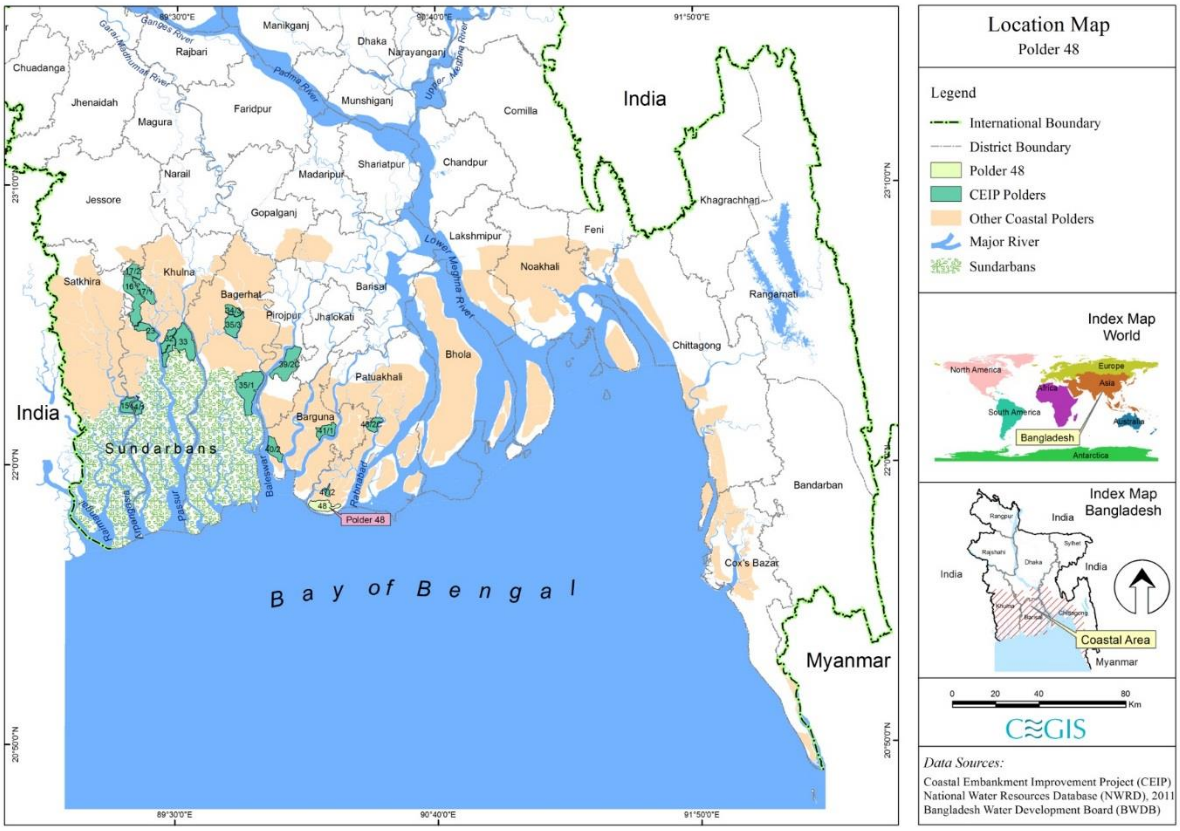
FINAL REPORT

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- 48 FOR PACKAGE-2

February 2017

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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:

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Abbreviations and Acronyms

AD	Assistant Director
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 Precedure
BRDB	Bangladesh Rural Development Board
BRAC	Bangladesh Rural Advancement Committee
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
CLAC	Central Land Allocation Committee
CZPo	Coastal Zone Policy
DAE	Department of Agricultural Extension
DC	Deputy Commissioner
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
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 Screening
ESBN	Estuarine Set Bag Net
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
LCB	Local Competitive Bidding
LCS	Landless Contracting Society
LGI	Local Government Institution
LLP	Low Lift Pump
LV	Local Variety
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 Cropped Area
NCR	Non-Compliance Report

NGO	Non-Governmental Organization
NOC	No Objection Certificate
NWRD	National Water Resources Database
OMD	Operation and Maintenance Group
O&M	Operation and Maintenance
OP	Operation Policy
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
RCP	Representative Concentration Pathway
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
UHC	Union Health Complex
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.

Arat: Generally an office, a store or a warehouse in a market place from which Aratdar conducts his business.

Aratdar: Main actor act as a wholesaler or commission agent or covers both functions at the same time; carries out public auctions and is the main provider of credit in the marketing chain.

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.

Baor: Dead arm of a river in the Moribund Delta as in the case of the Ganges; also called oxbow lake. It appears as a saucer shaped depression. The term baor is synonymous to beel, familiar in the southwestern part of Bangladesh.

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/dry season 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.

Charland: The chars, otherwise known as charlands, are riverine lands located in the active river basins of the main rivers of Bangladesh. They are located on the banks of the river and islands in the mid-stream of the main channel that are created by the continual shifting of these rivers and emerge from the deposition of sand and silt from upstream.

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.

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

Haatbar: Weekly market day (which varies in different locations), where people's gathering is intensive

Jhupri: Very small shed for living, made of locally available materials. One type of thatched house 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, 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: A land holding by the Government.

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

Mohasen *A cyclone occurred in the polder areas dring 2013*

Perennial Khal: Khal containing water all the year round.

Pacca: Well constructed building with concrete roof.

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

Ring Slab: The simple hygienic 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: Water available in the khal during part of the year.

Semi pucca: House with concrete wall and tin roof.

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

T. *Aman*: Transplanted paddy grown during July-November, generally rain-fed, require supplement irrigation during drought.

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 (Area of Bigha changes in some locations)
1 Bigha	= 20 Katha
1 Acre	= 100 Decimal
1 Acre	= 4046.825 sq. meter
1 Hectare	= 247 Decimal /10,000 sq meter
1 Hectare	= 2.47 Acre
1 metric ton	= 1000 Kilogram
1 kilometer	= 1000 meter
1 meter	= 1000 millimeter
1 inch	= 25.4 millimeter
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 in the coastal area of the country will be rehabilitated and improved. The GoB has obtained financial assistance from the World Bank (WB) for this Project. The CEIP includes rehabilitation and improvement activities of 17 polders will be implemented in three packages. Polders 32, 33, 35/1 and 35/3 are included in the first package for which EIA and EMP studies have already been completed. Polders 43/2C, 47/2, 48, 40/2, 41/1 and 39/2C are included in the Package-2 whereas Polders 14/1, 15, 16, 17/1, 17/2, 23 and 34/3 are included in the Package-3. In accordance with the national regulatory requirements and WB safeguard policies, EIA and EMP studies of six polders under Package-2 have been carried out. This document presents the EIA report of Polder- 48, which is one of these 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 receiving huge sediment inflows from the upstream. The coastal zone, in its natural state, used to face inundation by high tides, salinity, cyclonic storms and associated tidal surges. Polderization in the coastal zone of the country started in 1960s to convert this area into safe agricultural lands. The polders are closed 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 polders were designed to keep the land safe from the tidal effect and allow agriculture activities. These polders are equipped with inlet and outlet sluice gates on the natural drainage channels to control water inside the embanked area.

The polders were originally designed without much attention to storm surges. Recent cyclones caused substantial damage to the embankments and threatened the integrity of the coastal polders. In addition to breaching of the embankment due to cyclones, siltation of peripheral rivers surrounding the embankment caused the coastal polders to suffer from water logging, which led to environmental, social and economical degradation. Poor maintenance and inadequate management of the polders have also caused internal drainage congestion and heavy external siltation. As a result, soil fertility and agriculture production in some areas inside the polders are declining.

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 apporach.

Location and Synopsis of Rehabilitation Work

The Polder-48 is located at Kuakata under Kalapara Upazila of Patuakhali District. The polder covers two Union Parishads (U/P), namely Latachapli and Dhuleshwar. The polder is bounded by Andharmanik River in the west, Ramnabad River in the East, the Bay of Bengal in the south and Mahipur Channel in the North. The rehabilitation activities planned for the Polder- 48 under CEIP-1 are: re-sectioning of embankment (38.09 km); re-excavation of drainage channels (41.045 km); slope protection of embankment (4.078 km); replacement and repairing of 9 drainage sluices, 3 flushing sluices and afforestation on the foreshore areas (16.89 ha). Bangladesh Water Development Board 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 alongwith an Environmental Management Plan (EMP) and a Resettlement Action Plan (RAP).

Environmental Baseline and Existing Conditions

Polder-48 falls under the southern hydrological zone of Bangladesh with a rather flat landscape and relatively low laying topography. Topography with a very minor downward sloping from South to North, where the project land elevation of the study area varies from 1.26 to 3.04 m, PWD. From the Digital Elevation Model it is found that around 73% lands of the areas have elevation between 1.26 to 1.96 m above MSL, whereas 27% have elevations between 1.96 to 3.04 m above MSL. The gross area of the polder is 5,087 hectare (ha) of which net cultivate area is 3,715 ha. The dominant cropping pattern in the medium high land is Fallow-T. Aman (HYV) -Fallow and Fallow- T. Aman (Local) -Fallow which occupies about 31.5% and 15.2% of the NCA.The overall cropping intensity in the Polder area is 157%.

Average winter temperature ranges from 13°C to 26°C. The monsoon season starts in June and continues up to September with maximum temperature of 32°C and maximum relative humidity around 89%. In the coastal areas, relative humidity values are usually higher than the other parts of the country. The average annual rainfall of this area is about 2,788 mm of which around 72% (2,018 mm) mainly concentrated during monsoon which last from June till 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. Wind speed is the highest in April (around 8.09 km/hr) and the lowest in November (around 1.12 km/hr). During cyclone Sidr (2007) and Aila (2009), 1 minute sustained wind speeds were recorded as 260 kph and 120 kph respectively, the former one created devastating impacts due to the high wind speed whereas the later one is more related to the increased storm surge.

The canals have been silted up due to increased siltation. Local people opined that the drainage dynamics of the polder is mainly governed by eight (08) drainage sluices associated with other internal khals. Presently, the internal khals have silted up. The sluice gates at *Koloipara khal, Khejura khal, Matiranga khal, Loxir khal, Nayapara khal, Tulatali khal, Char*

Chapali khal and Kurarchar khal have become non-functional due to poor maintenance, leading to siltation at the inlets of the khal. The rate of sedimentation on *Mohipur* channel and its bank side deposition is increasing day by day and the cumulative sedimentation causes raising the bed levels of the internal khals. With deposition of silt in khal beds, water conveyance capacity is decreasing affecting drainage from the polder area.

Erosion is the most common cause of failures of sea dyke or embankment through overtopping, tidal wave action and cyclonic storm surge. During field investigation in July 2015, one erosion hotspot was observed in the southwestern part along the Bay of Bengal, i.e. *Thanju Para, Shutkipolli and Sarifpur* Villages from Ch. 29+000 km to Ch. 33+700 km of sea dyke is under threat of severe erosion. Local people opined that, sea dyke may breach in the near future if hit by a devastating cyclone and will allow storm surge water to enter into the polder particularly in Sarifpur village from Ch. 32+000 km to 33+500 km.

The soil salinity level is found to be varied widely with range from 0.88 to 29.78 (ds/m) in the top soil (depth of 0-15 cm) in all agricultural land. This indicates that, soils reaction ranges from non-saline to very strongly saline.

The Polder-48 area lie within the Saline Tidal Floodplain and and slight portion of Coastal Marine Water zone.

Fish habitats of the polder area including external rivers is 786 ha, of which 731 ha is capture fish habitat in the rivers and canals and culture fish habitat is 55 ha in the homestead ponds and permanent wetlands. The polder area consists of a number of seasonal and perennial canals/khals. Among which, some are fish spawning ground and some are nursery ground. Moreover, all of these areas are used as feeding ground. However, depth of seasonal canals of the project area is reducing with time, decreasing the area for sheltering fish juveniles as the canals are being silted up. Local people reported that siltation rate in the internal fish habitats of the project area is 2-3 cm per year. Estimated total fish production of the Polder area is 190 mt. Bulk of the fish production (about 59%) is coming from culture fisheries habitats while the rest (about 41%) from capture fisheries habitats.

The polder touches two mangrove forests such as Khajura and Gangamati Reserved Forests within its boundaries. There are three major types of terrestrial ecosystem consisting inside the project area. In the terrestrial ecosystem, there are huge number of diversified homestead plants including the forest resources, which play an important role for the livelihoods of people living in the polder area. Crop field vegetation is another major part of the flora terrestial ecosystem. The seasonal fallow lands have also important roles in ecosystem functioning as grazing support for cattle, feeding and breeding habitats of many arthropods, reptiles and avifauna. The polder areas are low lying where the embankments are mainly used as rural road. Some plantation by the Forest Department as per social forestry rules is contributing another major source of flora terrestrial ecosystem in the project area. Moreover, there are diversified terrestrial fauna with different species in the polder area consist of different types of mammals, birds, reptiles and amphibians. This polder area is an important habitat for wintering birds. The aquatic fauna found in this polder are more diverse compared to other polder areas because of having an area rich with mud flats in the project periphery.

The Polder area is the home of 44,168 people from 9,846 households. Of the total population: 22,516 (51%) are male and 21,652 (49%) females. The average household size is 4.5, and is equal to the national average. The average population density is 384 per square kilometer, which is lower than that of the national average (1,055). Literacy rate, based on “ability to write a letter in any language” is 53.5%, whereas for males it accounts to 53.7% and females 53.4%. Out of total 44,168 people 7,403 (16.8%) are economically active which include 3,744 (41%)

employed, 121 (1.3%) looking for jobs/works, and 3,538 (37.8%) engaged in household works. Twenty seven percent (27%) of households are under electricity coverage. Rural Electrification Board (REB) is the main electricity provider. The coverage of solar power is found nominal in the entire study area. It is found that most of the houses are kutcha (84.3%) compared with the other three types such as pucca, semi- pucca and jhupri. Only 3.3% houses are semi- pucca, 1.9% is pucca and 10.5% percent is still jhupri. Forty-three percent (43%) households in the study area use non-sanitary latrines, 35% use non water-sealed sanitary latrines, 14% use sanitary water-sealed latrines and still 8% households have no sanitation facilities.

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 replacement of water control regulators and retired embankments. Land acquisition will affect homesteads, agricultural land, orchards, commercial land, and fish ponds/ditch. A total of 69 common properties are considered to be affected. Among these, the impacts associated with acquisition of about 9.04 ha of land are of very significant considering the tourist spot.

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.

Fish migration between the outside rivers and internal *khals* is likely to be affected temporarily during, re-excavation of *khal*. Besides, fish migration within the Polder between khals and low lying areas may be affected as well during construction of drainage.

The proposed project activities will impact on faunal and floral resources during the construction phase. About 94,906 trees of different species and various sizes would need to be cut for re-sectioning of existing embankments. Piling of excavated spoils may also damage the vegetation if not handled properly. Constructions activities may temporarily disturb terrestrial fauna remaining in the polders such as monitor lizards, jackals, l and snakes.

During construction phase there would be temporally increase of job opportunities for the local population, as it is considered that at least 60% of the labour force will be local. In addition, local business would be boosted up as a result of consumption of food and other necessities by the external labours of the project.

Potential social impacts include conflicts between local labor and outside labor could arise, if not handled properly. Besides, the presence of outside labor can potentially disrupt the privacy of the local population, particularly women whose mobility can be negatively affected

The agricultural activities will be increased after implementation of the project. As a result, farmers will use more fertilizers for cultivation of crops, which would contaminate soil and water. About 269,500 kg of chemical fertilizers are considered to be applied additionally along with the expansion of cropping, as well as the expected conversion from local lower yielding varieties to high yielding varieties. The increase in runoff from the cropped areas may potentially pollute water bodies causing reduction of fish production.

Replacement of drainage sluices on water channels which are currently connected directly with the peripheral rivers, would potentially result in hindering fish migration. This can result in a decrease of species diversity and size of fish stocks inside the Polder, thus adversely affecting the fish catch and fishermen's income.

A Resettlement Action Plan (RAP) has been prepared to address the involuntary resettlement issues arising from acquisition of 9.04 ha of land and loss of other private and or community structures. To address the impacts associated with material and equipment transportation and traffic congestion, the contractor will prepare and implement a traffic management plan, which will ensure that sensitive receptors such as schools and busy markets and bazaars are avoided during the peak hours. The contractor will also prepare and implement a pollution control plan which will be included in the Environmental Action Plan to address the air and water pollution. Similarly, the contractor will prepare and implement an occupational health and safety plan to cater for the safety and public health concerns.

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 and lead to an increase in crop production and create opportunity for employment generation. Presently, total cropped area is about 5,826 ha of which rice cropped area is 4,581 ha and non-rice cropped area is 1,245 ha. The crop production might be boosted up significantly under the FWIP condition. The total crop production would be 20,370 tons of which rice would be 10,333 tons (51%) and non-rice would be 10,037 tons (49%).

Analysis of Project Alternatives

Several alternatives were considered during design phase of the Project like 'no-project' alternative and with project alternatives.

The present situation of the polder 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 face crisis from January to April (salinity intrusion). The silted up channels are resulting to declining fisheries, and increasing environmental pollution. The proposed interventions under CEIP-1 have been designed to address the above problems of the Polder. The proposed interventions if not implemented, the present poor state of the Polder will continue or may further be deteriorated as such, therefore, the 'no-project' alternative is not a recommended option.

A number of project alternatives were considered to address 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 for 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 the Polder were drawn to investigate the nature of inter-annual fluctuations. It was found that all seasons are in decreasing trends except the monsoon season. The rate of decreasing trends of the annual precipitation, pre-monsoon, post-monsoon and winter seasons were observed as -

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 showed increasing trend and the rate is 3.82 mm/year, which is not statistically significant for the same period as it does not cause any significant impact on agricultural practices and crop yield of the area.

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.

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.

Cumulative and Reciprocal Impacts

Polder 48 is located right on the coast of the Bay of Bengal. The existing crest levels of the embankment polder varies from 4.8 to 6.0 m PWD and in most of the places, the crest levels are an around 4.8m PWD. In consequences, surge water used to enter into the polder overtopping the embankment at the locations where crest level is near at 4.8mPWD. In this situation, with a view to protect the polder from cyclonic surges and tidal flooding, CEIP proposed to increase the crest level up to 6.10m PWD. After rehabilitation of the polder, the crest level of the entre embankment will be raised to 6 mPWD. The entire polder therefore, will be safeguard from the cyclonic storm surges and tidal flooding. Polder- 47/2 is located near this polder, where some interventions have also been considered for rehabilitation at the same time under the CEIP-1 as it has also been dilapidated in absence of adequate maintenance. It may be mentioned that these two polders are in existence since long. However, there will be no impact in terms of hydro-morphology, socio-economic and biological resources of the Polder-48. As such, there will be no additional impact due to rehabilitation of these two polder in one each other’s.

Environmental Management Plan

The Environmental Management Plan (EMP) provides the implementation mechanism for the mitigation measures identified during the present EIA study. A comprehensive EMP that focuses in managing both construction and post-construction (operation) phases-related impacts should suffice in managing the potential construction and operation phase impacts. The EMP will have to be attached with the Bidding Document. The environmental management parameter will be included in the BoQ. Since most of the contractors do not have clear understanding on the need of environmental management, some of them tend to quote very low price for implementation of EMP and eventually cannot implement it as per suggestion. To overcome this problem, Fixed Budget may be assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting. The total cost of EMP implementation for Polder 48 has been estimated as BDT 0.26 million (without Training and Field trip costing). The contractor needs to submit an Environmental Action Plan (EAP) based on the EIA and EMF in line with the construction schedule and guideline. The EAP needs to be reviewed by the supervision consultant and to be approved by BWDB and World Bank.

Extensive monitoring of the environmental concerns of the Polder 48 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 are included in the EMP for specific sub-project. Moreover, for all type of monitoring, a comprehensive database of the polder specific Environmental Impact and Monitoring information will be created, which will help to evaluate the impacts easily.

The study infers that EMP has been developed after assessing the impacts of interventions on the basis of the baseline and prediction information. But monitoring has to be carried out to collect information on the impacts that actually resulted due to interventions. Furthermore, actual information due to implementation of EMP measures need to be collected for updating the EMP to make the development more environmental friendly as because EMP is not one time plan rather it is a plan which needs continuous updating.

Institutional Responsibility and Report Requirement

The contractor will be responsible for implementation of EMP during construction works and Project Supervision Consultant will be primarily responsible for supervision of the implementation of the EMP. BWDB will conduct field inspections and surveys by the Environment Specialist (to be employed by BWDB on regular basis) at field. S/he will report to the Senior Environmental Specialist at Head Quarter. The M&E consultant will be responsible for independent monitoring of the implementation of EMP and external monitoring and evaluation. DoE will be consulted if any complicated issue arises during construction and operation stages. BWDB will apply for annual site clearance from DoE. WMOs will be trained to ensure environmental management during project operation. Environmental Management Unit of BWDB, strengthened through this project, will ensure and oversee the environmental management during project operation.

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

The Environment, Social and Communication Unit (ESCU) will be established to implement and manage the EMP, and to provide co-ordination, technical support and services during the environmental screening and preparation of EA and implementation of the environmental mitigation measures. At least one of the two Environmental Specialists must be on board before effectiveness of the project. The Specialists will prepare subproject specific environment screening/assessment report on 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**

Public consultation meetings were organized with the participation of local people, representatives of local government and BWDB and other stakeholders during the study period. Local people have shown keen interest for rehabilitation of the project for their existence. They had no objection for implementation of the project, rather ready to help the implementing agency spontaneously. Two (2) Public consultations (Latachapli Union Porishod Conference room, Kalapara Upazila Conference room) and three (3) focus group discussion meetings (Haridebpur bazaar, Shuari Bridge bazaar, Goalkhali) were arranged to collect stakeholders' perception on the proposed interventions considering the EMP measures.

1 Introduction

1. The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase I (CEIP-I) (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 three. 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 48.

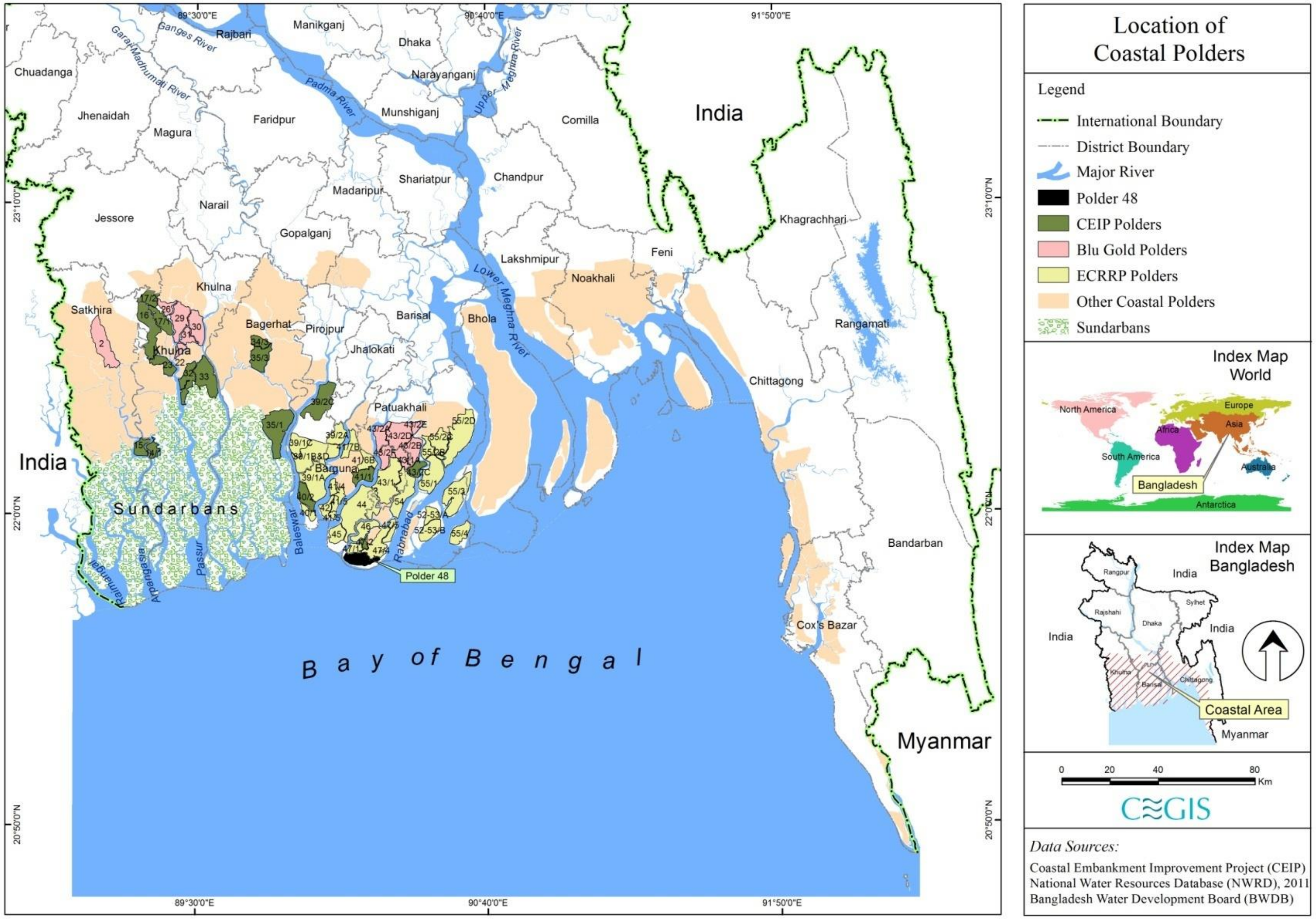
1.1 Background

2. In the 1960s, polderization was started in the coastal area of the country (see Map 1.1 for coastal polders) to increase the agriculture production. Presently, the coastal region of Bangladesh has modified ecosystem, where tidal flooding enters into the polders through controlled way using the existing water control structures.

3. The polder in this area is 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 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 the water inside the embanked area.

4. The coastal embankment system of Bangladesh was originally designed without much attention to storm surges. Recent cyclones brought substantial 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 the coastal polders to suffer from water logging, which 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. Soil fertility and agriculture production in some areas are declining because of water logging and salinity intrusion inside the polders.

5. The above reasons have led the government to readjust its strategy on the coastal area from only ensuring protections against high tides to provide protection against frequent storm surges as well. The long-term objective of the government is to increase the resilience of the entire coastal population to tidal flooding as well as natural disasters by upgrading the whole 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-I is the first phase of this long-term program.



Map 1.1: Location of Coastal Polders

1.2 Project Overview

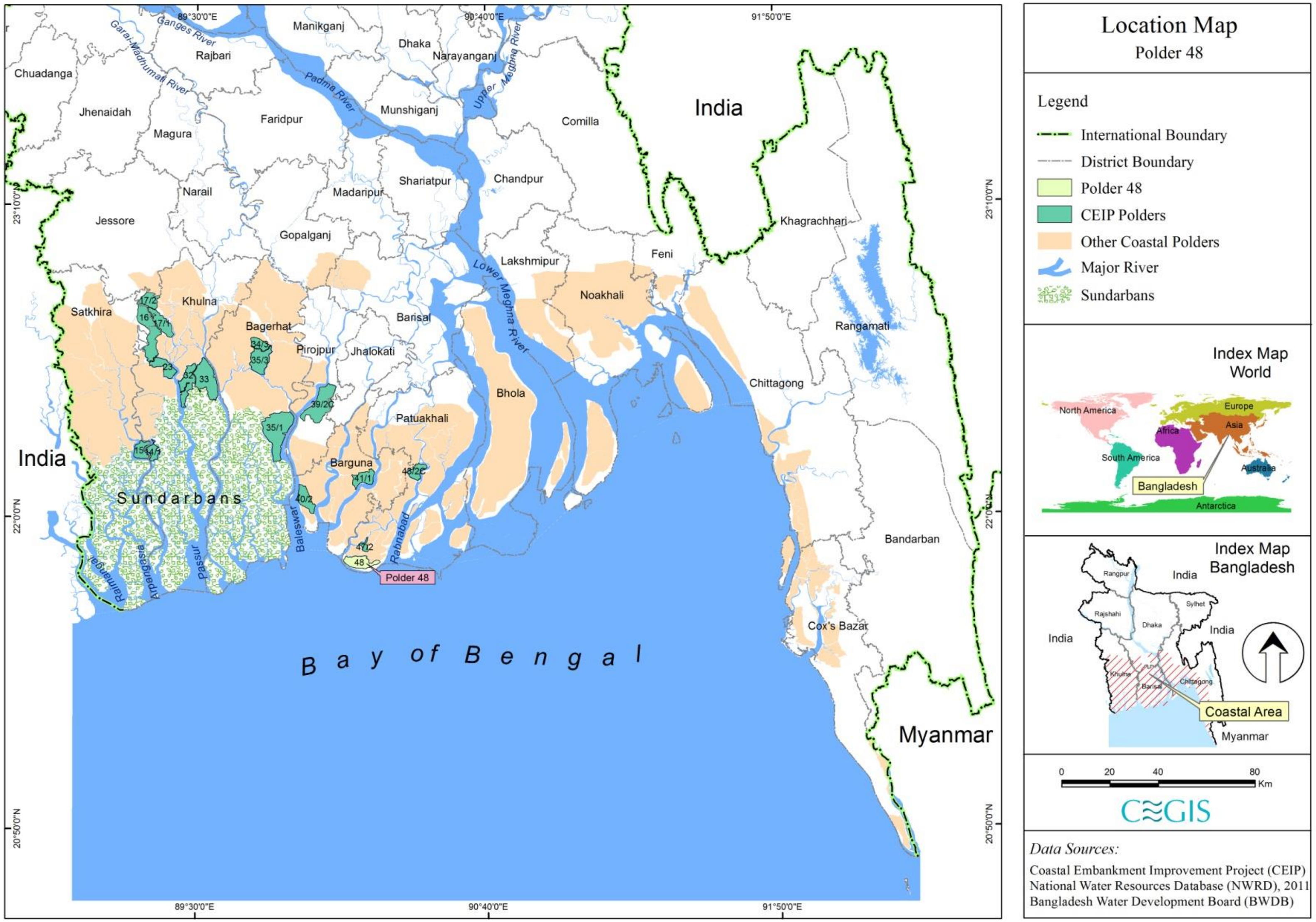
6. Polder 48 is located in Kalapara upazilas of Patuakhali district of Barisal DIvision (Map 1.2). The Polder covers a gross area of 5087 hectare (ha) with net cultivable area of about 3,715 ha. The overall cropping intensity is around 157% (which is much below the national average of 191%) giving a total cropped area of 5,826 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 improvement and rehabilitation works will be carried out in Polder 48 under Package-II of CEIP-1:

Re-section of embankment	: 38.09 km
Re-excavation of drainage Channels	: 41.045 km
Re-excavation outfall Channels	: 8:00
Slope protection of embankment	: 4.078 km
Replacing of drainage sluice	: 6 Nos.
Replacing of flushing sluice	: 3 Nos.
Repairing of drainage sluices	: 2 Nos.
Afforestation on the foreshore and slope areas	: 16.89 ha

7. 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, 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

8. 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 these requirements.



Map 1.2: Location of Polder 48

1.4 Objectives of the Study

9. The objective of the EIA study for Polder48 is to to identify and assess the potential environmental impacts of the proposed project interventions, evaluate alternatives, 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 Chapter 3).

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 48 includes the following:

i. Carry out detailed field investigation/data collection of existing environmental and social parameters especially on the potential 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 Components (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 avoid/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

[1]WB Operation Policy 4.01. 2011 Revision

the project activities. These would include, but not 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.

vii. Consult with modeling consultants to establish conformity of the impact assessment with existing and ongoing mathematical models due to climate change developed by a number of reputed organizations.

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 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 a detailed Environmental Management Plans along with respective EIA separately to monitor the implementation of mitigating measures and the impacts of the project of other inputs (such as training and institutional strengthening) needed to conduct it during construction and operation. Include in the plan an estimate of capital and operating costs 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 at the pre-construction, construction and operational stage; 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 employed to conduct the EIA study. The Chapter also describes data sources and methodology of data collection, processing and impact assessment.

Chapter 3 (Policy, Legislative and Regulatory Framework) reviews the national legislative, regulatory and policy framework relevant to the EIA study. Also given in the Chapter is a discussion on the WB safeguard policies and their applicability for the Project.

Chapter 4 (Description of Proposed Interventions) 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 (Environmental Impacts and Mitigation Measures) identifies the environmental impacts that may potentially be caused by various project phases, and also proposes appropriate mitigation measures to avoid, offset, reduce, or compensate these impacts.

Chapter 7 (Analysis of Project Alternatives) discusses various alternatives considered during the 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. The EMP also includes environmental monitoring plan.

Chapter 11 (Stakeholders Consultation, Participation and Disclosure) provides details of the consultations held with the stakeholders at the project site and framework for consultations to be carried out during construction phase. Also included in the Chapter are 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 describes 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 Polder48 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.

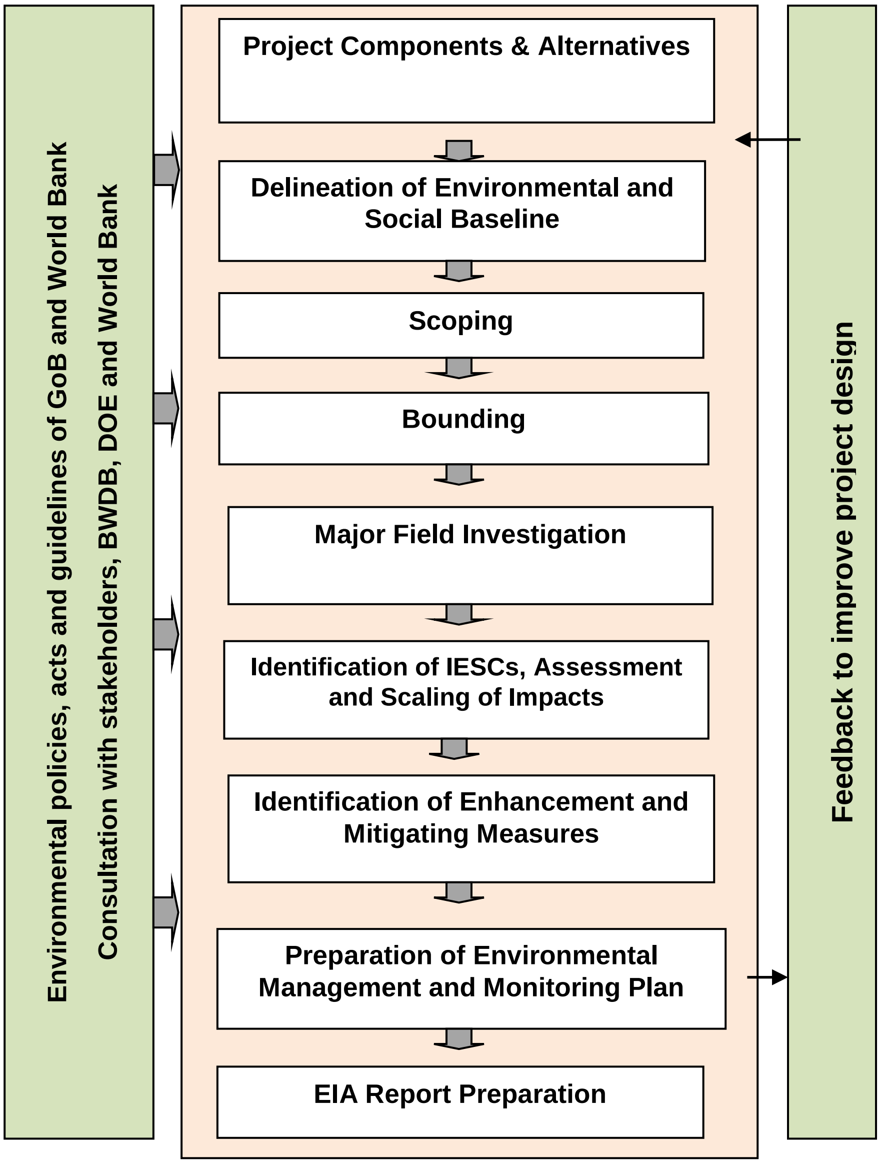


Figure 2.1: Overall approach of the EIA study

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 includes 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 to/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 Mohipur Khal to the north and Andharmanik River to the west, Bay of Bengal to the south and Ramnabad River to the east.

2.2.2 Analysis of the Project Design and Description

15. Detailed information on the Polder 48 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.

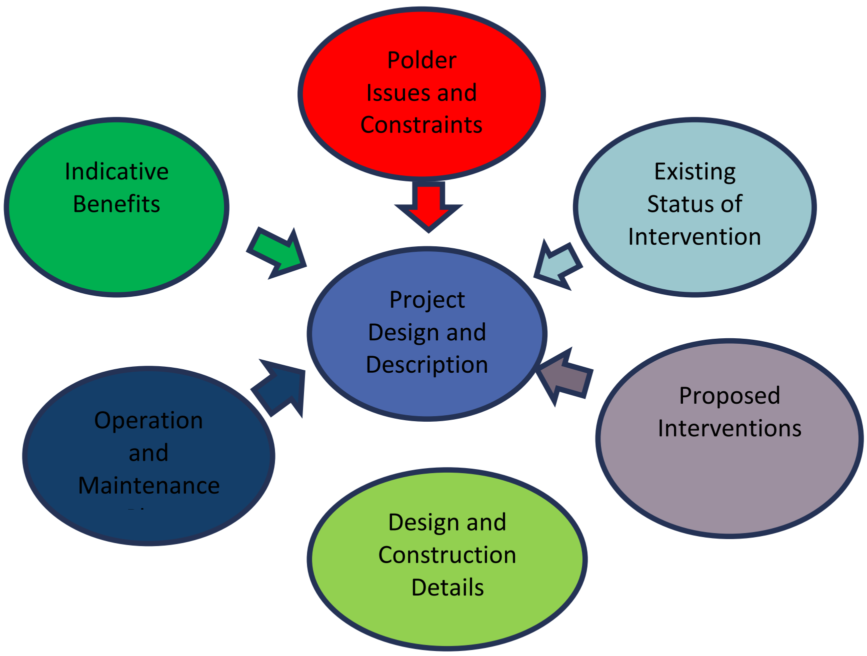


Figure 2.2: Aspects to be addressed in the Project Design and Description

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 2.3 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 stackyards, sources for material procurement, transportation routes, modes of material and manpower mobilization, scheduling, etc., were analyzed during the study.

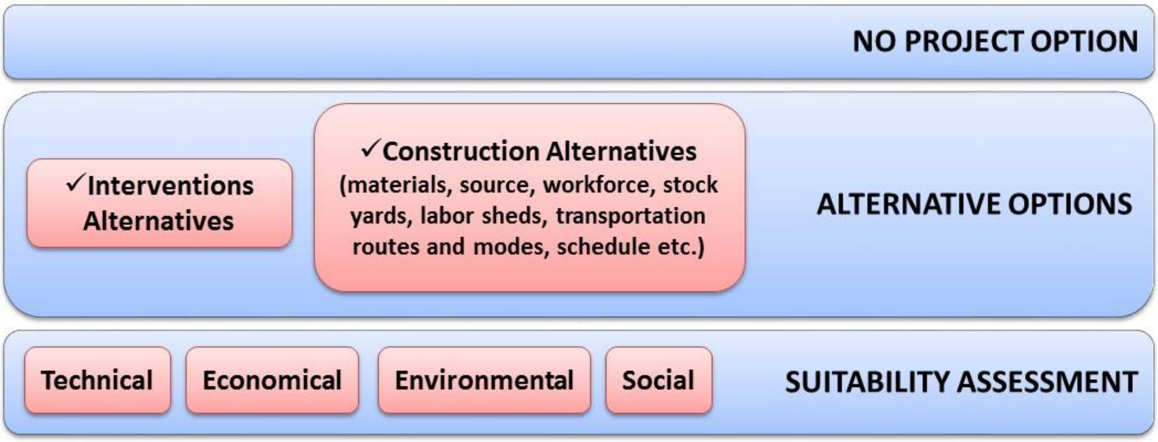


Figure 2.3: Concept of Alternative analysis to be used in the EIA study

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 (details of PRA, FGD are attached in Chapter -11).

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 Design and Construction Supervision Consultant (DCSC) and 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

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 analyzed. 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. The NWRD contains long series of temporal data showing daily values for meteorological stations maintained by the Bangladesh Meteorological Department (BMD).

25. Master Plan Organisation (MPO) digitised a national level grid of elevation points with 1 km by 1 km resolution from topographic maps published by BWDB. FAP19 increased the resolution up to 500m by 500m grid and developed a DEM with 300 m resolution. Afterwards NWRD updated the existing base elevation points using contour maps with scale of 4 inch = 1 mile, irrigation maps, and topo maps and regenerated a national level DEM. The scales of irrigation and topo maps are 1:40,000 and 1: 50,000 respectively.

Land Resources

26. The agro-ecological region of the project area was identified using secondary sources including Food and Agriculture Organization (FAO). The land type and soil texture data were collected from Upazila Land and Soil Resources Utilization Guide of Soils Resources Development Institute (SRDI). The secondary data of these parameters were 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. Crop production was determined using the following formula:

- Total crop production = damage free area × normal yield + damaged area × damaged yield.
- The crop damage (production loss) was calculated using the following formula:
- Crop production loss = Total cropped area × normal yield - (damaged area × damaged yield + damage free area × normal yield)

28. The crop damage data was collected from the field for the last three years.

Ecological Resources

29. The ecological component of the EIA study focused on terrestrial and riverine ecology including flora, reptiles, amphibians, mammals, and resident/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 ecosystems was generated through analysis of recent satellite imagery.

30. 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 and their status was developed based on field surveys and from the species database of Bangladesh National Herbarium and the Status of Vertebrates/ Red List of International Union for Conservation of Nature (IUCN).

Fish and Fisheries

31. 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.

32. 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, tidal floodplains, borrow pits and beels. The culture fish habitats included homestead culture fishponds, commercial fish farms and shrimp ghers.

33. 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.

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

Livestock Resources

35. Data on the present status of livestock (cow/bullock, buffalo, goat and sheep) and poultry (duck and chicken) in the polder area were 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

36. 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 reviewed discussion made with DCSC;

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 from district and upazila levels.

37. 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 polder area were collected mainly from primary sources through PRA and FGDs and public consultations.

2.2.5 Climate Change

38. 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 among 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 affects 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.

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

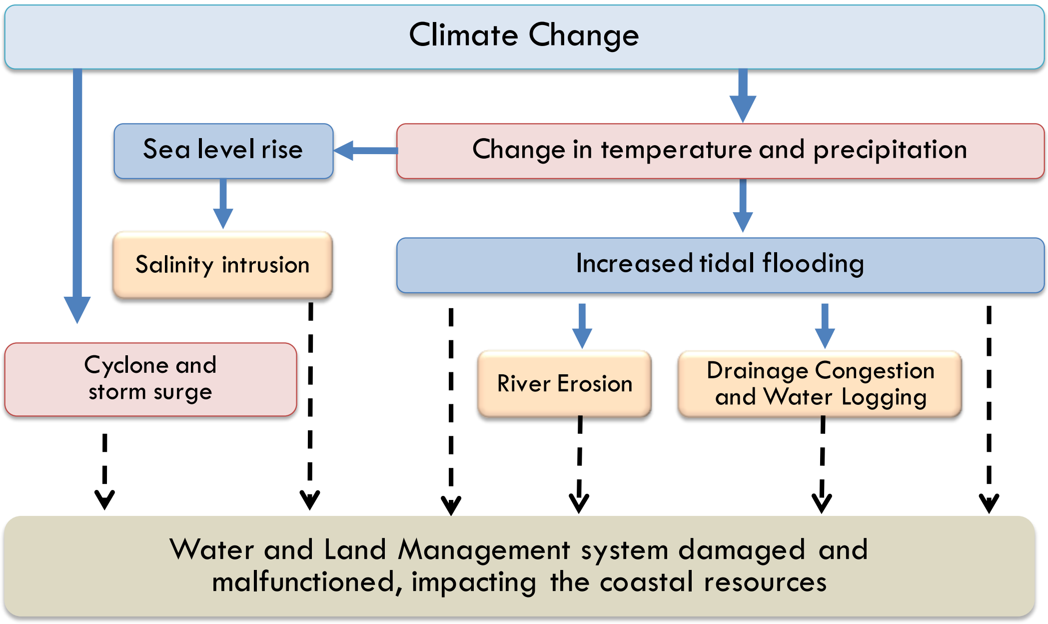


Figure 2.4: Typical diagram of climate change impacts in coastal areas

40. 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

41. A structured scoping process in two stages was followed to identify 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

42. 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.

43. 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.

44. The climate change impact is the key factor in this case. Climate change impact has been assessed through hydrodynamic modelling study of the CEIP polders by IWM and utilized in EIA. In the polder area, the change of flood level and storm surge height of the peripheral rivers/channels in different return periods due to climate change has been considered as crucial factors for future sustainability of the polder area.

Methodology

45. 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.

46. 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

47. 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.

48. 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

49. 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

50. 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.

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

51. 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.

52. 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

53. 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

54. 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

55. 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

56. At the end of the study, the present report was prepared, incorporating all the data/information of the EIA.

3 Policy, Legislative and Regulatory Framework

57. 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

58. 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

59. 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.

60. 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

61. 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

62. 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.

63. 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.

64. 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)

65. The National Water Management Plan (NWMP) 2001, approved by the National Water Resources Council in 2004, envisions to establish 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.

66. 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 Guidelines for Participatory Water Management 2014

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

Guidelines for Participatory Water Management (GPWM) in Bangladesh provides 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.

3.1.6 Coastal Zone Policy, 2005

67. 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.

68. 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.

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

3.1.7 Coastal Development Strategy, 2006

70. 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

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

3.1.8 National Land Use Policy (MoL, 2001)

72. 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.

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

3.1.9 National Agriculture Policy, 1999

74. 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.

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

3.1.10 National Fisheries Policy, 1996

76. 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.

77. 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.

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

3.1.11 National Forest Policy, 1994

79. 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, 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 add to forest resilience.

3.1.12 Private Forest Policy 1994

80. The Forest Policy, 1994 recognizes the importance of biodiversity for environmental sustenance. The policy 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.

3.1.13 National Livestock Development Policy, 2007

81. 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.

82. 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

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

3.2.1 Bangladesh Water Act, 2013

84. 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.

85. 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 Act 2013

86. 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.

87. 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.

88. 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

89. 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.

90. 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.

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

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

92. 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

93. The Environment Conservation Rules, 1997 was 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.

94. The Rule 3 defines the factors to be considered in declaring an area 'ecologically critical area' (ECA) as per Section 5 of ECA 95. 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.

95. 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.

96. All existing and proposed i 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'.

97. 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

98. 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 creates 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

99. 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."

100. 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 Private Forest Ordinance (PFO), 1959

101. The Private Forest Act of 1959 allows the Government to take over management of improperly managed private forest lands, any private lands that can be afforested, and any land lying fallow for more than three years. The Private Forest Ordinance was originally enacted in 1945, as the Bengal Private Forest Act, and was re-enacted by the Bangladesh (then East Pakistan) in 1949 before being issued as an Act in 1959. These government managed lands under this act are called "vested forests". The Forest Department manages approximately 8,500 hectares in the country as "vested forests". This area is relatively small, but the area historically affected by this law is much larger.

102. PFA, 1959 empowers the government to require management plans for private forests and to assume control of private forests as vested forests. Government has broad powers to write rules regarding use and protection of vested forests, and apply rules to "controlled forests," which include all private forests subject to any requirement of the Act.

3.2.8 Social Forestry Rules, 2004 and Amendments

103. Social forestry was included in the Forest (Amendment) Act 2000 and the Social Forestry Rules were approved in 2004 (amended in 2010 and 2011). The Rules defined the process of beneficiaries' selection, roles and responsibilities of different stakeholders, management, capacity building and distribution of earnings from social afforestation.

According to the rules, the beneficiaries shall be selected from amongst the local communities and shall preferably be from the amongst the followings persons, namely: (a) landless persons; (b) owners or occupants of less than 50 decimals of land; (c) destitute women; (d) unprivileged community; (e) poor ethnic minority; (f) poor forest villages; and (g) insolvent freedom fighters or insolvent successor of freedom fighters. The rules provided the rotation period for different plantation and benefit sharing. In general, the communities responsible for maintenance of plantation will receive around 45% of timber value of the forest.

3.2.9 Antiquities Act, 1968

104. An Act to consolidate and amend the law relating to the preservation and protection of antiquities. This Act may be called the Antiquities Act, 1968.

105. In this Act, unless there is anything repugnant in the subject or context, -

a) "immovable antiquity" means an antiquity of any of the following descriptions, namely: -

i. any archaeological deposits on land or under water,
ii. any archaeological mound, tumulus, burial place or place of interment, or any ancient garden, structure, building erection or other work of historical, archaeological, military or scientific interest,
iii. any rock, cave or other natural object of historical, archaeological, artistic or scientific interest or containing sculpture, engraving, inscription or painting of such interest, also includes -
iv. any gate, door, window, paneling dados, ceiling, inscription, wall-painting, wood work, iron work or sculpture of other thing which is attached or fastened to an immovable antiquity;
v. the remains of an immovable antiquity;
vi. the site of an immovable antiquity;
vii. such portions of land or water adjoining the site of an immovable antiquity as are reasonably required for fencing or covering or otherwise preserving such antiquity;
viii. the reasonable means of access to, and convenient inspection of, an immovable antiquity; and
ix. any urban site, street, group of buildings or public square of special value which the Central Government, being of the opinion that its preservation is a matter of public interest by reason of its arrangement, architecture or materials of construction, by notification in the official Gazette, declares to be an immovable antiquity for the purposes of this Act;

106. Advisory Committee. - For the purposes of this Act, the Government shall constitute an Advisory Committee consisting of the following members, namely,

(a) the Director, who shall also be its Chairman;

(b) two members of the National Assembly of Pakistan, one being from each Province; and

(c) three other persons having special knowledge of antiquities.

107. Dispute as to whether any product, etc., is an antiquity**.** - If any question arises whether any product, object or site is an antiquity within the meaning of this Act, it shall be referred to the Central Government which shall, after consultation with the Advisory Committee, decide the same; and the decision of the Central Government shall be final.

108. Prohibition of destruction, damage, etc., of antiquities.

- Subject to the provisions of this Act or of any agreement under section 12, no person shall, except for carrying out the purposes of this Act, destroy, break, damage, alter, injure, deface or mutilate, or scribble, write or engrave any inscription or sign on, any antiquity in respect of which the Director has accepted guardianship or the Central Government has acquired any right.
- The court trying an offence under sub-section (2) may direct that the whole or any part of the fine recovered shall be applied in defraying the expenses of restoring the antiquity to the condition in which it was before the commission of the offence.

109. Dealing in antiquities.

1. No person shall deal in antiquities except under and in accordance with a license granted by the Director.
2. Every dealer shall maintain a register in such manner and form as the Director may prescribe from time to time.
3. A license granted under sub-section (1) may be cancelled by the Director for the breach of any condition of the license.
4. The Director may, with a view to securing compliance with the provisions of this section, -
   a. require any person dealing in antiquities to give such information in his possession with respect to any business carried on by him as the Director may demand;
   b. inspect or cause to be inspected any book, register or other document belonging to or under the control or any person dealing in antiquities; and
   c. enter and search, or authorize any officer subordinate to him to enter and search, any premises and seize, or authorize any such officer, to seize, any antiquity in respect or which he has reason to believe that a breach or any condition or the license has been committed.

110. Prohibition of movement of antiquity.

1. No person shall transport an antiquity from one place in Pakistan to another with the object of exporting it in contravention of section 22.
2. Whoever contravenes the provisions of sub-section (1) shall be punishable with imprisonment for a term which may extend to three months, or with fine, or with both.
3. The court trying an offence under sub-section (2) may direct that any antiquity in respect of which the offence has been committed shall be forfeited to the Central Government.

3.2.10 Bangladesh National Building Code, 2006

111. Part-7, Chapter -1 of the Bangladesh National Building Code (BNBC) clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety of the workmen. According to section 1.2.1 of chapter 1 of part 7, “In a construction or demolition work, the terms of contract between the owner and the contractor and between a consultant

and the owner shall be clearly defined and put in writing. These however will not absolve the owner from any of his responsibilities under the various provisions of this Code and other applicable regulations and bye-laws. The terms of contract between the owner and the contractor will determine the responsibilities and liabilities of either party in the concerned matters, within the provisions of the relevant Acts and Codes (e.g.) the Employers' Liability Act, 1938, the Factories Act 1965, the Fatal Accident Act, 1955 and Workmen's Compensation Act 1923". (After the introduction of the Bangladesh Labor Act, 2006, these Acts have been repealed).

112. Section 1.4.1 of chapter-1, part-7 of the BNBC, states the general duties of the employer to the public as well as workers. According to this section, "All equipments and safeguards required for the construction work such as temporary stair, ladder, ramp, scaffold, hoist, run way, barricade, chute, lift etc shall be substantially constructed and erected so as not to create any unsafe situation for the workmen using them or the workmen and general public passing under, on or near them".

113. Part-7, Chapter-3 of the Code has clarified the issue of safety of workmen during construction and with relation to this, set out the details about the different safety tools of specified standard. In relation with the health hazards of the workers during construction, this chapter describes the nature of the different health hazards that normally occur in the site during construction and at the same time specifies the specific measures to be taken to prevent such health hazards. According to this chapter, exhaust ventilation, use of protective devices, medical checkups etc. are the measures to be taken by the particular employer to ensure a healthy workplace for the workers.

114. To prevent workers falling from heights, the Code in section 3.7.1 to 3.7.6 of chapter 3 of part 7 sets out the detailed requirements on the formation and use of scaffolding. According to section 3.9.2 of the same chapter, "every temporary floor opening shall either have railing of at least 900 mm height or shall be constantly attended. Every floor hole shall be guarded by either a railing with toe board or a hinged cover. Alternatively, the hole may be constantly attended or protected by a removable railing. Every stairway floor opening shall be guarded by railing at least 900 mm high on the exposed sides except at entrance to stairway. Every ladder way floor opening or platform shall be guarded by a guard railing with toe board except at entrance to opening. Every open sided floor or platform 1.2 meters or more above adjacent ground level shall be guarded by a railing on all open sides except where there is entrance to ramp, stairway or fixed ladder the above precautions shall also be taken near the open edges of the floors and the roofs".

115. The major challenge is the proper implementation of the Code as section 2.1 of chapter 2 of part 1 duly states that, "The Government shall establish a new or designate an existing agency responsible for the enforcement of this Code with a given area of jurisdiction. For the purpose of administering and enforcing the provisions of the Code, the enforcing agency shall have the authority of the Government and shall herein be referred to as the Authority."

116. Part 9, 1.2.1 states that if the land is changed and the occupants of the area are against the change, no change in use of an existing building will be allowed.

3.2.11 Standing Orders on Disaster, 2010

117. 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 neighboring 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.

118. Improvement of coastal polders under CEIP-I will provide better communication facilities in the coastal areas, which is crucial for emergency response to disasters.

3.2.12 National Adaptation Programme of Action (NAPA)

119. 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.

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

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

121. 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.

122. 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).

3.2.14 The Acquisition and Requisition of Immovable Property Ordinance, 1982

123. This Ordinance is the basic instrument governing land acquisition in Bangladesh. It is restricted to “legal” owners of property as supported by records of ownership such as deeds, title or agreements to compensating for land as well as any business, structure, trees and crops on the land. The owners of acquired land receive cash compensation at market value with a premium of 50 per cent on the assessed price. The law specifies methods for calculation of market value of property based on recorded prices obtained from relevant Government departments such as Registrar (land), Public Works Department (structures), Department of Forest (trees), Department of Agriculture (crops) and Department of Fisheries (fish stock).

124. 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 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.

125. The land owner 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 land owners 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).

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

126. 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.[2]

3.2.16 Constitutional Right of the Tribal Peoples Rights

127. 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.

3.2.17 Ethnic Minority Rights in PRSP, 2005

128. 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:

- 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.

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[2] 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.

- 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.

3.2.18 Acquisition and Requisition of Immovable Property Ordinance, 1982

129. 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 Deputy Commissioner (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.

130. 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 are no other policies 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.

131. 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 prices3. 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[4.]
- Socio-economic 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.

132. 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

3 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.

4 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.

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.

3.2.19 THE EMBANKMENT AND DRAINAGE ACT, 1952 (EAST BENGAL ACT NO. I OF 1953). [7th January, 1953]

133. An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion or other damage by water.

134. Whereas, it is expedient to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage and improvement of lands in the territories comprising the province of East Pakistan and for the protection of such lands from floods, erosion or other damage by water.

135. The Act has been formulated during the Pakistan regime when Bangladesh was known as East Pakistan.

136. Improvement of coastal polders under CEIP-1 will improve embankment and drainage and provide better construction, maintenance and management in the coastal areas, which is crucial for emergency response to disaster.

3.2.20 Bangladesh Labour Act, 2006 (XLII of 2006)

137. According to Labour Act, 2006 the following labour relevant 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

138. The above relevant by-laws deal with the 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 polder.

3.3 The Constitution

139. 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."

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

3.3.1 Other Relevant Acts

141. 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 offishes 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
Bangladesh Labor Law (2006)	Deals with occupational rights and safety of factory workers; provision of comfortable work environment and reasonable working conditions	MoL

3.4 International Treaties Signed by GoB

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

143. 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 fall under Red Category. Therefore, the CEIP-I intervention in Polder 48 falls under the ‘Red’ category.

144. 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)

145. 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:

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

3.6 Detailed Steps of In Country Environmental Clearance Procedure

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

148. 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 it is 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.

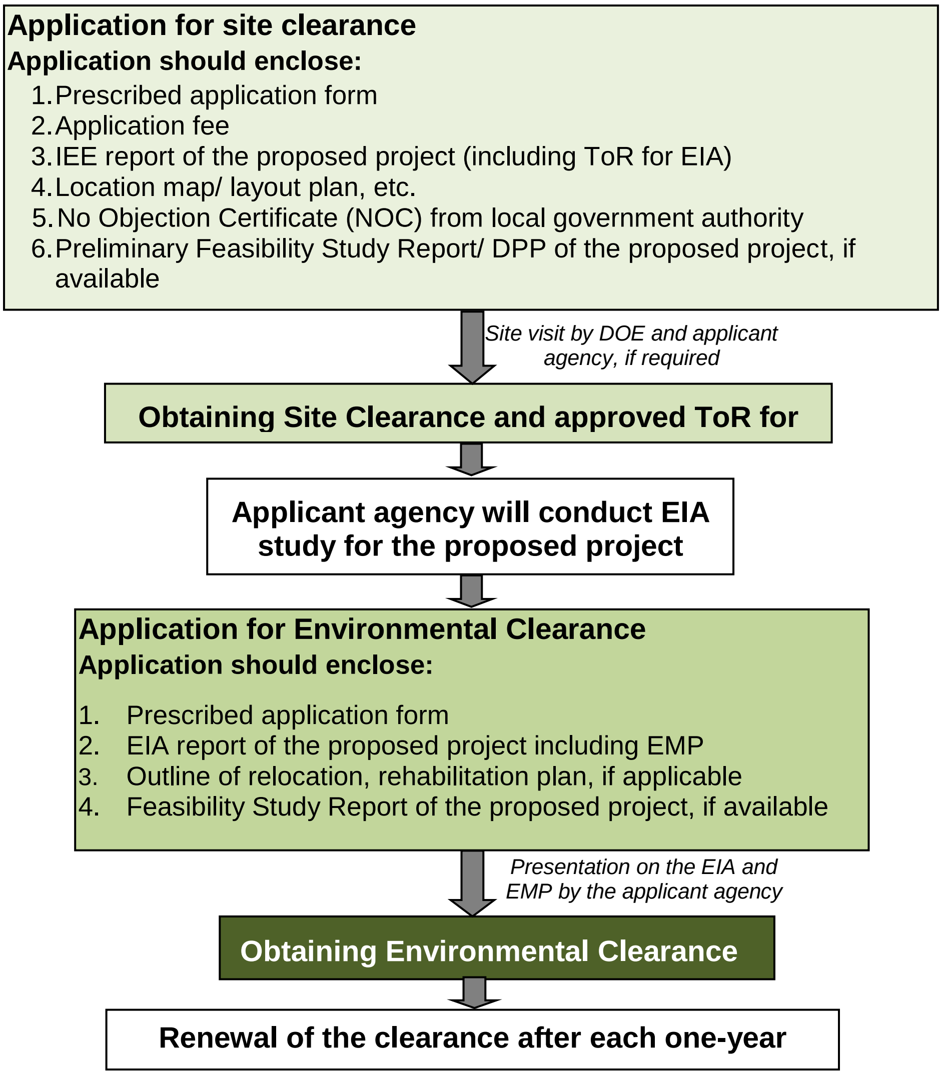

Figure 3.1: Process of obtaining Clearance certificate from DoE

3.7 World Bank's Environmental Safeguard Policies

149. 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.

3.7.1 Environmental Assessment (OP 4.01)

150. 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.

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

152. **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.

153. ***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.

154. ***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.

155. ***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.

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

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

3.7.2 Natural Habitats (OP 4.04)

158. 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.

159. The WB OP 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 lands 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.

3.7.3 Water Resources Management (OP 4.07)

160. 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.

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

3.7.4 Physical Cultural Resources (OP 4.11)

162. 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. [5]

- 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.

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

- 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.

163. 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.

3.7.5 Forestry (OP 4.36)

164. 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 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.

165. 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.

3.7.6 Projects on International Waterways (OP 7.50)

166. 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 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 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.

3.7.7 Pest Management (OP 4.09)

167. 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.

3.7.8 Indigenous Peoples (OP 4.10)

168. 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:[6]

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

- 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.

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

170. 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.

171. 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.

3.7.9 Involuntary Resettlement (OP 4.12)

172. 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.[7]

173. 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.

174. 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.

[7] Excerpts from WB OP 4.12. WB Operational Manual. December 2001.

3.7.10 Projects in Disputed Areas (OP 7.60)

175. 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 neighboring 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.

176. 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. [8]

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

3.7.11 Safety of Dams (OP 4.37)

178. 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.

3.7.12 Public Disclosure of Information (BP 17.50)

179. 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.

180. 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.

3.7.13 Environment, Health and Safety Guidelines

181. The Environment, Health, and Safety (EHS) [9] 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.

3.8 Implications of WB Policies on CEIP

182. The project interventions for Polder 48 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.

[8] Excerpts from the OP 7.60. WB Operational Manual. November 1994.

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

183. 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 archeological, 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, since re-excavation will take place in the internal khals only. 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.

4 Description of the Project

4.1 General

184. 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 north-eastern corner of the Bay near Sandwip.

185. 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

186. 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.

187. 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).

188. 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.

189. 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

190. 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.

191. 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).

192. 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.

193. The Polder 48 is one of the polders to be rehabilitated under the CEIP-1.

4.2 Overview of the Polder

194. The polder is located at Kuakata under Kalapara Upazila of Patuakhali District. The polder covers two Union Parishads (U/P), namely Latachapli and Dhuleshwar. The polder is bounded by Andharmanik River in the west, Ramnabad River in the East, the Bay of Bengal in the south and Mahipur Channel in the North. Construction of the Polder 48 was started in 1962-63 and completed in 1967-68. Later on, the polder was included in CERP for rehabilitation. The original concept of construction of this polder was only to protect the agricultural lands from salinity intrusion caused due to tidal inundation from the sea and the river. A large part of the embankment directly faces the sea. At present, the embankment of the polder is under heavy threat of cyclone surges, wave attack, sea & river erosion and increasing risks brought about by climate change. This is one of the 17 polders selected for the feasibility study under CEIP-1. Information/data of the existing water management infrastructures are incorporated in the following Table: 4.1.

Table 4.1: Summary of the existing water management infrastructures

Type	Specification
Total length of Embankment	38.00 km
Total length of Sea-dyke	19.78 km
Total length of Interior-dyke	18.10 km
Total number of Drainage Sluices	08 nos
Total number of Flushing Sluices	04 nos
Total length of Drainage *Khal* (Water Channel)	45 Km

Source: DDCS&PMSC Design Team, CEIP-1

4.3 Objective of the Project

195. 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.

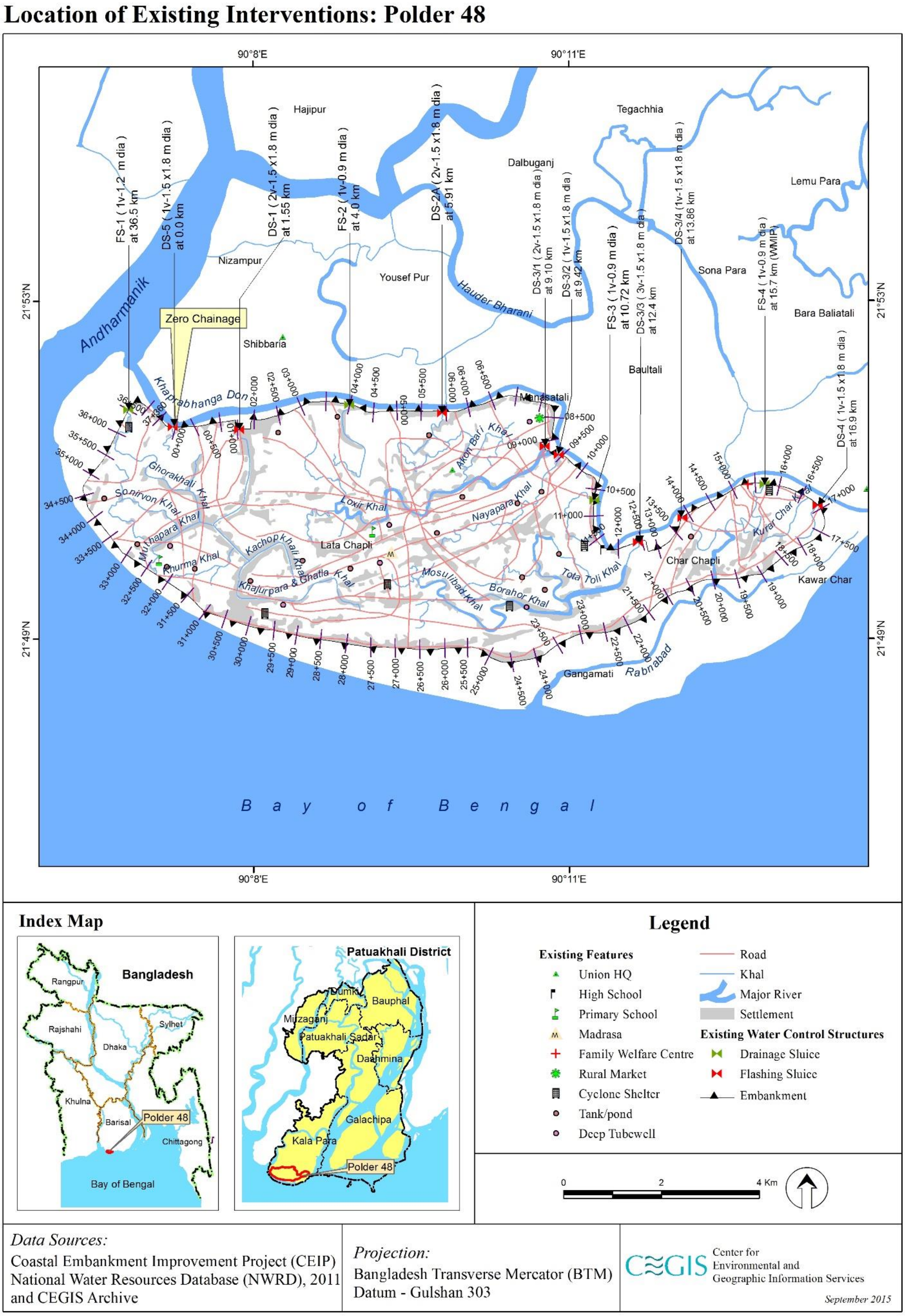
4.4 Water Management Problems and Issues in the Polder

196. Providing safeguard against high tide is the main consideration of the Polder 48 as it is situated on the coast of Bay of Bengal. The present condition of the Polder is extremely vulnerable, with a large numbers of segments of the embankment have been damaged by the recent cyclonic storm surges, i.e. Sidr, Aila, etc. Breaches were formed at some weak sections of embankment and the polder area was inundated with about 1m of water during Sidr. It is been reported that five (5) people died and some people were injured during Sidr at Gyanpara area. The seaside slope of embankment along the Bay of Bengal from km 29.50 to 34.60 is subject to severe wave action from the sea, particularly when the water level increases during adverse weather condition. The embankment is under-sectioned with respect to the design, with deteriorated condition, which is being aggravating day by day as a result of the effect of climate change. Poor maintenance and inadequate management of the polders have also contributed internal drainage congestion and heavy external siltation. As a result, soil fertility and agriculture production are declining because of water logging and increase of salinity inside the polder.

197. Currently, about 15 to 20% of the polder area is facing problems from salinity for around seven to eight months of a year. Primarily because of ineffective water control structures and silting of water channels made the problem more severe. There are eight sluices in the polder but no one on the sea facing embankment. The concrete surface of these structures have been deteriorated for long time use and effect of saline water. Gates have been corroded and loose apron have been damaged. Except DS-5 and DS-3/1, all the sluices required to be replaced. DS-5 and DS-3/1 need to be repaired. Moreover, there are four Flushing Inlets in the Polder. All the Flushing Inlets were constructed with reinforced concrete pipe (RCP) with 0.9m dia and are in extremely poor condition, which need to be replaced by Reinforced Concrete Box (RCB) (1v-0.9×1.2) sluice for flushing and drainage purpose.

198. People demanded facilities for storage of fresh water during post-monsoon period in the internal canal system for cultivating winter-crops as the salinity in the river water increases during the month of February and continues till May. Regulators are thus required to be constructed with provision for flushing and drainage. The internal drainage channels have been silted up and need to be re-excavated for smooth drainage. The outfall channel namely Mohipur Khal at the periphery from Ch. 9.00 to Ch. 17.00 has been silted up which is needed to be re-excavated. There is bitumenous carpeting road constructed by LGED on the top of embankment from Alipur to Kauar char (Ch. 00.00 to Ch. 17.00) and from Ch. 29.00 to Ch. 31.00 at Kuakata sea beach which needed to be upgraded under CEIP programme by raising the crest level up to recommended level. Kuakata beach is a tourist spot and is located at the southern side of the polder. There is newly accreted land with Reserved Forest, which is located on the eastern side of the Polder (at Char Gangamoti). The existing foreshore adjacent to the embankment between Ch. 26.50 to Ch. 19.00 has been accreted naturally towards sea keeping a strip of about 1.25 km matured lands beyond the existing embankment. There is a scope of afforestation in this area.

199. An Index Map (Map 4.1) showing the alignment of the embankment, drainage sluice, drainage channels etc. is shown below:



Map 4.1 Existing Interventions of Polder 48

200. Based on local opinions collected during major field investigation carried out in June 2015, the study team identified the following key water management problems and issues in the Polder 48.

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

4.5 Present Status of Water Management Infrastructures

201. To ensure sustainable water management, optimal use and equitable sharing of water resources Water Management Infrastructures are conceived as physical interventions, which are the key features of intervention work. There are some typical water management infrastructures such as peripheral embankments, drainage and flushing sluices, drainage chennels etc. in the polder. Based on field investigation, coupling with the information received from CEIP consultants, the study team gathered the following information regarding status of the existing infrastructure:

4.5.1 Embankment

202. The total length of the embankment is divided into interior-dyke embankment (Ch. 0+000 to Ch.16+500 and Ch. 37+000 to Ch. 38+090) and sea-dyke embankment (Ch. 16+500 to Ch. 37+000). The polder is surrounded by Andharmanik River in the west, Ramnabad River in the East, the Bay of Bengal in the south and Mahipur Channel on the North. Presently, a significant portion of the polder is directly vulnerable to cyclones and storms surge from the Bay of Bengal. Many segments of the embankment have been damaged during Sidr and Aila, especially along Khaprabhanga union.

203. During field survey, 58% area of the peripheral embankment was found as unpaved, which hampers communication during wet season (Picture 4.1). The polder from Alipur Bazar to Naya mistrypara i.e. 35% area is found to be paved, which is predominantly used for vehicular movement (Motorcycle, Tomtom/ van, etc.). Erosion hotspots have also been observed during field investigation adjacent to the Kuakata sea beach (Picture 4.2).

Picture 4.1: Embankment at Panau Para and adjacent to Kuakata sea beach

4.5.2 Slope Protection

204. The existing condition of the slope of the embankment from Ch. 29.00 to Ch. 34.50 has fallen under threat of wave action of the Bay of Bengal. Damages to the embankment occur when depression is formed in the sea especially during cyclone and high tide period. To protect the embankment from wave thrust, slope protection work of the embankment from Ch. 31.70 to Ch. 31.90 and from Ch. 33.70 to Ch. 35.20 has been taken care under WMIP, FDR and GoB. The length of embankment from Ch. 29.00 to Ch. 34.50 is required to be protected by providing slope protection works under CEIP-1.

Picture 4.2: Deteriorated condition of bank protection (Kuakata sea beach)

4.5.3 Water Control Structures

206. There are eight (8) numbers of drainage sluices and four (4) numbers of flushing inlets in the polder (Picture 4.3 to 4.6). The existing drainage and flushing structures are to be replaced in most of the cases on emergency basis. The concrete surface of the structures has been deteriorated due to prolonged exposure to saltwater. A number of gates have been corroded and the loose aprons have been damaged as well. Some of the sluices were found with no gates. Furthermore, the structures have also been deteriorated due to the mismanagement of local communities. Local people opined that most of the gates are operated on the basis of the local interest rather than water management interest. Fresh water retention

need to be ensured within the internal canal system for cultivating Rabi-crops. Some of the Reinforced Concrete Pipe (RCP) sluices will have to be replaced by Reinforced Concrete Box (RCB) sluices. **Table 4.2** below provides a detail understanding of the existing drainage and flushing sluices of 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. 1+550	RCP (5vent-0.9 m dia)	• It was constructed in the year 1966-67. • Loose aprons have been partially damaged • Gates corroded. • Sluice is in deplorable condition.	Needs to be replaced
2	D/S – 2A	Ch. 5+910	RCB (2vent-1.5mx1.8m)	• The construction work of the sluice was completed in 1966. • Gate and loose-aprons damaged.	Needs to be replaced
3	D/S – 3/1	Ch. 9+100	RCB (2vent-1.5mx1.8m)	• Constructed in the year 2009-10 and is in good condition. • Gates and loose aprons damaged.	Needs to be repaired
4	D/S – 3/2	Ch. 9+420	RCB (1vent-1.5mx1.8m)	• Constructed in the year of 1982-83. • Concrete surface has been deteriorated and • Gate damaged.	Needs to be replaced
5	D/S-3/3	Ch.12+425	RCB (3vent-1.5mx1.8m)	• Constructed in the year 1982-83. • Loose-aprons damaged • Gate has been lost.	Needs to be replaced
6	D/S-3/4	Ch.13+860	RCP (3vent-0.9m dia)	• Constructed in the year 1966-67. • Concrete surface is in deplorable condition. • Gate has been lost • Loose aprons damaged.	Needs to be replaced
7	D/S-4	Ch. 16+900	RCB (1vent-1.5mx1.8m)	• It was constructed in the year of 1986-87. • Loose aprons. • Gate damaged.	Needs to be replaced

Sl.	Structure	Chainage	Type and Size	Observations	Rehabilitation Needs
8	D/S-5	Ch.0+000	RCB (1vent-1.5mx1.8m)	• The structure was constructed in the year 2002-03. • Sluice is in good condition but Gate damaged. • Diversion channel	Needs to be repaired
Flushing Sluice					
1	F/S-1	Ch. 36+500	RCP (1vent-1.2m dia)	• The sluice is badly damaged.	Needs to be replaced.
2	F/S - 2	Ch. 4+000	RCP (1vent-0.9m dia)	• It was constructed in the year 1965-66 and is functioning as drainage regulator. • Loose aprons damaged. • Concrete surface deteriorated.	Needs to be replaced.
3	F/S - 3	Ch. 10+725	RCP (1vent-0.9m dia)	• Concrete surface is in deplorable condition. • Loose-aprons damaged. • Gate lost.	Needs to be replaced.
4	F/S - 4	Ch. 15+700	RCP (1vent-0.9m dia)	• Construction work of the structure is going on under WMIP.	Taken up under WMIP

Source: DCSC Design Team, CEIP-I , CEGIS Field investigation, 2015

Note: F/S = Flushing Sluice, D/S = Drainage Sluice, RCP = Reinforced Concrete Pipe, RCB = Reinforced Concrete Box

Picture 4.3: Deteriorated condition of D/S-1 (Alipur Bazar)

Picture 4.4: Deteriorated condition of D/S-5 (Khajura)

Picture 4.5: Damaged Structure F/S-2 (Tulatuli Village)

Picture 4.6: Damaged Structure F/S-3 (Naya Mistripara)

4.5.4 Drainage Chennels

207. There is presently a length of around 45 km of drainage khals (water channel) inside the polder. The peripheral channels (Mohipur Channel) in between km.9.00 and km.17.00 has been silted up and needs to be re-excavated for smooth drainage through the existing drainage sluice. Besides, the internal drainage channels have also been silted up which need to be re-excavated.

4.6 Proposed Rehabilitation/ Improvement Activities in Polder

208. The proposed interventions in Polder 48 (Map 4.2, Map 4.2-a, Map 4.2-b, Map 4.2-c and Map 4.2-d) 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. 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.

209. The interventions have further been detailed in the following sections:

Table 4.3: List of Proposed Interventions in Polder 48

Type of Work	Specification
Re-sectioning of embankment	38.09 km
Design crest level of embankment	5.00mPWD and 7.5mPWD
Construction (Replacement and repairing) of Drainage Sluice	09 nos. (1 nos. FS-2 replaced by DS-6)
Construction (Replacement) of Flushing Sluices	03 nos.
Re-excavation of drainage channel	42.38 km
Design Slope of the embankment	R/S 1:7 and C/S 1:2 -sea dyke R/S 1:3 and C/S 1:2 - Interior dyke
Slope protection of embankment	4.078 Km (1.70 km new and 2.378 km enhancement)
Afforestation	16.89 ha

Source: DCSC Design Team, CEIP-I

210. Moreover, a total of 8 km peripheray river/khal in Polder 48 from 9.00 km to 17.00 km of Mohipur khal will be re-excavated/dredged under this project.

211. To implement the aforementioned project interventions, the following phase-wise activities are to be carried out (Figure 5.1). The activities under each of the interventions have further been discussed and specified in the following sections:

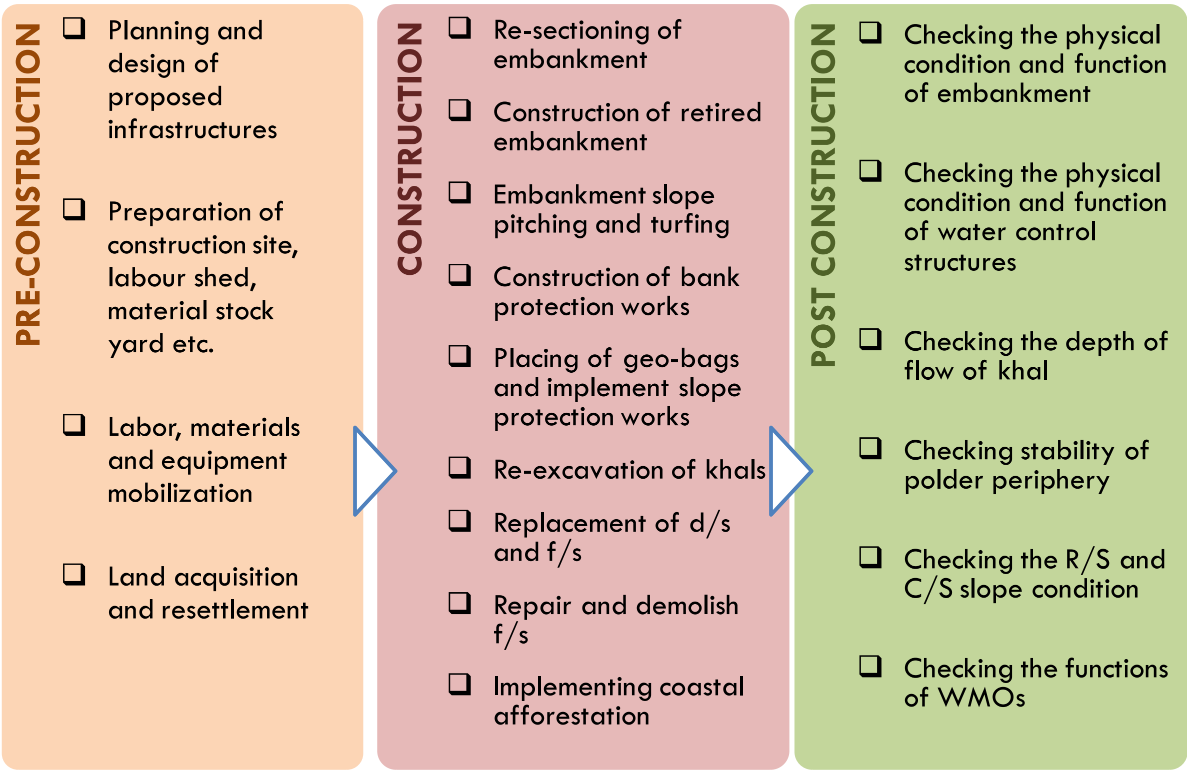
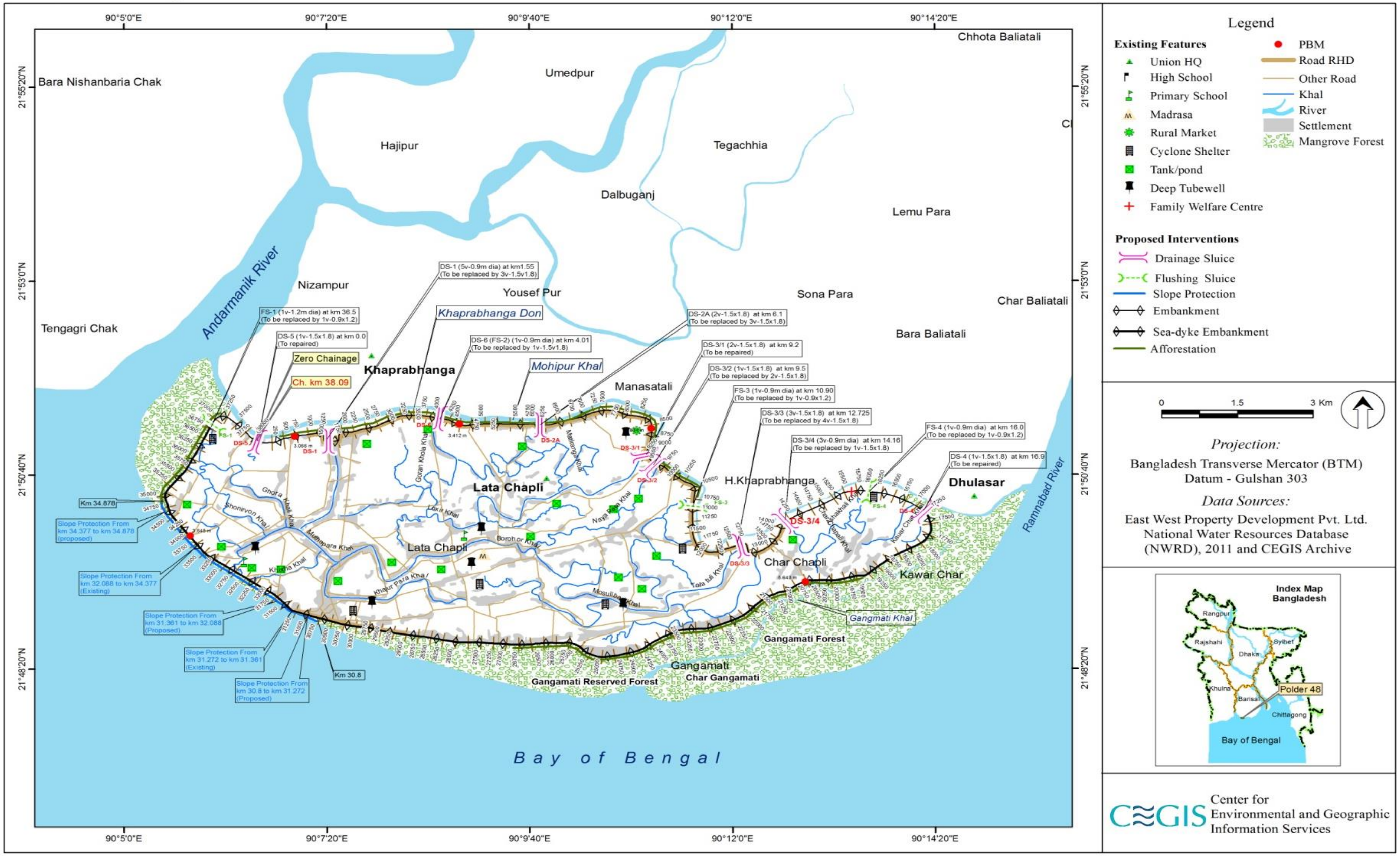
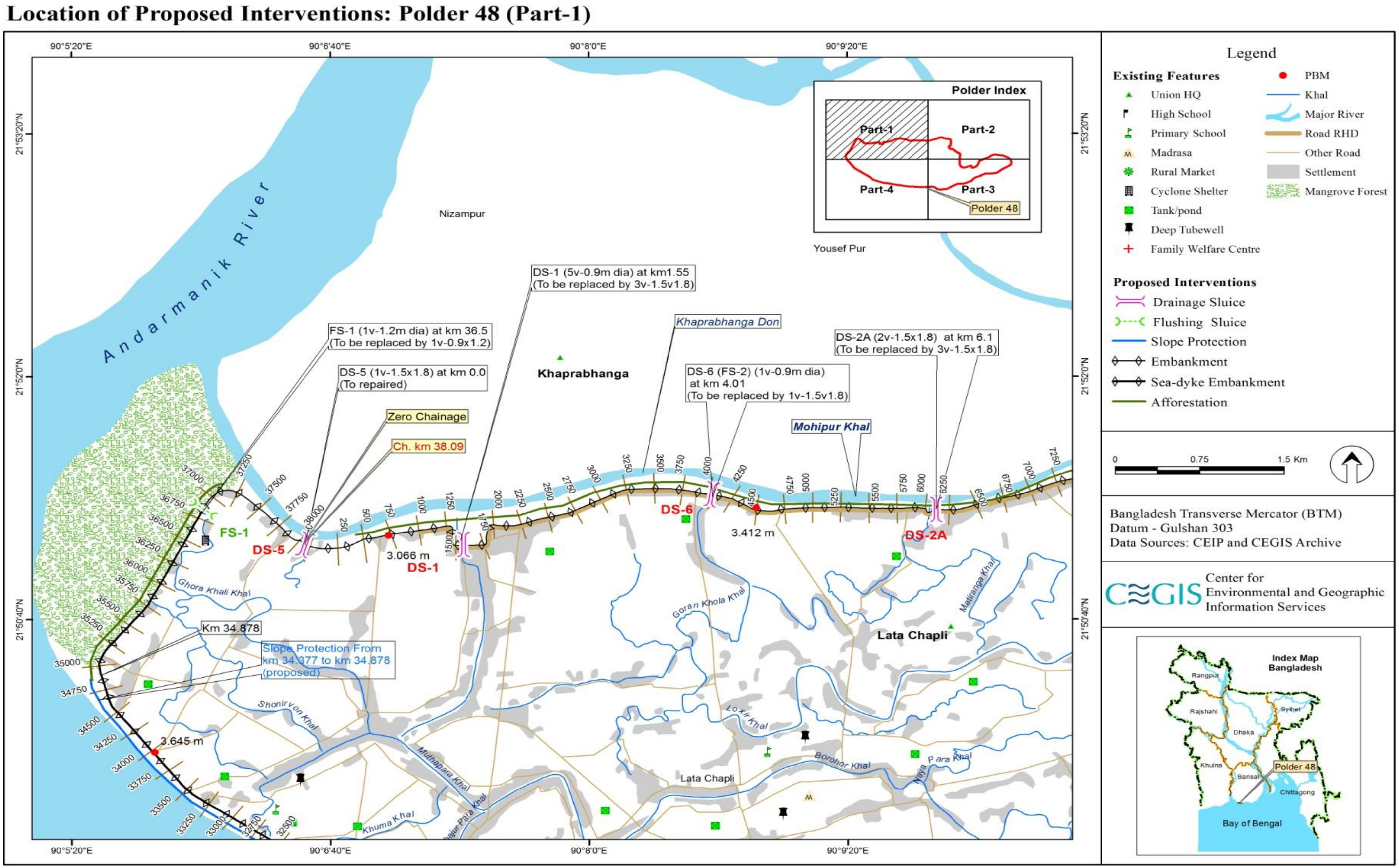


Figure 4.1: List of activities in Polder 48 at different project phases

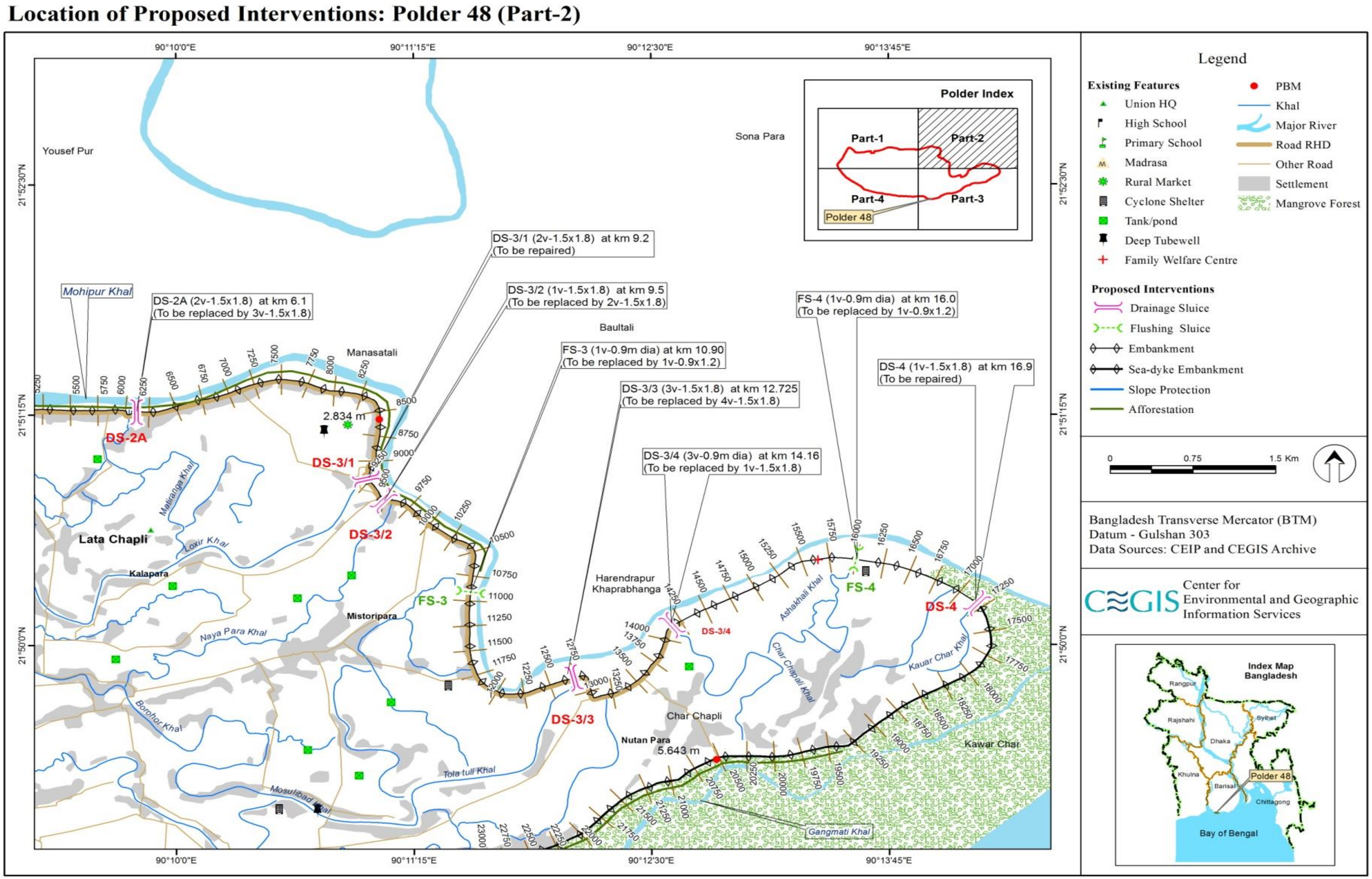
Location of Proposed Interventions: Polder 48



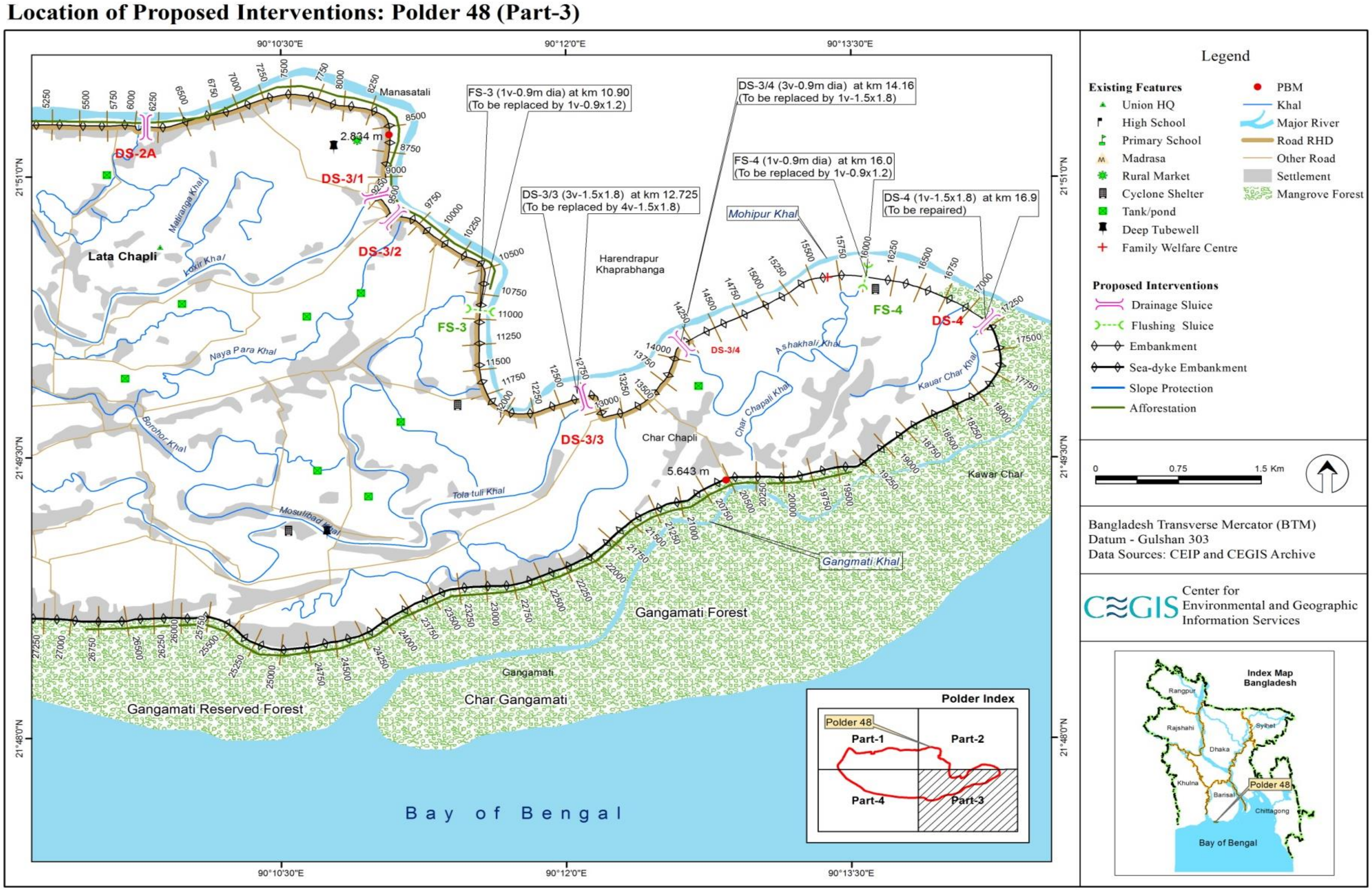
Map 4.2: Proposed Interventions of Polder 48



Map 4.2 (a): Proposed Interventions of Polder 48 (Part 1)

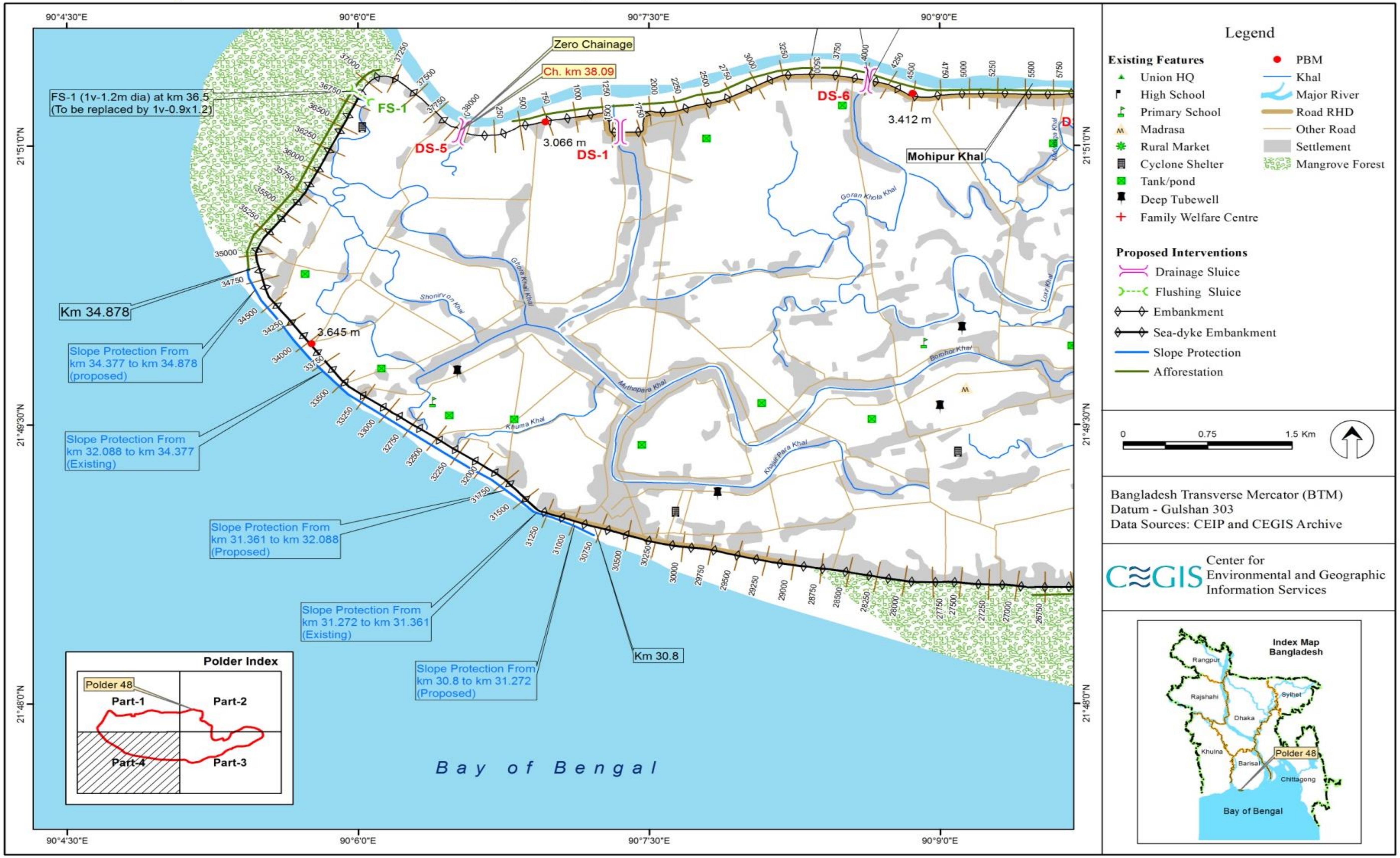


Map 4.2 (b): Proposed Interventions of Polder 48 (Part 2)



Map 4.2 (c): Proposed Interventions of Polder 48 (Part 3)

Location of Proposed Interventions: Polder 48 (Part-4)



Map 4.2 (d): Proposed Interventions of Polder 48 (Part 4)

4.6.1 Works on Embankment

212. Under the proposed interventions in the Polder, a total length of 38.09 km of embankments will be re-sectioned. The process will be done with mechanical compaction as per recommended crest level in consideration of the wave surge, cyclone surge and climate change scenarios based on mathematical modelling. The bitumen carpeted road on the top of the embankment needs to be upgraded under CEIP program. The side slopes of the embankment will also be rehabilitated. Table 4.4 shows detail information on the works to be carried out on the embankment.

Table 4.4: Detail of Works on Embankments

Sl.	Chainage (Km)	Proposed Crest Level	Side slopes
1	0+000 to 16+500	5 mPWD	R/S 1:3 and C/S 1:2
2	16+500 to 27+500	7.5 mPWD	R/S 1:7 and C/S 1:2
3	27+500 to 37+000	5 mPWD	R/S 1:3 and C/S 1:2
4	37+000 to 38+090	7.5 mPWD	R/S 1:7 and C/S 1:2

Source: DCSC Design Team, CEIP-1

Description of construction activities

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

214. Labor sheds construction with proper sanitation and other required facilities should be planned before the commencement of construction activities of the embankment. 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 made as per the instruction of the Engineer in-charge. The tools required for the construction of embankments will be procured within this period. After validating the final design, excavated soil/carried earth will be dumped in layers on the aligned length of the embankment. At the same time, each layer (of 1.5 feet) of dumped soil will have to be compacted by a compactor machine. The sloping and shaping of embankment will be developed after proper compaction in layers. The required turfing with grass will then be provided on the slope of the embankment. Watering and fertilizing will also be provided.

4.6.2 Construction (Replacing and repairing) of Drainage Sluices

215. The nine number of proposed Drainage Sluces will be managed as three to be repaired and six to be replaced including one Flushing Sluice replaced by a Drainage Sluice, the summary of design information of the proposed works in the Drainage Sluices are given in Table 4.5.

Table 4.5: 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 (2v-1.5m x 1.8m)	1.55	Khajur para Khal	Khapra Bhanga Don	7.50	-0.943	0.77	-1.060	-0.10	Needs to be replaced by RCB (2vent-1.5mx1.8m) sluice has been proposed
02	DS-2A (2v-1.5m x 1.8m)	5.91	Matiranga Khal	Khapra Bhanga Don		-0.86	0.77	-1.607	-0.10	Replacement of structure has been proposed
03	DS-3/1 (2v-1.5m x 1.8m)	9.10	Loxir Khal	Mohipur Khal		-0.709	0.77	-0.735	-0.10	Repairing of the structure has been proposed
04	DS-3/2 (1v-1.5m x 1.8m)	9.42	Naya para khal_01	Mohipur Khal	4.25	-0.707	0.77	-1.049	-0.10	Replacement of structure has been proposed
05	DS-3/3 (3v-1.5m x 1.8m)	12.425	Tola Toli Khal	Mohipur Khal	5.50	-0.656	0.77	-1.010	-0.10	Replacement of structure has been proposed
06	DS-3/4 (1v-1.5m x 1.8m)	13.860	Char Chapali Khal	Mohipur Khal		-0.606	0.77	-0.550	-0.10	Needs to be replaced by RCB (1vent-1.5mx1.8m) sluices has proposed
07	DS-4 (1v-1.5m x 1.8m)	16.90	Kauar Char Khal	Mohipur Khal		-0.639	0.77	-0.622	-0.10	Repairing of structure has been proposed
08	DS-5 (1v-1.5m x 1.8m)	0.00	Koloipara Khal	Khapra Bhanga Don		-0.959	0.77	-1.058	-0.10	Repairing of the structure has been proposed
09	DS-6 (1v-0.9m dia)	4.01	Goran khola Khal	Khapra Bhanga Don						Replacing flushing sluices no. 2 with a drainage sluice

Source: DDCS&PMSC Design Team, CEIP-1

Description of construction activities

216. During pre-construction phase for construction of 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 for it 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 Construction (Replacing) or Repairing of Flushing Sluice

217. Out of total four Flushing Sluices in the Polder- 48, F/S-1 at Ch. 36+500, and F/S-3 at Ch. 10+725 will be replaced. The F/S-2 at Ch. 4+000, which will be replaced as DS-6 (already included in Table 4.5). Construction work of Flushing Sluice FS-4 at Ch. 15+700 is going on under WMIP. A detailed description of the flushing sluices is given in Table 4.6.

Table 4.6: Detail of Works in Flushing Sluices

Sl.	Name of Structure	Chainage	Structure Type and Size	Proposed works
1	F/S-1	Ch. 36+500	RCP (1vent-1.2m dia)	The structure is proposed to be replaced by RCB (1vent-0.9mx1.2m) sluice with provision for flushing cum-drainage.
2	F/S - 3	Ch. 10+725	RCP (1vent-0.9m dia)	The structure is proposed to be replaced by RCB (1vent-0.9mx1.2m) sluice in place of pipe sluice.
3	F/S - 4	Ch. 15+700	RCP (1vent-0.9m dia)	Taken up under WMIP

Source: DDCS&PMSC Design Team, CEIP-1

Description of construction activities

218. Before starting the construction activities of drainage 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, pipes and machine pipe along with allied construction and fittings will then be made along with construction of collar joints as and where required. 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 re-sectioned 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

219. Twelve (12) drainage channels with a total length of 41.045 km will be re-excavated to ease water flow and reduce drainage congestion. The re-excavation works may be implemented either manually or mechanically. No dredging operation will be carried for removal of sedimentation from the khals. 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 kutcha 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. Figure 4.7 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.

Table 4.7: Khals/Channels to be re-excavated

No.	Khal Name	Length (m)	Length (km)
1	Khunjupara Khal	7500	7.50
2	Matiranga Khal	2000	2.00
3	Loxir Khal	7000	7.00
4	Nayapara Khal-1	4250	4.25
5	Tolatoli Khal	5750	5.75
6	Charchapali Khal	2500	2.50
7	Kuarchar Khal	1000	1.00
8	Kalapara	345	0.345
9	Ghorakhali Khal	4000	4.00
10	Goramkhali khal	2750	2.70
11	Nayapara Khal	2000	2.00
12	Ashakhali khal	2000	2.00

Source: DDCS&PMSC Design Team, CEIP-1

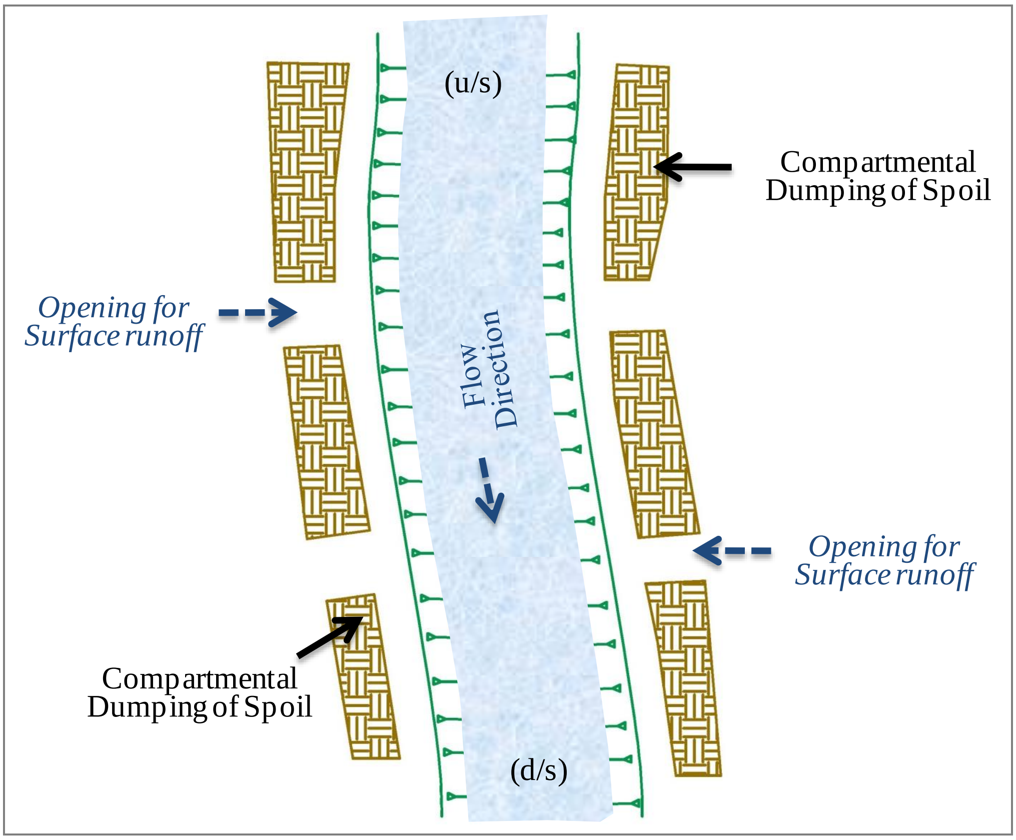


Figure 4.2: Plan form of a typical khal to be re-excavated

Description of construction activities

220. For re-excavation of the drainage channels, the required tools will have to be procured first. A schematic diagram showing the centerline and layout plan will be made for re-excavation, the depth and width of excavation will also be noted as per section of the channel. The entire channel will then be divided into number of reaches. The excavation will be started from the upstream of the channel. Cross dams will be built on both ends of the reach and soil will be removed from the channels up to the required depth and width. The excavated soil/sludge should be dumped in a suitable place as, specified by the Engineer in-charge, so that the sludge or soil will not affect the channel flow by any means. After finalizing the excavation in one reach, the next reach at its downstream would be re-excavated following the same procedures as stated above. The entire length of the channel will thus be re-excavated.

4.6.5 Afforestation

221. Foreshore area and embankment slope afforestation by plantation of mangrove and local timber/fruit yielding tree species is proposed under the interventions. The areas selected for afforestation in Polder 48 are shown in detail in Map 4.2. A total of 94,906 nos of trees will need to be felled from the RoW (Source RAP Report). About 9.48 ha area of embankment slope is available for afforestation in this Polder (Source: Final Interim Report on Additional Tasks Assigned, Volume III; Afforestation Report, Page: III-19). In addition, about 7.41 ha of foreshore area will be planted with different mangrove species (Source: Final Interim Report on Additional Task Assigned, Volume III: Afforestation Report, Page: III-21).

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

Species Selection for Afforestation

223. 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* (Tatul) & *Acacia nilotica* (Babla) at a spacing of 2m (6-7 feet) apart. The upper row will be at a distance of. 2m to 3m (6 to 10 feet) from the lower row. The upper row will be planted with *Borassus flabellifer* (Tal), *Cocos nuciferal* (Narikal) and *Phoenix sylvestris* (Khajur) at a spacing of 2m (6-7 feet) apart, but staggered with the lower row plants. The *Tamarindus indica* (Tatul) and *Acacia nilotica* (Babla) seedlings will be raised in 10” × 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 nuciferal* (Narikal) and *Phoenix sylvestris* (Khajur) seedlings will be purchased from nurseries. Planting of 2,500 seedlings will make one hectare plantation. An estimated 23,700 nos of saplings will be planted along the 9.48 ha area of embankment slope.

224. The available foreshore area of the polder will be planted with suitable mangrove species. Keora *(Sonneratia apetala)*, Baen *(Avicennia officinalis)*, Chaila/Ora *(Sonneratia caseolaris)*, Kankra *(Bruguiera gymnorhiza)*, Gewa *(*Excoecaria *agallocha),* Bhola *(Hibiscus tiliaceous)* and Golpata *(Nypa fruticans)* have been selected as the suitable species for this polder. Average distance between two saplings will be 1.5 m. Accordingly; about 33,000 mangrove saplings will be planted in 7.41 ha of available foreshore area. A typical cross section of embankment slope and foreshore afforestation is shown in Figure 4.8.

Table 4.8: Detail works of afforestation

Sl. No.	Description	Chainage (km)	Length (km)	Total Afforested area (ha)
1	Slope Plantation	-	37.88	9.48
2	Foreshore Afforestation including Golpata Plantation	0.50 km to 10.50 km	10.00	7.41
	Total Land Area (ha) to be Afforested			**16.89**

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

225. In addition, another afforestation program to be included in the Polder for sustenance of green environment of the Polder and restoration of proper eco-balance. It is observed that, in total 94,906 nos. of trees to be felled in Polder 48, which will require plantation of total 284,718 (94,906 x 3) trees in the area, according to practice of DoE (according to DoE, 3 plants to be planted for 1 tree felled). Since, 23,700 sapplings will be planted in 9.48 ha of embankment slope and 33,000 plants at 7.41 ha of foreshore area and the remaining 228,318 nos. saplings to be distributed among the local inhabitatns to be planted at suitable locations identified by the community members (for this purpose, the required cost is included in cost of estimates for environmental Management and Monitoring, (Table 10.4).

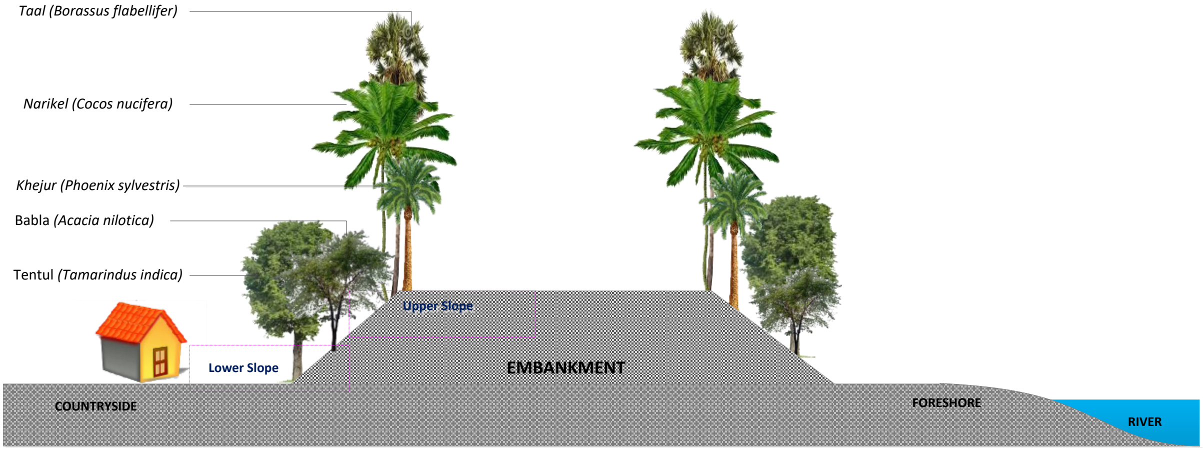


Figure 4.3: Typical cross section of Embankment slope and Foreshore Afforestation

226. Detail Plantation establishment Matrix is presented in following Table 4.9:

Table 4.9: Details Plantations establishment matrix of the Polder

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	

Item of works	Time schedule for the given type				
	Golpata (Nypa) Plantation	Chailla, Kankra, Gewa Plantation	Keora Baen Plantation	Embankment Slope Plantation.	Additional Plantatation
				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 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 2013Construction Details

4.7 Construction Details

4.7.1 Construction Schedule

227. The construction works in Polder 48 under the CEIP-1 is expected to be completed in four years. The construction schedule is presented in appendix 1.

4.7.2 Construction Manpower Requirement

228. Technical and non-technical 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. The estimated manpower requirement is presented in Table 4.11.

Table 4.10: Required manpower for construction

Sl.	Required Manpower	Numbers
1	Engineer	15
2	Machinery operator	25
3	Mechanics	7
4	Surveyor	7
5	Skill labour (person-day)	6,000
6	Un-skill labour (Person-day)	20000

Source: Engineering & Procurement Team of CEIP-1

4.7.3 Construction Material

229. The construction materials required for re-sectioning of the embankment. Water regulatory sluices, flushing sluices, and bank protection work will include soil, cement, steel, and sand. The estimated quantities of these materials are shown in Table 4.12:

Table 4.11: Details of Construction materials

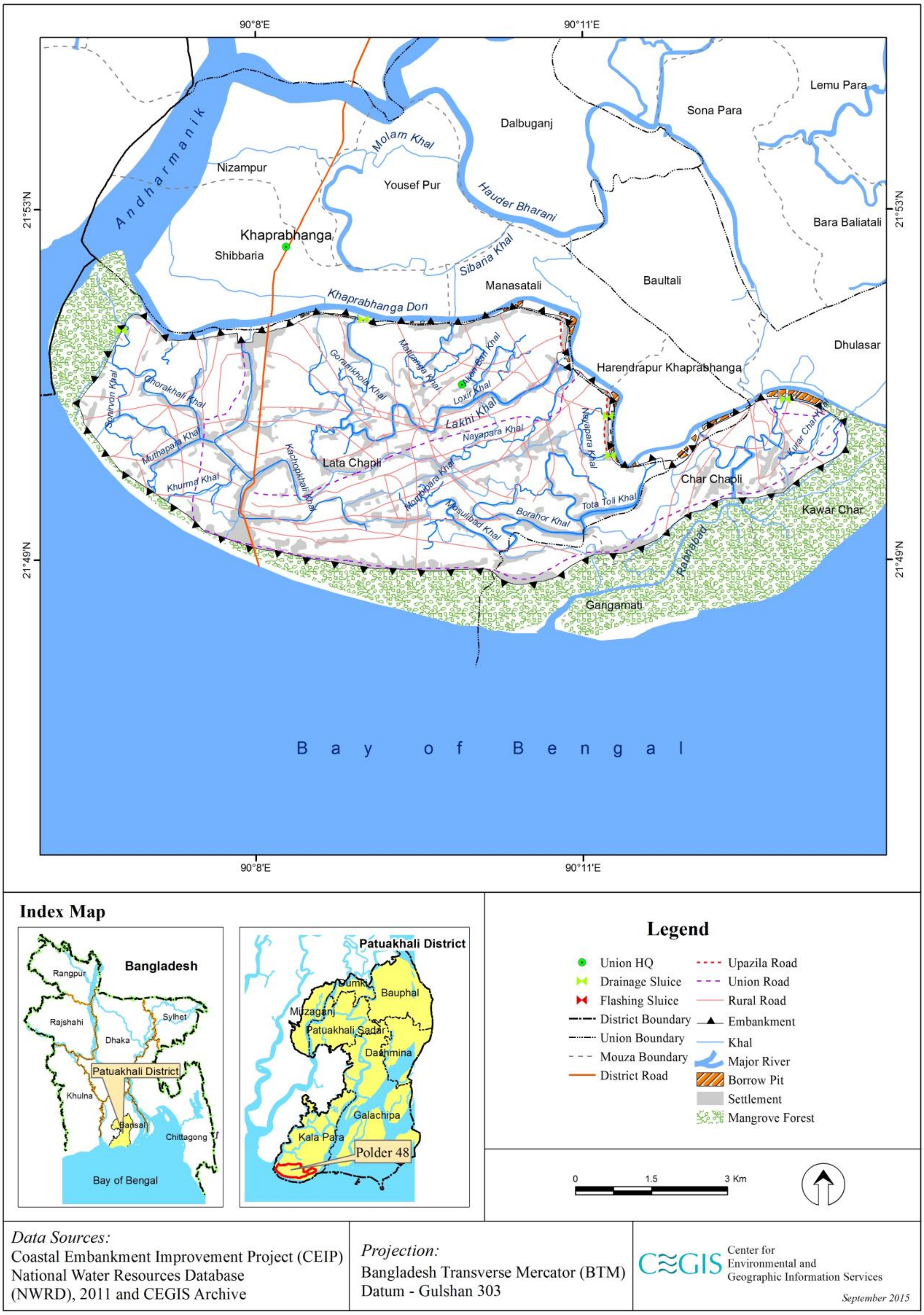
	Description	Quantity	Sources
Re-sectioning and retired embankment			
1	Earth work	15,00,000 m^3	Borrow pits, dredging spoils from re-excavation of drainage channels.
Construction of sluices and flushing sluices			
2	Cement	50,000 bags	To be procured from local market
3	Sand	4,500 m^3	To be procured from Barisal
4	Stone	4,000 m^3	To be procured from Barisal
5	Steel	750 Tons	To be procured from Barisal
Bank protection			
6	CC Blocks	60,00,000 nos	To be made at construction site during implementation

Source: Engineering & Procurement Team of CEIP-1

<u>Earth from borrow pit area</u>

230. The earth for rehabilitation of the embankment will be collected mainly from the offshore borrow areas of Polder-48. 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 design by Main-Consultant) which does not cause any geo-morphological . 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 borrow 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 4.3.

Borrow Pit: Polder 48, Kalapara Upazila, Patuakhali



Map 4.3: Map showing the available Borrow pit areas of Polder 48

4.7.4 Construction Machinery

231. A number of construction machinery and equipment would be required for the construction activities in the polder. A tentative list of these machinery and equipment is presented in the table below:

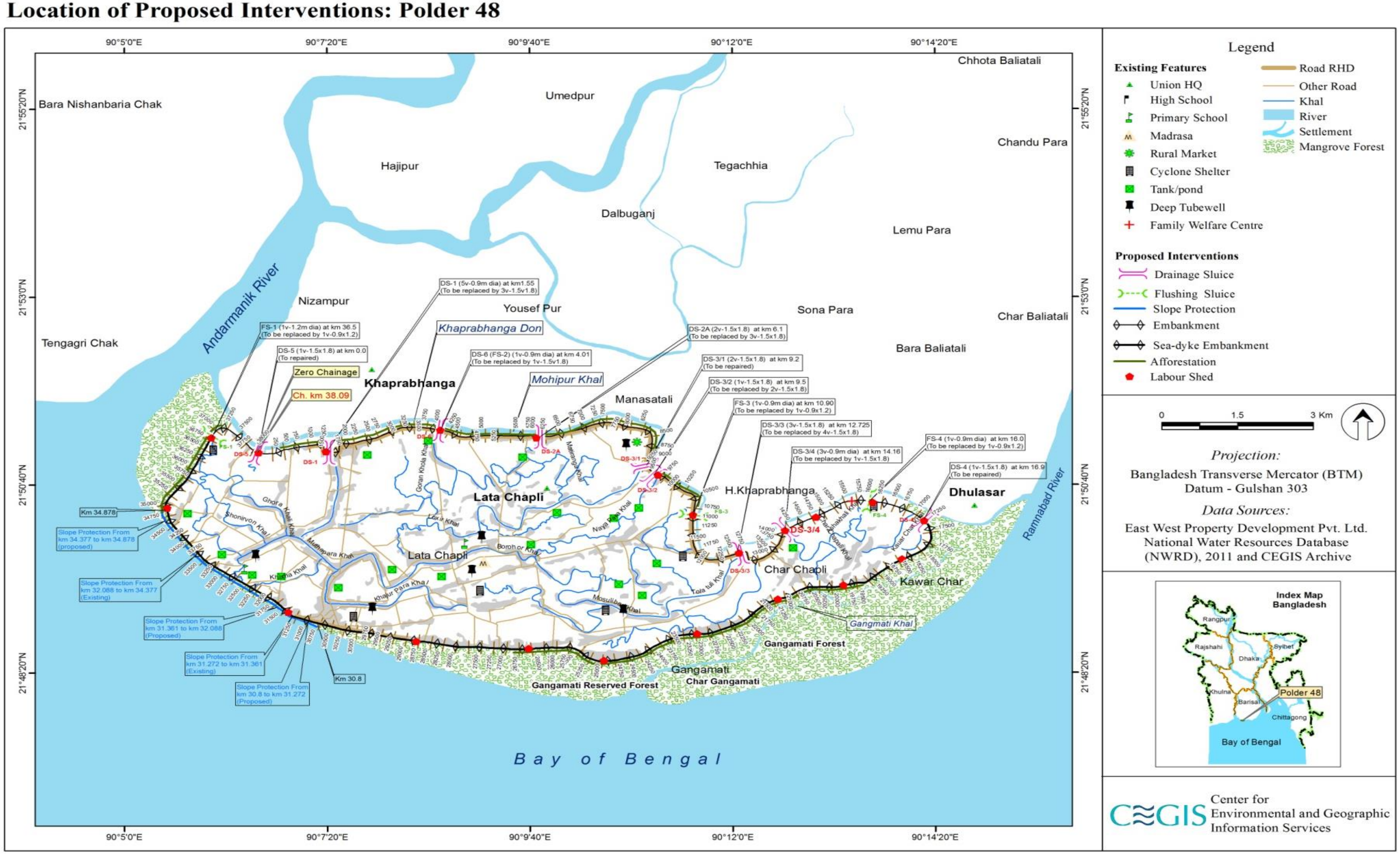
Table 4.12: List of construction equipment and machinery

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

Source: Procurement/Engineering Team, DDCS&PMSC, CEIP-I, 2015

4.7.5 Construction Camps

232. Camps for labour will be constructed at all construction sites. A total of 21 camps for labor is foreseen to be established during construction period. All the camps are for embankment works, drainage sluices and flushing sluices works and for bank protection 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 locations of construction camps are shown in Map 4.4.



Map 4.4: Location of proposed labour Shed/camps for Polder 48

4.8 Project Implementation Arrangements

233. **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).

234. **Project Steering Committee (PSC)**. The PSC would be chaired by the Secretary of the Ministry Water Resources and will include the Secretaries of the ministries, namely Finance, Agriculture, Environment & Forests, Public Health Engineering, 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.

235. **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 be of 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 Director. The Field Offices will be located in each of the three main project districts, namely *Khulna, Patuakhali/ Barguna and Bagerhat*.

236. **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 the progress of the project, 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.

237. **The Engineering Unit.** will oversee the work of the consultants engaged for 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.

238. **A 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.

239. **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.

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

- An experienced NGO will be mobilized by the PMU to implement the afforestation, recommended in the the EMP, the Social Action Plan including mobilization of Water Management Organization, the RAP and the EMP.
- A Design and Construction Supervision Consultancy Firm will assist the PMU in preparing the detailed design of the remaining polders and supervise all construction works. For civil works, the Project Director will serve as the Employer and the Project Supervision Consultant will serve as the Engineer for construction supervision. At site, a Resident Engineer, appointed by the consultant, with a team of specialists and inspectors will supervise the Contractor.
- The DSC will be responsible for supervising the implementation of the EMP/RAP.
- A Monitoring and Evaluation Consultants will monitor the implementation and evaluate the impacts 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.

241. *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 five (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 Operation Plan

4.9.1 Introduction

242. 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.

243. The Polders have been playing vital role in safe guarding the coastal area; ensuring and increasing agricultural production; improving livelihoods of the people and mitigating environmental damages. The Polders 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 coup 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 assistance from international donors and lending agencies or out of its own resources has been spending money almost on 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 initiative 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

244. There is no denying 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 also 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. This is summarized as below:

Community Participation in Operation and Preventive Maintenance

245. 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 worthy 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.

246. For effectively and meaningful community participation, the following remarks are important.

- **Firstly, 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 irrational 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.

Annual Evaluation of the O&M activities done by WMOs

247. 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.

248. It is wiser to remove persons 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

249. 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 costs 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

250. Field staffs of BWDB should work more closely with the leaders of Union Parishads and Community Groups in the field. Local stakeholders' participation will be 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.

251. 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

Engaging NGOs in operation and Preventing Maitanance

252. 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

253. 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 project 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

254. 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 on the availability of 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 (Figure 5.4) because adequate preventive and minor periodic maintenance pushes down the need of rehabilitation; infrastructure remains in good condition.

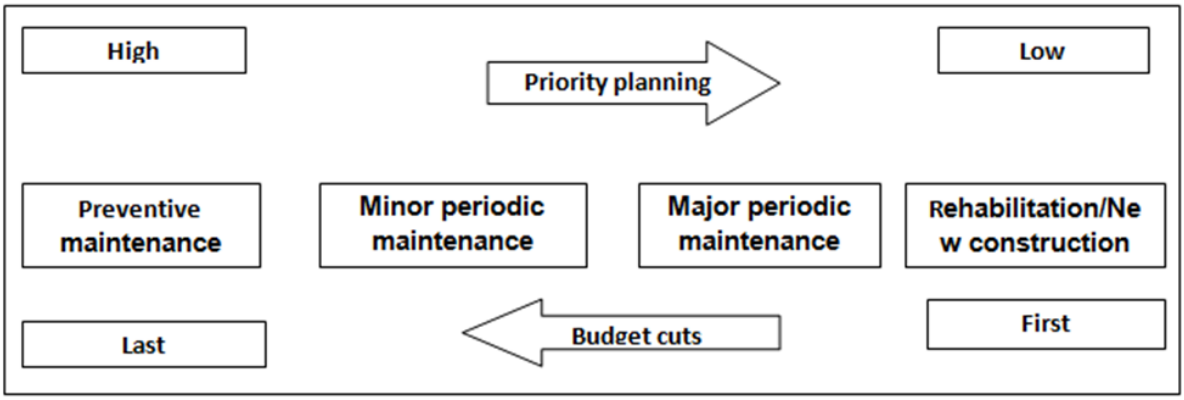


Figure 4.4: Priority Budgeting for O&M

255. 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

256. 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

257. 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)

258. 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

259. 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.

260. 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.

261. 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.

262. 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.

263. 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 over time.

264. 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.

4.10.2 Frequent Watching of Embankments

265. 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

266. 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

267. 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

268. 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

269. 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. Therefore, in the planning of operation, the demands of all categories of beneficiaries should be taken into account for achieving a perfectly integrated water management. Participation of beneficiaries at all levels of planning is essential.

270. The decision making process involved in structure operation is shown in Figure 5.5. 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.

271. 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. A gate operation plan in Bengali is provided in Appendix-12.

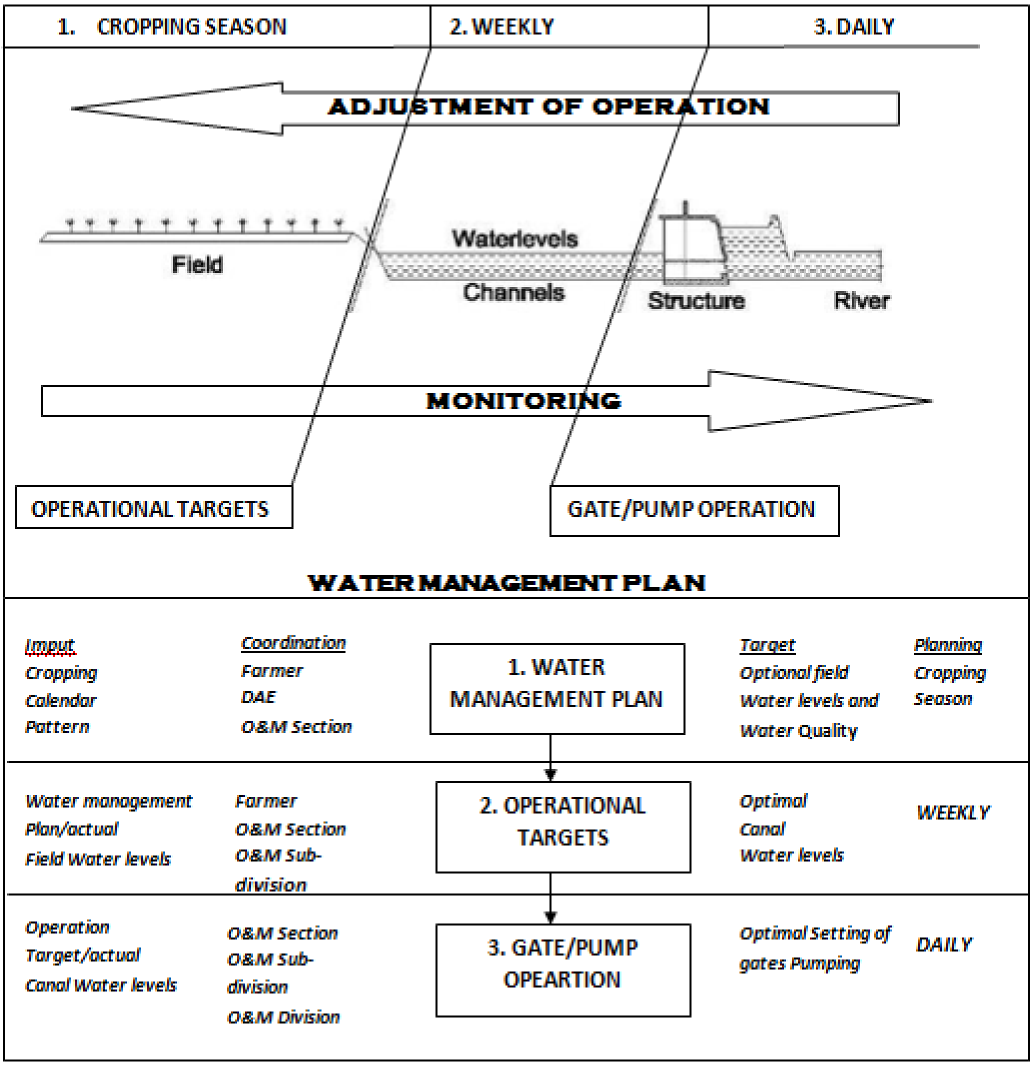


Figure 4.5: Decision making in operation

(a) Seasonal Water Management Plan (WM Plan)

272. 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.

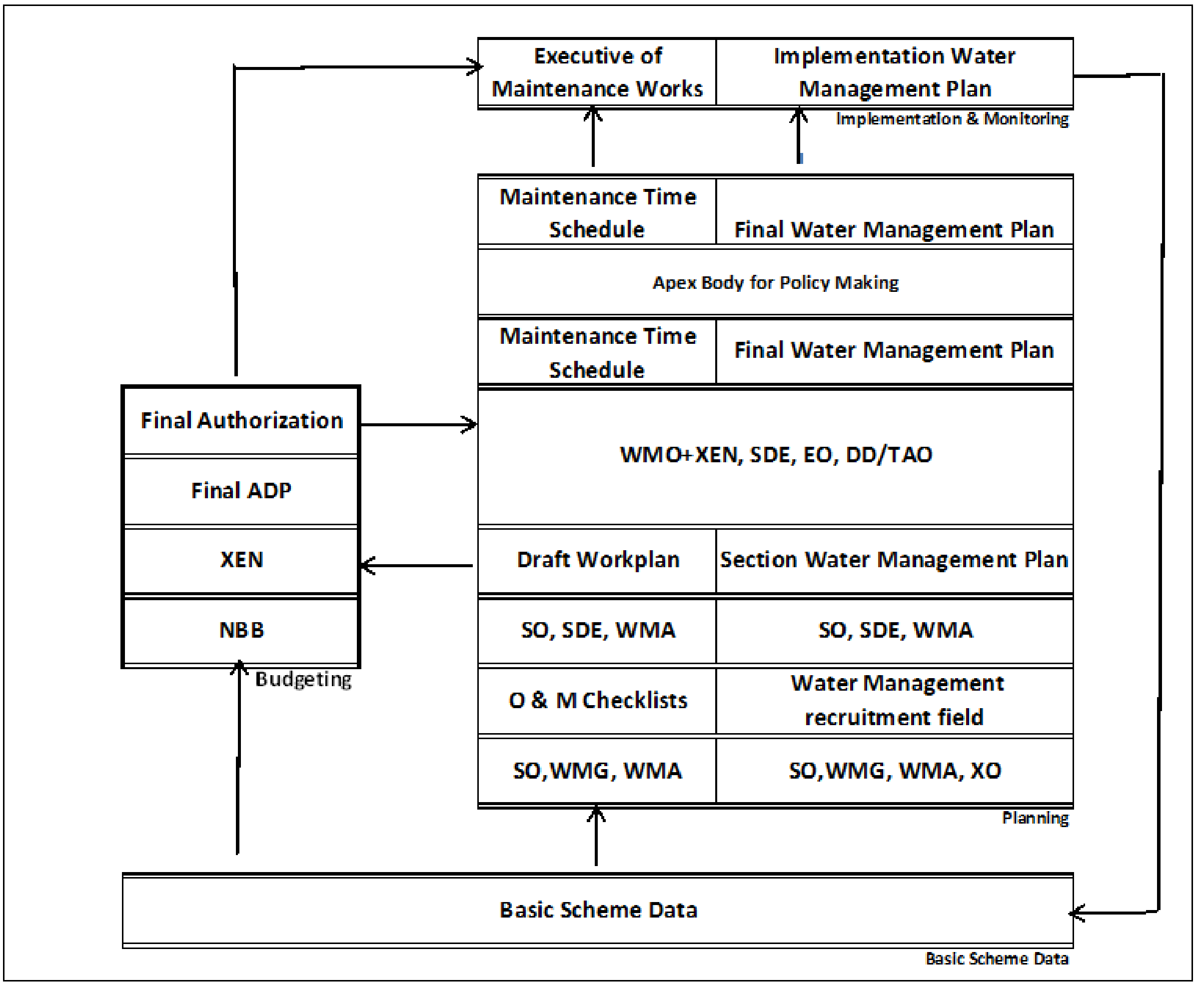


Figure 4.6: Standard Planning Procedure

<u>Note:</u>
DD Deputy Director
TAO Thana Agriculture Officer
BS Block Supervisor
For other abbreviations, see FIG: Relationship between WMGs ang LGIs.

273. Inputs required for the WM plan includes information on cropping 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.

274. 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.

(b) Weekly Operation Targets

275. 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.

(c) Day-to Day operation

276. 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

277. 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-today tasks schedule and needs continuous efforts, maintenance of coastal polders put emphasis on simple and cost effective community-based interventions.

278. 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

279. 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.

280. The preventive maintenance interventions have been spelled out precisely in Table 4.10 below:

4.13 Periodic Maintenance

281. 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.

282. 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.

283. The periodic maintenance interventions have been spelled out precisely in Table 4.14 below.

4.14 Emergency Maintenance

284. 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 4.14 indicates each type of emergency maintenance works.

Table 4.13: Types and Classification of Maintenance Works

Sl.	Description of Maintenance Works	Implementation Mode									
		Classification by Type of Maintenance			Community Based Functional Groups under WMOs						LCB
		I	II	III	EMG	ES	CMG	SMG	LCS	PIC	
	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/ moribund/dead trees.	√			√	√					
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 earth works: 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	√							√		
10	Checking and tightening nuts and bolts	√						√	√		

Sl.	**Description of Maintenance Works**	**Implementation Mode**									
		Classification by Type of Maintenance			**Community Based Functional Groups under WMOs**						**LCB**
		I	**II**	**III**	**EMG**	**ES**	**CMG**	**SMG**	**LCS**	**PIC**	
11	Brushing cheeped or loose paint rust on metal parts; and painting	√						√	√		
12	Patching minor damages or minor brick		√								√
13	Replacingrubbersealofgate, positioning		√					√			√
14	Repairing or replacing damaged metal works /hinges, lifting devices for flap or Vertical sliding gates		√					√			√
	Repair defective block works (aprons)										
16	Replacing stop logs, flap gate or vertical		√	√							√
17	Repair head walls, wingwalls, aprons of structures		√								√
18	**<u>Protective Works</u>** Re-positioning/replacing of incidentally displaced blocks/ boulders /concrete frames, small repair to sand/gravel filter		√								√
19	**<u>Channels</u>** 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)		√			√					

<u>Notes:</u> <u>Maintenance Class;</u> I- Preventive or routine maintenance; II-periodic Maintenance; III- Emergency Maintenance

4.15 Planning of Maintenance

285. 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 seasonal 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.

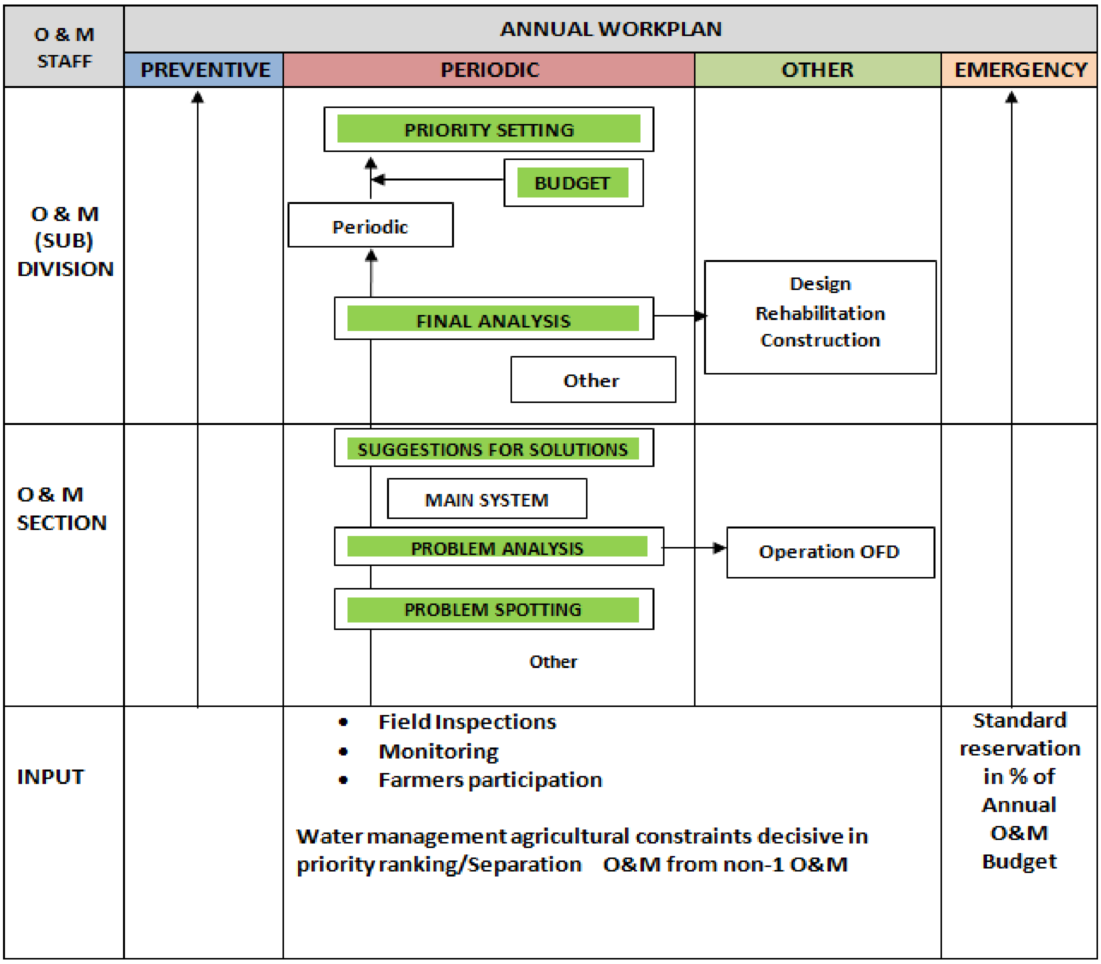


Figure 4.7: Decision Making in Maintenance

286. 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

287. 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 also on 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, remodeling 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.

288. Figure 4.8 below depicts the Type of Rehabilitation works.

Figure 4.8: Type of Rehabilitation Works

Sl. No.	Description of Maintenance Works	Implementation Mode						
		Community Based Functional Groups under WMOs						LCB
		EMG	ES	CMG	SMG	LCS	P I C	
1	**Embankment** Construction of new or retired embankment, closing of breach (not emergent)					√		√
2	**Structures** Big repair or replacing of lifting mechanisms for flap gates or vertical slide gates							√
3	New protective works (CC blocks/boulders), big repair of block works (aprons)							√
4	Repar of head walls / wing walls/ aprons							√
5	**Protective works** Big repair, remodeling 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: DCSC Design Team, CEIP-I

4.15.2 Local Participation in O&M and Water Management

289. 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 most of these sub-projects vis-a-vis coastal polders have been chronically 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 yet.

4.16 Institutions for Participation

290. 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.

291. 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

292. 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.

293. 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.

294. 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.

295. 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

296. 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:

297. 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 as shown below;

Box-1 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 to 5000 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):

298. This organization, at the grass-root level will provide the platform for all those who live inside or adjacent (close vicinity) to 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 thousand as its primary members.

299. 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.

300. 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.

301. 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 iare 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):

302. 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.

303. 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):

304. 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 federating 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.

Table 4.14: Duties and Responsibilities of WMOs at different tiers

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

Water Management Group (WMG)	Water Management Association (WMA)	Water Management Federation (WMF)
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

305. 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

306. ESs are 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 certain period. Unlike CERP they will simply enjoy the settlement facility and usufructuary rights of the plantation on embankment slopes and toes.

EMG - Embankment Maintenance Group

307. 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 paid laborers on a daily basis payment. Responsibilities and mode of payment are same as those already in practice in BWDB polders /sub-projects.

LCS – Landless Contracting Society

308. 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 up of the assigned job. This has become a popular means of executing earthworks especially in case of emergency needs because they can start works immediately.

CMG – Canal Maintenance Group

309. 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 on the basis of volumes of actual works done.

4.16.4 Roles of NGOs in participation

310. 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

311. 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

312. 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.

Capacity Development of WMOs

313. WMOs, in its current forms in the coastal polders will be quite new at many places. It would not be sufficient enough 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. So 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

314. 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 back stopping 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

315. 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.

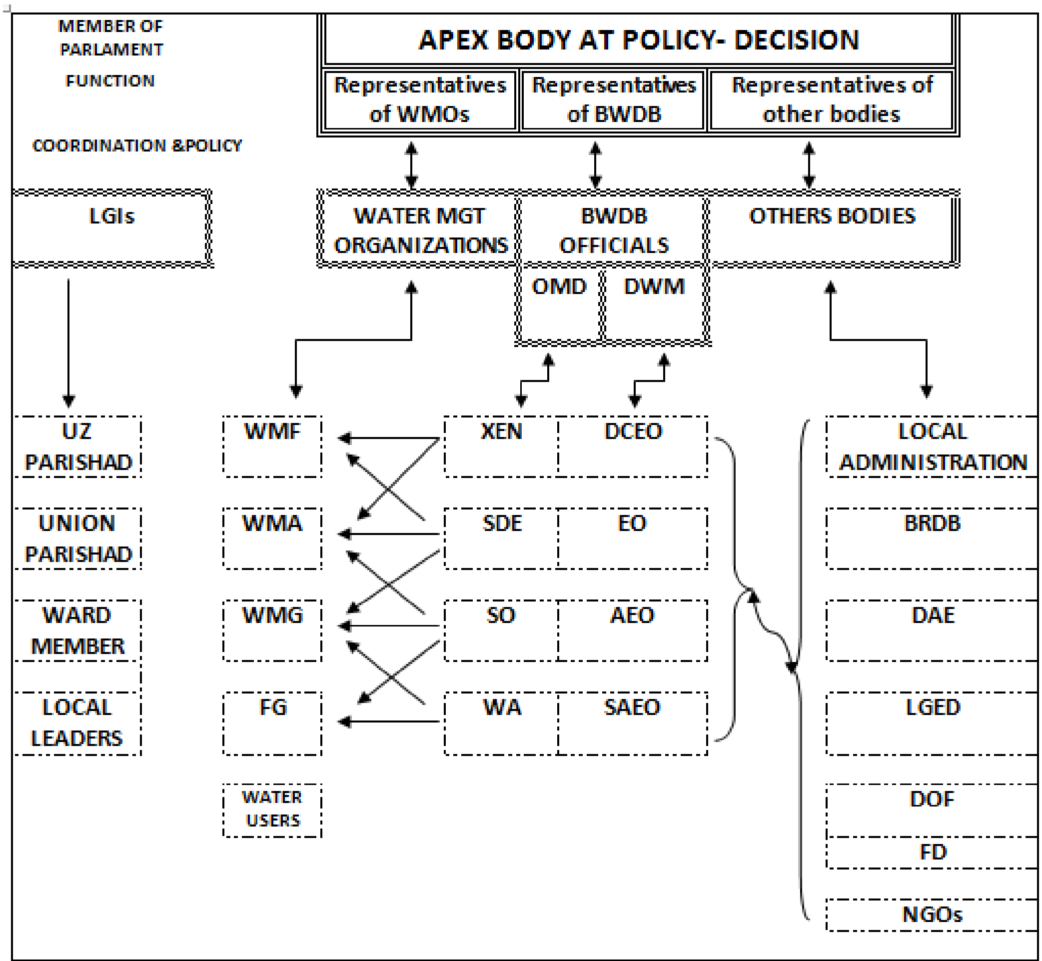
Cooperation of LGIs

316. 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.

317. Apart from the farm families living inside the polder, the embankment settlers; landless section; aboriginals; 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.

318. 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:



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 4.9: Inter-relationship between WMOs and the LGIs

Support from Local Administration

319. 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

320. 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

321. 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 honored 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

322. The implementation cost of the rehabilitation of Polder 48 is BDT Tk. 1,520,928,731 (Taka one hundred fifty two crore nine lac twenty eight thousand seven hundred thiry one) only.

4.18 Need of Resettlement Action Plan (RAP)

323. The interventions proposed in Polder- 48 do not include any major works. All proposed structural works would be undertaken on the existing alignment. There is no new 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 adjacent to the polder periphery, which may be displaced during construction works. A separate RAP is being conducted by the concerned consultants.

4.19 No Objection Certificate

324. Polder 48 is located in the Kalapara Upazila under Patuakhali District, covering Dablugonj Union. No archeological sites or cultural heritages are known to exist in these unions, which might be affected interventions proposed for the 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 3**.

5 Environmental Baseline and Existing Conditions

5.1 Physical Environment

5.1.1 Geology

325. Polder 48 is situated in a low-lying coastal region. From Spatial analysis, it has been observed that the polder is composed of Tidal Deltaic Deposit. The major portion of this deltaic sediment is deposited in the permanent body of water where tidal waves and currents aid in transportation and deposition. Typically, low-lying deltaic environment comprises of soft sediments and are densely populated again, these regions are quite dynamic and changes in coastal geomorphology are quite rapid from impact of each cyclone.

5.1.2 Topography

326. The study area is located in the southern hydrological zone of Bangladesh with a rather flat landscape and relatively low laying topography. The elevations are more or less similar, with a very minor downward sloping from South to North. The area is interspersed with network of khals. Land elevation of the study area varies from 1.26 to 3.04 m, PWD. From the Digital Elevation Model it is found that around 73% lands of the areas have elevation between 1.26 to 1.96 m above MSL, whereas 27% have elevations between 1.96 to 3.04 m above MSL. The Area Elevation Curve and Digital Elevation Model of the study area are given in Figure 5.1 Map 5.1. respectively.

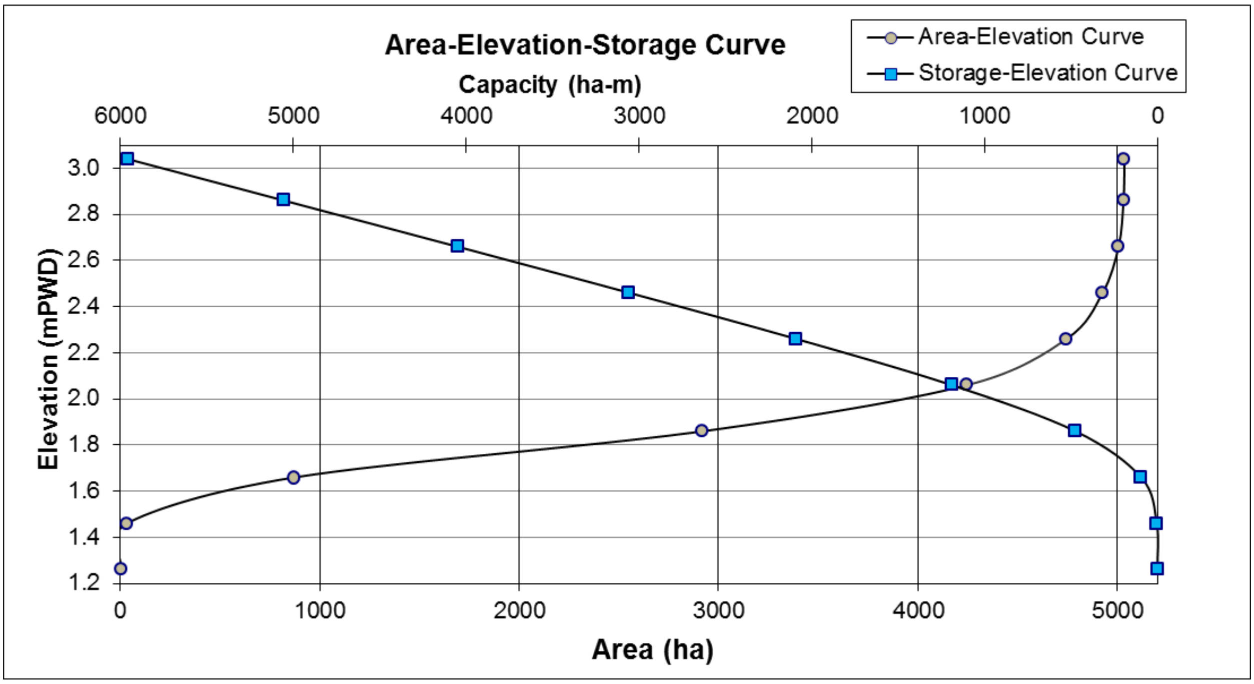
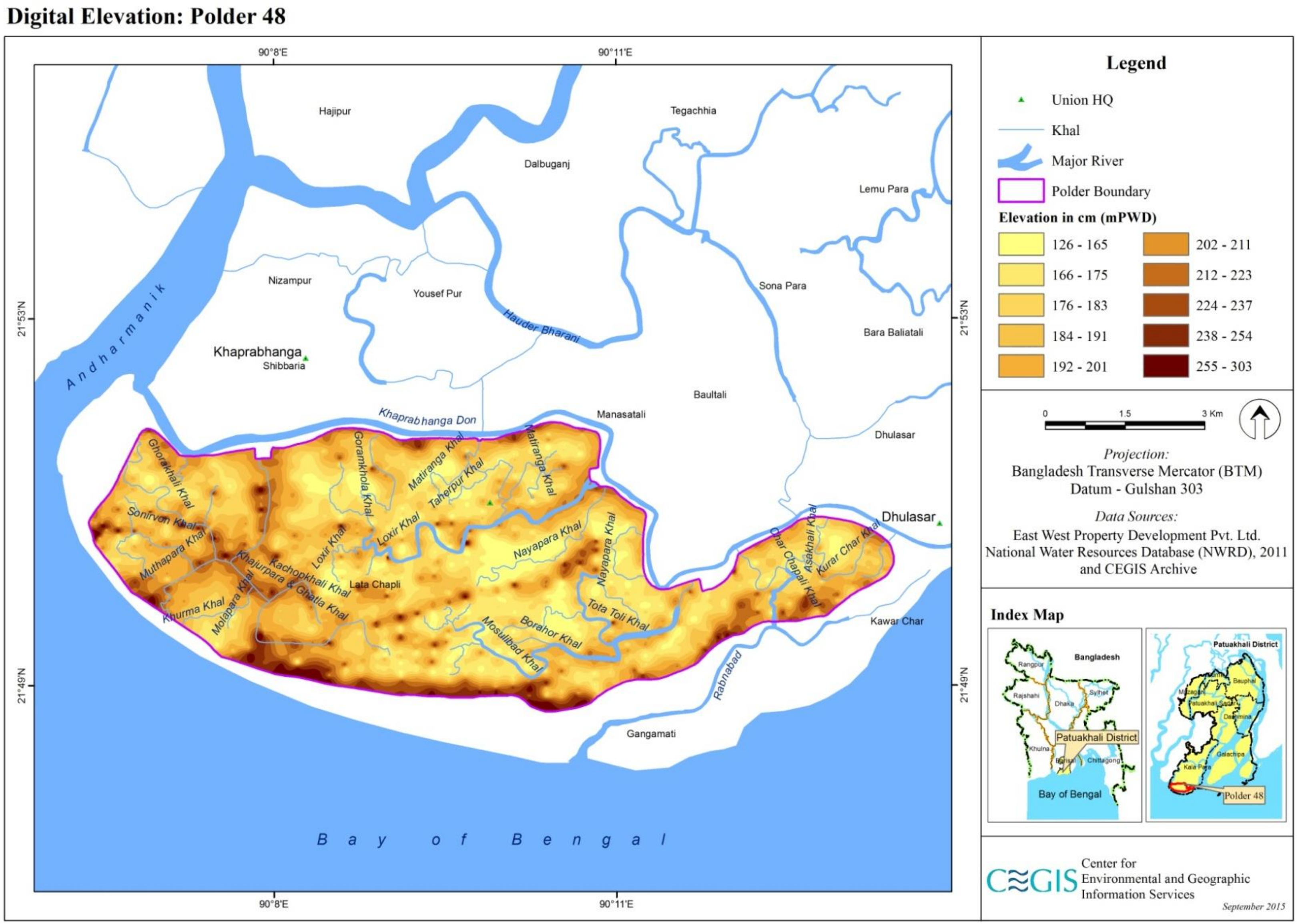


Figure 5.1: Area–Elevation-Storages curve of Polder 48.



Map 5.1: Digital Elevation model of the study area

5.1.3 Seismicity

327. Bangladesh is one of the seismically active regions of the world, experiencing numerous earthquake since last 200 years. Geographical location of Bangladesh has made it ideal suited for natural disasters like earthquake. Tectonic framework of Bangladesh and adjoining areas indicate that Bangladesh is suited adjacent to the plate margins of India and Eurasia where devastating earthquakes have occurred in the past. Depending on the geological structure, Geological Survey of Bangladesh (GSB) has prepared a seismic zoning map of Bangladesh in 1979 dividing the country into three generalized seismic zones: Zone-I, Zone-II, and Zone-III (Map 5.3). Accordingly, the Polder 48 falls under Zone-III, which is characterized by Low earthquake prone site and has a basic seismic coefficient of 0.04g and the polder is relatively safer (seismically quiet) side. Map 5.2 shows the seismic zone map of the study area.

Map 5.2: Polder 48 shown on seismic zone map

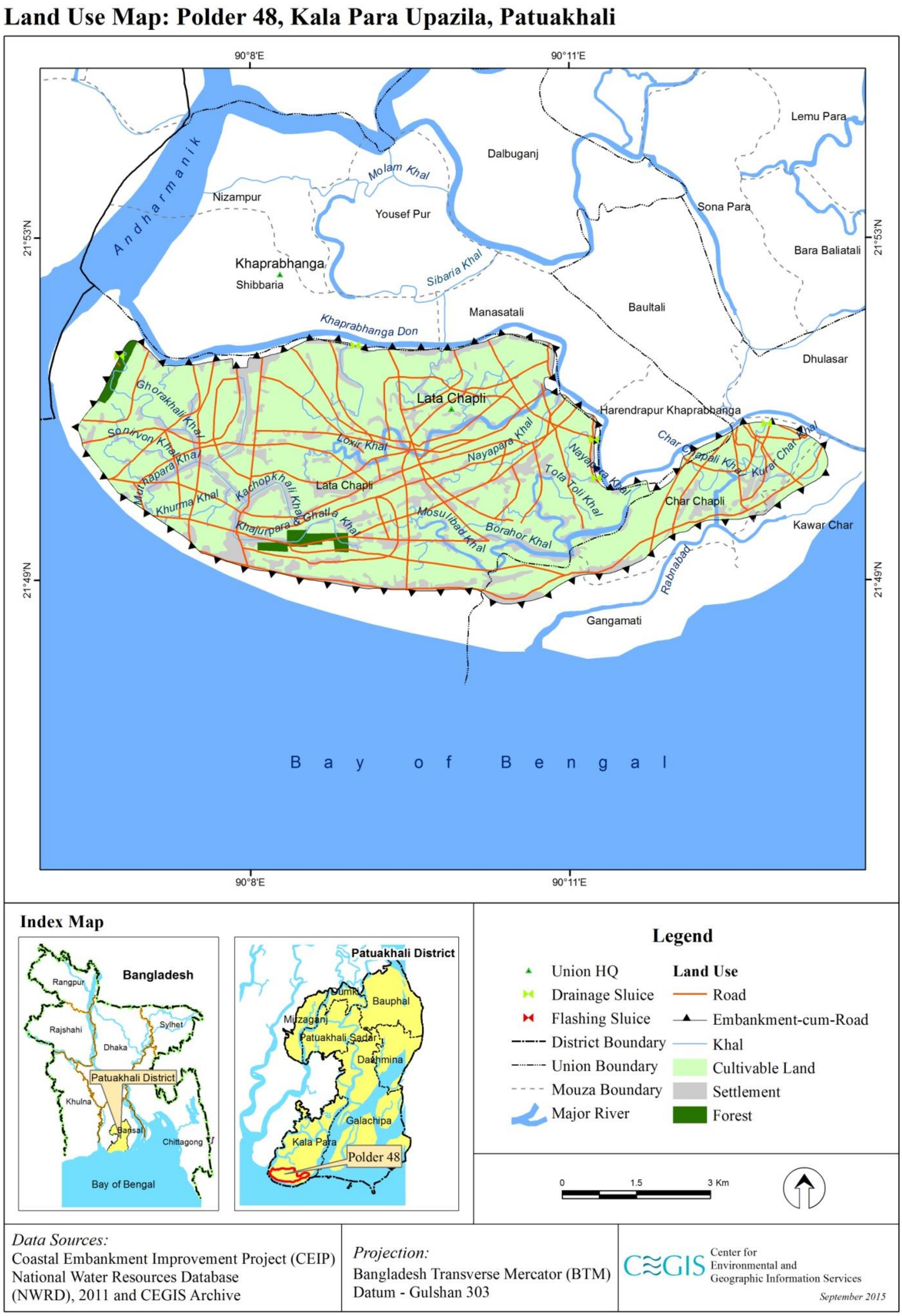
5.1.4 Land Use

328. The gross project area is about 5,087 ha of which 3,715 ha is net cultivable area (NCA). The NCA is about 73% of the gross area. The coverage of settlement, vegetation and khals are 1373 ha (27%) of the gross area. Detailed land use of the polder area is presented in Table 5.1. and map-5.3.

Table 5.1: Detailed land use in the Polder area

Land use	Area (ha)	% of area
Net cultivable area (NCA)	3,715	73
Single crop	1,906	51.3
Double crop	1,497	40.3
Triple crop	308	8.3
Fallow	4	0.1
Others (settlement, Vegetation and Khals)	1,373	27
Total gross area	**5,087**	**100**

Sources: Feasibility report, 2012 and IWM, 2015



Map 5.3: Land use of the Polder area

5.1.5 Soil Properties

(a) Agro-Ecological Zones

329. There are 30 agro-ecological zones and 88 sub zones in Bangladesh as part of Land Resources Appraisal of Bangladesh for agricultural development. The major components of these regions and sub-regions are physiographic (land forms and parent materials), soil properties, soil salinity, depth and duration of seasonal flooding, agro-climatology (length of Kharif and Rabi growing seasons, length of pre-Kharif transition period, number of days below certain winter critical temperatures (<15^0C) and number of days with extremely high summer temperature (>40^0C) which are relevant for land use and for the assessment of present and future agricultural potential (FAO/UNDP,1988, BARC,2012). The Polder area is covered by one AEZ namely the Ganges Tidal Floodplain (AEZ-13). The location of the Polder area is shown in AEZ Map 5.4. Physio-chemical properties of soils of AEZ-13 are presented in 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

OM=Organic matter; VL=Very low; L=Low; M=Medium; Opt=Optimum; H=High

Source: Fertilizer Recommendation Guide; BARC, 2012

Map 5.4: Agro-ecological zone of the Polder area

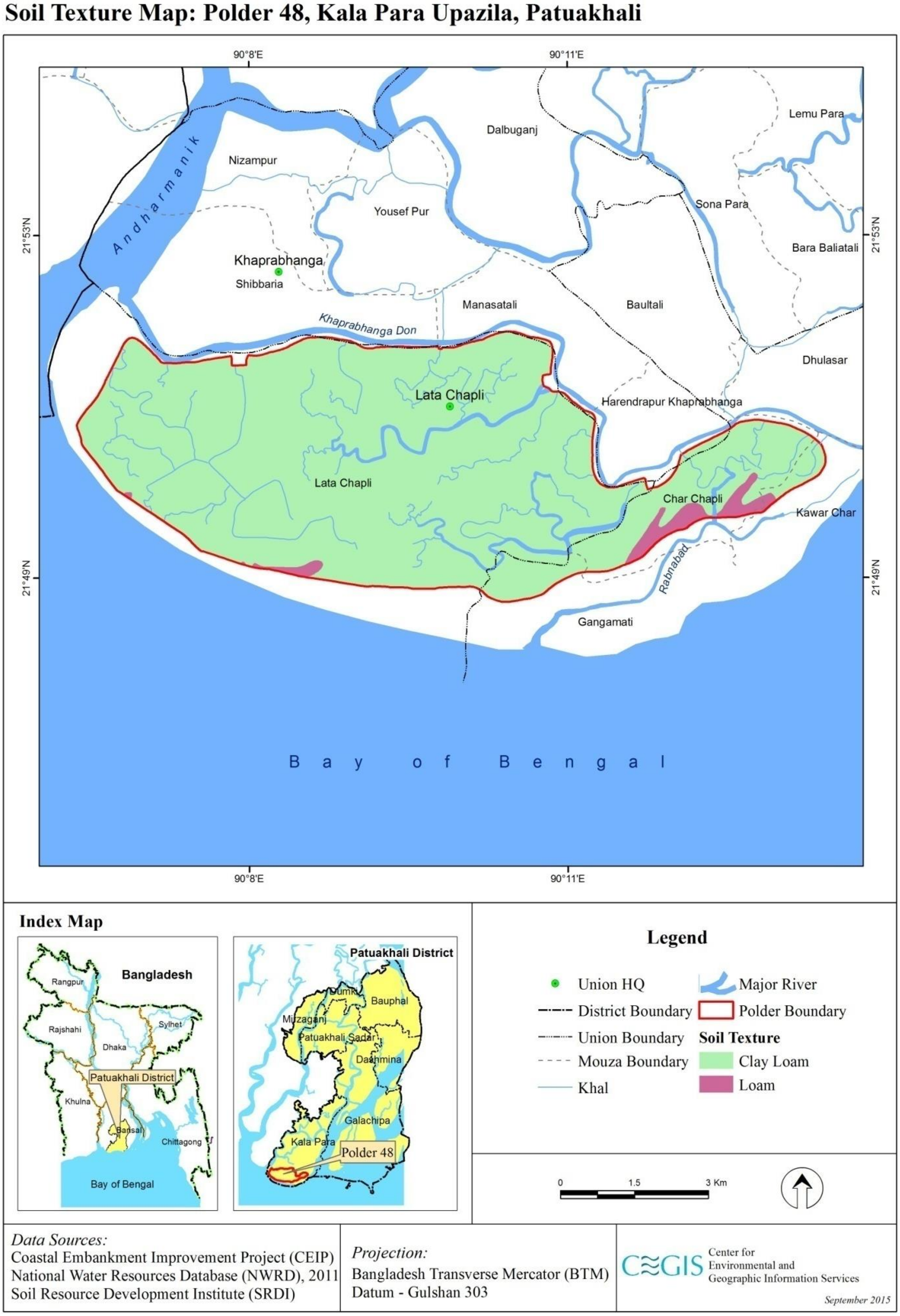
(b) Soil Texture

330. Soil texture is the relative proportions of sand, silt and clay. It is very important for soil characteristic that guides crop selection, crop production and field management. Soil can be classified as one of four major textural classes: a) sands b) silts c) loams and d) clays. It is observed that the soil texture in the polder area varies from clay loam to loam. The soil texture of Polder- 48 has been presented in Table 5.3 and Map 5.5.

Table 5.3: Detailed Texture of Surface Soil (0-15cm) of the Polder area

Texture	Area (Ha)	% of NCA
Clay Loam	3,622	97.5
Loam	93	2.5
Total	**3,715**	**100**

Sources: SRDI, 2006



Map 5.5: Soil Texture of the Polder area

(c) Land Types

331. Land type classification is 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 (Table 5.4) are recognized by the Master Plan Organization (MPO).

332. Around 9.1%, 10.2%, 60.9%, 19.7% and 0.1% of the net cultivable area (NCA) of the polder area (Polder 48) fall under flood free land/high land, high land, medium high land, medium low land and low land respectively. The distribution of land types under Polder 48 is presented in Table 5.4.

Table 5.4: 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	338	9.1
F_0	High land	(0.0-0.3m)	Non-flooded to intermittent	379	10.2
F_1	Medium Highland	(0.3-0.90m)	Seasonal	2262	60.9
F_2	Medium Low Land	(0.90-1.80m)	Seasonal	732	19.7
F_3	Low land	(1.80-3.60m)	Seasonal, but remains wet in early dry season	4	0.1
F_4	Very Lowland	(>3.60m)	Seasonal, but remains wet in most of the dry season	0	0
Total				**3,715**	**100**

Source: IWM, 2015

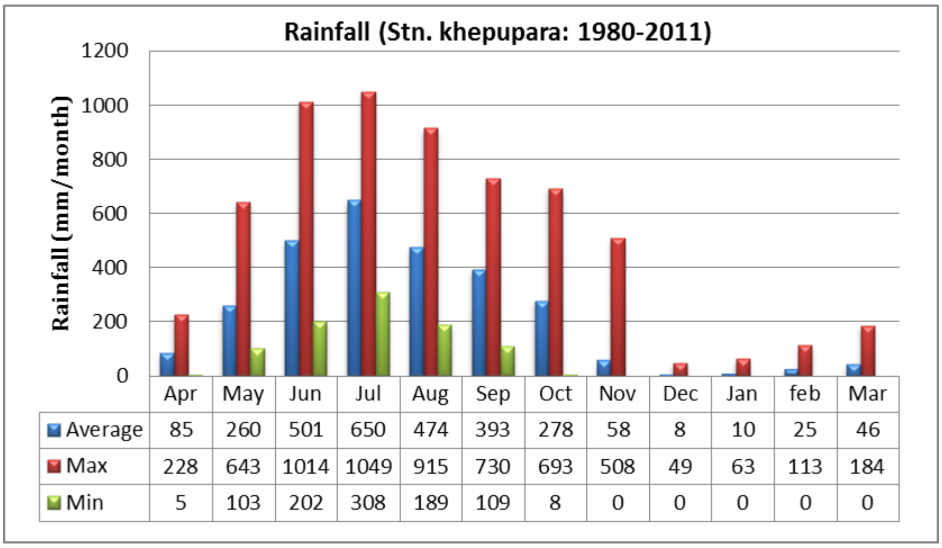
5.1.6 Climate Science

333. The study area lies in the southeastern 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 from BMD station in *Khepupara* and analyzed to get the overall conditions of the study area. *Khepupara* station is situated at about 17.0 km in the northeast side of the polder. Summary of the analysis of climatic parameter are given in following sections:

Rainfall

334. The average annual rainfall of this area is about 2,788 mm of which around 72% (2,018 mm) mainly concentrated during monsoon which last from June till 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 rainfall. 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 average 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 at *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

Figure 5.2: Average Monthly Rainfall at Khepupara BMD station

Temperature

335. The normal average winter temperature ranges from a minimum of 13°C to a maximum of 26°C. The winter season receives 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 with occasional heavy thunderstorms and hailstorms. The summer is characterized by its high temperature and evaporation rates. The monsoon season starts in June and continues up to September with maximum temperature usually around 32°C with high humidity and low solar radiation due to extensive cloud cover. The results of monthly average, maximum and minimum temperature variations of the polder are shown in Figure 5.3.

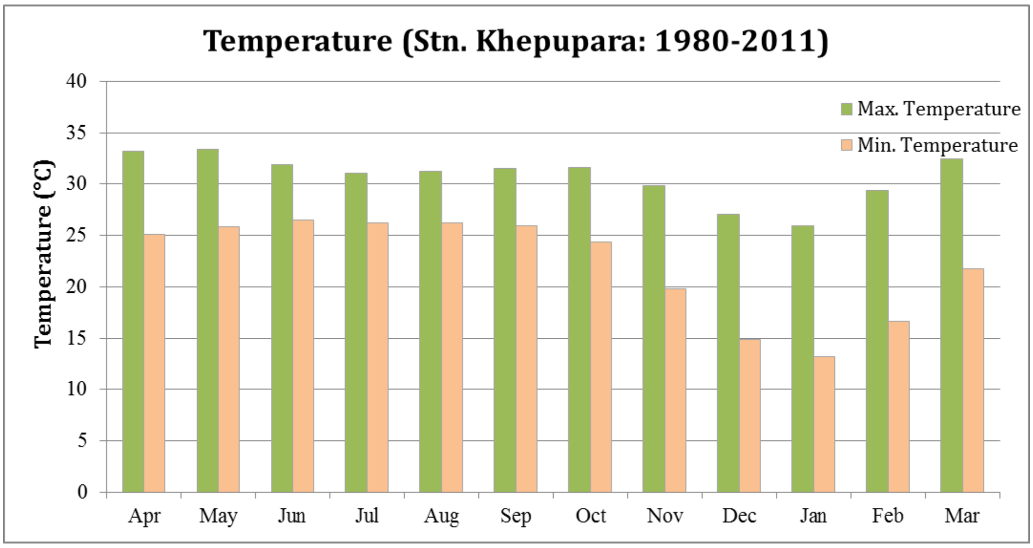


Figure 5-3: Average of Maximum and Minimum Temperatures at Khepupara BMD Station

Relative Humidity

336. Variation of monthly relative humidity, as recorded by in Khepupara BMD station (1980~2011) 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 the 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.

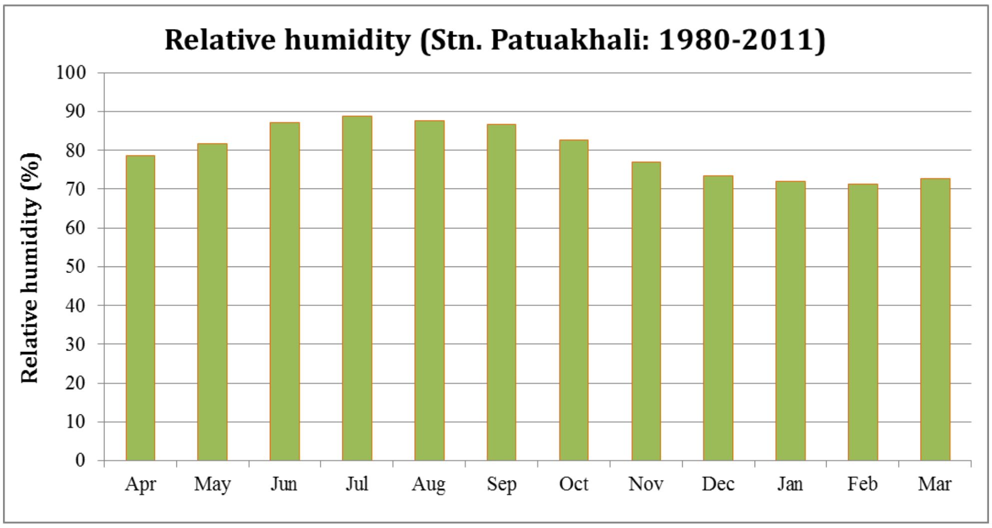
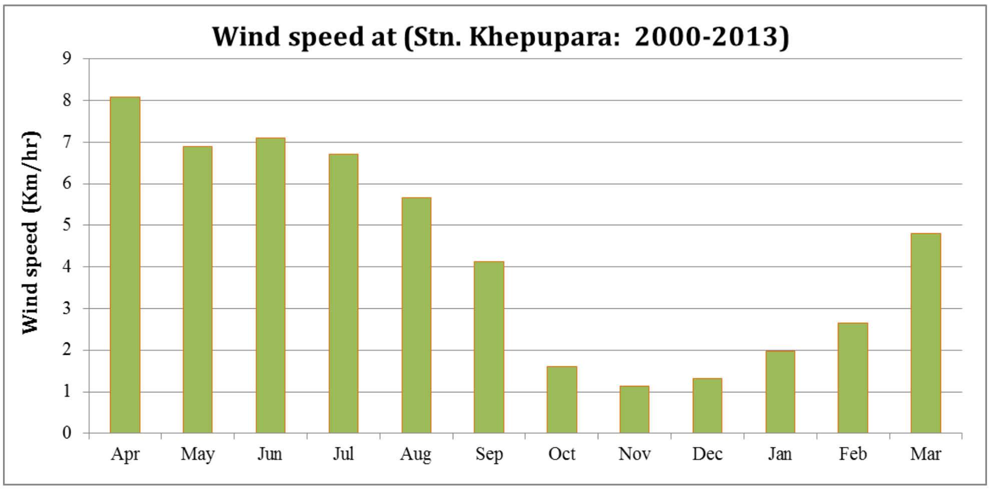


Figure 5.4: Average Relative Humidity at KhepuparaBMD station

Wind Speed

337. Figure 5.5 shows the distribution of average monthly wind speeds, at Khepupara BMD station (from 2000 to 2013). Wind speed is the highest in April (around 8.09 km/hr) and the lowest in November (around 1.12 km/hr). During cyclone SIDR (2007) and AILA (2009), 1 minute sustained wind speeds were recorded as 260 kph and 120 kph respectively, the former one created devastating impacts due to the high wind speed whereas the later one is more related to the increased storm surge.

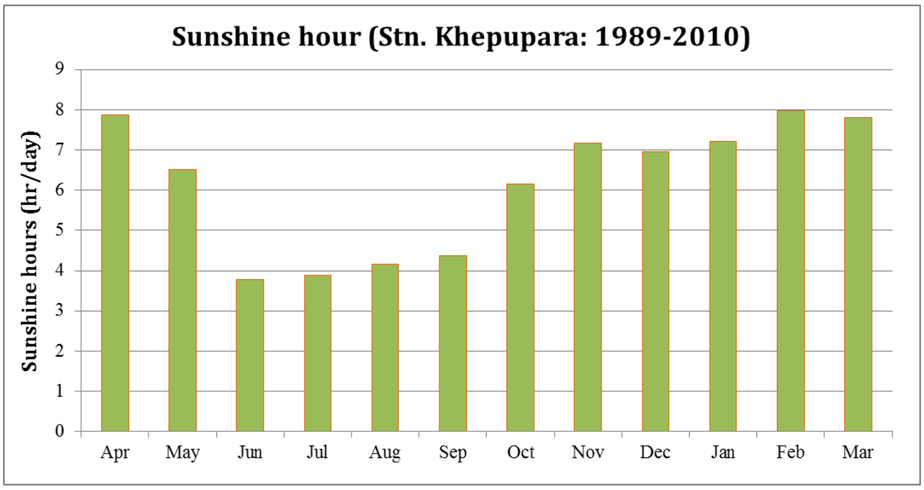


Source: BMD, 2013

Figure 5.5: Variation of average wind speed at Khepupara BMD station

Sunshine Hours

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



Source: BMD, 2010

Figure 5.6: Monthly variation of average sunshine hours at Khepupara BMD station

5.1.7 Water Resources System

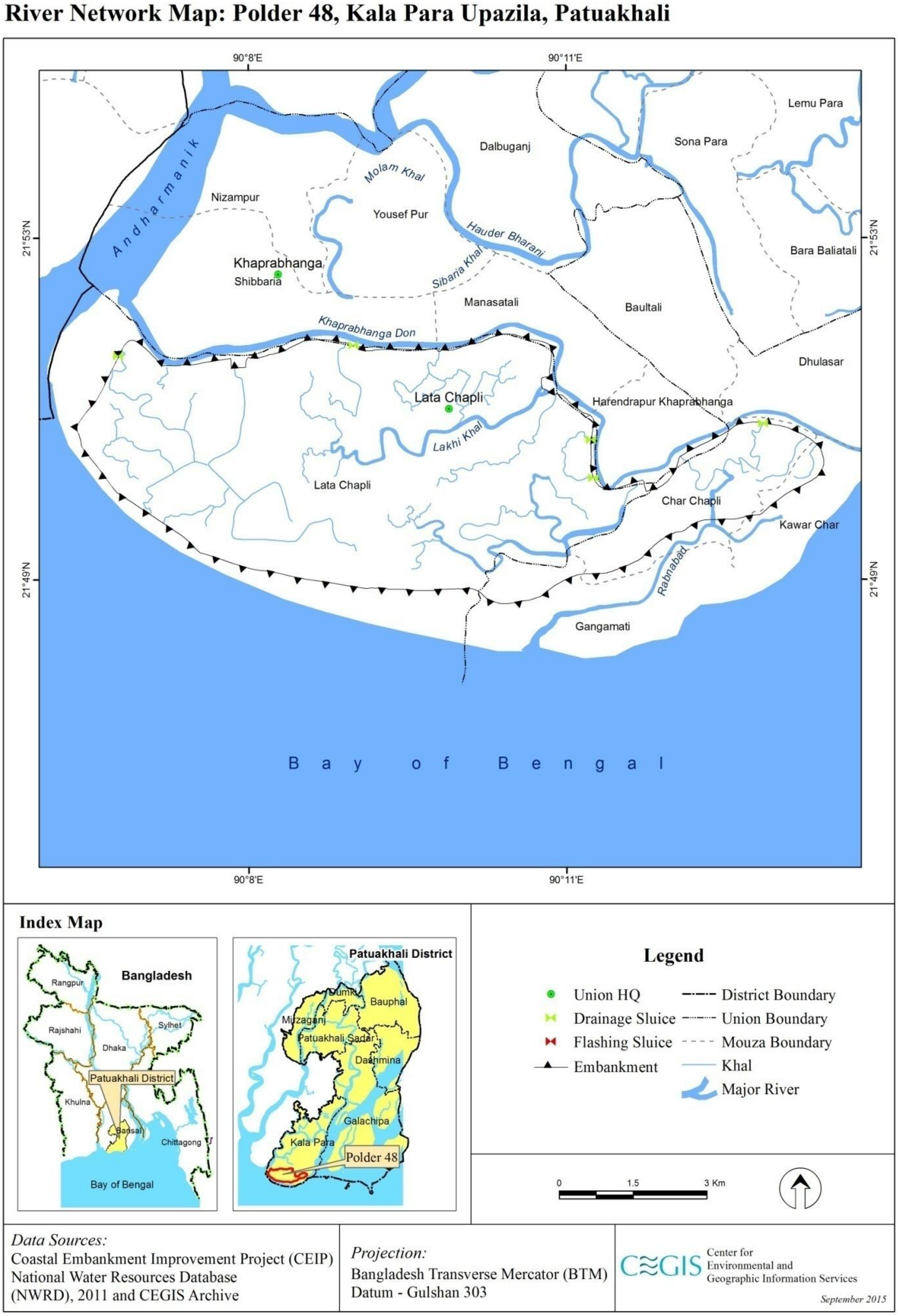
339. The existing water resources system of the polder area depend on the surrounding ecosystem. It is the source of water supply that plays an indispensable role in attenuating and regulating drainage, recharge into the aquifer, and maintaining the environment for aquatic habitats.

Major Rivers and Khals

340. The Polder 48 covers two unions namely Latachapli and Dhuleshwar. It is bounded by Andharmanik River in the west, Rabnabad River in the East, the Bay of Bengal in the south and Mahipur Channel in the North.

341. The main rivers of the study area are *Andharmanik* River and *Rabnabad* River, which are connected by Mahipur khal *(Khaprabhanga Don)*. The Andharmanik River has originated from the *Tiakhali* River at *Kalapara* Upazila and discharges into the Bay of Bengal at *Amtali* Upazila. The total length of the Andharmanik River is about 29 km and width is maximum 1,363 m, minimum 250 m and average 500 m. It is a tide dominated river so water is available throughout the year. During monsoon, flow from the upstream is dominating but in the dry period, tidal water flow is dominating. The average variation of water level is 3.0 m between high tide and low tide. The width of the river is greater in the downstream than the upstream portion. *(Bangladesh Rivers, August 2011, BWDB).*

342. The *Rabnabad* River originates from the Lohalia River at *Chalitabunia* union of *Galachipa* Upazila. Flowing through the *Bara Baisdia* Union, the river falls into the Bay of Bengal. The length of the Rabnabad River is approximately 28.0 km with a maximum, minimum and average width of 4,408m, 1,190m and 1,840m respectively. It is tidal river and flow is available throughout the year. *(Bangladesh Rivers, August 2011, BWDB).* The river system of the area is shown in Map 5.6.



Map 5.6: River system of the Polder area

Hydrological Connectivity

343. The Polder 48 is located in the southwestern hydrological zone of Bangladesh. The water resources system of this area is mainly governed by the Andharmanik River and Rabnabad River, which feed the peripheral Mahipur khal (*Khaprabhanga Don*).There are numerous khals in the polder namely *Goromkhola khal, Khejura khal, Matiranga Khal, Loxir Khal, Akonbari Khal, Nayapara Khal, Tulata-likhal, Kauar Char Khal, Char Chapali Khal, Asakhali Khal, Sonirvon Khal, Khajurpara & Ghatia Khal, Muthapara Khal, Khurma Khal, Molapara Khal, Kolipara Khal* and other branch khals which facilitate the flow circulation insider the polder. The outfalls of all these internal khals are connected with Mohipur Khal, which controls the main drainage system. These khals have tidal effects and the flow direction is from south to north. During high tide, the flow direction of the khals is from *Mohipur* Khal to the inner side of the polder whereas at low tide period, tidal water recedes through the peripheral water courses and reaches the Bay of Bengal.

344. During rainy season, these khals are used to drain the surplus water out of the polder. However, in recent years, most of the khals have been silted up due to increased siltation because of the damaged sluice gates. This also hampers the flow circulation inside the polder area.

Picture 5.1: Mohipur Khal at Char Chapali village near DS-4 Regulator

Picture 5.2: Khejura Khal at C/S of DS-1 Regulator

Picture 5.3: Goromkhola Khal at C/S of FS-2 Regulator

Picture 5.4: Matiranga Khal in Maitbhanga village at C/S of DS-2A Regulator

Picture 5.5: Loxir Khal at DS-3/1 Regulator near Lokkhir Hat

Picture 5.6: Nayapara Khal at C/S of DS-3/2 Regulator

Picture 5.7: Tolatoli Khal at C/S of DS-3/3 Regulator

Picture 5.8: Kauar char Khal at C/S of DS-4 Regulator

5.1.8 Hydrological Setting

Surface Water Levels

345. The surface water level is an important issue for water resources. The available surface water level data of BWDB tidal water level station at Khepupara (Station ID-220: *Andarmanick* River) was collected from 1959 to 1987 (Figure 5.7). The Khepupara station is situated at the offtake of *Sonatala* River, which is at a distance of 15.0 km in the northeast of this Polder. Figure 5.7 shows that water level during high tide ranges from +0.75 mPWD to +1.69 mPWD, whereas low tidal water level ranges from (-)1.12 mPWD to (-) 0.54 mPWD.

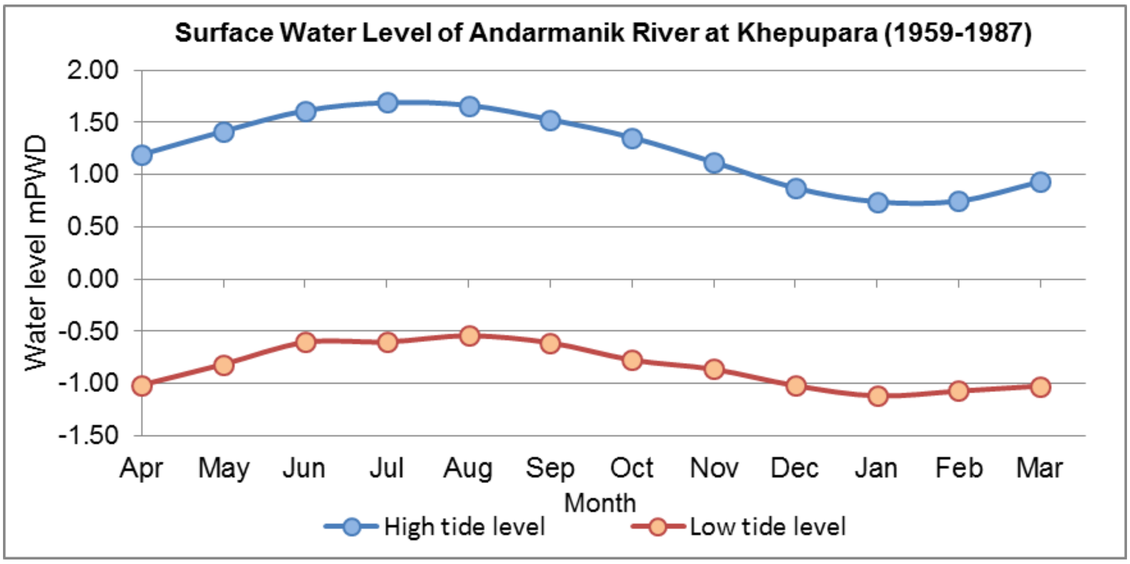


Figure 5.7: Surface water level of Andarmanck River at Khepupara

Groundwater Table

346. Like other parts of the country, the study area also receives sufficient amount of rainfall and there is good availability of groundwater and is used for drinking and domestic purposes through hand pumps. 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 values are fairlylow, with lowest and highest values found in September and March respectively. The average monthly depth of ground water table at Amtali Upazila is shown in Figure 5.8.

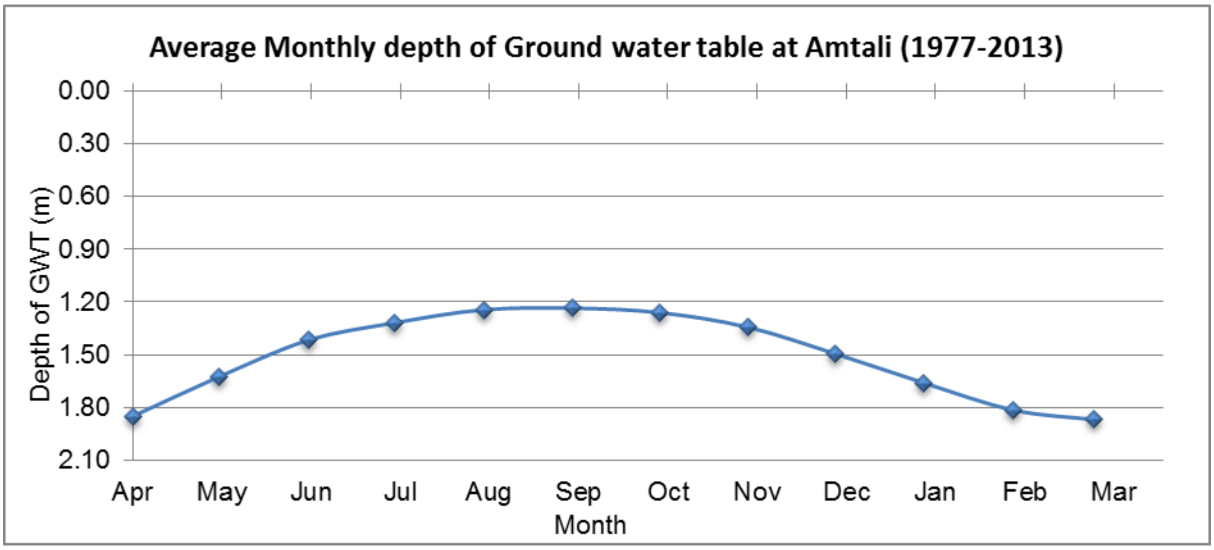


Figure 5.8: Average monthly variations of GWT

347. The Ground Water Table (GWT) measured at the aforementioned location at ten year intervals are shown Table 5.5. Values are analyzed for the months of March (considering as dry period) and September (considering as wet period). In the dry season, increased dependence 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 5.5: 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							
PAT002	Amtali	2.51	1.48	2.00	1.36	1.41	0.98	1.61	1.54

Source: NWRD, 2010

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

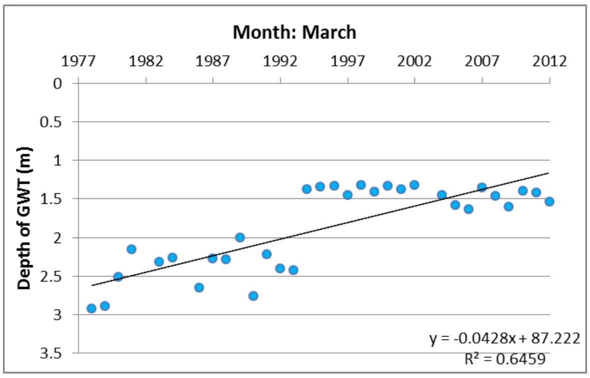


Figure 5.9: Variation of GWT at PAT002 in March (1977-2013)

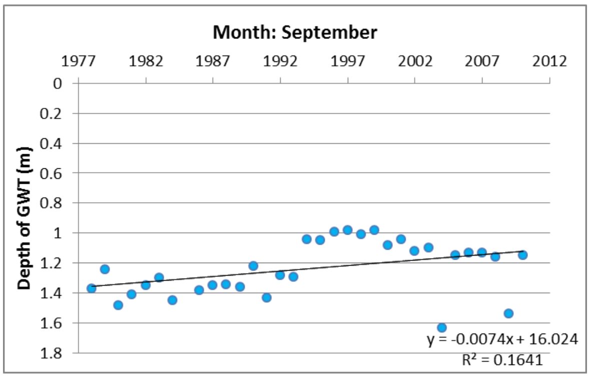


Figure 5.10: Variation of GWT at PAT002 in September (1977-2013)

Source: Bangladesh Water Development Board, 2014

Aquifer System

349. The aquifer system in Bangladesh is categorized mainly in three groups and are; a) the upper aquifer or composite aquifer, b) the main aquifer and c) deeper aquifer. However, the study area (Polder 48) has fallen under coastal area, which belongs to deeper aquifer of the country. The brief characteristics of this aquifer system is described below:

350. 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 where water have no access vertically upward or 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 are 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 due to the 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 5.6a. From the Table it has been observed that the lithology of the coastal aquifer is grey medium to coarse sands with mostly confined to semi-confined in nature and with transmissivity rate of 1,000-3,000 m^2/day.

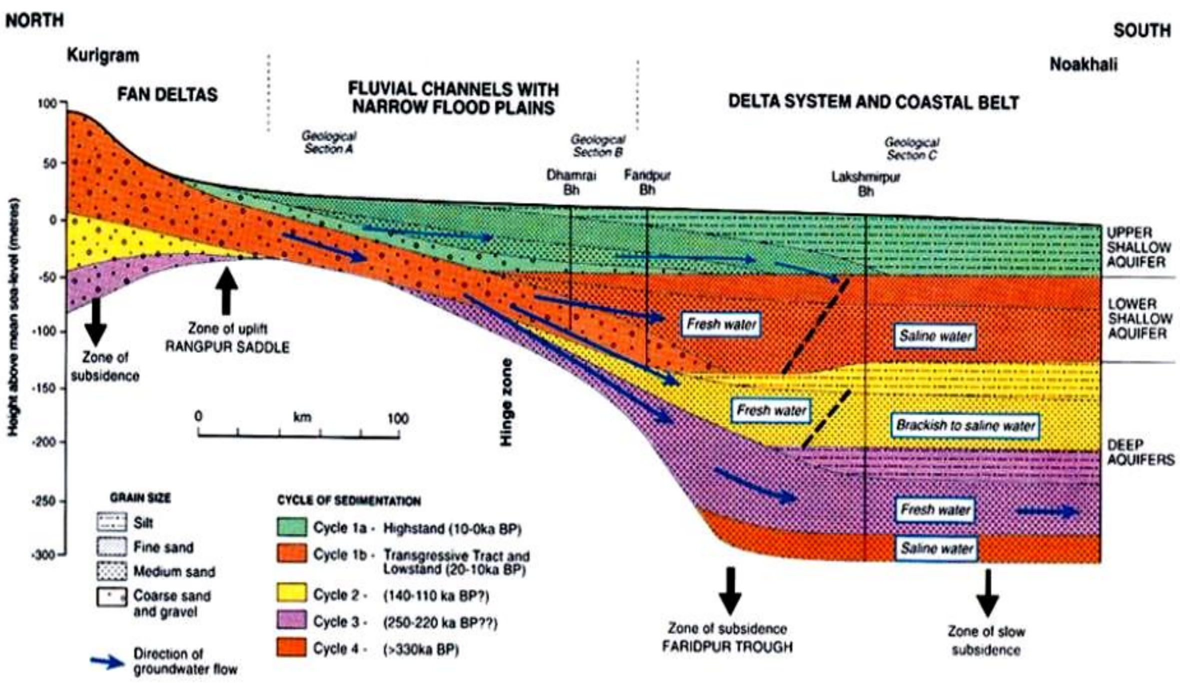


Figure 5.11: Hydro-geological Cross Section from North to South across Bangladesh.

Table 5.6-a: The Main aquifers in Bangladesh, their lithology, relative ages and transmissivities

Aquifer	Lithology	Age	Transmissivity (m^2 per 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

351. The lithology of coastal aquifer is presented in Figure-5.12 below.

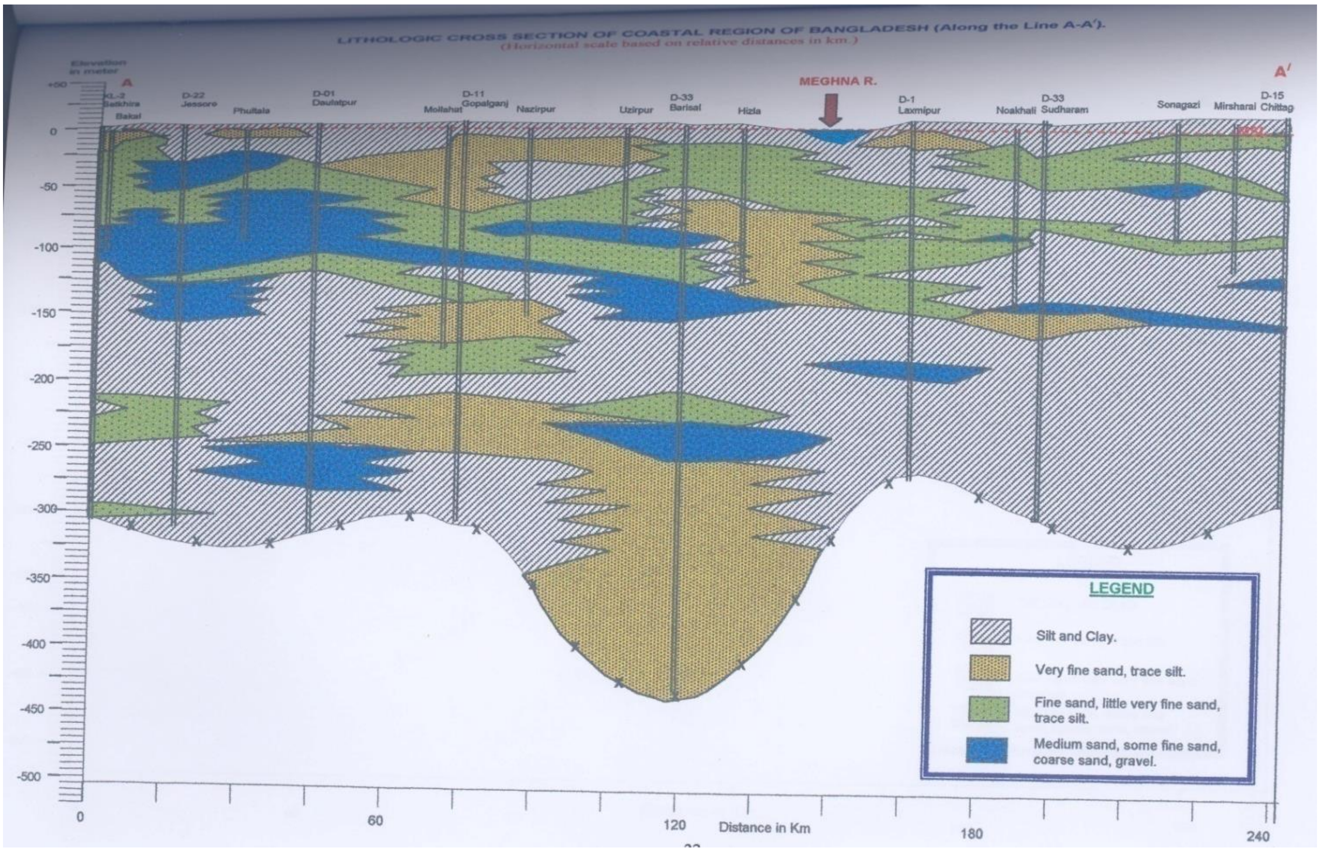


Figure 5.12: Lithological Cross-section of the coastal aquifer.

352. Furthermore, based on the lithology and other characteristics of the aquifer the entire country has been divided into 15 potential groundwater development zones (Figure 5.13). The study area has fallen under zone N **(Table 5.7)** which has been characterized as Floodplains of GBM with brackish & saline water problems.

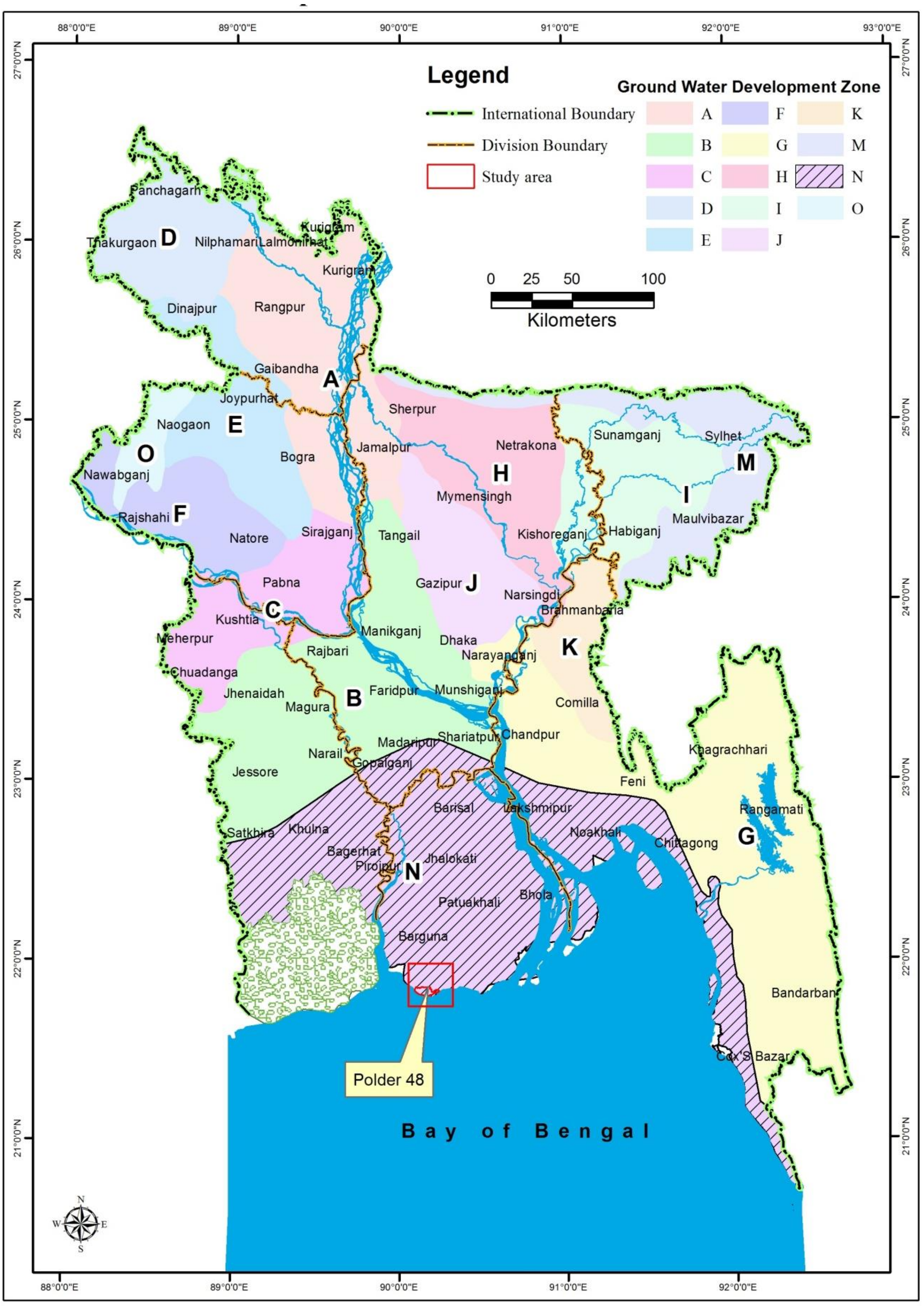


Figure 5.13: Potential groundwater development zones

Table 5.7: 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 cusecfor 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	1,000-3,000 m^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

353. 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 because of seawater encroachment into 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 has been shown in Figure-5.14 and Figure-5.15 below:

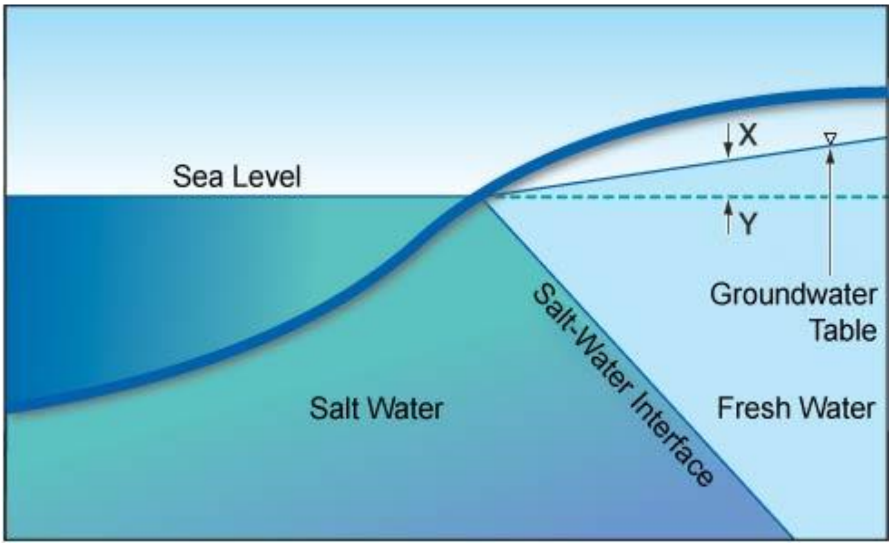


Figure 5.14: Seawater intrusion mechanism for homogeneous and unconfined coastal aquifer

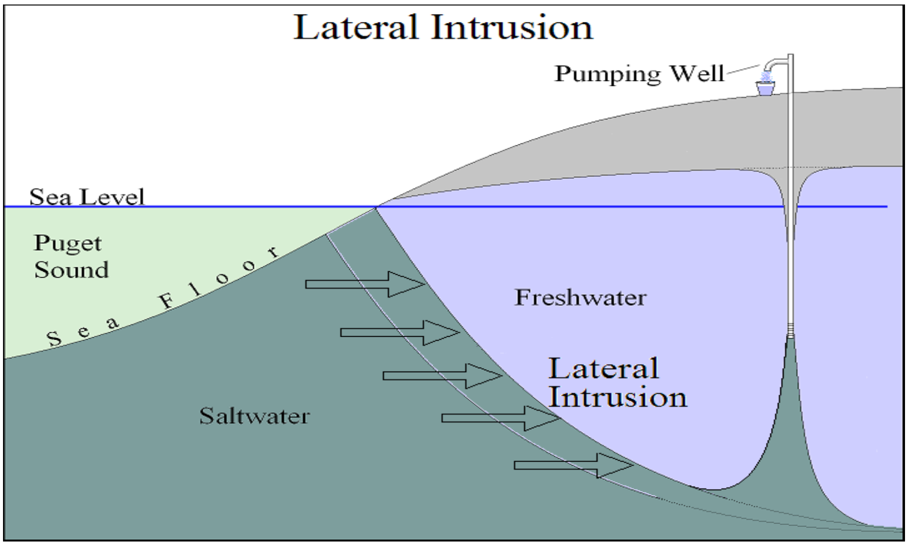


Figure 5.15: Lateral intrusion mechanism of coastal aquifer

354. The mechanism of saltwater intrusion is related with water table and saltwater interface. The water table (fresh water) in a coastal aquifer when lowers the salt-water interface rises. However, the saltwater intrusion in the coastal aquifers is caused under two process which are:

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

5.1.9 Water Resources Issues and Functions

355. Salinity due to tidal and storm surges flooding is one of the major problems in Polder 48. It is evident from the field visit and consultation with local people that the polder encounter various problems like drainage congestion and water logging navigation and water uses.

Salinity

356. Salinity intrusion is one of the major problems in the polder area. During monsoon moderate salinity (about 7 ppt) is found in the inner part of the polder which increases in the dry season (November to May), and increased salinity is observed in that period. The surface water as well as ground water in most of the areas are severely saline because the polder is very near to the Bay of Bengal and the surrounding channels are directly connected with the sea. The Entrance of tidal water during high tide through unprotected and deteriorated water control structures, into *Khejura khal, Goramkhola khal, Matiranga khal, Loxir khal, Nayapara khal, Tulatali khal, Char Chapali khal and Kurarchar khal* results to some extent in saline water intrusion. The river water become saline in the month of November and continues untill May and the salinity level stand to a moderate level during monsoon. The local people has a demanded for the storage of sweet water in the internal canals system for cultivating Robi-crops, when the outer river contains salinity at a high level.

Tidal and storm surge flooding

357. Tidal flooding is very common in the project area. The major reason of this flooding is tide, the damaged water retension structures (i.e; sluices) allows the entry of tidewater into project area. At present, tidal flooding occurs almost in every year inside the Polder and inundates about 7 to 8 % of the total area. Northern part of Khajura, Gora *Amkhola* Para, *Maitbhanga*, *Lakshmipara*, *Naya Misripara* and eastern part of *Tulatali* villages are mainly affected by tidal flooding.

358. The peripheral flood control embankment (interior dyke and sea dyke) effectively offers protection from the storm surge flooding in the area. Local people opined that there was no major storm surge flooding in the Polder area during AILA (2009) and SIDR (2007). However, this problem will aggravate in future particularly at the southwestern part of the polder area (i.e., Ch. 29.00 to Ch. 33.70 km) which is under threate of severe bank erosion from tidal wave action and storm surge of the Bay of Bengal.

Drainage Congestion and Water Logging

359. Drainage congestion has been identified as a common problem inside the polder area and its intensity varies from place to place. *Goramkhola khal, Matiranga khal, Loxir khal, Nayapara khal, Tulatali khal, Char Chapali khal and Kurarchar khal* suffer from *moderate drainage congestion*[10] problems. The drainage direction of these khals is from the south to the north and are interconnected by a lateral channel *Mohipur (Khaprabhanga Don). The Mohipur channel* is flowing from east to west and mainly drains into the *Andharmanik* River which is very near to the Bay of Bengal. About 84% (2,354 mm) of total annual rainfall occurs during monsoon and post-monsoon periods. For the time being the siltation occurs a permanent blockage/congestion at every outfall of hydraulic structures surrounding the project area and eventually the water due to heavy rainfall cannot be drained out quickly. Local people opined that, about 375.3 ha (7.4% of total polder area) suffers from *moderate drainage congestion* problems. From field investigation during June 2015 and using Digital Elevation Model (DEM); the village wise drainage congestion areas (approximate) found are shown in Table 5.8.

[10] Moderate Drainage Congestion has been defined as the water courses which have low conveyance capacity and usually take 2 to 6 days to properly drain out rainwater.

Table 5.8: Village wise drainage congestion area

Union name	Village name	Affected area (ha)
Lata Chapli Union	Gora Amkhola Para	77.92
	Maitbhanga	106.08
	Lakshmi Para	48.93
	NayaMisripara	67.41
	Tulatali	57.51
	Char Chapli	17.52
	Total	**375.37**

Source: CEGIS field survey, June 2015

Such drainage congestion mostly affects the agriculture and production sector. Due to the reduced drainage capacity of khals, rainwater inundates the agricultural fields for a period of 4~5 days, and mainly affects the Aman crops. The main reason for drainage congestion is of two-fold; decrease in the conveyance capacity of internal and lateral khals for sedimentation and occurrence of heavy rainfall during monsoon.

360. The main drainage dynamic of the polder is governed by eight (08) drainage sluices associated with other internal khals. At present, the internal khals are silted up because of the damaged sluice gates at the intake point of the khals. Some of the gates *(Koloipara khal, Khejuran khal, Matiranga khal, Loxir khal, Nayapara khal, Tulatali khal, Char Chapali khal and Kurarchar khal, etc*.) became non-functional due to poor maintenance, leading to siltation adjacent to the khal openings. The rate of sedimentation on Mohipur channel and its bank side deposition is increasing day by day and the cumulative sedimentation causes rise of bed level of the internal khals. Since the khals are deposited with silt, water conveyance capacity has decreased and quick drainage from the polder area is not possible. Local people opined that, no prolonged water logging situation exists inside the polder, however, rainfed inundation exists in some areas as already discussed above.

Picture 5.9: Drainage congestion in Tulatali village; Ch. 11+750 km, (21°49’52.30” N; 90°11’25.66” E, Date: 21 July 2015)

Picture 5.10: Drainage congestion in Naya Misripara village; Ch. 11+525 km, (21°50’37.16” N; 90°11’08.02” E, Date: 21 July 2015)

Navigation

361. Waterway is the most important means of communication in this area, which is cheaper compared to that of the road communication. The peripheral Andarmanick River and Mohipur Khal are used as primary waterway for the area. Local people use small and medium sized mechanise boats for carrying passengers and goods from one place to another throughout the polder area. The important inland navigation facilities are Alipur Ferry Ghat and Chapli Bazar Ghat. Alipur ferry Ghat is prominent where a large number of passengers (about 200-250 passengers/hr) as well as fishing boat (70-80 nos/day) move round the year. One small ferry, with capacity of carrying 3-4 buses, passes from Mohipur Ferry Ghat to Alipur Ferry Ghat.

Picture 5.11: Navigation at Alipur Ferry Ghat

Water Use

362. 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). During field survey in the Polder-48, it was found that the average daily domestic use of water was around 40 lpc which is below average daily demand. The study found that around 1,236 m^3 of water is consumed daily by the total number of 30,908 people living in the polder. Local people opined that they prefer Deep Tube Wells (DTWs) as drinking water sources to meet up their daily requirements. For other domestic uses, Shallow Tube Well (STW) and surface water sources are used.

5.1.10 River Morphology and Dynamics

Historical Erosion Accretion Analysis along Andharmanik River

363. Historical satellite images for the year 1997 and 2015 were analyzed to understand the historical erosion-accretion of the adjacent rivers of the Polder. 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. Then these images were co-registered with each other. Bankline was delineated from the satellite images and by superimposing the banklines of two different years and finally the erosion/accretion was assessed. The 28 km reach around the Andharmanik River and the Bay of Bengal has been considered during the erosion-accretion

analysis. From the analysis, it has been found that 350.37 hectares of land has eroded during this period at the rate of 19.47 hectares per year while the accretion was 90.89 hectares at the rate of 5.05 hectares per year in Kalapara upazila of Patuakhali district around the polder. The amount of erosion is comparatively much higher than that of accretion at the Bay of Bengal portion, which indicates the effect of induced sea wave in this region. Few accretion has occurred along Kawar Char (Map 5.6-a).

364. Erosion is the most common cause of failures of sea dyke or embankment. The process of erosion gradually destroys the shore lands, foreshore areas/berms and successively the earthen sea dyke/embankment engulfing the plain agricultural lands, habitats and many important installations. During field investigation in July 2015, one erosion hotspot was found mainly in the southwestern part along the Bay of Bengal. At Thanju Para, Shutkipolli and Sarifpur Villages from Ch. 29+000 km to Ch. 33+700 km, the sea dyke is under threat of severe erosion. Local people opined that, sea dyke may breach in the near future by direct struck of devastating cyclone and will allow storm surge water to intrude inside the polder particularly in Sarifpur villages from Ch. 32+000 km to 33+500 km.

365. Sea dyke and internal roads (about 11.95 ha), important infrastructures, settlement with homestead vegetation (about 114 ha and 3200 people), agricultural lands (about 350 – 370 ha), livestock and other natural resources will remain exposed to sea erosion with serious consequences on society, economy and environment. Due to sea dyke breaches, tidal saline water will enter into the polder area and raise the soil salinity. It will retard economic and social development. To protect these areas slope protection work with the rising of the sea dyke is needed.

Picture 5.12: Erosion at Shotki polli Ch. 31+000 km (21°49’58.20” N; 90°06’44.96” E, Date: 21 July 2015)

366. Sedimentation is also 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 Mohipur channel is severely silted up, especially at Naya Misripara to Char Chapali villages. Sedimentation has taken place in most of the internal khals mainly in *Khejura khal, Goramkhola khal, Matiranga khal, Loxir khal, Nayapara khal, Tulatali khal, Char Chapali khal* and *Kurarchar khal* of the polder area due to non maintenance and malfunctioning of the structures. As a result, it causes rise of bed level and reduces the conveyance capacity of the khals. In the polder area, on an average, roughly 4-5 inches sedimentation took place in most of the internal and lateral khals each year.

Map 5.6-a: Erosion-Accretion along Andharmanik River

5.2 Environmental Quality and Pollution

5.2.1 Air Quality

367. The national standards for air quality are given in Table 5.9.

Table 5.9: Standards of ambient air quality

Organiza-tion	Unit	Concentration of micrograms per meter cube				
		PM_{10}	$PM_{2.5}$	BC in $PM_{2.5}$	SO_2	NO_2
BNAAQS	24h average (µg/m^3)	150	65	-	365	-
	Annual (µg/m^3)	50	15	-	-	100
WHO	24h average (µg/m^3)	50	25	-	-	200 (1h average)
	Annual (µg/m^3)	20	10	-	-	40

Source: Bangladesh National Ambient Air Quality Standard

368. Table 5.10 shows the air quality data measured inside the polder at Kuakata, under Patuakhali district. The values suggest that except for $PM_{2.5}$, the concentrations of the measured air quality parameters (PM_{10}, BC in $PM_{2.5}$, SO_2, NO_2) lie within the range of standard values for Bangladesh (refer Table 5.7(a)). The observed $PM_{2.5}$ level is marginally higher than the Bangladesh National Ambient Air Quality Standard. This may be due to large number of diesel vehicles used for internal communication, besides most of the passenger bearing and fishing boats are also mechanized.

Table 5.10: Values of ambient air quality parameters in the project area

Area	Concentration of micrograms per meter cube (24h average)				(µg/m^3) (1h average)
	PM_{10}	$PM_{2.5}$	BC in $PM_{2.5}$	SO_2	NO_2
Kuakata (Polder 48)	84.2	65.2	17.2	146	0.184

Source: Air quality measured by Bangladesh Atomic Energy Commission, November, 2015

5.2.2 Water Quality

369. Five major water quality parameters (pH, TDS, Temp., DO and Salinity) were measured at site in June 2015 from six different sampling locations of the polder. One of the six samples was collected from a Deep Tube Wel (DTW) at *Rakhine* Market. The other five samples were all collected from different surface water sources (two from outside the polder and three from inside the polder). Water samples of same locations were also measured during February, 2016 for monitoring the seasonal variation. The results of the in-situ water quality measurements are shown in Table 5.11 Table 5.12 below:

370. From the laboratory analytical data, it is observed that, in case of pH, all of them are within the permissible limit and alkaline in nature, although the alkalinity shows an increasing trend during the dry season comparatively. Water quality needs to be assessed regularly for freshwater irrigation needs from local sources. All the samples are also within the permissible limit of TDS contents, although it is slightly higher in the khals outside the polder. This is because of the increased sediment load carried by the peripheral rivers and khals, which, to

some extent, is partly prevented by the damaged water control structures from entering the polder. It is striking to note that, TDS contents in the khals is low during the monsoon season, whereas its content increased during dry season in DTW water. All the temperature values are within permissible limit. Values of DO were also found within the standards set by DoE for both irrigation (5 to 6 mg/l) and fishing. Salinity of surface water in dry season has been found to be slightly higher than measured in wet season. According to local people, salinity of both ground and surface water are higher in dry season than wet season, which agree with the laboratory test results.

Table 5.11: Water quality parameters in different locations (wet season)

Location	Sampling Water Source	GPS readings	pH	TDS (ppm)	Temp. (ºC)	DO (mg/l)	Salinity (ppt)
Mohipur khal at Khajura village near Kolipara sluice (DS-5)	Mohipur khal, outside the polder	21°51’09.3”N 90°06’24.9”E	7.4	1012	29.5	6.1	7.0
Matiranga Khal near DS-2A	Inside the polder	21°51’08.8”N 90°09’31.7”E	7.8	485	28.5	4.8	6.0
Naya Misripara village near DS-3/1	Outside polder	21°50’58.7”N 90°10’53.2”E	7.5	945	28.6	5.8	7.0
Nayapara khal at Naya Misripara village near Lakshmir hat (DS-3/2)	Inside polder	21°50’43.0”N 90°10’55.7”E	7.6	568	29.2	4.7	6.0
Char Chapali Khal near DS-3/4	Inside polder	21°50’58.7”N 90°10’53.2”E	7.7	670	29.3	5.0	7.0
Shallow Tube Well, inside the polder	Rakhaine Market	21°48’59.1”N 90°07’21.2”E	7.4	178	27.2	4.5	1.0
DoE Standard Value (Bangladesh)			**6.0-9.0**	**2,100**	**20-30**	**4.5-8.0**	

Source: CEGIS field survey & Laboratory test, June 2015

Table 5.12: 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)
Matiranga khal	Maitbhanga	21°51'17.39"N 90° 9'34.58"E	8.3	1	26.3	5.8	9
Laxmipara khal	Laxmipara	21°50'56.76"N 90°10'48.27"E	8.4	1	26.5	5.5	10
Nayapara khal	Laxmibazar	21°50'49.98"N 90°10'58.07"E	8.7	1	27.4	9.2	10
Char Chapli khal	Char Chapli	21°50'8.16"N 90°12'26.20"E	8.4	1	26.5	6.2	9

Source of surface water	Location	GPS point	Water quality parameter				
			pH	TDS (ppm)	Temp (°C)	DO (mg/L)	Salinity (ppt)
Khaprabhanga Don/Mohipur khal	Koloipara	21°51'9.81"N 90° 6'22.75"E	8.4	1	25.2	4.3	9
Tubewell	Rakhaine village	21°48'59.76"N 90° 7'21.40"E	8.2	258	25.0	2.0	0
DoE Standard Value (Bangladesh)			***6.0-9.0***	***2100***	***20-30***	***4.5-8.0***	***-***

Source: CEGIS field survey & Laboratory test, February 2016

5.2.3 Noise Quality

371. During the field survey, sound levels were measured at Khajura village near DS-5 on BWDB flood control embankment with 10-minutes 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 49 dB, which is equivalent to the standard Leq value for residential zone, set by ECR 1997 (50 dB).

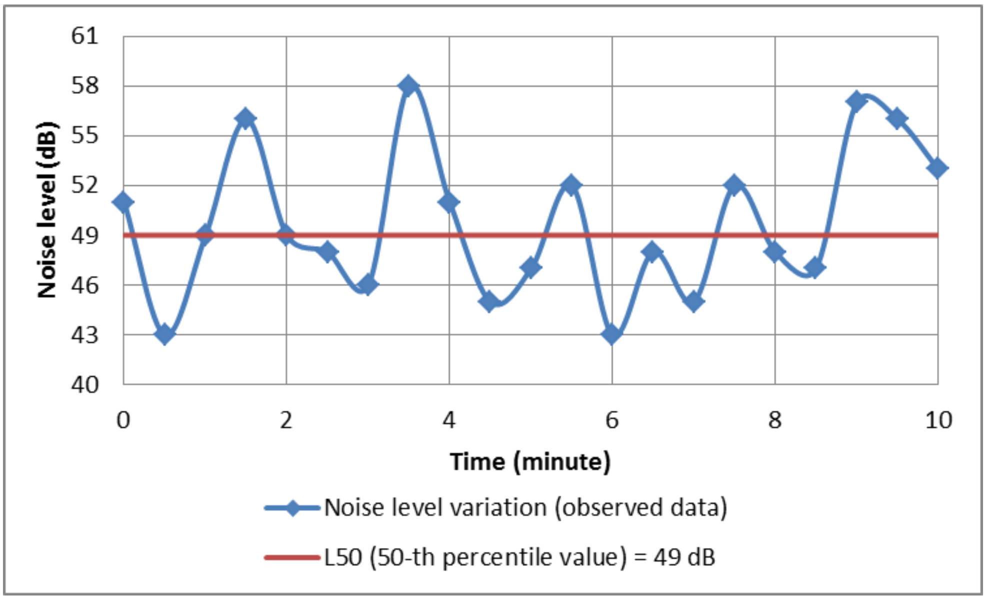


Figure 5.16: Variation of sound levels for 10 minute sampling period at Khajura village near DS-5

Source: CEGIS field survey, June 2015
N.B.: All values were collected during daytime

5.2.4 Soil Quality

372. Soil samples were collected from three locations in one depth i.e. top soil (0-15 cm) inside the polder area on 22nd June, 2015. Collected soil samples were handed over to Soil Resource Development Institute (SRDI), Dhaka to analyze the Soil salinity (EC), Soil reaction (pH), Organic Matter (OM), Nitrogen (N), Phosphorus (P), Potassium (K), Sulfur(S) and Zinc (Zn) and Entomology Division, BARI, Gazipur to detect pesticide residues. The methods used for soil quality analysis is presented in Table 5.13. Soil quality of the agricultural land is presented in Table 5.14.

Table 5.13: Methods used for soil quality analysis

Parameter	Methods using
Soil salinity(EC)	Glass Electrode method
Soil reaction(pH)	
Organic Matter(OM)	Wet oxidation method
Nitrogen(N)	Kjeldahl distillation method
Potassium(K)	NH4OAc method
Phosphorus(P)	Olsen/Bray and Kurtz method
Sulphur(S)	CaH2PO4 Extracting method
Zinc(Zn)	DTPA Extraction method
Pesticides residues (Detection limit 0.004ppp=m)	GC-MC (Thermo Electron & Pekin Elmer)

Sources: SRDI and BARI Laboratory

Table 5.14: 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	Carbofuran (ppm)
						%		meq/ 100g	µg/g			
Ali pur	21° 25' 7.5'' N 90°7' 10.4'' E	Fallow-Lt. Aman-Pulse	0-15	1.56	6.8	1.0	0.06	0.21	6.63	35.50	0.56	ND
Mati Bhanga	21° 50' 09'' N 90° 12' 25.6'' E	Lt. Aus-HYV Aman-Pulses	0-15	29.78	7.2	1.24	0.07	0.43	9.02	238.50	0.59	ND
Chapli, Dhuleswar	21° 49' 52.2'' N 90° 11' 54.4'' E	Fallow-Lt. Aman-Potato	0-15	0.88	7.1	0.62	0.03	0.17	13.78	10.88	1.22	ND

Sources: SRDI and BARI laboratory test, August; 2015; Note: ND (Not Detected)

373. The soil salinity levels are 0.88 to 29.78 (ds/m) in the top soil (depth of 0-15 cm) in all the agricultural land. It indicates that, respective agricultural land belong to from non-saline to very strongly saline group. The pH levels were observed between 6.8 and 7.2 in all the locations of the selected land. It indicates that, pH level is close to neutral in nature of the concerned land. It is revealed that, pH level within the limit in all agricultural land. The Organic Matter (OM %) are between 0.62 and 1.24 in all the selected agricultural land. OM status is very low to low (≤1.0-1.7%) for all samples of all the agricultural land (BARC, 2012). In case of Nitrogen (N) level, it is found from 0.03 to 0.07% in all locations of the soils. The N level is observed as very low in nature. Potassium (K) level is found from 0.17 to 0.43 (meq/100g) in all location. The K level is observed as low to high in nature. Concentration of Phosphorus (P) is found from 6.63 to 13.78 (µg/g) in all locations. The P level is observed as low to medium in all locations. The range of Sulfur (S) is found from 10.88 to 238.50 (µg/g) in all locations. The S level is low to very high. The Zinc (Zn) levels varied from 0.56 to 1.22 (µg/g) in all the locations. The level of Zn is low to medium in nature. The analyzed result shows that no pesticide (Furadan) exists in the soil samples.

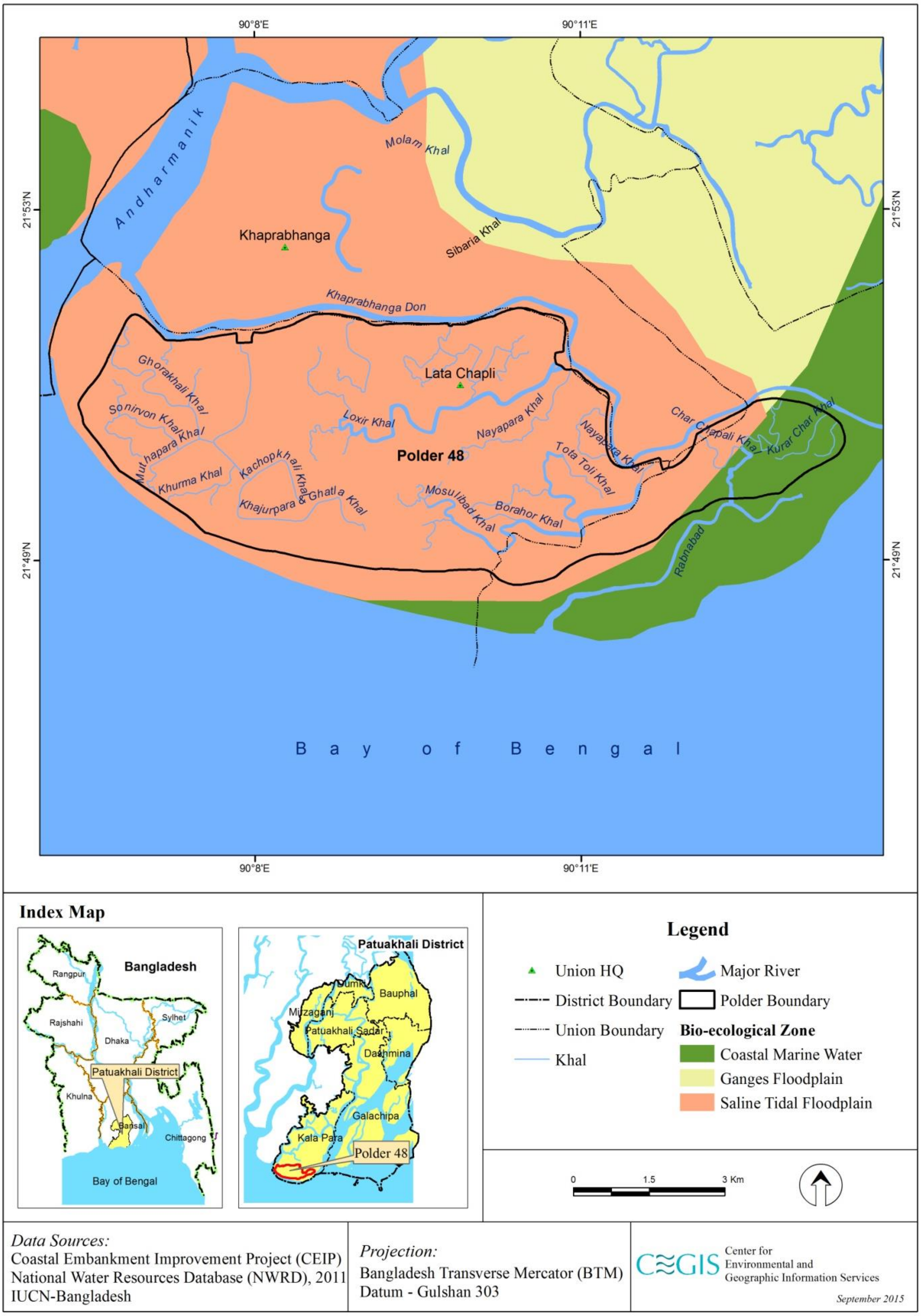
5.3 Biological Environment

374. 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.

5.3.1 Bio-ecological Zones

375. IUCN-The World Conservation Union has identified 25 bio-ecological zones (IUCN, 2002) in Bangladesh. The aspects of these zones are primarily centered on physiographic, climate, soil type, flooding depth and biodiversities. These bio-ecological zones can be classified as major ecosystems of the country. The polder area encompasses two of these bio-ecological zones, namely the Saline Tidal Floodplain and a slight portion of Costal Marine Water.

Bio-ecological Zone Map: Polder 48, Kala Para Upazila, Patuakhali



Map 5.7: Bio-ecological Zone

5.3.2 Terrestrial Ecosystem

- **Terrestrial Flora**

376. The polder touches two mangrove forests namely Khajura and Gangamati Reserved Forests within its boundaries. The major types of terrestrial ecosystem are found within the polder area are:

- Settlement/Homestead;
- Roadside and
- Cropland vegetation

i. **Settlement/Homestead vegetation**

377. Homestead forest resources play important role for the livelihoods of people living in the polder area. Majority of the people of polder area largely depend on homestead vegetation production as cash crop for their income and nutrition as well. Homestead vegetation is one of the most important natural resource bases of Bangladesh having huge number of diversified plant species within a specified area where herbs, shrubs, trees are present. Most of the homestead forest consists of fruit yielding plant, timber trees and medicinal plants. The homestead vegetation is the important place for wildlife as well as birds.

378. Vegetation survey marked that, the trees which are successfully adapted in peripheral homesteads are, Akashmoni *(Acacia auriculiformes*), Raintree (*Albizia saman*), Sada koroi *(Albizia procera)*, Raj koroi/Chambol (*Albizia richardiana*), Babla *(Acacia Arabica),* Khoiya Babla *(Pithocelobium dulci),* Velveti/Bilati Gab *(Diospyros discolor),* Tentul *(Tamarindus indica),* Taal *(Borassus flabeliffer),* Narikel/Coconut (*Cocos nucifera*), Supari *(Areca catechu)*, Khejur *(Phoenix sylvestris),* Aam *(Mangifera indica)*, Safeda *(achras sapota)*, and Bamboo/Bash *(Bambusa Spp.).*

379. Shrubs and herbs occupy lower canopies in the homesteads. Many species of undergrowth wild plants (herbs, shrubs, creepers) are found in the homestead vegetation and also village groves. Among this type, Akand (*Calotropis procera*), Vaant/Bhat (*Clerodendron viscosum*), Hatisur (*Heliotropium indicum),* Dhol Kolmi (Ipomoea carnea), are common species.

380. Table 5.15 provides a list of major tree species within the homestead vegetation in the polder area. Settlement vegetation is also providing shelter to various terrestrial fauna.

Table 5.15: Major tree species within the homestead area

Tree species name	Family name	Local Status	Habit	Utilization	Ecological Value
Supari (*Areca catechu*)	Palmae	VC	Monocot	Fruit and Thatching	3
Narikel (*Cocos nucifera)*	Palmae	VC	Tall monocot	Fruit and Thatching	1,2
Khejur (*Phoneix sylvestirs)*	Palmae	VC	Monocot	Fruit	1,2
Tal (*Boassus flabelifer)*	Palmae	VC	Tall monocot	Fruit and thatching	1,2
Bash (*Bamboosa sp.)*	Gramineae	C	CL	Thatching	1,2,3
Babla (*Acacia nilotica)*	Fabaceae	VC	T	Timber, fuel wood and fruit	1,2,3

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

(Sources: CEGIS Field Survey, 2015); Note: Local Stratus: C= Common, VC = Very Common, O = Occasionally, R= Rare; Habit: T= tree, H= Herb, S= Shrub, V=Vine; VC= Very Common, C= common, UC= Uncommon CL=Clump; Ecological Value: 1 = For Wildlife, 2 = For Avifauna, 3 = For micro-Ecosystems

Picture 5.13: Homestead vegetation is at risk due to wave action

ii. Crop field vegetation

381. Varities of field crops and their cropping patterns & production have been discussed in the agricultural section of this report.

382. The seasonal fallow lands have also important roles in ecosystem functioning as grazing support for cattle, feeding and breeding habitats of many arthropods, reptiles and avifauna. In cropland, some flora are found along with crops which are not cultivated, are known as agricultural weeds. The weeds have important roles in terms of ecosystem those contribute to the ecosystem functionality.

383. The dominant cropland's wild species in this polder area are Dhol Kolmi (*Ipomoea carnea*), Hatisur (*Heliotropium indicum)*), Durba Gash (*Cynodon dactylon*), Thankuni (*Centella asiatica*), Akand (*Calotropis procera*), Vaant/Bhat (*Clerodendron viscosum*), Bondhone (*Scoparia dulcis*), Bagha Jongla (*Borreria articularis*), Telakhucha (*Coccinia grandis*), Jhunjhuni (*Crotalaria allid*), etc.

Picture 5.14: Homestead and crop field vegetation affected by drainage congestion

iii. Embankment /Roadside vegetation

384. The polder areas are low lying, so the embankments are mainly used as rural road. Major tree species found along the village road/embankments are Babla (*Acacia Arabica*), Akashmoni (*Acacia auricoliformes)*, Chambol (*Albizia richardiana*), Raintree (*Samanea saman*) etc. These plants had been planted by Forest Department as per social forestry rules. Community people who are residing near the embankment along with Bangladesh Water Development Board and Forest Department are the beneficiary from this plantation. Vegetation of this type supports good habitats for local avifauna.

385. Cactus, Akand (*Calotropis procera*), Telakucha (*Coccinia indica*), Durba Ghash (*Cynodon dactylon*). Vaant (*Clerodendron viscossum*), sech/sezi *(Euphorbia grandialata)* are common wild shrubs and herbs sighted along most of the roadsides.

386. Table 5.16 provides a list of major tree species within the embankment/ road side vegetation in the polder area

Table 5.16: 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
Arjun	*Terminalia arjuna*	Medicinal and Timber	M
Sisoo	*Dalbergia sissoo*	Timber and Fuel wood	M
Ghora Neem	*Melia azedarach*	Timber and Fuel wood	M
Khejur /Date Palm	*Phoenix sylvestris*	Fruit and Fuel wood	M
Khoiya Babla	*Pithocelobium dulci*	Fruit and Fuel wood	M
Raintree	*Albizia saman*	Timber and Fuel wood	H
Mahogoni	*Swietenia macrophylla*	Timber and Fuel wood	M
Kola	*Musa sp*	Fruit	H
Jhau	*Casuarina equisetifolia*	Fuel wood	M
Ipil-ipil	*Leucauna laucocephalata*	Fuel wood	M
Mandar	*Erythrina variegata*	HH use and Fencing	M

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

Picture 5.15: Road side vegetation (Cactus)

Picture 5.16: Road side vegetation (Akand)

- **Terrestrial fauna**

387. There are diversified terrestrial fauna with different species in the polder area. The major terrestrial fauna are different types of mammals, birds, reptiles and amphibians.

388. The amphibians have not attracted much attention than those of the magnificent species like birds and mammals. However, they act as indicators to the ecosystem. During survey some of the amphibian species found within the polder are Common Toad (*Duttaphrynus melanostictus*), Indian Bullfrog (*Hoplobatrchus tigerinus*), , Common Tree Frog (*Polypedetes maculatus*) and Green Paddy Frog (*Hylarana sp.*).

389. Reptiles are generally few in number but species are higher than amphibians within Bangladesh territory. The House Lizard (*Hemidactylus brookii*), Common Garden Lizard (*Calotes versicolor*), Brahminy Skink (*Eutropis carinata*), Gui Sap/Bengal Monitor (*Varanus bengalensis),* Checkered Keelback (*Xenochropis piscator*), Common Smooth Water-snake (*Enhydris enhydris*), were commonly observed.

390. The birds are the most magnificent species in the world. This polder area is an important habitat for wintering birds. The resident and migratory birds available in this polder

are Blue Rock Pigeon (*Columba livia*), Spotted Dove (*Streptopelia chinensis*), Black Drongo (*Dicrurus macrocercus*), House Crow (*Corvus splendens*), Large-billed Crow (*Corvus macrorhynchos*), Asian Palm Swift (*Cypsiurus balasiensis*), Oriental Magpie Robin (*Copsychus saularis*), Black Kite (*Milvus migrans*),

391. The mammals are scarce throughout the polder area. Common species are House Mouse (*Mus musculus*), Asian House Shrew *(Suncus murinus*), Common Mongoose *(Herpestes edwarsii*), Jungle Cat *(Felis chaus*), Small Indian Civet *(Viverrricula indica*), Indian Palm Civet *(Paradoxurus hermaphroditus*), Asiatic Jackal *(Canis aureus*) and Flying Fox *(Pteropus giganteus*).

Table 5.16-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	-	-
	Indian Pond Frog	C	-	-
	Common Tree Frog	C	LC	-
	Green Paddy Frog	C	-	
	Bengal Monitor	C	NT	
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	-
Aves	Black Drongo	VC	-	-
	Blue Rock Pigeon	C	-	-
	Oriental Magpie Robin	VC	-	-
	House Crow	C	-	-
	Black Kite	UC	LC	-
	Oriental Magpie Robin	C	NO	-
	Large-billed Crow	C	LC	-
	Asian Palm Swift	C	LC	-
Mammalia	House Mouse	C	-	-
	Asian House Shrew	C	LC	-
	Indian Palm Civet	UC	-	-

Class	Common Name	Local *Status*	IUCN-Bangladesh Status (2015)	CITES (2016)
	Small Indian Civet	UC	NT	-
	Common Mongoose	UC	LC	Appendix III
	Asiatic 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

5.3.3 Aquatic Ecosystem

392. Polder 48 stands on the coast of the Bay of Bengal. The northern side of the polder is bounded by Andarmanik River, and *Mohipur* Khal. Besides, many other canals have crisscrossed the entire polder area. In addition, some fishponds and gher have turned these areas as resourceful aquatic ecosystems.

393. The aquatic bodies provide support to the existing aquatic biota. Aquatic resources in this polder are mainly flora and fauna. The major species of these two groups found in the polder are described below (Table-5.17):

(a) Aquatic flora

Table 5.17: List of plant species found in the wetlands of the polder area

Local/English name	Scientific name	Abundance
Kutipana	*Azolla pinnata*	H
Singara	*Trapa bispinosa*	L
Kochu	*Colocasia esculenta*	M
Kochuripana	*Eichhornia crassipes*	H
Helencha	*Enhyra flactuans*	M
Jhangi	*Hydrilla verticillata*	M
Dhol Kolmi	*Ipomoea aquatica*	H
Khudipana	*Lemna perpusilla*	H
Fern	*Lindsaea ensifolia*	M
Bishkatali	*Polygonum barbatum*	M
Kuripana	*Salvina cucullata*	H
Shapla/Poddo	*Nymphaea nouchali*	M
Topapana	*Pistia stratiotes*	H
Mangrove Vegetation		
Golpata	*Nypa fruticans*	H
Hargoza	*Acanthus ilicifolius*	H
Choila/Ora	*Sonneratia caseolaris*	H
Hogla	*Typha elephantalis*	H
Gewa	*Excoecharia agallocha*	H
Keora	*Sonneratia apetala*	H

Sources: CEGIS Field Survey, June 2015. (Note: Abundance Code, H= High, M= Medium, L= Low)

(b) Aquatic fauna

394. The aquatic fauna found in this polder are more diverse compared to other polder areas because of having an area rich with mud flats in the project periphery. This type of habitat is very important for waders. Available species in the habitat are are giveb in the following table.

Skipper Frog (*Euphlyctis cyanophlyctis*), Ornate Microhylid (*Microhyla ornata*), Cricket Frog (*Fejervarya limnocharis*), Spotted Flapshell Turtle (*Lissemys punctata*), Roofed Turtle (*Pangshura tecta*).

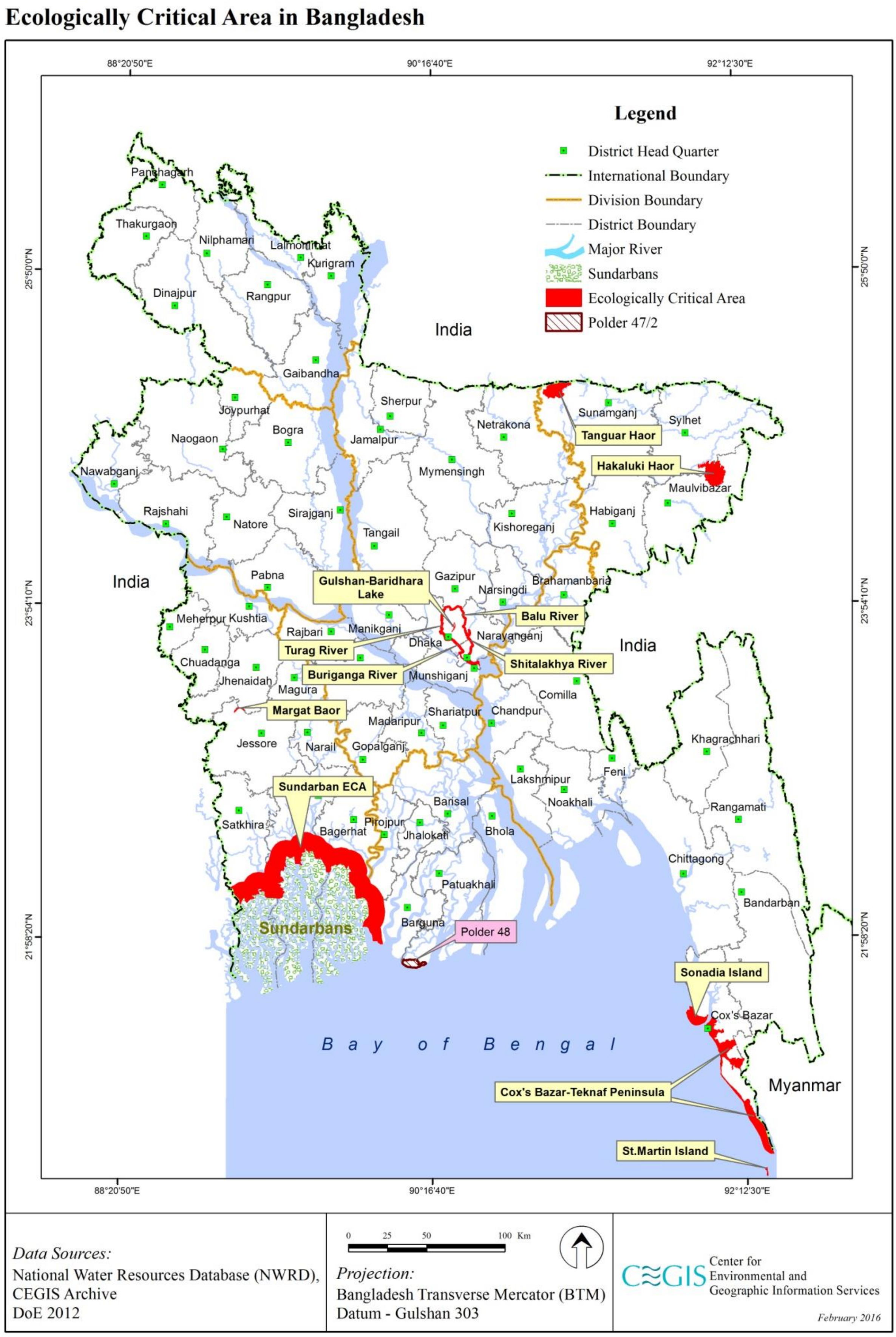
Types of Species	Name (generic name)	Habitat
Birds	Indian Pond Heron, Little Egret Cinnamon Bittern, Cotton Pigmy Goose, Little cormorant, White-breasted Water Hen, Common Kingfisher, Lesser Whistling Duck, and, Brahminy Kite, and Pied Kingfisher, etc	Birds habitat can be divided into two major groups: birds observed in floodplains and wetland, and birds observed in dry habitat such as homestead, open woodland, scrub and grass land.
Reptiles	Aquatic snakes include Checkered Keelback (*Xenochrophis piscator*), and Common Smooth Water Snake (*Enhydris enhydris*). Among waders, Common Snipe (*Gallinago gallinago*), Common Kingfisher (*Alcedo atthis*), Great Egret (*Casmerodius albus*), White-breasted Waterhen (*Amaurornis phoenicurus*), Little Cormorant (*Phalacrocorax niger*), Indian Pond Heron (*Ardeola grayii*), Little Egret (*Egretta garzetta*), Garganey (*Anas querquedula*), Eurasian Widgeon (*Anas penelope*), Eurasian Teal (*Anas crecca*), Northern Shoveler (*Anas clypeata*), and Black-tailed Godwit (*Limosa limosa*) were found. White-breasted Waterhen (*Amaurornis phoenicurus*), Little Cormorant (*Phalacrocorax niger*),Eurasian Curlew (*Numenius arquata*), Northern Shoveler (*Anas clypeata*), Eurasian Teal (*Anas crecca*), Eurasian Widgeon (*Anas penelope*), Common Greenshank (*Tringa nebularia*) and Common Redshank (*Tringa totanus*).	Habitats belongs to these species are wetland area.
Amphibians	Skipper Frog Common Toad *(Duttaphrynusmelanostictus)*Bullfrog (*Hoplobatrachus trigerinus*), Indian Pond Frog (*Euphlyctis hexadactylus*). Asian Brown Tree Frog *(Polypedates leucomystax)*	Wetland areas and the dried areas.

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

395. Peripheral embankments of the polder protects against tidal flooding, saline water intrusion and the sluices act as drainage controller. The land of the polder supports different types of ecosystems. Homesteads and crop fields 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 population indicates a change of water salinity due to malfunctioning of water control structures like sluices.

5.3.5 Protected Areas

396. Polder 48 is within the buffer area of Kuakata National Park. The polder is located is about 16 km away from the nearest ECA of Sundarban as shown in Map 5.8.



Map 5.8: Location of Polder 48 from Ecologically Critical Area (ECA) of Bangladesh

5.3.6 Ecosystem Services

(a) Output of ecosystem services

397. Ecosystem services are the tangible and intangible benefits to people obtained from ecosystem. These include provisioning services such as food from different homestead trees and cultivable lands inside the polder, the Dulasar is one of the important for such services; and water; regulating services such as flood and disease control; cultural services are spiritual, recreational, and cultural benefits; and supporting services, indicates nutrient cycling that maintain the conditions for life on earth. Particularly, religiously important places like Misripara Boudhya Bihar, Misripara Buddhist Temple and Rakhain Buddhist Temples have great contribution in terms of cultural services of the ecosystem.

398. Healthy ecosystems provide both goods (tangible benefits) and services (intangible benefits) to humanity. Here, goods refer to items given monetary value, whereas the services from ecosystems are valued, but are rarely bought or sold. Ecosystem "goods" includes foods, construction materials, medicinal plants and tourism.

399. On the other hand, ecosystem "services" includes maintaining hydrological cycles, regulating climate, shelterbelt, cleansing 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.

400. The table below represents the provisional services from different common plants of the polder areas.

Table 5.18: Showing 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 Kolmishak (*Ipomoea aquatica*)	Leaf and stem
Fodder	Kochuripana, (*Eichhornia crassipe*), Phutku (*Hygroryza aristata*) etc.	Leaf and stem
Wood, timber	Aam *(Mangifera indica),* Bot *(Ficus benghalensis),* Babla *(Acacia nilotica),* Mahogany (*Swietenia mahagoni),*	Trunk
Medicine	Mahogany (*Swietenia mahagoni),* Tulshi (*Ocimum americanum),* Sezi *(Euphorbia antiquoram),* Bel (*Agle marmelos*)*,* Nim (*Azadirachta indica*)	Roots, Leaf, Stem
Thatching and mat making	*Cyperus platystylis*, Supari *(Areca catechu),* Narikel (*Cocos nucifera*)*,* Bash (*Bamboosa* sp.), Bel*(Aglemarmelos*)*,* Tal (*Boassus flabelifer)* and Hogla (*Typha elephantalis*),	Thatching and fencing for huts and as protective screen in homestead.

Goods/Services/Purpose	Source	Plants Parts used
Fuel	Babla *(Acacia nilotica)*, Akashmoni *(Acacia auriculiformis,)* Boroi *(Zizyphus sp),* Gab *(Diospyros perigrina),* Jhau *(Casuarina equisetifolia),* and etc.	Brunches, Leaf
Biofertilizer/Guano	Kochuripana,	As compost,
Hydroponics	Kochuripana to make baira (floating platforms)	to grow seedlings and vegetables
Bio-gas	Kochiripana, Khudipana (*Lemna* and *Spirodela spp.*) and other aquatic plants.	All parts of the pant
Erosion Protection	Dholkolmi *(Ipomoea fistulosa)*,	Against wave action, erosion and storm

Sources: CEGIS Field Survey, June 2015

(b) Present threats to ecosystem

401. According to the field survey, tidal flood, drainage congestion, river bank erosion is the main threat for ecosystem sustainability.

402. Most of the wetlands, especially khals were found silted. Non-functioning of water control structures like regulators, drainage sluice and flashing sluice caused insufficient drainage and created drainage congestion. So poor drainage system is the main problem, which severely affect the surrounding vegetation specially, cropland vegetation.

403. Embankment breaches due to river bank erosion every year. For which, this embankment cannot protect flood inflation and causes flood water inundation that adversely affect the surrounding vegetation. Consequently, faunal population and diversity decreases due to habitat destruction

404. Pests and diseases infestation and improper homestead space utilization planning is also a problem. 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 Mammals' population is very low in the polder area. Big mammals have already disappeared from the area, because jungle area is reducing and for different human activities.

5.3.7 Fish Habitats

406. Fisheries resources of the project area are diversified with different fresh and saline water fish habitats. Open water fish habitat of the polder includes surrounding external rivers and internal khals, such as *Mohipur khal and internal khals,* which are acting as major arteries of fish migration inside the project area. Various inter-connected water bodies, fishing activities, fish demand, access to the market, etc are playing vital role in maintaining moderate fisheries productivity in the project area in respect of nation fisheries productivity. The cultures of fishponds are almost traditional in practice. The identified fisheries problems are morphological changes, loss of connectivity, indiscriminate fishing, and reduction of breeding, spawning, nursing and feeding ground, lack of quality fish fingerlings for culture, lack of trained fish farmer etc.

5.3.8 Habitat Description

Habitat distribution

407. Nearly 85% of the study area fish habitats are situated in Lata Chapli union and Dhula Shar Union and (15%) under Kalapara Upazila.

Habitat classification

408. Fish habitat in this Polder area is mainly classified into two fisheries, such as, open water or capture fisheries and culture fisheries. Fish habitats of the project area are shown in Figure 5.17 & Map 5.9.

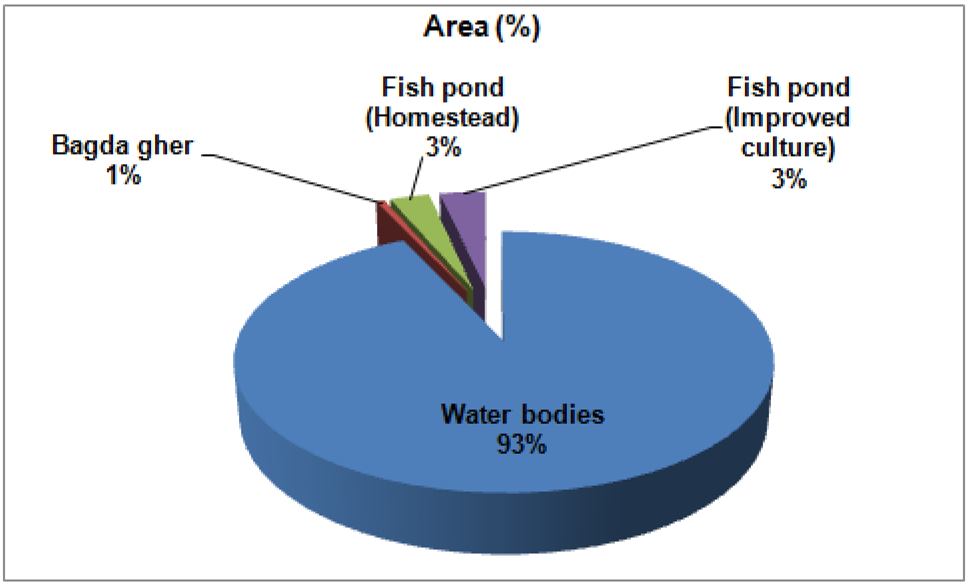


Figure 5.17: Distribution of fish habitat in the polder area

Fish Habitat and Migration Route Map: Polder 48, Kala Para Upazila, Patuakhali

Map 5.9: Fish habitat and migration route

Capture fisheries

409. Fish habitat in the project area is 786 ha of which 731 ha and 55 ha are capture fish habitat and culture fish habitat respectively (Table 5.19).

Table 5.19: Fish habitat status of the Polder area

Sl. No.	Fishery category	Habitat type	Area (Ha)
1	Capture	Water bodies	731
		Total	***731***
2	Culture	Bagda gher	5
3		Fish pond (Homestead)	23
4		Fish pond (Improved culture)	27
		Total	***55***
		Grand Total	**786**

Source: Draft Final of Fisheries Report (from DDCS&PMSC, CEIP-I

DS-1: Kuakata Khal (Alipur Bazar)

DS-2A: Matiranga Khal (Taherpur)

DS-3/1: Loxir Khal (Naya Misripara)

Picture 5.17: Major capture fish habitat in the polder area

410. The project area consists of a number of seasonal and perennial canals/khals. Among which some are spawning ground and some are nursery ground. Moreover, all of these are used as the feeding ground found in Polder 48. However, depth of seasonal canals of the project area is reducing day by day to be insufficient for sheltering fish juveniles as they are silting up. Local people reported that siltation rate in the internal fish habitats of the project area is 2-3 cm per year. The following table shows the habitat use of the identified khals of associate interventions (Table 5.20):

Table 5.20: Habitat use of different identified khals by different age class of different fish species

Sl. No.	Intervention	Habitat	Age Class
1	DS-1	Kuakata Khal	Juvenile and Adult
2	DS-2A	Taherpur Khal	Juvenile and Brood
3	DS-3/1	Loxir Khal	Juvenile, Adult and Brood
4	DS-3/3	Tola Toli Khal	Juvenile and Adult
5	DS-3/4	Char Chapali Khal	Adult and Brood
6	DS-4	Kauar Char Khal	Age-1 Juvenile, Adult and Brood
7	DS-5	Koloipara Khal	Juvenile and Adult
8	FS-2	Goram Khola Khal	Juvenile, Adult and Brood
9	FS-3	Naya Para Khal-02	Juvenile, Adult and Brood

Source: CEGIS field survey (KII with professional fishermen), 2015.

411. Moreover, through investigating habitat use of different age classes of different fish species, the identified khals have further been clustered as Spawning Ground (SG), Nursery Ground (NG) and Feeding Ground (FG) as shown in the following figure (Figure 5.18):

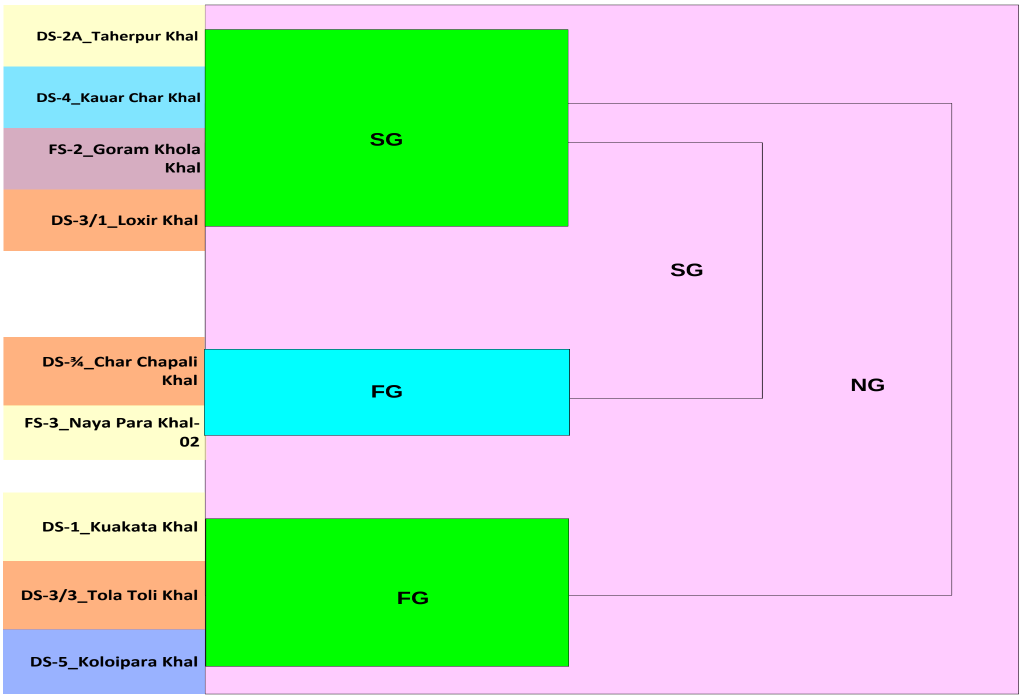


Figure 5.18: Habitat classification of Intervention-specific fish habitat

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

Culture fisheries

412. Aquaculture practice 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. Exclusively poly-culture practice is adopted by the local people. Estimated area under culture habitat is 55 ha. Most of these are extensive culture in practice (Picture 5.18).

Picture 5.18: Homestead pond in the project area

5.3.9 Fish Migration

413. Overall fish migration status is poor in the polder area. It has been found that only one species, *Gulsha Tengra* is widely distributed among the internal khals. On the other hand, *Tara Baim, Lal Chewa, Ram Tengra, Pheksa, Khorsula, Golda, Bagda, Boal, Batasi* and *Bata* have restricted distribution (Figure 5.19). It, nevertheless, has been reported by the local people that peripheral rivers along with the internal rivers and khals of the project area are silted up naturally and structures on the khals cause the reduction in the length of successive migration routes.

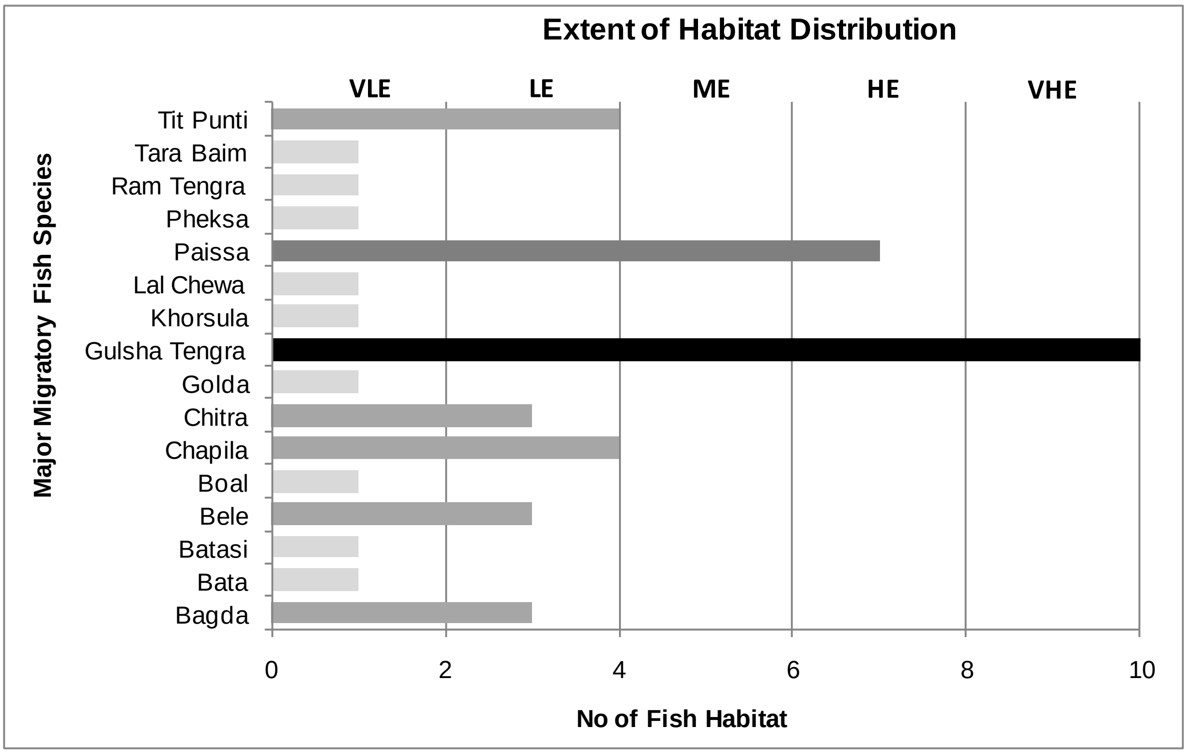


Figure 5.19: Extent of habitat distribution of major migratory fish species in the project area

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

Source: Catch Assessment Survey, CEGIS (2015).

414. Both 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. The following table shows the purposes of migration with time of some major migratory fish species (Table 5.21).

Table 5.21: The purpose and timing of migration for some major migratory fish species

Sl. No.	Fish Species	Habitat	Purpose	Timing
1	Bagda	Kauar Char Khal	Feeding	All the Year Round
2		Koloipara Khal		
3		Kuakata Khal		
4	Bata	Loxir Khal	Nursing	Ashar-Aswin
5	Batasi	Tola Toli Khal		
6	Bele	Kuakata Khal		
7		Loxir Khal		
8		Tola Toli Khal		
9	Boal	Taherpur Khal		
10	Chapila	Koloipara Khal	Feeding	All the Year Round
11		Naya Para Khal-02		
12		Tola Toli Khal		
13	Chitra	Kauar Char Khal	Nursing	Ashar-Aswin
14		Koloipara Khal		
15		Kuakata Khal		
16	Golda	Kauar Char Khal	Feeding	Jaistha-Aswin
17	Gulsha Tengra	Char Chapali Khal	Feeding and Spawning	Ashar-Aswin
18		Goram Khola Khal		
19		Kauar Char Khal	Spawning	Boishakh-Ashar
20		Koloipara Khal	Feeding	All the Year Round
21		Kuakata Khal		
22		Naya Para Khal-02		
23		Taherpur Khal	Nursing	Ashar-Vadro
24	Khorsula	Kauar Char Khal	Feeding	All the year round
25	Lal Chewa	Kuakata Khal		
26	Paissa	Goram Khola Khal	Nursing	Ashar-Aswin
27		Koloipara Khal		
28		Kuakata Khal	Feeding	All the Year Round
29		Loxir Khal	Nursing	Ashar-Aswin
30	Pheksa	Kuakata Khal		
31	Ram Tengra	Loxir Khal	Feeding and Spawning	Ashar-Aswin
32	Tara Baim	Tola Toli Khal	Nursing	Ashar-Aswin
33	Tit Punti	Char Chapali Khal	Spawning	Boishakh-Ashar
34		Goram Khola Khal		
35		Naya Para Khal-02		
36		Taherpur Khal		

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

5.3.10 Fish Biodiversity

415. The project area is very poor to moderate in fish biodiversity as the biodiversity of fishes has the declining trend over the years. Pollutants, agrochemicals and pesticides coming from paddy fields, obstruction in fish migration routes, morphological changes of internal khals, siltation of fish habitats, squeezing of spawning and feeding grounds and further expansion of both culture fishery and *rice* cultivation are responsible for gradual decline of fish abundance and biodiversity.

Picture 5.19: Fish catch of the project area

416. The project area comprises an assemblage of both fresh and brackish water fish species (Picture 5.19). The available fish species are *Bagda and Golda Chingree, Bele, Tengra, Paissa, Tit Punti, Motka Chingree, Tara Baim,* etc (Table 5.22).

Table 5.22: 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	*Amblypharyngodonmola*	P	P
		Gutum	*Lepidocephalusguntea*	P	A
2	Climbing perch	Koi	*Anabas testudineus*	A	P
		Kholisa	*Colisa fasciatus*	P	A
3	Small catfish (mostly commercially important)	Magur	*Clariasbatrachus*	P	P
		Singi	*Heteropneustesfossilis*	P	P
		Tengra	*Mystustengara*	P	A
		GulsaTengra	*Mystus cavasius*	P	A
4	Major carps (include four species and orderly)	Rui	*Labeorohita*	P	P
		Catla	*Catlacatla*	P	P
		Mrigel	*Cirrhinuscirrhosus*	P	P
		Kalibaus	*Labio calbasu*	P	P
5	Large catfish (six species and orderly)	Boal	*Wallago attu*	P	A
		Pangas	*Pangasiushypophthalmus*	A	P
6	Herring (Highly valued)	Ilish	*Tenualosailisha*	P	A
7	Snakeheads	Shol	*Channastriatus*	P	A
		Gazar	*Chana marulius*	P	A
		Taki	*Chana punctatus*	P	A
		Cheng	*Chana orientalis*	P	A
		Khorsula	*Rhinomugil corsula*	P	A
8	Knife fishes	Foli	*Notopterus notopterus*	P	A
9	Needle fishes	Kaikka	*Xenentodoncutcutia*	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	*Mastacembelusaculeatus*	P	A
12	Mud perch	Bheda	*Nandas nandas*	P	A
13	Glass fishes	Chanda	*Chanda spp.*	P	A
14	Goldspot Mullet	Parsa	*Liza persia*	P	A
15	Prawns	Golda chingri	*Macrobrachiumrosenbergii*	P	P
		Gura chingri	*Leander styliferus*	P	P
16	Exotic introductions (Five carps, two cichlids and one barb)	Silver carp	*Hypophthalmichthys molitrix*	A	P
		Mirror carp	*Cyprinuscarpio var. specularis*	A	P
		Grass carp	*Ctenopharyngodonidella*	A	P
		Thai barb	*Barbodesgonionotus*	A	P
		Telapia	*Oreochromismossambicus*	A	P
		Nilotica	*O. niloticus*	A	P

Source: FAP 6, Here, A=Absent and P=Present

417. Moreover, during the investigation period in June, evenness in the fish composition has been analyzed through applying Shannon-Weiner Diversity Index. The highest evenness in fish composition has been found in Naya Para Khal-02, while the lowest in Kuakata Khal (Table 5.23). It has also been found for Rishir Khal and Mondir khal that all the three fish species are dominant in equal proportion out of three fish species which are supposed to improve the species evenness in the fish composition. On the other hand, in case of Kauar Char Khal and Kuakata Khal, fish composition is highly dominated by one fish species (Horina in both cases) causing lowest evenness in fish composition.

Major Indicative Species

418. Major indicative species has been identified during the investigation period of June, 2015 by assessing evenness and fish richness in the fish composition. Table 5-22 describes the fish biodiversity status of the area, It has been done based on the regularly caught major fish species. Among the fish species, the indicative species in the polder area are Gulsha Tengra, Horina Chingree and Motka Chingree, Parsa (*Liza persia*), Khorsula (*Rhinomugil corsula*) which is sensitive to high salinity of water.

Table 5.23: Species evenness and richness in the intervention specific fish habitat

Sl. No	Site	Species No	Dominated Fish Number**	SI*	SWDI**
1	Char Chapali Khal	2	2	0.42	0.88
2	Goram Khola Khal	4	2	0.54	0.24
3	Kauar Char Khal	6	1	0.25	0.30
4	Koloipara Khal	7	2	0.58	0.56
5	Kuakata Khal	8	1	0.17	0.22
6	Loxir Khal	5	2	0.41	0.53
7	Naya Para Khal-02	3	3	0.64	0.96
8	Taherpur Khal	4	3	0.60	0.33
9	Tola Toli Khal	5	3	0.68	0.56

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

419. It has also been found that Gulsha Tengra, Tit Punti, Motka Chingri, Horina Chingri, Bagda, Golda, Bele, Chapila, Tara Baim are the most dominant fish species in the Polder.

5.4 Human and Economic Development

5.4.1 Fish Production

420. Estimated total fish production of the project area is 190 MT. Bulk of the fish production (about 59%) is from culture fisheries while rest of the production (about 41%) is from capture fisheries habitats (Table 5.24).

Table 5.24: Fish production in the Polder area

Sl. No.	Fishery category	Habitat type	Production (Ton)
1	Capture	Water bodies	78
		Total =	**78**
2	Culture	Bagda gher	1
3		Fish pond (Homestead)	30
4		Fish pond (Improved culture)	81
		Total =	**112**
		Grand Total =	**190**

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

421. Highest catch has been observed in the drainage sluice (DS-4) associated Kauar Char Khal, and lowest catch in the drainage sluice (DS-2A) associated Taherpur Khal (Table 5.25). However, highest minimum productivity level has been reported in case of newly

proposed drainage sluice (DS-3/3) associated *TolaToli Khal*. These indicate that fish production function is highly seasonal.

Table 5.25: Minimum catch and productivity per haul in the intervention associate fish habitat

Sl. No.	Intervention	Minimum Catch (kg/Year)	Minimum Productivity per haul (Kg/hl)
1	DS-1	75	1.423
2	DS-2A	22	0.003
3	DS-3/1	24	0.002
4	DS-3/3	246	7,392
5	DS-3/4	197	2
6	DS-4	554	0.01
7	DS-5	110	0.07
8	FS-2	259	0.012
9	FS-3	129	1.34

Source: CEGIS field visit, 2015

422. Catch susceptibility of different fish species varies with the use of fishing gears fishing in the intervention located khals. The Figure 5.15 shows the matrix of fish susceptibility to fishing at different intervention specific fish habitat.

5.4.2 Fishing Efforts

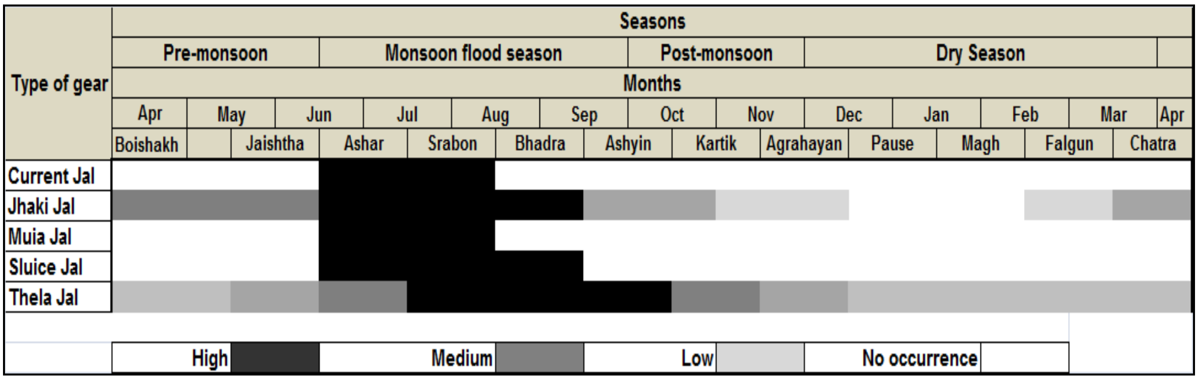
Fishers' Type

423. Commercial fishers of the study area are mostly from Muslim community (85%). Field investigation revealed that among the various types of fishermen engaged in commercial fishing, a good number of households are involved in part time and subsistence fishing. They usually catch fish in the nearby river, khals and floodplain using country boat and dingi boats.

Fishing Season

424. Capture fishing is the major fishery of the polder area. Fishing in khals starts in May and continues up to October especially by the use of Jhaki Jal and Thela Jal. They are mainly engaged in other fisheries activities (like fish traders) rest of the time. The seasonality of major fishing is furnished in the Table 5.26.

Table 5.26: Fishing seasonality of the project area



Source: CEGIS field investigation, 2015

Fishing Gear and Crafts

425. The commercial fishermen usually catch fish in the nearby rivers and connecting khals using country boat and dingi boats. Five major types of nets/gears have been observed to be used for fishing in the Polder area. These are: (1) Jhaki jal (cast net), (2) Current jal (mono-filament gill net[11]), (3) Muia jal, (4) Thela jal (push net[12]), and (5) Badha/Sluice [13] jal. Only 20 to 25% of fishermen have fishing boats and around 70% fishermen have fishing gears/nets. Among these gears, Thela jal is mostly used especially for fishing in the intervention location (Table 5.27).

Table 5.27: Major gears used in the intervention specific fish habitat in the polder

Sl. No.	Habitat	Gear	Haul Duration (hr/haul)	Haul No	Operated Person (N)
1	Char Chapali Khal	Sluice Jal	4	1	2
2	Goram Khola Khal	Jhaki Jal	2	100	1
		Thela Jal	1	30	1
3	Kauar Char Khal	Jhaki Jal	0	60	1
4	Koloipara Khal	Jhaki Jal	1	50	1
		Muia Jal	1	20	2
		Sluice Jal	6	1	1
5	Kuakata Khal	Current Jal	2	2	1
		Jhaki Jal	1	50	1
		Sluice Jal	6	1	1
6	Loxir Khal	Jhaki Jal	1	40	1
7	Naya Para Khal-02	Sluice Jal	6	1	1
8	Taherpur Khal	Jhaki Jal	1	30	1
9	Tola Toli Khal	Jhaki Jal	0	30	1

Source: CEGIS field visit, 2015

Vesal Jal

Badha/Sluice Jal-1

[11] Mono-filament Gill Nets: vertical panels of netting normally set in a straight line

[12] Push Net: Nets pushed, footing in very shallow waters or before a small boat. The net bag is fixed on scissors like cross-sticks to keep the net open

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

Thela Jal

Garo/Sluice Jal-2

Picture 5.20: Major fishing gears in the polder area

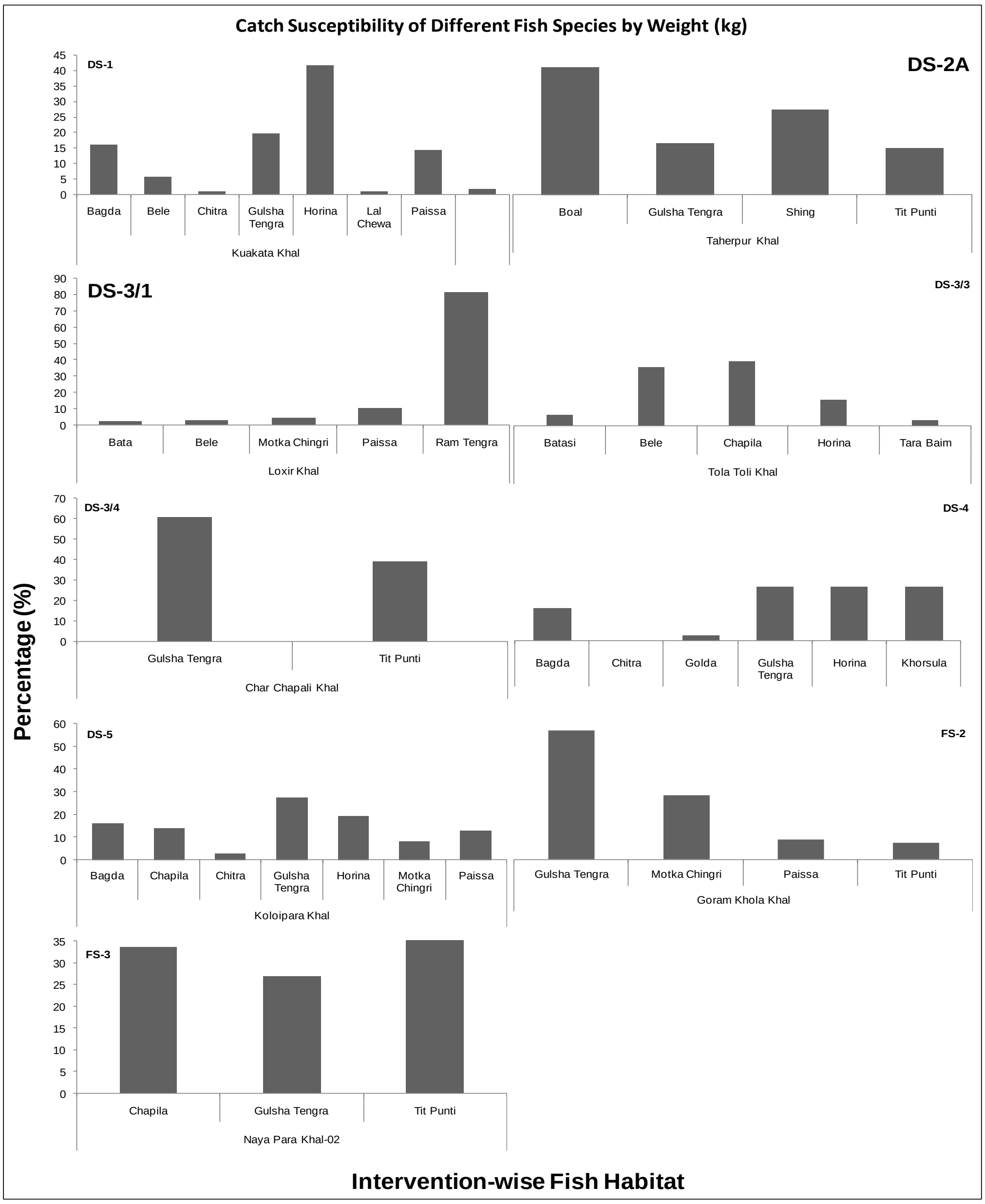


Figure 5.20: Catch susceptibility of different fish species (by Weight) in the intervention specific fish habitats

Source: Catch Assessment Survey, CEGIS (2015)

5.4.3 Fish Marketing –Post harvest facilities and damage

426. Market accessibility is moderate in this polder area due to the moderate proximity (inversely related to distance between two supply chains) to local fish market, lack of legal basis of wholesale fish market (located on the embankment of Kuakata Sea Beach), poor infrastructure (road), limited transportation vehicles and vessels. The local fishermen sell bulk of their catch directly to the local fish market. Lowest proximity to local fish market has been observed in case of DS-4 where the fishermen transport their fish by engine boat (Figure 5.16). Fishes are directly sold from the local fish market to the nearby Kuakata wholesale fish market. Moreover, fishermen also directly sell their fish to the wholesale market in Kuakata. No structured fish landing centers are found in the area. Kuakata Ice Plant, Himalaya Ice Plant, and Mayer Doa Ice Plant are the ice factories found in Alipur Bazaar of the project area.

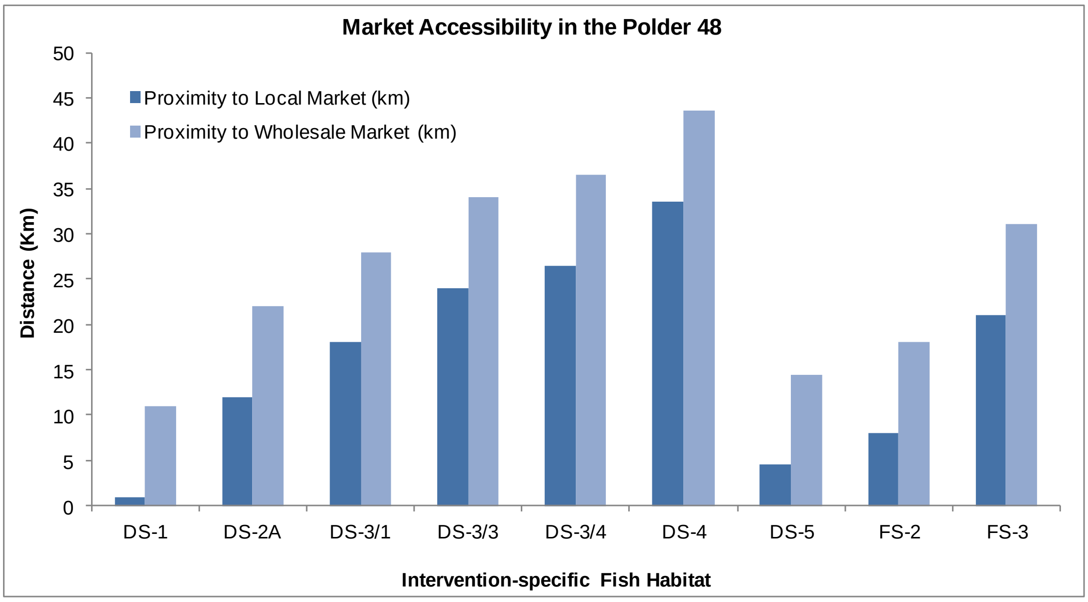


Figure 5.21: Market accessibility in view of proximity to local fish markets and wholesale fish markets

Source: Market Survey, CEGIS (2015)

5.4.4 Fisher Lifestyle

427. Average daily income of the 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 are mostly practicing traditional culture methods.

5.4.5 Fisheries Management

428. Fishermen Community Based Organizations (FCBOs) is absent in the project area. Department of Fisheries (DoF) has limited activities 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.

5.4.6 Farming Practices

429. Farming practices largely depend on the cropping seasons. In the polder area, there are three cropping seasons in a year. 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 favored 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). However, there are occasional overlaps such that Kharif-I season crops such as summer vegetables are harvested in Kharif-II season, Kharif-II season crops (HYV Aman) are generally harvested in Rabi season as well as Rabi season crops (HYV Boro) are harvested in Kharif-I season.

5.4.7 Present Cropping Patterns and Intensity

430. The dominant cropping pattern in the medium high land is Fallow-T. Aman (HYV) - Fallow and Fallow- T. Aman (Local) -Fallow which occupies about 31.5% and 15.2% of the NCA. Detailed cropping patterns along with land type are presented in Table 5.28. The overall cropping intensity in the Polder area is 157%.

Table 5.28: Detailed cropping patterns by land type in the Polder area

Land type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-Feb.)	Area (ha)	% NCA
High land(FF)	Orchard	Orchard	Orchard	45	1.2
	Vegetables	Fallow	Chilli	85	2.3
	Vegetables	T. Aman (HYV)	Spices	48	1.3
	T. Aus (LV)	T. Aman (LV)	Potato	11	0.3
	T. Aus (LV)	T. Aman (LV)	Vegetables	149	4
			Sub-total	**338**	**9.1**
High land (F_0)	Fallow	T. Aman (HYV)	Watermelon	67	1.8
	Vegetables	T. Aman (HYV)	Fallow	100	2.7
	T. Aus (HYV)	T. Aman (HYV)	Oil seeds	100	2.7
	Fallow	T. Aman (HYV)	Chilli	112	3
			Sub-total	**379**	**10.2**
Medium High land (F_1)	T. Aus (HYV)	T. Aman (LV)	Fallow	301	8.1
	Fallow	T. Aman(LV)	Fallow	565	15.2
	Fallow	T. Aman (HYV)	Fallow	1170	31.5
	Fallow	Fallow	Boro (HYV)	26	0.7
	T. Aus(HYV)	Fallow	Oilseeds	100	2.7
	Fallow	Fallow	Pulses	100	2.7
			Sub-total	**2262**	**60.9**
Medium Low Land (F_2)	T. Aus (LV)	T. Aman (HYV)	Fallow	539	14.5
	Fallow	T. Aman(LV)	Pulses	71	1.9
	Fallow	T. Aman (HYV)	Pulses	74	2
	Fallow	T. Aman (HYV)	Watermelon	48	1.3
			Sub-total	**732**	**19.7**
Low land (F_3)	Fallow	Fallow	Fallow	4	0.1
			Sub-Total	**4**	**0.1**
			Grand Total	**3,715**	**100**

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

Picture 5.21: View of T. Aus rice field in the Polder area

5.4.8 Cropped Area and Production

431. Detailed cropped area, crop production and yield rate are presented in Table 5.29.

Cropped Area

432. Total cropped area is 5,826 ha of which rice occupied 4,581 ha and the rest 1,245 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 (Table 5.29).

Crop Production

433. Total crop production is 20,370 metric tons of which rice production is 10,333 metric tons (Table 5.29) and non-rice production is 10,037 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 10%, 13%, 21%, 55% and 1% respectively. Detailed are presented in Table 5.29.

Table 5.29: Present cropped area, yield and production of the Polder area

Name of crop	Cropped area (ha)	Yield (ton/ha)	Production (metric ton)
T. Aus (LV)	698	1.5	1,048
T. Aus (HYV)	502	2.7	1,354
T. Aman (LV)	1,096	2	2,192
T. Aman (HYV)	2,259	2.5	5,648
Boro (HYV)	26	3.5	91
Total rice	**4,581**		**10,333**
Orchard	45	13.5	602
S. Vegetables	234	12.5	2,926
Chilli	197	1.25	247
Pulses	245	1.5	368
Potatoes	11	15.5	173
W. Vegetables	149	12.5	1,858
Spices	48	3.5	169
Oil seeds	201	1.2	241
Watermelon	115	30	3,455
Total non rice	**1,245**		**10,037**
Grand Total	**5,826**		**20,370**

*Sources: Feasibility report (Agriculture), CEIP and field information; 2015 *Indicates cleaned rice*

5.4.9 Crop Damage

434. The crop damage due to various means of the Polder area during 2007-2011 is presented in Table 5.30. About 50% and 80% field crops (T. Aman HYV and Vegetables crops) were damaged in the year 2007 by natural calamities (SIDR). About 80% and 60% field crops (Vegetables and Pulses) were damaged by AILA in the year 2009. In 2008 about 20% & 30% 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. 15-20% of Vegetables, T. Aman and fruit crops were lost due to pest infestation in the year 2011. In the year 2013, Pulses and Spices were damaged by 25% and 20% respectively by MOHASEN. Detailed crop damage is presented in Table 5.30.

Table 5.30: 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)	50	2007	Sidr
	Vegetables	80	2007	Sidr
	Fruits	30	2007	Sidr
2.	T. Aman	20	2008	Heavy rainfall
	Vegetables/Fruits	30	2008	Heavy rainfall & Pests
3.	Pulses	60	2009	Aila
	Vegetables	80	2009	Aila
4.	T. Aman	20	2010	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

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

5.4.10 Agricultural Inputs

Seeds

435. The role of seeds is very important for growing crops. Selection of seeds has to be made carefully. More than 85% germination rate, free from disease infestation and high yield potential need to be considered. Good quality vegetables seeds 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 the private dealer is poor and market price is very high. Farmers use higher quantity of seeds than the recommended quantity.

Fertilizer

436. 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. Farmers in the polder use chemical fertilizers such as Urea, TSP, MP and Gypsum in different crops. Farmers do not use organic manure or compost (Table 5.31) for crop cultivation.

Pesticides

437. 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. However, it is observed that farmers did not use pesticide in all crops. The highest quantity of pesticides was applied in vegetables and potato fields. Farmers applied pesticides twice or more times and overdosed. The major insects as reported by the farmers were Yellow stem borer, Rice hispa, Leaf folder, Rice bug, Ear cutting caterpillar, Fruit fly and Cut worm. Local farmer reported that they were using different types of pesticides such as Furadan 3G (Carbofuran), Karate (Landacyhalothrin), Virtako40WG (Diazinon), Rovral (Iprodion) and Theovit powder (Mancogeb), etc., to prevent pest infestation in crop field.

Table 5.31: Fertilizer, pesticide and seed used within Polder - 48

Crop name	Seeds used (Kg/ ha)	Fertilizer (Kg/ha)					Irrigation cost (Tk./ha)	Pesticide (Tk./ha)	Percent farmers using	Cost power tiller (Tk./ha)
		Urea	TSP	MP	Gypsum	Zinc				
T. Aus (LV)	38	115	70	50	-	-	-	1000	70	3200
T. Aus (HYV)	35	100	80	70	-	7	-	1500	70	3200
T. Aman (LV)	38	100	45	35	-	-	-	1000	70	3200
T. Aman (HYV)	30	130	85	70	-	-	-	1200	70	3200
Boro (HYV)	25	200	100	80	40	7	3500	2000	70	3200
Chilli	1-1.5	120	100	80	40	-	1000	2000	70	3200
Pulses	35	40	30	30	-	-	-	1000	70	3200
Potatoes	1500	175	90	135	55	6	1000	2500	70	3200
S. Vegetables	4	120	80	60	30	-	-	2000	70	3200
W. Vegetables	5	120	80	60	30	-	700	2000	70	3200
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
Watermelon	0.75-1.0	130	90	30	-	-	500	1000	90	2900
Spices	10	100	80	60	-	-	200	500	70	3200
Oil seeds	8	80	50	50	40	-	-	800	70	3200

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

Labor

438. Most of the cultural practices in the study area for crop production are manual. 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 5.32.

Table 5.32: Average labor used in the Polder area

Sl. No.	Crop name	Labor (No./ha)
1	T. Aus (LV)	150
2	T. Aus (HYV)	160
3	T. Aman (LV)	160
4	T. Aman (HYV)	170
5	Boro (HYV)	180
6	Orchard	140
6	Chilli	180
7	Pulses	100
8	Potatoes	140
9	S. Vegetables	180
10	W. Vegetables	180
11	Spices	170
12	Oil seeds	120

Source: CEGIS Assessment from field information, 2015

Irrigation

439. Irrigation is provided mainly in HYV Boro crops in the polder area. Irrigation coverage of the polder area is only about 0.7% (26 ha) of the total NCA during the dry season. Surface water is being used for irrigation. Khaprabhanga Don, Khals (Ali pur, Kalaia, Nayapara, Tulatoli) 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, *don* are used for lifting irrigation water. However, the availability of irrigation water has been declining due to siltation of the rivers, beels and khals. T. Aus (Local), T. Aus (HYV), T. Aman (Local) and T. Aman (HYV) are cultivated under rain-fed condition.

5.4.11 Livestock and Poultry

440. Livestock and poultry, being essential element of integrated farming system, play an important role in the economy of Polder. 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, a practice that significantly reduce poverty through generating income and employment. The numbers of livestock and poultry in the Polder area are presented in Table 5.33.

Table 5.33: Number of Livestock and Poultry of the Polder Area

Name of livestock/poultry	Present number
Cow/Bullock	14769
Buffalo	394
Goat	3938
Sheep	2462
Duck	20677
Chicken	24615
Total	**66854**

Sources: CEGIS estimated from DLS and field information; 2014

441. 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 were between 500 and 800. The overall farm management is good but food and fodder crisis occurs in the rainy season due to shortage in the market.

442. The owners of the livestock population face 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. Poultry population at family level survives by scavenging and generally, no feed supplements are provided. However, at times kitchen wastes become feed to the poultry.

Picture 5.22: Livestock (cow) in the Polder area

Picture 5.23: Livestock (buffalo) in the Polder area

Picture 5.24: Livestock (sheep) in the Polder area

Picture 5.25: Poultry (duck) in the Polder area

443. Productions of livestock and poultry are mainly constrained due to diseases and death of the population. Outbreak of disease causes 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), Sore neck (Gola fula), Black leg (Badla), Diarrhoea and Goat Peste Des Petits of 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, the soggy condition of the animal shelter promotes various kinds of diseases to the bullocks and cows.

5.5 Socio-Culture Environment

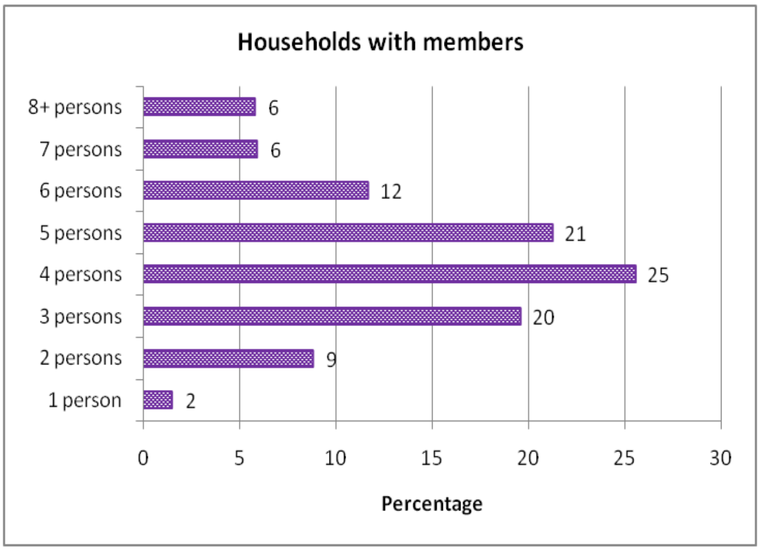
444. Baseline on the state of socio-culture environment is sketched out here for the entire polder. The polder covers mostly two unions named Lata Chapli and Dhulasar of Kalapara Upazila under Patuakhali district. The study area covers 6 mouzas and 49 villages, of which Lata Chapli has only one mouza and 27 villages whereas Dhulasar union has 5 mouzas and 22 villages.

5.5.1 Demography

445. The study area is the home of 44,168 people belonging to 9,846 households. Of the total population; 22,516 (51%) are male and 21,652 (49) are female. The average household size is 4.5, which is equal to the national average of 4.50 [BBS, (HIES) 2010[14]]. The average population density is 384 per square kilometer, which is lower than that of national average (1,055) (Housing and Population Census, BBS, 2011; CEGIS estimation, 2015[15]).

446. There are 673 ethnic populations in the study area belonging to 185 households. Of them, male populations are 336 and females are 337. Out of them, most of the populations are *Rakhain* comprising of 669 populations. Average household size of this ethnic community is 3.6 and sex ratio is 99.7.

447. Households with four members are the dominant category in the study area; 25% households belong to this category (Figure 5.22). Although average household size is 4.5, 45% households have 5 or more than five members.



Source: Housing and Population Census, BBS, 2011

Figure 5.22: Distribution of households comprising member in each

[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

5.5.2 Age Structure

448. The highest number of population (23%) in the study area belongs to the age category of 30 to 49 years old. The lowest 3% population belongs to 60 - 64 years category. Age groups of 0-14 years is defined as children, 15-24 years as early working age, 25-54 years as prime working age, 55-64 years as mature working age and 65 years and over as elderly people (source: World Fact Book, CIA[16]). This classification is important, as the size of young population (under age 15) would need more investment in schools, while size of the older populations (ages 65 and over) would call for more invest in health sector.

449. According to the international standards, the “economically active population” comprises all persons of either sex who furnish the supply of labour for the 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.

450. The population data, analyzed to ascertain the size of (potentially) active working population and it appears that 57% percent population who are in the age bracket of 15-64 can be classified under this category. Conversely, there are 43% population who are defined as economically inactive comprising of elderly people (6%) and children (37%) (Figure-5.24).

451. Estimating total dependency ratio[18], it is found as 75 in which child dependency ratio is 65 and aged dependency ratio is 11. It illustrates that total 75 persons are dependent on 100 labour forces in which 65 are children and 11 are elderly people.

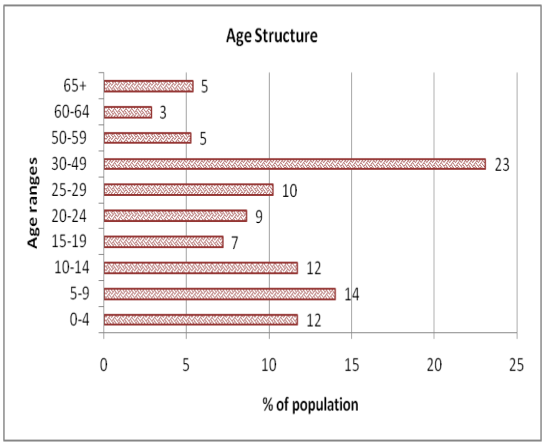


Figure 5.23: Age structure of the studied population

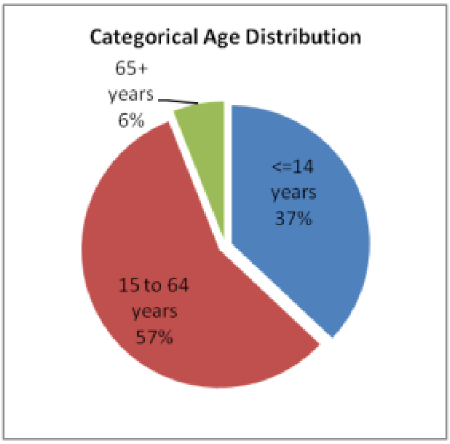


Figure 5.24: Categorical distribution of studied population

[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= $\frac{number\ of\ people\ aged\ 0-14}{number\ of\ people\ aged\ 15-64} \times 100$

Aged dependency ratio= $\frac{number\ of\ people\ aged\ 65\ and\ above}{number\ of\ people\ aged\ 15-64} \times 100$

5.5.3 Education

452. There are 19 government primary schools, 2 registered high schools, 2 Dakhil Madrasahs and one registered college[19] in Lata Chapli union. On the other hand, there are 7 government primary schools, 2 Dakhil Madrasahs and one registered college. Accessibility to these institutions is very much limited due to several reasons-such as poor communication facilities, higher poverty rate, inadequate health care and nutrition services etc.

453. School attendance rate is measured by BBS from 3 years to 29 years in six clusters of age groups. 3 to 5 years are defined as preschool attendance, 6 to 10 as primary, 11 to 19 years as secondary and higher secondary and finally 20 to 29 years as higher and advanced level attendance at educational institutions. Comparative picture of attending and not attending rate shows that net attendance rate is the highest (19.5%) at primary level after which the rate starts declining. The secondary level shows the threshold point from which not attending rate moves upward and attending rate starts sliding. This trend is true for higher as well as advanced level studies.

Picture 5.26: Educational institution in the Polder area

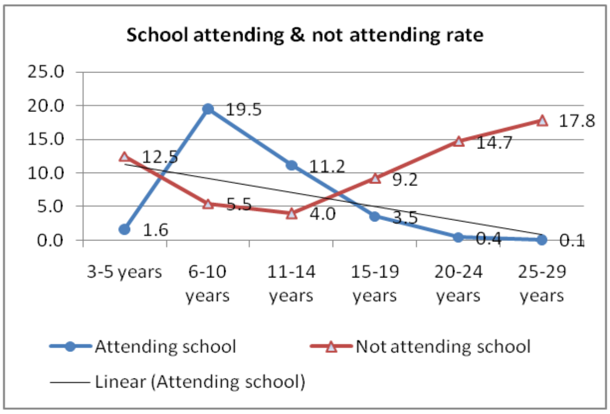


Figure 5.25: Portrayal of school attending and not attending rate in terms of age groups

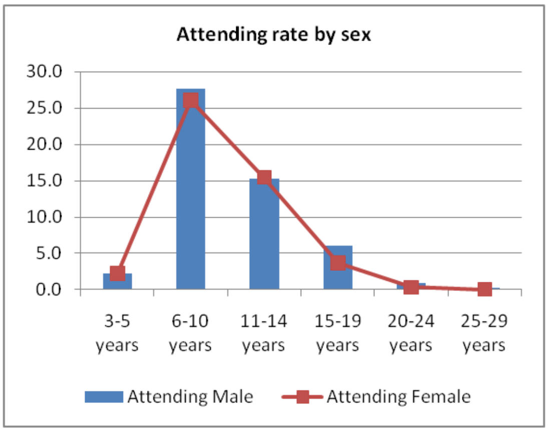
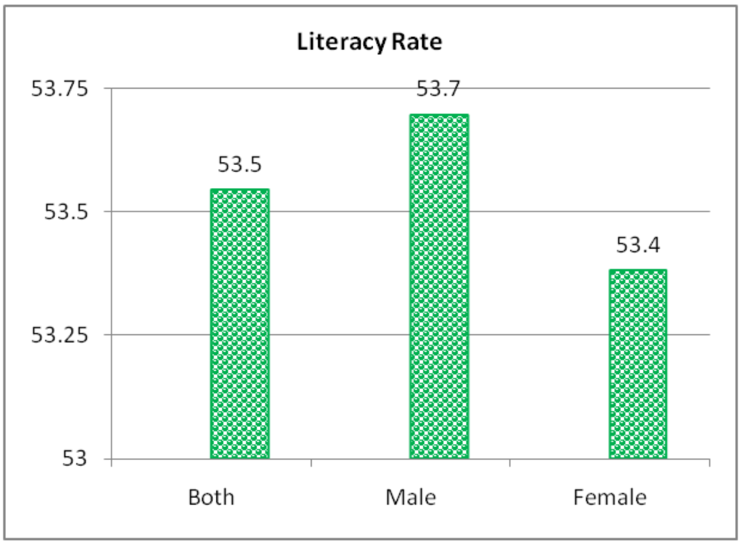


Figure 5.26: Comparative picture of male-female attendance rate

Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

19 Data retrieved from http://latachapliup.patuakhali.gov.bd/ and also verified in field visit.

454. Male-female attendance ratio is almost equal with a little difference at primary level in which female attendance is comparatively higher than that of males. Field findings confirm that female attendance at this stage is higher because of the existence of existing scholarship program, and the parents also consider this basic schooling as an investment for securing a good marriage of their girl child. It has also been observed and our data confirms that after completion of primary education, most of the girls get married and thus the attendance rate gradually starts decreasing. However, male attendance rate also starts decreasing due to their involvement in income generating activities. Prevalence of child labour in the study area is on average 2.0%, of which boys is 2.1% and girls is 1.3% (Source: Progotir Pathey, MICS, 2009). This rate is almost equal to those of national average. Field findings also proved that impoverishment of local people pushed them toward livelihood harnessing at their early age. Figure-5.27 depicts the literacy rate of the polder area.



Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

Figure 5.27: Literacy rate among the studied population

455. Literacy rate, based on the definition “ability to write a letter in any language” is 53.5%(while national literacy rate is little higher than 57.6%), where for male it accounts to 53.7% and female 53.4%. The rate of literacy reported above is for population of 7 years and over ages.

5.5.4 Public Health

Prevalence of diseases

456. Field findings show that waterborne diseases, coldness and fever are dominant diseases in the study area where tidal and rain water remains stagnant. This stagnant water bodies appeared to be the abode of mosquitoes that leads to prevalence of skin diseases due to itching after mosquito bites. However, during wet season waterborne 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 road 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 houses that increases coldness.

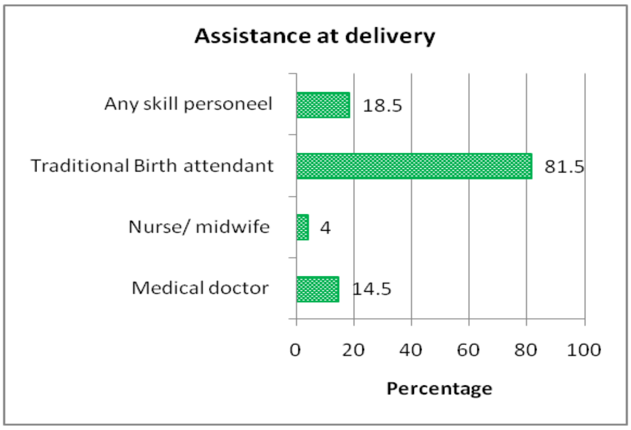
Access to health services

457. Access to health services and facilities refer to availability and adequacy of supply, affordability, physical accessibility and socio-cultural acceptability. Field data shows that there is one community clinic in the study area. Therefore, most of them are to receive health services from local chemists. Upazila Health Complexes (UHCs) located at Kalapara Upazila, which is far from the study area. People need to cross three rivers on boat and/or ferry to reach the UHC.

Child and Mothers' Health

458. Infant mortality rate (IMR) in the upazila is 44. IMR is defined as the number of deaths of infants under one year old per 1,000 live births. On the other hand, the under 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 the national average which is 49 for IMR and 64 for U5MR (source: Progoti Pathey, MICS, 2009). Although this scenario represents for entire upazila, italso occurred in both unions also. The child mortality occurrs due to malnutrition, lacking of trained attendants during delivery, and more importantly lack of health services due to poor communication and infrastructural facilities.

459. It is found in the entire upazila that about 89.60% women aged 15-49 years with a birth in the 2 years preceding the survey can breastfeed their baby within one hour of birth and about 98% 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 18.5% by skill personnel, about 14.5% by medical doctor and about 4% by nurse/midwife. Although the rate of delivery assistance by traditional birth attendant is higher but, peoples' tendency to consult with the skilled physician is also significant.



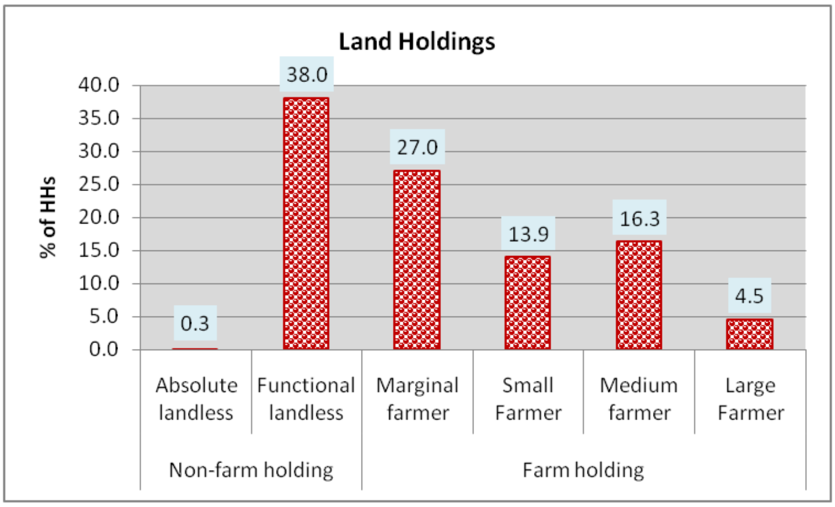
Source: Progotir Pathey, MICS, 2009

Figure 5.28: Percentage of women aged 15-49 with a birth by type of personnel assisting with the delivery

5.5.5 Ownership and Utilization of Land

460. The Census of Agriculture, 2008 conducted by BBS classified land holdings into two broad categories - one is farm-holdings and the other is non-farm holdings. A 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. The study area shows that out of total holdings 62% is farm-holder and the rest 38% is non-farm holders.

461. 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 cultivable. 38% households belong to functional landless category, who have land upto 0.04 acres. Among them 24.15% households have only homestead lands and 13.9% have homestead plus farm land within the limit of 0.04 acre. These households mainly own land adjacent to their homesteads and being used as kitchen garden, which are primarily used by the female members for household consumption.



Source: The Census of Agriculture, 2008, BBS

Figure 5.29: Households by land holdings

462. On the other hand, farm holding distribution shows that 27% households belong to marginal farmer (0.05 to 0.99 acre), 13.9% belong to small farmer (1.00 to 2.49 acre), 16.34% belong to medium farmer (2.5 to 7.49 acre) and 4.5% belong to large farmer (7.5+ acre) categories. It is evident that land fragmentation decreases the holding size therefore; large and medium farmers are gradually being converted to marginal farmers.

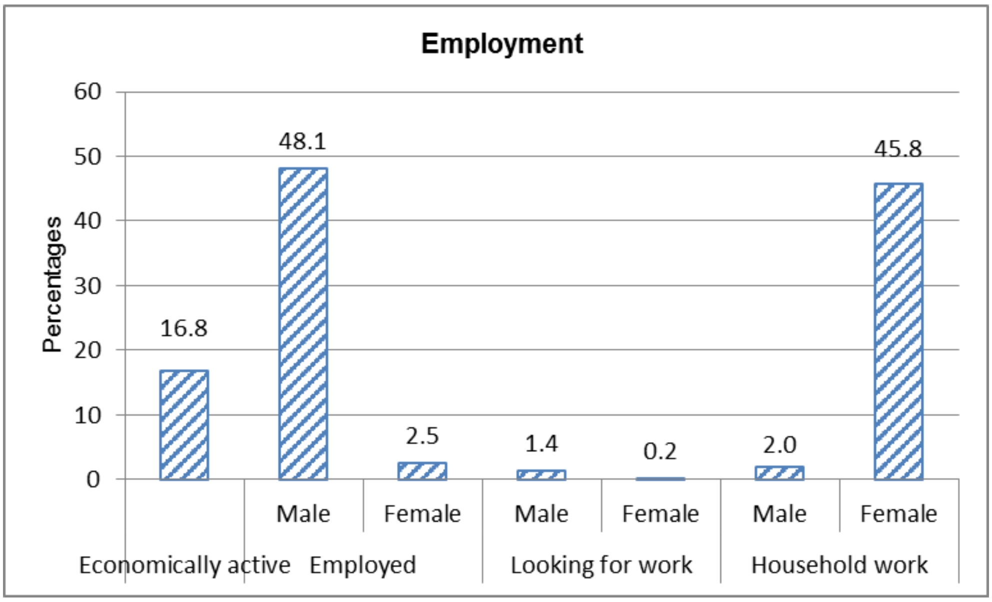
463. The entire land holdings can be categorized into three groups such as “owned land”, “land given to others” and “land taken from others”. It is found in the study area that about 70% holdings are under owned category; which means the land owned by holder including members of his/her family having 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 16% 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 or kind or both. About 14% holdings are found to be taken by the farmers from others in terms of sharecropping and/or lease on other terms (BBS, 2008).

464. 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 landowner gives land to the farmers. Conversely, farmers cultivate land with all input supplies except seeds. Both the farmers and landowners carry the cost of seeds in this condition. After harvesting, crops are distributed equally between the farmers and landowners. However, in *kot-kawla* system the landowners give land to others at Taka 2500 to 3000 per decimal. The receivers cultivate lands until the land owners repay his/her paid amount.

5.5.6 Occupations and Livelihoods

465. Out of total 44,168 population, 7,403 (16.8%) are economically active of which 3,744 (50.6%) are employed, 121 are (1.6%) looking for work, and 3,538 (47.8%) are engaged in household work. 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 children below 7 years, attending school population, physically challenged and elderly people who are not engaged in income generating works at reference period. Here household work particularly for women participation is accounted in terms of household activities as well as alternative income generation such as livestock rearing, poultry farming, etc.

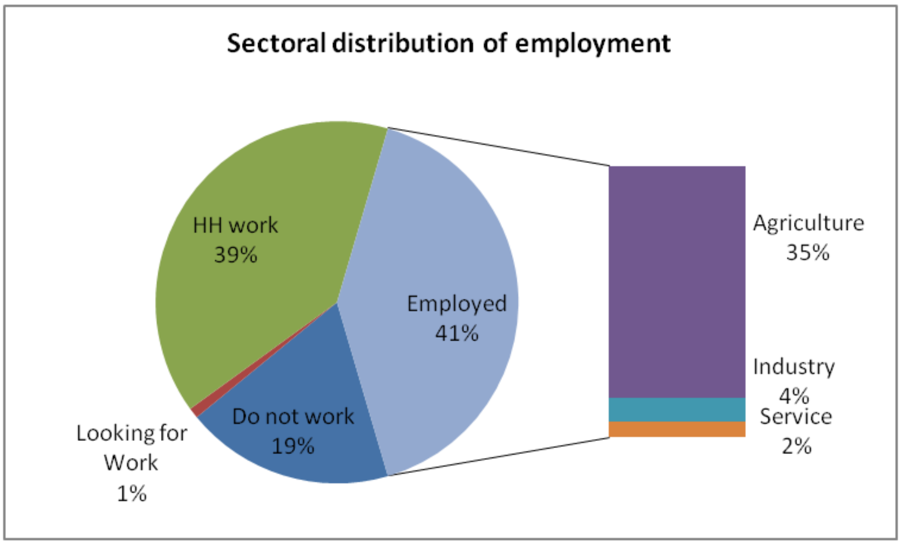
466. The education status confirms that the attending males are engaged in employment, females are getting married and in turn, contribute to the highest participation in household work (45.8%). Therefore, women participation in direct income generating activities (employed category) is negligible (2.5%). 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 sub-chapter 5.5.3 of education section.



Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

Figure 5.30: Employment status among the studied population

Distribution of employed population at reference period of the 2011 census shows that 32% are engaged in agricultural activities, 1% in industry and 7% in service. Agricultural activities includes broadly crop farming, fishery, livestock and poultry farming. It is evident that the study area is agrarian based as it provides mainstay of livelihood. Males are the main group dominating this sector. Females' are mainly involvement in service sector for income generation. Figure-5.31 shows the employment status of the polder area.



Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

Figure 5.31: Employment status by field of activities

5.5.7 Labor Market

467. The employment[20] rate[21] in the study area is 40.95 whereas the unemployment rate[22] is 59.04. It is evident that more than half of the total economically active population are still unemployed. Most of the unemployment populations are females who are solely involved in household works, and only 0.5% populations are looking for work.

468. Data confirms that agriculture is the main sector generating employment for the local people (see paragraph 5.4.7 of occupations and livelihood section). In agricultural sector, almost all labors come from the local villages. A nominal number of labors come from *Rangpur* district during harvesting time. A group of labors work under a *sarder*, each worker is provided with 350 Taka without food supplement and *sarder* receive taka 10 per labors.

5.5.8 Standard of Living

469. 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 having access to electricity, sanitation facilities, safe drinking water availability, housing condition and fuel consumption.

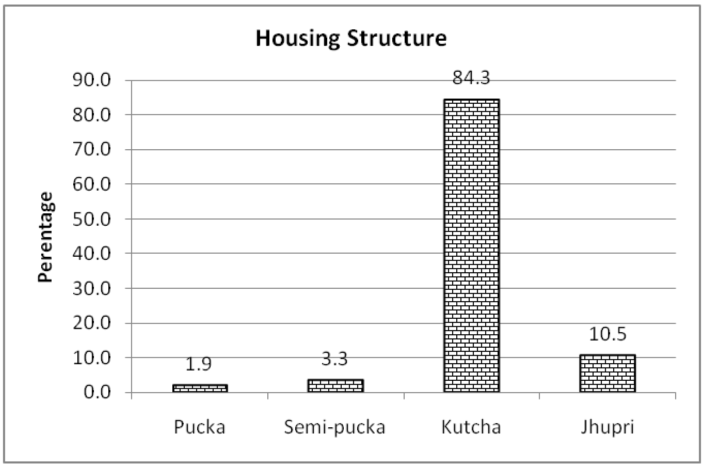
470. Data shows that only 26.7% households are under grid electricity coverage. Rural Electrification Board (REB) is the main electricity provider. The coverage of solar home system is found nominal in the entire study area.

[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 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 = $\frac{Employed\ Population}{Total\ labour\ force} X\ 100$

[22] Unemployment Rate= 100-Employment Rate

471. The study area shows the predominance of kutcha houses (84.3%) compared to other three types of houses such pucca, semi-pucca and jhupri. Only 3.3% houses are semi-pucca, 1.9% is pucca and 10.5% percent is still jhupri. Field data confirms that prevalence of extreme poverty push them to live in kutcha houses (Figure 5.32).

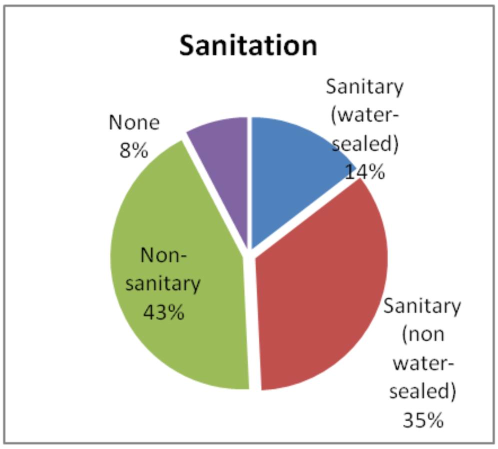


Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

Figure 5.32: Housing condition in the Polder area

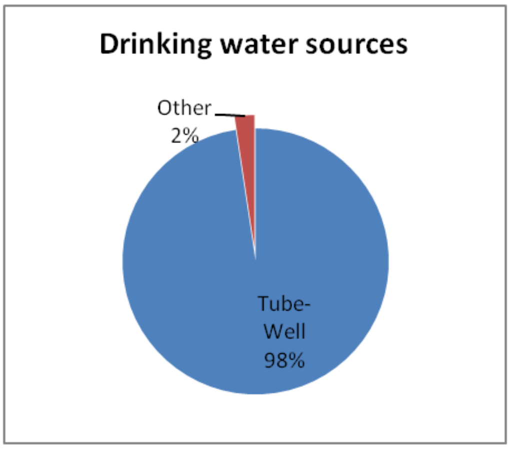
472. 43% households of the study area use non-sanitary latrines, 35% use non water-sealed sanitary latrines, 14% use sanitary water-sealed latrines and still 8% households have no sanitation facilities either owned or on shared basis. Field findings confirmed that non-sanitary latrines are predominant among kutcha houses. (Figure 5.33).

473. Collection of drinking water from tube-well is predominant (98%) throughout the study area. However, 2% households are still depending on open water bodies as sources of drinking water. These houholds are basically the poorest and have no access to tube-wells (Figure 5.34).



Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

Figure 5.33: Distribution of households by sanitation facilities



Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

Figure 5.34: Distribution of households by sources of drinking water facilities

474. Fire wood and husk of paddy are the only source of fuel consumption in the study area. People purchase firewood from saw-mill and use round the year. They also store chips during crop harvesting time for cooking in wet season. Poor people who cannot afford

usually collect leaves from neighbours' garden and also collect crop residue from paddy field.

5.5.9 Poverty

475. Poverty for the study area has been measured following the Multidimensional Poverty Index (MPI) method. The process is intended to indentify multiple deprivations at the household level in three broad dimensions such as education, health and standard of living. Alkire and Santos, 2010, describe the total 10 standard indicators along with threshold[23]. Of them, total eight indicators were selected for analyzing in this study based on data availability and accordingly adapted to the prescribed methodology (detail methodology in Appendix-1). The indicator and the thresholds for defining poverty are presented in the following table (Table 5.34).

Table 5.34: 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 drinking 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

476. Analyzing poverty status it is found that about 15% households are multidimensional poor (index value 0.15 out of 1= MPI). About 26% populations are living in these poor households (poverty head count=H) and on average 58% poor people are deprived of any indicator (intensity of deprivation=A).

Table 5.35: State of Multidimensional poverty

Dimensions	Indicators	Deprivation per indicator (%)	Contribution of deprivation in dimension to overall poverty (%)
Education	School attainment	22	48.9
	School attendance	26	
Health	Child mortality	4	8.8
Standard of living	Electricity	73	42.3
	Drinking water	2	
	Sanitation	86	
	Cooking fuel	88	
	Housing	98	

Source: CEGIS calculation, 2015

[23] Retrieved from http://hdr.undp.org/sites/default/files/hdr14_technical_notes.pdf

477. Illustrating the contribution of deprivation in dimension to the overall poverty, the highest deprivation (48.9%) is found in education dimension. Considering two dimension it is found that 22% household members have not completed at least six years of schooling, and 26% school-age children (up to grade 8) are not attending school.

478. The second highest deprivation is found in standard of living dimension (42.3%) as 86% populations have no access to improved sanitation facilities (water-seal sanitation), 98% are living on dirt floored households (considering kutcha and jhupri), 88% are using dirty fuel (considering all types of traditional fuel), 73% households have no grid electricity coverage and 2% households still collect drinking water from unsafe sources (ponds, river etc.).

479. In case of health, dimension only one indicator (child mortality) is considered as nutrition data are not available. It contributes 8.8% in the overall poverty as 4% children are found to die in the households within the five years prior to the survey (considering both IMR and U5MR).

5.5.10 Institutions and Infrastructure

Markets

480. There are four local markets called hat-bazaar throughout the study area. Of them, two are in *Lata Chapli* and the remaining two in *Dhulasar* Union. Most of the hat-bazaars are located near the embankment.

Transport network

481. Both *pacca* and *kutcha* roads are available in the polder area, although kutcha roads networks are dominant. There is a connecting road through the middle of the polder to the *Kuakata* Sea Beach. For communication, people are to use motorcycle, *Nosimon*, Bi-cycle, engine boat and bus. Bus services from Patuakhali and Barisal to Kuakata Sea Beach are also available.


Picture 5.27: Roadway in the polder area

5.5.11 Cultural Heritage/ Tourism

482. The second important sea beach namely "*Kuakata* Sea Beach" of Bangladesh is located near the Polder 48. Every year a substantial number of tourists visit the location. A number of hotel/motels have also developed inside the polder centering the beach.

483. Adjacent to this beach area, there is the largest assemblage of *Rakhaine* (ethnic population) population. There are also religiously important places called "*Misripara Boudhya Bihar*" *Misripara* Buddhist Temple and *Rakhain* Buddhist Temple. Furthermore, there is a reserve forest area called Char Gongamoti located in *Dhulasar* Union.

5.5.12 Social Structure

484. Agrarian social relation more or less exists in the study area, as agriculture is the predominant mode of production. Land owners belong to the highest strata and landless to the lowest. Although power structure was operated centering the land ownership in the past, the trend is now changing. The people who are linked with external power sources are now dominant in the rural power structure as well.

485. 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 performed by the women. In decision making both in society and family, males are the main contributors. Peoples reported that as female literacy rate is gradually increasing, they are now contributing, although trivial, in household income. Women are particularly employed in service sectors such as teaching, factory worker etc.

6 Environmental Impacts and Mitigation Measures

6.1 Preamble

486. 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 Intervention, which may cause potential environmental impacts during pre-construction, construction, and post-construction stages have been identified in Chapter 4. The project influence 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;
- Developed Polder drainage model 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 the 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;
- Offshore surveys comprising socio-economic status and environmental settings,
- Expert consultations, focus group discussions, and public consultations.

487. 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

488. 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 the pre-construction, 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 then 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;

489. The matrix is provided in Table 6.1. The negative impacts predicted in this manner are the 'unmitigated' impacts. Appropriate mitigation measures have been recommended as part of this EIA, 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 and social screening matrix (Unmitigated)

Project Phases and Activities	Physical									Social and Socioeconomic										
	Soil Erosion/Contamination	Air Quality	Surface Water Quality	Groundwater Quality	Water Availability and Consumption	Blocked Access Routes	Noise and Vibration	Flooding	Water logging and Drainage	Irrigation and Water Management	Vehicular Traffic	Agriculture and grazing land	Fish Habitat	Fish Migration	Stock Susceptibility	Natural Vegetation	Social Conflict	Communication	Livelihood improvement	Employment Generation
Design Phase and Pre-Construction Phase																				
Land Acquisition	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	HN	I	I	MP
Contractor Mobilization	MN	MN	MN	I	I	MN	MN	I	I	I	HN	MN	I	I	I	I	I	I	I	I
Construction Camp Establishment	MN	MN	MN	I	I	MN	MN	I	I	I	MN	MN	I	I	I	I	I	I	I	I
Construction Phase																				
Equipment / Material Transportation	MN	MN	MN	I	I	MN	MN	I	I	I	MN	MN	I	I	I	MN	I	I	I	HP
Operation of Construction Camp	HN	MN	HN	MN	MN	I	MN	I	I	I	MN	I	I	I	I	MN	I	I	I	I
Site Clearance	MN	MN	MN	I	I	MN	MN	I	I	I	MN	I	I	I	I	MN	I	I	I	I

Project Phases and Activities	Physical									Social and Socioeconomic										
	Soil Erosion/Contamination	Air Quality	Surface Water Quality	Groundwater Quality	Water Availability and Consumption	Blocked Access Routes	Noise and Vibration	Flooding	Water logging and Drainage	Irrigation and Water Management	Vehicular Traffic	Agriculture and grazing land	Fish Habitat	Fish Migration	Stock Susceptibility	Natural Vegetation	Social Conflict	Communication	Livelihood improvement	Employment Generation
Borrow and disposal area management	MN	MN	HN	I	I	MN	I	MN	MN	MN	MN	MN	I	I	I	I	I	I	I	I
Excavations of water channels	MN	MN	HN	I	I	I	I	MN	MN	MN	MN	I	HN	HN	HN	MN	I	I	I	I
Re-sectioning of Embankments	HN	MN	MN	I	I	HN	MN	MN	MN	MN	MN	MN	MN	MN	I	MN	I	I	I	I
Bank Revetment work	MN	MN	MN	I	I	HN	MN	MN	MN	MN	MN	MN	MN	MN	I	I	I	I	I	I
Installation/replacement/repair/demolition of Regulators	HN	MN	MN	I	I	HN	MN	HN	I	I	MN	I	MN	HN	MN	I	I	I	I	I
Demobilization	MN	MN	MN	I	I	MN	MN	I	I	I	HN	I	I	I	I	I	I	I	I	I
Operation Phase																				
Operation of Regulators	MN	I	HN	I	MN	I	I	HN	HP	MP	I	HP	I	MN	I	I	HN	HP	HP	LP
Repair and Maintenance	MN	I	MN	I	I	MN	MN	HN	MP	MP	MN	HP	I	MN	I	I	I	I	I	I
Monitoring	I	I	I	I	I	I	I	I	MP	MP	MN	I	I	I	I	I	I	I	I	I

Key: HN: High negative impact; MN: Moderate negative impact; I: Insignificant/negligible impact; HP: High positive impact; MP: Moderate positive i6.3

6.3 Impacts during Pre-Construction Phase

490. Site development involves the following activities:

- Mobilization of construction equipment, materials and vehicles
- Clearing of sites
- Construction of health and sanitation facilities, and
- Establishment of temporary construction yards and labor sheds with sanitation and safe drinking water facilities

491. The activities will cause the following environmental impacts

6.3.1 Site Environmental Management Plan

Impact

492. The activities that take place for construction camp and labor shed development are land cleaning, leveling of site and construction of temporary buildings. During site development activities, the polder may be potentially affected through air and water contamination, noise generation, safety hazards, hindrance to local communities and other relevant impacts. Map 6.1 shows the key locations in the Project area where these impacts are likely to take place. Mostly, all labor force facilities and sheds will be implemented in the peripheral of the embankment, which may affect the nearest five (05) educational institutions.

493. The significance of this unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Mitigation

494. The following mitigation measures will have to be implemented to address the above concerns:

- Contractor will prepare site establishment plan and obtain approval from the DCSC Consultant
- The approval of the location of temporary facilities will be obtained from the DCSC Consultant
- 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 safe distance from the communities
- Contractor will prepare and implement pollution control and waste management plans
- No untreated wastes will be released on ground or in water bodies
- 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.

Residual Impacts

495. The impacts associated with establishing the site facilities are likely to be adequately addressed, with the help of the above mitigation measures, and the significance of residual impact will be Low.

6.3.2 Increased Vehicular Traffic During Mobilization

Impact

496. During mobilization of construction, 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 in Alipur Bazar to Chapli Bazar road and Alipur Ferry terminal. Map 6.1 shows the key locations of the Project area where this impact is likely to take place. Three (03) important rural markets are located on BWDB embankment; Alipur Bazar (Ch. 2.338 km), Lakshmi Bazar (Ch. 9.42 km) and Chapli Bazar (Ch. 13.80 km) which will face traffic congestion.

497. Among these markets, *Alipur* Bazar is prominent because Dhaka – Kuakata highway passes through this Bazar. The section at the existing road is narrow (20~22 ft) because many shops are situated along the road side which occupied the right of way. Moreover, loading and unloading of goods for market creates traffic congestion and additional project-related traffic will aggravate this problem. Besides, this increased traffic may affect movement of students and guardians of five (05) schools and college including *Hatempur* Govt. Primary School (Ch. 1.50 km), *Khanabad* College (Ch. 3.88 km), Maitbhanga Primary School (Ch. 6.933 km), *Chapli* Primary School (Ch. 13.273 km) and Chapli High School (Ch. 13.44 km) which are located within 75 m to 100 m of BWDB embankment.

498. The significance of this potential 'unmitigated' impact has been assessed as Moderate to Major.

Mitigation

499. The following mitigation measures will be implemented to address the above concerns:

- The contractor will prepare a traffic management plan (TMP) and obtain approval from the DCSCconsultant. The TMP will be shared with the communities and will be finalized after obtaining their consent.
- The TMP will address the existing traffic congestion particularly at the Alipur Bazaar. Similarly, for school time. Project-related traffic will be minimized during the peak traffic hours (from 8 am to 1 pm).
- Ensure minimal hindrance to local communities and commuters
- Liaise with local communities and concerned authorities

Residual Impacts

500. With the help of the above mitigation measures, the impacts associated with establishing the site facilities are likely to be adequately addressed and the significance of residual impact will be Low.

6.3.3 Change of Land Use

Impact

501. Land would be needed to establish temporary facilities including construction camp (labor shed) and borrow pit areas. It is estimated that about 30 labor sheds would be constructed to establish temporary facilities for the rehabilitation works. All labor sheds would be constructed in the designated land.

502. The borrow pit areas mainly remain fallow during dry season. In wet season, these borrow pit areas are used for seedbed or grazing of livestock by the dwellers of the polder. The significance of this potential unmitigated impact has been assessed as Low on the basis of impact magnitude and receptor sensitivity. All borrow pits of the foreshore areas will be filled up within one or two years due to tidal inundation.

503. The significance of this potential 'unmitigated' impact has been assessed as Low.

Mitigation

504. The following mitigation measures will be implemented to address the above concerns:

- Established all the construction camps within the area owned by BWDB.
- Pay compensation/rent if private properties are acquired on temporary basis, which instructions should be specified in the tender documents.
- Construct labor shed/camp at government khas land/Non agricultural land

Residual Impacts

505. With the help of the above mitigation measures, the impacts associated with changes in land use are likely to be adequately addressed and significance of residual impact will be very Low.

6.3.4 Cutting of Trees

Impacts

506. Trees need to be felled to clear land for the construction of new sluice gates while trenching. The embankment slopes are vegetated with number of trees, herbs and shrubs. A large portion of the embankment is occupied by timber trees planted by the Forest Department (FD) under Social Forestry programme. Herbs and shrubs also will be damaged during site preparation for labour shed and stack yards. It is difficult to count the numbers of small plants/ bushy existing at the proposed sites. Small herbs and shrubs would re-grow naturally within 1 to 2 years after completion of the construction works but timber trees would need to be planted as a replacement. Wildlife affected will migrate to other suitable places. Following Table represents the total number of trees to be cut down for construction of the water control structures. The tree types and their numbers are in Table-6.2.

507. It is noted that the borrow pit is situated about 50 m from polder area wherefrom soil would be collected. So, there will be no damage on Gangamoti reserve forest during construction activities.

Table 6.2: List of trees to be cut for replacement of water control structures

Structure ID	Tree to be cut		
	Species Name	Scientific name	No. of trees
D/S – 1	Nim	*Azadirachta indica*	5
D/S – 2A	Nim	*Azadirachta indica*	5
	Tal	*Boassus flabelifer*	2
	Khejur	*Phoneix sylvestirs*	5
	Rain tree	*Samanea saman*	6
D/S – 3/1	Akashmoni	*Acacia auriculiformis*	8
	Raintree	*Samanea saman*	3
	Kola	*Musa sp*	5
	Babla	*Acacia nilotica*	5
	Payara	*Psitium guajava*	2
	Narikel	*Cocos nucifera*	3
	Sobeda	*Manilkara zapota*	1
D/S – 3/2	No big tree		
D/S-3/3	Nim	*Azadirachta indica*	2
	Khejur	*Phoneix sylvestirs*	8
D/S-3/4	Khejur	*Phoneix sylvestirs*	5
	Babla	*Acacia nilotica*	6
	Tal	*Boassus flabelifer*	2
	Nim	*Azadirachta indica*	6
D/S-4	Babla	*Acacia nilotica*	10
	Khejur	*Phoneix sylvestirs*	2
	Jhau	*Casuarina equisetifolia*	4
D/S-5	Vant, Akand, Jiga(Bushy)		Medium
FS1	Babla	*Acacia nilotica*	12
	Ora	*Sonneratia caseolaris*	10
	Jhau	*Casuarina equisetifolia*	3
	Kola	*Musa sp*	5
	Khejur	*Phoneix sylvestirs*	2
	Tal	*Boassus flabelifer*	3
FS2	Kola	*Musa sp*	15
	Raintree	*Samanea saman*	3
	Khejur	*Phoneix sylvestirs*	8
FS3	Khejur	*Phoneix sylvestirs*	8
	Bushy (Herbs, Shrubs)		Medium
	Akashmoni	*Acacia auriculiformis*	5
	Bansh	*Bamboosa sp*	3
		Total=	**172**

Source: Socio-economic Survey conducted by KMC

Mitigation

508. The following mitigation measures will be implemented to address the above concerns:

- Notify the proper authorities (i.e.: Forest Department) in advance about tree felling
- Avoid vegetation damage as much as possible in selecting sites for labour sheds and material stock by using nearer fallow land or barren homestead yards
- Ensure proper implementation of afforestation on available land, primarily on embankments with local floral species after completion of construction works.
- Provide appropriate compensations 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 (The species will be locally suitable and not exotic)

Residual Impacts

509. With the help of the above mitigation measures, the impacts associated with establishing the site facilities are likely to be adequately addressed and the significance of the residual impact will be Moderate.

6.4 Impacts During Construction Phase

510. Reconstruction and rehabilitation of flood control embankment and water control structures will involve the following activities during construction phase:

- Mobilization of equipment, construction materials and vehicles
- Placement and compaction of earth for flood control embankment/sea dyke
- Embankment slope pitching and turfing
- Re-excavation of canals
- New construction/replacement of water control structures
- Disposal of canal excavated wastes andImplementing coastal afforestation

6.4.1 Damages of properties due to Project Intervention and Land Acquisition

Impact

511. It is estimated that about 9.04 ha of land would be acquired for implementation of the proposed interventions. The details of acquired lands are 1.12 ha of households, 0.90 ha of Vita/Highland, 6.24 crop land, 0.43 ha of orchard, 0.08 ha of wetland/ditch and 0.19 ha of commercially used land. The social network e.g somiti, club , party office will be affected. Therefore, the structure of the club will be re-located and their activies will also be hampered temporarily. Moreover, a total of 562 number of shops will be affected from which373 shops are operating their business by themselves while 189 shops are running their business as tenants. As a result, 562 households will loss their bussines and their daily imcome will be declined. The proposed polder will be developed through retirements of embankment at a number of segments, and constructing water regulatory structures. Presently, Planning and Design consultants along with KMC have prepared Land Acquisition and Resettlement Action Plan as per guidelines of acquisition and requisition of immovable property ordinance,

1982 (Ordinance II of 1982). 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 the 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. The details of the damages due proposed rehabilitation of polder 48 are presented in Tables 6.3 to 6.7

Table 6.3: Land to be Acquired in the Polder

Type of land use	Quantity (ha)
Homestead	1.12
Vita/ Highland	0.90
Crop land	6.24
Orchard/ Forest land	0.43
Wetland/ Ditch	0.08
Fallow	0.08
Commercially used	0.19
Total	9.04

Source: Socioeconomic survey conducted by KMC in Dec 2011-Feb 2012 and revised, 2016

Table 6.4: Primary Structures to be Affected in the Polder

Description	Covered Area (square feet)
Pucca (made of bricks and mortar)	14998
Semi pucca	25670
Tin	261210
Kutcha	60949
Thatched	62052
Total	**424,879**

Source: Socioeconomic survey conducted by KMC in 2016

Table 6.5: Secondary Structures to be Affected in the Polder

SL No	Description	Quantity
01	Pucca Floor (sft.)	7927.72
02	Gate (sft.)	1556.61
03	Billboard/Signboard (sft.)	483
04	Mehrab (sft)	74
05	Nameplate (sft.)	73.06
06	Boundary wall (rft.)	3237.27
07	Drain (rft.)	14
08	Bench (rft.)	68.17
09	Grave wall (rft.)	301
10	Stairs of House (rft.)	283.01
11	Tin made Boundary wall (rft.)	56

SL No	Description	Quantity
12	Pacca Latrine (Nos.)	42
13	Slab Latrine (Nos.)	334
14	Kutcha Latrine(Nos.)	55
15	Tube Well (Nos.)	95
16	Pillar (Nos)	124
17	Motor(Nos)	6
18	Machine(Nos.)	27
19	Septic Tank (Cft.)	990
20	Water Tank (Cft.)	56
21	Place of Tank (Cft.)	124.14

Source: Socioeconomic survey conducted by KMC in 2016

Table 6.6: Trees to be Affected in the Polder

Types	Big	Medium	Small	Plant	Total
Fruit trees (nos.)	2,899	2,738	6,197	5,593	**17,427**
Timbers trees (nos.)	2,933	5,391	30,603	4,565	**43,492**
Medicinal (nos.)	53	275	2,178	2,248	**4,754**
Banana (nos.)	4,910	3,936	2,957	3,099	**14,902**
Bamboo (nos.)	2,942	4,743	4,450	2,196	**14,331**
Total	**13,737**	**17,083**	**46,385**	**17,701**	**94,906**

Source: Socioeconomic survey conducted by KMC in 2016

Table 6.7: Common Properties to be Affected in the Polder

Description	Quantity (Nos)
School/Pathshala	3
Govt. Office	7
Mosque	16
Mondir	2
Pagoda	1
Grave Yard	1
Madrasha	3
Somiti	5
Club	6
Party Office	2
Majar	1
Tubewell	3
Private Organization	15
CEIP-1 Embankment Protection Group	2
EPG	1
Public Toilet	1
Total	**69**

Source: Socioeconomic survey conducted by KMC in 2016

512. The significance of this potentially ‘ unmitigated’ impact has been assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation

513. The following mitigation measures are to undertaken to address the above concerns:

514. 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 181 latrines and ten tube wells will have to 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 the communities.
- Grievance Redress Mechanism (GRM) will have to be established.
- Follow 'Find Chance' procedures for common properties resources.
- Follow the social networks to resettle the affected households due to project implementation.

Residual Impacts

515. 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 is considered to be Moderate.

6.4.2 Hindrance for Pedestrians and Vehicles Movement During Re-sectioning of Embankment

Impacts

516. Construction activities, i.e. re-sectioning of embankment and sea dyke will cause temporary disturbance in the movement of the tourists and local people particularly at Kuakata beach area from Ch. 29.50 km to 31.50 km. Tourism is the integral part as well as the main source of income of the local people, which may be severely affected by the construction activities. Besides, four (04) important rural markets are located on BWDB embankment; Alipur Bazar (Ch. 2.338 km), Lakshmi Bazar (Ch. 9.42 km), Chapli Bazar (Ch. 13.80 km) and Kuakata bus stand Bazar (Ch. 30.50 km). These markets, mainly Alipur and Kuakata bus stand Bazar play important roles by providing source of livelihood of the Polder inhabitants as well as meeting the daily needs of the people. During haat day and marketing time, all stakeholders use the embankment as road for carrying their goods for buying and selling and other purposes. Re-sectioning of the embankment and sea dyke may disrupt the markets and other relevant activities.

517. The significance of this potentially 'unmitigated' impact has been assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation

518. The following mitigation measures are to undertaken to address the above concerns:

- The embankment works will be carried out in segment wise and soil will be placed linearly on half of the embankment, leaving the other half to be used as public transportation. When the works on the first half are completed, it will be opened for local traffic and the works 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 if available 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; and
- Earth work for re-sectioning of embankment during haat day can be shortened for easy movement of the local people;

Residual Impacts

519. With the help of the above mitigation measures, the impacts are likely to be adequately addressed and the significance of residual impact will be Moderate.

6.4.3 Generate Noise and Vibration

Impact

520. 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 for the Project activities. Therefore, sensitive receptors including five schools and college, which are located within 75m to 100 m of embankment are likely to be more severely affected. The students of these schools may face serious noise and vibration problem during school hours (8:00 am to 1:00 pm). Table 6.8 shows the noise level to be expected from the equipment. According to ECR'97 60 dBA is applicable for mixed area in Bangladesh.

Table 6.8: Noise level expected from the equipment

Sl.	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: CEIP report, 2013

521. The significance of this potentially 'unmitigated' impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Mitigation

522. The following mitigation measures will have to be implemented to address the above concerns:

- Demolition of the regulators will not be carried out during the school hours (8 am to 1 pm) particularly near the schools;

- Restricting/limiting 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, as needed;
- Provision of PPE (ear muffs and plugs) to labor;
- The construction crew will be instructed to use proper and quality equipment, to minimize noise levels;
- Camps will be located at safe distances from the communities; and
- Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.

Residual Impacts

523. With the help of the above mitigation measures, the impacts associated with noise and vibration are likely to be adequately addressed and the significance of residual impact will be Low.

6.4.4 Soil and Water Contamination due to Wastes

Impact

524. Construction materials, demolition debris, fuel both from transportation vessel and construction machinery (piling machine, pump, etc.) may degrade the soil and water quality. The construction workers will generate domestic solid wastes and wastewater including sewage. The amount of domestic waste water 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 the workshops. The stores and warehouses will generate solid waste such as empty cement bags, cardboards and wooden crates. Improper disposal of these waste streams can potentially contaminate the soil 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, which is necessary for promoting photosynthesis of aquatic plants.

525. The significance of this potential 'unmitigated' impact has been assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation

526. The following mitigation measures will have to be implemented by the contractor to address the above concerns:

- 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 close to waterbodies;
- 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 machineries, vehicles, boats, launches, and barges. Contractor will regularly monitor the condition of its fleet;
- Materials 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 the communities and drinking water sources;
- Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal);
- Not to release any untreated wastes on ground or in water bodies
- Recycle spoil and excavated material as and where possible;
- Dispose spoil at designated areas with the consent of the community and
- Construction material, demolition debris and excavated soil/silt will not be allowed to enter water bodies.

Residual Impacts

527. With the help of the above mitigation measures, the impacts associated with soil and water contamination are likely to be adequately addressed and the significance of residual impact will be Low.

6.4.5 Sedimentation

Impact

528. Borrowing material from the river banks may potentially cause increased sediments in the rivers. Similarly, excavation of water channels (0.26 Mm^3 spoils) if carried out in water can potentially increase their sediment load. Excavated material from the channels if left along their banks may again enter into 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 in them. Run off from construction sites, camps and other temporary facilities may enter water bodies increasing their sediment load.

529. The significance of this potential 'unmitigated' impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity (see Table 6.11).

Mitigation

530. The following measures will have to be implemented to address the above concerns:

- Contractor will protect untreated embankment slopes;
- Contractor will excavate channels after dewatering the same (in case of manual excavation);
- 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 materials from river banks in such manner so that there is no increased siltation in rivers and will not leave any loose soil after excavation.

Residual Impacts

531. With the help of the above mitigation measures, the impacts associated with sedimentation are likely to be adequately addressed and the significance of residual impact will be Low.

6.4.6 Effects on Agriculture Crop Production

Impact

532. During collection of earth from the borrow pit areas no agriculture land would be impacted in the Polder area. All spoil earth would be collected from offshore area through manual excavation and river bed of *Andharmanik* River on the west, *Ramnabad* River as well as *Alipur khal, Khajur para khal, Loxir khal, Nayapara khal, Tolatoli khal* and *Char Chapli khal,* etc., through dredging. In addition, construction activities, movement of construction machinery, project related vehicular traffic, material borrowing, material stockpiling, waste disposal or camp establishment may damage crops or affect the cultivated 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 afterwards.

533. The significance of this potential unmitigated impact has been assessed as Medium based on impact magnitude and receptor sensitivity.

Mitigation

534. The following mitigation measures will have to be implemented to address the above concerns:

- Compensation would be made for crop damages if the cultivable land is required for the movement of construction machinery and other activities ;
- Contractor would avoid cultivable fields during construction;
- Contractor would avoid agricultural land for material borrowing, material stockpiling and labor camps;
- Dredged materials to be tested for contamination, if there are no toxic materials only then the dedged material may be used. A toxic material containment plan should also be prepared by the contractor;

- Contractor would ensure that no vehicular movements take place through the cultivable fields;
- Contractor would ensure that no material is dumped in the cultivation fields; and
- Contractor would maintain liaison with the communities;

Residual Impacts

535. With the help of above the mitigation measures, the impacts associated with loss of agriculture are likely to be adequately addressed and the significance of residual impact would be Low.

6.4.7 Irrigation

Impact

536. Construction activities particularly in repairing of drainage sluices (4 nos.) 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.

537. The significance of this potential 'unmitigated' impact has been assessed as Major based on impact magnitude and receptor sensitivity.

Mitigation

538. The following mitigation measures will have to be implemented to address the above concerns:

- Contractor would construct temporary bypass canal before construction/replacement of each regulator;
- Sequence of work for the regulators and the water channels would be carefully planned to avoid irrigation disruption;
- Contractor would ensure no negative impacts on crop irrigation;
- Contractor would maintain liaison with communities; and
- Contractor would work during dry season.

Residual Impacts

539. With the help of the above mitigation measures, the impacts associated with disruption of irrigation are likely to be adequately addressed and the significance of residual impact would be Low.

6.4.8 Feeding, Nursery and Spawning Ground of Fish Habitat

Impact

540. Nine (9) khals have been found as the fish feeding, nursery and spawning ground in the Polder (Table 6.9). It is supposed that due to the activities of re-excavation of (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 6.9: Use of fish habitat (khals) by some major fish species

Sl	Intervention	Habitat	Age Class
1	DS-1	Kuakata Khal	Nursery and Feeding
2	DS-2A	Taherpur Khal	Nursery and Spawning
3	DS-3/1	Loxir Khal	Nursery, Feeding and Spawning
4	DS-3/3	Tola Toli Khal	Nursery and Feeding
5	DS-3/4	Char Chapali Khal	Feeding and Spawning
6	DS-4	Kauar Char Khal	Nursery, Feeding and Spawning
7	DS-5	Koloipara Khal	Nursery and Feeding
8	FS-2	Goram Khola Khal	Nursery, Feeding and Spawning
9	FS-3	Naya Para Khal-02	

Source: CEGIS Field Survey, 2015

Mitigation

541. The following mitigation measures will have to be implemented to address the above concerns:

- Earth work should be conducted during the dry season
- Sequence of work on the khals 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

542. With the help of the above mitigation measures, the impacts on spawning and nursery ground are likely to be adequately addressed and the significance of residual impact will be minimized.

6.4.9 Fish Migration Behavior

Impact

543. Nine (9) drainage sluice gates are proposed to be replaced by new ones, which will regulate the water availability and water quality of the associated khals. These khals are found to be used as the feeding, nursing, spawning and even breeding ground by different fish species in different seasons (Table 6.10). 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) the migration behavior of the following fish species towards feeding, nursing, spawning and breeding might somewhat be hindered (in the dry season) or fully hampered (in the rainy season). 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 6.10: Future migration scenarios towards the use of fish habitat (khals) by some major fish species

Sl	Fish Species	Habitat	Purpose	Remarks for Construction Phase
1	Bagda	Kauar Char Khal	Feeding	Somewhat hampered
2		Koloipara Khal		
3		Kuakata Khal		
4	Bata	Loxir Khal	Nursing	Hampered (if conducted in rainy season)
5	Batasi	Tola Toli Khal		
6	Bele	Kuakata Khal		
7		Loxir Khal		
8		Tola Toli Khal		
9	Boal	Taherpur Khal		
10	Chapila	Koloipara Khal	Feeding	Somewhat hampered
11		Naya Para Khal-02		
12		Tola Toli Khal		
13	Chitra	Kauar Char Khal	Nursing	Hampered (if conducted in rainy season)
14		Koloipara Khal		
15		Kuakata Khal		
16	Golda	Kauar Char Khal	Feeding	Somewhat hampered
17	Gulsha	Char Chapali Khal	Feeding and Spawning	Strongly Hampered (if conducted in rainy season)
18	Tengra	Goram Khola Khal		
19		Kauar Char Khal	Spawning	Strongly Hampered (in Boishakh-Ashar)
20		Koloipara Khal	Feeding	Somewhat hampered
21		Kuakata Khal		
22		Naya Para Khal-02		
23		Taherpur Khal	Nursing	Strongly Hampered (Ashar-Vadro)
24	Khorsula	Kauar Char Khal	Feeding	Somewhat hampered
25	Lal Chewa	Kuakata Khal		
26	Paissa	Goram Khola Khal	Nursing	Hampered (if conducted in rainy season)
27		Koloipara Khal		
28		Kuakata Khal	Feeding	Somewhat hampered
29		Loxir Khal	Nursing	Hampered (if conducted in rainy season)
30	Pheksa	Kuakata Khal		
31	Ram Tengra	Loxir Khal	Feeding and Spawning	
32	Tara Baim	Tola Toli Khal	Nursing	
33	Tit Punti	Char Chapali Khal	Spawning	Somewhat Hampered (in Boishakh-Ashar)
34		Goram Khola Khal		
35		Naya Para Khal-02		
36		Taherpur Khal		

Source: CEGIS Field Survey, 2015

Mitigation

544. The following mitigation measures will have to be implemented to address the above concerns:

- Replacement should be conducted during the dry season (December-January) for
- which contractor to be informed;
- Contractor might maintain liaison with experienced fishermen.

Residual Impacts

545. With the help of the above mitigation measures, the impacts on migration for spawning and breeding are likely to be adequately addressed and the significance of residual impact will be minimized.

6.4.10 Benthic Fauna

Impact:

546. 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 nine *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 6.11).

Table 6.11: 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

547. The following mitigation measures will have to be implemented to address the above concerns:

- Contractor will not release untreated wastes on soil or in water. and
- Contractor will carry out khal re-excavation in segment wise thus minimizing impacts on benthic fauna.

Residual Impacts

548. With the help of the above mitigation measures, the Project's impacts on benthic fauna will be somewhat reduced. After the construction phase, these resources are likely to be completely recovered gradually. The significance of the residual impacts has therefore been assessed as Low.

6.4.11 Stock Susceptibility to Catch

Impact

549. Re-excavations of water channels and Installation/replacement/repair of Regulators are two major activities of the proposed interventions in the Polder. 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

550. The following mitigation measures will have to be implemented to address the above concerns:

- Replacement should be conducted during the dry season (December-January); and
- Close monitoring should be conducted during the construction by local commercial fishermen under the supervision of DoF so that allowable biological catch can be ensured.

Residual Impacts

551. With the help of the above mitigation measures, the impact on stock susceptibility is likely to be adequately addressed and the significance of residual impact will be Low.

6.4.12 Impacts on Flora and Fauna

Activity: Re-sectioning of Embankment

Impacts

552. All the existing vegetation on both slopes of the Embankment during re-sectioning work would be damaged. Most of the plant (herbs/shrubs) species are either annual or biennial plants and grow seasonally and life span is not more than one-two years. Therefore, it is expected that the herbs and shrubs damaged at sites will be recovered within 1 to 2 years by natural regeneration. Existing big trees of the embankment slopes will not be felled in most of the cases. For each tree felled, will be replaced by planting three indigenous species saplings. For this reason, this negative impact is temporary and recoverable.

Mitigation

553. The following mitigation measures will have to be implemented to address the above concerns:

- Collect soil from barren land as much as possible; and
- Proper turfing should be made at slopes of the embankment with local grasses (i.e. *Durba* (*Cynodon dactylon*), *Mutha* (*Cyperus sp*) and ensure regular monitoring of turf grasses till they are matured.

Residual Impacts

554. With the help of the above mitigation measures, the impacts associated with re-sectioning of the embankment and will be Low.

Activity: Re-excavation of khals

Impacts

555. Re-excavation works will damage the existing aquatic flora and fauna of the proposed khals. In addition, existing bank line vegetations will be damaged due to dumping of soil along both sides of the khal. However, the temporary deterioration of the habitat quality during construction phase will be re-generated within 2/4 years by regenerating all existing aquatic plants. But vegetation composition will be changed due to change of khal depth and velocity. Abundance of free floating species will be low during monsoon for regular velocity and high during dry season. On the other hand, there is little scope of growing rooted floating plants inside the khals for the same reasons.

Mitigation

556. The following mitigation measures will have to be implemented to address the above concerns:

- Keep the deepest points of the khal untouched as much as possible;
- Create new habitat adjacent to the existing habitats before any re-excavation of the khals;
- Use the excavated soil in khal dyke re-sectioning;
- Use minimum land as much as possible for excavator/ labour movement; and
- Implement plantation along the dumping sites with indigenous plant species

Residual Impacts

557. With the help of the above mitigation measures, the impacts associated with khal re-excavation will have moderate residual impact that is expected to further mitigate successively within few years by natural regeneration of marginal plants.

Activity: Implementing coastal afforestation

Impacts

558. 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 due to accumulation of plant or plant shoots. Inadequate distance between two saplings may hinder proper growth and caused disease outbreak.

Mitigation

559. The following mitigation measures will have to be implemented to address the above concerns:

560. 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 dumped or burnt in proper way;
- Care should be taken for physical and biological control of plant disease while nursery raising and sapling plantation (i.e.: use of disease free seeds, proper treatment of nursery soils, use appropriate doses of pesticides and fertilizers);
- Pre consultation with Forest Department, BWDB and other related non-government organizations for selecting suitable species including vetibver grass for plantation and spacing of the saplings.
- Develop a pest management plan for the total afforestation activity; and
- Collect saplings from nearer natural and local source as much as possible.

6.4.13 Communication

Impact

561. A number of local people use the embankment as road for carrying their goods for buying and selling and 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 water ways.

562. Road communication system will be deteriorated during the construction period, it may create disturbance in local road communication during this phase. Therefore, suffering of people will emerge temporarily among the local people.

Mitigation

563. The following mitigation measures will have to be implemented to address the above concerns:

564. 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:

565. The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes.

566. Temporary arrangement of boat for navigation, and need to construct alternative way such as temporary footpath for road communication

567. 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.

568. Work schedule will be finalized in coordination and consultation with local representatives and communities.

569. Local routes will not be blocked as far as possible. If unavoidable, alternative routes will be identified in consultation with local community.

Residual

570. With the help of above mitigation measures, the impacts on the communication are likely to be adequately addressed and the significance of residual impact will be Low.

6.5 Impact during Post-Construction Phase

6.5.1 Impact on agrochemical use

Impact

571. At present, about 26 ha and 502 ha of land are under Boro and Aus rice cultivation. Presently, 140,116 kg of chemical fertilizers and 2,216 kg granular pesticide are required for cultivation Boro and Aus. In future without project, the cultivation cost and uses of pesticides would increased from the present situation due to farmers would desperate to cultivate more crops due to their increased demand of crops in adverse situation. 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.

572. This would allow expansion of area under irrigated cultivation of Boro and Aus varieties of rice to about 843 ha of which Boro and Aus area are 48 ha and 795 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 84,695 kg of chemical fertilizers and 1,348kg of granular pesticide would be required in future (Table 6.12). Runoff from such cultivation fields might potentially pollute the water bodies and even drinking water sources thus causing health hazards to the communities.

Table 6.12: Impact of agrochemical use in 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)	Future granular Pesticides (kg)	Future liquid pesticides required (ml)	Impact		
													Fertilizers (kg)	Pesticides (kg)	Pesticides (ml)
T. Aus(HYV)	502	257	4	700	129,014	2,008	351,400	795	293	204,315	3,180	556,500	75,301	1,172	205,100
HYV Boro	26	427	8	800	11,102	208	20,800	48	22	20,496	384	38,400	9,394	176	17,600
Total	**528**	**684**	**12**	**1,500**	**140,116**	**2,216**	**372,200**	**843**	**315**	**224,811**	**3,564**	**594,900**	**84,695**	**1,348**	**222,700**

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

573. The significance of this potential unmitigated impact has been assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation

574. The following mitigation measures will have to be implemented to address the above concerns:

- Capacity building and awareness raising of the farmers would be conducted regarding use 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

575. 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 Increased Crop Production and Cropped Area

Impact

576. Presently, total cropped area is about 5,826 ha of which rice cropped area is 4,581 ha and non-rice cropped area is 1,245 ha. On the other hand, total crop production would be 20,370 tons of which rice would be 10,333 tons (51%) and non rice will be 10,037 tons (49%). Adverse impact might occur due to siltation of river and drainage channels (Table 6.7).

Table 6.13: 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 (LV)	698	1.5	1,048	424	1.6	678	-370
T. Aus (HYV)	502	2.7	1,354	795	2.9	2,306	951
T. Aman (LV)	1,096	2	2,192	1,007	2.1	2,114	-78
T. Aman (HYV)	2,259	2.5	5,648	2,496	2.6	6,491	843
Boro (HYV)	26	3.5	91	48	4	193	102
Total rice	**4,581**		**10333**	**4770**		**11781**	1449
Orchard	45	13.5	602	56	13.5	752	150
S. Vegetables	234	12.5	2926	245	13	3,187	262
Chilli	197	1.25	247	353	1.3	459	212
Pulses	245	1.5	368	542	1.6	868	500
Potatoes	11	15.5	173	56	17	947	775
W. Vegetables	149	12.5	1,858	167	13	2,173	316
Spices	48	3.5	169	613	3.5	2,145	1976
Oil seeds	201	1.2	241	509	1.3	662	421
Watermelon	115	30	3,455	245	35	8,582	5,127
Total non rice	**1,245**		**10,037**	**2,786**		**19,776**	9,739
Grand Total	**5,826**		**20,370**	**7,556**		**31,557**	1,1187

Source: CEGIS Assessment based on field survey July, 2015

577. The cropped area would be changed if the project is implemented. The cropped area would be 7,556 ha of which rice cropped area would be 4,770 ha and non-rice cropped area would be 2786 ha. The crop production might be boosted up significantly under the FWIP condition. The total crop production would be 31557 tons of which rice would be 11,781 tons and non-rice would be 19,776 tons. The rice and non-rice production would be about 14% and 97% higher in FWIP than that of FWOP respectively. Rice production would be increased mainly due tore-excavation of khals, construction of structure and repair/replaced of structure with adoption of modern technology in crop production, change in cropping pattern etc. Crop production would be increase due to expansion of T. Aus (HYV), T. Aman (HYV), Boro (HYV), Orchard, Spices, Watermelon, summer vegetables and winter

vegetables cultivation area. Additional 1449 tons (14% higher) of rice and 9739 tons (97% higher) of non-rice would be produced in FWIP over FWOP (Table 6.10).

578. Agriculture production increase, reduction of drainage congestion, income generation is expected to improve the livelihood of the people

Enhancement

579. The following enhancement measures will have to 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. and
- Introduction of HYV/Hybrid crop cultivars along with crop diversification need to be practiced.

6.5.3 Reduced Fish Migration Time and Extent

Impact

580. Drainage sluice gates will be designed to control water for improvement of drainage system of the polder area. Sluice gates are mainly operated in order to meet the irrigation purpose. Thus, it would hamper the migration behavior of above mentioned fish species. Moreover, the extension of *Boal, Paissa and Gulsha, Tengra* would be very restricted with the replacement of the proposed drainage sluices (Table 6.14).

Table 6.14: Future probable migration status towards the use of different fish habitat by some major fish species

Sl	Fish Species	Habitat	Purpose	Remarks for Future Scenarios
1	Bagda	Kauar Char Khal	Feeding	May be Shifted
2		Koloipara Khal		
3		Kuakata Khal		
4	Bata	Loxir Khal	Nursing	
5	Batasi	Tola Toli Khal		
6	Bele	Kuakata Khal		
7		Loxir Khal		
8		Tola Toli Khal		
9	Boal	Taherpur Khal		
10	Chapila	Koloipara Khal	Feeding	
11		Naya Para Khal-02		
12		Tola Toli Khal		
13	Chitra	Kauar Char Khal	Nursing	Will be Shifted
14		Koloipara Khal		
15		Kuakata Khal		
16	Golda	Kauar Char Khal	Feeding	

Sl	Fish Species	Habitat	Purpose	Remarks for Future Scenarios
17	Gulsha Tengra	Char Chapali Khal	Feeding and Spawning	
18		Goram Khola Khal		
19		Kauar Char Khal	Spawning	
20		Koloipara Khal	Feeding	May be Shifted
21		Kuakata Khal		
22		Naya Para Khal-02		
23		Taherpur Khal	Nursing	Will be Shifted
24	Khorsula	Kauar Char Khal	Feeding	
25	Lal Chewa	Kuakata Khal		
26	Paissa	Goram Khola Khal	Nursing	
27		Koloipara Khal		
28		Kuakata Khal	Feeding	
29		Loxir Khal	Nursing	May be Shifted
30	Pheksa	Kuakata Khal		
31	Ram Tengra	Loxir Khal	Feeding and Spawning	
32	Tara Baim	Tola Toli Khal	Nursing	
33	Tit Punti	Char Chapali Khal	Spawning	
34		Goram Khola Khal		
35		Naya Para Khal-02		
36		Taherpur Khal		

Source: CEGIS Field Survey, 2015

Mitigation

581. The following mitigation measures will be implemented to address the above concerns:

- Sluice gates should be operated properly allowing fish migration in time. Details on the issue will have to be worked out before start of operation of sluices.
- Core commercial fishermen having more than 20 years experience should be appointed in Operation and Maintenance of sluice gates. and
- Provide training to WMOs, specially on fish migration of the polder area.

Residual Impacts

582. With the help of the above mitigation measures, the impacts on migration status are likely to be adequately addressed and the significance of residual impact will be minimized.

6.5.4 Increased Stock Susceptibility of Fish to Catch

Impact

583. Fishing activities are highly confined around the sluice gates of the proposed khals using *Badha*/Sluice *Jal* and *Jhaki Jal*. It is expected that installation of sluice gates will result

in increasing the stock susceptibility to fishing more than that of today (Table 6.15). Long term monitoring of fish catch assessment in canal and river is required to identify the real impact from the hydraulic structure operation activities.

Table 6.15: 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
Slightly Increased	Paissa
Increased	Tit Punti, Chitra, Bele, Chapila and Bagda
Highly Increased	Tara Baim, Pheksa, Khorsula, Golda, Boal, Batasi and Bata

Source: CEGIS Field Survey, 2015

Mitigation

584. The following mitigation measures will have to 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 determine the allowable biological catch.

Residual Impacts

585. With the help of the above mitigation measures, the impacts on stock susceptibility to catch are likely to be adequately addressed and the significance of residual impact will be Minimized.

6.6 Positive Impact of the Project

6.6.1 Change of land type

586. 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 and productivity. Presently, maximum 16% of the study area is under F_1 land type of the NCA which is followed by F_2 (19.7%), F_0 (10.2%) and FF (9.1%) land type (Table 6.16). 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_1, F_2, F_3 land type would be converted to FF and F_0 land type. F_1, F_2 and F_3 land type area could be reduced 51.9%, 19.5% and 0.10% respectively. According to Institute of Water Modellling (IWM) by around 31.4% & 40.1% would be under FF & F_0 land type which is followed by F_1, F_2 F_3 land type respectively.

Table 6.16: 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)	338	9.10	1505	40.50	31.4
F_0(0.0-0.30m)	379	10.20	1869	50.30	40.10
F_1(0.3-0.90m)	2,262	60.90	334	9.00	-51.90
F_2(0.90-1.80m)	732	19.70	7	0.20	-19.50
F_3(1.80-3.60m)	4	0.10	0	0.00	-0.10
F_4(>3.60m)	0	0.00	0	0.00	0.00
Total	**3,715**	**100**	3715	**100**	**0**

Sources: Feasibility report-Agriculture, CEIP, 2012 and IWM, 2015

6.6.2 Changing of Cropping Pattern and Intensity

587. Presently, cropping intensity of the polder area is 157%. 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 be encouraged to cultivate more crops in their lands. It is thus expected that cropping intensity would be 234% in the polder area in future **(Table 6.17).** So, cropping intensity of the polder area would be changed by around 77% from the base situation.

Table 6.17: Future cropping patterns of the Polder area

Land type	Kharif-I	Kharif-II	Rabi	Area	% NCA
	(March-June)	(July-October)	(Nov-Feb.)	(ha)	
High land(FF)	Orchard	Orchard	Orchard	56	1.5
	Fallow	T. Aman (HYV)	Spices	464	12.5
	T.Aus (LV	T.Aman (LV)	Pulses	316	8.5
	T.Aus (HYV	T.Aman (LV)	Chilli	353	9.5
	Fallow	T.Aman (HYV)	Vegetables	316	8.5
Sub-total				**1,505**	**40.5**
High land (F_0)	Fallow	T.Aman (HYV)	Potato	576	15.5
	Vegetables	T.Aman (LV)	Watermelon	245	6.6
	T. Aus (HYV)	T. Aman (HYV)	Oil seeds	401	10.8
	T.Aus (HYV	Fallow	Boro (HYV)	41	1.1
	Fallow	T.Aman (HYV)	Wheat	606	16.3
Sub-total				**1,869**	**50.3**
Medium High Land (F_1)	T. Aus(LV)	Fallow	Oilseeds	108	2.9
	Fallow	T. Aman(LV)	Pulses	93	2.5
	Fallow	T. Aman (HYV)	Pulses	134	3.6
Sub-total				**334**	**9**
Medium Low Land (F_2)	Fallow	Fallow	Boro (HYV)	7	0.2
Sub-total				**7**	**0.2**
Grand Total				**3,715**	**100**

Sources: Feasibility report-Agriculture, CEIP, 2012 and IWM, 2015

6.6.3 Enhanced Species Evenness

Impact

588. It is observed that previously more than 100 freshwater fish species were available in the project area. Moreover, it has been found that richness of species composition varies with khals, water of which are regulated by different sizes of drainage sluices. 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 Table 6.18.

Table 6.18: Future scenarios of Species evenness in the intervention specific fish habitat

Sl	Site	Remarks of Species Evenness
1	Char Chapali Khal	Slightly Increased
2	Goram Khola Khal	Highly Increased
3	Kauar Char Khal	
4	Koloipara Khal	Slightly Increased
5	Kuakata Khal	Highly Increased
6	Loxir Khal	Moderately Increased
7	Naya Para Khal-02	Slightly Increased
8	Taherpur Khal	Insignificant Change
9	Tola Toli Khal	Moderately Increased

Source: FGD and KII, CEGIS, 2015

6.6.4 Afforestation

589. Afforestation will mitigate the negative impacts. Consequently, foreshore plantation will enhance mangrove vegetation coverage surrounding the polder and is expected that the embankment will be protected from tidal surges, will reduce the erosion of foreshore land and provide habitats especially for local avifauna and fishes.

6.6.5 Cultural Heritage and Tourisam

590. The rehabilitation activities of the Polder 48 would protect the nember of hotel/motels which have been developed in the side polder centering the Kuakata Sea Beach as well as the religious temple from the tidal surges associated tidal flooding. The largest assemblage of Rakhaine (ethnic population) community as well as Religiously important places called “Misripara Boudhya Bihar”. Misripara Buddhist Temple and Rakhain Buddhist Temple will also be protected from the hazard. As a result, the tourist flow in the beach area will be increased in future and ecomomic activity in the polder area will be increased.

6.6.6 Employment Generation

591. 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 construction of the structures will create temporary employment opportunities for the labours. The employment generation represents

the different ways of livelihood by which people can generate their income and improve their living standard.

6.6.7 Social Conflict

592. In each of the drainage and flushing sluices local people use net for catching fish. In some cases, these nets are set permanently. The farmers stated that social conflict over this issue often appears between the fishers and the farmers. Farmers urged not to have any interruption on water movement in the polder area, whereas fishers intend to control water movement for the sake of catching fisheries. It is evident that the damaged and non-functioning drainage and flushing sluices encourages the fisher to control over water movement. However, it is anticipated that if these sluices are repaired and/or restructured the social conflict will be mitigated.

6.6.8 Livelihood Improvement

593. 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 remains broken. If the project is implemented, these problems will be solved and livelihood of local people will be improved. Additionally, any production will be increased if irrigation facilities are enhanced by the construction of flushing sluices.

6.7 Risk Assessment

6.7.1 Risk of Embankment Failure

Impact

594. The major causes of embankment breaching of the Polder 48 are rain splash, wave action and cyclonic storm surge. Inaccuracy of construction for side slopes, i.e., poor construction and lack of regular maintenance may create piping due to internal erosion, seepage and sliding and weaken the sensitive locations of the embankment/sea dyke where the set back distance is less than 75m to 100m. Mal-maintenance, increasing intensity and magnitude of the cyclone and storm surge simultaneously have accelerated the risk of embankment failure. The southwestern part of the polder area (from Ch. 29.00 to Ch. 33.70 km) at Thanju Para, Shutkipolli and Sarifpur Villages along the Bay of Bengal is more susceptible to breaches in near future due to storm surge and counter circulation of the cyclone.

595. The significance of this potential ‘unmitigated’ impact has been assessed as Major based on impact magnitude and receptor sensitivity.

Mitigation

596. The following mitigation measures will have to be implemented to address the above concerns:

- Regular monitoring and careful maintenance of the embankment, Sea dyke and existing water control structures especially Sea dyke along the south western part of the Polder will be ensured. This monitoring will particularly be carried out before and after monsoon season.

- The construction work will be completed accurately as per design.
- Available cyclone and flood shelter will be prepared as a contingency measure for emergency situation.
- WMG will develop a fund to cope with such of emergency situation. and
- Structural measures like geo bag and sand bag will be kept in the Upazila office for emergency use.

Residual Impacts

597. With the help of the above mitigation measures, the impacts associated with risk of embankment failure are likely to be adequately addressed and the significance of residual impact will be Low.

6.7.2 Cyclonic Storm Surge and Tidal Flooding

Impact

598. The existing peripheral embankment effectively protects the polder area from cyclonic storm surge and regular tidal flooding. However, a vulnerable location of sea dyke (from Ch. 29.00 km to Ch. 33.70 km) at Thanju Para, Shutkipolli and Sharifpur Villages may breach in near future and will be affected by tidal flooding. Besides, at present, almost all the water control structures are not functioning up to the desired level. During high tide, water enters into the polder area through damaged sluice gates and inundates about 7 to 8% of the total polder area including the northern part of Khajura, Gora Amkhola Para, Maitbhanga, Lakshmipara, Naya Misripara and eastern part of Tulatali villages. This is a localized problem and would be reversible through proper rehabilitation works, which have been considered in the Feasibility Study and Detail Design. If the proposed implementation works, i.e., slope protection of the sea dyke and replacing of all hydraulic structures are not implemented immediately, the problem will be further aggravated severely. If the aforementioned vulnerable location of sea dyke suffers from any failure or breach; about 114 ha of settlement with homestead vegetation, around 3200 numbers of inhabitants, about 11.95 ha are of sea dyke and internal road and approximately 350 to 370 ha of agricultural lands, livestock and natural resources will be severely affected to regular tidal flooding in future.

599. The significance of this potential unmitigated impact has been assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation

600. The following mitigation measures will have to be implemented to address the above concerns:

- Slope protection work along the Kuakata Sea beach should be constructed to protect tidal flooding during high tide, cyclonic storm surge and natural calamities.
- Seepage of surface waters from peripheral river through the regulators will be checked during dry seasons and necessary steps will have to be taken to control seepage, if any. and

- Afforestation program will be taken at both sides of the embankment, which will help more of reducing wind speed and surge impact on the embankment as well as to strengthen the embankment.

Residual Impacts

601. With the help of the above mitigation measures, the impacts associated with tidal inundation are likely to be adequately addressed and the significance of residual impact will be Low.

6.7.3 Drainage Congestion and Increased Sedimentation in Khals

Impact

602. A total of about 375 ha (7%) of the polder area has been suffering from moderate drainage congestion due to siltation of the internal khals and Mohipur khal. During monsoon, major internal khals cannot cope with the increased rainfall occurrences and drain out properly to the connected rivers which leading Moderate drainage congestion. In particular, the conveyance capacity of the *Mohipur* khal has been reduced over the years; as a result, it needs re-excavation from Naya Misripara to Char Chapali village, have been considered in the Feasibility Study and Detail Design. If the proposed re-excavation work and replacing of all hydraulic structures with adequate vent size is not implemented properly, the problem will worsen in future.

603. The proposed implementation works may improve the drainage congestion problem and rain water could be drained out properly during monsoon and regular tides. However, drainage congestion is a recurring problem and silt deposition in the rivers outside and water channels inside the Polder is likely to continue. Particularly, the low lying areas of the polder may face drainage congestion in the future.

604. The significance of this potential unmitigated impact has been as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation

605. The following mitigation measures will have to be implemented to address the above concerns:

- 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 unplanned development works. For this purpose, further research should be undertaken by the SRDI or Agriculture Extension Office 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 the farmers and the fishermen.

Residual Impacts

606. With the help of the above mitigation measures, the impacts associated with drainage congestion are likely to be mostly addressed and the significance of residual impact will be Moderate.

6.7.4 Salinity Intrusion

Impact

607. Presently, salt water enters into the polder area during dry season through the unprotected deteriorated water control structures (DS-1, DS-2A, DS-3/1, DS-3/2, DS-3/3, DS-3/4, DS-4, FS-2, and FS-3) causing damages to the soil, water resources and crop lands. The salinity concentration inside the polder area is found to be around 6.0~7.0 ppt *(sample taken in June 2015)* and local people mentioned it to be equivalent to the peripheral Mohipur khal during dry season and mainly affect the northern part of Khajura, Gora Amkhola Para, Maitbhanga, Lakshmipara, Naya Misripara, Tulatali and Char Chapli villages. This localized problem would be reversible and permanently prevented through proper rehabilitation works, which have been mentioned in the Feasibility Study and Detail Design. If the existing water control structures are not replaced, the internal khals *(Khejura khal, Goramkhola khal, Matiranga khal, Loxir khal, Nayapara khal, Tulatali khal, Char Chapali khal and Kurarchar khal)* prevailing with 6~7ppt salinity concentrations, may increase more than 10~12 ppt and this problem likely to intensified in future.

608. According to coastal polders experiences, mal-operation and leakage of regulators will also result in salinity intrusion. After completion of the project activities, if the operation and regular maintenance work is not been executed by BWDB, then salinity intrusion due to leakage of regulators will be initiated in future.

609. The significance of this potential unmitigated impact has been assessed as Major on the basis of impact magnitude and receptor sensitivity.

Mitigation

610. The following measures will be implemented to address the above concerns:

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 by the feasibility study team. These procedures will be translated in Bangla as well. and

Capacity building of WMOs will be carried out.

Residual Impacts

611. With the help of the above mitigation measures, the impacts associated with salinity intrusion are likely to be adequately addressed and the significance of residual impact will be Low.

6.7.5 Function of Water Management Association (WMA)

The Polder 48 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:.

- There is no water management association for operation and maintenance of the polder. It is felt that existing water management association should be reactivated to identify the problems of the polder and take appropriate measures. This could help to develop ownership of the WMA 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 deteriorated due to lack of necessary O & M budget and absence of active Water Management Association (WMA).

6.8 Summary of Assessed Impacts

612. A summary of these impacts and their significance discussed in the sections above is presented in Table 6.19.

Table 6.19: Significance of Negative Environmental 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									
Preparation of facilities for contractor(s) and labor force	Short term	Local	Reversible (after construction phase)		Certain	Medium	Moderate	• Contractor will prepare site establishment plan and obtain approval from the DCSC • The approval of the 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 safe distance from the communities • Contractor will prepare and implement pollution control and waste management plans • No untreated wastes will be released on ground or in water • Exhaust emissions from vehicles and equipment will comply with standards • Vehicles, generators 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)		
								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 to Major	• The contractor will prepare a traffic management plan (TMP) and obtain approval from DCSC. The TMP will be shared with the communities and will be finalized after obtaining their consent. • The TMP will address the existing traffic congestion particularly at the Alipur bazaar. Similarly, school time. Project-related traffic will be minimized during the peak traffic hours (from 8 am to 1 pm). • Ensure minimal hindrance to local communities and commuters	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)		
								• Liaise with local communities and concerned authorities	
Changes in land use	Short term	Local	Reversible (after construction phase)		Certain	Low to Medium	Low	• Establish all the construction camps within the area owned by BWDB. • Pay compensation/rent if private properties are acquired on temporary basis, which instructions should be specified in the tender documents. • Construct labor shed/camp at government khas land. • Avoid impacts on local stakeholders.	Low
Cutting of Trees	Sort term	Local	Reversible (after construction phase)		Certain	Low to Medium	Low	• Notify the proper authorities (i.e.: Forest Department) earlier about tree felling • Avoid vegetation damage as much as possible in selecting sites for labour sheds and material stock by using nearer fallow land or barren homestead yards • Provide appropriate compensations to the tree owners against tree felling specially for fruit yielding trees • Implement tree plantation at the damaged sites after	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)		
								completion of the construction works	
B. Construction Phase									
Damages of properties due to Project Intervention and Land Acquisition	Short term	Local	Irreversible		Certain	Medium	Major	• Compensation will be made prior to construction in accordance with RAP. • Contractor will maintain liaison with the communities. • Grievance Redress Mechanism (GRM) will have to be established. • Follow 'Find Chance' procedures for common properties resources.	Moderate
Hindrance for Pedestrian and Vehicle Movement	Short term	Local	Reversible		Certain	Medium	Major	• The embankment works will be carried out in segment wise and soil will be placed linearly on half of the embankment, leaving the other half to be used as public transportation. When the works on the first half are completed, it will be opened for local traffic and the works on the other half of the embankment will be undertaken; • Work schedule will be finalized in coordination and consultation with local	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)		
								representatives (Union Parishad Chairman & members) and communities; • Alternative road if available 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; and • Earth work for re-sectioning of embankment during haat day can be shortened for essay movement of the local people;	
Generate Noise and vibration	Short term	Local	Reversible (after construction phase)		Certain	Medium to high	Moderate	• Demolition of the regulators will not be carried out during the school hours (8 am to 1 pm) particularly near the schools; • Restricting/ limiting 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	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)		
								silencers; • Provision of noise barriers at schools and other sensitive receptors, as needed; • Provision of PPE (ear muffs and plugs) to labor; • The construction crew will be instructed to use proper equipment, to minimize noise levels; • Camps will be located at safe distances from the 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 machineries 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	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)		
								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 machineries, vehicles, boats, launches, and barges. Contractor will regularly monitor the condition of its fleet; • Materials 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 the communities and drinking water sources; • Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal); • Not to release any untreated wastes on ground or in water; • Recycle spoil and excavated	

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)		
								material as and where possible; • Dispose spoil at designated areas with the consent of the community and • Construction material, demolition debris and excavated soil/ silt will not be allowed to enter water bodies.	
Sedimentation	Short term	May extend beyond Polder	Mostly Irreversible		Likely	High	Moderate	• Small scale Tidal River Management (TRM) will have to be implemented where appropriate; • Contractor will protect untreated embankment slopes; • Contractor will excavate channels after dewatering the same; • 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 materials from riverbanks in such manner so that there is no increase	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)		
								siltation in rivers, and will not leave any loose soil these after excavation.	
Affects on agriculture crop production	Short term	Local	Reversible		Likely	Minor	Low	• Compensation would be made for crop damages; • Contractor would avoid cultivable fields during construction; • Contractor would avoid agricultural land for material borrowing, material stockpiling and labor camps; • Contractor would ensure that no vehicular movements take place through the cultivable fields; • Contractor would ensure that no material is dumped in the cultivation fields; and • Contractor would maintain liaison with the communities;	Negligible
Affects on irrigation	Short term	Local	Reversible		Likely	High	Major	• Contractor would construct bypass canal before construction/replacement of each regulator; • Sequence of work for the regulators and the water channels would be carefully planned to avoid irrigation disruption;	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 would ensure no negative impacts on crop irrigation; • Contractor would maintain liaison with communities; and • Contractor would work during dry season.	
Feeding, Nursery and Spawning Ground of Fish Habitat	Short term	Local	Reversible		Likely	Medium	Major	• Earth work should be conducted during the dry season (December-January) • Sequence of work on the khals will be carefully planned to minimize impacts on spawning and subsequently nursery ground of fish. and • Contractor will maintain liaison with experienced fishermen.	Medium
Impacts on Migration Behavior	Short term	Local	Reversible		Likely	Medium	Major	• Replacement should be conducted during the dry season (December-January); and • Contractor might maintain liaison with experienced fishermen.	Medium
Affects on benthic communities	Short term	Local	Reversible (in medium to long term)		Likely	Medium	Moderate	• Contractor will not release untreated wastes on soil or in water. and • Contractor will carry out khal re-excavation in segment wise thus minimizing impacts on	Low to medium

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)		
								benthic fauna.	
Increased Stock Susceptibility of Fish to Catch	Short term	Local	Reversible		Likely	High	High	• Replacement should be conducted during the dry season (December-January); and • Close monitoring should be conducted during the construction by local commercial fishermen under the supervision of DoF so that allowable biological catch can be ensured.	Medium
Impacts on Flora and Fauna	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 slopes of the embankment with local grasses (i.e. Durba (Cynodon dactylon), Mutha (Cyperus sp) and ensure regular monitoring of turf grasses till they are matured • Keep the deepest points of the khal untouched as much as possible; • Create new habitat adjacent to the existing habitats before any re-excavation of the khals; • Use the excavated soil in khal dyke re-sectioning;	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)		
								• Use minimum land as much as possible for excavator/ labour movement; and • Implement plantation along the dumping sites with indigenous plant species • All kinds of polyethylene bags and plastic ropes should be piled up in a pit for dumped or burnt in proper way; • Care should be taken for physical and biological control of plant disease while nursery raising and sapling plantation (i.e.: use of disease free seeds, proper treatment of nursery soils, use appropriate doses of pesticides and fertilizers); • Pre consultation with Forest Department and other related non-government organizations for selecting 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	

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)		
								much as possible.	
Interrupt communication	Short term	Local	Reversible (after construction phase)		Positive	Medium to high	Medium	• Temporary arrangement of boat for navigation, or to construct alternative way such as temporary footpath for road communication. • The construction of embankment will be carried out section wise and soil will be placed lineup on half of the embankment, leaving the other half to be used as 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. • Earth work for re-sectioning of embankment can be shortened for easy movement of local people. • All the works will be conducted in presence of Union Parishad Chairman and 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)		
								• Project Implementation Officer (PIO) will be informed during construction and completion of the 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, Sea dyke and existing water control structures especially Sea dyke along the south western part of the Polder will be ensured. This monitoring will particularly be carried out before and after monsoon season. • The construction work will be completed accurately as per design. • Available cyclone and flood shelter will be prepared as a contingency measure for emergency situation. • WMG will develop a fund coping with such of emergency situation. and • Structural measures like geo bag and sand bag will be kept	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)		
								in the Upazila office for emergency.	
Cyclonic storm surge and Tidal flooding	Long term	Local	Reversible		Likely	High	Major	• Slope protection work along the Kuakata Sea beach should be constructed to protect tidal flooding during high tide, cyclonic storm surge 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 have to be taken to control seepage, if any. and • 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	• 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 unplanned development works. For this	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)		
								purpose further research should be under by the SRDI or Agriculture Extension Office 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 the farmers and the fishermen. and • 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 by the feasibility study team. These procedures will be translated in Bangla as well. and • Capacity building of WMOs will be carried out.	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)		
Soil and water contamination (increased use of chemical inputs) and reduced soil fertility	Long term	Local	Reversible		Likely	High	Major	• Capacity building and awareness raising of the farmers would be conducted regarding use 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.	Moderate
Reduced Fish Migration Time and Extent	Long term	Local	Nor reversible		Likely	Medium	Moderate	• Sluice gates should be operated properly allowing fish migration in time. • Core commercial fishermen having more than 20 years experience should be appointed in Operation and Maintenance of sluice gates.	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)		
								and • Provide training to WMOs.	
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

613. "Analyses of Project Alternatives' will describe the consequential scenarios emerging with the project. These scenarios are plotted under 'with project' as well as 'no project' alternatives. The description will cover not only in case of environmental context but also socio-technical context.

7.1 'No Project' Alternative

614. According to last investigation report, Polder 48 has been found under threatening condition due to feeble embankments. The alarmingly deteriorating embankments of the Polder are being degenerated on account of continuous wave action. Already, few symptoms have been encountered at many points; it has become unfit to provide its valuable services. The 'No Project Alternative' elaborates the detail of consequences in the Polder towards various contexts since degradation continues. Furthermore, proposed interventions under CEIP-I along with its probable consequences are summarized correspondingly. Natural disaster such as cyclones, storm flows as well as mean sea level rise for global warming will aggravate the Polder condition. Table 7.1 shows these proposed interventions under the heading of 'no project' and 'with project' alternative.

Table 7.1: Comparison of 'No Project' and 'With Project' Scenarios

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
Re-sectioning of embankments (38.09 km)	The embankments will further deteriorate at a number of locations, and will drop below 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, will reduce the loss of lives and assets from natural disasters.
	Because of submergence of the embankments during monsoon, transportation system would be further deteriorated 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 to farmers from January to April (salinity intrusion) and May to August (flooding).	Re-sectioned embankments will provide enhanced protection to the Polder, facilitating enhanced agriculture activities and increased area for cultivation, thus increasing agriculture output.
	Continue silt deposition inside the Polder due to cyclonic surges and floods would be increased causing water logging, drainage congestion and other associated problems.	Decrease silt deposition in the Polder will result improved drainage and navigation in internal lakes/khals, increase usage of surface water for irrigation, and reduce water logging problem.

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
	Local farmers and labor will remain financially stressed. Livelihood opportunities will remain limited, and local people will migrate outside the Polder for employment.	Enhance agricultural activity will increase the demand of 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.
Slope protection (4.078 km) (1.70 km new + 2.378 km enhancement)	Continue the weakening of embankments; continuous subsidence of embankments due to traffic load and wave action; land resources would continue to be damaged/ lost.	Slope protection works will strengthen the embankments and protect them against subsidence, wave action, and wear and tear.
Construction (replacement) of 03 flushing sluices	Cultivable lands and irrigable lands will further decrease in future.	New flushing sluices will facilitate the availability of surface water, better control on irrigation during periods of low rainfall and will increased agricultural production.
Construction (replacement, repairing) of 09 flushing sluices	Continue 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.
Re excavation of Drainage Channels (41.045 km)	Depth of water bodies would further decrease, and drainage congestion and water logging will further increase.	Depth of water bodies will increase, water logging and drainage congestion will decrease and fish habitats will increase.

7.2 Site Selection Alternatives

615. 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 Table 2 under Appendix 2.

7.3 Technical, Financial, Economic, Environmental and Social Considerations of Selected Options

616. Steps are taken to assess the technical, financial, economic, environmental, and social considerations which are presented in Table 7.2 below:

Table 7.2: 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.

Intervention	**Considerations**			
	Technical	**Financial/Economic**	**Environmental**	**Social**
	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		
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 and repairing of existing drainage sluice with drainage-cum-flushing sluice and flushing sluices where needed	Better functional performance in both flushing and drainage; achieving the objectives of Polder and CEIP-1	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 would increase	Water logging, drainage congestion would be reduced	
			.	
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.

7.4 Alternatives during Construction

617. Alternative options of material stockpiling, material sourcing, manpower supply, required transportation, etc., which are the key factors of construction site. A discussion upon alternatives of the abovementioned factors is made consecutively.

7.4.1 Material Storage

618. Two alternative options can be suggested as alternative material storage 1) Inside the Polder; and 2) Outside the Polder. The first option would entail easy transportation of bulk materials from the sources; however, it would involve regular transportation of materials from the storage site to the work sites. 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.

7.4.2 Material Sources

619. The sources of construction materials will be explored at this point of study. The findings after analysis pointed out here.

Soil for Embankments

620. In order to renovate of embankments, a l extensive amount of soil will be required. The following options are available for sourcing this material:

621. Borrow pits must be taken into account as one of the main source of soil. A good volume of soil can be obtained from borrow pits on the bank of the river. Minimizing transportation requirement so as minimizing the cost the source has become a worthy alternative option. It has minimal negative impacts in borrwo pit areas. Because those pits will be filled up through sediment deposition within a season or two. It ensures minimum social and environmental impacts from excavation and transportation.

622. Another alternative option for obtaining soil is re-excavation of channels/khals. This option would minimize the excavation cost for borrow material if the material meets the required quality. Although transportation cost will be slightly more than the first option in addition to few environmental and social impacts, i.e., traffic congestion and air pollution, etc.

623. If riverside soil quality is not compatible for the embankments of the Polder, then the desired quality might be achieved from the river beds. This option would entail higher cost of material transportation and other social and environment related problems such as traffic congestion, air and water pollution.

624. The final decision of source of the material is still yet to be decided at this time. This decision will be taken during construction face of the project.

Sand

625. Sand is used to a large extent for repairing and renovating embankment, concreting works, and manufacturing concrete blocks for slope protection. Two alternative options are available for sourcing sand.

626. Sand can be acquired 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.

627. Riverbed can be another source of sand. 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 utilizing precious freshwater.

628. At this stage, the final decision regarding the source of sand has not been finalized. This decision is likely to be taken during the construction phase.

7.4.3 Alternatives for Workforce Procurement

629. Two alternative options are available for sourcing the manpower for the construction works. These are discussed below.

630. Major part of employee/ labourers is sourced from the inhabitants of Polder area, but only skilled and technical manpower are from outside. The option will reduce labor camp sizes, and decrease transportation need and associated environmental and social problems. This option will also offer employment opportunities for the local community. Thus increasing their economic condition and also increasing the local ownership of the project. In view of these advantages, this is the preferred option for manpower sourcing.

631. Employing major part of the manpower from outside of the Polder. This can create traffic congestion and air pollution requiring larger camps and labor transport. It may trigger resentment and ultimately possible resistance as consequence from the local community.

7.4.4 Alternatives for Mode of Transportation

632. Trucks are common vehicles within the Polder to transport all the construction materials to main stack yard. The materials will be carried from the main stack yard to the worksite not only by river and but also by road. The roadway status is not that favorable for larger vehicles, i.e. dump truck, trolley, excavator, etc., within the polder. Therefore, carrying of earth and other construction materials will be done by small carts, non-motorized vehicles, manual labor, etc. Small boats, trawlers are used to transport in case of waterways.

Waterways

633. The polder is encompassed by Andharmanik River to the west, Ramnabad River to the East, Bay of Bengal to the south and Mahipur Channel to the north. The Andharmanik is one of the larger coastal rivers and one of the main rivers of Kalapara Uazila in Patuakhali. In recent years the people of Kalapara have raised their concerns regarding the gradual drying up of the river. Total length of the river is around 40 kilometres. At least 25 kilometres have permanently been dried out due to the sedimentation and alluviums. In late 2013, since the government announced for establishment of a new deep sea port on the bank of Ramnabad river, the river has gained importance as the future economic hub of southern Bangladesh.

Roadways

634. The polder is located in *Kuakata, Kalapara* Upazila under Patuakhali District. The polder covers two Union Parishads. 1) *Latachapli* and 2) *Dhuleshwar*. Patuakhali *Kuakata* main highway road (R881) is the main conveyance of construction material to the site. Otherwise, Andharmanik River will be used as waterways.

8 Climate Change Impact

635. 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.

636. 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- 48 area

637. 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:

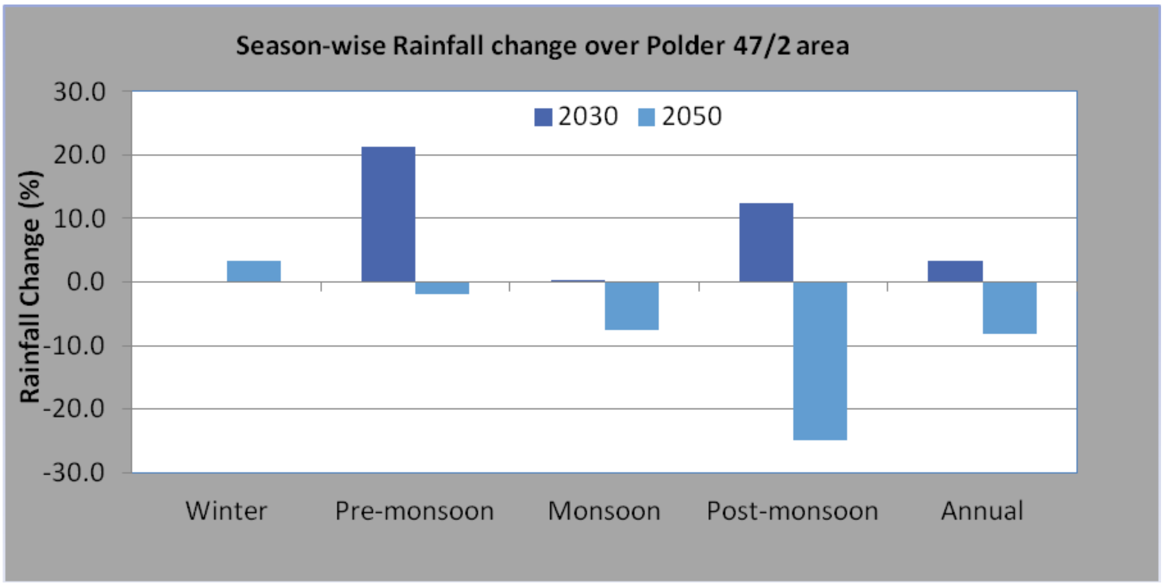


Figure 8.1: Change of seasonal rainfall (%) over Polder 48 area for the year 2030 and 2050, respectively

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 48is 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 48 is minus 8.2% for the year 2050.

8.1.3 Maximum temperature projections over Polder 48 area for RCP4.5 scenario

Year-2030: The maximum surface air temperature is predicted to increase by 0.2 - 1.2^{o}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^{o} C. On an average, the maximum surface air temperature is estimated to be increased by 1.4^{o}C for 2050 (Table 8.1).

8.1.4 Minimum temperature projections over Polder 48 area for RCP4.5 scenario

Year-2030: The minimum surface air temperature may change in 2030 by 0.6-2.1^{o} C with highest increase during winter season.

Year-2050: The minimum surface air temperature is predicted to increase 1.3-2.6^{o} 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 48 area for the year 2030 and 2050.

Scenario	Base line	Maximum Temperature Change(°C)												
		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(°C)														
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

8.2 Projection of sea level rise

638. According to IPCC AR5 Working Group 1 report, the Observed and projected relative sea level change in Bay of Bengal is presented in figure 8.5 (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.

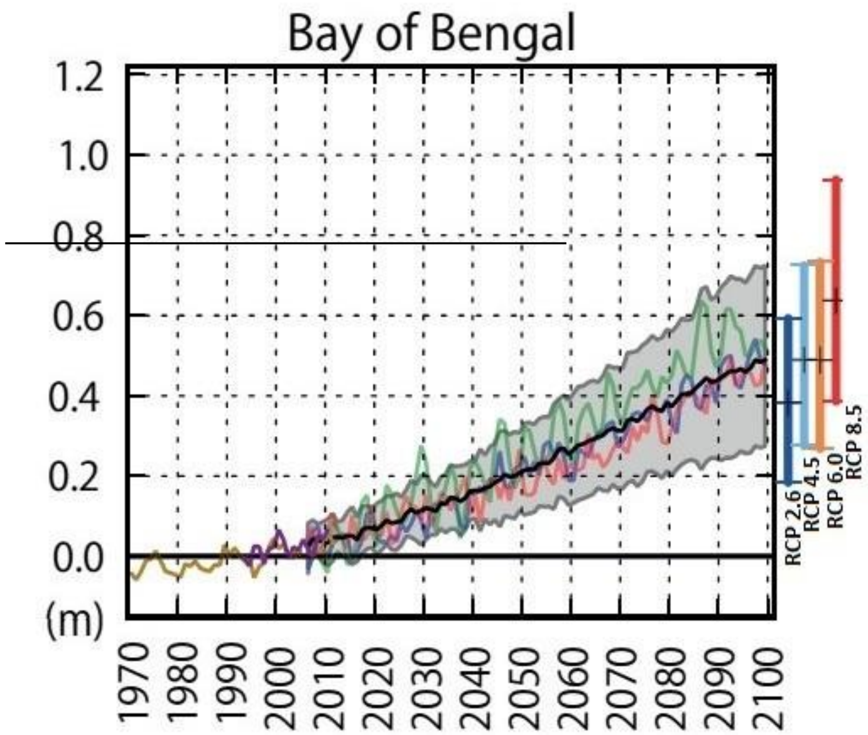


Figure 8.2: Sea level rise projections for Bay of Bengal

8.3 Projection of cyclonic storms

639. 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.

640. According to 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 8.6 shows the inundation risk map for 2050 under climate change.

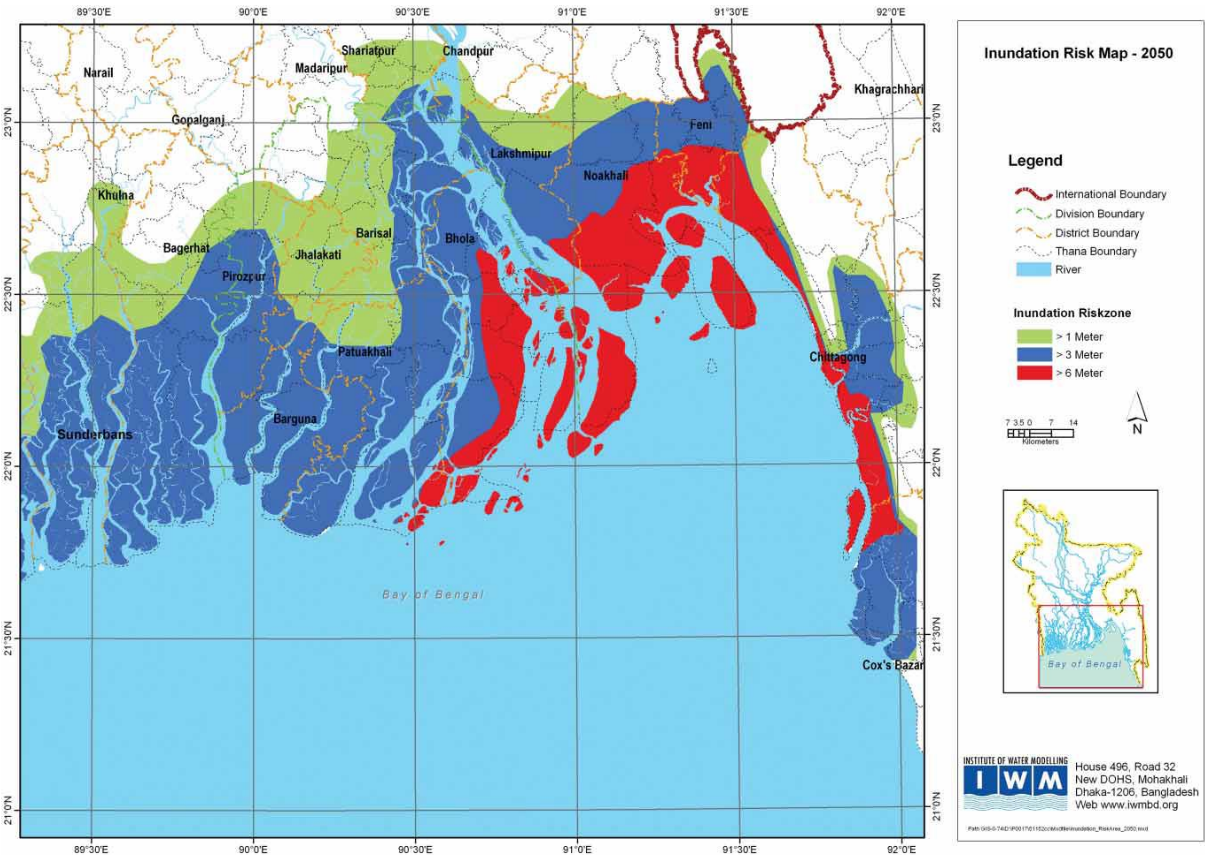


Figure 8.3: Storm surge High-risk area by 2050 under climate change

9 Cumulative and Reciprocal Impacts

9.1 General

641. Cumulative Impact Assessment is the process of analyzing the potential impacts and risks of proposed interventions in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen Valued Environmental and Social Components (VESCs) over time and proposing concrete measures to avoid, reduce or mitigate such cumulative impacts and risk to the extent possible. These effects include cumulative impact of Polder 48 and the reciprocal impacts of climate change and polder (based on modeling report by IWM). In the vicinity of Polder 48, a number of other polders also exist apart from the CEIP polders.

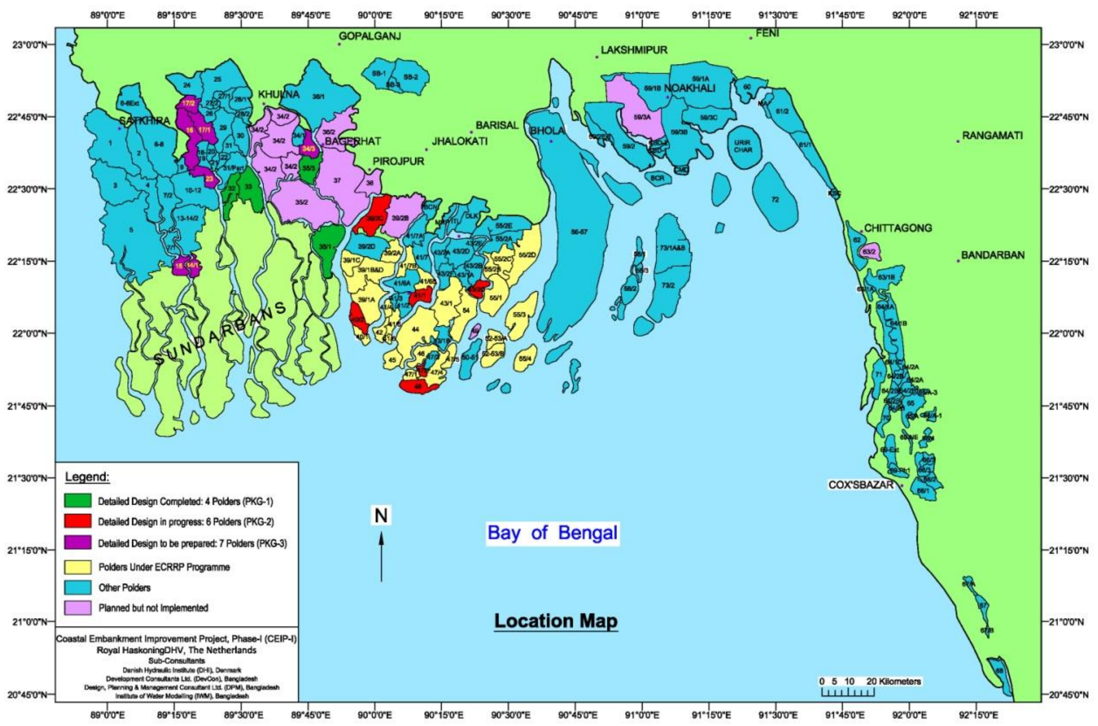
9.2 Cumulative Impacts of all CEIP-1 interventions on Polder -48

642. The location of Polder- 48 is too proximate of Bay of Bengal, specially the total southern portion. The existing crest levels of the polder ranges from 4.8 to 6.0 mPWD above MSL. Re-sectioning works are proposed in the polder under CEIP-1, which would increase its crest level up to 6.10mPWD above MSL. This intervention would reduce storm surge to enter into the polder. It is a great safeguard to this region against seasonal storm surges and flooding. Under CEIP-1 project, Polder -47/2 is located near to this polder which has some proposed interventions. Existing crest level of Polder- 47/2 ranges from 4.1 to 4.2 mPWD, which will be risen upto 4.88 mPWD after the proposed intervention. There is a less chance to divert the wind direction and storm surges to Polder- 48. Therefore, during cyclonic events storm water would not be able to enter Polder- 47/2, because of its re-sectioned embankments; the diverted river water may actually generate increased hydraulic pressure on the embankments of Polder- 48.

643. The overall developments of Polder- 47/2 would lead to the increased labor attraction towards Polder- 48; the economic status of the people living in Polder 48 may improve.

9.3 Synopsis of projects around Polder 48

644. Other than CEIP-1 interventions, there are some other development projects nearby Polder- 48, 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.



Map 9.1: Locations of polders under CEIP-1

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 (CCTF)	2013-ongoing	Entire country	Low
	Capital Dredging of River system of Bangladesh	2012-ongoing	Entire country	Low
	Water Management Improvement Project (WMIP)	2010-ongoing	Entire country	Low
Regional				
DMB, BWDB, LGED	Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)	2008-ongoing	Coastal Zone	Moderate
BWDB	Blue Gold Program	2013-ongoing	Coastal zone	Moderate
	Coastal Embankment Rehabilitation Project (CERP)	1995-2004	Coastal zone	Negligible

Source: Prepared by secondary literature review

645. The projects (listed in Table 9.1) which have or may have high or moderate sensitivities on some of the environmental or social components of Polder 48, are briefly discussed in the following sections:

9.3.1 Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)

646. In order to quick recovery from damage to livelihoods and infrastructure caused by Cyclone Sidr and to build long-term preparedness through strengthened disaster risk management, GoB implemented the 'Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)' in a total number of 13 districts (Barguna, Bagerhat, Barisal, Khulna, Bhola, Pirojpur, Jhalakati, Noakhali, Feni, Chittagong, Patuakhali, Sathkhira, Laksmipur) of Bangladesh.

647. A major component of the activities of this project is rehabilitation of embankments. Among the 35 polders considered for rehabilitation under the project, Polders 47/1 (upstream of Andharmanik river) and 47/4 are located near Polder 48 (Map 10.1). The design crest levels of these polders are: 4.88 to 5.18 mPWD above MSL for Polder 46, 4.88 to 6.10 mPWD above MSL for Polder- 47/1 and 47/4. After the completion of proposed interventions, Polder-47/1 may divert the flow of Andharmanik River further downstream and may transfer storm surge inundation risks. There may also be flood plain sedimentation along the Khaprabhanga don and Mohipur khal as a significant portion of tidal water would be prevented from entering those polders, which may reduce the depth of flow of these khals.

9.3.2 Blue Gold interventions

648. 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 and 50/51 are located near Polder 48 and therefore, may generate some impacts in future. The existing crest level of Polder 47/3 is 4.0 mPWD above Mean Sea Level. Re-sectioning works are carried out along the periphery of these polders up to the design elevation of 4.88 mPWD. There would be more floodplain sedimentation adjacent to the upstream polders. This may result increase in sedimentation along the Khaprabhanga don and Mohipur Khal. 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 48. Furthermore, repairing of existing water control structures of Polders 47/3 under Blue Gold program would ensure reduction of dry season flow towards the Polders 48. As such, surface water salinity, surrounding the Upper Andharmanik Rivers may increase, which might affect the existing river ecosystem, as well as the multifaceted surface water use of Polder 48.

9.3.3 Projects under Climate Change Trust Fund (CCTF)

649. 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. 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 Rainwater to increase Agricultural Production and Removal of Drainage Congestion) lies near Polder 48.

The interventions proposed under the project are localized adjacent to the Polder and will not have any large scale impact on Polder 48. However, there may still be some social impacts regarding labor harnessing, employment opportunities etc.

9.4 Reciprocal Impacts of Climate Change and Polder Improvement

650. 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 that 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.

651. In order to evaluate the reciprocal impacts of Climate Change and Polder improvement of Polder 48, both quantitative assessments and qualitative judgments have been carried out. Two separate hydrological and hydrodynamic models have been setup and simulated with data input from climate and hydro-meteorology to assess the impact of climate change on some sensitive issues of the polder namely, water availability, flood security and salinity.

9.4.1 Impact of Increased Water Level

652. 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 the increase in extreme flow during monsoon that ultimately result the increase in flood water level. IWM predicted water level in peripheral river of the Polder 48 as shown in Table 9.2.

Table 9.2: Water level of Peripheral river/canal of Polder 48

Sampling point	Chainage along Embankment	Peripheral River	Water Level (mPWD)
51	4+500	Mohipur Khal	3.17

Source: IWM, 2016

653. It is clear from the above table that existing crest level (6.0 mPWD) of the embankment of Polder 48 is much higher than the predicted (25 year) water levels due to climate change of the surrounding water bodies/khals. There is a less chance of overtopping flood water during monsoon period. Due to design crest level of polder the adjacent areas which are not protected may be inundated.

9.4.2 Impact of Storm Surge Level

654. From table 9.3 it is observed that the predicted storm surge level due to climate change is slightly lower than the existing crest level of the polder 48. Storm surge level due to climate change in 25 year return period is predicted 33% higher than without climate

change which is a great threat. In future the proposed higher creast level will act as a safeguard against storm surge attack. However, the higher crest level may divert the storm surges to surrounding unprotected areas where agricultural lands and local communication condition may deteriorate due to inundation. The existence of local households and livestock may face a great risk. Storm surge level with climate change effect for Polder 48 is presented in Table 9.3.

Table 9.3: Storm surge level in Polder 48 in different locations

Sampling Point	Existing Average Crest Level (mPWD)	Storm Surge Level (mPWD) in different Return Period (years)							
		Without Climate Change					With Climate Change		
		Sidr	Aila	10 year	25 year	50 year	10 year	25 year	50 year
49; Kalapara	6.00	4.3	2.51	2.41	3.24	3.87	3.44	4.59	5.44
51; Khaprabhanga Don	6.00	4.36	2.56	2.54	3.45	4.14	3.19	4.13	4.82
52; Kalapara, Tentulia	6.00	5.1	2.52	2.58	3.49	4.18	3.46	4.67	5.56
53; Kalapara, Tentulia	6.00	5.33	2.52	2.74	3.69	4.41	3.54	4.8	5.73

Source: IWM, 2016

9.4.3 Impact of Wave height due to climate change

655. Polder 48 is located adjacent to the Bay of Bengal and the sea beach is likely to be affectedby tidal wave action. The predicted wave heights are lower than the existing crest level however, the emabkments will be threatened by the predicted sea level rise. The most significant issue is that the wave heights prediction for short period (25 year) is higher than long duration (50 year). The wave heights during cyclonic condition for different return period with climate change effect around Polder 48 is presented in the **Table 9.**4.

Table 9.4: Wave height (m) for different return period with climate change condition

Sampling Point	Location	Wave Height (m) in Different Return Period (Years) with Climate Change					
		Sidr	**Aila**	**10**	**25**	**50**	**100**
49	Kalapara	3.82	2.18	2.54	3.14	3.51	3.82
52	Kalapara, Tentulia	4.03	2.04	2.61	3.38	3.87	4.31
53	Kalapara, Tentulia	4.3	2.03	2.65	3.57	4.16	4.69

Source: IWM, 2016

9.4.4 Climate Change Resilience Developed in Polder 48

656. 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 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-1 which they believe, enhanced their understanding and preparedness on flood and disaster management.

10 Development of Environmental Management Plan

657. This Chapter presents the Environmental Management Plan (EMP) for the rehabilitation activities in the Polder 48. The EMP essentially provides the implementation mechanism for the Environmental and Social mitigation measures discussed in Chapter 6.

10.1 Objectives of EMP

658. 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.

10.2 EMP Components

659. 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

660. These components are discussed in Sections below

10.3 Institutional Arrangement

661. 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 set up of CEIP-1 including organisation for implementation and monitoring of the EMP is shown in Figure 10.1.

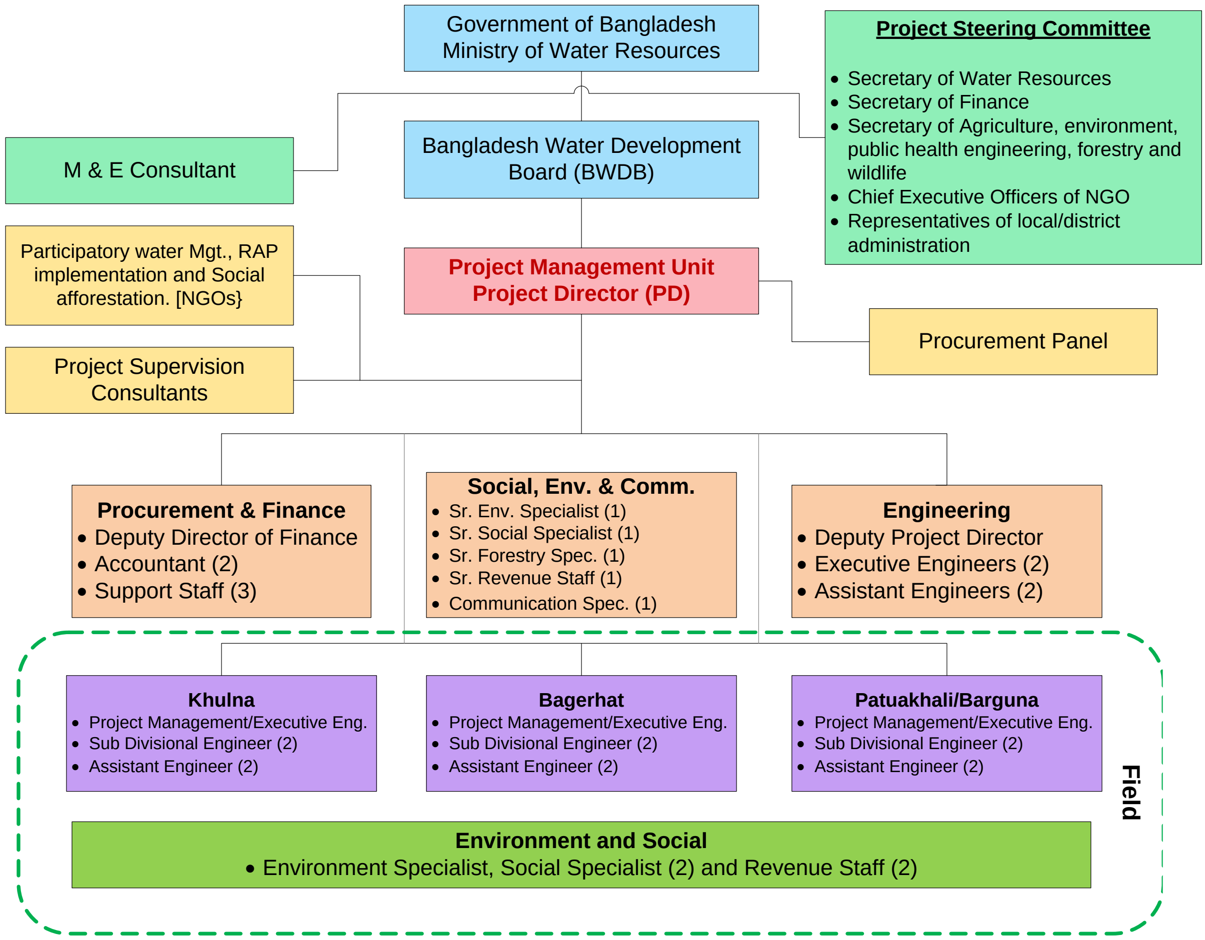


Figure 10.1: Organogram showing the institutional setup for CEIP-1

662. The institutional arrangements proposed to implement the EMP of Polder 48 are described in detail below.

10.3.1 Overall Responsibility

663. The overall responsibility of EMP implementation and fulfilling other environmental obligations during the Project rests on the Project Director (PD). For this purpose, the PD will be supported by environmental and social staff of the PMU, Detail Design, Construction Supervision and Project Management Support Consultants and contractors.

10.3.2 Construction Phase

Environment and Social Staff in PMU

664. 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 Unit (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. ESCU will be responsible for updating the EIA after receiving the pending information. Figure 10.2 represents the mechanism for EMP implementation of CEIP-1 polders.

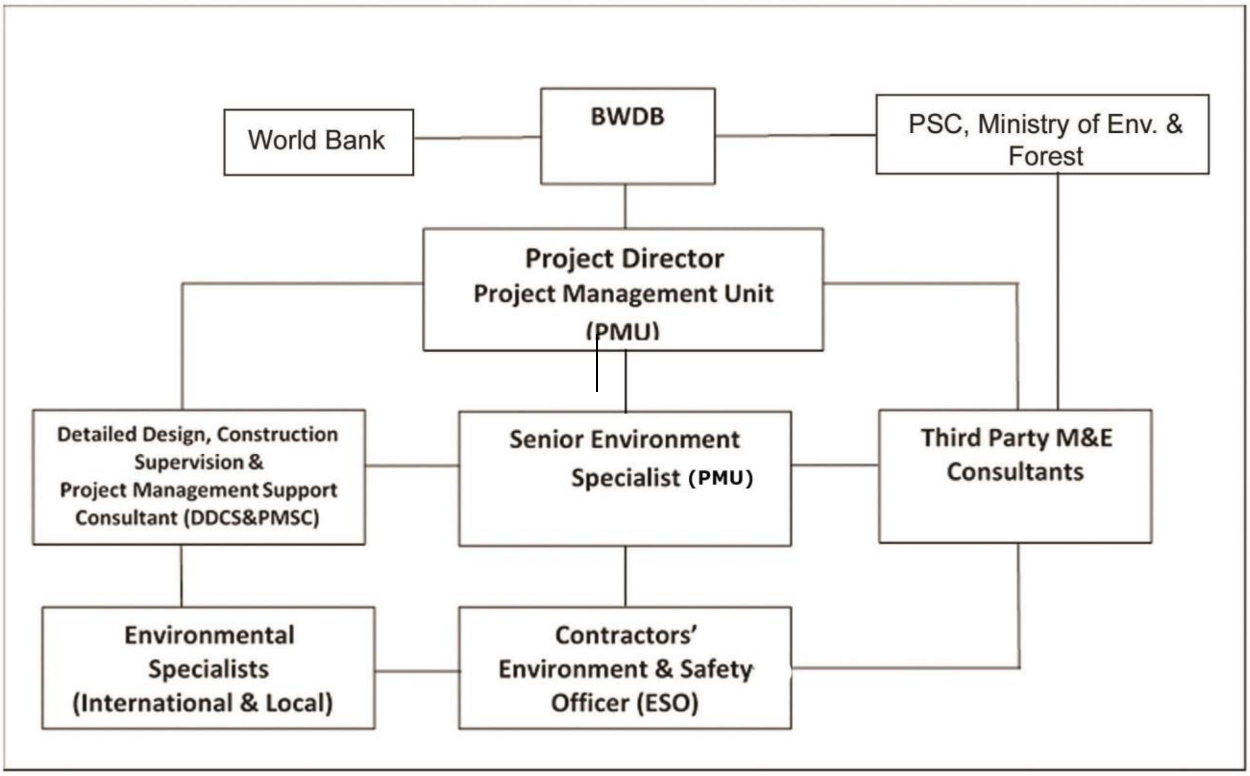


Figure 10.2: Diagram for Monitoring of EMP

665. Environment and Social Staff with Detail Design, Construction Supervision and Project Management Support Consultants (DCSC)

666. The DCSCwill be responsible for overall supervision of polder rehabilitation related activities. The DCSCwill ensure quality control and report to the PD. The DCSCwill also assist the ESCU for ensuring environmental compliance and monitoring of progress including EMP and/or ECP implementation. The DCSCwill supervise the contractors, ensuring design compliance and quality of works. For supervising the EMP implementation, DCSCwill have dedicated and adequately qualified and experienced environmental staff including field-based environmental monitors (EMs). The DCSCwill supervise and monitor contractors to ensure compliance with the EMP. The DCSCenvironmental staff will maintain coordination with the ESCU unit for the effective implementation of EMP and other environmental commitments and obligations of the Project.

Contractor's Environment Supervisors

667. The construction contractors will have an adequate number of dedicated, properly qualified and experienced, site-based Environment Supervisors at the construction sites. The Environment Supervisors 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 Environment Supervisors will maintain coordination with the DCSCat the site level. The Environment Supervisions will also be responsible to conduct environmental trainings for the construction crew.

10.3.3 Post-Construction Phase

668. The BWDB core unit has posting of 4 Assistant Chiefs and 2 Deputy Chiefs to oversee the overall environmental compliance of BWDB implemented projects. Under CEIP-1, 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 polder and maintain fish migration. Water Management organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (Nov 2000) and involved 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

669. 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.

670. 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.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 safety and welfare measures.
- operational control procedures
- management systems

671. 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

(ECoP: Environmental Code of Practice)

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 will be identified. • Selection of Borrow pit areas for earthen material collection. • No objection from land owner/Revenue authorities as applicable • Contractor shall ensure that borrowed materials used for embankment filling is free of pollutants • Disposal of excess soil will be made at site with no objection from DoE and local authority
Borrowing of Earth	**Borrow Area Selection** Borrowing of spoil from places 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 the approval of the Engineer, with respect to acceptability of the material. Borrowing to be avoided from the following areas: • Lands close to toe line and within 15m from toe line. • Irrigated agricultural lands (In case of necessity for borrowing from such lands, the topsoil shall be preserved in stockpiles, although borrowing of agricultural land need to be avoided). • Grazing lands to be avoided. • Lands within 1km of settlements. • Environmentally sensitive areas such as reserve forests, protected forests, sanctuary, wetlands. A distance of minimum 500 m will have be maintained from such areas. • Unstable side-hills to be avoided. • Water-bodies (only if permitted by the local authority, and with specific pre-approved redevelopment plans by the PMU and DCSC) • Avoid streams and seepage areas. • Areas supporting rare plant/ animal species to be avoided. **Documentation of Borrow Pit** The contractor must ensure that following data base is 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;

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Type of access/width/kutcha/pucka etc. from the roadway; • Soil type, Slope/drainage characteristics; • Water table of the area identified from the nearest well, etc.; • Existing land use, for example barren / agricultural /grazing land; • Location/name/population of the nearest settlement from borrowing 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 land owner along with at least four photographs of the rehabilitated site from different angles.
Excavation operation and Management of Excavated Material	To minimize any adverse impact during excavation of material following measures are need to be undertaken: • Adequate drainage system shall be provided to the excavated area • The Contractor shall construct sediment barriers at the stockpiling locations to prevent the erosion of excavated material due to runoff. The followings precautions shall be undertaken during quarry operations. • . • During excavation slopes shall be flatter than 20 degrees to prevent any sliding. • The Contractor shall ensure that all workers' related safety measures are in place. • 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, waste, noise and to prevent accidents.
Handling Dredged Material from River Dredging	• Contractor to develop a dredged material disposal plan to be approved by the PMU • Dredging sites to be identified using river bathymetric data • Deposition of dredged material will 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 seasonal grazing pastures. • Apply biotechnical engineering where possible for example geo textiles, may be used to help in stabilizing the material and aid re-colonization. • Other possibilities include: drying and spreading the spoil over adjacent land, which can improve soil fertility in some cases, but may also smother important flora and habitats; excavating a trench and infilling 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).
Stagnant water/water logging/ drainage	• Do not allow stagnant water especially near the waste storage areas and construction camps • Discard all storage containers, which are capable of storing water, after use or store them in inverted position • Reinstate relief and landscape • Monitor drainage pattern after rain and recession flood • Connect water pockets to the nearest drainage channels/canals
Soil Erosion and siltation	The Contractor shall: • Water the material stockpiles, access roads and bare soils regularly to minimize dust. Increase the watering frequency during periods of high risk,

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	dry season (e.g. high winds). • All working sites (except permanently occupied by the road and supporting facilities) will be reinstated to its initial conditions (relief, topsoil, vegetation cover) on completion of the tasks. • Ensure that roads used by construction vehicles are swept regularly to remove sediment.
Dredging	• Disturbance can be minimized if mechanical excavators work from one 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'. Smal 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 curing used for 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 • Ensure emergency measures to tackle/mitigate any oil spill, leakage from the equipment, machinery (dredger, excavator, etc.) into the waterbodies
ECoP 3: Air Management	
Construction vehicular traffic	The Contractor will • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in an efficient manner • Covered haul vehicles to be used carrying dusty materials (cement, borrow and quarry) moving outside 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 transport • Service all vehicles regularly to minimize emissions • Materials will be transported to site in off-peak hours.
Construction activities	• Water and/or cover the material stockpiles, access roads and bare soils on an as and where 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, dry season). • Stored materials such as excavated earth, dredged soil, gravel and sand shall be covered and confined to avoid any wind-drift • 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 such 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. • Contractor to construct separate sanitary latrines for the male & female laborers at the camp sites • Ensure no direct disposal of sewage waste into the rivers or waterbodies

Parameter/Activities	Mitigation/Compensation Measure/Guideline
ECoP 3: Agriculture Management	
Loss of Top Soil	• Soil from fallow lands/ non-agricultural lands will be used in all type of earthwork and in embankments • Collect/strip top soil before earth filling and store the same for and reusing it for final 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 stockpiles will be maintained a 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 topsoil will be utilized for covering all disturbed area and along the proposed plantation sites • Topsoil stockpiles will be monitored and the adverse conditions are to be identified and the following corrective actions are to be undertaken: o Anaerobic conditions-turning the stockpile or creating ventilation holes through the stockpile; o Erosion – temporary protective silt fencing will be erected;
Soil salinity	• Use of duckweed will remove soil salinity • Flushing with pre-monsoon rain water will reduce soil salinity. • Saline tolerant crops need to be cultivated. • Environmentally and socially responsive shrimp farming, e.g. integrated shrimp-rice farming to be encouraged. • Increasing upland discharge of freshwater will push back ingress of saline water from the sea • Green manure application is to be promoted • Avoid ground water abstraction for shrimp farming.
ECoP 4: Noise Management	
Construction vehicular traffic	• Maintain all vehicles in order to keep it in good working condition in accordance with manufactures 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 site 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 any typical noise events outside 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 residences.
ECoP 5: Ecology Management	
Flora	
Vegetation Clearance	• Tree felling will 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,

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	marking, and supervision by Forest Department is necessary. • Provide adequate knowledge to the workers regarding nature protection and the need to avoid felling trees during construction • Fruit and timber trees owned by local population will be compensated at their replacement cost according to market price
Plant Management	• Tree seedlings of local/indigenous species are planted in such a way that minimizes damage to the soil, while facilitating seedling survival. Tree species are to be selected appropriately for maintaining long-term productivity. • Select site/habitat specific indigenous tree species • Prevent planting species with slow growth rate, require less water and soil conservation and prevent pest or disease outbreaks • Local species for planting since natural selection and succession are most suitable for local climates and natural conditions • Ensure avoiding single species or clone monoculture • Choose suitable indigenous 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, practice physical and biological controls to control the pests and diseases in the nurseries. • Do not plant exotic species on sites • 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 neighbors by identifying existing pests and diseases and the risks for the introduction of new pests and diseases.
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 agrichemical should be far 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 • To restrict any destruction of 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 illegal poaching.
ECoP 6: Fisheries Management	
Construction works in the rivers and on the surrounding lands	• Critical breeding areas of major fish species will be identified and managed in consultation with the Dept of Fisheries. • Creation of small lagoons and pools, which may trap the fishes should be avoided. • Creation of artificial waterfalls and other barriers for migration to be avoided. • Natural river channel will be reinstated after completion of construction works
Hydraulic Structure	• Sufficient free flow will be guaranteed in the design and construction work to ensure free passage of migrating fishes. • Hydraulic structure will be operated considering the time of fish migration and spawning time

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Area specific hydraulic structure operation guideline will have to be developed
Dredging	• Ensure that the dredging activity will create minimum sediment load in the water • Avoid dredging during spawning period of fish
ECoP 7: Socio-Economic Management	
Construction Camp Management	
Location of constructionCamps (MRDI, 2011)	• The contractor shall erect signboard/s at worksite mentioning the details of adtivities to be performed along with cost, work tenure and name and address of the firm. It will also contain the address of the supervision organization, who may be informed of any grievances of the activities. • Locate the construction camps at areas which are acceptable from environmental, cultural or social points 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 will endorse detailed layout plan for the development of the construction camp submitted by the contractor. The plan will show the relative 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 will have to 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 manpower and equipment/vehicles needed. • Not to establish site specific landfill sites. All solid waste will 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 for transferringto nearest hospitals. • Initial health screening of the laborers coming from outside areas • Train all construction workers on basic sanitation and health care issues and

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	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 repellant 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 will be as per the Minimum Wages Act, Department of Labor, and Government of Bangladesh for both male and female workers. • Display of the minimum wages board at camps and major construction sites will be made in local languages at the construction and labor camp sites. • Wages will 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 and when asked by the DCSC, PMU and/or the concerned BWDB staff/DCSC'srepresentative • Contractor to follow the guidelines of prevalent by-laws of Bangladesh Labour Act, 2006.
Rehabilitation of Labor and Construction Camp	At the 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. Various activities to be carried out for site rehabilitation include: • Oil and fuel contaminated soil shall be removed and transported or buried in waste disposal areas. • Soak pits, septic tanks shall be covered and effectively sealed off. • Debris (rejected material) will be disposed of suitably. • Underground water tank in a barren/non-agricultural land should be covered. However, the tank shall be removed from agricultural land. • If the construction camp site 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 the guideline. The rehabilitation is mandatory and will be included in the agreement with the landowner by the contractor. Also, he would have to obtain a certificate for satisfaction from the landowner.
Damage and Loss of Cultural Properties	
Conservation of Religious Structures and Shrines	• All necessary and adequate care shall be taken to minimize impact on cultural properties which includes cultural sites and remains, places of worship including mosques, temples, 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.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• 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 chance find and the DCSCshall 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, andstructures 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 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 aprons, safety goggles, helmets, masks, boos, 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 DCSC.
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.
Disruption to Users	
Loss of Access	• At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock. Work that affects the use of existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the DCSC. • 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 preparation of the traffic control plan for the safety of pedestrians and workers at night • The temporary traffic detours in settlement areas shall be kept free from 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 barricades, including signs, markings, flags, lights and flagmen as may be required by the DCSCfor the information and protection of traffic approaching or passing through the cross section.

10.5 Chance-Find Procedures for Physical Cultural Property

672. 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 archeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;
- Protect artifacts as well as possible using plastic covers, and implement measures to stabilize the area, if necessary, to properly protect artifacts;
- Prevent and penalize any unauthorized access to the artifacts; and
- Restart construction works only upon the authorization of the relevant authorities (e.g. Upazila Nirbahi Officer, Deputy Commissioner and Department of Archeology).

10.6 Monitoring Plan

673. 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.

674. 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.

675. 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.

676. 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 Polders 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 materials (Cement, soil).	Before an agreement for the supply of material is finalized.	Contractor	DCSC, M&E Consultant, BWDB
Operation of borrow site	Borrow pit/site	Visual inspection of borrow 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 should be excavated and stored properly	Beginning of earthwork	Contractor	DCSC, M&E Consultant, BWDB
	do	The stored top soils should be used as cladding material over the filled lands	Immediately after filling and compaction of dredge materials	Contractor	DCSC, M&E Consultant, 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, M&E Consultant, BWDB
Erosion	Side slopes of the embankments and material storage sites	Visual inspection of erosion prevention measures and occurrence of erosion	At the end off filling activity	Contractor	DCSC, M&E Consultant, BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are	Monthly	Contractor	DCSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
		engaged			
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, M&E Consultant, BWDB
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DCSC, M&E Consultant, BWDB
Air Quality (PM_{10}, $PM_{2.5}$)	Close to School/ Madrasha, Hospital &Villages	Air quality monitoring	Half Yearly	Contractor through a nationally recognized 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 work restriction between 09:00 pm-6:00 am close to School/ Madrasha, Hospital & Villages	Weekly	Contractor	DCSC, M&E Consultant, BWDB
Surface Water Quality (TDS, pH, DO, BOD, COD etc.)	Water sample at each of river for each polder	Sampling and analysis of surface water quality	During dry season	Contractor through a nationally recognized laboratory	DCSC, M&E Consultant, BWDB
Drinking Water Quality (Arsenic,Fe, chloride and total fecal coliform etc.)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality	yearly	Contractor through a nationally recognized laboratory	DCSC, M&E Consultant, BWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid waste and solid waste is deposited at designated site	Weekly	Contractor	DCSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Reinstatement of Work Sites	All Work Sites	Visual Inspection	After completion of all works	Contractor	DCSC, M&E Consultant, BWDB
Top Soil	Storage area	Top soil of 0.15 m depth should be excavated and stored properly	Beginning of earthwork	Contractor	DCSC, M&E Consultant, BWDB
	Storage area	The stored top soils should be used as cladding material over the filled lands	Immediately after filling and compaction of dredge materials	Contractor	DCSC, M&E Consultant, 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, M&E Consultant, BWDB
Workers' Health safety	Workers' camp site and work site	Use of PPE by the workers, provision of safe drinking water, sanitation and first aid facilities	Daily	Contractor	DCSC, M&E Consultant, BWDB
Habitat Condition	Khals	Observation	Four (4) times of year (dry & wet season)	Consultancy farm	DoF, BFRI, DCSC, M&E Consultant, BWDB
Fish Migration		Catch Assessment Survey	Two (2) times of year (dry & wet season)	Consultancy farm	DoF, BFRI, DCSC, M&E Consultant, BWDB
Vegetation clearance	Each of construction sites at embankment and proposed khal bank	Survey and comparison with baseline environment	Quarterly	Contractor through nationally recognized institute	DCSC, M&E Consultant, BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, pH, DO, BOD, COD etc)	Water sample at each of river for each polder	Sampling and analysis of surface water quality	Yearly	BWDB through a nationally recognized 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 recognized laboratory	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant
Crop production	In the polder area	Compare the production with the baseline	3 (Three) cropping season	BWDB through a nationally recognized institution	M&E Consultant
Soil quality	In the polder area	Compare the soil quality with the baseline	Two (2) times of year (dry & wet season)	SRDI	Consultant
Habitat Condition	Khals	Observation	Four (4) times of year (dry & wet season)	Consultancy farm	DoF, BFRI, DCSC, M&E Consultant, BWDB
Fish Migration		Catch Assessment Survey	Two (2) times of year (dry & wet season)	Consultancy farm	DoF, BFRI, DCSC, M&E Consultant, BWDB
Fishing Activities and Stock susceptibility		Catch Assessment Survey	Two (2) times of year (dry & wet season)	Consultancy farm	DoF, BFRI, DDCS&PMSC and BWDB
Bagda/Golda Gher and Fish Farm	Polder Area	Farm Survey	Four (4) times of year (dry & wet season)	Consultancy farm	DoF, BFRI, DCSC, M&E Consultant, BWDB

(Source: MRDI, 2011, LGED, 2011)

Table 10.3: Environmental Monitoring Plan during Construction and Operation of Afforestation*

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
During Implementation					
Water Quality	Water bodies near nursery	Odor and chemical testing	Half yearly	Contractor through nationally recognized laboratory	DCSC, M&E Consultant, BWDB
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, M&E Consultant, 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, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
During Operation and Management					
Erosion	Along Alignment	Visual Inspection presence of gullies or erosion	Yearly	BWDB	M&E Consultant
Survival and growth of coastal afforested saplings and turfed grasses	Proposed afforestation foreshore area and re-sectioned embankment	Survey and comparison with baseline environment	Yearly	Contractor through nationally recognized institute	DCSC, M&E Consultant, BWDB

* Environmental monitoring formats will be prepared prior to the implementation of Package 2 work.

Qualitative Spot Checking Indicators

677. Moreover a rapid environmental monitoring will be carried out according to the following checklist as given below in terms of visual judgment during field visit as an indirect control to implement Environmental Mitigation plan. Table 10.4 can be followed during project construction and operation process.

Table 10.4: Spot Checking Indicator

Parameter	Visual Judgment			
	Poor	Moderate	Satisfactory	Comments
Workers' Safety (provision of PPE, safe drinking water, sanitation facility, first aid facility etc.)				
Hoisting of signboard for work				
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				

Third Party Validation

678. BWDB will engage independent consultants to conduct a third party validation (TPV) of the EMP implementation on a 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 remediation.

10.7 Documentation, Record keeping and Reporting

10.7.1 Record Keeping

679. Proper arrangements are necessary for recording, disseminating and responding toinformation 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.

10.7.2 Monitoring Records

Quantitative Physical Monitoring

680. 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. The DCSC will regularly monitor and provide information to ESCU for updating the database. The 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.

681. The monitoring data would be continually processed as it is received, so as to avoid a buildup of unprocessed data.

General Site Inspections and Monitoring

682. 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 6.11, during the construction phase. The Site Inspection Checklist would be supported by sketches, as necessary.

10.7.3 Information Sources

683. 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 fulfill 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.

10.7.4 Non-Compliance Report

684. Any breaches of the acceptable standards specified, would be reported to the PMU using a standard form, i.e. a Non-Compliance Report (NCR).

685. 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.

10.7.5 Monthly Internal Reports by DDCS&PMSC

686. The DCSCwill prepare a monthly report for issue to the ESCU of PMU. These reports will summarize the following:

- Progress in implementation of 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.

10.7.6 Bi-annual Progress Report by BWDB

687. ESCU of BWDB will prepare the Bi-annual progress report on environmental management and will submit to the World Bank for review during construction phase. The progress report will summarize the information presented in Article 10.6.

10.7.7 Environmental Audit Report & Third Party Monitoring Report

688. It is expected that BWDB will have an annual environmental audit carried out by the Third Party Validation team. Besides, an 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. tThe Third Party Validation and Monitoring report will be shared with Bank.

10.7.8 WB Monitoring

689. The World Bank or The Donar Agency would also supervise the environmental compliance as part of their regular implementation support missions.

10.8 Contractual arrangements for EMP implementation

690. 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.

10.8.1 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-1 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.

10.8.2 Guideline for Compensation and Contingency Plan during Project Period

691. 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 handled by the Grievance Redress Committee.

692. 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 numbers of sand bags in reserve.
- Bank caving/erosion – keep sufficient numbers of concrete blocks and sand bags in reserve.
- Have an emergency evacuation plan for the people in the line of danger.
- Have a place designated as emergency shelter and ensure proper water supply, power supply and sanitation at this site.
- Accidental spill of harmful chemicals – train some members on how to confine such a spill and minimize potential danger to humans and other animals.

- Fire – keep fire extinguisher or emergency water pump ready at local project office.
- Personal injury – keep a first aid box at the project office. Have a plan for quickly transporting a seriously injured person to the nearest hospital.

10.9 EMP Implementation Cost

693. The estimated costs for the environmental management and monitoring activities are set in Table 10.5.

Table 10.5: Tentative Cost Estimates for Environmental Management and Monitoring*

Item No.	Description	Amount in BDT	In thousand $	Responsible Agency	Timeframe
1	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils	500,000	62.50	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 (12 samples in polder 48) during pre-construction, construction and post construction periods)= 12 samplesx3 times @ Tk.5,000	180,000	2.25		
3	Habitat Observation for four (4) times of year (dry & wet season).	50,000	0.63		
5	Catch Assessment Survey for two (2) times of a year (dry & wet season).	142,500	1.78		
6	Farm Survey for four (4) times of year (dry & wet season).	60,000	0.75		
7	Awareness program on plant and wild life conservation.	97,000	1.21		
8	Consultancy services cost for supervision and monitoring of EMP	276,440	3.46		
9	Training to the farmers with field demonstration regarding IPM and ICM.	80,000	1.00		
10	Awareness building up to local community for conservation of threatened fish species.	40,000	0.50		
11	Training to the fisherman/pond owner with field demonstration regarding pond culture.	115,000	0.93		
12	Release fish fry in the khals inside the Polder after completion of construction works.	37,500	0.47		
13	Air and noise quality monitoring and analysis.	200,000	2.50		
15	Solid and liquid waste disposal arrangement.	60,000	0.75		
16	Capacity building and training to the WMOs regarding gate operation, post project monitoring	900,000	11.25		
17	Consultancy services cost for river bank erosion monitoring	1,200,000	15.00		

Item No.	Description	Amount in BDT	In thousand $	Responsible Agency	Timeframe
18	Training to the Contractors regarding environmental management	100,000	1.25		
	Training of Environmental awareness of local population	120,000	1.50		
19	Updating EMP as per requirement.	100,000	1.25		
20	Construction of alternative or bypass channels at each construction sites.	1,061,053	13.26		
21	Materials for net pen culture (at least 25 households in each word/council of a Union).	648,000	8.10		
22	Conservation and stocking of threatened fish species (at least 3 spots).	240,000	3.00		
23	Campaigning and providing training on improved culture practices as well as the rice cum golda farming.	300,000	3.75		
24	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	1,200,000	15.00		
25	Additional Tree Plantation at HH and other grounds to compensate the tree cutting (planting 3 trees for cutting I tree) @ Tk.50 each tree including the cost of sapling, gabion and nursing etc.	11,415,900	142.70		
26	Water sprinkling at resectioned/newly constructed embankments (@ Tk.3,000 per km of embankment	114,000	1.43		
27	WMOs monitoring cost	120,000	1.50		
	Total Cost	**19,567,093**	**297.72**		

Note: 1 $= 80 BDT

10.10 EMP Updating

694. 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.

10.11 Grievance Redress Mechanism

695. 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 too expensive, time-consuming legal action. The procedure will however not pre-empt a person's right to go to the courts of law.

10.11.1 Grievance Redress Focal Points

696. 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.

<u>Membership of GRC</u>

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

697. Members of the GRCs will be nominated by the Executive Engineer at division level and approved by the Project Director, PMU, BWDB, Dhaka.

10.11.2 Grievance Resolution Process

698. 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.

699. 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.

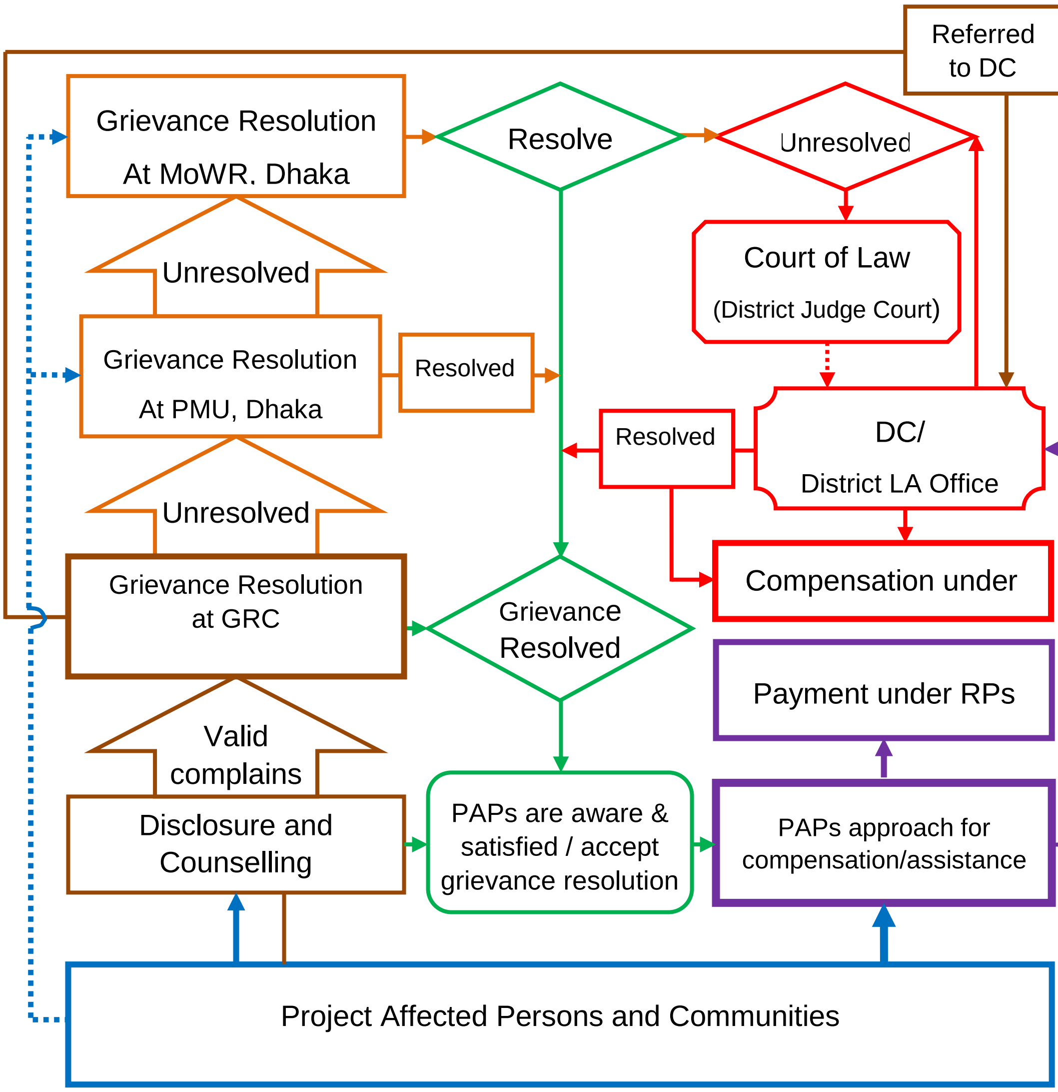


Figure 10.3: GRM Process flow Chart

700. 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.

10.11.3 GRM Disclosure, Documentation and Monitoring

701. 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.

702. 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.

703. Grievance resolution will be a continuous process in RP implementation. The PMU and SMOs 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.

10.12 Capacity Building

704. 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.

705. 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: 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 DCSCstaff	DCSC& ESCU	Prior to the start of the Project activities (To be repeated as needed.)
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

706. 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;
- 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.

707. 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

708. 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 is also included in the Chapter.

11.1 Overview

709. The GoB as well as international donors (the World Bank) place great importanceon 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.

710. 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 EA are finalized, and again with draft EIA report is prepared.

711. 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

712. 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

713. A participatory approach was followed in conducting the public consultation meetings in Polder 48. 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-I. 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.

714. 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-I, 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 consultation meeting all relevant issues within the water resources, land resources, socio-economic resources, and disaster aspects were discussed in detail.

715. During the FGDs and consultation meetings, the EIA team displayed maps of the Project area, shared the initial concepts on proposed interventions and facilitated the response of the participants. The stakeholders of the Polder 48 were requested 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

716. 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.

717. **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 48, 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.

718. **Secondary Stakeholders:** This category of stakeholders pertains with 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.

719. 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

720. Venues, dates and times of meetings were selected through consultation with local people, the project proponent and the consultant. These three groups discussed and 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

721. A comprehensive list of potential stakeholders was prepared through the consultation. This list was intended to cover all sorts of interest groups, occupational groups, socially acceptable and knowledgeable peoples.

722. Formal invitations were sent to them and also communicated over telephone for ensuring their presence in the meeting.

Consultation Instrument

723. Checklist: A checklist covering all possible issues to be addressed was prepared through consultation with the multidisciplinary study team. This checklist was used in the meeting to unveil peoples' perception and opinion along with suggestions.

724. Attendance list: An inventory of the participants was maintained in attendance sheet containing contact number. Scanned list of participants is attached in Appendix 4.

725. 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.

Consultation Process

726. The study team conducted the meeting. During consultation meeting, the following process was followed with sequences.

727. **Greetings:** At the outset, the team spelled greetings to all participants. Welcomed them for attending and stated the entire design of the meeting.

728. **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.

729. **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.

730. **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.

731. **Note taking:** discussed issues and opinions were written in notebook carefully. All issues were given equal importance.

732. **<u>Recapitulation and closing the session:</u>** At the end the study team recapitulated the session and responded to the quarries. Finally, the Facilitator closed the session thanking the participants.

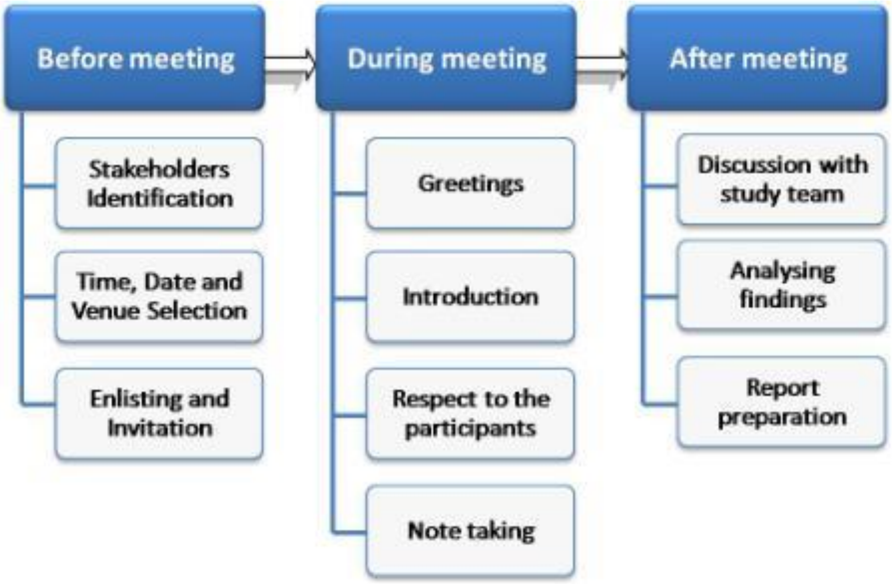


Figure 11.1: Overall consultation process

11.5 Public Consultation Meetings and FDGs

11.5.1 11.5.1 Consultation Process

733. A number of public consultation meetings and FGDs were conducted at different locations of the Polder 48. 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.

11.5.2 11.5.2 Consultation Details

Table 11.1: Meeting venues with time and date

District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
Patuakhali	Kalapara	Latachapli	Latachapli Union Porishod Conference room	PCM	11/08/2015	10:00
			Kalapara Upazila Conference room	PCM	17/08/2015	10:00
				FGD		10:00
						15:00
						12:30

Source: PCM Team of CEGIS

11.5.3 11.5.3 Consultation Participants

734. The main participants of the consultation meetings included public representatives, farmers, traders and daily-wage laborers of the Polder 48 and nearby areas. A total of 123 participants attended in these consultations. The participant details are provided in Table 11.2.

Table 11.2: Participant Details

Sl	Meeting venue	Type of consultation	Type of Participants	No. of participants
1	Latachapli Union Porishod Conference room	PCM	Secondary and Primary stakeholders	47
2	Kalapara Upazila Conference room	,,	,,	41
3	Haridebpur bazaar	FGD	Primary stakeholders	12
4	Shuari Bridge bazaar	,,	,,	12
5	Goalkhali	,,	,,	11

Source: PCM Team of CEGIS

Picture 11.1: PCM at Kalapara Upazila Auditorium

Picture 11.2: PCM at Latachapli Union Auditorium

11.6 Issues discussed in FGDs and Meetings

735. 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)
- Water logging and drainage congestion

Land resources

- Cropping practice
- Production and yield
- 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.

11.7 Community Concerns and Suggested Solutions

736. 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 clear about the objectives and process of the project.

11.7.1 Attitude to the Project

737. The communities including the persons to be affected by the Project, expressed their views in favor 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 different locations of Latachapli Union


Picture 11.4: FGD at Haridebpur Bazar and Shauri Bazar area

738. 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	Drainage congestion, Flood, Tidal surge, Salinity intrusion, Encroachment of internal khal, erosion, water logging due to siltation at certain portions of the polder and poor communication system are the main community concerns in the polder area.	• Comprehensive rehabilitation of the polder should be taken up at the earliest with the active involvement of the local community. • Proper compensation should be given to affected people • Illegally captured cannel should be liberated and that cannel should be excavated • Embankment height should be designed after calculating surge height. • Environment friendly policy should be adopted to expand tourism industry • Erosion at Bishkhali and Bolesshar River due to wave action must be controlled.
Water resources	• Tidal Flooding, Storm surge, salinity intrusion, Encroachment of internal khal, erosion, inactive sluice gate and khal has been silted up • Height of the embankment is being eroding gradually	• Re-sectioning of the Sea dyke and the Interior dyke • Internal drainage canal should be re-excavate

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
	• Sea dyke is more vulnerable than the Interior dyke	
Agriculture resources	• Crop damage due to drainage congestion and water logging • Lack of irrigation water during dry season due to siltation of rivers and internal khals	• Repair the embankment as per design • Re-excavation of rivers and khals as per design • Connecting the khals with rivers. • Repairing of the sluices and construction of new sluice • Regular operation and maintenance the regulators. • As soon as possible Blocked linkage cannel and large cannel should be excavated like as Khajuri khal, Lokkhe khal, Kuakata khal, Borua khal etc.
Fishery resources	• Reducing depth of internal khals and habitat quality degradation due to siltation • Hatchling and fish movement disrupted due to improper operation of water control structures. • Illegally control khal & water control infrastructure to catch fish • 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 • Repairing embankment with reasonable height • Prohibit illegally control khal & water control infrastructure to catch fish • Using angler in an illegal way should be stopped • Illegally captured cannel should be liberated and that cannel should be excavated
Ecological resources	• A number of trees would be cut down 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	• Provide 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 • Local people should be engaged on afforestation. • Plantation for local species and maintain proper monitoring for saplings and fencing

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
	• Already sea dyke afforestation was destroyed due to recent storm surge, named 'Comen"	
Socio-economic resources	• A number of HHs will be displaced and their life and livelihood may be hampered. • 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. • Capturing open water bodies by rural power elites • Rural power elite captured illegally open water bodies i.e. khals, ditches for their own purposed • Hampering tourism due to vulnerable see dyke by erosion	• Ensure proper resettlement of the households, which may be affected by the project intervention of drainage sluice. • The embankment cum road should be repaired immediately. • After re-sectioning of embankment a maintenance and monitoring team should be formed for proper O&M. • Strengthening of WMGs so that mass people can access to open water bodies easily • Gate operator (locally called gate khalishi) should be requited • Illegal DCR cut off should be stopped • To expand tourism industry, environment friendly policy should be followed • In mud work Participation of local people should be given the first priority • To expand tourism industry, environment friendly policy should be followed

11.8 EIA Disclosure

739. 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.

740. 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:

741. The communities including the persons to be affected of Polder 48 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:

- 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
- Need formation of Water Management Organizations (MWOs) to manage properly water control structures
- Setting of billboard with details construction activities in the project site have to be ensured before construction

National Dissemination Seminar

742. A dissemination seminar on the "Environmental Impact Assessment (EIA) 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.

743. 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 11.6: Welcome Speech by the Project Director of CEIP-1

Picture 11.7: Presentation of EIA findings by Mr. Malik Fida Abdullah Khan, Deputy Executive Director (Operation), CEGIS

Picture 11.8: View of Participants of the Seminar

Picture 11.9: A view of open discussion

Picture 11.10: Special Guest delivering his speech

Picture 11.11: Special Guest delivering his speech

Picture 11.12: Guest of Honour delivering his speech

Picture 11.13: Chief Guest delivering his speech

Picture 11.14: Closing remarks by the Chair

744. 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.

745. 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.

746. The minutes of the dissemination seminar containing inter-alia the Comments and Responses is provided in **Appendix-13.**

11.9 Framework for Consultations during Project Implementation

747. The stakeholder consultation is a continuous process and should be maintained throughout the project. The consultations carried out during the present EIA and reported in this Chapter are essentially the first step of 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 pit areas, and access routes	BWDB; Supervision Consultants; Contractors
	Grievance Redresses Mechanism and Social Complaint Register (discussed later in the document)	The affected communities	BWDB; Supervision Consultants; Contractors
	Consultations with the communities during Compliance Monitoring	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

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Appendix 1 : Construction Schedule

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												

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												

SI 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)	
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 Certificate

কলাপাড়া, পটুয়াখালী

স্মারক নং-

তারিখ-

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 ৪৮ 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 ৪৮ 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।

Appendix 3: Standard for Physio-Chemical Propertises 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

Nutrientelement	VeryLow	Low	Medium	Optimum	High	Veryhigh
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 Participant 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	[illegible]	চেয়ারম্যান উপজেলা [illegible]	01716538157	
২	[illegible] UNO (Acting)	সহকারী কমিশনার (ভূমি) কলাপাড়া	01733334156	
৩	মো: [illegible]	[illegible]	01716640775	
৪	মো: মনিরুজ্জামান খান	উপজেলা [illegible] (USSO)	01712274629	
৫	মো: [illegible]	SUFO, DoF	01716537230	
৬	[illegible]	[illegible]	01740975201	
৭	[illegible]	USSO	01711113397	১৭/৮/১৫
৮	মোহাম্মদ আরিফুজ্জামান	উপজেলা শিক্ষা অফিসার (মাধ্য) কলাপাড়া	01718176151	
৯	মো: তরিকুল ইসলাম	উপজেলা সমবায় অফিসার, কলাপাড়া	01717886116	১৭/৮/১৫
১০	মো: বেলায়েত হোসেন	ভারপ্রাপ্ত কর্মকর্তা, বন বিভাগ	01712-230731	১৭/৮/১৫
১১	[illegible]	[illegible]	0172-1810055	১৭/৮/১৫
১২	মো: [illegible]	[illegible]	01718562688	
১৩	[illegible]	[illegible]	01724055311	
১৪	মো: [illegible]	[illegible] ১১ নং UP	0176199177	
১৫	জাহিদা বেগম	উপ: আনসার ও ভিডিপি অফিসার, কলাপাড়া	01721059834	১৭/৮/১৫
১৬	মো: [illegible]	C.I.P. [illegible]	01721457325	১৭/৮/২০১৫
১৭	মো: আবদুর রহমান	[illegible]	01757435722	১৭/৮/১৫
১৮	মো: [illegible] খান	[illegible]	01758053259	১৭/৮/১৫

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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
১৯	মোঃ আইয়ুব আলী	ইউ. পি. সদস্য ৩নং [illegible]	01775566874	[illegible]
২০	মোঃ ফারুক হাওলাদার	সমাজ সেবক	01818991187	ফারুক
২১	মোঃ আলাউদ্দিন খাঁ	সমাজ সেবক	01791080630	[illegible]
২২	এ.বি.এম নুরুল আমিন	[illegible]	01718435045	[illegible]
২৩	আঃ ছালাম সিকদার	চেয়ারম্যান	01715097404	[illegible]
২৪	মো: [illegible]	UDMO	01865042151	[illegible]
২৫	মো: [illegible]	UPHE	01740978118	[illegible]
২৬	তাহমিনা আকতার	VWAO	01720494734	[illegible] ১৭/০৮/১৫
২৭	শহীদুল ইসলাম	SDE	01711 314365	[illegible] ১৭/৮/১৫
২৮	মো: আমিনুল ইসলাম	URDO	01714-244355	[illegible]
২৯	বিলকিস জাহান	ভাইস. চেয়ারম্যান	01710703241	[illegible]
৩০	মো: [illegible]	[illegible]	01718668935	[illegible] ১৭/৮/১৫
৩১	রেহানা সুলতানা	সাঁট-মুদ্রাক্ষরিক	01815442875	রেহানা ১৭/৮/১৫
৩২	[illegible] মো: [illegible]	সহকারী প্রোগ্রামার	0924590318	[illegible]
৩৩	উবায়েদ	মিস্ত্রি	01824805470	[illegible]
৩৪	আবদুল মতিন	চৌকিদার	0172-3848256	আ: [illegible] ১৭/৮/১৫
৩৫	মো: [illegible] মিয়া	গ্রা: [illegible]		[illegible]
৩৬	মো: [illegible] মিয়া	[illegible]		[illegible]

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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	ইঃ নিশানবাড়িয়া		কামরুজ্জামান
৩৮	মুনসুর মল্লিক	ঐ		মুনসুর
৩৯	মো: জলিল হাওলাদার	ঐ		জলিল
৪০	মো: জামাল	ঐ		জামাল
৪১	মো: কামরুজ্জামান খান	ঐ		[illegible]

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মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান: ইউনিয়ন পরিষদ, [illegible], কলাপাড়া
সময়: ১০.৩০

তারিখ: ২২/০৫/২০১৮

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১.	মো: [illegible]	ঠিকাদার	01720584325	[illegible]
২.	[illegible] আবেদ হোসেন	প্রভাষক কলেজ, [illegible]	01716900401	ড.: [illegible]
৩.	ডা: সিদ্দিকুর রহমান বিশ্বাস	সভাপতি বাংলাদেশ আওয়ামীলীগ	01731912070	[illegible] ২২/০৫/২০১৮
৪.	আলহাজ মো: নূর আলম	সহ-সভাপতি বাংলাদেশ আওয়ামীলীগ	01718049460	[illegible]
৫.	মো: [illegible] হোসেন [illegible]	"	01724554537	[illegible]
৬.	মোসাঃ ফিরোজা বেগম	মহিলা প্রতিনিধি	01733263756	ফিরোজা ২২/৫/২০১৮
৭	মোসাঃ আকলিমা	"		আকলিমা
৮	মোসাঃ আফিয়া বেগম		[illegible]	মোসাঃ আফিয়া
৯	মোসা: নারগিস আক্তার	ইউ.পি. সদস্য	01732776279	[illegible]
১০	কাজী সাহেদ	সাংবাদিক	01717845271	[illegible]
১১.	মো: আবু জাফর	ব্যবসায়ী	01712-389426	জাফর
১২.	মো: রবিউল	ব্যবসা	01712-366-937	মো: রবিউল
১৩.	মো: [illegible]	ব্যবসা	01761701327	[illegible]
১৪.	মো: ইব্রাহিম	গ্রাম: আলিপুর	01860737006	ইব্রাহিম
১৫.	আবু বাকের	গ্রাম- আলিপুর-	01730929262	[illegible]
১৬.	[illegible]	[illegible]	01860197284	[illegible]
১৭.	মো: নাসির উদ্দিন	[illegible]	01736034372	[illegible]
১৮.	মনির মোল্লা			

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স্থান ঃ ইউনিয়ন পরিষদ, [illegible], কলাপাড়া
সময় ঃ [illegible] তারিখঃ [illegible]

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯.	মো: [illegible]	সচিব [illegible] ইউনিয়ন পরিষদ	01720-584502	[illegible]
২০.	মো: [illegible]	[illegible]	01733172302	[illegible]
২১.	মোঃ মনিরুজ্জামান	U.P. সদস্য [illegible]	01713688966	[illegible]
২২.	মো: [illegible]	[illegible]	01717245053	[illegible]
২৩.	মো: [illegible]	কৃষক	01923221407	[illegible]
২৪.	মো: [illegible] আলী	কৃষক	01775593149	[illegible]
২৫.	মো: [illegible]			[illegible]
২৬.	মো: [illegible]		01822825 53	[illegible]
২৭.	[illegible]		01763206559	[illegible]
২৮.	[illegible]	মৎস্যজীবী	01992393687	[illegible]
২৯.	মো: [illegible]	[illegible]	01928557464	[illegible]
৩০.	মো: [illegible]	[illegible]	01725377764	[illegible]
৩১.	[illegible]	—	01759707778	
৩২.	মোঃ [illegible]	মৎস্যজীবী	01926784009	
৩৩.	মোঃ [illegible]	মৎস্যজীবী		
৩৪.	[illegible]	[illegible]	01736249622	[illegible]
৩৫.	মোঃ [illegible]	[illegible]	01763062400	[illegible]
৩৬.	[illegible]	[illegible]	01718460928	[illegible]

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মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থানঃ [illegible]
সময়ঃ [illegible]

তারিখঃ [illegible]

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৩৭.	মোঃ [illegible]	[illegible]	01718249697	[illegible]
৩৮.	মোঃ [illegible]	[illegible]	01771539539	[illegible]
৩৯.	[illegible]	খাজুরা	01732030365	
৪০.	[illegible]	খাজুরা	01790982555	
৪১.	[illegible]	আলীপুর	01940421128	
৪২.	[illegible]	[illegible]	[illegible]	
৪৩.	মোঃ [illegible]	[illegible]	01752606274	
৪৪.	মোঃ [illegible]	[illegible]	01729745193	
৪৫.	[illegible]	[illegible] R.B.W.A	01915169899	[illegible]
৪৬.	মোঃ [illegible]	[illegible]	01718014800	[illegible]
৪৭.	ডাঃ নারায়ণ চন্দ্র [illegible]	[illegible]	01717612038	[illegible] 11/08.

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Appendix 5: List of Participant of PDM at Kalapara Upazila under Patuakhali district.

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)

তারিখঃ ০৭/১২/২০১৭

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১.	আবু [illegible]	চেয়ারম্যান কলাপাড়া উপজেলা	[illegible]	৭.১২.১৭
২.	এ.বি.এম. সাদিকুর রহমান	UNO, কলাপাড়া	01733334155	৭/১২/১৭
৩.	বিপুল হাওলাদার	মেয়র কলাপাড়া পৌরসভা	01712877242	৭/১২/১৭
৪.	মো: [illegible]	[illegible]	01718690725	
৫.	[illegible]	[illegible]	01819459528	৭/১২/১৭
৬.	মো: [illegible]	[illegible], NSS, কলাপাড়া	01757682272	৭/১২/১৭
৭.	মো: [illegible]	[illegible] CODEC	01718787743	
৮.	[illegible]	[illegible]	01755532470	
৯.	S. M. Mehedi Hasan	DRM Analyst, World Bank	01827525068	Mehedi
১০.	মো: [illegible] সিকদার	[illegible]	01725651141	
১১.	মো: [illegible]	U.P - [illegible]	[illegible]	
১২.	[illegible]	[illegible]	01775566824	
১৩.	[illegible]	প্রতিনিধি দৈনিক যুগান্তর	01712689367	
১৪.	[illegible]	প্রতিনিধি দৈনিক কালের কণ্ঠ	01711144770	
১৫.	[illegible]	প্রতিনিধি দৈনিক [illegible]	01715042673	
১৬.	[illegible]	[illegible]	01712699815	
১৭.	[illegible]	[illegible]	[illegible]	
১৮.	[illegible]	[illegible]	01720208028	

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উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

স্থান ঃ ~~বরগুনা সদর~~ কলাপাড়া উপজেলা পরিষদ মিলনায়তন

সময় ঃ

তারিখঃ ০৭।১২।২০১৬

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯.	হুমায়ুন কবীর	দৈনিক বরিশালের কলাপাড়া [illegible]	01718440023	
২০.	[illegible]	[illegible] প্রতিনিধি	01728467047	
২১.	[illegible] বিশ্বাস	[illegible]	01739024476	
২২.	মো: আছাদ উজ্জামান [illegible]	সহ: পরিচালক [illegible]	01712200762	
২৩.	[illegible] ইসলাম	[illegible]	01711316365	
২৪.	আ: ছালাম তালুকদার	চেয়ারম্যান ডালবুগঞ্জ ইউ/পি	01715097407	৭/১২/১৬
২৫.	[illegible]	U.D.O	017[illegible]	৭/১২/১৬
২৬.	[illegible]	[illegible]	01725023742	৭/১২/১৬
২৭.	মো: [illegible]	[illegible]	01717886116	
২৮.	মো: [illegible]	[illegible]	01735032545	৭/১২/১৬
২৯.	মো: [illegible]	[illegible]	01718272099	৭/১২/১৬
৩০.	[illegible]	[illegible], CEGIS	0191168671	[illegible] saha
৩১.	[illegible] রহমান	Socio-Economist CEGIS	01713-865525	
৩২.	মো: [illegible]	URDO - BRDB	01714-244355	
৩৩.	ডা: মো: [illegible] রহমান	ULO	01718623474	
৩৪.	সুমন চন্দ্র দেবনাথ	PIO	01912-940894	
৩৫.	[illegible]	UPHE	01740978118	
৩৬.	মো: [illegible]	UAO	01716349939	

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স্থান : ~~[illegible]~~ [illegible] উপজেলা পরিষদ মিলনায়তন

সময় :

তারিখঃ ০৭/১২/২০১৬

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
০১	মো: [illegible]	[illegible]	01712512887	[illegible]
০২	[illegible]	[illegible]	01717325640	[illegible]
০৩.	আব্দুল [illegible]	চেয়ারম্যান	0172-3848256	[illegible]
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Center for Environmental and Geographic Information Services
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

Appendix 6: Photo Album

Picture 1: Non-functioning DS3_3

Picture 2: Non-functioning DS3_1

Picture 3: Non-functioning DS4

Picture 4: Non-functioning FS2

Picture 5:Non-functioning FS3

Picture 6: Eroded Embankment

Picture 7: Eroded Embankment

Picture 8: Pucca road

Picture 9: Road cum embankment

Picture 10: Local Common Fishes

Picture 11: Local Common Fishes

Picture 12: Homestead Vegetation

Picture13: View of public consultation meeting (Lotachiply UPZ)

Picture14: View of public consultation meeting (Lotachiply UPZ)

Picture15: View of public consultation meeting (Lotachiply UPZ)

Picture16: View of public consultation meeting (Kolapara UPZ)

Appendix 7: DoE's Approved Terms of Reference (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

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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] 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.

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Appendix 8: Comments and Responses

Comments, response and actions taken on Draft EIA Report of Polder 48 under CEIP

Chapter	Page no. / paragraph no	Comments	Responses
Executive summary	Page-xxvi	Polderization	Corrected
		Inlet	Corrected
		High tides	Corrected
	Page-xxvii	Net cultivable area	Corrected
		Bay of Bengal i. e.	Bay of Bengal i. e. sea
	Page-xxviii	Pacca/pucka: use any one	Used Pucca
	Page-xxxi	Firm	Used Farm
	Environmental impacts and mitigation measures (Page-xxix)	9 drainage sluice gates are proposed to be replaced by new ones. Whereas, number mentioned at the starting of the document is different. Like: replacement of 2 drainage sluices, repairing of 3 flushing sluice and repairing 4 drainage sluices. What is the actual number?	The actual number of drainage sluices have been mentioned (Page xxix)
	Climate change (Page-xxix)	Why the rate of rainfall (increasing/decreasing) is not significant?	Rainfall is not significant because it is decreasing insignificantly. As such it has been written as not significant.
	Environmental management plan (Page-xxxi)	No EMP is mentioned in this part; rather how monitoring work will become helpful is explained.	It is mentioned in the executive summary
Introduction	Page 1	• **The Government of Bangladesh** • **Scope of work is not clear**	This section has been updated as per comment. Scope of works provided in the report were copied from the ToR of EIA study for 13 Polders.
Approach and methodology	Article 2.2.4, page 11, 12, 13, 16	• **In this report, it is mentioned that, RRA, PRA, FGD are held but no specific location was mentioned for RRA, PRA of survey.(page 11)** • **The approved checklist by MC, CEIP (page 12, paragraph 22) was not attached in annex** • **The process or any other information regarding transect survey is not given (page- 13)**	-During field visit RRA, PRA, FGD techniques have been applied. Number of FGD was conducted in structured way which are mentioned in Chapter 11 (Public consultation chapter). On the other hand, RRA and PRA were carried informally at different locations, as such these were not mentioned in the report -The approved checklist have been appended in the report. -The vegetation and agriculture survey was

Chapter	Page no. / paragraph no	Comments	Responses
		• **"Thefuture-without-project (FWOP) conditions were generated through trend analysis and consultations with the local public."(page-16, paragraph-42) How future-without-project (FWOP) conditions were generated through trend analysis and which type of trend analysis is not explained here. Is it possible to do so?**	conducted through transect survey. -Trend analysis was done for agriculture and fisheries for which historical data could be generated in consultation with farmers and fishers.
Policy, legislative and regulatory framework		The followings are not given which are mentioned in EMF: Private Forest Ordinance (PFO), 1959 Private Forest Policy 1994 Social Forestry Rules, 2004 and Amendments Antiquities Act, 1968 The Embankment and Drainage Act, 1952. Bangladesh Labor Act, 2006 Bangladesh National Building Code, 2006. Detailed Steps of In Country Environmental Clearance Procedure	The policies as mentioned in the comments have been incorporated in the respective chapter (Chapter 3)
Description of the project	Pg 44, pg 47	In several sections, only km of embankment, khal, road are mentioned instead of chainage. To understand properly the spots should be named with chainage.	The chainages for understanding the spots have been provided
	Pg 51, Table 4.3	In table 4.3, there are 3 flushing sluices need to be constructed/ replaced. In Executive summary, 3 flushing sluices need to be repaired. (pg xxvi), which one is correct?	The corrected information has been finalized on the basis of the model result and provided by the MC have been incorporated in the Table 4.3 and Executive summary
	Pg 51, Table 4.3	Design slope for R/S is of two types. Any specific reason?	Polder is located at Kuakata Sea beach. The slope of the embankment varied, along the sea (km 0.00 to 17.00) the R/S of the same is 1:7 while at other location (km 17.00 to 37.88) is 1:3
	Pg 57, fig 4.1	In construction activities, it is said that construction of new embankment will be done but it is not mentioned before? Is it right information?	No new embankment will be constructed in polder 48. It was mentioned in the report by mistake.. This has been corrected and incorporated in the report.
	Pg 64, table 4.9	What are the sources of this information? Are they tentative?	The sources of information are mentioned. The MC has

Chapter	Page no. / paragraph no	Comments	Responses
			provided them tentatively.
	Pg 52-56, Map 4.2, map 4.2 (a, b, c, d)	The dimensions, chainage and information are wrong in Map 4.2, map 4.2 (a, b, c, d). It should be corrected according to table 4.5. Please check all the details in map with table)	Corrected maps with updated information along with chainage have been used and provided in the report.
	Pg 71, article 4.12	The implementation cost is not mentioned.	This has been included in Ch. 4.10, stanza 315, page 98.
Environmental baseline and existing conditions	Pg 78, fig 5.5	The wind speed given in km/day may create confusion as the wind speed in Sidr and Aila was recorded as kph.	The figure has been converted as per comments, the wind speed in km/d has been converted into km/hr.
		The time range for different parameters is different. Why? What is the basis of selecting different time range?	Wind speed is not available before 2000.Climate data of different parameter were available for different period and have been used in different analyses.
	Pg 84, fig 5.7	Why recent data are not used here? Any specific reason?	Surface water level data was not available in BWDB after 1987.
	Pg 84, fig 5.8	Is it GWT or depth of GWT? Which one is correct?	It is depth of GWT and the heading of the Figure 5.8 has been corrected.
	Pg 85, fig 5.9, fig 5.10	March is considered as dry period. Then how the water level increases in march because the trend line is increasing in the graph? And the R^2 values are ok or not, need to be checked.	This paragraph (Para. 246) has been revised according to the comments and R^2 value has been checked.
	Pg 137, footnote 15	Total dependency ratio, child dependency ratio, aged dependency ratio equations are missing in footnote.	This has been considered in the report.
Environmental impact and mitigation measures	Pg 150-151, table 6.1	What does N, LP, LN mean?	It is mentioned through mistake in the table. The table has been corrected.
	Pg 154, table 6.2	The species name should be given in English or scientific names can also be used if available.	Scientific name of the species are given in the table (Table 6.2)
	Pg 166, mitigation of resection of embankment	Instead of durba, mutha, vetiver can be used which is good for slope protection. BWBD and Bangladesh Forest Research Institute already have a guideline on this and consultant should take note of that document.	Durba and Mutha can be used as these grasses roots penetrate at shallow depth and not are aggressive to other plants. On the other hand, *Vetiver* is aggressive, with deep penetrated roots and is favorable to mouse. So, it may threatened of the embankment Stability.
	Pg 169, mitigation of cyclonic storm	Is it possible to monitor seepage of surface water regularly? How?	It is possible through physical monitoring by the local BWDB officials under

Chapter	Page no. / paragraph no	Comments	Responses
	surge and tidal flooding		the Operation and Maintenance works.
Climate change impact	Pg 201	The term RCP is used but not enlisted in abbreviations.	It has been enlisted in the abbreviations
Cumulative and reciprocal impacts	Pg 214, 216	Article 9.4.3 and 9.5.3 are same. Any justification of repeating same article?	The chapter consisting of cumulative and reciprocal impacts has been revised.
Development of environmental management plan	Pg 229	For surface water quality, the frequency is half yearly. It should be mentioned that quality should be checked except wet season. Because of heavy water flow in wet season, the concentration could be diluted.	As per comments, it has been mentioned in the monitoring section

Appendix 9: Comments by Mr. Marcelo (WB) and Responses by CEGIS

All the comments for Polder 47/2 are not applicable for other Polders. The relevant comments have been addressed in Polder 48.

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

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
4	Page 61, Description of construction activities. It is not explained how is the necessary transport movement to get to the various project sites with machinery and ancillary interventions.	Transportation modes for carrying construction instruments and materials to the site has been described.
5	It is important to determine where disposal sites for excavated soil/sludge are.	It has already been mentioned
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	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 **4.9.8** have consulted, accepted by stakeholders involved and implemented? Is there capacity to do that? Who is going to deliver training?	Section **4.9.8** 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	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	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.

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
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	It is describe, key environmental baseline conditions that would be reverted by the project and that need to be better 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.	All the issues and key issues have been addressed. But have not been prioritized.
15	Section 5.3.1. 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 390. 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
18	The section 5.3.6 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	Section 5.3.9. 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.

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
20	Para 408. 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 carrying their livelihood. After bad functioning of the polders and sluices fisheries activities reduced substantially.
21	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.
22	Section on 5.3.10 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.	This has already been mentioned in para 412 and Table 5.22. Shannon-Weiner Diversity Index and Sympson's Index has been used to analyze the fish diversity. The Table 5.22 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.

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
23	Section 5.4 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.
24	Para 432 on pesticides. It would be important to know if the polder interventions would incentivize the use of pesticides in a context of improved agricultural activities that might need more inputs.	Yes, because farmers will grow more High Yielding Variety of crops after implementation of the project interventions.
25	To what extent the market mentioned in para 475 is sensitive to project's interventions.	This issue is sensitive to project interventions of which impact has been discussed .
26	Has the Bank reviewed the RAP?	Yes, the RAP report has been reviewed by World Bank
27	How the potential impact on social network would be addressed?	This issue has been addressed in the respective paragraph
28	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
29	Para 491. What is the meaning of proper compensation?	Omitted this sentence
30	Para 509 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
31	Para 523. 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
32	Section 6.46. 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.
33	Para 538. 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
34	Para 541. 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
35	There is not mention to water related diseases such as Malaria.	There is no Malaria disease in the polder area.
36	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
37	The mitigation measures of para 582 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)
38	Para 583. 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.
39	We need a scientific reference to support the statement related to increased fish production.	As comment is not clear, response could not be addressed.
40	The WB 2010 report is not mentioned in the list of references.	It has been included in the list of references
41	Section 9.2. This is an important item and it is not clear which is the cumulative impact?	This chapter has already been revised
42	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.
43	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 5.5.11. As there is no cultural heritage in the polder, there will be no impact on cultural heritage.

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
44	Malaria risk has not been considered as part of the baseline.	There is no risk of malaria in the surrounding areas.
45	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.
46	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

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 use 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 ৪৩/২সি এর গেটপরিচালনায় 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;
- বর্ষাপরবর্তীসময় (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 ক্ষেত্রেওএকই 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@nl.dhv		
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 Resou	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 (A-3)	MOWR	ahsan.en@gmail.com 01711431009	MAHFUL 01915531903	
8	Ebrahim Akanda	CEGIS	ebrahimakhand@yahoo.com	01675507173	
9	Md Zaid Hussain Bhuiyan Deputy Chief Conservator of Forest	FD	dccf-adtw@bforest.gov.bd	01712-074357	
10	Md. Delwar Hossain PD/CEIP-1	BWDB.	Php.mucEIP@gmail.com	Rashed. 01723881698	
11	MD CHAN MIA	P.I.D	chanmia.pid08@gmail.com	01712223881	
12	Md. Abdul Hannan XEN, CEIP, BWDB	BWDB	xen.ceip1.khulna@gmail.com	Taleb	25/1/17

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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. Nowazesh Asst. Director	MoWR	01911282278		
15	Md. Habibur Rahman	CEIP-1	01199808796	Rony	
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 Chowdhury	CEGIS		01938242287	Jalal
22	K B S Rahman	CEGIS		01730320385	
23	Mir Sajjad Hossain	CEGIS			
24	Sakib Mahmud	IWA		01852833381	

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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 Halung Ramgun CEIP Snt'l Environment Adist	DHI			Apel
26	MOTAHER HOSSAIN CE. Ganges Barrage	BWDB	motaher_hossain @yahoo.com		Motaher
27	Md. Abdur Rahman Akhanda ADG (P)	BWDB			
28	Md. Mahbubar Rahman	CEIP			
29	Md. Abul Kausar SE / BWDB	BWDB	sami_kausar@yahoo.com	Md Ahsanullah vehicle no: 3083	Kausar
30	GERARD PICHEL	RHDHV	fatty zebra@ gmail Com		

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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	Muhammed Anisur Rahman	PLA	mazizur@ccomsltd.com		Anis
33	Glandly Chong	DDPYN			
34	Saika Nowshin Junior consultant	CEGIS	nowshin.sait_@ gmail.com 01673602 6625		Saika
35	Shihab Monjur Research Consultant	CEGIS	shihab186@live.com 01735363323		S.Monjur
36	AKM Hasan	CEGIS	01911364049		

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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	IRC	shahid.215ce@yahoo.com 01712831502		
38	Khair Reporter	Metar	01916143317		
39	Md. Sarfaraz Wahed.	CEGIS	01712209364		
40	Faria Tuz Zahura	CEGIS	01675489594		
41	Dr. Maminul Haque Sarker	CEGIS	01817006780		
42	Asma Akter	CEGIS			Asma

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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 Hana	CEGIS			
46	Dr. Ashadul Alam Sr. Env. Specialist	PMU,CEIP-1 BWDB	01747215770		25.01.2017
47	Shaheen Afrose	CEGIS	01715304133		25/01/2017
48	Chaitanya Kumar Das Director Field service wing DAE	DAE	01718956169 kkdaldas@yahoo.com	Lookman	25.1.17

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Dissemination Seminar on
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49	Jan T. Twarowski Team Leader M+E Consultants	Sheladia Associates USA	jant@sheladia.com	Ali	
50	Dr. Kazi Nurul Newaz Advisor,	CEGIS	[illegible]@cegisbd.com		
51	Dr. Sajid	C3ER BRAC Uni	sajid_ru@yahoo.com	01921X983934	
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53	Md. Gulzer Hossain	CEIP-1		-	
54	ANISUR KAWSAR WAWESI	BETS			

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55	K. M. Aminul Haque	BWDB	01552397776	Dhalu	
56	Jasim Uddin Ahd	BWDB/HQ	01716209774		
57	Dr. AZHARUL HAQ	BWP	01819212996	Iskander	
58	Dr. Ashraful Alam	CEGIS	01818290847		
59	Md. Ahmed [illegible]	CEGIS	01715712614		
60	Anjuman Ara Baby	CEGIS	01711-377-306	—	

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61	Md. Khalequzzaman Chief Planning	BWDB	01822812562 cplan.wdb@yahoo.com	Jahangir	
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63	AKM Tahmidul Islam	BWDB	01712171241	Selim	
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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	
68	MD. SHAHJAHAN X-DG, WARPO		01715078833		
69	Mihir Biswas	BAPA	01700678233		
70	Enter Ali	BTV	01911988779	Sowit	
71	MUSA NURUR RAHMAN SUPERINTENDING ENG	BWDB	01715740505	Oli	25.1.17
72	Mohammad Alamgir Principal Scientific Officer	WARPO	01556555689		

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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 Mattorul Murshed	Reporter Naya Diganta		own # (01718417187)	
77	Mantu Kumar Poddar Joint chief	Ministry of Water	aditya_sudityo @yahoo.com	0177 21 43441 Mr. Razzak Driver	
78	Mohammad Abdur Rashid	CEGIS			

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83	Md. Safiul Alam	CEGIS	safiul_bau@yahoo.com 01707709758		
84	Md. Ashraful Alam	CEGIS	01722602667		

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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	[illegible]@gmail.com 01911686[illegible]		Sanat Saha
88	Muhammad Shahidur Rah[illegible]	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		

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92	Badal Md. Faruque principal Specialist	CEGIS	BFARUQUE@CEGISBD.COM 01715111661		
93	Motaleb H. Sarker Director Ecology	CEGIS	0171501549		
94	Mamun Mamun	Somoy TV	0196444127		
95	Md. Amanat Ullah	CEGIS	01717443291		Amanat
96	Marshuda Parvin	CEGIS	01705066867		M. parvin

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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	It has already been considered in the study.

Sl.	Comments/suggestions	Responses
	(WMO) for proper maintenances of the polder.	
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.

Sl.	Comments/suggestions	Responses
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 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.
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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
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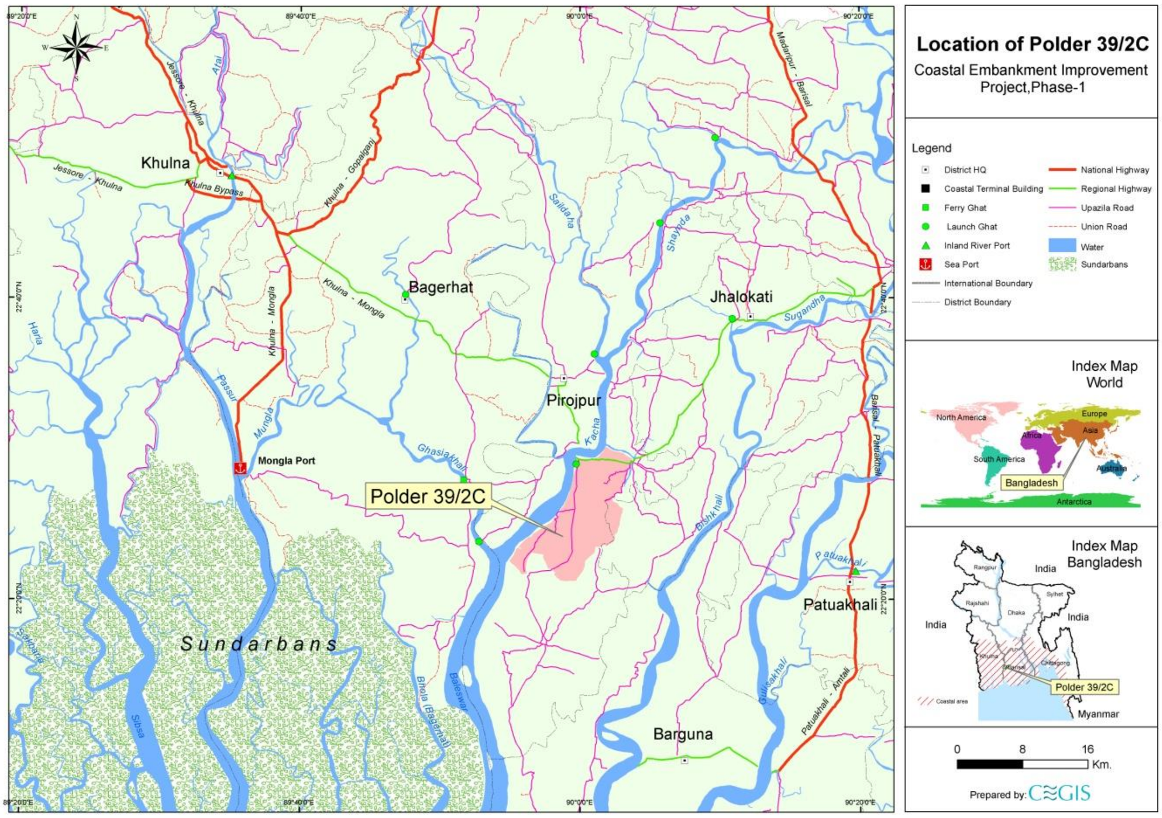
Government of the People's Republic of Bangladesh
Ministry of Water Resources
Bangladesh Water Development Board

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- 48 FOR PACKAGE-2

February 2017

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.