings of the general site condition surveys would be developed by the respective contractors, on the basis of the Environmental Mitigation Plan described in Chapter 6 and Table 10.4 during the construction phase. The Site Inspection Checklist would be supported by sketches, as necessary.

10.8.3 Information Sources

699. A complete and up-to-date file of all relevant sources of information should be maintained by the ESCU of PMU. This file would be readily accessible and include, as a minimum, copies of the following documents:

- Current environmental permits and consents;

- Action to fulfil the requirement of annual site clearance for polder area
- All relevant national regulations, international guidelines and codes of practice;
- Manufacturers' MSDSs for all hazardous substances used on the plant;
- Manufacturers' operating manuals for all the environmental monitoring equipment;
- Current calibration certificates for all the equipment that requires calibration by an external organization; and
- The latest version of this Environmental Management and Monitoring Plan.

10.8.4 Non-Compliance Report

700. Any breaches of the acceptable standards specified, would be reported to the PMU using a standard form, i.e. a Non-Compliance Report (NCR).

701. A copy of each completed NCR would be held on file by DCSC, to be replaced by the reply copy when it is received. A record of corrective actions would also be made and tracked to their completion.

10.8.5 Monthly Internal Reports by DCSC

702. The DCSC will prepare a monthly report for issue to the ESCU of PMU. These reports will summarize the following:

- Progress in implementing this EMP;
- Findings of the monitoring programs, with emphasis on any breaches of the control standards, action levels or standards of general site management;
- Any emerging issues where information or data collected is substantially different from the baseline data reported in the Environmental Assessment;
- Outstanding NCRs;
- Summary of any complaints by external bodies and actions taken / to be taken; and
- Relevant changes or possible changes in legislation, regulations and international practices.

10.8.6 Bi-annual Environmental Monitoring Report by BWDB

703. ESCU of BWDB will prepare the Bi-annual Environmental monitoring report during construction phase and will submit to the World Bank for review during construction phase. The monitoring report will include the status of environmental monitoring and the plan for the next six months. The report will summarize the information presented in Table 10.2, 10.3 and 10.4.

10.7.7a EMP compliance and Environmental Audit Report & Third Party Monitoring Report

704. It is expected that BWDB will conduct annual environmental audits. In addition, the environmental audit will be carried out before the mid-term evaluation and before project closing. All Environmental Audit Report will be shared with Bank. Environmental monitoring will be conducted during the project..

Third Party Monitoring

705. The Third Party Monitoring consultants will monitor the quality of environmental compliance and will share their findings with the World Bank.

Donor Agency/WB Monitoring

706. The Donor Agency/WB will also monitor from time to time the quality of environmental compliance as part of their regular implementation support missions.

10.9 Contractual arrangements for EMP implementation

707. A fixed Budget will be assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting. The contractor needs to submit a Construction Environmental Action Plan (CEAP) based on the EIA including the EMP in line with the construction schedule and guideline. The CEAP needs to be reviewed by the supervision consultant and cleared by BWDB and World Bank.

10.9.1 Guideline to Incorporate Environmental Management in Bid Document & Preparation of EAP

- Prepare cost estimates, to be incorporated in Bid Documents.
- The EMP along with the good environmental construction guidelines to be incorporated in the bid document's work requirements.
- Preparation of work requirement (addendum/corrigendum to polder & hydraulic structure construction/afforestation) and
- Corrigendum / Addendum to polder/embankment specification, if any, as special provisions to be incorporated in bid document.
- Penalty clauses for not complying with EMP requirements to be incorporated. Indicative penalty clauses proposed in the CEIP-I are presented below (Addendum to Clause 17.2 Contractor's Care of the Works of FIDIC).
    - The contractor has to follow all traffic safety measures as defined in the technical specification. Damage shall be levied at the rate Tk. 3000/- per day per location for non – conformity of traffic safety measures as per the decision of the Engineer.
    - The contractor has to follow all environmental mitigation measures as defined in the technical specification read along with the Environmental Management Plan for the specific CEIP activities. Damage shall be levied at the rate Tk. 3000/- per day per location for nonconformity of Environmental Management Plan measures as per the decision of the BWDB Engineer.
    - The contractor has to ensure that prior to every monsoon season, during the construction period; all the temporary and permanent cross drainage structures are free from debris as defined in the Technical Specifications read along with the Environmental Management Plan. Damage shall be levied at the rate of Tk.3000/- per day per location for non-conformity as per the decision of the Engineer.
    - The contractor has to ensure that sufficient numbers and good quality Personnel Protective Equipment (PPE), should be provide to staff and labor all time as defined in the labor codes read along with the EMP. Damage shall be levied at the rate of Tk. 1000/- per day for non-conformity as per the decision of the Engineer.

10.9.2 Guideline for Compensation and Contingency Plan during Project Period

708. Compensation becomes necessary when project impacts cannot be mitigated satisfactorily. This can be paid in cash or kind and the emphasis should be on ensuring fairness and causing minimum inconvenience to the affected party. The most common cause of compensation payment is displacement of people and loss of productive land due to land acquisition, tree cutting, or property damage. Such impacts can rarely be fully

compensated. The compensation should be given as per provision of the Resettlement Action Framework. Any disputes over the compensation should be handles by the Grievance Redress Committee.

709. In addition to the compensation, water management projects should also have a contingency plan to deal with emergencies and accidents. Such incidences encompass a whole range of situations from personal injury during operation of a machine to breaching of an embankment. Therefore, BWDB would prepare for the following emergency situations:

- Embankment failure during a flood – keep sufficient number of sand bags in reserve.
- Bank caving/erosion – keep sufficient number of concrete blocks and sand bags in reserve.
- Have an emergency evacuation plan for the people in the line of danger.

10.10 EMP Implementation Cost

710. The estimated costs for the environmental management and monitoring activities are set out in **Table 10.5** below:

Table 10.5: Tentative Cost Estimates for Environmental Management and Monitoring*

Item No.	Description	BDT	In Thousand $	Responsible Agency	Time frame
1	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils	75,715	0.950	Contractor	As per BoQ of contract agreement
2	Soil quality monitoring including N,P,K, S, Zn, salinity, organic Matter, pH etc. during pre-construction, construction and post construction period 6 samples in polder 47/2 = 6 samplesx3 times @ Tk.5,000	90,000	1.125	do	
3	Habitat Observation for four (4) times of year (dry & wet season).	50,000	0.625	do	
4	Construction of fish sanctuary in perennial khals	50,000	0.625	do	
5	Catch Assessment Survey for two (2) times of a year (dry & wet season).	142,500	1.781	do	
6	Farm Survey for four (4) times of year (dry & wet season).	60,000	0.750	do	
7	Awareness program on plant and wild life conservation.	96,000	1.200	do	
8	Consultancy services cost for supervision and monitoring of EMP	276,440	3.455	do	
9	Training to the farmers with field demonstration regarding IPM and ICM.	80,000	1.000	do	
10	Awareness building up to local community for conservation of threatened fish species.	40,000	0.500	do	
11	Training to the fisherman/pond owner with field demonstration regarding pond culture.	40,000	0.500	do	
12	Release fish fry in the khals inside the Polder after completion of construction works.	37,500	0.469	do	
13	Air and noise quality monitoring and analysis.	200,000	2.500	do	
15	Solid and liquid waste disposal arrangement.	60,000	0.750	do	
16	Capacity building and training to the WMOs regarding gate operation, post project monitoring	900,000	11.250	do	
17	Consultancy services cost for river bank erosion monitoring	1,200,000	15.000	do	

Item No.	Description	BDT	In Thousand $	Responsible Agency	Time frame
18	Training to the Contractors regarding environmental management	100,000	1.250	do	
	Training of Environmental awareness of local population	80,000	1.000	do	
19	Updating EMP as per requirement.	100,000	1.250	do	
20	Construction of alternative or bypass channels at each construction sites.	1,061,053	13.263	do	
21	Materials for net pen culture (at least 25 households in each word/council of a Union).	324,000	4.050	do	
22	Conservation and stocking of threatened fish species (at least 3 spots).	120,000	1.500	do	
23	Conserve threatened animals	300,000	3.750	do	
24	Campaigning and providing training on improved culture practices as well as the rice cum golda farming.	200,000	2.500	do	
25	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	1,200,000	15.000	do	
26	Surface and ground Water quality monitoring cost (testing for Turbidity, pH, DO, BOD, Salinity etc. + test of As, e etc. for HTWs at workers' camp site) 6 samples in polder-47/2 during pre-construction, construction and post-construction periods + water quality analysis of HTWs of 10 workers' camp= (Tk.4,000x6x3) + (Tk.700X10)	79,000	0.988	do	
27	Additional Tree Plantation at HH and other grounds to compensate the tree cutting (planting 3 trees for cutting 1tree) @ Tk.50 each tree including the cost of sapling, gabion and nursing etc. (19,834 nos. of trees)	991,700	12.396	do	
28	Water sprinkling at re-sectioned/newly constructed embankments (@ Tk.3,000 per km (of embankment 17.49 km)	51,750	0.646	do	
29	WMOs monitoring cost	120,000	1.500		
Total Cost		**8,125,658**	**101.53**		

* 1 US$= BDT 80

10.11 EMP Updating

711. The study infers that the EMP has been developed assessing the impacts of interventions on the basis of baseline and prediction information. However, monitoring has to be carried out to collect information on the impacts that actuality have occurred due to construction of interventions. Furthermore, actual information due to implementation of the EMP measures need to be collected for updating the EMP to make the development more environmental friendly as because EMP is not an one time plan rather it is a plan which needs updating continuously.

10.12 Grievance Redress Mechanism

712. BWDB will establish a Grievance Redress Mechanism (GRM) as a means to ensure social accountability and to answer to queries and address complaints and grievances about any irregularities in application of the guidelines adopted in this EMF for assessment and mitigation of social and environmental impacts. Based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly, saving the aggrieved persons from having to resort to expensive, time-consuming legal action. The procedure will however not pre-empt a person's right to go to the courts of law.

10.12.1 Grievance Redress Focal Points

713. A Grievance Redress Committee (GRC) at local level will be formed for each Union with union level representation to ensure easy accessibility by the project affected persons and communities. This local GRC will be the local focal points of the project GRM. The GRM sets out the information and communications strategy to ensure that PAPs and communities are fully informed about their rights to offer suggestions and make complaints. All grievances received through the GRM process will primarily be forwarded to the GRCs. The Secretariat for each GRC will be at the office of the Executive Engineer. If any grievance is not resolved at GRC, the aggrieved person may request the convener of GRC to forward the case to the Project Director at PMU. The GRC will officially forward the cases with their comments to the Project Director. Hearing of petitions with GRCs will be held at the Convener's office or at Union Parishad/Ward Councillor's office as agreed by the committee members. The membership of the GRCs will ensure proper presentation of complaints and grievances as well as impartial hearings and investigations, and transparent resolutions.

Membership of GRC

1. Executive Engineer (BWDB Division Office): Convener
2. Representative of the RP Implementing NGO: Member -Secretary
3. Local UP Chairman /Ward Councillor: Member
4. Teacher from Local Educational Institution (nominated by Upazila Administration): Member
5. Representative from Local Women's Group: Member
6. Representative from the PAP Group: Member

714. Members of the GRCs will be nominated by the Executive Engineer at division level and approved by the Project Director, PMU, BWDB, Dhaka.

10.12.2 Grievance Resolution Process

715. All complaints will be received at the GRCs facilitated by the implementing agency. The aggrieved persons may opt to make complaints directly to the Project Director or Secretary of the MoWR or even to the court of law for resolution. The Member Secretary will review and sort the cases in terms of nature of grievance, urgency of resolution, and schedule hearings in consultation with the Convener. All cases will be heard within four weeks from the date of receiving the complaints.

716. If the resolution attempt at the local level fails, the GRC will refer the complaint with the minutes of the hearings to the Project Director at PMU for further review. The Project Director will assign the ESCU at PMU for review the grievance cases and assist Project Director in making decision. The ESCU will review the case records and pay field visits for cross-examining and consult the GRC members and aggrieved persons, if required. If a decision at this level is again found unacceptable by the aggrieved person(s), BWDB can refer the case to the MoWR with the minutes of the hearings at local and headquarters levels. At the ministry level, decisions on unresolved cases, if any, will be made in no more than four weeks by an official designated by the Secretary, MoWR. A decision agreed with the aggrieved person(s) at any level of hearing will be binding upon BWDB. The GRM Process is shown in Figure 10.3.

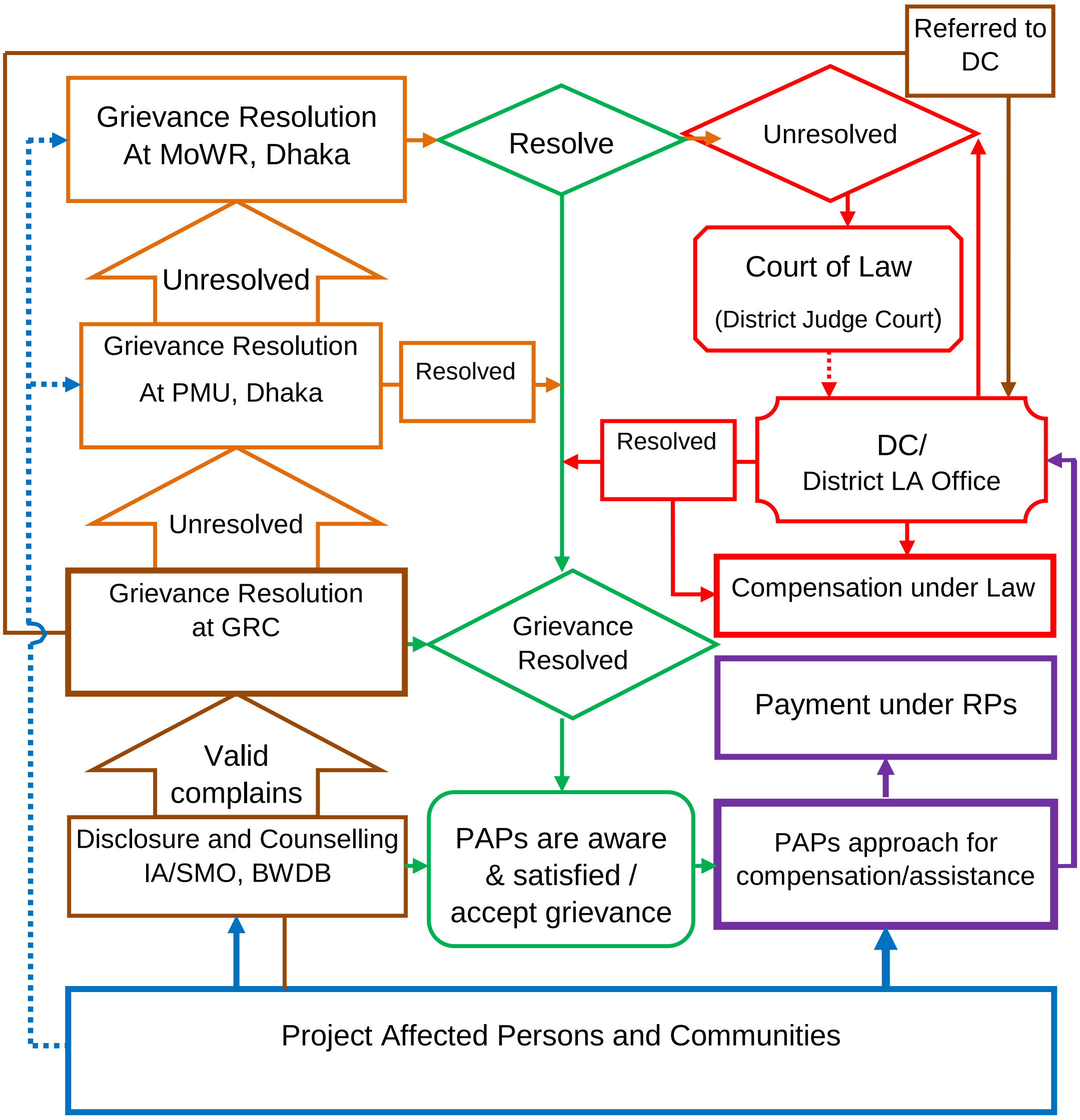


Figure 10.3: GRM Process flow Chart

717. To ensure that grievance redress decisions are made in formal hearings and in a transparent manner, the Convener will apply the following guidelines:

- Reject a grievance redress application with any recommendations written on it by a GRC member or others such as politicians and other influential persons.
- Remove a recommendation by any person that may separately accompany the grievance redress application.
- Disqualify a GRC member who has made a recommendation on the application separately before the formal hearing:
- A GRC member when is removed, appoint another person is to be appointed in consultation with the Project Director.
- The Convener will also ensure strict adherence to the impact mitigation policies and guidelines adopted in this SMRPF and the mitigation standards, such as compensation rates established through market price surveys.

10.12.3 GRM Disclosure, Documentation and Monitoring

718. The affected persons and their communities will be informed of the project's grievance redress mechanism in open meetings at important locations and in PAP group

meetings. Bangla translations of the EMF and the GRM in the form of information brochures will be distributed among the project-affected persons. The PAPs will also be briefed about the scope of the GRC, the procedure for lodging grievances cases and the procedure of grievance resolution at the project level.

719. To ensure impartiality and transparency, hearings on complaints will remain open to the public. The GRCs will record the details of the complaints and their resolution in a register, including intake details, resolution process and the closing procedures. BWDB will maintain the following three Grievance Registers:

Intake Register: (1) Case number, (2) Date of receipt, (3) Name of complainant, (4) Gender, (5) Father or husband, (6) Complete address, (7) Main grievance regarding social (loss of land/property or entitlements) or environmental, (8) Complainants' story and expectation with evidence, and (8) Previous records of similar grievances.

Resolution Register: (1) Serial no., (2) Case no.,(3) Name of complainant, (4) Complainant's story and expectation, (5) Date of hearing, (6) Date of field investigation (if any), (7) Results of hearing and field investigation, (8) Decision of GRC, (9) Progress (pending, solved), and (10) Agreements or commitments.

Closing Register: (1) Serial no., (2) Case no., (3) Name of complainant, (4) Decisions and response to complainants, (5) Mode and medium of communication, (6) Date of closing, (7) Confirmation of complainants' satisfaction, and (8) Management actions to avoid recurrence.

720. Grievance resolution will be a continuous process in RP implementation. The PMU will keep records of all resolved and unresolved complaints and grievances (one file for each case record) and make them available for review as and when asked for by WB and any other interested persons/entities. The PMU will also prepare periodic reports on the grievance resolution process and publish these on the BWDB website. The format of SMF may be used for periodic grievance reporting.

10.13 Capacity Building

721. Since the effectiveness of the Environmental Assessment & implementation depends considerably on the understanding and preparedness of their Engineers and in particular their Environmental Team (Consisting of Contractor Environmental specialist, Consultant environmental specialist, and ESCU of BWDB). It is important that the project authority makes effort to sensitize the Engineers and Environmental Team on management of environmental issues, provides guidance, and encourages them to build requisite capacities. Table 10.6 provides a summary of various aspects of the environmental and social trainings to be conducted at the construction site. PMU may revise the plan during the Project implementation as required.

722. During the O&M phase of the Project, these trainings will continue to be conducted by BWDB staff for all relevant O&M personnel and community (Table 10.6).

Table 10.6: Environmental Training

Contents	Participants	Responsibility	Schedule
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area.	Selected BWDB; PMU and DCSC staff	DCSC & ESCU	Prior to the start of the Project activities. (To be repeated as needed.)

Contents	Participants	Responsibility	Schedule
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Mitigation measures; Community issues; Awareness of transmissible diseases Social and cultural values.	PMU; DCSC; selected contractors' crew	DCSC & ESCU	Prior to the start of the field activities. (To be repeated as needed.)
EMP; Waste disposal; HSE	Construction crew	Contractors	Prior to the start of the construction activities. (To be repeated as needed.)
Road/waterway safety; Defensive driving/sailing; Waste disposal; Cultural values and social sensitivity.	Drivers; boat/launch crew	Contractors	Before and during the field operations. (To be repeated as needed.)
Camp operation; Waste disposal; HSE Natural resource conservation; Housekeeping.	Camp staff	Contractors	Before and during the field operations. (To be repeated as needed.)
Restoration requirements; Waste disposal.	BWDB core unit, Restoration teams	Contractors	Before the start of the restoration activities.
Strengthening of water management organizations(i.e. WMGs, WMAs and WMF) and beneficiaries organizations	Member of water management organizations(i.e. WMGs, WMAs and WMF) and beneficiaries organizations	BWDB, ESCU, Contractor	Before and during construction activities

723. Capacity building training programs will be undertaken in the following area:

- Training of the management level officials of BWDB, BWDB environmental compliance personnel on the overall environmental concerns and responsibilities for implementing EMP;
- Recruitment of new professionals with background on environment, if required and provide necessary training ;
- Organizing workshop, seminar, with stakeholders on the environmental concerns of CEIP-1 ;
- Special training program for the contractors and workers on the EMP and their responsibilities, who will actually be involved in the construction of the project interventions. The Contractors will be provided guideline for preparation of Environmental Action Plan in line with the construction work plan;
- Training of the WMOs on successful operation of hydraulic structures; and
- Training on structured format in reporting for all stages of implementation and those of relevant agencies who are involved in EMP implementation.

724. The training programs should be arranged before implementation of the interventions in the polder area. A detailed plan can be made by the proposed ESCU of BWDB.

11 Stakeholder Consultations and Disclosure

725. This Chapter provides details of the consultations held with the stakeholders at the Project site and framework for consultations to be carried out during construction phase. The disclosure requirements for the EIA are also included in this Chapter.

11.1 Overview

726. The GoB as well as international donors (the World Bank) place great importance on involving primary and secondary stakeholders for determining the environmental and social impacts associated with project implementation. In order to gather local knowledge for baseline conditions, understand perceptions of the community regarding impact significance, and propose meaningful mitigation measures, participation of stakeholders is an integral part of the EIA process. During the present EIA, an attempt has been made to consult with a full range of stakeholders to obtain their views on the Project interventions.

727. According to the EIA Guidelines of the DoE, public participation is obligatory for the EIAs of the Red Category projects. Public participation through consultations in the water sector project is also mandated according to the Guidelines for the Participatory Water Management (GPWM) of the BWDB. Similarly, the World Bank's OP 4.01 requires that stakeholder consultations are to be carried out at least twice for the Category A projects, once shortly after environmental screening and before the terms of reference for the EIA are finalized, and again with the draft EIA report is prepared.

728. The present EIA has been conducted after consulting with local communities, non-governmental organizations (NGOs) and concerned government departments/ organizations dealing particularly with related fields, thus ensuring that their views and concerns are taken into account in the study.

11.2 Objectives of Stakeholder Consultations

729. The following objectives have served as the moving force for the design, implementation and fact findings during the participation process:

- To provide key Project information and create awareness among various stakeholders about project intervention;
- To have interaction for primary and secondary data collection with project beneficiaries, affectees, and other stakeholders;
- To identify environmental and social issues such as displacement, safety hazards, employment, and vulnerable persons;
- To begin establishing communication and evolving mechanism for the resolution of social and environmental problems at local and Project level;
- To involve Project stakeholders in an inclusive manner; and
- To receive feedback from primary stakeholders on mitigation and enhancement measures to address the environmental and social impacts of the Project.

11.3 Approach and Methodology

730. A participatory approach was followed in conducting the public consultation meetings in Polder- 47/2. The consultants first discussed with the BWDB officials and then the Upazila Parishad Chairmen (UZPC) and/or the Upazila Nirbahi Officers (UNOs) and the Project Implementation Officers (PIOs) of the polder area to share the Feasibility and EIA process of the CEIP-1. The BWDB and local government officials/representatives were consulted to identify the potential stakeholders at the Polder level. With supports from the UNOs and/or PIOs, the union level public representatives as well as the key persons were informed about the specific consultation meetings and requested them to be present in the meeting.

731. Focus Group Discussions (FGD) were carried out during in the public consultation process. In order to conduct the FGD and consultation meetings, two checklists were prepared covering the aspects including an overview of the proposed CEIP-1, information on the ongoing EIA process, and seeking information on the problems of the area with their potential solutions, the local needs and demands have been discussed by giving equal opportunities to all participants attending in the meeting. During the consultation meetings, all relevant issues within the water resources, land resources, socio-economic resources, and disaster aspects were discussed in detail.

732. During the FGDs and consultation meetings, the EIA team displayed maps of the Project area, shared the initial concepts of the proposed interventions and facilitated the response of the participants. The stakeholders of the Polder- 47/2 were asked to share their needs, problems, possible sustainable solutions, and their views on the Project interventions. The stakeholders' perceived views on important environmental and social components (IESCs) and the impacts of the interventions on them, along with perceived benefits, risks, threats and demand from the Project were identified during discussions.

11.4 Identification of Stakeholders

733. Stakeholders include all those who will be affected and are being affected by policies, decisions or actions within a particular system. Stakeholders can be groups of people, organizations, institutions and sometimes even individuals. Stakeholders can be divided into primary and secondary stakeholder categories.

734. **Primary Stakeholders:** Primary stakeholders are the people who would be directly benefited or impacted by a certain project intervention. In case of the proposed Project i.e. in Polder- 47/2, the primary stakeholders include the people living within the Project area particularly who reside within and in the immediate vicinity of the Polder. The primary stakeholders of the Project include the farmers, fishermen, local business community as well as the households to be displaced, women groups and caretakers of community properties. Primary stakeholders identified and consulted during the present EIA include communities to be benefitted and/or affected by the Project, local leaders, community members and other local representatives.

735. **Secondary Stakeholders:** This category of stakeholders pertains to those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project aspects. In this Project, NGOs, concerned government departments and line agencies fall under this category.

736. Secondary stakeholders for the Project include local government institutions (LGI), Bangladesh Water Development Board, the Ministry of Water Resources, Department of Forest, other government agencies, academia, NGOs, the World Bank and general public at large.

Time, Date and Venue Selection

737. Venues, dates and times of meetings were selected through consultation with local people, the project proponent and the consultant. These three group selected the venues considering the closeness to the proposed project, easy accessibility to the venues and which is likely to be neutral. Dates and times were also finalized in the similar way considering availability of the participants, ensuring the maximum participation, weather and compliance with the other arrangement.

Enlisting and Invitation

738. Comprehensive lists of potential stakeholders were prepared through consultation. This list were intended to cover all sorts of interest groups, occupational groups, socially acceptable and knowledgeable peoples.

739. A formal invitation was sent to them and also communicated over telephone for ensuring their presence in the meeting.

Consultation Instrument

740. ***Checklist:*** A checklist covering all possible issues to be addressed was prepared through consultation with the multidisciplinary study team. This checklist (Appendix-11) was used in the meeting to unveil peoples' perception and opinion along with suggestions.

741. ***Attendance list:*** An inventory of the participants was maintained in attendance sheet containing contact number. Scanned list of participants is attached in Appendix-4.

742. ***Camera***: For visualizing the participants, photographs were taken using camera. These photos are presented in this chapter. Photos of the participants attended the meeting are presented at the end of this chapter.

11.5 Consultation Process

743. The study team conducted the meeting. During consultation meeting, the following process was followed with sequences.

Greetings: At the outset, the team spelled greetings to all participants. Welcomed them for attending and stated the entire design of the meeting.

Introduction: The team members introduced themselves to the participants and gave detail description of the project, spelled out about the objectives and anticipated outcome of the meeting.

Respect to the participants: The study team showed respect to all participants. They respected not only to the individuals but also to their values, cultural practices and social structures.

Ensuring peoples' voice: Generally, all participants cannot participate equally. In fact, a substantial number of participants tended to remain silent in any meeting. However, the study team encouraged all to participate willingly, explaining the ethics of the study.

Note taking: discussed issues and opinions were written in notebook carefully. All issues were given equal importance.

Recapitulation and closing the session: At the end, the study team recapitulated the session and responded to the quarries. Finally, the facilitator closed the session thanking the participants. The steps of the overall consultation process is shown in the following Figure:

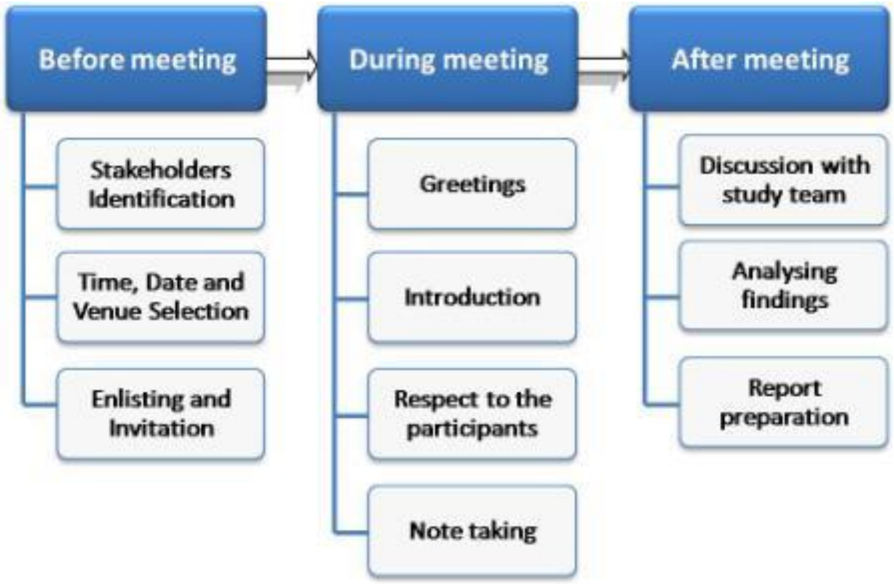


Figure 11.1: Overall Consultation Process

11.6 Stakeholder Consultation Meetings and FDGs

11.6.1 Consultation Process

744. A number of stakeholder consultation meetings and FGDs were conducted at different locations of Polder 47/2. The details of these meetings and FDGs are presented in Table 11.1 and some photographs of these meetings are given in Pictures 11.1 to .11.4.

Table 11.1: Meeting venue including time and date

Sl	District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
1	Patuak hali	Kalapara	Dablugonj	Dablugonj union Auditorium	PCM	12/08/15	10:00
2			Kalapara	Kalapara Upazila Auditorium		17/08/15	10:00
3			Dablugonj	Maherpur	FGD	23/06/15	10:30
4				Fulbunia		23/06/15	15:00
5				Thankhuli		24/06/15	11:00

Source: PCM Team of CEGIS, 2015

11.6.2 Consultation Participants

745. The main participants of the consultation meetings included public representative, farmer, trader and daily-wage laborers of the Polder- 47/2 and nearby areas. A total of 100 participants attended these consultations. The participant details are provided in Table 11.2 below:

Table 11.2: Participant Details

Sl	Meeting venue	Type of consultation	Type of Participants	No. of Participants
1	Dablugonj union Auditorium	PCM	Secondary and Primary stakeholders	36
2	Kalapara Upazila Auditorium			41
3	Maherpur	FGD	Primary stakeholders	07
4	Fulbunia			08
5	Thankhuli			08

Source: PCM Team of CEGIS, 2015

Picture 11-1: PCM at Kalapara Upazila Auditorium

Picture 11.2: PCM at Dablugonj Union Auditorium

11.7 Issues discussed in FGDs and Meetings

746. At the outset of the meetings and FGDs, an overview of the proposed Project including the ongoing activities of the implementing agencies and the EIA process are shared with the participants. Subsequently, the key environmental, social, and socioeconomic aspects listed below were discussed.

Water resources:

- Surface water (tidal flooding, drainage, salinity, siltation)
- Water management (flood control, drainage, irrigation)

Land resources:

- cropping practice,
- production and yield,
- water logging and drainage congestion
- crop damage.

Socio-economic aspects:

- Occupation and Employment (unemployment/joblessness)
- Migration (temporary/permanent out-migration)
- Poverty (food and income poverty)
- Education (poor literacy rate, non-schooling, less female education, drop out etc)
- Health and nutrition (illness, diseases, poor nutrition)
- Quality of life (poor housing and sanitation facilities, scarcity of drinking water, fuel and fodder)

Disasters:

- Cyclones
- River erosion
- Associated damages

The sustainable and integrated solutions of the main problems being faced in the Polder:

- Water resource management
- Agriculture and fisheries management
- Land resource management
- Disaster management.

11.8 Community Concerns and Suggested Solutions

747. At the outset, the study team gave a brief description about the project. The participants also stated that the project authority informed them frequently about this project. However, the stated description by the study team made them clearer about the objectives and process of the project.

11.8.1 Attitude to the project

748. The communities including the persons to be affected by the Project, expressed their views in favour of the Project and wanted early implementation to protect them from the tidal surges and disasters such as Aila and Sidr. They demanded adequate compensation and other benefits for the loss of their assets and livelihood, as well as alternative place for relocation of their houses and business.

Picture 11.3: FGD at Maherpur and Fulbunia

Picture 11.4: FGD at Thankhuli

749. The outcomes of the FGDs and consultation meetings in terms of concerns and the suggested solutions were noted and organized by themes, which are presented in the Table 11.3 below.

Table 11.3: Community Concerns and Suggested Solutions

Themes/topics	Concerns/issues/problems	Suggested solution/remedies
Overall	Tidal flooding, salinity intrusion, drainage congestion, erosion, water logging due to water control infrastructure was damaged of the polder, scarcity of drinking water and poor communication system are the main community concerns in the polder area.	Inclusive rehabilitation of the polder should be taken up at the earliest with the active involvement of the local community.
Water resources	Tidal flooding, salinity intrusion, drainage congestion, erosion, water logging	• Replace the damaged/non-functional sluices and construct new one as and where required (Eight numbers of sluices and lifting devices and gates are partially damaged condition) • Proper maintenance and management of the water control structures should be made sure • Re-sectioning of the embankment to protect erosion and embankment breach • The slope of the embankment at some places have been fallen under the thrust of wave action and damaged during monsoon where slope protection with CC block is needed. • Backing of the embankments must include slope protection and strong afforestation on the foreshore area • Strong design with high quality construction materials are to be used for construction works
Agriculture resources	• Crop damage due to entrance of saline water and drainage congestion and water logging. • Suffered from scarcity of irrigation water dry season due to siltation of rivers and internal khals	• Re-excavation of rivers and khals as per design level. • Repairing and constructed of control infrastructures should be made sure • Regular operation and maintenance the regulators. • Repair the embankment as per design level.
Fishery resources	• Reducing depth of internal khals and habitat quality degradation due to siltation • Hatchling and fish movement disrupted due to properly operation of water control structures. • Indiscriminate fishing by Sluice net • Entrance of saline water	• Re-excavation of khal will help to increase the richness of fish species in the polder area. • Application of fisheries rules and regulation by the government strongly • Take necessary action to stop illegal way to catching fish. • Repairing embankment with reasonable height.

Themes/topics	Concerns/issues/problems	Suggested solution/remedies
Ecological resources	• A number of trees would be felt and existing undergrowth vegetation would be damaged at construction sites for implementation of project activities • Lack of foreshore afforestation accelerate bank erosion as well as destruction of embankment by tidal surge	• Keep compensation to the proper owners/authorities against tree felling • Implement social afforestation along the embankment slopes • Proposed afforestation plan would arrest the vulnerabilities of embankment and protect bank erosion from tidal surge
Socio-economic resources	• A number of HHs will be displaced and their life and livelihood may be hampered due to project intervention. • Communication system is a vital issue of this polder. Embankment is only roadway communication in the polder. Roadway communications are extremely poor condition (existing embankment cum road) due to river erosion. • Lack of adequate expertise and experienced manpower to carry out the O&M of the polder and the numbers of field staffs are also insufficient and inadequate in some places of the polder with respect to the actual requirement.	• Rehabilitation of affected people should be done in proper way • Ensure proper resettlement of those household, which may be affected by the project intervention. • The embankment cum road should repair immediately which places was erode by river erosion. • Strengthening of WMGs so that mass people can access to open water bodies easily. • Need awareness building about water management, health and sanitation among the communities to reduce hazards and secured livelihood and quality of life will improve significantly.

11.9 EIA Disclosure

Regional Level Worshop

750. The EIA report and Bengali translation of its executive summary was disclosed to the public on 7th December (from 10:00am to 13:00pm), 2016 in Kalapara Upazila, Patuakhali. The main aim of the meetings was to present the findings of the final draft report on FS and EIA and having feedback from the local stakeholders attended. The report was also finalized through incorporation of comments and suggestions got from the meetings.

751. The participants of the PDM include Upazila Chairman, Kalapra, Upazila Nirbahi Officer (UNO), other concerned government officials, Journalists, NGO representatives, environmentalists and activists, local stakeholders and other representatives of CEGIS. A total of 54 participants attended the public disclosure meetings. The findings of the Public Disclosure Meeting (PDM) and some photographs of the meeting are given in Photo 11.5

Picture 11.5: PDM at Upazila Auditorium, Kalapara, Patuakhali

Findings of the PDM:

752. The communities including the persons to be affected of Polder 47/2 by the Project expressed their views in favour of the Project and wanted early implementation to protect them from natural disasters. They demanded following actions to be taken immediately. These are:

- Due to the closure in Polder 47/2 area, at present 4 Union Parishads are facing serious water logging problems. Consequently, the bread and butter of the people are being hampered. So, this problem may be solved by the making switch gates which may remove water through canals.
- The situation regarding salinity intrusion is also getting worse, since most of the switch gates became out of use. So the project activities need to start immediately.
- Issues like climate change, sustainable development etc should be taken into consideration while implementing the project.
- There is a lack of co-ordination between the Bangladesh Water Development Board (BWDB) and the Ministry of Water Resources, which is affecting the project.
- Effective monitoring should be maintained during the construction of the project activities.
- The intrusion of saline water might be controlled by the improvement of embankment.
- Need awareness building among the communities about water management;
- Ensure proper compensation for affected people

- O & M for embankments and sluice gates in the polder area
- Need formation of Water Management Organizations (MWOs) to manage properly water control structures
- New embankment is required to be constructed by developing village road.

National Dissemination Seminar

A dissemination seminar on the "Environmental Impact Assessment (EIA) on Six Polders under Package-2 of CEIP-1 at Spectra Convention Centre, Gulshan 1, Dhaka was held on 25 January 2017. Mr. Anisul Islam Mahmud, M.P, Hon'ble Minister, Ministry of Water Resources Government of the People's Republic of Bangladesh, graced the occasion as the chief guest and Mr. Muhammad Nazrul Islam, Bir Protik, M.P, Hon'ble State Minister, Ministry of Water Resources, Government of the People's Republic of Bangladesh was present as the Guest of Honour. Dr. Zafar Ahmed Khan, Senior Secretary, Ministry of Water Resources, Government of the People's Republic of Bangladesh and Engr. Md. Waji Ullah, Executive Director, CEGIS were the special guests in the seminar. The meeting was chaired by Mr. Md. Mahfuzur Rahman, Additional Director General (West region), BWDB.

The program started with registration of the participants at 9:30 am. Thereafter, the seminar commenced at 10:00 am through recitation from the holy Quran. Mr. Md. Delwar Hossain, Project Director, CEIP-1, BWDB delivered the welcome speech. After that Mr. Malik Fida Abdullah Khan, Deputy Executive Director (Operation), CEGIS presented the findings of the Environmental Impact Assessment (EIA) study of six polders under package-2 of CEIP-1.

Picture 11.6: Chief Guest, Guest of Honour, Special Guests and Project Director

Picture 11.7: Welcome Speech by the Project Director of CEIP-1

Picture 11.8: Presentation of EIA findings by Mr. Malik Fida Abdullah Khan, Deputy Executive Director (Operation), CEGIS

Picture 11.9: View of Participants of the Seminar

Picture 11.10: A view of open discussion

Picture 11.11: Special Guest delivering his speech

Picture 11.12: Special Guest delivering his speech

Picture 11.13: Guest of Honour delivering his speech

Picture 11.14: Chief Guest delivering his speech

Picture 11.15: Closing remarks by the Chair

753. National experts from multi-disciplinary fields such as engineers, agriculturists, economists, environmentalist, sociologists and other as well as local stakeholders were present in that seminar. Besides, three international Environmentalists were present in the seminar.

754. After the presentation, the floor was opened for all to take part in discussion on the study. A host of participants took part in discussions and expressed valuable comments and suggestions on the study.

755. The minutes of the dissemination seminar containing entire area inter-alia the Comments and Responses is provided in **Appendix-13**

11.10 Framework for Consultations during Project Implementation

756. The stakeholder consultation is a continued process, and should be maintained throughout the project. The consultations carried out during the present EIA and reported in this Chapter are essentially a first step in this process. During the subsequent project phases as well, participation of the project stakeholders need to be ensured. Table 11.4 charts out the proposed participation framework during different project Phases.

Table 11.4: Participation Framework

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
Project Design Phase	Meetings with institutional stakeholders (carried out during the present EIA and RAP preparation); meetings with grass root stakeholders (carried out during the present EIA and RAP preparation)	Institutional stakeholders; Grass root stakeholders, including the communities to be affected by the Project.	EIA consultant.
Project Construction Phase	Information disclosure (sharing of the project objectives, project components, major benefits, potential impacts, mitigation measures and Resettlement Plan with the affected communities and other stakeholders).	Institutional stakeholders; Grass root stakeholders, including the communities to be affected during the project implementation.	BWDB; Supervision Consultants; Contractors
	Consultations and liaison	The communities around the work sites, borrow areas, and access routes	BWDB; Supervision Consultants; Contractors
	Grievance Redress Mechanism and Social Complaint Register (discussed later in the document).	The affected communities.	BWDB; Supervision Consultants; Contractors
	Consultations with the communities during Compliance Monitoring and Effects Monitoring (discussed later in the document).	Affected communities.	BWDB; Supervision Consultants; Contractors
	Consultations with the project affectees / communities during the external monitoring (discussed later in the document).	Affected communities.	External monitoring consultants.
	Consultations with the project affectees / communities during the site visits by the WB monitoring mission.	Project site staff; Contractors; Affected communities.	WB monitoring mission.
Project Operation Phase	Community participation in O&M activities (see Section 4.9)	Institutional stakeholders; Grass root stakeholders, including the beneficiary communities.	BWDB

References

Alam, M., and Laurel, M., 2005. Facing Up To Climate Change in South Asia, Gatekeeper Series, 118, International Institute for Environment and Development, London, UK

BARC (2012). (Bangladesh Agricultural Research Council), Fertilizer Recommendation Guide, Farm gate, Dhaka-1215.

BBS, 2011. Population Census 2011, Bangladesh Bureau of Statistics (BBS), Statistical Division, Ministry of Finance and Planning,

Francisco A. S., 1996. Catchability: a key parameter for fish stock assessment. Reviews in Fish Biology and Fisheries. Volume 6, Issue 2, pp 221–242.

GOB. DoE, 1997, EIA Guidelines for Industries. Department of Environment (DoE), Dhaka, Bangladesh.

Hassan, A., Hossain B.M.T.A., and Ahsan, M. R. 2010a. Mean Area Distribution Method for Downscaling GCM Results. In: Choudhury, G. A., Hassan, A., and Ahmed, A. U.(Eds.), Climate Change Risk and Adaptation for Bangladesh, CEGIS, Dhaka, Bangladesh.

Hilborn and Walters, 1992. Quantitative fisheries stock assessment: Choice, dynamics and uncertainty. Reviews in Fish Biology and Fisheries. Volume 2, Issue 2, pp 177–178.

IPCC, 2001, Climate Change 2001: The scientific Basis, Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Houghton, J.T., Ding. Y., Griggs, D.J., Noguer, M., van der Linden, P.J., Dai, X., Maskell, K., Johnson, C.A. (Eds), IPCC, Cambridge University Press, Cambridge, p. 881.

IPCC, 2007, Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller, H.L. (Eds), IPCC, Cambridge University Press, Cambridge, p. 996.

IUCN, 2000. Red list of threatened animals of Bangladesh. The World Conservation Union (IUCN), Dhaka, Bangladesh. 54 pp.

IWM and CEGIS: 2007. “Investigating the Impact of Relative Sea-Level Rise on Coastal Communities and their Livelihoods in Bangladesh”

MoWR, 1999. National Water Policy, Ministry of Water Resources, Government of the People’s Republic of Bangladesh.

MoWR, 2005. Coastal Zone Policy, Ministry of Water Resources, Government of the People’s Republic of Bangladesh.

Nishat, A., Huq, S.M. Imamul, Barua, Shuvashish P., Reza, Ali A.H.M., Khan, Moniruzzaman A.s. (eds.), 2002. Bio-ecological zones of Bangladesh. IUCN Bangladesh Country Office, Dhaka, Bangladesh, xii+ 141 pp.

SOLARIS-SRDI (Soil and Land Resources Information System-Soil Resource and Development Institute), 2006. SOLARIS Model developed by Center for Environmental and Geographic Information Services (CEGIS) for Soil Resource and Development Institute (SRDI), Farmgate, Dhaka-1215.

Thompson, P., Chowdhury, S.N. (2007). Experiences in wetland co-management: the MACH project. Proceedings of the CBFM-2 International Conference on Community Based Approaches to Fisheries Management. The WorldFish Center.

UNDP, 1982,Ground Water Survey:The Hydrological conditions of Bangladesh. UNDP Technical Report. DP/UN/BGD-74-009/1, 113 P

WARPO, 2005. Guidelines for Environmental Assessment of Water Management (flood control, Drainage and Irrigation) projects. National Water Management Project. Water Resources Planning Organization (WARPO), Dhaka

World Bank. 2010, The Cost to Developing Countries of Adapting to Climate Change; New Methods and Estimates, Washington DC, USA

Appendix 1: Construction Schedule

Table 1: Construction Schedule

Part A

SI No	Description	Year One								Year Two			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)												
2	Construction of embankment (km)												
3	Construction of Drainage Sluices (No)												
4	Construction of Flushing Inlets (No)												
5	Bank and Slope Protection Works (km)		Manufacture of cc blocks and procurement of hard rock										
6	Re-excavation of Drainage Channels (km)												
7	Repairing of Drainage Sluices and Flushing Inlets												
8	Constructing Roads												
9	Other works, including surveys, quality checks, testing, inspections and the like												

Part B

SI No	Description	Year Two								Year Three			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)					Turfing							
2	Construction of embankment (km)												
3	Construction of Drainage Sluices (No)												
4	Construction of Flushing Inlets (No)												
5	Bank and Slope Protection Works (km)												
6	Re-excavation of Drainage Channels (km)												

7	Repairing of Drainage Sluices and Flushing Inlets												
8	Constructing Roads												
9	Other works, including surveys, quality checks, testing, inspections and the like												

Part C

Sl No	Description	Year Three								Year Four			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)												
2	Construction of embankment (km)												
3	Construction of Drainage Sluices (No)												
4	Construction of Flushing Inlets (No)												
5	Bank and Slope Protection Works (km)												
6	Re-excavation of Drainage Channels (km)												
7	Repairing of Drainage Sluices and Flushing Inlets												
8	Constructing Roads												
9	Other works, including surveys, quality checks, testing, inspections and the like												
10	Site clearance and clean up												

Appendix 2: No Objection Certificates

১১ নং ডালবুগঞ্জ ইউনিয়ন পরিষদ
কলাপাড়া, পটুয়াখালী

স্মারক নং- ৪৯ তারিখ- ২২/৮/১৫

অবস্থানগত/পরিবেশগত ছাড়পত্রের স্থানীয় কর্তপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্রের ছক

১। আবেদনকারীর নাম ঃ প্রকল্প পরিচালক, সিইআইপি-১ (CEIP-1), বাংলাদেশ পানি উন্নয়ন বোর্ড ।

২। পিতা/স্বামীর নাম ঃ প্রযোজ্য নয়

৩। আবেদনকারীর ঠিকানা ঃ প্রকল্প পরিচালক, সিইআইপি-১ (CEIP-1), বাংলাদেশ পানি উন্নয়ন বোর্ড হাউস নং-১৫,রোড নং-২৪,গুলশান-২ ঢাকা-১২১২।

৪। প্রকল্পের অবস্থানগত ঠিকানা ঃ পোল্ডার ৪৭/২, পটুয়াখালী জেলা কলাপাড়া উপজেলায় অবস্থিত।

৫। প্রকল্পের তফছিল ঃ

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
পটুয়াখালী	কলাপাড়া				মাঝারি উচু ভূমি	হেক্টর

৬। প্রকল্পের কার্যক্রম ঃ বাঁধ উচুঁকরন, স্লুইজ গেট ও রেগুলেটর মেরামত, খাল পূনঃখনন ইত্যাদি।

উপরোক্ত তথ্যাদির আলোকে পোল্ডার ৪৭/২ পূর্নবাসন প্রকল্প বাস্তবায়নের জন্য নিম্নেবর্ণিত অনাপত্তি প্রদান করা হলো।

শর্তাবলী ঃ

১। প্রকল্প/ স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষণ আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে।
২। পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত ছাড়পত্র গ্রহণ করতে হবে।
৩। কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তার নিশ্চিত করতে হবে।
৪। উপযুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে। এবং অগ্নিকান্ড কিংবা অন্য কোন দূর্ঘটনার সময় জরুরী নির্গমন ব্যবস্থা থাকতে হবে।
৫। বায়ু ও শব্দ দূষন করা যাবে না।
৬। প্রকল্প সৃষ্ট তরল বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না।

উপরে উল্লিখিত যে কোন শর্ত লঙ্গন করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক কারখানা/প্রকল্পের বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

২২/০৮/১৫
আবদুস সালাম সিকদার
চেয়ারম্যান

তারিখ ঃ স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও সীলঃ

Appendix 3: Standard for Physico- Chemical Properties of Soil

Table 1a: Soil Salinity (ECe) class and soil reaction (p^H)

Characteristics	Salinity range (ECe=ds/m)*	Characteristics/Soil reaction class	pH range
Non Saline	0-2.0	Very strongly acidic	<4.5
Very Slightly Saline	2.1-4.0	Strong acidic	4.5-5.5
Slightly Saline	4.1-8.0	Slightly acid	5.5-6.5
Moderately Saline	8.1-12.0	Neutral	6.6-7.3
Strongly Saline	12.1-16.0	Slightly alkaline	7.4-8.4
Very Strongly Saline	>16.0	Strongly alkaline	8.5-9.0
		Very strongly alkaline	>9.0

Source: Soil and Land Utilization appraisal, SRDI; 1999

Table 1b: Classification of nutrient elements based on chemical properties of soil

Nutrient element	Very Low	Low	Medium	Optimum	High	Very high
OM (%)	<1.0	1.0-1.7	1.8-3.4	-	3.5-5.5	>5.5
N(%)	≤0.09	0.091-0.18	0.181-0.27	0.271-0.36	0.361-0.45	>0.45
P(µg/g)(Olsenmethod)	≤7.5	7.51-15.0	15.1-22.5	22.51-30.00	30.1-37.5	>37.5
K (meq/100g)	≤0.09	0.091-	0.181-0.27	0.271-0.36	0.361-0.45	>0.45
s(µg/g)	≤7.5	7.51-15.0	15.1-22.5	22.51-30.00	30.1-37.5	>37.5
Zn(µg/g)	≤0.45	0.451-0.9	0.91-1.35	1.351-1.8	1.81-2.25	>2.25

Sources: Fertilizer Recommendation Guide, BARC, 2012

Appendix 4: List of Participants of PCM

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান ঃ উপজেলা পরিষদ মিলনায়তন, কলাপাড়া

সময় ঃ

তারিখঃ ১৭/০৮/২০১৫

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১	মোঃ [illegible]	চেয়ারম্যান উপজেলা পরিষদ	01716538157	
২	[illegible] UNO (Acting)	সহকারী কমিশনার (ভূমি) কলাপাড়া	01733334156	
৩	মো: [illegible]	অফিসার ইনচার্জ [illegible]	01718640775	
৪	মোঃ মনিরুজ্জামান খান	উপজেলা [illegible] USEO	01712274629	
৫	মো: [illegible]	SO FO, DoF	01716537230	
৬	[illegible]	[illegible]	01740975201	
৭	[illegible]	USSO	01711113397	১৭/৮/১৫
৮	মোহাম্মদ আরিফুজ্জামান	উপজেলা শিক্ষা অফিসার (মাঃ) কলাপাড়া	01718176151	
৯	মোঃ তরিকুল ইসলাম	উপজেলা সমবায় অফিসার, কলাপাড়া	01717886116	১৭/৮/১৫
১০	মোঃ বেলায়েত হোসেন	ভারপ্রাপ্ত কর্মকর্তা, বনবিভাগ	01712-230731	১৭/৮/১৫
১১	[illegible]	[illegible]	0172-1810055	১৭/৮/১৫
১২	মোঃ [illegible]	[illegible]	01718562688	
১৩	[illegible]	[illegible]	01724055311	
১৪	মোসা: [illegible]	[illegible] ১১নং UP	0176199177	
১৫	[illegible] বেগম	উপঃ [illegible]	01721059834	১৭/৮/১৫
১৬	মোঃ [illegible]	C.I.P. [illegible]	01721457325	১৭/৮/২০১৫
১৭	[illegible]	[illegible]	01757435722	১৭/৮/১৫
১৮	মোঃ [illegible]	[illegible]	01758053259	১৭/৮/১৫

আয়োজনে
CEGIS Center for Environmental and Geographic Information Services
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক
মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থানঃ উপজেলা পরিষদ মিলনায়তন কলাপাড়া

সময় ঃ

তারিখঃ ১৭/০৮/২০১৫

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯	মোঃ আইয়ুব আলী	ইউ.পি সদস্য [illegible]	01775566874	[illegible]
২০	মোঃ ফারুক হাওলাদার	সমাজ সেবক	01813991187	ফারুক
২১	মোঃ আলাউদ্দিন খাঃ	সমাজ সেবক	01791080630	[illegible]
২২	[illegible] নুরুল আমিন	[illegible]	01718435045	[illegible]
২৩	আঃ ছালাম তালুকদার	চেয়ারম্যান	01715097407	[illegible]
২৪	মোঃ [illegible]	UDBO	01865042151	[illegible] ১৭/৮/১৫
২৫	মোঃ [illegible]	UPHE	01740978718	[illegible]
২৬	[illegible]	VWAO	01720494734	[illegible] ১৭-০৮-১৫
২৭	মাহবুবুল ইসলাম	SDE	01711 314365	[illegible] ১৭/৮/১৫
২৮	মোঃ আমিনুল ইসলাম	URDO	01714-244355	[illegible]
২৯	বিলকিস জাহান	ভাইস.চেয়ারম্যান	01710703241	[illegible]
৩০	মোঃ মাসুদ আলম	[illegible]	01718668935	[illegible] ১৭/৮/১৫
৩১	রেহানা সুলতানা	সাঁট-মুদ্রাক্ষরিক	01815442875	রেহানা ১৭/৮/১৫
৩২	[illegible] মোঃ [illegible]	সহ-সভাপতি [illegible]	01924590318	[illegible]
৩৩	উবায়দুল্লাহ	মিস্ত্রী	01824805470	[illegible]
৩৪	আবদুল মতিন	[illegible]	0172-3848256	[illegible] ১৭/৮/১৫
৩৫	মোঃ [illegible]	[illegible]		[illegible]
৩৬	মোঃ মোশারফ মিয়া	[illegible]		মোশারফ

আয়োজনে CEGIS Center for Environmental and Geographic Information Services
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক
মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান ঃ উপজেলা পরিষদ মিলনায়তন, কলাপাড়া

সময় ঃ

তারিখঃ ১৭/০৮/২০১৫

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৩৭	মো: কামরুজ্জামান	[illegible]		কামরুজ্জামান
৩৮	[illegible]	ঐ		[illegible]
৩৯	মো: জাকির হাওলাদার	ঐ		জাকির
৪০	মো: [illegible]	ঐ		[illegible]
৪১	মো: কামরুজ্জামান [illegible]	ঐ		[illegible]

আয়োজনে
CEGIS Center for Environmental and Geographic Information Services

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান ঃ [illegible] ইউনিয়ন পরিষদ, কলাপাড়া
সময় ঃ

তারিখঃ ২২/০৮/২০১৫

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১.	[illegible]	চেয়ারম্যান	01715095407	[illegible]
২.	মো: আবদুর রহমান	মেম্বার-৪	01757435722	[illegible]
৩.	মো: [illegible]	মেম্বার-৬	[illegible]	[illegible]
৪.	[illegible]	কৃষি	01724055311	[illegible]
৫.	মো: [illegible]	কৃষি	01748560189	[illegible]
৬.	মো: আলমগীর হোসেন	[illegible]	01740991850	[illegible]
৭.	মো: [illegible]	কৃষি	01925495484	[illegible]
৮.	মো: [illegible]	কৃষি	01725881731	[illegible]
৯.	মো: [illegible]	কৃষি	01712560014	[illegible]
১০.	[illegible]	ইউপি সচিব	0172-1810055	[illegible]
১১.	মো: [illegible]	কৃষি	01714043852	[illegible]
১২.	[illegible]	কৃষি	01733393984	[illegible]
১৩.	মো: সুলতান [illegible]	কৃষি	[illegible]	[illegible]
১৪.	এ,বি,এম নূরুল আমিন	[illegible]	01718435045	[illegible]
১৫.	মো: [illegible]	কৃষি	01733172233	[illegible]
১৬.	মো: [illegible]	কৃষি	[illegible]	[illegible]
১৭.	[illegible]	ইউপি: [illegible]	01371607410	[illegible]
১৮.	মো: [illegible]	UISC	01736224112	[illegible]

আয়োজনে
CEGIS **Center for Environmental and Geographic Information Services**
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান ঃ জালালপুর ইউনিয়ন পরিষদ, কলাপাড়া
সময় ঃ
তারিখঃ ১২/০৮/২০১৬

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯.	মো: মজিবুর রহমান	জালালপুর	01760960468	[illegible]
২০.	মো: [illegible]	জামালপুর	01791080630	[illegible]
২১.	মো: [illegible] মোড়ল	[illegible]	01727429832	[illegible]
২২.	মো: [illegible]	[illegible]	01757441368	[illegible]
২৩.	মো: [illegible]	[illegible]	0172335874	[illegible]
২৪.	মো: [illegible]	ইউ.পি. সদস্য	0177[illegible]	[illegible]
২৫.	মোসা: [illegible]	[illegible]	017[illegible]33082	[illegible]
২৬.	মো: [illegible]	জালালপুর	01721457325	[illegible]
২৭.	মো: [illegible]	সহকারী শিক্ষক	01719018349	[illegible]
২৮.	মো: [illegible]	[illegible]	01236249800	[illegible]
২৯.	[illegible]	জালালপুর	01926035872	[illegible]
৩০.	মো: [illegible]	[illegible]	01712569014	[illegible]
৩১.	মো: [illegible]	[illegible]	01719635082	[illegible]
৩২.	মো: [illegible]	[illegible]	01949361185	[illegible]
৩৩.	মো: [illegible]	[illegible]	01674932673	[illegible]
৩৪.	মো: আবু [illegible]	[illegible]	01860196260	[illegible]
৩৫.	মো: [illegible]	[illegible]	01845293702	[illegible]
৩৬.	[illegible]	[illegible]	01936383759	[illegible]

আয়োজনে
CEGIS Center for Environmental and Geographic Information Services
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

List of FGD's participants

SL	Name	Gender	Occupation	Age	Address/Mobile No
1	Md. Abu Bakkar	M	Fisherman	42	Maherpur
2	Md. Nurujaman	M	Ex UP Member	45	1718898334
3	Abu Yousuf	M	Day labor	30	Maherpur
4	Md. Millat Hossain	M	Day labor	42	Maherpur
5	Md. Saber Ali Mallick	M	Farmer	70	Maherpur
6	Abdus Sattar	M	Old aged	74	Maherpur
7	Md. Ansar Hawlader	M	Business	55	1728632273
8	Md. Sajahan Ali	M	Farmer	60	Thankhuli
9	Md. Motahar Hossain	M	Student	25	Thankhuli
10	Md. Belal Mallick	M	Farmer	55	Thankhuli
11	Md. Selim	M	Student	25	Thankhuli
12	Md. Sulaiman	M	Day labor	42	Thankhuli
13	Md. Abdul Hamid	M	Farmer	60	Thankhuli
14	Md. Golam Kibria	M	Day labor	45	Thankhuli
15	Abdur Rashid Talukder	M	Farmer	55	Thankhuli
16	Nurul Hoque	M	Business	25	1710121300
17	Md. Golam Mawla	M	Amin	62	Fulbunia
18	Abdus Sattar	M	Business	55	Fulbunia
19	Md. Altaf Hossain	M	Farmer	60	Fulbunia
20	Md. Golam Kuddus	M	Farmer	60	Fulbunia
21	Md. Ismail Hossain	M	Farmer	48	Fulbunia
22	Md. Nural Mia	M	Farmer	51	Fulbunia
23	Md. Zinnah Shekh	M	Day labor	40	Fulbunia
24	Md. Surab Ali	M	Farmer	42	Fulbunia
25	Abdul Latif	M	Farmer	50	Fulbunia

Appendix 5: List of Participants of PDM at Kalapara Upazila, Patuakhali

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

স্থান : ~~[illegible]~~ কলাপাড়া উপজেলা পরিষদ মিলনায়তন

সময় : ১০.৩০ (সকাল)

তারিখ: ০৭/১২/২০১৬

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১.	আবু [illegible]	চেয়ারম্যান কলাপাড়া উপজেলা	০১৭১৫৬০৮৭৮৯	[illegible]
২.	এ.বি.এম. সাদিকুর রহমান	UNO, কলাপাড়া	01733334155	[illegible]
৩.	[illegible]	মেয়র কলাপাড়া পৌরসভা	01712877242	[illegible]
৪.	মো: [illegible]	[illegible]	01718690725	[illegible]
৫.	[illegible] মাহমুদ	[illegible]	01819459528	[illegible]
৬.	মো: [illegible]	[illegible], NSS, কলাপাড়া	01757682272	[illegible]
৭.	মো: [illegible]	[illegible] CODEC	01718787743	[illegible]
৮.	[illegible]	[illegible]	01755532470	[illegible]
৯.	S. M. Mahedi Hasan	DRM Analyst, World Bank	01827525068	Mehedi
১০.	মো: [illegible]	[illegible]	01725651141	[illegible]
১১.	মো: [illegible]	U.P - [illegible]	01758065259	[illegible]
১২.	মো: [illegible]	[illegible]	01775566824	[illegible]
১৩.	[illegible]	প্রতিনিধি দৈনিক যুগান্তর	01712689367	[illegible]
১৪.	[illegible]	প্রতিনিধি দৈনিক [illegible]	01711144770	[illegible]
১৫.	[illegible]	প্রতিনিধি দৈনিক [illegible]	01715042673	[illegible]
১৬.	[illegible]	[illegible]	01712699815	[illegible]
১৭.	[illegible]	[illegible]	01715[illegible]11588	[illegible]
১৮.	[illegible]	[illegible]	01720208028	[illegible]

C≋GIS Center for Environmental and Geographic Information Services
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

স্থান ঃ কলাপাড়া ~~বরগুনা সদর~~ উপজেলা পরিষদ মিলনায়তন

সময় ঃ

তারিখঃ ০৭।১২।২০১৬

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯.	হুমায়ুন কবীর	দৈনিক বরিশালের কলাপাড়া [illegible]	01718440023	[illegible]
২০.	[illegible]	[illegible] প্রতিনিধি	01728467047	[illegible]
২১.	[illegible] বিশ্বাস	[illegible]	01739024476	[illegible]
২২.	মো: আহাদ উজ্জামান [illegible]	সহঃ পরিচালক [illegible]	01712200762	[illegible]
২৩.	[illegible]	[illegible]	01711316365	[illegible]
২৪.	আ: ছালাম [illegible]	চেয়ারম্যান [illegible] ইউ/পি	01715097407	[illegible] 7/12/16
২৫.	[illegible] চন্দ্র দাস	U.P.D.O	[illegible]	[illegible] 7/12/16
২৬.	[illegible]	[illegible]	01725023742	[illegible]
২৭.	মো: [illegible]	[illegible]	01717886116	[illegible]
২৮.	মো: [illegible]	[illegible]	01735032545	[illegible]
২৯.	[illegible]	[illegible]	01718272044	[illegible]
৩০.	[illegible]	Ecologist, CEGIS	[illegible]	[illegible] saha
৩১.	[illegible]	Socio-Economist CEGIS	01713-865525	[illegible]
৩২.	মো: [illegible] ইসলাম	URDO - BRDB	01714-244355	[illegible]
৩৩.	ডাঃ মোঃ হাবিবুর রহমান	ULO	017[illegible]623474	[illegible]
৩৪.	সুমন চন্দ্র দেবনাথ	PIO	01912-940894	[illegible]
৩৫.	[illegible]	UPHE	01740978118	[illegible]
৩৬.	মো: [illegible]	UAO	01716349939	[illegible]

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

[illegible]
স্থান ঃ ~~[illegible]~~ উপজেলা পরিষদ মিলনায়তন

সময় ঃ

তারিখঃ ০৭।১২।২০১৫

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
০১	মো: [illegible]	[illegible]	01712512887	[illegible]
০২	[illegible]	[illegible]	01717325640	[illegible]
০৩.	আবদুল্লাহ [illegible]	চেয়ারম্যান	0172-3848256	[illegible]
০৪.	উজ্জ্বল রায়	সাংবাদিক	01824805440	[illegible]
০৫	মো: [illegible]	[illegible]	01716400378	[illegible]
০৬	[illegible]	[illegible]	01950700563	[illegible]
৭	মো: [illegible]	অফিস সহকারী	01720462768	[illegible]
৮	মো: [illegible]	"	০১৭৫১০৬৭০১১	[illegible]
৯।	আবদুল্লাহ আল মোমেন	কার্যালয়	01718815559	মোমেন
১০।	[illegible]	[illegible]	01726562640	[illegible]
১১।	[illegible]	"	01758923142	[illegible]
১২।	[illegible]	[illegible]	01748250946	[illegible]
১৩।	মো. [illegible]		01715851834	[illegible]
১৪।	মো: [illegible]	অফিস সহায়ক	01722955581	[illegible]
১৫।	[illegible]	[illegible]	01712798223	[illegible]
১৬	মো: [illegible]	U.T	01724496120	[illegible]
১৭	মো: [illegible]	উপজেলা [illegible]	01739930969	[illegible]
১৮	[illegible]	উপজেলা মহিলা বিষয়ক কর্মকর্তা	01720494734	[illegible]

Appendix 6: Photo Album

Picture1:Non-functioned Drainage Sluice (DS)

Picture 2: Damaged Drainage Sluice (DS2)

Picture 3: Narrow Embankment

Picture 4: Narrow Embankment

Picture 5:Non-functioned Flashing Sluice(FS)

Picture 6: Existing condition of FS3

Picture 7: Periphery River

Picture 8: Afforastation in the polder area

Picture 9: BWDB closer

Picture10: Agriculture field and tidal floodplain

Picture 11: Location of Proposed FS

Picture 12: Location of Proposed FS

Picture 13: Location of Revetment Activity

Picture 14: Location of Revetment Activity

Picture 15: Primary school

Picture 16: Primary school

Picture17: View of public consultation

Picture 18: View of public consultation

Picture 18: View of public consultation meeting (Dulbugang UPZ)

Picture 18: View of public concentration meeting (Kolapra UPZ)

Picture 19: View of public consultation meeting (Kolapra UPZ)

Picture 20: View of public consultation meeting (Kolapra UPZ)

Appendix 7: DoE's Approved Terms of Referrence (ToR)

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207
www.doe-bd.org

Memo No : DoE/Clearance/5196/2013/125 Date: 05/06/2013

Subject: Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I).

Ref: Your Application dated 31/03/2013.

With reference to the above mentioned subject, the Department of Environment (DOE) hereby accords Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I) at Satkhira, Khulna, Bagerhat, Pirojpur, Patuakhali and Barguna Districts subject to fulfilling the following terms and conditions.

I. This clearance shall only be applicable for the development of the infrastructure of the said project.
II. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) report considering the overall activity of the said Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE).
III. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)

4a. Project activities:
- A list of the main project activities to be undertaken during site clearing, construction as well as operation
- Project Plan, Design, Standard, Specification, Quantification, etc.

4b. Project schedule: The phase and timing for development of the Project

4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.

4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.

5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
   - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
   - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
   - Environment Quality : Air, Water, Soil and Sediment Quality
   - Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions
6. Socio-economic environment should include, inter alia, following:
   - Population: Demographic profile and ethnic composition
   - Settlement and housing
   - Traffic and transport
   - Public utilities: water supply, sanitation and solid waste
   - Economy and employment: employment structure and cultural issues in employment
   - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.
7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).
   In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the

1/2

scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man maid or natural, wildlife, socio-economic aspect shall be incorporated in detail.

8. Management Plan/Procedures:
For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.
An outline of the Environmental Management Plan shall be developed for the project.
In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)
Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
10. Conclusion and Recommendations

IV. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.
V. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project.
VI. Violation of any of the above conditions shall render this clearance void.
VII. The project authority shall submit the EIA along with an application for Environmental Clearance, the applicable fee in a treasury chalan and the no objection certificates (NOCs) from the local authority to the head office in Dhaka with a copy to the Khulna and Barisal Divisional Office of DOE.
VIII. This clearance is valid for one year from the date of issuance and the project authority shall apply for renewal to Head Office with a copy to the Khulna and Barisal Divisional Office of DOE at least 30 days ahead of expiry.
IX. This Site Clearance Certificate has been issued with the approval of the appropriate authority.

05.06.2013

(Syed Nazmul Ahsan)
Deputy Director (Environmental Clearance)
&
Member Secretary
Environmental Clearance Committee
Phone # 02-8181778

Mr. Md. Sarafat Hossain Khan
Superintending Engineer & Project Coordinator
Coastal Embankment Improvement Project (Phase-I)
Bangladesh Water Development Board (BWDB)
72, Gre[illegible]d, Dhaka-1205.

Copy Forwarded to :

1) PS to Secretary, Ministry of Environment and Forest, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Khulna/Barisal Divisional Office, Khulna/Barisal.
3) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

2/2

Appendix 8: Comments and Responses

Comments, responses and actions taken on Draft EIA Report of Polder 47/2 under CEIP-1

Sl	Comments	Responses
1	Table 4.8 and Para 186, stated a list of construction machineries to be used for the construction activities. However, it is not mentioned in this document that how and which roads would be used to bring these machines inside the polder as no paved road seem to exist connecting this polder with the regional highway (Barisal-Kuwakata) which can carry this kind of load. This should be added in this document.	In order to carry construction materials, only waterway is the solution. It is not feasible to use Barisal-Kuwakata Main road. Because the Polder is located around 3 km apart from that main road. This connecting earthen road is not at all suitable for carrying the heavy load. Furthermore, it is too narrow for heavy vehicular movement. At best microbus can be used. However it is mentioned in alternative section (art 7.3.6)
2	Para 210 Regulation of Gates. According to this paragraph, regulators will remain largely closed during pre-monsoon and monsoon. However, in Table 6.14 (operation phase) indicates that regulator operation will facilitate the migration of fish species.	The decision of keeping the regulator open or close largely depend on water level, fish migration; rainfall intensity and agricultural practices. And it is distinctly mentioned in the Art 4.10.1 regarding this variation of decision making process with the seasonal condition.
3	Para 224: No implementation cost associated with this report.	Project implementation cost has been provided.
4	Para 268 and Table 5.4. It is difficult to understand the local condition of water quality with a single reading. Almost all these parameters are highly variable with time of year and even fluctuate with tide condition. In the report it is written June 2015. So it is some time in the early monsoon, but the onset of the monsoon also varies and so the readings of these parameters. At least for salinity model outputs from IWM may provide a better understanding, Monsoon 2015 was late and so salinity level probably showing a bit higher than the average year.	This depends on the time when the measurement was taken. An unpredictable tidal interference can raise the salinity level anytime.
5	List of species in Table 5.9 is different from the list given Para 283-286 and Para 298.	It has been corrected in Table 5.14 according to description.

Sl	Comments	Responses
6	Para 299. According to the definition Protected Areas in Bangladesh, several different types of protected area exist in the country, Why only the ECA?	CEIP study area does cover a certain portion within which only one ECA lays. And other sort of protected area is not encompassed by the study area. The map (Map 5.9) shows that the polder area is not situated within or nearby ECA declared by DoE. The map also indicates that the polder area is away (19kms) from the nearest ECA, the Sundarban Forest.
7	Para 320. Picture 5.20 doesn't show what is written. Moreover, the picture 5.23 is showing all brackish water fish species.	Para 320 has been omitted from that section. At the time of visiting field, those fishes were available in the local market.
8	Table 5.17. is mysterious Pangas (*P Pangasius*) should be in good number in the rivers as it is their prime breeding habitat and juveniles are caught in large numbers in all these coastal rivers. However, this species is not generally used for culture in the pond, so presence in the pond and absent in river is difficult to understand. All snakehead species absent in pond and present in river is also a bit confusing.	It is mistakenly mentioned in the table (Table 5.18) and corrected accordingly
9	Table 6.1 Environmental Screening Matrix is largely subjective and as stated earlier lacks analytical results to support these assumptions.	As the project is rehabilitation project, that's why the assumptions were made focusing only on proposed intervention and based on earlier observations. And it is less likely to have further impact.
10	The total gross area of the polder is 2065 ha and net cultivate area is 1850 ha as written in both Executive Summary and in Table 5.21. However, total cropped area is mentioned as 2,870 ha in para 342 as well as in the Executive Summary, this looks impossible with the cropping intensity of the area is 99% In Table 5.22 Rice crop area and non-rice crop area is mentioned as 1,033 and 475 ha respectively but in Para 342 they were written as 2,269 and 610 ha.	All the information are correct. Area under different crops grown in Kharif-I, Kharif-II and Rabi seasons are added to derive the total cropped area which is higher than the net cultivated area because of double and triple cropping (Please see table 5.25). The cropped area and cropping intensity have been changed as per fresh calculation
11	Table 6.14 Significance of Environmental Impacts. In the Operation phase, all the major potential impacts identified here are very well known and triggered immense difficulties to its population especially in the south-west part of the country. Unfortunately, the proposed mitigation measures failed to bring out any innovative idea to handle this old	Actually, proper implementation of proposed EMP on the basis of identified environmental hazards is required in CEIP-I, for which emphasis to be laid at all levels.

Sl	Comments	Responses
	and persistent problem.	
12	Para 340, Present cropping pattern. Why Medium Low land remain fallow throughout the year? No explanation provided. This 883 ha land is almost 47% of the total NCA and it is difficult to understand without any given explanation.	This section has been revised according to field data (art 5.3.7 & Table 5.24)
13	Para 349. Irrigation coverage is only 1% of the Net Cultivated Area and that is by surface area. But in Para 527 (Climate Change Chapter) stated 'Ground water level already reached alarming value'. Feels like a 'cut and paste' from another document and this is supported by the fact that this same sentence written in all other EIA documents submitted by the consultant.	Irrigation coverage was 1% area before, now it has increased up to 5% area.and surface water use is increasing day-by-day for irrigation. Ground water level alarming value because of extraction for domestic use
14	Para 490, Table 6.9. Consultant need to look at the Table?? Baseline Rice cropped area is already 2,269 ha and this is going to reduce 1,126 ha after the project? Do we need this project for this? (I know the baseline is wrong and this same statement is repeating again and again. Actually it is impossible to get the real rice and non-rice crop area at the baseline, not provided correct data anywhere. Anyway, the increments from FWOP to FWIP is large, probably due to converting medium low land into medium high land and brought into Aman crop. But the large increase of winter crop is difficult to digest. In a place where the water salinity in June 2015 (field data presented in this document) is around 4-5 ppt what could be the dry season salinity is anybody's guess. Increase of winter cropped area by almost 700 ha, from where the irrigation water going to come? The internal canal? We don't see much analysis to support this notion. And 700 ha is a very large are to irrigate from the water of these small canals. It all looks too inflated.	This section have been revised and updated information have been presented in Table 5.25 and Table 6.18
15	Para 507 onward, Project alternatives. No real alternatives visible except 'No Project' scenario.	The chapter has been updated as per comment.
16	Para 511, 518, 520 no alternatives are defined. Both storage and sourcing of construction materials can have	These have been updated as per recommendations.

Sl	Comments	Responses
	environmental consequences and thus need to be defined.	
17	In Environment Management Plan, plantation on and around the slope is mentioned without referring any species. BWBD and Bangladesh Forest Research Institute already have a guideline on this and consultant should take note of that document.	Name of the species for plantation around the slope will be mentioned after getting Afforestation Report from the DCSC However, reviewing the guidelines of different agencies/institutes, *Acacia nilotica* (Babla) is the most suitable species for this purpose. In addition, lower rows of the embankment may be planted by *Borasus flabellifer* (Tal*), Phoenix sylvestri*s (Khajur) &*Cocos nucifera* (Narikal) for this Polder.
18	In Climate Change Chapter, it is difficult to understand why annual rainfall and temperature data is used only until 2005 when up-to-date data is available. Moreover, in same paragraph (Para 530) it is mentioned that Sunshine hour and humidity data is not available for the polder and so the data is extracted from the model. However, both these data are available from Khepupara meteorological station, which is less than 8 km from the project boundary. Again in Para 531 (which in the first place should not be a separate para at all) stated that 'for rainfall and temperature because there is no meteorological station near the polder area so in this respect model data has been used'. But in Chapter 5 (Environmental baseline) para 234-238 all data used is from Khepupara meteorological station and that makes perfect sense.	IPCC has been used climate data from 1961-1990 for 30 years. It is also recognized by world scientist's communities. In this respect CEGIS has used 1976-2005 data because before 1976 data is not available and quality is not good also. If CEGIS used up to 2012 years data for this study then results will not vary for climate data. As per reviewer suggestion, CEGIS will use up-to-date data in future. In this study CEGIS has used model data for rainfall and temperature to see the trend analysis and generate future scenario. For using model data, calibration and validation with observed data is used the model. So thereis no problem for using model data for this study. Besides, model data is necessary to generate future scenarios.
19	Para 532 and 533 also showed mistakes in Figure numbers.	It has been corrected
20	Para 534 'land use changes has impacts on the local changes of thermal regime', a theoretical perception, but I'm afraid the local land use hasn't changed much in last few decades let alone after the clearing of Sundarban from this area in the early twentieth century which could substantially change the local thermal regime.	Land use changes have impacts on the local changes of thermal regime', it is not only theoretical perception, and it is also reality because irrigation coverage is increasing and human also increasing over this area. We can say everything is changing day to day in every place. It may be gradually or tremendously.
21	Para 556. Stated significant impact on Ploder 47/2 from Ganges Barrage, however, no connectivity between	This article has been cleared.

Sl	Comments	Responses
	proposed Ganges Barrage distributaries and peripheral river systems of this polder is evident. The eastern most rivers which might get freshwater boot from Ganges barrage is the Baleshwar, but it is difficult to conceive any freshwater increase in river systems eastern side of the Baleshwar.	
22	Para 556. 'At present, the peripheral Sonatala and Baraitala rivers carry low salinity concentrations during dry season, which hampers the agricultural water use.' Should be more careful what you are delivering?	The ambiguity of this article (9.3.1) has been cleared
23	Para 556. 'Several saltwater species may extinct in the long run, creating new ecological diversities of freshwater tolerant species.' A confusing and controversial statement.	Statement with ambiguity has been cleared off.
24	Cumulative impact defines as "changes to the environment that are caused by an action (in this case the proposed work of Polder 47.2) in combination with other past, present and future actions." But, Chapter 9 (Cumulative Impact) mostly inscribed the impacts of other activities on Ploder 47/2, which should not be the case.	The impacts due to proposed interventions of polder 47/2 has been described and related to surrounding polders interventions in Art 9.2
25	Confusion everywhere, in Para 568, it is written that CEGIS recently (2014) conducted a study and presents the result in a table (Table 9.2), but at the end, the source of this table is declared to be from IWM, 2015.	This section has been improved according to comments (art 9.4.2)
26	Differences in the maps. Maps attached in this document don't show any breach in the embankment, however, maps from IWM showing its presence in two different places.	The location of eroded point of embankment have been presented in the map 5.8

Appendix 9: Comments by Mr. Marcelo (WB) and Responses by CEGIS

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
1	Overall: the reports needs of a better correlation among baseline, analysis of impact and mitigation measures. This is not very well articulated. Some issues raised by the baseline are not addressed by the impact analysis and vice versa, etc.	Baseline data and information of physical, environmental, biological and social resources of the study area have been collected and incorporated in the report. Most of these bassline have been used in the EIA study.
2	Overall: is there a study (model) that has analyzed how the polder system works with and without the proposed intervention? This is an important analytical piece to determine if the proposed intervention would address the already existing issues. There are multiple factors and scenarios that could be backed with the project implementation (erosion, salinity, flooding, soil productivity, hydrodynamics, etc.) that need to be backed a solid analytics. Where is the water management plan and the operational targets? Have they been prepared? These are critical pieces to feed the EIA report.	Both with and without proposed interventions have been considered in model and this EIA studies Drainage modelling of the coastal polder has been carried out by IWM to find out the design parameters for drainage canal systems, drainage regulator, river bank, slope protection works. Climate resilient coastal embankment crest level has been design considering the combined effects of cyclone storm surge effects and cyclone induced wind wave. The model has been developed and simulated considering climate change condition. The impact of proposed interventions on drainage, flooding, river dynamics has also been analyzed through modeling. The model results have been utilized in the EIA study. The water management plan and the operational plan have been elaborately provided in section 4.10 (**re-name Water Management and Operational Plan**) which mainly focuses on water management and operational plan after the implementation of the proposed interventions.
3	It is clear that the proposed intervention will take place in a system that was modified in the past, that is not working properly well and that the social and physical environment is being affected. Therefore the proposed project is absorbing those liabilities.	Agreed
4	Page 45, Description of construction activities. It is not explained how is the necessary transport movement to get to the various project sites with machinery and	Transportation modes for carrying construction instruments and materials to the site has been described in article 7.3.7.

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
	ancillary interventions.	
5	Para 184. It is important to determine where disposal sites for excavated soil/sludge are.	It has already been mentioned in section 4.6.4
6	Table 4.8 should be used in an integrated manner with the EMP which is pretty general in terms of specifications.	This issue has been addressed as per suggestions
7	Para 194. Impacts from borrow pits should be analyzed.	There would be no impact of borrow pit which has been discussed in same para of the report
8	Section 4.8 on implementation arrangements. This section suggests that the implementation arrangement are not effective. Is that correct?	The implantation arrangements is effective which are being followed in Package-1 under CEIP
9	To what extent the local participation schemes present in section 4.15.2 have consulted, accepted by stakeholders involved and implemented? Is there capacity to do that? Who is going to deliver training?	Section 4.15.2 has discussed the previous experience of local participation in water management. In case of CEIP, stakeholder involvement, capacity, training issues have already been discussed in section 4.16.1-5 respectively
10	Para 293. I have not seen the connection between seismicity and embankments analyzed in other sections of the document. Is it correct to assume the low risk discussed in the EIA?	Yes, it is correct, the polder falls in low risk area
11	The document mixes two different concepts. Land use and soil productivity. It would be good to fix it in item 5.1.4 to determine if the existing baselines condition with the project footprint would be leading to (i) land use changes, that is to say from agricultural to residential use and/or (ii) changes in soil productivity.	Land type will be changed but land use will not be changed. Such changed is related to the crop productivity. Soil productivity will also be changed which would increase cropping intensity and productivity. Impact on agriculture land has been analyzed in this study i.e. to what extent of agriculture land would be increased due to proposed interventions
12	Para 305. To what extend factors such as wind speed or other meteorological elements are related to the project? This is not factored later in the document as part of the EIA.	Wind speed and other meteorological elements have been provided as baseline information. However, these parameters could have been used in Model study by IWM for storm surges analysis.
13	Para 305 presents a strong statement that needs to be explained or clarified. It says that the EXISTING water system of the polder meets the demands of the surrounding system. If this meets the demand which is the added value of the proposed intervention?	This paragraph has been rephrased.
14	Pages 107-110 describes key environmental baseline conditions that would be reverted by the project and that need to be better	All the issues and key issues have been addressed. But have not been prioritized.

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
	predicted by the EIA such as surge flooding, drainage congestion and water logging, salinity, navigation, water use, sedimentation and erosion. The report needs to be specific on these aspects which are key.	
15	Section 5.2.1. It is important to clarify the implications of this classification for the project and what does it means that it have been identified by IUCN. This needs to be handled with care to avoid confusions with the WB natural habitats concept.	The whole Bangladesh has been divided into 25 Bio-ecological zones by IUCN depending on the biodiversity in the respective area.
16	Para 355. Reports about the ecological importance of coastal areas. It is not clear in the rest of the document the impacts on these areas.	This section has been revised
17	In regards to fauna species, we recommend the present a table including all species, with the conservation taking into account CITES and IUCN classification and local classifications, if applicable.	Agreed and presented in a Table-5.12-b [section 5.2.2 (b)]
18	The section 5.2.5 on ecosystem services is too light. It mixes de concept of services with goods. In my opinion, for example, the project would have a positive impact in soil productivity which is clearly an environmental service.	This section has been updated
19	Table 5.14 provides the basis for specific management actions that I do not seen proposed as part of the EMP.	It has been considered in the EMP
20	Para 390. This section does not explain how culture fisheries rely on water level fluctuations.	Kindly note that culture fisheries in Bangladesh in general require at least 1 m depth. If water fluctuates and become less than 1 m then the concern habitat will be less productive.
21	Section 5.2.7. It should explain the importance of the migrations, if it is seasonal, etc.	Fish is highly influenced by environmental factors, such as, water temperature, rainfall, water quality, etc. Moreover, these interactions are species specific. The various physiological condition needs appropriate environment. To meet up various biological purposes, like feeding, breeding, spawning, etc., fish normally migrate from one habitat to other suitable habitat.
22	Para 392. It would be important to explain how the bad functioning of the polder, sluices, etc. has favored the fish migration. This should be the baseline to explain how the project intervention would impact on that and how this is related to the economic activity.	Fish migration is impeded by the malfunctioning of the polder, sluices, etc. Once when the polders and the sluices were functioning well fisheries activities were there and some people were dependent on it for

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
		carrying their livelihood. After bad functioning of the polders and sluices fisheries activities reduced substantially.
23	Table 5.18 and associated paragraphs. The table presents a static description. The report should indicate if there is any associated sensitivity, the use of the habitat, preferences, etc.	Different fish species have different habitat preferences and having different sensitivities to the physical condition of the area. The larger catfishes like *Wallago attu*, *Pangasisus pangasius*, etc, prefer deeper water having connectivity with the large river and drainage canal (particularly for *Wallago attu*). These are sensitive to warm water and shallow water habitat. They breed when they get new water in the following season. If sluices are not functioning properly then the large catfish population will be declined. Smaller catfishes (*Clarius batrachus, heteroneustes fossilis, Mystus tengara,* etc.) prefer shallower habitat. They usually breed in the ditches and borrow pits. Snakeheads also inhabit in the drainage canal and in the pond.
24	Section on 5.2.8 on fish and biodiversity composition needs to be supported by the scientific information that demonstrates that the project area is very poor to moderate in fish biodiversity which does not seem to be the case of what I presented in Table 5.8.	This has already been mentioned in section 5.2.8 (para 4.4 and Table 5.19). Shannon-Weiner Diversity Index and Sympson's Index has been used to analyze the fish diversity. The Table 5-19 describes the fish biodiversity status of the area, It is done based on the regularly caught major fish species. It is seen that Baraitala River has high species dominance while in the Kichikata Khal the species dominance is moderate. Though water quality mentioned in the Table 5-8, the parameters are showing well within the permissible limit but timely availability of water due to malfunctioning of the polders and sluices is scarce. For this reason, species diversity is considered poor to moderate.
25	Section 5 on fish production. It would be important to explain how sensitive this activity is to polder management. In the same line, we would like to know if the stakeholders related to this activity were consulted.	Fish production is directly linked with the livelihood of the dependent fishermen community of the area. If production declines due to bad functioning of the polders and sluices, the livelihood of the area will be affected and the economy of the area as well. Yes, local people including fishermen, fish traders and local fisheries officials were consulted during collection of fish data and analysis was done based on those information.
26	Para 413 on pesticides. It would be important to know if the polder interventions would incentivize the use of pesticides in a context	Yes, because farmers will grow more High Yielding Variety of crops after implementation of the project interventions.

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
	of improved agricultural activities that might need more inputs.	
27	To what extent the market mentioned in para 458 is sensitive to project's interventions.	This issue is sensitive to project interventions of which impact has been discussed in section 6.4.1
28	Para 472. Has the Bank reviewed the RAP?	Yes, the RAP report has been reviewed by World Bank
29	Para 473. How the potential impact on social network would be addressed?	This issue has been addressed in the respective paragraph
30	Section on land use change. In fact this is not land use change!. This is the impact on lands.	This section is correct. Land will not be changed because this land will be used for construction of labour camps as a temporary facilities and it would be brought back to original use
31	Para 483. No restorarion of borrow pit areas?	This issue has been addressed in Para 194
32	Para 491. What is the meaning of proper compensation?	Omitted this sentence
33	Para 495. If I am not wrong, the baseline has identified only one market and this para. Mentions more than that, or these are different markets?	This anomaly has been removed from the baseline (section 5.4.9) and updated accordingly
34	Para 497 on mitigation measures. Does the RAP addresses the economic displacements of certain activities due to disruptions, etc?	It has been checked and addressed in the report
35	Para 498. The section is not about floral resources.	Agreed and corrected
36	Para 508. Has any model being applied to estimate the impact of sedimentation? Is it going to do after the EMP and before initiating the sediments removal?	No, sedimentation model has not been applied because it is beyond of scope of ToR
37	Para 510. Which is the impact of dewatering channels?	Dewatering is not essential for excavator cutting , it is only for manual excavation
38	Section 6.4.5. On one had the EIA says there will be no impact on crops but on the other, suggests to compensate if that happens.	Rightly mentioned but crop damaged will not be occurred due to borrow pit while transportation of earth materials may cause crop damage in the surrounding area.
39	Para 519. One of the mitigation actions targeted to irrigation disruption is the construction of diversion channels but the impact of this proposal is not examined.	Generally, diversion channel is constructed temporarily during construction of water control structures. For this, quantative information has not been assessed
40	Para 521. What other indirect impacts are related to the direct destroy of feeding, nursery and spawning ground of fish habitats?	It has been considered

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
41	Para 524. This is a little complicated because the impact is a prediction that is not supported by scientific information related to the species listed in table 6.10. The replacement of sluices and other infrastructure during the dry season seems to be a good idea. But what would happen with the functioning of the new infrastructure and the new waters flows?	Sluice gate operation committee will operate the gate for fish migration during May to July which has been mentioned in the respective section
42	Para 527. Benthic fauna has not been developed as part of the baseline section.	Information regarding benthic fauna has been mentioned in the baseline section (5.2.8)
43	Para 530 is not clear or I do not understand the issue.	As comment is not clear, response could not be addressed
44	There is not mention to water related diseases such as Malaria.	There is no Malaria disease in the polder area.
45	The EIA chapter mixes project actions with impacts. This need to be harmonized. The impact of tidal flooding is something the project comes to resolve and is not an impact of the project. The same with Drainage congestion and increased sedimentation.	Agreed. This chapter has been harmonized and updated accordingly
46	How is determine the final disposal of sediments removed from khals as part of dredging operations? Is the quality of the sediment determined? Please revisit para 575 in that context.	No dredging operation will be carried for removal of sedimentation from khals.
47	The mitigation measures of para 566 are interesting but how are they going to be implemented?	Water management Organization (WMO) will implement these measures with guidance of BWDB in association of DAE (Department of Agriculture Extinction)
48	Para 569. I like the idea of the involvement of experienced fishermen to guide the sluices operations. How is it going to be implemented?	Water management Organization (WMO) will implement these measures with guidance of BWDB
49	Para 574. Which is the timeframe for the potential land use changes. The topic needs to be discussed so the reader can have an idea about the implications of lad type changes. The same with para. 576 related to the increased crop production.	Agreed, after 3-5 years of implementation of the project land use will be changed which is also applicable for crop production.
50	We need a scientific reference to support the statement in para 579, related to increased fish production.	As comment is not clear, response could not be addressed
51	Para 605. The WB 2010 report is not mentioned in the list of references.	It has been included in the list of references

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
52	Section 9.2. This is an important item and it is not clear which is the cumulative impact?	This chapter has already been revised
53	I would suggest to revisit the EMP to state clearly in each of the mitigation actions who is the responsible, the timeframe and the budget. How these measures become mandatory as part of the contract?	It has been considered and mentioned in Table 10.5.
54	Page 224 raises the issue of cultural heritage which was not included as part of the baseline and impact analysis.	This issue has been addressed in section 5.4.12. As there is no cultural heritage in the polder, there will be no impact on cultural heritage.
55	Page 225. Malaria risk has not been considered as part of the baseline.	There is no risk of malaria in the surrounding areas.
56	Table 10.2. Is turbidity going to measured? Is it a relevant variable?	Most of the canals inside the polder will be re-excavated under this project. After re-excavation of canals, turbidity of the water may be increased.
57	Table 103.3 the timeframe to monitor afforestation and faunal composition is vague. There could be seasonal factors to be considered.	Agreed and omitted
58	Table 10.5 raises some issues: is the construction of a fish sanctuary included as a mitigation measure? What is the awareness program about? Why to monitor aquatic mammals and which are the mammals? This was not mentioned in the baseline.	Fish sanctuary could be established in the perennial Khal with the co-management of the local fisheries office and the local people. In this regard, local people can be trained up on the sanctuary issue. The Fisheries Department can be involved in this process. Water management organization will be given responsibility of awareness building program to the local people. Mammals has been deleted from the EMP as there is no aquatic mammals inside the polder
59	Para 703. I do not understand. The draft was never disclosed? So which is the basis for a meaningful consultation process.	Regional level disclosure meeting will be conducted in the first week of December,2016

Appendix 10: Pest Management Plan

Pest Management

A Pest Management Plan should be prepared for specific areas where needed, considering the type of pest/insects and their possible impacts. Plant diseases and insect pests control should involve precaution and microbiological processes. The 1st species of first and second category of pesticides are forbidden to use. The first year of the planting farmyard manure will be applied and then the organic fertilizers will be used after. These will improve the physical and chemical properties of soil, and cause slight adverse environmental impact. Besides, the packing receptacle of the pesticides and fertilizers should be collected and treated centralized, and also the vessel must be forbidden to wash in the river or lake.

A. Culture Method

- Tillage operation
- Selection seeds and cultivars
- Destruction of alternative host
- crop production
- Use of resistant variety
- Nutrient Management
- Strip farmers
- Pruning and thinning
- Variation in timing of plant and harvest

B. Mechanical Method

- Trenching
- Burring
- Sieving
- Netting & bagging

C. Physical method

- Temperature
- Moisture
- Sound
- Electromagnetic filed

D. Biological Method

- Parasitoids & predators
- Microbial agent

E. Chemical Method

- Insecticides
- Attractant
- Repellent
- Sterilants

1. Integrated Pest Management (IPM)

Recently, Integrated Pest management (IPM) is practiced in many areas that were covered by the study. In this system, insects are controlled biologically. Farmers of the IPM areas use branches of trees, bamboo and jute sticks etc to make favorable perches for birds in fields with standing crops. The birds eat the insects which help control infestation. In this process, the crops are protected without applying pesticides.
Light trap is another technique for controlling pests under IPM. This system is used in the agriculture fields especially on HYV rice and vegetables for attracting insects. At the base of the light trap, there is a sheet generally made of steel that slopes downward. The light trap is installed on a water basin. At night, when the light trap is emitting light,

Component/ Element of IPM

- Conservation of beneficial insect, animal
- There are many pathogen (fungi, bacteria &viruses) which can attack and kill many pests
- There are many insectivorous plants, which also plays some role in controlling pests.

2. Disease resistance variety

- BRRI Dhan 28is moderately resistant to blast and leaf blight
- BRRI Dhan 29 is moderately resistant to leaf blight

3. Modern cultivation method

- Use of healthy Seeds
- Proper crop rotation
- Line sowing with proper spacing
- Proper management of water in the crop field
- proper crop rotation
- Weed free cultivation
- Use of balasnced fertilizer
- Water management by planting at appropriate distance

4. Mechanical & physical control management

- By cutting infected leaves or plant parts
- By using hand net
- By perching in the field
- By using light trap

5. Chemical control management

Chemical control method shod be applied only when the other control methods fails to control the pest. That means pesticides should be used only as a last resort and in doing so right pesticide with right dose at right time and with right method of application should be taken in to consideration. Pesticides should be handled with proper care because all pesticide are poisonous.

Appendix 11: Checklist for Consultation Meetings

Environmental Impact Assessment (EIA) under CEIP-1

Issues of the Public/Stakeholder Consultation Meeting

The possible issues that would be discussed in the public consultation meetings are:

1. Productivity (e.g. agriculture and fishery)
2. Livelihood options
3. Vulnerability issues
4. Ecological imbalance
5. Resource redistribution
6. People's perception, opinion and attitude
    - 6.1. Major problems
        - 6.1.1. Problems in productivity
        - 6.1.2. Problems in service and facilities
        - 6.1.3. Infrastructural problems
    - 6.2. Attitude of the people towards the project
    - 6.3. Impact (positive and negative) of the project and mitigation measures
        - 6.3.1. Alternative sites
        - 6.3.2. Mitigation measures for planners
        - 6.3.3. Mitigation measures of implementing agency
7. Income restoration and generation issues
    - 7.1. Current income generating activities
    - 7.2. Type of occupation
    - 7.3. Income-generating activities
    - 7.4. Current market situation (job opportunities, competition, land price and market price situation)
    - 7.5. Skill development and IGA
8. Social development support
    - 8.1. Name of NGOs prevailing in the study area
    - 8.2. Social safeguard and safety nets
    - 8.3. Community interventions
9. Gender issues
    - 9.1. Unemployment of female labor force
    - 9.2. Literacy rate of female students
    - 9.3. Anticipated changes in the wage rate
    - 9.4. Health issues of women
10. Participation of women in service and facilities

FGD issues

The possible issues that would be discussed in the focus group discussions are:

1. People's perception, opinion and attitude
   - 1.1. Initial discussion about the selected Important Social Components (ISCs)
   - 1.2. Attitude of the people towards the project
   - 1.3. Impact (positive and negative) of the project and mitigation measures
2. Demographic distribution
   - 2.1. Population distribution
   - 2.2. Major age group
   - 2.3. Dependency ratio/status)
3. State of Education
   - 3.1. Impact of illiteracy
   - 3.2. Variation in school Attendance between girls and boys
   - 3.3. Variation in drop-out between girls and boys
4. Health Situation
   - 4.1. Prevalent diseases
   - 4.2. People's health seeking behavior
   - 4.3. Local health facilities
5. Employment and Occupation
   - 5.1. Existing occupations in the locality
   - 5.2. Major occupations
   - 5.3. Reasons of unemployment
   - 5.4. Impacts of unemployment
   - 5.5. Occupation problems/conflict
   - 5.6. Impacts of variation in water level on employment
6. Service and Facilities)
   - 6.1. Existing housing tenancy and structure
   - 6.2. Drinking water and sanitation facilities in the locality
   - 6.3. Energy Facility
   - 6.4. State of market Facility
7. Gender Issues
   - 7.1. Unemployment of female labor force
   - 7.2. Literacy rate of female students
   - 7.3. Anticipated changes in the wage rate
   - 7.4. Health issues of women
   - 7.5. Participation of women in service and facilities
   - 7.6. Women leadership
8. Poverty and food security status
   - 8.1. Number of working days, disaggregated by seasons and occupations
   - 8.2. Status of subsistence, disaggregated by seasons
   - 8.3. Usual food menu
   - 8.4. Adaptation strategies during poverty state
9. Ethnicity
   - 9.1. Major ethnic groups
   - 9.2. Cultural conflict and coexistence
   - 9.3. Potential impacts of project on ethnic groups
10. Archaeological/heritage sites
    - 10.1. Major archaeological/heritage sites
    - 10.2. Cultural values
    - 10.3. Potential impacts of project

Appendix 12: Gate Operation Plan (Bengali)

পোল্ডারের স্লুইস গেট পরিচালনার ক্ষেত্রে নিয়মাবলী

অতীতে পানি উন্নয়ন বোর্ডের কর্মচারীর মাধ্যমে স্লুইস গেটগুলো পরিচালিত হতো। বাজেট স্বল্পতার কারণে সে পদগুলো এখন স্থগিত করা হয়েছে। বর্তমানে গেটগুলো পরিচালনার দায়িত্ব সুবিধাভোগীদের উপর অর্পন করা হয়েছে। প্রতিটি পোল্ডাওে এ জন্য পানি ব্যবস্থাপনা সংস্থা (**WMG, WMO, WMA**) গঠন করা হয়। কৃষি উন্নয়ন ও মৎস্য সম্পদের কথা বিবেচনা করে পোল্ডার ৪৭/২ এর গেট পরিচালনায় পানি ব্যবস্থাপনা সংস্থাগুলোকে নিম্নোক্ত বিষয়গুলো বিবেচনা করতে হবে:

- কৃষি ও মৎস্য সম্পদ ব্যবস্থাপনার সাথে সামঞ্জস্য রেখে একটি নির্দিষ্ট নিয়মের মধ্য দিয়ে প্রতিটি রেগুলেটরের গেট অবশ্যই নিয়ন্ত্রিণ করতে হবে ;
- প্রকৃত পানি ব্যবস্থাপনা বিশেষ করে কৃষি ও মৎস্য সম্পদের প্রয়োজনীতার ভিত্তিতে পানি উন্নয়ন বোর্ডের পরিচালনা ও রক্ষণাবেক্ষণ শাখা সুবিধাভোগী সংস্থা, কৃষি সম্প্রসারণ অধিদপ্তর এবং মৎস্য অধিদপ্তরের মাঠ কর্মীদের যৌথ পরামর্শক্রমে গেট পরিচালনা করতে হবে;
- শুধুমাত্র মেরামত ও ফ্ল্যাশিং ব্যতীত রেগুলেটরের ফ্ল্যাপ একটি নির্দিষ্ট স্থানে সব সময় একই অবস্থানে রাখতে হবে;
- খালে পানি সংরক্ষণ করে কৃষি কাজে সেচের জন্য বর্ষার পূর্বে (মার্চ - মে) গেট বন্ধ রাখতে হবে;
- বর্ষার সময় (জুলাই -সেপ্টেম্বর) গেট সাধারণত বন্ধ থাকবে তবে পোল্ডারের ভিতর ও বাহিরের পানির স্তর একটি নিরাপদ লেভেলের বাইরে যাতে চলে না যায় সেদিকে লক্ষ্য রাখতে হবে। এক্ষেত্রে, প্রতিদিনের বৃষ্টিপাত, নদীর অবস্থা, নদীর এবং পোল্ডারের ভিতরের পানির লেভেল বিবেচনা করে যথাযথ সিদ্ধান্ত নিতে হবে;
- মাছের সর্বোচ্চ প্রজননের সময় ডিমসহ মা মাছ (ব্রুড মাছ) ও মাছের পোনা অভিগমনের বিষয় বিবেচনা করে মে হতে জুন মাস পর্যন্ত গেট খোলা রাখতে হবে;
- বর্ষা পরবর্তী সময় (অক্টোবর-নভেম্বর) গেট এমনভাবে পরিচালনা করতে হবে যাতে খালে শুষ্ক মৌসুমেও পর্যাপ্ত পানি থাকে। এক্ষেত্রে লক্ষ্য রাখতে হবে যেন খালের পানি তীর উপচে না যায় এবং কৃষি কার্যক্রম ব্যাহত না হয়;
- ফ্ল্যাশিং স্লুইস ও পাইপ ইনলেট পরিচালনার ক্ষেত্রেও একই নিয়ম অনুসরণ করতে হবে;
- কৃষি কার্যক্রম, শষ্যের নমুনা ও ধরণ, মাছের প্রজনন সময় ও অভিগমন ইত্যাদি পরিবর্তনশীল বিধায় সময়ের সাথে সুবিধাভোগী সংস্থার (কৃষক, মৎস্যজীবি, মৎস্যচাষি) সাথে নিয়মিত পরামর্শ করতে হবে;
- কৃষি ও মৎস্য উভয় সম্পদ বিবেচনায় নিয়ে পানি ব্যবস্থাপনা সংস্থাগুলোকে (**WMG, WMO, WMA**) সমন্বিত পানি ব্যবস্থাপনার উপর প্রশিক্ষণ প্রদান করতে হবে।

Appendix 13: Minutes of the National Dissemination Seminar held on 25 January, 2017

A dissemination seminar on the "Environmental Impact Assessment (EIA) under Package-2 of CEIP-1 was held at Spectra Convention Centre, Gulshan 1, Dhaka on 25 January 2017. Mr. Anisul Islam Mahmud, M.P, Hon'ble Minister, Ministry of Water Resources, Government of the People's Republic of Bangladesh, graced the occasion as the chief guest and Mr. Muhammad Nazrul Islam, Bir Protik, M.P, Hon'ble State Minister, Ministry of Water Resources, Government of the People's Republic of Bangladesh was present as the Guest of Honour. Dr. Zafar Ahmed Khan, Senior Secretary, Ministry of Water Resources Government of the People's Republic of Bangladesh and Engr. Md. Waji Ullah, Executive Director, CEGIS were the special guests in the seminar. The meeting was chaired by Mr.Md. Mahfuzur Rahman, Additional Director General (West region), BWDB. The photographs of the seminar is provided herewith as Appendix A.

The program started with registration of the participants at 9:30 am. Thereafter, the seminar commenced at 10:00 am through recitation from the holy Quran. Mr. Md. Delwar Hossain, Project Director, CEIP-1, BWDB delivered the welcome speech. After that Mr. Malik Fida Abdullah Khan, Deputy Executive Director (Operation), CEGIS presented the findings of the Environmental Impact Assessment (EIA) study of six polders under package-2 of CEIP-1.

About 100 NationalExperts from multi-disciplinary fields such as engineers, agriculturists, economists, environmentalist, sociologists and others as well as local stakeholders were present in the seminar. Besides, three international Environmentalists were present in the seminar. A List of participants attending the seminar is given as Appendix-B.

After the presentation, the floor was openedto the participants for their comments/suggestions on the study. Many valuable comments and suggestions received from the Honourable Chief Guest, Guest of Honour, special guests and participantswhich are furnished below.

1. Mr. Anisul Islam Mahmud, M.P, Honourable Minister, MoWR stated that the provisionfor re-excavation/dredging of peripheral rivers of the polders should be included under the CEIP project.

2. Dr. Zafar Ahmed Khan, Senior Secretary, MoWR informed that the Government of Bangladesh has specific development targets by 2021 and 2041. As such the polder rehabilitation process, should be considered on the basis of past experience and future challenges particularly climate change issue. He saidthat we should think about WMO for polder maintenances and how this association can work properly.He further added that we have gathered various ideas and knowledge from today's dissemination seminar on Coastal Embankment Improvement Project, Phase-1,(CEIP-1) which may play vital role for decision making in future for effectiveness of this project.

3. Mr. Md. Habibur Rahman, PD, ECRRP, BWDB informed that the polder rehabilitation plan is good initiative which has already been done by ECRRP. At present, CEIP-1 polder rehabilitation works should be conducted considering climate change scenarios and sea level rise. He also mentioned that polder works should have scope for green belt along the polder which should be monitored by Water Management organization (WMO) for proper maintenances of the polders.

4. Mr. K.M. Fakhrul Islam, Chief Engineer, Central Zone, BWDB made questioned How WMO will be involved in the rehabilitation work of all polders? In addition, he also told that sufficient training programs should be introduced for the WMOs of the polder.

5. Dr. Khondaker Azharul Haq, President, Bangladesh Water Partnership (BWP) expressed that the presentation is quite good but why only few polders have been considered for rehabilitation out of 139 polders. We should take initiatives for engaging NGOs/private sector for monitoring of the polder maintenance as the WMO does not sustain in most of the cases. Coastal polders are very vulnerable due to climate change. So we should look for new operation system for polder rehabilitation.

6. Mr. Md. Zaid Hussain Bhuiya, Deputy Chief Conservator of Forest (DCCF), Department of Forest suggested that Social forestry based green belt system should be included in polder rehabilitation work process. He also proposed to initiate social forest co-management system along embankment and also in the protected areas.

7. Mr. Giasuddin Ahmed Chowdhury, Deputy Team Leader, Delta Plan Project, Mott McDonald suggested that internal water management system is very important for rehabilitation of the polders. The polder works should include plan for eco system service providers.

8. Mr. Abani Kumar Thakur, DCCF, Department of Forest (DoF) mentioned that we know that coastal Greenbelt is a measure to prevent coastal erosion and reduce other natural hazards by planting trees and creating forests along the coasts. As such more exclusive green belt project should be implemented which has recently been studied by DoF.

9. Mr. Mohammad Alamgir, Principal Scientific Officer, WARPO commented that fish management plan is still missing in CEGIS power point presentation. Thus he insisted a comprehensive plan including polder rehabilitation work along with fish management plan.

10. Professor Dr. KB Sajjadur Rasheed, Environmentalist and Advisor, CEGIS expressed that CEGIS presentation was good for understanding. He enquired whether the crest level of the embankment of the polder has been designed considering climate change scenario.

11. Mr. Mahbub Murshed, Reporter, The Daily Naya Diganta informed that in future, the Koshi dam in Nepal and Ganges Barrage in Bangladesh would be constructed which will be the source of huge quantity of fresh water to the south western region of Bangladesh. Whether this issue has been considered in the study?

11. Mr. Md. Harun ur Rasheed, BWDB suggested that aseparate tree plantation plan should be included here for cutting of trees in the polder during intervention works. He also said why WMO are not working successfully in Bangladesh which is successfully working in other countries of the world?

After the comments and suggestions from the floor, the Chief Guest, Guest of Honour , Special Guests and Chairperson of the seminar delivered their valuable speeches .

The comments and responses are given as Appendix-C

Dr. Maminul Haque Sarker, Deputy Executive Director (Development) gave vote of thanks to theChief Guest, Guest of Honour , Special Guests and Chair, participants and representatives of media for their kind presence and active participation in the seminar.

Appendix A: Photographs of Seminar

Chief Guest, Guest of Honour, Special Guests and Project Director

Welcome Speech by the Project Director of CEIP-1

Presentation of EIA findings by Mr. Malik Fida Abdullah Khan, Deputy Executive Director (Operation), CEGIS

View of Participants of the Seminar

A view of open discussion

Special Guestdelivering his speech

Special Guestdelivering his speech

Guest of Honour delivering his speech

Chief Guestdelivering his speech

Closing remarks by the Chair

Appendix-B: List of Participants of Seminar

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
1	Dr SMA Rashid	IWM/CEIP	rashidsma@yahoo.co.uk 01717318906	Titon 01914618745	25/01/17
2	Abu Bakr Siddique	CEIP-1	abs-1947@yahoo.com 01795095607		
3	Henk Blok	CEIP-1	henk.blok@nhdhv		
4	Md. Mahfuzur Rahman ADG (West Region)	BWDB	01741-382792		
5	A.K. Manzur Hasan Chief Engr BWDB	BWDB	01711175477	Jewel. 01921985023	
6	Mollah Rezaul Alam Adviser Water Resour	CEGIS	01715406565		

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
7	SYED ALI AHSAN PS TO SENIOR SECRETARY (D-S)	MOWR	ahsan.en@gmail.com 01711431009	MAHFUL 01915531903	
8	Ebrahim Akand	CEGIS	ebrahimakhnd@yahoo.com	01675507173	
9	Md Zaid Hussain Bhuiyan Deputy Chief Conservator afforest	FD	dccf-aftn@bforest.gov.bd	01712-074350	
10	Md. Delwar Hossain PD/CEIP-1	BWDB.	Pdpmu.ceip@gmail.com	Rashed. 01722388698	
11	MD CHAN MIA	P.I.D	chanmia@gmail.com	01712223881	
12	Md. Abdul Hannan XEN, CEIP, BWDB	BWDB	xen.ceip1.khulna@gmail.com	Taleb	25/1/17

2

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
13	Jahangir Alam PRO, MOWR	MoWR	pro@mowr.gov.bd 01975105850	Shafiqul Islam 01728912590	25.01.17
14	Md. Nowruzzaman Ass. Director	MoWR	01911282278		
15	Md. Habibur Rahman	CEIP-1	01199808796	Rana	
16	Subrata Ku Mondal	CEGIS	01715669850		25/1/17
17	Dilruba Ahmed	CEGIS	dahmed@cegisbd.com		25.01.17
18	Md. Anwar Kadir SDE	JRC	01817527677 anwarkadir07@gmail.com	Saiful 01739259695	25.01.17

3

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
19	Md. Azizul Haque Adviser	CEGIS			
20	Md. Maqbul-E-Elahi	CEGIS			
21	Jalal Ahmed Choudhury	CEGIS		01938242287	Jalal
22	K B S Rahman	CEGIS		01730300385	
23	Mir Sajjad Hossain	CEGIS			
24	Sakib Mahmud	IWA		01852833381	

4

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 Time: 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
25	Anders Halunga Ramjam CEIP Int'l Environmental Asist	DHI			Apel
26	MOTAHER HOSSAIN CE. Ganges Barrage	BWDB	motaher_hossain@yahoo.com		Mtn
27	Md. Abdur Rahman Akanda ADG(P)	BWDB			
28	Md. Mahbubur Rahman	CEIP			
29	Md. Abul Kawsar SE/BWDB	BWDB	sani_kawsar@yahoo.com	Md. Ahsan ullah vehicle no: 3083	Kawsar
30	GERARD PICHEL	RHDHV	fatty.zebra@gmail.com		

5

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 Time: 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
31	Mobasher Bin Ansari	Jr. Specialist	mansari@cegisbd.com 01718 244298		Mobasher
32	Muhammad Anisur Rahman	PLA	mazizur@ceauste.com		Anis
33	Glandlin Chow	BDP2100			
34	Saika Nowshin Junior consultant	CEGIS	nowshin.saif@gmail.com 01673062425		Saika
35	Shihab Monjur Research Consultant	CEGIS	shihab.186@live.com 01735263323		S.Monjur
36	A K M Hasan	CEGIS	01911364049		

6

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
37	Kazi shahidur Rahman Sub-divisional Engr	JRC	shahid.215cuet... 01712831502		
38	Khair Reporter	Metar	01916143317		
39	Md. Sarfaraz Wahed.	CEGIS	01712209364		
40	Faria Tuz Zahura	CEGIS	01675489594		
41	Dr. Maminul Haque Sarker	CEGIS	01817606781		
42	Asma Akter	CEGIS			Asma

7

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
43	Mohad. Hassan	Deputy Manager	01711260139	-	Mohad.
44	Khaleda Saladin	CEGIS			Saladin
45	K. Kanti Hore	CEGIS			
46	Dr. Ashadul Alam Sr. Env. Specialist	PMU,CEIP-I BWDB	01747215770		25.01.2017
47	Shaheen Afroze	CEGIS	01715304133		25/01/2017
48	Chaitanya Kumar Das Director Field service wing DAE	DAE	01718956169 kbdaluder@yahoo.com	Lookman	25.1.17

8

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
49	Jan T. Twarowski Team Leader M+E Consultants	Sheladia Associates USA	jant@sheladia.com	Ali	
50	Dr. Kazi Nurun Newaz Advisor,	CEGIS	nnewaz@cegisbd.com		
51	Dr. Sajid	C3ER BRAC Uni	sajid_ru@yahoo.com	01921X982934	
52	Dr. Monowar Hossain	IWM	mnh@iwmbd...	Jafar	
53	Md. Gulzer Hossain	CEIP-1		-	
54	ANISUR KAWSAR WAWE SI	BETS			

9

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
55	A. M. Aminul Haque	BWDB	01552396776	Dhalu	
56	Jasim Uddin Ahmed	BWDB/Hq	01716209774		
57	Dr. AZHARUL HAQ	BWP	01819212996	Iskandar	
58	Dr. Ashraful Alam	CEGIS	01818290847		
59	Md. Alamgir Kabir	CEGIS	01715712614		
60	Anjuman Ara Baby	CEGIS	01711-377-306	—	

10

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
61	Md. Khalequzzaman Chief Planning	BWDB	01822812062 cplan.wdb@yahoo.com	Jahangir	[illegible]
62	Md. Abu Hasnat	CEGIS	01911597899		[illegible]
63	AKM Tahmidul Islam	BWDB	01712171241	Selim	[illegible]
64	Abani B. Thakur DCCF	Forest Dept.	01720543473	Nur Mohammad	[illegible]
65	Md. Harun ur Rashid	BWDB	01711383744 harun6205@gmail.com		[illegible] DC-2
66	RAKSHANDA RABBI	CEGIS			

11

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
67	Md Habibur Rahman PD/ECRRP	BWDB	01712008322	Md. Suman	[illegible]
68	MD. SHAHJAHAN X-DG, WARPO		01715078833		[illegible]
69	Mihir Biswas	BAPA	01700678233		[illegible]
70	Sattar Ali	BTV	01911938790	Sowit [illegible]	[illegible]
71	MUSA NURUR RAHMAN SUPERINTENDING ENGR	BWDB	01715740505	Oli	[illegible] 25.1.17
72	Mohammad Alamgir Principal Scientific Officer	WARPO	01556555684		[illegible]

12

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
73	Md. Jahid H Jahangir former Member, JRC				
74	[illegible]	BTV		01712354990 [illegible]	
75	A. Latif	Gm		01710089153 [illegible]	
76	Syed Mottaleb Murshed	Reporter Naya Din		own # (01718417189)	
77	Mantu Kumar Poddar Joint Chief	Ministry of Water	aditya_suditya @yahoo.com	01772643441 Mr. Razzak Driver.	
78	Mohammad Abdur Rashid	CEGIS			

13

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
79	Fakhrul Islam Chief Engineer Central Zone, DHK	BWDB	fakhrulbwdb@yahoo.com 01670-757384	Monju 01774-218775	
80	AKM. SAHADAT HOSSAIN. SE, IWRM	LGED	sahadat_lg @yahoo.com 01712209191	JAHID	
81	Md. Zahid Hasan Dhali	CEGIS	zahiddhali@yahoo.com 01816399598		
82	Roland Nathan Mondal	CEGIS	fish03nath@gmail.com 01758188740		
83	Md. Safiul Alam	CEGIS	safiul_bd@yahoo.com 01709709758		
84	Md. Ashraful Alam	CEGIS	01722602667		

14

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
85	Mirza Golam Shaukat	CEGIS	01729-088099		
86	Dr. Engr. Md. Lutfar Rahman	RRI	01715-039646	Paritosh Kumar Biswas	25/01/17
87	Sanat Kumar Saha Ecologist	CEGIS	gautam...@gmail.com 01911686...		Sanat Saha
88	Muhammad Shahidur Rah	CEGIS	shahidurrahman03@gmail.com 01713-865525		
89	Ashoke Kumar Das Fisheries Expert	CEGIS	ashoke@cegis.bd.com	–	
90	Md. Shakil Ahmed	CEGIS	sahmed@cegisbd.com		

15

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
91	SHAHED	BTV	—	—	
92	Badal Md. Faruque principal Specialist	CEGIS	BFARUQUE@CEGISBD.COM 01715111661		
93	Motaleb H. Sarker Director Ecology	CEGIS	01715015441		
94	Mamun	Somoy TV	019644441127		
95	Md. Amanat Ullah	CEGIS	01717443291		Amanat
96	Marjuda Parvin	CEGIS	01705066867		M. parvin

16

Appendix-C: Comments and Suggestions

Sl.	Comments/suggestions	Responses
1	**Mr. Anisul Islam Mahmud, M.P, Honourable Minister, MoWR** The provision for re-excavation/dredging of peripheral rivers of the polder should be included in the polder rehabilitation activities	The provision for re-excavation/dredging of peripheral rivers in Polder 48 from km. 9.00 to km 17.00 (Mohipur Khal) and Polder-41/1 from km. 15.00 to km 20.00 (Bashbonia Khal) have been made as these rivers are narrow and shallow in depth. On the other hand, the peripheral rivers of other polders in this package are wide and deep. As such, re-excavation/dredging has not been considered.
2	**Dr. Zafar Ahmed Khan, Senior Secretary, MoWR** The Government of Bangladesh has specific development targets by 2021 and 2041. As such the polder rehabilitation process should be considered on the basis of past experience and future challenge particularly climate change issue. He said that we should think about WMO for polder maintenances and how this association can work properly. He further said that we have gathered various ideas and knowledge from today's dissemination seminar on Coastal Embankment Improvement Project (CEIP) which may play vital role for decision making in future for effectiveness of this project.	The coastal polder since it implementation have appreciably contributed to the food production in Bangladesh as well as provided safety to the people of the polders against saline water intrusion and tidal surges. The rehabilitation of the polder is being done considering climate change scenarios and other current water management concepts. As such, the rehabilitation of the polder would greatly contribute to the development targets of 2021 and 2041. The involvement of the WMA for operation of the polder have been emphatically suggested in the study. In this regard, capacity building and training to the WMOs regarding gate operation, post project monitoring etc. has been included for their involvement in the project operation phase.
3	**Md. Habibur Rahman, PD, ECRRP, BWDB** The polder rehabilitation plan is good initiative which has already been done by ECRRP. At present, CEIP polder rehabilitation work should be conducted considering climate change impact and sea level rise. He also mentioned that polder works should have scope for green belt along the polder which should be monitored by Water Management organization (WMO) for proper maintenances of the polder.	It has already been considered in the study.

Sl.	Comments/suggestions	Responses
4	**K.M. Fakhrul Islam, Chief Engineer, Central Zone, BWDB** How WMO will be involved in the rehabilitation work of all polders?	As per bid document of CEIP-1, there is no scope for involvement of WMO in rehabilitation works because the polder construction works will be implemented by the contractor, engaged through the International bidding process. However, capacity building and training to the WMOs regarding gate operation, post project monitoring etc has been included for their involvement in the project operation phase.
5	**Dr. Khondaker Azharul Haq, President, Bangladesh Water Partnership (BWP)** The presentation is quite good but why only few polders have been considered for rehabilitation out of 139 polders. We should take initiatives for engaging NGOs/private sector for monitoring of the polder maintenance as the WMO does not sustain in most of the cases. Coastal polders are very vulnerable due to climate change. So we should look for new operation system for polder rehabilitation.	A total of 17 most vulnerable polders have been selected for rehabilitation under CEIP-1. During selection of polders, a screening matrix in the form of multi - criteria analysis has been done considering the physical condition of the structures as well as environmental, social and economic conditions of the polder area. BWDB has planned to rehabilitate the remaining vulnerable polders after successful completion of rehabilitation works of polders under Phase-II, on priority basis. Climate change issue has been considered in rehabilitation of the polders.
6	**Md. Zaid Hussain Bhuiya, Deputy Chief Conservator of Forest (DCCF), Department of Forest** Social forestry based green belt system should be included in polder rehabilitation works process. He also proposed to initiate social forest co-management system along embankment and also in the protected areas.	It has been considered in the project
7	**Mr. Giasuddin Ahmed Chowdhury, Mott McDonald** Internal water management system is very important for rehabilitation of the polders. The polder works should include plan for eco system service providers	To ensure fresh water availability as well as enrichment of ecosystem inside the polder, provision for internal khal re-excavation has been considered in this project. The plan for eco-system service provider has also been made in the study.
8	**Abani Kumar Thakur, DCCF, Department of Forest (DoF)** We know that coastal Greenbelt is a measure to prevent coastal erosion and reduce other natural hazards by planting trees and creating	The rehabilitation of the polders inter-alia includes foreshore afforestation program, The green belt project may be implemented in future.

Sl.	Comments/suggestions	Responses
	forests along the coasts. As such more exclusive green belt project should be implemented which has recently been studied by DoF.	
9	**Mohammad Alamgir, Principal Scientific Officer, WARPO** Fish management plan is still missing in CEGIS power point presentation. Thus he insisted a comprehensive plan including polder rehabilitation work along with fish management plan.	The detailed fishery management plan has been provided in the study which could not be presented in the dissemination seminar due to time limit.
10	**Professor Dr. KB Sajjadur Rasheed, Environmentalist and Advisor, CEGIS** CEGIS presentation was good for understanding. He enquired whether the crest level of the embankment of the polder has been designed considering climate change scenario.	Yes, the crest level of the embankment has been designed considering the climate change scenarios.
11	**Mr. Mahbub Murshed, Reporter, The Daily Naya Diganta** In future, the Koshi dam in Nepal and Ganges Barrage in Bangladesh would be constructed which will supply huge amount of fresh water to the south western region of Bangladesh. Whether this issue has been considered in the study ?	In the cumulative impact assessment of the EIA study, Ganges Barrage has been considered.
12	**Md. Harun ur Rasheed, BWDB** A separate tree plantation plan should be included here for cutting trees in the polder during intervention works. He also said why WMo are not working successfully in Bangladesh which is successfully working in other countries of the world?	A detailed tree plantation plan has been provided in the study report. The involvement of the WMO for operation of the polder has been emphatically suggested in the study. In this regard, capacity building and training to the WMOs regarding gate operation, post project monitoring etc. have been included for their involvement in the project operation phase.

Responses on Comments/suggestion of the Dissemination Seminar on EIA study under Package-2

Sl.	Comments/suggestions	Responses
1	**Mr. Anisul Islam Mahmud, M.P, Honourable Minister, MoWR** The provision for re-excavation/dredging of peripheral rivers of the polder should be included in the polder rehabilitation activities	The provision for re-excavation/dredging of peripheral rivers in Polder 48 from km. 9.00 to 17.00 (Mohipur Khal) and Polder-41/1 from km. 15.00 to 20.00 (Bashbonia Khal) have been made as these rivers are narrow and shallow in depth.On the other hand, the peripheral rivers of other polders in this package are wide and deep. As such, re-excavation/dredging has not been considered.
2	**Dr. Zafar Ahmed Khan, Senior Secretary, MoWR** The Government of Bangladesh has specific development targets by 2021 and 2041. As such the polder rehabilitation process should be considered on the basis of past experience and future challenge particularly climate change issue. He said that we should think about WMO for polder maintenances and how this association can work properly. He further said that we have gathered various ideas and knowledge from today's dissemination seminar on Coastal Embankment Improvement Project (CEIP) which may play vital role for decision making in future for effectiveness of this project.	The coastal polder since it implementation have appreciably contributed to the food production in Bangladesh as well as provided safety to the people of the polders against salt water intrusion and tidal surges. The rehabilitation of the polder is being done considering climate change scenario and other current water management concepts. As such, the rehabilitation of the polder would greatly contribute to the development targets of 2021 and 2041. The involvement of the WMA for operation of the polder have been emphatically suggested in the study. In this regard, capacity building and training to the WMOs regarding gate operation, post project monitoring etc. has been included for their involvement in the project operation phase.
3	**Md. Habibur Rahman, PD, ECRRP, BWDB** The polder rehabilitation plan is good initiative which has already been done by ECRRP. At present, CEIP polder rehabilitation work should be conducted considering climate change impact and sea level rise. He also mentioned that polder works should have scope for green belt along the polder which should be monitored by Water Management organization (WMO) for proper maintenances of the polder.	It has already been considered in the study
4	**K.M. Fakhrul Islam, Chief Engineer, Central Zone, BWDB** How WMO will be involved in the rehabilitation work of all polders?	As per bid document of CEIP, there is no scope for involvement of WMO in rehabilitation works because the polder construction works will be implemented by the contractor, engaged through the International tendering process. However, capacity building and training to the WMOs regarding gate operation, post project monitoring etc has been included for their involvement in the project operation phase.

Sl.	Comments/suggestions	Responses
5	**Dr. Khondaker Azharul Haq, President, Bangladesh Water Partnership (BWP)** The presentation is quite good but why only few polders have been considered for rehabilitation out of 139 polders. We should take initiatives for engaging NGOs/private sector for monitoring of the polder maintenance as the WMO does not sustain in most of the cases. Coastal polders are very vulnerable due to climate change. So we should look for new operation system for polder rehabilitation.	A total of 17 most vulnerable polders have been selected for rehabilitation under CEIP-1. During selection of polders, a screening matrix have been analyzed considering the physical condition of the structures as well as environmental, social and economic conditions of the polder area. BWDB has planned to rehabilitate other polders after successful completion of rehabilitation works of polders under Phase-1, based on priority if fund is available. Climate change issue has been considered in rehabilitation of the polders.
6	**Md. Zaid Hussain Bhuiya, Deputy Chief Conservator of Forest (DCCF), Department of Forest** Social forestry based green belt system should be included in polder rehabilitation work process. He also proposed to initiate social forest co-management system along embankment and also in the protected areas.	It has been considered in the project
7	**Mr. Giasuddin Ahmed Chowdhury, Mott McDonald** Internal water management system is very important for rehabilitation of the polders. The polder works should include plan for eco system service providers	To ensure fresh water availability as well as enrichment of ecosystem inside the polder, provision for internal khal re-excavation has been considered in this project. The plan for eco-system service provider has also been made in the study.
8	**Abani Kumar Thakur, DCCF, Department of Forest (DoF)** We know that coastal Greenbelt is a measure to prevent coastal erosion and reduce other natural hazards by planting trees and creating forests along the coasts. As such more exclusive green belt project should be implemented which has recently been studied by DoF.	The rehabilitation of the polders inter-alia includes foreshore afforestation program, The green belt project may be implemented in future.
9	**Mohammad Alamgir, Principal Scientific Officer, WARPO** Fish management plan is still missing in CEGIS power point presentation. Thus he insisted a comprehensive plan including polder rehabilitation work along with fish management plan.	The detailed fishery management plan has been provided in the study which could not be presented in the dissemination seminar due to time limit.
10	**Professor Dr. KB Sajjadur Rasheed, Environmentalist and Advisor, CEGIS** CEGIS presentation was good for understanding. He enquired whether the crest level of the embankment of the polder has been designed considering climate change scenario.	Yes, the crest level of the embankment has been designed considering the climate change scenario

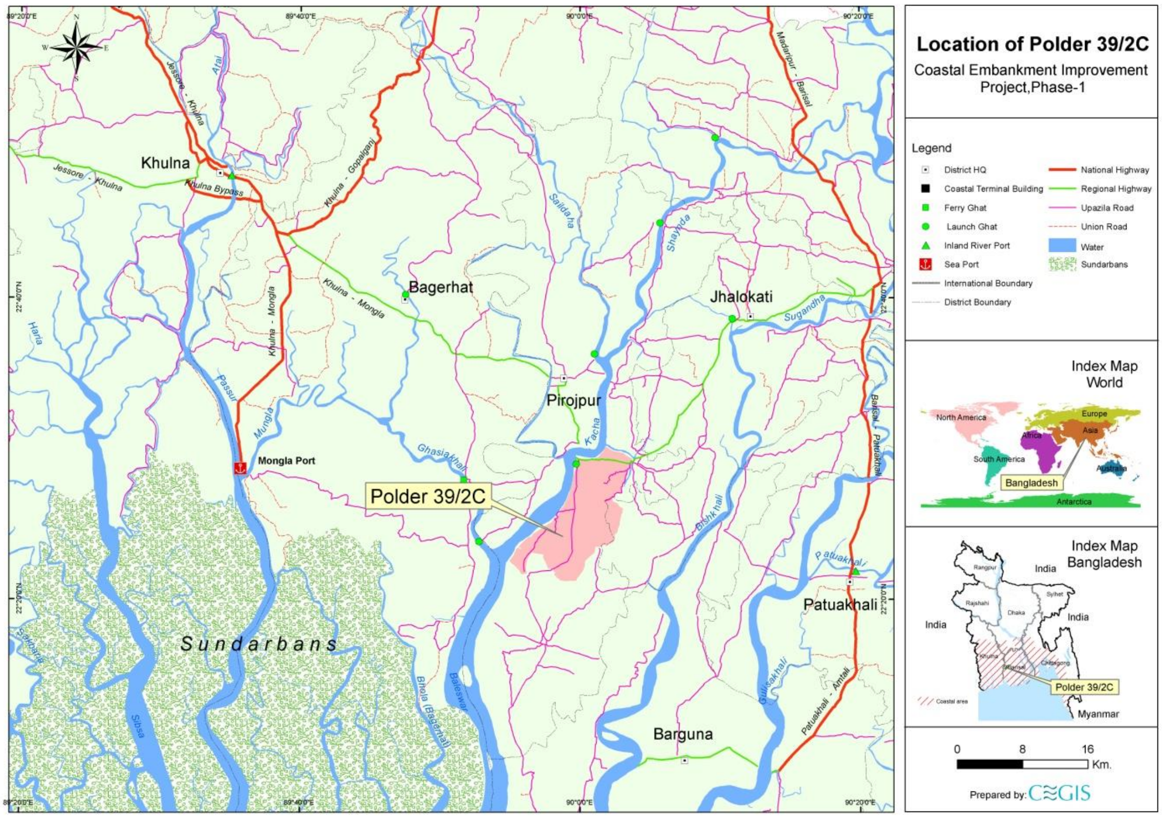
Sl.	Comments/suggestions	Responses
11	**Mr. Mahbub Murshed, Reporter, The Daily Naya Diganta** In future, the Koshi dam in Nepal and Ganges Barrage in Bangladesh would be constructed which will supply huge amount of fresh water to the south western region of Bangladesh. Whether this issue has been considered in the study ?	In the cumulative impact assessment of the EIA study, Ganges Barrage has been considered.
12	**Md. Harun ur Rasheed, BWDB** A separate tree plantation plan should be included here for cutting trees in the polder during intervention works. He also said why WMo are not working successfully in Bangladesh which is successfully working in other countries of the world?	A detailed tree plantation plan has been provided in the study report. The involvement of the WMO for operation of the polder has been emphatically suggested in the study. In this regard, capacity building and training to the WMOs regarding gate operation, post project monitoring etc. have been included for their involvement in the project operation phase.

Government of the People's Republic of Bangladesh

Ministry of Water Resources

Bangladesh Water Development Board

COASTAL EMBANKMENT IMPROVEMENT PROJECT, PHASE-1 (CEIP-1)



Consultancy Services for Detailed Design, Construction Supervision and Project Management Support

ADDENDUM TO

ENVIRONMENTAL IMPACT ASSESSMENT POLDER- 47/2 FOR PACKAGE-2

February 2017

Royal HaskoningDHV Enhancing Society Together

DevCon Leading Today for Tomorrow

dpm

IWM

DHI

The following recommendations are considered to ensure that all 6 EIA Reports in CEIP Package-2 fully cover environmental risks and impacts under the project and clearly communicate those risks and impacts and corresponding mitigation measures and that it's an effective management tool.

Strategic/Sectoral Assessment: The rationale of Coastal Zone Policy states three reasons as the basic principles:

a) Coastal zone is lagging behind in socio-economic developments
b) Poor initiatives to cope with disasters
c) Coastal zone has potential to contribute to national development.

The CEIP-1 Project fulfils all the three features/ criteria to be selected as development area.

Strategic or Sectoral Environmental Assessment in relation to the Coastal Zone Policy (2005) and the Coastal Development Strategy (2006) was not considered because the Coastal Development Strategy defines 9 priorities which mainstream environmental considerations, i.e. the following relevant ones:

-ensuring fresh and safe water availability

-safety from man-made and natural hazards

-improving of livelihood conditions of the polder dwellers

-environmental mitigation and conservation.

The CEIP-1 Project is conceived as a water infrastructure Project, aiming to retrofit the sluices, embankment, canals and bank protection with climate change impacts mitigation. In that sense, sustainability is incorporated. No fundamental modification of the basic concept of polderization is operated. When the 139 coastal polders were designed/built in 1970s, this all was done in a purely civil engineering approach. Ever since, IPCC report has been published and it has given impetus to more eco-engineering approach in design and construction. Idem ditto for the designs and construction under BWDB, however with core focus on water management infrastructures improvement (raison d'être of BWDB agency). This CEIP-1 Project design is adapted to the climate resiliency objectives with design of the infrastructures alone and its environment-compliant implementation. As the 139 Polders have undergone so many rounds of rehabilitations over the past 50 years, this is the living proof that the coastal polders have sustained half a century. This CEIP-1 brings in climate resiliency as added value to design and construction.

It can be assured that the CEIP-1 Project does not and will not worsen the present coastal situation whatsoever. Moreover, the said infrastructures are built inside the perimeter of the polders and no construction is done to protrude onto the surrounding rivers and existing waterscape/landscape systems and other surrounding sensitive ecosystems. On the operational level at construction sites, mitigation measures have been inserted in the EMP/EAP manual of all Contractors. This is a sufficient safeguard measure for pre, during, and post-construction stages.

Selection Criteria: All the 17 Polders in CEIP-1 including Polder 41/1 out of total 139 were selected by multi-criteria analysis based on physical conditions of existing infrastructures of the Polders. The physical conditions mainly include breach of embankment, overtopping, river erosion, wave action, internal drainage congestion etc. which relates to environmental components.

Past Experiences: In the tidal estuarine dynamics of the South West region of the country, a large scale water logging problem has been created through these polders.

CEGIS has recommended Tidal River Management (TRM) for sustainable solution of water logging problem.

Prior to the proposed interventions, polder areas faced several environmental adverse impacts as follows:

In general, the natural flow of rivers has been restricted for the construction of the Polders causing siltation of the river bed which create obstacles of navigation as well as drainage congestion.

There is no organized track record of the Government in managing such impacts but observation of the polders indicates that there has been increased siltation; reduction of open water fisheries, birds, wild animals; Reduction of soil fertility; deterioration of Water quality over time.

Brownfield vs. Greenfield: The Project mostly entails outright rehabilitation worksof infrastructure where their spatial domain already exists. The structure as indicated in Table 4.3 of EIA Reports is being replaced on the footprint of existing old structures. There are about 4.0 km of new embankment to be constructed; rest of the embankment is re-sectioning of the existing embankment. Hence, very few new impacts are likely to arise.

Gap Analysis: The differences between GOB/Local legal safeguards policies and the WB safeguards policies are highlighted in the Table below:

Comparison between GoB and WB Guidelines

After reviewing the laws of GOB and World Bank Safeguards guidelines, it is necessary to identify the similarities and differences between those so that the more stringent requirements can be applied for the Projects. In general OP 4.01 and OP 4.12 requirements are more comprehensive when compared with the requirements of Bangladesh legal system. The differences have been addressed by the measures proposed by the EIA reports and to be adopted by the Project. Table below lists some key comparisons between GOB and World Bank Safeguards guidelines.

Table: Comparison between GOB and World Bank Safeguards Guidelines

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
1	Type of Environmental Analysis	Project specific	Project specific, regional and sectoral
2	Basis for Categorization	Currently, screening criteria available only for industrial projects, where assessment is done based on: • Level of pollution emission • Type of project and location • Scale of project • Operational activities Non–industrial projects are reviewed on a case by case basis by DOE	Detailed screening criteria for all projects based on • Sensitivity • Nature and magnitude of potential impacts

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
3	EA Outputs	Since detailed rules and regulations for EA have not been prescribed, EA outputs are not specified. However, the industrial sector guidelines, the water sector guidelines and the road sector guidelines have specific EA output requirements, such as: • Baseline survey • IEE/EIA Report • Site clearance • Risk analysis and management • Analysis of alternatives	• EA Report • Analysis of alternatives • Environmental Management Plan
4	Public Consultation	No special mention is made for public consultation in BECA. Sectoral guidelines mentioned above have prescribed consultation.	Mandatory at the stage of • Preparation of EA • Project appraisal • Project design • Project implementation and monitoring
5	Disclosure of Information	BECA makes no reference to disclosure. The Sectoral guidelines prescribe some provisions for disclosure	Mandatory at • Summary of project description an potential adverse impact • Summary of EA report and conclusion • EA report
Social/Resettlement		**1982 ORDINANCE**	**OP 4.12**
6	Coverage	Legal owners Share-croppers Tenants	All affected parties, including squatters and illegal occupant
7	Compensation	Based on market values over previous 12 months No provision for restoration of income streams	Replacement cost at current market price Requires livelihood restoration component.
8	Uses of material from dismantled structures	Material is to be auctioned after being compensated for it	Material can be taken and re-used by affected party
9	Minimization of impacts	Discourages unnecessary acquisition but no mechanisms to monitor	Alternative analysis required to justify avoidance and/or mitigation of impacts
10	Cut-off dates	Not addressed	Important to ensure that squatters are included in compensation and to prevent rent-seeking behavior of additional squatters settling onto project land

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
11	Consultation	No consultation required	Consultation as core issue in RAP preparation and implementation
12	Livelihood restoration	Not addressed	Livelihood restoration component and attention to post-resettlement required

Construction Camps: All Labor Sheds/camps will be built for the workers, although most of the local workers from the surrounding villages who prefer to stay in their houses. During construction of camps for accommodation of workers internationally recognized guidelines such as IFC/EBRD workers accommodation guidelines will be ensured.

Traffic Management: There are some bazars (markets) and shops beside the embankment of the Polders, which are important for socio-economic and livelihood of the people of the polder area. The construction activities along the embankment may temporarily disrupt the market activities causing hindrance to movement of the local people, who will suffer due to their limited roadway movements during construction.

Mitigation measures:

- The works on the embankment will be carefully scheduled in consultation and coordination with local representatives to minimize the impacts on local markets and transportation routes.
- The embankment works will be carried out in segments and the soil will be placed linearly on half of the embankment, leaving the other half to be used as track. After the completion of the first half, it will be opened for the local traffic and then the work for the other half of the embankment will be undertaken.
- Local routes will be kept free, as far as possible, if unavoidable, alternative routes will be identified in consultation with the local community.
- The Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock.
- The works shall not interfere unnecessarily or improperly with conveyance of public to use public or private roads or footpaths.
- Special consideration will be given for preparation of the traffic control plan to the safety of pedestrians and workers at night.
- The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the cross section.

In regards to the increase of Vehicular Traffic during mobilization – EIAs include procedures to ensure: adequate signaling for traffic and pedestrian safety, speed limits for project-related trucks when crossing heavily populated areas and dust control measures and to manage noise levels. This also applies to 6.4.5 Hindrance of Pedestrian and Vehicular Movement. These aspects are comprehensively covered by the EHS Guidelines, as per the said web-link:

http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

Mangrove Afforestation: Afforestation for polders 41/1, 40/2, 47/2 and 43/2C is envisaged. Mangrove vegetation has immense contribution to protect the embankments and char land from tidal surge, provides fuel and thatch materials to the local inhabitants as well as creates ideal habitats for the local avifauna and other wild animals. Given the importance of mangroves, and the fact that survival rates of replanted mangroves tends to be very low, Mangrove afforestation will be carried out as per a specific afforestation plan volume-V Part-C (1- Forestry). These activities will be guided by a Sr. Forestry Expert for which there is a provision under PMU.

EHS Guidelines: Section on *Environment, Health and Safety Guidelines* for all 6 EIAs polder will follow the EHS Guideline 1 (General). The link to the document is as follows:

http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

Pesticides: The CEIP-1 is basically an infrastructure improvement project and not an agricultural project. The handling of pesticides is not a part of project activities. Although intensive afforestation is a part of project activity, the provision of nursery is not included in project activities. The interventions under the proposed project may result in an increased availability of irrigation water through cleaning and excavation of watercourses in the Polder. This increased water availability can in turn potentially increase the usage of agro-chemical fertilizers and pesticides. To address this eventuality, linkages will be developed with the up-coming Consultancy Services (NGO), the TOR is consistent with Integrated Pest Management policy that would address the indirect impact highlighted by the EIAs.

The Department of Agriculture Extension (DAE) is mandated for all types of agricultural extension activities including the preparation and implementation of Integrated Pest Management Plan (IPMP) and Integrated Crop Management Plan (ICMP). The DAE conducts capacity building both for IPMP& ICMP. The scope of project activities did not include DAE. The DAE will start its activities after successful completion of the project.

However, the pollution will be cross checked through testing of soil and water parameters as approved by ECR, 1997, DOE, Bangladesh throughout the Project period (see table below).

Table: Standards for Inland Surface Water

Sl. No.	Designated best use classification	Values			
		pH	BOD (mg/l)	DO (mg/l)	Total Coliform (number/100m l)
A.	Source of drinking water for supply only after disinfecting	6.5-8.5	2 or less	6 or above	50 or less

Sl. No.	Designated best use classification	Values			
		pH	BOD (mg/l)	DO (mg/l)	Total Coliform (number/100m l)
B.	Water usable for recreational activity	6.5-8.5	3 or less	5 or more	200 or less
C.	Source of drinking water for supply after conventional treatment	6.5-8.5	6 or less	6 or more	5000 or less
D.	Water usable by fisheries	6.5-8.5	6 or less	5 or more	----
E.	Water usable by various process and cooling industries	6.5-8.5	10 or less	5 or more	5000 or less
F.	Water usable for irrigation	6.5-8.5	10 or less	5 or more	1000 or less

Source: Standards for Water Schedule 3 of Environment Conservation Rule 1997

Periodic Maintenance Works: The BWDB monitoring unit has postings of 4 Assistant Chiefs and 2 Deputy Chiefs to oversee the overall environmental compliance of BWDB implemented projects. Under CEIP-1, the Environment Social Communication Unit will provide training to the BWDB people responsible for monitoring of environmental compliance. Thus, a smooth transition to BWDB will happen to ensure environmental compliance during the O&M after the project completion. These staff will be responsible to manage the environmental aspects of the operation and maintenance of polder, its water control structures, and other relevant issues such as protection of key environmental resources of the older and maintain fish migration. Water Management Organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (November 2000) and involve the beneficiary communities. WMOs will be trained by BWDB to ensure environmental management during project operation. The Environmental Management Unit of BWDB will ensure and oversee the environmental management during project implementation and operation. The Water Management Organization will also be trained and involved in EMP implementation during the operation phase.

Mitigation Measures: Chapter 6 addresses location specific impacts and mitigation measures. Whereas, Table 10.1usually presents measures for environmental code of practices based on the experience and generic mitigation measures for EMP. Table 10.1 also uses in conjunction with polder specific measures. Thus, measures mentioned in Chapter 6 are not concur with each and every code of practices in the Table 10.1.