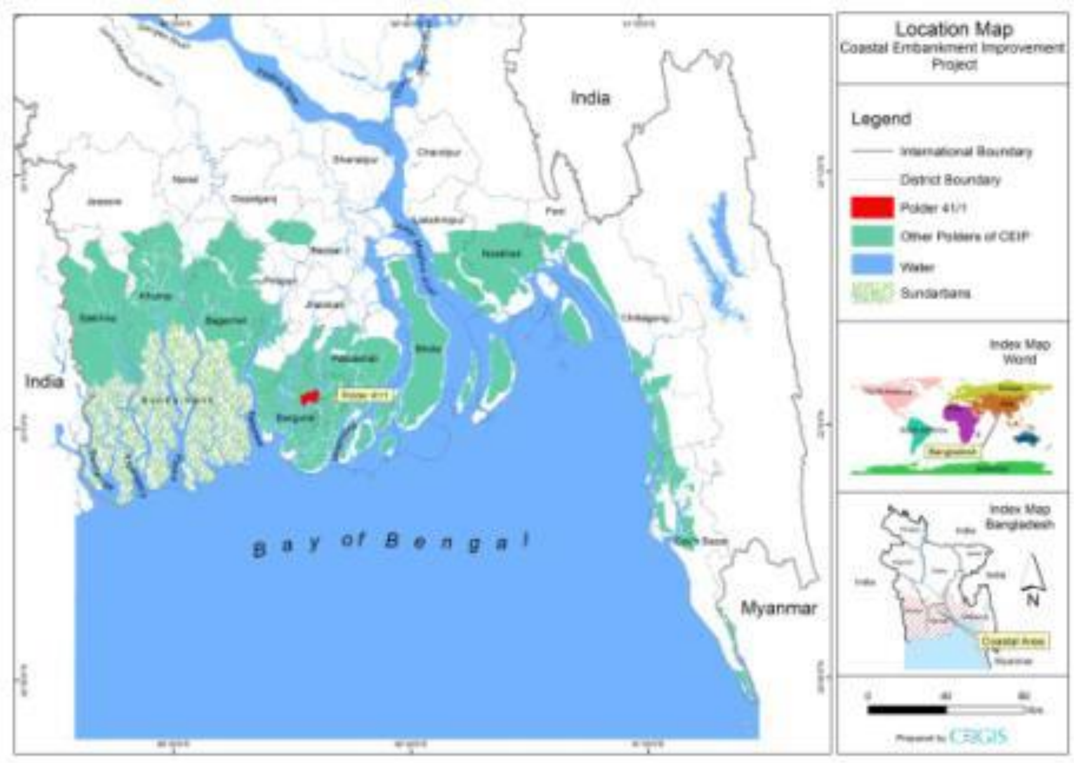
Final Report

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 41/1 FOR PACKAGE-2

February 2017

EIA 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	Alluvion-diluvion
ASA	Annual Development Plan
AEO	Assistant Extension Officer
AP	Affected Person
ASA	Association for Social Advancement
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorology Department
BP	Bank Procedure
BRDB	Bangladesh Rural Development Board
BRAC	Bangladesh Rural Advancement Centre
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CBOs	Community Based Organizations
CCP	Chittagong Coastal Plain
CDS	Coastal Development Strategy
CDP	Coastal Development Partner
CEGIS	Center for Environmental and Geographic Information Services
CEIP	Coastal Embankment Improvement Program
CEIP-1	Coastal Embankment Improvement Project, Phase -1
CERP	Coastal Embankment Rehabilitation Project
CMG	Canal Maintenance Group
CES	Consulting Engineering Services
CAFOD	Catholic Fund for Overseas Development
CS	Construction Supervision
CLAC	Central Land Allocation Committee
CZPo	Coastal Zone Policy
DAE	Department of Agricultural Extension
DC	Deputy Commissioner
DSC	Design & Supervision Consultants
DCEO	Deputy Chief Extension Officer
DD	Deputy Director

DCSC	Design and Construction Supervision Consultant
DEA	Department of Agricultural Extension
DEM	Digital Elevation Map
DOE	Department of Environment
DOF	Department of Fisheries
DPHE	Department of Public Health Engineering
DPM	Design Planning & Management Consultants
DTW	Deep Tubewell
DWM	Directorate of Water Management
EA	Environment Assessment
EAP	Environmental Action Plan
EC	Executive Committee
ECA	Environment Conservation Act
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules
ECoP	Environmental Code of Pracetice
ECRRP	Emergency 2007 Cyclone Recovery and Restoration project
ESCU	Environment, Social and Communication Unit
EDS	Environmental Data Sheet
EIA	Environmental Impact Assessment
EMG	Embankment Maintenance Group
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EO	Extension officer
ES	Embankment Settler
ESBN	Estuarine Set Bag Net
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
FIDIC	International Federation of Consultaing Engineers
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
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
MC	Main Consultant (for CEIP-I Feasibility study)
MDP	Meghna Deltaic Plain
MOEF	Ministry of Environment and Forest
MOL	Ministry of Land
MOWR	Ministry of Water Resources
MP	Muriate of Potash
MSDS	Project Management Data Sheets
MSL	Mean Sea Level

NAPA	National Adaption Program of Action
NCA	Net Cultivated Area
NCR	Non-Compliance Report
NGO	Non-Governmental Organization
NOC	No Objection Certificate
N,P,K	Nitrogen, Phosphorous, Potashium
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
RCP	Reinforced Concrete Pipe
RCC	Reinforced Concrete Cement
RL	Reduced Levels
RRA	Rapid Rural Appraisal
SAEO	Sub-Assistant Extension Officer
SDE	Sub-Division Engineer
SEA	Strategic Environmental Assessment
SEO	Secondary Education Office
SLR	Sea Level Rise

SMG	Structure Maintenance Group
SO	Sectional Officer
SRDI	Soils Resources Development Institute
SSO	Social Service Office
STW	Shallow Tubewell
TAO	Thana Agriculture Officer
TDS	Total Dissolved Solids
TOR	Terms of Reference
TPV	Third Party Validation
TSP	Triple Superphosphate
UFO	Upazila Fisheries Office
UNDP	United Nations Development Program
UP	Union Parishad
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: 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 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 days(1/2 days a week,days varies in different location), where people gather for selling and buying of commodities.

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 consist of a hole without cover.

Perennial Khal: Water available in the khal all the year round.

Pucca: Well constructed building using modern masonary materials

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

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

Seasonal Khal: Water not available in the khal all the year round.

Semi-pacca: 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 crop, 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 Hectare	= 247 Decimal
1 Hectare	= 7.5 Bigha
1 Hectare	= 2.47 Acre

Executive Summary

Background

Bangladesh is a low- lying flat delta at the confluence of the Ganges-Brahmaputra-Meghna rivers system. The country is crisscrossed with an intricate network of rivers and also has a long coast line in its southern side which is about 710 km long and runs parallel to the Bay of Bengal through 19 districts and 151 upazillas. The coastal region occupies 20% area of the country. The coastal region is highly susceptible to various natural calamities viz. tidal floods, storm surge, river floods, salinity intrusion which makes livelihoods vulnerable. In order to mitigate the sufferings of the inhabitants to some extent the GoB with the assistant of donors has built 139 polders in the coastal region since 60s. The polders in this area are enclosed on all sides by dykes or embankments, separating the land from the main river system and offering protection against tidal floods, salinity intrusion and sedimentation. The polders were designed to keep the land safe from regular tides and to allow agriculture activities. These polders were equipped with flap gates to control the water inside the embanked area. The polders have been dilapidated due to erosion and lack of proper maintenance. In addition to breaching of the embankments due to cyclones and river erosion, siltation of peripheral rivers surrounding the embankment caused coastal polders to suffer from water logging, which lead to large scale environmental and social degradation and economic loses. Besides, the climate change impact has prompted Sea Level Rise (SLR) and height of the storm surges. Recent cyclones caused substantial damage to the embankments and threatened the integrity of the coastal polders. These polders are required to be rehabilitated for proper functioning towards saving the residents of the localities from the disaster and ensure agricultural and other livelihood activities.

With this end in view, the Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase-1 (CEIP-1), under which seventeen polders will be rehabilitated and improved in the coastal area of the country. The project is being finalized by the World Bank (WB). Polders 32, 33, 35/1 and 35/3 are included in first package of which EIA studies have been conducted. Polders 43/2C, 47/2, 48, 40/2, 41/1 and 39/2C are included in package two and polders 14/1, 15, 16, 17/1, 17/2, 23 and 34/3 are included in package three. The polder under Package-1 is presently being implemented. In accordance with the national regulatory requirements and WB safeguard policies, EIA study of six polders under package two has been carried out. This document presents the EIA report of Polder 41/1, which is one of these six polders of package 2.

Location and Synopsis of Rehabilitation Work

Polder 41/1 is located in Barguna Sadar Upazila under Barguna District. The polder covers two Union Parishads (U/P), namely Burir-Char and Aila Patakata.. The gross area of polder is 4,048 ha of which the net cultivable area is 3,440 ha.

The aim of the polder improvement project is to enhance protection against natural disasters, increase resilience during and after disasters, and improve agricultural production by reducing saline water intrusion. To meet up the objectives of the CEIP-I, improvement works to be carried out in Polder 41/1 under CEIP-1 are: re-sectioning of embankment (33.70 km); construction of retired embankment (1 km); replacement of 10 drainage sluices; construction/replacement of 19 flushing inlets; re-excavation of drainage channels (33.25 km); bank protection works (0.875 km); and afforestation on the foreshore areas (22 ha). CEIP-I study will also include implementation of social action plan and environmental management plan; supervision, monitoring and evaluation of project impacts; project management, technical assistance, trainings, and technical studies; and contingent emergency response. The Bangladesh Water Development Board (BWDB) is the implementing agency of this Project.

Regulatory and Policy Framework

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

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

Environmental Baseline and Existing Conditions

The Polder 41/1 is situated in a low-lying coastal region. The major portion of this deltaic sediment is deposited subsequently in the permanent body of water where tidal waves and velocity helps in transportation and deposition. Land Levels inside the polder vary from 0.56 to 5.18 m +PWD with average level of 2.86 m +PWD. Polder 41/1 is surrounded by the Payra (Buriswar) River in the east and the south and Khakdon River in the North. Khakdon River flows from the north-west corner of the polder and narrows down to Keorabunia Khal in the north-east corner of polder. Apart from these rivers, the polder is bordered by Bashbunia Khal in the west. A number of khals situated within the polder are supported by these peripheral rivers and khals. The Chhoto Lobongola khal, Burir Char khal etc. are the distributaries of the Payra, and maintain the water resources functions of the polder. Water quality parameters (pH, TDS, DO and salinity) have been measured at different locations of the internal khals and rivers. The surface water salinity was found as zero in both wet (June, 2015) and dry (February, 2016) seasons respectively.

The total population is 47,859, with 24,071 males and 23,788 females, are living in the polder area. Here the male population is higher than the female population. The estimated household number is 11,133. The inhabitants of this Polder belong to two main religious faiths; i.e. the Muslims and the Hindus. Among them, about 91% of the total population are Muslims and 9% are Hindus. Agriculture is the main occupation in the polder area followed by fishing and agriculture labor. The housing condition in the polder is dominated by kutcha houses (85%) over other three types of housing (semi-pucca, pucca and jhupri houses). Sanitation system in the polder area is satisfactory and about 24% of households use non-sanitary latrines whereas 46% use non water-sealed sanitary latrines. Water-sealed sanitary latrines are available predominantly in pacca houses which contains 27% of the total sanitation system.

The total polder area is 4,048 ha, of which 3,440 (85% of total land) ha is available for cultivation. The single, double and triple cropped areas are 22%, 72% and 6% of the NCA (Net Cultivable Area) respectively. The remaining 15% of the land is covered by settlements and water bodies (khal) etc.

The polder area is covered by four types of lands, e.g flood free land/high land (FF), high land (Fo), medium high land (F1) and medium low land (F2) respectively. These land types occupy around 37%, 43%, 18% and 2% of the net cultivable area (NCA) of the polder area respectively. The salinity of the soil have low to very high level in the dry season and soil salinity level and pH values range from 4.9 to 18ds/m and 5.2 to 7.6 respectively.

Total cropped area is about 6,344 ha in the polder area of which 5,552 ha area is covered with rice and 792 ha with non-rice crop. The dominant cropping patterns in the Polder area are T. Aus (HYV)-T Aman (HYV)-Fallow and T. Aus (Local)-T. Aman (Local)-Fallow practiced on about 23.5 % and 16.3% of the net cultivable area respectively. Thus, cropping intensity of the polder area is 184%.

Total crop production is 15,502 metric tons of which rice production is 12,400 metric tons and non-rice crop production is 3,109 metric tons. The contribution of T. Aus (Local), T. Aus (HYV), T. Aman (Local), T. Aman (HYV) and Boro (HYV) are 15%, 21%, 25%, 35% and 4% respectively.

The estimated total fish production of the polder area is 546 tons. Bulk of the fish production (about 60%) is from capture fisheries and the remaining from the culture fisheries. The internal khals (both perennial and seasonal) are acting as major arteries of fish migration inside the polder area. Most of the perennial khals have been silted up and water-flow during dry season is very low.

The tidal floodplain is characterized by mixed vegetation and supports a habitat of rich bio-diversity due to the presence of many stagnant waterbodies and channels, rivers and tributaries. The major divisions found within the terrestrial ecosystems of the project area are: i) agricultural land, ii) settlement/ homestead vegetation, iii) embankment and roadside vegetation and iv) fallow lands. Aquatic habitat in this area includes tidal floodplain, internal channels and homestead ponds.

Potential Impacts and their Mitigations

Pre-construction phase

The potential environmental and social impacts associated with the **pre-construction phase** of the project include increased vehicular traffic during mobilization of machineries and equipments, change in landscape, loss of agricultural land and air and noise pollution. Among these, establishment of the contractor's temporary site facilities may involve land clearing, land leveling, excavation and construction of buildings. More than 36,000 timber and fruit yielding trees are suspected to be cut down for trenching at proposed points of the embankments for construction of new structures. Moreover, shrubs and herbs will also be damaged for contractor's temporary site facilities.

During-construction phase

The potential impacts during the **construction phase** include increased drainage congestion and water logging, affects on irrigation, soil and water contamination, generation of noise and vibration, hindrance of pedestrians and vehicular movements loss of agricultural crop production, destruction of feeding and spawning ground of fish, disturbance of fish habitats and fish migration, damage to benthic fauna, loss of vegetation, and interruption of road communication.

The key construction activities which are likely to cause environmental and social impacts include construction of camp establishment and operation, equipment and material transportation, material borrowing, excavation, embankment raising, repair and construction of regulators, re-excavation of water channels and waste disposal.

The Project activities such as the replacement of regulators and sluices in water channels may block or clog the drainage channels, potentially causing water logging in the surrounding areas and negatively affecting the cultivation and the associated communities. In particular, areas along Kewrabunia and Chorokgachia water channels are already facing drainage congestion, and this might worsen during the construction period. On the other hand, irrigation facilities for both wet and dry seasons, at Purbo Kewrabunia, Napitkhali and Chhotolobongola area will be affected.

It is apprenhended that activities of bank revetment and slope protection (earth work from km 4.0 to km 5.0) might cause partial (in the dry season) or complete destruction (in the rainy season) of the feeding, nursery and even spawning grounds of the fish species, such as *Paissa, Gulsha Tengra, Bagda*, etc. During embankment re-sectioning activities, all the existing undergrowth vegetation will be cleared from both the slopes as well as of the soil collection sites. Existing bankline vegetation of Malther Khal, Charakgachia Khal, Langolkata Khal, Doctor Bari Khal and Chaltatola Khal will also be damaged for withdrawal of soil from channel bed. Moreover, during the movement of excavator/labour as well as spoil dumping along both sides of channel banks would also damage the existing vegetation there. However, most of the marginal vegetations are grown seasonally and will re-establish within a few years after completion of re-excavation activities.

The fish habitat as well as benthic community will be damaged during re-excavation of channels. Fish migration between outside rivers and internal channels is likely to be affected. The spawning time for open water fish in the channels is late June to August. Similarly, fish migration within the Polder between the channels and floodplains can also be affected for the construction activities, particularly during the channel re-excavation.

In addition, there may be health and safety hazard from the heavy construction equipments. The construction workers are likely to be exposed to these hazards during the construction phase. It is apprehended that the construction activities may be hampered as well as the workers may get injured due to the occurance of natural hazards (cyclone and storms surges). The construction activities along the embankments will also cause temporary disturbance in the movement of the local people. Social unrest due to conflict between the local labours and outside labours may also take place. The presence of outside labors can potentially disrupt the privacy of the local population, particularly the women, whose mobility can be negatively affected.

Project operation phase

The potential impacts **during the operation phase** include soil and water contamination associated with increased usage of fertilizers and hindrance in fish migration. Lack of regular maintenance may create weak points at the sensitive locations of the embankment. Mal-maintenance, increasing intensity and magnitude of the cyclone and storm surge simultaneously may accelerate the risk of embankment failure. Mal-operation and leakage of regulators combine can and most probably will, result in salinity intrusion during the low flow season, causing severe damage to the soil, water resources, and crops in the Polder. Total cropped area would be changed after implentations of the proposed interventions. The total cropped area would be 7,358 ha of which rice cropped area would be 6,235 ha and non-rice cropped area would be 1,123 ha. It is estimated that the total crop production would be 37,001 m. tons of which rice 22,687 m. tons and non-rice 14,314 m. tons respectively. Rice production would be increased due to expansion of T. Aus (HYV), T. Aman (HYV) and Boro (HYV) and production of all non-rice crops will also increase, except pulses and oil seeds cultivation area. Additional 21,492 m. tons crop would be produced of which rice production would 10,288 m. tons and non-rice would be 11,204 m. tons in the polder area. The expansion of irrigated area as well as increased cultivation area will increase the use of chemical inputs including fertilizers and pesticides. This additional use of agrochemicals in the crop field may degrade the soil quality. Moreover, runoff of residual agro-chemicals in the water bodies (i.e. channel, floodplain) may deteriorate the water quality which in turn may cause negative impact on aquatic biota.

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, busy markets and bazaars can be avoided during peak hours. To address the air and water pollution, the contractor will prepare and implement a Pollution Control Plan which will be included in the Environmental Action Plan prepared by the contractors. Similarly, to address the safety and public health concerns, the contractor will prepare and implement an Occupational Health and Safety Plan. To avoid the natural hazards, weather signals will have to be considered by the contractors during constructions. Besides, radio and television will be provided in all labour sheds for labourors to receive weather information through these media.

On the positive aspect, the construction work will generate significant opportunities of employment throughout its construction period to the local people and other associated professionals. People will also be involved to carry out operations and maintenance related jobs to operate the hydraulic structures. It is expected that, the agricultural production will be increased and water logging will be decreased in the project area which will create jobs indirectly in agriculture, business and commercial services sectors.

Analysis of Alternative

Several alternatives were considered during the design phase of the project. These include 'no-project' alternative and technical alternatives.

The present situation of the Polder is extremely vulnerable to cyclones, storm surges, wave action and climate change impacts. 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. A considerable portion of the Polder area is vulnerable to saline water intrusion and water logging. Due to high salinity and scarcity of ground water during the periods of low rainfall, the area under irrigation is limited to a small proportion of the total Polder area. The silted up water channels are resulting in limited navigation in their waterways, declining fisheries, and increasing environmental pollution. The proposed interventions under CEIP-1 have been designed to address the above mentioned problems of the Polder. If the proposed interventions are not implemented, the present poor state of the Polder will continue and may further be deteriorated; therefore the 'no-project' alternative is not a recommended option.

Several technical alternatives were considered to address each of the problems. These included alternatives for embankment strengthening, river bank protection works, protection of embankment slopes, replacement of drainage sluices, rehabilitation of flushing sluices and addressing of water logging and drainage congestion.

Climate Change Impact

Climate of the study area is typical monsoon considering four seasons: winter season – December to February, pre-monsoon – March to May; monsoon – June to September and post-monsoon-October-November. The temporal plots of the annual and seasonal precipitation of Polder-41/1 have been drawn to investigate the nature of inter-annual fluctuations. Rainfall projection is found to be -8.3, 12.2, 1.7, 14.2% and -2.0, 1.0, -4.6, -18.5% for winter, pre monsoon, monsoon, post-monsoon in 2030 and 2050 respectively.Maximum surface air temperature may change by 1.1, 0.3, 0.6, 0.9^{o}C and 1.8, 1.3, 1.3, 1.2^{o}C for winter, pre monsoon, monsoon, post-monsoon in 2030 and 2050 respectively. Maximum surface air temperature may increase in winter season in future. Similarly, Minimum surface air temperature may change by 1.7, 1.0, 0.8, 1.3 and 2.2, 1.9, 1.4, 1.3 for winter, pre monsoon, monsoon, post-monsoon in 2030

Commulative and Reciprocal Impact

The polder is surrounded by Polder 41/6B (north), 41/6A (north-east) and 41/2 (west) and is located on the bank of the Payra River. The design crest level of Polder 41/1 is from 5.0 to 5.7 mPWD whereas the level of Polder 40/2 is 5 to 6 m. The implementation of CEIP-I in Polder 40/2 would not divert storm surges further upstream and downstream because the area is not hydrologically connected with the Polder 41/1.

Siltation in the rivers or water bodies outside the polder would cause drainage congestion on a more frequent basis. The smaller khals and rivers, i.e. the Khagdon River would undergo frequent water congestion. During low tides, the Khagdon River and Keorabunia Khal become shallower. In the next few years, there is a possibility of the Khagdon River and Keorabunia Khal being filled up permanently due to accumulation of silt and low flow velocity.

Climate change has a long term effect on the Polder as well as on the surroundings of the coastal areas. In this connection, reciprocal impact of climate change along with improvement of the polder has been assessed simultaneously. In this case, a hydrodynamic model result was used. The projection of 2050s hydrodynamic model result indicates a higher storm surge level and wave height that may deteriorate the drainage condition, inundate agricultural land, overflow local water bodies and also cause salinity intrusion.

Environmental and Management Plan

The environmental management plan (EMP) provides the implementation mechanism for the mitigation of impacts. A comprehensive EMP which focuses in managing construction phase-related impacts should suffice in managing the potential construction and operation phase impacts. The total cost of EMP implementation for Polder 41/1 has been estimated as BDT 23.96 million of which monitoring cost 0.8 million . 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 cleared by BWDB and World Bank.

Extensive monitoring of the environmental concerns of the Polder 41/1 will be required as per World Bank guidelines. 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 will be included in the EMP for specific sub-projects. Moreover, for all types 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.

Institutional Responsibility and Report Requirement

The contractor is responsible for the implementation of EMP during construction works and the Project Supervision Consultant will be primarily responsible for supervision of the implementation of the EMP. BWDB will conduct field inspections and surveys by the environmental specialist (to be employed by BWDB on regular basis) at the field. S/he will report to the Senior Environment Specialist at the Head Quarter. The M&E consultant will be responsible for independent monitoring the implementation of EMP, as well as 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 up to ensure environmental management during the project operation period. An Environmental Management Unit of BWDB, strengthened through this project, will ensure and oversee the environmental management during project operation.

BWDB will prepare the Quarterly/Bi-annuallyAnnual Report on environmental management and will share with World Bank for review. Contributing development partners (if any) may join the field visit to understand the environmental compliance of the project. In addition, the third party monitoring firm along with the project component activity monitoring quarterly/bi-annually/annually will carry out the effectiveness of screening, monitoring and implementation of EMP. The Environmental Audit Report prepared by the third party monitoring firm will be shared with the safeguards secretariat.

The project activity will be implemented through systematic organizational structure adopted by BWDB headquarter and field level. The Project Management Unit will implement the project and the Project Steering Committee under the Ministry of Water Resources will oversee and monitor overall activities. The Environment, Social and Communication Unit (ESCU) to be established to implement and manage the EMP will be structured 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 a subproject specific environmental screening/assessment report with EMP; supervise the implementation of EMP and support capacity building of the field level staff of BWDB and the contractor. The ESCU will review the EMF and ensure quality of the environmental screening/assessment with EMP.

Stakeholder Consultation and Disclosure

Several public consultation meetings were conducted with the participation of the local people, representatives of local government (Union Parishad and Upazila Parishad) and representatives of the BWDB. The local people have shown much interest for the project and were of the opinion that its implementation would be important for their survival. They have at all no objection for the project to be implemented. They also expressed that if the monitoring plan is implemented properly during the pre-construction, construction, post-construction and operation phases, they would help the implementing agency spontaneously. Public disclosure meetings will be carried out for disclosing the impact of the Project and the Environmental Management Plan (EMP).

1 Introduction

1. The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase- 1 (CEIP-1) (In the following referred to as the 'project'), under which seventeen polders will be rehabilitated and improved in the coastal area of the country in three packages. The GoB has obtained financial assistance from the World Bank (WB) for the polders under CEIP-1. Polders 32, 33, 35/1 and 35/3 are included in first package of which the Environmental Impact Assessments (EIAs) have been completed and the Environmental Management Plans (EMPs) prepared. 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. In accordance with the national regulatory requirements and WB safeguard policies, EIA studies of the six polders under package two have been carried out. This document presents the EIA report of Polder 41/1.

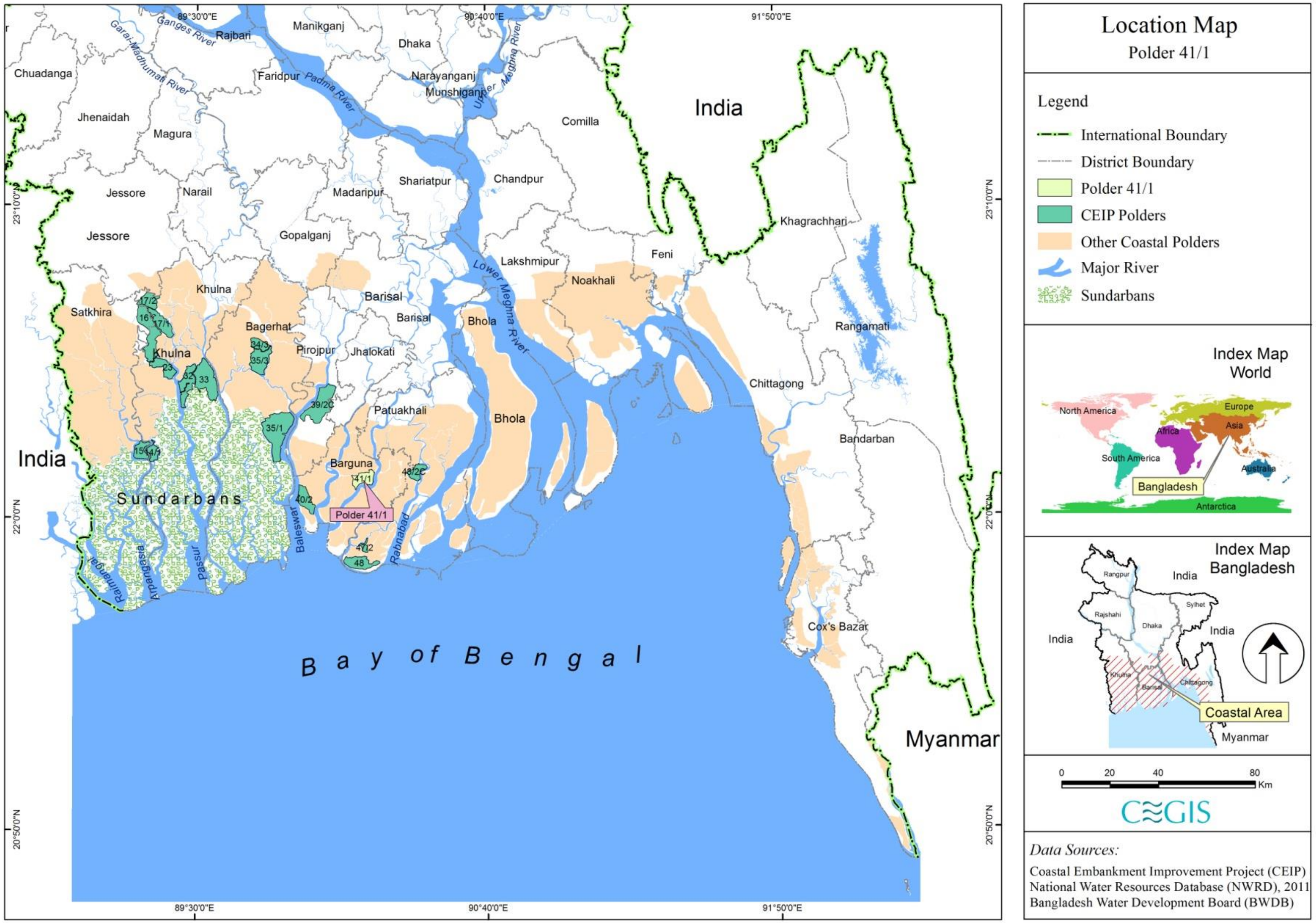
1.1 Background

2. Bangladesh is a low lying flat delta at the confluence of the Ganges-Brahmaputra-Meghna rivers system. The country is crisscrossed with an intricate network of rivers and also has a long coast line in its south side which is about 710 km long and runs parallel to the Bay of Bengal through 19 districts and 151 upazillas.

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

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

5. The above reasons have led the Government of Bangladesh (GoB) to readjust its strategy on the coastal area from ensuring protection against high tides only but to the protection against frequent storm surges as well. The long-term objective of the GoB 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 approach of embankment improvement and rehabilitation was adopted over a period of 15 to 20 years. The proposed CEIP-1 is the first phase of this long-term approach.



Map 1.1: Location of coastal Polders

1.2 Project Overview

6. The Polder 41/1 is located in Sadar upazila under Barguna district of southern Bangladesh (**Map 1.2**). The Polder covers a gross area of 4,048 hectare (ha) with net cultivable area of 3,440 ha. The Project aims to enhance protection against natural disasters, increase resilience during and after disasters, and improve the agricultural production by reducing drainage congestion. To meet up these objectives, the following key improvement and rehabilitation works will be carried out in Polder 41/1 under Package 2, CEIP-1:

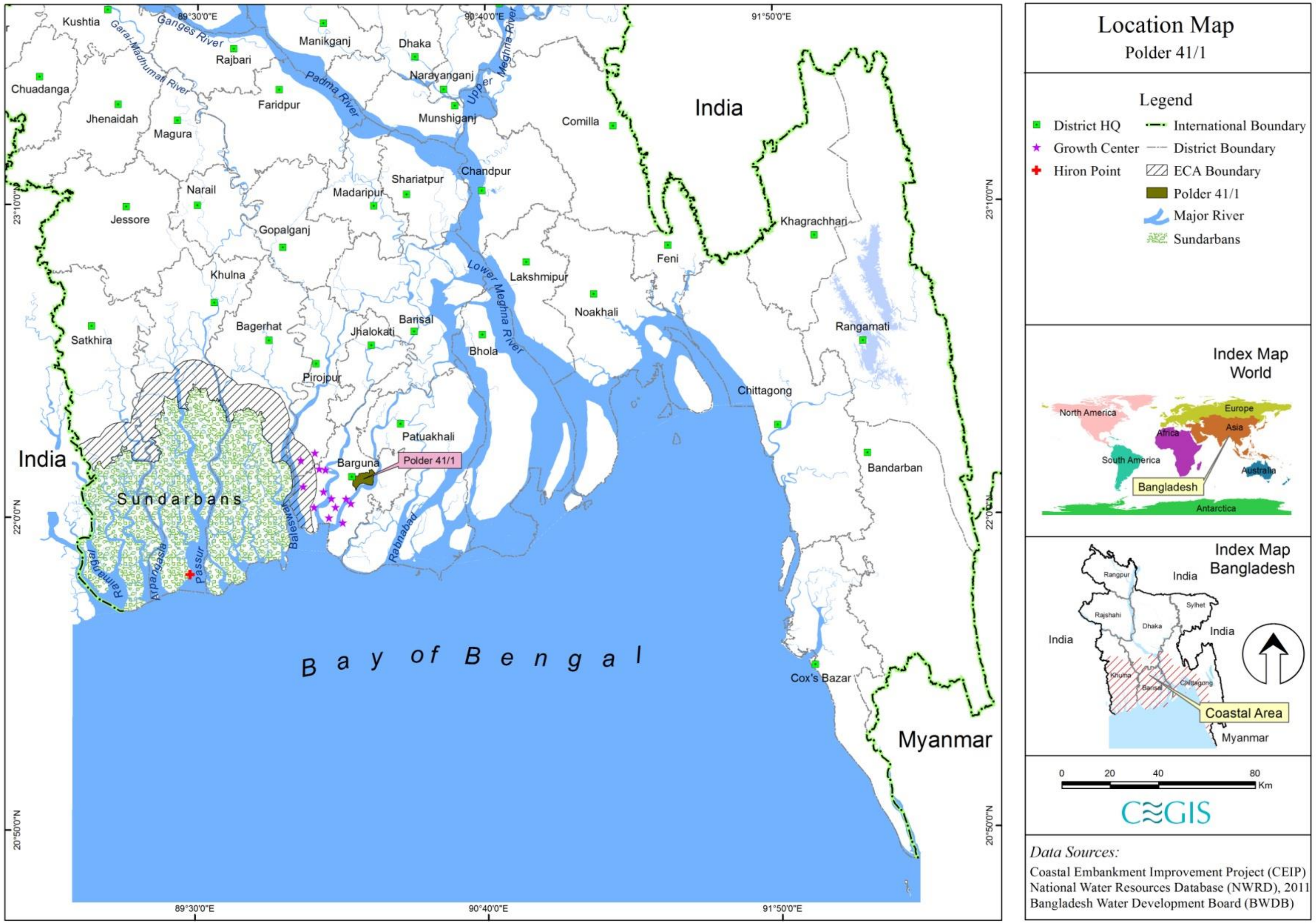
Total length of Embankment	: 33.70 km
Total number of Drainage Sluices	: 10 nos.
Total number of Flushing Sluices	: 19 nos.
Drainage channel	: 33.25 km

7. Other components of the CEIP-1 will include implementation of a social action plan and an environmental management plan; supervision, monitoring and evaluation of project impacts; project management, technical assistance, trainings, and technical studies; and contingent emergency responses. BWDB is the implementing agency of the Project.

8. Detailed information of the project is presented in this project description chapter of the report.

1.3 Regulatory and Policy Framework

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



Map 1.2: Location of Polder 41/1

1.4 Objectives of the Study

10. The objective of the EIA study for Polder 41/1 is to to identify and assess the potential environmental impacts of the proposed project interventions, evaluate alternatives, and design appropriate mitigation, management, and monitoring measures to be addressed in the Environmental Management Plan (EMP)[1] in compliance with the national regulatory and WB environmental policies and guidelines (for further details refer Chapter 3).

The specific objectives of the EIA study are to:

a. Comply with the national regulatory and WB policy frameworks (further discussed later in the document);

b. 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);

c. Identify and assess the potential environmental and social impacts of the Project;

d. Identify mitigation measures to minimize the negative impacts and enhancement measure to enhance the positive impacts; and

e. Prepare an EMP including a detailed monitoring plan.

1.5 Scope of work

11. The scope of work of the present EIA study for Polder 41/1 includes the followings:

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

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

(iii) Determine the cumulative environmental impacts of the project which 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 to reduce potentially significant adverse environmental impacts to acceptable levels.

(vi) Determine the capital and recurrent costs of the measures, and institutional, training and monitoring requirements to effectively implement these measures. The consultant is required to identify all significant changes likely to be generated by the project activities. These would include, but not be limited to, changes in the

[1]WB Operation Policy 4.01. 2011 Revision

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. The developed models may be available from the DSC Consultant and implementing agency.

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

(ix) Describe alternatives that are 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 impacts 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 impacts on the environment due to polder rehabilitation activities. For example, adequate fish passes 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 Plan along with respective EIA separately to monitor the implementation of mitigative measures and the impacts of the project of other inputs (such as training and institutional strengthening) needed to conduct 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 for implementing the plan

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

(xiii) Develop an Environmental monitoring format for regular monitoring of the project at pre-construction, construction and operational stage.

(xiv) Prepare the EIA report.

1.6 Structure of the Report

12. The report comprises the following chapters:

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 followed to conduct the EIA study. The Chapter also describes data sources and methodology of data collection, processing and impact assessment.

Chapter 3 (Policy, Legal and Administrative Framework) reviews the national legislative, regulatory and policy framework relevant to the EIA study. Discussions on the WB safeguard policies and their applicability for the Project is also been highlighted.

Chapter 4 (Description of the Project) provides the simplified description of the project and its phases, key activities under three phase, manpower, 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 which may potentially be caused by various project phases, and the proposed appropriate mitigation measures to avoid, offset, reduce, or compensate these impacts.

Chapter 7 (Analysis of 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 probable impacts on the project area as well as 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 this 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 (Stakeholder Consultations 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. The Chapter also includes the disclosure requirements of the EIA.

2 Approach and Methodology

13. This Chapter presents the detailed approach and method followed to conduct the EIA study for rehabilitation of Polder 41/1. Also described in the Chapter are data sources and methodology of data collection, processing and approach used in the impact assessment.

2.1 Overall Approach

14. The EIA study for the rehabilitation of Polder 41/1 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:

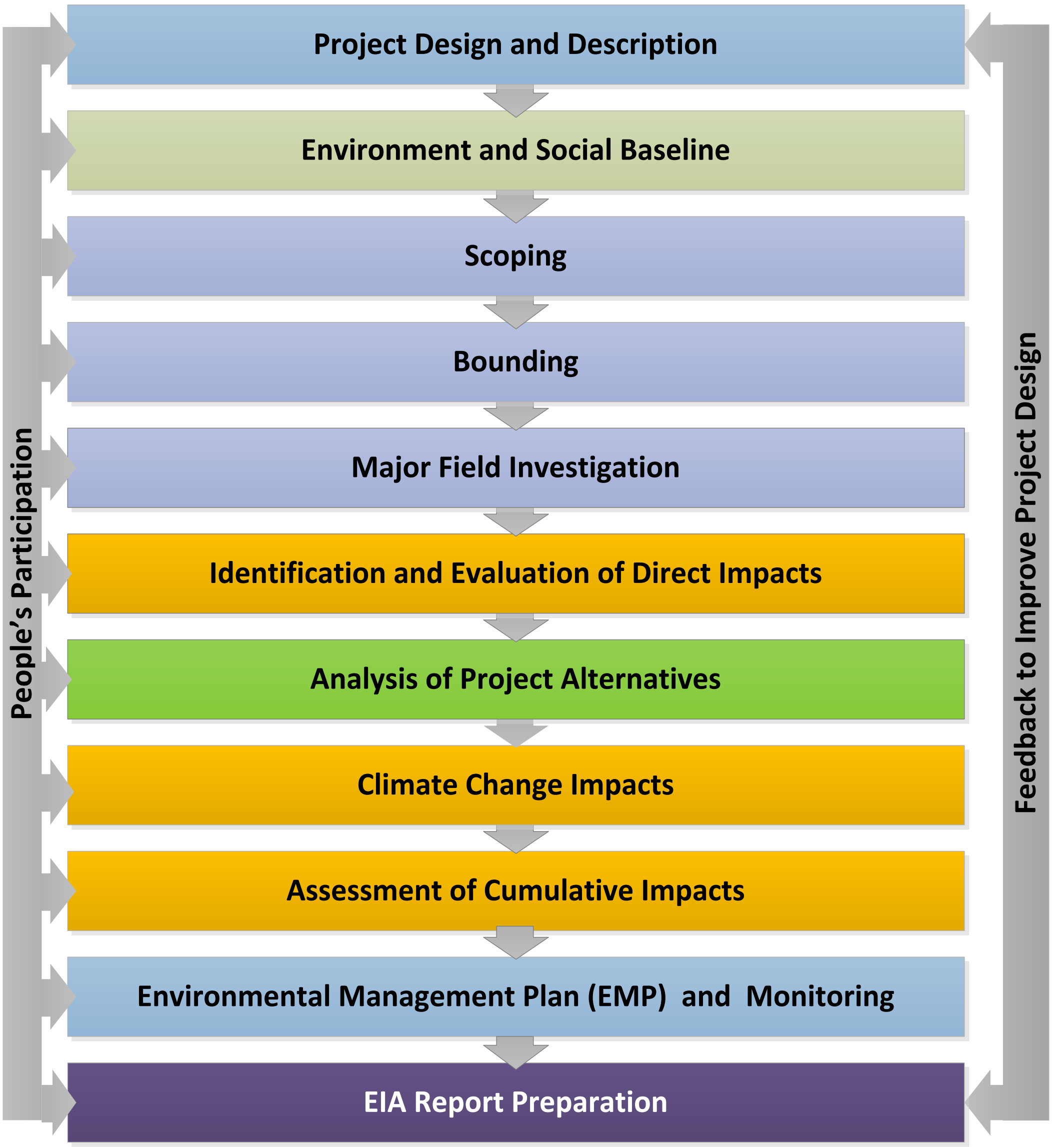


Figure 2.1: Overall approach of the EIA study

2.2 Methodology

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

2.2.1 Influence of Polder Area

16. The Polder area of influence was broadly delineated considering the external river system of the polder. This included the area inside the polder where most of the Project interventions would be carried out, the area immediately outside the polder embankments (this area could be used for staging of construction works, material stockpiling, and/or earth borrowing), access routes for the polder, borrow as well as spoil disposal areas if located outside the polder, and labor camps/contractor facilities if located outside the polder. The area of influence is bounded by Payra River in the east and the south and Khakdon River in the North. Khakdon River starts from the north-west corner of the polder and narrows down to Keorabunia Khal in the north-east corner of polder. Apart from these rivers, the polder is bordered by Bashbunia Khal in the west. It is noted that project area includes polder area only whereas study area includes both project area and peripheral rivers.

2.2.2 Analysis of the Polder Design and Description

17. Detailed information on the Polder 41/1 including objective, nature and location of proposed and existing interventions, construction works, and other related aspects was obtained from the DCSC of CEIP-1..

18. 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.

19. Since the location of most of the polder area 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 Polder Design and Description step of the EIA studies.

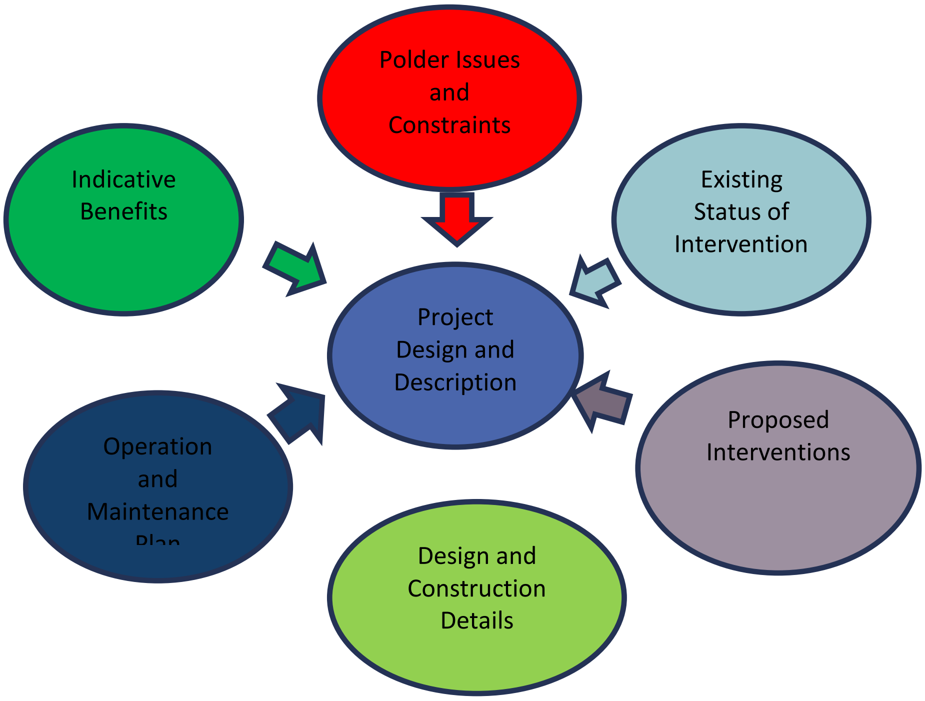


Figure 2.2: Aspects to be addressed in the Polder Design and Description

2.2.3 Analysis of the Project Alternatives

20. 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.

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

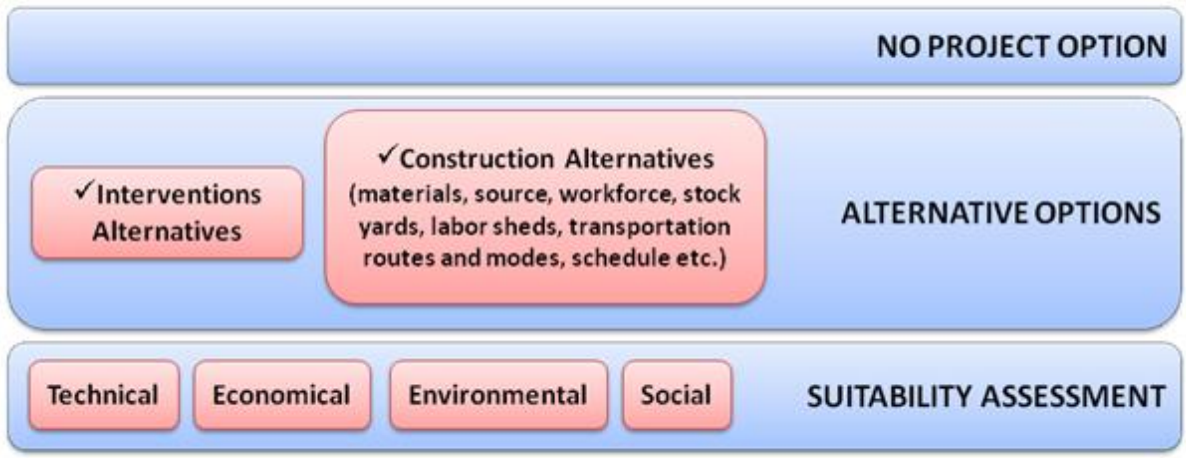


Figure 2.3: Concept of Alternative analysis to be used in the EIA study

2.2.4 Collection of Environmental and Social Baseline Data

22. A reconnaissance field visit was conducted in the polder area to identify the existing environmental and social settings of the polder area. Subsequently, Rapid Rural Appraisals (RRAs), Participatory Rural Appraisals (PRAs), Focused Group Discussions (FGDs) and Key Informants Interviews (KII) 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 gather reflection 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.

23. 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 and approved by the Design and Construction Supervision Consultant (DCSC) and used to register the information obtained from different stakeholders.

2.2.5 Physical Environment

24. A developed checklist was used to obtain the information on different resources. Local knowledgeable persons and community representatives were also interviewed. During field visits, the multidisciplinary EIA study team made observations pertaining to their individual areas of expertise.

2.2.6 Water Resources and Metereology

25. 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, salinity etc. were collected and analysed. Observations by the professionals of the multi-disciplinary team were backed up by feedback from the local people. Major river systems were identified for hydrological and morphological investigation through historical and current

image data collection and analysis. Specific areas or points of interest were selected for collecting data on special hydrological and morphological aspects, water availability, drainage pattern, water quality (surface and ground water), tidal flood, risk of erosion and sedimentation.

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

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

2.2.7 Land and Soil Resources

28. The agro-ecological region of the polder area was identified using secondary sources including Food and Agriculture Organization (FAO) and United Nations Development Program (UNDP) information. The land type and soil texture data were collected from Upazila[2] 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.

2.2.8 Biological Environment

Ecological Resources

29. The ecological component of the EIA study focused on terrestrial and riverine ecology including flora, birds, reptiles, amphibians, mammals, and migratory birds. The field activities included collection of ecosystem and habitat information, sensitive habitat identification, identification of ecological changes and potential ecological impact. The land use information on different ecosystem was generated through analysis of recent satellite imagery. Field investigation methods included physical observation, transect walk, habitat survey and consultations with local people. Field visits were carried out for establishing the ecological baseline condition. 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 survey and the species database of Bangladesh National Herbarium and the Status of Vertebrates/ Red List of the International Union for Conservation of Nature (IUCN).

Fish and Fisheries Resources

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

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

2 Upazila is an administrative subdivision of a district.

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.

2.2.9 Socio-cultural Environment

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

- Data were collected from Bangladesh Bureau of Statistics (BBS), 2001 and enumerated for 2010, relevant literatures from BWDB and main consultants were also reviewed;
- Reconnaissance field visit and discussions with BWDB officials and local stakeholders were made for primary data collection;
- PRA /RRA, FGDs, KII were carried out for primary data collection;
- Institutional survey was conducted for primary data collection from district and upazila level.

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

Agricultural Resources

34. 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 were collected through extensive field surveys with the help of questionnaire and consultations with local people and concerned agricultural officials. Agricultural resources data were also collected from secondary sources, namely 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)

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

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, .i.e. Upazila Livestock Office.

2.2.10 Climate Change

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

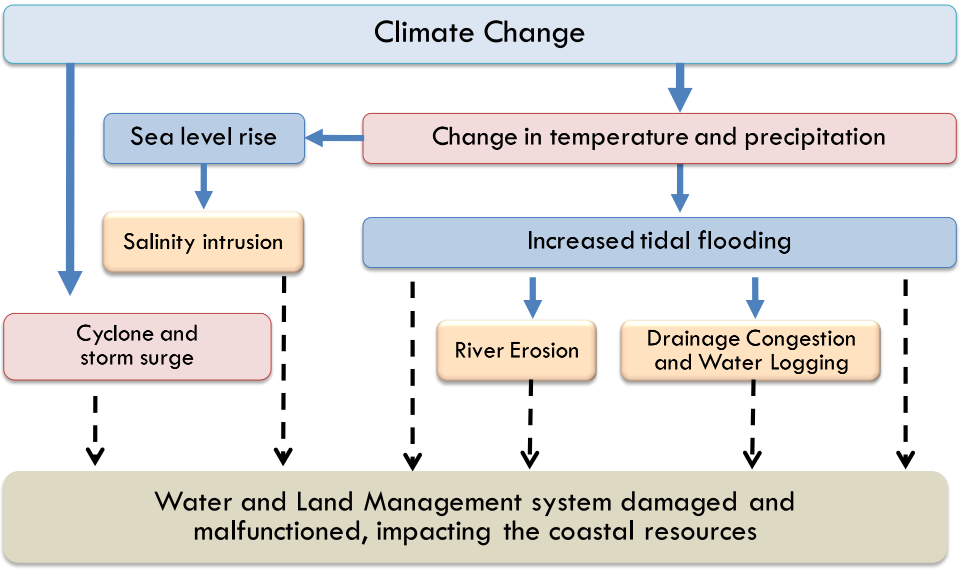


Figure 2.4: Typical diagram of climate change impacts in coastal areas

37. The polder has previously been affected by some of the major climate change induced natural disasters, and therefore, may be considered as sensitive hotspots of climate variability. The polders were heavily impacted during the events of Aila and Sidr, which lcaused severe damages on the polder infrastructures and created widespread impacts on the lives and livelihoods of local people. Furthermore, vulnerability of saltwater intrusion is another major concern.

38. 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 are to be collected from the 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 issues and concerns.

2.2.11 Scoping

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

2.2.12 Assessment and Scaling of Impacts

40. At this stage, attempts were made to quantify the impacts of the proposed interventions of the polder as much as possible. In cases, quantification was not possible, qualitative impacts were assessed and scores were assigned with (+P) sign for positive impacts and (-N) sign for negative impacts. The magnitude of both positive and negative impacts was indicated by HN, MN, HP and MP based upon extent, magnitude, reversibility, duration and sustainability considerations. 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 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 the proposed interventions in the polder were assessed to generate the FWIP condition. Comparison and projection methods were used for impact prediction.

41. 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.

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

Methodology

43. 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.

44. 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

45. The assessment of magnitude has been undertaken in two steps. Firstly the key issues associated with the Polder area 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.

46. 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)	Med 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 the 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

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

Assigning Significance

48. 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

49. 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 **Table 2.3** require appropriate avoidance/ mitigation/compensatory measures to reduce the significance. Impacts having low to negligible significance are not considered for any mitigation measures.

50. 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

51. 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.

2.2.13 Preparation of Environmental Management and Monitoring Plan

52. 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).

2.2.14 EIA Report Preparation

53. At the end of the study, the present report is prepared incorporating all findings of the EIA.

3 Policy, Legal and Administrative Framework

54. This Chapter presents a review of the national policy, legal, and regulatory framework relevant to the environmental and social aspects of the Project. The chapter also presents the review of the WB environmental and social safeguard policies and guidelines.

3.1 National Environmental Laws

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

3.1.1 The National Water Act, 2013

56. The Water Act 2013 is based on the National Water Policy, and provides the legal framework for integrated development, management, abstraction, distribution, usage, protection and conservation of water resources in Bangladesh.

57. The management of water resources within the territory of the country in rivers, creeks, reservoirs, flood flow zone, and wetlands has been assigned to the Executive Committee under the Ministry of Water Resources.

58. Draining of wetlands that support migratory birds has been prohibited by the Act. Consequently, without prior permission from the Executive Committee, building of any structure that can impede the natural flow of water has been prohibited.

A few activities like dredging of rivers for maintaining navigability, land reclamation projects by filling wetlands, and flood control and erosion control structures will be exempted pending prior permission.

59. The Act provides provisions for punishment and financial penalty for non-compliance, including negligence to abide by government policy, ordinance, non-cooperation with government officials, refusal to present necessary documents, providing false information, affiliation with perpetrators, and protection measures for water resources management. The maximum penalty for violations is set to five years of imprisonment and/or a monetary penalty of Taka 10,000.00 (Ministry of Law, Justice and Parliamentary Affairs, 2013).

3.1.2 Bangladesh Environment Court Act, 2010

60. Bangladesh Environment Court Act, 2010 has been enacted to resolve the disputes and establishing justice over environmental and social damage raised due to any development activities. This act allows government to take necessary legal action against any parties that create environmental hazards/ damage to environmentally sensitive areas as well as human society. According to this act, the government can take legal actions if any environmental problem occurs due to CEIP-1 interventions.

3.1.3 The Forest Act, 1927 & Amendment Act 2000

61. 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."

62. 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.

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

63. 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 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.

64. In accordance with this Act, the CEIP-I needs 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 the coastal zone, defined by DoE under this act, has to be considered while planning and designing of the CEIP-I project interventions.

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

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

66. 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.

3.1.5 Bangladesh Environment Conservation Rules (ECR), 1997

The Environment Conservation Rules, 1997 were issued by the Government of Bangladesh in exercise of the power conferred under the Environment Conservation Act (Section 20), 1995. Under these Rules, the following aspects, among others, are covered:

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

67. 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.

68. 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**.

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

70. 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.

3.1.6 The Embankment and Drainage Act 1952

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

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

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

3.1.7 The Inland Water Transport Authority Ordinance, 1958 (E.P. Ordinance No. Lxxv of 1958)

74. This is an Ordinance to set up an Authority for the development, maintenance and control of inland water transport and certain inland navigable waterways in Bangladesh. The Authority is mandated to perform any other function such as, carrying out river conservancy work, including river training for navigation purposes and aiding navigation; drawing up programs on dredging requirements and priorities for the efficient maintenance of existing navigable waterways; and reviving dead or dying rivers, channels, or canals, including developing new channels and canals for navigation.

3.1.8 The Ground Water Management Ordinance, 1985 (Ordinance No.XxvitOf 1985)

75. This is an Ordinance to manage ground water resources for agricultural production. This Act authorizes the Thana Parishad to grant license for installing tube wells under its jurisdiction. The Thana Parishad may grant the license if the Parishad is satisfied that the installation of the tube well applied for complies with the following points;

- will be beneficial to the areas where it is to be installed, or
- will not have any adverse effect upon the surrounding areas, or
- is otherwise feasible.

3.2 Relevant National Policies, Strategies and Plans

3.2.1 National Agriculture Policy, 2013

76. The National Agriculture Policy, 2013 approved by the Government of Bangladesh focuses on agriculture production, alleviating poverty through generating jobs and ensuring food security. The Policy outlined nine specific objectives. Although the policy does not emphasize the coastal zone separately, all specific objectives are applicable to the development of coastal zone agriculture.

77. The GoB will pursue programme for agro-ecologically disadvantaged regions in the hilly area, drought-prone area, Barind tract, char land, haor-baor and coastal belt with appropriate technological support.

78. To increase water productivity and enhance irrigation efficiency through optimal use of available water resources the GoB will facilitate dissemination of water management technology. Modern irrigation, drainage and water application systems will be introduced for expanding irrigation coverage including difficult or disadvantaged areas i.e. in char, hilly areas, Barind tract, drought-prone and saline areas.

79. The proposed CEIP-1 is expected to contribute to achieving the objectives of the agriculture policy.

3.2.2 Master Plan for Agricultural Development in Southern Region of Bangladesh, 2013

80. The Master Plan for Agriculture Development in the Southern Region of Bangladesh has been prepared by the Ministry of Agriculture in collaboration with the Ministry of Fisheries & Livestock and Ministry of Water Resources, and with technical assistance from the Food and Agriculture Organization of the United Nations (FAO). The Plan covers three hydrological regions- south central, southwest and southeast of the coastal zone covering 14 districts. The objective of the Plan is to provide a road map for integrated agricultural development in the coastal districts of Bangladesh, aiming at sustainable food security, poverty reduction and livelihood development for the poor. The Plan particularly focuses on, among others increasing agricultural production and productivity; improving water management, infrastructure development for surface water irrigation; improving productivity of brackish water shrimp and capture fisheries; and promoting smallholder poultry and dairy development. The Plan formulated a set of programmes and activities across all branches of agriculture and other related fields. The Plan is for 2013 to 2021.

81. The proposed CEIP-I is expected to contribute to achieving the objectives of the Master Plan for Agriculture Development in the Southern Region of Bangladesh.

3.2.3 Standing Orders on Disaster, 2010

82. The Standing Orders on Disaster is designed to enhance capacity at all tiers of the government administrative and social structures for coping with and recovering from disasters. The document contains guidelines for construction, management, maintenance and use of cyclone shelter center. According to the guideline, geographical information system (GIS) technology will be applied at the planning stage to select the location of cyclone shelters considering habitation, communication facilities, 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 reach necessary services there. For this reason, the road communication from the cyclone shelters should not only link up with city or main road but also with neighbouring village areas. Provision of emergency water, food and sanitation and shelter space for livestock during the distress period should also be kept in view for future construction of shelters.

83. Improvement of coastal polders under CEIP-1 will provide better communication facilities in the coastal areas, which is crucial for emergency response to disasters.

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

84. 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.

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

3.2.5 National Livestock Development Policy, 2007

86. The National Livestock Development Policy (NLDP) has been prepared to address the key challenges and opportunities 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:

87. 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.

88. Special programs will be taken up for the production of grass in the Chittagong Hill-tracts and the coastal areas.

89. 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-I interventions will contribute to the safety of livestock and thus, increase livestock productivity in coastal areas.

3.2.6 Coastal Development Strategy, 2006

90. 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 the use of coastal lands
- promoting economic growth emphasizing non-farm rural employment
- sustainable management of natural resources: taking advantage of untapped and less explored opportunities
- improving livelihood conditions of people especially women
- environmental conservation
- empowerment through knowledge management
- creating an enabling institutional environment

3.2.7 Proposed interventions under CEIP-I are in line with this strategy and support most of the above listed priorities. Coastal Zone Policy, 2005

91. 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.

92. 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.

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

3.2.8 Ethnic Minority Rights in PRSP 2005

94. 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 the 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.
- Strengthen their competence in job markets through affirmative action's at higher levels of education and skills training to promote their inclusion in the 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.

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

95. The National Water Management Plan (NWMP) 2001, approved by the National Water Resources Council in 2004, envisions establishing an integrated development, management and use of water resources in Bangladesh over a period of 25 years. WARPOhas 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 Rivers, (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.

96. 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.

3.2.10 National Land Use Policy (MoL, 2001)

97. The National Land Use Policy 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 process, which is 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 the 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.

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

3.2.11 National Water Policy, 1999

99. Endorsed by the GoB in 1999, the National Water Policy (NWP) aims to provide guidance to the major players in the 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.

100. 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 GoB.

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 movements 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 the 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 the 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.

101. 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.

3.2.12 National Fisheries Policy, 1996

102. 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.

103. The policy suggests the 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.

104. The CEIP-1 integratesthe guidelines of NFP in design and implementing the proposed interventions.

3.2.13 National Environment Management Action Plan, 1995

105. 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.

3.2.14 National Forest Policy, 1994

106. The Forest Policy 1994 recognizes the importance of biodiversity for environmental sustenance. The policy is explicitly mentioned that habitats for the wildlife and vegetation will be conserved through afforestation and by bringing forest lands under Protected Areas. The policy targets to bring 20% of the total land area of the country under forest cover, and at least 10% of which under protected areas by 2015. It also declared that measures will be taken to improve degraded forests. The Policy, at the same time, advocated social forestry,

which includes agro forestry, woodlot plantations, and strip plantations in vacant public and private lands of the country. Afforestation could directly contribute to climate change mitigation efforts and efforts to improve forest quality and add to forest resilience.

3.2.15 National Environment Policy, 1992

107. 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
- 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 impacts;
- 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.

108. 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.

3.2.16 National Adaptation Programme of Action (NAPA)

109. In 2005, the Ministry of Environment and Forest (MoEF), Government of the People's Republic of Bangladesh has prepared the National Adaptation Program of Action (NAPA) for Bangladesh, as a response to the decision of the Seventh Session of the Conference of the Parties (COP7) of the United Nations Framework Convention on Climate Change (UNFCCC). The basic approach to NAPA preparation was along with the sustainable development goals and objectives of the country where it has recognized the necessity of addressing climate change and environmental issue 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.

110. The CEIP-1 broadly contributes toward achieving the aims and objectives of the climate change adaptation strategies.

3.2.17 The Acquisition and Requisition of Immovable Property Ordinance, 1982

111. 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).

112. 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 compensations 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 GoB proposed by the MoL.

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

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

114. The State Acquisition and Tenancy Act (Sections 86 and 87) also define the ownership and use right of alluvion (payosti or reformation in situ or original site) and diluvion land (nadi sikosti) in the country. In legal terms, eroded lands (sikosti) inside the alluvion-diluvion (AD) line (i.e. including submerged land or underwater land) are considered khas land once declared by concerned Deputy Commissioner (DC) demarcating the AD Line.3 However, the "original" owner(s) can claim the land if it reappears through natural process within 30 years. The original private owners cannot claim any eroded land if developed by the government through land filling for use in public purpose.

3.2.19 Constitutional Right of the Tribal Peoples Rights

115. In the context of People's Republic of Bangladesh, the Constitution of Bangladesh does not mention the existence of the 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.

3.2.20 GoB Laws on Land Acquisition

116. The principle 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 Government of Bangladesh 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 no property 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.

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3 The Assistant Commissioner of Lands (AC Land) in respective district 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.

Inadequacies of 1982 Ordinance

117. 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 Bank'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.

118. 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:

119. **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.

120. **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.

121. **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.

122. **Compensation standards**: Although the law stipulates 'market prices' of the acquired lands as the just compensation, the legal assessment method almost always results in prices that are far below the actual market prices[4]. Certain pricing standards, which are regarded as unrealistic, are used to assess other losses like structures and various built amenities, trees, crops and the like.

123. **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.

124. **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

4 According to the law, the 'market price' is calculated by averaging the sales prices recorded in the previous one year, in terms of land characteristics by land administration units or mauzas. But it is a widely accepted fact 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 fall far too short of the real market prices.

producing an array of documents that the acquired lands legally belong to them. As gathering these documents is a long, expensive and cumbersome process, many landowners may remain unable to claim their awards[5.]

125. **Socioeconomic rehabilitation:** The law shows no concern whatsoever about the long-term socioeconomic changes the affected persons and households might undergo in the post-acquisition period. There is no provision in the law except compensation for ensuring economic rehabilitation and social reintegration of the displaced persons.

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

3.2.21 The Constitution

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."

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

3.2.22 Bagladesh Labour Act, 2006 (XLII of 2006)

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

- Serious bodily injury
- Condition of employment
- Payment of wages
- Stoppage of work
- Death benefit
- Prohibition of employment of children and adolescent
- Cleanliness
- Dust and fume
- Disposal of waste and effluents
- Drinking water
- Latrines and urinals
- First aid appliance
- Weekly hours

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

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

3.2.23 Bangladesh Water Act, 2013

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.

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.

3.2.24 National River Protection Commission Act 2013

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.

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.

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.

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 30percent will be women.

3.2.25 Other Relevant Acts

129. 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 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 Forest Act (1927)	Regulates the protection of forests reserves, protected forests and village forests	MoEF
The Private Forests Ordinance (1959)	Deals with the conservation of private forests and afforestation of wastelands	MoEF
The Protection and Conservation of Fish Act (1950)	Deals with the protection/conservation of fishes in Government owned water bodies	DoF
The Embankment and Drainage Act (1952)	Describes the protection of embankments and drainage facilities	MoWR
The Antiquities Act (1968)	Describes the preservation of cultural heritage, historic monuments and protected sites	DoArch
Acquisition and Requisition of Immovable Property Ordinance (1982)	Describes procedures and provides guidelines to acquisition and requisition of land	MoL

3.3 International Treaties Signed by GoB

130. Bangladesh has signed most of the international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, including the Ramsar Convention, the Bonn Convention on migratory birds, the Rio de Janeiro Convention on biodiversity conservation and the Kyoto protocol on climate change. An overview of the relevant international treaties and conventions signed by the GoB is shown in **Table 3.2** below:

Table 3.2: Treaty or Convention and Responsible Agency

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

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

131. The environmental legislative basis for approval of the CEIP-1 project is the Environmental Conservation Act 1995 (ECA'95) and the Environmental Conservation Rules 1997 (ECR'97). DoE), under MoEF is the regulatory body responsible for enforcing the ECA'95 and ECR'97. According to the Rule 7 (1) of the Environmental Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every project, in consideration of their site and impact on the environment, will be classified into the four categories and they are: Category I (green), Category II (Orange-A), Category III

(Orange B) and Category IV (Red). According to the categorization, all construction/reconstruction/expansion of flood control embankment/polder/dykes etc falls under Red Category. Therefore the CEIP-I Project intervention in Polder 41/1 falls under the 'Red' category.

132. 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)

133. 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:

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

3.5 Detailed Steps of In Country Environmental Clearance Procedure

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

136. Environment (DoE), under the Ministry of Environment and Forest (MoEF), is the regulatory body responsible for enforcing the ECA'95 and ECR'97. According to the Environment Conservation Act 1995, no industrial unit or project will be established or undertaken without obtaining, in the manner prescribed by the Environment Conservation Rules 1997, an Environmental Clearance Certificate from the Director General. Therefore, every development projects/industries, which are specified under the Schedule 1 of the Environmental Conservation Rules 1997, require obtaining site clearance and environmental clearance from DoE. For 'Red' category, it is mandatory to carry out an EIA including an EMP and where necessary develop a Resettlement Plan for getting environmental clearance from DoE. The application procedure for obtaining site clearance and environmental clearance for the sub-projects of Red category is shown in Figure 3.1.

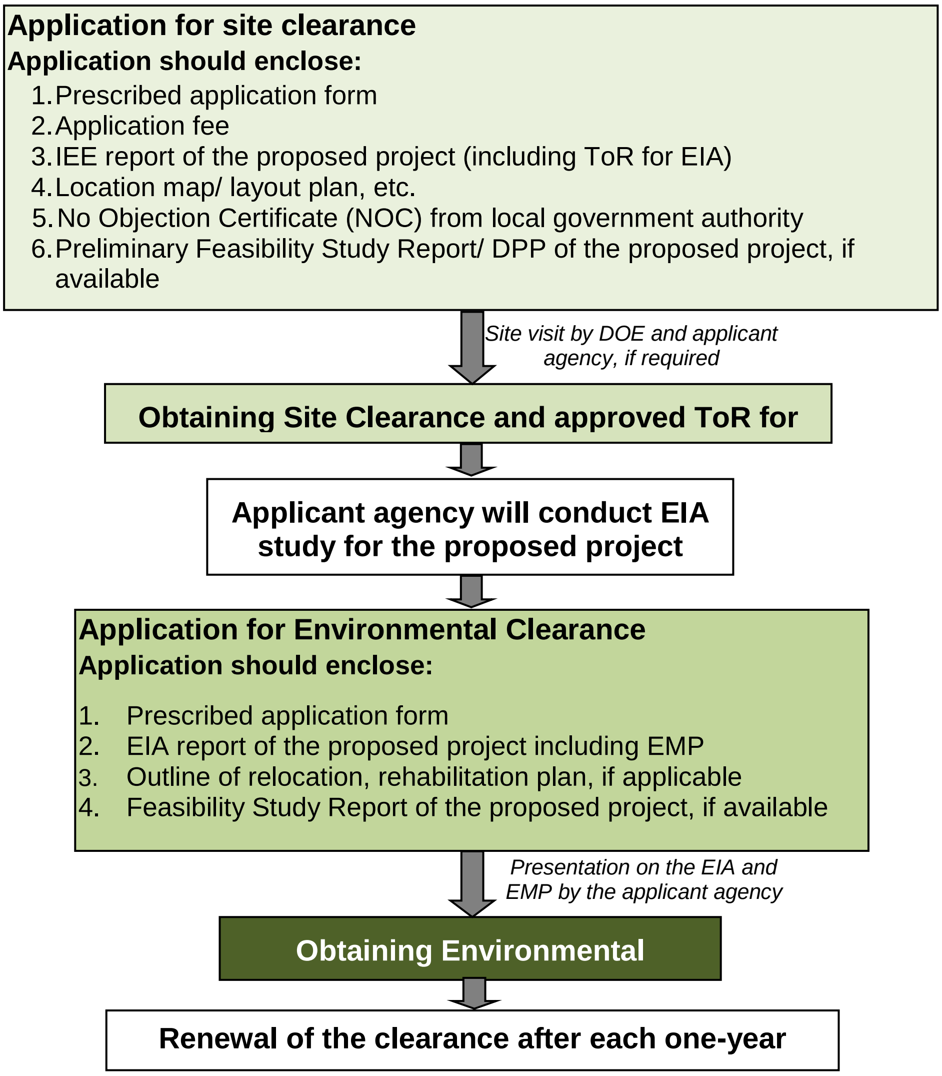

Figure 3.1: Process of obtaining Clearance certificate from DoE

3.6 World Bank's Environmental Safeguard Policies

137. Developers seeking financing from the World Bank 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.

3.6.1 Environmental Assessment (OP 4.01)

EA requirement

138. The WB 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.

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

EA classification

140. 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:

> **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.
>
> **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.
>
> **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.
>
> **Category FI:** 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.

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

3.6.2 Natural Habitats (OP 4.04)

142. 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.

143. The WBOP 4.04 is triggered for the proposed Project. However, the proposed activities will be undertaken in an area where natural habitat has already been modified to farm lands and built-up area. Furthermore, appropriate control measures have been

incorporated in the environmental management plan (EMP) (provided later in the document Water Resources Management (OP 4.07)

144. 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.

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

3.6.3 Physical Cultural Resources (OP 4.11)

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

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

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

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

3.6.4 Forestry (OP 4.36)

147. 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.

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

3.6.5 Projects on International Waterways (OP 7.50)

149. Projects on international waterways may affect the relations between the World Bank 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.

3.6.6 Pest Management (OP 4.09)

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

3.6.7 Indigenous Peoples (OP 4.10)

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

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

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

- an indigenous language, often different from the official language of the country or region.

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

153. 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.

154. 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.

3.6.8 Involuntary Resettlement (OP 4.12)

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

156. 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.

3.6.9 Projects in Disputed Areas (OP 7.60)

157. 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.

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

8 Excerpts from WB OP 4.12. WB Operational Manual. December 2001.
9 Excerpts from the OP 7.60. WB Operational Manual. November 1994.

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

3.6.10 Safety of Dams (OP 4.37)

160. 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.

3.6.11 Public Disclosure of Information (BP 17.50)

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

162. 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.

3.6.12 Environment, Health and Safety Guidelines

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

3.7 Implications of WB Policies on CEIP

164. The interventions for Polder 41/1 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 the 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.

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

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

4 Description of the Polder

4.1 General

166. The Coastal Embankment Improvement Project (CEIP) intends to protect the polder from tidal flooding, salinity intrusion and climate change induced storm surges. Proper implementation of the plan will have substantial impact on improving agricultural production. The project activities, construction methodology, construction schedule and institutional arrangements for implementation of the Project are described in this chapter.

4.2 Overview of Polder 41/1

167. The Polder is located in Barguna Sadar Upazila under Barguna District. The polder covers two Union Parishads (U/P), namely *Burir-Char* and *Aila Patakata*. The polder is bounded by *Bashbunia Khal* in the west, *Payra* (Buriswar) rivers in the East and South and Khakdon River in the north. The polder covers a Gross area of 4,048 ha of which net cultivable area is 3,440 ha.

168. The polder was initially constructed in the early 1960 under Coastal Embankment Project (CEP). Construction of the Polder started in 1963-64 and has completed in 1966-67. The original concept of the Polder was only to protect the agricultural lands from salinity intrusion caused due to tidal inundation from the sea and river. At present, the embankment of the Polder is subject to cyclone surges, wave action causing erosion and increasing risks brought about by climate change. This polder is one of the 17 Polders selected for rehabilitation through feasibility study under CEIP-1. The features of the polder are given in **Table 4.1** below:

Table 4.1: Salient features of the Polder 41/1

Type	Specification
Total length of Embankment	33.81 km
Total number of Drainage Sluices	6 nos
Total number of Flushing Sluices	28 nos
Drainage Khal	84 km

Source: DCSCDesign Team

4.3 Objective of the Project

169. 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 in the Polder

170. Polder 41/1 was originally designed to provide protection against high tide, without providing much attention to storm surges. The present condition of the polder is extremely vulnerable. A number of the embankment has been damaged mainly by overtopping of water during Sidr It is reported that about 70 people died in the polder area during Sidr. Recent cyclones have substantially damaged the embankments and further threatened the integrity of coastal polders. In addition, breaching of embankments due to cyclones and siltation of peripheral rivers surrounding the embankments have caused the coastal polders to suffer from water logging; leading to large scale environmental, social and economic degradation. Poor maintenance and inadequate management of the polders are causing internal drainage congestion and heavy external siltation. As a result, soil fertility and agriculture production are declining because of water logging and salinity increase inside the Polder.

171. Currently, the Polder area is facing problems of salinity primarily because of ineffective water control structures and silting of water channels. This situation is further compounded by unavailability of suitable ground water at shallow depth from April to May. At present, the problems been faced by the stakeholders in the polder area after Sidr and Aila are: (a) the total length of embankment is under-sectioned and some segments of the sea-dyke have been badly damaged along the Payra (Buriswar) river as there is river erosion and the polder areas are in threat from the tidal flood and surges.(b) most of the water control structures are in deteriorated condition and thus, the tidal water frequently enter in the polder area and creates drainage congestion in the polder areas.(c) the internal khals have been moderately silted up and reduced conveyance capacity that also cause drainage congestion of the polder area and the desired supplementary irrigation facilities as well. In addition, the open water fisheries have declined because of shrinkage of water areas, restricted fish movement and environmental pollution. The absence of adequate functioning of local water management organizations has resulted in poor operation and maintenance of the polder and its water control structures. Based on local opinions clustered during the major field investigation carried out in June 2015, the study team identifies the following key water management problems and issues in the Polder:

- Lack of regular repair and maintenance of water control structures and embankments.
- Inadequate budget allocation and its inefficient use.
- Community’s abuse of existing infrastructure for fishing, shrimp/ prawn farming through unauthorized and inappropriate water sluices which result in weakening of the embankments and malfunctioning of regulators.
- High rate of siltation in peripheral rivers which hinders natural overland drainage.
- Inadequate plantation in the foreshore and lack/damage of coastal green belt.
- Absence of functional community organizations for operation and co-management of the polder system.

4.5 Present Status of Water Management Infrastructures

172. Water Management Infrastructures are the physical interventions which ensure sustainable management, optimal use and equitable sharing of water resources. There are some typical water management infrastructures such as peripheral embankments, drainage and flushing sluices, drainage khals, etc., in Polder 41/1. Based on field investigation carried

out in June 2015, coupling with the information received from CEIP consultants, the study team gathered the following information regarding the status of the existing infrastructure.

4.5.1 Embankment

173. The total length of the embankment is 33.81 Km, and is mostly fit for movement of vehicles. The length of embankment includes both Sea Dyke and Interior Dyke. From km 0.00 to 14.14 there is Sea-Dyke with side slopes C/S: 1:2 and R/S 1:5 and from km 14.14 to 33.81 is Marginal Dyke with side slope C/S 1:2 and R/S 1:3. The segment of embankment from km 12.40 to 13.40 km along the River Payra (Buriswar) has been badly damaged due to river erosion. Moreover, the segment of embankment from km 4.50 to km 5.00 falls under the thrust of river erosion of the River Payra (Buriswar). This segment of the embankment needs to be repaired under CEIP. The remaining portion of the embankment shall be re-sectioned (present crest level is 4.57mPWD to 5.18mpWD while proposed crest level is 4.57mPWD to 5.7mpWD) with mechanical compaction as per design crest level in consideration with the wave surge, cyclone surge and climate change scenarios to be obtained from mathematical modelling. The bituminous road on the top of the embankment should be dismantled and the crest level shall be heightened under CEIP Programme.

4.5.2 Water Control Structures

174. There are 6 drainage sluices and 28 flushing sluices in the Polder.Most of which are in dis-repair and have to be replaced. Their non-operational condition creates drainage congestion along with obstacles to water supply from river. The concrete surface of the structures has deteriorated due to prolonged exposure to saltwater. Most of the drainage and flushing structures are beyond repair,which are to be replaced by new ones with provisions for both flushing and drainage, which will last long to achieve project objectives. 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. There are 6 (six) drainage sluices all of which are not repairable. All these drainage sluices are to be replaced for smooth drainage of the polder area. Some Flushing Inlets are required to be demolished which are presently not used. Some RCP (Reinforced Concrete Pipe) Flushing Inlets are to be replaced by RCB (Reinforced Concrete Box) sluice.

175. Furthermore, the structures also undergo issues in connection with mismanagement of local communities. The local people opined that many gates are operated based on the local interest rather than water management interest. People are demanding sweet water preservation in the internal canal system for cultivating Rabi-crops, when the saline water cannot be used for irrigation. Therefore, structures are required to be constructed with provision for flushing and drainage and vertical lift gates are required to be provided to retain water inside the polder.

176. The internal drainage Khals have silted up which needs to be re-excavated for efficient drainage of the polder area and to increase the fresh water storage capacity. The outfall khal namely Bashbunia khal at the periphery from km 15.00 to km 20.00 has also silted up and no water is retained during low-tide period. This needs to be re-excavated. There is bitumeous road constructed by LGED on top of embankment from km 5.00 to km 20.00 and 0.00 to km 2.50 which has to be replaced while crest level is raised as per CEIP Design. There is dense tree cover along the banks of Payra (Buriswar) River which needs to be extended under CEIP.

177. **Table 4.2** below provides a detail understanding of the existing drainage and flushing sluices in Polder 41/1, 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
1	D/S – 1	Ch.16+886	RCB (5 vent – 1.5 m x 1.8 m)	Partially damaged loose apron, railing, nose wall. Expansion joint damaged and leakage behind it. Concrete surface is in deplorable condition.	Needs to be replaced.
2	D/S – 2	Ch.22+400	RCB(2 vent-1.5mx1.8m)	Constructed in 1966-67. Concrete surface is in deplorable condition.	Needs to be replaced
3	D/S – 3	Ch.26+750	RCB(1vent-1.5mx1.8m)	Constructed in 1966-67 Structure is partially damaged	Needs to be replaced
4	D/S – 4	Ch.32+280	RCB (2 vent – 1.5 m x 1.8 m)	Loose aprons and gates of the structure damaged Gates are corroded.	Needs to be replaced
5	D/S – 5	Ch.6+100	RCB (4 vent - 1.5 m x1.8 m)	Damaged loose apron. Constructed during 1966-67	Needs to be replaced
6	D/S – 6	Ch.8+890	RCB (2 vent – 1.5 m x 1.8 m)	Concrete surface is deteriorated. Damaged Loose apron and railing.	Needs to be replaced
Flushing Sluice					
1	F/S – 1	Ch.0+230	(1vent-0.9 m dia)	Structure is badly damaged	Needs to be demolished.
2	F/S – 2	Ch.0+805	(1vent-0.9x1.2)	• Loose aprons are damaged • Gate has been lost;	Needs to be repaired.
3	F/S – 3	Ch.1 +810	(1vent-0.9m dia)	Both sides of the structure silted up.	Needs to be demolished
4	F/S - 4	Ch.2+160	(1vent-0.9x1.2)	Damaged loose aprons	Needs to be replaced
5	F/S – 5	Ch.2+380	(1vent-1.2m dia)	Damaged Loose aprons and the structure are in deplorable condition.	Needs to be replaced
6	F/S - 6	Ch.2+960	(1vent-0.9x1.2)	Damaged Loose aprons and the structure are in deplorable condition.	Needs to be replaced
7	F/S – 7	Ch.3+950	(1vent-0.9 m dia)	• Loose aprons have been damaged and gate has been lost	Needs to be replaced
8	F/S – 8	Ch.5+050	(1vent-0.9x1.2)	Concrete surface has been deteriorated and gate has been corroded. Loose aprons are damaged.	Needs to be replaced
9	F/S – 9	Ch.6+565	(1vent-0.9 m dia)	The structure is in deplorable condition and pipe is damaged	Needs to be demolished
10	F/S - 10	Ch.6+855	(1vent-0.9x1.2)	Loose apron and railing of the structure are damaged	Needs to be replaced
11	F/S - 11	Ch.7+690	(1vent-1.2 m	The structure is fully been	Needs to be

Sl.	Structure	Chainage	Type and Size	Observations	Rehabilitation Needs
			dia)	damaged.	replaced
12	F/S - 12	Ch.8+245	(1vent-0.9x1.2)	Concrete surface has been deteriorated and gate has been corroded. Loose aprons are damaged.	Needs to be replaced
13	F/S - 13	Ch.9+240	(1vent-0.9x1.2)	The structure is in deplorable condition, loose aprons are damaged	Needs to be replaced
14	F/S - 14	Ch.10+330	(1vent-1.2 m dia)	The structure is in deplorable condition, loose aprons are damaged	Needs to be replaced
15	F/S -15	Ch.10+960	(1vent-0.9x1.2)	The concrete surface of the structure is deteriorated There is a leakage along the barrel wall.	Needs to be replaced
16	FS – 16	Ch.14+250	(1vent-1.2 m dia)	Concrete surface of the structure is deteriorated Loose aprons are damaged	Needs to be replaced
17	F/S - 17	Ch.16+440	(1vent-0.9x1.2)	Concrete surface has been deteriorated and gate has been corroded. Loose aprons are damaged.	Needs to be replaced
18	F/S - 18	Ch.17+570	(1vent-0.9x1.2)	Concrete surface of the structure is deteriorated Railing is damaged	Needs to be replaced
19	F/S - 19	Ch.18+780	(1vent-0.9x1.2)	Constructed during 1999-2000 and the condition of the structure is good.	Needs minor repaire
20	F/S - 20	Ch.18+810	(1vent-0.9m dia)	Loose aprons and railing are damaged Concrete surface is in deteriorated condition	Needs to be replaced
21	F/S - 21	Ch.21+625	(1vent-0.9m dia)	Structure is in deplorable condition.	Needs to be demolished
22	F/S - 22	Ch.22+980	(1vent-0.9x1.2)	Structure is in deplorable condition.	Needs to be replaced
23	F/S-23	Ch.25+715	(1vent-0.9x1.2)	Concrete surface of the structure is deteriorated.	Needs to be replaced
24	F/S-24	Ch.27+305	(1vent-1.2m dia)	The structures are in deplorable condition.	Needs to be replaced
25	F/S-25	Ch.28+000	(1vent-0.9m dia)	Loose aprons and concrete surface are damaged and gate has been lost	Needs to be replaced
26	F/S-26	Ch.28+630	(1vent- 90 m dia)	The condition of the structure is poor condition	Needs to be replaced
27	F/S-27	Ch.28+840	(1vent-0.90 m dia)	The structure is in poor condition	Needs to be replaced
28	F/S-28	Ch.29+010	(2vent- 0.90 m dia)	The condition of the structure is not good.	Needs to be replaced

Source: DCSC Design Team, 2015; ;

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

4.5.3 Drainage Khals

178. There are around 84 km of drainage khals inside the polder. The present condition of some of the internal drainage khals is undesirable. Over the years, siltation from both river sediments and topsoil wash-outand other land filling activities have resulted in gradual decrease of water courses within the polder. The internal khals are moderately silted up reducing the conveyance capacity that causes drainage congestion inside the polder area and lessen the desired supplementary irrigation facilities as well. These internal khals in the polder has been silted up moderately due to lack of maintenance for a long back. These khals need to be re-excavated for efficient drainage of the polder area as well as to increase the fresh water storage capacity. From field observations, it was found that, the outfall khal namely Bashbunia Khal has also been silted up and no water retains during low-tide period. This outfall khal also needs to be re-excavated to improve the drainage system of the polder.

4.6 Proposed Rehabilitation/ Improvement Activities in Polder

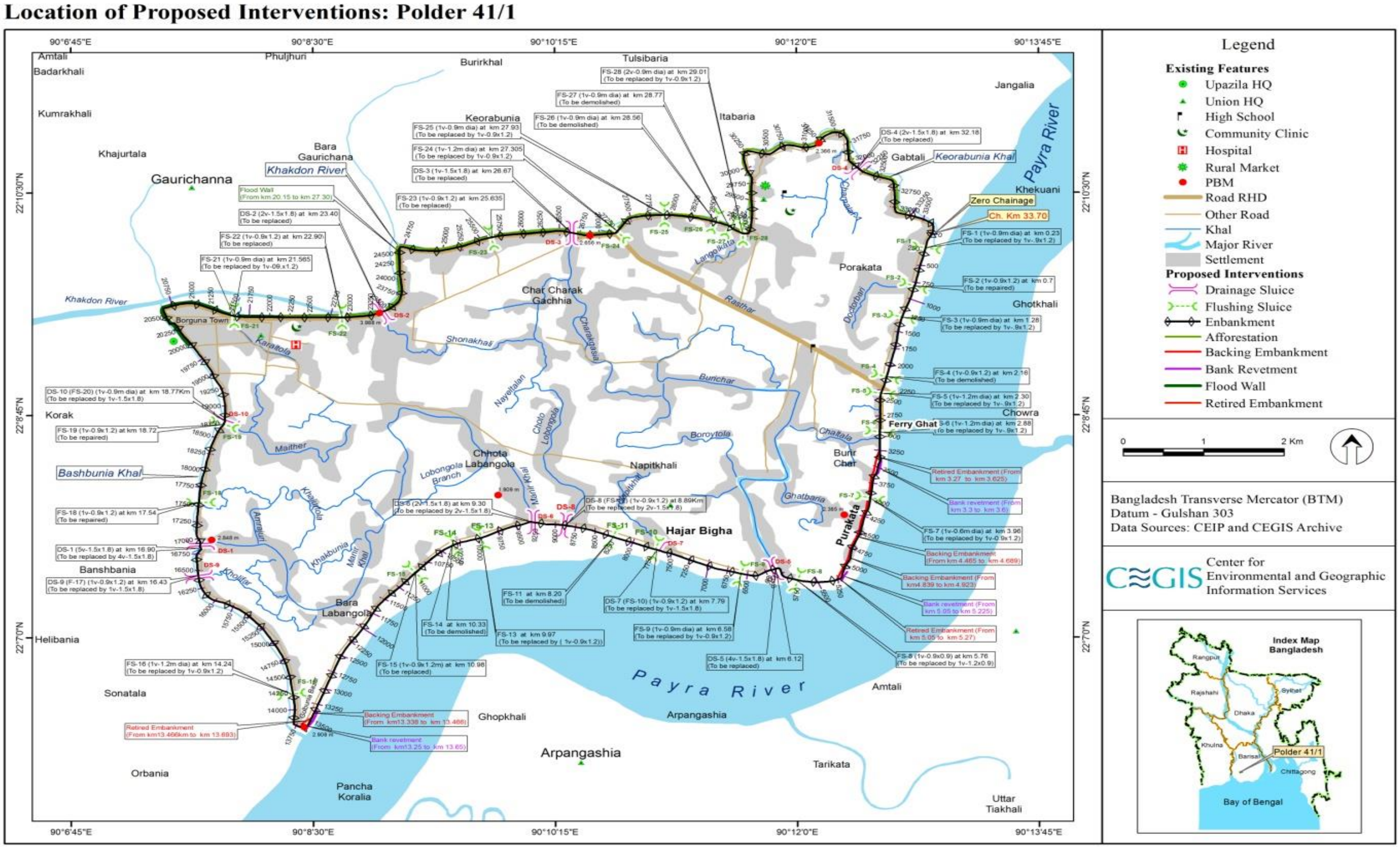
179. The proposed interventions in the polder are listed in **Table 4.3** below and shown in Map 4.1 and 4.2 (a-d). It is mentionable that drainage modelling of the coastal polder has been carried out by IWM to find out the design parameters for drainage cannel systems, drainage regulator, river bank, slope protection works. Climate resilient coastal embankment crest level has been design considering the combined effects of cyclone storm surge effects and cyclone induced wind wave. The model has been developed and simulated considering climate change condition considering with and without interventions (IWM, 2016). The interventions have further been detailed in the following sections.

Table 4.3: List of Proposed Interventions in Polder 41/1

Type of Work	Specification
Re sectioning of embankment	33.7 km
Bank protection	875 m
Construction (Replacement) of Drainage Sluice	10 nos.
Construction (Replacement) of Flushing Sluices	19 nos.
Re excavation of Drainage khal	33.25 km
Flood Wall	7.15 km
Afforestation	8.45 ha

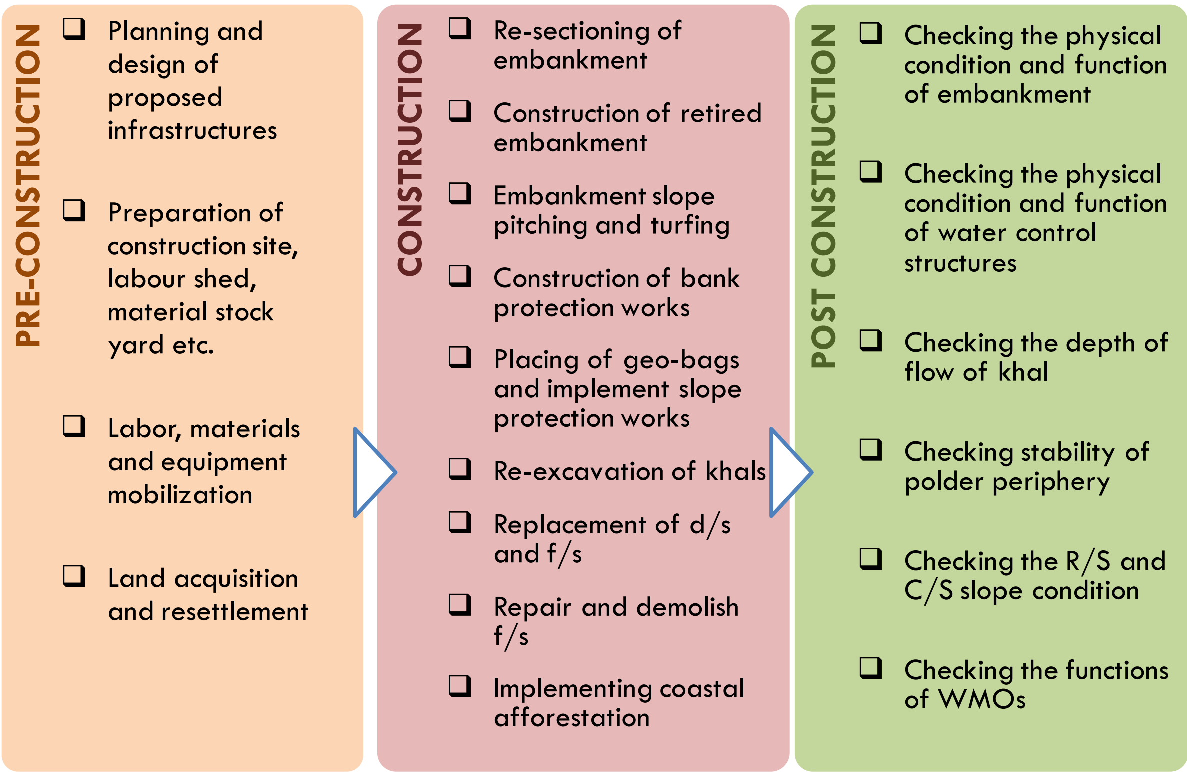
Source: **DCSC Design Team, 2015**

180. Moreover 5 km of periphery khal namely Basbunia khal from 15.00 to 20.00 will be reexcavated. Map 4.1 shows the location of the proposed interventions of the Polder-41/1 under CEIP-1. However, the proposed intervention will take place in a system that was modified in the past, that is not working properly well and that the social and physical environment is being affected. Therefore, the proposed project will absorb those liabilities.



Map 4.1: Proposed Interventions of Polder 41/1

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



Note: DS-Drainage Sluice, FS-Flashing Sluice

Figure 4.1: List of activities in Polder 41/1 at different project phases

4.6.1 Activities on Embankments

182. A total of 33.7 km of embankments will be re-sectioned under the proposed interventions in the Polder and their height will be increased. The side slopes of the embankment will also be rehabilitated. **Table 4.4** shows detail information about the works to be carried out on the embankment. The portion of the Polder from (Ch. 0+000 to Ch.14+14) will be provided additional emphasis during re-sectioning of the embankment. As such, the proposed crest level and R/S side slope values have been designed as 5.50 m, PWD and 1:5 respectively, which are higher than the remaining portion of the embankment.

Table 4.4: Detail of activities on Embankments

Sl	Chainage	Proposed Crest Level	Side slopes
1	0+000 to 14+140	5.70 m, PWD	R/S 1:5 and C/S 1:2
2	14+140 to 33+819	5.50 m, PWD	R/S 1:3 and C/S 1:2
	33+26 to 33+70	5.70 m, PWD	R/S 1:5 and C/S 1:2

Source: CEIP-I Design Study Finding

Description of construction activities

183. Before commencement of the construction activities for embankment works, labor sheds should be constructed with proper sanitation and other required facilities. A suitable site shall be selected and prepared by cleaning bushes, weeds, trees, etc. Alignment of the embankments has to be fixed with adequate base width. Base stripping and removal of trees, weeds, etc. will be done as per the instruction of the Engineer in-charge. The tools required for the construction of embankments will be procured during this period. After validating the final design, excavation of soil/carried earth will be followed and deposited in a selected area. Soil will be dumped on the alignment of the embankment in layers. At the same time, each layer (of 0.46 m) 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 made on the slope of the embankment. Water and fertilizer will also be provided.

4.6.2 Construction (Replacing) of Drainage Sluices

184. Ten number of drainage sluices will be replaced under the proposed interventions of the rehabilitation works of the polder. The summary of design information of the proposed works in these drainage sluices are given in **Table 4.5**.

Table 4.5: Detail information of Drainage Sluices

Sl.	Name of drainage sluices	Chainage (at km)
01	DS-5 (4vent-1.5m x 1.8m)	6.12
02	DS-6(2vent-1.5m x 1.8m)	9.30
03	DS-1 (5vent-1.5m x 1.8m)	16.88
04	DS-7 (1vent-0.9m x 1.2m)	18.78
05	DS-2 (2vent-1.5m x 1.8m)	23.40
06	DS-3(1vent-1.5m x 1.8m)	26.67
07	DS-4 (2vent-1.5m x 1.8m)	32.18
08	DS-10 (1vent-0.9m)	18.77
09	DS-8 (1vent-0.9 m x 1.2m)	8.89
10	DS-10 (1vent-0.9 m x 1.2m)	16.43

Source: CEIP-I Design Study Finding

Description of construction activities

185. During pre-construction phase of the drainage sluices, construction of labor shed with sanitation, water supply 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 the drainage sluices, ring bundhs and diversion khals 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. Cement Concrete (CC) and Reinforced Cement Concrete (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 and Repairing) of Flushing Sluices

186. Out of 28 flushing sluices, 19 flushing sluices with pipe structures (0.9 m dia) will be replaced by 1 vent (0.9 m x 0.9 m) structures. A detailed description of the flushing sluices is given in **Table 4.6.**

Table 4.6: Details of activities in Flushing Sluices

Sl.	Name of Structure	Location and Chainage	Structure Type and Size
1	F/S – 1	Ch. 0+230	RCB (1vent-0.9mx1.2m)
2	F/S – 3	Ch. 1+810	RCB (1vent-0.9mx1.2m)
3	F/S – 5	Ch. 2+300	RCB (1vent-0.9mx1.2m)
4	F/S - 6	Ch. 2+880	RCB (1vent-0.9mx1.2m)
5	F/S – 7	Ch. 3+960	RCB (1vent-0.9mx1.2m)
6	F/S – 8	Ch. 5+760	RCB (1vent-1.2mx0.9m)
7	F/S – 9	Ch. 6+580	RCB (1vent-0.9mx1.2m)
8	F/S - 10	Ch. 7+790	RCB (1vent-1.5mx1.8m))
9	F/S - 13	Ch. 9+970	RCB(1vent-0.9x1.2m)
10	F/S -15	Ch. 10+980	RCB(1vent-0.9x1.2m)
11	FS - 16	Ch. 14+240	RCB(1vent-0.9x1.2m)
12	F/S - 18	Ch 17+540	RCB(1vent-0.9mx1.2m)
13	F/S - 19	Ch 18+720	RCB(1vent-0.9mx1.2m)
14	F/S - 21	Ch. 21+625	RCB(1vent-0.9x1.2)
15	F/S - 22	Ch. 22+900	RCB (1 vent – 0.9 m x 1.2 m)
16	F/S-23	Ch.25+635	RCB (1 vent – 0.9 m x 1.2 m)
17	F/S-24	Ch.27+305	RCB(1vent-0.9x1.2m)
18	F/S-25	Ch.27+930	RCB(1vent-0.9x1.2)
19	F/S-28	Ch.29+010	RCB(1vent-0.9x1.2m)

Source: CEIP-I Design Study Finding

Description of construction activities

187. Before starting the construction activities of flushing sluices, a labor shed will be constructed by provision of sanitation, water supply along with 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 would also be completed After a few days of construction, gates will be installed at the upstream end of each flushing sluice. After completion of all construction activities, the embankments will be constructed and turfed with grass. Finally, a channel will be excavated through lead cut and tail cut to divert the flow through the flushing gates.

4.6.4 Re-excavation of Drainage Khals

188. Nine (9) drainage channels with a total length of 33.25 km will be re-excavated to ease water flow and reduce drainage congestion. An estimated volume of 0.291 million cubic meters of soil/silt will be excavated. The excavated soil will be used for strengthening the khal banks. Local people may be encouraged to take earth from the spoils, as well. The spoil may be used for raising the plinth level of their earthen kacha houses as well as individual house yards. If the excavated materials are found suitable, the Contractor can use the

materials for construction of embankments upon prior approval by the DCSC. The water channels to be re-excavated under the project are listed in Table 4.7. Figure 4.2 below shows the conceptual layouts of proposed dumping technique. Compartmental dumping spots will be created along the sides of the excavated khals, allowing any runoff from de-watering of the spoils and from precipitation to drain into the excavated khals.

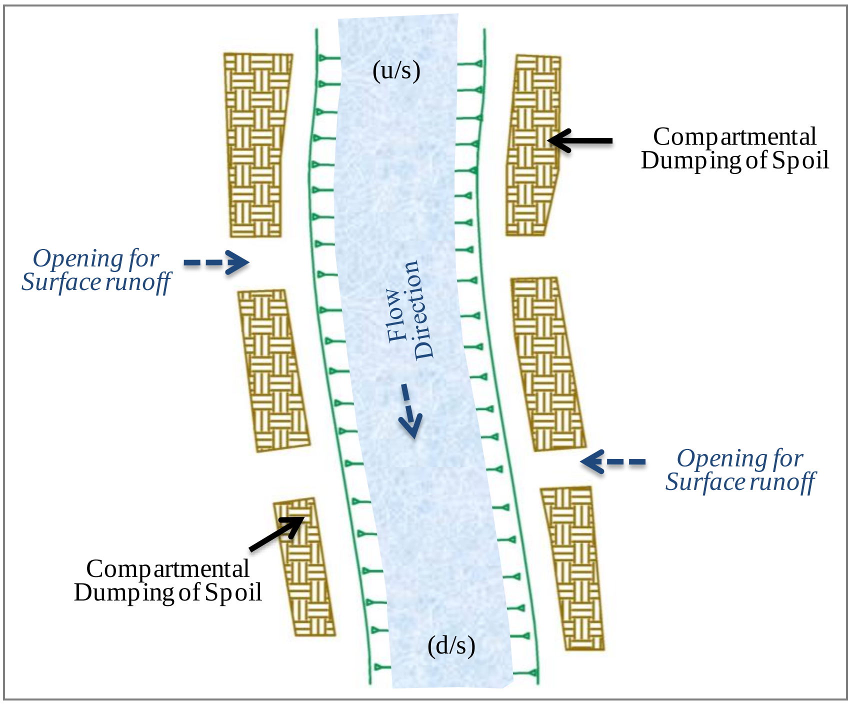


Figure 4.2: Plan form of a typical khal to be re-excavated

Table 4.7: Channels to be Re-excavated

Sl	Khal Name	Length (m)
1	Lobongola khal DS-1	8500
2	Sonakhali khal (DS-2)	2500
3	Charakgasia khal (DS-3)	2500
4	Hafaribigha khal	4500
5	Napitkhali khal (DS-7)	1500
6	Kholifar khal (DS-9)	2000
7	Burirchar khal (DS-5)	7500
8	Charnalar khal (DS-4)	1250
9	Maither khal	3000

Source: CEIP-I Design Study Finding

Description of construction activities

189. At first, the required tools will have to be procured for re-excavation of the drainage khals. A schematic diagram showing the centerline and layout plan will be made for the re-excavation the design depth and width of excavation will also be noted as per section of the

khal. The entire khal will then be divided into a number of reaches. The excavation will be started from the upstream of the khal. Cross dams will be built in the reach, and soil will be removed from the channels upto the required depth and width. Both manually and mechanically (excavator) methods will be used for excavation of drainage khals. No dredging operation will be carried to removal of sedimentation from the khals. The excavated soil/sludge should be dumped in a suitable place, specified by the Engineer in-charge, so that the sludge or soil will not affect the channel flow by any means. After finalizing excavation in one reach, the next reach in the downstream would be excavated following the same procedures as stated above. The entire length of the channel will thus be re-excavated.

4.6.5 Bank Protection Works

190. The segment of the embankment at km 3.00 to km 3.30 ; km 4.30 to km 5.30 and 13.25 to km 13.65 have fallen under the thrust of river erosion of the River Payra (Burishwar) which is required to be protected by bank protective works.

Description of construction activities

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

4.6.6 Afforestation

192. Afforestation on the foreshore area by plantation of mangrove species is proposed under the interventions. The areas selected for afforestation in Polder 41/1 are shown in detail in Map 4.2. A total of 69,840 nos of trees will need to be cut from the RoW (Source RAP Assessment). About 33.81 km of embankment slope with 13.2 ha area is available for afforestation of this polder (Source: Final Interim Report on Additional Tasks Assigned, Volume III: Afforestation Report, Page: III-19). In addition, about 6.61 ha of foreshore area within Chainage from 22.0-33.0 km. will be planted with different mangrove species (Source: Final Interim Report on Additional Tasks Assigned, September, 2013, Volume III: Afforestation Report, Page: III-21).

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

194. For the Slope Plantation, the lower one third of the slope may be planted with deep-rooted tree species, the mid one third may be planted with shallow rooted medium size tree species and the upper one third may be planted with species that have very small root system. Keeping this in view, the lower row along the slope will be planted with *Tamarindus indica* (Tetul) & *Acacia nilotica* (Babla) at a spacing of 2M (6 ft) apart. The upper row will be

at a distance of 6 to 8 feet i.e. 2 to 3M from the lower row. The upper row will be planted with *Borassus flabellifer* (Tal), *Cocos nuciferal* (Narikal) and *Phoenix sylvestris* (Khajur) at a spacing of 2 M (6 feet) apart, but staggered with the lower row plants. The *Tamarindus indica* (Tetul) and *Acacia nilotica* (Babla) seedlings will be raised in 10" X 6" poly bags. Before plantation, a temporary nursery will be established in the polder area to ensure the availability of seedlings. Nursery costing has been shown separately in Feasibility Report. The *Borasus flabellifer* (Tal), *Cocos nuciferal* (Narikal) and *Phoenix sylvestris* (Khajur) seedlings will be purchased from nurseries. 2,500 seedlings will be planted in one hectare area. An estimated 33,000 nos of saplings will be planted along the 13.2 ha area of embankment slope.

195. 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*) has been selected as the suitable species for this polder. Average distance between two saplings will be 1.5 m. Accordingly, more than 29,300 mangrove saplings will be planted in 6.61 ha of available foreshore area.

196. In addition, another afforestation program to be included in the polder for sustenance of green environment of the polder and restoring of proper eco-balance. It is observed that, total 69,840 nos. of trees to be cut in Polder 41/1, which will require plantation of total 20,9520 (69,840x3) trees in the area, according to practice of DoE (according to DoE, 3 plants to be planted for 1 tree cutting). Since, 33,000 sapplings will be planted in 13.2 ha of embankment slope and 29,300 plants at foreshore area the remaining 147,200 nos. tree plantation to be carried out in the area, which, to be distributed among the polder inhabitants for planting in their suitable locations (for the purpose, the required cost is included in cost of estimates for environmental Management and monitoring, (Table 10.5).

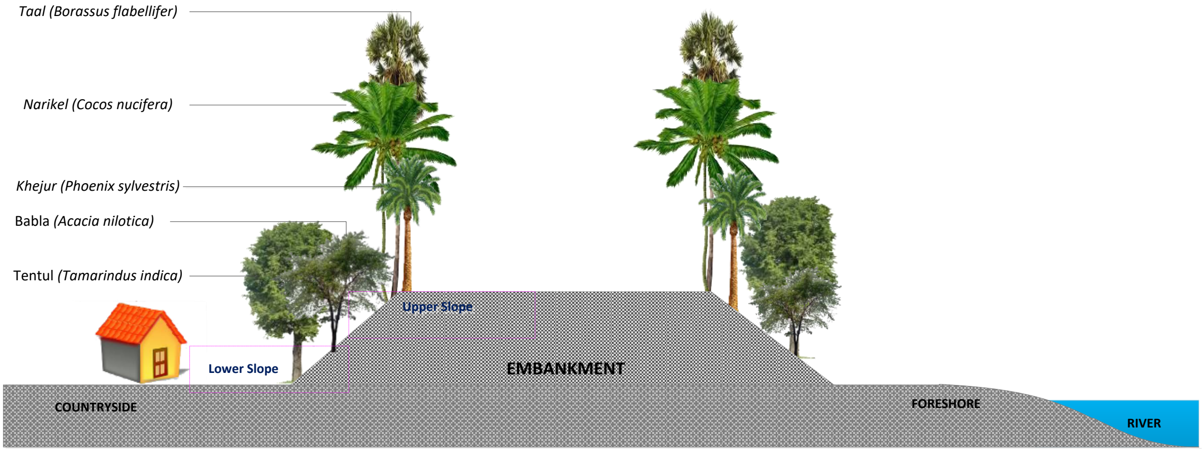


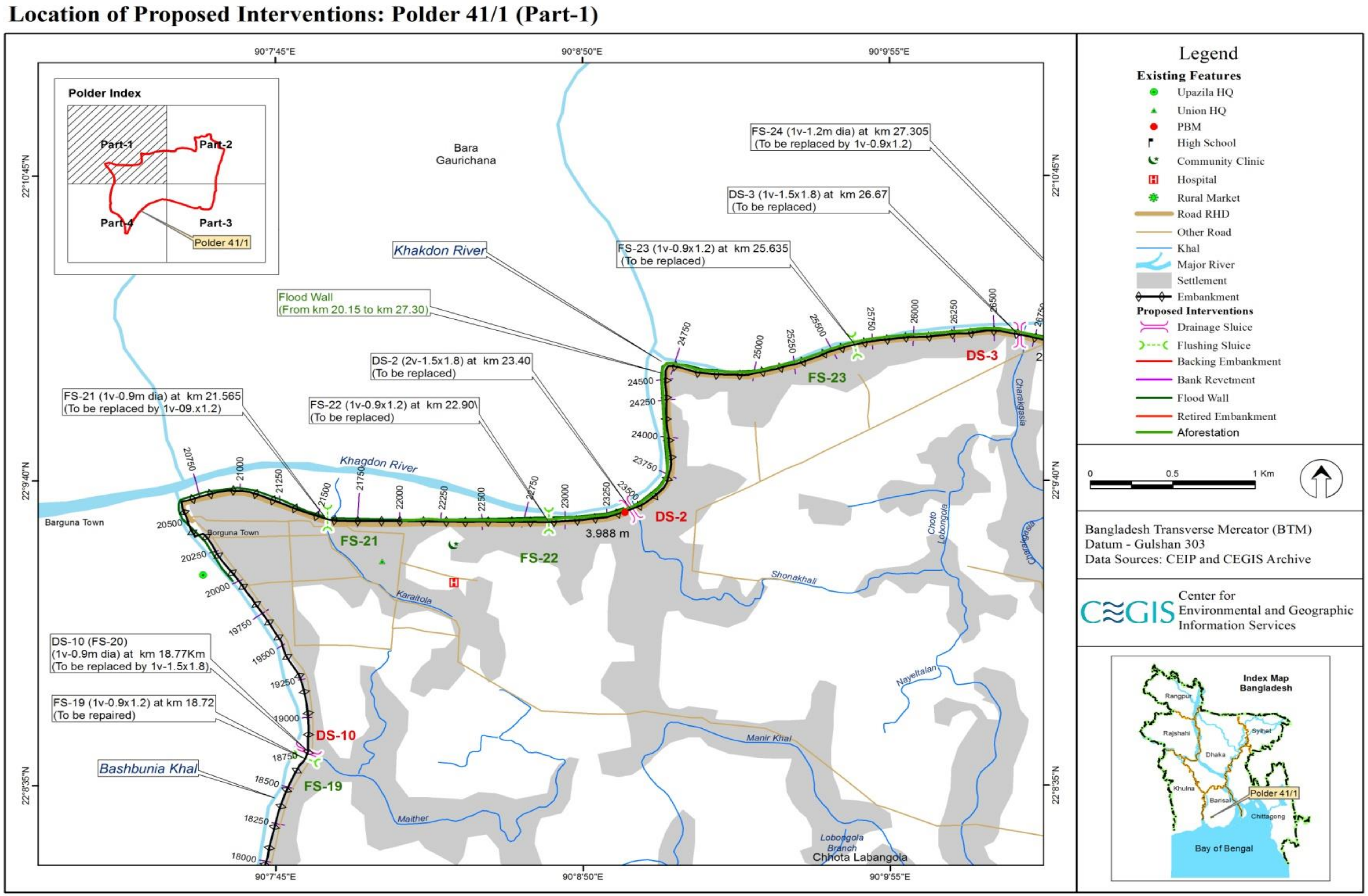
Figure 4.3: Typical cross section of Embankment slope and Foreshore Afforestation

197. Detail Plantation establishment Matrix is presented in following Table:

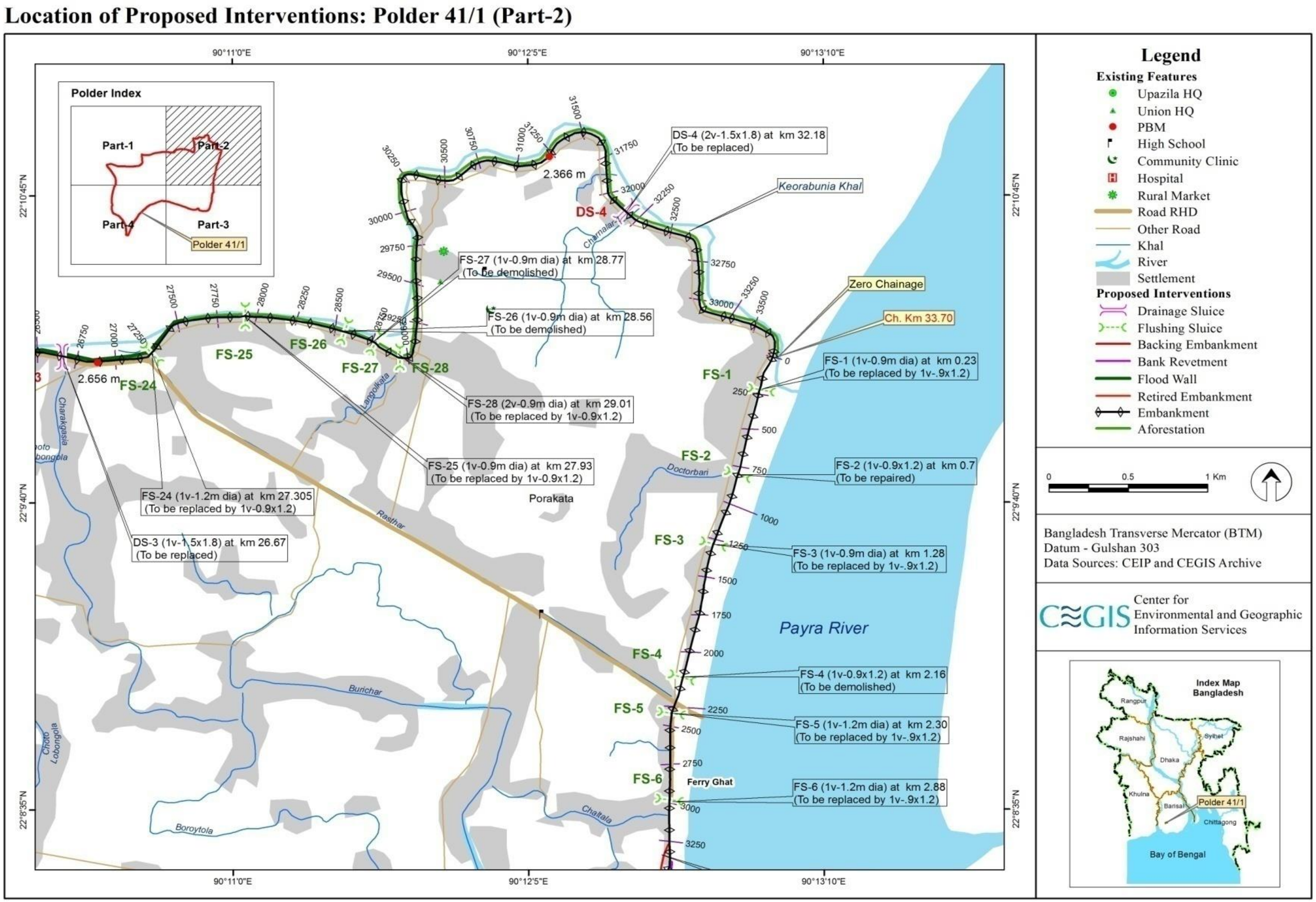
Table 4.8: Detail information on plantation program

Item of works	Time schedule for the given type				
	Golpata (Nypa) Plantation	Chailla, Kankra, Gewa Plantation	Keora Baen Plantation	Embankment Slope Plantation.	Additional Plantatation
Selection of site, survey the site and prepare plantation site map.	March	January	February and March	February	February and March
Cleaning of unwanted growths by cutting them off.	May 3rd week.	April 4th week immediately before planting.	One week before the planting day. May be in the 1st week of May.	April 1st week.	-
Pit making	n.a.	March 2nd week.	n. a.	April 1st week.	-
Application of Compost	n.a.	March 4th week.	n. a.	April 3rd week.	-
Stacking	May 3rd week.	April 1st week.	n. a.	April 3rd week.	
Bring seedlings from the nursery to plantation site.	June 1st week.	April 3rd week.	On the day of planting during 1st or 2nd week of May.	April 4th week.	
Planting of seedlings.	June 1st week. Immediately after bringing seedlings from the nursery.	April 4th week.	May be 1st or 2nd week of May.	Immediately after bringing the seedlings.	
Fixing of red flags indicating planting sites to avoid fishing.	May 4th week.	n. a.	n. a.	n. a.	
Application of fertilizers.	n. a.	After of week of planting the seedling.	n. a.	After of week of planting.	
First weeding	August 1st week	May 4th week	May 4th week. 1st year.	May 2nd week, 1st year, to be done by the watcher free of charges.	
Second weeding	November 1st week	June 3rd week	June 1st week. 1st year.	July 1st week, 1st year, to be done by the watcher free of charges.	
Third weeding	May 1st week next year	July 2nd week	June 4th week. 1st year.	May 1st week, 2nd year, to be done by the watcher free of charges.	
Fourth weeding	n.a.	August 4th week.	May 1st week. 2nd year.	August 1st week, 2nd year, to be done by the watcher free of charges.	
Sapling Distribution	-	-	-		July, last week
Fifth weeding with light pruning if necessary.	n. a.	April 1st week next year.	October 1st week. 2nd year.	n. a.	
Sixth weeding (Climber cutting)	n. a.	June 1st week next year.	n. a.	n. a.	
Seventh weeding (Climber cutting)	n. a.	August 1st week. Next year.	n. a.	n. a.	
Pruning.	n. a.	n. a.	n. a.	n. a.	
Watching	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	

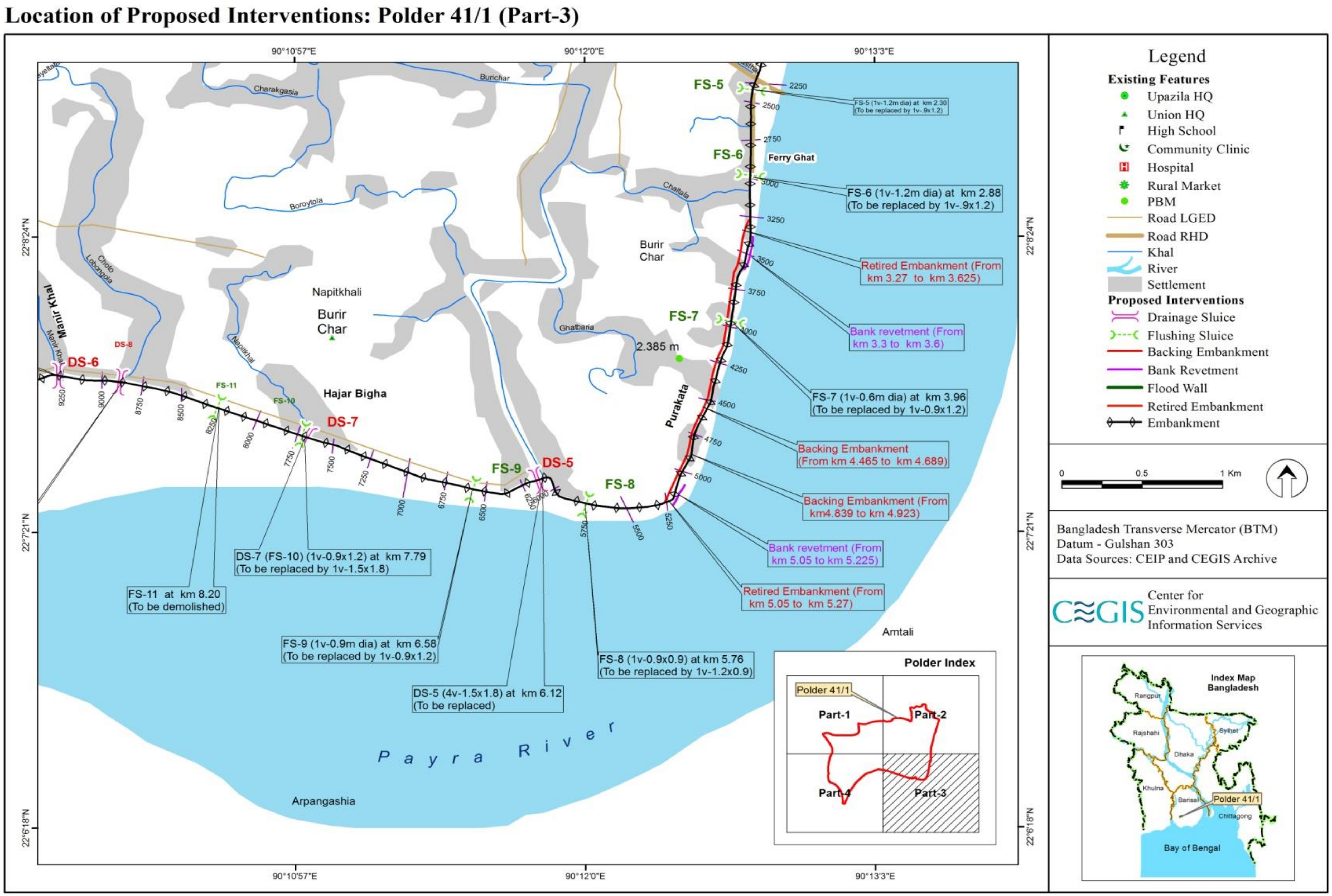
Source: Feasibility Report of CEIP, Volume III: Afforestation Report, September 2013



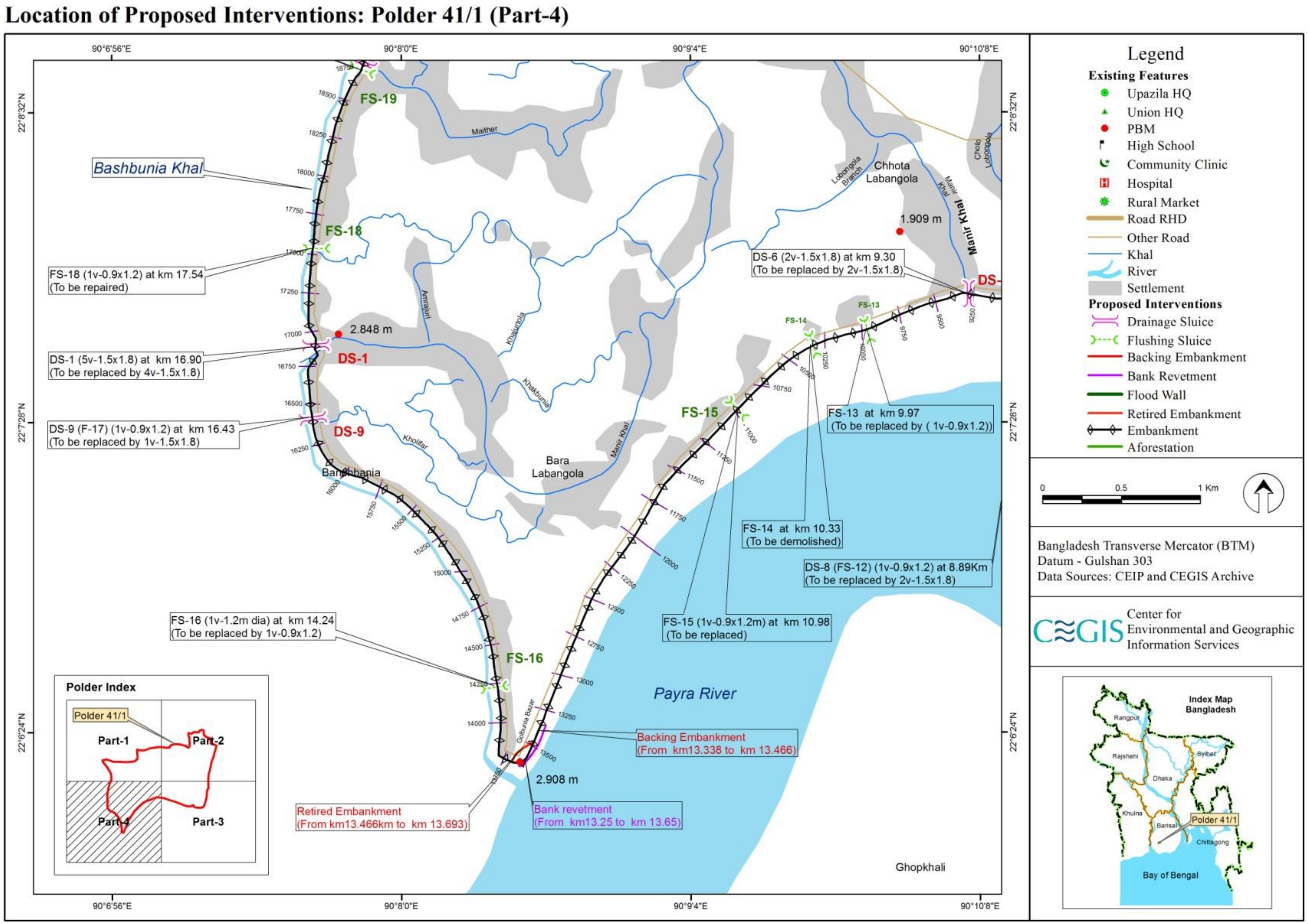
Map 4.2 (a): Location of Proposed Interventions in Polder 41/1 (Part-1)



Map 4.2 (b): Location of Proposed Interventions in Polder 41/1 (Part-2)



Map 4.2 (c): Location of Proposed Interventions in Polder 41/1 (Part-3)



Map 4.2 (d): Location of Proposed Interventions in Polder 41/1 (Part-4)

4.7 Details of Construction

4.7.1 Construction Schedule

198. The construction works in Polder 41/1 under the CEIP-1 are expected to be completed in four years. The construction schedule is presented in Appendix- 2.

4.7.2 Construction Manpower Requirement

199. Technical and nontechnical manpower will be required for the construction works. The manpower will include Engineers, Technicians, Supervisors, Surveyors, Mechanics, Foremen, Machinery operators, Drivers, and un-skilled laborers. Around 60 to 70% of the laborers will be engaged from the local area and the rest from outside. The manpower required for the construction work as estimated is presented in **Table 4.10.**

Table 4.10: Required manpower for construction

	Required Manpower	Number
1	Engineers	15
2	Machinery operators	250
3	Mechanics	2
4	Surveyors	2
5	Skilled labours (person-day)	5,000
6	Un-skilled labours (person-day)	30,000

Source: CEIP-I Design Study Finding

4.7.3 Construction Material

200. The construction materials required for re-sectioning and retired embankment, water regulatory sluices and flushing sluices and bank protection work will include soil, cement, steel and sand. Estimated quantities of these materials are presented in **Table 4.11.**

Table 4.11: Details of Construction materials

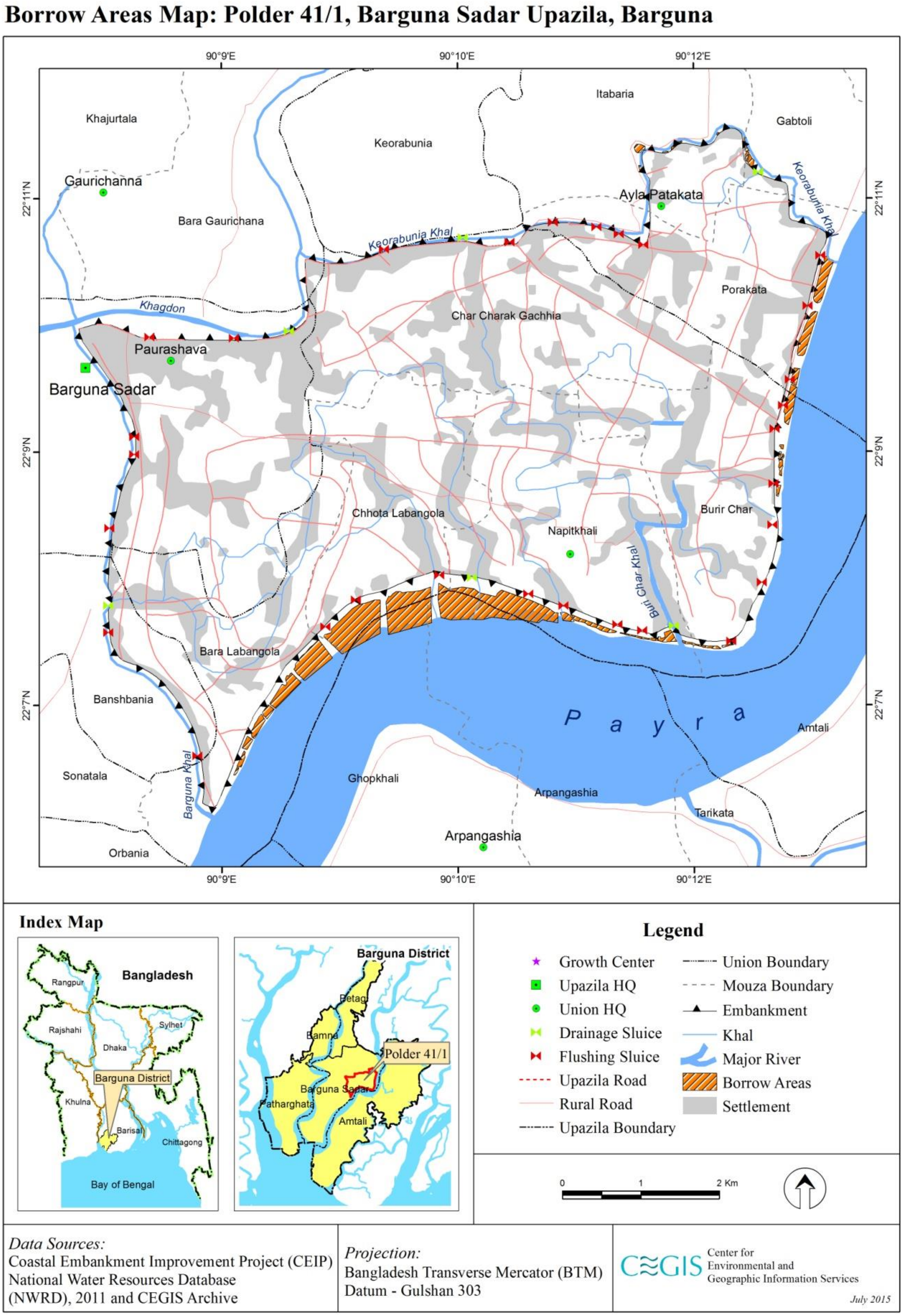
	Description	Quantity	Sources
For Re-sectioning and and construction retired embankment			
1	Earth work	11,00,000 m^3	Borrow pits, dredged spoils from re-excavation of drainage channels
For Construction of sluices and flushing inlets			
2	Cement	1,60,000 bags	To be procured from local market
3	Sand	8,000 m^3	To be procured from Barisal
4	Stone	7,000 m^3	To be procured from Barisal
5	Steel	1,200 tons	To be procured from Barisal
Bank protection			
6	CC Blocks	20,00,000nos	To be manufactured in the construction site during construction

Source: CEIP-I Design Study Finding

201. The carried earth required for embankment rehabilitation will mainly be collected from the borrow pit of Polder 41/1. Dredging spoils from re-excavation of drainage channels will also be used for the re-sectioning of embankments. If additional earth is required, Contractor will collect from other suitable places.

Earth from borrow pit area

The earth for rehabilitation of the embankment will be collected mainly from the offshore borrows pit areas of Polder 41/1. The EIA team of CEGIS has identified the available borrow pit areas during field investigation considering minimum set back distance of 15 m from the toe of the embankment. The required earth for the embankment could be obtained from the identified borrows pits. The depth of the borrow pits area shalll not be more than 1.5 m design by DCS 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 borro pits, a separate walk way will be kept for the movement of workers and pedestrians. In the coastal area, on an average, roughly 5 to 10 inches sedimentation takes place in most of the major khals and the surrounding rivers each year. Therefore, it is expected that the pit area will be restored within 5 to 10 years after excavation. The identified borrow areas for earthwork of the embankment is shown in Map 4.3.



Map 4.3: Map showing the available borrow pit area of the Polder 41/1

4.7.4 Construction Machinery

202. A number of construction machineries and equipment will be required for the construction activities. A tentative list of these machineries and equipments is presented in Table 4.12 below.

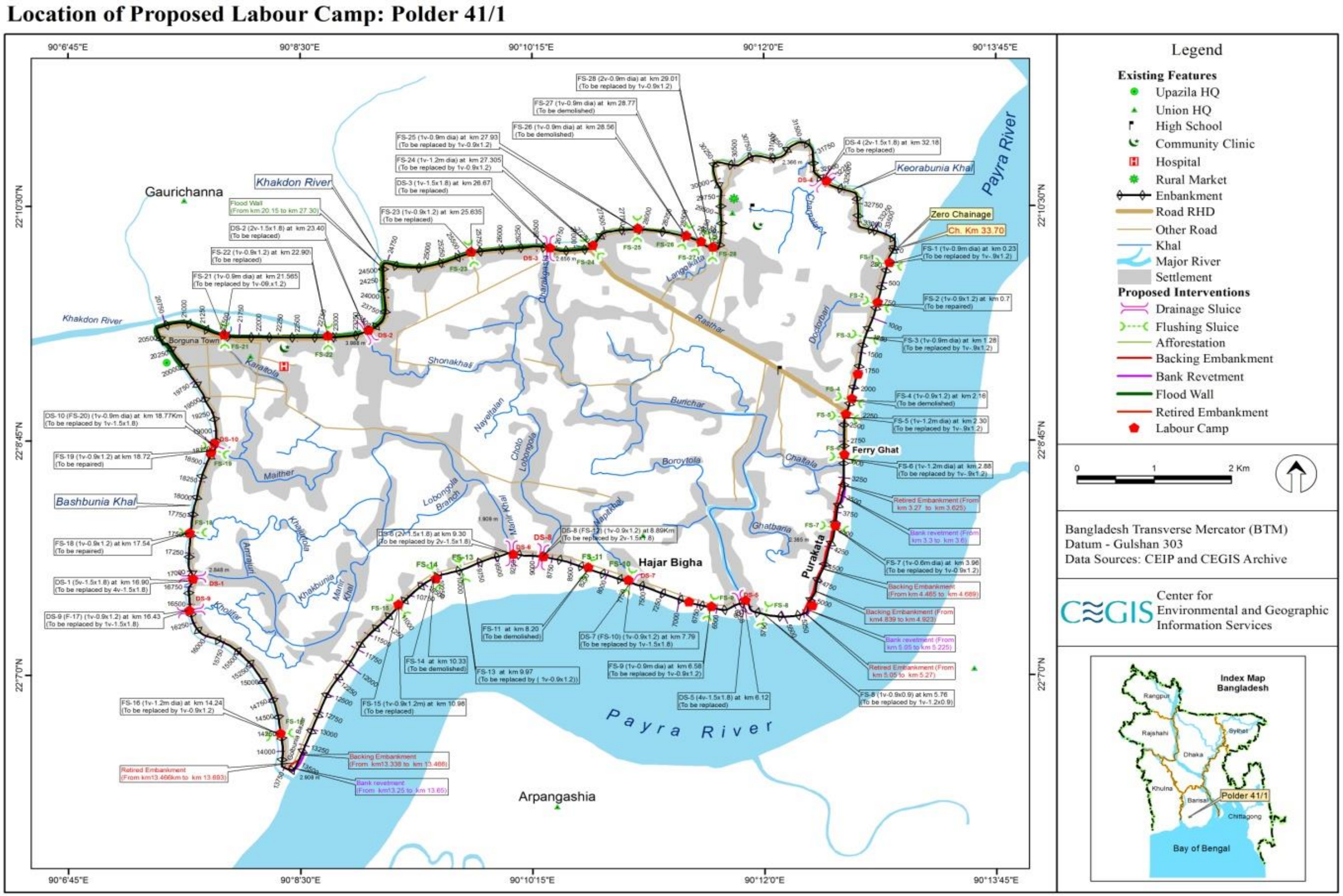
Table 4.12: List of construction equipment and machinery

Sl. No.	Description	Quantity (number)
1	Bulldozer	4
2	Dump- truck	20
3	Pay Loader	0
4	Excavator	4
5	Barge	2
6	Engine Boat	8
7	Vibrator	2
8	Compactor	14
9	Mixture Machine	16
10	Mixing-Plant	2
11	Truck	14
12	Tractor	10
13	Generator	20
14	Levelling Instrument	4
15	Total Station	1
16	De-watering System	2
17	Low lift pump	22

Source: Engineering/ PoccurmentTeam of CEIP-I

4.7.5 Construction Camps

203. A total number of 34 labor camps will be established during the construction period. The camps will be set up for embankment works, construction of drainage sluice works, flushing sluice works, bank protection works and flood wall. The Contractor will select the location of the camp through consultation with the Chairman of the local Union Parishad and the community inside the polder, and will need to obtain permission from the DCSC before constructing them. The location of labour camps are shown in **Map 4.4.**



Map 4.4: Map showing the locations of proposed labour camps

Drinking Water and Sanitation System of Camps

204. A total number of 35 tube wells will be installed in the labor camps premises near the construction sites for supplying water drinking water as well as for construction activities. Sanitary latrines will be constructed along with septic tanks for safe disposal of sewage.

4.7.6 Vehicular Traffic during Construction

205. Major portion of earth will be carried to the working location of the embankment by mechanical equipment like excavators, pay loaders, dump trucks, trolleys while a small quantity through manual labor.

206. For western and north part of the polder, the materials would be collected from the stockyard at Barguna BWDB premises and would be transported to the working site using heavy trucks. Because Barguna BWDB owns a vast area and no other land requisition is needed for storing the materials. But if necessary, the contractor might use other storage location/s.

207. The equipment and construction materials including hard rock dumping materials and sluice gate equipment will be transported from Barisal on water vessels through Biskhali River.

4.7.7 Jetty Construction

208. A temporary jetty near the stockyard of BWDB colony will be constructed for unloading the construction materials.

4.8 Project Implementation Arrangements

209. **Overall Project Management.** The Government of Bangladesh has the overall responsibility for project management and coordination through the 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).

210. **Project Steering Committee (PSC).** The Secretary, Ministry of Water Resources will be the convener of the PSC with the Secretaries of Finance, Agriculture, Environment & Forest, 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.

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

212. The Engineering Unit will oversee the works of the consultants on design and construction supervision matters. A Deputy Project Director will head the Engineering Unit and spend about half of his/her time at project 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.

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

214. A Social, Environment and Communication Unit will supervise the works 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.

215. Each Field Office 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.

216. The PMU will be supported by the following Consultants/Consulting Firms:

217. An experienced NGO will be mobilized by the PMU to implement the social afforestation, recommended in the EMP, the Social Action Plan including mobilization of Water Management Organization, the RAP and the EMP.

218. A Design and Construction Supervision Consultant *(DCSC)* that will assist the PMU in preparing the detailed design of the remaining polders and supervise all construction. For civil works contracts, the Project Director will serve as the Employer, and the DCSC will serve as the Engineer for construction supervision. At site, a Resident Engineer, appointed by the consultant, with a team of specialists and inspectors will supervise the Contractor.

219. A Third Party Monitoring and Evaluation Consultant will provide support in monitoring impacts and supervise the implementation of the EMP/RAP and report to the PMU.

220. 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.

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

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

4.9 Water Management and Operational Plan

4.9.1 Introduction

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

224. The polders have been playing a vital role in safeguarding the coastal area; ensuring and increasing agricultural production; improving livelihoods of the people; and mitigating environmental damages. However, these are vulnerable to storm surges; high tides; annual floods; land erosion and drainage congestion. In many cases, the structures as built have not been found adequate to cater to the diverse needs of the local people. Changes in the land use pattern have created water management conflicts and newer dimension needs asking the structures to allow flows of water both ways. So maintaining the polder system with embankments and structural elements has become a permanent, important task. The GoB either with assistances from international donors and lending agencies or out of its own resources has been spending money almost in a regular basis to keep the polders in good working condition eventually to save the coastal people. The Coastal Embankment Improvement Program (CEIP) is one of the latest such interventions to address a systematic restoration and upgrading of the 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 Operational Plan

225. The operational plan involves setting out the schedule of activities related to operation of gates of structures by the users' organization to control water levels best suited to water management and agricultural needs. In the coastal polders, operation of gates mainly focuses on keeping 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 at 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 user. 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.

(i) Operational Activities

226. 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)*

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

(a) Regulation of gates

228. BWDB, in the past, 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.

229. 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 details in the following chapter to address Beneficiaries Participation in coastal polders.

230. 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.

231. Flap Gates of regulators should remain in place at all times except during maintenance or if flushing is taking place. During the 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 it 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.

232. During the 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 have enough consultation with the beneficiaries' organizations because agricultural practices, crop varieties; and cropping pattern are changing over time.

233. Operation of Flushing Sluices and Pipe Inlets should also have similar practices with maximum involvement of beneficiaries' organizations. The O&M section and DWM staffs of BWDB will assist them in the water management of command areas inside the polders. A gate operation plan in Bangali is provided in **Appendix-15**.

(a) Frequent Watching of Embankments

234. 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.

235. Recommendations for the frequency of field inspections and reporting of the physical condition of canals and embankments with its associated structures and protective works by BWDB's O&M field staffs have been made quite in details in the relevant SRP reports and findings.

(b) Regular Checking of Structures

236. 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 Sectional Office of BWDB to identify and report the damages for rectification.

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

237. 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.

(d) Supervision of preventive maintenance works

238. Preventive maintenance works are done 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.

(ii) Planning of Operation

239. 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 also like fisher folk community, navigators/boatmen, salt growers (if applicable) and general water users for domestic purpose. So in the planning of operation, the demands of all categories of beneficiaries should be taken into account for achieving a perfect integrated water management. Participation of beneficiaries at all levels of planning is essential.

240. The decision making process involved in structure operation is shown in Figure 4.5. This illustrates schematically the procedural steps necessary to translate water management needs into actual structure operation. The water management plan drawn over a season provides 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 needs of adjusting the operational measures.

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

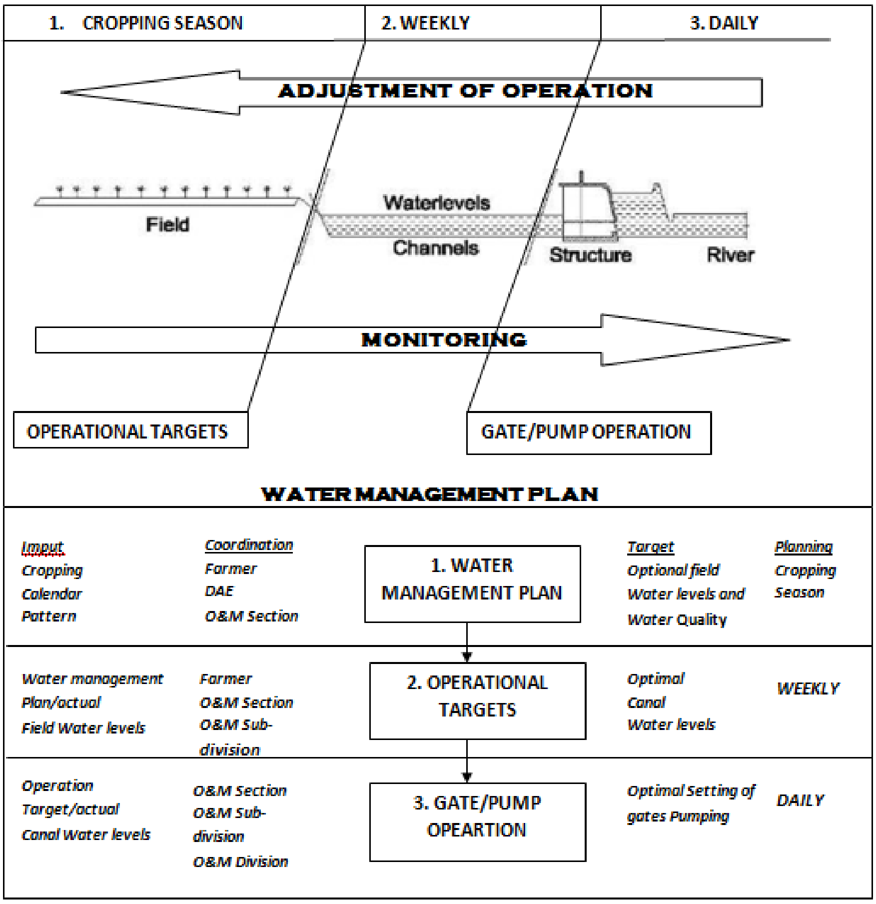


Figure 4.4: Decision making in operation

(a) Seasonal Water Management Plan (WP Plan):

242. In the 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 at the user level i.e. at WMGs (**Figure 4.5, 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 it exists) and DWM to produce the final WM plan. This needs to be prepared well ahead of the cropping season so that critical farm operation (e.g. seed bed preparation, shrimp or salt production requirements) can be carried out in line with the plan.

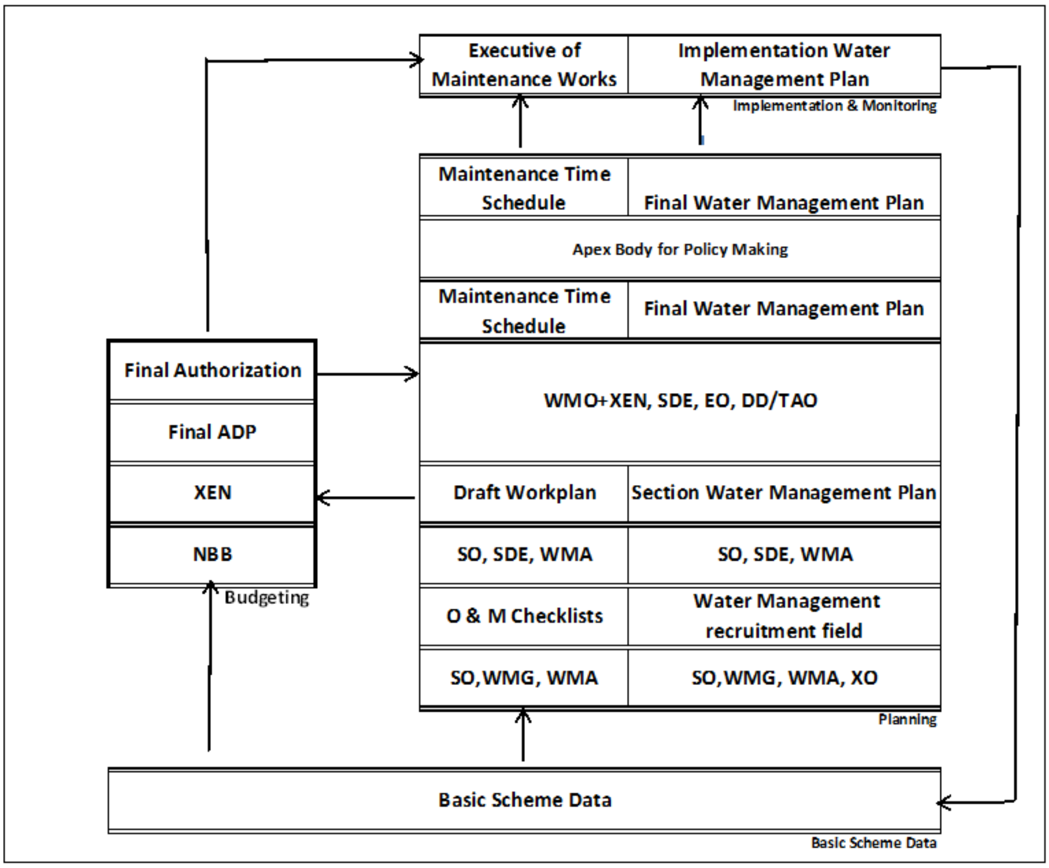


Figure 4.5: Standard Planning Procedure

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

243. 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 drawing up of a detailed water management plan. In large polders, water management computer model can be 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. However, specially trained staff with required hardwares and softwares will be required for such advanced calculation.

244. In fact the WM Plan is a formal agreement between the BWDB's O&M offices and the water users' platforms (be it 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:

245. 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/floodplain 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:

246. Daily structure operation requirements involve manipulation of gates 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.

4.9.3 Maintenance Works

247. 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 preserving the infrastructure in good and functional condition; protects investments; and prevents high rehabilitation costs. Since this is included in the day-to-day tasks schedule and needs continuous efforts, maintenance of coastal polders put emphasis on simple and cost effective community-based interventions.

248. In the coastal polders, the works, which inly 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;

249. 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 round 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.

(i) Periodic Maintenance

250. 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.

251. The most important distinguishing characteristic of minor periodic maintenance works is that it is 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:

(a) 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;

(b) 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.

252. The periodic maintenance interventions have been spelled out precisely in **Table 4.11** below**.**

(ii) Emergency Maintenance

253. 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 4.13** indicates each type of emergency maintenance work.

Table 4.13: Types and Classification of Maintenance Works

Sl. No	Description of Maintenance Works	Implementation Mode: Classification by Type of Maintenance			Community Based Functional Groups under WMOs						LCB
		I	II	III	EMG	ES	CMG	SMG	LCS	PIC	
	Embankment										
1	Incidental earth works: Minor filling so frills; 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, up keep 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: Re-sectioning or fillings of crest and slope but not re-sectioning so as to bring it back in a shape that allows ESs to settle and trees to be planted.		√						√		
5	Major earthworks: Re-sectioning or filling of crest and/ or slope including turfs so as to bring it back to its design level.		√						√	√	
6	Repair of damaged access ramp, construction of small partition dyke		√			√			√		
7	Emergency closing of breached section			√					√		√
	Structure										
8	Cleaning and greasing of moving and/or sliding parts and seal	√						√	√		
9	Removing silt and debris (water hyacinth, aquatic weeds and others) near intake	√							√		
10	Checking and tightening nuts and bolts	√						√	√		
11	Brushing cheeped or loose paint rust on metal parts; and painting	√						√	√		
12	Patching minor damages or minor brick		√								√
13	Replacing rubber seal of gate, positioning		√					√			√
14	Repairing or replacing damaged metal works /hinges, lifting devices for flap or Vertical sliding gates		√					√			√
15	Repair of defective block works(aprons)		√								√
16	Replacing stop logs, flap gate or vertical		√	√							√
17	Repair head walls, wing walls, aprons of		√								√
18	**Protective Works** Re-positioning/replacing of incidentally displaced blocks/ boulders /concrete frames, small repair to sand/gravel filter		√								√
19	**Channels** Cleaning khal and outfall drains and de-silting outfall drains	√					√				
20	Re-excavation of khal		√						√		
21	Removing cross dams (used as access roads, flashing bunds or water retention)		√			√					

Source: Source: Engineering Team of CEIP-I;

Notes: Maintenance Class; I- Preventive or routine maintenance; II-periodic Maintenance; III-Emergency Maintenance *(iii) Planning of Maintenance*

254. 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 (Figure 4.6). 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 hampers in any area, all these should be reflected in the water management plan. This concerns mainly the periodic maintenance works. The 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 monitor the maintenance schedule is followed for executing these physical work plans.

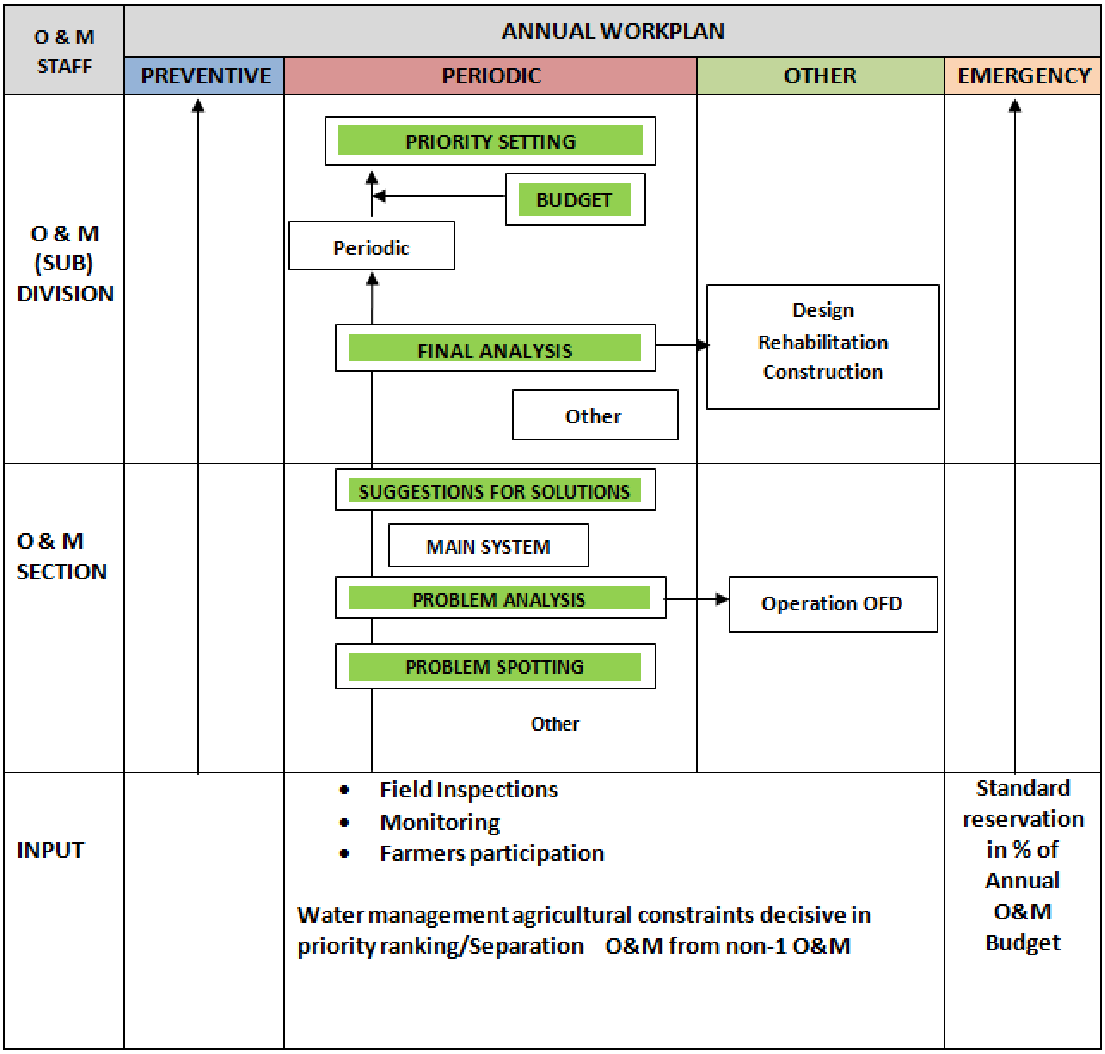


Figure 4.6: Decision Making in Maintenance

255. Before any planning of maintenance, there should have the separation between O&M and non-O&M works. Only the 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 centred on the selection of works to be included under periodic maintenance.

4.9.4 Rehabilitation works

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

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

257. Table 4.14 below depicts the Type of Rehabilitation works.

Table 4.14: Type of Rehabilitation Works

Sl. No.	Description of Maintenance Works	Implementation Mode						
		Community Based Functional Groups under WMOs						LCB
		EMG	ES	CMG	SMG	LCS	PIC	
1	**<u>Embankment</u>** Construction of new or retired embankment, closing of breach (not emergent);					√		√
2	**<u>Structures</u>** Big repair or replacing and up lifting flap gates or vertical slide gates;							√
3	New protective works (CC blocks/boulders), big repair of block works (aprons);							√
4	Repair of head walls / wing walls/ aprons							√
5	**<u>Protective works</u>** 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	**<u>Channels</u>** Excavation of new *Khals*					√	√	√

*Source: Engineering Team of **DCSC**;*

Note: EMG-Embankment Maintenance Group; ES-Embankment Settler; CMG-Canal Maintenance Group; SMG-Structural Maintenance Group; LCS-Landless Contracting Society; PIC-Project Implementation Committee, LCB-Local Contracting Bidding.

4.9.5 Local Participation in O & M and Water Management

258. Local stakeholders' participation in the development and maintenance of water resources of polder is a much-talked issue. This is looked upon more seriously in FCD and / or FCDI interventions of BWDB because chronically most of these projects vis-a-vis coastal polders have been showing poor performances in terms of water management and agricultural crop production mainly due to inadequate Operation and Maintenance (O&M). The potentials in many cases remain under-utilized; neither the beneficiaries nor the local government institutions find effective ways and means to get themselves involved in O&M and water management issues. In the past standard procedures were prescribed in some of

the study reports under different projects but instances are few where these are commonly followed to achieve substantial results. Untill 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 in coastal polders thus remains as a big question as yet.

a. Institutions for Participation

259. 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.

260. 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 polder is together termed as the Water Management Organization (WMO).

i. Current status of Participation in CEIP Polders

261. 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 catastrophies 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.

262. 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.

263. 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 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.

264. 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 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'.

ii. Institutional framework for Participation

265. 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:

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

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

For 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 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 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):

267. 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 polder will be 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 of 2 or 3 villages and part thereof. One WMG may therefore include several hundreds to a few thousand as its primary members.

268. A complete household census will provide the actual number of beneficiaries. By virtue of their residence in the Units or having land holdings inside the polder areas each of the household chiefs will qualify for becoming the Primary Member.

269. 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.

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

Water Management Association (WMA):

271. 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.

272. 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):

273. 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.

274. Moreover, the duties and responsibilities of WMOs at different tiers are shown in Table 4.15.

Table 4.15: 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
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

b. Participation of Community Based Organizations (CBOs)

275. 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

276. 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 (approx. 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 usufractuary rights of the plantation on embankment slopes and toes.

EMG - Embankment Maintenance Group

277. 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 labourers on a daily basis payment. Responsibilities and mode of payment are same as those already in practice in BWDB polders.

LCS – Landless Contracting Society

278. 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 value 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 contractors. 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

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

c. Roles of NGOs in participation

280. 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

281. 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

282. The NGOs with proven track records of experiences to work among the costal 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

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

New Plantation and Re-enforcing the Vegetative Covers

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

d. Relationship with LGIs and Local Administration

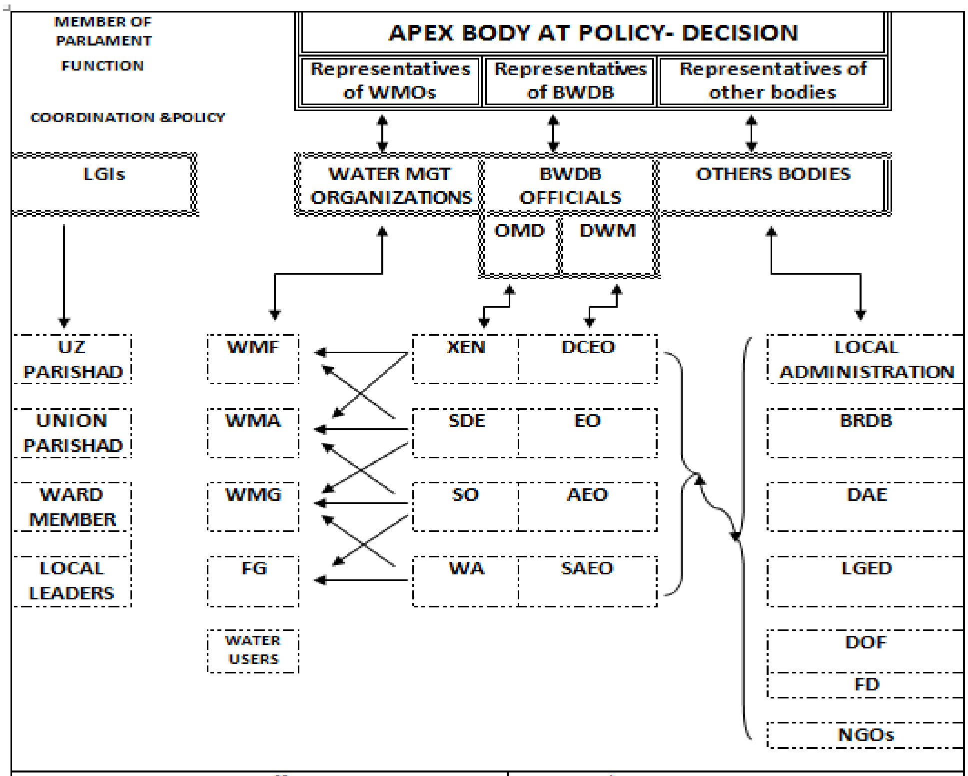
285. At the lowest tier of administration, the Local Government Institutions (LGIs) in Bangladesh have a very good record of existence and performance among the local community. It also becomes the inevitable part of development activities. It would not be appropriate to introduce WMOs to function in 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

286. 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.

287. 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.

288. 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 4.7: Inter-relationship between WMOs and the LGIs

Support from Local Administration

289. 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:

(a) Participation in the Union Parishad and Upazila Parishad Review Meetings

290. 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*".

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

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

4.10 Project Cost

292. The total estimated cost as calculated is Tk.1,780,530,764 (BDT one hundred seventy eight crore, five lac thirty thousand seven hundred sixty four) only.

4.11 Need of Resettlement Action Plan (RAP)

293. The interventions proposed in Polder 41/1 do not include any major type of works to be carried out in new alignments. All Drainage or Flushing Sluices proposed to be replaced will be re-constructed on the existing alignment. Also for the embankment re-sectioning works, the existing alignment is to be used and for R/S slope protection works, the additional set back distance is to be used. Moreover, there is no such intervention of construction of retired embankments. It can therefore be concluded that no major resettlement may occur during project implementation. However, some minor resettlements may be needed as some households still exist over or adjacent to the polder periphery, which may be displaced during construction works. In this connection, a detail RAP investigation is required, which is being conducted by the consultants.

4.12 No Objection Certificate

294. Polder 41/1 is located in the Barguna Sadar upazila under Barguna district, covering three Unions namely Barguna, Barir Char and Aila Patakata and one Paurashava (Barguna Paurashava). No archaeologicasites or cultural heritage are known to exist in these unions, which might be affecte the interventions proposed for the rehabilitation of the polder. The No Objection Certificates (NOCs) collected from the union chairmen, are attached in **Appendix-2.**

5 Environmental Baseline and Existing Conditions

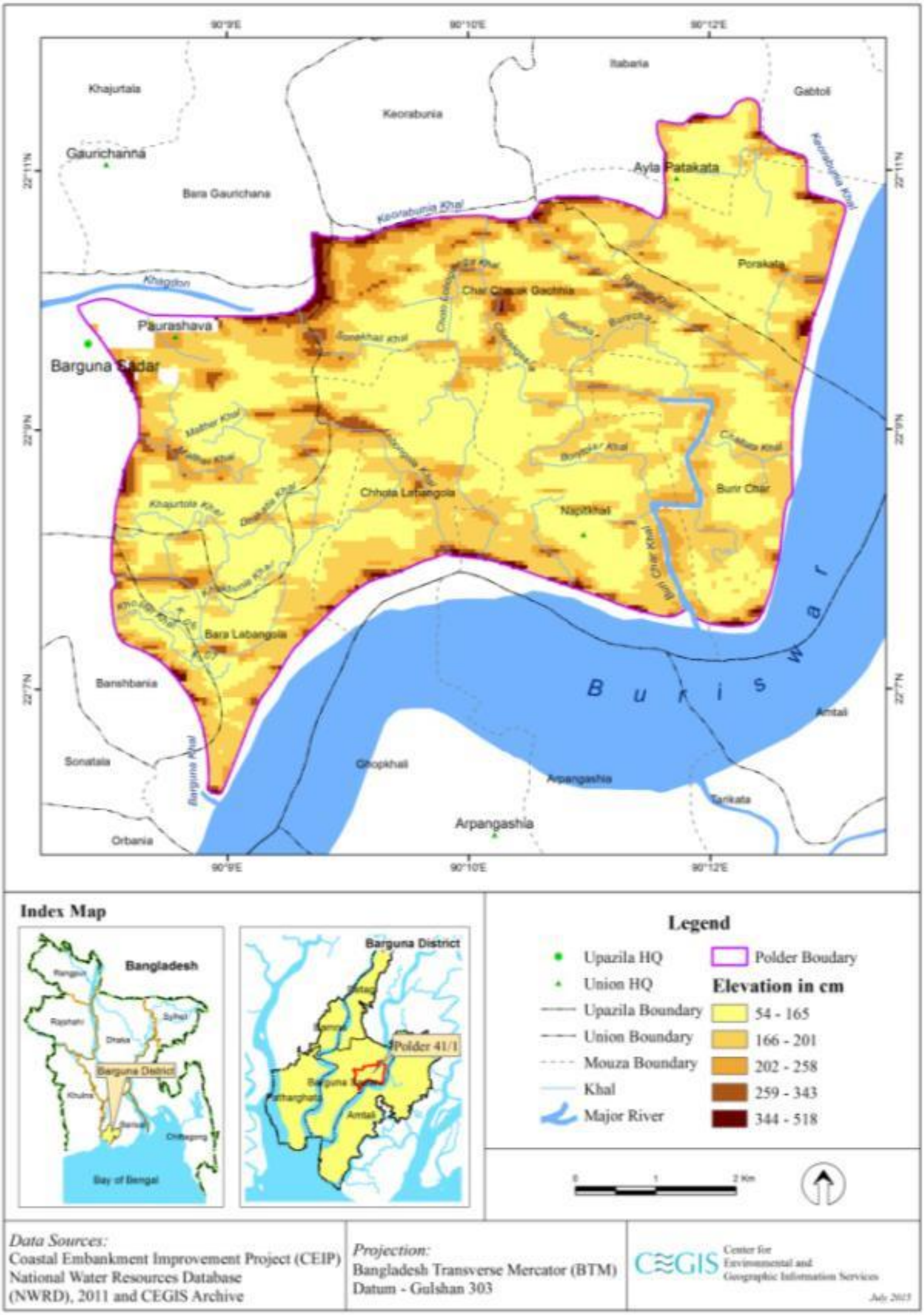
5.1 Physical Environment

295. Physical environment refers to the physical and chemical features of an area. It includes climate, rainfall, wind, soil along with nutrients and all other natural resources within the area. The following sections provide analyses on different physical environmental features of the Polder 41/1.

5.1.1 Geology

296. The Polder 41/1 is situated in a low-lying coastal region. From spatial analysis, it is observed that the polder comprises Tidal Deltaic Deposit. The major portion of this deltaic sediment deposited subaqueously in the permanent body of water where tidal waves and currents aid in transportation and deposition. Typically low-lying deltaic environment comprises soft sediments. this area is densely populated and these regions are quite dynamic and changes in coastal geomorphology are also quite rapid. Topography

297. The study area is located in the southern hydrological zone of the country, with very low average elevations. Analysis using Digital Elevation Model (DEM) infers that the Reduced Levels (RLs) inside the polder vary from 0.56 to 5.18 m +PWD with average RL of around 2.86 m +PWD., During high tides the highest water level at Payra (Buriswar) River reaches to 2.38m +PWD which inundates entire polder while during the lowest water level (1.28m +PWD) around 97% of the polder’s area remain under water. From the DEM it is also found that around 10% of land area in the periphery, mostly in the north side of the polder, has higher elevation between 3.44 to 5.18 m +PWD, whereas 70%, mostly in the centre, has elevation between 0.54 m to 1.65 m +PWD. The rest 20% of land area has an elevation below 2.0 m. **Map 5.1** below shows the topography of the study area, identifying the rivers and water bodies as well as categorizing land elevations.



Map 5.1: Digital Elevation Model (DEM) of Polder 41/1

5.1.2 Seismicity

298. Bangladesh is one of the seismically active regions of the world, experiencing numerous earthquakes in the past 200 years. As per the updated seismic design provisions of Bangladesh National Building Code, 1993, the Polder 41/1 occupies Zone-I, which is considered as a seismically quiet zone, with Seismic Zone Coefficient[11] of 0.075, comprising the southwest portion of Bangladesh. **Map 5.2** below shows the seismic location of Polder 41/1.

299. Polder 41/1 is located inside the sub-zone Barisal-Chandpur Gravity High of Bengal Foredeep[12], which is situated between Faridpur trough and Hatiya trough, and this zone has not been sufficiently investigated during seismic surveys. **Map 5.3** below represents the tectonic units available in Bangladesh and the location of Polder 41/1 (within the Barisal-Chandpur Gravity High).

300. It can therefore be inferred in consideration of seismicity and stratigraphy that the polder falls on a relatively safer side.

11 Seismic Zone coefficient is a dimensionless number which represents the (maximum) earthquake acceleration as a fraction of the acceleration due to gravity.

12 Bengal Foredeep is one of the world’s largest exogeosynclines.

Map 5.2: Earthquake Zones of Bangladesh and location of Polder 41/1

Map 5.3: Tectonic Units Bangladesh and location of Polder 41/1

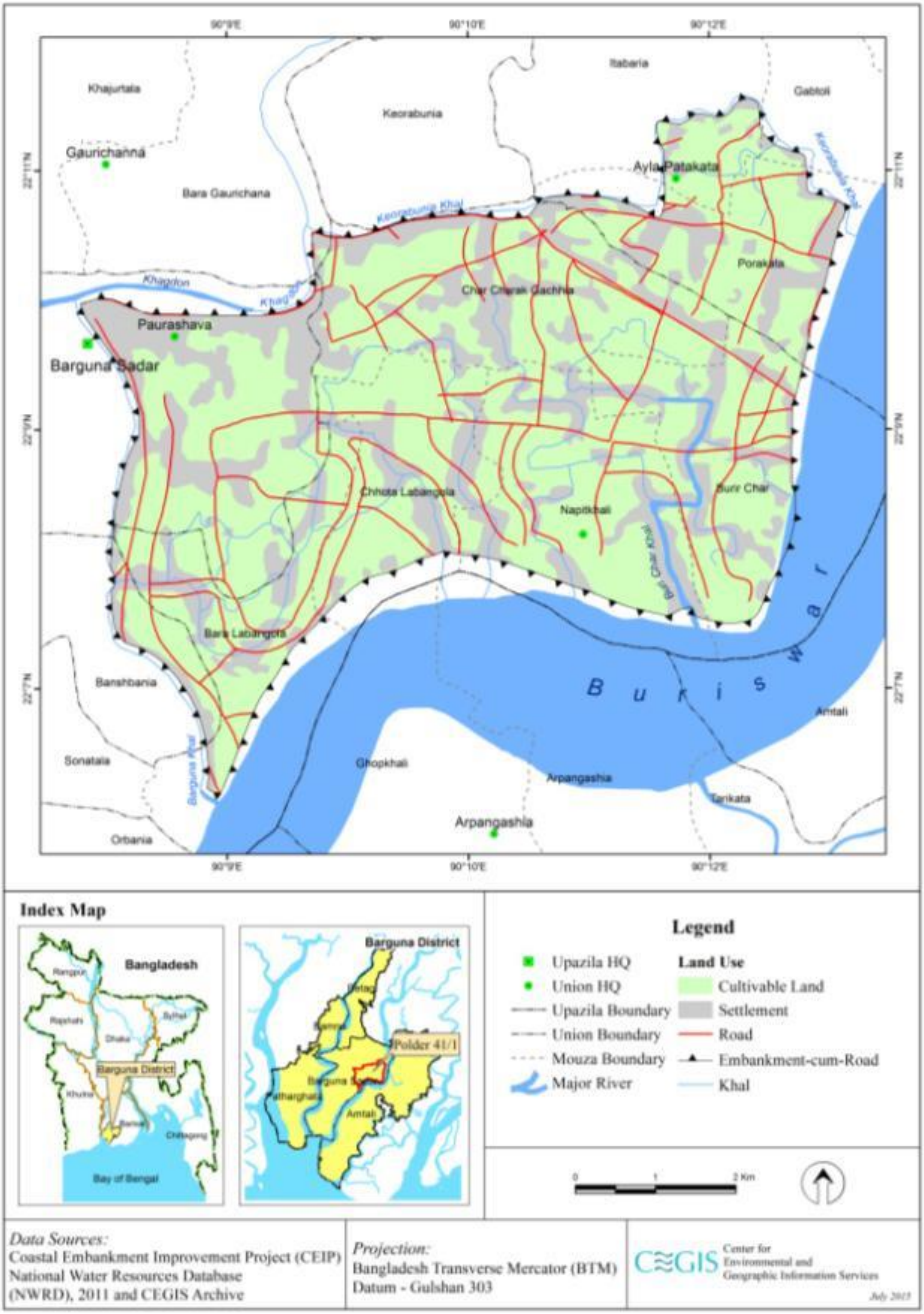
5.1.3 Land use

301. Land use data were collected from feasibility report (Agriculture), CEIP; 2012 and validated during field visit June, 2015. The total polder area is 4,048 ha, of which 3,440 ha is available for cultivation. The single, double and triple cropped area is 22%, 72% and 6% respectively. Data on existing land use practices in the polder area are presented in **Table 5.1** and Map **5.4**.

Table 5.1: Present land use in Polder 41/1

Land use	Area (ha)	%
Net cultivable area (NCA)	3,440	85
Single crop	751	22
Double crop	2,475	72
Triple crop	213	6
Others (settlement & khals)	607	15
Total area	**4,048**	**100**

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



Map 5.4: Present Land Use of the Polder Area

5.1.4 Soil Properties

Agro-Ecological Zone (AEZ)

302. 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^{0}C) and number of days with extremely high summer temperature (>40^{0}C) which are relevant for land use and for the assessment of present and future agricultural potentials (FAO/UNDP,1988, BARC,2012). The Polder 41/1 comprises of one Agro-ecological zone, namely: Ganges Tidal Floodplain characteristics which is briefly discussed below.

Ganges Tidal Floodplain (AEZ-13)

303. This region occupies an extensive area of tidal floodplain land in the south-west of the country. The entire Polder 41/1 area is covered by this agro-ecological zone. The polder is bounded by Payra (Buriswar) and Khakdon River. This region occupies an extensive area of tidal floodplain land in the south-west of the country. The greater part of this region has smooth relief having large area of salinity. There is a general pattern of grey, slightly calcareous, heavy soils on river banks and grey to dark grey, non calcareous, heavy silty clays in the extensive basins. Non-calcareous Grey Floodplain soil is the major component of General Soil Types. Acid Sulphate soils also occupy a significant part of the area where it is very strongly acidic during the dry season. In general, most of the top soils are acidic and sub-soils are neutral to slightly alkaline. Soils of the Sundarban area are alkaline. General fertility level is high with low to medium organic matter content and very high CEC and K status. There are limitations of high exchangeable Na and low Ca/Mg ratio. The Zn status is low to medium and the B and S status is medium to optimum.

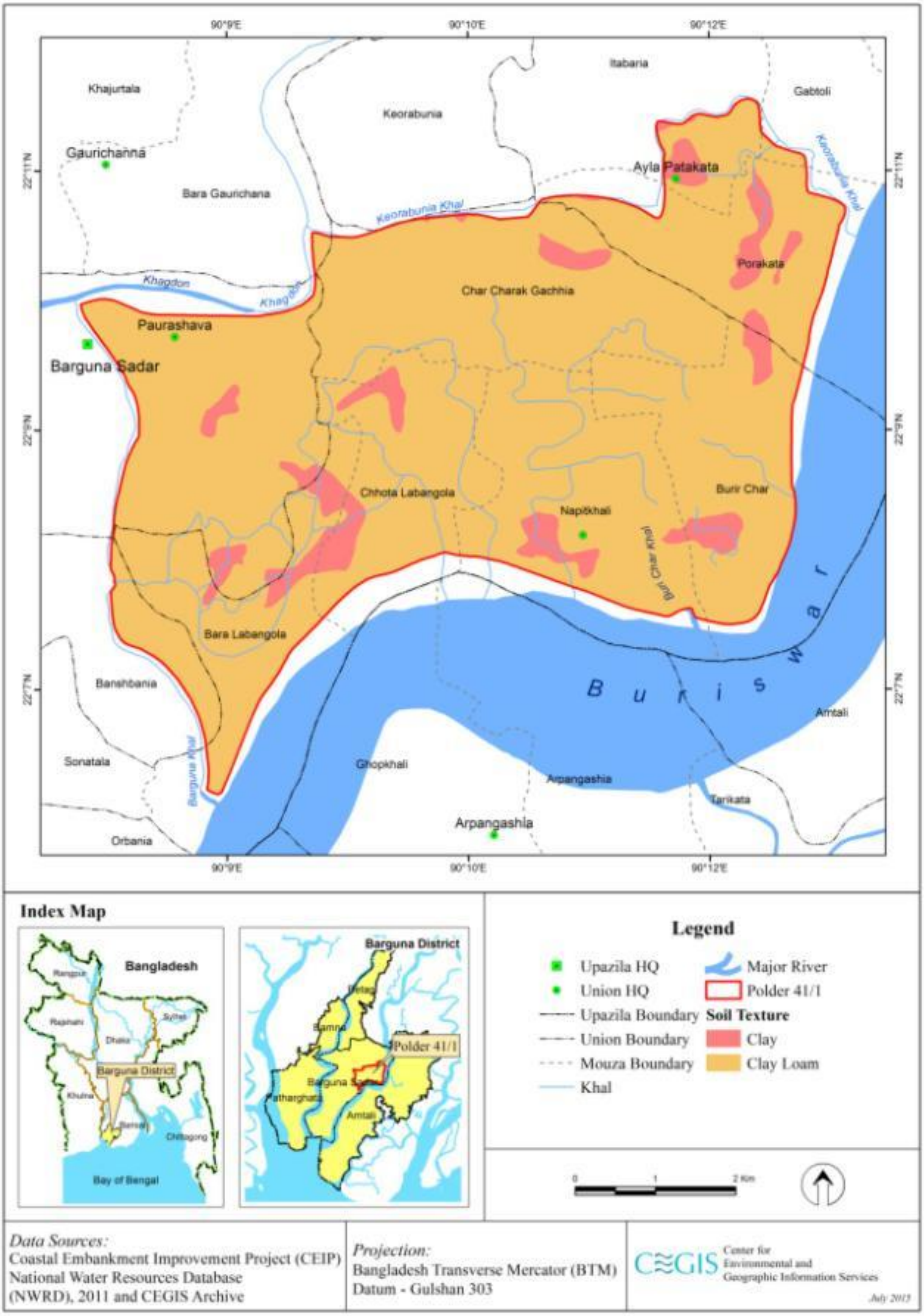
Soil Texture

304. Soil texture is the relative proportions of sand, silt and clay. Soil texture is an important soil characteristic that guides crop selection, crop production and also field management. Soil can be classified into four major textural classes: a) sands, b) silts, c) loams, and d) clays. Clay loam soil is dominant which contains more than 92% of the total NCA. Detailed distribution of soil texture is presented in **Table 5.2 and Map 5.5**.

Table 5.2: Detailed Texture of Surface Soil (0-15cm) of the Polder Area

Soil texture	Area(ha)	% of NCA
Clay	322	8
Clay loam	3719	92
Total	4041	100

Sources: CEGIS Assessment from SOLARIS-SRDI; 2006



Map 5.5: Soil Texture of the Polder Area

Land type

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

306. Around 37%, 43%, 18% and 2% of the net cultivable area (NCA) of the polder area (Polder 41/1) fall under flood free land/high land, high land, medium high land and medium low land respectively. The distribution of land types under Polder 41/1 is presented in **Table 5.3.**

Table 5.3: Distribution of Land Types of the Polder

Land Type	Description	Flooding depth(meter)	Flooding characteristics	Area(Ha)	% of NCA
FF	High land	(<0)	Non-flooded to intermittent	1,273	37
F_0	High land	(0.0-0.3m)	Non-flooded to intermittent	1,479	43
F_1	Medium Highland	(0.3-0.90m)	Seasonal	619	18
F_2	Medium Low Land	(0.90-1.80m)	Seasonal	69	2
F_3	Low land	(1.80-3.60m)	Seasonal, but remains wet in early dry season	0	0
F_4	Very Lowland	(>3.60m)	Seasonal, but remains wet in most of the dry season	0	0
Total				**3,440**	**100**

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

5.1.5 Climate

Rainfall

307. The average monthly rainfall variation at Khepupara BMD station (from 1974 to 2013) is shown in Figure 5.1. The hyetograph shows that the highest and lowest values of rainfall are usually observed during the months of July (645 mm) and December (6 mm) respectively. Additionally, for better representation of the real world situation, values on rainfall from 1968 to 2008 have also been collected from the BWDB station located at Khepupara. The entire Polder lies inside the Thiessen Plygon developed around the Khepupara BWDB station and the peak rainfall at this station is 591 mm in July, which is close to the maximum monthly rainfall observed in the Khepupara BMD station in July.

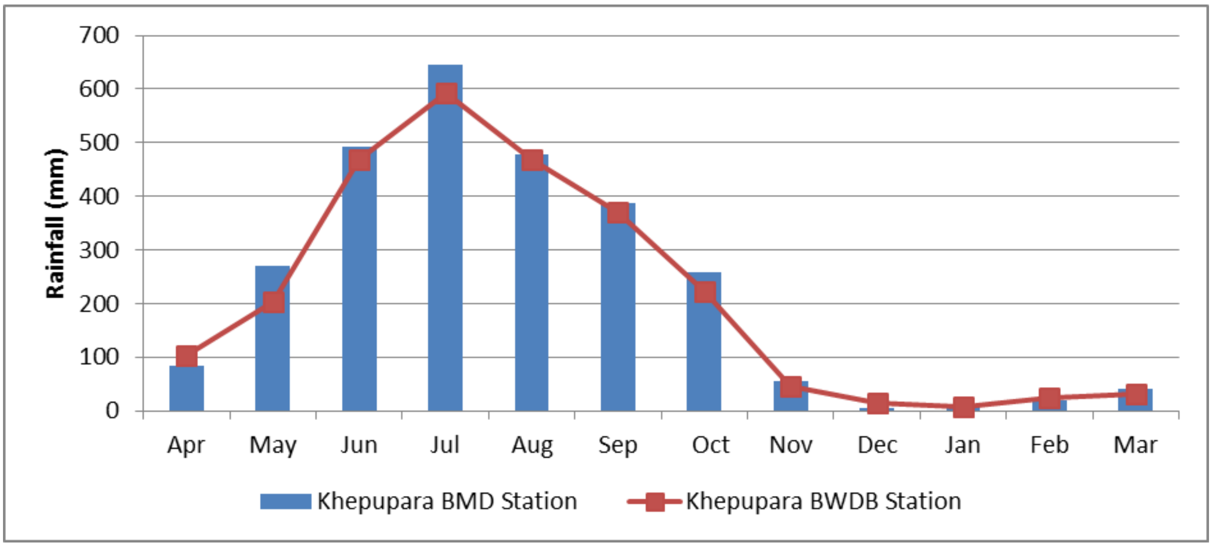


Figure 5.1: Monthly Variation of Average Rainfall at Khepupara BMD (2000-2013) and Khepupara BWDB station (2000-2008)

Temperature

308. Mean maximum temperature varies between 25.9°C to 33.3°C over the year with the highest temperature experienced in the month of May. The minimum temperature exists between 13.2°C to 26.5°C. The lowest temperature is experienced in the month of January. The results of monthly average of maximum and minimum temperature variations of the polder are shown in **Figure 5.2**.

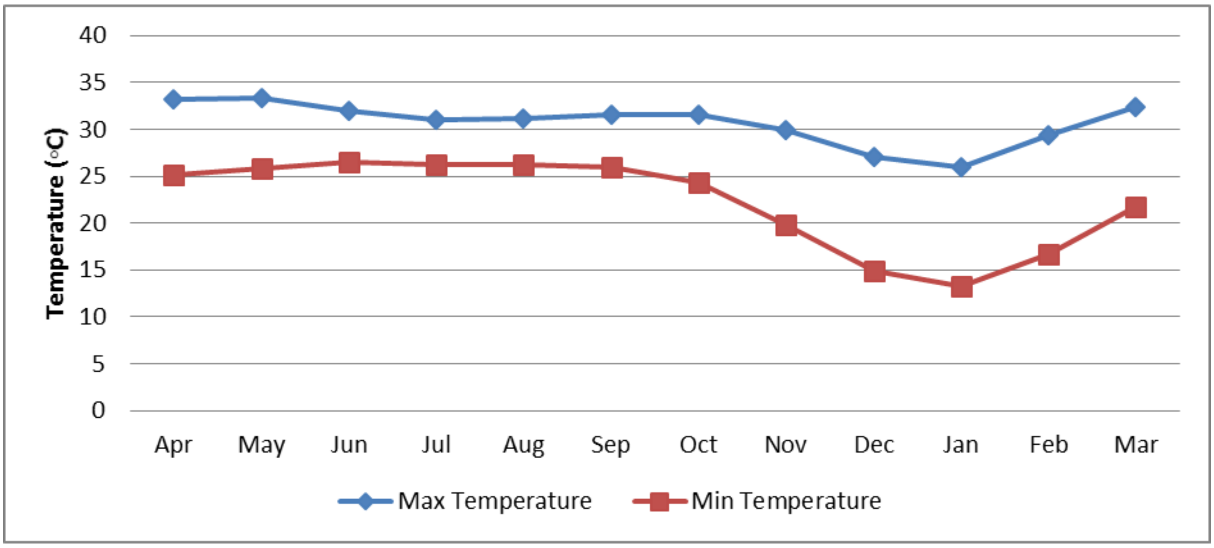


Figure 5.2: Average of Maximum and Minimum Temperatures at Khepupara (2000-2013)

Relative Humidity

309. **Figure 5.3** below shows the variation of monthly relative humidity, as recorded in the Khepupara BMD station (2000~2013). A significant fluctuation has been observed as relative humidity values start to increase from March due to the increase in atmospheric water vapours coupled with temperature rise. Relative humidity rises above 85% in monsoon (June to October), 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.

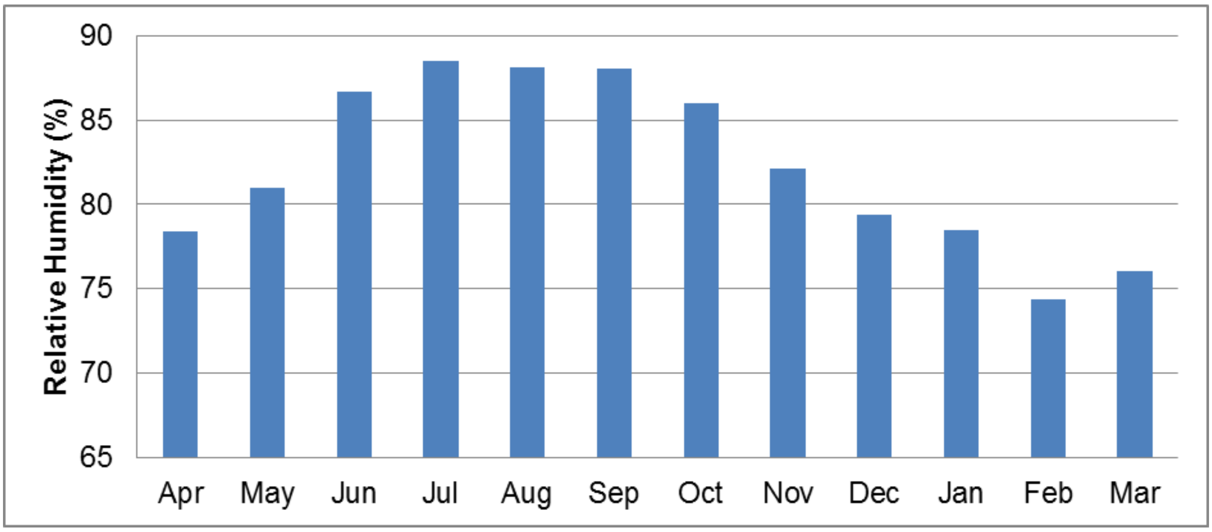


Figure 5.3: Monthly Variation of Average Relative Humidity at Khepupara (2000-2013)

Wind Speed

310. **Figure 5.4** shows the distribution of average monthly wind speeds, at Khepupara BMD station (from 2000 to 2013). Wind speed is the highest in April (around 195 kph) and the lowest in November (around 27 kph). 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. As per Bangladesh National Building Code (BNBC), the basic wind speeds[13]for Barguna is 260 kph.

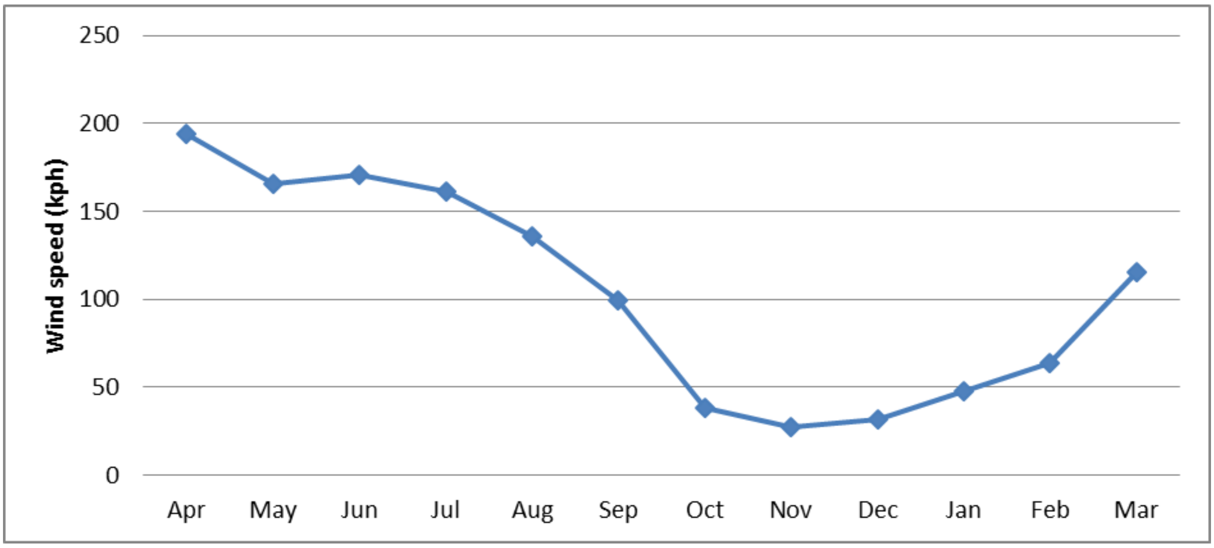


Figure 5.4: Monthly Variation of Average Wind Speed at Khepupara (2000-2013)

13 Basic wind speeds of BNBC refer to the speeds above 10m from ground surface, with terrain exposure B (open terrain with scattered obstructions having heights generally less than 10m and extending 800m or more from the site in any full quadrant)

Sunshine Hours

311. The average sunshine hour data has also been collected from Khepupara BMD station (2000-2013). **Figure 5.5** 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) the values dropped below 5 hours.

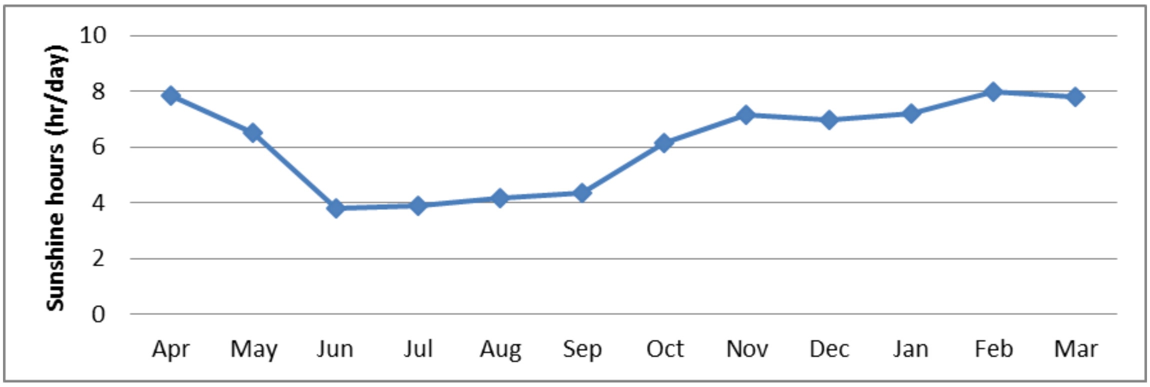


Figure 5.5: Monthly Variation of Average Sunshine Hours at Khepupara (2000-2013)

5.1.6 Water Resources System

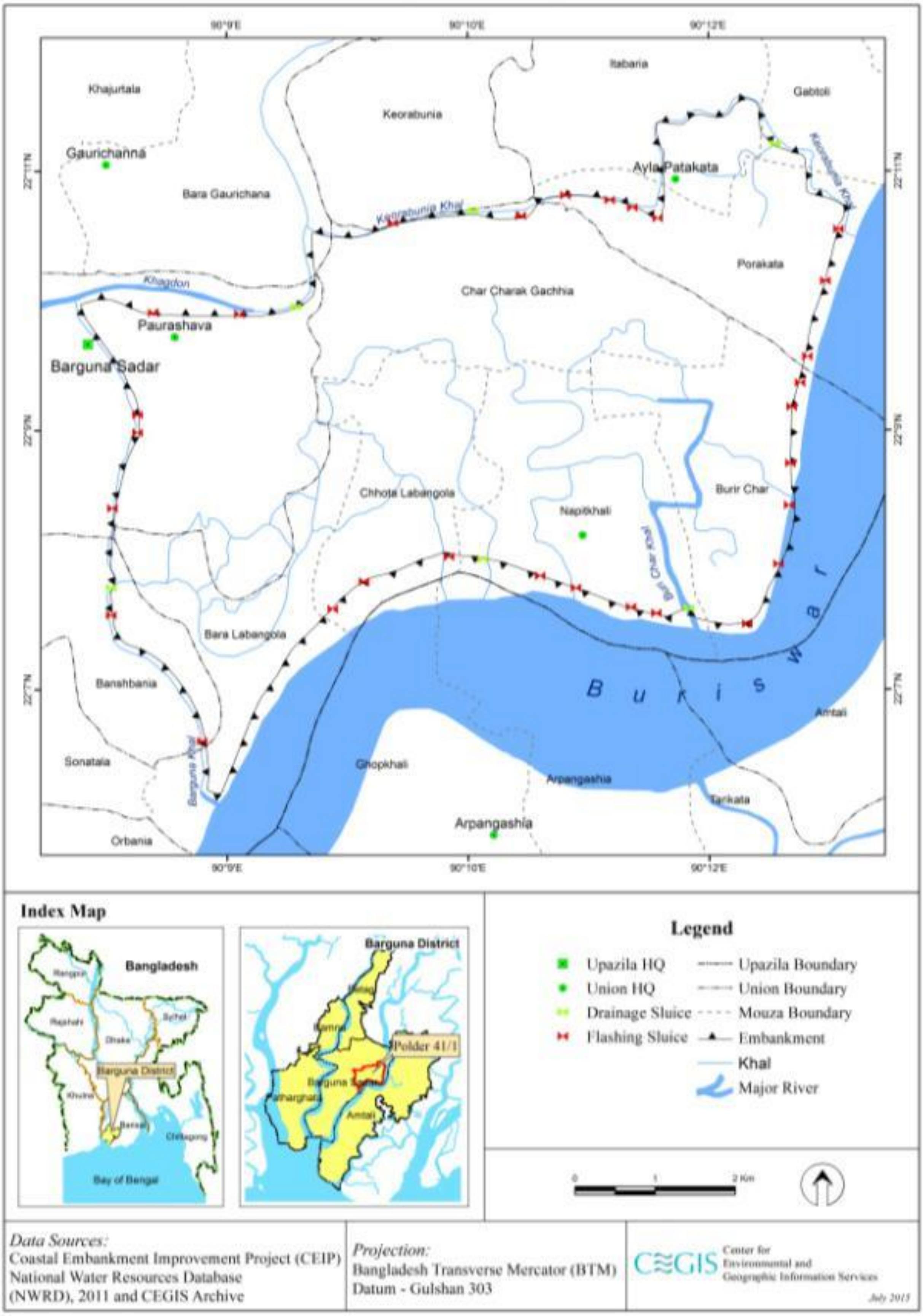
312. The water resource system is the source of water supply and plays an indispensable role in assimilating and diluting waste, attenuating and regulating flood, drainage, recharge into the aquifer, and maintaining the environment for aquatic habitats.

Major Rivers and Khals

313. Polder 41/1 is surrounded by Payra (Buriswar) River (**Picture 5.1**) in the east and the south and Khakdon River in the North. Khakdon River starts from the north-west corner of the polder and narrows down to Keorabunia khal in the north-east corner of polder. Apart from these rivers, the polder is bordered by Bashbunia Khal (**Picture 5.2**) in the west. In addition, there are about 84 km water courses inside the polder, known as khal. The River system of the area is shown in **Map 5.6**.

Picture 5.1: Payra River at Golbunia

Picture 5.2: Bashbunia Khal



Map 5.6: Water Resources System of the Polder

Hydrological Connectivity

314. During high tide, water flows from the Bay of Bengal to the peripheral Payra River, which feeds the peripheral Bashbunia Khal while Khakdon River feeds Keorabunia Khal. There are also a number of khals situated within the polder which are supported by these peripheral rivers and khals. The Chhoto Lobongola Khal, Burir Char Khal, etc. are the distributaries of the Payra and maintain the functions in connection with water resources of the polder. On the other hand, *Sonakhali khal*, *Chargachhia khal, Charnalia khal*, *Porakata khal* etc. are supported by tributaries namely, Khakdon River and Bashbunia Khal. The internal water courses of the polder facilitate the flow circulation within the polder. During low tide, tidal water recedes through the peripheral water courses and reaches the Bay of Bengal.

315. During dry season the khals are usually blocked off by the sluice gates so as to prevent the entry of saltwater, whereas in wet season, these khals are used to drain the excess water out of the polder to prevent any water logging within the polder.

5.1.7 Hydrological Setting

Surface Water Levels

316. The surface water levels of BWDB station at Barguna (Bishkhali River) from 2000 to 2008 has been analyzed (**Figures 5.6**). This station lies on the periphery of the polder. Water levels during high tide range from 1.28 to 2.38 m, PWD. On the other hand, the low tidal water levels range from 0.14m below the MSL to 0.37m, PWD.

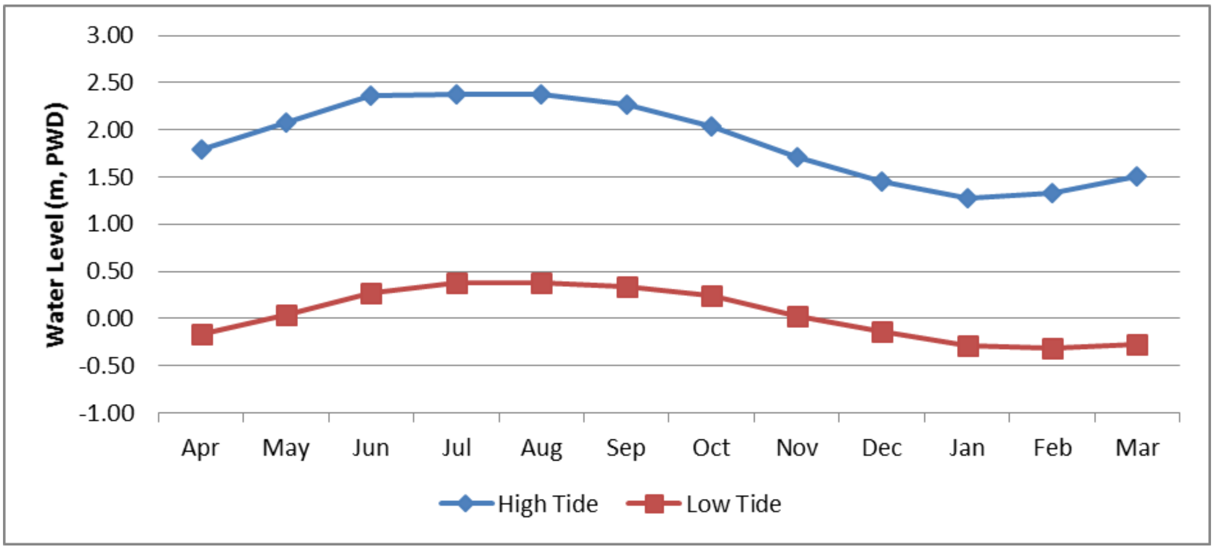


Figure 5.6: Surface Water Level at Patharghata (Bishkhali River)

317. Most of the major khals (80%) (except Dakshin Itbaria Khal, Napitkhali Khal, etc.) during field investigation were identified as perennial water course[14] , thus carrying sufficient water in all seasons. Around 60% khals namely, Keorabunia Khal, Golbunia Khal, Boro Lobongola Khal, Chhoto Lobongola Khal, Purakata Khal carry water with a depth of 4~6 feet during dry season and the rest (Kholifar Khal, Khajurtola khal, etc.) carry fewer amount of flow ranging from 2.7~3.6 feet.

14 Perennial water courses are defined as the khals or canals which contain water during all seasons.

Groundwater Table

318. Monthly variations in groundwater table for year 2000 - 2013 have been plotted in Figure 5.7 for the groundwater observation well, in the station BAG004 (at Barguna). The variation pattern of the GWT values is fairly high, with lowest and highest values in April and August respectively.

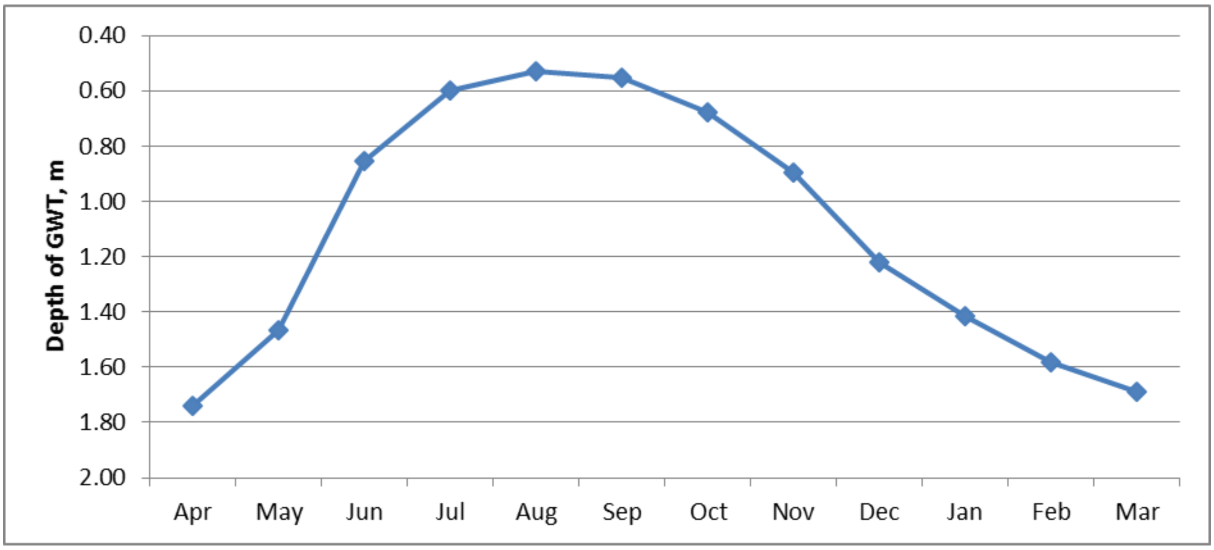


Figure 5.7: Monthly Variations of Average GWT

319. Analyses have also been made to understand the long-term annual variations of GWT at BAG004 station for the month of April and August (for the period of 1978 to 2013). The values show a decreasing trend in both the cases (**Figure 5.8 and 6.9**) which reflect that ground water level is rising with respect of time. The rise is relatively slow during pre-monsoon, approximately 0.014m per year but relatively rapid during post monsoon and is approximately 0.033m per year.

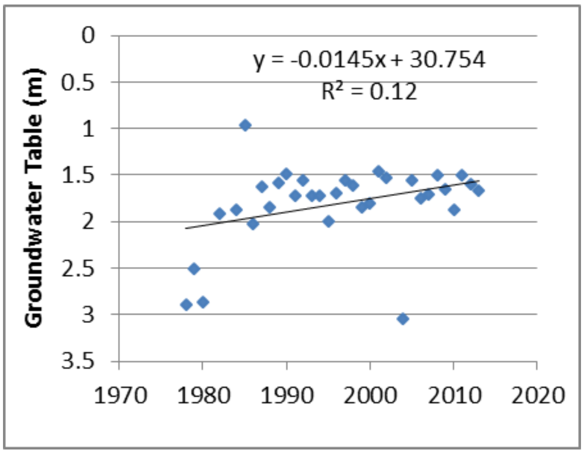


Figure 5.8: Variation of GWT in April (1978-2013)

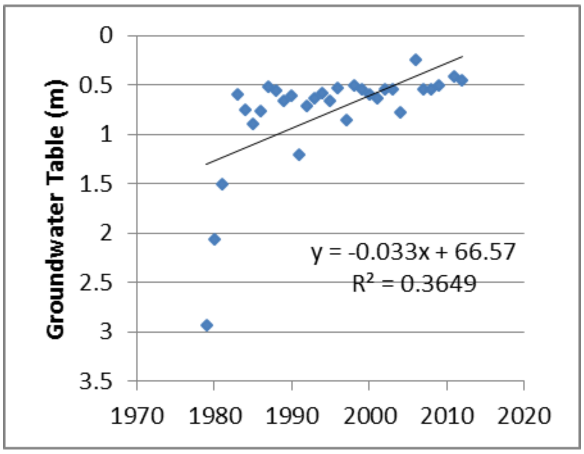


Figure 5.9: Variation of GWT in August (1978-2013)

Source: Bangladesh Water Development Board, 2014

5.1.8 Hydro-geological Profile and Aquifer Conditions

- Aquifer System

320. The aquifer system in Bangladesh is categorized mainly in three groups, which are ; a) the upper aquifer or composite aquifer, b) the main aquifer and c) deeper aquifer. However, the study area (e.g. Polder 41/1) has fallen under coastal area, which is the deeper aquifer of the country. The brief characteristics of this aquifer system is described below:

321. 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 which have no access to water vertically upward or downward but flows very slowly along the dips and slopes of the aquifers (Figure 5.10 a -c). This water bearing zone comprises of medium to coarse sand in places inter bedded with fine sand, silt and clay. At present water 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 5.4. From the Table 5.4, 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 m2/day.

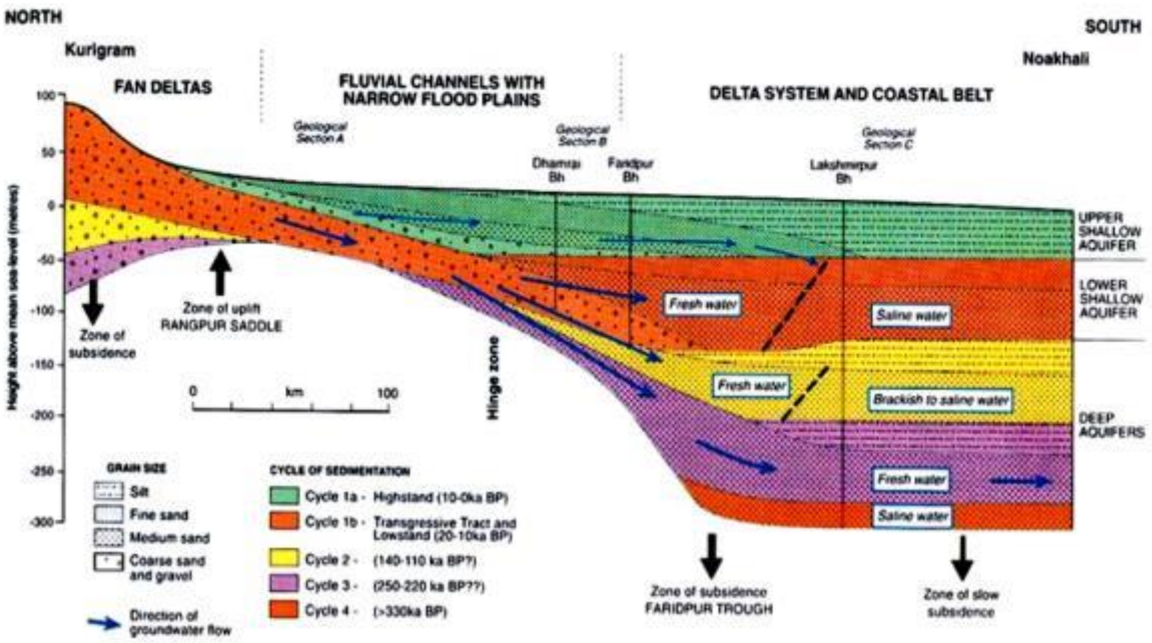


Figure 5.10-a: Hydrogeological Cross Section from North to South across Bangladesh

Table 5.4: 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.

322. Further, the lithology of coastal aquifer is presented in Figure 5.10 b below.

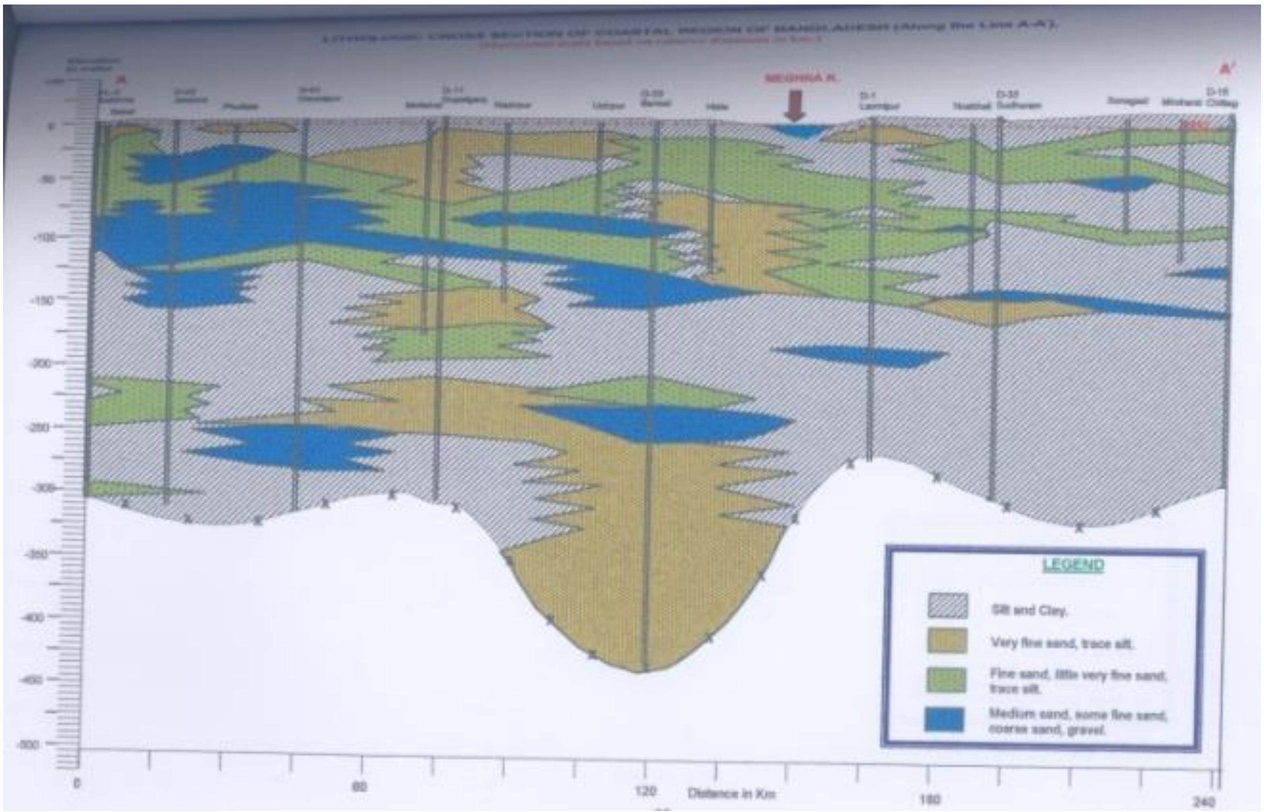
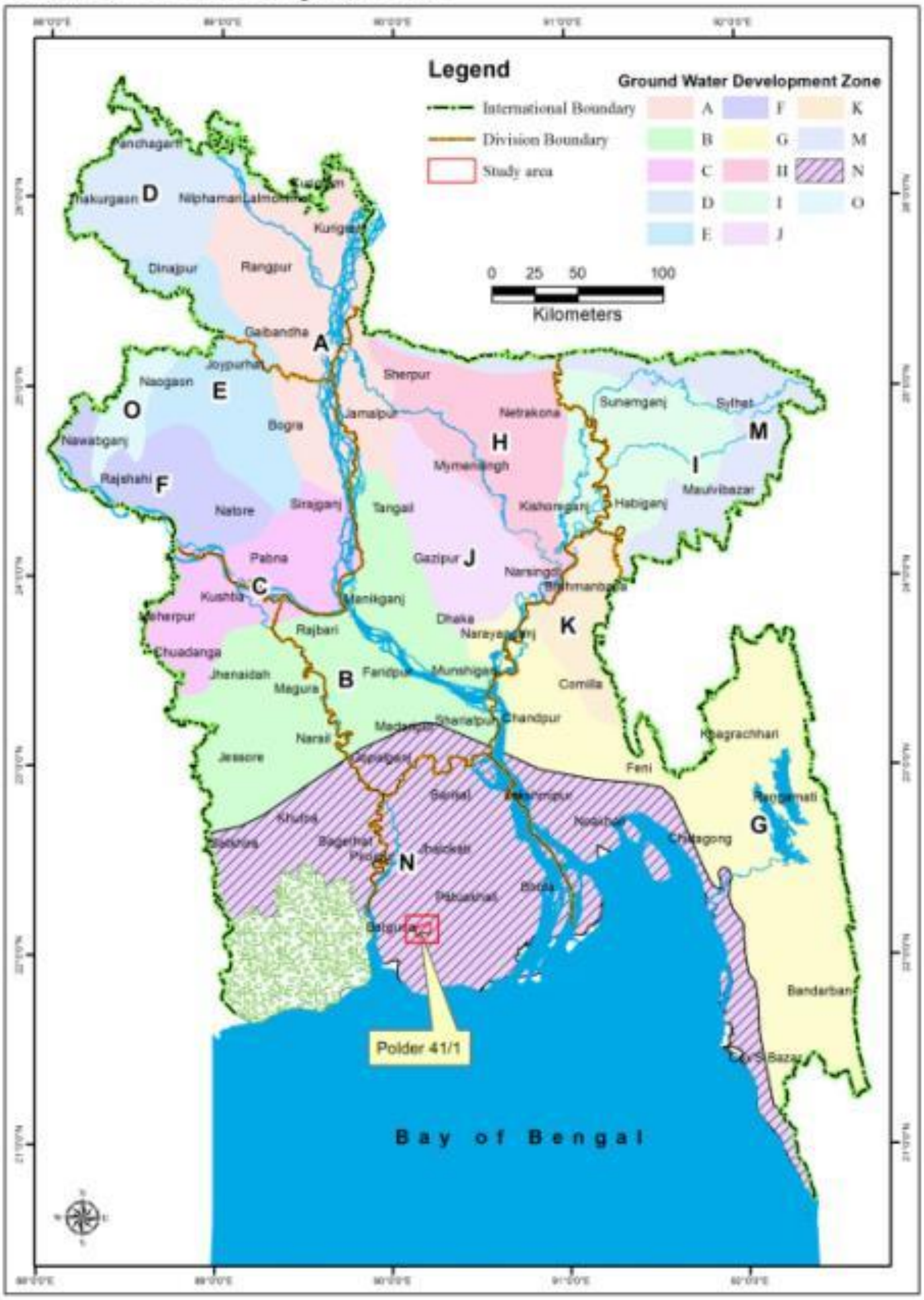


Figure 5.10 b: Lithological Cross-section of the coastal aquifer

323. Furthermore, based on the lithology and other characteristics of the aquifer, the entire country has been divided into 15 potential groundwater development zones (**Map 5.7**). The study area has fallen under zone N (Table 5.5) which has been characterized as Floodplains of GBM with brackish & saline water problems.

Garound Water Development Zone



Map 5.7: Potential groundwater development zones

Table 5.5: 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

324. The term salinity intrusion specially describes the situation where seawater displaces or mixes with freshwater within an aquifer in response to change in the hydro- geological environment. Salinity intrusion occurs as a result of seawater encroachment into 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 5.10c and Figure 5.11 below:

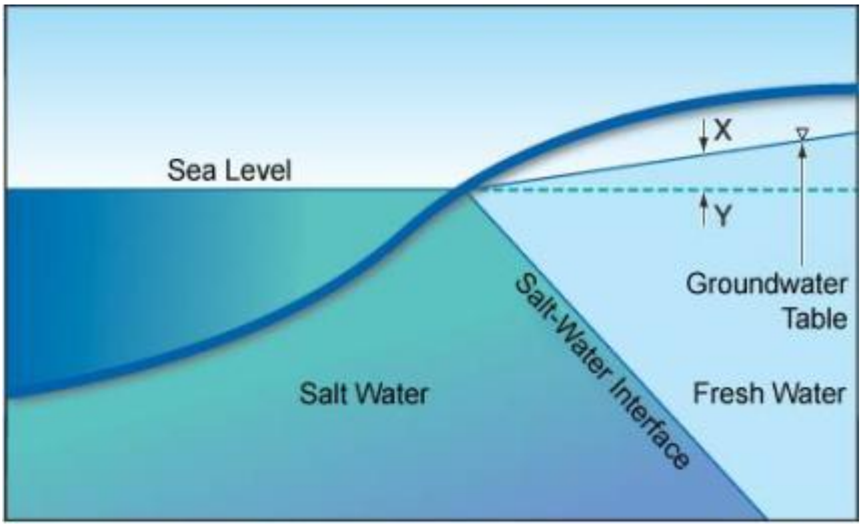


Figure 5.10 c: Seawater intrusion mechanism for homogeneous and unconfined coastal aquifer

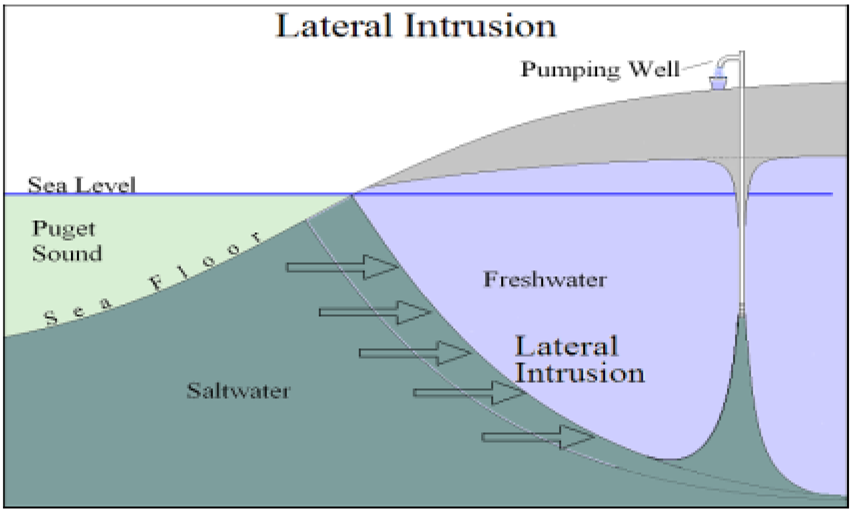


Figure 5.11: Lateral intrusion mechanism of coastal aquifer

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

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

5.1.9 Water Resources Issues, Functions and Problems

326. Salinity is major problem in Polder 41/1. It is evident from the field visit and consultation with local people that the polder encounter various problems like tidal and storm surges flooding, , drainage congestion and water logging, water use and irrigation water use.

a. Salinity

327. Salinity intrusion is one of the major problems in the polder area. Low salinity in the surface water is found in the polder area during monsoon. However, during the dry season (December to March), increased salinity is observed in the surface water. The entrance of tidal water during high tide through unprotected and deteriorated water control structures, into *Sonakhali khal*, *Chargachhia khal, Charnalia khal*, *Porakata khal* etc. are supported by tributaries namely, Khakdon River and Bashbunia Khal results to some extent in saline water intrusion to some extent. The river water become saline in the month of February and continue until May and salinity level lowers down during monsoon. The local people has a demand for storage of sweet water in the internal canals system for cultivating Robi-crops when the river water is saline.

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

Tidal and Storm Surge Flooding

329. Local people during field consultation in the polder, opined that the peripheral embankment does not provide protection from regular tidal flooding effectively. The people at Purakata and Hajarbigha recapitulated of the endless hardships they have faced in the month of July to October every year. Leakage of water take place through the Water control structures at Purba Kewrabunia, Burir Char and Charakgachhia and the amount of flow entering through such leakage causes flood in around 15% of the polder. Local People also alleged that there was a major loss of lives and property in cyclone Sidr (2007). 2-3 persons at Purakata have lost their lives, totaling about 6 in the entire polder. There was also a major storm surge flooding during Aila (2009). The wind-driven tidal surge inundated vast tract of land in Barguna.

Drainage Congestion and Water Logging

330. Drainage congestion inside the internal khals is prevalent in Polder 41/1. However, this is not a major issue in this area as the local people asserted of only 15% of the khals (Keorabunia, Borolobongola and Charnalar khal) being subjected to moderate drainage congestion. According to a key informant, rainwater presently takes 3-4 days to properly drain out which would take 1-2 days time 8/9 years back. Over the years, siltation, topsoil erosion and other land filling activities have resulted in gradual decrease of water within the polder. Siltation reduces capacity of these khals and consequently drainage congestion is taking place to some extent. Incidents of water logging are very rare inside the Polder. No event of prolonged water logging has been recorded in the last 10 yrs.

Navigation

331. Polder 41/1 is located along the Payra River in the south and east and Khakdon River in the north-west corner. Payra River is major river in terms of their depth and width. The rivers remain navigable throughout the year and can be used for transportation during

construction phase of the project. The internal khals/lakes are not suitable for navigation of larger vessels but can easily accommodate small to medium boats. Especially Golbunia Khal, Charnalia Khal and Boro Lobongola Khal are wide and deep enough to carry trawlers.

Water Use

332. The standard value of average daily demand of water for domestic and drinking purposes in rural areas is considered as 50 lpc (Ahmed and Rahman, 2010). However, the actual status of drinking water in some of the coastal polders is very poor. During the field survey in Polder 41/1, it was found that the average daily domestic use of water was around 30 lpc. The study found that around 1,436 m^3 of water is consumed daily by the total number of 47,859 people living in the polder.

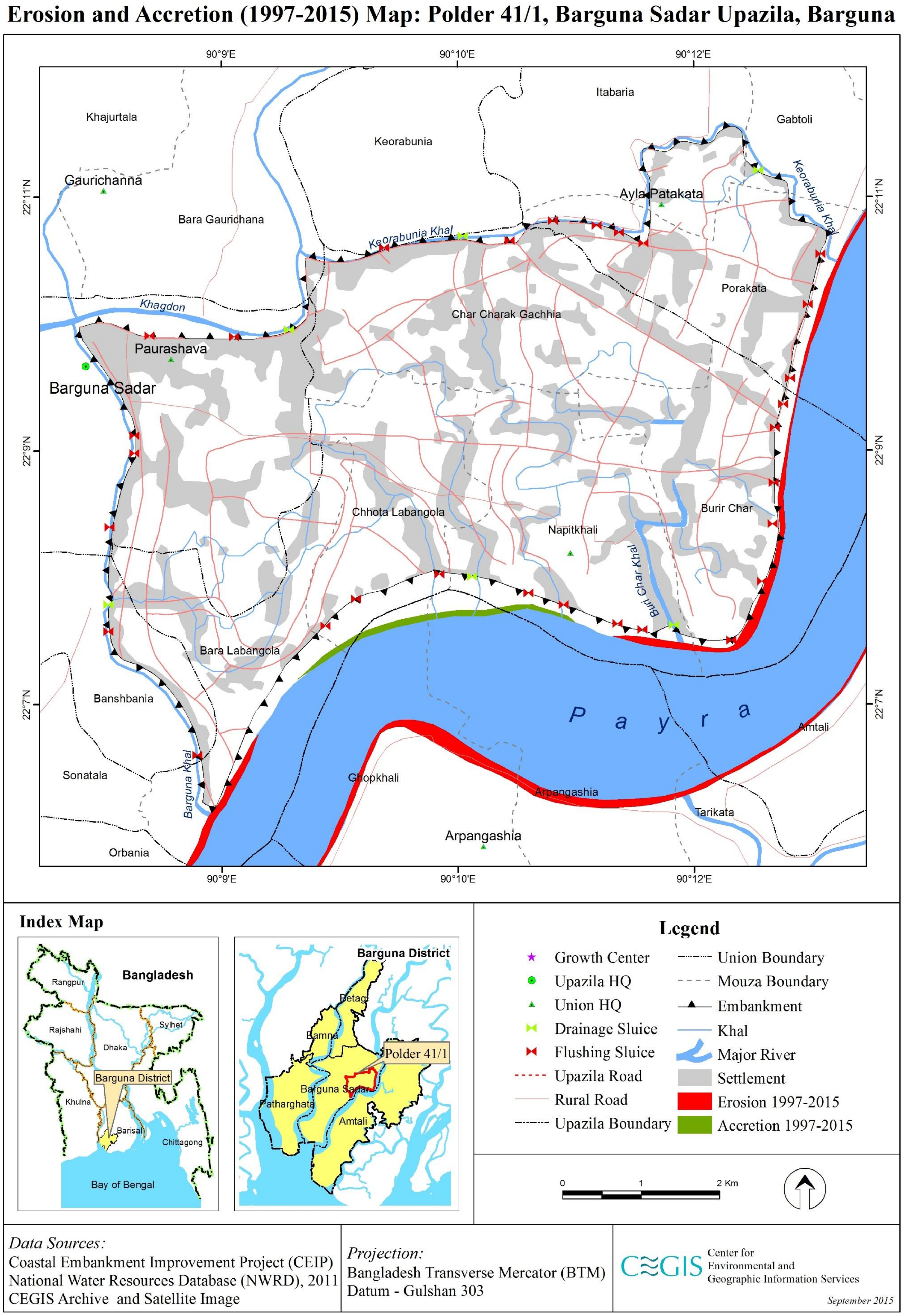
Irrigation Water Use

333. The local farmers in Polder 41/1 cultivate Aus (Local), T Aman (HYV) and some vegetables in Kharif-I (March-June) season; HYV T Aman, LT Aman in Kharif-II season (July-October); and Boro, Pulse and vegetables in Rabi (November-February) season. The crops are mostly rain-fed during Kharif-I and Kharif-II season for T Aus (LV), T Aman (HYV), Aman (LV) and some Vegetables. During Rabi season Boro crop requires irrigation. Boro crop occupies 4% of the net cultivable area, which needs irrigation and is provided from surface water through LLPs.

5.1.10 River morphology and dynamics

Historical Erosion-Accretion Analysis along Buriswar River

334. Historical satellite images for the year 1997 and 2015 were analyzed to understand the historical erosion-accretion of the adjacent river of the Polder 41/1. 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 delineation was done from the satellite images and by superimposing the bank lines of two different years erosion/accretion was assessed. The 17 km reach around the Buriswar River has been considered during the erosion-accretion analysis. From the analysis, it has been found that erosion was 189.35 hectares at the rate of 10.52 hectares per year while the accretion was 21.93 hectares at the rate of 1.22 hectares per year during the specified period in Barguna Sadar upazila of Barguna district around Polder 41/1. The amount of erosion is comparatively very high than the accretions in this reach (Map **5.8**).



Map 5.8: Erosion-Accretion along Buriswar River

5.1.11 Environmental quality and pollution

(a) Air quality

335. The national standards for air quality are given in **Table 5.6.**

Table 5.6: Standards of ambient air quality

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

Source: Bangladesh National Ambient Air Quality Standard

336. **Table 5.7** shows the air quality data measured inside the polder at Barguna Sadar Upazila under Barguna District. The values suggest that the concentrations of the measured air quality parameters (PM10, BC in PM2.5, SO_2, NO_2) lie within the range of standard values for Bangladesh (refer Table 5.6).

Table 5.7: Values of ambient air quality parameters in the project area

Area	Concentration of micrograms per meter cube (24h average)				($\mu g/m^3$) (1h average)
	PM_{10}	$PM_{2.5}$	BC in $PM_{2.5}$	SO_2	NO_2
Barguna sadar (41/1)	71.5	57.5	18.3	24.0	0.070

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

(b) Water quality

337. Water quality parameters (pH, TDS, DO and salinity) have been measured during the major field investigation in June 2015, from different locations of the Polder (Table 5.8). The pH values of the measured surface water samples were found higher than the neutral value (pH=7), which indicates that the water in these locations was alkaline. This may be for the typical monsoon rainfall just started at the time of the field visit, and it may take almost a month for pH values to drop below the neutral/acidic threshold. However, the pH value is within DoE's standard value. Values of TDS were found very low (250 ppm) in Payra River, but were slightly high (320 -405 ppm) in the khals inside the polders. This may be due to the increased siltation of the internal khals. The tidal water from the peripheral rivers with high silt concentrations often intrude the internal water courses, but sometimes during low tide a substantial amount of sediments get entrapped or silted in those khals. The malfunctioned or permanently blocked sluice gates also contribute the siltation process of this internal khal. Such siltation increases the amount of dissolved solids in the internal water samples, for which higher TDS values were observed in the khals.Values of DO were found close to the standard values set by DoE for both irrigation (5 to 6 mg/l) and fishing (5 mg/l).

338. The surface water samples had no salinity concentrations during June, 2015. But local people opined that in the dry season, specifically in the months from February to April, the concentration of salinity in drinking and irrigation water is found to be higher.

Table 5.8: Surface water quality measurement during wet season

Location	GPS Reading (Lat-Long)	pH	TDS (ppm)	DO (mg/l)	Salinity (ppt)	Remarks
Charnalia Khal	22º10’43.7’’N 90º12’17.7’’E	7.8	370	6.0	0	Inside polder
Boro Lobongola khal	22º07’45’’N 90º07’30’’E	7.7	390	5.8	0	Inside polder
Payra River	22º28’03’’N 90º12’21.3’’E	7.9	250	6.2	0	Outside polder
Chhoto Lobongola Khal	22°07'56"N 90°09'56”E	7.4	407	5.9	0	Inside polder
Charakgachhia Khal	22°10’11.2”N 90°10’14”E	7.7	320	5.3	0	Inside polder
Burir Char Khal	22°07’35”N 90°11’41”E	7.8	380	5.4	0	Inside polder
DoE Standard Value (Bangladesh)		***6.0-9.0***	***2100***	***4.5-8.0***		

Source: Field test, June 2015

339. In addition, surface water quality has also been measured in dry season (February, 2016). Table 5.9 presents the water quality result in dry season.

Table 5.9: Water quality measurement during dry season

Source of surface water	Location	GPS point	Water quality parameter				
			pH	TDS (ppm)	Temp (°C)	DO (mg/L)	Salinity (ppt)
Boro Lobongola khal	Boro Lobongola	22° 7'45.00"N 90° 7'30.00"E	7.7	257	23.0	9.2	0
Katakhali/Manir khal	Choto Lobongola	22° 7'50.39"N 90° 9'34.12"E	7.3	189	24.1	9.8	0
Choto Lobongola khal	Choto Lobongola	22° 7'56.94"N 90° 9'55.67"E	7.5	156	24.8	9.5	0
Burir char khal	Burir char bazar	22° 7'35.44"N 90°11'40.58"E	7.7	159	24.4	7.5	0
Payra River	Amtoli Fery ghat	22° 8'36.57"N 90°12'31.06"E	8.1	147	23.5	6.9	0
Charnalia khal	Purba Kewrabunia	22°10'43.70"N 90°12'17.70"E	7.7	242	26.9	5.8	0
Charakgachia khal	Charakgachia	22°10'11.20"N 90°10'14.00"E	7.7	258	25.8	5.9	0
DoE Standard Value (Bangladesh)			***6.0-9.0***	***2100***	***20-30***	***4.5-8.0***	***-***

Source: Field Test, February, 2016

340. But no increase in the surface water salinity has been found, which may be caused due to the increased flushing by early rain this year.

341. It was observed that the pH value is higher than neutral scale (pH=7), which means the water in these locations was alkaline. Values of TDS in dry season were found low in the internal khals and peripheral rivers ranges between 147 and 258 ppm, which are within the DoE's standard value. Values of DO were also found within the standards set by DoE. Salinity of the surface water was not found in this period yet. But local people opined that during the month from February to April, salinity increases in both ground and surface water. However, in the month of February, no salinity was found as shown in **Table 5.9**, since rain water inside the Polder was still present and tidal flow from the Payra River was yet to intrude.

342. Besides, it is also observed that river water is slighty saline (<1ppt) during dry season in Payra River from the available seceondary data of BWDB. Figure 5.12 shows the salinity in Payra River during dry season.

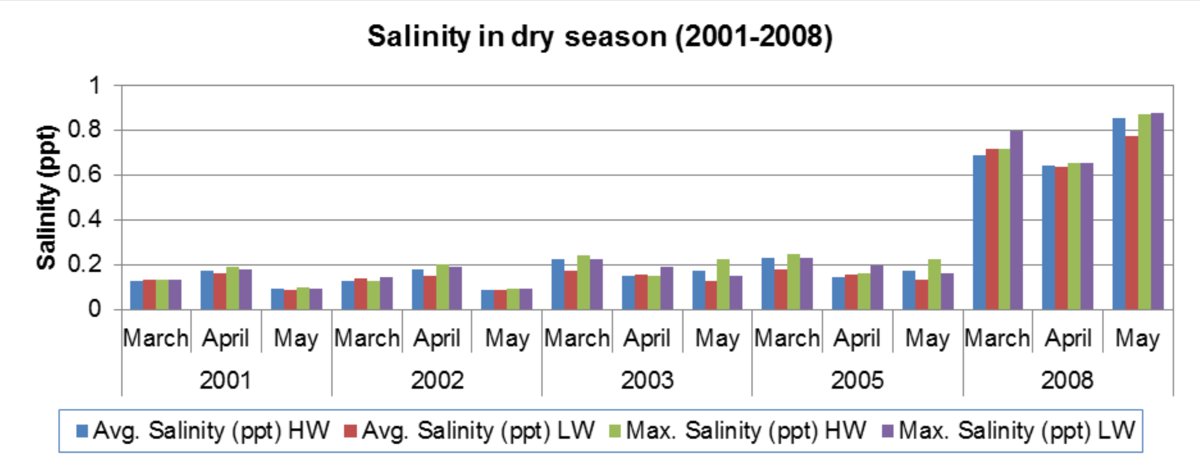


Figure 5.12: Salinity in Payra river during dry season

(c) Noise quality

343. A number of suitable sites were selected within the Polder area for noise level measurements, considering some criterion in connection with sound generation (project interventions and other secondary activities) and places which are to be affected by the anomalies in noise level (settlements, schools). The Environmental Conservation Rules 1997, of Department of Environment (DoE), Bangladesh has defined standard noise levels as **50 dB** during daytime for residential area. The Polder area has fallen under the category of residential area and the values of noise levels were found within the standard limit. The noise level was measured during daytime. The values of noise level (location wise) are shown below:

Sl. No	Location	GPS Reading	Values (dB)	Area Category by ECR'97
1	Boro Lobongola	22° 7'45.00"N 90° 7'30.00"E	41.4	Residential area
2	Choto Lobongola	22° 7'50.39"N 90° 9'34.12"E	38.8	Residential area
3	Choto Lobongola	22° 7'56.94"N 90° 9'55.67"E	42.1	Residential area
4	Burir char bazar	22° 7'35.44"N 90°11'40.58"E	47.6	Residential area
5	Amtoli Fery ghat	22° 8'36.57"N	48.5	Residential area

Sl. No	Location	GPS Reading	Values (dB)	Area Category by ECR'97
		90°12'31.06"E		
6	Purba Kewrabunia	22°10'43.70"N 90°12'17.70"E	42.6	Residential area
7	Charakgachia	22°10'11.20"N 90°10'14.00"E	41.5	Residential area

Source: CEGIS field survey, February 2016

(d) Soil quality

344. Soil quality of different three locations in the Polder was analyzed from the Soil Resource Development Institute (SRDI). The samples were collected on 19th and 20th June, 2015. The analyzed results are presented in **Table 5.10.** The soil salinity levels are found from 1.93- 8.55 (ds/m) at a depth of 0-15 cm in all agricultural land. These values reveal that respective agricultural land is non saline to slightly saline. The pH level varies in these locations and is found within in a range of 7.4-7.8 in all agricultural land. These indicate that, the crop land is slightly alkaline in nature. The presence of Organic Matter (OM %) in the soil is very low to medium (≤1.0-3.4%). The concentration levels of Nitrogen (N), Phosphorus (P), and Potassium (K) in soil are recorded as very low. These results indicate that the use of N, P, K chemical fertizers in the agriculture land in the polder area is comparatively low. However, the values of Sulphur (S) were found from optimum to very high level in the polder area. The standard for physico-chemical properties of soil are provided in Appendix-3

Table 5.10: Chemical Properties of Top Soil (0-15cm) 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			
Charakgachia	22°1012.9"N 90°10'13.7"E	HYV Aus-Lt.Aman-Mung bean	0-15	1.93	7.8	1.36	0.08	0.20	6.94	29.31	0.79	0
Koroitola/Burir char	22°0740..2'' N 90°07'32.7"E	Fallow-Lt.Aman-Khesahri	0-15	4.01	7.7	2.24	0.13	0.20	6.85	84.97	0.85	0
Burirchar	22°07'33.4"N 91°11'25.8"E	HYV Aus-HYV Aman-Kheshari	0-15	8.55	7.4	0.48	0.03	0.35	5.73	104.20	0.62	0

Sources: SRDI laboratory test, August; 2015 (sample collection date 19th and 20th June, 2015)

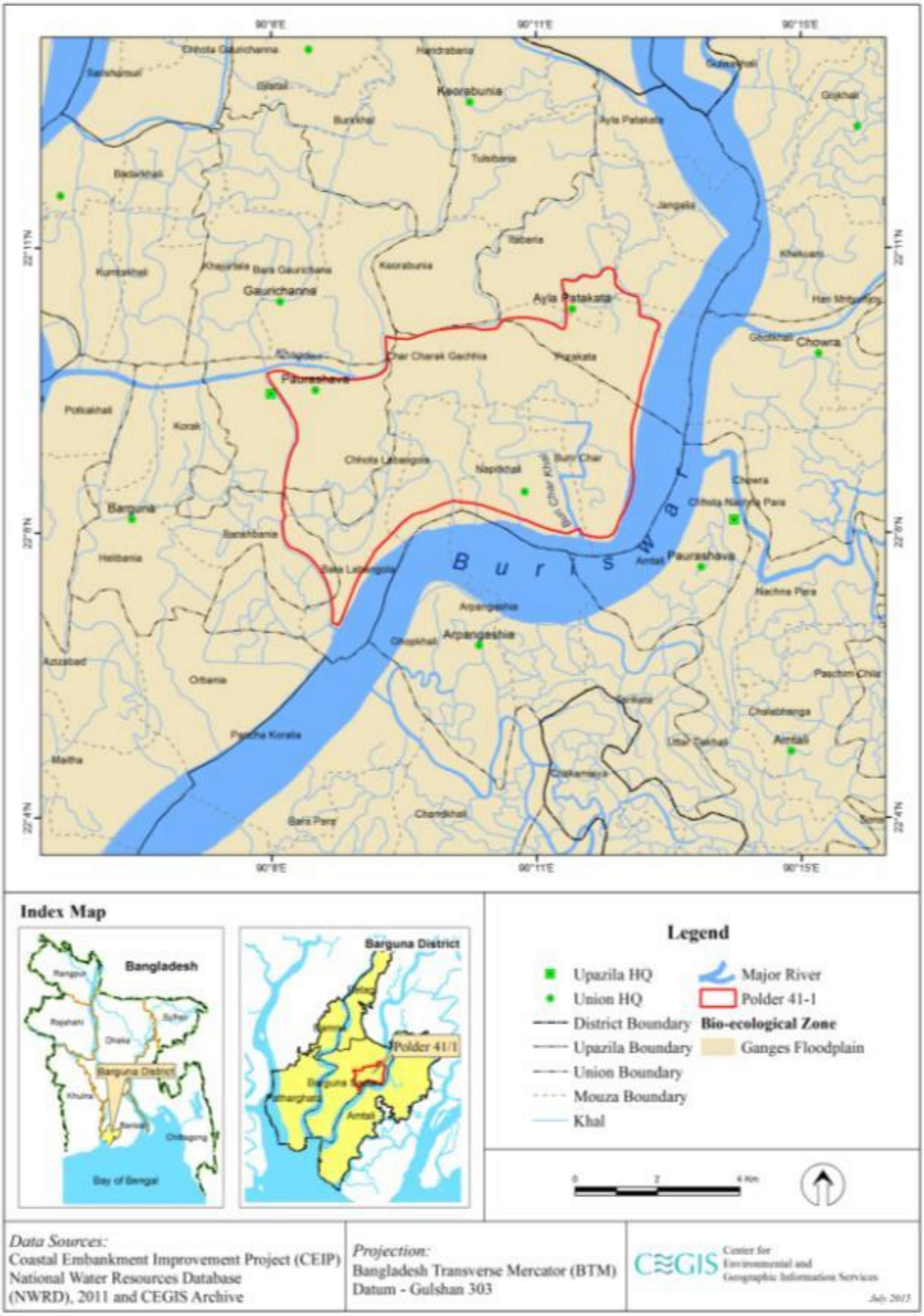
5.2 Biological environment

345. Polder 41/1 is located at the southern part of the country that is affected by the tidal influence. Existence of internal canals, foreshore, creeks, cropland and homestead created different ecological features of the polder supporting numerous floral and faunal species.

5.2.1 The Bio-ecological Zones

346. According to the ecosystem features, physiography and species diversity, IUCN Bangladesh has identified 25 Bio-ecological Zones in Bangladesh (Nishat *at el*, 2002).

347. The polder is located in Ganges Flood Plain (**Map 5.9**) bio-ecological zone – 4b. A brief description of ecological characteristics of bio-ecological zone 4b is given below:



Map 5.9: Polder inside the Bio-ecological Zones of Bangladesh

348. The Ganges floodplain basically consist of the active floodplain of the Ganges River and the adjoining meandering floodplains and is mostly situated in the administrative districts of greater Jessore, Kushtia, Faridpur and Barisal. The adjoining meander floodplains mainly comprise a smooth landscape of ridges, basins and old channels. Noteworthy aspect here is that the Gangetic alluvium is readily distinguishable from the Old Brahmaputra, Jamuna and Meghna sediments by its high lime content. Besides, the relief is locally irregular alongside the present and former river courses, especially in the west, comprising a rapidly alternating series of linear low ridges and depressions. The Ganges channel is constantly shifting within its active floodplain, eroding and depositing large areas of new char lands in each flooding season, but it is less braided than that of the Brahmaputra-Jamuna. Interestingly enough, both plants and animals move and adapt with the pattern of flooding (Brammer, 1996).

349. This floodplain is characterized by mixed vegetation. Presence of a lot of stagnant waterbodies and channels, rivers and tributaries in this zone support a habitat of rich biodiversity to some extent.

5.2.2 Ecosystems

The study area supports different type of habitats with different species of flora and fauna. Ecosystems of the study area can be divided into two major categories: Homestead and Embankment sides' ecosystems. The study was carried out under line transect walk literature review, and peoples' interviews to survey both flora and fauna. A detail on methodology has been presented in the section 2.2.8

350. Land topography, seasonal inundation and tidal influence persist ecosystem pattern of the polder area. Ecosystems of the polder are divided into two broad classes according to habitat. Those are: a) Terrestrial Ecosystem and b) Aquatic Ecosystem. Each broad classes further divides in different ecosystems. Each type of ecosystems hold distinguished composition of flora and fauna (**Figure 5.13**).

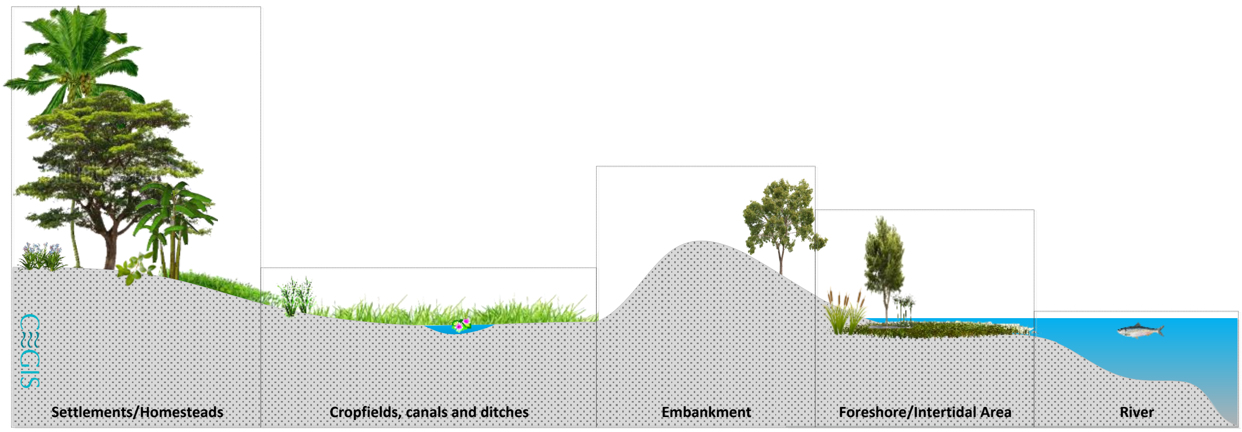


Figure 5.13: Typical Ecosystems pattern of the polder

Terrestrial ecosystems

351. Polder 41/1 possesses three major types of terrestrial ecosystems like: i) Settlement/ homesteads, ii) Agricultural land, and iii) Roads and Embankment. Each of the ecosystems contains both natural and human influenced vegetation. Natural vegetation includes wooded areas, grassland and other natural habitats. Human influenced vegetation includes homestead gardens, plantation, cropland and cultivated habitat.

352. Homestead ecosystems: Presence of sufficient moisture as well as clayey loam texture of homesteads soil, this polder support high density of vegetation. Of all the vegetation types, homesteads consists top biological productivity. According to dominance, homestead vegetation is enriched with both timber and fruit yielding trees. Rain tree (*Albizia saman*), Mahogani (*Swietenia mahagoni*) and Chambol (*Albizia richardiana*) occupied the top canopy coverage and these species serve meeting timber and a part of fuelwood demand. Among the fruit yielding plants, Kola (*Musa* sp), Narikel (*Cocos nucifera*), Supari (*Areca catechu*), Khejur (*Phoenix sylvestris*) etc are common of all. In addition to all the above vegetation there are numerous species of natural flora which are mainly undergrowth vegetation. Jiga/Kafila (*Lannea coromandelica)* is the most common floral species that usually used as live fencing of the settlement boundaries. Bilati Gaab (*Diospyros blancoi*) is another small sized tree and that is an indicative plant species of south central coastal area of Bangladesh. The density and abundance of natural vegetation on homestead platforms depend on the availability of soil moisture round the year, types of human interventions and value of utilization to the homestead owners. Human influenced vegetation of this area mainly contributes foods and furniture/house making materials. Natural vegetation performs as shelter of the most groups of wildlife as well as fuel and thatching to the human.

Picture 5.3: A homestead showing high density of vegetation at Manik Khali village

Table 5.11: Major tree/plant species in different layers of homestead vegetation

Layer	Height (m)	Plant species
Super	>15	Chambol/Raj Koroi (*Albizia richardiana*)
		Rain Tree/ Rendi Koroi (*Albizia saman*)
Upper canopy	14-12	Narikel (*Cocos nucifera*)
		Bansh (*Bamboosa spp*)
		Khejur (*Phoenix sylvestris*)
		Mehogoni (*Swietenia mahagoni*)
		Shimul (*Salmalia malabarica*)
Lower canopy	11-8	Supari (*Areca catechu*)
		Bilati Gaab *(Diospyros blancoi)*
		Kanthal (*Artocarpus heterophyllus*)
Upper bole	7-5	Bilati Gab (*Diospyros blancoi*)
		Aam (*Mangifera indica*)
		Jamboora (*Citrus maxima*)
		Lichu (*Litchi cinensis*)
Shrub	<5	Jamrul (*Syzigium samarangense*)
		Kul Boroi (*Zizyphus mauritiana*)
		Kola (*Musa spp*)
		Peyara (*Psidium guyava*)
		Jaba (*Hibiscus rosa-sinensis*)
Herb/undergrowth	<2	Akanda (*Calotropis procera*)
		Ghagra (*Crozophora plicata*)
		Hatisur (*Helitropium indicum*)
		Dumur (*Ficus hispida*)
		Daton (*Glycosmis pentaphylla*)

Source: Field Visit, June 2015

Common fruits: Bilati Gaab (*Diospyros blancoi*)

Backyard of a homestead with different undergrowth vegetation

Picture 5.4: Homestead vegetation

353. Embankment sides' ecosystem: Embankment of the polder consists of long timber trees and small natural herbs and shrubs (**Picture 5.5**). Embankment slopes along the Payra river side are exclusively dominated with Khai Babla (*Pithocelobium ducis*) (Picture 5.6), Sissoo (*Dalbergia sissoo*) and some portions with Akasmoni (*Acacia moniliformis*). It is difficult to distinguish vegetation between embankment slopes and homesteads at the western and northern boundaries of the polder as homestead merges with road cum embankment. This portion is full of different types of herbs with common grass *Cynodon dactylon as* found along the embankment. Vaat (*Clerodendrum infortunatum*) and Danton (*Glycosmis pentaphylla*) are remarkable herbs that grow beside the embankment of this polder and contribute protection against slope erosion and support lizards and many other insects.

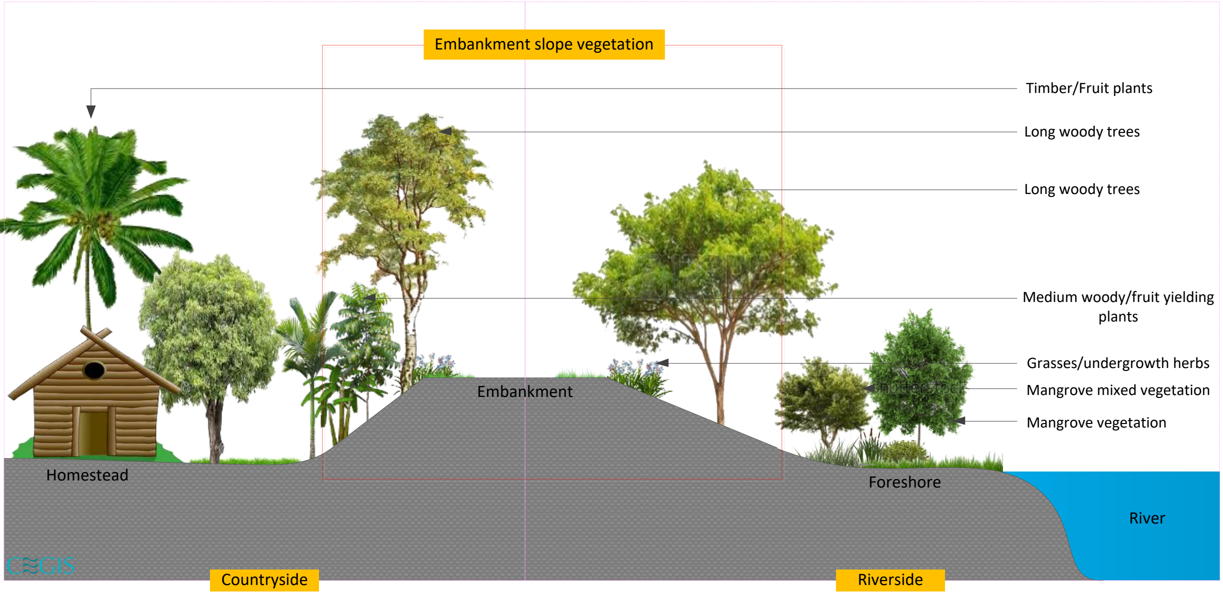


Figure 5.14: Typical ecosystem of the polder

354. Embankment side vegetation at Daskhin Burir Char and Golbunia is vulnerable due to river erosion. These parts of the embankment have long timber trees and various undergrowth herbs. A list of matured tree species which exist at proposed water control structure sites is presented in **Appendix 4**.

Picture 5.5: Khai Babla (*Pithocelobium duci*) trees beside the embankment at the bank of Payra river

Picture 5.6: Vegetation along a part of paved embankment at Purba Kewrabunia

355. The major biotic components of crop fields ecosystem is mainly cultivated crop varieties and temporary dwellers of avifauna, insects and reptiles. Crop field of this polder is mainly used for rice, pulse and a little little bit of vegetable cultivation. A detail description of cultivated crop varieties has been provided in the agricultural section of this report. The crop field vegetation has the lowest diversity of all types, but it is an essential habitat for local wildlife that depends on it for grazing. Except for cultivated varieties, numerous weeds grown in these crop fields supported by various species of insects. The major common species (weed) growing with the crops in this area are *Alternanthera sessilis, Ageratum conyzoides, Heliotropium indicum, Cyperus cephalotes, Digitaria longiflora, Amaranthus spinosus, Polygonum sp, Oxalis corniculata* and *Cynodon dactylon*, etc. The cropfield of this polder is inundated during monsoon and followed by succession of reeds, sedges and marginal plants. Seasonal inundation of cropfield creates grazing and feeding habitats for local fishes, aquatic snakes and water-dependent birds.

Aquatic Ecosystems

356. Existence of peripheral rivers, internal canals and intertidal area of the polder support different types of aquatic ecosystems. Major aquatic ecosystems of the study area are:

- Rivers
- Foreshore Inter-tidal area and mangroves
- Internal canals, and
- Homestead ponds and ditches

357. Considering the area and ecosystem functions, rivers and canals are the major component of aquatic body of the polder that acts as mainstream of all other aquatic ecosystems. Surrounding major River Payra possess no vegetation, but tidal effect of this river influences the vegetation pattern of the intertidal area and inside the polder area through numerous internal canals. The canals act as arteries of aquatic ecosystems of the polder. Marginal zone of each internal canal possesses various sedges and marginal plants. Dhol Kolmi (*Ipomoea fistulosa*), Bishkantali (*Polygonum* sp), Khagra (*Phragmites karka*), Shitkey (*Phylanthus* sp.), Kochu (*Colocasia* sp.) are common among this type of plants. A number of small tributaries from the nearby canals pass over the homesteads and carry turbid water that provide nutrients and moisture for the vegetation. High density of foreshore vegetation along Bashbunia and Kewratola Khal shows a significant contribution of river flow for plant succession.

Picture 5.7: Foreshore area of Payra River vegetated with Hogla (*Typha elephantalis)* indicates brackish nature of the aquatic ecosystem

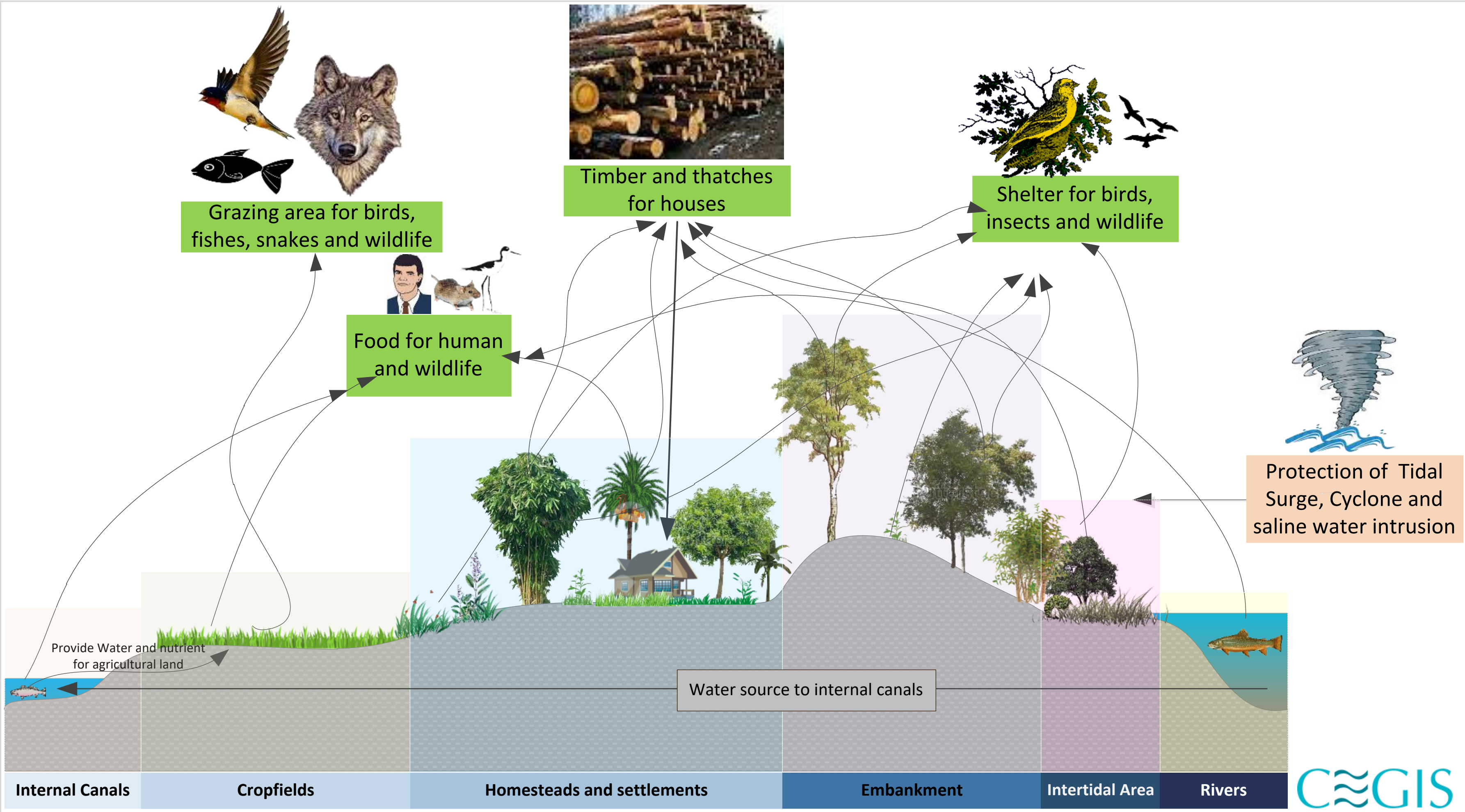
358. Intertidal area exists between the river and the embankment that is locally known as ‘char’. This area is naturally inundated twice in a day and deposit tidal sediment on the charland that helps foreshore plant succession. Saline water flow in Payra River and the connected khal helps grow various mangrove species at foreshore land. Though this river carries saline water during a small proportion of the year, the foreshore vegetation is not completely the mangrove type. The existence of Hogla (*Typha elephantina*) along foreshore and khal margins indicates brackish nature . Among the mangrove species, Ora/Chailla (*Sonneratia caseolaris*), Kewra (*Sonneratia appetala*) and Baen (*Avicenia officinalis*) are commonly found. Shoti (*Cucuma elongata*) is the commonest wild herb that luxuriously grows along the toe of the embankment as well as comparatively upland of foreshore. Foreshore afforestation of this polder was being enhanced through different projects of Bangladesh Government for the last 40 years. The forest patches of this polder is now in a ruined condition due to excess harvest, river bank erosion Mangrove vegetation has immense contribution to protect the embankments and charland 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.

359. Continuous river erosion at Burir Char and Golbunia caused narrowing of inter-tidal area and damage of foreshore vegetation.

Picture 5.8: Vulnerable foreshore vegetation at Burir Char

Picture 5.9: Mangrove mixed vegetation at Purba Kewrabunia

360. Homestead ponds are used for domestic purposes, while ditches inside agriculture land contribute to crops by supplying irrigation water. However, this type of waterbody inside the polder becomes very shallow during the dry season.



Figur 5.15: Major functions of different ecosystems of the Polder

5.2.3 Wildlife

361. Different habitats and vegetation patterns of the polder supports various wildlife. Among the mammals, Common mongoose, Field mouse, Indian Jackal, Small Indian Civet are found inside homestead vegetation, crop fields and embankment slopes.

362. Of the terrestrial avifauna, Common Myna, Asian Pied Starling, Red-vented Bulbul, Oriental Magpie Robin, Common Tailorbird, Black Drongo, and House Sparrow are most sighted birds those prefer homestead vegetation for their breeding habitat and cropfields as feeding habitat. Common toad, cricket frog and skipper frog are common amphibians found throughout the year. They prefer cool and damp places of the homestead vegetation and beside most of the wetlands. Indian Bullfrog is sighted at seasonal inundated croplands during monsoon.

363. Snakes, and lizards are the common types of reptiles residing in/around wetlands and homestead forest. Indian roofed turtle and spotted flapshell turtle are two species rarely found in this polder. Dolphins are the only aquatic mammals that roam through Payra River throughout the year. The wildlife composition of the polder is presented in **Appendix- 5.**

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

Class	Common Name	Local Status	IUCN-Bangladesh Status (2015)	CITES (2016) Appendix
Amphibia	Common Toad	VC	-	-
	Green Frog	O	-	II
	Bullfrog	C	-	-
	Cricket Frog	C	LC	-
Reptilia	House Lizard	C	-	-
	Common Garden Lizard	C	-	-
	Brahminy Skink	UC	LC	-
	Brahminy Turtle	VR	EN	-
	Monocellate Cobra	R	VU	-
	Binocellate Cobra	R	EN	-
	Common Smooth Water-snake	UC	LC	-
	Common Vine Snake	C	LC	-
	Brahminy River Turtle	R	EN	-
	Common Roof Turtle	R	EN	-
	Flap-shelled Spotted Turtle	R	LC	-
	Bengal Monitor	O	VU	I
	Rat Snake	C	-	II

Class	Common Name	Local Status	IUCN-Bangladesh Status (2015)	CITES (2016) Appendix
Aves	Black Drongo	VC	-	-
	Common Myna	C	-	-
	Red-vented Bulbul	C	-	-
	Asian Pied Starling	C	-	-
	Common Tailorbird	C	-	-
	Oriental Magpie Robin	VC	-	-
	House Sparrow	C	-	-
Mammalia	Mole Rat	VC	-	-
	Field Mouse	VC	LC	-
	Grey Musk Shrew	C	LC	-
	Small Indian Civet	R	NT	-
	Common Mongoose	UC	LC	III
	Jackal	C	LC	III
	Jungle Cat	UC	NT	-
	Indian Flying Fox	C	LC	-

Note: Local Status: VC-Very Common, C-Common, UC-Uncomon; O-Ocassional, R-Rare VR-Very Rare

IUCN-Bangladesh Status: LC-Least Concern, NT- Near threatened , EN-Endangered, VU-Vulnerable

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

364. 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 cropfields are dominated by fresh water loving plant species whereas khal banks and river foreshores are dominated by saline water loving mangrove plant species. Hargoza (Acanthus illicifolius), Kewra (Sonneratiaappetala), and Ora (Sonneratiacaseolaris) 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.

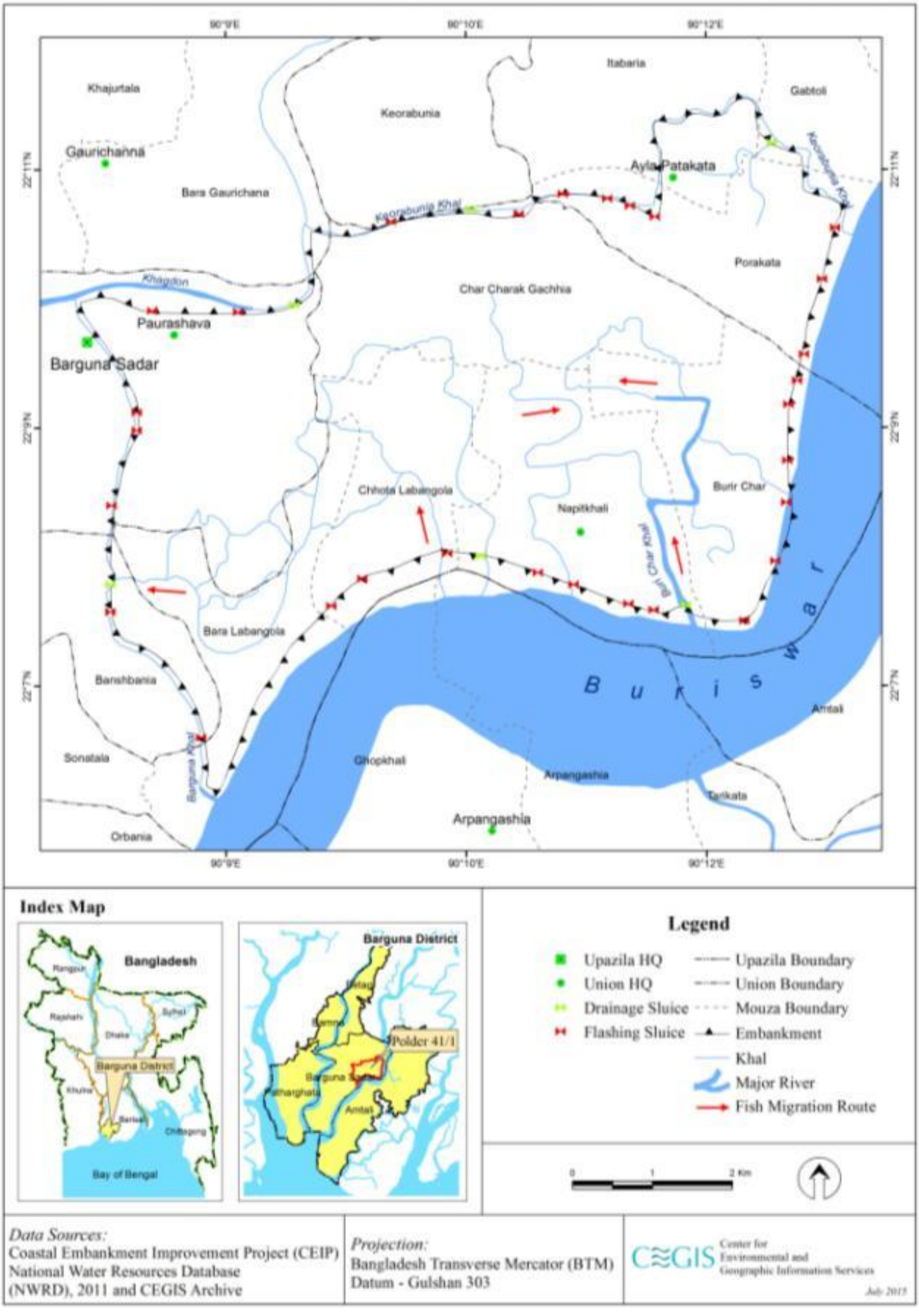
5.2.5 Protected areas

365. The Department of Environment (DoE) in 1999 circulated that, no development projects to be implemented within 10 Km of any Environmental Critical Areas (ECAs). The proposed polder (41/1) is not within the ECA or near the restricted area (Map 5.10).

Map 5.10: Ecologically Critical Area in Bangladesh

5.2.6 Fish Habitat

366. The polder is bounded by Payra River in the south and east, Bashbunia Khal in the west, and Khakhdon River and Keorabunia Khal in the south. Fisheries resources in the polder are primarily classified under two broad categories, namely, capture and culture fisheries. Capture fisheries include mainly internal khals (**Map 5.11**). The internal khals (both perennial and seasonal) are acting as major arteries for fish migration into the study area. Though, tidal effects in the dry season are observed in seasonal khals, the volume of water is not sufficient for fish habitation. The culture fishery of the polder area is dominated in culturable (homestead) fish pond. The contribution of cultured pond is reported to be very low, but it has the increasing trend in the polder area. There is no bagda and golda gher in the polder area.



Map 5.11: Fish habitat in the study area

Capture fisheries

367. The polder area consists of a number of seasonal and perennial canals/khals. These khals are important with respect to fisheries habitat. The estimated fish habitat in the Polder area is 166 ha of which 115 ha is open water fish habitat (**Table 5.13**).

Table 5.13: Fish habitat status of the polder area

Fisheries type	**Habitat type**	**Area (ha)**
Capture	Open water bodies	115
	Sub Total	**115**
Culture	Fish pond (Homestead)	42
	Fish pond (commercial culture)	9
	Sub total	**51**
	Total	**166**

Source: Image analysis, 2015 Field survey, 2015

368. Average depth of internal khals (canals) varies between 1.5-2.5 m which is sufficient for fish habitation (Picture 5.10). The depth of seasonal khals of the study area is insufficient for sheltering fish juveniles due to over siltation in the canals. Local people reported that the siltation rate in the internal khals of the polder area is gradually increasing.

Shonakhali khal (perennial)

Langgolkata khal (seasonal)

Picture 5.10: Open water fish habitat

Culture fisheries

369. The estimated culture fish habitat is 201 ha (**Table 6.13)** of which homestead pond is 165 ha and commercial or cultured pond is 36 ha. Aquaculture practice is gradually expanding in the polder area. Various types of fish culture are adopted by the local people including mono-, poly- and mix-culture. Exclusively poly-culture practice is adopted by the local people.

(a) Homestead pond

(b) Improved cultured pond

Picture 5.11: Fish pond in the polder area

Water Quality

370. The surface water quality parameters of the peripheral rivers and khals have been measured and compared with the fish habitat suitability standards and are presented in **Table 5.14.** From the measured data, it is observed that all water quality parameters are within the permissible limit for fisheries resources. The salinity in water bodies (both internal and river) is nil, as found below:

Table 5.14: Water quality parameters of different water bodies in the polder area

Water bodies	Parameters				
	Temp (ºC)	pH	DO (mg/l)	TDS (ppm)	Salinity (ppt)
Payra River	29	7.8	6.1	170	Nil
Internal Khal (Boro Lobongola khal))	28	7.8	5.9	290	Nil
Standard values for fish	(28-34)**	(6.5-8.5)*	4.0-6.0*	1000*	(0-4) for golda and (5 -35) for bagda**

*Source - *M A Mazid 2002 ** Jack M. et al, 2002 (Water quality measured in last June, 2015)*

Aquatic Vegetation

371. Aquatic plants or vegetation play an important role in the function of the aquatic ecosystem. It provides essential habitat for a number of small animals like aquatic insects, snails and freshwater shrimp, which in turn supply food for fish and waterfowl. Moreover, different types of hydrophytes like emergent, submerged and floating with leaves are used as spawning ground of fisheries and other insects and crustaceans. In the wetland, some fishes lay eggs in the body of plants. Beside these, some fishes live on the rotten part of the aquatic plants (Khondker, 2004). Insufficiency of aquatic floras, such as free floating, submerged, sedges and meadows are observed in the water bodies (mainly khals) in the polder area during field visits. This happens mainly due to regular tidal flow. Free floating plants especially duck weeds are found in the closed khals, namely, the floodplains within the polder area.

5.2.7 Fish Migration and Movement

372. The riverine fish species migrate through regulated khals in the polder to some extent during the period of June to August. In the polder area, perennial khals (Amrajuri, Shonakhali, Charkgasia, Charnalar, Burir Char, and Choto Lobongola etc) along with other seasonal internal khals are used as feeding and nursing ground of the fishes. Fish species such as Chingri, Baila, Pairsa, Koral, Puti, Boal, Rui, and Tengra migrate through the regulators to the water bodies as part of their life cycle. Local people reported that fish fry of Chingri, Ayre, Boal and Baila migrate through the perennial khals during the period of April to August. Fish migration status in the polder area is found as poor due to mal-functioning of water control structures, poor/non functionality of the Water Management Organizations (WMOs) in operating sluices and regulators. The improper management of regulators hinder the migration of fish hatchling especially the carp fry and others during pre-monsoon.

5.2.8 Fish Biodiversity

373. The study area is moderate in fish biodiversity though the biodiversity of fishes has shown a declining trend over the years. Local people reported that more than 70 numbers of fish species are available in the area. The study area comprises an assemblage of both fresh and brackish water fish species (photo below). A list of some of the representatives' fishes of different habitat in the study area is presented in **Table 5.15.**

Picture 5.12: Composition of Fish Catch of the Polder Area

Table 5.15: Available Fish Species Diversity of Different Fish Habitats in the Study Area

Scientific Name	Local Name	Habitat type		
		Periphery River	Khal	Fish pond
Brackish Fish Species				
Tenualosa ilisha	Ilish/Hilsha	H	NA	NA
Lates calcarifer	Koral/Bhetki	H	M	NA
Otolithes argentatus	Sada Poa	L	NA	NA
Liza parsia	Pairsa	H	M	NA
Liza tade	Bata	M	L	L
Mystus gulio	Tengra	M	M	NA
Pangasius pangasius	Pangus	H	NA	NA
Polynemous paradiseus	Tapasi / Muni	L	L	NA
Sillaginopsis panijus	Tolar dandi	H	L	NA

Scientific Name	Local Name	Habitat type		
		Periphery River	Khal	Fish pond
Macrobrachium rosenbergii	Golda chingri	L	L	L
Metapenaeus monoceros	Horina chingri	H	H	NA
Penaeus monodon	Bagda chingri	M	L	NA
Fresh Water Fish Species				
Puntius sophore	Jat puti	NA	M	L
Channa punctatus	Taki	NA	M	L
Channa orientalis	Cheng taki	NA	L	L
Channa striatus	Shol	NA	L	L
Clarius batrachus	Magur	NA	L	L
Mystus vittatus	Tengra	M	M	M
Macrognathus pancalus	Chirka baim	NA	L	L
Macrognathus aral	Tara baim	NA	L	L
Lepidocephalus guntea	Gutum	NA	L	L
Puntius chola	Chola puti	NA	M	L
Wallago attu	Boal	L	L	NA
Aorichthyes seenghala	Ayre	L	L	NA
Gudusia Chapra	Chapila	M	NA	NA
Glossogobius giuris	Baila	M	L	L
Eutropiichthyes vacha	Bacha	M	L	NA
Culture Fish Species				
Labeo rohita	Rui	NA	NA	H
Catla catla	Catla	NA	NA	H
Cirrhina cirrhosus	Mrigel	NA	NA	M
Hypophthalmicthys molitrix	Silver carp	NA	NA	L
Ctenopharyngodon idellus	Grass Carp	NA	NA	M
Telapia nilotica	Telapia	NA	NA	H
Cyprinus carpio	Miror Carp	NA	NA	L
Pungasius hypophthalmous	Thai Pungus	L	NA	M

Source: Field Survey, 2015;

Note: Abundance Code: H= High; M= Medium; L= Low; NA= Not available

374. There are variations of species composition in river, khal and pond. Brackish water fish species like Hilsha, Ayre, Baila, Bhetki, Tapasi, Bagda, Horina chingri etc are found in the open water bodies especially in the peripheral rivers of the polder area. Local fishers reported that only Chingri contribute about 40% of total open water (Khal habitat) fish production inside the polder. Taki, Shol, Cheng, Koi, Shing, Puti, etc., are common fresh water fishes which are found both in the khal and pond. Local people informed that, once brackish water fish species like Koral/Bhetki, Pairsa, Tapasi and fresh water fish species e.g. Rui, Catla, Ayre were commonly found in the internal khal. Presently their abundance is in the decreasing trend. In addition, plenty of Golda and Bagda chingri were found in the last decade in all habitats. At present, they are found to lower extent only in the perennial khals. However, Horina chingri is still highly available in the khals. This may be due to the change of salinity in the water bodies, obstruction of fish migration route, indiscriminate fishing by slice net. The dominant cultured fish species include Tilapia, Pungus and Sarputi and are commercially cultured in the polder area.

375. **Indicative fish species** – Brakish water fish species like Bhetki, Pairsa Bagda, Horina, Chingri etc are reported as an indicator fish species which prefer brackish to

moderate salinity. On the other hand, Taki, Shol, Cheng, Koi, Shing, Puti, etc., are common fresh water fishes which are very sensitive to saline water.

5.2.9 Threatened fish species

376. Threatened fish species which are locally rare and unavailable or extinct for the last 10-15 years as reported by the local fishermen and concerned elderly people are given in **Table 5.16.** Local people reported that *Gojar, Pabda, Kine* and *Shorputi* have been extinct from the polder area. Other fishes like *Boal, Meni* and *Ayre* are rarely found due to declining of water depth and obstruction of fish hatchling route for improper and irregular operation of water control structures.

Table 5.16: List of threatened fish species

Scientific Name	Local Name	Local Status		
		Rare	Unavailable	Extinct
Channa marulius	Gojar			√
Nandus nandus	Meni	√		
RWallago attu	Boal	√		
Aorichthyes aor	Ayre	√		
Ompok pabda	Pabda			√
Plototus canius	Kine	√		
Puntius sarana	Shorputi			√

Source: Field Survey, 2015

5.3 Human and Economic Development

5.3.1 Fish Production

377. The estimated total fish production of the polder area is 105 tons (**Table 5.17**). Bulk of the fish production (about 82%) is obtained from culture fisheries and the remaining from the capture fishery. The fish production trend of the capture fishery in the polder area is decreasing due to indiscriminate fishing by illegal nets, agrochemicals coming from crop fields, siltation and low water flow in the internal khals, obstruction of fish migration, improper and mal-functioning of water control structures. In case of culture fish production, about 57% fish production is obtained from homestead ponds. The contribution of commercial pond in total fish production is low but it is gradually increasing in the polder area.

Table 5.17: Fish Production from Different Habitats of the Polder Area

Sl.	Fisheries Category	Habitat Type	Production (ton)
1	Capture	Open water	19
Sub-total			19
2		Homestead pond	60
3		Commercial pond	26
Sub-total			86
Grand Total			105

Source: FRSS and Field survey, CEGIS (2015)

5.3.2 Fishing Effort

Fishermen number

378. The fishers' households in the Polder area include both commercial and subsistence fishers. Local people reported that fisher composes about 20% of the households in the polder. Among them, 60% households are engaged as professional/commercial fishers and they spend almost 20 hours of a day and 8-9 months of a year in fishing activities. The remaining 40% of households are subsistence level fishers and they spend 2-3 months of a year for the same. During field visits, it is learnt that 95% fishers are Muslim and 5% are Hindu cast. A number of "Fishers village" are reported to exist in the polder area. These villages are Burir Char, Feri ghat; Nobogram, Napitkhali, Koroitola and Taltibunia which are located near the periphery of the polder. The socio-economic conditions of the commercial fishermen are poor to moderate. About 70% of fishers have fishing nets and boats. The rest of the fishers catch fish in sharing or as daily labours. The seasonal vulnerability of the fishers in the polder area starts from late January and lasts till April. During this period, fish catch is hardly recorded due to cool water during winter season. Moreover, during fish ban period (for protecting jatka of hilsha) the poor fishers suffered more as they do not have other alternate options of livelihood. They are affected during these 2-3 months fishing ban period . The government provides rice as rationing during this period which is not sufficient (40 kg rice/family) for a family. Under such circumstances, the fishers maintain their livelihood through Dadon (money borrowing from local merchant with high interest) or taking loan from local NGOs. Some fishers also get involved in daily larbour or are involved in shrimp/prawn fry collection and fish trading

Fishing Season

379. Fishing in the polder area starts in April / May and continues up to December. Most of the fish catch by different gears take place during late June to Mid November. Ber jal, Current jal and shuti jal are commonly used in the periphery river round the year. The seasonality of major fishing is furnished in **Table 5.18**

Table 5.18: Fishing Seasonality of the Polder Area

Type of Gear	Seasonality											
	Apr–May	May–Jun	Jun–Jul	Jul–Aug	Aug–Sep	Sep–Oct	Oct–Nov	Nov–Dec	Dec–Jan	Jan–Feb	Feb–Mar	Mar–Apr
	Boishakh	Jaishthya	Ashar	Sravon	Bhadra	Ashyin	Kartik	Agrahayan	Paush	Magh	Falgun	Chaitra
Ber jal (Siene net)	Medium	Medium	Medium	Medium	High	High	High	Medium / Low	Low	Low	Low	Low
Current jal (Gill net)	High	High	High	High	High	High	High	High	Low	Low	Low	Low
Dhela jal/net jal (Push net)	High	High	Low	Low	Low	Low	Low	Low	Low	Low	High	High
Jhaki jal (Cast net)	Low	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium / Low	Low	Low	Low
Dharma jal (Lift net)	No occurrence	No occurrence	High	High	High	High	High	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence
Shuti jal (Siene net)	Low	Low	Medium	Medium	High	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence
Trap gear (Dugair/Chau)	No occurrence	No occurrence	High	High	High	High	High	Low	No occurrence	No occurrence	No occurrence	No occurrence
Lining (Borshi)	No occurrence	No occurrence	Low	Low	Medium	Medium	Medium	Medium	No occurrence	No occurrence	No occurrence	No occurrence

Legend: High (dark) | Medium (grey) | Low (light grey) | No occurrence (white)

Source: Field Survey, 2015

Fishing Crafts and Location

380. The commercial fishermen of the polder area catch fish in the peripheral rivers and internal khals using both mechanized and traditional boats including Jala Nouka and Kusha, Dingi fishing boats etc. Some of the fishing boats in the polder area are shown in Picture 5.14 below.

Picture 5.13: Fishing boat in the study area

Fishing Gear

381. Different types of nets/gears are used for fishing as mentioned in Table 5.16. Of the fishing gear, (a) Seine net (Ber jal/bendi jal) is used to catch all types of small and big fishes; (b) Mono filament net, locally known as Current jal is used to catch hilsha; (c) Lift net (veshal jal) is used to catch small and big fishes, (c) Cast net, locally known as Jhaki jal is used to catch puti, chingri, tengra etc., and also (d) Push net, locally known as Thela jal, are used to catch puti, tengra, chingri etc. Around 80% fishermen have fishing gears/nets. Jhaki jal (cast net) is a common traditional fishing gear which is used in all water bodies.

Picture 5.14: Fishing net used at the periphery river

5.3.3 Fish Marketing and Post Harvest Facilities

382. Local fishermen sell bulk of their catch to the local fish market located at Barguna Paurashouva area or to the fish traders. There is no fish landing center in the polder area. Fish traders or buyers (Bepari) come from different district of the country to purchase the fishes from this area. There are seven ice factories inside the polder area. There is no fish storage facility in or adjacent to the polder area. Local fishers preserve the fish in ice.

Transportation facility at the root level is moderately developed. There is no private hatchery inside the polder area. Also, the availability of fish feeds for culture ponds are insufficient. Fish seeds for culture fishery are collected from the hatcheries and nurseries of Patuakhali. In addition, fish feeds are also collected from the local market or from the mobile sellers coming from Khulna and Barisal districts.

5.3.4 Fisheries Management

383. There is a government registered fisherman association (Manikkhali-Golbunia Moatshya Jibi Somiti) in the polder area. The activities of the association are to organize the fishermen and to remove their internal collision and to protect them from the robbers. The fishermen have full access to the existing fish habitats for fishing. There is no leased water body in the polder. The Department of Fisheries (DoF) has limited activities for fisheries resource conservation and management in this area. Some NGOs are working in the polder area, but they have limited services on the development of aquaculture as well as fishers livelihood. Enforcement of fisheries regulation is weak in and outside the Polder area. However, the fishing ban period is strictly observed by the DoF.

5.3.5 Agriculture Practices

384. Agriculture practices within most of the Polder area have adjusted to agro-climatic conditions prevailing in Kharif-I (March-June), Kharif-II (July –October) and Rabi (November-February) seasons. The crop year starts from the Kharif-I season which is characterized by high temperature, low humidity, high evaporation, high solar radiation and early rain fall causing flash floods. S. Vegetables, T. Aus (Local) and T. Aus (HYV) crops are grown in this season.

385. High rainfalls, low temperatures, high humidity, low solar radiation and high floods that recede towards the end of the season are the characteristics of Kharif-II season. T. Aman (Local) and T. Aman (HYV) crops are grown in this season.

386. The Rabi season is characterized by low temperature, high solar radiation, low evaporation, insignificant rainfall and low humidity. A wide range of crops such as Spices, Chili, various winter vegetables, Potato, Boro (HYV), Oil seeds and Pulses are grown in this season. Sugarcane and Orchard are perennial crops of the Polder area. There are some occasional overlaps of crop season in the polder area, such as Kharif-I crops (S. Vegetables, T. Aus) are harvested in Kharif-II season, Kharif-II crops (T. Aman) are harvested in the Rabi season and Rabi crops (W. Vegetables, Spices, Potato, Chilli, Wheat, Pulses, Oil seeds and Boro) are harvested in Kharif-I season.

5.3.6 Present Cropping Pattern and Intensity

387. The information of cropping pattern was collected from feasibility report (Agriculture), CEIP; 2012 and validated during field visit, June, 2015. The dominant cropping patterns in the Polder area are T. (AusHYV)-T (Aman HYV)-Fallow and T. (Aus Local)-T. (Aman Local)-Fallow practiced on about 23.5 % and 16.3% of the net cultivable area respectively. Thus, present cropping intensity of the polder area is 184%. Detailed existing cropping pattern of the polder area by land type is presented in **Table 5.19.**

Table 5.19: Present Cropping Pattern by Land Type

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-Feb)	Area (ha)	% of NCA
High land(FF)	Orchard	Orchard	Orchard	29	0.8
	Vegetables	T. Aman(Local)	Spices	18	0.5
	Vegetables	T. Aman (Local)	Chili	28	0.8
	T. Aus (Local)	Fallow	Vegetables	79	2.3
	T. Aus (Local)	T. Aman (Local)	Potato	18	0.5
	T. Aus (Local)	T. Aman(Local)	Fallow	561	16.3
	Fallow	T. Aman (Local)	Fallow	540	15.7
			Sub-total	**1,273**	***37***
High land(F_0)	T. Aus (HYV)	T. Aman (HYV)	Fallow	808	23.5
	T. Aus (Local)	T. Aman (HYV)	Fallow	519	15.1
	T. Aus (HYV)	T. Aman (HYV)	Boro (HYV)	151	4.4
			Sub-total	**1,479**	**43**
Medium high land(F_1)	Fallow	T. Aman (HYV)	Oil seeds	144	4.2
	Fallow	T. Aman (HYV)	Fallow	114	3.3
	Fallow	T. Aman (Local)	Pulses	361	10.5
			Sub-total	**619**	**18**
Medium low land(F_2)	Fallow	Fallow	Pulses	69	2
			Sub-total	**69**	***2***
			Total	**3,440**	**100**
			Cropping Intensity (%)	**184%**	

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

Picture 5.15 : View of T. Aman Rice Cultivation in Polder Area

Source: Field visit; June, 2015

Picture 5.16: View of T. Aus (HYV) Crop field and pesticide applies in T .Aus (HYV) Crop Field

5.3.7 Cropped Area and Production

388. The yield of different crops has been collected from feasibility report (Agriculture), CEIP; 2012 and data were validated with the consultation of local farmers and DAE personnel during field visit, 2015. Total cropped area is about 6,344 ha in the polder area of which 5,552 ha area is covered with rice and 792 ha with non-rice crop. Total crop production is 15,502 metric tons of which rice production is 12,400 metric tons and non-rice crop production is 3,109 metric tons. The contribution of T. Aus (Local), T. Aus (HYV), T. Aman (Local), T. Aman (HYV) and Boro (HYV) are 15%, 21%, 25%, 35% and 4% respectively. Details of cropped area and crop production in Polder 41/1 are presented in **Table 5.20.**

Table 5.20: Annual Agricultural Cropped area and Productions in the Polder Area

Name of crop	Cropped area (ha)	Yield (mt/ha)	Production (mt)	% of Contribution of production
T. Aus (Local)	1,178	1.6*	1,885	15
T. Aus (HYV)	960	2.7*	2,592	21
T. Aman (Local)	1,526	2*	3,052	25
T. Aman (HYV)	1,737	2.5*	4,343	35
Boro (HYV)	151	3.5*	529	4
Total rice	**5,552**	**0**	**12,400**	**100**
Orchard	29	13.5	392	13
Summer Vegetables	46	12.5	575	18
Chili	28	1.25	35	1
Pulses	430	1.5	645	21
Potatoes	18	15.5	279	9
Winter Vegetables	79	12	948	30
Spices	18	3.5	63	2
Oil seeds	144	1.2	173	6
Total non rice	**792**	**0**	**3,109**	**100**
Grand Total	**6,344**	**0**	**15,509**	**0**

Source: Feasibility report (Agriculture), CEIP; 2012 and based on field information, June; 2015

Crop damage

389. The scenarios of crop damage during 2007- 2013 are presented in **Table 5.21**. Seed beds of T. Aman crop are normally damaged due to drainage congestion during heavy rainfall in almost every year. It was observed that, 50% of T. (AusHYV) was damaged in 2013 by Mahasen.

Table 5.21: Crop Area Damaged by Different Means and Losses during 2007-2013

Sl. No.	Crops	Damage (%)	Year	Reason of damage
1.	T. Aman (HYV)	80	2007	Sidr
	Vegetables	80	2007	Sidr
	Fruits	30	2007	Sidr
2.	T. Aman	20	2008	Water logging
	Vegetables	30	2008	Water logging
3.	Potatoes	20	2009	Aila
	Spices	25	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.	T. Aus(HYV)	50	2013	Mahasen

Sources: Feasibility report (Agriculture), CEIP; 2012 and Field Survey, June, 2015

5.3.8 Agricultural input use

390. Information on agricultural inputs has been collection from the feasibility report (Agriculture), CEIP; 2012 and collected data were validated with the consultation of local farmers and DAE personnel during field visit, 2015.

Fertilizers

391. Not all kind of chemical fertilizers are available in local dealers shop but the prices are very high. The polder's farmers use chemical fertilizers such as Urea, TSP, MP and Gypsum in different crops. Urea use is higher than other chemical fertilizers, probably due to a lack of knowledge of farmers on balanced use of fertilizers and economic problems. Farmers use no organic manure/compost. Detailed is presented in Table 5.22.

Seeds

392. The quality seeds of different crops along with saline/drought tolerant different HYV/Hybrid variety crops seeds are not available in the market. Most of the farmers use their own seeds in case of local variety such as T. Aus and T. Aman. The Quality of seeds available with the private dealers is poor and the market price is very high. Farmers use higher or lower amount of seeds than the recommended doses. This may be due to lack of knowledge. Detailed is presented in Table 5.22.

Pesticides

393. Most of the farmers applied pesticides in all crops such as T. Aus (Local), T. Aus (HYV), T. Aman (Local), T. Aman (HYV), Boro (HYV), Chilies, Potatoes, summer and winter vegetables and spices. They spend about Taka 1000-4000/ha for pest control in each crop. The highest doses of pesticide are applied in T. Aman, Boro, vegetables and potato fields. The polder farmers applied pesticides once, twice or more than twice. They use pesticides

either under dose or overdose due to a lack of knowledge on pesticides application mainly. Detail agricultural inputs used presently for different crops are presented in **Table 5.22.**

Table 5.22: Present Level of Crop Production Input Used Within Polder 41/1

Crop Name	Seed used (Kg/ ha)	Fertilizer (Kg/ha)						Irrigation cost (Tk)	Pesticide (Tk/ha)	Percent of farmers using Power tiller	Cost power tiller
		Urea	TSP	MP	Gypsum	Zinc	Manure				
T. Aus (HYV)	30	150	-	-	-	-	-	-	4,000	80	3,500
S. Vegetables	4	160	80	67	60	5	-	-	2,500	80	3,500
T. Aman (Local)	30	109	70	40	40	4	-	-	3,000	80	3,500
T. Aman (HYV)	30	152	133	67	51	8	-	1000	4,000	80	3,500
Chili	1-1.5	180	30	20	20	-	-	600	1,000	80	3,500
Pulses	25	155	30	15	-	-	-	-	500	80	3,500
Potatoes	1,500	175	90	135	55	6	-	3,500	3,000	80	3,500
Boro (HYV)	40	217	178	100	50	40	-	4,500	4,000	80	3,500
W. Vegetables	5	300	150	130	100	-	-	1,000	2,000	80	3,500
Spices	10	150	90	40	70	6	-	200	1,500	80	3,500
Oil seeds	8	220	135	35	115	9	-	-	1,000	80	3,500

Source: Feasibility report (Agriculture), CEIP; 2012 and field visit, June; 2015

Labor

394. The information of labour engaged in the field was collected with the consultation of local famers and DAE personnel during field visits in June, 2015. Most of the cultural practices for crop production in the polder area are manual. So, agricultural labor is considered as one of the essential inputs for crop production. The number of labor requirement varies from crop to crop. The average labor requirement in the polder area is presented in **Table 5.23.**

Table 5.23: Labor Used in Different Crops in the Polder Area

Sl. No.	Crop name	Labor(No/ha)
1	T. Aus(Local)	130
2	T. Aus(HYV)	160
3	S. Vegetables	180
4	T. Aman (Local)	160
5	T. Aman(HYV)	170
6	Chili	180
7	Pulses	100
8	Potatoes	140
10	Boro (HYV)	170
11	W. Vegetables	180
12	Spices	170
13	Oil seeds	120

Source: CEGIS Assessment from field information, June; 2015

Irrigation

395. Irrigation is provided in T. Aman (HYV), Boro (HYV), Chili, Potatoes, Winter vegetables and spices. Surface water is being used for irrigation. The rivers (Paiyra and Khakdon), and the channels (Bashbunia khal, Manir khal, Labongona khal, Choto Labongona, Boro Labongona, Maither, Napit, Manir, Charakgasia, Sonakhali, Charnalar, Keorabunia) , are the main sources of surface water irrigation. However, the availability of irrigation water has been declining due to siltation of the river, and khals. Boro cultivation cannot be increased under the present situation because the availability of sweet water is less than needed as most of the Khals have been silted up (**Field visit; June, 2015**). Irrigation is also provided in vegetables by traditional means using surface water from the pond, khals, ditches etc. Supplementary irrigation is also needed in high lands and medium high lands crops. Only the LLPs are used for supplementary irrigation. The cost required for supplementary irrigation is Taka 500/- to 3,500/- per ha depending on crops and the number of application. Generally, the farmers provide supplementary irrigation in Rabi season crops. The crops cultivated in the polder area during Rabi Season (November-February) are primarily bean, potato, pulses, winter vegetables, spices, onion etc.

5.3.9 Livestock and Poultry

396. Livestock and poultry are essential elements of integrated farming systems, which play important role in the economy of the polder area. Livestock provides 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; meat, milk and eggs for human consumption. Most of the households raise poultry and livestock, a practice that significantly reduces poverty through generating income and employment. Detailed status of livestock/poultry is presented in **Table 5.24**

Table 5.24: Status of Livestock and Poultry in the Polder Area

Name of Livestock/poultry	% of HH having livestock and poultry	Number of livestock and poultry
Cow/Bullock	82	73,362
Buffalo	1	210
Goat	24	13,434
Sheep	2	641
Duck	31	20,800
Chicken	35	18,500

Source: Feasibility report (Livestock), CEIP; 2012 and based on field information and KII with DLS Personnel, June; 2015

397. The owners of the livestock population are facing problems in respect of availability of fodder and feeds during the month of July to November as the lands are generally covered with T. Aus (HYV) and T. Aus (Local) and T. Aman (HYV) and T. Aman (Local). Rice straw is the main fodder. Oil cakes, Rice bran, Rice soup (Bhater Mar), etc. are the other common fodders. 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, sometimes kitchen waste becomes feed for the poultry.

Picture 5.17: View of Cattle in the Polder Area

398. Productions of livestock and poultry are mainly constrained due to diseases and death of the population. An outbreak of diseases is causing a considerable economic loss in livestock farming. Every year livestock population is affected by different diseases. Major livestock diseases are Foot and Mouth Disease (FMD), Gola fula (*Hemorrhagic Septicemia*), Black leg (Badla), Pest Des Petits Ruminants (PPR) and Goat cyst. Major poultry diseases are: Ranikhet (New castle), Cholera, Duck plague, and Fowl pox. The most vulnerable period is June –July for spreading diseases to livestock and poultry populations

5.4 Socio-cultural environment

5.4.1 Introduction

399. The socio-economic condition of the people living in Polder 41/1 is described in this section. In doing so, primary data were collected using a range of RRA techniques including Key Informant Interview (KII), Focus Group Discussion (FGD), observation and public consultation. Moreover, relevant secondary information was compiled from the community series of the Population Census 2011 published by Bangladesh Bureau of Statistics (BBS).

5.4.2 Area and Location

400. The Polder 41/1 is located in Barguna Sadar Upazila under Barguna District. The polder covers three Unions namely Barguna, Barir Char and Ayla Patakata and one Paurashava (Barguna Paurashava). The polder is bounded by Bashbunia Khal to the west, Paira (Buriswar) River to the east and south, Khakdon River to the north. The percentage of union boundary are shown in **Table 5.25**

Table 5.25: Unions and upazilas in polder41/1

Name of district	Name of upazila	Name of unions	Percentage of union within polder
Barguna	Barguna Sadar	Ayla Patakata	17
		Barguna	5
		Paurashava	50
		Burir Char	70

Source: Spatial GIS Analysis, CEGIS, 2015

5.4.3 Demography

401. The 11,133 households living in the polder area have a total population of 47,859 of which 24,071 are male and 23,788 are female (Housing and Population Census, BBS, 2011, CEGIS estimation, 2015[15]). Here, the male population is higher than the female population. The average male-female sex ratio[16] is 100 of which there are 100 males per 100 females which is lower than the national figure of 100.3 [BBS, (HIES) 2010[17]]. The average density of population is 814 persons per sq. km which is less than the national density of 1,015 persons per sq. km. The inhabitants of this Polder belong to two main religious groups; i.e. the Muslim and Hindu. About 91% of total populations are Muslim and 9% are Hindu. The demographic data of this Polder is presented in **Table 5.26.**

Table 5.26: Demographic data of polder

Unions	Households	Population			Sex ratio	Population density [sq. km]
		Both	Male	Female		
Ayla Patakata	930	3889	1928	1961	98	690
Barguna	258	1120	550	570	97	910
Paurashava	4291	18812	9744	9068	107	-
Burir Char	5654	24039	11848	12190	97	843
Total/Average	11,133	47,859	24,071	23,788	101	814

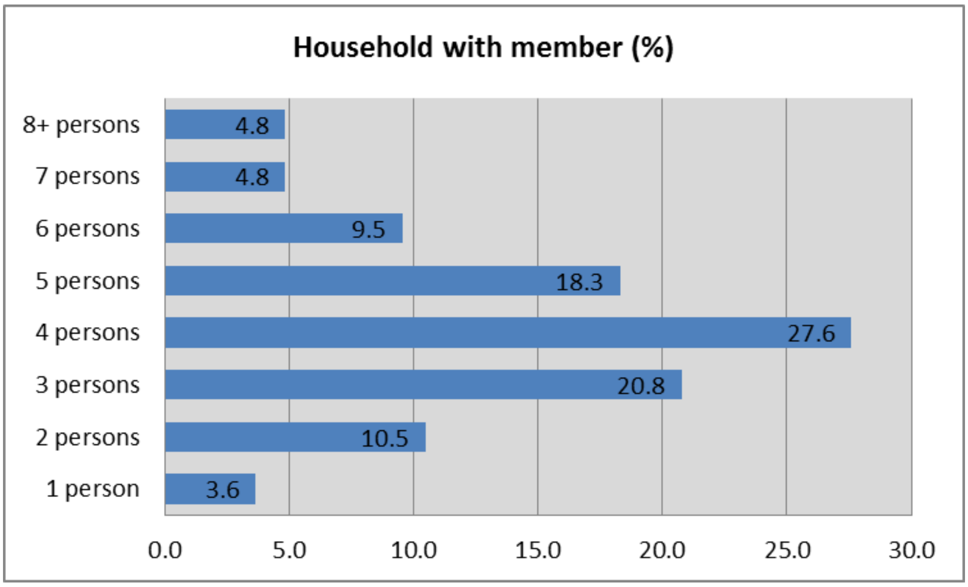
Source: Population Census 2011, BBS

402. Household distribution in the overall study area by number of persons show that the highest percentage (27.6%) of households comprises of 4 persons in each (Figure 5.14). Although the average household size is 4.2, a substantial percentage (18.3%) of households comprises of 5 or more persons each.

15 This estimation is based on BBS, 2011 Census data and 1.37 linear national growth rate

16 Number of males per 100 females in a population, using the formula: Sex Ratio SR = M x 100 / F

17 HIES 2010 refers to Household Income and Expenditure Survey conducted by the Bangladesh Bureau of Statistics (BBS) in 2010.



Source: Housing and Population Census, BBS, 2011

Figure 5.16: Distribution of households comprising member in each HH

5.4.4 Age Structure

403. The highest number of population (27%) in the study area belongs to the age category of 30 to 49 years old. Only 3% people are in 60 to 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[18]). This classification is important as the size of young population (under age 15) would need more investment in education, while the size of older populations (ages 65 and over) would need far more investment in the health sector.

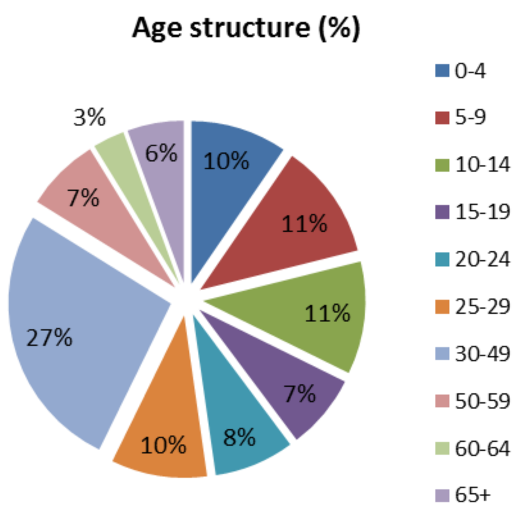
404. The population data when analyzed to ascertain the size of (potentially) active and working population, appears that 62% population are in the age bracket of 15-64 and can be classified under this category. A small percentage (6%) is of 65 years above. The categorization is made on the basis of ILO reference for opting out potential labour force and dependent population. Population of 15 to 64 years category is considered as labour force whereas, populations below 14 years and above 65 years are considered as dependents. Thus, the total dependency ratio[19] is 61 in which child dependency ratio[20] is 52 and aged dependency ratio[21] is 9. It illustrates that a total of 61 persons are dependent on 100 labour forces in which 52 are children and 9 are elderly people.

18 Retrieved on 30/06/2015 from https://www.cia.gov/library/publications/the-world-factbook/docs/notesanddefs.html

19 Total dependency ratio= $\frac{\text{number of people aged } 0-14 \text{ \& those } 65 \text{ and above}}{\text{number of people aged } 15-64} \times 100$

20 Child dependency ratio= $\frac{\text{number of people aged } 0-14}{\text{number of people aged } 15-64} \times 100$

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



Source: Housing and Population Census, BBS, 2011

Figure 5.17: Age structure of the studied population

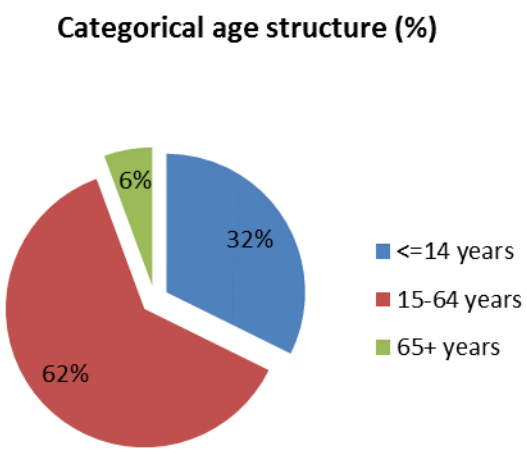


Figure 5.18: Categorical distribution of studied population

5.4.5 Education

405. Literacy rate, based on a definition "ability to write a letter in any language" is 59.8%, where for the male population it accounts to 61.6% and female 58.1%. The rate of literacy reported above is for population of 7 years and over ages (**Figure 5.19**). Data confirms that like the national scenario of Bangladesh (Male 54.1% and Female 49.4%), in the study area the male populations are more educated than their female counterpart.

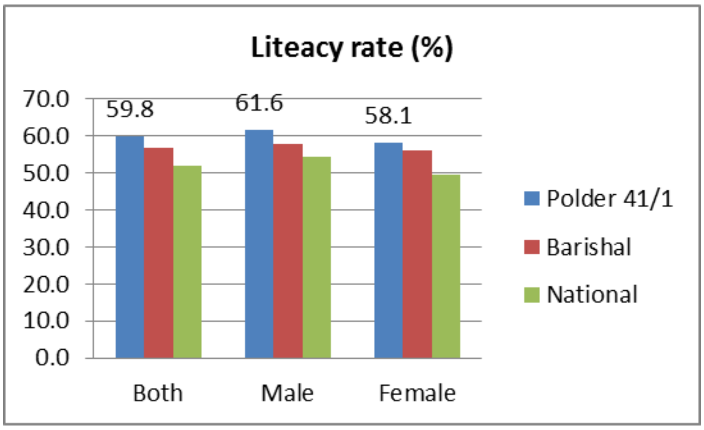


Figure 5.19: Literacy rate among the studied population

406. Field findings shows that there are 54 primary schools, 19 high schools and 31 Ebtedaye/ Dakhil Madrashas in the polder area (Table 5.27). There are two colleges in the study area. Accessibility to these institutions is very much limited due to a number of reasons-such as poor communication facilities, higher poverty rate, inadequate health care and nutrition services etc (**Picture 5.18**).

Table 5.27: Academic institutions

Unions	Nos of Primary School	Nos.of Madrasha	Nos.of High School	Nos. of College
Ayla Patakata	07	08	03	01
Barguna	15	07	06	-
Paurashava	18	10	08	01
Burir Char	14	06	02	-
Total	54	31	19	2

Source: CEGIS field work, 2015

Picture 5.18: Local educational institution at Polder area

5.4.6 Public Health

Access to health service

407. 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 Barguna Sadar hospital, one upazila health complex, three Union Family Planning and Health Complexes and fourteen community clinics in the polder area (**Table 5.28**). Additionally, there are peripheral health services institutions outside the polder area.

Table 5.28: Health service facilities in the study area

Unions	No of Hospital	No of Community Clinic	Health facilities (outside of Polder)
Ayla Patakata	1 (Union Family Planning Health Complex)	3	Barguna & Patuakhali
Barguna	1 (Union Family Planning Health Complex)	3	Barguna & Patuakhali
Paurashava	1 (Union Family Planning Health Complex & 1 Upazila Health Complex)	6	Barguna & Patuakhali
Burir Char	1 (Union Family Planning Health Complex)	2	Barguna & Patuakhali

Source: CEGIS field work, 2015

408. RRA findings show that waterborne diseases, fever, cold and respiratory complications are dominant throughout the Polder. Field data confirms that water in polder area remains stagnant in the linked canals and ditches round the years which helps spread unpleasant odors leading to air pollution. It eventually increases respiratory diseases, particularly to children. The stagnant waterbodies appeared to be the abode of mosquitoes that leads to prevalence of fever. Local people sometimes tend to wash their hands and legs with this stagnant water where children also take their bath. It eventually leads them to suffer from skin diseases as the water is already contaminated.

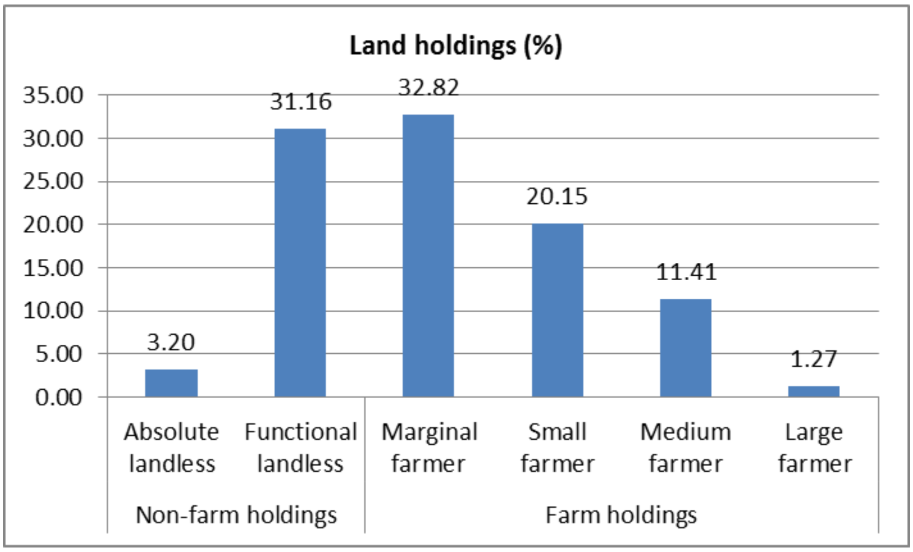
409. The survey also confirmed that nearly 45 percent people receive health services from quack doctors and 30 percent from paramedic/ diploma physicians and only 15 percent from trained doctors. It is noteworthy that about 10 percent do not receive treatment facility due to their impoverishment. People reported that earlier there was a tendency to receive treatment from local healers for diseases, this trend has been changed and at present people go for treatments from the registered/trained physicians. It is assumed that economic wellbeing may drive them toward receiving treatment facilities from trained physicians whether it is expensive or cost effective.

410. The Population Census, 2011 identified almost six types of disabilities with their proportionate distribution in the respective area. It is found that the study area comprises 1.9% of all types of disabilities and 0.8% people reported that they are physically challenged, whereas 0.4% mentioned speech and mental disorder. Local people opined that the incidence of Typhoid is the most prevalent ailment in the area.

5.4.7 Ownership and utilization of land

411. The Census of Agriculture, 2008 by BBS classified land holdings into two broad categories- one is farm-holdings and the other is non-farm holdings. The farm holding is defined as being an agricultural production unit having cultivated land equal to or more than 0.05 acre. Conversely, non-farm holding includes landless households and households having lands up to 0.04 acre. The study area shows that out of the total holdings 66.64% is farm and the rest 34.36% is non-farm.

412. Therefore, the land holdings in the study area show that 3.2% households are absolutely landless i.e. they have no lands either homesteads or cultivable. 31.16% households belong to functional landless category that comprises households those who have only homestead lands (24.22%) and those who have homesteads with 0.01 to 0.04 acre cultivated lands (6.94%). Here, cultivated lands include mainly kitchen gardening produced predominantly by housewives mainly for household consumption.



Source: The Census of Agriculture, 2008, BBS

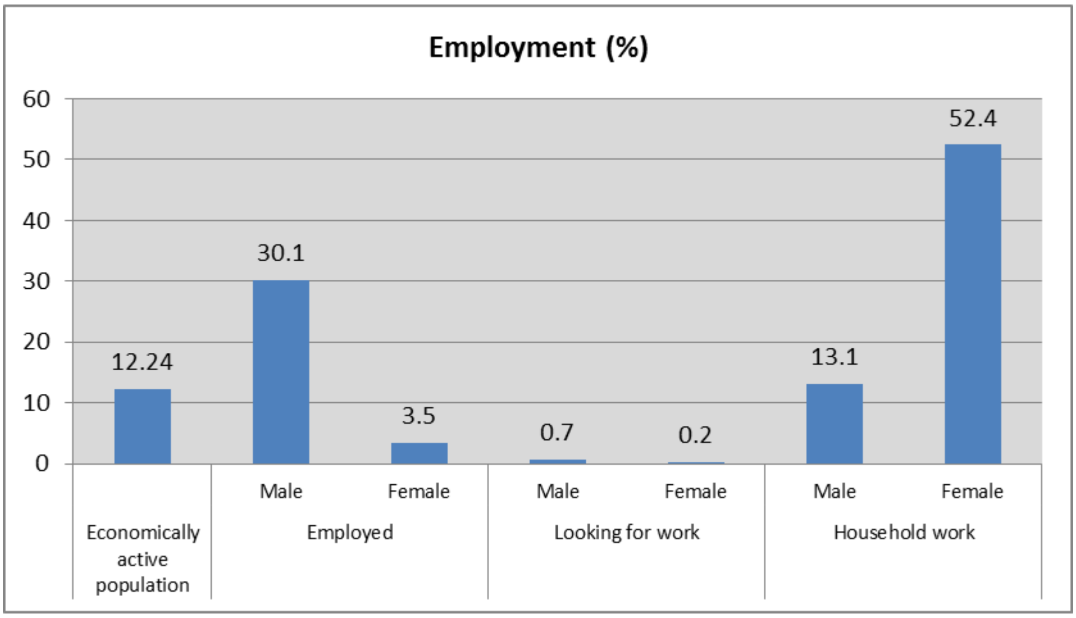
Figure 5.20: Households by land holdings

413. On the other hand, farm holding distribution shows that 32.82% households belong to marginal farmer (0.05 to 0.99 acre), 20.15% belong to small farmer (1.00 to 2.49 acre), 11.41% belong to medium farmer (2.5 to 7.49 acre) and 1.27% belong to large farmer (7.5+ acre) categories. It is evidential that land fragmentation decreases the holding size therefore; large and medium farmers are gradually being turned into marginal farmers.

414. Field data indicated that large numbers of landless populations usually adopt alternative livelihood options, for instances; farm and non-farm laboring, driving, earth work, and other manual works.

5.4.8 Occupations and Livelihood

415. Out of total 47,859 population, 5,859 (12.24%) are economically active of which 1,968 (34%) employed, 52 (0.89%) are looking for work, and 3,838 (66%) engaged in household works. 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 impaired and elderly people who are not engaged in income generation 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. **(Figure 5.21**)



Source: Housing and Population Census, BBS, 2011

Figure 5.21: Employment status of the polder

416. Women's participation in direct income generating activities (employed category) in the Polder is negligible as education status confirmed that whereas males are engaged in employment, females are getting married and in turn, contributed in household work (52.4%). The employed category also includes child labour as it was accounted from 7 years old population.

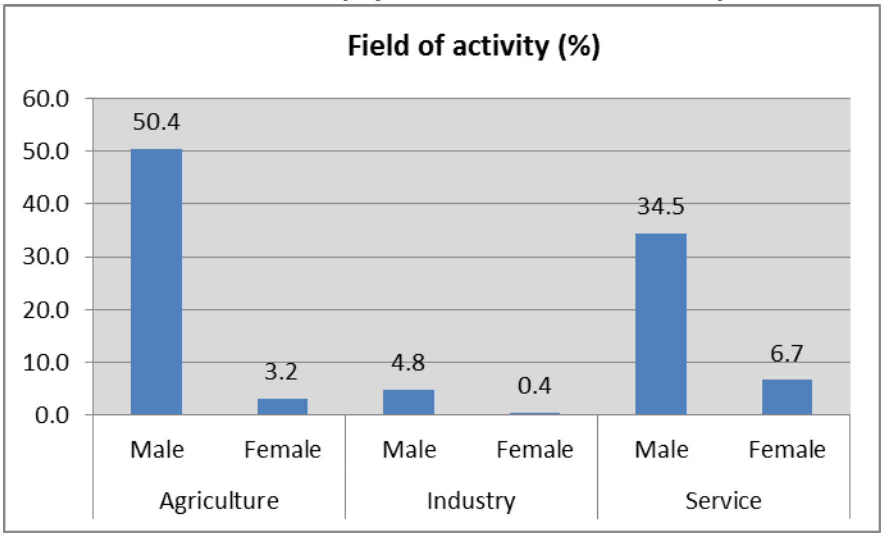
417. Distributing employed population at reference period of census it is found that 53.7% are engaged in agricultural activities, 5.2% in industry and 41.1% in service. Agricultural activities includes broadly crop farming, fishery and livestock and poultry farming. Scope of employment in agricultural sectors is gradually decreasing for tidal flooding due to lack of embankment around the polder area . Field findings suggest that rural women's participation is relatively higher in various post harvest activities and livestock management activities than other agricultural activities. Few of them participate in some non-agricultural activities like handicrafts making, tailoring, etc.

Picture 5.19 : Different modes of livelihood activities in polder 41/1

Labor market

418. The employment[22] rate[23] in the study area is 34 whereas the unemployment rate[24] is 64. It is evident that more than 64% of the total economically active population is still unemployed. Most of the unemployment populations are females who are solely involved in household works and only 0.90% populations are looking for works (section 5.3.8).

419. Data confirms that agriculture, industry and services are the sole sectors to generate employment for the local people (Section 5.3.8). Field findings documented that people who are not permanently employed tend to engage themselves in those sectors in the form of agricultural labourers, fishers, brick field workers, earth workers, and cleaners. In agricultural sectors most of the labourers engaged are from the local villages.



Source: Housing and Population Census, BBS, 2011

Figure 5.22: Distribution of population by field of activity

420. The above figure implies that female participation in service sectors is higher than that of agriculture and industry sectors. Field findings documented that during the harvesting period, women take part with men in same agricultural field work. Some of them also collect fry fish from river or engage in earthwork, etc .The wage rate varies between Tk.300 to Tk.350 /day for male whereas wage the rate for women's labour per day is about Tk.200 to Tk.250.

421. During the field visit, it is learnt that out migration of laborers is low (3%) in the study area whereas in-migration is almost absent. These out-migrants are mainly agricultural labourers who usually go to the neighboring upazilas (Barishal and Patuakhali) during May to September for better livelihood because there is lack of employment opportunity in the polder from April to June. Additionally, there is a very small number of international out migrants (1%) who tend to go to the Middle East in search of better livelihood options.

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22 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.

23 Employment Rate = $\frac{Employed\ Population}{Total\ labour\ force} X\ 100$

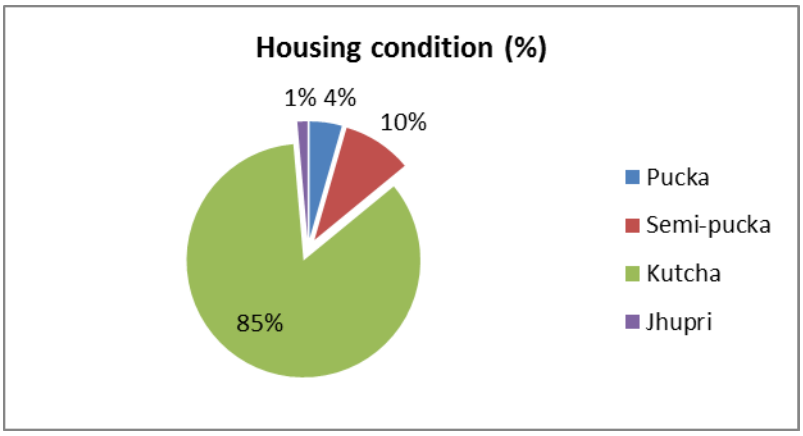
24 Unemployment Rate= 100-Employment Rate

5.4.9 Standard of living

422. Standard of living indicates the level of wealth, comfort, material goods and necessities available to the studied area population. This section defines it narrowly and necessarily includes people' access to electricity, sanitation facilities, safe drinking water availability, housing condition and fuel consumption.

423. Electricity facility is very poor (39%) in the entire Polder. Data shows that Barguna Paurashava comprises of the highest (84%) electricity coverage whereas Ayla patakata union has the lowest (16%) coverage. Moreover, about 30% households are now using solar electricity in the polder area (CEGIS fieldwork, 2015).

424. The overall housing condition[25] is not satisfactory. The study area shows the predominancy of kutcha houses (85%) over other three types of houses. Semi-pucka household is 10%, Pucka is 4% and 1% is Jhupri houses (**Figure 5.23**). Statistics show that Barguna Paurashava comprises of the highest number of pucka household (14.3%) whereas Burir Char union comprises of the highest kutcha households (92%). It can be concluded that the people living in the study area belong to poor category in term of housing type.



Source: Housing and Population Census, BBS, 2011

Figure 5.23: Housing condition in the study area

25 BBS distinguishes housing structures into four classes such as- i) Jhupri: House which consist mud walls of 1.5 to 3.0 ft thickness, which carry the roof load. Earthen floor, thatch or CI sheets are used as roofing materials. There is no monolithic joint between the wall and the roof. ii) Kutcha: Walls: Organic materials like jute stick, catkin grass, straw, and bamboo mats. In some areas the walls are made of earth. Foundation: Earthen plinth with bamboo or timber posts. Roof: Thatch-rice or wheat or maize straw, and catkin grass, with split bamboo framing; iii) Semi-pacca: Walls: Bamboo mats, corrugated iron (CI) sheet, Timber or bamboo framing. In some areas the walls are made by earth, sometimes part or full brick: sometimes part of it by brick and sometimes the wall are fully built by brick). Foundation: Earthen plinth; Brick perimeter wall with earth infill; Brick and concrete are also used. Roof: CI sheet with timber or bamboo framing; and iv) Pacca: House which is made fully by concrete, cement, and iron

Picture 5.20: Housing structure at polder area

425. Sanitation[26] facilities in the study area show that about 24% households use non-sanitary latrines and 46% use non water-sealed sanitary latrines. Field findings confirm that Non Water-sealed sanitary latrines are used in kutcha, semi-pacca and pacca households (46%). Where Water-sealed sanitary latrines are available predominantly in pacca houses (27%). . However, there are 3% houses having no sanitation facilities but tend to use them on shared basis and in some cases uses open spaces (**Figure 5.24**).

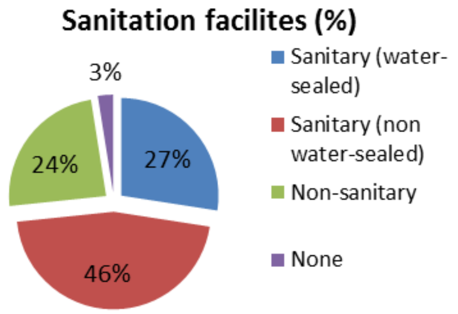


Figure 5.24: Distribution of households by sanitation facilities

Source: Housing and Population Census, BBS, 2011

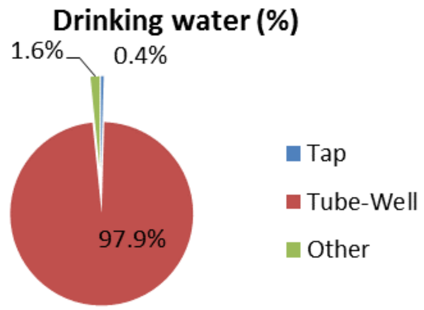


Figure 5.25: Distribution of households by sources of drinking water facilities

426. Collection of drinking water from Tube well is predominant (97.9%) throughout the study area and other sources (1.6%) are very few which are open water bodies as unorthodox sources, i.e. PSF, ponds, rain water, etc. These households basically belong to poor classes and living in the rural areas having no access to tube-wells. Supply of "tap water" (0.4%) (Source from Tap) is mainly used in paurashava areas on rental basis. This supply system is dependent on abstraction of water from ground water. Major sources of drinking water in the Polder is shown above (Figure 5.25).

26 BBS defined four types sanitation in Bangladesh such as (i) Sanitary (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. (ii) Sanitary (not water-sealed/ring slab), latrine with a slab or other secure cover over the drop hole, or a polyethylene flap preventing in-sects from flying into or coming out of the pit; and (iii) Non-sanitary (Kutcha): latrine is a frame or platform extending over earth or water; an "open pit latrine" does not have a squat platform or slab on the pit; and (iv) No facilities: Defecation in bushes or fields or other outdoor locations.

5.4.10 Poverty situation

427. Poverty is often defined by one dimensional measure. However, no one dimension alone can capture the various dimensions of poverty. Multidimensional Poverty Index (MPI) is composed of several factors which constitute poor people's experience of deprivation- These are:

- Poor health;
- Lack of education ;
- Inadequate living standard;
- Lack of income;
- Disempowerment;
- Poor quality of work; and
- Threat from violence.

428. Multidimensional measures can incorporate a range of indicators to capture the complexity of poverty and better policies to relieve it. MPI has been assessed for the above category of the people. The detail process and methods of the MPI are given in the **Appendix D**. The analysis and results are given below.

Polder Area (Gross) 4048 ha (40.48 km^2);

Net cultivated area 3440 ha (34.40 km^2);

Population per km^2 of the project is about 1142 people and

Headcount ratio for the Division is 27.3 (village), which indicates % of people who are income poor ($1.25/day).

Analysis of MPI Poor and result

429. Polder 41/1 with the features is given below:

Table 5.29: Weighted score and status of MPI poor of Polder 41/1

Poor Category of People	Landless persons work in share cropping and agricultural labour (L)	Day labourers work in Brick Field (DL)	Marginal Grosser sell things in the rural bazar (MG)
Weighted Score (deprivation score)	38.89%	33.33%	22.22%
Status: MPI poor (33.33%)	Greater than MPI poor	Equal to MPI poor	Less than MPI poor

It is seen in polder 41/1 that about 22% of MG category HHs are seen non poor.

Table 5.30: Results of MPI

Factor H for the Polder	0.667
Factor A for the polder	0.361
MPI	0.241

430. According to **Table 5.30**, headcount ratio (H) about 66% of people live in poor households. In the context of intensity of poverty, (A), the average poor person is deprived in 36% of the weighted indicators. Thus the MPI of the polder is 0.241 (in 2015) compared to Bangladesh 0.292 (in 2007)[27] which indicates the status of the poor HHs have been reducing very slowly.

27 http://en.wikipedia.org/...../Multidimensional_Poverty_Index (web page) p.6.

5.4.11 Social Capital

Extension services

431. The major social safety nets and poverty reduction programs initiated in the area include the Vulnerable Group Development (VGD), Food/Taka for Work (F/TFW), Food for Education/Cash for Education, Rural Maintenance Program (RMP), Old Age Allowance, Freedom Fighter Allowance and Integrated Poverty Reduction Program. According to the local people, these programs have created food security as well as social safety nets among the targeted poor households and vulnerable communities to some extent. **Table 5.31** shows the current social services and facilities for alleviating poverty in the study area.

Table 5.31: Households served by different social safety nets programs

Social Safety Net Programs	Households/Communities Served (%)
Vulnerable Group Development (VGD)	6
Food/Taka For Work (F/TFW) of PIO	4
Food for Education/Cash for Education	10
Rural Maintenance Programme (RMP)	6
Old Age Allowance	5
Freedom Fighter Allowance	3
Integrated Poverty Reduction Program of BRDB	6

Source: CEGIS Fieldwork, 2015

432. A number of local, national and international NGOs are working in the polder area. The main activities of these NGOs are operating micro credit programs among the rural poor and landless women/men. The major NGOs working in the area include BRAC (Bangladesh Rural Advancement Committee), ASA (Association for Social Advancement), Bureau Bangladesh, Nobolok, CCDA (Centre for Community Development Assistance) and Heed Bangladesh. These NGOs are serving with micro credit while BRAC is working for non-formal primary education (NFPE) (which is discontinuing at present), Health, water and sanitation, gender and children development programs. About 45% of the households are found to benefit from the NGOs interventions. After disasters (Sidr, Aila and Mohasen) the Nobolok appeared as the most important NGO for the local people.

Roads

433. Various types of roads provide means of communication mostly within the Polder. According to the NWRD Database (WARPO, 2015), there are 8.98 km of regional, 6.36 km of upazila, 18.48 km of union and 59.70 km of village roads serves the polder area. Besides, there are 39.31 km of notable road network exists in the studied unions of which 27.91 km roads are paved, 11.40 km roads are brick soled and earthen. **Table 5.32** presents data on road network in the polder area; **Picture 5.21** presents some photographs of these roads.

Table 5.32: Road Network in Polder

Name of Upazila	Type of Road	Description	Length (Km)
Barguna Sadar	Paved/Brick soling	Barguna UP-Chander Hat-South Hewlibunia-Lemua Hat	8.16
		Burirchar UP-Hazarbigha-Kamrabad-Purakata Ferryghat	9.85
		Burirchar UP office-Golbunia Hat-Zelkhana	5.2
		Aylapatakata UP (Kadamtala)-Tulatala-Kotbaria Hat-Baikalin Hat	1.5
		Ayla Patakata (Kadamtala Bazar) UP office-Masturtana-Gabtala Bazar.	3.2
	Earthen road	Burirchar UP office-Golbunia Hat-Zelkhana	2.8
		Aylapatakata UP (Kadamtala)-Tulatala-Kotbaria Hat-Baikalin Hat	5.8
		Ayla Patakata (Kadamtala Bazar) UP office-Masturtana-Gabtala Bazar.	2.8

Source: CEGIS fieldwork and LGED website, 2015


Picture 5.21: Paved and soling roads in the Polder area

Market/growth centre

434. There are 8 markets/bazaars in the study area, among them 4 in Barguna paurashava and Barguna union, 3 in Ayla Patakata & 1 in Burir Char union respectively (**Table 6.33**). All of the bazaars are located in these unions which are serving the local people.

Table 5.33: Markets in project area

Unions	Nos of markets/bazaar	Name of the Markets/bazaar
Ayla Patakata	3	Ayla Hat, Zanzilia Bazar, Court Baria Bazar
Barguna	2	Barguna Bazar Goulbunia Bazar
Paurashava	2	Barguna Paurashava Bazar
Burir Char	1	Burir hat

Source: LGED website, 13/07/2015

5.4.12 Gender and Women

435. Field observation suggests that Polder 41/1 is a highly male dominated area. Roles of women in both decisions making at household level and economic contribution to household income are inconsequential. Traditional belief is very strong here that generally males make all major household decisions and at the same time they contribute to household income more than females. Very few women work as day labourer but in that case wage discrimination is very common, where a male labourer gets Tk 300 to 350 a famale labourer gets Tk 200 to 250 per day.

436. Over time government's strong policy towards women's education has changed a lot in the polder area. Women's education rate has increased, the drop-out rate among female students has reduced due to a declining trend of early marriage. NGO interventions have changed the rural society to a significant extent in terms of awareness raising. Different NGOs along with community health clinics work for raising women's health and reduced maternal mortality rate.

437. Women's mobility in the area is mostly localized except when they go for medical treatments, fetching water, farming activities, and visiting relatives. Mortality rate of the pregnant mothers during delivery period has reduced in the area (20/1000). The growing consciousness among the local people as well as the health services provided by the public and other health centers including the programs of NGOs have contributed to the decrease of the female mortality rate. About 15 percent women are living with good health condition and the rest are suffering from various diseases such as low blood pressure and premature delivery. About 25 % women are getting proper nutrition and about 10% have access to the health centers, which are located around 10-15 km away on average from their residence. (CEGIS field work, 2015).

Vulnerable Communities

438. In the Project area, three types of people could be considered as vulnerable. These include marginal farmers having less than Taka 6,000 monthly income, fishermen and women headed households. Local economy is mostly agriculture based and most of the land owners cultivate their land by themselves. Some of the land lords give their land for sharecropping to the marginal farmers and other vulnerable groups. Some people of the Project area depend on fishing from the open water bodies.

Common Property Resources

439. The common property resources and/or community facilities in the area are different social amenities e.g. mosques, graveyards, temples, cremation grounds, playgrounds, open water bodies and Eidgahs (place for offering Eid prayers). These are used by the local people for the purposes of religious, social and cultural gathering. Besides these, the BWDB embankment is also commonly used for different livelihood purposes i.e. living or take shelter at times of distress/natural disaster by the local inhabitants.

440. There are 5 cyclone shelters in the polder area, among them one is under construction. Beside those, there are 59 mosques, 17 temples, 16 Eidgahs, 10 graveyards, 12 playgrounds and 5 crematoriums in the polder area. There is no known historical and archeological sites declared by the government in the Polder area (Source: Union web site and CEGIS field work, 2015).

6 Environmental Impacts and Mitigation Measures

6.1 Preamble

441. This Chapter identifies the environmental and social impacts, which may potentially occur in various Project phases, and proposes appropriate mitigation measures to avoid, offset, reduce or compensate these impacts. Potential interventions which may cause potential environmental impacts during pre-construction, construction and post-construction stages have been identified in Chapter 4. The project 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.;
- Environmental quality baseline monitoring of air, noise, surface water, groundwater and soil;
- Ecological surveys comprising vegetation, wildlife and fisheries covering both mainland and the offshore area;
- Polder surveys comprising socio-economic status and environmental settings,
- Surveys comprising of socioeconomic status and environmental settings in and surrounding polder
- Expert consultations, focus group discussions and public consultations.

442. 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

443. As a part of the environmental impact assessment process, a screening matrix was customized specifically for the proposed Project, focusing on the potential environmental impacts during 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 each of these broad categories were further divided into different aspects. The potential impacts thus predicted are characterized as follows:

- Highly negative (adverse) impact;
- Moderately negative impact;
- Insignificant impact;
- Highly positive (beneficial) impact;
- Moderately positive impact.

444. 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 study, thus reducing the occurrence possibility and severity of the potentially adverse impacts. he potentially negative impacts identified through this process are discussed in the subsequent sections.

Table 6.1: Environmental Screening Matrix (Unmitigated)

	Physical					Biological		Social and Socioeconomic														
Project Phases and Activities	Soil Erosion/Contamination	Air Quality	Surface Water Quality	Groundwater Quality	Water Availability and Consumption	Natural Vegetation	Aquatic Fauna	Resettlement	Blocked Access Routes	Noise and Vibration	Impacts on Agriculture and grazing	Impacts on Fisheries	Flooding	Waterlogging and drainage	Irrigation and water management	Vehicular Traffic	Safety Hazard	Damage to Infrastructure	Public Health	Aesthetic Value	Gender and Cultural Issues	Employment Opportunities
Design Phase and Pre-Construction Phase																						
Land Acquisition	0	0	0	0	0	0	0	HN	0	0	0	0	0	0	0	0	0	MN	0	0	0	0
Contractor Mobilization	0	MN	MN	0	0	MN	MN	0	MN	MN	0	0	0	0	0	HN	MN	MN	0	MN	0	MP
Construction Camp Establishment	0	MN	MN	0	0	MN	MN	MN	0	0MN	MN	0	0	0	0	MN	MN	MN	MN	MN	MN	MP
Construction Phase																						
Equipment / Material Transportation	0	MN	MN	0	0	MN	0	0	MN	MN	MN	MN	0	0	0	HN	MN	MN	HN	MN	MN	MP
Operation of Construction Camp	0	MN	0	0	MN	MN	0	0	MN	0	0	0	0	0	0	MN	MN	MN	0	MN	MN	MP
Site Clearance	MN	MN	MN	0	0	HN	MN	0	MN	MN	MN	MN	0	0	0	MN	MN	MN	MN	MN	MN	HP
Borrow and disposal area management	HN	MN	0	0	0	MN	MN	0	MN	MN	HN	MN	0	MN	MN	MN	MN	MN	HN	MN	MN	HP
Excavations of water channels	MN	0	HN	0	0	MN	HN	0	o	MN	0	HN	MN	MN	MN	0	MN	0	0	MN	MN	HP
Re-sectioningof Embankments	HN	MN	0	0	0	MN	0	0	HN	MN	MN	0	MN	MN	MN	HN	MN	MN	MN	MN	MN	HP
Replacement/repairing of Regulators	0	MN	MN	0	0	0	MN	0	HN	MN	0	MN	HN	MN	MN	MN	MN	MN	MN	MN	MN	HP
Operation Phase																						
Operation of Regulators	0	0	HP	0	HP	MP	MP	0	0	0	0	HP	HP	HP	MP	0	0	0	0	0	0	HP
Repair and Maintenance	0	0	MN	0	0	0	MN	0	MN	MN	MN	MN	MN	MP	MN	MN	MN	0	0	0	0	MP

Key:-HN: High negative impact; MN: moderate negative impact; 0: insignificant/negligible impact; HP: high positive impact; MP: moderate positive impact.

6.3 Impacts during Pre-construction phase

445. Site development involves the following activities:

- Mobilization of construction equipment, materials and vehicles;
- Cleaning of sites
- Establishment of temporary construction yards and labor sheds with sanitation and safe drinking water facilities.

446. The activities will cause the following environmental and social impacts

6.3.1 Damages of properties due to Project Intervention and Land Acquisition

Impact

447. It is estimated that about 7.49 ha of land would be acquired. The details of acquired land are 0.76 ha of household, 1.20 ha of Vita/Highland, 3.17 ha crop land, 0.67 ha of orchard, 0.65 ha of pond and 1.03 ha commercially used land. The proposed Polder 41/1 will be developed through retirements of embankment at a number of segments, water regulatory structures, etc. Planning and Design consultant has 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. During distribution of compensation, conflict may arise due to absence of proper legal documents in connection with the ownership of land. Moreover, a number of primary and secondary structures, common properties as well as many trees will be affected by the proposed activities. The social network e.g somiti and club will be affected but there activity is minor scale. Therefore, the structure of the club will be re-located and their activies will be hampered temporarily. the project interventions in Polder 41/1 will affect a number of shops which are operating by themselves and running business as tenants. As a result, daily imcome of the shop owner will be declined. The details of these damages in Polder 41/1 are presented in **Tables 6.2** to **6.6**

Table 6.2: Land to be acquired in Polder

Type of land use	Quantity (ha)
Homestead	0.76
Vita/ Highland	1.20
Crop land	3.17
Orchard/ Forest land	0.67
Pond	0.65
Commercially used	1.03
Total	**7.49**

Source: Socioeconomic survey conducted by KMC in 2016

Table 6.3: Primary Structures to be affected in Polder

Description	Covered Area (square feet)
Pucca (made of bricks and mortar)	24,057
Semi pucca	32,763
Tin	257,787
Kutcha	73,839
Thatched	49,057
Total	**437,503**

Source: Socioeconomic survey conducted by KMC in 2016

Table 6.4: Secondary Structures to be affected

SL No	Description	Quantity
01	Pucca Floor (sft.)	1,169
02	Gate (sft.)	497
03	Rice granary (sft.)	45
04	Mehrab(sft)	455.5
05	Nameplate (sft.)	233.16
06	Under construction building (sft).	189.96
07	Bathroom(sft)	1,129
08	Boundary wall (rft.)	5,595.5
09	Bench (rft.)	119
10	Grave wall (rft.)	460.5
11	Stairs of House (rft.)	114
12	Tin made Boundary wall (rft.)	524
13	Pucca Latrine (No.)	45
14	Slab Latrine (No.)	421
15	Kutcha Latrine(No.)	17
16	Tube Well (No.)	20
17	Pillar (No)	41
18	Urinal Place (No.)	3
19	Ablutions Bench (No.)	4
20	Motor(No)	2
21	Machine(no.)	15
22	Septic Tank (Cft.)	5,406
23	Water Tank (Cft.)	1,760.04
24	Machine Foundation (Cft.)	28.215

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

Table 6.5: Trees to be affected in the Polder

Types	Big	Medium	Small	Plant	Total
Fruit trees	4,659	3,805	5,408	3,880	17,752
Timbers trees	3,697	4,083	5,830	5,108	18,718
Medicinal	85	77	64	36	262
Banana	7,418	5,109	3,610	3,499	19,636
Bamboo	11,116	1,302	563	491	13,472
Total	**26,975**	**14,376**	**15,475**	**13,014**	**69,480**

Source: Socioeconomic survey conducted by KMC in 2016

Table 6.6: Common Properties to be affected in the Polder

Description	Quantity
School/Pathshala	3
College	2
Govt. Office	5
Mosque	17
Mondir	2
Eid Ga	1
Madrashs	5
Somiti	10
Club	6
Party Office	1
Private Organization	3
Passenger terminal	1
Training Center	1
Sluice Gate	1
Total	**58**

Source: Socioeconomic survey conducted by KMC in 2016

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

Mitigation

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

450. 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, livelihood and sanitation facilities to be provided for each displaced household in the Polder area since about 181 latrines and ten tube wells will be displaced during construction works; and community-based drinking water facilities are to be constructed.

- Compensation will be made prior to construction work in accordance with RAP.
- Contractor will maintain liaison with communities.
- Grievance Redress Mechanism (GRM) will be established.
- Follow 'Find Chance' procedures for common property resources.
- Follow the social networks to resettle the affected households due to project implementation.

Residual Impacts

451. 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**.

6.3.2 Increase of Vehicular Traffic during mobilization

Impact

452. During mobilization, various construction equipments and machineries will use the existing road network Moreover, transportation of construction material and manpower will be transported to the polder resulting additional traffic on roads and in water ways. This traffic may potentially cause traffic congestion particularly in Barguna Sadar to Purakata road. Moreover, important bazaars are located near the embankment of which Barguna Bazaar, Courtbaria Bazaar and Golbunia Bazaar will face traffic congestion during market time.

453. The significance of this potential impact before mitigation has been assessed as **Major** on the basis of impact magnitude and receptor sensitivity.

Mitigation measures

454. The following mitigation measures are being suggested to address the above concerns:

- Contractor to prepare and implement a mobilization plan considering water vessels and launch movement in the external rivers. The timing of launch movement as mentioned in the baseline chapter should be avoided.
- The movement of vehicles in the polder area and on the embankment should be restricted during peak hours. No vehicular movement should be made during school time (10:00 a.m. to 13:00 p.m.) and on the days of weekly markets (Haatbars).

- Regularly liaison to be made with local communities and concerned bazaar committees, specifically union parishad members of the polder. Provision of training on vehicular traffic moving pattern and management system are to be arranged for the local stakeholders using multimedia presentations and showing videos at different places of the polder especially in the Barguna Bazaar, Courtbaria Bazaar, and Golbunia Bazaar. These three places are the common gatherings places for the locals in the polder area. This training is very much needed for the safety of the local stakeholders.

Residual Impacts

455. The impacts associated with the increased traffic are likely to be adequately addressed with the help of the above mitigation measures and the significance of residual impact will be **low**.

6.3.3 Change of Land Use

Impact

456. Land would be needed to establish temporary facilities including construction camp (labor shed). It is estimated that about 34 labor sheds would be constructed to establish temporary facilities for the rehabilitation works. All labor sheds would be constructed in the borrow pits or in the requisite land. It is mentioned here that land will not be changed because this land will be used for construction of labour camps as a temporary facilities and it would be brought back to original use.The use of borrow pits area are majorly fallow during dry season. In wet season, these borrow pits area is used scattered for seedbed or grazing of livestock by the dwellers of the polder.

457. The significance of this potential before mitigation impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity. All the borrow pits of the foreshore areas will be filled up within one or two years due to tidal inundation.

Mitigation

458. The following mitigation measures are being suggested to address the above concerns:

- Establish all construction camps within the BWDB owned area.
- if private land is required on temporary basis, which instructions should be specified in the tender documents with compensation;
- Construct labor shed/camp at government khas land where low vegetation exists.

Residual Impacts

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

6.3.4 Loss of Vegetation

Impact

460. About 36,470 wood and fruit yielding trees are calculated to be felled for trenching at proposed points of embankment for construction of new structures. The embankment slopes are vegetated with a number of trees, herbs and shrubs. A large portion of the embankment along Payra River at Daskhin Burir char, Manikkhali, Choto Labangola and Hazarbigha is occupied by timber trees which were planted by the Forest Department (FD) under the

Social Forestry programme. Besides, site preparation for labour shed and material stock will damage mainly undergrowth herbs and shrubs, most of which are seasonally grown. These types of vegetation will re-grow within 1 to 2 years after completion of the construction works. However, the timber trees would not grow if someone or some authorities do not go for planting them.. A list of trees to be cut for re-sectioning of embankment and construction of new structures are presented in Appendix 5.

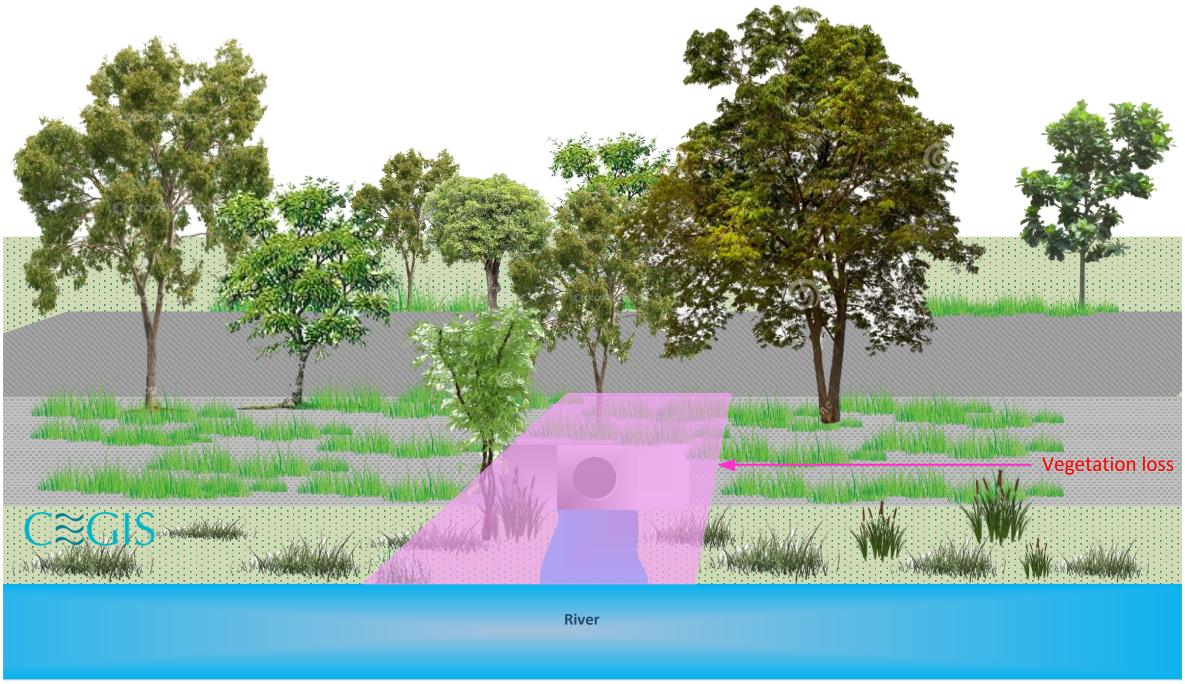


Figure 6.1: Probable loss of vegetation for construction of new water control structure

461. In addition, a major portion of the proposed alignment for retired embankment falls on agricultural field. However, the connection points with existing embankment have homestead vegetation which will be clear. The vulnerable part of the existing embankment contains vegetation with timber trees and many undergrowth wild plants. All of these plants and trees would be damaged within a few years due to bank erosion hence this portion of embankment will remain unsafe.

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

Figure 6.2: Satellite image showing vegetation loss for construction of retired embankment

Mitigation

463. The following mitigation measures are being suggested to address the above mentioned concerns:

- Proper compensation against tree felling at private land should be given to the owners
- Make early notification to the proper authorities (i.e.: Forest Department) about tree felling along the abandoned portion of the embankment
- Avoid vegetation damage as much as possible to select sites for labour shed and material stock by using nearer fallow land or barren homestead yards
- Implement tree plantation at the damaged sites after completion of construction works
- Implement plantation along the newly constructed retired embankment
- Afforestation program among the polder inhabitants should be implemted
- Plan and implement all arrangements for proper safeguards and nursing of the planted trees for the required period for growth

Residual Impacts

464. 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.**

6.4 Impacts during Construction Phase

6.4.1 Increased Drainage Congestion and Water Logging

Impact

465. The Project activities such as the replacements of regulators and sluices in water channels may block or clog water drainage channels, potentially causing water logging in the surrounding areas and negatively affecting the cultivation and the associated communities. In particular, areas along Kewrabunia and Chorokgachia water channels are already facing drainage congestion problems. The activities on the regulators in the area and any additional drainage congestion caused by the construction activities are likely to worsen the situation and exacerbate the water logging problem.

466. The significance of this potential impacts, not yet been mitigated, have been assessed as **Major** on the basis of impact magnitude and receptor sensitivity.

Mitigation

467. The following mitigation measures are being suggested to address the above mentioned concerns:

- Construction of diversion channels before replacement of regulators;
- Sequence of works in the regulators and in the water channels will have to be carefully planned to avoid any drainage congestion.

Residual Impacts

468. The impacts associated with water logging are likely to be adequately addressed with the help of the above mentioned mitigation measures so that the degree of residual impact will be **low.**

6.4.2 Affects on Irrigation

Impact

469. Irrigation, both during the wet and the dry seasons, is playing a vital role for the agricultural activities at Purbo Kewrabunia, Napitkhali and Chhoto Lobongola area in the Polder. Construction activities, particularly regulators replacement and khal re-excavation works, may disrupt irrigation in the cultivation land.

The significance of this potential impact, if not mitigated, has been assessed as **Major** on the basis of impact magnitude and receptor sensitivity.

Mitigation

470. The following mitigation measures are being suggested to address the above concerns:

- Construction of diversion channels before construction of each regulator
- Sequence of works in the regulators and in the water channels will have to be carefully planned to avoid any disruption in irrigation
- Ensuring of having no negative impacts in irrigation
- Maintain liaison with the communities

Residual Impacts

471. The impacts associated with disruption of irrigation are likely to be adequately addressed with the help of the above mentioned mitigation measures and the significance of residual impacts will be **low.**

6.4.3 Soil and Water Contamination

Impact

472. Wastes particularly effluents from the working sites may contaminate the soil and water. Construction material, demolished debris, or fuel/oils may enter the river Payra and Khakdon or other water bodies causing contamination. Moreover, improper disposal of domestic solid wastes and wastewater including sewage, oily water, waste oils, oily rags, wastes from workers' shed and other similar wastes coming from workshops can contaminate the soil and water quality in and sourrounding the polder area. The contaminated water can potentially have negative impacts on natural vegetation, agriculture, and biological resources of the area including aquatic flora and fauna. Borrowing materials from the river banks may potentially cause increased turbidity in the rivers which would prevent sunlight to enter into the water that is necessary for promoting photosynthesis of aquatic plants.

473. The significance of these potential impacts, if not mitigated, has been assessed as **Major** on the basis of impact magnitude and receptor sensitivity.

Mitigation measures

474. The following mitigation measures are being suggested to address the above mentioned concerns:

Contractor will prepare and implement site-specific pollution control plan and a Standard operation plan and procedures for handling pollution spills, and management of fuels and hazardous wastes for implementation upon approval by the DSC Consultant and PMU

- Prepare arrangement for contractor/representative for training for proper collection and management of all organic and inorganic waste
- Prepare and implement pollution control plan.
- Ensure workshops to have oil separators/sumps to avoid release of oily water;
- Avoid repairing vehicles and machinery in the field.
- Avoid releasing fuel, oil or any other affluents/wastes on the ground or in the water from its construction machineries, vehicles, boats, launches, and barges in the water bodies.
- Conduct regular monitoring of the condition of all sorts of vehicles/fleets.
- Material borrowing from the river banks will be carried out sufficiently away from the water line, minimizing the possibility of loose soil to wash away in the river.
- Establish camps far away from communities and drinking water sources.
- Contractor will prepare and implement camp waste management plan (septic tanks, proper solid waste disposal).
- Contractor will dispose spoil at designated areas with community consent.
- Construction materials, demolished debris, and excavated soil/silt will not be allowed to enter water bodies.

Residual Impacts

475. The impacts associated with soil and water contamination are likely to be adequately addressed with the help of the above mentioned mitigation measures and the significance of residual impact will be **low**.

6.4.4 Generation of Noise and Vibration

Impact

476. 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.

477. Increased noise levels may cause disturbance, nuisance and even health hazards for the nearby communities as well as for the construction workers. In particular, the settlements near the working areas will be exposed to noise and vibration generated by the Project activities; in addition sensitive receptors such as education institution are likely to be more severely affected by noise. The students of the schools situated along the embankment may face serious noise problem during school time.

478. The significance of this potential impacts, not yet been mitigated, have been assessed as **Moderate** on the basis of impact magnitude and receptor sensitivity.

Mitigation measures

479. The following mitigation measures are being suggested to address the above concerns:

480. The Contractor will prepare site specific pollution control plans for noise control for each construction site as well as a traffic management plan to be implemented upon approval by the DSC Consultant and PMU, for:

-
- 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 to be provided at schools and other sensitive receptors, as needed.
- Provision of PPE (ear muffs and plugs) is to be ensured for the labors.
- The construction crews will be instructed to use the equipments properly to minimize the noise levels.
- Camps will be located at a safe distance from the communities/ educational institution
- Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.

Residual Impacts

481. The impacts associated with noise and vibration are likely to be adequately addressed with the help of the above mentioned mitigation measures and the significance of residual impact will be **low**.

6.4.5 Hindrance of Pedestrian and Vehicular Movement

Impact

482. Barguna Bazaar, Courtbaria Bazaar, Golbunia Bazaar and few other small markets are located beside the marginal dyke of the Polder. These markets play very important roles in the livelihood of the Polder inhabitants as well as in meeting the daily needs of the people. Construction activities along the embankments are likely to disrupt the markets as they will be displaced during construction of embankments. The construction activities along the embankments will also cause temporary disturbance to the movements of local people. The internal roadways are not sufficient enough to provide alternate means of transportation. Local people will suffer due to their limited roadway movements during construction works along the embankment. This will affect their economy and earning options as well.

483. The significance of this potential impacts, not yet been mitigated, have been assessed as **Moderate** on the basis of impact magnitude and receptor sensitivity.

Mitigation measures

484. The following mitigation measures are being suggested to address the above mentioned concerns:

- The works on the embankment will be carefully scheduled to minimize the impact to local markets and transportation routes.
- The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. After completion of the works on the first half are completed, it will have to be opened for local traffic while the works on the other half of the embankment will be undertaken.
- Work schedule will be finalized in coordination and consultation with local representatives and communities.
- Local routes will be kept free for use as much as possible. If unavoidable, alternative routes will be identified in consultation with the local community.
- GRM will be put in place.

Residual Impacts

485. The impacts on <u>pedestrians and vehicles movement</u> are likely to be adequately addressed with the help of the above mentioned mitigation measures and the significance of residual impact will be **Low.**

6.4.6 Hamper construction activities due to natural hazards

Impact

486. The coastal area of Bangladesh is historically vulnerable to cyclone, storm and tidal surges. As per construction schedule, the improvement activities of proposed polder will be conducted from October to May when most of the cyclone and storm surges occur in this area. According to the previous records of cyclone and storm surges, October to November and April to May are the peak months of occurrence of cyclone and storm surges. It is apprehended that the construction activities during this period may be hampered as well as the workers may receive injuries.

487. The significance of this potential impact, prior to mitigation, has been assessed as **Moderate** on the basis of impact magnitude and receptor sensitivity.

Mitigation

- Weather signals will have to be considered by the contractors during constructions.
- Radio and television will be provided to all the labour sheds for getting weather information through the media.
- Standard protocols for occupational health and safety should be in place.
- All preparation to be taken by the contractor for medical, shelter and food facilities during and post disaster period
- Labourers and other employees of the contractor should be briefed about the protocols to be followed during such natural disasters

Residual Impacts

488. The impacts associated with natural hazards are likely to be adequately addressed with the help of the above mentioned mitigation measures and the significance of residual impact will be **low.**

6.4.7 Change of Agricultural Land Use

489. About 3.17 ha of land are likely to be required for construction of retired embankment along Payra River. This land includes (Ch 12.40 km- 13.40 km) is likely to be affected. Total 3,906,694 tk. would require for land compensation (Source: Resettlement report, developed by KMC).

6.4.8 Destroyed Feeding and Spawning Ground of Fish due to bank revetment activity

Impact

490. Polder 41/1 is bounded by the Payra River on the south–east part of the polder. According to field visits and consultation with local fishers, the bank side of the river is used as the feeding, nursery and spawning ground for brackish water fish species like *Paissa, Gulsha Tengra, Bagda*, etc. It is expected that activities of bank revetment and slope protection (earth work from km 4.0 to km 5.0) would cause partial destruction (if in the dry season) and full destruction (if in the rainy season) the feeding, nursery and even spawning ground of these fish species. 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).

491. The significance of this potential unmitigated impact has been assessed as **Low**on the basis of impact magnitude and receptor sensitivity.

Mitigation

492. The following mitigation measures are being suggested to address the above concerns:

- Earth work should be conducted during the dry season (November-February)
- Sequence of work at the bank side of Payra River will be carefully planned to minimize impacts on spawning and subsequently nursery ground of fish.
- Contractor will maintain liaison with experienced fishermen to reduce damage of fish feeding and spawning ground.

Residual Impacts

493. The impacts on spawning and nursery grounds are likely to be adequately addressed with the help of the above mentioned mitigation measures and the significance of residual impact will be **Low**.

6.4.9 Disturbance of Fish Habitat and Migration Behaviour

Impact

494. There are 12 drainage sluices in Polder 41/1. All the 12 drainage sluices will be replaced by new ones as part of the Project. These sluices are connected with the khals of the Polder. Among the internal khals, six khals such as Amrajuri Khal (DS1), Sonakhali Khal DS2), Chargachia Khal (DS3), Charnalar Khal (DS4), Burirhar Khal (DS5), and Choto Langolgula Khal (DS6) are found as both migration route and spawning ground of brackish and fresh water fish species like Paissa, Vetki, Chingri, Puti and Tengra . The Construction activities especially replacement of sluices would be carried near the khal through closing of the khals. This activity can potentially affect fish migration in the khals (DS1-6). Though the fish habitat in these khals is already modified due to construction of embankments and sluices in 1970s, some fish migration between outside rivers and internal khals still occur along those khals. Fish species including *Paissa, Vetki, Horina Chingri*, *Puti* and *Tengra* have been reported to move between the internal khals and floodplain during the breeding season (mid May to July). Moreover, during construction activities (repairing of drainage sluices), fish migration between the outside rivers and internal khals is likely to be affected. The spawning time for open water fish in the khals is late June to August will also be affected. On the other hand, during re-excavation of khals, habitat of bottom dweller fishes will be affected significantly. Similarly, fish migration within the Polder between khals and floodplain will also be affected for such activities.

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

Mitigation

496. The following mitigation measures are being suggested to address the above mentioned concerns:

- Construct bypass canal before construction of each regulator
- Proper scheduling of the construction work to avoid migration period (May to July)
- Sequence of work at the regulators and in the water channels will be carefully planned to minimize impacts on fish and their migration.
- Fish fry/fingerlings will be stocked in channels within polder where appropriate.
- Maintain liaison with fishery communities during re-excavation of khals.
- Fish catch to be monitored (outside and inside the polder) on a weekly basis to assess any impacts so that mitigation measures can be modified.

Residual Impacts

497. The impacts on fish habitat and migration are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be **Low**.

6.4.10 Damage Benthic Fauna

Impact

498. Benthic species perform a diversity of functions in freshwater food webs as well as food chain for both lentic (standing water) lotic (flowing) water bodies. During re-excavation of khals, benthic fish species (*chew, cheng, cuchia, baim,* etc) will be impacted. The food chain of aquatic fauna may also be hampered. This impact is **temporary and recoverable**.

Mitigation

499. The following mitigation measures are being suggested to address the above concerns:

- Khal re-excavation should be carried out segment wise.
- Release fish fry in the re-excavated khals
- The Contractor will prepare site-specific plans for pollution control and for standard operation and procedures for handling pollution spills to be implemented upon approval by the DSC Consultant and PMU.
- Contractor will carry out *khal* excavation in segments thus minimizing impacts on benthic fauna

Residual Impacts

500. 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 fully recover gradually. The significance of the residual impacts has therefore been assessed as **Low.**

6.4.11 Loss of vegetation

Impact

501. All the existing undergrowth vegetation would be damaged at both slopes of the embankment as well as the sites from where soil would be collected. Most of the plant species at the proposed re-sectioned alignment and soil collection sites are seasonally grown and their life span is not more than one year. So, it is expected that the damaged sites will be recovered within 1 to 2 years by natural regeneration of herbs and shrubs. Existing big trees at the embankment slopes will not to be felled for re-sectioning in most of the cases. For this reason, this negative impact is **temporary and recoverable.**

502. Minor vegetation damage is expected at the proposed bank revetment sites. About 200m riverside slope vegetation out of proposed 500 m embankment revetment site (at 6 no Burirchar) have already been damaged. All the tall trees are already felled, during site clearance of pre-construction phase, no big trees would be felled further. For this reason, no tree damage is predicting for slope raising or placing of geo textile. Only seasonal undergrowth vegetation (i.e: grasses and wild herbs) would be damaged permanently where CC blocks would be placed. The damage of the undergrowth vegetation at CC Block manufacturing/ casting yards may take place if the contractor has no other alternative.

503. Existing marginal vegetation of Malther Khal, Charakgachia Khal, Langolkata Khal, Doctor Bari Khal and Chaltatola Khal will be damaged for withdrawal of soil from the khal bed. Moreover, the excavator/labour movement as well as spoil dumping along both the sides of khal banks will also damage the existing vegetation there. However, most of the marginal vegetation is grown seasonally and will re-grow within a few years after completion of re-excavation activities.

504. During plantation at foreshore area, the existing undergrowth vegetation would be damaged due to the movements of labours who will engage in plantation. Incautious disposal of sapling poly bags may cause deterioration of soil quality. There may be a risk of outbreak of plant diseases to the other existing plants from the planted disease affected saplings. Water flow in creeks and strips of planted area may interrupt for aggregation of plant or plant shoots. Inadequate distance between two saplings may hinder proper growth and cause disease outbreaks.

505. According to Afforestation Plan of Feasibility Report (Volume III: Afforestation Report, September 2013), there is a scope of only 62,300 nos trees (2500 saplings/ha slope area and 4,444 saplings/ha foreshore area with a space of 1.5m between two saplings) of proposed species along 19.81 ha embankment slope and foreshore area. That number is not sufficient considering number of trees felled for implementation of proposed interventions.

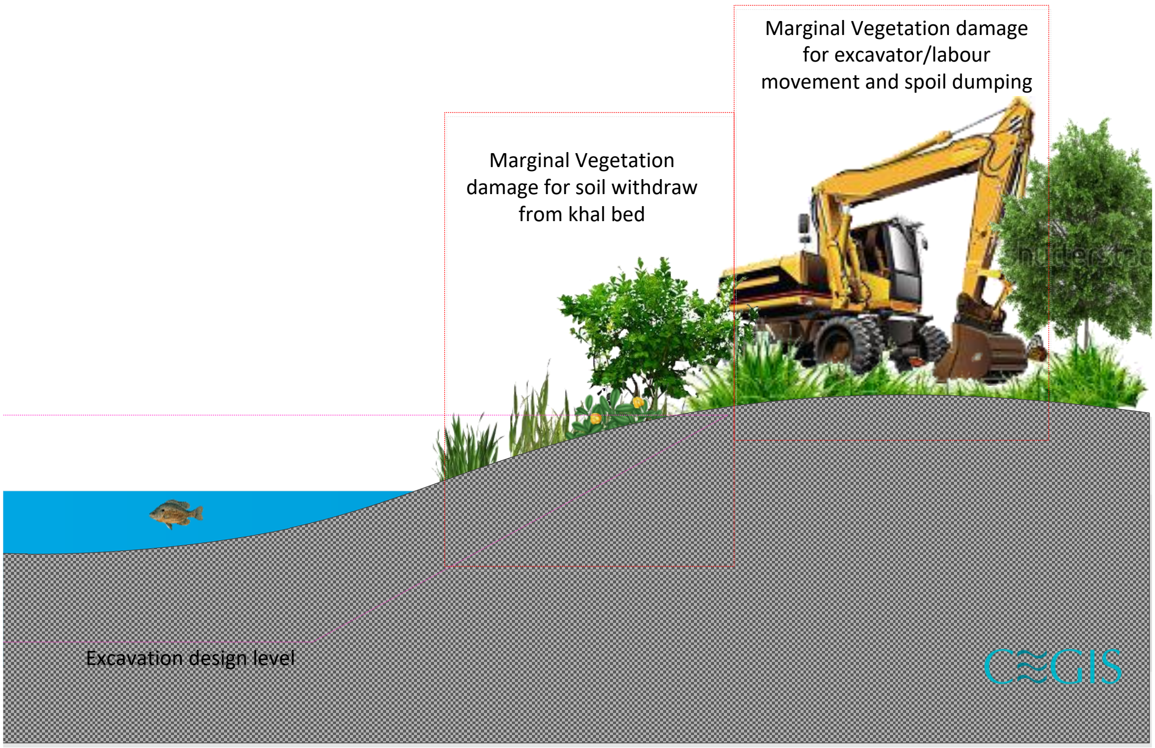


Figure 6.3: Probable ecological impact for Khal re-excavation

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

Mitigation

507. The following mitigation measures are being suggested to address the above mentioned concerns:

- Collect soil from barren/fallow land as much as possible
- Choose barren/fallow land for CC Block manufacturing and material storing
- Use excavated soil spoils for khal dyke re-sectioning
- Avoid re-excavation of the deeper portions of the khal
- Use minimum land as much as possible for excavator/ labour movement

- Proper turfing should be implement at embankment slopes with local grasses (i.e Durba *(Cynodon dactylon)* , Mutha *(Cyperus rotundus)*) and ensure regular monitoring of turf grasses till they are matured
- Implement plantation with native species at countryside slope of the embankment to protect vegetation loss
- Implement plantation along the dumping sites with indigenous plant species
- Detail survey of economic plants should be addressed in RAP study for construction of temporary bypass road/s
- Keep provision for compensation against tree felling for private properties
- Implement tree plantation on damaged sites after completion of construction works
- Keep setback distance in plantation plan layout from the water passes
- All kinds of polyethylene bags and plastic ropes should be dumped in a pit or burned in a proper way
- Care should be taken for physical and biological control of plant diseases while nursery raising and sapling plantation (i.e. using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers)
- Pre consultation with the Forest Department and other related non-government organizations for selecting of suitable species for plantation and spacing of the saplings
- Collect saplings from nearer natural source (i.e: from mangrove forest patches at north bank of Payra River surround the Manik Khali and Hazarbiga Villages) as much as possible
- Implement additional social afforestation programme at homestead platforms, khal dykes, graveyards, institution grounds and other available lands to compensate tree felling for embankment construction

Residual Impact

508. The impacts on vegetation are likely to be adequately addressed with the help of the above mitigation measures and the significance of residual impact will be **Low.**

6.4.12 Interruption of Road Communication

Impact

509. A number of local people use this embankment as road for regular movement, carrying their goods selling and for buying various other required materials. The construction activities along the embankments will cause temporary disturbance in the movement of local people.. There is bitumeous road constructed by LGED on top of embankment from km 5.00 to km 20.00 and 0.00 to km 2.50 which has to be replaced while crest level is raised as per CEIP Design which would cause interruption of the road communication. The internal roadways are not sufficient enough to provide alternate means of transportation. Mobilization of equipment, machinery, material and manpower may be transported to the Polder resulting additional traffic on roads and in water ways. Moreover, during unloading of construction materials Barguna-Patharghata road would face traffic congestion.

510. Road communication system will be deteriorated during the construction period. It may create disturbance in local road communication during this phase. So, people will suffer temporarily.

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

Mitigation

512. The following mitigation measures are being suggested to address the above mentioned concerns:

- 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:
- The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes.
- Temporary arrangement of boat for navigation, and need to construct alternative way such as temporary footpath for road communication
- 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.
- Work schedule will be finalized in coordination and consultation with local representatives and communities.
- Local routes will not be blocked as far as possible. If unavoidable, alternative routes will be identified in consultation with local community.
- A GRM will be put in place.

Residual Impact

513. 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**.

6.4.13 Affects on Social and Gender Issues

Impact

514. It is envisaged that about 60 percent construction workers will be recruited from within the Polder while the remaining will come from other areas. The presence of outside laborers in the area may create conflict with the local labors and between local community and outside labors.

515. Presence of a large number of outside labors can potentially cause encroachment in the privacy of the local population particularly women and their mobility can be negatively affected.

Mitigation

516. The following mitigation measures are being suggested to address the above mentioned concerns:

- Proper awareness programs will be conducted through public consultation measures such as village scoping sessions, meetings and placement of bill boards with assistance from the Union Parishad Chairman, Upazila Nirbahi Officer (UNO) and BWDB local officers
- Liaison will be maintained with the communities during mobilization of labour
- Cultural norms of the local community will be respected and honored

- GRM will be established to address the grievances of local as well as outside laborers
- Restrictions related to consumption of alcohol and drugs should be ensured;
- Avoidance of construction activities during Prayer time.

Residual Impacts

517. The impacts associated with social unrest are likely to be adequately addressed with the help of above mitigation measures and the significant residual impact will be **Low.**

6.5 Impacts during Post-construction Phase

6.5.1 Reduce Fish Migration Time and Extent

Impact

518. The mal-functioned drainage sluices in the Polder area are still facilitating the migration of Boal, Paissa and Gulsha Tengra fishes from river to internal khal and vice-versa. However, drainage sluice gates are designed to control water for improvement of the drainage system of the polder area. Sluice gates are mainly operated in order to meet the irrigation purpose. Thus, the improved drainage sluices would hamper the migration behaviour of above mentioned fish species. Moreover, the extension *of Boal, Gulsha Tengra* would be very restricted with the replacement of the proposed drainage sluices.

519. The significance of this potential mitigated impact has been assessed as **Moderate** on the basis of impact magnitude and receptor sensitivity.

Mitigation

520. The following measures are being suggested to address the above concerns:

- WMO groups with representatives of fishermen will be established for management of the sluice gates and trained in proper water management, including fish friendly operation allowing fish migration at critical periods. Core commercial fishermen having more than 20 years' experience should be appointed in WMOS for Operation and Maintenance of sluice gate. A gate operation manual will be prepared and provided to the WMOs. The Manual should be translated into Bangla and the WMOs trained for properly management of the structures[28].
- Provide training to WMOs
    - Fish sanctuary could be established in the perennial Khal with the co-management of the local fisheries office and the local people. In this regard, local people can be trained up on the sanctuary issue. The Fisheries Department can be involved in this process. Water management organization will be given responsibility of awareness building program to the local people. Identified water bodies (deep portion) should be marked as the sanctuary with the presence of red flags surrounding the sanctuaries during operation phase.

521. BWDB with collaboration of DoF is expected to provide training and introduce net pen, cage culture*Residual Impacts*

522. The impacts on migration status are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be Low.

[28]The "Wet land Biodiversity Rehabilation Project" of Department of Fisheries already successfully implemented 5 Sluice gate management and operation committee through WMA. Based on this result a guidelines prepared on how to operate and manage sluice gate in eco-friendly manner was already submitted by Department of Fisheries to the concerned Ministry for approval (source DoF).

6.5.2 Increase use of agrochemicals

Impact

523. At present, about 151 ha and 960 ha of lands are under Boro (HYV) and T. Aus (HYV) rice cultivation. Presently, about 232 tons of chemical fertilizers and 5 tons (Both granular and liquid) pesticides are being used for cultivation Boro (HYV) and T. Aus (HYV) rice. After implementation of the project interventions especially re-excavation of khals would cause expansion of area under irrigated cultivation of Boro (HYV) and T. Aus (HYV) varieties of rice. It is expected that about 2,042 ha of which Boro (HYV) and T. Aus (HYV) area are 159 ha and 1,883 ha would come under cultivation. The expansion of irrigated area in association of cultivation area would increase use of chemical inputs including fertilizers and pesticides. It is estimated that additional 799.38 tons of agrochemicals would be required for the agricultural practices. The residual of agrochemicals may degrade the soil quality. Moreover, runoff of residual agrochemicals in the water bodies may deteriorate water quality (Table 6.7).

Table 6.7: Impact on Area (ha), Fertilizers (kg) and Pesticides (kg/ml) required in Present and Future Situation

Present and Future cultivated Area and Input uses	Crop name		*Total*
	T. Aus (HYV)	*Boro (HYV)*	
Present total cultivate area (ha)	960	151	1,111
Present total Fertilizer required (kg)	1, 44,000	88,335	2,32,335
Present total granular pesticides (kg)	3,840	1208	5,048
Present total liquid pesticides (ml)	6, 72,000	1, 20,800	7, 92,800
Future cultivate area (ha)	1,883	211	2,094
Increased area (ha)	923	60	931
Future total Fertilizer required (kg)	2, 82,450	1, 23,435	4, 05,885
Future total granular pesticides (kg)	7,532	1,688	9,220
Future total liquid pesticides (ml)	13,18,100	1, 68,800	14, 86,900
Impact			
Fertilizer (kg)	1, 38,450	35,100	1, 73,550
Granular pesticides (kg)	3,692	480	4,172
Liquid pesticides (ml)	6, 46,100	48,000	6, 94,100

Source: Field information/data collected by CEGIS, 2015

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

Mitigation

525. The following measures are being suggested to address the above concerns:

- Capacity building and awareness rising of the farmers should be carried out to practice Integrated Pest Management (IPM) and Integrated Crop Management (ICM) in order to minimize usage of chemical inputs.
- Farmers group should have close contact with DAE for adoption of various measures of IPM/ICM.
- Farmers should be encouraged to use organic manure to increase soil fertility while avoiding water contamination.
- Farmers should be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.

526. Follow the Pest Management Guideline (Appendix-M)

Residual Impacts

527. 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 **Low**.

6.6 Positive impact of the Project

6.6.1 Increase surface water availability

528. It is estimated that additional volumes of around 60,000 m^3 water would be available in the re-excavated khals if the project is implemented, which can carry water at all seasons and serve a significant number of people. From the spatial distribution of settlements it is observed that around 40% population inside Polder41/1 are directly dependent on Lobogola, Sonakhali, Charakgacia, Hafaribigha, Napitkhali, Kholifar, Burirchar, Charnalar, Maither khals. They are likely to be benefited by the additional volume of water available in the re-excavation khals. According to Bangladesh Rice Research Institute (BRRI), standard irrigation water required for Boro cultivation is 1,200-1,500m^3/ha. It is expected that, irrigated area would increase by about 50 ha due to re-excavation of above mentioned khals and its proper management.

6.6.2 Change of land type

529. 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.

530. Presently, maximum (43%) study area is under F0 land type of the NCA which is followed by F_0 (37%), F1 (18%) and F2 (2%) land type (Table 6.8). 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. F0 land type would convert to FF land type. F0, F1 and F2 land type area reduced 5%, 14% and2% respectively. According to Institute of Water Modellling (IWM), around 58% would be under FF land type which is followed by F0, F1and F2 land type respectively.

Table 6.8: 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)	1,273	37	1,995	58	21
F_0(0.0-0.30m)	1,479	43	1,307	38	-5
F_1(0.3-0.90m)	619	18	138	4	-14
F_2(0.90-1.80m)	69	2	-	0	-2
F_3(1.80-3.60m)	-	0	-	0	0
F_4(>3.60m)	-	0	-	0	0
Total	**3,440**	**100**	**3,440**	**100**	**0**

Sources: IWM and field visit, 2015

6.6.3 Changing Cropping Pattern and Intensity

531. Presently, cropping intensity of the polder area is 184%. According to the proposed intervention, the polder would protect from tidal and monsoon flooding and will arrest salinity intrusion and would remove drainage congestion in the polder area. Besides, drainage congestion will be significantly reduced due to re-excavation of internal khals of the polder area as per proposed plan. Due to improved situation, farmers of the respective areas would encourage to cultivate more crops in their lands. Thus, it is expected that cropping intensity would 190% in the polder area in future **(Table 6.9)**. Therefore, cropping intensity of the polder area would increase around 6% from the base situation.

Table 6.9: Future Cropping Patterns of the Polder area

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (November-February)	Area (ha)	% of NCA
High land(FF)	Sugarcane	Sugarcane	Sugarcane	89	2.6
	Orchard	Orchard	Orchard	100	2.9
	S. Vegetables	T. Aman(Local)	Spices	128	3.7
	S. Vegetables	T. Aman (Local)	Chili	114	3.3
	T. Aus (Local)	T. Aman(HYV)	W. Vegetables	65	1.9
	T. Aus (Local)	T. Aman (Local)	Potato	53	1.5
	T. Aus (HYV)	T. Aman(HYV)	Fallow	596	17.3
	Fallow	T. Aman (HYV)	Fallow	850	24.7
			Sub-total	**1,995**	**58.0**
High land(F_0)	T. Aus (HYV)	T. Aman (HYV)	Fallow	963	28.0
	T. Aus (Local)	T. Aman (HYV)	W. Vegetables	21	0.6
	T. Aus (HYV)	T. Aman (HYV)	Boro (HYV)	155	4.5
	T. Aus(HYV)	T. Aman(HYV)	Pulses	169	4.9
			Sub-total	**1,307**	**38.0**
Medium high land(F_1)	Fallow	T. Aman (HYV)	Oil seeds	55	1.6
	Fallow	T. Aman (HYV)	Boro (HYV)	42	1.2
	Fallow	T. Aman (Local)	Pulses	28	0.8
	Fallow	Fallow	HYV Boro	14	0.41
			Sub-total	**139**	**4.0**
			Total	**3,440**	**100**
			Cropping Intensity (%)	**190**	

Sources: Field visit and IWM, 2015

6.6.4 Increased crop production

532. Polder 41/1 was one of the worst affected during cyclone Sidr. The project is expected to increase resilience of people within Polder 41/1.

533. Presently, total cropped area is 6,344 ha of which rice cropped area is 5,552 ha and non-rice cropped area is 792 ha. On the other hand, total crop production is 15,697 m. tons of which rice are 12,400 m. tons and non rice is 3,297 m. tons (Table 6.11).

534. Total cropped area would be changed if the project is implemented in future. Total cropped area would be 6,531 ha of which rice cropped area would be 5,469 ha and non-rice cropped area would be 1,061 ha. It is estimated that the total crop production would be 31,629 m. tons of which rice would 19,929 m. tons and non-rice would 11,700 m. tons respectively. Rice production would be increased due to expansion of T. Aus (HYV), T. Aman (HYV) and Boro (HYV) and all non-rice except pulses and oil seeds cultivation area. Additional 15,931 m. tons crop would be produced of which rice production would 7,529 m. tons and non-rice would 8,402 m. tons in the polder area (Table 6.11).

Enhancement

535. The following measures are being suggested to address the above concerns:

- Irrigation should be provided in optimum level with minimum conveyance loss.
- Involvement of WMOs in project activities should be ensured to enhance crop production.
- Introduction of HYV/Hybrid crop cultivars along with crop diversification need to be practiced

6.6.5 Enhance habitats of avifauna and fishes

536. Implementation of afforestation programme of this project will mitigate negative impacts associated with tree felling. Consequently, foreshore afforestation will enhance mangrove vegetation coverage surrounding the polder. Enhancement of mangrove vegetation will provide habitats especially for local avifauna and fishes.

6.6.6 Employment Generation

537. The construction work will generate a significant amount of employment over its construction period to local people and other associated professionals. The proposed project will diversify employment opportunity as a result of reduction of water logging by tide which will improve crop cultivation and crop intensity. On the other hand, during construction period, Earthwork of embankment and constructing structure will create temporary employment opportunities for day labours. The employment generation represents the different ways of livelihood by which people can generate their income and improve their living standards.

6.6.7 Accessibility of Social Use of Water

538. One of the main utility of water is its social use i.e. taking shower, washing chores and other social uses. During the summer, most of the open water bodies i.e. khals, ponds dry up at present and scarcity of water is severely felt. Hence, if the proposed canals are dug, it will increase water retention capacity and ensure the various social usages of water.

6.6.8 Reduce vulnerability of communities from natural disaster

502. The people of this Project area are very vulnerable to natural disaster incidences since the project area is located in the coastal area and is surrounded by river. Several disasters hit this area and affect the socio-economic portfolio significantly in the past. It is expected that people living in the polder could be protected through implementation of proposed interventions.

6.7 Risk Assessment

6.7.1 Increase Salinity Intrusion due to Leakage of Regulators

Impact

539. The proposed polder has been designed to protect salinity intrusion through marginal dyke from the Payra River. These interventions will expand the cultivation of Boro crops during the dry season. According to coastal polders experiences, mal-operation and leakage through regulators may also result in salinity intrusion during the dry season causing severe damage to the soil, water resources and crops in the Polder. If the regulators are not monitored and operated properly by the BWDB staff after project completion then the salinity intrusion due to leakage of regulators may again initiate/occur in future.

540. The significance of this potential mitigated impact has been assessed as **Low** on the basis of impact magnitude and receptor sensitivity.

Mitigation

541. The following measures are being suggested to address the above concerns:

- Regular monitoring and careful maintenance of the water control structures will have to be ensured.
- Standard operating procedures will have to be prepared and implemented for the water control structures. These procedures will be translated in Bangla as well.
- Capacity building of WMOs will be carried out.

Residual Impacts

542. The impacts associated with salinity intrusion are likely to be adequately addressed with the help of the above mentioned mitigation measures and the significance of residual impact will be **Negligible.**

6.7.2 Function of Water Management Association (WMA)

543. The coastal Polder 41/1 was built in 1964. 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 active Water Management Association for operation and maintenance of the polder. It is felt that water management should be formed and trained to identify the problems and take appropriate measures. This would help 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 dilapidated due to lack of necessary O & M budget, absence of Water Management Association (WMA) and inadequate staff of BWDB.

544. The objective of the rehabilitation of the polder may not be fulfilled if the above measures are not properly addressed.

6.8 Summary of Assessed Impacts

545. A summary of these impacts and their significance are discussed in the sections above is presented in Table 6.10.

Table 6.10: Matrix of Assessed Negative Impacts

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
A. Pre-construction Phase								
Increased Vehicular Traffic during mobilization	Short term	Local	Reversible (after construction phase)	Certain	High	Major	• Contractor to prepare and implement mobilization plan considering water vessels and launch movement in the external rivers. The timing of launch movement as mentioned in the baseline chapter should be avoided. • The movement of vehicles in the polder area and on the embankment should be restricted during off peak time. No vehicular movement should be made during school time (10:00 a.m. to 13:00 p.m.) and on the days of weekly marketing (Haatbar). • Regular liaison to be made with local communities and concerned bazaar committees, specifically union parishad members of the polder. The details of communication address of union parishad chairman and members have been provided in the public consultation chapter. • Keep provision of training on vehicular traffic movement pattern and management system for the local stakeholders using multimedia	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							presentation and showing Videos at different places of the polder especially in the Barguna Bazaar, Courtbaria Bazaar, and Golbunia Bazaar. These three places are the common gathering places for the local people in the polder area. This training is very much needed because of safety of the local stakeholders.	
Land loss due to Project Intervention and Land Acquisition	Long term	Local	Irreversible	likely	High	Major	• Compensation would be paid prior to construction in accordance with RAP. • Maintain liaison with communities. • Grievance redress mechanism (GRM) would be established.	Negligible
Changes in land use	Short term	local	Reversible (after construction phase)	Certain	Medium	Moderate	• Established all the construction camps within the area owned by BWDB. • Pay compensation/rent if private property is acquired on temporary basis, for which instructions should be specified in the tender document. • Construct labor shed/ camp at government khas land.	Very low
Loss of vegetation	Sort term	Local	Reversible (after construction phase)	Likely	Medium	Moderate	• Proper compensation against tree felling at private land should be given to the owners • Submit early notification to the proper authorities (i.e.: Forest Department) about tree felling • Avoid vegetation damage as much as possible to select sites for labour shed and material stock by using nearer	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							fallow land or barren homestead yards • Implement tree plantation at the damaged sites after completion of construction works	
B. Construction Phase								
Increased Drainage Congestion and Water Logging	Local	Short term	Reversibility	Likelihood	High	Major	• Construct diversion channels before replacement of regulators. • Sequence of works in the regulators and in the water channels will have to be carefully planned to avoid any drainage congestion.	
Affects on irrigation	Local	Short term	Reversible	Certain	High	Major	• Construct diversion channels before construction of each regulator. • Sequence of works in the regulators and in the water channels will have to be carefully planned to avoid any disruption in irrigation. • Ensue of having no negative impacts in irrigation. • Maintain liaison with the communities. • Construction works should be executed during dry season.	Low
Soil and Water Contamination	Local	Short term	Reversible	Certain	Minor	Low	• Prepare and implement pollution control plan. • Ensure workshops should have oil separators/sumps to avoid release of oily water; • Avoid repairing vehicles and machinery	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							in the field. • Contractor will ensure that there is no leakage, spillage, or release of fuel, oil or any other effluents/ wastes on the ground or in the water from its construction machineries, vehicles, boats, launches, and barges. Contractor will regularly monitor the condition of all sort of vehicles/fleets. • Material borrowing from the river banks will be carried out sufficiently away from the water line, minimizing the possibility of loose soil to wash away in the river. • Contractor will locate camps far away from communities and drinking water sources. • Contractor will prepare and implement camp waste management plan (septic tanks, proper solid waste disposal). • Contractor will dispose spoil at designated areas with community consent. • Construction materials, demolished debris, and excavated soil/silt will not be allowed to enter water bodies.	
Generate Noise and Vibration	Short term	Local	Reversible	Likely	Medium	Moderate	• Noise levels from vehicles, equipments and machineries to comply with national and WB noise standards. • Vehicles and machineries will have proper mufflers and silencers. • Provision of noise barriers to be provided at schools and other sensitive	low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							receptors, as needed. • Provision of PPE (ear muffs and plugs) is to be ensured for the labors. • The construction crews will be instructed to use the equipment properly to minimize noise levels. • Camps will be located at a safe distance from the communities. • Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.	
Hindrance of Pedestrian and Vehicular Movement	Short term	Local	Reversible	Likely	Medium	Moderate	• The works on embankment will be carefully scheduled to minimize impacts to local markets and transportation routes. • The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment first, leaving the other half to be used as track. After completion of the works on the first half, it will have to be opened for local traffic while the works on the other half of the embankment will be undertaken. • Work schedule will be finalized in coordination and consultation with local representatives and communities. • Local routes will be kept free for use as much as possible. If unavoidable, alternative routes will be identified in consultation with local community.	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• GRM will be put in place.	
Hamper construction activities due to natural hazards	Short term	Local	Reversible	Likely	Medium		• Weather signals will have to be considered by the contractors during constructions. • Radio and television will be provided to all the labour sheds for getting weather information through these media. • Ensure meticulous standards for occupational health and safety are in place.	Low
Loss of agricultural crop production	Short term	Local	Reversible	Likely	Medium	Minor	• Compensation would be paid to land owners or sharecroppers for any crop damage. • Avoid using of agricultural land for material borrowing, material stockpiling, and labor camps. • Avoid vehicular movement in the cultivation fields. • Construction material should not be dumped in the cultivation fields. • Contractor would maintain liaison with communities	Negligible
Destroy Feeding and Spawning Ground of Fish Habitat	Short term	Local	Reversible	Likely	Medium	Moderate	• Earthwork should be conducted during the dry season (November-February) • Sequence of work at the bank side of Payra River will be carefully planned to minimize impacts on spawning and subsequently nursery ground of fish. • Contractor will maintain liaison with experienced fishermen.	Low
Disturbance of fish habitat and	Short term	Local	Reversible	Likely	High	Major	• Construct bypass canal before construction of each regulator	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
migration							• Sequence of work at the regulators and in the water channels will be carefully planned to minimize impacts on fish and their migration. • Fish (particularly juvenile fish) will be transferred from rivers to Polder water channels where appropriate. • Maintain liaison with communities during re-excavation of khals.	
Damage benthic fauna	Short term	Local	Reversible	Likely	High	Major	• Khal re-excavation should be carried out segment wise. • Release fish fry in the re-excavated khals	Low
Loss of Vegetation	Short term	Local	Reversible (after construction phase)	Occasional	Medium to high	Major	• Collect soil from barren land as much as possible • Choose barren land for CC Block manufacturing and material storing • Use excavated soil spoils for khal dyke re-sectioning • Avoid re-excavation of the deeper portions of the khal • Use minimum land as much as possible for excavator/ labour movement • Proper turfing should be implement at embankment slopes with local grasses (i.e Durba (*Cynodon dactylon*) , Mutha (*Cyperus rotundus*) and ensure regular monitoring of turf grasses till they matured • Implement plantation with native species at countryside slope of the embankment to arrest vegetation loss	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Implement plantation along the dumping sites with indigenous plant species • Detail survey of economic plants should be addressed in RAP study for construction of temporary by pass road • Keep provision for compensation against tree felling for private properties • Implement tree plantation on damaged sites after completion of construction works • Keep setback distance in plantation plan layout from the water passes • All kinds of polyethylene bags and plastic ropes should be piled up in a pit for being dumped or burned in a proper way • Care should be taken for physical and biological control of plant disease while nursery raising and sapling plantation (i.e. using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers) • Pre consultation with Forest Department and other related non-government organizations for selection of suitable species for plantation and spacing of the saplings • Collect saplings from nearer natural source (i.e: from mangrove forest patches at north bank of Payra River surround the Manik Khali and	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							Hazarbiga Villages) as much as possible	
Interrupt Road communication	Short term	Local	Reversible (after construction phase)	Occasional	Medium to high	Major	• Re-sectioning work should be done section wise • Temporary arrangement of boats for navigation, and need to construct alternative ways such as temporary footpath for road communication. • The embankment works will be carried out in section 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 LGED , local representatives and communities. • Water way can be used especially along the river during construction period • Earth work for re-section of embankment can be shorted for easy movement of local people. • All the works will be conducted in presence of Union Parishad Chairman and members. • Project Implementation Officer (PIO) will be informed during construction and finishing of earth works of embankment.	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
C. Post Construction Phase								
Increased Sedimentation in Water Channels and Rivers	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. • Proper land zoning plan will be prepared in the Polder for controlling unplanned development works. For this purpose, further research should be taken by the SRDI or Agriculture Extension Office of Bangladesh. • The local government (union parishad) will be authorized to monitor the development activities. • Proper training programs in connection with land zoning and monitoring systems will be undertaken by the development authorities of Bangladesh. • A research program will be carried out for polder-wise land zoning plan preparation in future. • Prepare Bangla manual for sluice gate operation and provide trainings to WMOs; and • Reduce conflicts between farmers and fishermen.	Low
Increased Salinity Intrusion due to Leakage of Regulators	Long term	Local	Reversible	Likely	Minor	Low	• Regular monitoring and careful maintenance of the water control structures will have to be ensured. • Standard operating procedures will have to be prepared and implemented for the water control structures. These	Negligible

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							procedures will be translated in Bangla as well. • Capacity building of WMOs will be carried out.	
Reduced Fish Migration Time and Extent	Long term	Local	Reversible	Likely	High	Major	• Proper sluice gate operation allowing fish migration. • Provide training to WMOs; • Transferring juvenile fish from rivers to Polder.	Low
Increased use of agro-chemicals	Long term	Local	Reversible	Likely	High	Major	• Capacity building and awareness rising of the farmers would be carried out to practice Integrated Pest Management (IPM) and Integrated Crop Management (ICM) in order to minimize usage of chemical inputs. • Farmers group should have close contact with DAE for adoption of various measures of IPM/ICM. • Farmers should be encouraged to use organic manure to increase soil fertility while avoiding water contamination. • Farmers should be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.	Low

7 Analysis of Project Alternatives

7.1 Overview

546. This chapter presents an analysis of various alternatives considered during the Project feasibility and design stage including the ‘no project’ alternative. To the extent possible, environmental and social issues of these alternatives have been considered ‘No Project’ Alternative

547. The ‘no-project’ alternative gives a perception of current condition of the Polder and the significance of the proposed interventions under CEIP-1. It has been substantiated that the polder is susceptible to cyclones, storm surges, wave action and climate change effects at this point of time. Furthermore, this Polder is not in a state of providing desired services i.e. protection against tidal inundation, efficient drainage and minimizing the impact of cyclonic surges. About 40 percent of the Polder area is vulnerable to salinity intrusion and water logging. The silted water channels are resulting into limited navigation in these waterways, declining fisheries, and increasing environmental pollution.

548. The proposed interventions for Polder- 41/1 under CEIP-1 are aimed to eliminate the major problems described above. To highlight present state and various aspects of the Polder and to realize the importance of the proposed interventions under the Project, the ‘no project’ and ‘with project’ scenarios are compared in Table 7.1

549. Section 6.6 provides a detailed assessment of the high positive impacts of the Project that is considered to improve the security and socio-economic conditions for all strata in polder 47/2

550. Following Table 7.1 shows the consequences if no intervention is initiated in comparison with the proposed project intervention.

Table 7.1: Comparison of ‘No Project’ and ‘With Project’ Scenarios

Proposed Works under CEIP-1	‘No Project’ Scenario	‘With Project’ Scenario
1.Re-sectioning of embankments (35.58 km) and design crest level (6.00 m, PWD and 5.00 m, PWD)	At a certain number of points, the embankments will be further deteriorated and dropped below the design level. Therefore, cyclones, rise in surge heights due to global warming, and tidal actions will inundate the Polder, causing severe damage to the lives and property of local people.	Re-sectioned embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, reduction in loss of lives and assets caused by the natural disasters.
	Because of submergence of the embankments during monsoon, transportation system would further deteriorate inside the Polder, and sufferings of local people would further increase.	Re-sectioned embankments will provide enhanced protection to Polder, facilitating transportation within the Polder even during monsoon.
	Reduction of agricultural area, crisis situation for farmers from January to April (salinity intrusion) and May to	Re-sectioned embankments providing support to Polder facilitate enhanced agriculture activities and

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
	August (flooding).	increased area for cultivation, thus increasing agriculture output.
	Continued silt deposition inside the Polder due to cyclonic surges and floods would increase and cause water logging, drainage congestion and other associated problems.	Decreased silt deposition in the Polder will result into improved drainage and navigation in internal lakes/khals, increased usage of surface water for irrigation, and reduced water logging problem.
	Local farmers and labor will remain financially stressed. Livelihood opportunities will remain limited, and local people will migrate outside the Polder for employment.	Enhanced agricultural activity will increase the demand for farm workers. Local people can engage themselves in the construction works inside the Polder. Improve earnings of local people during the construction phase of the project.
Bank revetment (300 m)	River bank erosion would further deteriorate the embankments and land resources would be damaged/ lost.	Bank revetment will provide enhanced protection against erosion by wave action, storm surges and currents, and will result into preservation of Polder and its land/agriculture resources.
	Further subsidence of the embankments and further damage to transportation routes.	The bank revetment will protect the embankments and facilitate transportation within the Polder.
Slope protection of Embankment (1.00 km)	Continued weakening of embankments; continuous subsidence of embankments due to traffic load and wave action; land resources would continue to be damaged.	Slope protection works will strengthen the embankments and protect them against subsidence, wave action, and wear and tear.
Replacement of drainage sluices with drainage-cum-flushing sluices.	Continued use of the existing drainage sluices for both flushing and drainage would cause further damage to these structures. As a result, water logging and drainage congestion would be increased due to malfunctioning of the sluices.	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
Replacement of the existing flushing sluices	No dry season agriculture practice will be possible. Shrimp culture during January to May, as sweet water cannot be used in the periods of low rainfall.	Replaced flushing sluices will facilitate better agriculture practices, increased dry season rice cropping, and reduced shrimp culture - thus benefiting the poor farmers.
Construction of new flushing sluices	Cultivable lands will be decreased in future.	New flushing sluices will facilitate increased surface water, better control on irrigation during periods of low rainfall and increased agricultural production.
Afforestation (30 ha)	Wind and wave action during cyclones would cause severe damage.	Effects of cyclone surge, wave action and gusty wind could be

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
		mitigated to a certain extent, reducing the loss of lives and assets.
Re excavation of Drainage Channels (36.7 km)	Depth of water would be further decreased, and drainage congestion and water logging would be further increased.	Depth of water bodies will increase, water logging and drainage congestion will decrease and fish habitats will increase.

7.2 With Project Alternatives

7.2.1 Site Selection Alternatives

551. No alternative site selection is to be considered because it is a rehabilitation / maintenance project. However, a comprehensive multi-criteria analysis on 139 polders were conducted to prioritize the polder rehabilitation under CEIP-1. According to the multi-criteria analysis result, 17 polders (32, 33, 35/1, 35/3, 39/2C, , 41/1, 40/2, 43/2C, 47/1, 48, 23, 34/3, 14/1, 16 , 15, 17/1 and 17/2) are found to be most vulnerable.

7.2.2 Technical Alternatives

552. Once the problems being faced by the Polder and its inhabitants was identified, several technical alternatives were considered to address these issues. These alternatives pertained to strengthening the Polder embankment, protection of river banks, protection of embankment slope, improving the sluices and their performance, and reducing drainage congestion/ water logging and provision of partial irrigation. These technical alternatives are discussed in **Table 7.2** below.

Table 7.2: Technical Alternatives for Polder 41/1

Proposed Interventions	Alternative Options	Consequence
Strengthening of the embankment	No change in alignment and no re-sectioning/repairing of the existing embankment	The present vulnerable situation of the embankment and thus the entire polder would continue (similar to the 'no project' scenario discussed earlier).
	Retirement/relocation of the existing embankment, as and where required	The project objectives will be partially achieved. NO protection against storm surges and sea level rise.
	Backing/minor inward shifting of embankment with slope protection	Same as above.
	Constructing new embankments (selected option)	New embankments will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, there would be reduction in loss of lives and assets caused by the natural disasters.
	Re-sectioning of existing embankment with new design heights (selected option).	Higher and wide embankments would be more effective and resilient, and will safeguard the Polder against storm

Proposed Interventions	Alternative Options	Consequence
		surges, floods, and higher tides due to global warming. Hence, reduction in loss of lives and assets caused by the natural disasters.
River bank protection works	No change in the existing embankment	River bank erosion would further deteriorate the embankments and land resources would be damaged/lost (similar to the 'no project' scenario discussed earlier).
	Retirement of embankment	The project objectives will be partially achieved; Polder area will decrease; and erosion of the river bank will continue.
	Bank Revetment (selected option)	Bank revetment will provide enhanced protection against erosion by wave action, storm surges and currents, and will protect the Polder and its land/agriculture resources.
Replacement of drainage sluices	No change in the existing structures	Continuous 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 (similar to the 'no project' scenario discussed in earlier).
	Repairing of structures (possible where there is no need of re-sizing) (selected option for some structures)	For sluices which are beyond repair, this option would be similar to the 'no project' scenario described above.
	Replacement of existing Drainage Sluice with Drainage-cum-flushing sluice (selected option for some of the sluices depending upon need)	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
	Regulators with provision for appropriate arrangement of passages for fish and small boats.	In addition to the above advantages, the structures will facilitate fish migration and navigation through them. The cost of such structure is likely to be very high.
Rehabilitation of flushing sluices	No change in the existing structure	No dry season agriculture practice will be possible. Shrimp culture during January to May will be possible as sweet water cannot be used in the periods of low rainfall (similar to the 'no project' scenario discussed in earlier).
	Repair of the existing structures	For sluices which are beyond any repair works, and would be similar to the 'no project' scenario described above.
	Replacement of the existing Flushing Sluices (selected option)	Replaced flushing sluices will facilitate better agriculture practices, increase dry season rice cropping, and reduce shrimp culture - thus benefiting the poor farmers.

Proposed Interventions	Alternative Options	Consequence
	Construction of drainage cum flushing (selected option in certain cases)	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
	Construction of new Flushing Sluices (selected option in certain cases)	New flushing sluices will facilitate increased availability of surface water, better control on irrigation during periods of low rainfall and increased agricultural production.
	Providing closure dam (selected option in a few locations)	Providing closure dam would restrict the entry of silt and saline water into the internal rivers. In the same time it will increase the level of water in the channel to facilitate better irrigation.
Reducing water logging and drainage congestion	No action is taken.	Depth of water bodies would further decrease, and drainage congestion and water logging will further increase (similar to the 'no project' scenario discussed in earlier).
	Channel re-excavation (selected option)	Depth of water bodies will increase, water logging and drainage congestion will be decreased and fish habitats will increase.

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

553. An attempt has been made to evaluate the technical, financial, economic, environmental, and social considerations of the selected options discussed above. This evaluation is presented in Table 7.3 below.

Table 7.3: Technical, Economical, 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 reduction of damages to be caused by the floods	Improve surface water quality;	Reduce loss of lives and assets which would alleviate poverty; increase employment opportunities for local people.
	Protection to river bank erosion	Financial savings as the embankments will provide good road transportation.	Reduce traffic congestion inside the polder because of	Reduction loss of assets which would bring poverty reduction

Intervention	Considerations			
	Technical	Financial/Economic	Environmental	Social
	Prevention of salinity intrusion in the polder	Improve earnings of local people during construction Improve cropping pattern and boost up the local economy	improved embankments, which will facilitate vehicular traffic	Improve crop production particularly for small farmers thus alleviating poverty.
Bank revetment, slope protection	Enhanced embankment protection against tidal wave action of rivers, provide erosion protection	Financial savings for reduction of damages from floods; increase life span of the infrastructure and associated water control structures; improve earnings of local people through employment during bank revetment works and slope protection works.	Improve embankment stability; reduce soil erosion; and provide good means of transportation	Reduce loss of lives and assets which would alleviate poverty; increase employment opportunities for local people.
Replacement of existing drainage sluice with drainage-cum-flushing sluice and construction of new flushing sluices where needed	Better functional performance in both flushing and drainage; achieve the objectives of Polder and CEIP-1	Financial savings against damages from water logging, drainage congestion, and salinity intrusion. Agricultural production will boost up as dry season rice cropping would increase	Removal of inactive sluices would improve the drainage characteristics Water logging, drainage congestion would be reduced.	Better agriculture practice could be achieved which would improve cropping pattern, enhance local earnings, and alleviate poverty.
Channel re-excavation	Reduce water logging and drainage congestion	Enhance 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 will improve, the ecosystem will be enhanced	Increase cultivable area, increase availability of irrigation water thus increase farm income for local community; increase farm labor opportunities.

7.2.4 Alternatives during Construction

554. The influencing factors of construction site can be aggregated, i.e. material stockpiling, material sourcing, manpower sourcing, and transportation for all form of requirements (materials, equipment, manpower etc.). A discussion upon alternatives of the abovementioned factors is made consecutively in the following sub-sections

7.2.5 Material Storage

555. Seemingly,two alternative options can be proposed for storing construction materials at Polder 41/1: (a) Inside the Polder within the BWDB compound; and another is (b) Outside the Polder at a suitable space adjacent to Chaltala Ferry ghat. Both options 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. No significant environmental consequences are expected associated with this conveyance of construction materials to either way inside and outside storage of the Polder. Because roads are concrete pitched and regular bus services are in common within the Polder. And even Payra River is dedicated waterways which carry all forms of water vehicles. So, nominal impacts can be emerged for conveying these particular construction materials through this River way. However, storage of construction to be done properly, within embanked area along with proper coverage.

7.2.6 Material Sources

556. The sources from which the construction materials will be collected have been discussed below.:

Soil for Embankments

557. For retirement, re-sectioning, and construction of new embankments, about 126 thousand cubic meters of soil will be required. The following options are available for sourcing this material:

- Soil can be obtained from borrow pits along the river bank just outside the embankments, provided the soil quality is appropriate for this purpose. This is a feasible options with some benefits since it will minimize soil transportation needs, minimize related to material transportation and having minimum environmental and social impacts related to excavation and transportation. However, as BWDB does not own any land sites for borrow pits, these have to be obtained from the owners and compensation provided.
- Part of the required material can be obtained from the re-excavation of the water channels within the Polder, provided the quality of this material is technically acceptable. About 128 thousand cubic meters of earth will be obtained from re-excavation of channels during implementation of rehabilitation works inside the Polder. This option minimize the cost of excavation for the borrow material, though the cost of transportation to work site will be slightly more than the first option, This is the preferred option from an environmental point of view, as it will reduce the need for sourcing material from borrow pits or river bed material.
- If the riverbed material is, suitable having the required material quality, dredged material can be used for embankment construction as well. From an environmental point of view, this is the second preferred option, as there will be no terrestrial impact, while the aquatic impact will be very temporary and localised to the riverbed. Any dredged material will rapidly be replaced due to the high sediment transport capacity in the rivers in the polder region. Transport of the dredged material can take place directly at the embankment construction site, requiring minimal land transport. However, sites for de-watering the

dredged material will be required. The use of dredged material is considered the preferred option from an environmental point of view.

558. As per the Project design, the final decision regarding the material source will depend on the material quality, either dredged from rivers, from re-excavations of khals or from borrow pits, as well as the availability of the latter two. The Contractor will carry out tests of the material quality from various sources, provide a plan for obtaining the required amounts of suitable quality and obtain approval from the DSC Consultant before starting obtaining the material.

Sand

559. Sand would be needed for embankment improvement works, concreting works, and for manufacturing concrete blocks for slope protection. Two broad options are available to source this material as discussed below:

560. Sand could be procured from markets. This would entail consistent quality and assured supply; however, it would also entail increased transportation cost and associated environmental and social impacts including traffic congestion and air pollution.

561. The second option is to obtain sand from the riverbeds. This would reduce the transportation needs along with the associated costs and environmental as well as social impacts. However, quality of this sand may not be consistent and this sand may need to be washed before use.

7.2.7 Alternatives for Workforce Procurement

562. Two broad options are available for sourcing the manpower for the construction works. These are discussed below:

- Employing bulk of manpower from outside the Polder. This will lead to traffic congestion and air pollution requiring large number of camps and labor transport. It may also trigger resentment and ultimately possible resistance as consequence from the local community.
- Employing bulk of the manpower from within the Polder and bringing only skilled and technical manpower from outside. This 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.

7.2.8 Alternatives for Mode of Transportation

563. The condition of the road way inside the Polder is not suitable for larger vehicles i.e. dump truck, trolley, excavator etc. Therefore, earth and other construction materials will be carried by small carts, non motorized vehicles, manual labor, etc., using road ways; and small boats, trawlers in waterways.

564. Polder 41/1 is located along the bank of Payra River. This River is convincingly influenced by tide and ebb. The depth is around 20 meter. It remains navigable throughout the year and can be used for transportation purposes during construction. That’s why it is regarded as Perennial River. The Payra River is evolved from Kobai River and falls into the Bay of Bengal.

565. The materials stored in the stockyard can be transported to the construction sites by using main roads (i.e. Amtoli – Borguna Road). While transporting materials to the stock yard from Borguna or other suitable locations, road ways are recommended.

8 Climate Change Impact

8.1 General

566. 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.

567. 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 districtsAnalysis of Climate

568. Monthly and annual mean data of maximum and minimum surface air temperature, sunshine hour, relative humidity and monthly and annual rainfall over Khepupara has been used for the period of 1981-2012 in this study. It is to be mentioned here that Polder 41/1 is located near the Khepupara so meteorological parameters of Khepupara are considered in this study. Khepupara station data has been collected from Bangladesh Meteorological Department (BMD). Seasonal mean values have been computed from the monthly data of rainfall and temperature for the four meteorological seasons e.g. pre-monsoon (March-May), monsoon (June-September), post-monsoon (October-November) and winter (December-February). There are some months with where data of BMD Khepupara station are missing. To maintain the continuity, the gaps have been filled up by the time mean values of the existing years for maximum and minimum temperatures. The variation in rainfall data is very large as such time-interpolation is not possible and the spatial interpolation is also not reliable for rainfall analysis. It is mentioned that for climate change studies it is better if longer period of data is available.

8.1.1 Rainfall

569. The temporal plots of the annual and seasonal precipitation of Khepupara have been drawn to investigate the nature of inter-annual fluctuations. The linear regression lines have also been shown on the graphs. The temporal variations and the trends of seasonal precipitations for winter, pre-monsoon, monsoon and post-monsoon along with the annual

precipitation (Figure 8.1) are obtained during the period of 1981-2012. Increasing trends in the annual precipitation, pre-monsoon, monsoon, post-monsoon and winter are observed at the rate of 15.74 mm/year (Figure 8.1), -1.25 mm/year, 5.36 mm/year, 7.44 mm/year and -0.78 mm/year respectively during the same period, which are not statistically significant for the period 1981-2012.

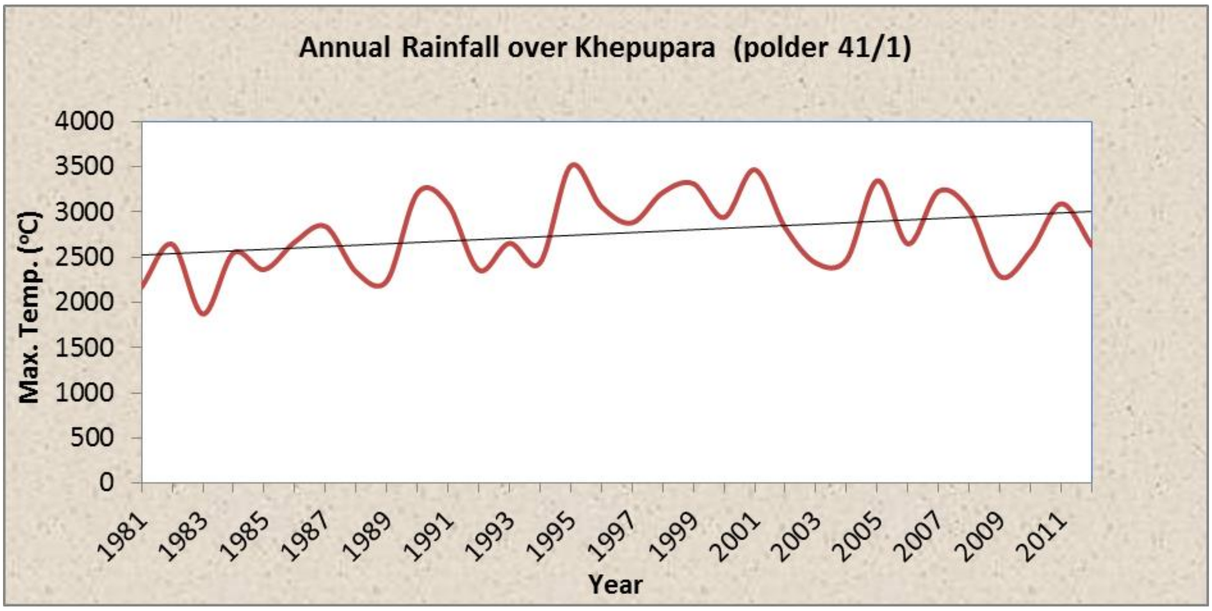


Figure 8.1: Inter-annual variation of annual rainfall over Khepupara (Polder 41/1) during the period 1981-2012

8.1.2 Temperature

570. The inter-annual and seasonal variations of mean maximum and minimum surface air temperatures have been studied using the yearly time series and least square regression analysis. The characteristics of trends of mean maximum and minimum and seasonal surface air temperatures are described below (Figure 8.2).

8.1.3 Trends of annual mean maximum surface air temperature

571. The temporal plots of the time series of annual mean maximum temperature over Khepupara shows that the temperature has the increasing trends (Figure 8.2). The causes of the warming are attributed mainly to the radiative forcing due to the increased greenhouse gases. The slopes of the linear trends of the regression analysis of the mean maximum temperature have been shown warming over Khepupara (Polder 41/1) area at the rate of 0.033°C/year, which is statistically significant at 1% level.

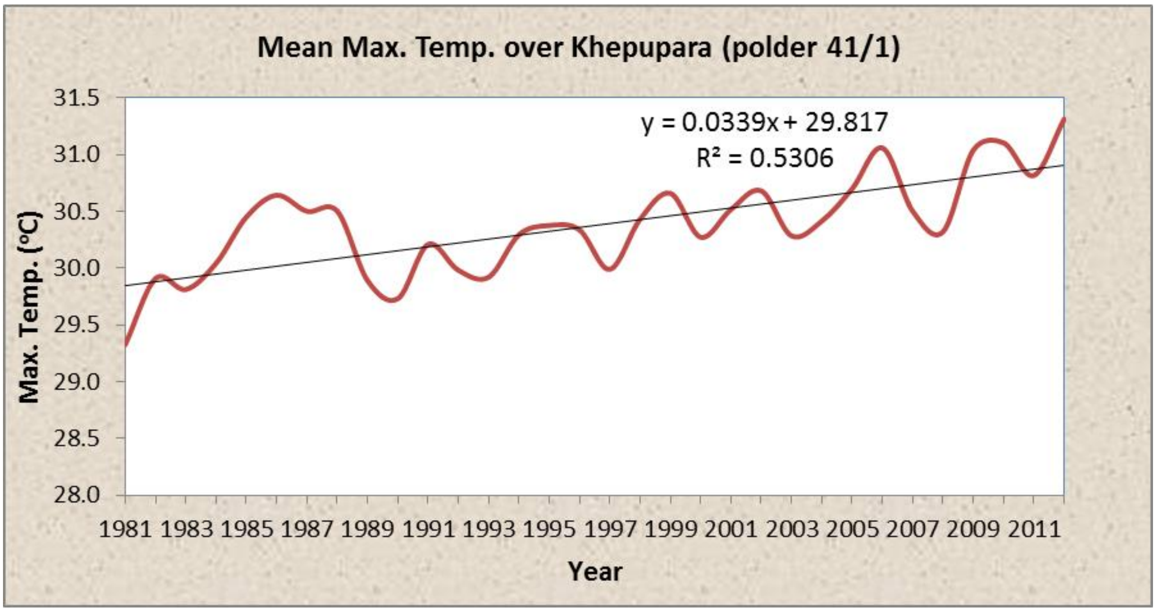


Figure 8.2: Inter-annual variation of Mean Maximum Temperature over Khepupara (polder 41/1) during the period 1981-2012.

8.1.4 Trends of seasonal mean maximum surface air temperature

Winter

572. The winter mean maximum surface air temperature has an increasing trend over Khepupara during the period of 1981-2012 (Figure not shown). The increasing trend at Khepupara is 0.025^{0}C/year which is statistically significant at 5% level.

Pre-monsoon

573. The Khepupara has shown warming trend for pre-monsoon season during the period 1981-2012 (Figure not shown). Warming is observed over Khepupara at the rate of 0.051°C/year, which is statistically significant at 5% level. The warming is more prevalent for all seasons over Khepupara area in Bangladesh.

Monsoon

574. The Khepupara has shown strong warming trends of maximum surface air temperature in the monsoon season during the period 1981-2012 (Figure not shown). Khepupara exhibit strong warming trend during monsoon season with high values at the rate of 0.032°C/year which is statistically significant at 1% level.

Post-monsoon

575. Warming trend of Khepupara is found in the post-monsoon season at the rate of 0.028°C/year, which is statistically significant at 5% level.

8.1.5 Trends of annual mean minimum surface air temperature

576. The temporal plots of mean minimum surface air temperature have been prepared over Khepupara (Polder 41/1). The yearly variation of annual mean minimum surface air temperature for Khepupara is shown in **Figure 8.3** for the period 1981-2012. The results of the trend analysis for mean minimum surface air temperature for Khepupara has been

shown a little bit warming trends at the rate of 0.008^{0}C/year which is not statistically significant.

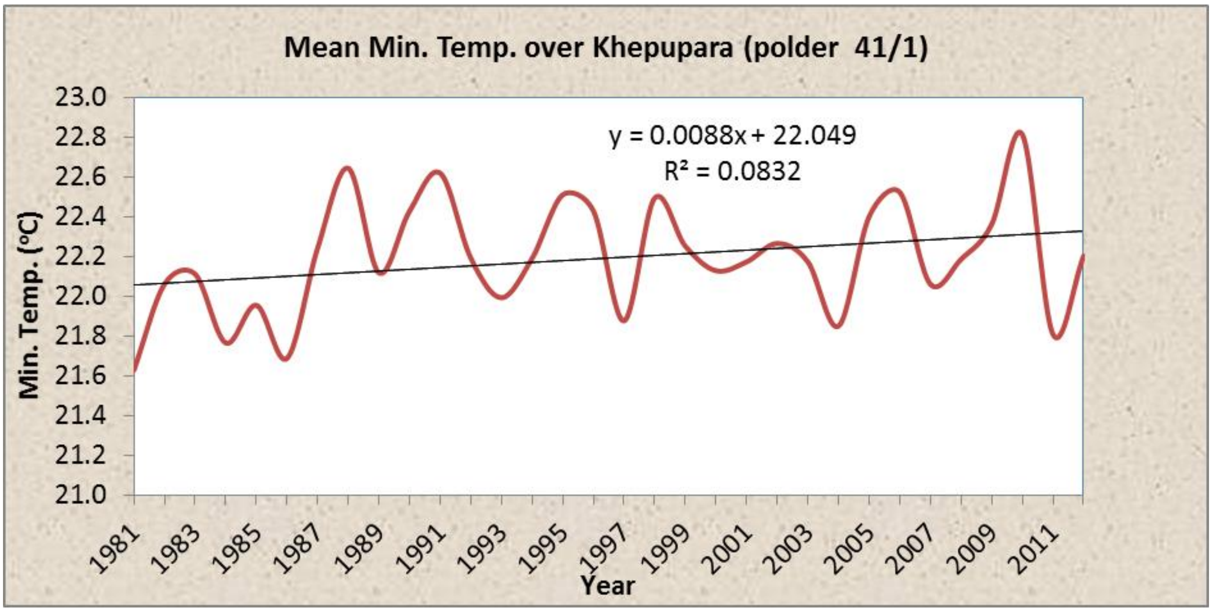


Figure 8.3: Inter-annual variation of Mean Minimum Temperature over Khepupara (polder 41/1) during the period 1981-2012

8.1.6 Trends of seasonal mean minimum surface air temperature

Winter

577. According to the trend analysis, it is found that the winter minimum surface air temperature is decreasing trend over Khepupara during the period of 1981-2012. It is also observed that the decreasing trend at the rate of -0.018^{0}C/year which is not statistically significant. The temperature of cold night may be increased in winter season in future due to climate change.

Pre-monsoon

578. Pre-monsoon seasonal mean minimum surface air temperature shows increasing trends over Khepupara and warming trend at the rate of 0.020^{0}C/year which is not statistically significant.

Monsoon

579. The Khepupara has shown strong warming trends of minimum surface air temperature in the monsoon season during the period 1981-2012 (Figure not shown). Khepupara has the warming trend with the value of 0.022^{0}C/year which is statistically significant at 5% level.

Post-monsoon

580. It is observed that Khepupara shows a little bit increasing trend at the rate of 0.004^{0}C/year for the post-monsoon season, which is not statistically significant.

Sunshine

581. The average durations of sunshine hour from 1987-2010 in the annual, winter, pre-monsoon, monsoon and post-monsoon seasons are found to be about 5.7, 6.8, 7.0, 3.5 and

6.3 hours a day, respectively. According to the trend analysis, it is observed that the seasonal sunshine hour is increasing for all seasons over Polder (41/1) area in Khepupara (Figure not shown). The increasing trend in the annual, winter, pre-monsoon, monsoon and post-monsoon season is about 0.67, 0.09, 0.07, 0.06 and 0.08 hours per day, respectively, which is statistically significance at 1, 5, 1, 1 and 5% level, respectively.

Relative Humidity

582. The relative humidity data has been used for Khepupara station (near the polder area) for the year 1981-2012, for the trend analysis. The trend analysis of time series of relative humidity over Khepupara shows increasing trend for all seasons (Figure 8.3). Post-monsoon and winter seasons shows mostly increasing trend over Khepupara, which is statistically significant at 5% level.

8.2 Climate change projection

8.2.1 Projection of rainfall over Khepupara (Polder 41/1) region

583. Global warming is an important issue, with a variety of influences on agriculture, water, health and economy. It is now recognized that climate variability and extreme events affect society more than changes in the mean climate (IPCC, 2001). Human induced changes in the global climate and associated sea-level rise are widely accepted by policy makers and scientists. The IPCC concluded that the balance of evidence suggests a discernible human influence on global climate (IPCC-AR4, 2007). The exact magnitude of the changes in the global climate is still uncertain and subject to worldwide scientific studies. It is broadly recognized that Bangladesh is more vulnerable to these changes. Indeed, it has internationally been argued that Bangladesh, as a country, may suffer the most severe impacts of climate change. Bangladesh is highly vulnerable because it is a low-lying country located in the deltaic plain of the Ganges, the Brahmaputra and the Meghna and densely populated. Its national economy strongly depends on agriculture and natural resources that are sensitive to climate change and sea-level rise. The impact of higher temperature and more extreme weather events such as floods, cyclone, severe drought and sea-level rise are already being felt in South Asia and will continue to intensify (Huq et al., 1999; Ali, 1999). In this connection proper planning and sensible management of water resources are essential for this region. Long-term planning is not possible without any idea of the change of climate that may happen in future. Climate models are the main tools available for developing projections of climate change in the future (Houghton et al., 2001).

584. 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 GCM. 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 during the period 1981-2000, the year 2030 means averaged precipitation/temperature during the period 2021-2040 and year 2050 means averaged precipitation/temperature for the period of 2041-2060.

585. Year-2030: The change of rainfall for 2030 is found to be -1.1, 19.8, 0.4 and 13.8 % for winter, pre-monsoon, monsoon, post-monsoon, respectively (Figure 8.4). On average, the projected change in annual rainfall over Polder 41/1is 3.3% for the year 2030.

586. Year-2050: The projected changes in rainfall for 2050 are 3.3, -1.9, -7.5 and -24.8 % for winter, pre-monsoon, monsoon and post-monsoon, respectively (Figure 8.4).). On an average, the protected change in annual rainfall change over the Polder 41/1 is -minus 8.2% for the year 2050.

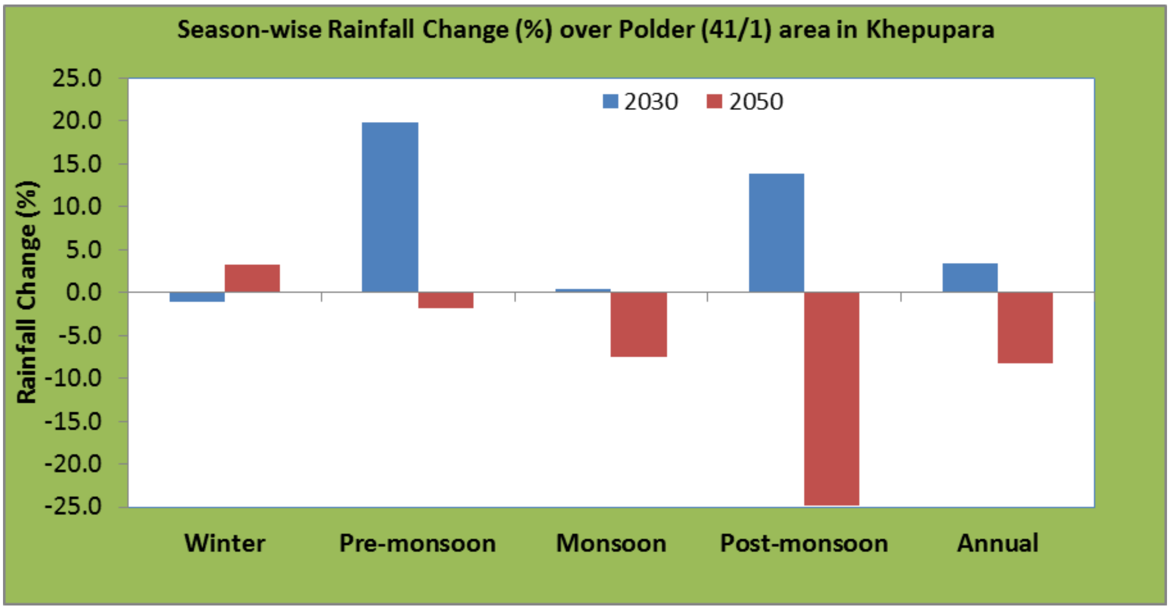


Figure 8.4: Change of seasonal rainfall (%) over Polder (41/1) area for the year 2030 and 2050 respectively.

8.2.2 Projection of Maximum and Minimum Temperature over Polder (41/1) area in Khepupara:

587. Maximum and Minimum surface air temperature projection is obtained by using a new set of scenario RCP4.5 (Assessment Report, AR5) which is called Representative Concentration Pathway (RCP). The year of 2030 and 2050 of maximum and minimum surface air temperature projections for RCP4.5 is given below:

588. Maximum temperature projections over Polder area for RCP4.5 scenario:

589. Year-2030: The maximum surface air temperature may change in 2030 by 1.1, 0.9, 0.4, 0.3, 0.2, 0.8, 0.5, 0.7, 0.7, 0.6, 1.2 and 1.0^{0}C for January, February, March, April, May, June, July, August, September, October, November and December, respectively (Table 8.1). Maximum surface air temperature in various months over Polder area may vary by 0.2 - 1.2^{0}C. On an average the maximum surface air temperature is estimated to be increased by 0.7^{0}C for the 2030.

590. Year-2050:The maximum surface air temperature may be changed in 2050 by 1.9, 1.7, 1.8, 1.5, 0.9, 1.4, 1.3, 1.5, 1.3, 0.9, 1.4 and 1.5^{0}C for January, February, March, April, May, June, July, August, September, October, November and December, respectively (Table 8.1). Maximum surface air temperature in various months over Polder area may be varied by 0.9 - 1.9^{0}C. On an average, the maximum surface air temperature is estimated to be increased by 1.4^{0}C for 2050.

8.2.3 Minimum temperature projections over Polder (41/1) area for RCP4.5 scenario

591. Year-2030: The change of minimum surface air temperature is found to be 2.0, 0.9, 1.4, 0.5, 0.7, 0.9, 0.7, 0.9, 1.1, 1.0, 1.7 and 2.10C for January, February, March, April, May, June, July, August, September, October, November and December, respectively (Table 8.1). It is observed that the change lies between 0.5-2.0^{0}C for the period 2030 and on an average, minimum surface air temperature may increase 1.2^{0}C over Polder area in future for the period 2030.

592. Year-2050: The change of minimum surface air temperature is found to be 2.6, 2.4, 2.4, 1.7, 1.3, 1.5, 1.4, 1.5, 1.5, 1.3, 1.5 and 1.7°C for January, February, March, April, May, June, July, August, September, October, November and December, respectively (Table 8.1). It is observed that the change lies between 1.3-2.6^{0}C for the period 2050 and on an average, minimum surface air temperature may increase 1.7^{0}C over Polder (41/1) area in future for the same period.

Table 8.1: The change of maximum and minimum surface air temperature over Polder (41/1) area for the year 2030 and 2050

Scenario	Reference period	Maximum Temperature Change (^{0}C)												
		Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RCP4.5	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(^{0}C)														
RCP4.5	1981-2000	2030	2.0	0.9	1.4	0.5	0.7	0.9	0.7	0.9	1.1	1.0	1.7	2.1
		2050	2.6	2.4	2.4	1.7	1.3	1.5	1.4	1.5	1.5	1.3	1.5	1.7

8.2.4 Projection of sea level rise

593. 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.

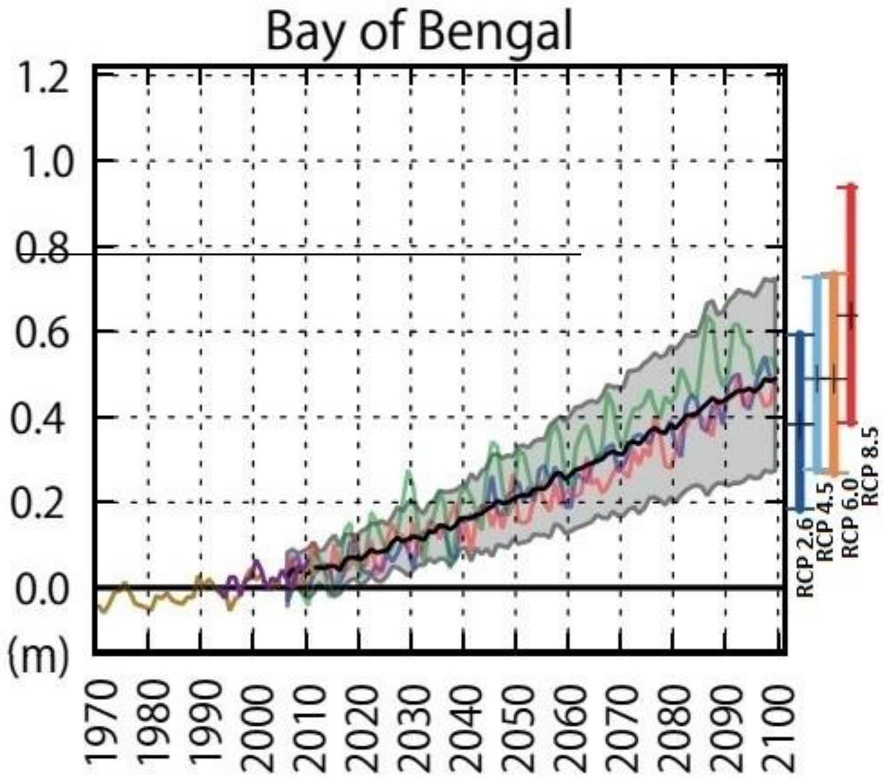


Figure 8.5: Sea level rise projections for Bay of Bengal

8.2.5 Projection of cyclonic storms:

594. 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.

595. According to a World Bank study (world bank, 2010), it is estimated that a 10-year-return period cyclone in a changing climate (2050) will be more intense and cover 43 percent of the coastal zone of Bangladesh, 17 percent more than the current coverage. To approximate cyclones and related storm surges in a changing climate, this analysis considered a SLR of 27 cm (UK DEFRA, 2007), increased wind speed of 10% (Nicholls et al., 2003), and landfall during high tide to approximate cyclones in a changing climate by 2050. The results show a 69% increase in area inundated by 3 m or more depth. Figure 8.6 shows the inundation risk map for 2050 under climate change.

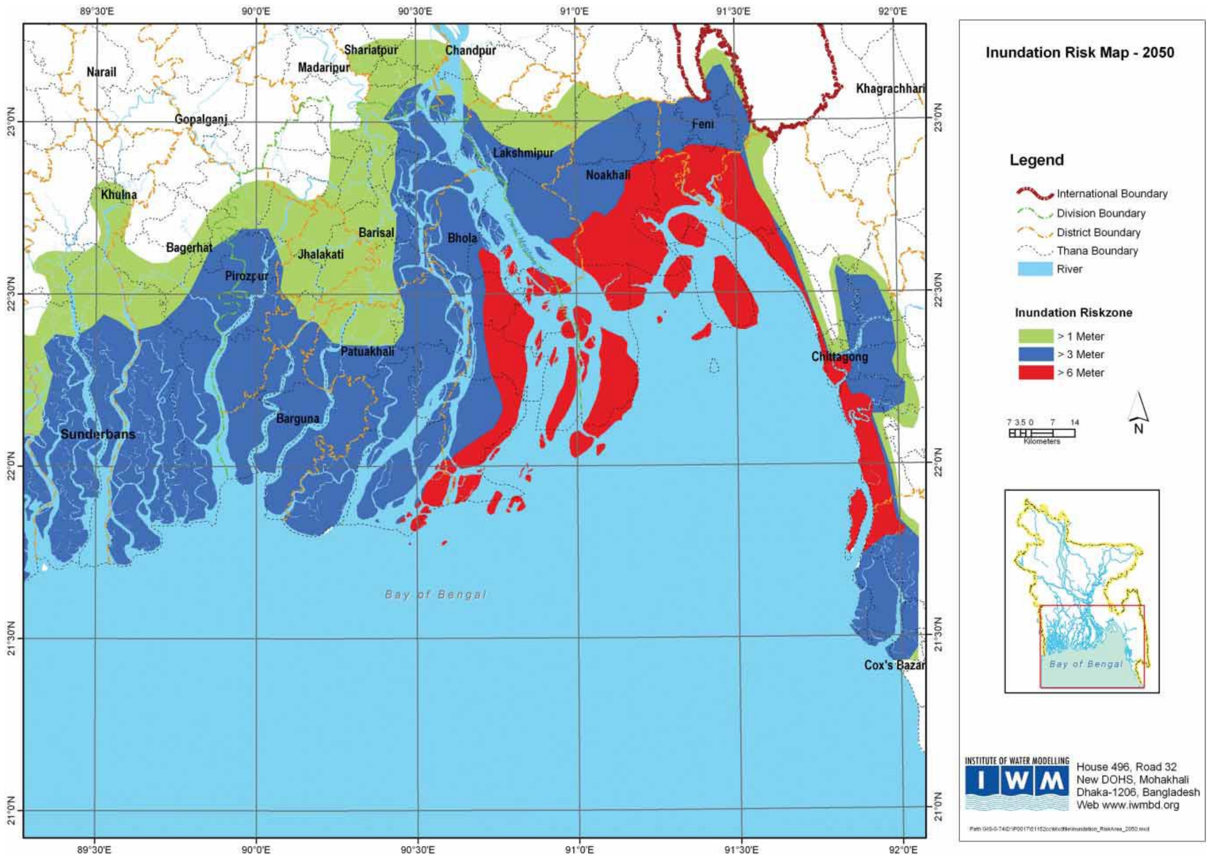


Figure 8.6: Storm surge High-risk area by 2050 under climate change

9 Cumulative and Reciprocal Impacts

9.1 General

596. Chapter 9 presents the analysis of cumulative and reciprocal impacts of the proposed Project and other projects in the area Cumulative Impacts of all CEIP-I interventions on Polder 41/1

597. To providing extra emphasis on frequent storm surges in the coastal area GoB has refocused its multi-phased strategy through CEIP. The long term objective of the project is to increase the resilience of the entire coastal population to tidal flooding as well as natural disasters by upgrading the entire embankment system. The embankment improvement and rehabilitation approach will be adopted over a period of 15 to 20 years and in this regard a total number of 17 polders have been selected through a participatory screening process. Among these 17 polders (shown in Figure 9.1), four polders (Polders 32, 33, 35/1, 35/3) were selected for rehabilitation works under the first phase of CEIP-1, which are being implemented. The other 12 polders would be implemented gradually in the later phases and they are located far away from polder 41/1. So, there will be no significant cumulative impact on it, however, the downstream polders exist outside the CEIP-1 polders may face hydrologicalcal impact, requiring increase of embankment height.

9.1.1 Synopsis of projects around Polder 41/1

598. Without CEIP interventions, there are some other development initiatives near Polder 41/1, implemented locally or regionally. Activities of these projects may generate cumulative impacts on this polder in future. Table 9.1 below shows a list of various projects in relevance with Polder 41/1, undertaken by different line agencies in Patuakhali and Barguna districts.

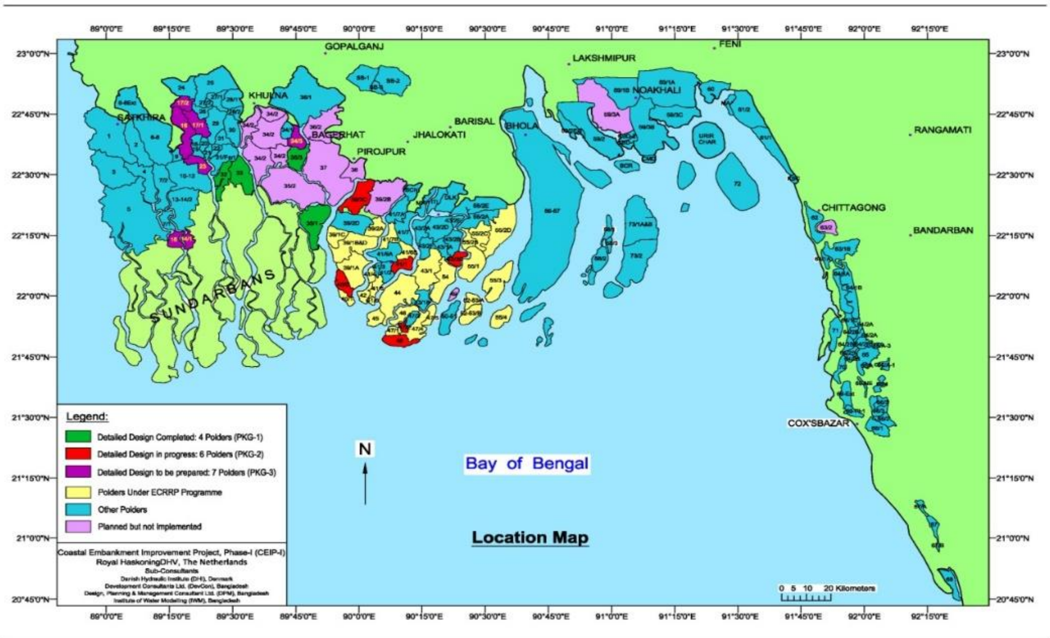


Figure 9.1: Locations of polders under CEIP-11

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

599. The projects (listed in **Table 9.1**) which have or may have low or moderate sensitivities on some of the environmental or social components of Polder 41/1 are briefly discussed in the following sections.

9.1.2 Cumulative Impacts of Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)

600. In order to upgrade from damage of 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 13 districts (Barguna, Bagerhat, Barisal, Khulna, Bhola, Pirojpur, Jhalokati, Noakhali, Feni, Chittagong, Patuakhali, Sathkhira, Laksmipur) of Bangladesh. Rehabilitation of embankments is a major component of the activities of this project. Among the 35 polders considered for rehabilitation under the project, Polders 41/6B, 43/1 and 44 have surrounded Polder 41/1. The design crest levels of these polders are: 4.57 mPWD above MSL for polder 41/6B, 4.57 to 5.18 mPWD above MSL for Polder 43/1 and 4.88 to 5.18 mPWD for polder 44.Polder 43/1 and 44 are situated downstream of Payra River (Figure 9.1) that will tend to divert the flow of Payra River further upstream and may transfer storm surge inundation risks. This may also increase the sediment load in Payra river as floodplains will be cut off from the river. Due to development of polders under ECRRP, the Payra River may undergo and the consequent shallow depth of this river will affect polder 41/1 in a number of aspects.

601. ECRRP also covers reconstruction and improvement of multipurpose shelters in all upazillas of Barguna district. Material and labor procurement for the construction of such shelters may influence the implementation of proposed interventions under CEIP-1 in polder 41/1.

9.1.3 Cumulative Impacts of all Blue Gold interventions

602. A total number of 12 polders in Satkhira, Khulna and Patuakhali districts have been selected for implementation in its first phase. Among these, polder 41/2 and 41/6A are situated very adjacent to Polder 41/1 and therefore may generate some impacts in future. The existing crest level of Polder 41/2 and 41/6A is 3.4-4.8 mPWD and 4.0mPWD above

Mean Sea Level respectively. Re-sectioning works are carried out along the periphery of these polders up to the design elevation of 5.18 mPWD. There would be more floodplain sedimentation adjacent to the upstream polders. This may result increase in sedimentation along the Payra River. 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 41/1. Furthermore, repairing of existing water control structures of Polder 43/2F under Blue Gold program would ensure reduction of dry season flow towards the polders 41/1. As such, surface water salinity, surrounding the Upper Payra Rivers may increase, which might affect the existing river ecosystem, as well as the multifaceted surface water use of Polder 41/1. Moreover, if any bank protection works are carried out in future in the aforementioned polder 41/2 and 41/6A, the morphological behaviour of Payra River may be changed. This might increase risk of river erosion in Polder 41/1.

9.2 Reciprocal Impacts of Climate Change and Polder Improvement

603. Reciprocal impacts of Climate Change and Polder improvement refers to the impacts occurred on polder due to climate change and vice versa. IWM used hydrodynamic models (MIKE 21) and analyzed the existing meteorological situation of the polder area. They have evaluated the physical changes in the relative polders, which may occur due to climate change. All data used in the model setup and calibration (including topography, soil maps, land use maps, and weather data, river network and cross-section, water level, discharge and salinity) were obtained from different sources. For Drainage Model, Rainfall Runoff Model and Water Flow Model IWM have used SWRM, NAM, Water Flow Model respectively.

604. In order to evaluate the reciprocal impacts of Climate Change and Polder improvement of Polder 41/1, both quantitative assessments and qualitative judgments have been applied. Two separate hydrological and hydrodynamic models have been setup and simulated using input data from climate and hydro-meteorology to assess the impact of climate change on some sensitive issues of the polder namely, water availability, flood security etc.

9.2.1 Impact of Increased Water Level

605. The rise in sea water level will affect the increase of the river water level outside of the polder area. The rainfall during the monsoon will be increased due to climate change which will result in an increase in extreme flow during monsoon that will ultimately result in an increase in water levels. Recently CEGIS (2014) conducted a study on climate change impact on stream flow for the GBM basin and found that the dry season flow will be reduced and monsoon flow will increase. For climate change there is a 15% reduction of dry season flow and 16% increase of monsoon flow for the Ganges basin. To understand the impact of climate change, the model was run for corresponding areas of Polder 41/1 to evaluate water level using climate change scenarios for the year 2050s. (Table 9.2)

Table 9.2: Water level of Peripheral river/canal of Polder 41/1 for 25 year return period with Climate Change

Sampling Point	Name of Khal on which Sluice is located	Chainage along the Embankment (Sluice location)	Water Level (mPWD)
111	Buriswar River	0+000	3.24
110	Buriswar River	5+370	3.17
109	Buriswar River	13+600	3.10

Source: IWM, 2016

606. It is observed that from table 9.2, the existing crest level (4.57 to 5.18 mPWD) of the embankment of Polder 41/1 is higher than the predicted (25-year) water levels due to climate change of the surrounding water bodies/khals. Tidal water would not be able to enter Polder 41/1 during monsoon period because of higher level of polder. As a result the nearby areas which are not protected (Amtali, Bamna) may be inundated and will be severely affected by cyclones storms in future.

9.2.2 Impact of Storm Surge Level

607. In total 38 number of storm surge model simulation results have been used in determining storm level for different return periods. The projection of storm surge level in the two locations (South-Eastern portion) of the Polder 41/1 considering with and without Climate Change are presented in Table 9.3. It is observed that in the 10 year return period surge levels with climate change will increase by 22% compared to the surge levels without climate change. For a 50 year return period the surge levels are predicted to increase by around 13%. Even with this increase, the design crest level of 4.5 mPWD is sufficient to protect Polder 47/2 against overtopping

Table 9.3: Storm surge level for different return period with and without climate change

Location	Location No.	Design Crest level (mPWD)	Surge Level (mPWD) in different Return Period (years) without Climate Change					Surge Level (mPWD) in different Return Period (years) with Climate Change (AR4)		
			Sidr	Aila	10	25	50	10	25	50
Barguna Sadar, Buriswar	110	4.50	3.7	2.58	2.40	3.17	3.75	2.93	3.73	4.32
Barguna Sadar, Buriswar	111	4.50	3.44	2.51	2.32	3.05	3.59	2.81	3.55	4.11

Source: IWM, 2016

9.2.3 Impact of Wave Height due to Climate Change

608. The significant wave heights during cyclonic conditions for different return periods with climate change effect around the Polder 47/2 are presented in the Table 9.4.

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

Station No.	Location	Significance wave Height (m) in Different Return Period (Years) with Climate Change					
		Sidr	Aila	10	25	50	100
110	Barguna Sadar, Buriswar	1.54	0.41	1.24	1.57	1.79	1.99
111	Barguna Sadar, Buriswar	1.14	0.41	0.85	1.15	1.37	1.59

Source: IWM, 2016

609. From the above table, it is predicted that wave heights increase in for duration return periods (i.e. 10 to 25 year return period) by up to 35% whereas for the long duration return periods (>25 years) wave heights are predicted to increase by up to 19%. The highest waves are found in the Sonatala River. Here the design crest level is 5.00 mPWD, sufficient to contain the projected 50-year return period wave height.

9.2.4 Climate Change Resilience Developed in Polder 41/1

610. 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, the insight of climate resilience has been developed within the polder habitants. Through the community mobilization in CEIP-1 program, local people have become more active towards building a climate resilient society. They are now driven by the concept of climate smart village. Most of the people who are able to afford are now re-building their houses and infrastructures on a relatively higher level. Local people claimed that they would use the excavated spoil from the internal khals for their household purpose if available. This will allow them to have their house and other infrastructures on a re-built higher land. The local farmers are now more concerned about climate change issues as well. They regularly follow and take part in the knowledge development and capacity building programs organized by CEIP, which they believe enhanced their understanding and preparedness on flood and disaster management.

10 Development of Environmental Management Plan

611. This Chapter presents the Environmental Management Plan (EMP) for the CEIP-I activities in the Polder 41/1.The EMP essentially provides the implementation mechanism for the environmental and social mitigation measures, discussed in Chapter-6.

10.1 Objectives of EMP

612. The basic objective of the EMP is to manage, prevent and mitigate potentially adverse impacts of Project interventions in the Polder 41/1. 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.
- Assess environmental training requirements for different stakeholders at various levels.
- Describe communication and documentation requirements.

10.2 EMP Components

613. The EMP components for this polder 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

614. These components are discussed in **Sections** below.

10.3 Institutional Arrangement

615. Clearly defined and functional institutional arrangements are essential for ensuring effective and sustainable implementation of the EMP, particularly the mitigation measures identified in the EIA. An Organogram showing the institutional setup of CEIP-1including organisation for implementation and monitoring of the EMP is shown in Figure 10.1.

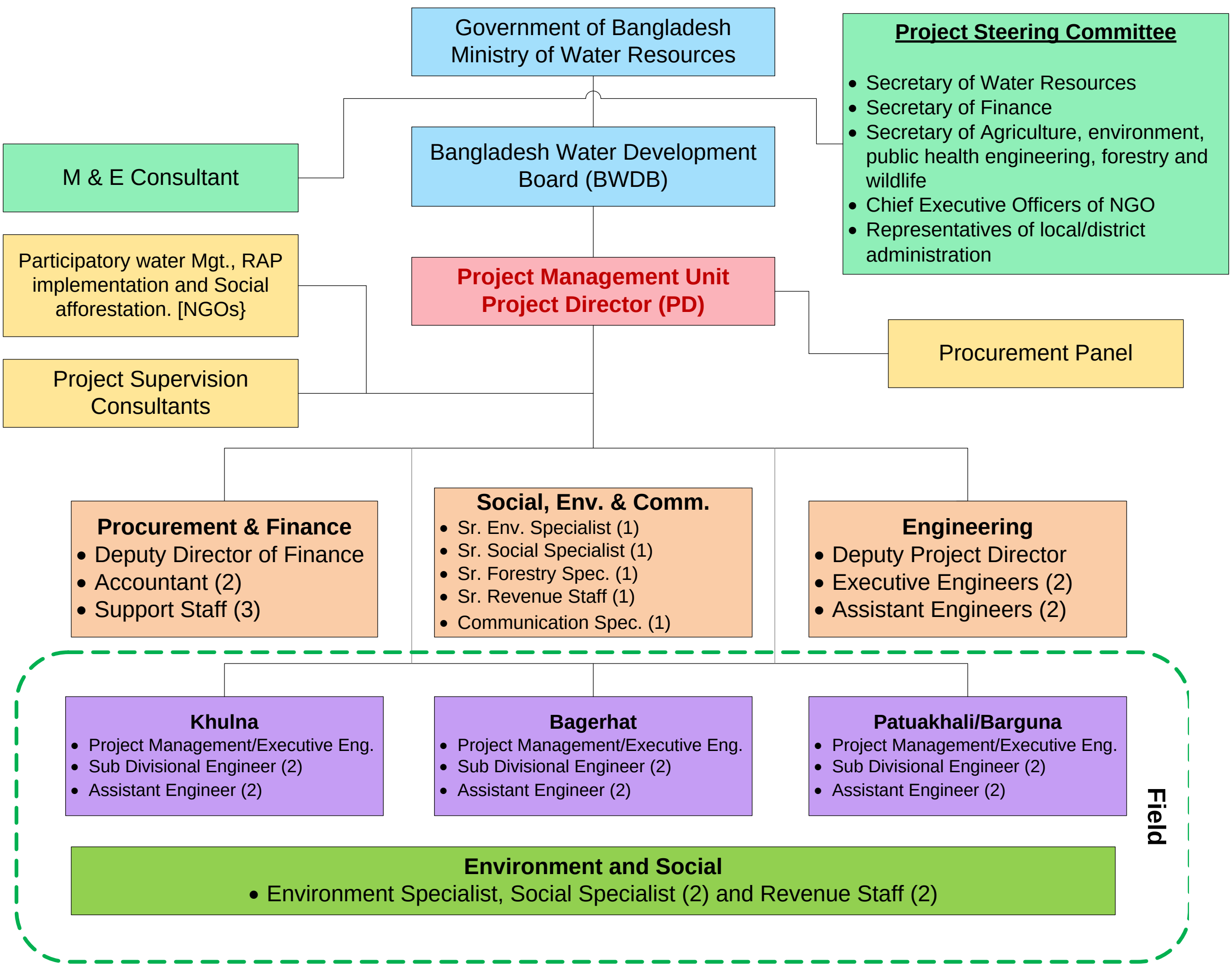


Figure 10.1: Organogram showing the institutional setup for CEIP-I

616. The institutional arrangements proposed to implement the EMP of Polder 41/1 are described in detail below.

10.3.1 Overall Responsibility

617. The overall responsibility of EMP implementation and fulfilling other environmental obligations during the Project rests with the Project Director (PD). For this purpose, the PD will be supported by environmental and social staffs of the PMU, DCSC and contractors.

10.3.2 Construction phase

Environment and Social Staff in PMU

618. As described in **Section 4.8**, the BWDB will set up the PMU to manage the Project implementation. The PMU will be led by the Project Director (PD). To manage and oversee the environmental and social aspects of the Project, the PMU will have an Environment, Social, and Communication (ESCU). The Unit will supervise compliance with and implementation of the EMP. The Unit will include a Senior Environmental Specialist. One environment specialist will be posted at the field level to support all three divisions. The ESCU will maintain liaison with WB safeguards team, regulatory agencies, and other

stakeholders during the Project implementation. The ESCU will also coordinate with the environmental staff of the DCSC. In order to manage the EA process and EMP implementation effectively, the ESCU will be established and made operational before awarding the contract to contractor. BWDB will update the EIA report, if necessary. The Mode of EMP implementation is shown in the figure-10.2 as follows:

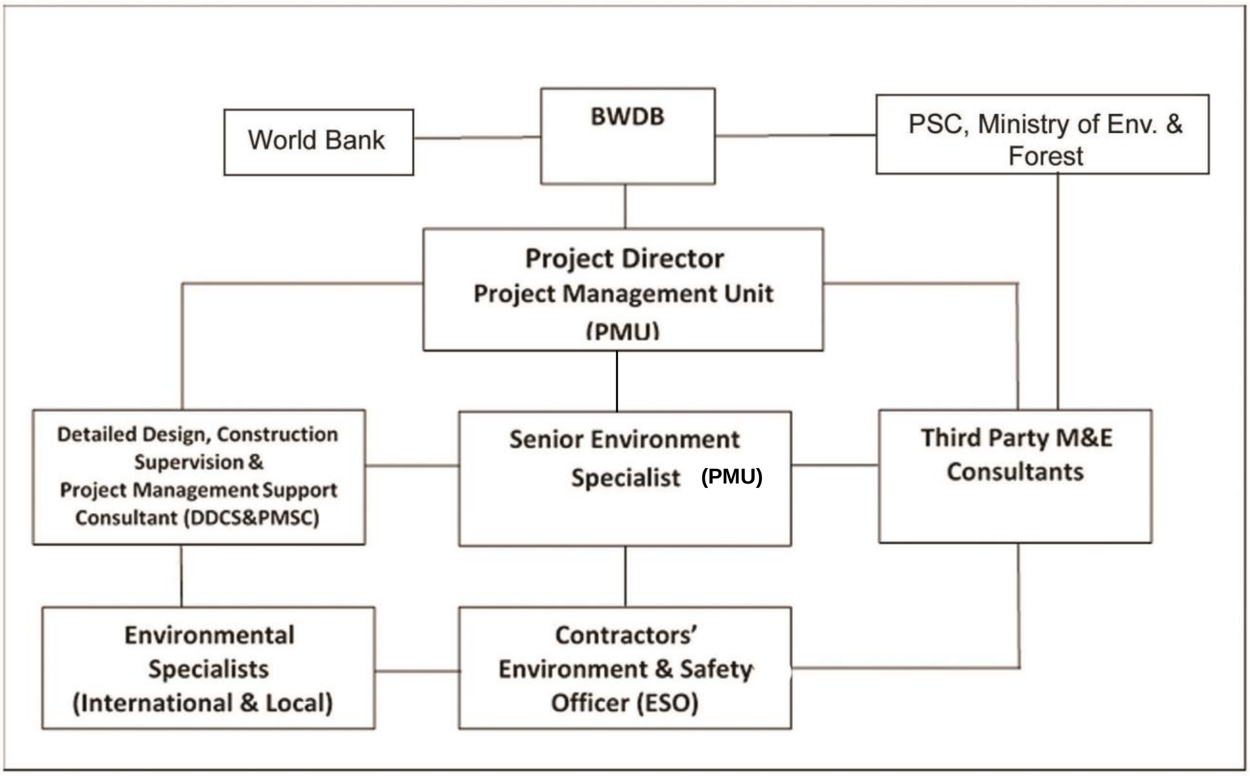


Figure 10-2: Organogram for Mode of EMP Implementation

Environment and Social Staff with DCSC

619. The DCSC will be responsible for the overall supervision of polder rehabilitation related activities. The DCSC will ensure quality control and report to the PD. The DCSC will also assist the ESCU for ensuring environmental compliance and monitoring of progress including EMP and/or ECoP implementation. The DCSC will supervise the contractors, ensuring design compliance and quality of works. For supervising the EMP implementation, DCSC will have dedicated and adequately qualified and experienced environmental staff including field-based environmental monitors (EMs). The DCSCwill supervise and monitor contractors to ensure compliance with the EMP. The DCSC environmental staff will maintain coordination with the ESCU for effective implementation of EMP and other environmental commitments and obligations of the Project.

Contractor's Environment Supervisors

620. 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 DCSC at the site level. The Environment Supervisors will also be responsible to conduct environmental trainings for the construction crews.

10.3.3 Post-construction Phase

621. The BWDB has 4 Assistant Chief and 2 Deputy Chief to oversee the overall environmental compliance of its implemented projects. Under CEIP-1, the ESCU will provide training to the BWDB people responsible for monitoring of environmental compliance. These staff will be responsible to manage the environmental aspects of the operation and maintenance of the Polder, its water control structures and other relevant issues such as protection of key environmental resources of the polder and maintan fish migration. Water Management Organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (Nov 2000) and involved in the beneficiary communities. WMOs will be trained up 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

622. Mitigation is an integral part of impact evaluation. Mitigation where deemed to be 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.

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.

623. Mitigation measures will be considered starting with Environmental Assessment process. It is therefore important, that there should be a good integration between the EIA team and project design engineers. Project specific environmental construction guidelines should be developed. These guidelines will specify precautions and mitigation measures for construction activities, and to be included with the EMP. An Environmental Construction guideline has been compiled in Appendix 10 of Environmental Management Framework.

624. 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 achieve an activity's objective
- stakeholders participation in finalizing mitigation measures
- construction practice, including labor welfare measures.
- operational control procedures
- management systems

625. 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 or soil borrowing areas for earthen material collection will be identified. • No objection from land owner/revenue authorities, as applicable will be in place • 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 the soil from close to the toe line on any part of the embankment is prohibited. Earth available from dredging as per design, may be used as embankment material (if necessary and applicable), subject to approval of the Engineer, with respect to the acceptability of the material. Borrowing to be avoided from the following areas: • Land close to toe line and within 0.5 km from the toe line. • Irrigated agricultural lands (In case of necessity for borrowing from such lands, the topsoil shall be preserved in stockpiles. • Grazing land. • Land within 1km of settlements. • Environmentally sensitive areas such as reserve forests, protected forests, sanctuary, wetlands. A distance of at least 500 m will be maintained from such areas. • Water-bodies (only if permitted by the local authority, and with specific pre-approved redevelopment plans by the concerned authority and engineer-in-charge) • Streams and sepage areas. • Areas supporting rare plant/ animal species. **Documentation of Borrow Pit** The contractor must ensure that following data base must be documented for each identified borrowing areas before commencing the borrowing activity that provide the basis of the redevelopment plan. • Chainage along with offset distance; • Area (sq.m); • Photograph and plan of the borrowing area from all sides; • Type of access/width/kutcha/pucca etc. from the roadway; • Soil type, Slope/drainage characteristics; • Water table of the area or from the nearest well, etc; • Existing land use, for example barren /agricultural /grazing land;

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Location/name/population of the nearest settlement from borrow area; • Quantity excavated (likely and actual) and its use; • Copy of agreement with owner/government; and • Community facility in the vicinity of borrow pit. • Rehabilitation certificate from the land owner along with at least four photographs of the rehabilitated site from different angles.
Excavation operation and Management of Excavated Material	To minimize the adverse impact during excavation of material following measures are receiving to be undertaken: • Adequate drainage system shall be provided to the excavated area • At the stockpiling locations, the Contractor shall construct sediment barriers to prevent any removal of excavated material due to runoff. The following precautions shall be undertaken during quarry operations. • Overburden shall be removed. • During excavation slopes shall be flatter than 20 degrees to prevent any sliding. • In case of blasting, the procedure and safety measures shall be taken as per DOE guidelines. • The Contractor shall ensure that all workers related safety measures are taken. • The Contractor shall ensure maintenance of crushers regularly as per manufacturer's recommendation. • During transportation of the material, measures shall be taken to minimize the generation of dust and to prevent accidents.
Handling Dredged Material from River Dredging	• Deposition of dredged material will be for away from the channel edge to limit damage to streamside habitats. This also allows a degree of flooding to occur on the floodplain, thereby creating opportunities for wet grassland, scrub/wet woodland, wetlands and seasonally grazed rough grass. • Apply biotechnical engineering where possible, for example geo-textiles, may be used to stabilize the material and aid re-colonization. • Other possibilities include: drying and spreading the spoil over the adjacent land, which can improve soil fertility in some cases, and also to other important flora and habitats; excavating a trench and 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).
Accumulate stagnant water/water logging	• Accumulation of stagnant water should not be allowed especially near the waste storage areas and construction camps • Discard all storage containers that are capable of accumulating water, after use or store them in inverted positions; • Reinstate relief and landscape; • Monitor drainage pattern after high down pouring and recession flood; • Connect water pockets to the nearest drainage structures/canals.
Soil erosion and siltation	The Contractor shall: • Spray water on the material stockpiles, access roads and bare soils as and where required on the basis to minimize dust emission. Increase the watering frequency during periods of high risk (e.g. high winds) • All working sites (except permanently occupied by the road and supporting facilities) will be reinstated to its initial conditions (relief, topsoil, vegetation

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	cover). • Ensure that roads used by construction vehicles are swept regularly to remove sediment
Dredging	• Disturbance can be minimized if mechanical excavators work from particular bank. If the channel is too wide, the digger must work within the channel. Disruption can be minimized by diverting the river down one side of the channel and dredging the other side while it is 'dry'. Smaller plant equipment generally limits the level of impact on the bank-side and in-stream habitats.
Construction activities in water bodies	• Protect water bodies from sediment loads by silt screen or bubble curtains or other barrier. • Do not discharge cement and water used for curing cement concrete directly into water courses and drainage inlets • Monitor the water quality in the runoff from the site or areas affected by dredge plumes, and improve work practices as necessary
ECoP 3: Air Management	
Construction vehicular traffic	The Contractor will • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner • Cover haul vehicles carrying dusty materials (cement, borrow and quarry) moving 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 the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. • Increase the watering frequency during periods of high risk (e.g. high winds). • Stored materials such as excavated earth, dredged soil, gravel and sand shall be covered and confined to avoid those being wind-drifted • Minimize the extent and period of exposure of the bare surfaces • Reschedule earthwork activities or vegetation clearing activities, where practical, if necessary to avoid during periods of high wind and if visible dust is blowing off-site • Restore disturbed areas/side of the embankment as soon as practicable by plantation/vegetation/grass-turfing • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations • Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems
Odor from Construction labor Camps	• Construction worker‘s camp shall be located at least 500 m away from the nearest habitation. • The waste disposal and sewerage system for the camp shall be properly designed, built and operated so that no odor is generated.
ECoP 3: Agriculture Management	
Loss of Top Soil	• Soil from fallow lands/ non-agricultural lands will be used in earthwork of

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	embankments • Collect/strip top soil before earth filling, store and reuse 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 soil are to be stockpiled with 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 from erosion • Spread the topsoil to maintain the physico-chemical and biological activity of the soil. • The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites • Topsoil stockpiles will be monitored and corrective measures are to be undertaken if any adverse condition is observed and the actions will include: • Anaerobic conditions-turning the stockpile or creating ventilation hole through the stockpiles • 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 practiced. • Environmentally and socially responsive shrimp farming e.g. shrimp-rice farming system is encouraged. • Increase of upland discharge of fresh water will push back ingress of saline water from the sea • Green manure application to be promoted • Ground water abstraction for shrimp farming will be avoided.
ECoP 4: Noise Management	
Construction vehicular traffic	• Maintain all vehicles in order to keep them in good working order in accordance with manufacturer’s maintenance procedures • Organize properly the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise at the work site.
Construction machinery	• Appropriately locate all noise generating activities to avoid noise pollution to local residents • Maintain all equipments in order to keep them in good working order in accordance with manufactures maintenance procedures.
Construction activity	• Notify adjacent landholders/Schools prior to any typical noise events outside of daylight hours • Employ best available working 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 06:00am within 500m from the exsting residences.
ECoP 5: Ecology Management	

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Flora	
Vegetation Clearance	• Tree felling will be performed upon preliminary notification to the relevant authority (District Forest Office, DoE). • Preparation of maps in GIS format, cadastral description of trees to be felled, marking, and supervision of Forest Department are necessary elements of the procedure. • Provide adequate knowledge to the workers regarding nature protection and the need of avoid felling trees during construction • Fruit and timber trees owned by local population will be compensated at their replacement cost according to market prices • Plant three saplings and maintain for at least three years for each tree felled
Plant Management	• Tree seedlings are to be planted in such a way that they minimize damage to the soil, while facilitating seedling survival. Appropriate tree seedling species are to be selected for maintaining long-term productivity. • Focus on tree species suitable for site condition. Prevent unreasonable species resulting in slow growth, less water and soil conservation and pest or disease outbreaks • Local species to be selected as planting materials, since natural selection and succession are most suitable for local climates and natural conditions along with people's selection and agreed with forestry's principles. • Ensure avoiding single species or clone monoculture
Planting	• Leave set back requirements around streams, restricted areas e.g. native vegetation, protected riparian strips, historic and heritage sites, research areas. • For nursery raising, physical and biological controls are practiced to control the pests and diseases in the nurseries. • 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
Pest Management to Nursery	• During an 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 introduction of new pests and diseases. • Share the plan with the Bank before application.
Water Management	• Install temporary sediment basins, where appropriate, to capture sediment-laden run-off from nursery • Divert runoff from undisturbed areas around the harvesting site • Stockpile of fertilizer or agrochemical 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 of construction • Limit the construction works within the designated sites allocated to the contractors • Not permitted to destroy active nests or eggs of birds or disturb animals • 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	

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Construction works in the rivers and on the surrounding lands	• Natural rivers channels will be reinstated after completion of construction works
Hydraulic Structure	• Sufficient free flow will have to be guaranteed in the design and construction work to ensure free passing of migrating fishes and other aquatic animals. • Hydraulic structures to be operated considering fish migration and spawning time • An area specific hydraulic structure operation guideline to be developed
Dredging	• Ensure that the dredging activity will create minimum sediment load in the water • Avoid dredging during the spawning period of fish
ECoP 7: Socio-Economic Management	
Construction Camp Management	
Siting and Location of construction Camps (MRDI, 2011)	• Locate the construction camps at areas which are acceptable from environmental, cultural or social point of view. • Consider the location of construction camps far away from the communities in order to avoid social conflicts 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 a detailed layout plan for the development of the construction camp submitted by the contractor. The plan will indicate the definite locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters
Construction Camp Facilities	The following facilities have to be provided by the contractor: • Adequate housing for all workers; • Safe and reliable water supply; • Hygienic sanitary facilities and sewage 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; • Do not establish site specific landfill sites. All solid wastes will have to be collected and removed from the working 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 locally procured 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

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	punishments on wildlife protection.
Health and Hygiene	• Provide adequate health care facilities within the construction sites; • Provide first aid facility round the clock. Maintain necessary stock of medicines in the facility; • Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals; • Ensure initial health screening of the laborers coming from outer areas; • Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work; • Provide HIV awareness programming, including STI (sexually transmitted infections); • 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 are not formed. Regular mosquito repellant sprays during monsoon are used; • 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 boards showing the minimum wages at camps and major construction sites in local languages will be placed; Wages will be paid to the laborers only in the presence of BWDB staff; • Contractor is required to maintain a register for payment of labor wages with entry of every labor working for him. He has to produce it for verification if required and asked by the Engineer, EMU and/or the concerned BWDB staff/Engineer‘s representative
Rehabilitation of Labor and Construction Camp	After completion of construction, all construction camp facilities shall be dismantled and removed from the site. The site shall be restored to a condition in no way inferior to the condition prior to commencement of the works. The activities to be carried out for site rehabilitation after completion of construction include: • Oil and fuel contaminated soil to be removed and transported and buried in waste disposal areas. • Soak pits, septic tanks to be covered and effectively sealed off. • Debris (rejected material) to be disposed of suitably. • Underground water tank in a barren/non-agricultural land to be covered. However, in an agricultural land, the tank shall be removed. • 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 to be done as necessary. This shall include the followings: • Photographs of rehabilitated site; • Land owners consent letter for satisfaction in measures taken for rehabilitation of site; and • Undertaking from the contractor; In cases, where the construction camp site is located on a private land holding,

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	the contractor would still have to restore the campsite as per this guideline. The rehabilitation is mandatory and will be included in the agreement with the landowner by the contractor. He would also have to obtain a certificate for satisfaction from the landowner.
Damage and Loss of Cultural Properties	
Conservation of Religious Structures and Shrines	• Necessary and adequate care shall be taken to minimize impact on cultural properties which includes cultural sites and remains, places of worship including temples, mosques, churches and shrines, etc., graveyards, monuments and any other important structures as identified during design and all properties / sites / remains notified. No work shall spillover to these properties and premises. The design options for cultural property relocation and enhancement need to be prepared. • All conservation and protection measures will be taken up as per design. Access to such properties from the road shall be maintained cleared and cleaned.
	• 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 of GoB shall be intimated of the chance find and the Engineer shall carry out a joint inspection with the Department. Actions as appropriate shall be intimated to the Contractor along with the probable date for resuming the work. • All fossils, coins, articles of value of antiquity and structures and other remains or things of geological or archaeological interests 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 International Labor Organization (ILO) convention. The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, books, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and outlet.
Risk from Electrical Equipment	• Adequate precautions will be taken to prevent danger/accidents from electrical equipment. No materials on any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Bangladesh Standards (BS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per BS provisions and to the satisfaction of the Engineer.
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, engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals.
Malarial Risk	• The Contractor shall, at his own cost, conform to all anti-malarial instructions given to him by the Engineer and the EMU, including filling up any borrow pits which may have been dug by him.
Disruption to Users	
Loss of Access	• At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock. Work that affects the use of existing accesses shall not be undertaken without providing adequate provisions to the

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	prior satisfaction of the Engineer. • The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, and any other access footpaths to or of properties whether public or private.
Traffic Management	• Special consideration shall be given in preparation of the traffic control plan to the safety of pedestrians and workers at night • The temporary traffic detours in settlement areas shall be kept free of dust by frequent application of water
Traffic Control and Safety	• The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the cross section.

10.5 Chance-Find Procedures for Physical Cultural Property

626. 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 artefacts 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 artefacts;; 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

627. Extensive monitoring of the environmental concerns of the CEIP-I 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 will be included in the EMP for specific sub-projects. Moreover, for all types 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.

628. The Monitoring activities during design/preconstruction periods are:

- checking the contractor's bidding documents, particularly to ensure that all necessary environmental requirements have been included; and
- checking that the contract documents' (Construction Environmental Action Plan) references to the environmental mitigation measures requirements have been incorporated as part of the contractor's assignment and making sure that any advance works are carried out in good time.

629. **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 unforeseen impacts are quickly discovered and remedied. This monitoring will be carried out by the Design and Supervision Consultants on a regular basis during and post-construction. Additional monitoring will be carried out by the Environmental and Social Unit.

630. Post Project Monitoring and Evaluation will be carried to evaluate the impacts of the Project during the 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 these activities, 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 are 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	
				To be Implemented by	To be 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 0.15m depth will be excavated and stored properly	Beginning of earthwork	Contractor	DCSC BWDB
	do	The stored top soils will be used as cladding	Immediately after filling and compaction of	Contractor	DCSC, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
		material over the filled lands	dredge materials		
	Work Site	Some of the top soil are placed on top and berm of embankment for turfing and plantation	At the end of filling activity	Contractor	DCSC, BWDB
Erosion	Side slopes of the embankments and material storage sites	Visual inspection of erosion prevention measures and occurrence of erosion	At the end of filling activity	Contractor	DCSC, M&E Consultant, BWDB
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	DCSC, BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DCSC, BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good and standard equipment are in use and dust suppression measures (spraying of waters) are in place.	Daily	Contractor	DCSC, BWDB
	Material storage sites	Visual inspection to ensure dust suppression work plan is being	Monthly	Contractor	DCSC

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
		implemented			
Air Quality (PM_{10}, $PM_{2.5}$)	Close to School/ Madrasha, Hospital & Villages	Air quality monitoring	Quarterly	Contractor through a nationally recognized laboratory	DCSC, M&E Consultant, BWDB
Noise	Construction sites	Visual inspection to ensure good standard equipments 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, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each polder	Sampling and analysis of surface water quality	Half Yearly	Contractor through a nationally recognized laboratory	DCSC, M&E Consultant, BWDB
Drinking Water Quality (TDS, Turbidity, pH, FC, as if groundwater etc)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality	Quarterly	Contractor through a nationally recognized laboratory	DCSC, M&E Consultant, BWDB
Sanitation	Construction camp/site	Visual Inspection	Weekly	Contractor	DCSC, M&E Consultant, BWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid waste and solid waste is deposited at designated site	Weekly	Contractor	DCSC, M&E Consultant, BWDB
Flora and Fauna	Project area	Survey and comparison with baseline environment	Half-Yearly	Contractor through nationally recognized	DCSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
				institute	
Cultural and archeological Sites	At all work sties	Visual observation for chance finding	Daily	Contractor	DCSC, M&E Consultant, BWDB
Reinstatement of Work Sites	All Work Sites	Visual Inspection	After completion of all works	Contractor	DCSC, M&E Consultant, BWDB
Safety of workers Monitoring and reporting accidents	At work sites	Usage of Personal Protective equipments	Monthly	Contractor	DCSC, M&E Consultant, BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each polder	Sampling and analysis of surface water quality	Quarterly	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	Quarterly	BWDB through a nationally recognized laboratory	M&E Consultant
Flora and Fauna specially fisheries	In the project area	Detail species assessment and compare with baseline	Half-Yearly	BWDB through a nationally recognized institution	M&E Consultant
Agriculture	In the project area	Compare the production with the baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant

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					
Plant Selection	Nursery	Visual inspection. Type and variety of plant species to be planted for turfing on the top of embankment and foreshore	Before plantation	Contractor	DCSC and M&E Consultants
Water Quality	Water bodies near nursery	Odor and chemical testing	Half yearly	Contractor through nationally recognized laboratory	DCSC and M&E Consultants
Waste Management	Work site and Nursery	Visual inspection of collection, transportation and disposal of grasses, debris and is deposited at designated site	Weekly	Contractor	DCSC and M&E Consultants
	Work site and Nursery	Visual inspection of Water bars & cut-offs sediment traps to prevent water pollution caused by run-off from harvesting areas	Beginning of work	Contractor	DDCS&PMSC, BWDB, M&E Consultant
Nursery Embankment Management	Nursery	Visual inspection of the height of embankment, possibility of water logging and connection to the waterbodies	Beginning of each nursery	Contractor	DDCS&PMSC, BWDB, M&E Consultant

Qualitative Spot Checking Indicators

631. Moreover, a rapid environmental monitoring will be carried out as per the following checklist in terms of visual judgment during field visit as a control of the implementation of the Environmental Mitigation plan. Table 10.4 can be followed during the construction phase.

Table 10.4: Spot Checking Indicator

Parameter	Visual Judgment			
	Poor	Moderate	Satisfactory	Comments
Workers Safety (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

632. 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 remedy.

10.7 Documentation, Record keeping and Reporting

10.7.1 Record Keeping

633. Proper arrangements are necessary for recording, disseminating and responding to information, which emerge, from the various environmental monitoring and management programs. These 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 a database of the polder specific Environmental Impact and Monitoring information for keeping all types of monitoring records. The ESCU will assist BWDB for keeping those records initially. The trained BWDB staff will take the responsibility of record keeping and monitoring during the operation phase.

10.7.2 Monitoring Records

Quantitative Physical Monitoring

634. The objective of quantitative physical monitoring is to ensure that the mitigation measures designed to prevent, reduce and where possible offset any significant adverse impacts on the environment are being implemented throughout the Project lifecycle. DCSC will regularly monitor and provide information to ESCU for updating the database. DCSC will provide the following information bi-weekly to ESCU, if not urgent.

- Sampling points;
- Dates and times of sample collection;
- Test results;

- Control limits;
- "Action limits" (about 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.
- The monitoring data would be continually processed as it is received, so as to avoid a build-up of unprocessed data.

General Site Inspections and Monitoring

635. 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, during the construction phase. The Site Inspection Checklist would be supported by sketches, as necessary.

10.7.3 Information Sources

636. A complete and up-to-date file of all relevant sources of information will be maintained by the ESCU of PMU. This file would be readily accessible and include, as a minimum, copies of the following documents:

- Current environmental permits and consents;
- Action to fulfil the requirement of annual site clearance for Polder area
- All relevant national regulations, international guidelines and codes of practice;
- Manufacturers' MSDSs for all hazardous substances used on the Plant;
- Manufacturers' operating manuals for all environmental monitoring equipment;
- Current calibration certificates for all the equipments that require calibration by an external organization; and
- The latest version of this Environmental Management and Monitoring Plan.

10.7.4 Non-Compliance Report

637. Any breaches of the acceptable standards specified, would be reported to the PMU using a standard form, i.e. a Non-Compliance Report (NCR).

638. 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 DCSC

639. The DCSC will prepare a monthly report for issuing to the ESCU of PMU. These reports will summarize the followings:

- Progress in implemention of this EMP;
- Findings of the monitoring programs, with emphasis on any breaches of the control standards, action levels or standards of general site management;
- Any emerging issue 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 Environmental Monitoring Report by BWDB

640. ESCU of BWDB will prepare the Bi-annual Environmental monitoring report during construction phase and will submit to the World Bank for review during construction phase. The monitoring report will include the status of environmental monitoring and the plan for the next six months. The report will summarize the information presented in Table 10.2, 10.3 and 10.**EMP compliance and Environmental Audit Report & Third Party Monitoring Report**

641. It is expected 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.

Third Party Monitoring

642. The Third Party Monitoring consultants will monitor the quality of environmental compliance and will share their findings with the World Bank.

Donor Agency/WB *Donor Agency/WB Monitoring*

643. The Donor Agency/WB will also monitor from time to time the quality of environmental compliance as part of their regular implementation support missions Guideline to Incorporate Environmental Management in Bid Document & Preparation of EAP

- Prepare cost estimates, to be incorporate in the 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 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 temporary and permanent cross drainage structures

are to be 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 Equipments (PPE), will be provide to staff and labor at 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 Guideline for Compensation and Contingency Plan during Project Period

644. Compensation becomes necessary when project impacts cannot be mitigated satisfactorily. This can be paid in cash or kind and the emphasis will 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 will be given as per provision of the Resettlement Action Framework. Any disputes over the compensation will be handled by the Grievance Redress Committee.

645. 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 be prepared 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

646. The estimated costs for the environmental management and monitoring activities are set out in **Table 10.5** below.

Table 10.5: Tentative Cost Estimates for Environmental Management and Monitoring

Item No.	Description	BDT	In thousand US$	Responsible Agency	Timeframe
1	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils	38,576	0.480	Contractor	Construction phase
2	Soil quality monitoring including N,P,K,S,Zn, salinity, organic Matter, pH etc. during pre-construction, construction and post construction period (10 samples in polder 41/1 during pre-construction, construction and post construction periods)= total 10 samplesx3 times @ Tk.5,000	150,000	1.875	BWDB in colaboration with DAE	Pre-construction, construction and post construction period
3	Habitat Observation for four (4) times of year (dry & wet season).	50,000	0.620	BWDB in colaboration with Upazila Fisheries Office	Construction and post construction period
4	Construction of fish sanctuary in perennial khals	100,000	1.250	BWDB in colaboration with Upazila Fisheries Office	Post construction period
5	Catch Assessment Survey for two (2) times of a year (dry & wet season).	142,500	1.781	BWDB in colaboration with Upazila Fisheries Office	Construction and post construction period
6	Farm Survey for four (4) times of year (dry & wet season).	60,000	0.750	BWDB in colaboration with Upazila Fisheries Office	Construction and post construction period
7	Awareness program on plant and wild life conservation.	100,000	1.250	BWDB in colaboration with Forest Office	Construction and post construction period
8	Consultancy services cost for supervision and monitoring of EMP	276,440	3.455	DCSC	Constructionan d post construction period
9	Training to the farmers with field demonstration regarding IPM and ICM.	80,000	1.000	BWDB in colaboration with DAE	Post construction period
10	Awareness building up to local community for conservation of threatened fish species.	40,000	0.500	BWDB in colaboration with Upazila Fisheries	Constructionan post construction period

Item No.	Description	BDT	In thousand US$	Responsible Agency	Timeframe
				Office	
11	Training to the fisherman / pond owner with field demonstration regarding pond culture.	40,000	0.500	BWDB in colaboration with Upazila Fisheries Office	Post construction period
12	Release fish fry in the khals inside the Polder after completion of construction works.	37,500	0.469	BWDB in colaboration with Upazila Fisheries Office	Post construction period
13	Air and noise quality monitoring and analysis.	200,000	2.500	BWDB in colaboration with DoE	Construction period
14	Solid and liquid waste disposal arrangement.	100,000	1.250	BWDB	Construction period
15	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1,500,000	18.750	BWDB	Construction and post construction
17	Consultancy services cost for river bank erosion monitoring	1,200,000	15.000	BWDB	Post construction period
18	Training to the Contractors regarding environmental management	100,000	1.250	BWDB in colaboration with DoE	Pre construction period
19	Training of Environmental awareness of local population	120,000	1.500	BWDB in colaboration with DoE	Pre construction period
20	Updating EMP as per requirement.	100,000	1.250	BWDB	Post construction
21	Construction of alternative or bypass channels at each construction sites.	1,061,053	13.263	BWDB and Contractor	Pre construction period
22	Materials for net pen culture (at least 25 households in each word/council of a Union).	972,000	12.150	BWDB in colaboration with Upazila Fisheries Office	Post construction period
23	Conservation and stocking of threatened fish species (at least 3 spots).	360,000	4.500	BWDB in colaboration with Upazila Fisheries Office	Post construction period
24	Monitoring of Aquatic mammal movement (Surfing, diving, migration, etc.).	100,000	1.250	BWDB in colaboration with Upazila Fisheries and Forest	Construction and post construction period

Item No.	Description	BDT	In thousand US$	Responsible Agency	Timeframe
				Office	
25	Campaigning and providing training on improved culture practices as well as the rice cum golda farming.	200,000	2.500	BWDB in colaboration with Upazila Fisheries Office	Post construction period
26	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	2,400,000	30.000	BWDB	Post construction period
27	Cost of Surface and ground Water quality monitoring cost (testing for TDS, pH, DO, BOD, Salinity etc. + test of As, Fe etc. for 10 samples in polder 41/1 during pre-construction, construction and post-construction periods + water quality analysis of HTWs of 34 workers' camp= (Tk.4,000x10x3) + (Tk.700X34)	143,800	1.798	BWDB in colaboration with DAE	pre-construction, construction and post-construction
28	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. 147,200x50	7,360,000	92.000	BWDB in colaboration with Forest Office	Post construction period
29	Water sprinkling at resectioned/newly constructed embankments (@ Tk.3,000 per km of enbankment	99,750	1.247	BWDB and Contractor	Construction period
30	WMOs monitoring cost	240,000	3.000	BWDB	Post construction period
Total Cost		**17,371,619**	**217.137**		

1 US$=80 BDT

10.10 Grievance Redress Mechanism

647. BWDB will establish a grievance redress mechanism (GRM) as a means to ensure social accountability and to answer to queries and address complaints and grievances about any irregularities in application of the guidelines adopted in this EMF for assessment and mitigation of social and environmental impacts. Based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly, saving the aggrieved persons from having to resort to expensive, time-consuming legal actions. The procedure will however not pre-empt a person's right to go to the courts of law.

10.10.1 Grievance Redress Focal Points

648. A Grievance Redress Committee (GRC) at the local level will be formed for each Union with union level representation to ensure easy accessibility by the project affected persons and communities. This local GRC will be the local focal points of the project GRM. The GRM sets out the information and communications strategy to ensure that PAPs and communities are fully informed about their rights to offer suggestions and make complaints. All grievances received through the GRM process will primarily be forwarded to the GRCs. The Secretariat for each GRC will be at the office of the Executive Engineer. If any grievance is not resolved at GRC, the aggrieved person may request the convener of GRC to forward the case to the Project Director at PMU. The GRC will officially forward the cases with their comments to the Project Director. Hearing of petitions with GRCs will be held at the Convener's office or at Union Parishad/Ward Councillor's office as agreed by the committee members. The membership of the GRCs will ensure proper presentation of complaints and grievances as well as impartial hearings and investigations, and transparent resolutions.

Membership of GRC

1. Executive Engineer (BWDB Division Office)	:	Convener
2. Representative of the RP Implementing NGO	:	Member-Secretary
3. Local UP Chairman /Ward Councillor: Member	:	Member
4. Teacher from the Local Educational Institution (nominated by Upazila Administration) Member	:	Member
5. Representative from the Local Women's Group: Member	:	Member
6. Representative from the PAP Group: Member	:	Member

649. Members of the GRCs will be nominated by the Executive Engineer at division level and approved by the Project Director, PMO, BWDB, Dhaka.

10.10.2 Grievance Resolution Process

650. 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 of the complaints.

651. 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 to review the grievance cases and assist Project Director in making decision. The ESCU will review the case records and pay field visits for

cross-examining and consult the GRC members and aggrieved persons, if required. If a decision at this level is again found unacceptable by the aggrieved person(s), BWDB can refer the case to the MoWR with the minutes of the hearings at local and headquarters levels. At the ministry level, decisions on unresolved cases, if any, will be made in no more than four weeks by an official designated by the Secretary, MoWR. A decision agreed with the aggrieved person(s) at any level of hearing will be binding upon BWDB. The GRM process flow chart are shown in Figure 10.3

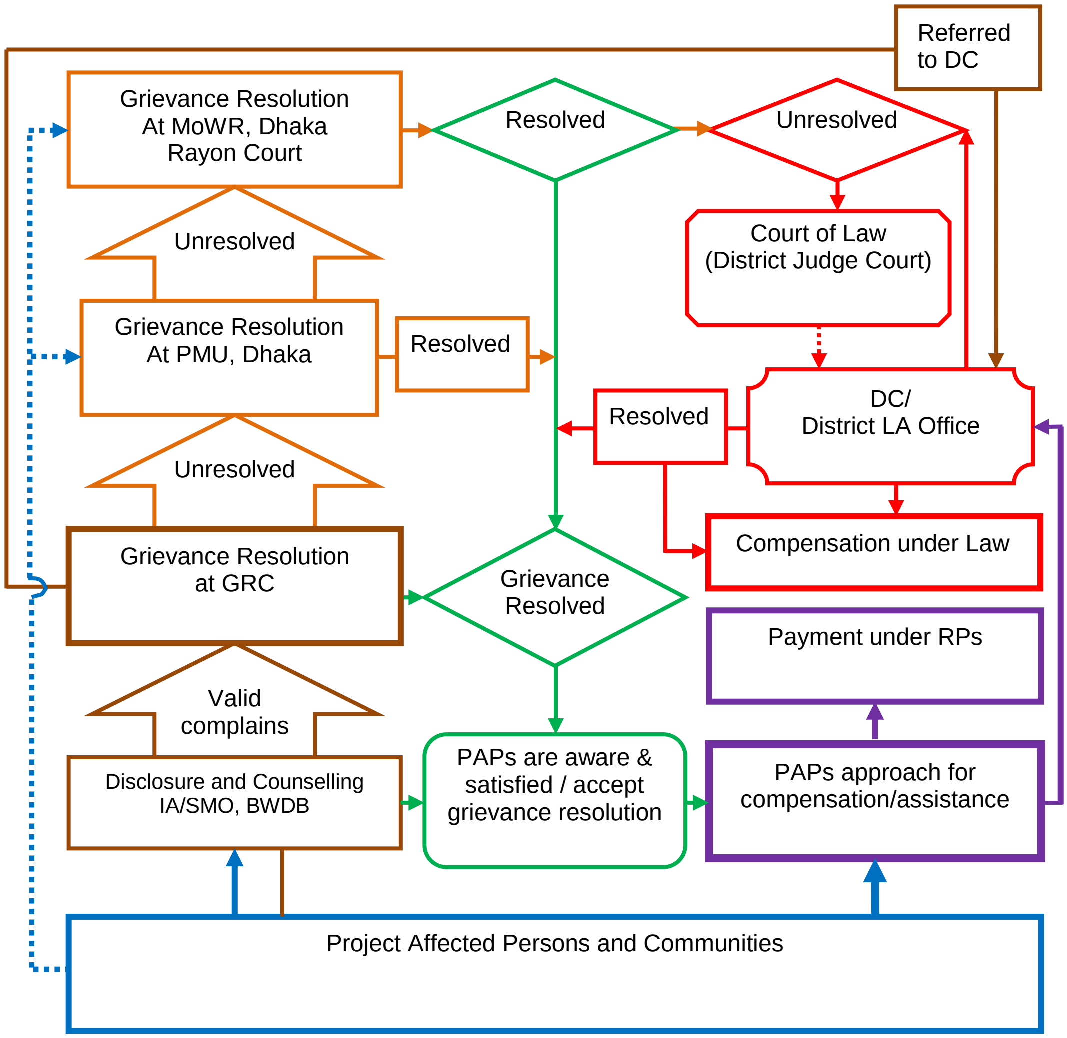


Figure 10.3: GRM Process Flow Chart

652. 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.

653. Disqualify a GRC member who has made a recommendation on the application separately before the formal hearing:

- A GRC member when is removed, 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.

10.10.3 GRM Disclosure, Documentation and Monitoring

654. 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.

655. 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.

656. Grievance resolution will be a continuous process in RP implementation. The PMO 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.

10.11 Capacity Building

657. 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. The PMU may revise the plan during the Project implementation as required.

658. 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 Trainings

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 & DCSCstaff	DCSC and 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 and 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 and Contractor	Before and during construction activities

659. Capacity building training programs will be undertaken in the following areas:

- 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 the preparation of Environmental Action Plan in line with the construction workplan
- Training of the WMOs on successful operation of hydraulic structures
- Training on structured format in reporting for all stages of implementation and those of relevant agencies who are involved in EMP implementation.

660. The training programs will be arranged before implementation of the interventions in the polder area. A detailed plan can be developed by the proposed ESCU of BWDB.

10.12 EMP Updating

661. The study infers that EMP has been developed assessing the impacts of interventions on the basis of baseline and prediction information. But monitoring has to be carried out to collect information on the impacts at actuality resulted due to construction of 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 an one time plan rather it is a plan which needs updating continuously.

11 Stakeholder Consultations and Disclosure

662. 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. Also included in the Chapter are the disclosure requirements for the EIA.

11.1 Overview

663. The GoB as well as international donors (e.g. the World Bank) place great importance on involving primary and secondary stakeholders for determining the environmental and social impacts associated with project implementation. In order to gather local knowledge for baseline conditions, understand perceptions of the community regarding impact significance, and propose meaningful mitigation measures, participation of stakeholders is an integral part of the EIA process. During the present EIA, an attempt has been made to consult with a full range of stakeholders to obtain their views on Project interventions.

664. 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 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 then once a draft EIA report is prepared.

665. 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

666. 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 an 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

667. Participatory approach was followed in conducting the public consultation meetings in the Polder 41/1. The consultants discussed first with the BWDB officials and then the Upazila Parishad Chairman (UZPC) and/or the Upazila Nirbahi Officers (UNOs) and the Project Implementation Officers (PIOs) of the polder area to share the Feasibility and EIA process of the CEIP-1. The BWDB and local government officials/representatives were consulted to identify the potential stakeholders at the Polder level. With the available support 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.

668. Focus group discussions (FGD) were carried out during 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 opportunity to all participants attending in the meeting. During the consultation meetings all relevant issues within the water resources, land resources, socio-economic resources, and disaster aspects were discussed in detail.

669. 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 41/1 were asked to share their needs, problems, possible sustainable solutions, and their views on the Project interventions. The stakeholders' perceived views on important environmental and social components (IESCs) and Project's impacts on them, along with perceived benefits, risks, threats and demand from the Project were identified during discussions.

11.4 Identification of Stakeholders

670. Stakeholders include all those who 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.

Primary Stakeholders

671. Primary stakeholders are people who would be directly benefited or impacted by a certain project intervention. In case of the proposed Project in Polder 41/1, the primary stakeholders include the people living within the Project area particularly those 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.

Secondary Stakeholders

672. This category of stakeholders pertains to those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project aspects. In this Project NGOs, concerned government departments, and line agencies fall under this category.

673. Secondary stakeholders for the Project include local government institutions (LGI), Bangladesh Water Development Board (BWDB), 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

674. Venue, date and time of meetings were selected through the consultation with local people, the project proponent and the consultant. These three groups selected the an agreed venue considering the closeness to the proposed project, easy accessibility to the venue and which is likely to be neutral. Date and times were also finalized in this way considering availability of the participants, ensuring the maximum participation, weather and compliance with the other arrangement.

Enlisting and Invitation

675. 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.

676. A formal invitation was sent to them and also communicated over telephone for ensuring their presence in the meeting.

Consultation Instrument

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 (checklist is attached in **Appendix -F).**

Attendance list: An inventory of the participants was maintained in attendance sheet containing contact numbers. Scanned list of participants is attached in **Appendix G.**

Camera: For visualizing the participants, photographs were taken using camera. These photos were presented in this chapter. Photos of the meeting participants are presented at the end of this chapter.

Consultation Process

677. The study team conducted the meeting. During consultation meeting, the following process was followed with sequences.

Greetings: At the outset, the team spelled greetings to all participants. Welcomed them for attending and stated the entire design of the meeting.

Introduction: The team members introduced themselves to the participants and gave detail description of the project, spelled out the objectives and anticipated outcomes of the meeting.

Respect to the participants: The study team showed respect to all participants. They showed respect not only to the individuals but also to their values, cultural practices and social structures.

Ensuring peoples' voice: Generally, all participants cannot participate equally. In fact, a substantial number of participants tended to remain silent in any meeting. However, the study team encouraged all to participate willingly through explaining the ethics of the study.

Note taking: discussed issues and opinions were written in notebook carefully. All issues were given equal importance.

Recapitulation and closing the session: At the end, the study team recapitulated the session and responded to the quarries. Finally, the facilitator closed the session thanking the participants.

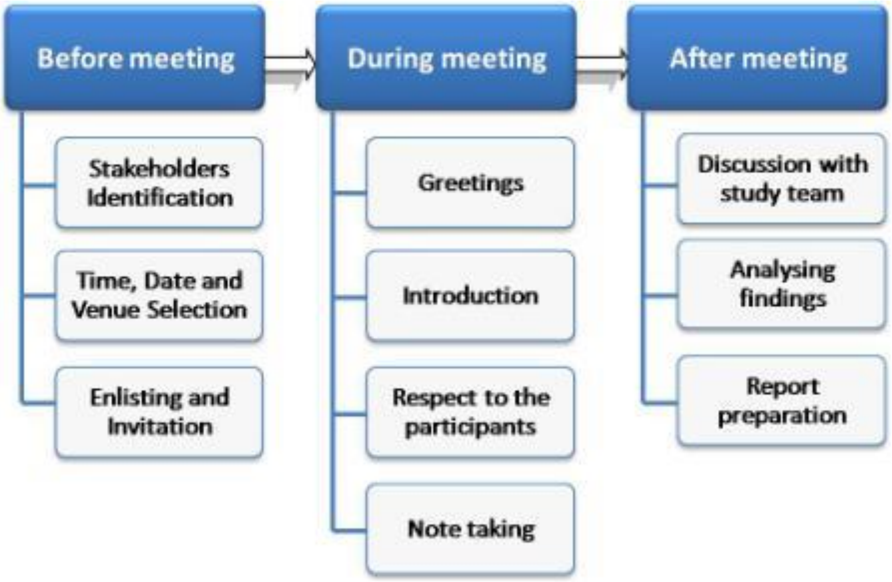


Figure 11.1: Overall consultation process

11.5 Public Consultation Meetings and FDGs

11.5.1 Consultation Process

678. A number of public consultation meetings and FGDs were conducted at different locations of Polder 41/1. The details of these meetings and FDGs are presented in

Table 11.1 and some photographs of these meetings are given in **Picture 11.1** to **11.4**

Table 11.1: Meeting venue including time and date

Sl	District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
1	Barguna	Barguna sadar	Burir Char	Burir Char union conference room	PCM	11/08/15	10:00 AM
2	,,	,,	Barguna sadar	Barguna sadar upazila conference room	,,	12/08/15	01:00 PM
3	,,	,,	Burir Char	Burir Char Bazaar	FGD	23/06/15	10:00 am
4	,,	,,	,,	Keorabunia Bazaar	FGD	,,	12:00 pm
5	,,	,,	Aylapatakata	Aylapatakata Bazaar	,,	24/06/15	10:00 am

Source: PCM Team of CEGIS

11.5.2 Consultation Participants

679. The main participants of the consultation meetings included public representative, farmer, trader and daily-wage laborers of the Polder 41/1 and nearby areas. A total of 140 participants attended these consultations. The participant details are provided in **Table 11.2** and list of participants are presented in **Appendix-6.**

Table 11.2: Participant Details

Sl	Meeting venue	Type of consultation	Type of Participants	No. of participants
1	Burir Char union conference room	PCM	Secondary and Primary stakeholders	50
2	Barguna sadar upazila conference room	,,	,,	57
3	Burir Char Bazaar	,,	,,	10
4	Keorabunia Bazaar	FGD	Primary stakeholders	12
5	Aylapatakata Bazaar	,,	,,	11

Source: PCM Team of CEGIS




Picture 11.1: PCM at Barguna sadar Upazila Auditorium

Picture 11.2: PCM at Burir Char Union Auditorium

11.6 Issues discussed in FGDs and Meetings

680. 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 was shared with the participants. Subsequently, the key environmental, social, and socioeconomic aspects listed below were discussed.

Water resources:

- Surface water (tidal flooding, drainage, salinity, siltation)
- Water management (flood control, drainage, irrigation)

Land resources:

- cropping practice,
- production and yield,
- water logging and drainage congestion
- crop damage.

Socio-economic aspects:

- Occupation and Employment (unemployment/joblessness)
- Migration (temporary/permanent out-migration)

- Poverty (food and income, poverty)
- Education (poor literacy rate, non-schooling, less female education, drop out etc)
- Health and nutrition (illness, diseases, poor nutrition)
- Quality of life (poor housing and sanitation facilities, scarcity of drinking water, fuel and fodder)

Disasters:

- Cyclones
- River erosion
- Associated damages

The sustainable and integrated solutions of the main problems being faced in the Polder:

- Water resource management
- Agriculture and fisheries management
- Land resource management
- Disaster management.

11.7 Community Concerns and Suggested Solutions

681. 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 makes them clearer about the objectives and process of the project.

11.7.1 Attitude to the project

682. The communities including the persons to be affected by the Project expressed their views in favour of the Project and wanted early implementation to protect them from the tidal surges and disasters such as Aila and Sidr.They demanded adequate compensation and other benefits for the loss of their assets and livelihood, as well as alternative place for relocation of their houses and business.

Picture 11.3: FGD at Ayla Patakata and Keorabunia bazaar

Picture 11.4: FGD at Burir Char Bazaar and Paschim Burir Char

683. 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, erosion, Salinity intrusion, water logging due to siltation at certain parts of the polder, scarcity of drinking water 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.
Water resources	- Tidal Flooding, Storm surge, Salinity intrusion, River erosion	- Proper maintenance and management of the water control structures should be made sure - Re-sectioning of the embankment to protect erosion and embankment breach - Abolish embankment should be repaired with CC block - Backing of the embankments must include slope protection and strong afforestation on the foreshore area - Strong design with high quality construction materials are to be used for construction works
Agriculture resources	- Crop damage due to drainage congestion and water logging. - Lack of fresh irrigation water during dry season due to siltation of rivers and internal khals	- Re-excavation of rivers and khals as per design level. - Connecting the khals with rivers. - Repairing and constructed of control infrastructures should be made sure - Repair the embankment as per design level. - Regular operation and maintenance the regulators.
Fishery resources	- Reducing depth of internal khals and habitat quality degradation due to siltation - Fish and hatchling movement	- Re-excavation of khal will help to increase the richness of fish species in the polder area. - Application of fisheries rules and

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
	disrupted due to properly operation of water control structures. - Indiscriminate fishing by Sluice net - Entrance of saline water	regulation by the government strongly - Repairing embankment with reasonable height. - Take necessary action to stop illegal way to catching fish.
Ecological resources	- A number of trees would be felled and existing undergrowth vegetation would be damaged at construction sites for implementation of project activities - Lack of foreshore afforestation accelerate bank erosion as well as destruction of embankment by tidal surge	- Keep compensation to the proper owners/authorities against tree felling - Implement social afforestation along the embankment slopes - Proposed afforestation plan would arrest the vulnerabilities of embankment and protect bank erosion from tidal surge
Socio-economic resources	- At least 1300 no of HHs will be displaced and their life and livelihood may be hampered. - Communication system is a vital issue of this polder. Main roadway communications are in extremely poor condition (existing embankment cum road) due to river erosion. - Lack of adequate expertise and experienced manpower to carry out the O&M of the Polder and the numbers of field staffs are also insufficient and inadequate in some places of the polder with respect to the actual requirement.	- Ensure proper resettlement of those household, which may be affected by the project intervention. - Rehabilitation of affected people should be done in a proper way. - The embankment cum road should be repaired immediately in places where it was damaged by river erosion. - Strengthening of WMGs so that mass people can access to open water bodies easily. - Need awareness building about water management , health and sanitation among the communities;

11.8 EIA Disclosure

684. The EIA report and Bengali translation of its executive summary was disclosed to the public on 8th December (from 10:00am to 13:00pm), 2016 in Barguna Sadar Upazila, Barguna. 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.

685. The participants of the PDM include Mayor, Barguna Paurashva, Upazila Nirbahi Officer (UNO), other concerned government officials, Journalists, NGO representatives, environmentalists and activists, local stakeholders and other representatives of CEGIS (**Appendix-7**). A total of 52 participants attended the public disclosure meetings. The findings of the Public Disclosure Meeting (PDM) and some photographs of the meeting are given in **Photo 11.4.**

Photo 11.4: PDM at Upazila Auditorium, Barguna Sadar, Barguna

Findings of the PDM:

686. The communities including the persons to be affected of polder 41/1 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 embankment of polder 41/1 is inside the Barguna town which is the only way for the communication of the people. The proposed flood wall may interfere with the physical communication of the people and therefore the proposed project should be implemented very rapidly. Besides, the embankment has to be refurbished through carpeting.
- Other possible harms that may cause due to the polder work have to be evaluated and clarified.
- The impact of flood wall on the roads and pathways inside the town and their possible outline should be given special consideration.
- Tree plantation need to be increased.
- Most of the sluice gates have been dysfunctional. These gates need to be operational.
- Adequate compensation for people who may be affected by the project activities has to be ensured.
- 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
- New embankment is required to be constructed by developing village road.
- Peripheral river should be re-excavted

National Dissemination Seminar

687. 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.

688. 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 11.5: 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

689. 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.

690. 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.

691. The minutes of the dissemination seminar containing inter-alia the Comments and Responses is provided in Appendix-16.

11.9 Framework for Consultations during Project Implementation

692. The stakeholder consultation is a continued process, and should be maintained throughout the project. The consultations carried out during the present EIA and reported in this Chapter are essentially a first step in this process. During the subsequent project phases as well, participation of the project stakeholders need to be ensured. **Table 11.4** charts out the proposed participation framework during different project Phases.

Table 11.4: Participation Framework

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
Project Design Phase	Meetings with institutional stakeholders (carried out during the present EIA and RAP preparation); Meetings with grassroot stakeholders (carried out during the present EIA and RAP preparation)	Institutional stakeholders; Grassroot 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; Grassroot stakeholders, including the communities to be affected during the project implementation.	BWDB; Supervision Consultants; Contractors
	Consultations and liaison	The communities around the work sites, borrow areas, and access routes	BWDB; Supervision Consultants; Contractors
	Grievance Redressal Mechanism and Social Complaint Register (discussed later in the document).	The affected communities.	BWDB; Supervision Consultants; Contractors
	Consultations with the communities during Compliance Monitoring and Effects Monitoring (discussed later in the document).	Affected communities.	BWDB; Supervision Consultants; Contractors
	Consultations with the project affectees / communities during the external monitoring (discussed later in the document).	Affected communities.	External monitoring consultants.
	Consultations with the project affectees / communities during the site visits by the WB monitoring mission.	Project site staff; Contractors; Affected communities.	WB monitoring mission.
Project Operation Phase	Community participation in O&M activities (see **Section 4.9**)	Institutional stakeholders; Grassroot stakeholders, including the beneficiary communities.	BWDB

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Appendix 1: Construction Schedule

Part A

Sl No	Description	Year One								Year Two			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)												
2	Construction of embankment (km)												
3	Construction of Drainage Sluices (No)												
4	Construction of Flushing Inlets (No)												
5	Bank and Slope Protection Works (km)		Manufacture of cc blocks and procurement of hard rock										
6	Re-excavation of Drainage Channels (km)												
7	Repairing of Drainage Sluices and Flushing Inlets												
8	Constructing Roads												
9	Other works, including surveys, quality checks, testing, inspections and the like												

Part B

Sl No	**Description**	**Year Two**								**Year Three**			
		May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**
1	Re-sectioning of Embankment (km)					Turfing							
2	Construction of embankment (km)												
3	Construction of Drainage Sluices (No)												
4	Construction of Flushing Inlets (No)												
5	Bank and Slope Protection Works (km)												
6	Re-excavation of Drainage Channels (km)												
7	Repairing of Drainage Sluices and Flushing Inlets												
8	Constructing Roads												
9	Other works, including surveys, quality checks, testing, inspections and the like												

Part -C

Sl No	Description	Year Three								Year Four			
		May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**
1	Re-sectioning of Embankment (km)												
2	Construction of embankment (km)												
3	Construction of Drainage Sluices (No)												
4	Construction of Flushing Inlets (No)												
5	Bank and Slope Protection Works (km)												
6	Re-excavation of Drainage Channels (km)												
7	Repairing of Drainage Sluices and Flushing Inlets												
8	Constructing Roads												
9	Other works, including surveys, quality checks, testing, inspections and the like												
10	Site clearance and clean up												

Source: CEIP-I Design Study Finding

Appendix 2: No Objection Certificate

৬নং বুড়িরচর ইউনিয়ন পরিষদ কার্যালয়

ডাকঘর.বরগুনা,উপজেলা ও জেলা বরগুনা

স্মারক নং- তারিখ- ২২/০৮/১৫

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য 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 ঃ

৪। প্রকল্পের অবস্থানগত ঠিকানা ঃ ৪১/১ বরগুনা জেলার সদর উপজেলায় অবস্থিত।

৫। প্রকল্পের তফছিল ঃ

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
বরগুনা	বরগুনা সদর				মাঝারি উচু ভূমি	হেক্টর

৬। প্রকল্পের কার্যক্রম ঃ বাঁধ উচুঁকরন, স্লুইজ গেট ও রেগুলেটর মেরামত, খাল পুনঃখনন ইত্যাদি।

উপরোক্ত তথ্যাদির আলোকে পোল্ডার ৪১/১ পুর্নবাসন 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 নির্বাপিক 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।

তারিখ ঃ
সীলঃ

স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও

মোঃ সিদ্দিকুর রহমান
চেয়ারম্যান
৬নং বুড়িরচর ইউনিয়ন পরিষদ
বরগুনা সদর,বরগুনা।

Appendix 3: Standard for Physico- Chemical Properties of Soil

Table 1a: Soil Salinity (ECe) class and soil reaction (p^H^)

Characteristics	Salinity range (ECe=ds/m)*	Characteristics/Soil reaction class	pH range
Non Saline	0-2.0	Very strongly acidic	<4.5
Very Slightly Saline	2.1-4.0	Strong acidic	4.5-5.5
Slightly Saline	4.1-8.0	Slightly acid	5.5-6.5
Moderately Saline	8.1-12.0	Neutral	6.6-7.3
Strongly Saline	12.1-16.0	Slightly alkaline	7.4-8.4
Very Strongly Saline	>16.0	Strongly alkaline	8.5-9.0
		Very strongly alkaline	>9.0

Source: Soil and Land Utilization appraisal, SRDI; 1999

Table 1b: Classification of nutrient elements based on chemical properties of soil

Nutrient element	Very Low	Low	Medium	Optimum	High	Very high
OM (%)	<1.0	1.0-1.7	1.8-3.4	-	3.5-5.5	>5.5
N(%)	≤0.09	0.091-0.18	0.181-0.27	0.271-0.36	0.361-0.45	>0.45
P(µg/g)(Olsenmethod)	≤7.5	7.51-15.0	15.1-22.5	22.51-30.00	30.1-37.5	>37.5
K (meq/100g)	≤0.09	0.091-	0.181-0.27	0.271-0.36	0.361-0.45	>0.45
s(µg/g)	≤7.5	7.51-15.0	15.1-22.5	22.51-30.00	30.1-37.5	>37.5
Zn(µg/g)	≤0.45	0.451-0.9	0.91-1.35	1.351-1.8	1.81-2.25	>2.25

Sources: Fertilizer Recommendation Guide, BARC, 2012

Appendix 4: Major Tree composition at of water control structures

Structure ID	Location	Existing Tree	
		Species Name	**No. of trees**
FS1	Purba Kewrabunia	Kola *(Musa sp)*	10
		Mahagani *(Swietenia mahogoni)*	1
DSD4	Charnalia Sluice	Kanthal *(Artocarpus heterophyllus)*	3
		Raintree *(Samanea saman)*	5
		Kola *(Musa sp)*	50
		Supari *(Areca catechu)*	4
		Aam *(Mangifera indica)*	4
		Mahagani *(Swietenia mahogoni)*	4
		Bilati Gaab *(Diospyros discolor)*	10
		Jamrul	1
		Bot *(Ficus benghalensis)*	1
		Kath Badam	2
		Piyara *(Psitium guajava)*	1
FS2	Purba Kewrabunia Doctorbari	No	0
FS3	Purba Kewrabunia	No	0
FS4	Purakata	Kola *(Musa sp)*	30
		Narikel *(Cocos nucifera)*	1
		Babla *(Acacia nilotica)*	1
		Khai Babla (*Pithecolobium dulce)*	1
		Shishu *(Dalbergia sissoo)*	2
FS5	Purakata 8 No. Ward	Kola *(Musa sp)*	50
		Narikel*(Cocos nucifera)*	2
		Khejur *(Phoneix sylvestirs)*	5
		Aam *(Magnifera indica)*	2
FS6	Purakatla Bazar	Kola *(Musa sp)*	40
		Amra (*Spondias pinnata*)	1
FS7	Burirchar Ferryghat	Kola *(Musa sp)*	20
		Babla *(Acacia nilotica)*	2
		Mahogony *(Swietenia macrophylla)*	4
FS8	6 No. Burir Char	Shishu *(Dalbergia sissoo)*	12
		Kola *(Musa sp)*	8
		Ora (*Sonneratia caseolaris*)	1
DS5	Daskhin Burir Char	Kola *(Musa sp)*	30
		Raj Koroi *(Albizia richardiana)*	4
		Mahogony *(Swietenia macrophylla)*	2
DS3	Charakgachia	Raintree *(Samanea saman)*	4
		Aam *(Magnifera indica)*	3

Structure ID	Location	Existing Tree	
		Species Name	No. of trees
		Supari *(Areca catechu)*	10
		Narikel *(Cocos nucifera)*	1
		Tentul *(Tamarindus indica)*	1
		Mahogony *(Swietenia macrophylla)*	31
		Kola *(Musa sp)*	45
		Jaam *(Syzygium sp.)*	1
		Bilati Gaab *(Diospyros discolorl)*	10
FS24	Daskhin Eitabaria	Jiga *(Lennea coromandelica)*	2
		Khejur *(Phoneix sylvestirs)*	1
		Kola *(Musa sp)*	30
FS25	Daskhin Eitabaria	Bansh *(Bambusa sp.)*	50
FS27	Daskhin Eitabaria	Aam *(Magnifera indica)*	3
		Mahogony *(Swietenia macrophylla)*	5
		Bel *(Aegle marmelos)*	1
		Kola *(Musa sp)*	10
		Kanthal *(Artocarpus heterophyllus)*	2
		Gaab *(Diospyros perigrina)*	1
		Jambura *(Citrus fistula)*	2
		Raintree *(Samanea saman)*	1
FS26	Daskhin Eitabaria	No	
DS2	Sonakhali Bazar	Kola *(Musa sp)*	120
		Jiga *(Lennea coromandelica)*	2
		Pitali (*Aphanamixis polystachya*)	2
		Supari *(Areca catechu)*	21
		Narikel *(Cocos nucifera)*	4
		Khejur *(Phoneix sylvestirs)*	1
		Taal *(Boassus flabelifer)*	1
DS1	Boro Labongola	Kola *(Musa sp)*	60
		Raintree *(Samanea saman)*	16
		Raj Koroi *(Albizia richardiana)*	15
		Mahogony *(Swietenia macrophylla)*	3
FS14	Manik Khali	Kola *(Musa sp)*	40
		Khejur *(Phoneix sylvestirs)*	8
		Khai Babla *(Pithecolobium dulce)*	5
		Kul Boroi	1
		Shishu *(Dalbergia sissoo)*	3
		Akashmoni *(Acacia auriculiformis)*	1
FS13	Choto Labongola Miabari	Kola *(Musa sp)*	30
		Dumur *(Ficus religiosa)*	10
		Jiga *(Lennea coromandelica)*	8
DS6	Choto Labongola	Kola *(Musa sp)*	20

Structure ID	**Location**	**Existing Tree**	
		Species Name	**No. of trees**
		Raj Koroi *(Albizia richardiana)*	2
		Taal *(Boassus flabelifer)*	6
		Khejur *(Phoneix sylvestirs)*	1
FS12	Daskhin Hazarbigha	Raj Koroi *(Albizia richardiana)*	7
		Raintree *(Samanea saman)*	4
		Kola *(Musa sp)*	90
		Bot *(Ficus benghalensis)*	1
FS11	Napitkhali	Kola *(Musa sp)*	100
		Shishu *(Dalbergia sissoo)*	4
		Khai Babla *(Pithecolobium dulce)*	2
		Supari *(Areca catechu)*	40
		Raintree *(Samanea saman)*	4
		Kanthal *(Artocarpus heterophyllus)*	5
		Chalta *(Dillenia indica)*	1
FS9	Burirchar Sluice Gate	No	0
FS8	Chunbunia	Raintree *(Samanea saman)*	2
		Shimul *(Bombax ceiba)*	1
		Bel *(Agle marmelos)*	3
		Chambal (*Albizia richardiana*)	1
		Kathal (*Artocarpus heterophyllus*)	3
		Bilati Gaab *(Diospyros discolor)*	5

Source: RAP Team & Field Survey, June 2015

Appendix 5 : Wildlife composition of the polder area

Scientific Name	English Name	Local Name	Status	Habitat Preference
CLASS MAMMALIA				
Order Rodentia				
Family Muridae				
Bandicota bengalensis	Mole Rat	Indur	VC	HF
Bandicota indica	Bandicot Rat	Dhari indur	C	HF, EM, CF
Mus booduga	Field Mouse	Metho indur	VC	HF, EM, CF
Mus musculus	House Mouse	Nengti indur	C	HF, EM, CF
Rattus rattus	Common House Rat	Indur	VC	HF
Family Soricidae				
Suncus murinus	Grey Musk Shrew	Chika	C	HF
Family Pteropodidae				
Cynopterus sphinx	Short-nosed Bat	Bocha Kola Badur	C	HF
Pteropus giganteus	Flying fox	Badur	C	HF, MF
Family Vespertilionidae				
Pipistrellus coromandra	Indian Pipistrelle	Khudi Chamchika	C	HF, MF
Order Carnivora				
Family Canidae				
Canis aureus	Jackal	Pati Shail	R	HF, CF
Family Herpestidae				
Herpestes edwardsi	Common Mongoose	Bara Beji	C	HF, EM
Family Viverridae				
Viverricula indica	Small Indian Civet	Khatash	R	HF
Family Felidae				
Felis chaus	Jungle Cat	Bon Biral	R	HF, EM, CF
Order Artiodactyla				
CLASS REPTILIA				

Order Testudines				
Family Emydidae				
Kachuga tecta tecta	Common Roof Turtle	Kori Kaitta	R	WL
Family Trionychidae				
Lissemys punctata punctata	Flap-shelled Spotted Turtle	Sundi Kachap	R	WL
Order Sauria				
Family Gekkonidae				
Hemidactylus brooki	House Lizard	Tiktiki	VC	HF
Hemidactylus frenatus	Common Lizard	Tiktiki	C	HF
Family Agamidae				
Calotes versicolor	Garden Lizard	Raktochusa	C	HF, EM, CF,MF
Mabuya carinata	Common Skink	Anjan	O	HF,CF,WL
Family Varanidae				
Varanus bengalensis	Bengal Grey Monitor	Gui Shap	O	HF, MF
Varanus salvator	Malayan water Monitor	Ram Gui	O	WL
Order Serpentes				
Family Dipradidae				
Lycodon jara	Yellow Wolf Snake	Ghorginni	C	HF, CF
Family Natricidae				
Amphiesma stolata	Stripes Keelback	Dora Sap	C	HF, WL
Atretium schistosum	Olive Keelback	Mete Sap	O	HF
Xenochrophis piscator	Checkered Keelback	Dhora Sap	C	HF, WL
Family Colubridae				
Ahaetulla nasutus	Common Vine Snake	Laodoga	C	HF, CF, MF
Ptyas mucosus	Rat Snake	Daraj/Darash	C	HF, CF
Family Homalopsidae				

Cerberus rhynchops	Dog-faced Water Snake	Jalbora	C	WL, CF
Enhydris enhydris	Smooth Water Snake	Pyna Sap	C	WL
Family Elaphidae				
Bungarus caeruleus	Common Krait	Kal Keotey	R	HF
Naja kaouthia	Monocellate Cobra	Gokhra	R	HF
CLASS AMPHIBIA				
Order Anura				
Family Bufonidae				
Duttaphrynus melanostictus	Common Toad	Kuno Bang	VC	HF, EM
Family Ranidae				
Euphlyctis hexadactylus	Green Frog	Sobuj Bang	O	HF, CF
Hoplobactrachus tigerinus	Bull Frog	Sona Bang	VC	CF
Rana cyanophlyctis	Skipper Frog	Kotkoti Bang	C	WL
Fejervaria sp.	Cricket Frog	Jhi Jhi Bang	C	HF, CF

Note: Status Code “C”=Common, “VC”= Very Common, “O”=Occasional, “R”=Rare

Habitat Preference Code: HF=Homestead Forest, “CF”=Cropfields, “MF”=Mangrove Forest, “WL”=Wetland

Appendix 6: List of Participants of FGD and PCM

List of FGD's participants

SL	Name	Gender	Occupation	Age	Address/Mobile No
1	Abu zafar	M	Fisherman	40	01706882305
2	Salim mirza	M	Agriculture	51	01934315142
3	Abdul rouf	M	Agriculture	47	01733830623
4	Mohammad Ali	M	Fisherman	45	Ayla Patakata
5	Zamirul Islam	M	Fisherman	53	Ayla Patakata
6	Aynal	M	Fisherman	23	Ayla Patakata
7	Proksh	M	Fisherman	42	Ayla Patakata
8	Mujib hawlader	M	Agriculture	54	Ayla Patakata
9	Golam sarowar	M	Agriculture	35	01767422686
10	Md. mustafa	M	Business	60	01937003034
11	Al Amin	M	-	27	01797146135
12	Abdul Aziz	M	Agriculture	60	01922707124
13	Md. Miraj Ali	M	Agriculture	36	Keorabunia
14	Md. Sohel Ali	M	Service	31	Keorabunia
15	Md. Saidul	M	Daylabour	34	Keorabunia
16	Md. Abdul Jalil	M	Agriculture	29	Keorabunia
17	Mokbul Akand	M	-	85	01929529331
18	FIroz khan	M	Agriculture	65	01736391515
19	Nazmul	M	Student	25	01712528014
20	Delowara begam	F	Housewife	50	Burir Char
21	Momtaz begam	F	Housewife	45	Burir Char
22	Md. Shahidur rahman	M	Fisherman	41	Burir Char
23	Porimal Ronju	M	Student	49	Burir Char
24	Md. Abu Bokkar Sarder	M	Business	25	Burir Char
25	Md. Shafiqul islam	M	Day labour	35	Burir Char
26					Burir Char
27	Jalal pollan	M	Agriculture	45	01783519197
28	Jorina	F	Housewife	35	-
29	Porkan	M	Business	30	01761361460
30	Haq Mia Hawladar	M	-	49	01940815377
31	Nasima begam	F	Housewife	32	01729647168
32	Md. Rasadul Islam	M	Fisherman	42	Paschim Burir Char
33	Bikash Chandra	M	Fisherman	19	Paschim Burir Char

Appendix 7: List of Participants of PDM

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

স্থান : বরগুনা সদর উপজেলা পরিষদ মিলনায়তন

সময় : সকাল ১০টা

তারিখ : ০৬/১২/২০১৬

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
০১	[illegible] হোসেন	SAAE	01718452247	[illegible]
২	[illegible]	[illegible]	01713464104.	[illegible]
৩	[illegible] ইসলাম	UNO বরগুনা সদর	01733348025	[illegible]
৪	শারমিন সুলতানা	মহিলা ভাইস চেয়ারম্যান বরগুনা সদর	01732454212	[illegible]
৫	মো: মুজিবুর রহমান	ভাইস চেয়ারম্যান বরগুনা সদর	0171761399	[illegible]
6.	S. M. Mehedi Hasan	DRM Analyst, World Bank	01827525068	mehedi
7.	মো: [illegible]	চেয়ারম্যান ৬নং [illegible]	01716044848	[illegible]
8.	[illegible] ইলিয়াস উদ্দিন	চেয়ারম্যান ২নং [illegible]	01712948180	[illegible]
9.	আবু হেনা মোস্তফা কামাল	চেয়ারম্যান, ৭নং [illegible]	01712897580	[illegible]
10.	[illegible]	সহকারী [illegible]	01719075004	[illegible]
১১	[illegible]	SAE, DPHE Barguna	01718736986	[illegible]

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স্থান : বরগুনা সদর উপজেলা পরিষদ মিলনায়তন

সময় : সকাল-১০ টা

তারিখ : ০৮/১১/২০১৬

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১২	নাজমুল আহসান	ইউপি সদস্য ৭ নং ঢলুয়া ইউপি	01757449438	[illegible]
১৩	মো: মাহমুদ রেজা	ইউপি সদস্য ৮ নং ওয়ার্ড	01713950997	[illegible]
১৪	মো: খলিলুর রহমান	স্যানিটারি ইন্সপেক্টর UH&FPO অফিস	01717276216	[illegible]
১৫	তালুকদার মো: আসাদুজ্জামান	সাবেক চেয়ারম্যান সদর বরগুনা	01720966733	[illegible]
১৬	লিটন চন্দ্র মজুমদার	সচিব, ঢলুয়া ইউপি	01750-300067	[illegible]
১৭	সুমন রঞ্জন শীল	সমাজকর্মী	01710703690	[illegible]
১৮	মো: মনিরুজ্জামান খান	সমাজকর্মী	01717313199	[illegible]
১৯	তপন কুমার রায়	ইউ.আর.ডি.ও (ভা:)	01710703707	[illegible]
২০	মো: হুমায়ুন কবির	SAE PIO office বরগুনা	01746766419	[illegible]
২১	মো: জোলফিকার [illegible]	চেয়ারম্যান ৩ নং বুড়িরচর	01716044848	[illegible]
২২	মো: কামরুজ্জামান খান	নির্বাহী অফিসার পৌরসভা, বরগুনা	01725684463	[illegible]
২৩	মোসা: তানি	U.P সদস্য ৭ নং ঢলুয়া ইউ.পি.	01775475896	[illegible]
২৪	মোস্তাফিজুর রহমান	[illegible]	01722135479	[illegible]
২৫	মো: জাহিদুল ইসলাম রিপন	২ নং [illegible] ইউপি	0173908978	[illegible]
২৬	আলহাজ্ব ইলিয়াস উদ্দিন	চেয়ারম্যান ১ নং বদরখালী	01712948180	[illegible]
২৭	আবু বকর সিদ্দিক	সাধারণ সম্পাদক [illegible]	01740860790	[illegible]
২৮	অনিমেষ রঞ্জন রায়	উপজেলা কৃষি অফিস	01710862798	[illegible]
২৯	মো: হাসান	কৃষক	01782597539	হাসান

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সময় : সকাল ১০ টা

তারিখ : ০৮/১১/২০১১

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৩০	মো: হাফিজুর রহমান	উপজেলা পরিসংখ্যান অফিসার (ভা:)	01716528177	
৩১	মোঃ আলফাজ উদ্দিন শেখ	সিনিয়র উপজেলা মৎস্য কর্মকর্তা	01795126051	
৩২	S M SOHEL	UAS VSEO	01738194532	Sohel
৩৩	বিজয় কুমার দাস	UYDO	01719687270	
৩৪	মো: [illegible]	UEO	01714714143	
৩৫	মো: তৌহিদ	UAO	01748021521	
৩৬	মো: মহিদুল ইসলাম	প্যানেল চেয়ারম্যান ৪নং ইউপি	01715019970	
৩৭	মো: ফজলুল হক	UP member 3 No. [illegible]	01753484837	
৩৮	মো: [illegible]	[illegible]	01710703318	
৩৯	মো: [illegible]	[illegible]	01712892565	
৪০	[illegible]	[illegible]	01716862728	
৪১	[illegible]	[illegible]	01712955296	
৪২	ড: [illegible]	CEGIS	01818290847	
৪৩	Md. Ashraful Alam	CEGIS	01710501562	Ashraf

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সময় : সকাল ১০টা

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ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৪৪	মো: আবু হোসেন	U.N.O অফিস	01716136145	[illegible]
৪৫	মো: আবুল কাশেম	U.N.O অফিস	01728367606	[illegible]
৪৬	মো: মামুন মোল্লা	U.N.O অফিস	01726120668	Mamun
৪৭	মো: জিয়াউল	U.N.O অফিস	01774918095	[illegible]
৪৮	[illegible]	ঐ অফিস	01714906681	[illegible]
৪৯	রবীন্দ্র নাথ দাস	ঐ	01912396042	[illegible]
৪৮	~~[illegible]~~ মো: মোতাহের	~~U.N.O~~ A [illegible]	01920249175	[illegible]
৪৯	[illegible]	C. A	01732776222	[illegible]
৫০	মো: [illegible]	U.N.O Office	01796462857	[illegible]
৫১	মো: [illegible]	U.N.O অফিস	01724171626	[illegible]
৫২	মো: [illegible]	"	01792241088	[illegible]

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Appendix 8: Photo Album

Photo Album 41/1

Picture 1: Non-function Drainage Sluice (DS6)

Picture 2: Non-function Drainage Sluice (DS5)

Picture 3: Non-functioning Drainage Sluice (DS2)

Picture 4: Non-functioning Flashing Sluice (FS1)

 Picture 5: Non-functioning Flashing Sluice(FS5)	 Picture 6: Breached embankment

Appendix 9: DoE's Approved Terms of Reference (ToR)

scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man maid or natural, wildlife, socio-economic aspect shall be incorporated in detail.

8. Management Plan/Procedures:
   For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.
   An outline of the Environmental Management Plan shall be developed for the project.
   In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)
   Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
10. Conclusion and Recommendations

IV. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.

V. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project.

VI. Violation of any of the above conditions shall render this clearance void.

VII. The project authority shall submit the EIA along with an application for Environmental Clearance, the applicable fee in a treasury chalan and the no objection certificates (NOCs) from the local authority to the head office in Dhaka with a copy to the Khulna and Barisal Divisional Office of DOE.

VIII. This clearance is valid for one year from the date of issuance and the project authority shall apply for renewal to Head Office with a copy to the Khulna and Barisal Divisional Office of DOE at least 30 days ahead of expiry.

IX. This Site Clearance Certificate has been issued with the approval of the appropriate authority.

05.06.2013

(Syed Nazmul Ahsan)
Deputy Director (Environmental Clearance)
&
Member Secretary
Environmental Clearance Committee
Phone # 02-8181778

Mr. Md. Sarafat Hossain Khan
Superintending Engineer & Project Coordinator
Coastal Embankment Improvement Project (Phase-I)
Bangladesh Water Development Board (BWDB)
72, Gre[illegible]d, Dhaka-1205.

Copy Forwarded to :

1) PS to Secretary, Ministry of Environment and Forest, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Khulna/Barisal Divisional Office, Khulna/Barisal.
3) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

2/2

Appendix 10: Comments and Responses

Comments, response and action taken on Draft EIA Report of Polder 41/1 under CEIP-I

<table>
<tr><th>Sl</th><th>Comments</th><th>Response</th></tr>
<tr><td>1</td><td>Executive Summary. Duplication of text third para (no para no provided here) page xxiii and sixth para (continue to the next page). These two consecutive paragraphs showing two completely different data on total cropped area, rice and non-rice crop area and their productivity.
<table>
<tr><td>Total cropped area</td><td>12,653 ha</td><td>5,556 ha</td></tr>
<tr><td>Rice area</td><td>11, 314 ha</td><td>4,289 ha</td></tr>
<tr><td>Non-rice area</td><td>1,339 ha</td><td>1,276 ha</td></tr>
<tr><td>Rice production</td><td>18,791 mt</td><td>9,349 mt</td></tr>
<tr><td>Non-rice production</td><td>7,060 mt</td><td>3,763 mt</td></tr>
<tr><td>Cropping intensity</td><td>149%</td><td>162%</td></tr>
</table>
Similarly, the project activities from two different tables are so different
<table>
<tr><td>Activities</td><td>Table 4.3</td><td>Table 7.1</td></tr>
<tr><td>Re-sectioning of the embankment</td><td>32.81 km</td><td>35.58 km</td></tr>
<tr><td>Bank revetment</td><td>500 m</td><td>300 m</td></tr>
<tr><td>Slope protection</td><td>1.5 km</td><td>1.3 km</td></tr>
<tr><td>Retirement of embankment</td><td>1 km</td><td>0</td></tr>
<tr><td>Re-excavation of canals</td><td>31 km</td><td>36.7 km</td></tr>
<tr><td>Afforestation</td><td>22 ha</td><td>31 ha</td></tr>
</table></td><td>All these anomalies have been checked and corrected</td></tr>
<tr><td>2</td><td>Executive Summary, Page xxvii. Impact on nearby area. The whole paragraph is written in a way that Polder 41/1 is very near to Polder 40/2 and even mentioned that they are hydrologically connected, but in reality they are not. Polder 41/1 is hydrologically controlled by the river Payra, while Polder is connected to the river Bishkhali and they are around 30 kilometers apart.</td><td>This paragraph has been updated as per write up mentioned in the chapter 9</td></tr>
</table>

Sl	Comments	Response
3	Para 208. Why the vessels have to travel through Baleshwar river while coming from Barisal to the project site?	This paragraph has been updated.
4	Para 207 & 209. Why Borguna BWDB stock yard need to be used? Polder 41/1 is sitting right on the bank of Payra river, which is navigable throughout the year. Moreover, even if Barguna stock yard is used, why for the eastern part of the project, which is further away. Western part should be closer to Barguna town (all kinds of silly mistakes).	This paragraph has been updated.
5	Community Participation in water management (Para 219 -244) describes all kind of theoretical and policy level details regarding community participation but no real concrete plan is visible.	This section has been revised which will visualize the community participation (chapter 4, article 4.10)
6	Para 233 Regulation of Gates. According to this paragraph, regulators will remain largely closed during pre-monsoon and monsoon. However, in Table 6.14 (operation phase) indicates that regulator operation will facilitate the migration of fish species.	The decision of keeping the regulator open or close largely depend on water level, fish migration; rainfall intensity and agricultural practices. And it is distinctly mentioned in the Art 4.10.1 regarding this variation of decision making process with the seasonal condition.
7	Para 246: No implementation cost associated with this report.	It is not yet been found from the Main Consultant (MC)
8	Para 286 and Table 5.5. It is difficult to understand the local condition of water quality with a single reading. Almost all these parameters are highly variable with time of year and even fluctuate with tide condition. In the report it is written June 2015. So it is some time in the early monsoon, but the onset of the monsoon also varies and so the readings of these parameters. At least for salinity model outputs from IWM may provide a better understanding. All readings of salinity showing zero value, which is kind of strange as salinity readings of Polder 47/2 were around 5 ppt and that polder is not very far from this polder.	Polder 47/2 is located near the coast line while the polder 41/1 is 35 km away from the coastline. To remove confusion, water quality in dry season (February, 2016) has been measured and the results are incorporated in the report (section 5.1.12, Table 5.9)
9	In case of Environmental baseline, it is difficult to recognize the length of field work done by the team. Description of flora and fauna are very generic without any particular assessment of their density or local status. No quantitative information provided. List of species in Table 5.12and names in Para 307 are different and there are mistakes.	This write up has been improved according to Table**.**

Sl	Comments	Response
10	Table 5.17. is mysterious Pangas (*P Pangasius*) should be in good number in the rivers as it is there prime breeding habitat and juveniles are caught in large numbers in all these coastal rivers. However, this species is not generally used for culture in the pond, so presence in the pond and absent in river is difficult to understand. All snakehead species absent in pond and present in river is also a bit confusing. Table 5.17 and Para 332 are contradictory and confusing, as the abundance of different fish species shown differently between table and text. Very badly written text in this paragraph. Pangas is commercially produced but the fisheries expert should know that it's a different species.	Riverine and culture pangus fish has been mentioned in Table 5.15 according to their habitat. The text has also been revised according to Table. As most of the predator fish including snakehead is eradicated during pond preparation as such they are usually not available in the cultured pond.
11	Table 6.1 Environmental Screening Matrix is largely subjective and as stated earlier lacks analytical results to support these assumptions.	As the project is rehabilitation project, such assumptions were made focusing only the proposed intervention and on basis of earlier observations. And it is not likely to have further any impact.
12	Table 6.14 Significance of Environmental Impacts. In the Operation phase, all the major potential impacts identified here are very well known and triggered immense difficulties to its population especially in the south-west part of the country. Unfortunately, the proposed mitigation measures failed to bring out any innovative idea to handle this old and persistent problem.	Proper implementation of the EMP measures is the answer. It is not fair to blame EMP measures without ensuring that they are properly implemented. One way could be the engagement a third party for environmental monitoring.
13	Para 349. Irrigation coverage is only 4% of the Net Cultivated Area and that is by surface area. But in Para 514 (Climate Change Chapter) stated 'Ground water level already reached alarming value'. Feels like a 'cut and paste' from another document and this is supported by the fact that this same sentence written in all other EIA documents submitted by the consultant.	Surface water use is increasing day-by-day for irrigation. Ground water level is alarming depleting because of excessive extraction and used for domestic purpose and ecosystem in polder areas; it may further increase in future.
14	Para 477-479, Table 6.6. The cropping intensity predicted to be increased from 162% to 192%, the increments from FWOP to FWIP is large and that is largely due to the expansion of HYV rice and vegetables. But this large increase of HYV crop and	These paragraphs have been revised according to modelling result. The additional irrigation water will come from re-excavated

Sl	Comments	Response
	vegetable, especially in winter and pre-monsoon is difficult to understand. 500 ha of HYV Boro and 900 ha of HYV Aus, where these additional irrigation water is going to come from? From 31 km of excavated channels? As an example of the lack of analytical details, no calculation or analysis is presented in this document that shows much water can be stored in these channels so that certain ha of land can be irrigated.	khals. The surface water availability for khals re-excavation has been mentioned in the article 6.6.1
15	Para 486 onward, Project alternatives.No real alternatives visible except 'No Project' scenario.	The entire chapter has been revised.
16	Another blunder Para 494, 'The storage site selected at this stage is located in the play ground near BhandariaUpazila Health Complex, which is situated within the Polder.' A clear example of cut and paste and no further editing!	This paragraph has been updated (article 7.2.5).
17	Para 493, 501, 505 no alternatives are defined. Both storage and sourcing of construction materials can have environmental consequences and thus need to be defined.	The paragraphs are been improved addressing the specific issue
18	In Environment Management Plan, plantation on and around the slope is mentioned without referring any species. BWBD and Bangladesh Forest Research Institute already have a guideline on this and consultant should take note of that document.	Name of the species for plantation around the slope will be mentioned during preparation of afforestation plan. However, reviewing the guidelines of different agencies/institutes, *Acacia nilotica* (Babla) is the most suitable species for this purpose. In addition, lower rows of the embankment may be planted by *Borasus flabellifer* (Tal*),* *Phoenix sylvestri*s (Khajur) & *Cocos nucifera* (Narikal) for this Polder.
19	In Climate Change Chapter, it is difficult to understand why climatic data used for this analysis up to 2004 when up-to-date data is available and used in the baseline chapter. Moreover, in same paragraph (Para 517) it is mentioned that Polder 41/1 is located near Patuakhali, while actually it is closer to Khepupara than Patuakhali. For rainfall data the report can even use Amtali or Borguna station data which are even closer. In the subsequent paragraphs, it is written consistently as Patuakhali (Polder 41/1), which is a bit	Thanks. The updated data from 1981-2012 has been incorporated instead of 1971-2004 for base line analysis. The rainfall data of Khepupara station has been used.

Sl	Comments	Response
	confusing as the Polder is located in Barguna district not in Patuakhali.	
20	Para 511. This paragraph is probably written for Polder 40/2 and cut and pasted here, as Pathorghata-Borguna road has nothing to do with this project. It should rather be Barguna-Amtali road. Nearby ferry is also on Payra river connecting Borguna with Amtali and not Bishkhali river which connect Borguna with Pathorghata.	This paragraph has been updated.
21	Para 520 'land use changes has impacts on the local changes of thermal regime', a theoretical perception, but I'm afraid the local land use hasn't changed much in last few decades let alone after the clearing of Sundarban from this area in the early twentieth century which could substantially change the local thermal regime.	Land use change assumed is one of the cause, but have no direct impact over the area. This sentence has been omitted from the paragraph due to controversy.
22	Para 545. Stated significant impact on Ploder 41/1 from Ganges Barrage, however, no connectivity between proposed Ganges Barrage distributaries and peripheral river systems of this polder is evident. The eastern most rives which might get freshwater boot from Ganges barrage is the Baleshwar, but it is difficult to conceive any freshwater increase in river systems eastern side of the Baleshwar.	The effect of Ganges barrage project is insignificant because it is still in the planning stage so the mentioned Para has been omitted.
23	Cumulative impact defines as "changes to the environment that are caused by an action (in this case the proposed work of Polder 41/1) in combination with other past, present and future actions." But, Chapter 9 (Cumulative Impact) mostly inscribed the impacts of other activities on Ploder41/1, which should not be the case.	The interventions which may have present and future impacts are stated in Table 9.1
24	Confusion everywhere, in Para 557, it is written that CEGIS recently (2014) conducted a study and presents the result in a table (Table 9.2), but at the end, the source of this table is declared to be from IWM, 2015.	The mentioned Paragraph has been revised.

Appendix 11: Comments by Mr. Marcelo (WB) and Responses by CEGIS

All comments for Polder 47/2 are not applicable for other polder. Relevant comments have been addressed for 41/1.

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	Agreed

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
	and that the social and physical environment is being affected. Therefore the proposed project is absorbing those liabilities.	
4	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 in article 7.4.7.
5	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
6	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
7	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
8	To what extent the local participation schemes present in section 4.15.2 have consulted, accepted by stakeholders involved and implemented? Is there capacity to do that? Who is going to deliver training?	Section 4.15.2 has discussed the previous experience of local participation in water management. In case of CEIP, stakeholder involvement, capacity, training issues have already been discussed in section 4.16.1-5 respectively
9	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
10	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.
11	Describes key environmental baseline conditions that would be reverted by the project and that need to be better predicted	All the issues and key issues have been addressed. But have not been prioritized.

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
	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.	
12	Section 5.2.1. It is important to clarify the implications of this classification for the project and what does it means that it have been identified by IUCN. This needs to be handled with care to avoid confusions with the WB natural habitats concept.	The whole Bangladesh has been divided into 25 Bio-ecological zones by IUCN depending on the biodiversity in the respective area.
13	In regards to fauna species, we recommend the present a table including all species, with the conservation taking into account CITES and IUCN classification and local classifications, if applicable.	Agreed and presented in a Table-5.12 [section 5.2.3]
14	The section 5.2.5 on ecosystem services is too light. It mixes de concept of services with goods. In my opinion, for example, the project would have a positive impact in soil productivity which is clearly an environmental service.	This section has been updated
15	Table 5.14 provides the basis for specific management actions that I do not seen proposed as part of the EMP.	It has been considered in the EMP
16	Para 413 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.
17	Has the Bank reviewed the RAP?	Yes, the RAP report has been reviewed by World Bank
18	How the potential impact on social network would be addressed?	This issue has been addressed in the respective paragraph
19	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
20	Which is the impact of dewatering channels?	Dewatering is not essential for excavator cutting , it is only for manual excavation
21	Section 6.4.5. On one had the EIA says there will be no impact on crops but on the	Rightly mentioned but crop damaged will not be occurred due to borrow pit while

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
	other, suggests to compensate if that happens.	transportation of earth materials may cause crop damage in the surrounding area.
22	Benthic fauna has not been developed as part of the baseline section.	Information regarding benthic fauna has been mentioned in the baseline section (5.2.8)
23	There is not mention to water related diseases such as Malaria.	There is no Malaria disease in the polder area.
24	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
25	The WB 2010 report is not mentioned in the list of references.	It has been included in the list of references
26	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.
27	Table 10.2. Is turbidity going to measured? Is it a relevant variable?	Most of the canals inside the polder will be re-excavated under this project. After re-excavation of canals, turbidity of the water may be increased.
28	Table 10.5 raises some issues: is the construction of a fish sanctuary included as a mitigation measure? What is the awareness program about? Why to monitor aquatic mammals and which are the mammals? This was not mentioned in the baseline.	Fish sanctuary could be established in the perennial Khal with the co-management of the local fisheries office and the local people. In this regard, local people can be trained up on the sanctuary issue. The Fisheries Department can be involved in this process. Water management organization will be given responsibility of awareness building program to the local people. Mammals has been deleted from the EMP as there is no aquatic mammals inside the polder
29	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 12: Pest Management Plan

Pest Management

A Pest Management Plan should be prepared for specific areas where needed, considering the type of pest/insects and their possible impacts. Plant diseases and insect pests control should 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 balanced 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 13: Checklist for Stakeholder Consultation

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 14: Checklist of Public Consultation Meeting

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:

11. Productivity (e.g. agriculture and fishery)
12. Livelihood options
13. Vulnerability issues
14. Ecological imbalance
15. Resource redistribution
16. People’s perception, opinion and attitude
    - 16.1. Major problems
        - 16.1.1. Problems in productivity
        - 16.1.2. Problems in service and facilities
        - 16.1.3. Infrastructural problems
    - 16.2. Attitude of the people towards the project
    - 16.3. Impact (positive and negative) of the project and mitigation measures
        - 16.3.1. Alternative sites
        - 16.3.2. Mitigation measures for planners
        - 16.3.3. Mitigation measures of implementing agency
17. Income restoration and generation issues
    - 17.1. Current income generating activities
    - 17.2. Type of occupation
    - 17.3. Income-generating activities
    - 17.4. Current market situation (job opportunities, competition, land price and market price situation)
    - 17.5. Skill development and IGA
18. Social development support
    - 18.1. Name of NGOs prevailing in the study area
    - 18.2. Social safeguard and safety nets
    - 18.3. Community interventions
19. Gender issues
    - 19.1. Unemployment of female labor force
    - 19.2. Literacy rate of female students
    - 19.3. Anticipated changes in the wage rate
    - 19.4. Health issues of women
20. Participation of women in service and facilities

FGD issues

The possible issues that would be discussed in the focus group discussions are:

11. People's perception, opinion and attitude
    - 11.1. Initial discussion about the selected Important Social Components (ISCs)
    - 11.2. Attitude of the people towards the project
    - 11.3. Impact (positive and negative) of the project and mitigation measures
12. Demographic distribution
    - 12.1. Population distribution
    - 12.2. Major age group
    - 12.3. Dependency ratio/status)
13. State of Education
    - 13.1. Impact of illiteracy
    - 13.2. Variation in school Attendance between girls and boys
    - 13.3. Variation in drop-out between girls and boys
14. Health Situation
    - 14.1. Prevalent diseases
    - 14.2. People's health seeking behavior
    - 14.3. Local health facilities
15. Employment and Occupation
    - 15.1. Existing occupations in the locality
    - 15.2. Major occupations
    - 15.3. Reasons of unemployment
    - 15.4. Impacts of unemployment
    - 15.5. Occupation problems/conflict
    - 15.6. Impacts of variation in water level on employment
16. Service and Facilities)
    - 16.1. Existing housing tenancy and structure
    - 16.2. Drinking water and sanitation facilities in the locality
    - 16.3. Energy Facility
    - 16.4. State of market Facility
17. Gender Issues
    - 17.1. Unemployment of female labor force
    - 17.2. Literacy rate of female students
    - 17.3. Anticipated changes in the wage rate
    - 17.4. Health issues of women
    - 17.5. Participation of women in service and facilities
    - 17.6. Women leadership
18. Poverty and food security status
    - 18.1. Number of working days, disaggregated by seasons and occupations
    - 18.2. Status of subsistence, disaggregated by seasons
    - 18.3. Usual food menu
    - 18.4. Adaptation strategies during poverty state
19. Ethnicity
    - 19.1. Major ethnic groups
    - 19.2. Cultural conflict and coexistence
    - 19.3. Potential impacts of project on ethnic groups
20. Archaeological/heritage sites
    - 20.1. Major archaeological/heritage sites
    - 20.2. Cultural values
    - 20.3. Potential impacts of project

Appendix 15: Gate Operation Plan in Bangla

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 পোল্ডারে এ জন্য পানি ব্যবস্থাপনা সংস্থা (WMG, WMO, WMA) গঠন করা হয়। কৃষি উন্নয়ন ও মৎস্য সম্পদের কথা বিবেচনা করে পোল্ডার ৪১/১ এর গেট পরিচালনায় পানি ব্যবস্থাপনা সংস্থাগুলোকে নিম্নোক্ত বিষয়গুলো বিবেচনা করতে হবে:

- কৃষি ও মৎস্য সম্পদ ব্যবস্থাপনার সাথে সামঞ্জস্য রেখে একটি নির্দিষ্ট নিয়মের মধ্য দিয়ে প্রতিটি রেগুলেটরের গেট অবশ্যই নিয়ন্ত্রণ করতে হবে ;
- প্রকৃত পানি ব্যবস্থাপনা বিশেষ করে কৃষি ও মৎস্য সম্পদের প্রয়োজনীতার ভিত্তিতে পানি উন্নয়ন বোর্ডের পরিচালনা ও রক্ষণাবেক্ষণ শাখা সুবিধাভোগী সংস্থা, কৃষি সম্প্রসারণ অধিদপ্তর এবং মৎস্য অধিদপ্তরের মাঠ কর্মীদের যৌথ পরামর্শক্রমে গেট পরিচালনা করতে হবে;
- শুধুমাত্র মেরামত ও ফ্ল্যাশিং ব্যতীত রেগুলেটরের ফ্ল্যাপ একটি নির্দিষ্ট স্থানে সব সময় একই অবস্থানে রাখতে হবে;
- খালে পানি সংরক্ষণ করে কৃষি কাজে সেচের জন্য বর্ষার পূর্বে (মার্চ - মে) গেট বন্ধ রাখতে হবে;
- বর্ষার সময় (জুলাই -সেপ্টেম্বর) গেট সাধারণত বন্ধ থাকবে তবে পোল্ডারের ভিতর ও বাহিরের পানির স্তর একটি নিরাপদ লেভেলের বাইরে যাতে চলে না যায় সেদিকে লক্ষ্য রাখতে হবে। এক্ষেত্রে, প্রতিদিনের বৃষ্টিপাত, নদীর অবস্থা, নদীর এবং পোল্ডারের ভিতরের পানির লেভেল বিবেচনা করে যথাযথ সিদ্ধান্ত নিতে হবে;
- মাছের সর্বোচ্চ প্রজননের সময় ডিমসহ মা মাছ (ব্রুড মাছ) ও মাছের পোনা অভিগমনের বিষয় বিবেচনা করে মে হতে জুন মাস পর্যন্ত গেট খোলা রাখতে হবে;
- বর্ষা পরবর্তী সময় (অক্টোবর-নভেম্বর) গেট এমনভাবে পরিচালনা করতে হবে যাতে খালে শুষ্ক মৌসুমেও পর্যাপ্ত পানি থাকে। এক্ষেত্রে লক্ষ্য রাখতে হবে যেন খালের পানি তীর উপচে না যায় এবং কৃষি কার্যক্রম ব্যাহত না হয়;
- ফ্ল্যাশিং স্লুইস ও পাইপ ইনলেট পরিচালনার ক্ষেত্রেও একই নিয়ম অনুসরণ করতে হবে;
- কৃষি কার্যক্রম, শষ্যের নমুনা ও ধরণ, মাছের প্রজনন সময় ও অভিগমন ইত্যাদি পরিবর্তনশীল বিধায় সময়ের সাথে সুবিধাভোগী সংস্থার (কৃষক, মৎস্যজীবী, 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 16: 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?

12. 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 .

13. 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-0	henk.blok@nhdhv		
4	Md. Mahfuzur Rahman ADG (West Region)	BWDB	01741-382792		
5	A.K. Manzur Hasan Chief Engr BWDB	BWDB	01711175677	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
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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 (C.D-3)	MOWR	ahsan.en@gmail.com 01711431009	MAHFUL 01915531903	
8	Ebrahim Akand	CEGIS	ebrahimakand@yahoo.com	01675507173	
9	Md Zaid Hussain Bhuiyan Deputy chief Conservator of Forest	FD	dccf-dltw@bforest.gov.bd	01712-074350	
10	Md. Delwar Hossain PD/CEIP-1	BWDB.	Pdpmucelp@gmail.com	Rashed. 01722388698	
11	MD CHAN MIA	P.I.D	chanmiapid08@gmail.com	01712223881	
12	Md. AbdulHannan XEN, CEIP, BWDB	BWDB	xen.ceip1-khulna@gmail.com	Taleb	25/1/17

2

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
13	Jahangir Alam PRO, MoWR	MoWR	pro@mowr.gov.bd 01975105850	Shafiqul Islam 01728912590	25.01.17
14	Md. Nowaysun Ass. Director	MoWR	01911282778		
15	Md. Habibur Rahman	CEIP-1	01199808796	[illegible]	
16	Subrata Kr 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	

4

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 Time: 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
25	Andrew Harvey Ramgarh CEIP Sr. Environmental Specialist	DHI			[illegible]
26	MOTAHER HOSSAIN CE. Ganges Barrage	BWDB	motaher_hossain@yahoo.com		[illegible]
27	Md. Abdur Rahman Akhanda ADG(P)	BWDB			[illegible]
28	Md. Abubakar Rahman	CEIP			[illegible]
29	Md. Abul Kawsar SE/BWDB	BWDB	[illegible]kawsar@yahoo.com	Md. Ahsanullah vehicle no: 3683	[illegible]
30	GERARD PICHEL	RHDHV	fattyzebra@gmail.com		[illegible]

5

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 Time: 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
31	Mobasher Bin Ansari	Jr. Specialist	mansari@cegisbd.com 01718 244298		[illegible]
32	Muhammad Anisur Dal	PLA	mazizur@[illegible]		[illegible]
33	Glandly Chong	BDP2100			[illegible]
34	Saika Nowshin Junior consultant	CEGIS	nowshin.saik@gmail.com 01673[illegible]		[illegible]
35	Shihab Monjur Research Consultant	CEGIS	shihab.l86@live.com 01735263323		S. Monjur
36	A K M Hasan	CEGIS	01911364049		[illegible]

6

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
37	Kazi shahidur Rahman Sub-divisional Engr	JRC	shahid.21scue@yahoo.com 01712831502		
38	Khair Reporter	Metar	01916143317		
39	Md. Sarfaraz Wahed.	CEGIS	01712209364		
40	Faria Tuz Zahura	CEGIS	01675489599		
41	Dr. Maminul Haque Sarker	CEGIS	01817606781		
42	Asma Akter	CEGIS			Asma

7

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
43	Mohad. Hassan	Deputy Manager	01711260139	–	Mohad.
44	Khaleda Saladin	CEGIS			Saladin
45	K. Kamil Hasan	CEGIS			
46	Dr. Ashadul Alam Sr. Env. Specialist	PMU,CEIP-I BWDB	01747215770		25.01.2017
47	Shaheen Afroze	CEGIS	01715304133		25/01/2017
48	Chaitanya Kumar Das Director field service wing DAE	DAE	01718956169 kkdalidas@yahoo.com	Lookman	25.1.17

8

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 Time: 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
49	Jan T. Twarowski Team Leader M+E Consultants	Sheladia Associates USA	jant@sheladia.com	Ali	[illegible]
50	Dr. Kazi Nuan Newaz Advisor,	CEGIS	[illegible]@cegisbd.com		[illegible]
51	Dr. Sajid	C3ER BRAC Uni	sajid_ru@yahoo.com	01921X981934	[illegible]
52	Dr. Monowar Hossain	IWM	mh@iwmbd...	[illegible]	[illegible]
53	Md. Gulzer Hossain	CEIP-1		-	[illegible]
54	ANISUR KAWSAR WAWE SI	BETS			[illegible]

9

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 Time: 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
55	A. M. Aminul Haque	BWDB	01552391776	Dhalu	[illegible]
56	Jasim Uddin Ahd	BWDB/Haor	01716209774		[illegible]
57	Dr. AZHARUL HAQ	BWP	01819212996	Iskander	[illegible]
58	Dr. Asraful Alam	CEGIS	01818290847		[illegible]
59	Md. Alamgir Kabir	CEGIS	01715712614		[illegible]
60	Anjuman Ara Baby	CEGIS	01711-377-306	—	[illegible]

10

Dissemination Seminar on
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Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
61	Md. Khaleguzzaman Chief Planning	BWDB	01822812662 cplan.wdb@yahoo.com	Jahangir	
62	Md. Abu Hasnat	CEGIS	01911597899		
63	AKM Tahmidul Islam	BWDB	01712121241	Selim	
64	Abani B. Thakur DCCF	Forest Dept.	01728549473	Nur Mohammad	
65	Md. Harun ur Rashid	BWDB	01711383744	harun6205@gmail.com DC-2	
66	RAKSHANDA RABBI	CEGIS			

11

Dissemination Seminar on
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Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
67	Md Habibur Rahman PD/ECRRP	BWDB	01712008322	Md. Suman	
68	MD. SHAHJAHAN X-DG, WARPO		01715078833		
69	Mihir Biswas	BAPA	01700678223		
70	Sattar Ali	BTV	01911988779	Sanit	
71	MUSA NURUR RAHMAN SUPERINTENDING ENG	BWDB	01715740505	Ok	25.1.17
72	Mohammad Alamgir Principal Scientific Officer	WARPO	01556555489		

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Dissemination Seminar on
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Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
73	Md. Jahid H Jahangir Former Member, JRC				
74	[illegible]	BTV		01712354990 [illegible]	
75	A. Latif	Gm		01710089153 [illegible]	
76	Syed Mottoni Murshe	Reporter Naya DIR		own # (01718417189)	
77	Mantu Kumar Poddar Joint Chief	Ministry of Water	aditya_sudity@yahoo.com	01772143441 Mr. Razzak Driver	
78	Mohammad Abdur Rashid	CEGIS			

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Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
79	Fakhrul Islam Chief Engineer Central Zone, Dhk	BWDB	fakhrulbwdb@yahoo.com 01670-757384	Monju 01774-218775	
80	AKM. SAHADAT HOSSAIN. SE, IWRM	LGED	sahadat_lg@yahoo.com 01712209194	JAHID	
81	Md. Zahid Hasan Dhali	CEGIS	[illegible] 01816399598		
82	Roland Nathan Mandal	CEGIS	fish03nath@gmail.com 01758188740		
83	Md. Safoul Alam	CEGIS	[illegible] 01707709758		
84	Md. Ashraful Alam	CEGIS	01722602667		

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Dissemination Seminar on
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Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
85	Mirza Golam Shoket	CEGIS	01729-088099		
86	Pr. Engr. Md. Lutfar Rahman	RRI	01715-039646	Paritosh kumar Biswas	25/01/17
87	Amal Kumar Saha Ecologist	CEGIS	gmail.com 01911686787		amal saha
88	Muhammad Shahidur Rah	CEGIS	shahidurrahman03@gmail.com 01713-865525		
89	Ashoke Kumar Das Fisheries Expert	CEGIS	ashoke@cegis.org.bd	-	
90	Md. Shakil Ahmed	CEGIS	sahmed@cegis.org.bd		

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Dissemination Seminar on
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Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
91	SHAHED	BTV	—	—	
92	Badal Md. Faruque principal Specialist	CEGIS	BPARUQUE@CEGISBD.COM 01715111661		
93	Motaleb H. Sarker Director Ecology	CEGIS	01715015449		
94	Mamun Mamun	Somoy TV	01964444127		
95	Md. Amanat Ullah	CEGIS	01717443291		Amanat
96	Mashuda Parvin	CEGIS	01705066867		M.parvin

16

Appendix-C: Comments and Suggestions

Sl.	Comments/suggestions	Responses
1	**Mr. Anisul Islam Mahmud, M.P, Honourable Minister, MoWR** The provision for re-excavation/dredging of peripheral rivers of the polder should be included in the polder rehabilitation activities	The provision for re-excavation/dredging of peripheral rivers in Polder 48 from km. 9.00 to km 17.00 (Mohipur Khal) and Polder-41/1 from km. 15.00 to km 20.00 (Bashbonia Khal) have been made as these rivers are narrow and shallow in depth. On the other hand, the peripheral rivers of other polders in this package are wide and deep. As such, re-excavation/dredging has not been considered.
2	**Dr. Zafar Ahmed Khan, Senior Secretary, MoWR** The Government of Bangladesh has specific development targets by 2021 and 2041. As such the polder rehabilitation process should be considered on the basis of past experience and future challenge particularly climate change issue. He said that we should think about WMO for polder maintenances and how this association can work properly. He further said that we have gathered various ideas and knowledge from today's dissemination seminar on Coastal Embankment Improvement Project (CEIP) which may play vital role for decision making in future for effectiveness of this project.	The coastal polder since it implementation have appreciably contributed to the food production in Bangladesh as well as provided safety to the people of the polders against saline water intrusion and tidal surges. The rehabilitation of the polder is being done considering climate change scenarios and other current water management concepts. As such, the rehabilitation of the polder would greatly contribute to the development targets of 2021 and 2041. The involvement of the WMA for operation of the polder have been emphatically suggested in the study. In this regard, capacity building and training to the WMOs regarding gate operation, post project monitoring etc. has been included for their involvement in the project operation phase.
3	**Md. Habibur Rahman, PD, ECRRP, BWDB** The polder rehabilitation plan is good initiative which has already been done by ECRRP. At present, CEIP polder rehabilitation work should be conducted considering climate change impact and sea level rise. He also mentioned that polder works should have scope for green belt along the polder which should be monitored by Water Management organization (WMO) for proper maintenances of the polder.	It has already been considered in the study.
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

Sl.	Comments/suggestions	Responses
		International bidding process. However, capacity building and training to the WMOs regarding gate operation, post project monitoring etc has been included for their involvement in the project operation phase.
5	**Dr. Khondaker Azharul Haq, President, Bangladesh Water Partnership (BWP)** The presentation is quite good but why only few polders have been considered for rehabilitation out of 139 polders. We should take initiatives for engaging NGOs/private sector for monitoring of the polder maintenance as the WMO does not sustain in most of the cases. Coastal polders are very vulnerable due to climate change. So we should look for new operation system for polder rehabilitation.	A total of 17 most vulnerable polders have been selected for rehabilitation under CEIP-1. During selection of polders, a screening matrix in the form of multi - criteria analysis has been done considering the physical condition of the structures as well as environmental, social and economic conditions of the polder area. BWDB has planned to rehabilitate the remaining vulnerable polders after successful completion of rehabilitation works of polders under Phase-II, on priority basis. Climate change issue has been considered in rehabilitation of the polders.
6	**Md. Zaid Hussain Bhuiya, Deputy Chief Conservator of Forest (DCCF), Department of Forest** Social forestry based green belt system should be included in polder rehabilitation works process. He also proposed to initiate social forest co-management system along embankment and also in the protected areas.	It has been considered in the project
7	**Mr. Giasuddin Ahmed Chowdhury, Mott McDonald** Internal water management system is very important for rehabilitation of the polders. The polder works should include plan for eco system service providers	To ensure fresh water availability as well as enrichment of ecosystem inside the polder, provision for internal khal re-excavation has been considered in this project. The plan for eco-system service provider has also been made in the study.
8	**Abani Kumar Thakur, DCCF, Department of Forest (DoF)** We know that coastal Greenbelt is a measure to prevent coastal erosion and reduce other natural hazards by planting trees and creating 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.

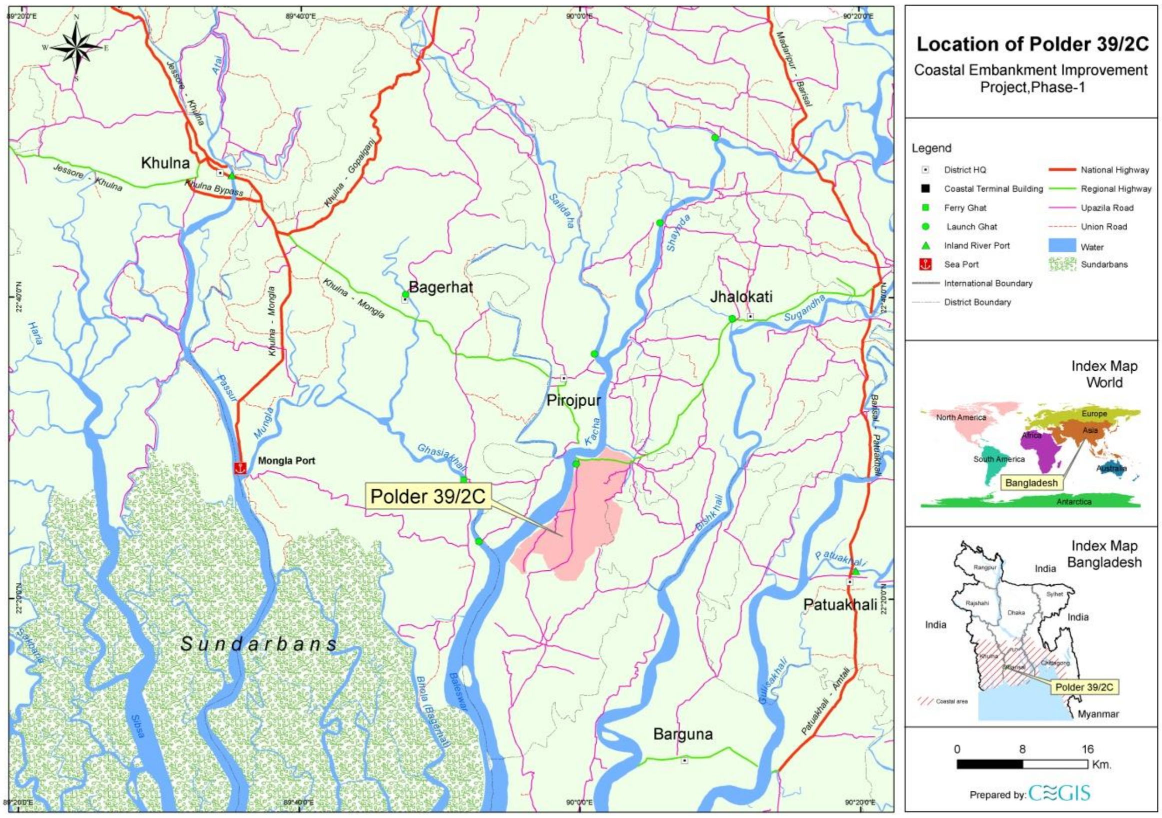
Sl.	Comments/suggestions	Responses
10	**Professor Dr. KB Sajjadur Rasheed, Environmentalist and Advisor, CEGIS** CEGIS presentation was good for understanding. He enquired whether the crest level of the embankment of the polder has been designed considering climate change scenario.	Yes, the crest level 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.

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- 41/1 FOR PACKAGE-2

February 2017

Royal HaskoningDHV Enhancing Society Together
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dpm
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DHI

The following recommendations are considered to ensure that all 6 EIA Reports in CEIP Package-2 fully cover environmental risks and impacts under the project and clearly communicate those risks and impacts and corresponding mitigation measures and that it's an effective management tool.

Strategic/Sectoral Assessment: The rationale of Coastal Zone Policy states three reasons as the basic principles:

a) Coastal zone is lagging behind in socio-economic developments
b) Poor initiatives to cope with disasters
c) Coastal zone has potential to contribute to national development.

The CEIP-1 Project fulfils all the three features/ criteria to be selected as development area.

Strategic or Sectoral Environmental Assessment in relation to the Coastal Zone Policy (2005) and the Coastal Development Strategy (2006) was not considered because the Coastal Development Strategy defines 9 priorities which mainstream environmental considerations, i.e. the following relevant ones:

-ensuring fresh and safe water availability

-safety from man-made and natural hazards

-improving of livelihood conditions of the polder dwellers

-environmental mitigation and conservation.

The CEIP-1 Project is conceived as a water infrastructure Project, aiming to retrofit the sluices, embankment, canals and bank protection with climate change impacts mitigation. In that sense, sustainability is incorporated. No fundamental modification of the basic concept of polderization is operated. When the 139 coastal polders were designed/built in 1970s, this all was done in a purely civil engineering approach. Ever since, IPCC report has been published and it has given impetus to more eco-engineering approach in design and construction. Idem ditto for the designs and construction under BWDB, however with core focus on water management infrastructures improvement (raison d'être of BWDB agency). This CEIP-1 Project design is adapted to the climate resiliency objectives with design of the infrastructures alone and its environment-compliant implementation. As the 139 Polders have undergone so many rounds of rehabilitations over the past 50 years, this is the living proof that the coastal polders have sustained half a century. This CEIP-1 brings in climate resiliency as added value to design and construction.

It can be assured that the CEIP-1 Project does not and will not worsen the present coastal situation whatsoever. Moreover, the said infrastructures are built inside the perimeter of the polders and no construction is done to protrude onto the surrounding rivers and existing waterscape/landscape systems and other surrounding sensitive ecosystems. On the operational level at construction sites, mitigation measures have been inserted in the EMP/EAP manual of all Contractors. This is a sufficient safeguard measure for pre, during, and post-construction stages.

Selection Criteria: All the 17 Polders in CEIP-1 including Polder 41/1 out of total 139 were selected by multi-criteria analysis based on physical conditions of existing infrastructures of the Polders. The physical conditions mainly include breach of embankment, overtopping, river erosion, wave action, internal drainage congestion etc. which relates to environmental components.

Past Experiences: In the tidal estuarine dynamics of the South West region of the country, a large scale water logging problem has been created through these polders.

CEGIS has recommended Tidal River Management (TRM) for sustainable solution of water logging problem.

Prior to the proposed interventions, polder areas faced several environmental adverse impacts as follows:

In general, the natural flow of rivers has been restricted for the construction of the Polders causing siltation of the river bed which create obstacles of navigation as well as drainage congestion.

There is no organized track record of the Government in managing such impacts but observation of the polders indicates that there has been increased siltation; reduction of open water fisheries, birds, wild animals; Reduction of soil fertility; deterioration of Water quality over time.

Brownfield vs. Greenfield: The Project mostly entails outright rehabilitation worksof infrastructure where their spatial domain already exists. The structure as indicated in Table 4.3 of EIA Reports is being replaced on the footprint of existing old structures. There are about 4.0 km of new embankment to be constructed; rest of the embankment is re-sectioning of the existing embankment. Hence, very few new impacts are likely to arise.

Gap Analysis: The differences between GOB/Local legal safeguards policies and the WB safeguards policies are highlighted in the Table below:

Comparison between GoB and WB Guidelines

After reviewing the laws of GOB and World Bank Safeguards guidelines, it is necessary to identify the similarities and differences between those so that the more stringent requirements can be applied for the Projects. In general OP 4.01 and OP 4.12 requirements are more comprehensive when compared with the requirements of Bangladesh legal system. The differences have been addressed by the measures proposed by the EIA reports and to be adopted by the Project. Table below lists some key comparisons between GOB and World Bank Safeguards guidelines.

Table: Comparison between GOB and World Bank Safeguards Guidelines

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
1	Type of Environmental Analysis	Project specific	Project specific, regional and sectoral
2	Basis for Categorization	Currently, screening criteria available only for industrial projects, where assessment is done based on: • Level of pollution emission • Type of project and location • Scale of project • Operational activities Non–industrial projects are reviewed on a case by case basis by DOE	Detailed screening criteria for all projects based on • Sensitivity • Nature and magnitude of potential impacts

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
3	EA Outputs	Since detailed rules and regulations for EA have not been prescribed, EA outputs are not specified. However, the industrial sector guidelines, the water sector guidelines and the road sector guidelines have specific EA output requirements, such as: • Baseline survey • IEE/EIA Report • Site clearance • Risk analysis and management • Analysis of alternatives	• EA Report • Analysis of alternatives • Environmental Management Plan
4	Public Consultation	No special mention is made for public consultation in BECA. Sectoral guidelines mentioned above have prescribed consultation.	Mandatory at the stage of • Preparation of EA • Project appraisal • Project design • Project implementation and monitoring
5	Disclosure of Information	BECA makes no reference to disclosure. The Sectoral guidelines prescribe some provisions for disclosure	Mandatory at • Summary of project description an potential adverse impact • Summary of EA report and conclusion • EA report
Social/Resettlement		**1982 ORDINANCE**	**OP 4.12**
6	Coverage	Legal owners Share-croppers Tenants	All affected parties, including squatters and illegal occupant
7	Compensation	Based on market values over previous 12 months No provision for restoration of income streams	Replacement cost at current market price Requires livelihood restoration component.
8	Uses of material from dismantled structures	Material is to be auctioned after being compensated for it	Material can be taken and re-used by affected party
9	Minimization of impacts	Discourages unnecessary acquisition but no mechanisms to monitor	Alternative analysis required to justify avoidance and/or mitigation of impacts
10	Cut-off dates	Not addressed	Important to ensure that squatters are included in compensation and to prevent rent-seeking behavior of additional squatters settling onto project land

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
11	Consultation	No consultation required	Consultation as core issue in RAP preparation and implementation
12	Livelihood restoration	Not addressed	Livelihood restoration component and attention to post-resettlement required

Construction Camps: All Labor Sheds/camps will be built for the workers, although most of the local workers from the surrounding villages who prefer to stay in their houses. During construction of camps for accommodation of workers internationally recognized guidelines such as IFC/EBRD workers accommodation guidelines will be ensured.

Traffic Management: There are some bazars (markets) and shops beside the embankment of the Polders, which are important for socio-economic and livelihood of the people of the polder area. The construction activities along the embankment may temporarily disrupt the market activities causing hindrance to movement of the local people, who will suffer due to their limited roadway movements during construction.

Mitigation measures:

- The works on the embankment will be carefully scheduled in consultation and coordination with local representatives to minimize the impacts on local markets and transportation routes.
- The embankment works will be carried out in segments and the soil will be placed linearly on half of the embankment, leaving the other half to be used as track. After the completion of the first half, it will be opened for the local traffic and then the work for the other half of the embankment will be undertaken.
- Local routes will be kept free, as far as possible, if unavoidable, alternative routes will be identified in consultation with the local community.
- The Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock.
- The works shall not interfere unnecessarily or improperly with conveyance of public to use public or private roads or footpaths.
- Special consideration will be given for preparation of the traffic control plan to the safety of pedestrians and workers at night.
- The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the cross section.

In regards to the increase of Vehicular Traffic during mobilization – EIAs include procedures to ensure: adequate signaling for traffic and pedestrian safety, speed limits for project-related trucks when crossing heavily populated areas and dust control measures and to manage noise levels. This also applies to 6.4.5 Hindrance of Pedestrian and Vehicular Movement. These aspects are comprehensively covered by the EHS Guidelines, as per the said web-link:

http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

Mangrove Afforestation: Afforestation for polders 41/1, 40/2, 47/2 and 43/2C is envisaged. Mangrove vegetation has immense contribution to protect the embankments and char land from tidal surge, provides fuel and thatch materials to the local inhabitants as well as creates ideal habitats for the local avifauna and other wild animals. Given the importance of mangroves, and the fact that survival rates of replanted mangroves tends to be very low, Mangrove afforestation will be carried out as per a specific afforestation plan volume-V Part-C (1- Forestry). These activities will be guided by a Sr. Forestry Expert for which there is a provision under PMU.

EHS Guidelines: Section on *Environment, Health and Safety Guidelines* for all 6 EIAs polder will follow the EHS Guideline 1 (General). The link to the document is as follows:

http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

Pesticides: The CEIP-1 is basically an infrastructure improvement project and not an agricultural project. The handling of pesticides is not a part of project activities. Although intensive afforestation is a part of project activity, the provision of nursery is not included in project activities. The interventions under the proposed project may result in an increased availability of irrigation water through cleaning and excavation of watercourses in the Polder. This increased water availability can in turn potentially increase the usage of agro-chemical fertilizers and pesticides. To address this eventuality, linkages will be developed with the up-coming Consultancy Services (NGO), the TOR is consistent with Integrated Pest Management policy that would address the indirect impact highlighted by the EIAs.

The Department of Agriculture Extension (DAE) is mandated for all types of agricultural extension activities including the preparation and implementation of Integrated Pest Management Plan (IPMP) and Integrated Crop Management Plan (ICMP). The DAE conducts capacity building both for IPMP& ICMP. The scope of project activities did not include DAE. The DAE will start its activities after successful completion of the project.

However, the pollution will be cross checked through testing of soil and water parameters as approved by ECR, 1997, DOE, Bangladesh throughout the Project period (see table below).

Table: Standards for Inland Surface Water

Sl. No.	Designated best use classification	Values			
		pH	BOD (mg/l)	DO (mg/l)	Total Coliform (number/100m l)
A.	Source of drinking water for supply only after disinfecting	6.5-8.5	2 or less	6 or above	50 or less

Sl. No.	Designated best use classification	Values			
		pH	BOD (mg/l)	DO (mg/l)	Total Coliform (number/100m l)
B.	Water usable for recreational activity	6.5-8.5	3 or less	5 or more	200 or less
C.	Source of drinking water for supply after conventional treatment	6.5-8.5	6 or less	6 or more	5000 or less
D.	Water usable by fisheries	6.5-8.5	6 or less	5 or more	----
E.	Water usable by various process and cooling industries	6.5-8.5	10 or less	5 or more	5000 or less
F.	Water usable for irrigation	6.5-8.5	10 or less	5 or more	1000 or less

Source: Standards for Water Schedule 3 of Environment Conservation Rule 1997

Periodic Maintenance Works: The BWDB monitoring unit has postings of 4 Assistant Chiefs and 2 Deputy Chiefs to oversee the overall environmental compliance of BWDB implemented projects. Under CEIP-1, the Environment Social Communication Unit will provide training to the BWDB people responsible for monitoring of environmental compliance. Thus, a smooth transition to BWDB will happen to ensure environmental compliance during the O&M after the project completion. These staff will be responsible to manage the environmental aspects of the operation and maintenance of polder, its water control structures, and other relevant issues such as protection of key environmental resources of the older and maintain fish migration. Water Management Organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (November 2000) and involve the beneficiary communities. WMOs will be trained by BWDB to ensure environmental management during project operation. The Environmental Management Unit of BWDB will ensure and oversee the environmental management during project implementation and operation. The Water Management Organization will also be trained and involved in EMP implementation during the operation phase.

Mitigation Measures: Chapter 6 addresses location specific impacts and mitigation measures. Whereas, Table 10.1usually presents measures for environmental code of practices based on the experience and generic mitigation measures for EMP. Table 10.1 also uses in conjunction with polder specific measures. Thus, measures mentioned in Chapter 6 are not concur with each and every code of practices in the Table 10.1.