FINAL REPORT

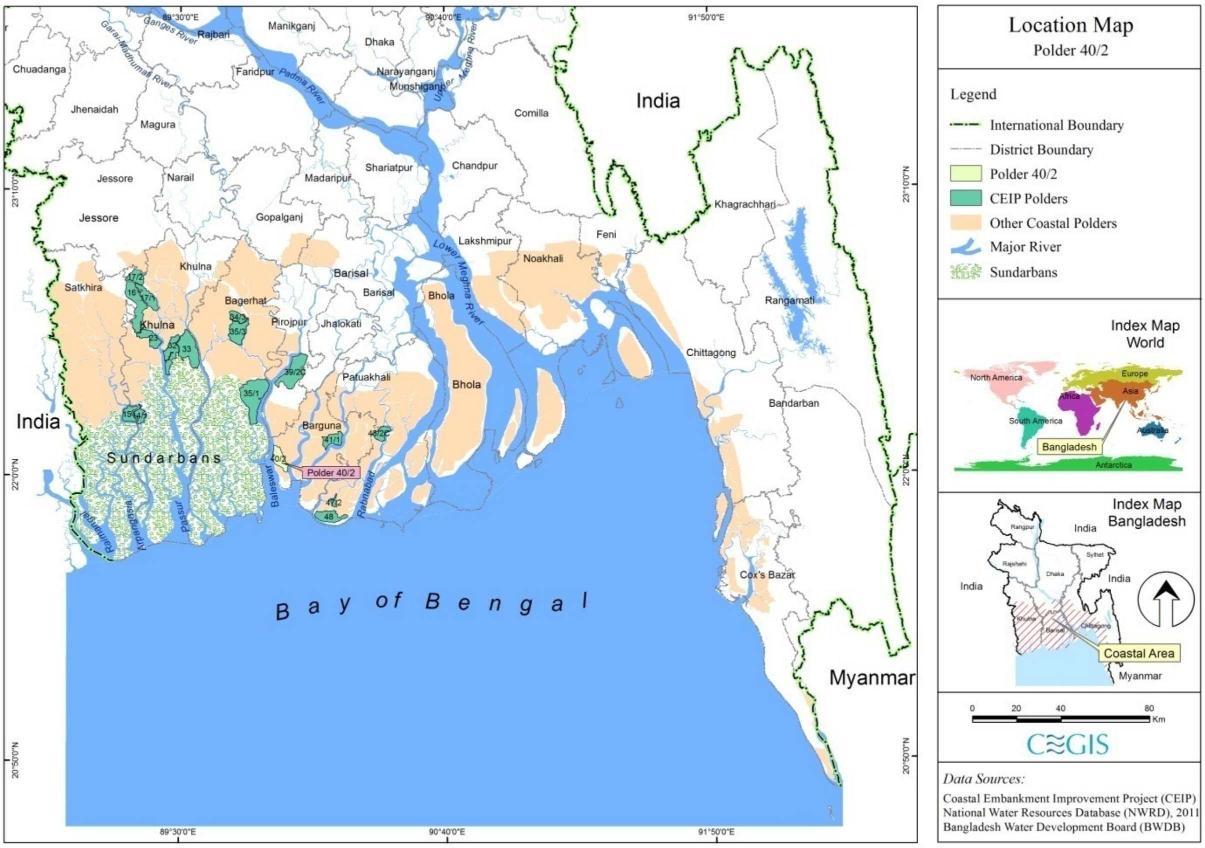
Government of the People's Republic of Bangladesh

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 OF POLDER -40/2 FOR PACKAGE-2

February 2017

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Abbreviations and Acronyms

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
CBO	Community Based Organization
CCP	Chittagong Coastal Plain
CDS	Coastal Development Strategy
CDP	Coastal Development Partner
CEC	Cation Exchange Capacity
CEGIS	Center for Environmental and Geographic Information Services
CEIP	Coastal Embankment Improvement Program
CEIP-I	Coastal Embankment Improvement Project, Phase I
CERP	Coastal Embankment Rehabilitation Project
CES	Consulting Engineering Services
CAFOD	Catholic Fund for Overseas Development
DAE	Department of Agricultural Extension
DCSC	Design & Construction Supervision Consultant
DOE	Department of Environment
DPHE	Department of Public Health engineering
DPM	Design Planning & Management Consultants
DTW	Deep Tubewell
EA	Environment Assessment
EAP	Environmental Action Plan
ECA	Environment Conservation Act
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules

ECRRP	Emergency 2007 Cyclone Recovery and Restoration project
EDS	Environmental Data Sheet
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ES	Embankment Settler
ESBN	Estuarine Set Bag Net
ESCU	Environment, Social and Communication Unit
FAO	Food and Agriculture Organization
FG	Functional Group
FGD	Focus group Discussion
FRSS	Fisheries Resources Survey System
FWIP	Future-with-Project
FWOP	Future-without-Project
GIS	Geographical Information System
GO	Government Organization
GTPE	Ganges Tidal Plain East
GTPW	Ganges Tidal Plain West
Ha	Hectare
HTW	Hand Tubewell
HYV	High Yielding Variety
ICZM	Integrated Coastal Zone Management
IDA	International Development Association (World Bank)
IEE	Initial Environmental Examination
IESCs	Important Environmental and Social Components
ILO	International Labour Organization
IS	Institutional Survey
IUCN	International Union for Conservation of Nature
IWM	Institute of Water Modelling
KCC	Khulna City Corporation
KII	Key Informant Interview
KJDRP	Khulna-Jessore Drainage Rehabilitation Project
KMC	Knowledge Management Consultants Ltd.
LLP	Low Lift Pump
Mahasen	Cyclone during Kharif-1 season of 2013

MCSP	Multipurpose Cyclone Shelter Programme
MDP	Meghna Deltaic Plain
MOEF	Ministry of Environment and Forest
MOWR	Ministry of Water Resources
MSL	Mean Sea Level
MT	Metric Ton
NCA	Net Cultivated Area
NFP	National Fishery Policy
NGO	Non-Governmental Organization
NLUP	National Land Use Policy
N,P,K	Nitrogen, Phosphorous, Potassium
NOC	No Objection Certificate
NWRD	National Water Resources Database
O&M	Operation and Maintenance
OP	Operation Procedure
PAP	Project Affected Person
PCM	Public Consultation Meeting
PCD	Project Concept Document
PID	Project Information Document
PIO	Project Implementation Office
PL	Post Larva (Shrimp/Prawn seed)
PRA	Participatory Rural Appraisal
PWD	Power Works Datum
PRSP	Poverty Reduction Strategy Paper
PSF	Pond Sand Filter
RCB	Reinforced Concrete Box
RL	Reduced Level
RoW	Right of ways
RRA	Rapid Rural appraisal
SEA	Strategic Environmental Assessment
SEO	Secondary Education Office
SLR	Sea Level Rise
SRDI	Soils Resources Development Institute
SSO	Social Service Office
STW	Shallow Tubewell
TDS	Total Dissolved Solids

TOR	Terms of Reference
UFO	Upazila Fisheries Office
UNDP	United Nations Development Program
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding
WAO	Women Affairs Office
WARPO	Water Resources Planning Organization
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-December. 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 where 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 market 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: Broadcasted short duration paddy crop grown during April-mid-August.

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

Baor: Baor is 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 place

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 mainly 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 locations), where many people gather.

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

Kutcha: House: 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).

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

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

Pucca House: Well constructed building using modern masonry materials.

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

Semi-pucca: House with concrete wall and tin roof

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 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.

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

T. *Aman*: Transplanted paddies grown during July-November, generally rain-fed crops, 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 varies in some locations)
1 Bigha	= 20 Katha
1 Acre	= 100 Decimal
1 Acre	= 4046.825 sq. meter
1 Hectare	= 247 Decimal/10,000 sq meter
1 Hectare	= 2.47 Acre
1 metric ton	= 1000 Kilogram
1 kilometer	= 1000 meter
1 inch	=25.4 millimeter
1 foot	=0.3048 meter

Executive Summary

The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase-1 (CEIP-1), under which seventeen polders will be rehabilitated and improved in the coastal area of the country. The GoB has obtained financial assistance from the World Bank (WB) for this Project. In accordance with the national regulatory requirements and WB safeguard policies, Environmental Impact Assessments (EIAs) of four polders have already been carried out in first package. This document presents the EIA report of Polder 40/2, which is one of the six polders of Package- 2.

Background

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

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

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

Location and Synopsis of Rehabilitation Work

The proposed Polder-40/2 is located in Patharghata upazila under Barguna district of Bangladesh. The administrative and management control lies with BWDB's Barguna O&M Division under the southern zone. Water related problems like saline intrusion, drainage congestion, sedimentation, shortage of irrigation water and tidal flooding have increased severely in this area. Consequently, the lives and livelihoods of the communities here have been disrupted. The side slopes of the embankment are being damaged and eroded in different places mainly due to river erosion and wave action. The overtopping that had occurred during the cyclone Sidr (2007) had also damaged and eroded the embankment in many locations.

The Project aims to enhance protection against natural disasters, increase resilience during and after such disasters and improve agricultural production by reducing saline water intrusion. To meet the objectives of the CEIP-1, the key improvement works to be carried out in Polder 40/2 are: re-sectioning of embankment (35.58 km); construction (replacing) of 10 drainage sluices; repair of 2 drainage sluices; construction (replacing) of 10 flushing sluices; repair of 4 flushing sluices and demolishing of 7 flushing sluices; re-excavation of drainage channels (36.60 km); slope protection of embankment (1 km); bank revetment 300m and afforestation on the slope and foreshore areas (17.06 ha). Other components of the CEIP-1 will 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 that needs to be carried out for projects being considered by its financing. The present EIA Report fulfills both these requirements.

According to the classification of Environmental Conservation Rules (1997) of DoE, the construction, reconstruction, expansion of polders and flood control embankment is categorized as Red. For Red category, it is mandatory to conduct Environmental Impact Assessment (EIA), Environmental Management Plan (EMP), and Resettlement Action Plan (RAP) for getting environmental clearance from DoE. On the other hand, according to the, the World Bank Safeguard Policy the project has been classified as Category A, because it encompasses high risk with wide involvement of major civil works considering the high ecological sensitivity and vulnerability in the coastal area.

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Regulatory and Policy Framework

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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 40/2 is located in the southern region of Bangladesh. Topographically, this area is flat and developed by alluvial deposition process by the three mighty rivers of the country. The polder area is crisscrossed by a large number of creeks. The total area is basically flat with the central part a bit higher than the surrounding land. Administratively, Polder -40/2 covers parts of Patharghata upazila under Barguna district.

The Polder -40/2 lies in agro-ecological zone of the Ganges Tidal Floodplain. The gross area of the Polder is about 4,453ha of which about 74% is available for cultivation. Other 26 % of areas are covered by settlements including homestead and water bodies. The total cropped area is around 4,650 ha. The annual total rice production is about 8,700 metric ton consisting of Aus, Aman and Boro. The total non-rice production is about 7,280 metric ton consisting of wheat, pulses and vegetables.

River bank erosion of both the Bishkhali and Baleswar Rivers is a problem in the polder area. Dakkhin Patharghata along the Bishkhali River and Tafalbaria at the northwestern part of the polder along the Baleshwar River are the two erosion hotspots.

The climate of the Polder area is monsoon tropical. The mean annual temperature is around 26.5^{0}C; mean annual rainfall is 2,770 mm. Total water body is **2675** ha and fish production of the polder area is around 1232MT comprising of both capture fisheries (69%) and the remaining from the culture fishery. Fish production trend from capture fisheries is declining in the polder area due to silting of internal khals and indiscriminate fishing activities. Perennial khals such as Nadmulla Khal, Hetalia Khal and Bamoner Khal along with other seasonal internal khals are used as feeding and shelter ground of most of the open water fishes. These khals are marked as areas of conservation significance.

The polder area falls under the bio-ecological zone namely Saline Tidal Floodplain. Major ecosystems of this polder are homesteads, crop fields, embankment, foreshore/intertidal area rivers and canals. Embankment of this polder is dominated by wild herbs/shrubs and number of timber trees. Intertidal area is vegetated by mangrove plants associated with some local terrestrial plants. Embankment and roadside vegetation play important roles for providence of shelter for many rodents, local avifauna and reptiles.

The population of the polder area is about 41,200 of which 20,610 are males and 20,590 females with a population density of 621 persons per sq km. The estimated total household number is 10,830 and the average household size is 3.80. The literacy rate is 61.5%, with male 61% literate and female 62%. Agriculture is the main occupation in the polder area followed by fishing and agriculture labor. A significant number of landless/marginal farmers of Polder 40/2 have migrated out from their villages in search of livelihood.

Potential Impacts and their Mitigations

Pre-construction phase

The potential environmental and social impacts associated with the pre-construction phase of the project include loss of agricultural land, loss of biomass, displacement of people, and psychological impact on people who have to change livelihood. It is estimated that about 16 houses and 611 matured trees will be affected for construction of drainage and flushing sluices. Establishing the contractor's temporary site facilities may involve land clearing, land leveling, excavation and construction of shelters.

During-construction phase

The potential impacts during the construction phase include air pollution, noise pollution, soil erosion and pollution, water contamination, increased siltation in water bodies, and loss of agriculture, disrupt irrigation during wet season, damage to fish and other aquatic fauna, traffic congestion, disturbance of local communication and safety hazards. The key construction activities that are likely to cause these environmental and social impacts include construction camp establishment and operation, equipment and material transportation, material borrowing, excavation, embankment raising, dismantling, repair and construction of regulators, re-excavation of water channels and waste disposal. After completion of construction activities most of these negative impacts will disappear. The project works on the regulators in the area likely to worsen the situation and exacerbate the water logging problem. Furthermore, areas along Patharghata, Charduani, Hatempur and Gyanpara water channels are also likely to face water logging during post monsoon season. After completion of construction activities, this temporary water logging will disappear.

Construction activities for the sluices can potentially affect aquatic habitat and fish migration in the khals if block the khals mouth during construction. 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. In addition, the fish species including Pairsa, Vetki, Horina Chingri, Puti and Tengra reported to move between the internal khals and floodplain during breeding season (mid May to July). During the construction activities, the 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 be affected. Similarly, fish migration within the Polder between khals and floodplain can also be temporarily affected by the construction activities particularly the khal excavation.

Embankment re-sectioning and re-excavation of khals will cause undergrowth vegetation damage both at embankment slopes, khals bed, both sides of khal bank and the sites from where soil would be collected. It is expected that the damaged sites will be recover within 1 to 2 years by natural regeneration of herbs and shrubs because of the plant species at the proposed sites are seasonally grown and life span is not more than one years. Minor vegetation damage is expecting at the proposed bank revetment sites. As all the tall trees at proposed sites have already felled while damage the embankment slopes, so no big tree exists there. During plantation at foreshore area, the existing undergrowth vegetation would be damaged due to plantation labour movement. Incautious disposal of sapling's poly bags may cause deterioration of soil quality. There may be a risk to outbreak of plant diseases to the other existing plants from the planted disease affected saplings. Water flow in creeks and strips of planted area may interrupt for aggregation of plant or plant shoots. Inadequate distance between two saplings may hinder proper growth and caused disease outbreak.

The social impacts include social unrest due to conflict between local labour and outside labour, the presence of outside labor can potentially disrupt the privacy of the local population particularly women whose mobility can be negatively affected.

Project operation phase

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

Presently around 1,220 metric tons of chemical fertilizers and 30 metric tons of pesticides are used for cultivation. The crop area will increase due to implementation of this project by improving irrigation facilities, removing of drainage congestion and arresting intrusion of saline water. Additional about 440 metric ton of chemical fertilizers and 16 metric ton of pesticides would be applied for expansion of crop area as well as conversion of local variety to high yielding variety. Runoff from such cultivation fields might potentially pollute the water bodies and would reduce fish production.

Replacement of drainage sluices on water channels that are currently directly connected with the Periphery Rivers will potentially result in reduction in fish migration. This can result in decrease of fish population in the Polder thus adversely affecting the fish catch and fishermen.

On the positive aspect, according to the proposed intervention, re-sectioning of embankment, replacement and repair of structures would protect the polder from tidal and monsoon flooding, will arrest salinity intrusion, in the polder area. Besides, drainage congestion will be significantly reduced due to re-excavation of internal khals as per proposed plan. These would increase area under cultivation, which would increase crop production as well as create employment generation.

Additional 9,680 metric tons of rice and 4,310 metric tons of non-rice would be produced annually in the polder area. About 5,000 skilled and 25,000 unskilled labours will be needed for implementation of the project. On the other hands, employment opportunity will be created especially in agriculture sector due to expansion of crop area during operation of the project.

The polder area being near to the Bay-of-Bengal, natural disasters often hit this area and without having proper protection measures, the people of this locality are very much vulnerable. After implementation of the polder, the area will be better protected from different natural disaster e.g. tidal surge, river erosion, flooding etc.

Implementation of afforestation programme will mitigate negative impacts associated with tree felling. Consequently, foreshore afforestation will enhance mangrove vegetation coverage surrounding the polder that expected to protect embankment from tidal surge, reduce erosion of foreshore land and provide habitats.

Analysis of Alternative

Several alternatives were considered during the design phase of the project. These included ‘no-project’ alternative and technical alternatives.

The present situation of the polder is vulnerable to cyclones, storm surges, wave action and climate change effects like the other Polders in the coastal area of the country and the Polder is not in a state to provide required services particularly protection against tidal inundation, drainage and minimizing the impact of cyclonic surges. A considerable portion of the polder area is vulnerable to salinity intrusion and water logging. Due to high salinity and scarcity of ground water during 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 and fisheries is declining. The proposed interventions under CEIP-1 have been designed to address the above-mentioned problems of the Polder. If proposed interventions are not implemented, the present poor state of the Polder will continue and may further deteriorate; therefore, the ‘no-project’ alternative is not a recommended option.

Several technical alternatives were considered to address each of the problems in the Polder. These included alternatives for embankment strengthening, riverbank protection works, protection of embankment slopes, replacement of drainage and flushing sluices, rehabilitation of drainage and flushing sluices, addressing 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-40/2 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 and 2050 respectively. Minimum surface air temperature may increase in winter season in future.

Cumulative and Reciprocal Impacts

The Baleswar and Bishkhali Rivers surround polder 40/2 at southwestern and southeastern portions respectively. The existing crest levels of the polder ranges from 3.95 to 4.50 mPWD. Re-sectioning works are proposed in the polder under CEIP, which would increase its crest level up to 5.18 mPWD. This increase would reduce storm surge to enter into the polder. The other CEIP Polders (41/1, 43/2C, 47/2 and 48) are far away from the project area for which their interventions have negligible impact on Polder -40/2.

Polders 39/1A, 40/1, and 42 are located near Polder- 40/2, along the downstream of Payra River. The design crest levels of these polders are: 4.57 to 5.18 mPWD. All these polders will tend to divert the flow of Payra River further upstream and will transfer storm surge inundation risks. There may also be flood plain sedimentation along the river as a significant portion of tidal water would be prevented from entering those polders, which may reduce the depth of flow of Payra River in future. Due to the reduced depth, river erosion probabilities in Polder- 40/2 may increase.

The reciprocal impacts of Climate Change and Polder improvement of Polder-40/2, both quantitative assessments and qualitative judgments have been carried out. In total 38 number of storm surge model simulation results have been used in determining storm level for different return period. The water level of peripheral rivers and canals in 25 years return period (by IWM) is projected up to 3.22 mPWD. The projection of storm surge level in the five locations of the Polder -40/2 considering with and without climate change. It is observed that in 10 year return period surge level may be increased around 25% whereas in 50 year return period it may be increased around 20%. Therefore, it can infer that surge level intensity may be more frequent in coming years in surrounding areas of Polder- 40/2. In 50-year projection, it has found that due to climate change storm surge levels are higher than the existing crest level of the polder that may cause severe inundation inside the polder.

Moreover, projected short duration wave height of peripheral rivers is also higher than the long duration wave heights due to climate change.

Environmental Management Plan

The Environmental Management Plan (EMP) provides the implementation mechanism for the mitigation measures identified during the EIA process. A comprehensive EMP focusing on managing construction phase-related impacts should suffice in managing the potential construction and operation phase impacts. The total cost of EMP implementation for Polder-40/2 has been estimated as BDT 27.653 million (app.). The contractor needs to submit an Environmental Action Plan (EAP) based on the EIA and EMF in line with the construction schedule and guideline, which will be reviewed by the supervision consultant and approved by BWDB and World Bank.

Extensive monitoring of the environmental concerns of the Polder- 40/2 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.

To address the impacts associated with material and equipment transportation and traffic congestion, the contractor will prepare and implement a traffic management plan, which will ensure that sensitive receptors such as schools and busy markets and bazaars are avoided during the peak hours. To address the air and water pollution, contractor will prepare and implement a pollution control plan, which will be included in the EAP 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.

Furthermore, EMP identifies capacity-building need with respect to environmental management of the Project, in addition to defining reporting and record keeping protocol.

Institutional Responsibility and Report Requirement

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

BWDB will prepare the Quarterly/Bi-annually Annual 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 Environment, Social and Communication Unit (ESCU) to be established to implement and manage the EMP, which 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 subproject specific environment screening/assessment report with EMP, supervise the implementation of EMP and support capacity building of the field level staff of BWDB and contractor. The ESCU will review the EMF and ensure quality of the environmental screening/assessment with EMP.

Stakeholder Consultation and Disclosure

Several stakeholder consultation meetings were conducted with the participation of local people, representatives of local government (Union Parishad) and representatives of the BWDB with the objective of disclosing the impacts of the project and the EMP. Local people showed interest in the project and were positive minded for its implementation, which is vital for their survival. They also expressed that if the monitoring plan is implemented properly during the pre-construction, construction, post-construction and operation periods, then they would have supported the implementing agency positively.

1 Introduction

1. The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase-1 (CEIP-1), in which seventeen polders will be rehabilitated and improved in the coastal area of the country under three packages. The GoB has obtained financial assistance from the World Bank (WB) for this project. In accordance with the national regulatory requirements and WB safeguard policies, Environmental Impact Assessment (EIA) of all the 17 (seventeen) polders have to be carried out. It is to be mentioned here that the Site Clearance of all the polders had been obtained from the Department of Environment (DoE), Bangladesh based on the Initial Environmental Examination (IEE) reports completed earlier. EIA studies of four polders of Package-1 have already been completed. EIA of the remaining 13 polders will be carried out under Packages-2 and 3. Accordingly, EIA of Package -2 of six polders has also been conducted. This EIA report (of Polder -40/2) is one of these six polders of Package- 2. The EIA reports of other five polders of the package have been prepared separately.

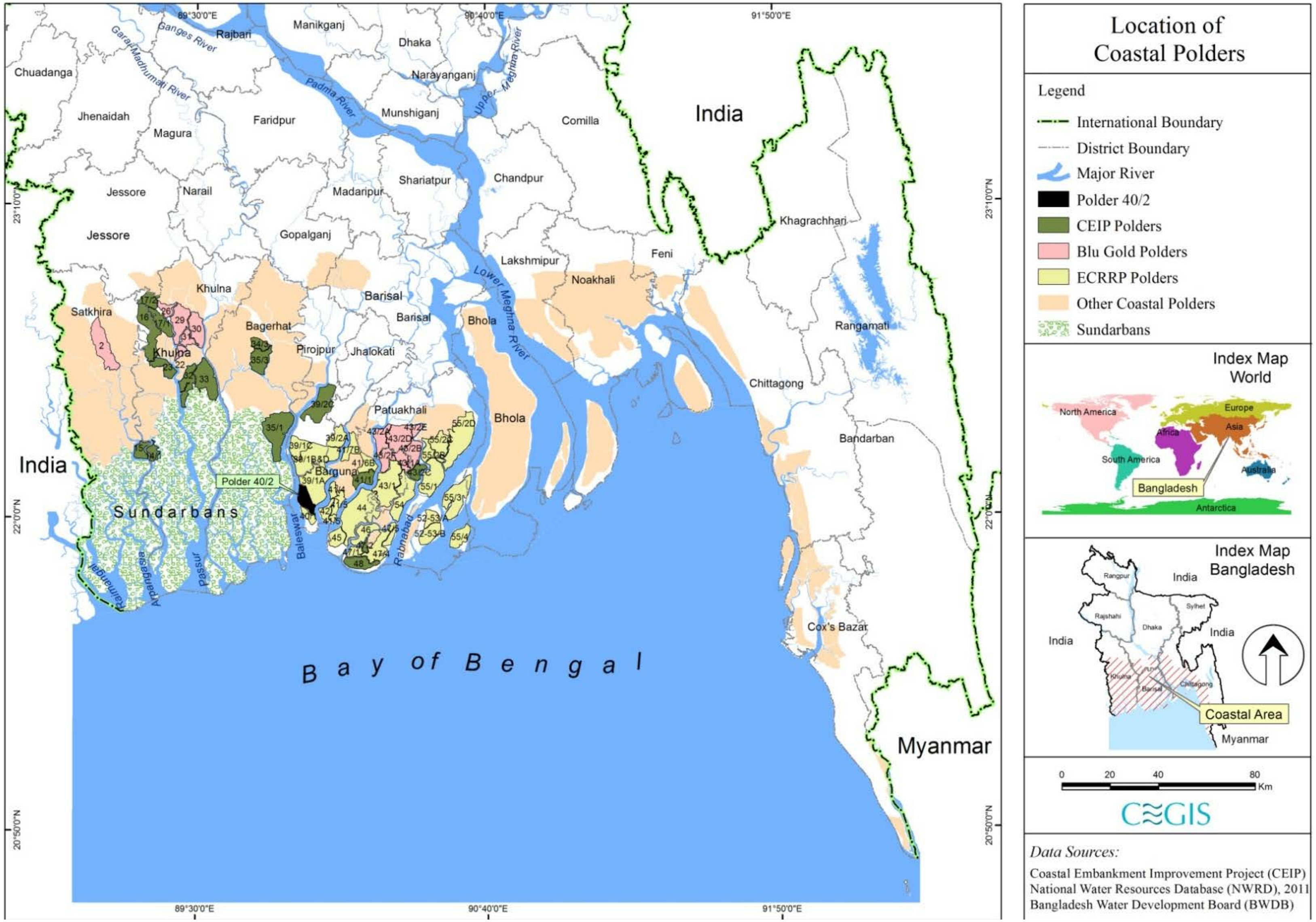
1.1 Background

2. The coastal region of Bangladesh covers of 19 districts adjoining the Bay of Bengal and is characterized by a delicately modified ecosystem of an evolving flat delta subject to very high tides, salinity intrusion and frequent cyclones coming from the Bay of Bengal encountering very large sediment inflows from upstream.

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

4. The coastal embankment system of Bangladesh was originally designed without much attention to storm surges. Recent cyclones brought substantial damage to the embankments and further threatened the integrity of the coastal polders. In addition to breaching due to cyclones, siltation of peripheral rivers surrounding the embankments have caused the coastal polders to suffer from water logging, which has led to large scale environmental, social and economical degradation. Poor maintenance and inadequate management of the polders have also contributed to internal drainage congestion and heavy external siltation. Soil fertility and agriculture production in some areas are declining because of water logging and salinity increase inside the polders.

5. The above-mentioned reasons have led the government to readjust its strategy on the coastal area from only ensuring protections against high tides by providing protection against frequent storm surges as well. The long-term objective of the government is to increase the resilience of the entire coastal population from tidal flooding, other 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 will be adopted over a period of 15 to 20 years. The proposed CEIP-1 is the first phase of this long-term program.



Map 1.1: Location of Coastal Polders

1.2 Project Overview

6. Polder-40/2 is located in Patharghata upazila under Barguna district of southern Bangladesh (Map 1.2). The Polder covers a gross area of 4,453 hectare (ha) with net cultivable area of 3,300 ha. The Project aims to enhance protection against natural disasters, increase resilience during and after such disasters and improve agricultural production by reducing drainage congestion. To meet up these objectives, the following key improvement and rehabilitation works will be carried out in Polder -40/2 under Package -2, CEIP-1 below:

Table 1.1: List of key improvement and rehabilitation works

Type of Work	Specification
Re-sectioning of embankment	34.40 km
Construction of embankment with design crest level	6.500 mPWD, 6.00 mPWD and 5.00 mPWD
Retire of embankment	415 m
Construction of Floodwall	7.90 km
Construction (Replacing) of Drainage Sluice	09 nos.
Repair of Drainage Sluice	02 nos.
Demolishing of Drainage Sluice	01 nos.
Construction (Replacing) of Flushing Sluice	12 nos.
Repair of Flushing Sluice	05 nos.
Demolish of Flushing Sluice	06 nos.
New construction of Flushing Sluice	01 nos.
Re-excavation of drainage channel	33.60 km
Slope protection and backing of embankment	1.137 km
Total Afforestation (Slope Foreshore)	17.06 (10.10+6.96)ha

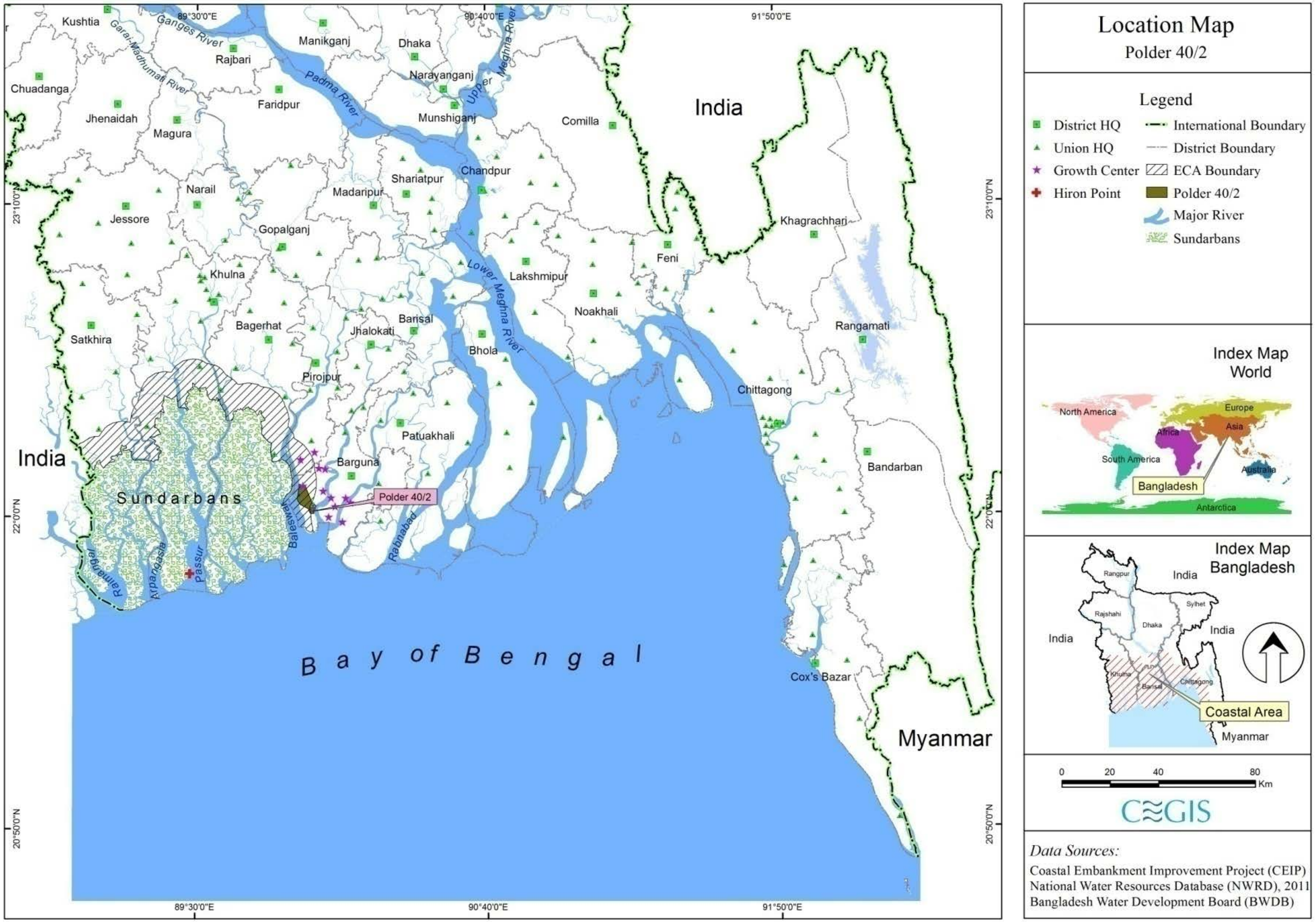
Source: CEIP-I Design Study Finding

7. Other components of the CEIP-1 will 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.

8. The BWDB is the implementing agency of the Project. Detail information of the Project are presented in the 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 from the DoE, Ministry of Environment and Forest (MoEF). Similarly, the World Bank's environmental safeguard policies require an environmental assessment for those projects under their financing. The present EIA fulfills both of these requirements.



Map 1.2: Location of Polder- 40/2

1.4 Objectives of the Study

10. The overall objective of the EIA study of Polder -40/2 is to ensure that the environmental and social management practices are integrated in the design, construction, operation and maintenance of the polder. The specific objectives of the EIA study are to:

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

1.5 Scope of Works

11. The scope of works of for conducting the EIA for Polder -40/2 includes the following:

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

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

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

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

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

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

(ix) Describe alternatives, which were examined in course of developing the proposed project, and identify other alternatives which could achieve the same objectives. The concept of alternatives extends to the sighting 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. While describing the impacts, the irreversible or unavoidable are unmitigable and impacts which may be mitigable. To the extent possible, quantify the costs and benefits of each alternative, incorporating the estimated costs of any mitigating measures. Include the alternative of not constructing the project to demonstrate environmental conditions without it.

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

(xi) Prepare detail EMP along with respective EIA separately to monitor the implementation of mitigating measures and the impacts of the project of other inputs (such as training and institutional strengthening) needed to conduct it during construction and operation. Include in the plan an estimate of capital and operating costs and a description of other inputs (such as training and institutional strengthening) needed to implement the plan.

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

(xiii) Develop Environmental monitoring format for regular monitoring of the project during 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. A discussion on the WB safeguard policies and their applicability for the Project has also been reviewed.

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

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

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

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

Chapter 10 (Development of Environmental Management Plan) includes estimate the impacts and costs of the mitigation measures, prepare detail 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. specifies the implementation arrangements for the mitigation measures identified during the EIA study. The EMP also includes among others mitigation plan, enhancement plan, contingency plan and the environmental monitoring plan.

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

2 Approach and Methodology

13. This chapter presents the detailed approach and methods followed in conducting the EIA study for rehabilitation of Polder- 40/2. 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-40/2 has been carried out following the approved Terms of References (ToR) of DoE dated 05/06/2013 and the Environmental Management Framework (EMF) for CEIP-1. The overall approach of the study is shown in Figure 2.1 below:

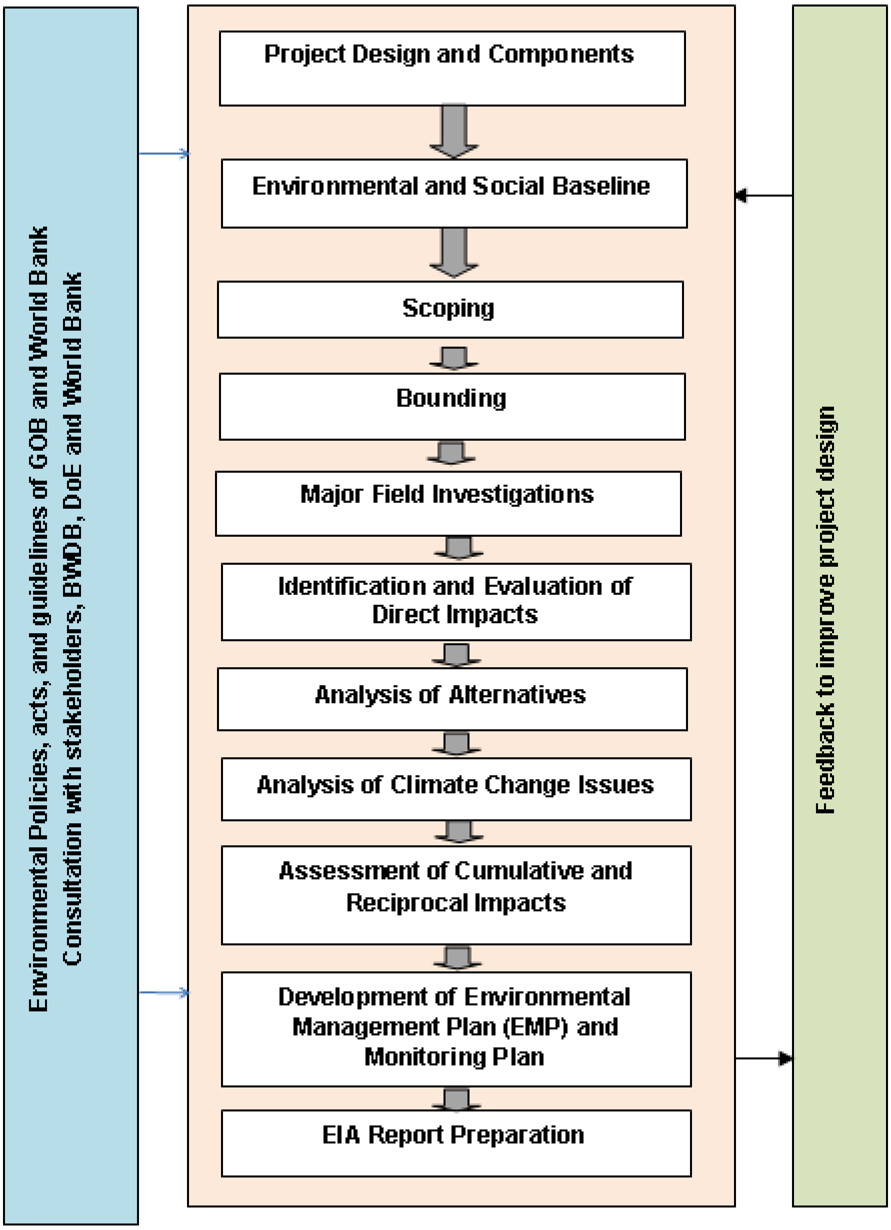


Figure 2.1: Overall approach of the EIA study

2.2 Methodology

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

2.2.1 Influence of Project Area

16. The Project 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 Baleswar River in the west and Bishkhali in the south-east corner. These two rivers are directly fed by oceanic tides. Apart from these prominent rivers, Lathimara Khal (south) encircles the polder and Charduani-Patharghata Bharani Khal (northeast).It is noted that project area includes polder area whereas study area includes both project area and peripheral rivers.

2.2.2 Analysis of the Project Design and Description

17. Detailed information on the Polder- 40/2 including objective, nature and location of proposed and existing interventions, construction works, and other related aspects were 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 project interventions are already fixed, alternative design options of the interventions were analyzed considering environmental, social, and technological criteria to identify suitable alternatives and appropriate mitigation measures for negative environmental impacts. **Figure 2.2** shows the different aspects to be addressed in the Project Design and Description step of the EIA studies.

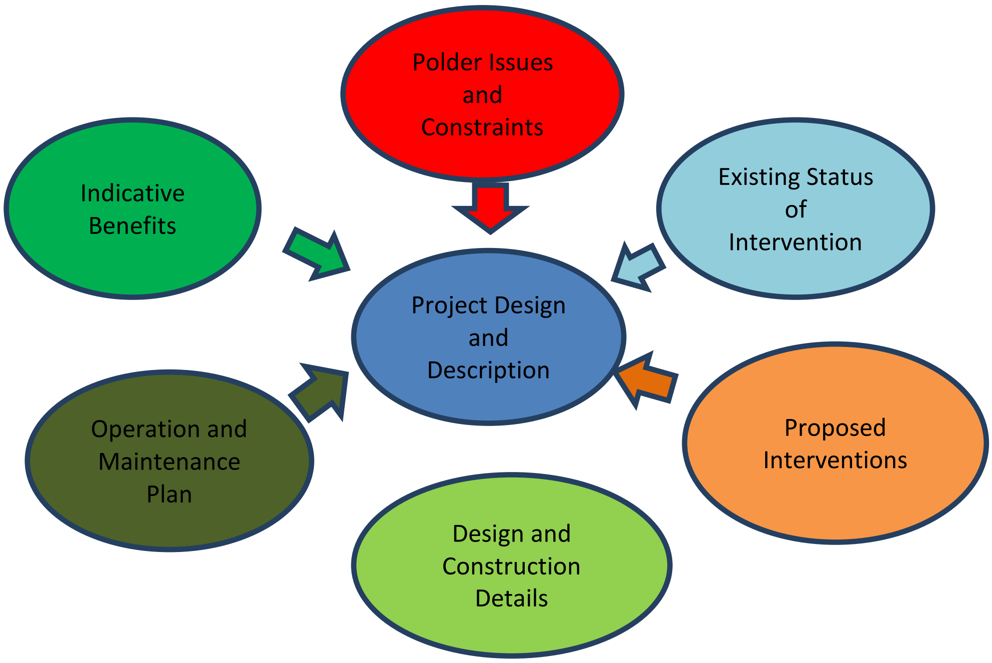


Figure 2.2: Aspects to be addressed in the Project Design and Description

2.2.3 Analysis of the Project 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.

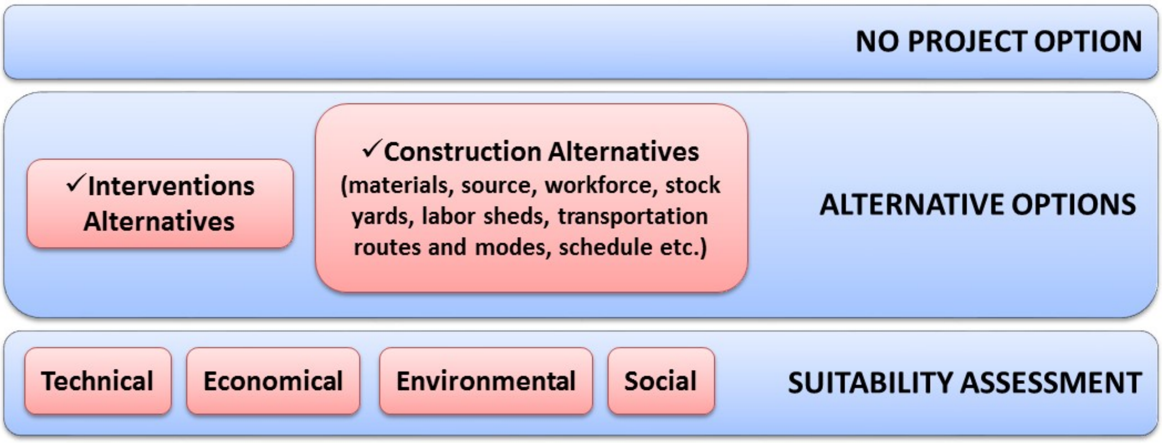


Figure 2.3: Concept of Alternative analysis to be used in the EIA study

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 Detailed Design, Construction Supervision and Project Management Support 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 Meteorology

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 air, water, noise, soil quality and water salinity were collected and analyzed. Observations by the professionals of the multi-disciplinary team were backed up by feedback from the local people. Major river systems were identified for hydrological and morphological investigation through historical and current image data collection and analysis. Specific areas or points of interest were selected for collecting data on special hydrological and morphological aspects, water availability, drainage pattern, water quality (surface and ground water), tidal flood, risk of erosion and sedimentation.

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. 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 project area was identified using secondary sources including Food and Agriculture Organization (FAO). The land type and soil texture data were collected from Upazila [1] Land and Soil Resources Utilization Guide of Soils Resources Development Institute (SRDI). The secondary data of these parameters was verified at field level through physical observations as well as consultations with the local people and officials of the Department of Agriculture Extension (DAE) during field visit.

2.2.8 Biological Environment

Agricultural Resources

29. 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

1 Upazila is an administrative subdivision of a district.

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.

30. 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)

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

Ecological Resources

32. 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 ecosystems were generated through analysis of recent satellite imagery. Field investigation methods included physical observations; 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 surveys and from the species database of Bangladesh National Herbarium and the Status of Vertebrates/ Red List of International Union for Conservation of Nature (IUCN).

Fish and Fisheries Resources

33. 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.

34. Fish habitat classification was made based on physical existence and was categorized into capture and culture fish habitats. The capture fish habitats included rivers, khals, and tidal floodplains, borrow pits, and beels. The culture fish habitats included homestead culture fishponds, commercial fish farms and shrimp ghers.

35. Capture fish habitat classification was assessed based on species diversity and composition, identification of species of conservation significance, identification of potential fish habitat prescribing to restore for fish conservation, fish migration survey, habitat identification for fish conservation. Culture fish habitat was assessed through homestead culture fishpond survey and commercial fish farm/gher survey.

36. 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.

37. Relevant secondary data were collected from the UFO’s annual reports and various literature study reports.

38. Fish productions for individual habitats were obtained from the secondary information collected from the UFOs and literatures were blended with primary data in production estimation.

Livestock Resources

31. 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 assessment (PRA) and rapid rural assessment (RRA). Livestock resources data were also collected from secondary sources i.e. Upazila Livestock Office.

2.2.9 Socio-cultural Environment

39. 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 –DCSC 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 levels.

40. 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.

2.2.10 Climate Change

41. 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 German watch Global Climate Risk Index, the country ranks first as the most vulnerable nation, to be highly impacted in the coming decades. In the coastal areas, the consequences of climate change are more staggering. Climate change directly contributes to changes in temperature and precipitation, which eventually 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:

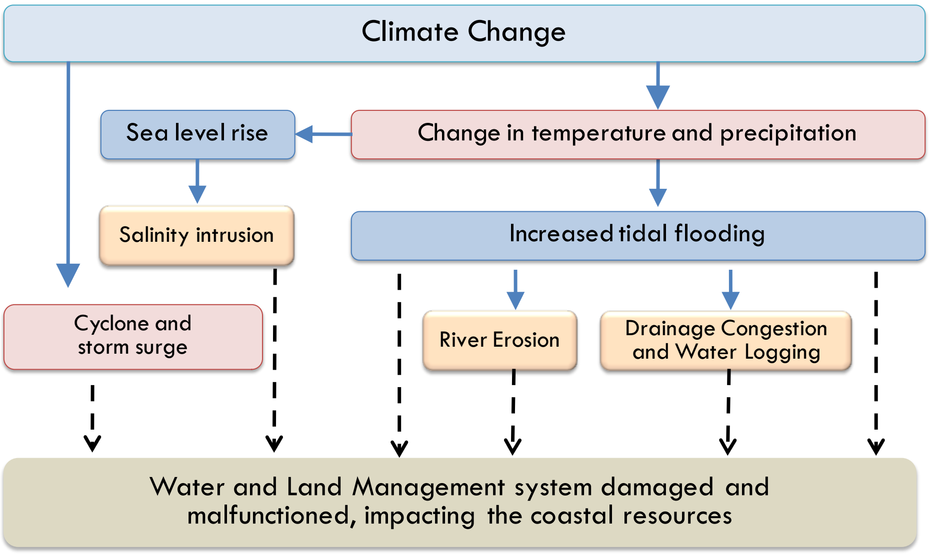


Figure 2.4: Typical process diagram of climate change impacts in coastal areas

42. The polder has been previously 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 left 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.

43. 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 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

44. 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

45. 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. HN, MN, HP and MP indicated the magnitude of

both positive and negative impacts based upon extent, magnitude, reversibility, duration and sustainability considerations. The impacts of proposed interventions, considering the climate-change scenario for 2050, were estimated based on 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 under the Project were assessed to generate the FWIP condition. Comparison and projection methods were used for impact prediction.

46. Cumulative impact assessment of a certain Polder is a two ways 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 consider to quantify the impact assessment. Finally, the impacts for development works of other adjacent polders have been consider for cumulative impact assessment.

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

48. 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 been analyzed through modeling. The model results have been utilized in the EIA study.

Methodology

49. 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.

50. 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

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

- Duration of the potential impact;

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

52. The magnitude of potential impacts of the Project has generally 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

53. 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

54. 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

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

56. 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

57. 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 Identification of Enhancement and Mitigating Measures

From literature survey, applying expert's judgement and consultation with stakeholders, possible enhancement and mitigating measures were identified for beneficial and adverse effects respectively.

2.2.14 Preparation of Environmental Management and Monitoring Plan

58. An environmental management plan (EMP) for the proposed Polder has been 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).

2.2.15 EIA Report Preparation

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

3 Policy, Legal and Administrative Framework

60. 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

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

3.1.1 The National Water Act, 2013

62. 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.

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

64. Draining of wetlands that supports 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.

65. 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.

66. 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 National River Protection Commission Act 2013

67. 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.

68. 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.

69. The Commission is formed with a chairman and four experts on river, environment, river survey and law (human rights) under the act for a three-year term. As per the Act, the Commission works for creating public awareness for protecting rivers, conducting

researches on river protection, ensuring river management, and taking up both short- and long-term plans for protection of rivers.

3.1.3 Bangladesh Environment Court Act, 2010

70. Bangladesh Environment Court Act, 2010 has 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 who creates 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.

3.1.4 The Forest Act, 1927 & Amendment Act 2000

71. 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."

72. 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.

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

73. 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 been established by 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.

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

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

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

76. 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, project affected persons (PAPs) were given provision for putting objections or taking legal actions against the polluters or any entity creating nuisance to affected person.

3.1.6 Bangladesh Environment Conservation Rules (ECR), 1997

77. 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.

78. The Rule 3 defines the factors to be considered in declaring an area 'ecologically critical area' (ECA) as per Section 5 of ECA95. It empowers the Government to declare an area 'ECA', if it is satisfied that the ecosystem of the area has reached or 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 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.

79. 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**.

80. All existing and proposed projects, that are consider low polluting are categorized under "Green" and shall be granted Environmental Clearance. For proposed projects falling in the Orange-A, Orange-B and Red Categories, firstly a site clearance certificate and thereafter an environmental clearance certificate will be required. A detailed

description of these four categories of projects has been given in Schedule-1 of ECR'97. Apart from the general requirements, for every Red category proposed project, the application must be accompanied with feasibility report, Initial Environmental Examination (IEE), and an Environmental Impact Assessment (EIA) based on approved ToR by DoE, as well as an Environmental Management Plan (EMP). As per ECR'97, water resources development projects, such as the present CEIP-1 is considered as category 'Red'.

81. 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 favor 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.

3.1.7 The Embankment and Drainage Act 1952

82. 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 water-courses or better drainage of lands and for their protection from floods, erosion or other damage by water.

83. 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.

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

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

85. 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.

3.1.9 The Ground Water Management Ordinance, 1985 (Ordinance No. Xxvit of 1985)

86. 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.

3.1.10 The Constitution

87. 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."

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

3.2 Relevant National Policies, Strategies and Plans

3.2.1 National Agriculture Policy, 2013

89. 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.

90. 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.

91. 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.

92. 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

93. 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.

94. The proposed CEIP-1 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

95. 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. Accordingly, to the guideline, geographical information system (GIS) technology will applied at the planning stage to select the location of cyclone shelters considering habitation, communication facilities, and distance from the nearest cyclone centre. The advice of the concerned District Committee is to 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 neighboring 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.

96. 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

97. 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.

98. CEIP-1 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

99. 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:

100. 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.

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

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

3.2.6 Coastal Development Strategy, 2006

103. 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

104. Proposed interventions under CEIP-1 are in line with this strategy and support most of the above listed priorities. Coastal Zone Policy, 2005

105. 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.

106. 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.

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

3.2.7 Ethnic Minority Rights in PRSP 2005

108. 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 and recognition of ethnic minority communities and their specific needs in all relevant government policies and programs towards improving the socio-economic conditions of these communities.
- Proper actions for protecting the rights of ethnic minority people, particularly their rights to land and forests.

- Transfer of land administration in CHT to the hill districts councils in accordance with the 'Hill District Councils Acts of 1989'.
- Provide education to ethnic minority people with a curriculum that allows learning in their own language at the primary level.
- Strengthen their competence in job markets through affirmative actions at higher levels of education and 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 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.

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

109. The National Water Management Plan (NWMP) 2001, approved by the National Water Resources Council in 2004, envisions establishing an integrated development, management and use of water resources in Bangladesh over a period of 25 years. WARPO has been assigned to monitor the national water management plan. The major programs in the Plan have been organized under eight sub-sectoral clusters: (i) Institutional Development, (ii) Enabling Environment, (iii) Main 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 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.

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

3.2.9 National Land Use Policy (MoL, 2001)

111. 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 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.

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

3.2.10 National Water Policy, 1999

113. 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.

114. 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:** Consider 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.

115. 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.

3.2.11 Guidelines for Participatory Water Management 2014

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

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

- Participation is an important voluntary process in which local stakeholders influence policy formulation, alternative plans/designs, investment choices and management decisions affecting their communities and establish the sense of ownership.
- Give the local stakeholders a decisive voice at all stages of water management.

- Participation of local stakeholders to prepare production plans on agriculture, fishery, forestry and livestock development and environmental management plan based on the feasibility study by the implementing agencies.
- According to this rule, every water management group shall will form cluster groups including landless men and women of the project area for infrastructure development or maintenance related activities of which 30percent will be women.

3.2.12 National Fisheries Policy, 1996

118. 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.

119. 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.

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

3.2.13 National Environment Management Action Plan, 1995

121. 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

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 would 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 add to forest resilience.

3.2.15 National Environment Policy, 1992

122. 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.

123. The Policy is applicable to the Package-2 under CEIP-1and 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)

124. 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 and 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.

125. 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

126. 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).

127. The Ministry of Land (MoL) is authorize 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 transferre 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.

128. 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 land owners have faced difficulties trying to “prove” ownership. The affected person (AP) has also to produce rent receipt or receipt of land development tax, but this does not assist in some situations as a person is exempted from payment of rent if the area of land is less than 25 bighas (3.37 ha).

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

129. 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 as khas land once declared by concerned Deputy Commissioner (DC) demarcating the AD Line.2 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

130. 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 favor 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, 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

131. 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.

2 The Assistant Commissioner of Lands (AC Land) in respective districts demarcates the AD Line each year in areas where rivers frequently erode their banks. According to law, if the land classified by an AD Line re-appears within 30 years from the date of erosion, the original owner(s) can claim the land.

Inadequacies of 1982 Ordinance

132. 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 leaseholders (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.

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

Avoid or minimize resettlement:

134. The law only implicitly discourages unnecessary acquisition, as lands acquired for one purpose cannot use for a different purpose. However, there are no mechanisms to monitor if this condition is actually adhered to.

Eligibility for compensation:

135. The law stipulates compensation only for the persons who appear in the land administration records as the owners. It does not recognize the rights of those, such as squatters, who do not possess legal title to the lands they live in or make a living from.

Compensation:

136. The law provides compensation for lands and other objects built and grown on them (structures, trees and orchards, crops and any other developments like ponds, built amenities, etc.). No provisions are there to assess and restore lost income stream or income sources that acquisition causes to the affected persons, be they legal titleholders or others like squatters, tenants and employees of affected businesses.

Compensation standards:

137. Although the law stipulates 'market prices' of the acquired lands as the just compensation, the legal assessment method usually results in prices that are far below the actual market prices[3]. Certain pricing standards, which regarded as unrealistic, are used to assess other losses like structures and various built amenities, trees, crops and the like.

3 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.

Relocation of households and other establishments:

138. No legal obligation is there to relocate or assist with relocation of, those whose homesteads have been acquired or whose place of residence or livelihoods has been affected. Such persons/households, be they titleholders or squatters, are left on their own.

Ensuring payment of compensation:

139. 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 obligation of the affected landowners to prove, by producing an array of documents that the acquired lands legally belong to them. As gathering these documents is a long, expensive and cumbersome process, many landowners may remain unable to claim their awards[4.]

Socioeconomic rehabilitation:

140. 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.

141. 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 Bagladesh Labour Act, 2006 (XLII of 2006)

142. According to Bangladesh 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

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

- Latrines and urinals
- First aid appliance
- Weekly hours

143. The above relevant by-laws deal 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-40/2.

3.2.22 Other Relevant Acts

144. 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

145. 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

146. The environmental legislative basis for approval of the CEIP-1is 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/dyke etc fall under Red Category. Thus, the CEIP-I intervention in Polder- 40/2falls under the 'Red' category.

147. 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)

148. 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:

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

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

150. 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**.

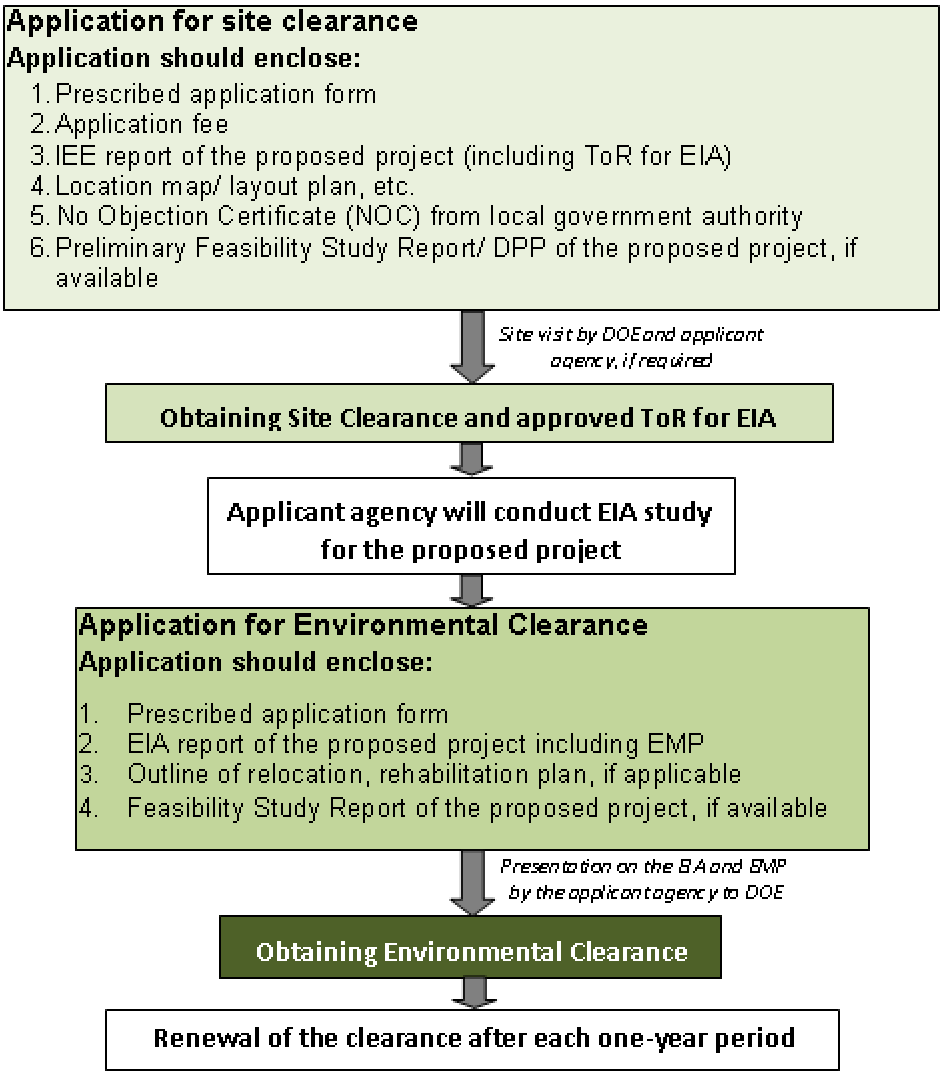


Figure 3.1: Process of obtaining Clearance certificate from DoE

3.6 World Bank's Environmental Safeguard Policies

151. 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

152. 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.

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

EA classification

154. 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.

155. 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)

156. 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.

157. 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).

158. 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.

159. 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)

160. The World Bank's general policy regarding cultural properties is to assist in their preservation, and to seek to avoid their elimination. The specific aspects of the Policy are given below.[5]

- The Bank normally declines to finance projects that will significantly damage non-replicable cultural property, and will assist only those projects that are sited or designed so as to prevent such damage.
- The Bank will assist in the protection and enhancement of cultural properties encountered in Bank-financed projects, rather than leaving that protection to chance. In some cases, the project is best relocated in order that sites and structures can be preserved, studied, and restored intact in situ. In other cases, structures can be relocated, preserved, studied, and restored on alternate sites. Often, scientific study, selective salvage, and museum preservation before destruction is all that is necessary. Most such projects should include the training and strengthening of institutions entrusted with safeguarding a nation's cultural patrimony. Such activities should be directly included in the scope of the project, rather than being postponed for some possible future action, and the costs are to be internalized in computing overall project costs.
- Deviations from this policy may be justified only where expected project benefits are great and the loss of or damage to cultural property is judged by competent authorities to be unavoidable, minor or otherwise acceptable. Specific details of the justification should be discussed in project documents.
- 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.
- This OP is not triggered since no cultural or archaeological resources are known to exist in the vicinity of the Project nor have any such resources been identified during

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

field investigations. However, 'chance find' procedures will be implemented in the EMP.

3.6.4 Forestry (OP 4.36)

161. 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.

162. 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)

163. 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)

164. 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)

165. For purposes of this Policy, the term 'Indigenous Peoples' is used in a generic sense to refer to a distinct, vulnerable, social and cultural group possessing the following characteristics in varying degrees:[6]

- 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

6 *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.

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

167. 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.

168. 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)

169. The WB's experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks: production systems are dismantled; people face impoverishment when their productive assets or income sources are lost; people are relocated to environments where their productive skills may be less applicable and the competition for resources greater; community institutions and social networks are weakened; kin groups are dispersed and cultural identity, traditional authority and the potential for mutual help are diminished or lost. This policy includes safeguards to address and mitigate these impoverishment risks.[7]

170. 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 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 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)

171. 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.

172. The Bank may proceed with a project in a disputed area if the governments concerned agree that, pending the settlement of the dispute, the project proposed for country A should go forward without prejudice to the claims of country B.[8]

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

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

173. 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)

174. 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)

175. 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.

176. Once finalized, the EIA report will be disclosed to the public and will 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

177. The Environment, Health, and Safety (EHS)[9] Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities or project by existing technology at reasonable costs. These Guidelines will be applicable to the Project.

3.7 Implications of WB Policies on CEIP

178. The project interventions for Polder 40/2includes 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.

179. The environment assessment (OP/BP 4.01), natural habitats (OP/BP 4.04) and forests (OP/BP 4.36) policy have been triggered for the proposed operation. Although no direct impacts on physical cultural resources are expected, screening mechanism incorporated into the EA process will identify subprojects with archeological, paleontological, historical, religious, or unique natural values, chance and find procedure will 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 trigger.

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

4 Description of the Project

4.1 General

180. The Coastal Embankment Improvement Project (CEIP) aims to safeguard the polder from tidal flooding, salinity intrusion and climate change induced storm surges. This would as a result, improve agricultural production. The project activities, construction methodology, construction schedule, and the institutional arrangements for implementation of the Project are discussed briefly in this chapter.

4.2 Overview of the Polder

181. The polder was initially conceived in 1960 under the Coastal Embankment Project (CEP). Construction works started in 1963-64 and completed in 1966-67. Afterwards, the polder was rehabilitated under Coastal Embankment Rehabilitation Project (CERP) during 1996-98. The summary of the existing infrastructures are given in **Table 4.1** below:

Table 4.1: Summary of existing water management infrastructures

Type	Specification
Total length of Embankment	34.40 km
- Sea-dyke	15.70 km
- Interior-dyke	18.70 km
Total number of Drainage Sluices	12
Total number of Flushing Sluices	24
Drainage Khal	50 km

Source: DCSC Design Team, 2015

4.3 Objective of the Project

182. The overall objective of the project is to increase the resilience of the coastal population to natural disasters and climate change. This may fulfilled by targeting the following specific objectives.

- Reduce loss of assets, crops and livestock during natural disasters
- Reduce the time of recovery after natural disasters such as cyclones
- Improve agricultural production by reducing saline water intrusion which is expected to worsen due to climate change
- Improve government's capacity to respond promptly and effectively to any crisis or emergency.

4.4 Water Management Problems and Issues in the Polder

183. Polder- 40/2 was originally designed to provide protection against high tide, without providing much attention to storm surges. Recent cyclones have substantially damaged the embankments and further threatened the integrity of coastal polders. In addition, breaching of embankments due to cyclones, siltation of peripheral rivers surrounding the embankments has caused the coastal polders to suffer from water logging; leading to large scale environmental, social and economic degradation. Poor maintenance and inadequate

management of the polders have also contributed to internal drainage congestion and heavy external siltation. As a result, soil fertility and agriculture production are declining because of water logging and salinity increase inside the polders.

184. Currently, about 30-40% of the polder area is facing problems of salinity primarily because of ineffective water control structures and silting of water channels. This situation further compounded by unavailability of suitable ground water at shallow depth from April to May. As a result, irrigated land area is now limited to only about 75 ha (around 2.3% of net area) out of the total net cultivable area of 3,300 ha. In addition, the open water fisheries have been declining because of shrinking water areas and hindrance to movement. 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 Polder - 40/2:

- Lack of regular repair and maintenance of water control structures and embankments
- Inadequate budget allocation and its inefficient use
- Community 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
- Recent cyclones and storm surges, particularly the recent cyclones of 2007 (Sidr) and 2009 (Aila);
- High rate of siltation in peripheral rivers which hinders natural overland drainage;
- Inadequate plantation in the foreshore and lack 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

185. 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- 40/2. 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

186. The embankment of the polder lengths from Ch 0+000 to Ch. 3+750, Ch. 10+450 to Ch. 21+750 and 33+750 to Ch. 34+400 include sea-dykes. The lengths from Ch. 3+750 to Ch. 10+450 and Ch. 21+750 to Ch. 33+750 entail interior dykes. About 14% (Ch. 29+000 to Ch. 34+000) of the polder embankment falls on Patharghata-Barguna Road, which is situated along the eastern side of the polder.

187. At present, a significant portion of the polder is directly vulnerable to cyclones and storm surge from the Bay of Bengal, which may enter through the large Baleswar estuary. A number of embankment segments of the polder have been damaged due to Sidrand Aila, especially along Gyanpara area, where it is reported that about 10 people died during Sidr.

188. Slope protection works from Ch. 0+567 to Ch. 0+667 and Ch. 13+155 to Ch. 13+426 have been implemented under CERP. The remaining segments of embankment from Ch. 1+820 to Ch. 2+120, Ch. 3+330 to Ch. 3+380, Ch. 13+100 to Ch. 13+155 and Ch. 13+426 to Ch. 13+750 need to be repaired by providing slope protection works with heavy afforestation to the foreshore area under CEIP-1.

189. During field observation in June 2015, it was found that almost 60% of the peripheral embankment was unpaved, which hampers communication during wet seasons. There is a paved portion along the polder from Patharghata Bazar to Char Duani Bazaar, which is predominantly used for vehicular movement. A couple of erosion hotspots have also been found during the field investigation, one near the Patharghata khal (adjacent to Bishkhali river), and the other at Tafalbaria (besides Baleshwar river).

190. Looking at the previous status of existing embankment, it can be understood that the entire length of embankment shall be re-sectioned with mechanical compaction as per newly designed crest level in consideration of wave surge, cyclone surge and climate change scenarios.

4.5.2 Water Control Structures

191. There are 12 Drainage Sluices and 24Flushing Sluices in the polder, many of which are presently in poor condition. The concrete surface of the structures has been deteriorated due to prolonged exposure to saltwater. A number of gates have been corroded and the loose aprons have been damaged as well. Few sluices were found with no gates. Furthermore, the structures also undergo issues in connection with mismanagement of local communities. Local people opined that many gates are operated based on the local will rather than the interest of water management.

192. Most of the drainage and flushing structures are beyond repairing works, and are to be replaced by new ones with provisions for both flushing and drainage, which will last long to achieve project objectives. Local people opined that sweet water retention is ensured within internal canal system for cultivating rabi-crops, when the saline river water cannot be used. **Table 4.2** below provides detail understanding of existing drainage and flushing sluices in Polder -40/2 and addresses the need for future works.

Table 4.2: Status of existing water control structures

Sl.	Structure	Chainage	Type and Size	Observations	Rehabilitation Needs
Drainage Sluice					
1	D/S - 1	Ch. 3+140	RCB (1 vent – 1.5 m x 1.8 m)	✓ Constructed in 1982-83 ✓ Railing and loose aprons are damaged. ✓ No provision for vertical lift gate.	Needs to be repaired
2	D/S - 2	Ch. 6+760	RCP (1 vent - 0.90 m pipe dia)	✓ Concrete surface in deplorable condition ✓ Loose apron damaged.	Needs to be replaced
3	D/S - 3	Ch. 8+740	RCP (2 vent – 0.9 m dia)	✓ Structure is fully damaged and opened.	Needs to be replaced
4	D/S - 4	Ch. 16+010	RCB (2 vent – 1.5 m x 1.8 m)	✓ Structure in deplorable condition. ✓ Loose apron, nose-wall and railing damaged. ✓ Gates are corroded.	Needs to be demolished

Sl.	Structure	Chainage	Type and Size	Observations	Rehabilitation Needs
5	D/S - 5	Ch. 16+100	RCP (4 vent - 0.9 m dia)	✓ Constructed in 1964-65. ✓ Loose aprons are damaged ✓ Gate is lost	Needs to be replaced
6	D/S - 6	Ch. 19+870	RCB (1 vent – 1.5 m x 1.8 m)	✓ Constructed under CERP ✓ Functioning relatively well.	Minor repairing is still required.
7	D/S - 7	Ch. 23+600	RCP (3 vent - 0.9 m dia)	✓ Constructed in 1964-65. ✓ Loose aprons are damaged ✓ Concrete surface in dilapidated condition.	Needs to be replaced
8	D/S - 7A	Ch. 25+500	RCB (1 vent – 1.5 m x 1.8 m)	✓ R/S loose aprons are damaged ✓ Structure is in dilapidated condition.	Needs to be replaced
9	D/S - 8	Ch. 28+240	RCP (4 vent – 0.9 m dia)	✓ R/S loose aprons are damaged ✓ Flap gate is lost ✓ Sluice in dilapidated condition.	Needs to be replaced
10	D/S - 9	Ch. 29+770	RCP (6 vent – 0.9 m dia)	✓ Pipes have been damaged ✓ Earth on top of pipe settled down. ✓ Sluice is in dilapidated condition.	Needs to be replaced
11	D/S - 10	Ch. 31+600	RCP (3 vent – 0.9 m dia)	✓ Constructed in 1965-67 ✓ Sluice is in dilapidated condition.	Needs to be replaced
12	D/S - 10A	Ch. 33+380	RCB (2 vent – 1.5m x 1.8 m)	✓ Constructed in 1965-67 ✓ In dilapidated condition. ✓ Nose wall and R/S loose aprons are damaged.	Needs to be replaced
Flushing Sluice					
1	F/S - 1	Ch. 0+350	RCP (1 vent – 0.9 m dia)	✓ Structure is not functioning	Needs to be replaced
2	F/S - 2	Ch. 2+150	RCB (1 vent – 0.9 m x 0.9 m)	✓ Structure is functioning well ✓ Loose aprons are is damaged.	Needs to be repaired
3	F/S - 3	Ch. 4+820	RCP (1 vent - 0.9 m dia)	✓ Structure is in deplorable condition.	Needs to be demolished
4	F/S - 4	Ch. 5+470	RCP (1 vent - 0.9 m dia)	✓ Structure is in deplorable condition.	Needs to be replaced
5	F/S-4/1	Ch. 5+900	RCP (1 vent - 0.9 m dia)	✓ Structure is in deplorable condition.	Needs to be replaced
6	F/S - 5	Ch. 7+750	RCP (1vent – 0.9 m dia)	✓ Structure is badly damaged	Needs to be demolished
7	F/S - 6	Ch. 8+150	RCB (1 vent (0.9 m x 1.2 m)	✓ Structure is functioning well ✓ Loose apron has been damaged.	Needs to be repaired
8	F/S – 6/1	Ch. 8+450	RCB (1 vent (0.9 m x 1.2 m)	✓ Structure is functioning well ✓ Loose apron has been damaged.	Needs to be repaired
9	F/S - 7	Ch. 11+480	RCP (1 vent – 0.9 m dia)	✓ Structure has fully been damaged.	Needs to be demolished
10	F/S - 8	Ch. 14+25	RCB (1 vent – 0.9 m x 1.2 m)	✓ Structure is in good condition but loose apron damaged.	Need to be replaced
11	F/S - 9	Ch. 17+240	RCB (1 vent – 0.9 m x 1.2 m)	✓ Structure is in deplorable condition.	Needs to be replaced
12	F/S - 10	Ch. 18+410	RCP (1 vent – 0.9 m dia)	✓ The structure is in deplorable condition.	Needs to be replaced
13	F/S - 11	Ch. 20+480	RCB (1 vent – 0.9 m dia)	✓ Constructed under CERP and functioning well.	Needs to be replaced

Sl.	Structure	Chainage	Type and Size	Observations	Rehabilitation Needs
14	F/S - 12	Ch. 20+800	RCP (1 vent – 0.9 m dia)	✓ The structure is functioning well.	Well functioned
15	F/S - 13	Ch. 21+460	RCP (1 vent – 0.9 m dia)	✓ The structure is fully damaged.	Needs to be demolished
16	F/S - 14	Ch. 22+940	RCP (1 vent – 0.9 m dia)	✓ The structure is in deplorable condition ✓ Loose apron have been damaged.	Needs to be replaced
17	F/S -15	Ch. 24+500	RCP (1 vent – 0.9 m dia)	✓ The structure is not functioning well. ✓ Concrete surface is in deplorable condition.	Needs to be demolished
18	FS - 16	Ch. 25+080	RCB (1 vent – 0.9 m x 1.2 m)	✓ The structure has been fully damaged.	Needs to be replaced
19	F/S - 17	Ch. 26+030	RCB (1 vent – 0.9 m x 1.2 m)	✓ Railing has been damaged and gate is s lost.	Needs to be replaced
20	F/S - 18	Ch. 26+900	N/A	✓ The structure has been partially damaged.	Need to be repaired
21	F/S - 19	Ch. 19+480	RCB (1 vent – 0.9 m x 1.2 m)	✓ Constructed under CERP ✓ Some damages in loose aprons ✓ Gate is lost.	Need to be repaired
22	F/S - 20	Ch. 30+680	RCP (1 vent – 0.9 m dia)	✓ Pipes of sluice are damaged ✓ Deplorable condition.	Needs to be replaced
23	F/S - 21	Ch. 31+260	RCP (1 vent – 0.9 m dia)	✓ R/S loose aprons are damaged ✓ Gate has been lost.	Needs to be demolished
24	F/S - 22	Ch. 0+750	RCP (1 vent – 0.9 m dia)	✓ The structure in deplorable condition and is not repairable.	Needs to be replaced

Source: DDCS&PMSC and CEGIS Field Investigation, 2015: Note: F/S= Flushing Sluice, D/S=Drainage Sluice, RCP=Reinforced Concrete Pipe, RCB= Reinforced Concrete Box

4.5.3 Drainage Khals

193. There are around 50 km of drainage khals at present inside the polder. Present condition of some of the internal drainage khals is undesirable. Over the years, siltation, topsoil erosion and other land filling activities have resulted in gradual decrease of watercourses within the polder. From field observations, it is found that Patharghata, Nalbunia, Munshiganj khals have been silted up over the years. The Badurtala-Tengra Bharani (Lathi mara Khal) along the southern periphery of the polder has been silted up and no water remaining during low-tide period.

4.6 Proposed Rehabilitation/ Improvement Activities in the Polder

Proposed Rehabilitation Activities

194. The proposed interventions in the Polder 40/2 are listed in **Table 4.3** below and shown in Map 4.1. 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

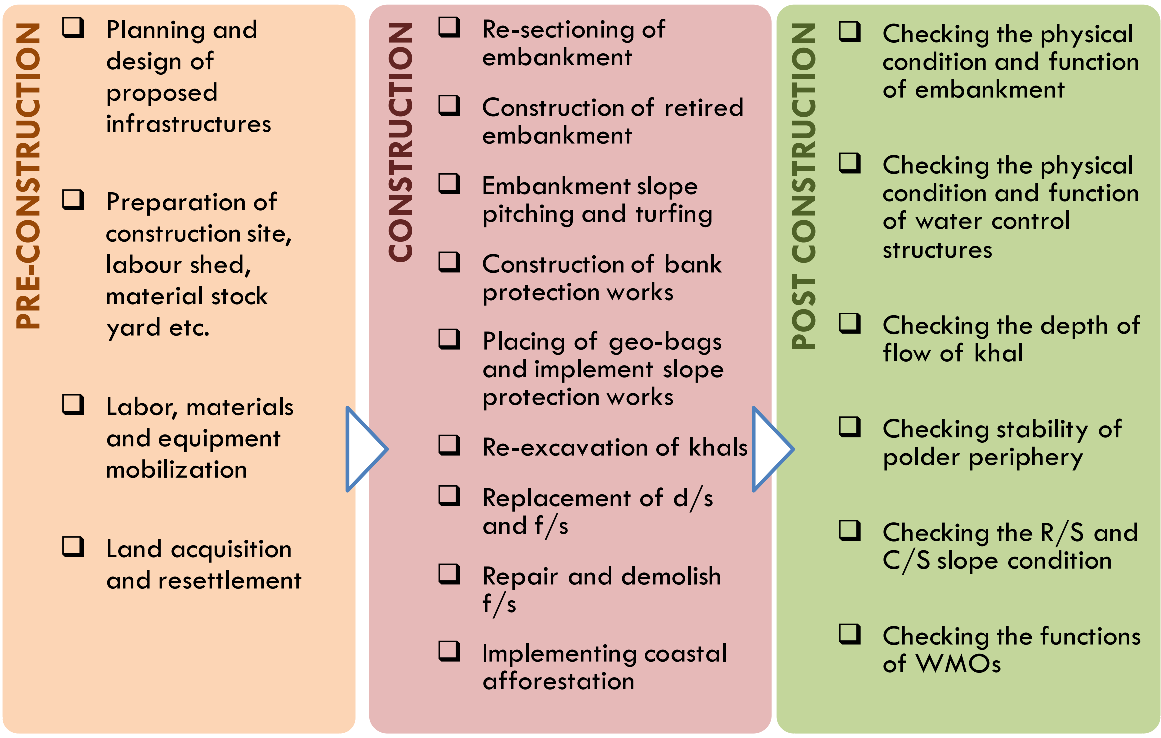
climate change condition considering with and without interventions (IWM, 2016). The interventions have further been detailed out in the following sections.

Table 4.3: List of Proposed Interventions in Polder 40/2

Type of Work	Specification
Re-sectioning of Embankment	34.40 km
Construction of Embankment with design crest level	6.500 mPWD, 6.00 mPWD and 5.00 mPWD
Retire of Embankment	415 m
Construction of Floodwall	7.90 km
Construction (Replacing) of Drainage Sluice	09 nos.
Repair of Drainage Sluice	02 nos.
Demolishing of Drainage Sluice	01 nos.
Construction (Replacing) of Flushing Sluices	12 nos.
Repair of Flushing Sluices	05 nos.
Demolish of Flushing Sluices	06 nos.
New construction of Flushing Sluice	01 nos.
Re-excavation of Drainage Channel	33.60 km
Slope protection and backing of Embankment	1.137 km
Afforestation	17.06 ha

Source: DCSC Design Team, 2015

195. 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: d/s- Drainage Sluice; f/s- Flushing Sluice; R/S-River Side; C/S-Country Side

Figure 4.1: List of activities in Polder- 40/2 at different project phases

4.6.1 Works on Embankments

196. Under the proposed interventions in the polder, a total of 34.40 km of embankment will be re-sectioned and its height will be increased. The side slopes of the embankment will be rehabilitated. Table below shows the detail information about the works to carried out on the embankment. The portion of the polder located by the sides of Bishkhali (Ch. 0 + 000 to Ch. 3+750) and Baleswar (Ch. 11 + 000 to Ch. 21+750) rivers 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 6.5 m, PWD and 1:7 respectively, which are higher than the remaining portion of embankment. The detail information of various works on embankments are as follows:

Table 4.4: Detail of Works on Embankments

Sl	Chainage (Ch. Km)	Proposed Crest Level	Side slopes
1	0+000 to 3+750	6 m PWD	R/S 1:7 and C/S 1:2
2	3+750 to 10+450	5 m PWD	R/S 1:3 and C/S 1:2
3	10+450to 21+750	6.5 m PWD	R/S 1:7 and C/S 1:2
4	21+750 to 33+750	5 m PWD	R/S 1:3 and C/S 1:2
5	33+750 to 34.400	6 m PWD	R/S 1:7 and C/S 1:2

Source: Design Team of DCSC, 2015

Description of construction activities

197. Before commencement of the construction activities for embankment works, suitable labor sheds should be constructed with proper sanitation, supply of safe drinking water and other required facilities. A suitable site shall be selected and prepared by cleaning bushes, weed, 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. At the same time, each layer (of 1.5 feet) of dumped soil will be compacted by a compactor machine. The sloping and shaping of embankment will be developed after proper compaction of layers. The required turfing with grass will then be made on the sides of the embankment. Watering and fertilizing will also be provided.

4.6.2 Construction (replacing or repairing) of Drainage Sluices

198. Nine numbers of Drainage Sluices will be replaced out of the twelve (12) numbers of existing Drainage Sluices, which are under the proposed interventions of the rehabilitation works of the Polder. Furthermore, two (02) numbers of Drainage Sluices will undergo to repairing works and one Drainage Sluice will be demolished. The summary of design information of the proposed works in these Drainage Sluices are given in **Table 4.5** below:

Table 4.5: Detail of Proposed Structures (Drainage Sluices)

Sl.	Name of drainage sluices	Chainage (at km)	Khal Name	Lowest Tide level (m PWD)	Lowest elevation of basin (m PWD)	Existing Sill Level (m PWD)	Proposed Sill level (m PWD)
01	DS-1 (1v-1.5m x1.8m)	3.15	Mutainer Khal	-1.223	0.75	-0.646	-0.50
02	DS-2 (1v-1.5m x1.8m)	6.75	Adhania Khal	-1.183	0.75	-0.370	-0.50

Sl.	Name of drainage sluices	Chainage (at km)	Khal Name	Lowest Tide level (m PWD)	Lowest elevation of basin (m PWD)	Existing Sill Level (m PWD)	Proposed Sill level (m PWD)
03	DS-3 (1v-1.5m x1.8m)	8.55	Nijlatimara Khal	-1.183	0.75	0.031	-0.50
04	DS-4 (2v-1.5m x1.8m)	16.04	Ganpara Khal-1	-1.349	0.75	-1.087	-0.50
05	DS-5 (1v-1.5m x1.8m)	16.13	Ganpara Khal-2	-1.349	0.75	-0.730	-0.50
06	DS-6 (1v-1.5m x1.8m)	19.48	Keoratola Khal	-1.349	0.75	-1.260	-0.50
07	DS-7 (1v-1.5m x1.8m)	23.625	Charduani Khal	-1.349	0.75	-0.583	-0.50
08	DS-7A (1v-1.5m x1.8m)	25.54	Hoglapasha Khal	-1.349	0.75	-1.228	-0.50
9	DS-8 (1v-1.5m x1.8m)	28.20	Munshigonj Khal	-1.349	0.75	-0.750	-0.50
10	DS-9 (1v-1.5m x1.8m)	29.82	Maser khal	-1.183	0.75	-0.680	-0.50
11	DS-10 (1v-1.5m x1.8m)	31.60	Kajibari Khal	-1.183	0.75	-0.231	-0.50
12	DS-10A (2v-1.5m x1.8m)	33.38	Boroitola Khal	-1.183	0.75	-1.263	-0.50

Source: Design Team ofDCSC,2015

Description of construction activities

199. During pre-construction phase the activities of construction of drainage sluices i.e. construction of labor shed, providence of sanitation, safe drinking water and other facilities etc. should have to be developed. During this period, the contractor as per tender schedule will procure required construction materials (sand, cement, wood, shuttering materials etc.) Meanwhile, a suitable site will be selected for each sluice and prepared for construction of the water control structure. Before starting the construction of drainage sluices, ring bundhs and diversion channels will have to be constructed. After that the foundation treatment required for the structure will be carried out. CC and RCC works along with cutting, bending and binding of rods will then be performed as per specification. CC blocks will be prepared and placed as and where required as per design. After construction of approach roads, fitting and fixing of gates and hoisting device will be carried out. Gates will be properly painted. The intake and outfall of the gates will be constructed as per design. The CC blocks will be made for river training works and pitching works will then be conducted.

4.6.3 Construction (new, replacing and repairing) of Flushing Sluices

200. Out of total 24Flushing Sluices in the polder, one structure FS-12 (Ch. 20+80) is functioning well. Other than that, twelve numbers of Flushing Sluices will be replaced with new specification, five will be repaired and six in which will be completely demolished as per the proposed interventions. Besides, one new Flushing Sluice will be constructed (FS-7/1) at Ch. 9.85 Km. Proposed works of the Flushing Sluices with pipe structures (0.9 m dia) which will be replaced by RCB of 1 vent (0.9 m x 1.2 m) structures. A detailed description of this is given in **Table 4.6.**

201. Most of the flushing sluices were constructed as Reinforced Concrete Pipe (RCP) sluices with 0.9 m diameter, and these structures are presently in poor condition and hence need to be replaced by Reinforced Concrete Box (RCB) structures, with provisions for both flushing and Drainage facilities. The number of Flushing Sluices can be reduced by

demolishing of 5 pipe-sluices, which are not being presently used. The details of the proposed structures (Flushing Sluices) are as follows:

Table 4.6: Detail of Proposed Structures (Flushing Sluices)

Sl.	Name of Structure	Location and Chainage	Structure Type and Size	Proposed works
1	F/S - 1	Ch. 0+350	RCP (1 vent – 0.9 m dia)	Replacement of structure by RCB (1v-0.9x1.2m) is proposed
2	F/S- 22	Ch. 0+750	RCP (1 vent – 0.9 m dia)	Replacement of structure by RCB (1v-0.9x1.2m) is proposed
3	F/S - 2	Ch. 2+150	RCB (1 vent – 0.9 m x 0.9 m)	Repairing of the structure is proposed
4	F/S - 4	Ch. 5+470	RCP (1 vent - 0.9 m dia)	Replacement of structure by RCB (1v-0.9x1.2m) is proposed
5	F/S – 4/1	Ch. 5+470	RCP (1 vent - 0.9 m dia)	Replacement of structure by RCB (1v-0.9x1.2m) is proposed
6	F/S - 6	Ch. 8+150	RCB (1 vent (0.9 m x 1.2 m)	Repairing of the structure is proposed
7	F/S- 6/1	Ch. 8+450	RCB (1 vent (0.9 m x 0.9 m)	Repairing of the structure is proposed
8	F/S-7/1	Ch. 9+850	RCB (1 vent (0.9 m x 1.2 m)	Newly construction is proposed
9	F/S - 8	Ch. 14+25	RCB (1 vent – 0.9 m x 1.2 m)	Replacement of the structure is proposed
10	F/S - 9	Ch. 17+240	RCB (1 vent – 0.9 m x 1.2 m)	Replacement of structure by RCB (1v-0.9x0.9) is proposed
11	F/S - 10	Ch. 18+415	RCP (1 vent – 0.9 m dia)	Replacement of structure by RCB (1v-0.9x1.2m) proposed
12	F/S-19	Ch. 19+480	RCP (1 vent – 0.9 m dia)	Repairing of the structure is proposed
13	F/S-11	Ch. 20+480	RCP (1 vent – 0.9 m dia)	Replacement of structure by RCB (1v-0.9x1.2m) proposed
14	F/S - 14	Ch. 22+940	RCP (1 vent – 0.9 x 0.9m dia)	Replacement of structure by RCB (1v-0.9x1.2m) is proposed
15	F/S-16	Ch. 25+080	RCP (1 vent – 0.9 m dia)	Replacement of structure by RCB (1v-0.9x1.2m) proposed
16	F/S - 17	Ch. 26+400	RCB (1 vent – 0.9 m dia)	Replacement of structure by RCB (1v-0.9x1.2m) is proposed
17	F/S-18	Ch. 26+900	RCP (1 vent – 0.9 x 0.9m dia)	Repairing of the structure is proposed
18	F/S - 20	Ch. 30+680	RCP (1 vent – 0.9 m dia)	Replacement of structure by RCB (1v-0.9x1.2m) is proposed

Source: Design Team of DCSC, 2015

Description of construction activities

202. Before starting the construction activities of flushing sluices, a labor shed will be constructed by provision of sanitation, safe drinking water and other facilities. The required construction materials (sand, cement, wood, shuttering materials etc.) will be procured simultaneously. A suitable site for the structure will be selected at nearer location and prepared accordingly. Alternative diversion channels will be constructed before starting the construction works. After that, the foundation treatment required for flushing sluices will be carried out. RCC works, pipe and machine pipe along with allied construction and fittings will

then be made along with construction of collar joints as and where required. 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 approach 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

203. There are approximately 50 km drainage khals in the polder, of which around 33.60 km of the internal khals has been proposed to be re-excavated. The list of the proposed re-excavation of the internal khals with length is shown in Table 4.7. The excavated soil will be used for strengthening the khal banks. Local people may be encouraged to take earth from the spoils, as well. The spoil may be used for raising the plinth level of their earthen kutcha houses as well as individual house yards. If the excavated materials are found suitable, the Contractor can use the materials for construction of embankments upon prior approval by the DCSC. **Figure 4.2**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. The list of khals with length is given in the following table:

Table 4.7: List of the internal khals to be re-excavated

Sl. No.	Name of the internal khals	Length(km)
1	Adania khal (DS-2)	2.00
2	Mutainer	2.40
3	Keoratola khal	1.75
4	Nijladiamar khal	3.90
5	Charduani khal	6.50
6	Hoglapasha khal	7.00
7	Munshigonj khal	0.50
8	Maser khal	2.50
9	Kajibari khal	2.00
10	Boraitala khal	3.50
11	Ganpara Khal	1.55
	Total	**33.60**

Source: CEIP-I Design Study Finding, 2015

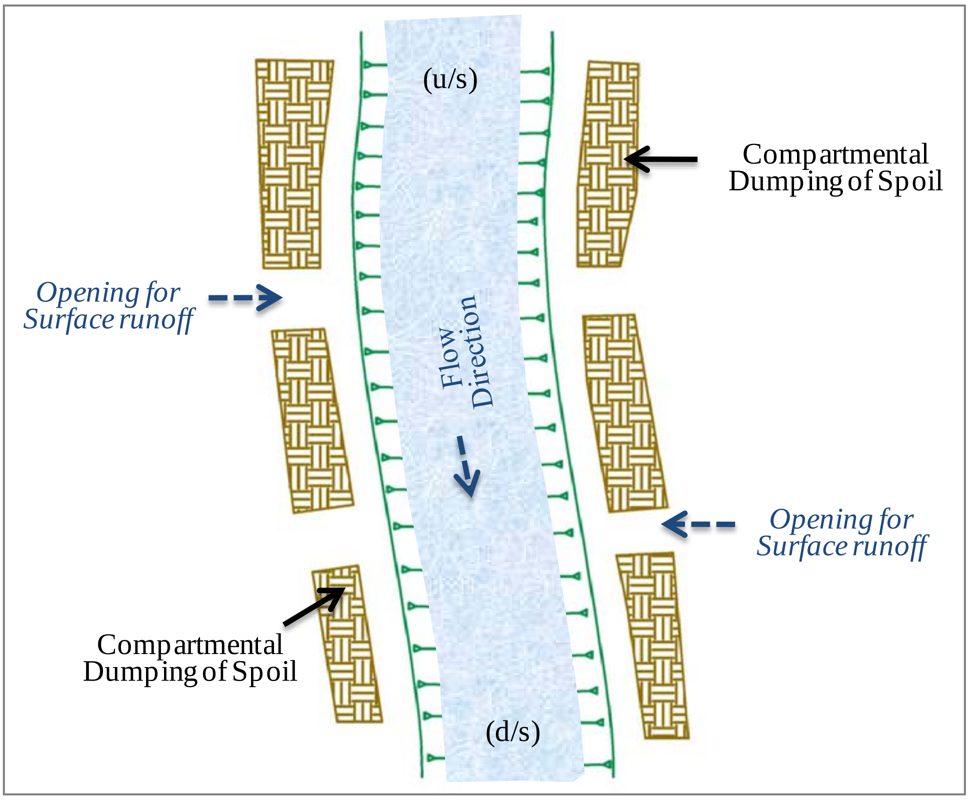


Figure 4.2: Plan form of a typical khal to be re-excavated

Description of construction activities

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

4.6.5 Slope Protection Works

205. The proposed intervention of the rehabilitation works of the project has considered slope protection works will be carried out in around 1.137 km length of the polder along the Bishkhali River (401 m) and along the Baleshwar River (736m). The proposed protective works will be carried out at from Ch. 1.24 km to Ch. 1.641 km along Bishkhali River and at from Ch. 12.871 km to Ch. 13.00 km, Ch. 13.184 km to Ch. 13.577 km and Ch. 13.745 km to Ch. 13.96 km along the Baleshwar River of the polder.

Description of construction activities

206. Before starting the construction activities of flushing sluices, a labor shed will be constructed by provision of sanitation, safe drinking water and other facilities. The construction activities involved in the bank protection and slope protection works are: the

construction of labor shed, creation of sanitation and safe drinking water supply etc. facilities and procurement of construction materials (sand, cement, wood, shuttering materials etc.), the slope of the river bank as per design will be developed 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 will be place 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 riverbanks. Finally, turfing will be made on the slope or crest of the embankment. Proper drainage provision will be kept to avoid formation of any rain cuts due to surface run off.

4.6.6 Afforestation

207. Foreshore and embankment slope afforestation is proposed under the interventions. The areas selected for afforestation in Polder 40/2 are shown in detail in Map 4.1. A total of 128,463 nos of trees will need to cut from the RoW (Source RAP Report). About 10.10 ha slope area is available along 35.58 km embankment length for afforestation of this polder (Source: Final Interim Report on Additional Tasks Assigned, Volume III: Afforestation Report, Page: III-19). In addition, about 6.96 ha of foreshore area will be planted with different mangrove species (Source: Final Interim Report on Additional Tasks Assigned, September, 2013, Volume III: Afforestation Report, Page: III-21).

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

209. For the Slope Plantation, the lower one third of the slope may be planted with deep rooted tree species, the mid one third may be planted with shallow rooted medium size tree species and the upper one third may be planted with species that have very small root system. Keeping this in view, the lower row along the slope will be planted with Tamarindus indica (Tatul) &Acacia nilotica (Babla) at a spacing of 2M (6 ft) apart. The upper row will be at a distance of. 2 to 3M from the lower row. The lower row will be planted with Borassus flabellifer (Tal), Cocos nuciferaI (Narikal) and Phoenix sylvestris (Khajur) at a spacing of 2 M (6 feet). The Tamarindus indica (Tatul) and Acacia nilotica (Babla) seedlings will be planted on upper mid rows and sapling 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 nuciferaI (Narikal) and Phoenix sylvestris (Khajur) seedlings will be purchased from nurseries. Planting of 2,500 seedlings will make one hectare Plantation. As per that estimation, a total of 25,250 nos of saplings will be planted along the 10.10 ha area of embankment slope.

210. 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, about 31,000 mangrove saplings will be planted in 6.96 ha of available foreshore area. A Typical cross section of embankment slope and foreshore afforestation is shown in Figure 4.3.

211. In addition, afforestation programs 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 128,463 nos. of trees to be cut in polder 40/2, which will require plantation of total

3,85,389 (128,463x3) trees in the area, according to practice of DoE (according to DoE, 3 plants to be planted for 1 tree cutting). Since, 25,250 saplings will be planted in 10.10ha of embankment slope and 31,000 plants at foreshore area the remaining 329,139nos. 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).

212. After plantation, proper care will be taken for watering of young plants and other protective and nursing measures will be adopted for safe growth of the planted plants.

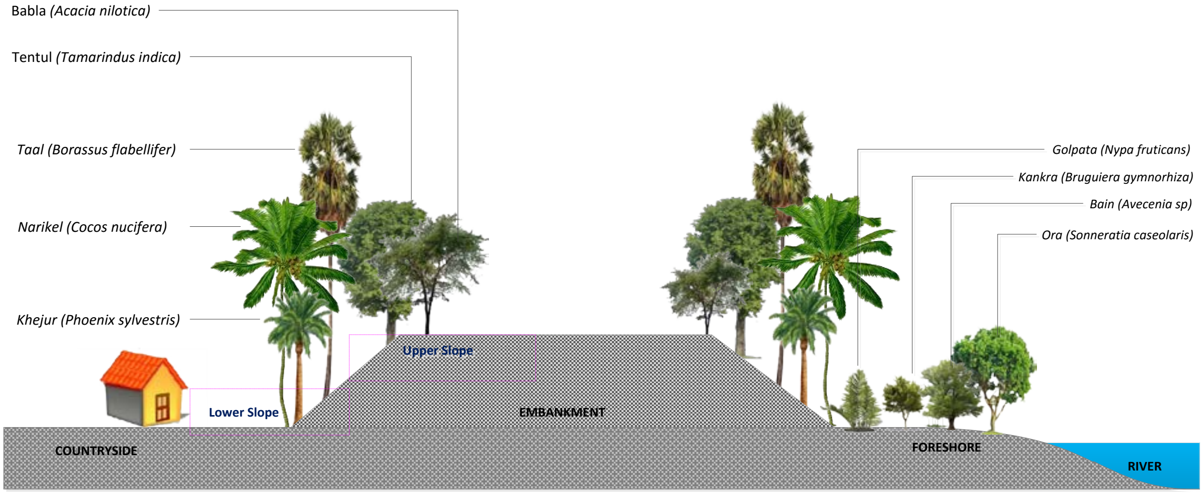


Figure 4.3: Typical cross section of Embankment slope and Foreshore Afforestation

213. Detailed information of afforestation with chainage is shown in Table 4.8 below:

Table 4.8: Detail works of afforestation

Sl	Description	Chainage (km)	Length (km)	Total Afforested area (ha)
1	Slope Plantation	-	35.58	10.10
2	Foreshore Afforestation including Golpata Plantation	Chainage from 01.00 km to 03.50 km, 12.00 km to 21.00 km, 25.00 km to 27.00 km, 30.00 km to 31.50 km.	15.00	6.96
Total Area (ha)				**17.06**

Source: Feasibility Report of CEIP, Volume III: Afforestation Report, September 2013 and Final Report, Volume-V, Landuse Reports, Part C: 1. Forestry.

214. Moreover, to compensate the tree cutting as well as enhance plantation, here is suggested to distribute timber, medicinal and fruit yielding tree sapling to planted in each the household and other available areas (i.e. institutional ground, graveyards, roadsides etc). To achieve the motto “planting 3 trees for cutting 1 tree”,

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

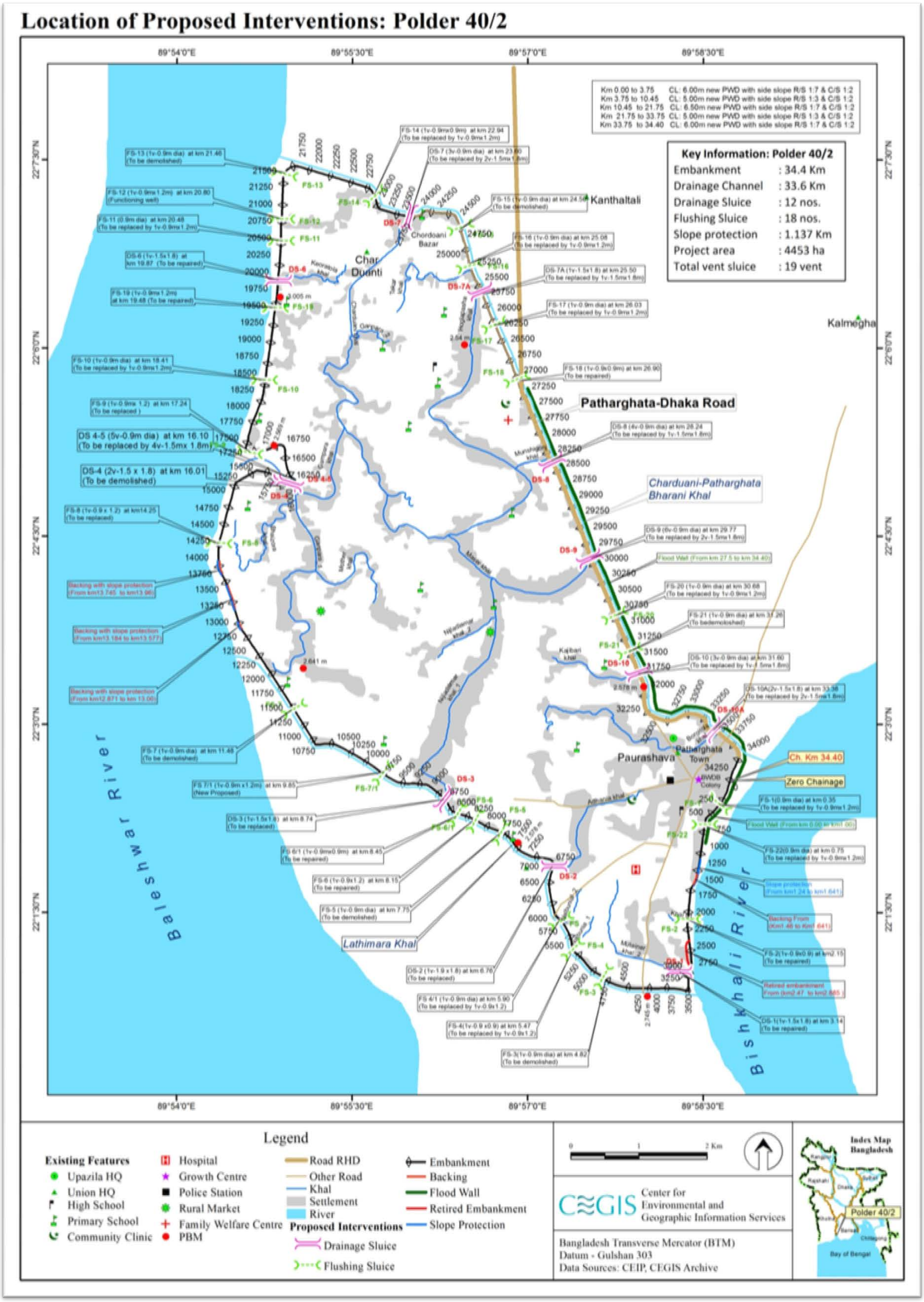
Table 4.8.a: Detail information of plantation program in the polder

Item of works	Time schedule for the given type			
	Golpata (Nypa) Plantation	Chailla, Kankra, Gewa Plantation	Keora Baen Plantation	Embankment Slope Plantation.
Selection of site, survey the site and prepare plantation site map.	March	January	February and March	February
Cleaning of unwanted growths by cutting them off.	May 3rd week.	April 4th week, immediately before planting.	One week before the planting . May be 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 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.
Fifth weeding with light pruning if	n. a.	April 1st week next year.	October 1st week. 2nd year.	n. a.

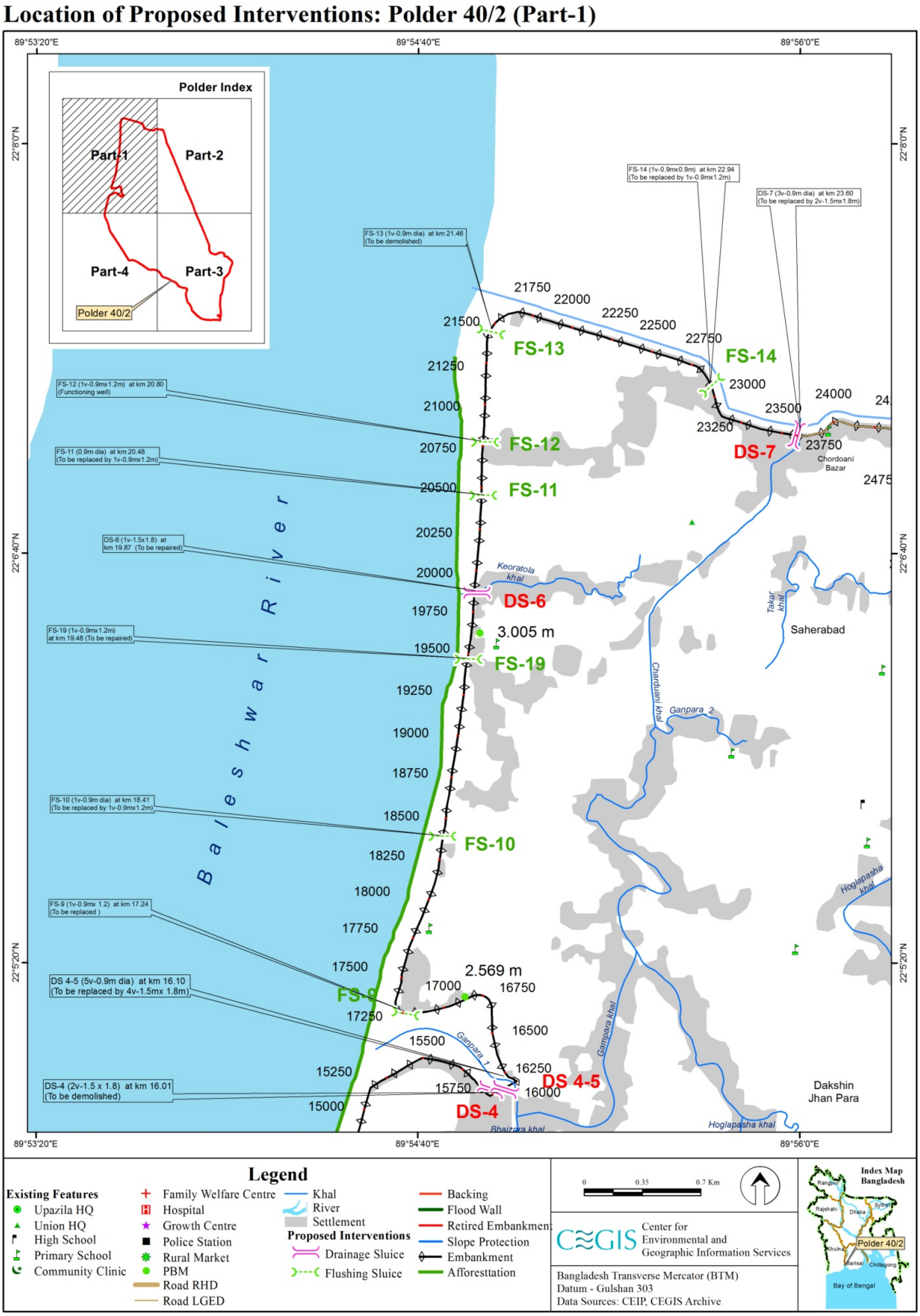
Item of works	Time schedule for the given type			
	Golpata (Nypa) Plantation	**Chailla, Kankra, Gewa Plantation**	**Keora Baen Plantation**	**Embankment Slope Plantation.**
necessary.				
Sixth weeding (Climber cutting)	n. a.	June 1st week next year.	n. a.	n. a.
Seventh weeding (Climber cutting)	n. a.	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

216. **Maps 4.1 to 4.5** below show the locations of proposed interventions in Polder- 40/2, under CEIP-1

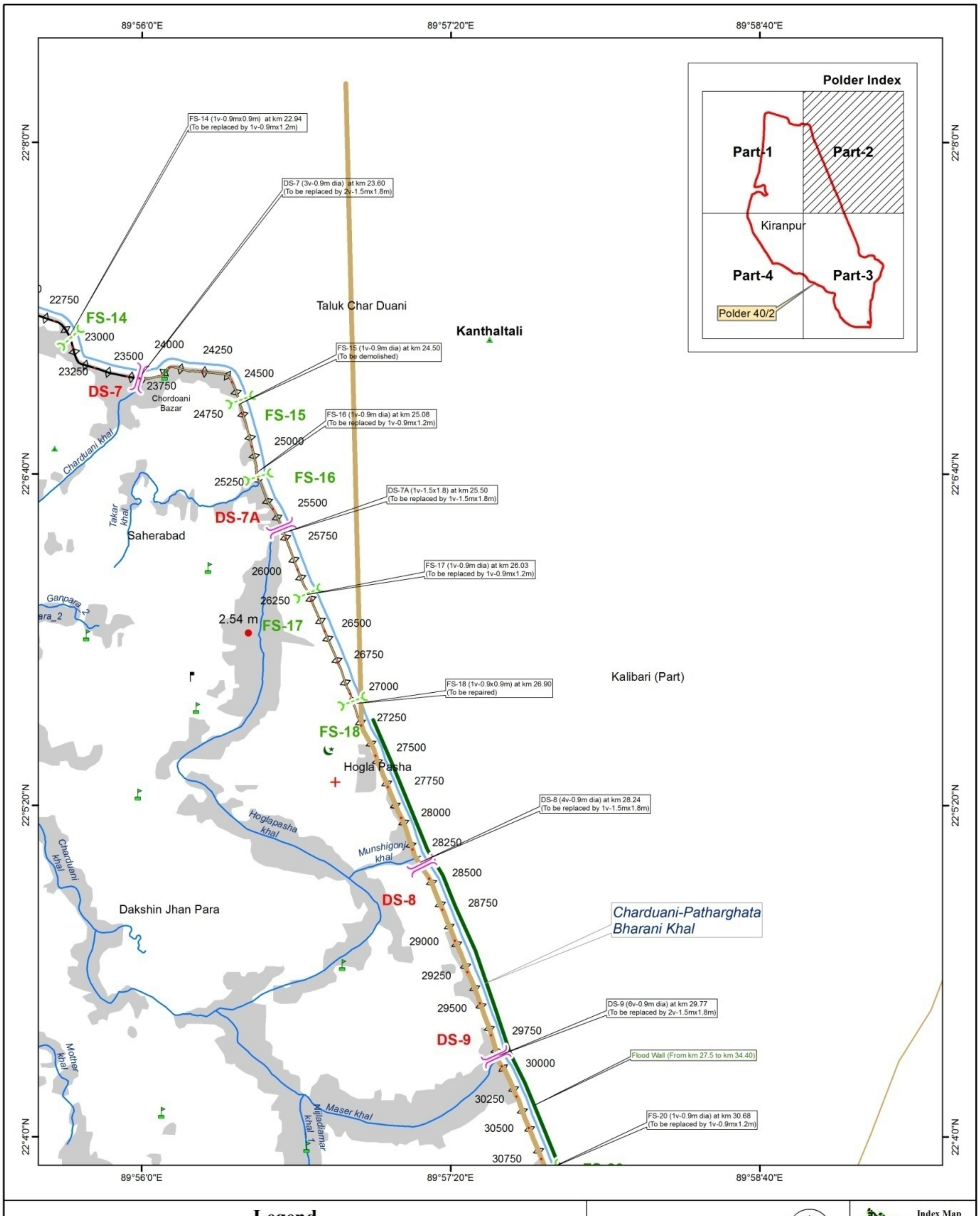


Map 4.1: Location of Proposed Interventions in Polder - 40/2

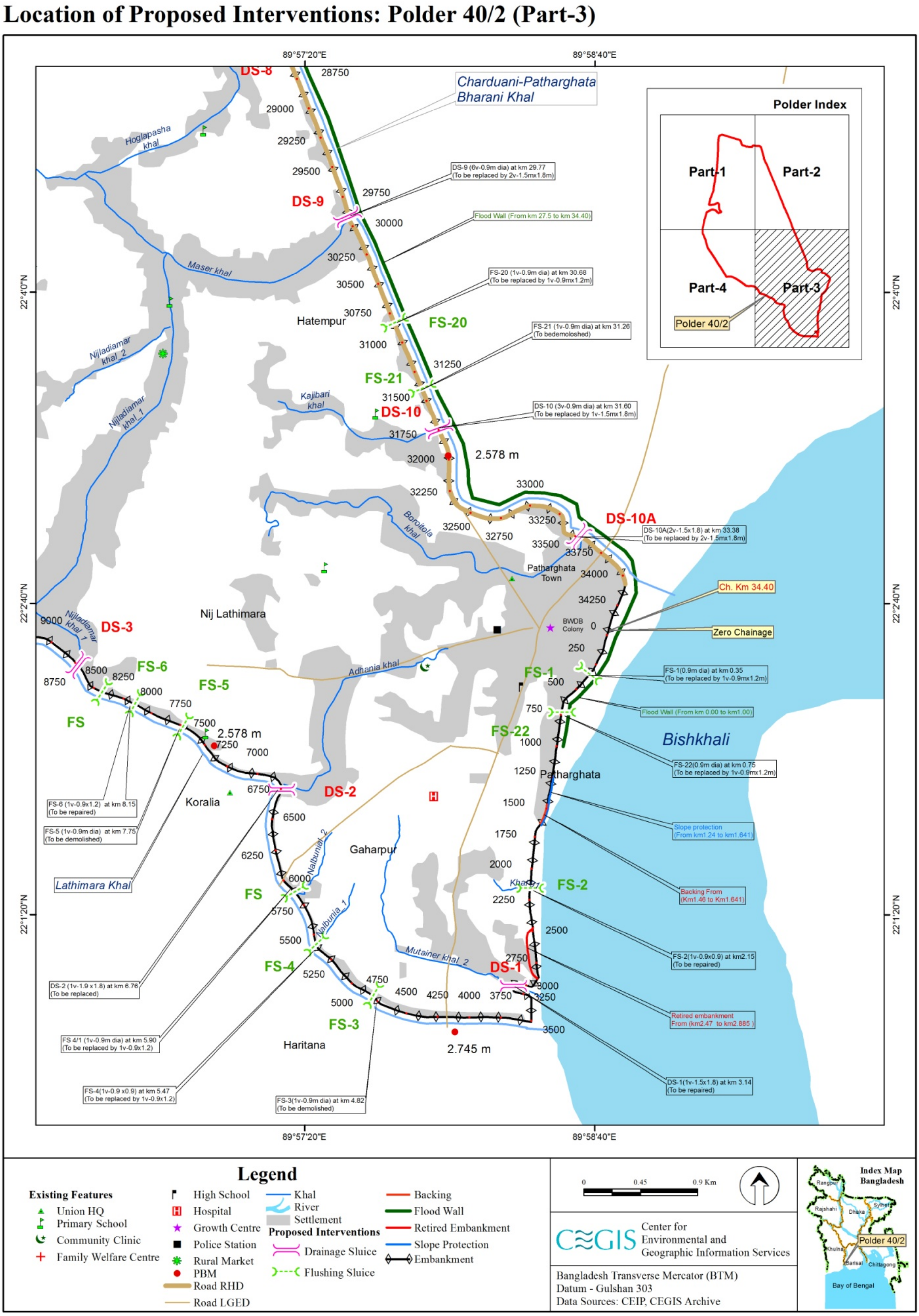


Map 4.2: Location of Proposed Interventions in Polder- 40/2 (Part 1)

Location of Proposed Interventions: Polder 40/2 (Part-2)

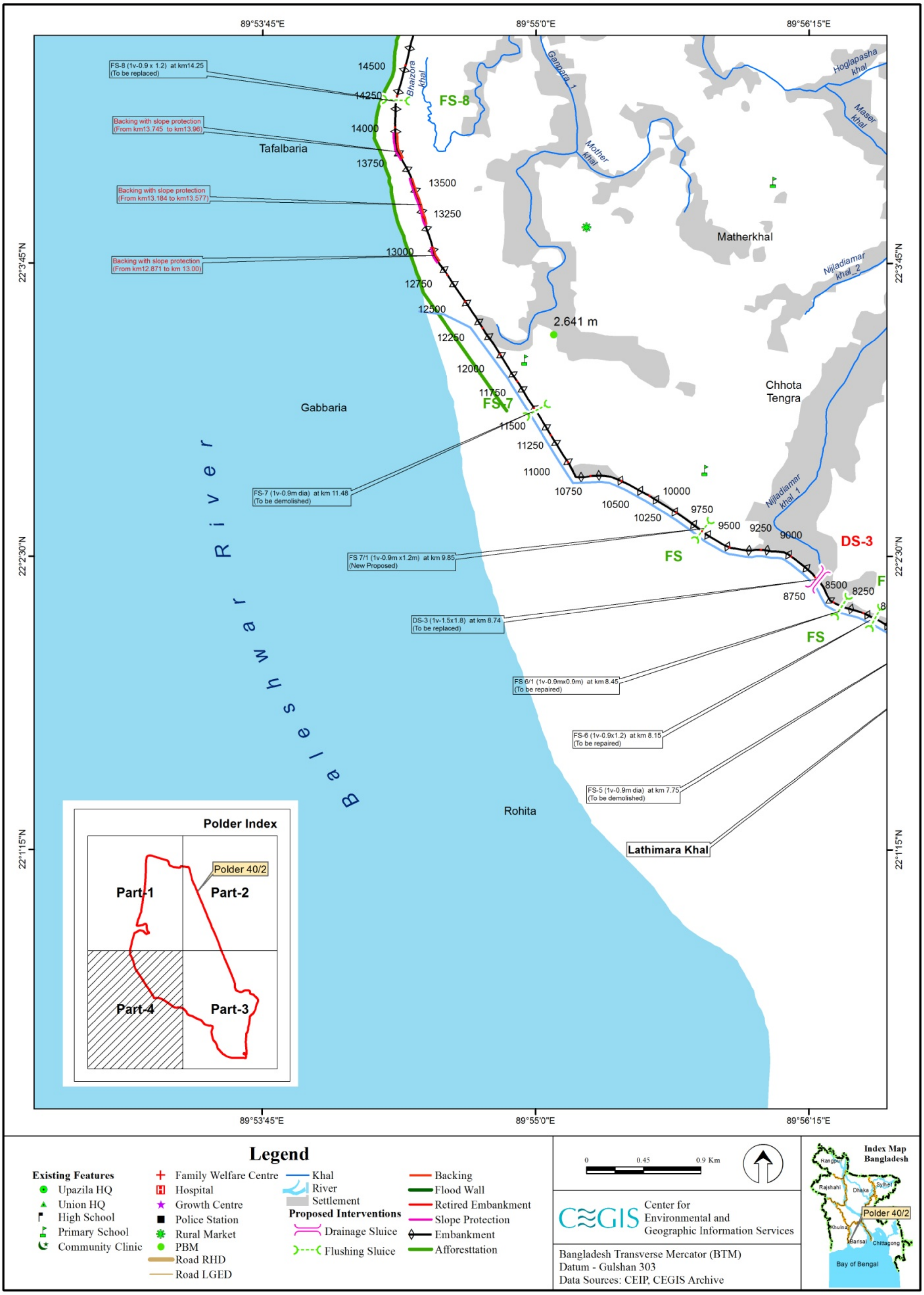


Map 4.3: Location of Proposed Interventions in Polder- 40/2 (Part 2)



Map 4.4: Location of Proposed Interventions in Polder- 40/2 (Part 3)

Location of Proposed Interventions: Polder 40/2 (Part-4)



Map 4.5: Location of Proposed Interventions in Polder- 40/2 (Part 4)

4.7 Construction Details

4.7.1 Construction Schedule

217. The construction works in Polder- 40/2 under the CEIP-1 are expected to be completed in four years. The construction schedule is presented in **Appendix-1.**

4.7.2 Construction Manpower Requirement

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

Table 4.9: Required labor for construction

SL.	Required Manpower	Number
1	Engineer	2
2	Machinery operator	40
3	Mechanics	2
4	Surveyor	2
5	Skilled labour (person-day)	5,000
6	Un-skilled labour (person-day)	25,000

Source: CEIP-1 ENGINEERING DESIGN TEAM, 2015

4.7.3 Construction Material

219. The construction materials required for re-sectioning of embankment, drainage sluices and flushing sluices and bank protection as well as revetment works will include soil, cement, steel and sand. Estimated quantities of these materials are presented in **Table 4.10**.

Table 4.10: Details of Construction materials

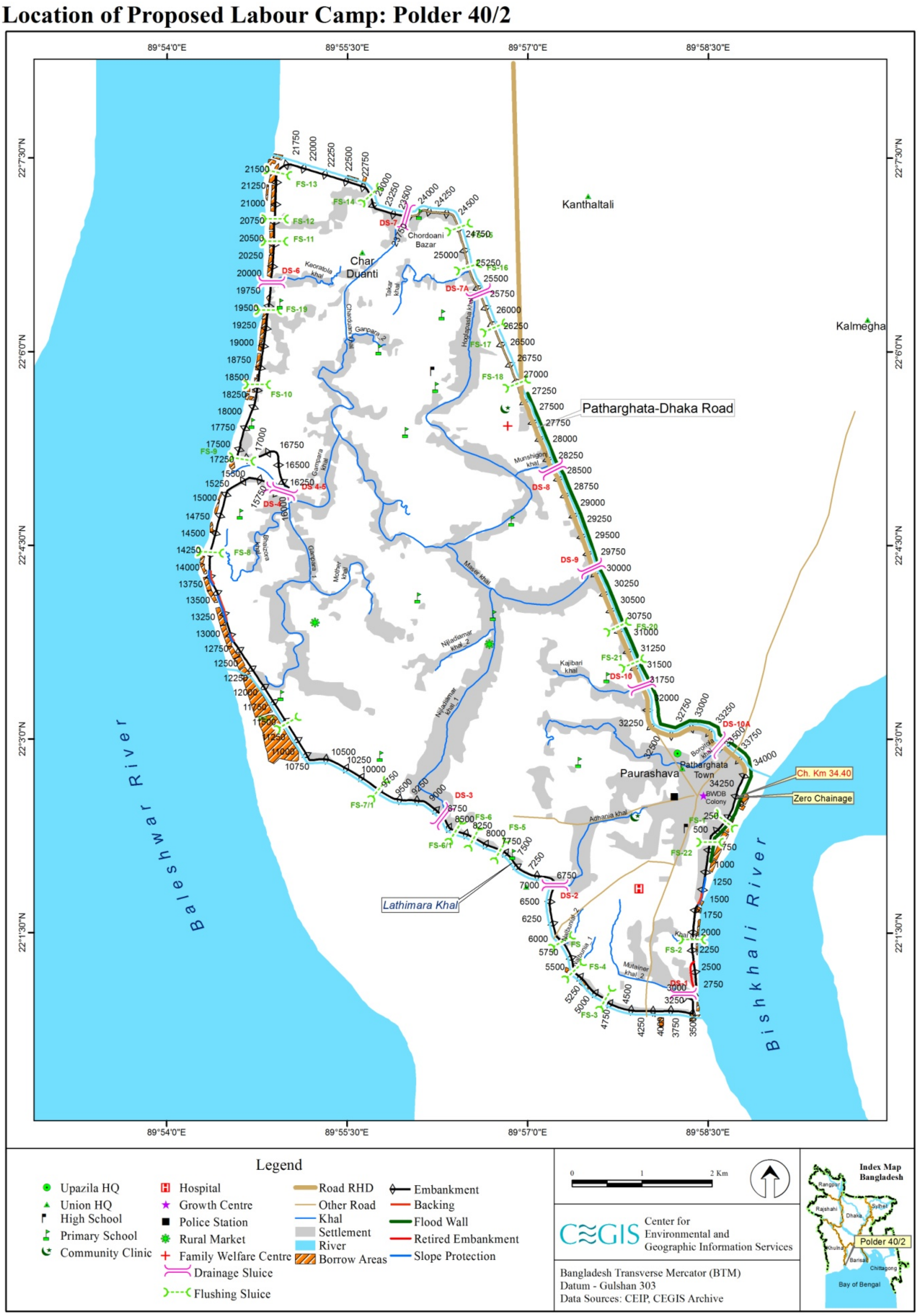
	Description	Quantity	Sources
Re-sectioning of embankment			
1	Earth work	1.35 million m3	Borrow pits, dredging spoils from re-excavation of drainage channels
Construction of sluices and flushing sluices			
2	Cement	80,000 bag	To be procured from local market
3	Sand	6,000 m^3	To be procured from Khulna
4	Stone	5,000 m^3	To be procured from Khulna
5	Steel	850 Ton	To be procured from Khulna
Bank protection			
6	CC Blocks	1.6 million nos	To be made at construction site during construction

Source: CEIP-1 ENGINEERING TEAM, 2015

220. The required earth for embankment rehabilitation will mainly be collected from the borrow pit of Polder- 40/2. Dredging spoils from re-excavation of drainage channels will 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

221. The earth for rehabilitation of the embankment will be collected mainly from the offshore borrows area of Polder-40/2. The EIA team of CEGIS has identified the available borrow areas during field investigation with consideration of minimum set back distance of 1.5 m design by Main-Consultant) which does not cause any geo-morphological. However, necessary approval has to be obtained in this regard. The borrow pit area have been selected based on khas land, fallow and tree less land which does not change the topography of this area. During excavation of borrow pits, a separate walk way will be kept for the movement of workers and pedestrians. In the coastal area, on an average, roughly 5 to 10 inches sedimentation takes place in most of the major khals and the surrounding rivers each year. Therefore, it is expected that the pit area will be restored within 5 to 10 years after excavation. The required earth for the earthwork of the embankment could be obtained from the identified borrows areas. The depth of the borrow areas not be more than 1.5 m for which approval of the Engineer to be obtained. The identified borrow areas for earthwork of the embankment is shown in **Map 4.6**.



Map 4.6: Map showing the available Borrow area of the Polder -40/2

4.7.4 Construction Machinery

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

Table 4.11: List of construction equipment and machinery

Sl.	Description	Quantity (number)
1	Bulldozer	3
2	Dump- truck	5
3	Pay Loader	0
4	Excavator	4
5	Barge	1
6	Engine Boat	6
7	Vibrator	2
8	Compactor	13
9	Mixture Machine	14
10	Mixing-Plant	1
11	Truck	12
12	Tractor	8
13	Generator	18
14	Leveling Instrument	4
15	Total Station	1
16	De-watering System	2
17	Low lift pump	20
18	Tubewell	35

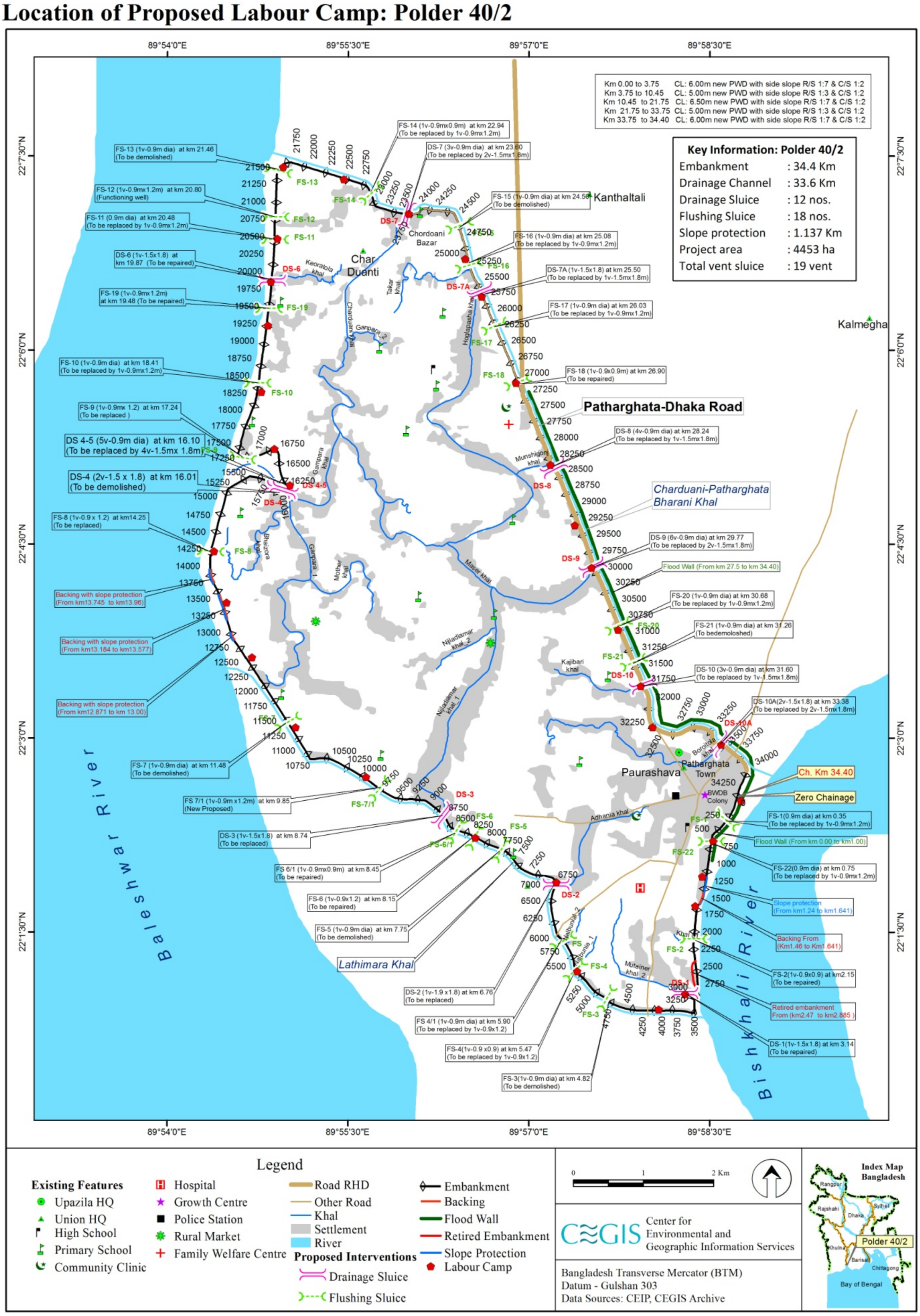
Source: CEIP-I Engineering Team, 2015

4.7.5 Construction Camps

223. A total number of 33 labor camps will established during construction period. These labour sheds will be set up for earth works of embankment, khals and for construction of drainage sluice, flushing sluice, slope protection and flood wall activities. **Map 4.7** shows the probable locations of the construction labor camps for the rehabilitation woks of the polder. The Contractor will select the location of the camps at their suitable locations through consultation with the local Union Parishad chairman and the community inside the polder as well as obtaining permission from the Supervision Consultant (Engineer).

4.7.6 Drinking Water and Sanitation System of Camps

224. A total number of 33 tube wells will need to be installed at the labor camp premises near all of construction sites for obtaining safe drinking water for camps workers, which will also be used for construction activities. Latrines with septic tanks along with safe disposal of sewage will be constructed for sanitation.



Map 4.7: Map showing the locations of proposed labour camps

4.7.7 Vehicular Traffic during Construction

225. For development of the proposed polder, major quantity of earth will be carried on the embankment by mechanical equipment like excavators, pay loaders, dump trucks, and trolleys. Some minor quantity of earthen materials will be carried manually.

226. The rivers surrounding the polder (Baleswar and Bishkhali Rivers) are navigable throughout the year. Apart from these prominent rivers, the polder is encircled by Lathimara Khal (south) and Charduani-Patharghata Bharani Khal (north-east). These khals are also navigable during high tide. Beside waterway communication, there exist direct road communication between polder and upazila as well as district head quarters. During construction works, the trucks or other vehicles will be used in internal road communication. Construction materials which to be procured from local market will be transported using both road and waterway communication. Heavy equipment and construction materials including stone, sand steel etc. and sluice gate equipment will be transported from Khulna by water vessels through the Passur and Baleshwar rivers.

227. The construction materials would collect from the stockyard and then would to be transported to the individual work sites through engine boat or trucks. The materials found usable from the polder may carry through smaller carts, non-motorized vans and other smaller vehicles inside the polder area.

4.7.8 Jetty Construction

228. A temporary jetty near the location of stockyards will be constructed for unloading of construction materials during construction period.

4.8 Project Implementation Arrangements

229. **Overall Project Management.** The Government of Bangladesh has the overall responsibility for polder 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).

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

231. **Project Management Unit (PMU).**BWDB will set up a PMU to oversee the development and management of the Project. 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), will lead it. 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.

232. **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, 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, 2 Accountants and 3 support staffs.

233. **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 among 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.

234. **An Environment, Social and Communication Unit (ESCU)** 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.

235. **Each Field Office** will 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.

236. The following Consultants/Consulting Firms will support the PMU:

- 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.
- The Detailed Design, Construction Supervision and Project Monitoring Support Consultants is responsible for the supervision of EMP/RAP implementation and 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 Project Supervision Consultant will serve as the Engineer for construction supervision. At site, a Resident Engineer, appointed by the consultant, with a team of specialists and inspectors will supervise the Contractor.
- The Monitoring and Evaluation Consultants will monitor the implementation and evaluate the impacts and report to the PMU.
- A Procurement Panel will be appointed by the BWDB to oversee the procurement process of large value contracts subject to prior review under the Project. The panel will consist of two international/expatriate specialists and one national specialist.
- 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, geo-technology, sociology and environment.

4.9 Water Management and Operational PlanPlan

4.9.1 Introduction

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

238. The polders have been playing vital role in safeguarding the coastal area; ensuring and increasing agricultural production; improving livelihoods of the people and mitigating environmental adverse effects. But 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. Therefore, 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 and resources. 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 stakeholder’s participation and need based budgeting will continue to remain at the apex.

4.9.2 Approach and Methodology

(a) Approach

239. There is no denying the fact that the Operation and Maintenance (O&M) of large scale water resources projects in Bangladesh are chronically under-financed. BWDB field offices have a common complaint that they are always provided with little amount of fund which is not only inadequate to cover the exact requirement of major preventive maintenance works; but also in most cases it is so meager compared to the total needs that even no minor maintenance work is possible to undertake. Thus, for the years together vital works of preventive maintenance are deferred and eventually pushed down to expensive rehabilitation measures. Several studies for O&M of BWDP sub-projects and polders have addressed this issue quite in depth and many suggestions have been put forward. The most relevant to the current assignment i.e. "Guidelines for O&M Planning and Budgeting, August 2001; CERP-II" has been consulted very carefully. Moreover, the Consultants discussed all the pros and cons of polders' O&M issues with BWDB's field staffs and local stakeholders to suggest this approach for polder O&M planning. This is summarized as under:

Community Participation in Operation and Preventive Maintenance

240. Polders need to be taken care of its every day wear and tear quite effectively. Experiences show that preventive maintenance of polders (embankments, structures, canals etc.) through community participation becomes successful if necessary supervision and guidance are ensured from BWDB's end. To make participation worth and meaningful, stakeholders should be allowed to ventilate their opinion right from the planning process to actual implementation stages. However, the success depends on the active participation of the local stakeholders. Above all, institutionalization is most importantly considered in this

kind of local participation. There should have some cohesive forces to unite the people together and that can be ensured through building of institutions. When there is a common platform to think on any particular issue leading to some common interests and are tied with some goals to achieve in the long run, the united people can work effectively and yield the desired results.

241. For effective and meaningful community participation, following remarks are important:

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

Annual Evaluation of the O&M activities done by WMOs

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

243. It is important that those who will be found worthless and ineffective in the accomplishment of jobs will be asked to vacate. Continuous guidance and monitoring the performance of WMGs vis-a-vis the functional groups by BWDB field staffs may make them more accountable and eventually some improvements will become apparent in the preventive maintenance program. In the process of this joint verification and assessment, the Local Government Institutions (LGIs) i.e. Union Parishad leaders / representatives (i.e. the Ward Members) will be involved for active support and cooperation.

Prioritization of Maintenance Works

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

Interaction with Local Government Institutions and Stakeholders

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

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

Engaging NGOs in operation and Preventive Maintenance

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

4.9.3 Methodology

Meetings with Local Stakeholders at site

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

Priority of Maintenance Works and preparation of Work Authorization

249. The most important step of O&M planning is the prioritization of the proposed works especially when there is anticipated shortfall in funding. The list of maintenance works normally considered necessary to undertaken in a polder for a particular period may be very big; but in comparison to the available fund for O&M, many items in the list have to be axed. The list thus becomes short and shorter based on priority. The criterion for prioritization or "Budget Cuts" should be applied quite judiciously i.e. coming down from the items of major periodic maintenance to the items of minor periodic maintenance. Preventive maintenance works should be left untouched (see the Figure 4.4 below) because adequate preventive and

minor periodic maintenance push down the need for rehabilitation; infrastructure remains in good condition.

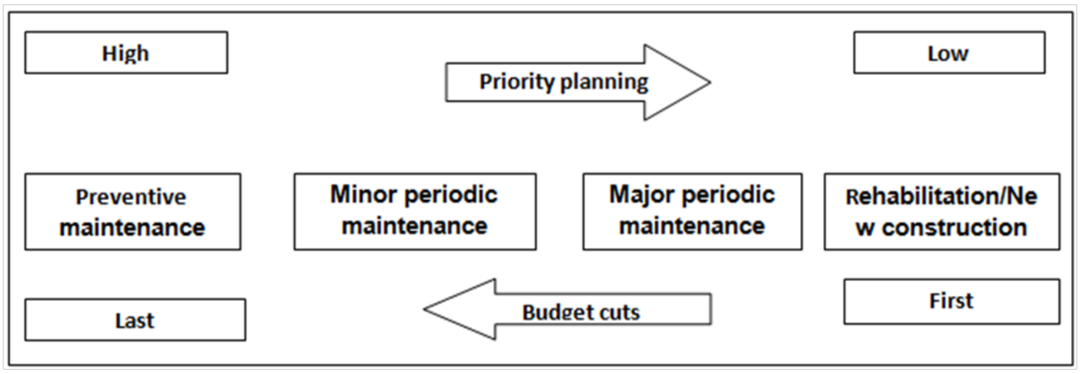


Figure 4.4: Priority Budgetingfor O&M

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

4.9.4 Operational Plan

251. 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 grower; salt producer (if there is any); shrimp producer (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

252. 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)*

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

(a) Regulation of gates

254. 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 developed under different projects but are hardly followed as common practices.

255. 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.

256. Whatever may be the form of participation, the gate operation in each drainage sluice / regulator must follow certain operational timing. 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.

257. Flap Gates of regulators should remain in place at all times except during maintenance or if flushing continues. 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) as soon as 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.

258. 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.

259. Operation of Flushing Sluices and Pipe Inlets should also have similar practices with maximum involvement of beneficiaries' organizations. The O&M section and DWM staffs of BWDB will assist them in the water management of command areas inside the polders. A gate operation plan in Bengali is provided in **Appendix-13.**

(b) Frequent Watching of Embankments

260. 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, cultivation of perennial cash crops, cuts in the embankments to accommodate homesteads, embankment subsidence and erosion and / or settlement of protection works.

261. 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.

(c) Regular Checking of Structures

262. 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.

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

263. 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.

(e) Supervision of preventive maintenance works

264. 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 implemented more or less continuously. The field staffs of O&M section of BWDB supervise all preventive maintenance works.

(ii) Planning of Operation

265. The objective of structures operation is to maintain control over water levels in the polder channels so as 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. Therefore, 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.

266. 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 is drawn over a season that 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.

267. 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.

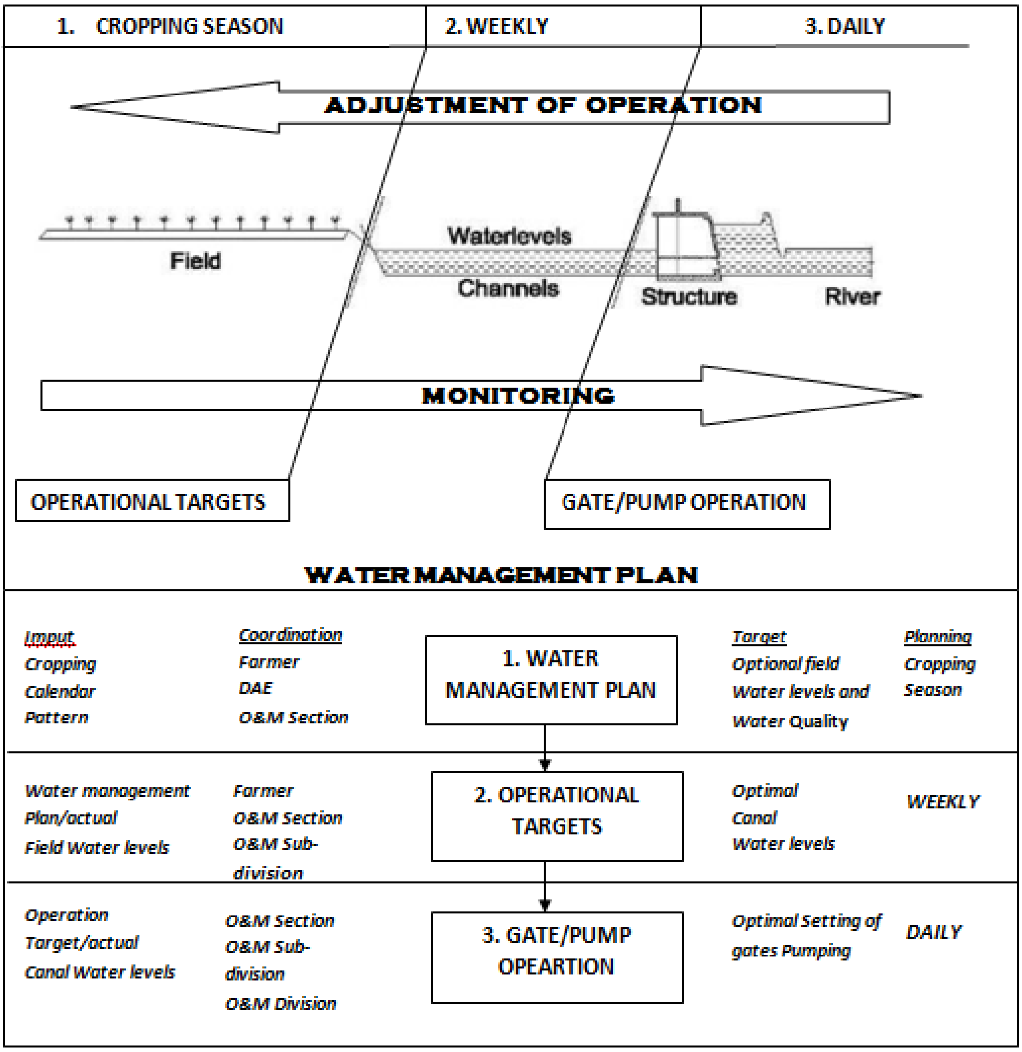


Figure 4.5: Decision making in operation

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

268. 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 (F**igure 4.6, Planning Procedure**); these will be combined into water management plans at WMA (Sub-Division level). In large polders the plans of DWM will be compiled by the Executive Engineer (in support and cooperation of the WMF- if it exists) and produce the final WM plan. This needs to be prepared well ahead of the cropping season, so that critical farm operation (e.g. seedbed preparation, shrimp or salt production requirements) can be carried out in line with the plan.

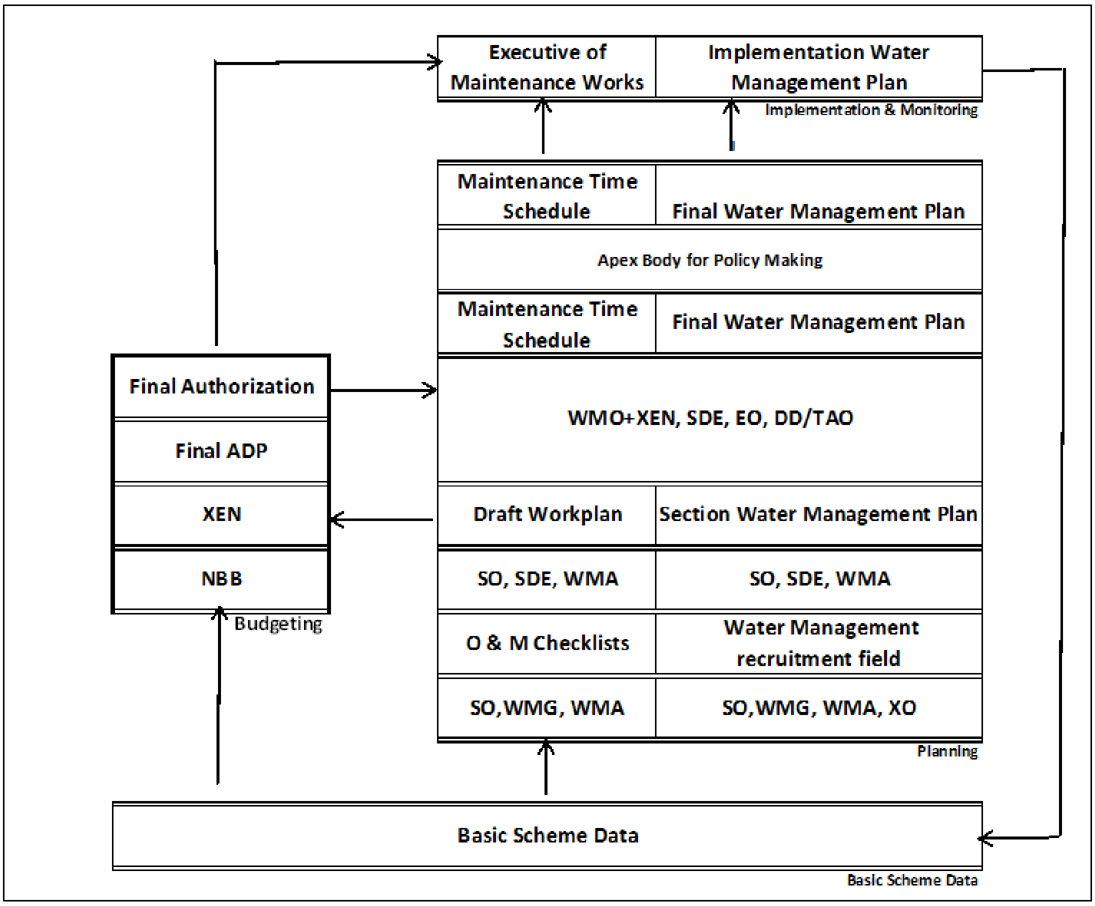


Figure 4.6: Standard Planning Procedure

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

269. 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, there will have water management computer model to use as an important tool in the planning process. The models can be used to compute several water management scenarios and the effects of certain measures (e.g. extra regulators, early drainage or flushing etc.) can be simulated. The model can also be used to develop weekly operation targets and may become a very useful tool in the day-to-day management of large polders. Specially trained staff will be required for such advanced calculation.

270. 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 the operational services to be 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:

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

(c) Day-to-Day operation:

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

4.9.5 Maintenance Works

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

274. In the coastal polders works which 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;

275. 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 which 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.

276. The preventive maintenance interventions have been spelled out precisely in Table **4.13**below:

(i) Periodic Maintenance

277. 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 of repair works and is identified during the field assessment at (more or less) regular intervals.

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

(a) Minor Periodic Maintenance Works:

- Minor earth works on the embankments byLCSs 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.

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

(ii) Emergency Maintenance

280. 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 works.

Table 4.12: Types and Classification of Maintenance Works

Sl. No	Description of Maintenance Works	Implementation Mode									
		Classification by Type of Maintenance			Community Based Functional Groups under WMOs						LCB
		I	II	III	EMG	ES	CMG	SMG	LCS	PIC	
	Embankment										
1	Incidental earthworks: Minor filling sofrills; ghogs; rodent holes at crest and/or slope	√			√	√					
2	New or additional planting of trees and/or shrubs on embankment or toe	√			√	√					
3	Maintenance of embankment vegetation: Patrolling and protecting young plants against browsing, protecting turfs/ grass/ shrubs against overgrazing and indiscriminate trampling by cattle, upkeep of paths to facilitate inspection of trees, clearing around trees, application of fertilizer, harvesting of produce from trees, replanting and replacement of diseased/ moribund/dead trees.	√			√	√					
4	Minor earth works: Shaping or minor fillings of crest and slope but not re-sectioning so as to bring it back in a shape that allows ESs to settle and trees to be planted.		√						√	√	
5	Major 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 Verticals liding gates		√					√			√
15	Repair defective blockworks(aprons)										

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	
			√								√
16	Replacing stop logs, flap gate or vertical		√	√							√
17	Repair head walls, wing walls, aprons of		√								√
18	**<u>Protective Works</u>** Re-positioning/replacing of incidentally displaced blocks/ boulders /concrete frames,smallrepairtosand/gravel filter		√								√
19	**<u>Channels</u>** Cleaning khal and out fall drains and de- silting out fall drains	√					√				
20	Re-excavation of khal		√						√		
21	Removing cross dams (used as access roads, flashing bunds or water retention)		√			√					

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

(iii) Planning of Maintenance

281. As already stated maintenance activities in BWDB polders are conceived in three distinct categories i.e., Preventive Maintenance; Periodic Maintenance; and Emergency Maintenance. Preventive maintenance requires little annual planning because Embankment Maintenance Groups and Canal Maintenance Groups go ahead in a continuous process. Emergency maintenance cannot be planned as this will be dependent on unexpected conditions and can hardly be foreseen. So, the maintenance planning centers on periodic maintenance. The selection of items to be maintained and repaired, and the ranking of the works, is the recurrent activities in maintenance planning. This selection depends on the project inventory; the O&M checklists filled in by the farmers under the guidance of the Section Officer; and monitoring data produced by BWDB. A clear dichotomy is apparent here; monitoring focuses on the elements of the infrastructure while the O&M checklists help identify the water management bottlenecks and support the system approach. Another important issue in the maintenance planning is the timing of maintenance i.e when certain works need to be carried out without hampering water management, and if it hampers in any area, all theses would be reflected in these as on al water management plan. This concerns mainly the periodic maintenance works. The third planning activity is apart 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 4.7).**

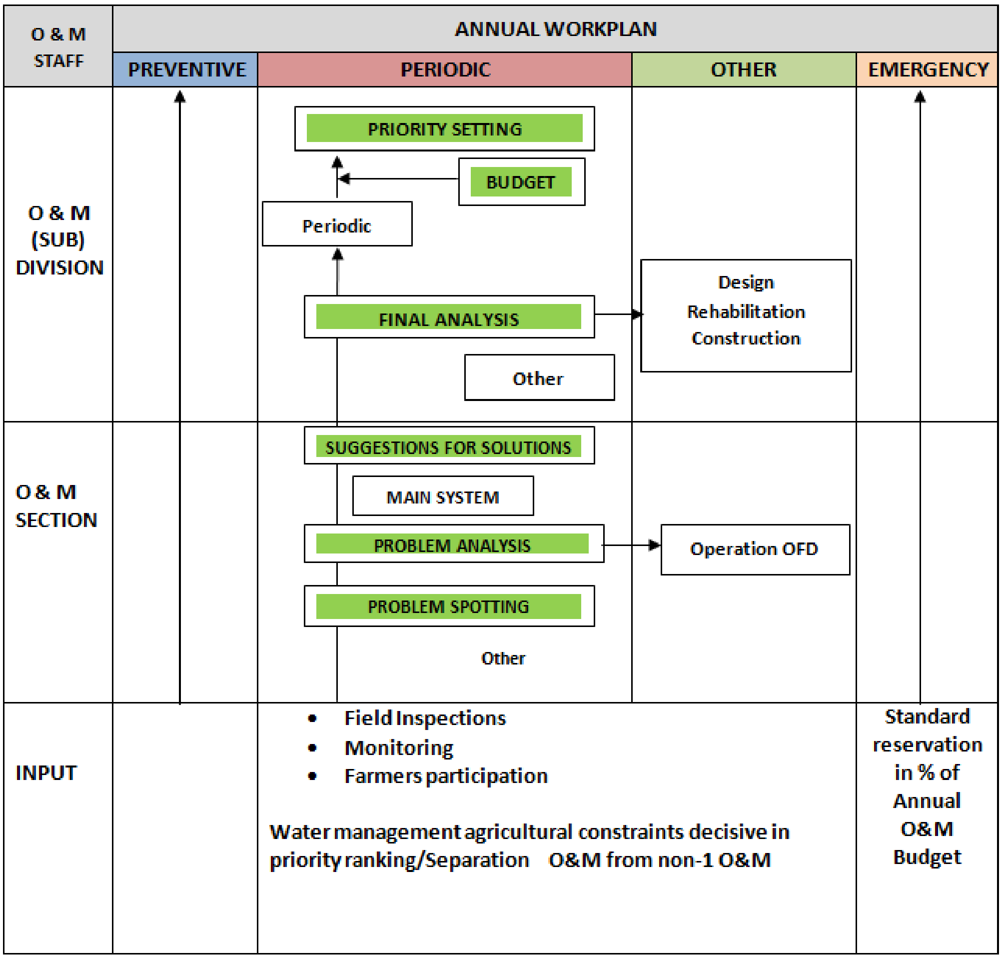


Figure 4.7: Decision Making in Maintenance

282. Before any planning of maintenance, there should have the separation between O&M and non-O&M works. Water management should include only the infrastructure related issues 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.

4.9.6 Rehabilitation works

283. 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 <u>of deteriorated facilities and infrastructure within the completed systems to their original functional condition</u>." Deterioration of structures and other polder elements usually occur due to normal wear and tear over time if the regular maintenance works are not done adequately and also 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*.

284. Table 4.13 below depicts the Type of Rehabilitation works:

Table 4.13: Type of Rehabilitation Works

Sl. No.	Description of Maintenance Works	Implementation Mode						
		Community Based Functional Groups under WMOs						LCB
		EMG	ES	CMG	SMG	LCS	PIC	
1	**<u>Embankment</u>** Construction of new or retired embankment, closing of breach(note mergent);					√		√
2	**<u>Structures</u>** Big repair or replacing of lifting mechanisms for flap gates or vertical slide gates;							√
3	New protective works(CC blocks/boulders), big repair of block works(aprons);							√
4	Repair of headwalls/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 maj or renovation to							√

Sl. No.	Description of Maintenance Works	Implementation Mode						
		Community Based Functional Groups under WMOs						LCB
		EMG	ES	CMG	SMG	LCS	PIC	
	geo-textile;							
6	**Channels** Excavation of new *Khals*					√	√	√

Source: Engineering Team of CEIP-1

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

4.9.7 Local Participation in O & M and Water Management

285. Local stakeholders' participation in the development and maintenance of water resources sub-projects / polders is much talked issue. This is looked upon more seriously in FCD and / or FCDI interventions of BWDB, because chronically most of these sub-projects vis-a-vis coastal polders have been showing poor performances in terms of water management and agricultural crop production mainly due to inadequate Operation and Maintenance (O&M). The potentials in many cases remain underutilized; 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. Till now the provisions of local level participation in the National Water Policy and in the Guidelines for Participatory Water Management that stressed the need for organizing the local stakeholders by themselves with LGIs (i.e. Union Parishad at the grass-root level) playing the roles of coordinating agencies could not succeed in drainage sub-projects for the benefit is not tangible. The challenge of shifting the responsibilities of O&M to beneficiaries' organizations in drainage sub-projects especially in coastal polders thus remains as a big question yet.

a. Institutions for Participation

286. 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.

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

at the apex. The combination of groups, associations and federations in a particular sub-project is together termed as the Water Management Organization (WMO).

i. Current status of Participation in CEIP Polders

288. 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.

289. 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.

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

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

ii. Institutional framework for Participation

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

293. As per GPWM provisions, local stakeholders belonging to the polder community may be brought under three tiers of organization or as applicable, namely - Water Management

Groups (WMGs) at the lowest tier; Water Management Associations (WMAs) at the mid-tier; and Water Management Federations (WMFs) at the apex level.

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

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

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

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

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

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

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

For sub-projects /polders above 5000 ha;

There will have the following three tiers of WMOs:

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

Source: Adopted from GPWM, 2001

Water Management Groups(WMGs):

294. 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 treated as the primary society. The entire command area of the sub-project/polder will be sub-divided into few Units preferably based on 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, turnouts 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 two or three villages and part thereof. One WMG may therefore include several hundreds to a few thousand as its primary members.

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

296. 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 treat as the legal management body of the WMG concerned.

297. The WMG should 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) need to establish on a firm foothold. These will led to success for the eventual sustained growth and effective local participation in water management and O&M.

Water Management Association (WMA):

298. 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.

299. 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):

300. 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 based on 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 beselected from among the MC members of WMAs. Important personalities in the area like Member of Parliament or local leader may be nominated as the chair-person of the WMF and other members (not exceeding 04 nos.) may come from the WMAs by virtue of their importance in controlling the numbers of WMGs etc. Table 4.14 shows the duties and responsiblilities of WMOs at different tiers.

Table 4.14: Duties and Responsibilities of WMOs at different tiers

WaterManagement Group (WMG)	WaterManagement Association (WMA)	WaterManagement Federation (WMF)
Initiation ofStakeholders activities through preliminarydiscussions, meetingsand 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.	Signingof management transfer agreementsonbehalf otheWMGswith implementingagencies orLGIsasappropriate	Coordinationof stakeholders'activities in watermanagement
Participationthroughout 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

WaterManagement Group (WMG)	WaterManagement Association (WMA)	WaterManagement Federation (WMF)
Preparation of annual crop production as well as O&M plans	Preparation of annual crop production/ O&M plans and/or collate the plans emanating from the WMGs	Preparation of annual crop production/ O&M plans and/or collate the plans emanating from the WMAs
Mobilization of local resources and collection of members' contribution towards and recurring costs	Collection of beneficiary contribution towards investment and operation costs and collection of consolidated contributions from WMGs as appropriate	Collection, where applicable, of beneficiary contribution towards polder level operation and maintenance
Maintenance of accounts	Supervision and guidance to WMGs on maintaining the accounts	Financial oversight
Work with implementing agencies, NGOs, CBOs and LGIs	Participation in the supervision of sub- project implementation to ensure that the works are as per design and agreement	Observation of sub- project's /polder's construction to ensure compliance with design and agreement
Progressive sharing of water management responsibilities	Operation and maintenance of works in accordance with any leasing agreement	On its completion, leasing out the polder/sub-project level infrastructure from the implementing agency and oversee the operation / maintenance as per terms of the lease.
Resolution of conflicts, election of office bearers, exploration of additional water based economic activities/ IGAs for the WMGs or its members	Assistances in organizing training courses for WMG members and general capacity building initiatives with Government or NGOs for different types of stakeholders	Coordination of WMA's activities in organizing training courses for WMG members and general capacity building initiatives with Government or NGOs for different types of stakeholders

b. Participation of Community Based Organizations

301. 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-1:

ES-Embankment Settler

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

303. 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 /sub-projects.

LCS – Landless Contracting Society

304. LCSs are the groups selected from landless people consisting of nearly 60 members or more per group (as the case may be). They are responsible for earthworks only up to a limit of Tk. 3.00 lacs in a single contract; they may be awarded a second contract based on their performances. These groups are entitled to have the facility of doing 25% of the total earthworks needed in a Division per year. LCSs are enlisted as D-class 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

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

c. Roles of NGOs in participation

306. 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 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

307. 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 looked upon by the NGOs.

Ensuring CBOs involvement in Preventive Maintenance

308. 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

309. WMOs, in its 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 footholds 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

310. 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 period 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

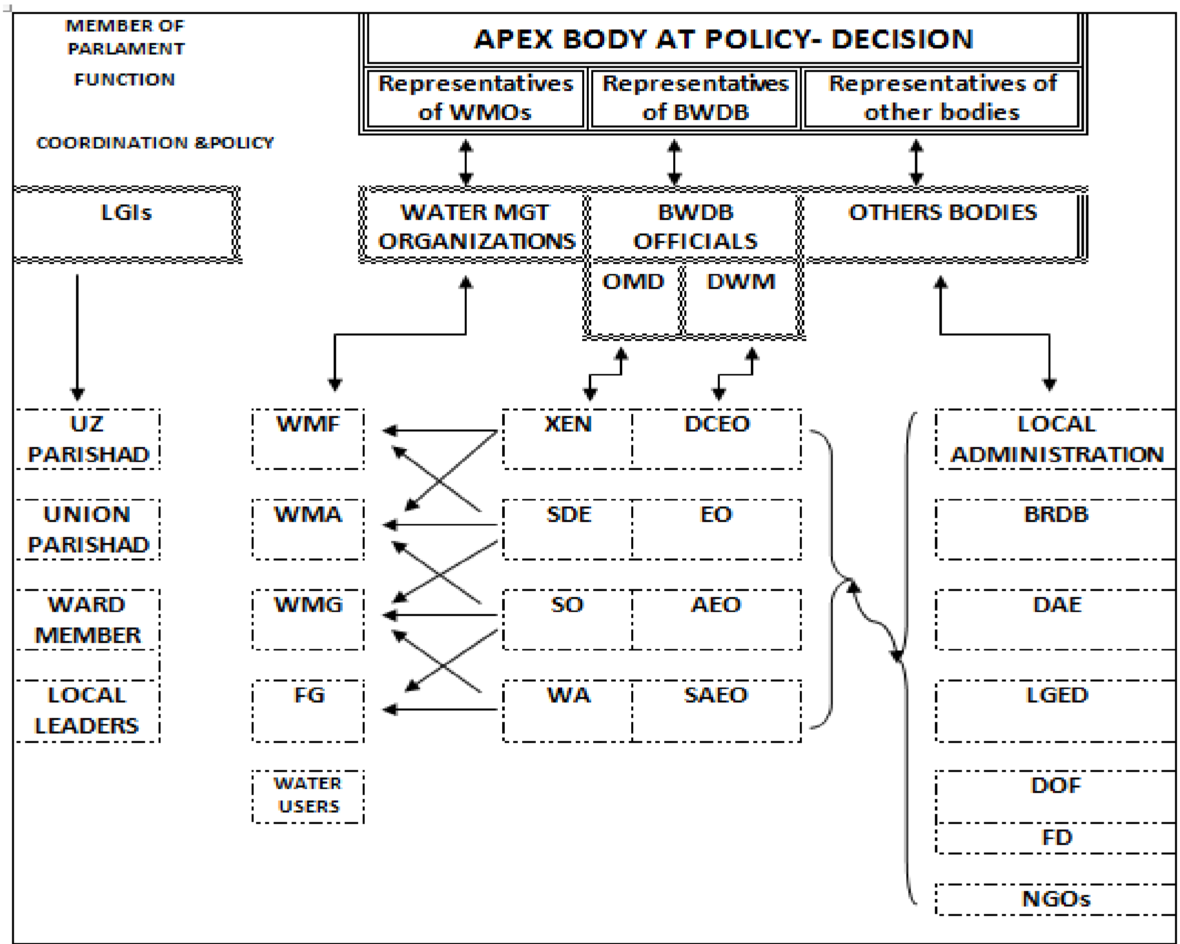
311. At the lowest tier of administration, the Local Government Institutions (LGIs) in Bangladesh have a very good record of existence and performance among the local community. It also becomes the inevitable part of development activities. It would not be appropriate to introduce WMOs to function in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

Cooperation of LGIs

312. 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 the public good done by the government. So, 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.

313. 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. But 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.

314. 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 specially 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 4.8 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 4.8: Inter-relationshipbetween WMOsandthe LGIs

Support from Local Administration

315. From the view point 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 happens 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:

316. Participation in the Union Parishad and Upazila Parishad Review Meetings

317. 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".

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

319. 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

320. Total cost of the project has been estimated to be Tk. 1,501,216,360 (Taka one hundred fifty crore twelve lac sixteen thousand three hundred sixty) only.

4.11 Need of Resettlement Action Plan (RAP)

321. A retired embankment has been proposed in the polder 40/2 from 2.470 -2.890 km that has a length 0.415 km. According to the joint field survey it will require 13.29 ha of land tentatively which has been sent to concerned BWDB XEN for review. All the Drainage or Flushing Sluices proposed to be replaced, will be re-constructed on the existing alignment. For 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. In this connection, a detail RAP investigation is required, which is being conducted by the consultants. Resettlement

Plan must be prepared to ensure that the affected people or commercial units receive fair and adequate compensation and rehabilitation.

4.12 No Objection Certificate

322. Polder 40/2 is located in the Patharghata upazila under Barguna district, covering two unions namely, Patharghata Sadar and Chardoani. No archeological sites or any cultural heritages are known to exist in these unions, which might be affected due to proposed rehabilitation works. Furthermore, there will be no problem in land acquisition or displacement of people since rehabilitation will be made on the existing structures. This has been addressed in the No Objection Certificates (NOCs) collected from the union Chairmen, which are attached in **Appendix B**.

5 Environmental Baseline and Existing Conditions

323. This chapter describes the existing environmental and social conditions in respect of water, land/soil, agriculture, livestock, fisheries, ecosystems and socio-economic aspects of the Project area.

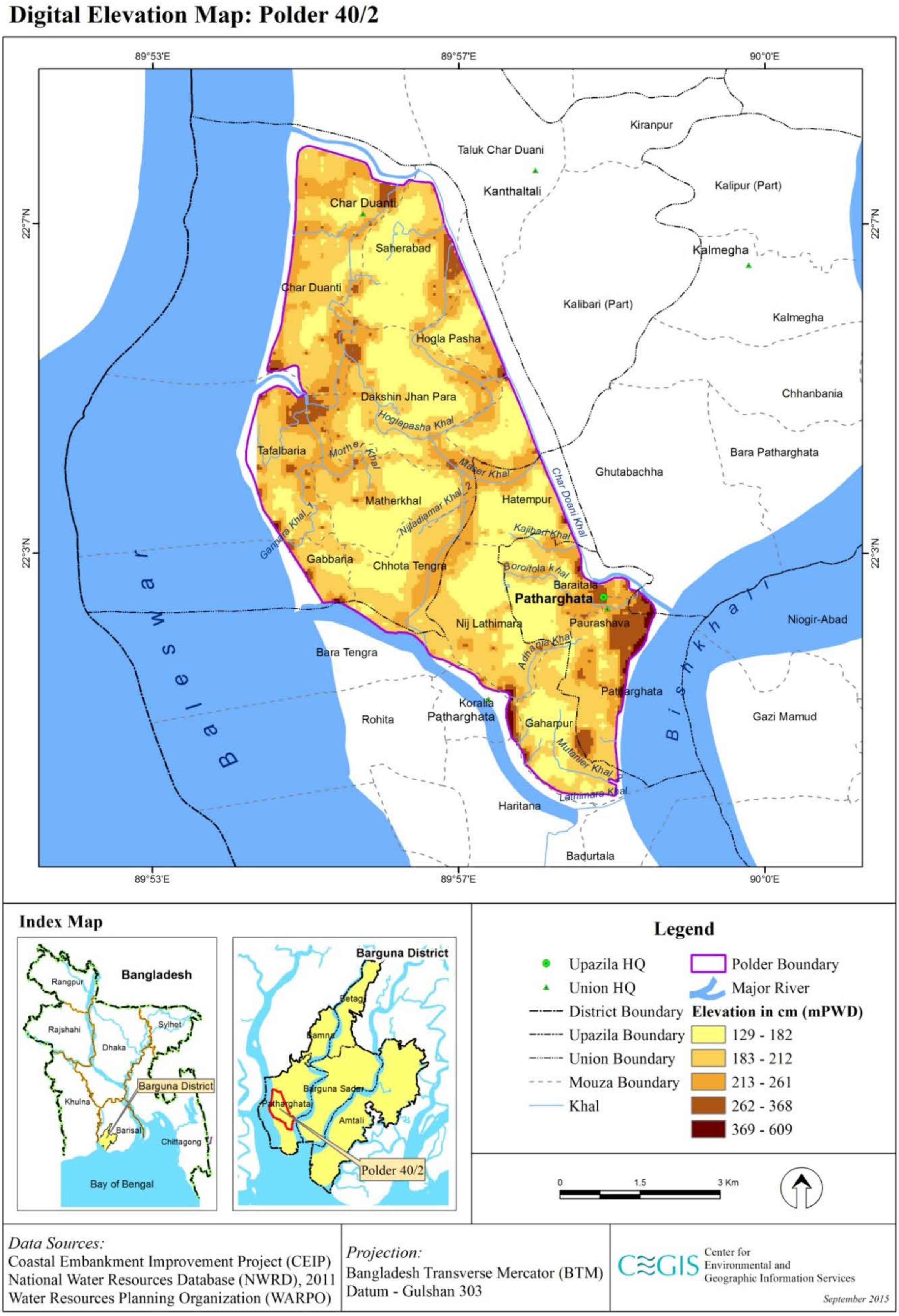
5.1 Physical Environment

5.1.1 Geology

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

5.1.2 Topography

325. The polder 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 1.25 to 2.37 mPWD, with average RL around 1.7 mPWD. From the DEM it is found that around 47% of land in the central portions of the polder has a very low elevation between 1.25 to 1.65 mPWD, whereas 43%, mostly in the periphery, has elevation between 1.65 to 2.00 mPWD. The rest 10% land area has an elevation above 2.00 mPWD. So, a radial topographic trend is observed, as most of the land elevations at the polder periphery are higher than those of the central areas. **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: Land Elevation of Polder-40/2

5.1.3 Seismicity

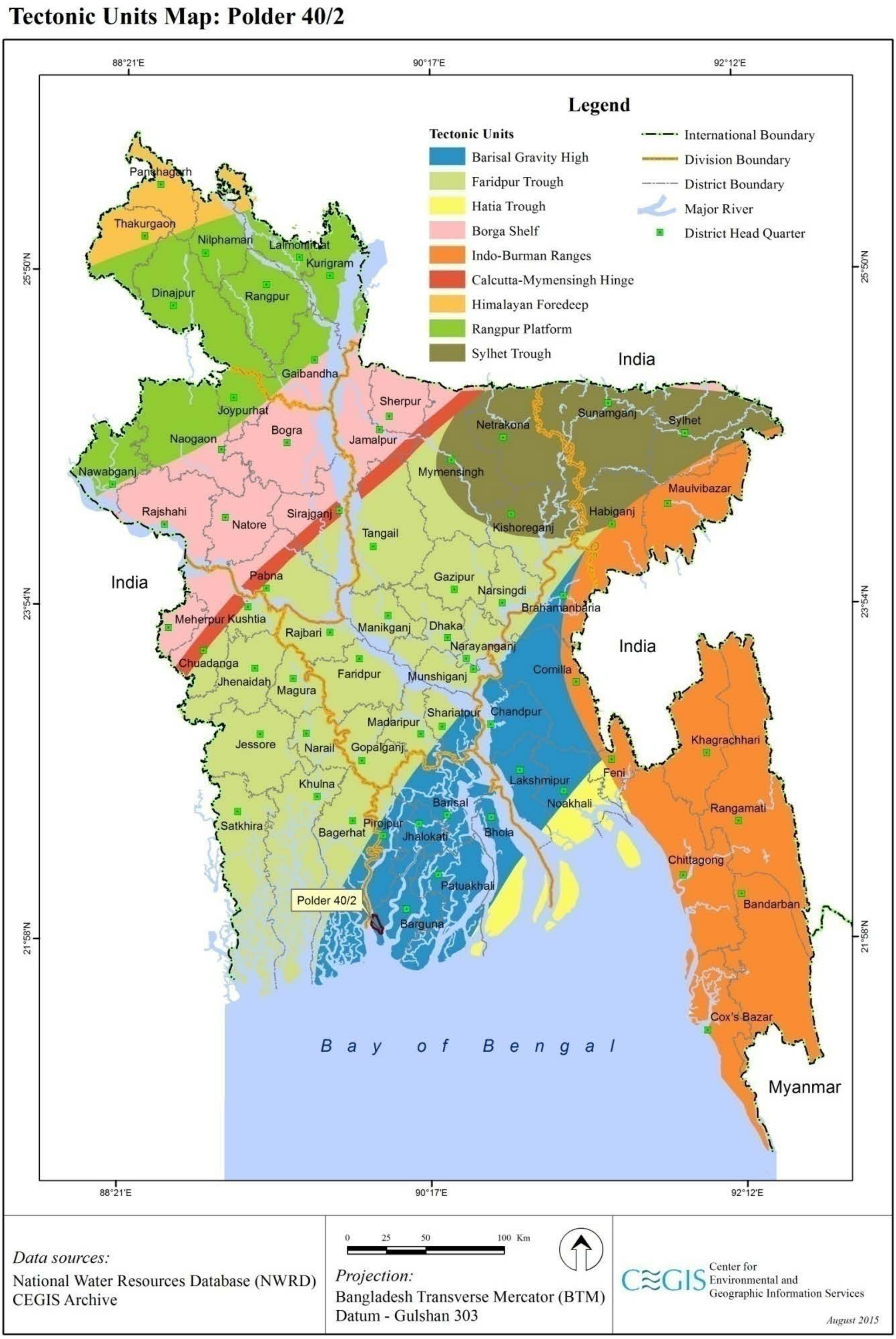
326. Bangladesh is one of the seismically active regions of the world, experiencing numerous earthquakes since last 200 years. Geographical location of Bangladesh has made it ideal suited for natural disasters like earthquake. Tectonic framework of Bangladesh and adjoining areas indicate that Bangladesh is suited adjacent to the plate margins of India and Eurasia where devastating earthquakes have occurred in the past. Depending on the geological structure, Geological Survey of Bangladesh (GSB) has prepared a seismic zoning map of Bangladesh in 1979 dividing the country into three generalized seismic zones: Zone-I, Zone-II, and Zone-III (Map 5.3). Accordingly, the Polder- 40/2 occupies Zone-III, which is characterized by Low earthquake prone site and has a basic seismic coefficient of 0.04g and the polder is relatively safer (seismically quiet) side. **Map 5.2** shows the seismic zone map of the study area.

327. Moreover, the Polder area is located inside the Barisal Gravity High, which is a basement controlled fault zone probably represents through the Swatch of no Ground the north-easterly extension of the continental-margin-flexures of the east coast of India, which have resulted in the initial breakup of the Gondwanaland.

328. **Map 5.3** represents the tectonic units available in Bangladesh and the location of the Polder area (within the Barisal Gravity High).

329. Therefore, it can be inferred that in consideration of both seismicity and stratigraphy, the Polder area belongs to a relatively safer (seismically quiet and tectonically stable) side.

Map 5.2: Earthquake Zones of Bangladesh and location of Polder 40/2



Map 5.3: Tectonic Units Bangladesh and location of Polder 40/2

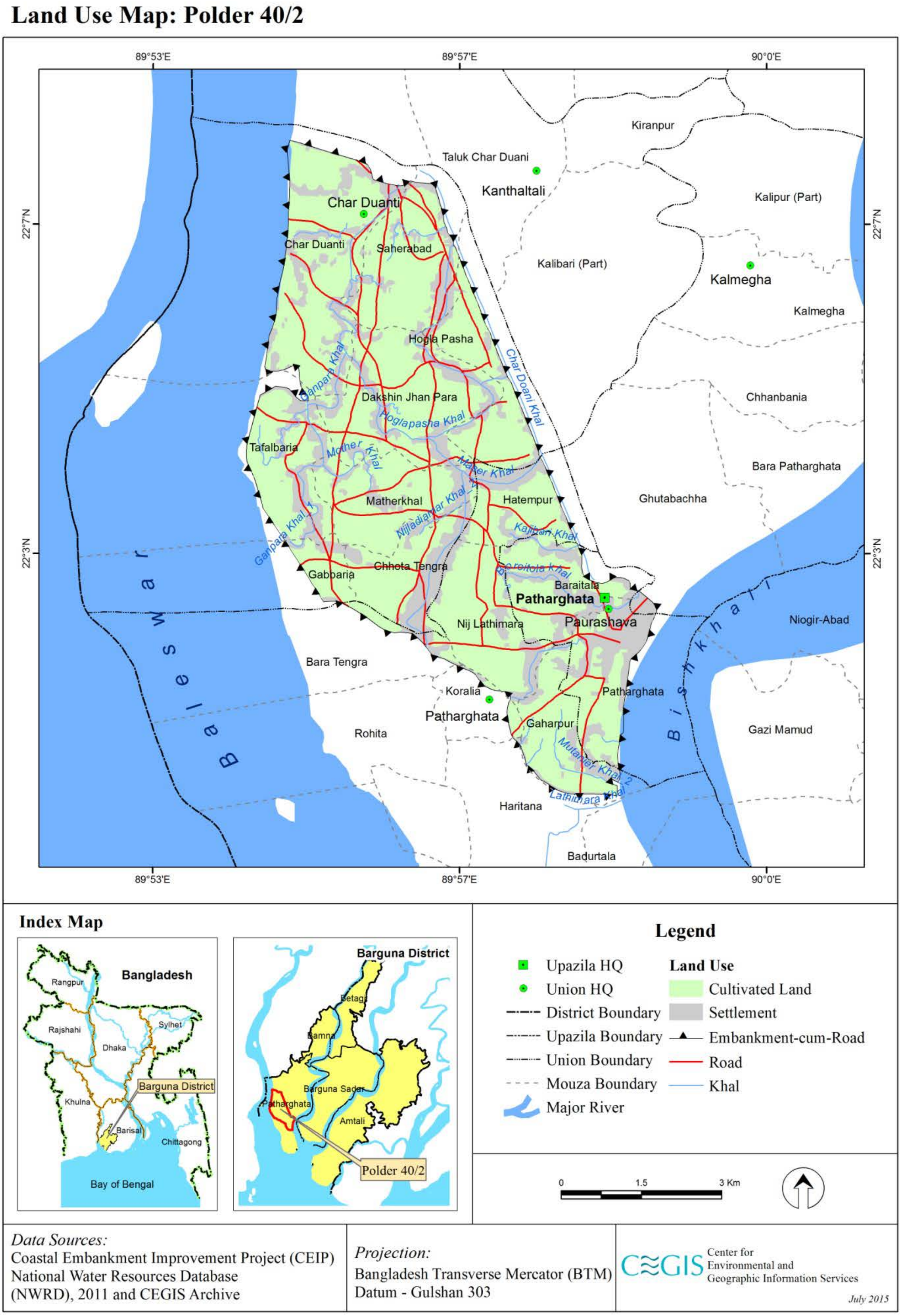
5.1.4 Landuse

330. The information on land use has collected from the feasibility report (Agriculture), CEIP; 2012 and validated during field visit, June; 2015. The gross area of the polder is about 4,453 ha, of which 3,300 ha is available for cultivation. The net cultivable area (NCA) is 74% of the total area. The single, double and triple cropped area is 61%, 24% and 15% of the NCA respectively. Detailed data on existing land use in the polder is presented in **Table 5.1** and **Map 5.4.**

Table 5.1: Present land use of the polder area

Land use	Area (ha)	% of Gross Area
Agriculture land/Net cultivable area(NCA)	3,300	74
Single crop	2,023	45
Double crop	785	18
Triple crop	492	11
Others (Settlements, Water bodies)	1,153	26
Gross area	**4,453**	**100**

Source: Feasibility report (agriculture), CEIP, 2012 and field information, June; 2015



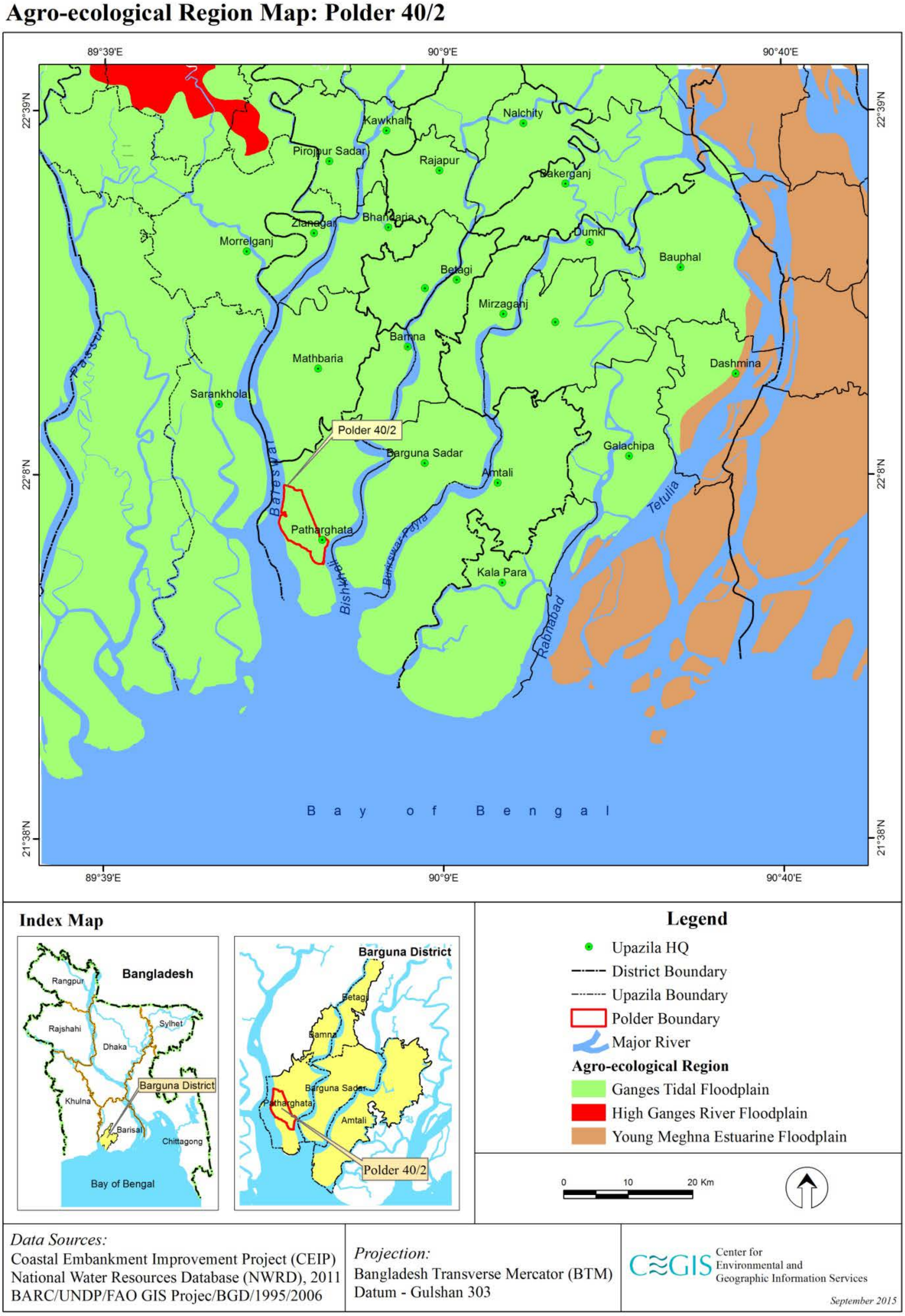
Map 5.4: Land Use Map

5.1.5 Soil Properties

Agro-Ecological Zone (AEZ)

331. There are 30 agro-ecological regions and 88 sub regions 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 potential (FAO/UNDP,1988, BARC,2012). The Polder-40/2 comprises of Agro-ecological zone-13 **(Map 5.5),** namely: Ganges Tidal Floodplain (AEZ 13).

332. This region occupies an extensive area of tidal floodplain land in the south-west of the country. The entire Polder-40/2 area is covered by this agro-ecological zone. Baleswar and Bishkhali River bound the polder. The greater part of this region has smooth relief having large area of salinity. There is general pattern of grey, slightly calcareous, heavy soils on river banks and grey to dark grey, non calcareous, heavy silty clays in the extensive basins. Acid Sulphate soils also occupy significant part of the area where it is very strongly acidic during dry season. In general, most of the top soils are acidic and sub-soils are neutral to slightly alkaline. General fertility level is high with low to medium organic matter content and very high CEC and K (Potassium) status. There are limitations of high exchangeable Na and low Ca/Mg ratio. The Zn (Zinc) status is low to medium and the B (Boron) and S (Sulphur) status is medium to optimum.



Map 5.5: Agro-ecological Zone (AEZ) of the Polder area

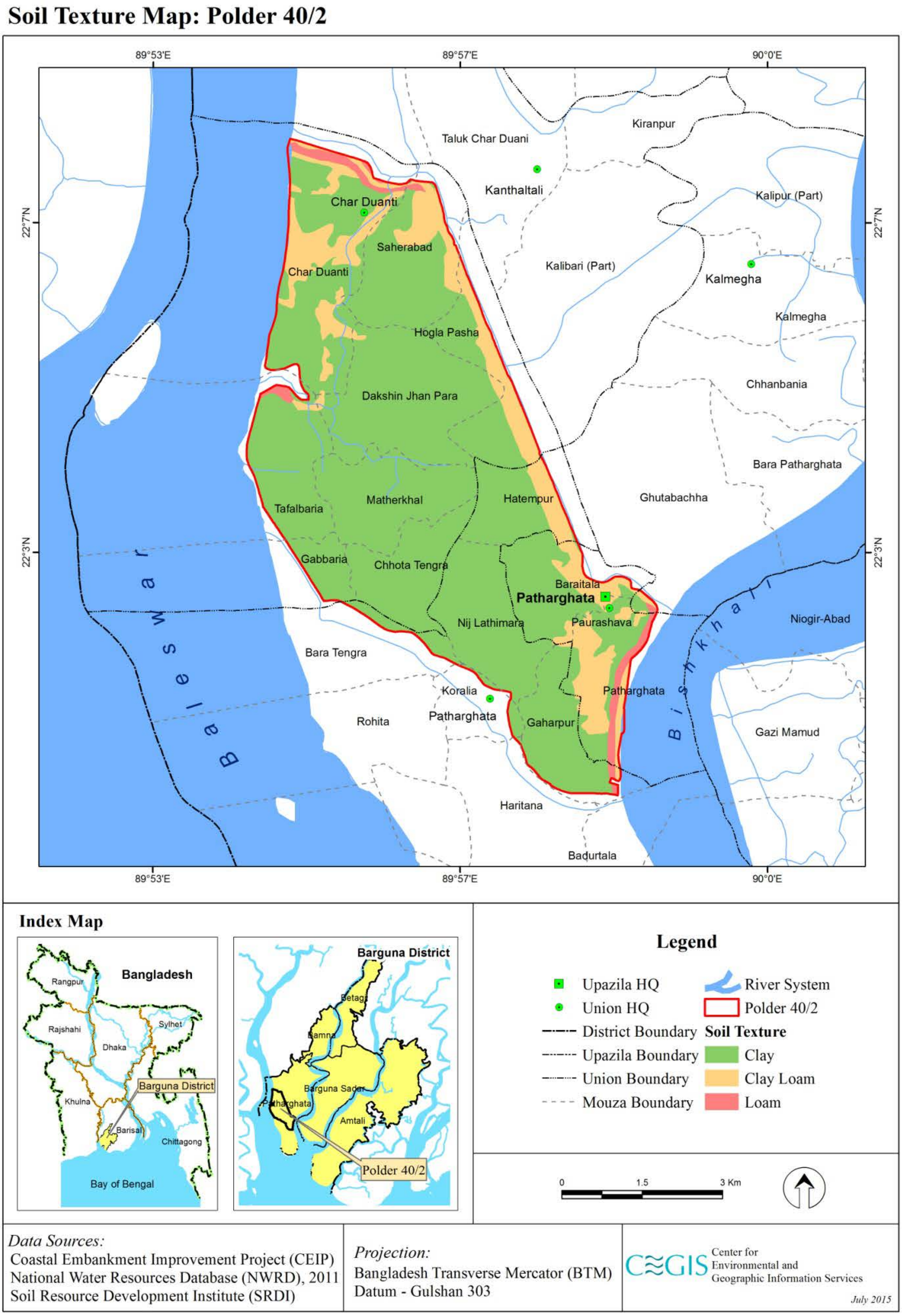
Soil Texture

333. 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 field management. Detailed distribution of top soil texture within 15 cm depth is presented in Table 5.2 and Map 5.6.

Table 5.2: Soil Texture of the Polder Area

Soil Texture	**Area(ha)**	**% of NCA**
Clay	2,721	82
Clay loam	511	16
Loam	68	2
Total	**3,300**	**100**

Source: CEGIS Assessment from SOLARIS–SRDI, 2006



Map 5.6: Top soil texture map of the Polder- 40/2 area

Land type

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

335. Around 19%, 33%,47% and 1% of the net cultivable area (NCA) of the polder area (Polder- 40/2) fall under flood free land/high land, high land, medium high land and medium low land respectively. The distribution of land types under Polder- 40/2 is presented in **Table 5.3.**

Table 5.3: Area under Different Land Types

Land Type	Description	Flooding depth(meter)	Flooding characteristics	Area(Ha)	% of NCA
FF	High land	(<0)	Non-flooded to intermittent	631	19
F_0	High land	(0.0-0.3m)	Non-flooded to intermittent	1,079	33
F_1	Medium Highland	(0.3-0.90m)	Seasonal	1,554	47
F_2	Medium Low Land	(0.90-1.80m)	Seasonal	36	1
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	**3,300**	**100**

Source: IWM, 2015

5.1.6 Climate

336. The following sections provide analyses on meteorological information (rainfall, temperature, relative humidity, wind speed and sunshine hour) of the polder area.

Rainfall

337. The average monthly rainfall variation at Khepupara BMD station (from 2000 to 2013) has been shown in Figure 5.1. The hyetograph shows that the highest and lowest values of rainfall are usually observed during the months of July (663 mm) and December (2 mm) respectively. The mean annual rainfall is 2,770 mm and varies from 1820 mm to 3470 mm. In addition, for better representation of the real world situation, values on rainfall from 2000 to 2008 have also been collected from the BWDB station located at Patharghata. This station falls under only one Theissen polygon and the peak rainfall at this station is 622 mm in July, which is almost equal to the maximum monthly rainfall observed in the Khulna BMD station in July.

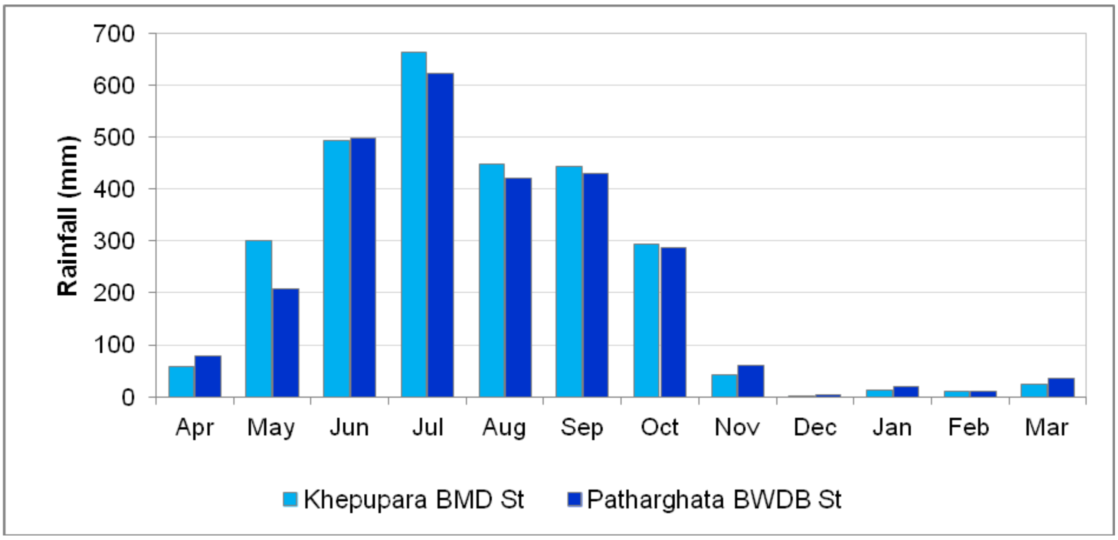


Figure 5.1: Average Monthly Rainfall at Patharghata

Temperature

338. The mean annual temperature is around 26.5^{0}C and mean monthly minimum and maximum temperature varies from 13.3^{0}C to 33.5^{0}Cat Khepupara BMD station (from 2000-2013). Mean maximum temperature fluctuates between 26.0°C to 33.5°C over the year with the highest temperature experienced in the month of May. The minimum temperature varies between 13.3°C to 26.5°C. The lowest temperature is experiencedin the month of January. The results of monthly average, maximum and minimum temperature variations of the polder are shown in **Figure 5.2.**

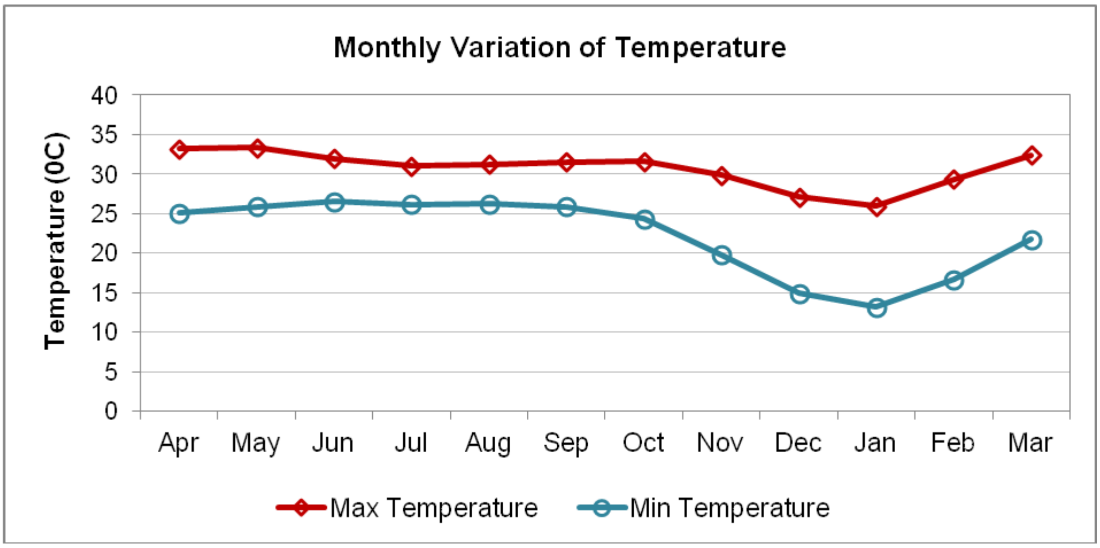


Figure 5.2: Average of Maximum and Minimum Temperatures at Khepupara BMD Station

Relative Humidity

339. Figure 5.3 below shows the variation of monthly relative humidity, as recorded by the Khepupara BMD station (2000~2013). A significant fluctuation has been observed as relative humidity values, which starts to increase from March due to the increase in atmospheric water vapors 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. The relative humidity are usually higher in the coastal areas than the other parts of

the country. This is because of having a greater extent of water bodies, leading to increased evaporation.

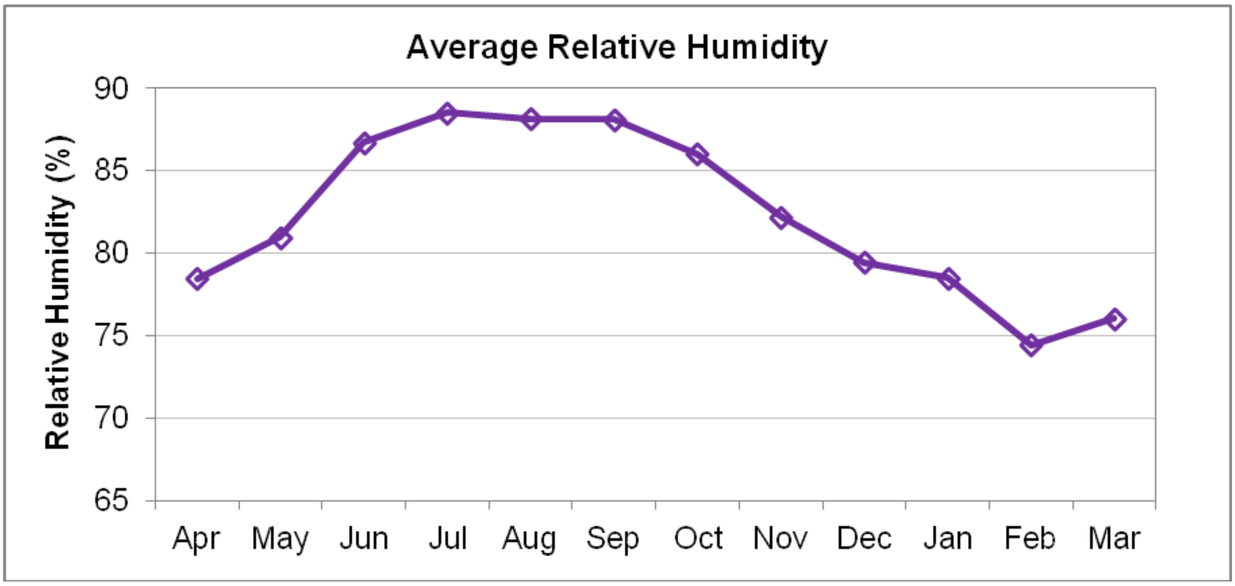


Figure 5.3: Average Relative Humidity at Khepupara BMD station

Wind Speed

340. Figure 5.4 below 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 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[10] for Khulna is 260 kph.

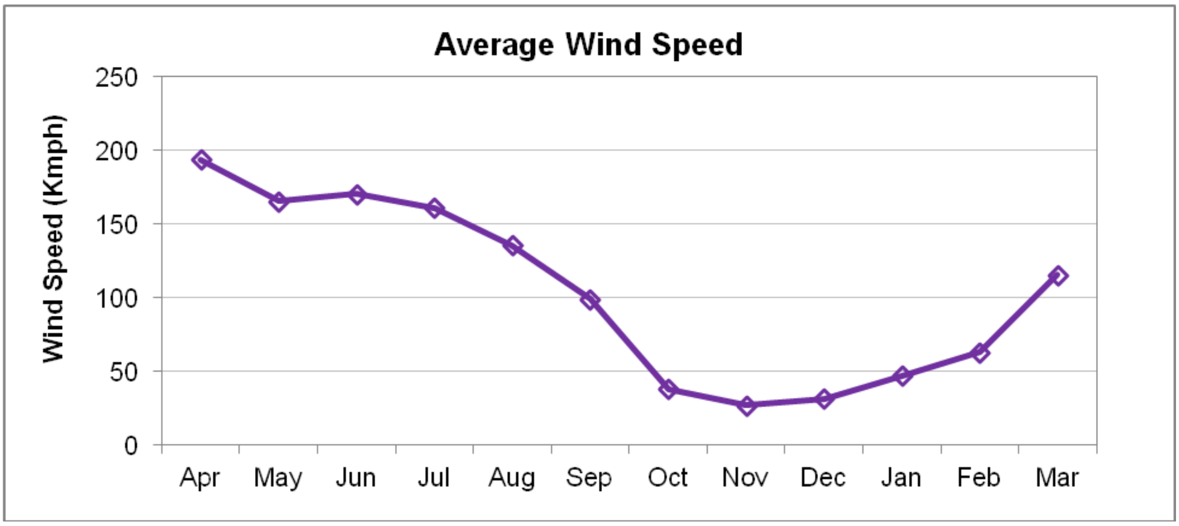


Figure 5.4: Variation of Average Wind Speed at Khepupara BMD station

[10]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)

Sun-shine Hour

341. 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 drop below figure 5.5.

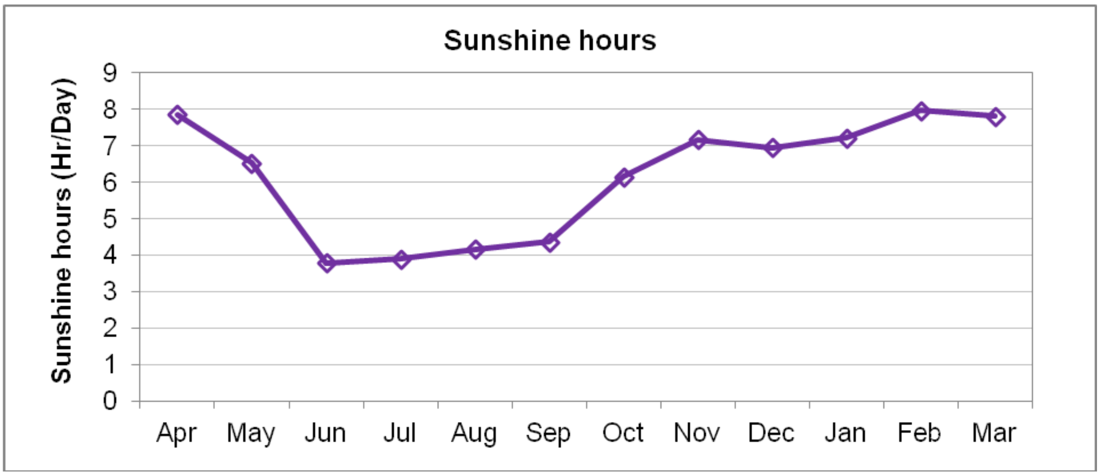


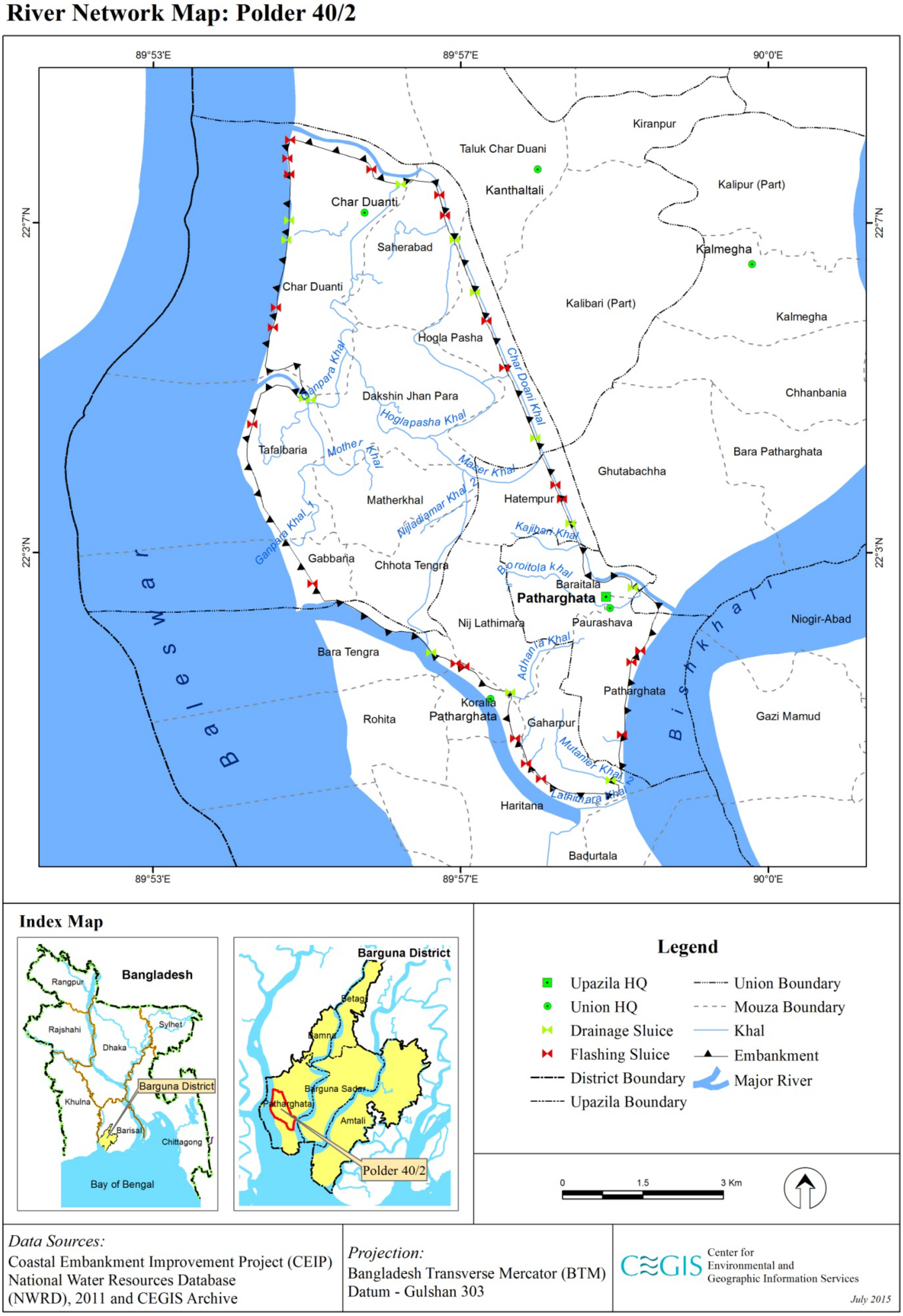
Figure 5.5: Monthly Variation of Average Sunshine Hours at Khepupara BMD Station

5.1.7 Water Resources System

342. 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

343. The Polder is surrounded by Baleswar River in the west and Bishkhali in the southe-east corner. These two rivers are directly fed by oceanic tides. The polder area undergoes diurnal tidal influence. Apart from these prominent rivers, Lathimara Khal (south) and Charduani-Patharghata Bharani Khal encircle the polder (northeast). In addition, there are around 50km of watercourses inside the polders, known as khal. The river system of the area is shown in the **Map 5.7.**



Map 5.7: Water Resources System of the Polder Area

Photo 5.1: Bishkhali River

Photo 5.2: Baleswar River

Hydrological Connectivity

344. During high tide, water flows from the Bay of Bengal to the peripheral Baleswar and Bishkhali rivers, which feed the peripheral Charduani-Patharghata Bharani khal and Lathimara khal. There are also a number of khals situated within the polder, which are supported by these peripheral rivers, and khals. The keoratola khal, Gyanpara khal etc. are the distributaries of the Baleshwar and maintain the water resources functions of the river. On the other hand, Charduani khal, Hoglapasha khal, Munshiganj khal, Boroitola khal, Patharghata khal etc. are supported by the tributaries namely, Bishkhali River and Charduani-Patharghata Bharani khal. The internal watercourses of the polder facilitate the flow circulation inside the polder, when needed. During low tide, tidal water recedes through the peripheral watercourses and reaches the Bay of Bengal.

345. 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 surplus water out of the polder. However, in recent years, due to the damage of a number of gates some khals carry saltwater during dry season.

5.1.8 Hydrological Settings

Surface Water Level

346. The surface water levels of BWDB station at Patharghata (Bishkhali River) from 2000 to 2013 has been analyzed (**Figure 5.6**). Water levels during high tide range from 1.73 to 2.52 mPWD. On the other hand, the low tidal water levels range from 0.2 to 0.48 mPWD.

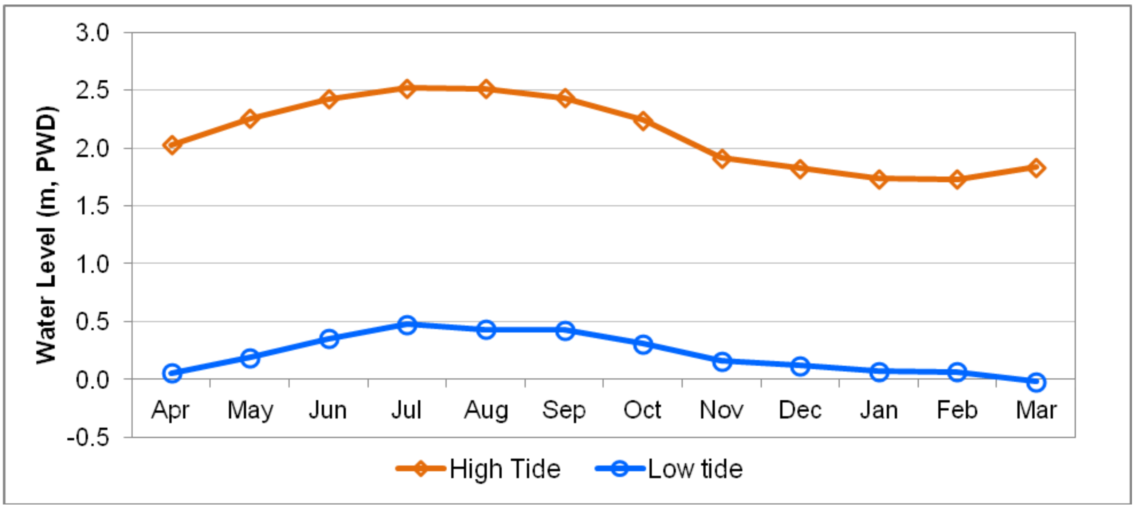


Figure 5.6: surface water level at Patharghata (Bishkhali River)

347. During field investigation, all of the major khals were identified as perennial water course[11], thus carrying sufficient water during all seasons. Around 60% khals namely, Keoratola khal, Gyanpara khal, Patharghata khal, Charduani khal, Munshiganj khal carry water upto 1.52-2.13 meter depth during dry season and rest of the khals (Takar Khal, Kajibari khal etc.) carry reduced amount of flow ranging from 1.22-1.83 meter deep.

Ground Water Table

348. Monthly variations in ground water levels for year 2000 - 2013 have been plotted in **Figure 5.7** for the ground water observation well, BAG005 (at Patharghata). The variation pattern of the GWT values are for BAG005 station fairly high, with lowest and highest values found in April and September respectively, as observed in the following figure:

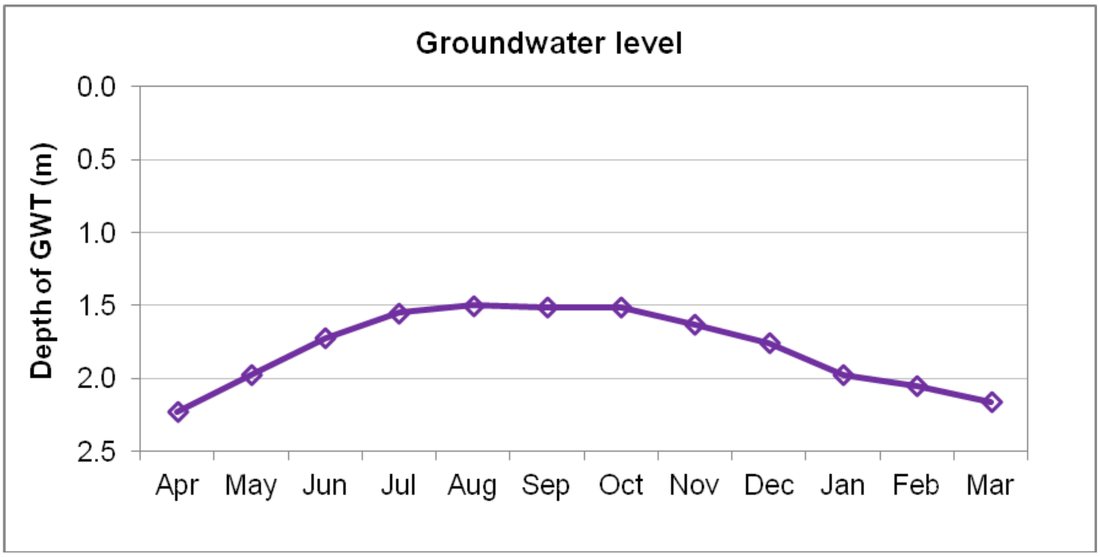


Figure 5.7: Average Monthly Variations of GWT

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

5.1.9 Hydro-geological Profile and Aquifer Conditions

Aquifer System

349. The aquifer system in Bangladesh is categorized mainly in three groups and are; a) the upper aquifer or composite aquifer, b) the main aquifer and c) deeper aquifer. However, the study area (e.g. Polder-40-2) has fallen under coastal area, which belongs to deeper aquifer of the country. The brief characteristics of this aquifer system is described below:

350. The deeper aquifer: The deeper unit is separated from the overlying main aquifer by one or more clay layers of varied thickness and extent. Deep aquifers are generally based on depth and in some areas the aquifers whose water have no access to water vertically upward or downward but flows very slowly along the dips and slopes of the aquifers (Figure 5.7-a). This water bearing zone comprises of medium to coarse sand in places inter bedded with fine sand, silt and clay. At present water are being exploited in limited quantity from the water bearing formations deeper than 150-200 m of coastal zone. Large-scale extraction is not encouraged in the coastal areas due to the every possibility of sea-water 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 (a). From the Table 5.4 (a) it has been observed that the lithology of the coastal aquifer is grey medium to coarse sands with mostly confined to semi-confined in nature and with transmissivity rate of 1,000-3,000 m^2/day.

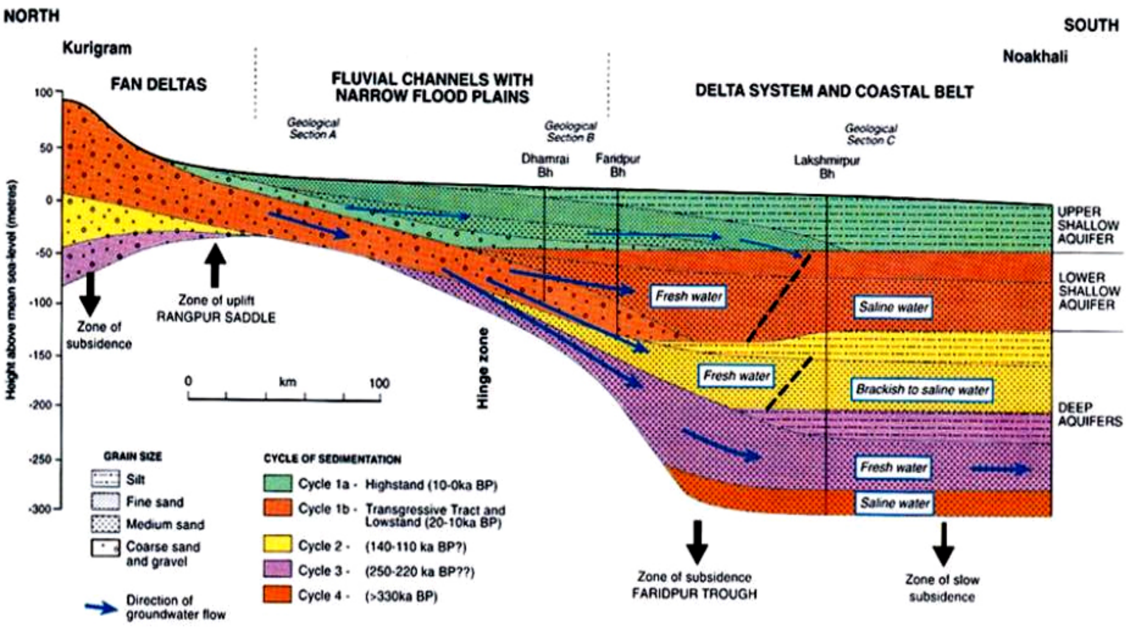


Figure 5.7-a: Hydrogeological Cross Section from North to South across Bangladesh.

Table 5.4-a: The Main aquifers in Bangladesh, their lithology, relative ages and transmissivities

Aquifer	Lithology	Age	Transmissivity (m^2 per day)
Brahmaputra-Teesta Fan and Brahmaputra basal gravels	Grey coarse sand, gravel and cobbles	Late Pleistocene and Holocene	3,500-7,000
Ganges, Lower Brahmaputra and Meghna main channels	Grey coarse to medium sands and gravel	Late Pleistocene and Holocene	3,000-5,000

Aquifer	Lithology	Age	Transmissivity (m^2per day)
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

Further the lithology of coastal aquifer is presented in Figure-5.7 b below:

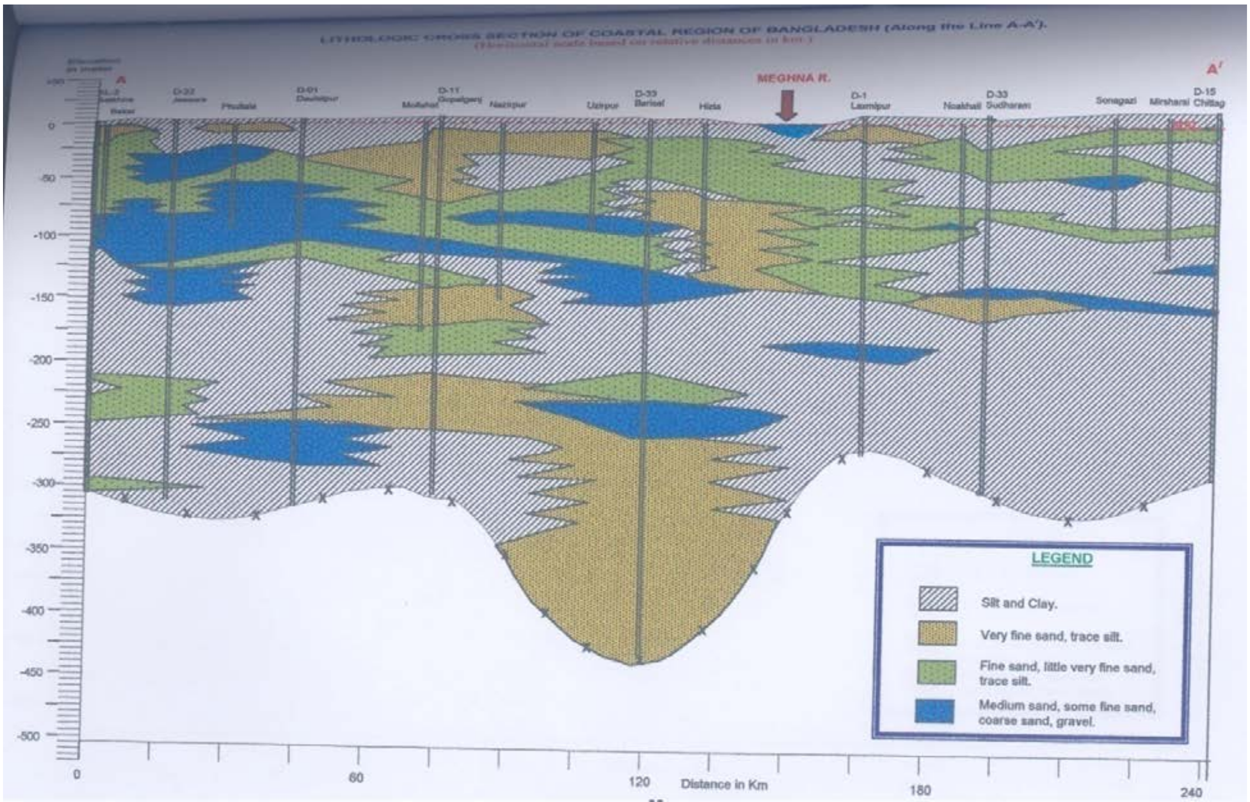


Figure 5.7-b: Lithological Cross-section of the coastal aquifer

351. Furthermore, based on the lithology and other characteristics of the aquifer the entire country has divided into 15 potential groundwater development zones (Figure 5.7 c). The study area occupies zone N (Table 5.4-b) which has characterized as Floodplains of GBM with brackish & saline water problems.

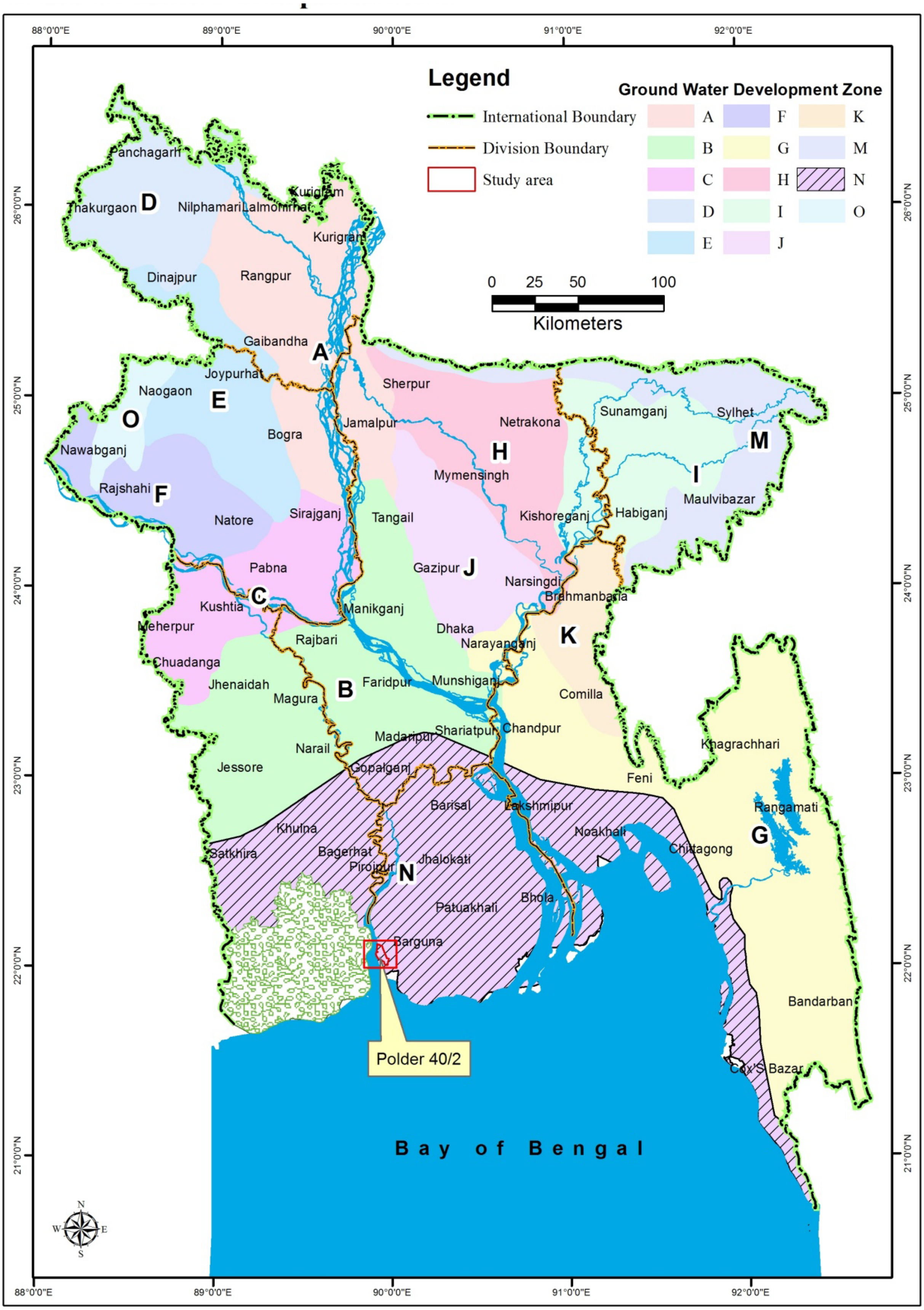


Figure 5.7-c: Potential groundwater development zones

Table 5.4-b: 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 cusecs 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 cusecsfor 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 cusecs	Suitable for deep wells
L	Chittagong & Noakhali	Piedmont deposits & estuarine deposits	T= 40 m^2/day	Not favouable for extensive withdrawal
M	Hilly areas of Sylhet& Mymensingh& Ctg. Hill Tracts	Tertiary sediments	Low transmissivity	Not favouable for extensive withdrawal
N	Coastal areas of Barisal, Patuakhali, most of Khulna, Noakhali & Chittagong	Floodplains of GBM	1,000-3,000m^2/day	Brackish & saline water problems
O	Western Rajshahi district	Thick Madhupur clay on the top part with thin sand layers	---	Limited scope for development

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

352. The term salinity intrusion specially describes the situation where seawater displaces or mixes with freshwater within an aquifer in response to change in the hydro- geological environment. Salinity intrusion occurs because of seawater encroachment into coastal aquifer. If groundwater gradients are reduced (it may happen in coastal aquifer where excess pumping has disrupted the hydraulic equilibrium), the outflow of freshwater is reduced and denser saline water may displace the fresh water within the aquifer. Seawater intrusion mechanism and Lateral intrusion mechanism of coastal aquifer has been shown in Figure 5.7-d and Figure5.7-e below:

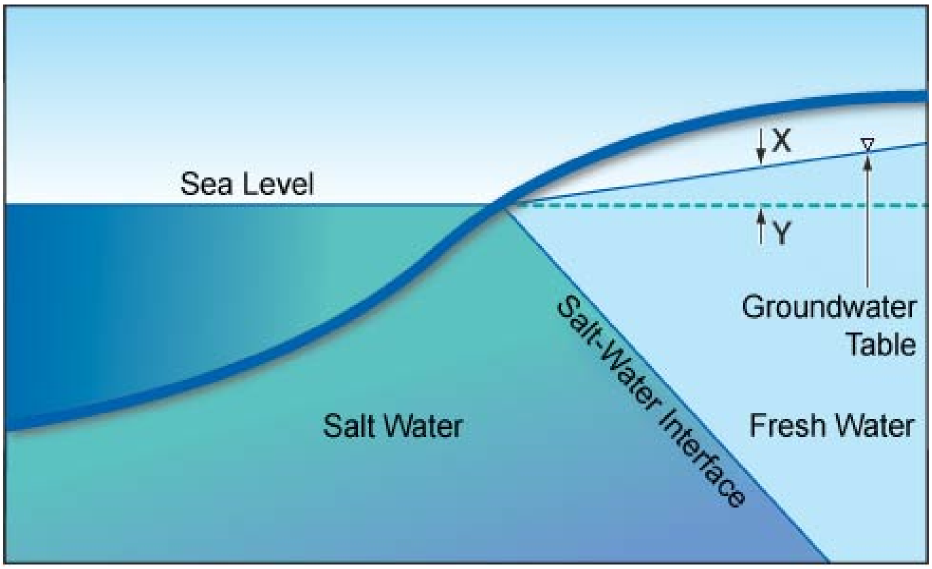


Figure 5.7-d: Seawater intrusion mechanism for homogeneous and unconfined coastal aquifer

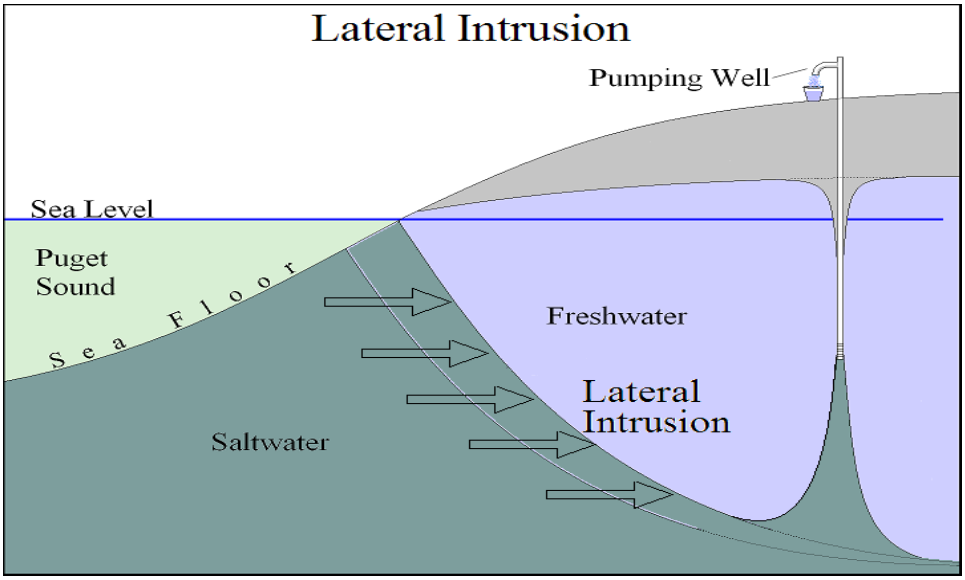


Figure 5.7-e: Lateral intrusion mechanism of coastal aquifer

353. 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; they 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.
- Water Resources Issues and Functions

Tidal and Storm Surge Flooding

354. Local people opined that the some locations of peripheral embankment do not offer protection from regular tidal flooding effectively. Especially the people at Charduani and Tafalbaria recounted the endless hardships they have to go through in the month of July to October. Some of the water control structures are subjected to leakage; the amount of flow entering the polder manages to flood some 10% of the polder area. Local people also alleged that there was major storm surge flooding in Polder- 40/2 during Aila (2009) and Sidr (2007).

Drainage Congestion and Water Logging

355. No major incident of drainage congestion and water logging has been observed during the field visit. Local people also reported of no such issue inside the polder area. All of the major khals have the capacity to accommodate water, even during heavy rainfall.

Navigation

356. Polder- 40/2 is located beside Baleswar River at the west and Bishkhali River at the southeast corner. Both the rivers are large rivers in terms of their depth and width. The rivers remain navigable throughout the year and can be used for transportation purposes during construction phase of the project. The internal khals/lakes are not suitable for navigation of large vessels but can accommodate small to medium boats. Especially Nijlathimara khal, Gyanpara khal and Mutainer khal are wide and deep enough to carry trawlers. There is a fish-landing center at Gyanpara on the bank of Gyanpara Khal. Presently, the local people conduct the loading and unloading of fish and other commodities by head load from outside of the polder. Local people opined that navigation connectivity between Baleswar River and Gyanpara khal would allow the carriage of goods by boat upto Gyanpara landing center.

Water Use

Domestic:

357. The standard value of average daily demand of water for domestic and drinking purposes in rural areas is considered as 50 lpc (Ahmed and Rahman, 2010). However, the actual status of drinking water in some of the coastal polders is very poor. During field survey in Polder- 40/2, it was found that the average daily domestic use of water was around 30 lpc. The study found that around 1,240 m^3 of water is consumed daily by the total number of 41,200 people living in the polder. Local people opined that they prefer filtered pond water as drinking water sources to meet up their daily requirements. This pond water is also used for other domestic chores.

Irrigation:

358. The local farmers in Polder area cultivated T Aus and some vegetables in Kharif-I (March-June) season; T Aman in Kharif-II season (July-October); and Boro, wheat, pulses, spices, potato and some winter vegetables in Rabi (November-February) season. Boro is the main irrigated crop, which is cultivated in about 75 ha of land by using surface water through LLP. However, farmers applied one, two, or three supplementary irrigation in wheat, potato and winter vegetables crop fields to the high land and medium high land areas. Only LLP are used for supplementary irrigation. Farmers normally do not practice supplementary irrigation in T. Aus and T. Aman crop fields. The local farmers reported that they use about 150 to 200 cm irrigation in their Boro crop fields and 20-40 cm in wheat, potato and winter vegetables

crop fields. Using these standards of water requirements, the study infers that the crops use approximately 2.41 Mm3 of irrigation water.

5.1.10 River Morphology and Dynamics

Riverbank Erosion

359. There are two erosion hotspots namely, Dakkhin Patharghata and Tafalbaria along the peripheral embankment of the polder. The location at Dakkhin Patharghata is at the southern corner of the polder, where the Bishkhali River flows into Lathimara khal. Local people informed that, the location is unstable and is being eroded for some 5~6 years. During field inspection, embankment breach was observed in that location and there was no setback distance along the riverside floodplain. A key informant living at Patharghata informed that the Bishkhali River course frequently move its way in the past, for which a substantial portion of lands have already been eroded.

360. The other erosion hotspot at Tafalbaria was inspected as well. Similar erosion features and morphological instability were also observed in that area, but sufficient riverside setback distance observed in this location.

Photo 5.3: Erosion point at Dakkhin Patharghata

Photo 5.4: Erosion point at Dakkhin Tafalbaria

5.1.11 Environmental Quality and Pollution

Air Quality

361. The national standards for air quality are given in **Table 5.5-a.**

Table 5.5-a: 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

362. **Table 5.5-b** shows the air quality data measured inside the polder inPatharghata 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 except for $PM_{2.5}$ values for Bangladesh (refer Table 5.5-a). The observed $PM_{2.5}$ level is marginally higher than the Bangladesh National Ambient Air Quality Standard. There isnumerous diesel vehicles mobilizedfor internal communication and some fishing boatsnavigate in the surrounding riivers of the polder. Besides, many boats and ferries aredriven by diesel engines, ply on the surrounding rivers, considered to contribute to the higher concentration ofblack carbon (BC) of Particulate Matter (PM2.5) measured.

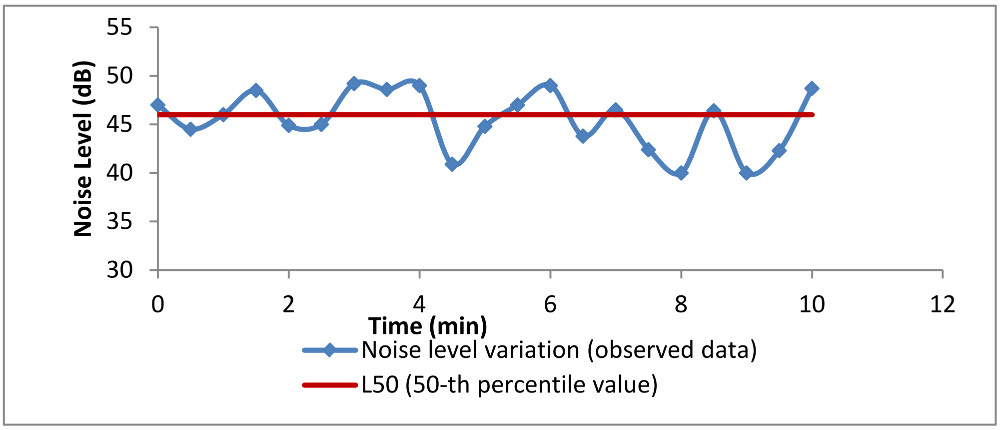
Table 5.5-b: Values of ambient air quality parameters in the project area

Area	**Concentration of micrograms per meter cube (24h average)**				**(µg/m^3) (1h average)**
	PM_{10}	**$PM_{2.5}$**	**BC in $PM_{2.5}$**	**SO_2**	**NO_2**
Patharghata (Polder 40/2)	101	76.1	18.6	<2.0	0.043

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

Noise Quality

363. During field inspection, sound levels were measured at Pashchim Tafalbaria (22º04'29''N) and 89º54'11''E), with a 10 minutes sampling period (Figure 5.8). The L_{50} (50-th percentile value) value was computed with the observed sound levels. For a normal time series distribution of sound levels, L_{50} is assumed equal to Leq, which is the Equivalent Noise Level. In the study area, the L_{50} value was found as 46 dB, which is within the standard Leq value for residential zone set by ECA 1997 (50 dB).



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

Figure5.8: Variation of sound levels for 10 minute sampling period at Pashchim Tafalbaria

Water Quality

364. Four major water quality parameters (pH, TDS, DO and salinity) have been measured during major field investigation in June 2015, from different locations of the study area (Table 5.6-a). The pH values in the inspected surface water sources were higher than the neutral scale (pH=7), which indicates the water in these locations were alkaline. Values of TDS were found very low in the Bishkhali and Baleshwar rivers, but were higherin the

khals inside the polders, which may be caused by the increased siltation of the khals, although TDS contents are quite less than permissible DoE value. Values of DO were mostly found close to the standards set by DoE for both irrigation (5 to 6 mg/l) and fishing (5 mg/l).

365. The surface water samples had no salinity concentrations. But local people opined that in dry season, specifically in the month from February to April, concentration of salinity in drinking and irrigation water is found to be high. According to them, there are some khals (e.g. Charduani khal), where the tidal water enters through the damaged sluice gatescausing salinity concentrationssimilar to those of the feeding rivers. On the other hand, some khals are somewhat protected by water control structures, but still carry some salinity as the high tidal water often leaks through the sluice gates and contaminates these khals (public opinion).

Table 5.6-a: Surfacewater quality during wet season

Location	GPS Reading (Lat-Long)	pH	TDS (ppm)	DO (mg/l)	Salinity (ppt)	Remarks
Charduani Khal	22º07’06.3’’N 89º55’49.3’’E	7.7	479	5.0	0	Inside polder
Takar khal	22º06’42.4’’N 89º56’20.2’’E	7.8	412	5.3	0	Inside polder
Baleswar River	22º07’34.2’’N 89º54’43.8’’E	7.9	230	6.1	0	Outside polder
Lathimara Khal	22°01'59.9"N 89°56'52.9”E	7.5	410	4.9	0	Inside polder
Gyanpara Khal	22°04’57.4”N 89°54’44.6”E	7.7	620	5.2	0	Inside polder
Kajibari khal	22°03’28.3”N 89°57’46.8”E	7.7	570	4.5	0	Inside polder
Bishkhali River	22°01’04.7”N 89°58’07.5”E	7.8	380	5.2	0	Outside polder
DoE Standard Value (Bangladesh)		***6.0-9.0***	***2100***	***4.5-8.0***	**-**	**-**

Source: CEGIS (Test from SRDI and BARIlaboratory), August 2015

366. Surface water quality has also been measured for the same parameters in dry season (February, 2016) as provided in Table-5.6b below for comparison with wet season:

367. 350. Some difference was observed between the water qualities of wet and dry seasons, although no salinity was found during the dry season as well (Table 5.6-b), During dry season it was observed that the pH value has a higher trend in general, indicating increased alkalinity, although they are within permissible limit. Values of TDS were found higher during dry season and their values are wirthin permissible limit althrough. Values of DO found to increased during dry season and were found well above the standards set by DoE, No salinity was found during February even, which may be explained by excess flushing of water due to early rainfall. Although according to lacal people salinity intrusion during dry season affects plant growth.

Table 5.6-b: Surface water quality during dry season

Source of surface water	Location	GPS point	Water quality parameter				
			pH	TDS (ppm)	Temp(°C)	DO (mg/L)	Salinity (ppt)
Kazibari khal	Patharghata	22° 3'28.15"N 89°57'45.98"E	7.8	430	22.5	7.6	0
Maser khal	Maser Khal bazar	22° 4'21.46"N 89°57'21.21"E	7.8	694	22.7	7.4	0
Hoglapasha Khal	Hoglapasha	22° 6'42.40"N 89°56'20.20"E	7.8	909	24.0	6.9	0
Charduani khal	Charduani bazar	22° 7'6.30"N 89°55'49.30"E	8.1	1267	24.3	7.2	0
Baleswar River	Madhya Charduani	22° 6'59.81"N 89°54'39.75"E	8.2	1338	22.6	8.4	0
Bishkhali River	Patharghata	22° 2'21.19"N 89°58'37.49"E	7.9	592	22.5	7.2	0
Gyanpara Khal	Ganpara	22° 4'57.40"N89°54'44.60"E	8.1	1082	22.8	8.1	0
DoE Standard Value (Bangladesh)			***6.0-9.0***	***2100***	***20-30***	***4.5-8.0***	**-**

Source CEGIS (Test from SRDI and BARI laboratory), February, 2016

Soil Quality

351.Soil samples were collected from inner parts of the polder area at Badurtola (22°01'28.3"N, 89°58'7.6"E), Hoglapasha (22°06.55'.8"N, 89°56'11.27"E) and Tafalbari (22°0443.8"N, 89°54'20.8"E) on 21th and 22th June, 2015 for analyzing chemical properties of the soil. The existing cropping pattern is Fallow-Lt. Aman-Mung bean, Fallow-HYVAman-Sunflower and HYV Aus-Lt. Aman-Kheshari at Badurtola, Hoglapasha and Tafalbari sampling site respectively. The sample were collected from top soil (depth: 0-15 cm from surface) and analyzed for Electrical Conductivity (EC), Soil Reaction (PH), Organic Matter (OM), Nitrogen (N), Potassium (K), Phosphorus (P), Sulfer (S) and Zinc (Zn) from laboratory of SRDI, Dhaka and pesticides residues (Carbofurane) from Entomolgy Division, BARI, Gazipur. The results show that organic matter content is very low to low. Soils are deficient in N, and P but the status of K, S and Zn are reasonable. The soils salinity is found very slight to strongly saline. Soil salinity level and pH range varies from 2.1-13.3 ds/m and 7.0-7.5 respectively among the soil sampling sites. The soil quality test results with methods by location are presented in **Table 5.7**.The standard for physico-chemical properties of soil is provided in Appendix-3.

Table 5.7: Chemical Properties of Soil on Agriculture Land

Parameters	Unit	Badurtola	Hoglapasha	Tafalbari	Method
EC	ds/m	7.43	13.28	2.09	Glass Electrode
PH	-	7.5	7.0	7.4	Glass Electrode
OM	%	0.62	0.86	1.00	Wet Oxidation
N	%	0.04	0.05	0.06	Kjeldahl distillation
K	meq/100gm	0.23	0.26	0.21	Olsen/ Bray and Kurtz
P	µg/g	4.74	5.20	5.37	NH4OAc
S	µg/g	94.05	72.50	20.38	CaH2PO4 Extracting

Parameters	Unit	Badurtola	Hoglapasha	Tafalbari	Method
Zn	µg/g	0.92	0.63	0.90	DTPA Extraction
Carbofuran	ppm	0	0	0	Thermo Electron & Perkin Elmer

Source: CEGIS (Test from SRDI and BARI laboratory), August 2015

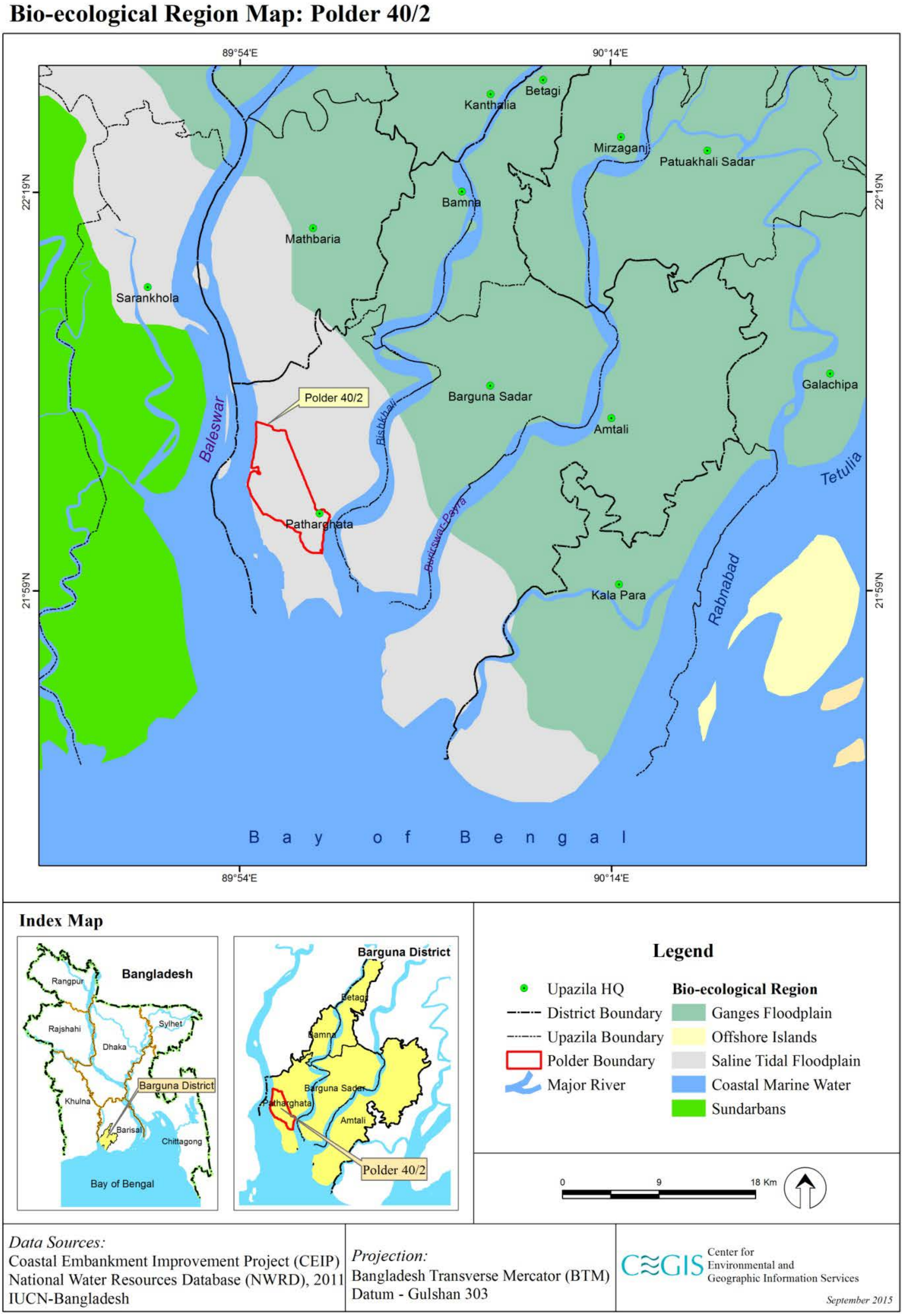
5.2 Biological Environment

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

5.2.1 Bio-ecological Zone

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

369. The polder is located in one of the important bio-ecological zones of the country namely Saline Tidal Flood plain **(Map: 5.8).** A brief description of ecological characteristics of this bio-ecological zone is described below:



Map 5.8: Polder inside the Bio-ecological Zones of Bangladesh

The Saline Tidal Floodplain

370. Saline tidal floodplain has a transitional physiography, which is located in the administrative district of Satkhira, Khulna, Bagerhat, Jhalakathi and Barguna. It has a low ridge and basin relief, criss-crossed by innumerable tidal rivers and creeks. Except for the Sundarban, the floral diversity of this zone is similar to those of adjoining areas. Innumerable indigenous weeds grow in beel areas. Several types of palm and bamboo clumps grow in almost all the villages. The zone supports different types of gamebirds and migratory birds for having mangrove vegetation, the network of rivers and expanse of beels.

5.2.2 Ecosystems

371. Ecosystems of the polder are divided into two broad classes according to habitat types. Those are, a) Terrestrial Ecosystem and b) Aquatic Ecosystem. Each broad class further divides in different ecosystems. The polder area supports different type of habitat with many species of flora and fauna including other wildlife species **(Figure 5.9).**

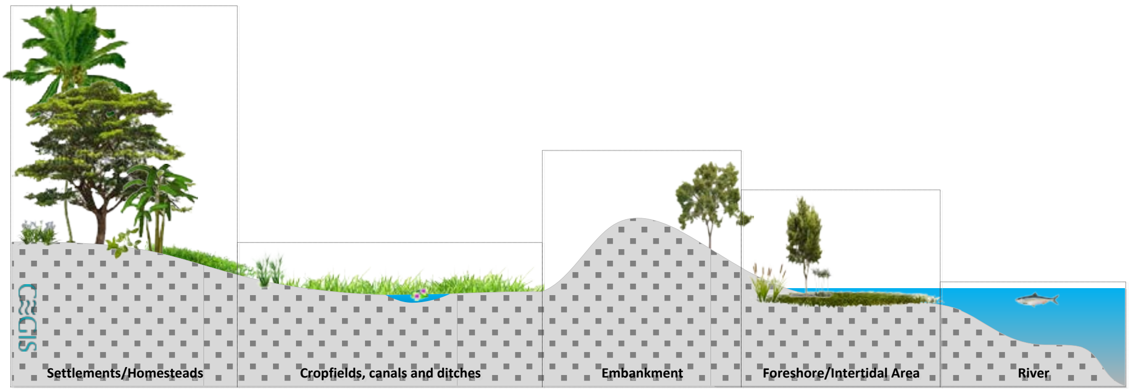


Figure 5.9: Typical Ecosystem patterns of the polder

Terrestrial ecosystems

372. Major types of terrestrial ecosystem of this polder are: i) Settlement/ homesteads, ii) Agricultural land and iii) Roads and Embankment. Each of the ecosystem contains two types of vegetation like: 1) Natural vegetation and 2) Human influenced vegetation. Natural vegetation includes timber areas, grassland and other natural habitats. Human influenced vegetation includes homestead gardens, plantation, cropland and cultivated habitat.

Photo 5.5: Part of a homestead vegetation at Uttar Gawharpur village

373. Homestead ecosystems: Considering vegetation diversity, density as well as biological productivity, homestead is the major type of terrestrial ecosystem. Homestead vegetation of this polder is dominated by species like Rain tree (Samanea saman), Narikel (Cocos nucifera), Supari (Areca catechu), Khejur (Phoenix sylvestris), Mahogani (Swietenia mahogoni) etc. All these species are human influenced plantation for meeting foods, fuel and timber demand and possess up canopy of the vegetation layer. Jiga/Kafila (Lanea coromandelica) is a commonest floral species that usually used for fencing of the settlement boundaries. On the other hand, remarkable number ofTaal (Borassus flabeliffer) have been found to exist on homestead platform likes as well as internal roadsides. Kola (Musa Spp.) is the prominent fruit yielding plant that occupies a staple amount of vegetation coverage. Most of the undergrowth vegetation are natural and influenced with rainfall and tidal effects, whichpersists through small tributaries of internal canals and ditches. The representative floral species according to canopy height of the homestead vegetation have been illustrated in **Table 5.8**.

Table 5.8: Major plant species in different layers of homestead vegetation

Layer	Height (m)	Plant species
Super	>15	Raj Koroi *(Albizzia richardiana)*
		Rendi Koroi *(Albizzia lebbeck)*
		Taal *(Borassus flabellifer)*
Upper canopy	14-12	Narikel *(Cocos nucifera)*
		Bansh *(Bamboosa spp)*
		Khejur *(Phoenix sylvestris*)
		Mehogoni (Swietenia mehogani)
		Supari *(Areca catechu)*
Lower canopy	11-8	Akashmoni *(Acacia moniliformis)*
		Jaam *(Syzigium cumini)*
		Kanthal *(Artocarpus heterophyllus)*
Upper bole	7-5	Gab *(Diospyros blancoi)*
		Aam *(Mangifera indica)*
		Jamboora *(Jamboora 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)*

Source: Field Visit, June 2015

374. Homestead vegetation supports numerous number of wildlives like mongoose, jackal, monitor lizards, various local avifauna as well as amphibians. (Wildlife composition of the polder area is described in the next section).

Photo 5.6: Dabur *(Cerbera odollam)* came from mangrove ecosystem, now are habituated with homestead vegetation inside the polder

Photo 5.7: Akanda *(Calotropis procera)* is a common embankment side weed of the polder that one can easily detect this plant for having it's violate flowers and green broad leaves

375. Embankment side' ecosystem: The encircled embankment of the polder holds an individual type of ecosystem that is dominated by long timber trees and small natural herbs and shrubs. Major tree species along the embankment are Rendi Koroi (Albizia saman) and Chambol (Albizia richardiana), Babla (Acacia nilotica) and Mehagoni (Swietenia mehagoni). Part of the embankment, which is paved, and the internal roadside of this polder is vegetated by remarkable number palm trees/Taal (Borassus flabellifer). Table 5.9 provides a list of major tree composition on the embankment slopes of the polder.

376. Among the herbs and shrubs, Danton (Glycosmis pentaphylla), Akanda (Calotropis procera) and Vaant (Clerodendrum viscossum) are frequently followed all over the embankment upper slopes.

Table 5.9: Major Tree composition of the embankment slopes

Species Name	Density/Acre
Kola *(Musa spp)*	230
Supari *(Areca catechu)*	22
Bansh *(Bamboosa spp)*	15
Mehagani (*Swietenia mehogani*)	15
Rendi *(Albizzia lebbeck)*	11
Chambol *(Albizzia richardiana)*	9
Bilati Gaab *(Diospyros blancoi)*	7
Shishu (Dalbergia sossoo)	6
Khejur *(Phoenix sylvestris*)	5
Kanthal *(Artocarpus heterophyllus)*	4
Aam (*Magnifera indica)*	4

Species Name	Density/Acre
Jiga (*Lanea coromandelica*)	4
Dumur *(Ficus hispida)*	3
Khai Babla (Pithecolobium dolce)	3
Narikel *(Cocos nucifera)*	2
Taal *(Borassus flabellifer)*	2
Bel (Ablemamelos)	1
Babla *(Acacia nilotica)*	1
Bot (Ficus benghalensis)	1
Jamboora *(Jamboora maxima)*	1
Kath Badam	1
Pitali	1

Source: RAP Team &Field Survey, June 2015

377. Some parts of the embankment at Daskhin Patharghata and Tafalbaria have been destroyed due to tidal surge and caused damage of trees. However, embankment and road side vegetation plays important role for providing of shelter to many rodents, local avifauna and reptiles.

Photo 5.8: Taal *(Borassus flabellifer)* remarkably found beside most of the part of embankment and internal roads of the polder

378. Cropfield Ecosystem: Cropfields of this polder is mainly used for rice monoculture and pulse cultivation. The crop field vegetation has low diversity of all types, but it is more important for searching food and grazing habitats of wildlife. Detail description of cultivated crop varieties has provided in agricultural section of this report. Except cultivated varieties, numerous weeds grow in cropfields, which support various species of insects. The major species (weed) grow 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.

Aquatic Ecosystems

379. Major aquatic ecosystems of the study area are:

- Rivers
- Foreshore Intertidal area and mangroves
- Internal khals/canals and
- Homestead ponds and ditches

380. Surrounding rivers themselves possess vegetation, but tidal influence of Baleswar and Bishkhali River is important to derive vegetation pattern of the intertidal area as well as inside the polder area. Numerous internal canals act as artery of aquatic ecosystems of the polder. Marginal zone of each internal canal possesses various sedges and marginal plants. Dhol Kolmi (Ipomoea fistulosa), Khagra (Phragmites karka), Shitkey (Phylanthus sp.), Kochu (Colocasia sp.) are common among this type. Canal water has also contribution to provide soil moisture and nutrients for homestead vegetation.

Photo 5.9: Mangrove forest patch at foreshore of Baleswar river near Tafalbari village

381. Intertidal area of polder is locally known as “Char” which exists between river and the embankment. This area is naturally inundated twice in a day and deposit tidal sediment on the charland that helps mangrove plant succession. Major plant species composition on the intertidal area is Ora/Chailla (Sonneratia caseolaris), Kewra (Sonneratia appetala), Baen (Avicenia officinalis). Golpata (Nipa fruticans) and Gewa (Excocharia agallocha) are scatterdly distributed. Foreshore afforestation of this polder was enhancing through different projects of Bangladesh Government from the last 40 years. The forest patches of this polder is now in ruined condition due to excess harvest, river bank erosion, unable to proper succession of mangrove species for increased forest bed level, invasion of local terrestrial plants inside forest and lack of continuation of forestry enhancement project. Mangrove vegetation have immense contribution to protect embankment and charland from tidal surge, providence of fuel and thatch materials to the local inhabitants as well as create ideal habitats for the local avifauna and other wild animals.

Photo 5.10: Mangrove mixed vegetation at Daskhin Pathorghata on the foreshore of Bishkhali River

382. Ponds and ditches are used for domestic purposes. This type of wetlands faces water fluctuation according to seasonal variation.

5.2.3 Wildlife

383. Existence of different habitats and vegetation patterns of the polder support various wildlife. Among the mammals, Common mongoose, Field mouse, Indian Jackal, Small Indian Civet are found inside homestead vegetation, cropfields and embankment slopes. Bird population is higher than other groups which dwell in most types of vegetation. Common terrestrial birds of this area are similar to other portions of the country. Common myna, Asian pied starling, Red vented bulbul, Magpie robin, CommonTailorbird, Black drongo, House sparrow are most sighted birds those prefer homestead vegetation for their breeding habitat and cropfields as feeding habitat. Egrets, herons, lapwing and cormorants are quite common along the foreshore area.

384. Amphibians prefer cool and dump place of the homestead vegetation and beside most of the wetlands. Common toad and cricket frog are common among this group found throughout the year. Indian bullfrog has been sighted in the seasonal inundated croplands during monsoon. A list of reptile is provided in the **Appendix- 4**.

385. Snakes, turtles and lizards are common type of reptiles residing in wetlands and homestead forest. Indian roofed turtle and spotted flapshell turtle are two species, which are rarely found in this polder. A list of reptile is provided in the **Appendix- 4**.

386. Dolphins are only aquatic mammals that roam through Baleswar and Bishkhali River throughout the year. Different status of the wildlife has been given in the Table 12-a below. Wildlife species composition of the polder area is listed in the **Appendix-4.**

Table 5.10-a: 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	-	-
	Bullfrog	C	-	-
	Cricket Frog	C	LC	-
	Green Frog	O		II

Class	Common Name	Local Status	IUCN-Bangladesh Status (2015)	CITES (2016) Appendix
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	-
	Brahminy River Turtle	Rare	EN	-
	Common Roof Turtle	R	EN	
	Bengal Monitor	O	VU	I
	Rat Snake	C	-	II
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	House Mouse	C	-	-
	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-Uncommon; VR-Very Rare,

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

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

387. Peripheral embankments of the polder protects against tital flooding, saline water intrusion and the sluices act as drainage controller. The land of the polder supports different types of ecosystems. Homesteads and cropfields are dominated by fresh water loving plant species whereas khal banks and river foreshores are dominated by saline water loving mangrove plant species. Hargoza (*Acanthus illicifolius*), Kewra (*Sonneratia appetala*), and Ora (*Sonneratia caseolaris*) and Leather fern (Acrostichum aureum) 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 indicatesa change of water salinity due to malfunctioning of water control structures like sluices.

5.2.5 Existence of ecological significance area of the polder

388. The polder is located withing 10 km buffer area ofEcologically Critical Area (ECA), Sundarban Reserve Forest (according to Environmental Conservation Act, 1999). Except this, there is no nationally or internationally designated ecological sensitive area or protected

area inside the polder (Map 5.9). Sundarbans Reserve Forest exists at the west bank of Baleswar River at a distance about 2.6km west from the polder boundary **(Figure 5.10),** altnough no occurrence of Human-Tiger conflict has been noticed inside this polder as opined by local people.

389. The proposed project involves the rehabilitation of the existing infrastructure of the polder constructed for control of tidal flood and saline water intrusion and sedimentation during 1960s. Present project effort also includesmeasure against damage to be caused by high tides of storm surges within the polder area.

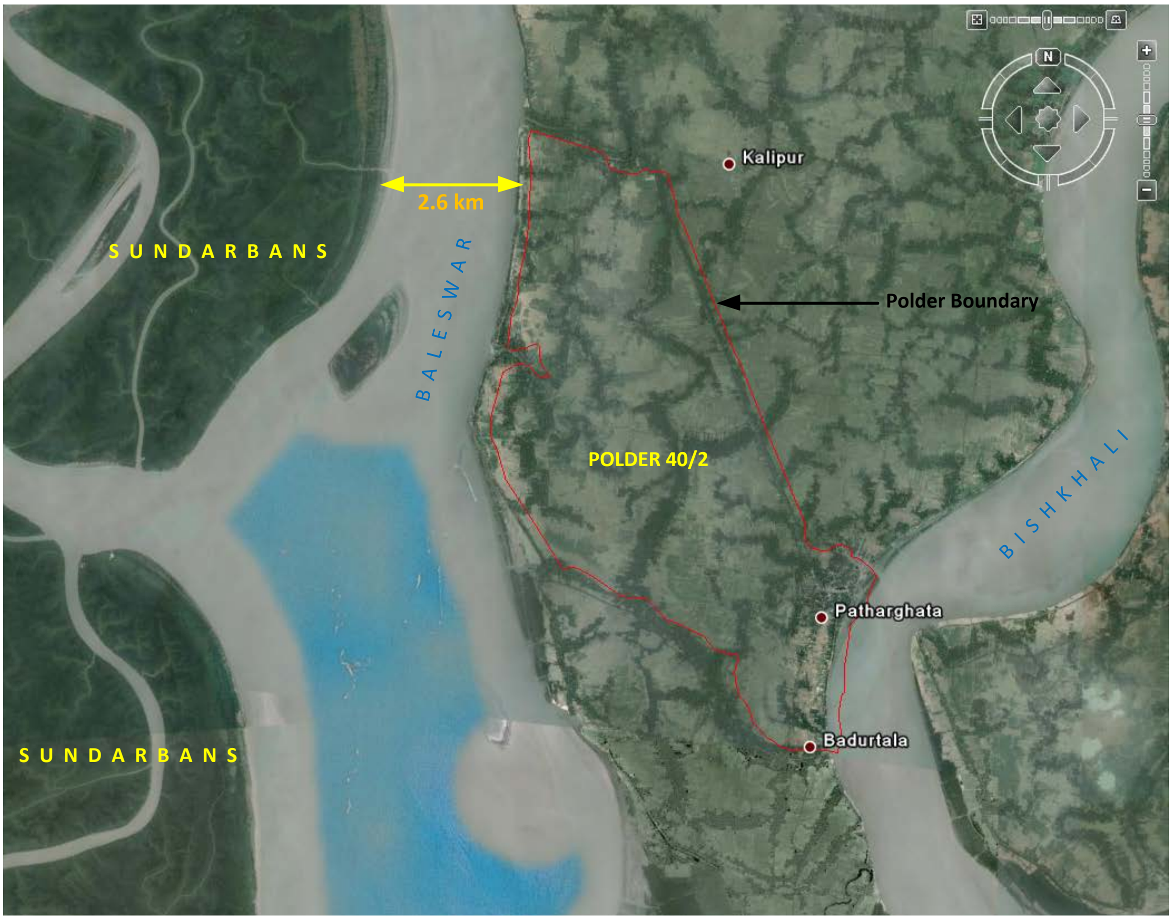
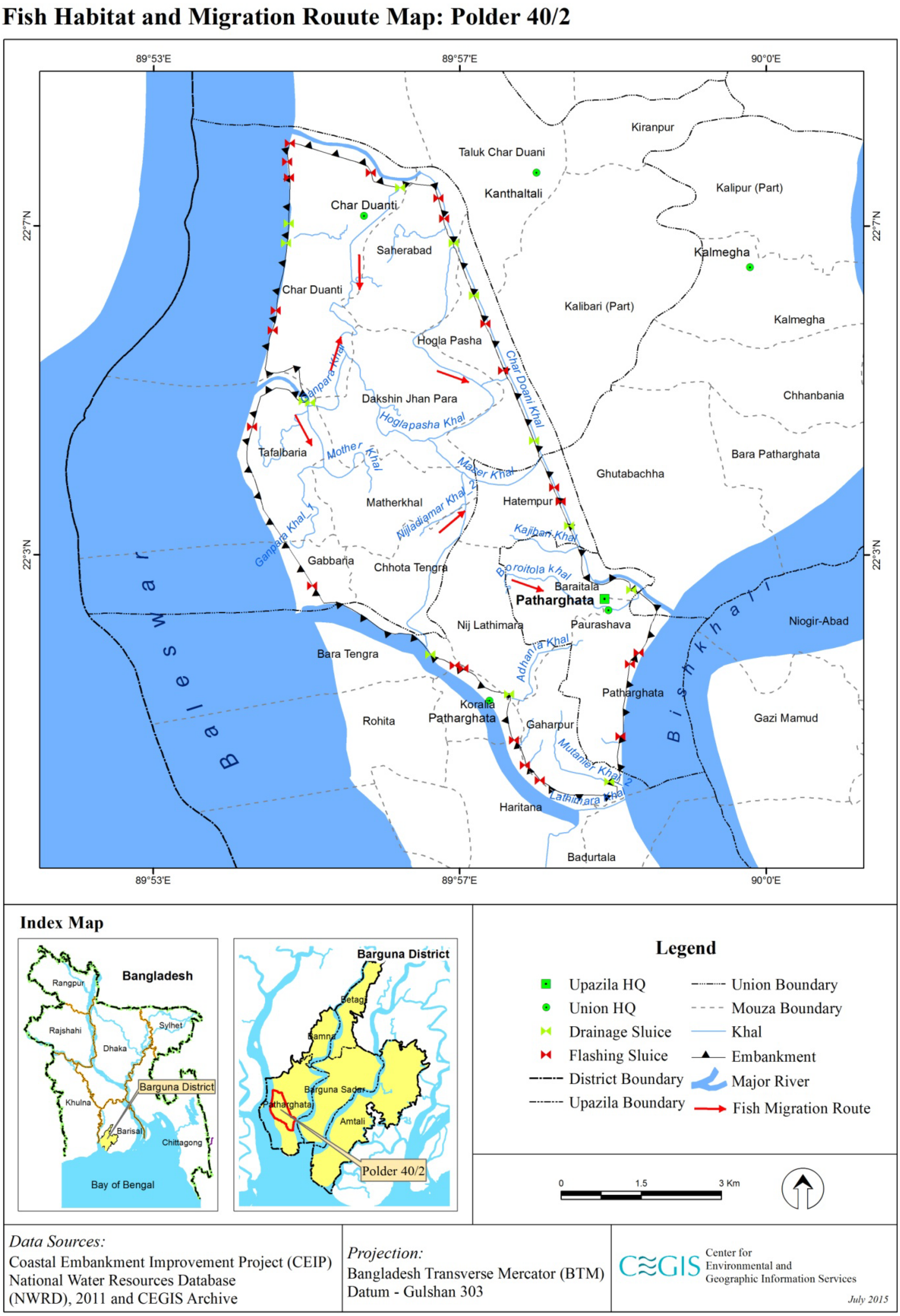


Figure 5.10: Distance of Polder from Sundarbans Reserve Forest

Map 5.9: Location of Polder- 40/2 from Ecologically Critical Area (ECA) of Bangladesh

5.2.6 Fish Habitat

390. Polder- 40/2 is located at Patharghata upazila of Barguna District under the coastal region of Bangladesh. The polder is bounded by Baleswar River to the west, Bishkhali River to the southeast, Chardoani-Patharghata Bharani khal to the north and east, and Badurtala – Tengra Bharani khal to the south. Lathimara and Charduanti khals are connected with Payra River and Baleswar River respectively. Fish habitats of the polder area are primarily classified under two broad categories, such as capture and culture fishery. Capture fisheries habitat include mainly internal khals (**Map 5.10)**. Among the khal Boroitola khal, Kajibari khal, Mutainerkhal, Nijladamar khal, Hoglapasha khal and Charduani khal are acting as major arteries of fish migration into the study area. However, tidal effect in dry season is observed in these khals yet the volume of water is not sufficient for fish habitation. The culture fishery of the polder area is dominated by culturable fishpond. The contribution of cultured pond is reported as very low but is in the increasing trend in the polder area. A few number of bagda gher is found in the polder area. The contribution of gher in fish production is negligible.



Map 5.10: Fish habitat in the study area

Capture fisheries

391. Fish habitat in the Polder area is 2,675 ha of which 2,410 ha is open water fish habitat that is considered as capture fish habitat **(Table 5.10).** The polder area consists of a number of seasonal and perennial canals/khals. These khals are important with respect to fisheries habitat.

Table 5.10-b: Fish habitat status of the study area

Sl.	Fisheries Category	Habitat Type	Area (Ha)
1	Capture	Open water	2410
Sub-total			*2410*
2	Culture	Bagda gher	1
3		Homestead pond	249
4		Commercial pond	15
Sub-total			*265*
		Grand Total	**2675**

Source: Feasibility Report (Final Fisheries Report), 2012

392. Average depth of internal khals is 2-2.5 m, which is sufficient for fish habitation. Depth of seasonal canals of the study area is insufficient for sheltering of fish juveniles due to over siltation in the canals. Local people reported that siltation rate in the internal canals of the polder area is gradually increasing.

(a) Ganpara khal (perennial)

(b) Mutainer khal (seasonal)

Photo 5.11: Open water fish habitat

Culture fisheries

393. The estimated culture fish habitat is 265 ha (**Table 5.11**) of which homestead pond is 249 ha and commercial or cultured pond is 15 ha. A few number of gher is reported whose area is negligible. Now a day, aquaculture practice is expanding gradually 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. Most of these are improved culture.

(a) Homestead pond

(b) Improved cultured pond

Photo 5.12: Fish pond in the polder area

5.2.7 Fish Migration and Movement

394. The riverine fish species migrate through regulated khals in the polder to some extent during the period of June to August. The perennial khals (Mutainer khal, Adhania khal, Ganpara khal, Kajibari khal, Boroitola khal etc) along with other seasonal internal khals in the polder are used as feeding and nursing ground of the fishes. Fish species such as Chingri, Baila, Pairsa, Koral, Puti, Boal, Tengra migrate through the regulators to the water bodies as part of their life cycle. Fish migration status in the polder area is found to be poor due to mal-functioning of water control structures, inactivity of the Water Management Organizations (WMOs) for operating the sluices and regulators. The improper management of regulators hinder the migration of fish hatchling especially carp fry migration during pre-monsoon and other fishes.

5.2.8 Fish Biodiversity

395. The study area is moderate in fish biodiversity though the biodiversity of fishes has the declining trend over the years. Local people reported that more than 90 numbers of fish species are available in the area. The study area comprises the assemblage of both fresh and brackish water fish species (photo 5.13). List showing the status of fishes of different habitat available in the study area is presented in Table 5.11.

Photo 5.13: Composition of Fish Catch of the Polder Area

Table 5.11: Available Fish Species Diversity of Different Fish Habitats in the Study Area

Scientific Name	Local Name	Habitat type		
		Periphery River	Khal	Fish pond/Gher
Brackish Fish Species				
Tenualosa ilisha	Ilish	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 mach	M	L	L
Mystus gulio	Tengra	M	M	L
Pangasius pangasius	Pangus	L	NA	NA
Polynemous paradiseus	Tapasi / Muni	L	L	NA
Sillaginopsis panijus	Tolar dandi	H	L	NA
Scylla serrata	Kankra	H	H	NA
Macrobrachium rosenbergii	Golda chingri	L	L	L (gher)
Metapenaeus monoceros	Horina chingri	H	L	NA
Penaeus monodon	Bagda chingri	M	L	NA
Fresh Water Fish Species				
Puntius sophore	Jat puti	L	NA	NA
Channa punctatus	Taki	NA	H	NA
Channa orientalis	Cheng taki	NA	H	NA
Channa striatus	Shol	NA	H	L
Clarius batrachus	Magur	NA	M	NA
Mystus vittatus	Tengra	M	M	NA
Macrognathus pancalus	Chirka baim	M	H	NA
Macrognathus aral	Tara baim	M	M	NA
Lepidocephalus guntea	Gutum	L	L	NA
Puntius chola	Chola puti	L	M	L
Wallago attu	Boal	L	L	NA
Aorichthyes seenghala	Ayre	M	L	NA
Gudusia Chapra	Chapila	M	NA	NA
Glossogobius giuris	Baila	M	L	L
Eutropiichthyes vacha	Bacha	M	L	NA
Culture Fish Species				
Telapia nilotica	Telapia	NA	NA	H
Hypophthalmichthys molitrix	Silver Carp	NA	NA	H
Puntius suchi	Sharputi	NA	NA	H
Pungasius hypophthalmous	Thai Pungus	NA	NA	M
Cyprinus carpio	Miror Carp	NA	NA	L
Hypophthalmicthys molitrix	Silver carp	NA	NA	L
Ctenopharyngodon idellus	Grass Carp	NA	NA	M
Catla catla	Catla	NA	NA	H
Labeo rohita	Rui	NA	NA	H
Cirrhina mrigala	Mrigel	NA	NA	M

Source: Field Survey, 2015; Note: Abundance Code: H= High; M= Medium; L= Low; NA= Not available

396. Fish species like Taki, Shol, Cheng, Puti, Koi, Shing, Puti, Chingri etc are commonly found in the polder area and their abundance is high. These species contribute about 40 % of total fish production. Local people informed that, once brackish water fish species like Koral/Vetki, Pairsa, Topse and fresh water fish species e.g. Rui, Catla, Ayre were commonly found in the internal khals. Presently, their abundance is in the decreasing trend. In addition, plenty of Golda and Horina chingri were found in the last decade in all habitats. At present, it is hardly found only in the perennial khal with lower status of abundance. This may be due to the presence of less 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 which are commercially cultured in the polder area. Carp fish species like Rui, catla, mrigel are also being cultured in the ponds. The number of carp fishpond is very low because of low growth rate of those fishes than those of shallow water culture fish species (e.g Tilapia, Thai Pungus).

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

Indicative fish specis

398. Major indicative species have been identified during the investigation period by assessing evenness and fish richness in the fish composition. Table 5-22 describes the fish biodiversity status of the area. Among the fish species, the indicative fish species in the polder area are Koral / Vetki (*Lates calcarifer*) Sada Poa (*Otolithes argentatus*), Parsa (*Liza Persia*), Bata (*Lizatade*), Gula Tengra (*Mystus gulio*), Tapasi / Muni (*Polynemous paradiseus*) Tolar dandi (*Sillaginopsis panijus*) Kankra (*Scylla serrata*). These species are highly sensitive to fluctuation of salinity.

5.2.9 Threatened fish species

399. Threatened fish species which are locally rare and unavailable for the last 10-15 years (as reported by the local fishermen and concerned elderly people) are given in Table 5.12. Local people reported that Gojar and Pabda have been extinct from the polder area. Other fishes like Boal, and Ayre are rarely found due to declining water depth and obstruction of fish hatchling route because of improper and irregular operation of water control structures.

Table 5.12: List of threatened fish species

Scientific Name	Local Name	Local Status		
		Rare	Unavailable	Extinct
Channa marulius	*Gojar*			√
Nandus nandus	*Meni*	√		
Wallago attu	*Boal*		√	
Aorichthyes aor	*Ayre*	√		
Ompok pabda	*Pabda*			√

Source: Field Survey, 2015

5.2.10 Fish Production

400. The estimated total fish production of the polder area is 1232MT (Table 5.13). Bulk of the fish production (about 68%) is coming from capture fisheries and the remaining from the culture fishery. Fish production trend of the capture fishery in the polder area is decreasing due to indiscriminate fishing by illegal nets, siltation and low water flow in the internal khals, obstruction of fish migration, improper and mal-functioning of water control structures.

Table 5.13: Fish Production from Different Habitats of the Polder Area

Sl.	Fisheries Category	Habitat Type	Production (ton)
1	Capture	Open water	844
Sub-total			*844*
2	Culture	Bagda gher	0.25
3		Homestead pond	349
4		Commercial pond	39
Sub-total			*388*
		Grand Total	**1232**

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

5.2.11 Fishing Effort

Fishermen number

401. The fisher households in the Polder area include commercial and subsistence fishers. Local people reported that about 75% of households of the polder are fishers. Among them, 50% households are engaged as professional/commercial fishers and they spend almost 16-20 hours of a day and 8-10 months of a year in fishing activities. Remaining 50% of households are subsistence level fishers. According to field visit, it is reported that 95% fishers are Muslim and 5% are Hindu. There is no specific “Fishers village” in the polder area. Most of the fishers are living along the periphery of the polder. The socio-economic conditions of the commercial fishermen are poor to moderate and they have no fishing net and trawlers/boats. They are dependent on fish traders (local elite) who provides fish trawlers and nets. The seasonal vulnerability of the fishers in the polder area starts from late January and continues upto April of the year. The fisher maintain their livelihood through Dadon (money borrowing from local merchant with high interest) or taking loan from local NGOs.

Fishing Season

402. Fishing season 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 along with gear type is furnished in the Table 5.14.

Table 5.14: Fishing Seasonality of the Polder Area

Type of Gear	Apr–May Boishakh	May–Jun Jaishthya	Jun–Jul Ashar	Jul–Aug Sravon	Aug–Sep Bhadra	Sep–Oct Ashyin	Oct–Nov Kartik	Nov–Dec Agrahayan	Dec–Jan Paush	Jan–Feb Magh	Feb–Mar Falgun	Mar–Apr 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

High | Medium | Low | No occurrence

Source: Field Survey, 2015

Fishing Crafts and Location

403. The commercial fishermen of the polder area catch fish in the peripheral rivers and internal khals by using both mechanized and traditional boats including Jele Nouka (large fishing boat) and Kusha (medium boat), Dingi (small boat) etc. Some of the fishing boats in the polder area is shown in the following photo 5.14:

Photo 5.14: Fishing boat in the study area

Fishing Gear

404. Different types of nets/gear are used for fishing as mentioned in **Table 5.14**of the fishing gear, (a) Seine net (Ber jal/bendi jal) which is used to catch all types of small and big fishes; (b) Mono filament net, locally known as Current jal used to catch hilsha; (c) Lift net (vesha 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. (d) Push net, locally known as Thela jal is used to catch puti, tengra, chingri etc. Around 80% fishermen have fishing gears/nets. Jhaki jal (cast net) is a common traditional fishing gear and practices of the polder area which is used in all water bodies.

Photo 5.15: Common fishing gear in the study area

5.2.12 Fish Marketing and Post Harvest Facilities

405. Fish edible quality is in good condition for human intake. But local people reported that pesticides coming from agriculture field are deteriorating the habitat quality and causing fish diseases which are not suitable for consumption.

406. Local fishermen sell bulk of their catch directly to the local fish market at Patharghata to the fish traders. There is a 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 fish landing center. Besides, Patharghata Paurashova and Char Duani have fish market. There are 15 ice factories inside the polder area. There are fish storage facilities both inside and adjacent areas of the polder area. Transportation facility at root level is moderately developed. There is no private hatchery inside the polder area. Availability of fish feeds for culture ponds are insufficient. Fish seeds for culture fishery are collected from the hatcheries and nurseries, which are situated at Patuakhali. In addition, fish feeds are also collected from the local market or from the mobile sellers coming from Khulna, Jessore and Barisal districts.

5.2.13 Fisheries Management

407. There is a government registered fisherman association in the polder area. The activities of the association are to organize the fishermen, to mitigate their internal conflicts and to protect them from the robbers. The fishermen have full access to fishing on existing fish habitats. There is no leased water body in the polder. Department of Fisheries (DoF) has limited activites for fisheries resource conservation and management in this area. Some NGOs are working, but they are very much limited in micro credit rather than extension services and aquaculture training. Enforcement of fisheries regulation is weak in and outside the Polder area.

5.2.14 Present Cropping Patterns and Intensity

408. Agriculture practices in Polder -40/2 area have been adjusted to the 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 rainfalls. Summer vegetables, T. Aus (Local) and T. Aus (HYV) crops are grown in this season.

409. High rainfall, lower 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.

410. The Rabi season is characterized by low temperatures, high solar radiation, low evaporation, insignificant rainfalls and low humidity. Winter Vegetables, Spices, Potato, Chilli, Wheat, Pulses, Oil seeds and Boro (HYV) crops area grown in this seasons. Sugarcane and Orchard are perennial crops in this polder area.

411. There are some occasional overlaps found 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 harvest in the Rabi season and Rabi crops (W. Vegetables, Spices, Potato, Chilli, Wheat, Pulses, Oil seeds and Boro) are harvested in Kharif-I season.

412. The information of cropping pattern was collected from feasibility report (Agriculture), CEIP; 2012 and validated consultation with the local farmers and DAE Personnel during field visit June, 2015. The dominant cropping patterns in the polder area are Fallow-T Aman (HYV)−Fallow and Fallow-T Aman (Local) - Fallow which are 37.1% and 20.7% of the NCA respectively. Detailed existing cropping pattern of the study area along with land type is presented in Table 5.15. The cropping intensity in Polder -40/2 is 153%.

Table 5.15: Present cropping pattern by land type in Polder -40/2

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Area (ha)	% of NCA
High land(FF)	Orchard	Cont'd	Cont'd	113	3.4
	S. Vegetables	T. Aman (Local)	Potato	146	4.4
	Fallow	T. Aman (Local)	W. Vegetables	268	8.1
	T. Aus (Local)	T. Aman (HYV)	Spices	103	3.1
			Sub total	**631**	**19**
High land(F_0)	T. Aus (HYV)	T. Aman (HYV)	Potato	50	1.5
	T. Aus (HYV)	T. Aman (Local)	Chili	73	2.2
	T. Aus (HYV)	T. Aman (Local)	Fallow	158	4.8
	Fallow	T. Aman (Local)	Fallow	683	20.7
	T. Aus (HYV)	T. Aman (HYV)	Wheat	116	3.5
			Sub-total	**1,079**	**33**
Medium high land(F_1)	T. Aus (Local)	T. Aman (HYV)	Fallow	86	2.6
	Fallow	T. Aman (HYV)	Fallow	1,225	37.1
	T. Aus(HYV)	Fallow	Pulses	103	3.1
	Fallow	T. Aman (HYV)	Pulses	137	4.1
			Sub total	**1,551**	**47**
Medium low land (F_2)	T. Aus (Local)	Fallow	Oil seeds	26	0.8
	T. Aus(Local)	Fallow	Boro(HYV)	7	0.2
			Sub total	**33**	**1**
			Total	**3,300**	**100**
			Cropping Intensity (%)	***153***	

Source: Feasibility report (agriculture), CEIP, 2012, Field information, June; 2015 and IWM,2015

Photo 5.16: View of HYV Aus field in the Polder Area

Photo 5.17: View of Rice by-product heap for Livestock in the Polder Area

Photo 5.18: View of Orchard in the Polder Area

Photo 5.19: View of Plowing land for T.Aman Seedbed Preparation

Photo 5.20: View of paddyfield in Tafalbaria

Photo 5.21:View of Soil Sample Collection from Agricultural Field

5.2.15 Cropped Area and Production

413. Yield rate data has been collected from feasibility report (Agriculture), CEIP; 2012 and validated with consultation with the local farmers and DAE personnel’s during field visit,

June; 2015. Detailed cropped area, crop production and yield rate are presented in Table 5.16.

Cropped Area

414. Total cropped area is 5,055 ha of which rice occupied 3,774 ha and the rest 1,281 ha is covered by non-rice crops. The rice and non-rice cropped area are 75% and 25% of the total cropped area respectively. Among the rice crops, T. Aus (Local), T. Aus (HYV), T. Aman (Local), T. Aman (HYV) and Boro (HYV) are commonly grown in the polder area.

Crop Production

415. Total crop production is 19,531 metric tons of which rice production is 8,678 metric tons and non-rice production is 10,852 metric tons (Table 5.9). Among the rice crops the contributions of T. Aus (Local), T. Aus (HYV), T. Aman (Local) and T. Aman (HYV) are about 4%, 16%, 31% and 49% respectively (Table 5.16).

Table 5.16: Present Cropped Area, Yield and Production of the Polder Area

Present crop grown	Present crop area, yield and production			% of contribution of production
	Cropped area(ha)	Yield/ha(mt)	Production(mt)	
T. Aus (Local)	222	1.6*	355	4
T. Aus (HYV)	500	2.7*	1,350	16
T. Aman (Local)	1,328	2*	2,656	31
T. Aman (HYV)	1,717	2.5*	4,293	49
Boro (HYV)	7	3.5*	25	0
Total rice	***3,774***	**-**	**8,678**	**100**
Wheat	116	5	580	5
Chili	73	1.25	91	1
Pulses	240	1.5	360	3
Potato	196	14.5	2,842	26
Orchard	113	12.5	1,413	13
S. Vegetables	146	12.5	1,825	17
W. Vegetables	268	12.5	3,350	31
Spices	103	3.5	361	3
Oilseeds	26	1.2	31	0
Total non-rice	***1,281***	**-**	**10,852**	**100**
Total	***5,055***	**-**	**19,531**	**0**

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

**Indicates cleaned rice*

5.2.16 Crop Damage

416. The scenarios of crop damage during 2007-2013 are presented in Table 5.17, which shows that Sidr damaged crops in 2007, by Aila in 2009 and by Mohasen in 2013. In 2008, 50-70% vegetables, potatoes were damage due to heavy rainfall in 2008. Farmers reported that 20% of T. Aman and vegetable crops were damage by water logging in the year 2010. Total 10% of vegetables, T. Aman and fruit crops were damage by infestation of pest and disease in the year 2011. In the 2013, chilli, pulses and oilseeds were damage by 15%, 50% and 30% respectively by cyclone Mohasen.

Table 5.17: Crop Area Damaged by Different Means and % Losses during 2007-2013

Sl No.	Crops	Damage (%)	Year	Reason of damage
1	Potatoes	100	2007	Sidr
	Chili	100	2007	Sidr
2	Boro	60	2008	Heavy rainfall
	Vegetables	75	2008	Heavy rainfall
3	Chili	70	2008	Aila
	Spices/Vegetables	80	2009	Aila
4	T. Aman	20	2009	Water logging
5	Vegetables/Fruits	15	2010	Pests
6	T. Aman	20	2011	Pests
7	Vegetables	15	2011	Pests
8	Fruits	20	2011	Pests
9	Pulses	50	2013	Mohasen
10	Oil seeds	30	2013	Mohasen
11	Chili	15	2013	Mohasen

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

5.2.17 Agriculture input use

417. Information on inputs using in the polder area has been validated by consultation with the local farmers and DAE Personnel during field visit in June 2015.

Seeds

418. The role of quality seeds is very important for growing crops. Selection of seeds has to be made carefully. More than 85% germination rate, free from disease infestation and high yield potential also need to be considered. The quality seeds of different vegetables 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 is poor and market price is very high which are available with the local dealers. Farmers use higher or lower amount of seeds than the recommended dose. Details of input used for different crop growth in the polder area is presented in Table 5.18.

Fertilizer

419. All kinds of chemical fertilizers are not available in local dealer shop, moreover, their prices are very high. The polder farmers use chemical fertilizers such as Urea, TSP, MP and Gypsum in different crops. Annually about 1,220 metric tons of chemical fertilizers are being used in the Polder area of which 47% is urea, 33% TSP, 18% MP and 2% Gypsum. Urea is using in higher amount than other chemical fertilizers. Farmers do not use organic manure or compost. Information/data on various input used presently for different crops are provided in the following table:

Table 5.18: Present Level of Crop Production Input used Within Polder -40/2

Crop Name	Seeds used/ (Kg/ ha)	Fertilizer (Kg/ha)				Irrigation cost	Pesticide/ha (Tk/ha)	% farmers using Power tiller	Cost of power tiller (Tk/ha)
		Urea	TSP	MP	Gypsum				
T. Aus(Local)	37	110	60	30	-	-	500	80	3,000
T. Aus (HYV)	30	130	90	33	-	-	800	80	3,000
T. Aman (Local)	37	105	60	20	-	-	500	80	3,000

Crop Name	Seeds used/ (Kg/ ha)	Fertilizer (Kg/ha)				Irrigation cost	Pesticide/ha (Tk/ha)	% farmers using Power tiller	Cost of power tiller (Tk/ha)
		Urea	TSP	MP	Gypsum				
T. Aman (HYV)	25	125	90	45	-	-	800	80	3,000
Boro (HYV)	40	172	98	100	-	3,500	2,000	80	3,500
S. Vegetables	4	130	100	67	-	500	1,500	80	3,000
Wheat	120	180	90	80	50	1000	-	80	3500
Orchard (10 yrs tree)	100-110 Sapling	1 .5 kg/tree/yr	0.22 kg/tree/yr	0.25 kg/tree/yr	0.135 kg/tree/yr	1000	1000	80	3000
Chili	1-1.5	80	30	20	20	600	500	80	3,000
Pulses	25	35	90	55	-	500	500	80	3,000
Potatoes	1,500	125	90	105	55	1,000	2,000	80	3,500
W. Vegetables	5	100	80	70	60	700	2,500	80	3,000
Spices	10	80	60	40	60	500	1500	80	3,000
Oil seeds	8	110	65	35	75	500	500	80	3,000

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

Pesticides

420. The use of pesticides depends on the degree of pest infestation. Most farmers apply pesticides in all crops such as T. Aus (Local), T. Aus (HYV), T. Aman (Local), T. Aman (HYV), Boro, Chillies, Potatoes, Summer and Winter Vegetables and Spices. They spent about Taka 500-3000/- against pest control in each crop. The highest pesticides are applied in vegetables and potato fields (Table 5.18). The major insects as reported by the farmers were Yellow stem borer, Rice hispa, Grass hopper, Ear cutting, Catter pilar, Brinjal fruit and shoot borer and Fruit weevil. According to local farmer, they use different types of pesticides such as Dimacron, Diazinon, Furadan, Kuratar, Virtako, Volume, Aktara, Sunfuran, Karate, Darsban, Cup granular and powder etc. to prevent pest infestation in rice non-rice and other croplands.

Labor

421. In the polder area, most of the cultural practices for crop production are being done manually. So, agricultural labor is considered as one of the essential inputs for crop production. However, the labor requirement is not equal throughout the year. The number of labor requirement varies from crop to crop. The average number of labor used in the polder area is presented in Table 5.19.

Table 5.19: Labor Used in the Polder Area

Sl. No.	Crop name	Labor(No/ha)
1	T. Aus(Local)	150
2	T. Aus(HYV)	150
3	T. Aman (Local)	160
4	T. Aman (HYV)	160
5	Boro (HYV)	170
6	Orchard	140
7	Wheat	180
8	Chilli	170
9	Pulses	120
10	Potatoes	200

Sl. No.	Crop name	Labor(No/ha)
11	S. Vegetables	180
12	W. Vegetables	180
13	Spices	140
14	Oilseeds	120

Source: CEGIS Assessment from field information, June; 2015

Irrigation

422. Irrigation with low lift pump (LLP is the most common practice, but availability is not sufficient and rate is high. Irrigation is provided mainly in Boro (HYV) crop in dry season. Rivers (Bishkhali river and Baleshawar river), Khals (Keoratola khal, Kajibari khal, Boroitola khal, Adhania khal, Nijladiamar khal, Maser khal, Patharghata khal, Char Duani-Patharghata-Bharani khal, Chechibunia khal, Hoglapasha khal, Mother khal, Munshiganj khal, Gyanpara khal, Charduani khal, Takar khal and Lathimara khal) and beel are the main sources of surface water irrigation. But the availability of irrigation water has declined due to siltation of the river, beels and khals. Occational salinity of surface water and ground water affects the irrigation practices in the area. T. Aus (Local), T. Aus (HYV), T. Aman (Local) and T. Aman (HYV) are cultivated under rain-fed condition. Supplementary irrigation is also provided to W. Vegetables, S. Vegetables, Orchard, Chili, Pulses, Spices, Oil seeds (Sunflower), Wheat and Potato etc. (Source: Field visit; June, 2015).

5.2.18 Livestock and Poultry

423. Livestock and poultry, being an essential element of integrated farming system, play an important role in the economy of Polder -40/2. Livestock provide significant draft power for cultivation, threshing and crushing of oil seeds; cow dung as a source of manure and fuel; a ready source of funds; and meat, milk and eggs for human consumption. Most of the households raise poultry and livestock, a practice that significantly reduce poverty through generating income and employment. The numbers of livestock and poultry in the study area are presented in Table 5.20.

Table 5.20: Number of Livestock and Poultry of the Polder Area

Name of Livestock/poultry	% HH having livestock and poultry	Present number
Cow/Bullock	15	4,815
Buffalo	2	180
Goat	4	1,350
Sheep	2	170
Duck	40	21,000
Chicken	45	24,000

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

5.2.19 Feeds and Fodder

424. The owner of the livestock population is facing problems in respect of availability of fodder and feeds during the months of July to November due to occupation of crops in the field. Rice straw is the main fodder of bovine animals. Oil cake, bran, Grass, etc. are the other common fodders in this polder area. Shortage of grazing areas throughout the year aggravates the feed problem to the animal population. Poultry population at family level survives by scavenging and generally, no feed supplements are provided. However, sometimes kitchen waste becomes feed to the poultry.

Photo 5.22: Ducks and Cattle of the Polder Area (Field visit, June 2015)

5.2.20 Livestock and Poultry Disease

425. Productions of livestock and poultry are mainly constrained due to diseases and death of the population. Outbreak of disease is causing a considerable economic loss in livestock farming. Every year livestock population is affected by different diseases. Major livestock diseases are Foot and Mouth Disease (FMD), Gola fula (Hemorrhagic Septicemia), Black leg (Badla), Dysentery, Pest Des Petits Ruminants (PPR) and Goat cyst. Major poultry diseases are Ranikhet (New castle), Cholera. Duck plague, and Fowl pox. The most vulnerable periods are the month between July to October and February to March months for spreading diseases to livestock and poultry populations. However, some diseases are spreading round the year. During monsoon season, the soggy condition of the animal shelter causes various kinds of diseases of the bullocks and cows (Field visit; June 2015).

5.3 Socio-cultural Environment

426. The socio-economic condition of the people living in the Polder (i.e. the study area) is captured in this chapter. 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).

5.3.1 Area and Location

427. The Polder is positioned in Patharghata upazila under Barguna district. The Polder area encloses three unions namely Patharghata, Patharghata Pourashava and Charduanti. Percentage of union boundary is shown in Table 5.21.

Table 5.21: Unions and Upazilas in Polder-40/2

Name of district	Name of upazila	Name of unions	Percentage of union area within the polder
Barguna	Patharghata	Patharghata	17
		Patharghata Pourashava	93
		Charduanti	83

Source: Spatial GIS Analysis, CEGIS, 2015

5.3.2 Demography

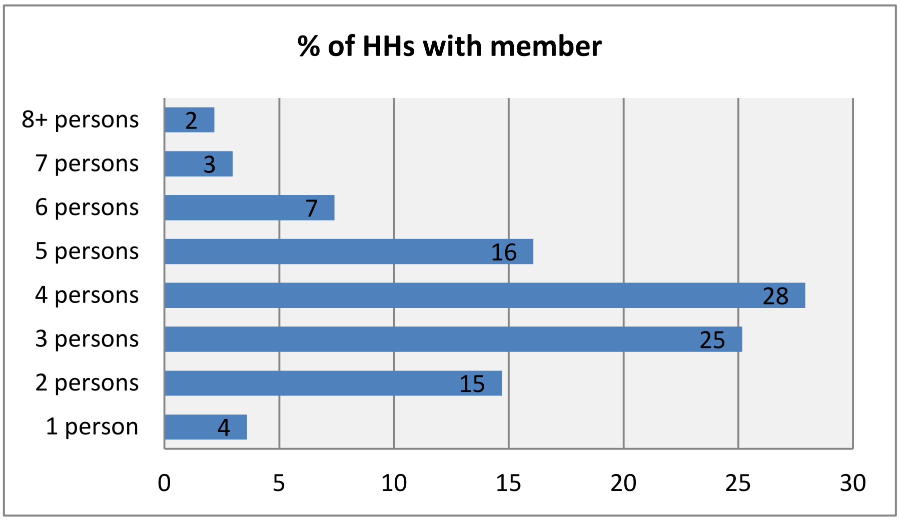
428. The 10,834 households living in the polder area have a total population of 41,206, of which 20,619 are male and 20,587 are female. The male population is little bit higher than the female population. The average male-female sex ratio[12] is 100 of which there are 100 males per 100 females which is slightly lower than the national figure of 100.3 (HIES) 2010[13]]. The average density of population is 621 persons per sq. km, which is quite less than the national density of 1,015 persons per sq. km. The inhabitants of this Polder belong to two main religions; i.e. the Muslim and the Hindu. About 89% of total populations are Muslim and 11% are Hindu. The demographic data of this Polder is presented in Table 5.22.

Table 5.22: Demographic data of polder

Households	Population			Sex ratio	Population density
	Total	Male	Female		
10,834	41,205	20,619	20,587	100	621
	100 (%)	50.04 (%)	49.96 (%)		

Source: Population Census 2011, BBS

429. According to household's distribution by number of persons in the overall study area, it is found that the highest percentage (28%) of household comprises of 4 persons in each (**Figure 5.11**). Although average household size is 3.8, a substantial percentage (25%) of households comprises of 3 and over persons in each.



Source: Housing and Population Census, BBS, 2011

Figure 5.11: Distribution of households comprising member in each

5.3.3 Age Structure

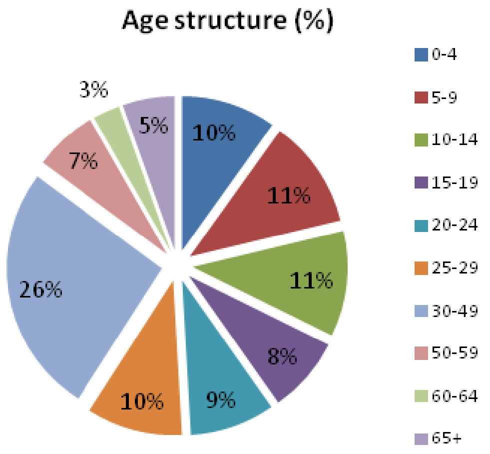
430. The highest number of population (26%) of the study area belongs to age category of 30 to 49 years old. Only 3% people are in 60 to 64 years category (Figure 5.12). Age groups of 0-14 years is defined as children, 15-24 years as early working age, 25-54 years as prime working age, 55-64 years as matured working age and 65 years and over as elderly people

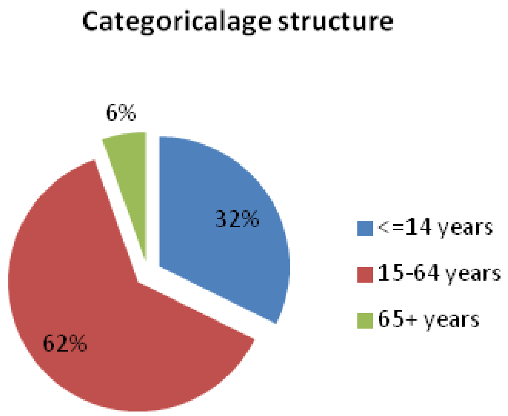
[12]Number of males per 100 females in a population, using the formula: Sex Ratio SR = M x 100 / F

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

(source: World Fact Book, CIA[14]). This classification is important as the size of young population (under age 15) would need more investment in schools, while size of older populations (ages 65 and over) would call it invest more in health sector.

431. The population data when analyzed to ascertain the size of (potentially) active working population, it appears that 62% population who are in the age bracket of 15-64 can be classified under this category. A small percentage (6%) is of 65 years and above (Figure 5.13). The categorization is made based on 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 dependent. Thus, the total dependency ratio[15] is 61 in which child dependency ratio[16] is 52 and aged dependency ratio[17] is 9. It illustrates that total 61 persons are dependent on 100 labour forces in which 52 are children and 9 are elderly people.





Source: Housing and Population Census, BBS, 2011

Figure 5.12: Age structure of the studied population

Figure 5.13: Categorical distribution of studied population

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

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

[16] Child dependency ratio= $\frac{\textit{number of people aged } 0-14}{\textit{number of people aged } 15-64} \times 100$

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

5.3.4 Education

432. Literacy rate, based on a definition “ability to write a letter in any language” is 61%, where for male it accounts to 61% and female 62%. The rate of literacy reported above is for population of 7 years and over ages (Figure 5.14). Data confirms that, the female populations are more educated than the male counterpart compared to the national picture of Bangladesh (Male 54.1% and Female 49.4%), in the study area.

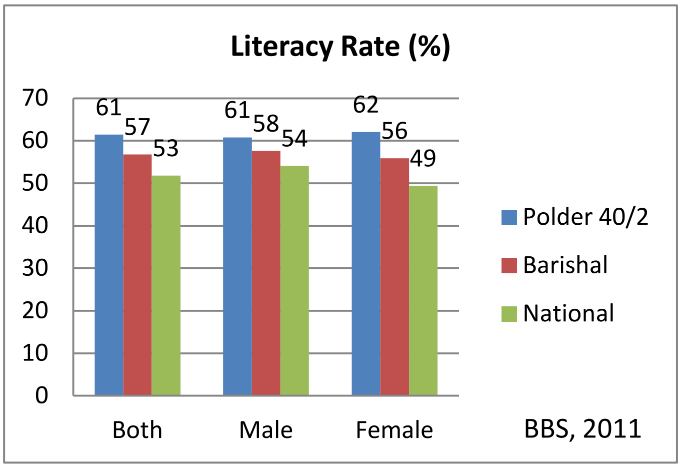


Figure 5.14: Literacy rate among the studied population

433. Field findings show that there are 33 primary schools, 6 high schools and 8 Ebtedaye/ Dakhil Madrashas in the polder area. There are two colleges one is Degree College, named Patharghata Degree College. The other college is Choudhury Masum TBM College (**Photo 5.23**). (Source: CEGIS field work, 2015).

Photo 5.23: Local educational institutions in the Polder area

5.3.5 Public Health

Access to Health Service

434. Access to health services and facilities refer to availability and adequacy of supply, affordability, physical accessibility and socio-cultural acceptability. Field data show that there are 14 community clinics and 2 union complexes at union level. People stated that the existing services are almost inaccessible for rural poor people. Therefore, a substantial pattern tends to receive services from local chemist and or village trained physicians. They stated that most of the community clinics are located at preferable location of local political leaders. Therefore, remote villagers have limited access in comparison to those of the adjacent villagers.

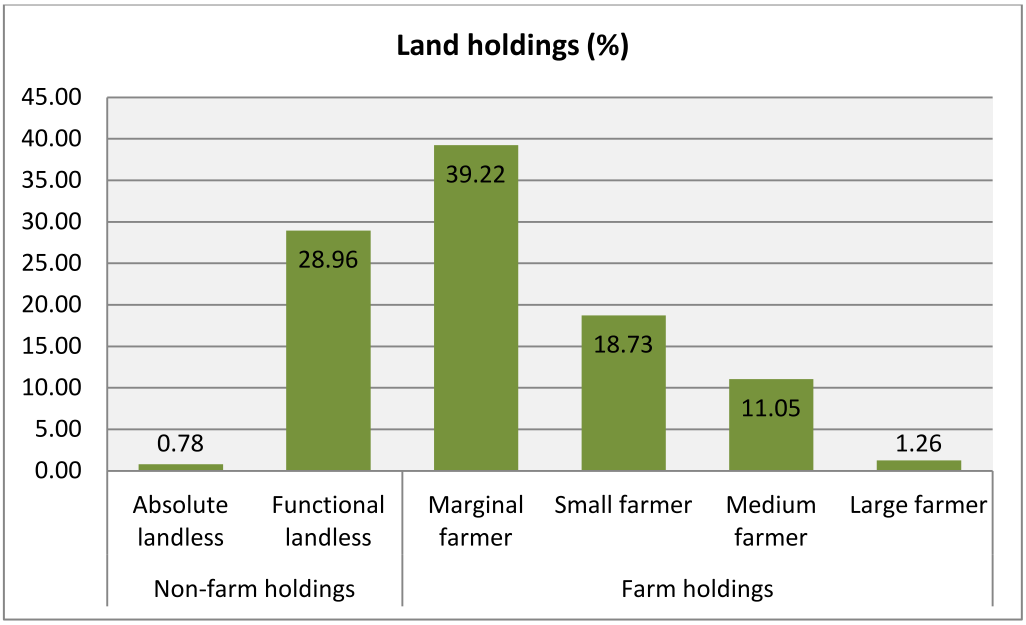
435. Survey also confirmed that nearly 45 percent people receive health services from quack doctors and 30 percent from paramedic/ diploma physicians and only 10 percent from trained doctors. It is noteworthy that about 5 percent do not receive treatment facility due to their impoverishment. People reported that the earlier tendency of going to the local healer for treatment is being taken place by registered/trained physicians. It is assumed that economic well being may drive them toward receiving treatment facilities from trained physicians, in spite of its' being expensive.

436. The Population Census, 2011 identified almost six types of disabilities and their proportionate distribution in the respective area. It is found that the study area comprises of 2.5% of all types of disabilities and 1.1% people reported that they are physically challenged. About 0.5% suffer from speech and mental disorder. Local people opined that the incidence of Typhoid is the most prevalent ailment in the area. Dysentery, skin diseases and common fevers are also common in the polder area.

5.3.6 Ownership and Utilization of Land

437. 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. A farm holding is defined as being an agricultural production unit having cultivated land equal to or more than 0.02hectacre. Conversely, non-farm holding includes landless households and households having lands less than 0.02hectacre. The study area shows that out of total holdings 70.26% is farm and the rest 29.74% is non-farm**.**

438. Therefore, the land holdings in the study area shows that 0.78% households are absolute landless i.e. they have no lands either for homestead or cultivation. 28.96% households belong to functional landless category that comprises of households having only homestead lands (20.18%) and those have homestead with 0.01 to less than 0.02hectacre cultivated lands (8.74%). Here, cultivated lands include mainly kitchen gardening carried out predominantly by housewives for household consumption.



Source: The Census of Agriculture, 2008, BBS

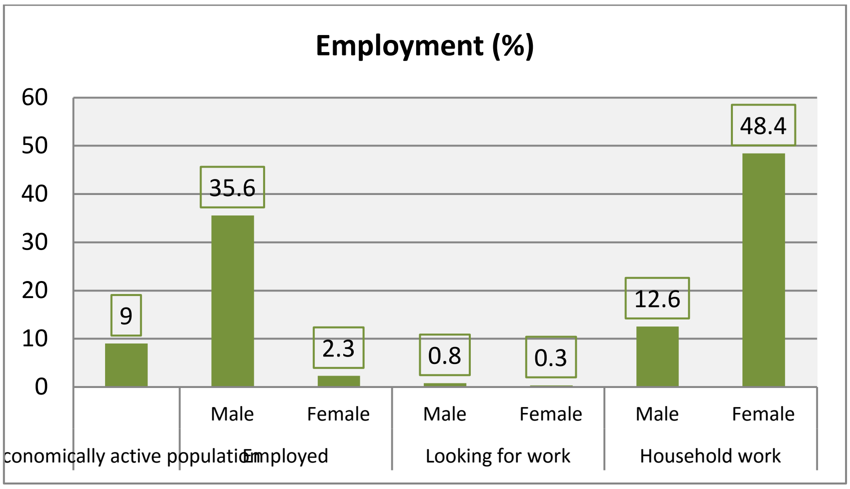
Figure 5.15: Households by land holdings

439. On the other hand, farm holding distribution shows that 39.22% households belong to marginal farmers (0.02 to 0.4 hectare), 18.73% belong to small farmers (0.41 to 1.00 hectare), 11.05% belong to medium farmer (1.01 to 3.00 hectare) and 1.26% belong to large farmers (>3.00 hectare) categories. It is evident that land fragmentation decreases the holding size, therefore, large and medium farmers are gradually being converted to small and marginal farmers (Figure 5.15).

440. Field data proved that this large numbers of landless populations usually adopt alternative livelihood options, for instances; farm and non-farm laboring, driving, earth work, working for shrimp farm and various manual works.

5.3.7 Occupations and Livelihood

441. Out of total 41,206 population, 3701 (9%) are economically active among which 1,375 (37.2%) are employed, 33 (0.9%) are looking for work, and 2,293 (61.9%) are engaged in household work. The economically active population includes those who are aged 7 and above 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 excluding 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 works particularly for women participation is accounted in terms of household activities as well as alternative income generation from various activities such as livestock rearing, poultry farming, kitchen gardening etc. (**Figure 5.16)**



Source: Housing and Population Census, BBS, 2011

Figure 5.16: Employment status of the polder

442. Women participation in direct income generating activities (employed category) is trivial as education status confirms that whereas not attending males are engaged in employment, females are getting married and in turn, contribute to the highest participation in household work (48.4%). The employed category also includes child labour as it was accounted from 7 years old population.

443. Distributing employed population at reference period of census it is found that, 65% are engaged in agricultural activities, 9% in industry and 26% in service. Agricultural activities include broadly crop-farming, fishery, livestock and poultry farming. Scope of employment in agricultural sectors is gradually decreasing mainly due to lack of sweet water tending to convert the productive land into fallow land. Field findings suggest that rural

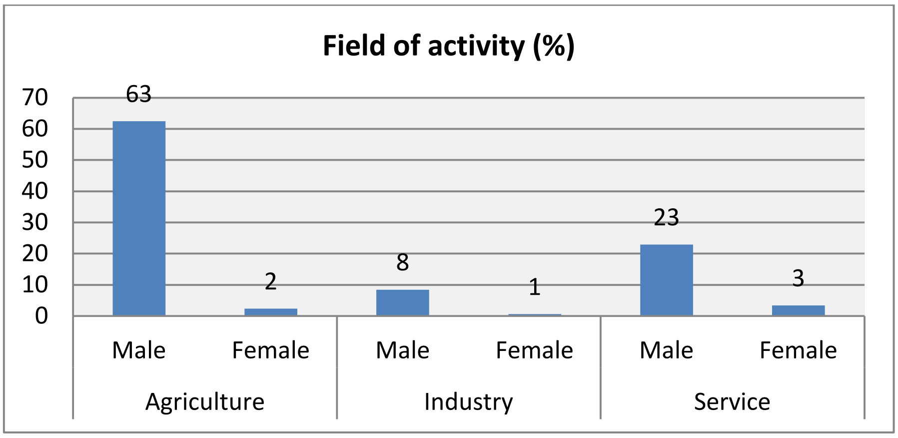
women's participation is relatively higher in various post harvest activities and livestock management activities than other agricultural activities. Few of them participate in some non-agricultural activities like handicrafts making, tailoring etc.

Photo 5.24 : Fishing is the major livelihood activites at the polder

5.3.8 Labor Market

444. The employment rate[18] in the study area is 38 whereas, the unemployment rate[19] is 62. It is evident that more than 62% of the total economically active population is still unemployed. Most of the unemployed populations are female, who are solely involved in household works and only 0.1% populations are looking for work.

445. Data confirms that agriculture, industry and service are the sole sectors to generate employment for the local people. Field findings documented that, people who are not permanently employed tend to engage themselves in those sectors in the forms of agricultural labourers, fishers, brick field workers, earth workers and cleaners. In agricultural sectors most of the labourers are supplied from the local villages.



Source: Housing and Population Census, BBS, 2011

Figure 5.17: Distribution of population by field of activity

[18] Employment Rate = $\frac{\textit{Employed Population}}{\textit{Total labour force}} X\, 100$

[19] Unemployment Rate= 100-Employment Rate

446. The above figure implies that female participation in agriculture, industry and service sectors are 2%, 1% and 3% respectively (Figure 5.17). Field findings documented that during harvesting period, they take part in action with men in same agricultural field. Some of them are also collect fry fish from river, involve in earthwork etc. The wage rate varies between 350 Tk. to Tk. 300/day for male, whereas, women wage rate is between Tk.160 Tk. to 200.

447. During field visit, people informed that out-migration of labourers is less (3%) in the polder area, whereas, in-migration is almost absent. These out-migrants are mainly agricultural labourer, usually go to the neighboring districts (Chittagong, Dhaka, Barisal and Khulna) during May to September for better livelihood and lack of employment opportunity inside the polder from April to June. Additionally, there is trivial international out migrants (1%) who tend to go to Middle East mainly for searching better employment / livelihood options.

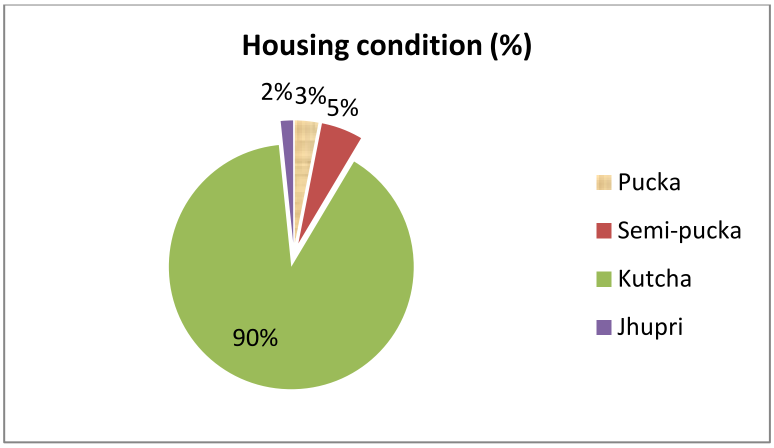
5.3.9 Standard of Living

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

449. Electricity facility is very poor (42%) in the entire polder area. Data shows that Patharghata Pourashava comprises of the highest (72%) electricity coverage whereas, Patharghata union has the lowest (25%) coverage. Moreover, about 30% households use solar electricity in the polder area at present (CEGIS fieldwork, 2014).

450. The overall housing condition [20] is not satisfactory. The study area shows the predominance of kutcha houses (90%) over other three types. Semi-pucca household is 5%, pucca is 3% and 2% is still thatched houses (**Figure 5.18**). Statistics indicates that Patharghata Paurashava comprises the highest pucca households (8%) whereas Patharghata and Charduanti unions comprise the highest kutcha households (95%). It can be concluded that the people living in the study area belong to poor category in term of housing type.

[20] 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. Split are bamboo framing. In some areas wall are made by 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-pucca**: Walls: Bamboo mats, CI sheet, Timber or bamboo framing. In some areas wall are made by earth, sometimes part or full brick. Foundation: Earthen plinth; Brick perimeter wall with earth infill; Brick and concrete also use. Roof: CI sheet with timber or bamboo framing; and iv) **Pucca**: House which is made by fully concrete, cement, and iron



Source: Housing and Population Census, BBS, 2011

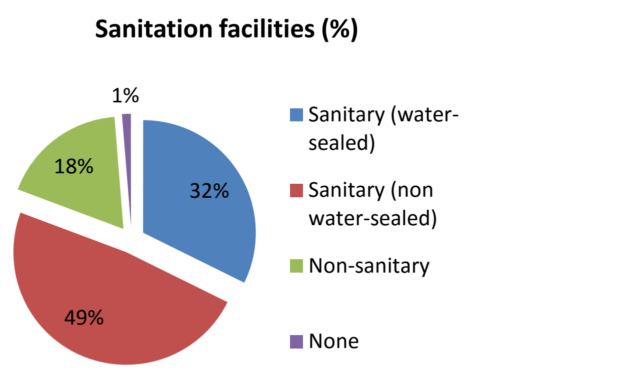
Figure 5.18: Housing condition in the study area

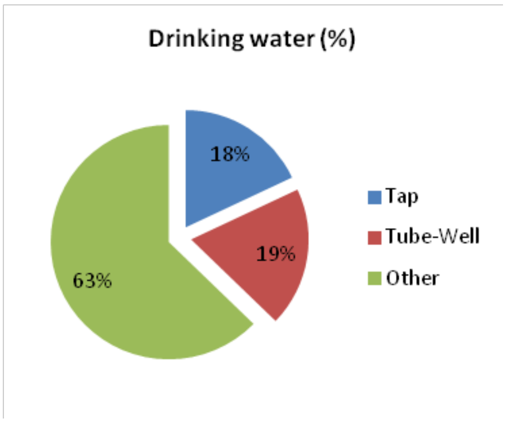
Photo 5.25: Housing structure at polder area

451. Sanitation[21] facilities in the study area show that about 18% households use non-sanitary latrines and 49% use non water-sealed sanitary latrines. Field findings confirm that non-sanitary latrines are predominant among kutcha houses. Water-sealed sanitary latrines are used by kutcha, semi-pucca and pucca households, to the extent of 32%. Water-sealed sanitary latrines are available predominantly in pucca houses. However, there are 1% houses, which have no sanitation facilities but tend to use on shared basis and in some cases uses open spaces (**Figure 5.19**).

452. Collection of drinking water from other sources is predominant (63%) throughout the polder area and is from open water bodies as unorthodox sources i.e. PSF, ponds, rain water etc. These households are basically from poor classes and living in the rural areas having no access to tube-wells. Supply of "tap water" (18%) is mainly used in pourashava areas on rental basis. This supply system is dependent on abstraction of water from under ground. However, only 19% households are still depending on Tube-well as their drinking water source. Major sources of drinking water in polder are shown in (**Figure 5.20**).

[21] 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 (Kucha): 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.





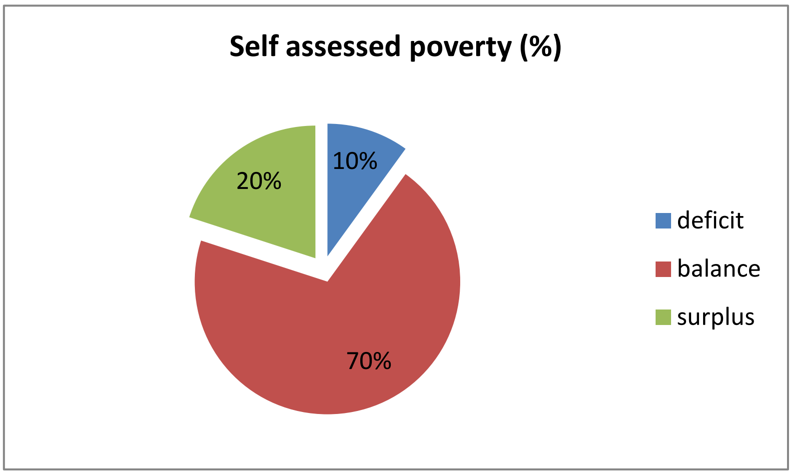
Source: Housing and Population Census, BBS, 2011

Figure 5.19: Distribution of households by sanitation facilities

Figure 5.20: Distribution of households by sources of drinking water facilities

5.3.10 Poverty Situation

453. Poverty profile has been prepared by the participants of the RRA based on the year-round income along with food consumption of the inhabitants within three different categories (Figure 5.21). It is observed that about 10% percent of the households in average are in the 'deficit' category. These households have been identified in the RRA as the poor households of the Polder area. Considering the standard consumption of food (three meals in a day), the deficit group usually can take two meals in a day in the lean period since they could not afford three full meals.



Source: CEGIS field work, 2015

Figure 5.21: Self assessment of poverty status

5.3.11 Social Capital

Extension Services

454. 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 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 5.23** shows the current social services and facilities provided for alleviating poverty in the study area.

Table 5.23: 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

455. A number of local, national and international NGOs are working in the polder area. The main activities of these NGOs include of 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), Heed Bangladesh etc. These NGOs are serving with micro credit while BRAC working for non-formal education, Health, water and sanitation, gender and children development programs. About 45% of households are found to benefit from the NGOs interventions. After disasters (Sidr, Aila and Mohasen), the “Nobolok” appeared the most important NGO for the local people.

Roads

456. Various types of roads provide means of communication mostly within the Polder. About 46 km of notable road network exists in the studied unions of which 23.88 km roads are paved and the remaining 22.22 km roads are brick soled and earthen. **Table 5.24** presents information and data on road network in the polder area; **Photo 5.26** presents some photographs of these roads.

Table 5.24: Road Network in Polder

Name of Union	Type of Road	Description	Length (Km)
Pathaghata	Paved/Brick soling	Patharghata-Harinbaria Badurtala	8.7
		Patharghata-Tengra Bazar	3.98
		Nachnapara UP (Bashtala Bazar)-Fakir Hat	5.2
		Patharghata-Padma sluice	2.6
	Earthen road	Charduani-Tengra Bazar	6
		Lemua GC-C & B Bazar (RHD) via Hemontopur	2.8
		Kathaltali Bazar via Burjugpur GPS	7.15
		Nachnapara UP-Taluker	6.25
		Charduani via Napiter Kheyaghat	

Source: CEGIS fieldwork and LGED website, 2015


Photo 5.26: Paved and soling roads in the Polder area

Market/Growth Centre

457. There are 11 markets/bazaars in the study area, among which 5 are in Pathaghata union, 3 in Patharghata Paurashava and 3 in Charduanti union (**Table 5.25**). All the bazaars located in these unions are serving the local people.

Table 5.25: Markets in project area

Unions	Nos of markets/bazaar	Name of the Markets/bazaar
Pathaghata	5	• Pathaghata hat • Patharghata bazaar • Munshiganj hat • Tengrabazar hat • Khaliphar hat
Pathaghata Paurashava	3	• Patharghata Paurashava bazar • Hatempur hat • Gutabasha hat
Charduanti	3	• Charduanti hat • Taluk char duanti hat • Padma hat

Source: LGED website, 02/07/2015

5.3.12 Gender and Women

458. Field observation indicates that Polder-40/2 is 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 decision and at the same time they contribute to household income more than females. A very few women work as day labourer but in that case wage discrimination is very common where male laborers get Tk. 300 to 350/day and women labor get Tk.160 to 200/day.

459. The Government’s strong policy towards women education has changed the situation a lot in polder area. For which, women education rate has increased, dropping school due to early marriage has reduced. NGO have changed the rural society to a significant extent in terms of awareness building. Different NGOs along with community health clinic are working for women health and reduce women maternal mortality rate.

460. Women mobility in the area is mostly localized excepting for medical treatment, fetching water, farming activities and visiting relatives.

461. Mortality rate of the pregnant mother during delivery has been 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 such decrease in the mortality rate. About 15 percent women are living with good health condition while the rest are suffering from various diseases such as low blood pressure and premature delivery. About 20 % women are getting proper nutrition and about 10% have access to the health centers, which is on average around 15 km away from their residence (CEGIS fieldwork, 2015).

5.3.13 Vulnerable Communities

462. Three types of people in the polder area could be considered as vulnerable. These include marginal farmers having monthly income less than Tk 6,000, fishermen and women headed households. Local economy is mostly agriculture based and most of the land owners cultivate their land themselves. Some of the land lords share their land to marginal farmers and other vulnerable groups. Some people of the polder area depend on fishing from the open water bodies.

5.3.14 Common Property Resources

463. The common property resources and/or community facilities in the area are different social amenities such as mosques, graveyards, temples, cremation grounds, playgrounds, open water bodies and Eidgahs (place for offering Eid prayers). The local people use these for the purposes of religious, social and cultural gathering. Besides, the local inhabitants also use the BWDB embankment very commonly for different livelihood purposes i.e. living or taking shelter, especially during emergency period.

464. It is observed that there are 2 cyclone shelters, of them one is under construction. Besides, there are 52 mosques, 12 temples, 12 Eidgah, 08 graveyards, 10 playgrounds and 3 crematoriums in the polder area. However, there is no known historical and archeological sites declared by government in the Polder area.

(Sources: http://patharghataup.barguna.gov.bd/node/544262)
(Sources: http://http://charduanyup.barguna.gov.bd/node/786769)

6 Environmental Impacts and Mitigation Measures

6.1 Preamble

465. This Chapter identifies the environmental and social impacts, which may potentially occur in various Project phases, and proposes appropriate mitigation measures to avoid, offset, reduce or compensate these impacts. Potential Intervention as described in chapter-4 may cause potential environmental impacts during pre-construction, construction, and O/M stages. The influence of project area has been identified in Article 2.2.1 of Chapter 2. The following detailed investigations are being carried out or proposed to assess the magnitude of these prioritized 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 of vegetation, wildlife and fisheries covering both mainland and Foreshore/Intertidal area,
- Surveys comprising of socioeconomic status and environmental settings in and surrounding polder,
- Expert consultations focus group discussions and public consultations.

6.2 Impact Screening

466. As a part of the environmental impact assessment process, a screening matrix was used specifically for the proposed Project activities, focusing on the potential environmental impacts during the design, construction and operation phases. The matrix examined the interaction of project activities with various components of the environment. The impacts were broadly classified as physical, biological and social, and then each of these broad categories were further divided into different aspects. The potential impacts thus predicted were characterized as follows:

- High negative (adverse) impact;
- Moderate negative impact;
- Insignificant impact;
- High positive (beneficial) impact;
- Moderate positive impact; and

467. The impact matrix of the polder is provided in Table 6.1. The negative impacts predicted in this manner were the ‘unmitigated’ impacts. Appropriate mitigation measures were recommended as part of this EIA study, thus reducing the occurrence possibility and severity of the potentially adverse impacts. The potentially negative impacts identified through this process are discussed in the subsequent sections.

Table 6.1: Environmental and Social Screening Matrix (Unmitigated)

Project Phases and Activities	*Physical*						*Biological*							*Social and Socioeconomic*					
	Soil Erosion/Contamination	Air Quality	Noise and Vibration	Surface Water Quality	Groundwater Quality	Water Availability and Consumption	Drainage Congestion/ /Waterligging	Natural Vegetation	Fish habitat and Migration	Benthic Fauna	Agriculture and grazing	Social Properties	Access Routes/Waterway	Vehicular Traffic	Safety Hazard	Public Health	Aesthetic Value	Gender and Cultural Issues	Employment Opportunities
Design Phase/ Pre-Construction Phase																			
Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	MN	0	0	MN	0	0	MN	0
Site Preparation	MN	MN	MN	0	0	0	0	MN	0	0	MN	MN	MN	MN	MN	MN	0	0	HP
Construction Camp Establishment	MN	MN	MN	MN	0	0	0	MN	0	0	MN	0	MN	MN	MN	MN	MN	MN	MP
Equipment / Material Transportation	0	MN	MN	MN	0	0	0	0	0	0	MN	0	MN	HN	MN	MN	0	MN	MP
Construction Phase																			
Operation of Construction Camp	0	MN	MN	MN	0	0	0	0	0	0	0	0	MN	MN	MN	MN	0	MN	MP
Borrow and disposal area management	MN	MN	MN	MN	0	0	0	0	0	0	HN	0	0N	0	MN	MN	0	MP	HP
Re-excavations of water channels	MN	0	MN	HN	0	0	0	MN	HN	HN	0	0	MN	MN	MN	MN	0	MP	HP
Re-sectioning of Embankments	0	MN	MN	0	0	0	0	MN	0	0	0	HN	HN	MN	MN	MN	0	MP	HP
Installation/replacement/repair of Regulators	0	MN	MN	MN	0	0	MN	MN	MN	MN	0	0	MN	MN	MN	MN	0	MN	HP
Operation Phase																			
Operation of Regulators	0	0	0	HP	0	HP	HP	0	MP	0	HP	0	0	0	0	0	0	0	MP
Repair and Maintenance	MN	0	0	MN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	MP

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

6.3 Impacts during Pre-Construction Phase

468. Site development involves the following activities:

- Mobilization of equipment, construction material/vehicles
- Clearing of sites
- Collection of earth materials from borrow pits
- Construction of civil amenities and development
- Establishment of temporary construction yards
- Construction of suitable labour shed with sanitation and safe drining water facilities.

469. The activities will cause the following environmental impacts:

6.3.1 Damages of properties due to Project Intervention and Land Acquisition

Impact

470. It is estimated that about 13.13 ha of land would be acquired resulting in displacement of about 1,747 households (Pucca 72, Semi pucca 97 nos, Tin shed 742 nos, Kutcha 468 nos and Thatched 368 nos). The details of acquired land are 2.87 ha for household, 2.27 ha of Vita/Highland, 7.10ha cropland, 0.18 ha of orchard and 0.71 ha commercially used land. The social network e.g somiti , business center and club will be affected but there activity is minor scale. The proposed Polder- 40/2 will develop through construction of retirements of embankment and water regulatory structures. Presently, DCSC 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 prepared by DCSC. During distribution of compensation, conflict may arise due to absence of proper legal document in connection with the ownership of land. The details of these damages in Polder-40/2 are presented in Tables 6.2 to 6.6.

Table 6.2: Land to be acquired

Type of land use	Quantity (ha)
Homestead	2.87
Vita/ Highland	2.27
Crop land	7.10
Orchard/ Forest land	0.18
Commercially used	0.71
Total	13.13

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

Table 6.3: Primary Structures to be affected

Description	Covered Area (square feet)
Pucca (made of bricks and mortar)	69,431
Semi pucca	85,231
Tin	485,485

Description	Covered Area (square feet)
Kutcha	152,833
Thatched	105,409
Total	898,390

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

Table 6.4: Secondary Structures to be affected

SL No	Description	Quantity
01	Pucca Floor (sft.)	4,025.25
02	Gate (sft.)	1,568.37
03	Mehrab(sft)	459.29
04	Solar Plant(sft)	147.29
05	Bathroom(sft)	571.08
06	Bridge(sft)	11.38
07	Steel Box(sft)	1,342
08	Box Frame(sft)	1,342
09	Tondur Chula/ Burner (sft)	176.40
10	Stage(sft)	146.25
11	Boundary- wall (rft.)	5,561.87
12	Bench (rft.)	483.52
13	Graveyard wall (rft.)	1,398.43
14	Stairs of House (rft.)	643.57
15	Tin made Boundary wall (rft.)	2,510.38
16	Karnechar Pipe (rft)	4,504
17	Pipe (rft)	120
18	Karnechar house (rft)	1,307.79
19	Frame(rft)	1,260
20	Grade Vim (rft)	408.56
21	Pucca Latrine (No.)	61
22	Slab Latrine (No.)	901
23	Kutcha Latrine(No.)	13
24	Tube Well (No.)	20
25	Pillar (No)	550
26	Urinal Place (No.)	4
27	Motor(No)	1
28	Machine(no.)	12
29	Iron(Steel Frame)(No)	4
30	Receiver (No.)	2
31	Koyel(No)	5
32	Acitor (No.)	2
33	Acomitar (no.)	2
34	Stator (No.)	2
35	Oil Seftor (no.)	2
36	Crane (No.)	3
37	Crash Machine (no.)	1
38	Pump (no.)	2
39	Engine (No.)	19
40	Angle (No.)	9
41	Water Point (No.)	6
42	Steel Frame (No.)	336
43	Septic Tank (Cft.)	5,698.16
44	Water Tank (Cft.)	1,326.33
45	Water Filters (Cft.)	317.84
46	Machine Foundation (Cft.)	1,336.36

SL No	Description	Quantity
47	Ice- maker House (cft.)	2,288.00
48	Place of Tank (Cft.)	39.00

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

Table 6.5: Trees to be affected

Types	Big	Medium	Small	Plant	Total
Fruit trees	6,215	9,996	12,304	13,171	**41,686**
Timbers trees	4,566	10,224	14,295	14,221	**43,306**
Medicinal	27	80	59	34	**200**
Banana	6,394	6,472	7,562	7,857	**28,285**
Bamboo	2,409	4,412	4,946	3,219	**14,986**
Total	**19,611**	**31,184**	**39,166**	**38,502**	**128,463**

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

Table 6.6: Common Properties to be affected

Description	Quantity
School/Pathshala	3
College	1
Govt. Office	3
Mosque	29
Grave Yard	2
Cremation ghat	1
Madrashs	3
Somiti	8
Club	3
Party Office	1
Market	1
Majar	1
Tubewell	5
Private Organization	8
Passenger terminal	1
Training Center	2
Total	72

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

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

Mitigation

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

- 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 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

473. 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 Moderate.

6.3.2 Deteriorate environmental quality due to preparation of facilities

Impact

474. Establishment and construction of site facilities in the Polder may potentially cause air and water contamination, noise generation, hindrance to local communities and other similar adverse impacts. Two primary schools, one college and four mosques are located within 50 meter from construction sites of different proposed structures.

475. The significance of this potential impact have been assessed as Major before taking any mitigation measures on the basis of impact magnitude and receptor sensitivity.

Mitigation

476. The following measures will be undertaken to address the above concerns:

- Contractor will prepare site establishment plan and obtain approval from the Detail Design, Construction Supervision and Project Monitoring Support Consultants (DDCS&PMSC).
- Approval from (DDCS&PMSC) will be obtained for the location of temporary facilities.
- Tree felling and vegetation clearing will be minimize to establish site facilities.
- Photographic record will be maintained to record pre-construction condition of the area.
- Site facilities will be established at safe distances from communities.
- Contractor will prepare and implement pollution control and waste management plans.
- No untreated wastes will be released on ground or in water bodies
- Exhaust emissions from vehicles and equipment will comply with standards.
- Vehicles, generators and equipment will be properly tuned.
- Water will be sprinkled where needed to suppress dust emissions.
- Speed limits will be enforced for vehicles on earthen tracks.
- Vehicles and machinery will have proper mufflers and silencers.
- Liaison will be maintained with the communities.

Residual Impacts

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

6.3.3 Increase vehicular traffic during mobilization

Impact

478. During mobilization, 87 equipment and machinery, construction materials and manpower will be transported to the Polder areas resulting additional traffic on roads and in water ways. This traffic may potentially cause traffic congestion particularly in Charduani to Patharghata road. Figure 6.1 shows the road of the project area where such impact is likely to take place. Moreover, important bazaars are located near the embankment among of which Charduani Bazar (Ch 25.54 km), Munshiganj hat (Ch 28.2 km), Maser khal bazar (Ch 29.82 km) and Patharghata Bazar (Ch 33.75 km) will face traffic congestion during “hut” (Weekly local Market) time.

479. The significance of this potential impact have been assessed as Major before taking any mitigation measures on the basis of impact magnitude and receptor sensitivity.

Mitigation measures

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

- 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 and on the days of weekly marketing (Haatbars).
- 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.)
- Provision of training on vehicular traffic moving pattern and management system are to be ensured by the contrctor for the local stakeholders using multimedia presentation and showing videos at different places of the polder especially in the Charduani Bazar, Munshiganj hat, Khalifar hat chowrasta and Patharghata Bazar. These four places are the common population gatherings in the polder area. This training is essential because of safety of the local stakeholders.

Residual Impacts

481. 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.

6.3.4 Change of land use for facilitating labours and other staffs

Impact

482. Land would be needed to establish temporary facilities including construction camp (labor shed) and borrow pit areas. It is estimated that about 33 labor sheds would be constructed to establish temporary facilities for the rehabilitation works. All labor sheds would be constructed in the requisite land (Table 6.8).

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

- Establish all the construction camps within the area owned by BWDB.

- Construct labor shed/camp at government khas land/ non-agricultural land
- Pay compensation/rent if private property is acquired on temporary basis, such instructions should be specified in the tender document.

Residual Impacts

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

6.3.5 Damages of vegetation for preparation of construction sites, labour shed and material stockyards

Impacts:

485. The embankment slopes are vegetated with number of trees herbs and shrubs. Site preparation for labour shed and material stock will damage the 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 construction works.

486. The sites for construction of new sluices need to cut/damage all types of floral species while trenching. Embankment slopes of the polder consists about 140 numbers of trees per acre. It is difficult to count the numbers of small plants exist in at the proposed sites. However, small herbs and shrubs would re-grow naturally within 1 to 2 years after completion of the construction works but woody trees would not grow unless they are re-planted. Following Table (Table-6.7) represents the number of trees to be cut down for construction of new structures:

Table 6.7: List of trees to be cut for construction of new structures

Structure ID	Location	Tree to be cut	
		Species Name	No. of trees
FS1	Patharghata Bazar	Rendi*(Smanea saman)*	6
		Shimul*(Bombax ceiba)*	2
		Taal*(Borassus flabellifer)*	1
		Chambol*(Albizzia richardiana)*	4
		Kulboroi*(Ziziphus mauritiana)*	1
		Mahogany (*Swietenia mahagoni)*	2
FS2	Patharghata Bazar	Rendi*(Smanea saman)*	3
		Chambol*(Albizzia richardiana)*	1
		Kath Badam	1
FS22	Patharghata Bazar	Chambol*(Albizzia richardiana)*	2
		Tentul*(Tamarindus indicus)*	1
		Rendi*(Smanea saman)*	1
DS1	Daskhin Pathorghata	Taal*(Borassus flabellifer)*	16
		Babla*(Acacia auriculiformis)*	1
		Chambol*(Albizzia richardiana)*	3
		Amra (Spondias pinnate)	1
		Shimul*(Cocos nicifera)*	1
FS3	Daskhin Patharghata	No	0
FS4	Paschim Gowharpur	Shimul*(Cocos nicifera)*	2
		Bansh (*Bamboosa spp)*	20
		Khejur*(Phoenix sylvestris)*	3
		Kola*(Musa sp.)*	20
		Taal*(Borassus flabellifer)*	1

Structure ID	Location	Tree to be cut	
		Species Name	No. of trees
		Gewa*(Exocharia agallocha)*	1
DS2	Uttar Gowharpur	Rendi*(Smanea saman)*	2
		Supari*(Areca catechu)*	25
		Narikel*(Cocos nicifera)*	5
		Tentul*(Tamarindus indicus)*	2
		Chambol *(Albizzia richardiana)*	1
		Mehagani*(Swietenia mahagoni)*	2
		Kadom*(Anthrocephalus chinesis)*	6
FS6	Nijlathimara	No	0
FS6_1	Paschim Nijlathimara	Chambol*(Albizzia richardiana)*	2
		Supari*(Areca catechu)*	25
		Rendi*(Smanea saman)*	1
		Kath Badam	1
		Mehagani*(Swietenia mahagoni)*	10
DS3	Choto Lengra, Charduani	Chambol*(Albizzia richardiana)*	2
		Rendi*(Smanea saman)*	3
		Akashmon *(Acacia moniliformis)*	3
		Narikel*(Cocos nicifera)*	2
FS7	Gabbaria, Charduani	No trees existed	
FS8	Paschim Tafalbari	Rendi*(Smanea saman)*	4
		Koroach	1
DS4	Uttar Tafalbari, Gyanpara	Chambol*(Albizzia richardiana)*	40
		Rendi*(Smanea saman)*	20
		Narikel*(Cocos nicifera)*	
DS5	Daskhin Charduani	Rendi*(Smanea saman)*	100
		Chambol*(Albizzia richardiana)*	50
		Khejur*(Phoenix sylvestris)*	30
		Narikel*(Cocos nicifera)*	10
		Aam*(Mangifera indica)*	10
		Taal*(Borassus flabellifer*	5
		Mehagani*(Swietenia mahagoni)*	15
DS10	Kazibari Khal	Taal*(Borassus flabellifer*	4
		Supari*(Areca catechu)*	4
		Bot*(Ficus religiosa)*	2
FS20		Narikel*(Cocos nicifera)*	4
		Kanthal*(Artocarpus heterophyllus)*	5
		Taal*(Borassus flabellifer*	2
		Khejur*(Phoenix sylvestris)*	1
		Shimul*(Bombax ceiba)*	1
		Aam*(Mangifera indica)*	1
DS8		No trees existed	0
DS18		Tentul*(Tamarindus indicus)*	3
		Koroach	4
		Taal*(Borassus flabellifer)*	2
		Khejur*(Phoenix sylvestris)*	2
DS7A	Hoglapasha	Mehagani*(Swietenia mahagoni)*	4
		Chambol*(Albizzia richardiana)*	4
		Shishu*(Dalbergia Sisoo)*	5
		Rendi*(Smanea saman)*	5
		Aam*(Mangifera indica)*	2
		Bansh *(Acacia auriculiformis)*	3
		Khejur*(Phoenix sylvestris)*	3
		Taal*(Borassus flabellifer)*	2

Structure ID	Location	Tree to be cut	
		Species Name	**No. of trees**
		Kath Badam	1
DS7	Saherabad	Babla*(Acacia auriculiformis)*	2
		Chambol*(Albizzia richardiana)*	1
		Akashmoni*(Acacia moniliformis)*	5
		Taal*(Borassus flabellifer*	4
		Supari*(Areca catechu)*	10
		Rendi*(Smanea saman)*	2
		Khejur*(Phoenix sylvestris)*	2
FS14	1 No. Charduani	Mehagani(*Swietenia mahagoni)*	10
		Rendi(*Smanea saman)*	4
		Gaab*(Diospyros peregrine)*	2
		Chambol*(Albizzia richardiana)*	2
		Khejur*(Phoenix sylvestris)*	2
		Jambura (*Citrus grandis))*	1
		Kath Badam	1
FS13	1 No. Charduani	Khejur*(Phoenix sylvestris)*	10
		Narikel*(Cocos nicifera)*	3
		Babla*(Acacia auriculiformis)*	5
		Total	**611**

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

Mitigation:

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

- Make 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 fallow land or barren homestead yards
- Give proper compensation to the tree owners against tree felling.
- Implement tree plantation at the damaged sites after completion of construction works (The species will be locally suitable and not exotic).

Residual Impacts

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

6.4 Impacts during Construction Phase

6.4.1 Increase drainage congestion

Impact

489. The Project activities such as replacements of drainage sluices and flushing sluices in water channels may block or clog water drainage channels, causing drainage congestion in the surrounding areas along Patharghata, Charduani, Hatempur and Gyanparanegatively affecting the cultivation and the associated communities. In addition, excavation of eleven khals in the Polder is likely to disturb the drainage system, takes place through these channels.

490. The significance of this potential impact have been assessed as Major before taking any mitigation measures on the basis of impact magnitude and receptor sensitivity.

Mitigation

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

- Construct diversion channels before replacement of sluices.
- Sequence of works in the regulators and in the water channels will have to be carefully planned to avoid any drainage congestion.
- Contractor will ensure that the drainage channels are not been obstructed or clogged for the construction activities.

Residual Impacts

492. The impacts associated with water logging are likely to be adequately addressed with the help of the above mentioned mitigation measures and the significance of residual impact will be Moderate.

6.4.2 Loss of agricultural crop production

Impact

493. During collection of earth from the Borrow pit areas no agriculture land in the Polder area would be affetcted as all spoil earth would be collected from offshore area and from river bed of Baleshwar and Bishkhali rivers as well as Patharghata, Nalbunia, Munshiganj and Badurtala-Tengra Bharani (Lathi mara Khal) khal etc.

494. In addition, construction activities, movement of construction machinery, project related vehicular traffic, material borrowing, material stockpiling and waste disposal might damage crops or affect the cultivated land.

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

Mitigation

496. The following mitigation measures would be implemented to address the above concerns:

- Compensation would be made for crop damages.
- Avoid standing cropland for machineries movement and material stockpiling.
- Contractor should maintain liaison with farmers.

Residual Impacts

497. The impacts associated with loss of agriculture are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact would be Negligible.

6.4.3 Disturbance of irrigation water conveyance

Impact

498. Construction activities particularly in regulators and sluices in water channels can potentially disrupt irrigation during both wet and dry season causing negative impacts on cultivation, if the construction of regulators and sluices in water channels block these channels, creating problem to the conveyance of water. In addition, excavation of eleven

khals in the Polder also likely to disturb the conveyance system, that takes place through these channels.

499. The significance of this potential impact have been assessed as Major before taking any mitigation measures on the basis of impact magnitude and receptor sensitivity.

Mitigation

500. The following mitigation measures would be implemented to address the above concerns:

- Contractor should develop a diversion channel before construction/demolishing of the regulators.
- Sequence of works for regulators and sluices in the water channels would be carefully planned to avoid disruption in irrigation water sources.
- Contractor should maintain liaison with farmers.

Residual Impacts

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

6.4.4 Disturbance of fish habitat and migration

Impact

502. Construction activities of the sluices can potentially affect the aquatic habitat and fish migration through the khals (Figure 5.9 for fish migration routes in the Polder). Though the fish habitats in these khals have already been modified for the construction of embankments and sluices in 1970s, fish migration between the peripheral rivers and internal khals still take place along those khals. In addition, the fish species including Paisa, Betki, Horina Chingri, Puti and Tengra are reported to move between the internal khals and floodplain during breeding season (mid May to July). During the construction activities, the fish migration between the external 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 be affected. Similarly, fish migration within the Polder between khals and floodplain can also be affected by the construction activities particularly during khal excavation. The significance of this potential unmitigated impact has been assessed as Major.

Mitigation

503. The following measures should be implemented to address the above concerns:

- Construct diversion channels before construction of regulator
- Sequence of work for the regulators and in the water channels will be carefully planned to minimize the impacts on fish and their migration.
- Contractor should maintain liaison with fisherman.
- Release fish fry in the khals inside the Polder after completion of construction works.

Residual Impacts

504. 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.

6.4.5 Damage of benthic fauna

Impact

505. Benthic communities play important role in food chain not only for lentic (standing water) but also for lotic (flowing) water bodies. Construction activities including re-excavation of 10 khals and discharge of solid wastes and waste effluents can potentially impact the benthic communities of the water bodies. As most of the construction activities will be implemented during dry season, benthic fauna would be more vulnerable during this time. It is expected that benthic fauna especially benthic fish species (cheng, chewa, cuchia, baim etc) will be affected during re-excavation of khals.

Mitigation

506. The following mitigation measures are to be implemented to address the above concerns:

- Carry out khal excavation in segment wise to minimize impacts on benthic fauna.
- Release fish fry in the khals inside the Polder after completion of construction works.

Residual Impacts

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

6.4.6 Soil and Water Contamination

Impact

508. Wastes particularly effluents from the working sites may contaminate the soil and water. Construction material, demolished debris, or fuel/oils may enter into the river Baleshwar and Bishkhali or other water bodies causing contamination. The contractor's camps will generate domestic solid wastes and wastewater including sewage. The contractor's workshops will generate oily water, waste oils, oily rags, and other similar wastes. The stores and warehouse will generate solid wastes such as empty cement bags, cardboards, and wooden crates. Moreover, organic waste is produced in workers' shade. Improper disposal of these waste streams can potentially contaminate the soil and water resources of the area. Soil and water contamination can potentially have negative impacts on the local community, natural vegetation, agriculture, and biological resources of the area including aquatic flora and fauna. Borrowing material from the river banks may potentially cause increased turbidity in the rivers. Further, release of effluents, soil, and/or sand in water bodies may increase water turbidity, which would prevent sunlight to enter into the water that is necessary for promoting photosynthesis of aquatic plants.

509. The significance of this potential impact has been assessed as Major before taking any mitigation measures based on impact magnitude and receptor sensitivity.

Mitigation measures

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

- Contractor will prepare and implement pollution control plan;
- Contractor will supply proper separate bins for collection of inorganic and organic waste and dispose them properly, which would require awareness building of construction work force;

- Contractor workshops will have oil separators/sumps to avoid release of oily water;
- Contractor will use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination;
- Contractor will dispose contaminated soil appropriately ensuring that it will not contaminate water bodies or affect drinking water sources;
- Ensure that there is no leakage, spillage or release of fuel, oil or any other affluent/wastes on the ground or in the water from its construction machineries, vehicles, boats, launches and barges. Contractor will regularly monitor the condition of its 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);
- Not release untreated wastes on ground or in water;
- Contractor will re-use spoil and excavated material where possible;
- 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

511. 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.

6.4.7 Generate noise and vibration

Impact

512. 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, camp sites may also generate noise.

513. 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 schools 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.

514. The significance of this potential impact have been assessed as Major before taking any mitigation measures on the basis of impact magnitude and receptor sensitivity.

Mitigation measures

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

- 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) are to be ensured for the labors.
- The construction crews will be instructed to use the quality 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.

Residual Impacts

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

6.4.8 Increase inland and waterway Traffic

Impact

517. Transportation of construction materials is a key concern during the Project activities as the Polder- 40/2 is located in a remote area of Barguna. A couple of options are available for carrying construction materials to the project stockyards in the Polder. The first option would involve water way transportation along Baleswar River from the Khulna/Mongla port to the Polder sites. Water vessels would be used for carrying materials in this case. The second option would involve directly road transportation from Khulna to the Polder.

518. Material transportation along the major roads and waterways may not create significant problem; however, additional traffic at smaller ferry ghat such as that in Charkhali ferry jetty (ghat) may cause traffic congestion and hindrance to other commuters, travelers, and transporters. Increased amount of waterway traffic would also increase the noise level of the area.

519. The significance of these potential impacts has been assessed as Moderate before taking any mitigation measure based on impact magnitude and receptor sensitivity.

Mitigation measures

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

- Contractors are to prepare and implement traffic management plan.
- Contractors are to establish new, temporary jetties as and where needed
- River crossings for material transportation should be made during night time where possible and appropriate.
- Liaison to be maintained with community.

Residual Impacts

521. The impacts associated with additional traffic on roads and water ways 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 construction activities due to natural hazards

Impact

522. Historically, this area is vulnerable to cyclone, storm and tidal surges. As per construction schedule, the development activities of the polder will be conducted from October to May when most of the cyclone and storm surges occur in this area. According to previous record 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 hamper as well as the workers may have injuries.

523. The significance of this potential impact has been assessed as Moderate before taking any mitigation measures on the basis of impact magnitude and receptor sensitivity.

Mitigation measures

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

- Workers' shed to be kept safe enough to withstand natural calamities.
- Weather signals will have to be considered by the contractors and contractors will be responsible for developing the awareness among the lebors during constructions.
- Labour sheds should be equipped with signal receiver (radio, television etc)
- Local announcement (miking) through related organization (Red Crescent/ Red Cross) must be ensured at the time of disaster.
- Overall, a disaster management program should be run by implementing agency.

Residual Impacts

525. 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.

6.4.10 Damages of embankment slopes vegetation for re-sectioning

Impacts:

526. Embankment re-sectioning will cause undergrowth vegetation damage both at embankment slopes and at the sites from where soil would be collected. Most of the plant species at the proposed sites are seasonally grown and 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. Cutting of existing large trees at the embankment slopes will try to be avoid. For this reason, this negative impact is temporary and recoverable.

Mitigation:

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

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

Residual Impacts

528. With the help of above mitigation measures, the impacts associated with re-section of embankment will have no residual impact.

6.4.11 Damages of vegetation at embankment site and construction yards for bank revetment works

Impacts:

529. Minor vegetation damage is expected at the proposed bank revetment sites. As most of the tall trees at proposed sites have already felled while embankment slopes were damage, so no/few big tree is exist there. For this reason, few/no tree damage is expected for slope raising or placing of geo textile. Only seasonal undergrowth vegetation (i.e: grasses and wild herbs) would be damaged in most cases permanently, where CC blocks would be placed.

Mitigation:

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

- To choose barren land for CC Block manufacturing and material storing.
- To implement plantation with native species at countryside slope of the embankment to address vegetation loss

Residual Impacts

531. The impacts associated with revetment of embankment with the help of above mitigation measures can be address and the significance of the residual impacts will be low.

6.4.12 Loss of marginal vegetation of khals for re-excavation

Impacts:

532. Re-excavation of khal will damage existing marginal vegetation of Nijlathimara Khal, Mulaniar Khal, Boroitala Khal, Kazibarir Khal, Maser Khal, Hoglapasha Khal and Charduani Khal for withdrawal of soil from khal bed. In addition, the right of the way for excavator/labour movement as well as spoil dumping along the both sides of khal bank will also damage the existing vegetation (Figure-6.1). However, most of the marginal vegetation is grown seasonally and will regrow within few years after completion of re-excavation activities.

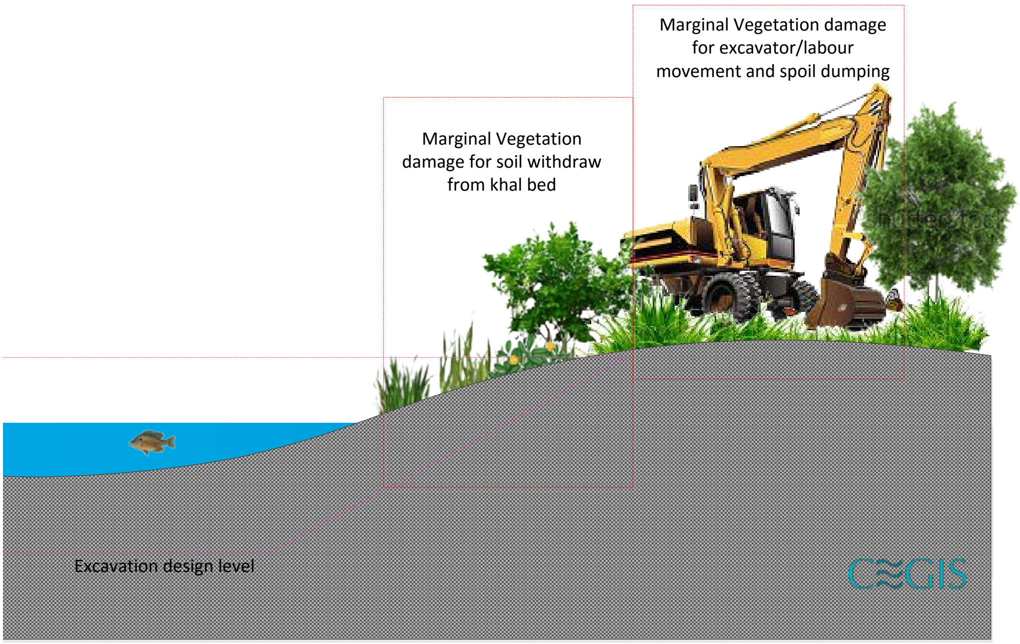


Figure 6.1: Probable ecological impact for Khal re-excavation

Mitigation:

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

- 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
- Implement plantation along the dumping sites with indigenous plant species

Residual Impacts

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

6.4.13 Loss of vegetation at construction sites of water control structures

Impacts

535. Major impact for construction of Drainage Sluice/Flushing Sluice is tree felling and damages of undergrowth vegetation, which would take place during site preparation at pre-construction phase. Besides, there would be additional vegetation damage at construction sites for labour and construction vehicles movement.

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

Mitigation

- Use low vegetative land for labour and construction vehicle movement. The following mitigation measure is being suggested to address the above concerns:
- Aware labours about plant conservation

Residual Impacts

537. With the help of above mitigation measures, the impacts associated with construction of drainage sluice/Flushing sluice will have low residual impact.

6.4.14 Interruptions on foreshore plants for coastal afforestation

Impacts:

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

Mitigation:

- Aware labours about plant conservation who are engaged for afforestation activities
- All kinds of polyethylene bags and plastic ropes should be piled up in a pit for dumping or burning in a proper way
- Care should be taken for physical and biological control of plant disease while nursery raising and sapling plantation (i.e.: using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers)
- Pre-consultation with Forest Department and other related non-government organizations for selecting of suitable species for plantation and spacing of the saplings
- Develop a pest management plan for the holistic afforestation
- Collect saplings from nearer natural source (i.e: from mangrove forest at western bank of Baleswar River) as much as possible.

Residual Impacts

539. The impacts associated with coastal afforestation will have no residual impact with the help of above mitigation measures

6.4.15 Impact on Sundarbans Reserve Forest

540. No impact to the wildlife of Sundarbans Reserve Forest is apprehended, which is located more than 2.5 km west from the polder boundary. There are two major causes for this issue; one, the existence of wider river (Baleswar) between the polder and the forest, the two refers to non-possibility of noise pollution. Noise, which would be generated from the construction machinery, is expected to be neutralized at before the forest zone due to long distance. Moreover, wildlife of this forest is already used to the noise of existing movement of Fishing boats, cargoes etc. and the expected sound is not more than the noise from water vessels. As the Baleshwar and Bishkhali rivers are tidal in nature and there is no remarkable pollutant in existing water, the negligible amount of suspected effluents from construction activities will be neutralized and no harm is apprehended to nearby forest areas.

6.4.16 Disturbance of local communication

Impact

541. A number of local people use this embankment as road for carrying their goods for buying and selling and other purposes. The construction activities along the embankments will also cause temporary disturbance in the movement of local people. The internal roadways are not sufficient enough to provide alternate means of transportation. Mobilization of equipment, machinery, material and manpower will be transported to the Polder resulting additional traffic on roads and in water ways. This traffic may potentially cause traffic congestion particularly in water ways.

542. Road communication system will deteriorated in construction period, it may create disturbance in local road communication during this phase. Moreover, some part of road infrastructure may be damaged within local community may require repairmen. So, suffering of people will emerge temporary among the local people.

Mitigation

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

- Re-sectioning work should be done segment wise
- 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 in segment wise and soil will be placed along the half of the embankment, leaving the other half to be used for vehicles. The other half will be implemented in the similar way.
- Work schedule will be finalized in coordination and consultation with local representatives and communities.
- Water way can be used especially along the river during construction period
- Earth work for re-section of embankment can be shorted for easy movement of local people.
- All works will be conducted in presence of Union Parishad Chairman and members.
- Project Implementation Officer (PIO) will be informed during construction and completion of earth works of embankment.

Residual Impacts

544. The impacts on the social resources are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Low.

6.4.17 Affect on social and gender issues

Impact

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

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

Mitigation

547. The following measures will be implemented to address the above 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 with the communities will be maintained.
- 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.
- Careful use of local natural resources and project resources, fuel, fuel-wood and electricity;
- Restrictions related to consumption of alcohol and drugs;
- Safe driving practices;
- Respect for the local community and its cultural norms in which laborers are working.
- Prayer time should be allowed for the construction workers **Residual Impacts**

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

6.5 Impacts during Post-Construction Phase

6.5.1 Increase sedimentation in water channels and rivers

Impact

549. Sedimentation problem in the external rivers of Bishkhali and Baleswar will be raised due to absence of silt management plan under feasibility study. Sediment may be deposited on the intake of regulator which may create further drainage problem inside the polder for lack of proper sediment management

550. The significance of this potential impact have been assessed as Major before taking any mitigation measures on the basis of impact magnitude and receptor sensitivity.

Mitigation measures

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

- The beneficiaries of a specific khal will re-excavate the khal if there is any problem of drainage congestion and sedimentation faced by them and this will be an ongoing process. Sediment should be removed from intake of regulator as well as connecting channels.
- The local government (union parishad) will be authorized to monitor the development activities.
- Prepare Bangla manual for sluice gate operation and provide trainings to WMOs; and
- Reduce conflicts between farmers and fishermen.

Residual Impacts

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

6.5.2 Increase use of agro-chemicals

Impact

553. At present, about 7 ha and 500 ha of lands are under Boro (HYV) and T. Aus (HYV) rice cultivation respectively. Presently, about 168,250 kg of chemical fertilizers and 2056 kg of granular pesticide and 355.6 litres of liquid pesticides are used. After implementation of the project interventions, especially re-excavation of khals would result in expansion of area under irrigated cultivation of Boro (HYV) and T. Aus (HYV) crops. It is expected that in total about 1,604 ha, of which 409 ha of Boro (HYV) and 1,195 haof T. Aus (HYV) would come under irrigated cultivation (Table 6.8). The expansion of irrigated crop area would increase use of chemical inputs including fertilizers and pesticides. It is estimated that additional 331,935 kg of fertilizers, 5,996 kg or granular pesticides and 808.1 litres of liquid agrochemicals would be required for the agricultural practices after the rehabilitation of the polder **(Table-6.8).** The residual of agrochemicals may degrade the soil quality. Moreover, runoff of residual agrochemicals in the water bodies will deteriorate water quality.

Table 6.8: Impact on Area (ha), Fertilizers (kg) and Pesticides (kg/ml) required in Present and Future Situation

Crop name	Present cultivate Area (ha)	Fertilizer required (kg/ha)	Granular pesticides required kg/ha	Liquid pesticide required ml/ha	Total Fertilizer required (kg)	Total granular pesticides require (kg)	Total liquid pesticides require (ml)	Future cultivated area (ha)	Increased Area(ha)	Total future fertilizer required (kg)	Total future granular Pesticides (kg)	Total future liquid pesticides required (ml)	Impact		
													Fertilizers (kg)	Pesticides (kg)	Pesticides (ml)
T. Aus(HYV)	500	333	4	700	166,500	2,000	350,000	1,195	695	397,935	4,780	836,500	231,435	2,780	486,500
Boro(HYV)	7	250	8	800	1,750	56	5,600	409	402	102,250	3,272	327,200	100,500	3,216	321,600
Total	**507**	**583**	**12**	**1,500**	**168,250**	**2,056**	**355,600**	**1,604**	**1,097**	**500,185**	**8,052**	**1,163,700**	**331,935**	**5,996**	**808,100**

Source: Feasibility report (Agriculture), CEIP-I and Data/information collected from field; 2015

554. The significance of this potential impact have been assessed as Major before taking any mitigation measures on the basis of impact magnitude and receptor sensitivity.

Mitigation

555. The following measures would be implemented to address the above concerns:

- Practice various measures of Integrated Pest Management (IPM) and Integrated Crop Management (ICM) to minimize usage of agro-chemical inputs through training and awareness raising of the farmers.
- Farmers group should have close contact with DAE for adoption of various measures of IPM/ICM.
- Farmers would be encouraged to prepare and use organic manure to increase soil fertility while avoiding water contamination.
- Farmers would be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.

Residual Impacts

556. Impacts associated with usage of increased level of chemical inputs are likely to be somewhat addressed with the help of above mitigation measures and the significance of residual impact will be Moderate.

6.5.3 Hampers fish migration

Impact

557. Replacement of drainage sluices on water channels, which are currently directly connected with the peripheral rivers, will potentially result in reduction in fish migration. This can potentially result in decrease of fish population in the Polder (thus adversely affecting the fish catch and fishermen.

Mitigation

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

- Sluice gate should properly operate for allowing fish migration especially during both full and dark moon period.
- Provide training to WMOs regarding operation of sluices;
- Pond culture demonstration should introduced to disseminate the fish culture knowledge to the pond owners.

Residual Impacts

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

6.6 Positive Impact of the Project (Operation Phase)

6.6.1 Reduce drainage congestion, flooding and salinity

560. The proposed interventions, re-sectioning of embankment and replacement and repair of structures would protect the polder 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. These would increase the area of cultivation thus increase crop production as well as create opportunity for employment generation.

561. ***Change of land type*** Presently, maximum (47.1%) study area is under $_{F1}$ land type of the NCA which is followed by $_{F0}$ (32.7%) and FF (19.1%) land type (Table 6.9). 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,F1 and F2 land type area will be reduced by 8.7%, 46.1% and1.1% respectively. According to Institute of Water Modellling (IWM), around 55.9% would be under FF land type that is followed byF0, F1and F2 land type respectively.

Table 6.9: Changing land type of the Polder area

Land Type	Baseline/FWOP		FWIP		Impact (FWIP-FWOP)
	Area(ha)	% of NCA	Area(ha)	% of NCA	
FF	631	19.1	2,475	75	+55.9
F_0	1,079	32.7	792	24	-8.7
F_1	1,554	47.1	33	1	-46.1
F_2	36	1.1	-	0	-1.1
F_3	-	0.0	-	0	0.0
F_4	-	0.0	-	0	0.0

Land Type	Baseline/FWOP		FWIP		Impact (FWIP-FWOP)
	Area(ha)	% of NCA	Area(ha)	% of NCA	
Total	**3,300**	**100**	**3,300**	**100**	**0**

Sources: IWM, 2015

6.6.2 Changing cropping pattern and intensity

562. Presently, cropping intensity of the polder area is 153%. 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 be encouraged to cultivate more crops in their lands. Thus, it is expected that cropping intensity would beincreased to 227% in the polder area in future (Table 6.10). Thus, increase of cropping intensity of the polder area would be about 74% from the base situation.

Table 6.10: Future cropping patterns of the Polder area

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Area (ha)	% of NCA
HIgh land (FF)	Orchard	Cont'd	Cont'd	113	3.4
	S. Vegetables	T. Aman (HYV)	Potato	410	12.4
	Fallow	T. Aman (Local)	W. Vegetables	268	8.1
	T. Aus (Local)	T. Aman (HYV)	Spices	83	2.5
	T. Aus (HYV)	T. Aman (HYV)	Potato	531	16.1
	T. Aus (HYV)	T. Aman (Local)	Chili	188	5.7
	T. Aus (HYV)	T. Aman (Local)	W. Vegetables	287	8.7
	Fallow	T. Aman (Local)	Fallow	594	18
			Sub total	**2,475**	**75**
High land (F_0)	T. Aus (Local)	T. Aman (HYV)	Fallow	73	2.2
	Fallow	T. Aman (HYV)	Boro(HYV)	383	11.6
	T. Aus(HYV)	Fallow	Pulses	73	2.2
	Fallow	T. Aman (HYV)	Pulses	149	4.5
	T. Aus (HYV)	T. Aman (HYV)	Wheat	116	3.5
			Sub-total	**792**	**24**
Medium high land(F_1)	T. Aus (Local)	Fallow	Oil seeds	7	0.2
	T. Aus(Local)	Fallow	Boro(HYV)	26	0.8
			Sub total	**33**	**1**
			Total	**3,300**	
Cropping Intensity(%)= 227 %					

Sources: FeasibilityReport-Agriculture, CEIP, 2012 &Field information, June;2015 and IWM, 2015

6.6.3 Increased crop production

563. Presently, total cropped area is about 5,055 ha of which rice cropped area is about 3,774 ha and non-rice cropped area is about 1,281 ha. Total annual crop production is about 19,531 metric tons of which rice is about 8,678 metric tons and non-rice is about 10,852 metric tons (Table6.11).

564. Total cropped area would increase if the project were implement in future. Total cropped area would be about 7,507 ha of which rice cropped area would be about 4,872 ha

and non-rice cropped area would about 2,635 ha. On the other hand, total crop production would boost up significantly under the FWIP condition. The total annual crop production would be about 56,171 metric tons of which rice and non-rice would be about 17,821 and 38,350 metric tons respectively. Rice production would increased due to expansion of T. Aus (HYV), T. Aman (Local), T. Aman (HYV), Boro (HYV), and non-rice crops, especially chilli, potato, summer and winter vegetables will increase production. Additional 9,143 metric tons of rice and 27,497 metric tons of non-rice crops would produced annually in the polder area **(Table 6.11).**

Table6.11: Impact on cropped area and production of the Polder area

Crops name	Present /FWOP crop area, yield and production			Future crop area, yield and production			Impacted area (ha)	Impacted production (m. tons) (FWIP-FWOP)	% of Change of production
	Cropped area (ha)	Yield/ ha (mt)	Production (mt)	Cropped area (ha)	Yield/ ha (mt)	Production (mt)			
T. Aus (Local)	222	1.6	355	188	2	376	-34	21	6
T. Aus (HYV)	500	2.7	1,350	1,195	3.6	4,302	695	2,952	219
T. Aman (Local)	1,328	2	2,656	1,337	3.5	4,680	9	2,024	76
T. Aman (HYV)	1,717	2.5	4,293	1,743	3.8	6,623	26	2,331	54
Boro (HYV)	7	3.5	25	409	4.5	1,841	402	1,816	7412
Total rice	**3,774**	**0**	**8,678**	**4,872**	**0**	**17,821**	**1,098**	**9,143**	**105**
Wheat	116	5	580	116	7	812	-	232	40
Chili	73	1.25	91	188	1.6	301	115	210	230
Pulses	240	1.5	360	222	2	444	-18	84	23
Potato	196	14.5	2,842	941	19.5	18,350	745	15,508	546
Orchard	113	12.5	1,413	113	14.5	1639	-	226	16
S. Vegetables	146	12.5	1,825	410	15	6,150	264	4,325	237
W. Vegetables	268	12.5	3,350	555	18.5	10,268	287	6,918	206
Spices	103	3.5	361	83	4.5	374	-20	13	4
Oilseeds	26	1.2	31	7	2	14	-19	-17	-55
Total non-rice	**1,281**	**0**	**10,852**	**2,635**	**0**	**38,350**	**1,354**	**27,497**	**253**
Total	**5,055**	**0**	**19,531**	**7,507**	**0**	**56,171**	**2,452**	**36,641**	**188**

Source: Field information, June; 2015

6.6.4 Increase employment generation

565. The construction work including re-sectioning of embankment, re-excavation of khals, construction and repairs of sluices, afforestration etc. will generate a significant amount of employment over its construction period. About 5,000 skilled and 25,000 unskilled labours will be needed for implementation of the project. On the other hands, employment opportunity will be created especially in agriculture sector due to expansion of crop area during operation of the project. Annually 212,160 man-days additional employment opportunity will be created in agriculture sector during operation of the project. The employment generation represents different ways of livelihood by which people can generate their income and improve their living standard.

6.6.5 Accessibility of social use of water

566. 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 become dried up. As a result, people cannot avail water for their social needs. Hence, re-excavation of those canals /khals will ensure improvement in provision of water to the local consumers.

6.6.6 Reduce disaster incidence

567. The study area being near to the Bay-of-Bengal, natural disaster often hit this area due to lack of proper protection measure and thus the people of this locality are very much vulnerable. There is no protection of lives and properties against different natural disaster. With the implementation of the proposed interventions in polder area, local people and the area will be saved from different natural disasters like tidal surge, river erosion, flooding etc.

6.6.7 Increase foreshore vegetation area for afforestation

568. Implementation of afforestation programme of this polder will mitigate negative impacts associated with tree felling. Consequently, foreshore afforestation will enhance mangrove vegetation coverage surrounding the polder that is expected to protect embankment from tidal surge, reduce erosion of foreshore land and provide habitats especially for various avifauna (i.e.: Egrets, Herons, Bee eaters, Sandpipers, Owls/owlets, Kingfishers, Sparrows, Wagtails, Sunbirds, Babblers, Starlings), reptiles (i.e. Garden Lizard, monitors, pit viper), mammals (i.e. Bats, flying fox and pipistrelle, jackal, spotted deer, monkeys) and fishes.

6.7 Risk Assessment

6.7.1 Risk of embankment failure

Impact

569. Rain cuts, wave action, tidal surges and public cuts are the major causes of embankment breaching of the coastal region. Lack of regular maintenance creates weak points at the sensitive locations of the embankment. Inadequate maintenance and increasing intensity and magnitude of the cyclones and storm surges simultaneously accelerate the risk of embankment failure. A very low setback distance in some part of eastern embankment (Ch 0.75 km to 03.20 km) along Bishkhali River and western embankment (Ch 11.60 km to ch 21.50 km) along the Baleswar (Kocha) river made them more susceptible to breaches.

570. The significance of this potential impact have been assessed as Major before taking any mitigation measures on the basis of impact magnitude and receptor sensitivity.

Mitigation measures

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

- Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the western side of the Polder will have to be ensured. This monitoring will particularly be carried out before and after monsoon season.
- Available cyclone and flood shelter will have to be prepared as a contingency measure for emergency.

- Structural measures like geo bag and sand bag will be stored in the Upazila office for emergency requirement.

Residual Impacts

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

6.7.2 Function of Water Management Association (WMA)

573. The coastal Polder 40/2 was built in 1963. 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 watermanagement 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.

574. 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 and Mitigations

575. Summary of these impacts and their significance as discussed in the sections above is presented in **Table 6.12**

Table 6.12: Significance of Negative Environmental Impacts

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
A. Pre-construction Phase								
Damages of properties due to Project Intervention and Land Acquisition	Mainly Short term with some long term	Local	Reversible	Certain	High	Major	Compensation will make prior to construction in accordance with RAP. Contractor will maintain liaison with communities. Grievance Redress Mechanism (GRM) will be established. Follow ‘Find Chance’ procedures for common property resources.	Modertae
Deteriorate environmental quality due to preparation of facilities	Short term	Local	Reversible	Certain	High	Major	Contractor will prepare site establishment plan and obtain approval from the DCSC Approval fromDCSC will be obtained for the location of temporary facilities. Tree felling and vegetation clearing will minimized to establish site facilities. Photographic record will maintained to record pre-construction condition of the area. Site facilities will established at safe distances from communities. Contractor will prepare and implement pollution control and waste management plans. No untreated wastes will released on ground or in water. Exhaust emissions from vehicles and equipment will comply with standards. Vehicles, generators and equipment will	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							properly tuned. Water will sprinkled where needed to suppress dust emissions. Speed limits will enforced for vehicles on earthen tracks. Vehicles and machinery will have proper mufflers and silencers. Liaison will maintained with the communities.	
Increase vehicular traffic during mobilization	Short term	Local	Irreversible /Reversible (after construction phase)	likely	High	Major	The movement of vehicles in the polder area and on the embankment should be restricted during off peak time. No vehicular movement should made during school time and on the days of weekly marketings (Haatbars). Regular liaison to 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.) Provision of training on vehicular traffic movement pattern and management system are to be ensured for the local stakeholders using multimedia presentation and showing videos at different places of the polder especially in the Charduani Bazar, Munshiganj hat, Khalifar hat chowrasta and Patharghata Bazar. These four places are the common population gatherings in the polder area. This training is much needed for safety of the local stakeholders.	Low
Change of land use for	Short term	local	Reversible (after	Certain	Minor	Low	Establish all the construction camps within the area owned by BWDB.	Very low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
facilitating labours and other staffs			construction phase)				Construct labor shed/camp at governmentkhas land. Pay compensation/rent if private property acquired on temporary basis, such instructions should be specified in the tender document.	
Damages of vegetation for preparation of construction sites, labour shade and material stack yards	Short term	Local	Reversible (after construction phase)	Likely	Medium	Moderate	Make 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 stcakyard by using nearer fallow land or barren homestead yards Give proper compensation to the tree owners against tree felling. Implement tree plantation at the damaged sites after completion of construction works	Low
B. Construction Phase								
Create drainage congestion	Short term	Local	Reversibility	Likely	High	Major	Construct diversion channels before replacement of sluices. Sequence of works in the regulators and in the water channels will be carefully planned to avoid any drainage congestion. Contractor will ensure that the drainage channels are not been obstructed or clogged for the construction activities including stacking of construction materials.	Moderate
Loss of agriculture crop production	Short term	Local	Reversible	Likely	Minor	Low	Compensation would be made for crop damages. Avoid standing cropland for machineries movement and material stockpiling. Contractor should maintain liaison with	Negligibl e

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							farmers.	
Disturbance of irrigation water conveyance	Short term	Local	Reversible	Certain	Minor	Low	Contractor should develop a diversion channel before construction/demolishing of the regulators. Sequence of works for regulators and sluices in the water channels would carefully planned to avoid disruption in irrigation water sources. Contractor should maintain liaison with farmers.	
Generate Noise and Vibration	Short term	Local	Reversible	Likely	Medium	Moderate	Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards. Quality Vehicles and machinery to be used and will have proper mufflers and silencers as and when needed Provision of noise barriers to provided at educational institution and other sensitive receptors, as needed. Provision of PPE (ear muffs and plugs)are 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.	low
Disturbance local community	Short term	Local	Reversible	Likely	Medium	Moderate	Re-sectioning work should be done segment wise Temporary arrangement of boat for navigation, and need to construct alternative	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							way such as temporary footpath for road communication with provision of proper sign and signal The embankment works will be carried out in segment wise and soil will be placed along the half of the embankment, leaving the other half to be used for vehicles. The other half will be implementd in the similar way Work schedule will be finalized in coordination and consultation with local representatives and communities. Water way can be used especially along the river during construction period Earth work for re-section of embankment can be shorted for esy movement of local people. All 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.	
Disturbance of construction activities due to natural hazards	Short term	Local	Reversible	Likely	Medium		Weather signals will have to be considered by the contractors and contractor will be responsible developing the awareness among the lebors during constructions. Labour sheds should be equipped with signal receiver (radio, television, etc) Local announcement (miking) through related organization (Red Cresent/ Red Cross) must be ensured at the time of disaster. Overall, a disaster management program should be run by implementing agency.	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
Disturbance of fish habitat and migration	Short term	Local	Reversible	Likely	High	Major	Construct diversion channels before construction of regulator Sequence of work for the regulators and in the water channels will be carefully planned to minimize the impacts on fish and their migration. Contractor should maintain liaison with fisherman. Release fish fry in the khals inside the Polder after completion of construction works.	Low
Damage benthic fauna	Short term	Local	Reversible	Likely	High	Major	Carry out khal excavation in segment wise to minimize impacts on benthic fauna. Release fish fry in the khals inside the Polder after completion of construction works.	Low
Damages of vegetation at embankment site and construction yards for bank revetment works	Short term	Local	Reversible (after construction phase)	Occasional	Medium to high	Major	To choose barren land for CC Block manufacturing and material storing. To implement plantation with native species at countryside slope of the embankment to arrest vegetation loss	Low
C. Post Construction Phase								
Increased Sedimentation in Water Channels and Rivers	Long term	Local	Reversible	Likely	High	Major	The beneficiaries of a specific khal will re-excavate the khal if there is any problem of drainage congestion and sedimentation faced by them and this will be an ongoing process. Proper land zoning plan will be prepared in the Polder for controlling unplanned development works. For this purpose the	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							SRDI or Agriculture Extension Office of Bangladesh should take further research. The local government (union parishad) will be authorized to monitor the development activities. The development authorities of Bangladesh will undertake proper training program in connection with land zoning and monitoring system. 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.	
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 procedures will be translated in bangla as well. Capacity building of WMOs will be carried out.	Negligible
Reduced Fish Migration Time and Extent	Long term	Local	Reversible	Likely	High	Major	Proper sluice gate operation allowing fish migration. Provision of training to fishermen; Transferring juvenile fish from rivers to Polder.	Low
Increase used of agro-	Long term	Local	Reversible	Likely	High	Major	Capacity building and awareness rising of the farmers would be carried out to practice	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
chemicals							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 prepare and use organic manure to increase soil fertility while avoiding water contamination (Training of farmers to be arranged). Farmers should be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.	

6.9 Enhancement Measures

576. The flap gate does not have any boat pass facilities for transportation of goods and other activities inside the polder area and vice-versa. Before construction of polder with flap gate, this khal had navigation facilities. Presently the navigation system has been disrupted. Local people demanded that there should have a provision for navigation route near the sluice gate of Gyanpara khal which will facilitate to carry fish and other commodities near the landing center (inside the polder) easily. It may be mentioned that the objective of the polder was to grow more agricultural production by preventing salt water intrusion inside the polder and facilitate damage of storm water of the polder through a flap gate. However, the agricultural practices in the polder area will be hampered due to salt water intrusion during boat passing. The impact magnitude of agriculture will be greater than that boat pass because a few number of navigation may be operated a week. The boat travel distance is very short i.e. about 20 meters only from the outside of the polder and the operation of boat pass would not be very frequent of make it economically valuable as the road communication inside the polder is quite good for transportation. Moreover, the economic and social benefit for boat pass will be much less than agricultural issue due to salinity intrusion.

7 Analysis of Project Alternatives

577. The chapter will analyze various alternatives including 'No Project Alternative' aiming to develop a lucid concept of consequences emerging with the project by delineating associated parameters even across the social and environmental context.

7.1 'No Project' Alternative

578. The 'no-project' option provides a clear concept of status of the Polder and outlines the necessities of the proposed interventions under CEIP-1. The polder is extremely vulnerable 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.

579. The proposed interventions for Polder- 40/2 under CEIP-1 are aimed to eliminate the major problems described above. To highlight 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**.

580. *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 40/2

581. 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
Re-sectioning of embankments (35.58 km) with design crest level **(6.00 m PWD and 5.00 m PWD)**	A certain number of points of the embankments will 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 area, causing severe damage to lives and property of local people.	Re-sectioned embankments would be more effective and resilient and safeguard the polder against storm surges, floods, salinity and high tides due to global warming. Hence, loss of lives and assets caused by the natural disasters will reduce.
	The submergence of the embankments during monsoon, transportation system will further deteriorate inside the Polder, and increase the sufferings of local people.	Re-sectioned embankments will enhance protection to the Polder, facilitating transportation within the Polder even during monsoon.
	Reduce agricultural area and crisis situation for farmers will be more from Januaryto April (salinity intrusion) and May to August (flooding).	Re-sectioned embankments will ensure stability of the Polder and facilitate enhanced agricultural activities, increased area for cultivation, thus increasing agriculture production.

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
	Silt deposition inside the Polder will be continued due to cyclonic surges and floods would increase and cause water logging, drainage congestion and other associated problems.	Decrease silt deposition in the Polder and result improved drainage and navigation in the internal lakes/khals, increase usage of surface water for irrigation, and reduce 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 more land resources would be damaged or lost.	Bank revetment will provide enhanced protection against erosion by wave action, storm surges and currents, and will protect the Polder along with land and agriculture resources.
	There will be more 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)	Subsidence of embankments due to traffic load and wave action; land resources would continue.	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.	Continues use of the existing drainage sluices for both flushing and drainage would further damage the structures. As a result, water logging and drainage congestion would increase 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 will introduced due to lack of sweet water during the periods of low rainfall.	Replaced flushing sluices will facilitate better agriculture practices, increase dry season rice cropping, and reduce 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 increase 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 mitigated to a certain extent, reducing the loss of lives and assets.
Re excavation of Drainage Channels (36.7 km)	Depth of water would further decrease, and drainage congestion and water logging would further increase.	Depth of water bodies will increase, water logging and drainage congestion will decrease and fish habitats will increase.

7.2 Site Selection Alternatives

582. Since CEIP-1 is a rehabilitation project, no site alternatives are considered. However, a comprehensive multi-criteria analysis was carried out to prioritize the polder rehabilitation under CEIP-1. The analyzed result of Polder ispresented in Table 7.2 and results of all 139 coastal polders are presented in **Appendix D**.

Table 7.2: Results of Multi-Criteria Analysis to Prioritize Polder Rehabilitation

Criteria		Mark Obtained
Polder No	40/2	
Type of Dyke	SD, ID, MD	
Location of the Polder	Patharghata	
Gross Area of the Polder (HA)	4453	
Embankment Length (Km)	36	
Breach of Embankment (Km)	-	0
Erosion (Km)	-	0
Requirement of BPW (Km)	-	0
Location in the Risk Zone	MRZ	10
Drainage Congestion (HA)	0	0
Opinion of Stakeholder (marks, MV=15, MDV=10, LV=5)	MV	15
Rehabilitation Cost (Crore BDT)	85	10
Special Criterion		0
Total Marks		35

Notes:

a) Rate of marks = Full marks allotted for the criterion against highest quantity of the criterion except "Rehabilitation Cost".

b) Negative marks has been allotted in case of "Rehabilitation Cost" exceeding $30 Million (210 Crore BDT).

c) HRZ = High Risk Zone, MRZ = Medium Risk Zone, LRZ = Low Risk Zone.

d) MV = Most Vulnerable, MDV = Medium Vulnerable, LV = Less Vulnerable.

e) SD = Sea Dyke; ID = Interior Dyke; MD = Marginal Dyke.

f) BPW = Bank Protective Work.

g) Rehabilitation Cost considers embankment section with one meter extra height over the existing designed level.

h) Special Criterion indicates territory loss due to erosion of polders located in border area.

7.3 Technical Alternatives

583. The problems are being faced by the Polder and the inhabitants of the polder have identified several technical alternatives based on the problems they faced earlier which are considered accordingly. These alternatives include the strengthening the Polder embankment, protection of riverbanks, protection of embankment slope, improvement the sluices and their performance and reducing drainage congestion and water logging. These technical alternatives are discussed in **Table 7.3** below:

Table 7.3: Technical Alternatives for Polder-40/2

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 in earlier) to be further vulnerable
	Retirement/relocation of the existing embankment, as and where required	The Project objectives will partially beachieved. No protection against storm surges and seawater 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, resilient and will safeguard the Polder against storm surges, floods and higher tides due to global warming. Hence, there will be 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 in earlier).
	Retirement of embankment	The Project objectives will be partially achieved of decrease in Polder area and continued erosion of the riverbank.
	Bank Revetment (selected option)	Bank revetment will provide enhanced protection against erosion by wave action, storm surges and currents and will protect thePolder and its land/agriculture resources.
Protection of embankment slope (against wave action)	No change in the existing embankment	Continuously weakening and subsidence of the embankments due to traffic load and wave action; land resources would continue to be damaged/ lost (similar to the 'no project' scenario discussed in earlier).
	Slope protection (selected option)	Slope protection works will strengthen the embankments and protect them against subsidence, wave action and wear and tear.
	Foreshore plantation (selected option)	Effects of cyclone surge, wave action and wind could mitigate to some extent, reducing loss of lives and assets.
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 increased due to malfunctioning of the sluices (similar to the 'no project' scenario discussed in earlier).

Proposed Interventions	Alternative Options	Consequence
	Repairing of structures (possible where there is no need of re-sizing) (selected option for some structures)	For sluices, which are beyond any repair, works 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 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, as sweet water cannot 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 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.
Reducing 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 decreased and fish habitats will increase.

584. Technical, Financial, Economic, Environmental, and Social Considerations of Selected Options.

585. An attempt has made to evaluate the technical, financial, economic, environmental and social considerations of the selected options discussed above. This evaluation is presented in **Table 7.4** below:

Table 7.4: Technical, Economic, Environmental and Social Considerations

Intervention	Considerations			
	Technical	Financial/Economic	Environmental	Social
Re-sectioning, embankment with new design heights	Better protection against cyclone surges and water level rise	Financial savings from reduction of damages to be caused by the floods	Improve surface water quality; improve natural vegetation	Reduce loss of lives and assets which would bring poverty reduction; scope for increased employment opportunities for local people.

Intervention	Considerations			
	Technical	**Financial/Economic**	**Environmental**	**Social**
	Protection to river bank erosion	Financial savings as the embankments will provide good road transportation routes.	Reduce traffic congestion inside the polder because of improvement of embankments, which will facilitate vehicular traffic movement	Reduction of loss of assets which would bring poverty reduction
	Prevention of salinity intrusion in the polder	Improved earning of local people during construction		Improve cropping particularly for small farmers thus alleviating poverty.
		Improved cropping pattern and boosting the local economy		
Bank revetment, slope protection	Enhance embankment protection against tidal wave action of rivers, provide erosion protection	Financial savings from reduction of damages caused by the floods; increase life span for 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 bring poverty reduction; 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-I	Financial savings against damages due to water logging, drainage congestion, and salinity intrusion.	Removal of inactive sluices would improve the drainage characteristics	Better agriculture practice could be achieved which would improve cropping pattern, enhance local earnings, and reduce poverty.
		Agricultural production will be boosted as dry season rice cropping would increase	Water logging, drainage congestion would be reduced.	
Channel re-excavation	Reduce water logging and drainage congestion	Enhance agriculture output; the dredged soil can later be used in construction works which will save construction cost	Increase navigability of water ways and fish habitats would improve, the ecosystem will be enhanced	Increase in cultivable area, increase availability of irrigation water thus increase farm income for local community; increase farm labor opportunities.

7.4 Alternatives during Construction

586. The key alternatives available during the construction phase include location of material stockpiling, material sourcing, labor sourcing and transportation of materials, equipment and labor. These are discussed below:

7.4.1 Material Storage

587. Two alternative locations are suitable for material storage in Polder-40/2: 1) within the Polder and 2) outside the Polder. The first option would entail easy transportation of bulk materials from the sources; however, it would involve regular transportation of materials from the storage site to the work sites.

588. The storage site selected at this stage is located in the BWDB yard at Patharghata. The required materials would be collected and transported from their respective sources to the Polder and would be then stored in the stack yard to be used during construction phase.

7.4.2 Material Sources

589. The sources from where the construction materials will be brought have been discussed below:

Soil for Embankments

590. For re-sectioning of embankments, around 19.55 million cubic meters of soil will be required. The following options are available for sourcing this material:

591. Plenty of soil can be excavated from borrow pits along the river. This can considered as one the better options. It will minimize soil transportation requirements, minimizing any additional transportation cost, having minimal negative impacts in the borrow pit areas, since these areas will be silted-up within a few seasons and having minimum environmental and social impacts related to excavation and transportation.

592. Part of the required material can obtain from the re-excavation of the water channel within the Polder, provided the quality of material is technically acceptable. About 0.27 million cubic meters of earth will obtained from re-excavation of channels during implementation of rehabilitation works inside the Polder. This option minimize the cost of excavation for the borrowed material though the cost of transportation to work site will be slightly more than the first option in addition to some environmental and social impacts such as traffic congestion and air pollution within the Polder.

593. A certain portion of soil can be sourced from borrow pits outside the Polder. It must be mutually accorded with the landownersbased oncompensation. This option will entail the cost of excavation similar to the first option. Other parameters for instance transportation cost, social and environmental impacts are likely to be similar to the first option, although land degradation may be integrated with air pollution and traffic congestion.

594. Soil from the riverside just outside the Polder embankment if not suitable, the material may obtained from the riverbeds having required material quality. This option will entail higher cost of material transportation and other related environmental and social problems such as traffic congestion, air and water pollution.

595. The final decision regarding the material source has not been finalized at this stage of study. This decision is likely to be taken during construction.

Sand

596. 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:

597. 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.

598. 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.

599. The final decision regarding the source of this material has also not been finalized at this stage. This decision is likely to be taken during the construction.

7.4.3 Alternatives for Workforce Procurement

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

601. Employing bulk of labor from outside the Polder. This will lead to traffic congestion and air pollution requiring large numbers of camps and labor transport. It may trigger resentment and ultimately possible resistance as consequence from the local community.

602. Employing bulk of the labor from within the Polder and bringing the skilled and technical labor from outside. This option will reduce labor camp numbers and 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 increasing the local ownership of the project. In view of these advantages, this is the preferred option for labor sourcing.

7.4.4 Alternatives for Mode of Transportation

603. All the construction materials are to be transported to the main stockyard by road with Trucks. The materials will carried from the main stockyard to the worksite mainly by river and by road. The roadway conditions inside the polder are not suitable for transportation of larger vehicles i.e. dump truck, trolley, excavator etc. Therefore, other construction materials will be carried by small carts, non-motorized vehicles, manual labor etc. using roadways and small boats, trawlers in the waterways.

Waterways

604. Polder -40/2 is located along the right bank of Baleshwar River. The Baleshwar River is a perennial river influenced by tide and ebb. The depth is around 9 meter. It remains navigable throughout the year and can used for transportation purposes during construction. The other part (Southeast) of the polder is adjacent with Bishkhali River. The average depth of which is about 16m. Deposition process and char (island) formation are encountered in many parts of this river.

Roadways

605. The materials stored in the stockyard can be transported to the construction sites by using Upazila roads (i.e. Patharghata–Barguna Road). While for transporting materials to the stockyard from Barguna or other suitable locations, the roadways are recommended. The district roadway named Patharghata-Barguna Road is the only way here for transference. A ferry, which operates intermittently around 3-4 hours in a day, comes across the way at Bishkhali River point.

8 Climate Change

8.1 Overview

606. 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.

607. Sea level rise has various impacts on Bangladesh, a coastal country facing a 710 km long coast to the Bay of Bengal. It already has affected Bangladesh by land erosion, salinity intrusion and loss in biodiversity. Its potential threats are coming even strongly in the future. Sea level rise will cause riverbank erosion, salinity intrusion, flood, damage to infrastructures, crop failure, fisheries destruction, loss of biodiversity, etc. along this coast. Overall impacts of climate change on Bangladesh would be significant. It was found that the population living in the coastal area is more vulnerable than the population in other areas (Alam and Laurel, 2005). Coastal resources upon which the most people are dependent and are likely to be severely affected due to climate variability and change. It is predicted that for 45 cm rise of sea level may inundate 10-15% of the land by the year 2050 resulting over 35 million climate refugees from the coastal districts. Higher temperature will increase evaporation and causeloss of surface water. This is particularly alarming considering that, in the quasi-totality of the aquifers, the groundwater level has already reached alarming values, and the water quality is at the lower limit of standard. Changes in extremes, including floods and droughts are projected to affect the water quality. Sea level rise is projected to extend areas of salinization of groundwater resulting in a decrease of freshwater availability for humans and the ecosystem in coastal areas (IPCC 2007).

608. The southern part of Bangladesh falls under coastal zone that receives discharge of numerous rivers, including Ganges-Brahmputra-Meghna (GBM) river system, creating one of the most productive ecosystems of the world. Bangladesh coastal zone has been divided into three regions namely eastern, central and western coastal region. However, the shape of the coastal zone is quite unstable and changes with time to time due to erosion and accretion.

609. In this context, meteorological parameters such as rainfall, temperature, sunshine hours, relative humidity etc are analyzed to observe the past and future projection over the polder area which may be take place in future for the climate change.

8.2 Regional Context

610. Asia is very likely to warmed during this century; the warming is likely to be well above the global mean in central Asia, the Tibetan Plateau and northern Asia, above the global mean in East and South Asia and similar to the global mean in Southeast Asia.

Precipitation in boreal winter is very likely to increase in northern Asia and the Tibetan Plateau, and likely to increase in eastern Asia and the southern parts of Southeast Asia. Precipitation in summer is likely to increase in northern Asia, East Asia, South Asia and most of Southeast Asia, but is likely to decrease in central Asia. There is very likely to be an increase in the frequency of intense precipitation events in parts of South Asia and in East Asia. Extreme rainfall and winds associated with tropical cyclones are likely to increase in East Asia, Southeast Asia and South Asia.

611. Many of these will need to done at the national and local level. But there are number of issues related to climate change which need to be addressed at the multi-country and the regional level. For example inter-country share larger ecosystems such as river basins, mountain ranges, forests; common disaster such as cyclones, floods, sea level rise and drought can sometimes affect the whole region. As an example, in the South Asian Context the glacial melt in the Himalayan Mountain or rainfall in the upper riparian countries affect lowers riparian countries in terms of water flow and flooding. Therefore, glacial melt in Nepal, Bhutan is likely to impact the areas of India and Bangladesh. Similarly, common cyclones in the Bay of Bengal can affect India, Bangladesh and Myanmar. Sunderbans, the World's largest mangrove forest shared by 40% in India and 60% in Bangladesh need to be addressed jointly to protect the forest and the floral and faunal species therein or manage ingress of salt water or tourism development. The Brahmaputra river system shared between China, India and Bangladesh. So, many developments of today will have to take into consideration of water flow regime in a climate change world for sustainable development of the river basins as a whole. If not consider or ignored will likely sow the seeds for future conflicts and sub-optimal decision making for all the populations and all the countries in a region.

8.3 Local Context

612. Bangladesh is vulnerable to sea level rise, as it is characterized by a densely populated coastal area with smooth relief comprising broad and narrow ridges and depressions (Brammer, et al., 1993). Sea level rise has various impacts on Bangladesh. The Bay of Bengal is one of the hotspots for the generation of tropical cyclones. In this region, cyclones occur in the pre- and post-monsoon seasons. The coast is also vulnerable to cyclone-induced storm surges. Following are the possible implications of climate change considered in this study for the coastal areas of Bangladesh:

8.3.1 Sea Level Rise and Coastal Inundation

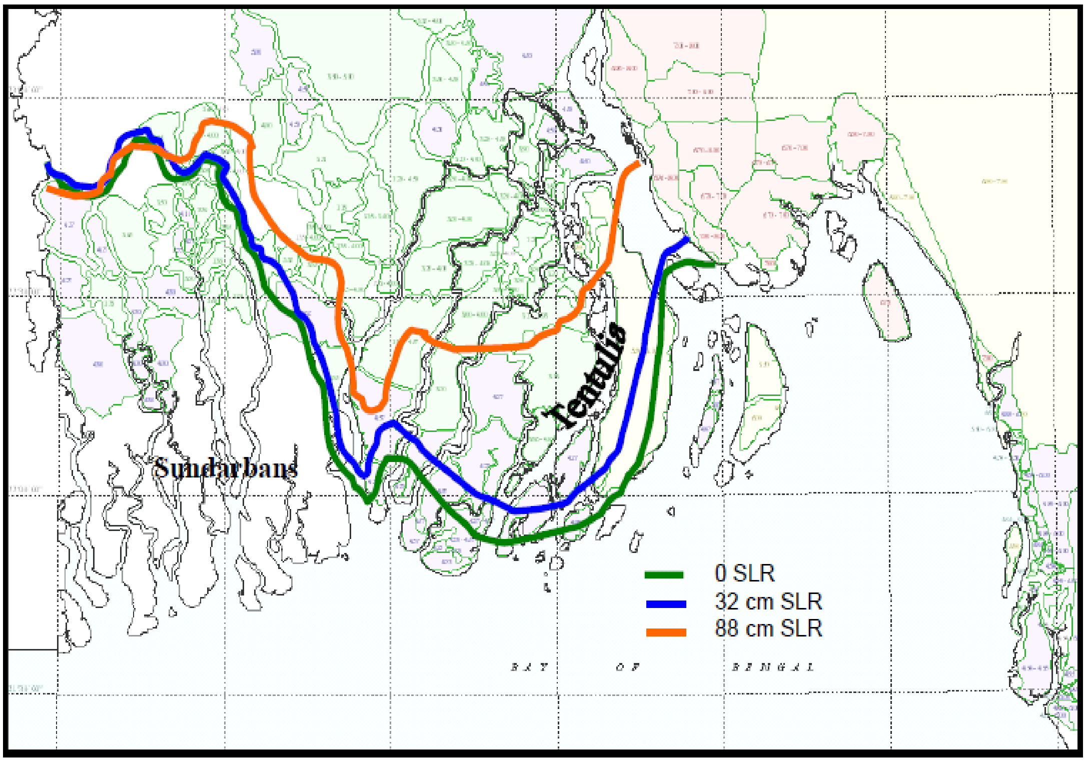
613. Bangladesh is vulnerable to current coastal hazards and anticipated Sea Level Rise (SLR) because of its lower elevation. WARPO (2006) predicted that the Sea Level Rise (SLR) may be increased by 14, 32 and 88 cm in 2030, 2050 and 2100 respectively which may inundate about 8, 10 and 16% respectively of total land mass of Bangladesh. The 5thIPCC (2013) predicted that the global sea level may be raised by 26 and 47 cm during the period 2046-2064 and 2081-2100 respectively using RCP4.5 scenario. The rate of sea level rise of Bangladesh is higher than that of global sea level rise. SMRC (2000) observing three tidal gauge records for the period 1977-1998 (22 years) and found that tidal level at Hiron Point, Char Changa and Cox's Bazar has been raised by 4.0 mm/year, 6.0 mm/year and 7.8 mm/year respectively. These three tidal gauge stations are located in western coast (Hiron Point), Central Coast (Char Changa) and Eastern Coast (Cox's Bazar) respectively. The rate of the tidal trend is almost double in the eastern coast than that of the western coast. This

difference would be due to subsidence and uplifting of land. However, Sing (2002) mentioned that the difference is mainly due to land subsidence.

8.3.2 Tidal Flooding

614. Tidal flood is a common phenomenon in the coastal belt of Bangladesh. Two tide events (high tide and low tide) occur in a day. During high tide, low lying and un-protected areas are inundated causing damage to agriculture and this extent even gradually increased due to sea level rise.

615. The average elevation of coastal lands in Bangladesh is below 1.5 mPWD. It is predicted in several studies that the sea level in the Bay of Bengal may rise in the range of 0.3 to 1.5 m by the year 2050 (DoE, 1993). In the coastal front there will be stronger-than-usual backwater effect due to sea level rise induced high oceanic stage, resulting into retardation of discharge flow, particularly around the confluence points of the major rivers. Consequently, the risk of floods of high intensity and duration, similar to that occurred in 1998, will be exacerbated. Under climate change scenario, about 18 per cent of current lowly flooded areas will be susceptible to higher levels of flooding while about 12 to 16%of new areas will be at risk of varied degrees of inundation. As per recommendations of NAPA, the SLRs in the coast of Bangladesh are 14 cm, 32 cm and 88 cm for the year 2030, 2050 and 2100 respectively. In a recent study, IWM (2006) predicted that flooding of coastal lands may increase by 21% by the year 2100 and 10.3% by the year 2050 with respect to the ordinary flooding condition when approximately 50% lands go under flood.



Map 8.1: Different sea level rise in dry season (IWM and CEGIS, 2007)

8.3.3 Salinity Intrusion

616. Saline water intrusion is highly seasonal in the coastal area of Bangladesh. Salinity and its seasonal variation are dominant factors for the coastal ecosystem, fisheries and agriculture. Therefore, any change in the present spatial and temporal variation of salinity will affect the biophysical system of the coastal area. IWM and CEGIS (2007) found that the

base condition, about 10 percent of the coastal area is less than 1 part per thousand (ppt) salinity and 16 percent area is under 5 ppt salinity. The area under 1 ppt will be increased to 17.5 percent from 10 percent and that of 5 ppt area will be increased to 24 percent (from 16 percent) by 2050 considering 88 cm sea level rise. Therefore, there will be an increase of about 8 percent in the area under 5 ppt salinity levels due to sea level rise. The areas of influence of 5 ppt salinity line under different sea level rise are shown in Map 8.1. The intrusion of salinity will increase soil salinity and surface water salinity and might affect agriculture crop production.

Table 8.1: Major Cyclones Hit the Bangladesh Coast

Major Cyclone year and Dates		Maximum Wind Speed (km/hr)	Storm Surge Height (meter)
30 Oct	1960	211	4.6-6.1
30 May	1961	160	6.1-8.8
28 May	1963	203	4.2-5.2
11 May	1965	160	6.1-7.6
15 Dec	1965	211	4.6-6.1
1 Nov	1966	146	4.6-9.1
23 Oct	1970	163	3.0-4.9
12 Nov	1970	224	6.1-9.1
25 May	1985	154	3.0-4.9
29 Nov	1988	160	3.0-4.0
29 Apr	1991	225	6.0-7.5
2 May	1994	210	2.0-3.0
25 Nov	1995	140	2.0-3.0
19 May	1997	220	3.1-4.2
15 Nov (Sidr)	2007	240	up to 10
25 May (Aila)	2009	120	3.0

Source: MCSP, 1993; Bangladesh Meteorological Department and field survey, 2010

8.3.3 Cyclones and Storm Surges

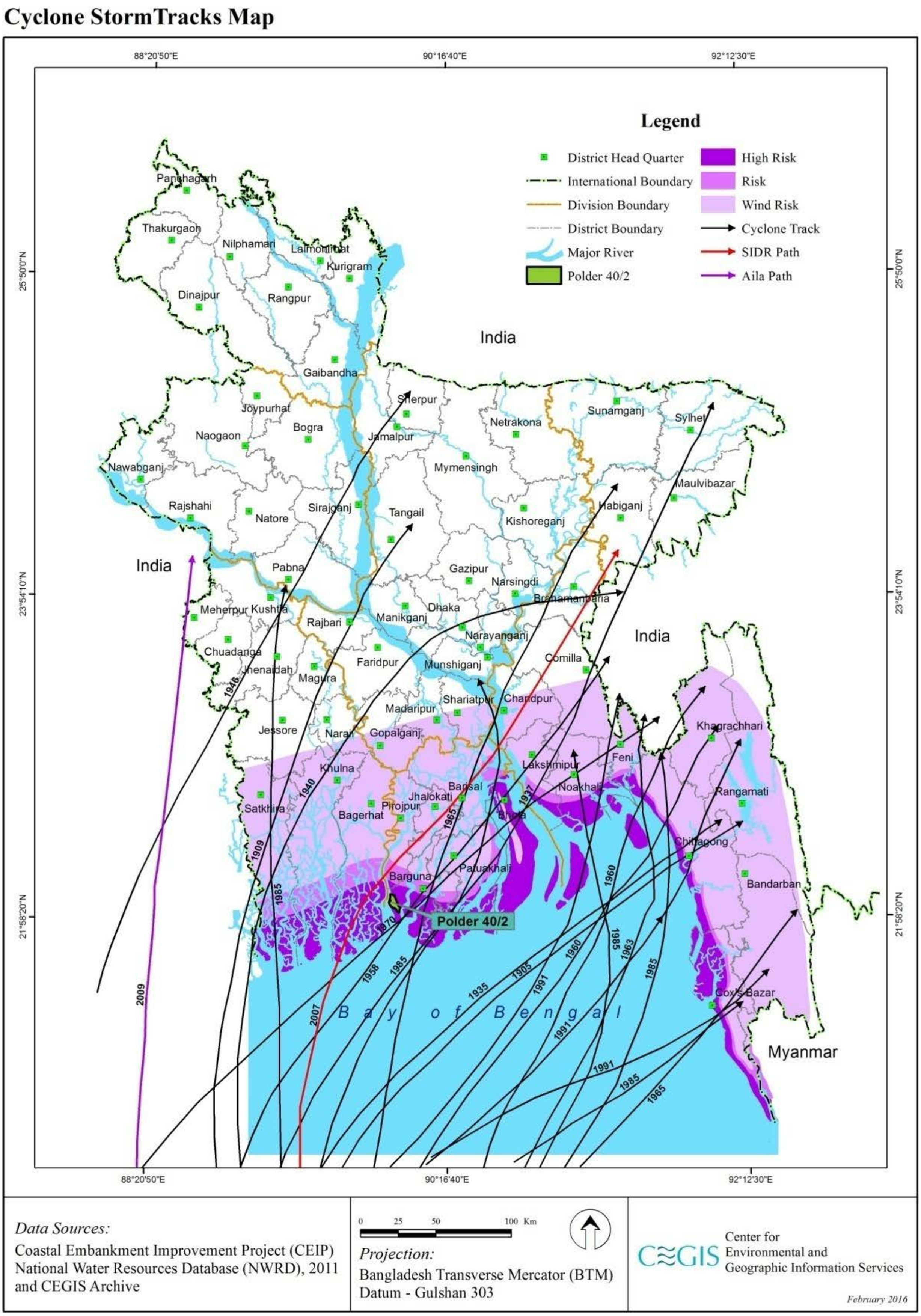
617. Bangladesh is especially vulnerable to cyclones because of its location at the triangular shaped head of the Bay of Bengal, the sea-level geography of its coastal area, its high population density and the lack of coastal protection systems. During pre-monsoon (April–May) or post-monsoon (October–November) seasons, cyclones frequently hit the coastal regions of Bangladesh. About 40% of the total global storm surges are recorded in Bangladesh (Murty, 1984).

618. Tropical cyclones accompanied by storm surges are among the major disasters that occur in Bangladesh and severely damage lives and standing crops in the study area. Roughly, three to seven severe cyclones hit the coastal area in each decade. There is some evidence that peak intensity may increase by 5 percent to 10 percent, which would contribute to enhance storm surges and coastal flooding. Increase in wind velocity and storm surge height will result in further inland intrusion.

619. Tropical cyclones and surges are the major threats to the coastal areas, causing loss of human lives and livestock and severe damage to crops and properties. During last 125 years, more than 42 cyclones had hit the coastal areas (Map 8.2) and 16 cyclones (Table 8.2) have occurred in the last 25 years. Table 8.2 represents that the occurrence of cyclone is more frequent due to climate change. The strength and number of major cyclones may be increased due to higher sea surface temperatures associated with global warming. Tropical

cyclones and storm surges are particularly severe in the Bay of Bengal region. Last devastating cyclone (Aila) hit the study area and project site on 25thMay 2009. The project area is located in the wind risk zone of Bangladesh.

620. The area is vulnerable to cyclone and storm surge. During Aila, storm surge water entered the polder area by overtopping the left bank of the Passur River. As per local community perception, the site has experienced the maximum surge height during cyclone Aila. The local people opined that the area was inundated by the surge height of 4.47m during Aila.



(Source: MCSP, 1993)

Map 8.2: Previous Cyclonic Storm Tracks

8.3.4 Rainfall and Temperature, Drainage, and Water logging

621. Global warming is an important issue, with a variety of influences on agriculture, water, health and economy. Now it is recognized that climate variability and extreme events affect the 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 the 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 take place in future. Climate models are the main tools available for developing projections of climate change in the future (Houghton et al., 2001).

622. 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) are available at Centre for Climate Change Research (CCCR), IITM, India. The CCCR is recognized by World Climate Research Programme (WCRP) and is responsible to generate downscaling model data over South Asia CORDEX domain. These data have been used to generate the future scenarios for rainfall and temperature at Patuakhali (because Patuakhali is the nearest place of the polder) in Bangladesh using RCP4.5 data set. The RCM model outputs were analyzed to find out seasonal and annual rainfall and temperature over Bangladesh. It is assumed that 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 and base period 1990 means averaged during the period 1981-2000.

8.4 Rainfall projections for RCP4.5 scenario

Year-2030: The change of rainfall is found to be -8.3, 12.2, 1.7, 14.2 and 3.4 % for winter, pre-monsoon, monsoon, post-monsoon and annual, respectively in 2020 (Figure 8.1)

Year-2050: The change of rainfall is observed to be -2.0, 1.0, -4.6, -18.5 and -4.8 % for winter, pre-monsoon, monsoon, post-monsoon and annual, respectively in 2050 (Figure 8.1)

8.5 Projection of Maximum and Minimum Temperature over the Polder area

Maximum temperature projections for 2030 and 2050 using RCP4.5 scenario:

Year-2030: Maximum surface air temperature may be changed in 2030 by 1.3, 1.0, 0.3, 0.2, 0.2, 0.8, 0.5, 0.7, 0.6, 0.6, 1.3 and 1.1^{o} C for January, February, March, April, May, June, July, August, September, October, November and December, respectively (Table 8.2). Maximum surface air temperature in various months over the Polder area may vary within the range of 0.2 - 1.3°C. On an average, the maximum surface air temperature is estimated to increased by 0.7°C in 2030.

Year-2050: Maximum surface air temperature may be changed in 2050 by 2.0, 1.8, 1.8, 1.5, 0.8, 1.4, 1.3, 1.6, 1.2, 1.0, 1.5 and 1.6° C for January, February, March, April, May, June, July, August, September, October, November and December, respectively (Table 8.2). Maximum surface air temperature in various months over the Polder area (Polder-40/2) may vary within a range of 0.8 - 2.0° C. On an average, the maximum surface air temperature is estimated to be increased by 1.5°C in 2050.

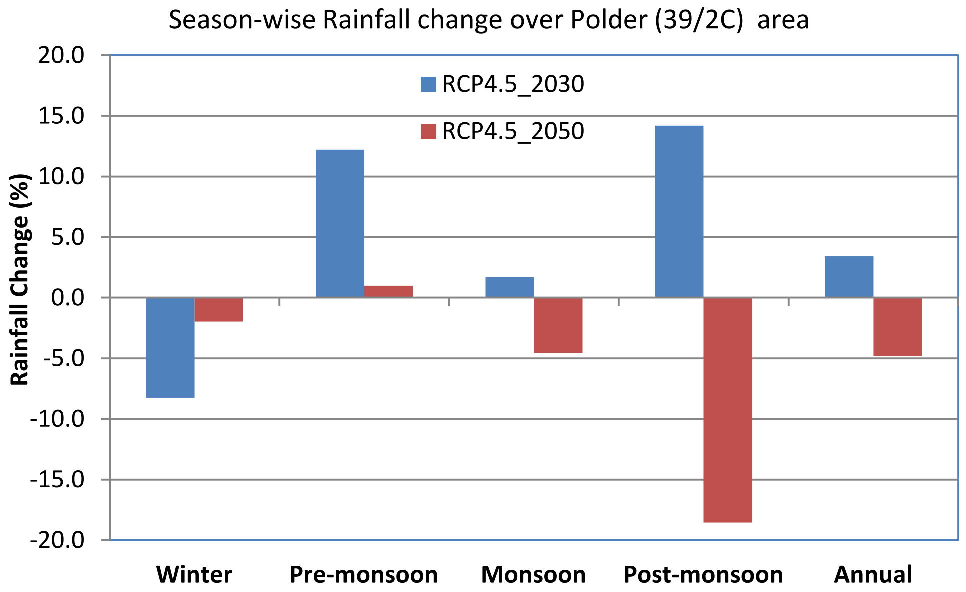


Figure 8.1: Change of seasonal rainfall (%) over Polder for 2030 and 2050

Table 8.2: The change of maximum and minimum surface air temperature over Polder area for the year 2030 and 2050

Scenario	Reference period	Maximum Temperature Change(°C)												
		Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RCP4.5	1990 (1981-2000)	2030	1.3	1.0	0.3	0.2	0.2	0.8	0.5	0.7	0.6	0.6	1.3	1.1
		2050	2.0	1.8	1.8	1.5	0.8	1.4	1.3	1.6	1.2	1.0	1.5	1.6
Minimum Temperature Change(°C)														
RCP4.5	1990 (1981-2000)	2030	2.0	1.1	1.7	0.7	0.7	1.0	0.7	0.9	0.9	1.0	1.6	2.0
		2050	2.7	2.3	2.5	1.9	1.3	1.5	1.4	1.5	1.5	1.3	1.4	1.7

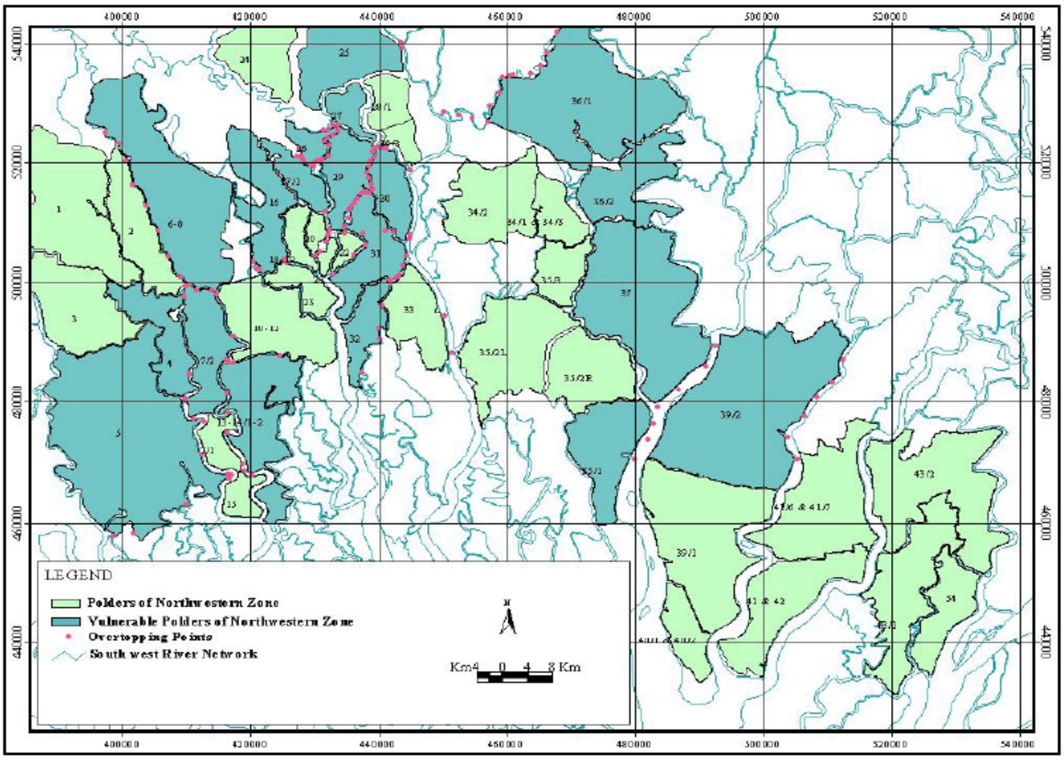
Source: Centre for climate change Research (CCCR),IITM, India

623. The drainage of coastal polders mainly depends on the tidal characteristics of the surrounding rivers and degree of siltation of these rivers. IWM (2008) found that high water level in the surrounding rivers of polders increases in the range of 30-80 cm for sea level rise. This rise will eventually hamper the smooth drainage of a number of polders. Inundation

area in few polders causing drainage congestion due to sea level rise is presented in Map 8.3.

624. Sea level rise will deteriorate the drainage conditions largely. 17 polders (light green in Map 8.3) out of 35 will face acute drainage congestion whereas present performance of these polders is satisfactory.

625. Riverbed siltation along with backwater effect due to sea-level rise and high tide is leading to prolonged waterlogging in south-west and central region in Bangladesh since last two to three decades. Gradual siltation is the main source of the problem on the riverbed triggered by inadequate runoffs in the southern reaches caused by the polders constructed under the Coastal Embankment Project (CEP) during the sixties. Awal MA (2014) noticed the consequent losses in agricultural production due to the inundation over the polder region. For removing water logging effect, plinth raising and elevating the local habitats and physical infrastructures can considered as an immediate and short-term measure whereas operation of Tidal River Management (TRM) technology might be considered for long-term or permanent solution for raising the low lands or beels. The dead or silted-up rivers, canals, ponds and irrigation channels can be excavated or re-excavated by operating the major workfare social safety net programmes of the government and the excavated soil can be utilized for creating, maintaining or raising the rural roads, polder/embankment and related other infrastructures which are quite crucial for mitigating the flood or water logging problem in the region.



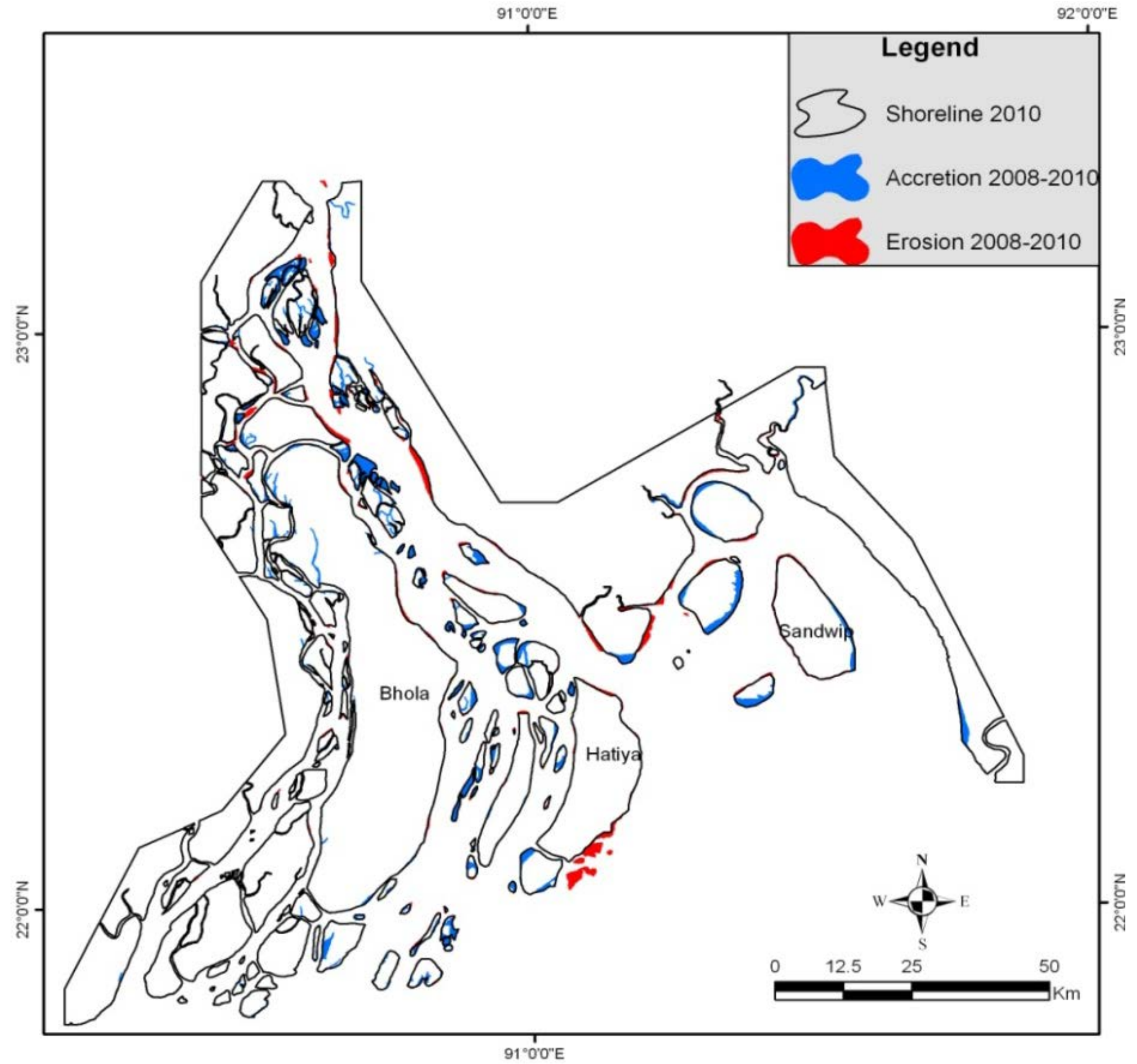
Map 8.3: Drainage Congestion in Affected Polders due to Sea Level Rise

8.5.1 River Erosion and Accretion

626. Bangladesh is a riverine country and morphology of the rivers is highly dynamic. Disastrous riverbank erosion is mainly associated with the major river systems of the country. The main rivers are braided and form islands or chars between the braiding channels. These chars (many of which are inhabited) move with the flows and are extremely sensitive to bring

changes in the river conditions (CEGIS, 2009). River erosion not only causes people's displacement but also leads to massive financial loss. River erosion is commonly observed in the entire coastal area specifically in the Meghna estuary region.

627. The magnitude of erosion and accretion in the Meghna estuary (Map 8.4) for the period of 2008-2010 is represent in the following figure. During this period, the extent of accretion was 250 km^2 while that of erosion was 153 km^2 with a corresponding net accretion of 97 km2. Extension of mainland of Noakhali towards the sea continued like the previous period with a net accretion rate of 4.3 km^2/yr. Significant amount of accretion occurred in Bhola Island with a net accretion rate of 27.6 km^2/yr. Both erosion and accretion process occurred along the shoreline in Chittagong district with a net accretion rate of 8.5 km^2/yr. Erosion is observed in Patuakhali and Lakshmipur district with a net erosion rate of 3.2 and 2.8 km2/yr respectively.



Map 8.4: Erosion and Accretion of Land in the Meghna Estuary from 2008 to 2010

8.6 Adaptation Strategy for Climate Change Impacts in the Project

8.6.1 Adaption at Local level

628. Local people of the project area are already facing different natural problems due to climate change. Specifically, drainage congestion, tidal flooding, water logging, storm surges

and salinity intrusion are the major natural hazards in the project area, some of which can be linked with the climate change phenomenon. People have reported that, the occurrence of the natural hazard is more frequent than before in the project area. Locally, the following adaptation measures have been practiced in different physical, environmental and social sectors in coastal belt of Bangladesh for adapting climatic hazards.

- People switching their livelihood from agriculture to shrimp culture.
- High yielding and salinity tolerant varieties of paddy are introduced in the project area.
- Social and homestead forestry is being increased to protect their life and properties from the strong wind velocity during cyclone.
- People raise the plinth level of their houses to adapt water logging and flooding.
- People introduced floating vegetable gardening system and case culture in the water logging area.
- Rainwater harvesting system is being adopted to mitigate their drinking water problem during dry season.

8.6.2 Adaptation at Rehabilitation and Improvement planning

629. The IPCC projections have been considered in the hydrologic and hydrodynamic modeling of the feasibility study of the CEIP-1. The climate change projections have been considered to determine the design criteria and finally these outcomes have been adopted in the planning and design of rehabilitation and improvement plan. The following criteria and the projected climate change information have been used in the design and planning of the interventions for taking care of climate change scenario in 2050.

- Sea level rise of 50 cm;
- 10 percent increase in maximum wind speed of cyclones; and
- Increaseing rainfall by 26 percent from March through May; and 13 percent from June through August.

630. In respect of polder areas in Bangladesh, rainfall may increase in pre-monsoon season (March-May) by 12.2% and monsoon season (June-September) rainfall by 1.2% in 2030 using RCP4.5 scenario.

631. These considerations have ultimately led to determine new height of the embankment and improved drainage system to cope with the impact of climate change. Afforestation is also needed over the Polder area to protect the wind speed of cyclones.

9 Assessment of Cumulative and Reciprocal Impacts

9.1 General

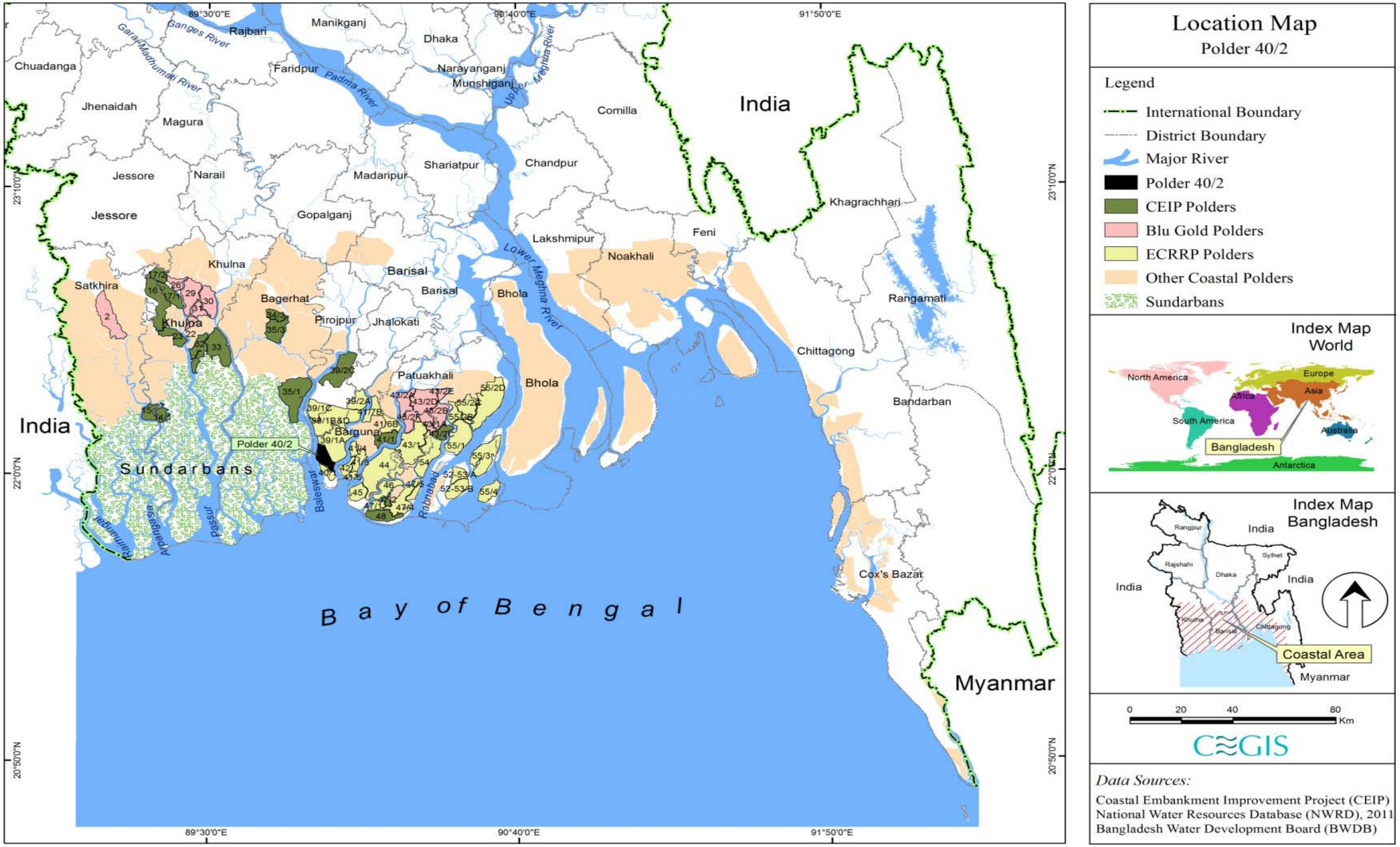
632. This Chapter 9 attempts to analyze several indirect effects regarding the implementation of different interventions proposed in Polder -40/2 under Coastal Embankment Improvement Project-1 (CEIP-1). These effects include cumulative impact of Polder-40/2 and the reciprocal impacts of climate change and polder (based on modeling report by IWM). Near Polder-40/2, a number of other projects exist apart from the CEIP polders.

9.2 Cumulative Impacts of all CEIP-I interventions on Polder- 40/2

633. The Baleshwar and Bishkhali Rivers surround polder- 40/2 at southwestern (2207'34'' N, 89054'43.8'' E to 2204'29'' N, 89054'11'' E) and southeastern (2202'24.8''N, 89058'28.6''E to 2201'4.7''N, 89058'7.5''E) portion respectively. The existing crest levels of the Polder ranges from 3.95 to 4.50 mPWD. Re-sectioning works are proposed in the polder under CEIP, which would increase its crest level up to 5.18 mPWD (at most locations). This increase would reduce chances of entrance of storm surge into the polder. The other CEIP Polders (41/1, 43/2C, 47/2 and 48) are far away from the polder areas, for which their interventions have negligible impact on Polder- 40/2. However, the downstream polders, especiallyPolders 40/1 and 42 may face hydrological impact, requiring increase of embankment height, which are expected to be taken care of by ECRRP.

9.2.1 Synopsis of projects around Polder -40/2

634. Apart from CEIP interventions, there are some other development projects nearby the Polder- 40/2, implemented locally or regionally. Activities of these projects may generate cumulative impacts on the polder in future. Table 9.1 below shows a list of various projects in relevance with Polder -40/2, undertaken by different line agencies in Patuakhali and Barisal districts.



Map 9.1: Location of Polders selected for CEIP, Phase-1

Table 9.1: List of water management projects

Agency	Project Name	Duration	Location	Sensitivity
National				
BWDB	Projects under Climate Change Trust Fund	2013-ongoing	Entire country	Low
	Capital Dredging of River system of Bangladesh	2012-ongoing	Entire country	Low
	Water Management Improvement Project (WMIP)	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	Negligible
	Coastal Embankment Rehabilitation Project (CERP)	1995-2004	Coastal zone	Negligible
Local				
LGED	Development of Union Parishad Connecting Roads	1999-2006	Patuakhali and Barguna	Negligible
	Rural Development Project-16: Infrastructure (Phase-II)	1999-2004	Patuakhali and Barguna	Negligible
DoF	Fisheries extension project	1994-2004	Patuakhali, Barguna	Negligible

Source: Review of BWDB and LGED literatures, 2015

635. The projects (listed in Table 9.1) which have or may have high or moderate sensitivities on some of the environmental or social components of Polder- 40/2 are briefly discussed in the following sections. Cumulative Impacts of Bangladesh Delta Plan 2100 (BDP-2100).

9.2.2 Cumulative Impacts of Bangladesh Delta plan 2100

636. Bangladesh Delta Plan 2100 is a long term, innovative, holistic and adaptive planning of the GBM delta, with bottom-up clustering of problems and proposed solutions followed by top-down decision implementation modality. The Plan addresses integrated water resources management and climate 12 related issues of water safety and availability, food production and food security, salt intrusion, shortage of land, environmental and ecological problems and other important aspects to reach an adequate level of safety and food security as well as sustainable economic growth of the entire Bangladesh.

637. The plan is still at an initial stage, where continual investigations on planning concept, framework and implementation modalities are being carried out. Nevertheless, it will have significant effects on environmental and socio-economic resources of all the coastal polders, including Polder- 40/2. The livelihood pattern and water governance of Polder- 40/2 may significantly change once the plan undergoes implementation. New development priorities may be introduced and different local level implementation modalities may be formed. Implementation of BDP 2100 would ensure multi-sector developments of the polder, and the economy as a whole may largely be benefited. More emphasis would be given to natural disasters and the polder will deal with many of the recent global and regional issues i.e. climate change, food security etc.

9.2.3 Cumulative Impacts of Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)

638. In order to facilitate the recovery of damage to livelihoods and infrastructure caused by Cyclone Sidr and to build a long-term preparedness through a strengthened disaster risk management, GoB implemented a project under the caption of ''Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)'' in 13 districts (Barguna, Bagerhat, Barisal, Khulna, Bhola, Pirojpur, Jhalakati, Noakhali, Feni, Chittagong, Potualkhali, Sathkhira, Laksmipur) of Bangladesh. The major component of the activities of this project is the rehabilitation of embankments and among the 35 polders considered for rehabilitation under this project, Polders-39/1A, 40/1, 41/4, and 42 are located near Polder -40/2, along the downstream of Payra River (Map 9.2). The design crest levels of these polders are 4.57 to 5.18 mPWD for Polder -39/1A, 41/4 and 42; 5.18 mPWD for Polder -40/1. All these polders will tend to divert the flow of Payra River further upstream and will transfer storm surge inundation risks. There may also be floodplain sedimentation along the river, as a significant portion of tidal water would be prevented from entering these polders, which may reduce the depth of flow of Payra River in future. Due to the reduced depth, river erosion probabilities in Polder -40/2 may increase.

9.3 Reciprocal Impacts of Climate Change and Polder Improvement

639. Reciprocal impacts of Climate Change and Polder improvement refers to the impacts occurred on the polder due to climate change and vice versa. IWM used hydrodynamic models (MIKE 21) and analyzed the existing meteorological situation of the polder area. They have evaluated the physical changes in the relative polders that may occur due to climate change. All data used in the model setup and calibration (including topography, soil maps, land use maps, and weather data, river network and cross-section, water level, discharge and salinity) were obtained from different sources. For Drainage Model, Rainfall Runoff Model and Water Flow Model IWM has used SWRM, NAM, Water Flow Model respectively.

640. In order to evaluate the reciprocal impacts of Climate Change and Polder improvement of Polder- 40/2, both quantitative assessments and qualitative judgments have been carried out. Two separate hydrological and hydrodynamic models have been setup and simulated using input data from climate and hydrometeorology to assess the impact of climate change on some sensitive issues of the polder namely, water availability, flood security etc.

9.3.1 Impact of Drainage Congestion

641. From the beginning of the 21stcentury a new problem “water logging” (the long-term inundation of areas because of inadequate drainage) arose in south/south-west coastal region of Bangladesh. It has become an increasing problem in recent years for various reasons: natural changes in river flow; increased sediment in riverbeds due to reduced sediment deposition on floodplains protected by embankments; and lack of proper operation and maintenance of sluice gates of the polders i.e. circular embankments. Due to the permanent water congestion, sudden flood occurs during the rainy months. In the other words, the water logging situation causes recurring flood in every monsoon seasons. Among the affected areas, Polder- 40/2 is the worst hit and experiencing severe and year-round water logging.

642. Although the dimension of water logging problem was insignificant in the initial stage that slowly increased over the years by natural disaster and is likely to occur by climate

change. The situation is apprehended to worsen more in future. Though there is a very little specific research on the water logging problem, yet it is believed that climate change could further exacerbate this issue through changes in sedimentation and river flow, increased monsoon rainfall and retarded discharge of rivers due to back water effect and sea-level rise.

643. On the contrary, the river water carrying huge amount of sediments will move further downstream and may cause siltation in the water bodies outside the polder. Sedimentation may take place in the surroundings Baleswar, Bishkhali Rivers, and new morphological changes to be established outside the polder. Moreover, sedimentation in smaller water bodies namely Lathimara and Bharanl khal may cause regular drainage congestion problems and several smaller water bodies may permanently silted up. The navigability of rivers may further deteriorate over the years.

9.3.2 Impact of Increased Water Level

644. 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 an increase in extreme flow during monsoon that ultimately will increase in flood water level. 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 be increased. 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 -40/2 to evaluate water level using climate change scenarios for the year 2050s (Table 9.2).

Table 9.2: Water level of Peripheral river/canal of Polder 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)
108	Bishkhali River	0+000	3.12
107	Bishkhali River	3+160	3.11
-	Peripheral Canal-1 (Latimara Khal)	7+300	3.15
-	Peripheral Canal-1 (Latimara Khal)	8+400	3.16
106	Baleswar	11+600	3.18
105	Baleswar	15+000	3.20
34	Baleswar	20+400	3.22
-	Peripheral Canal-2 (Charduani Patharghata Bharani Khal)	22+000	3.22
-	Peripheral Canal-2 (Charduani Patharghata Bharani Khal)	35+650	3.13

Source: IWM, 2016

645. It is observed from Table 9.3, that the existing crest level (3.11 to 3.22 mPWD) of the embankment of Polder 40/2 is slightly higher than the predicted (25-year) water levels due to climate change of the surrounding water bodies/khals. Moreover, new design crest level has suggested acting as a safeguard against the upcoming threat due to climate change. Tidal

water would not be able to enter the Polder-40/2 during monsoon period because of higher crest level of the polder. As a result, the nearby areas, which are not protected (Kathalia and Gazipur Bandar Bazar), will be inundated and will be severely affected by cyclones storms in future.

9.3.3 Impact of Storm Surge Level

646. In total 38 number of storm surge model simulation results have been used in determining storm level for different return period. The projection of storm surge level in the five locations (Southern portion) of the Polder- 40/2 considering with and without Climate Change are presented in Table 9.3. It is observed that in 10 years return period surge level will be increased due to climate change by 25% whereas in 50 year return period it will be increased by 20%. So, it can be inferred that, surge level intensity may be more frequent in the coming years in surrounding areas (Charduani, Majherchar etc.) of Polder- 40/2. In 50-year projection, it has been found that storm surge levels are higher than the existing crest level of the polder, which may cause severe devastation and inundate inner portions of the polder. Agricultural lands may be affected due to flooding and salinity severely. Local water bodies may also overflow inside the polder and salinity problem that will affect the fisheries and other aquatic bodies. Nonetheless the proposed protective measures of Polder-40/2 will protect it against surge level, but it may divert the storm surges and cause a great threat to the surrounding Polders i.e. 39/1A, 40/1 and 42. Storm surge levels for different return period with and without climate change, effect for Polder -40/2 is presented in Table 9.3.

Table 9.3: Storm surge level for different return period with and without climate change

Location Name	Location No.	Existing Avg. 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
Patharghata, Baleshwar	34	4.50	4.65	2.71	2.48	3.28	3.90	3.12	3.94	4.55
Patharghata, Baleshwar	105	4.50	4.61	2.67	2.54	3.31	3.88	3.11	3.94	4.56
Patharghata, Baleshwar	106	4.50	4.8	2.69	2.58	3.38	3.98	3.19	4.09	4.76
Patharghata, Bishkhali River	107	4.50	4.49	2.88	2.54	3.31	3.88	3.21	4.15	4.85
Patharghata, Bishkhali River	108	4.50	4.25	2.64	2.51	3.32	3.92	3.12	4.0	4.66

Source: IWM, 2016

9.3.4 Impact of Wave Height due to Climate Change

647. Significantwaveheightduringcyclonicconditionfordifferentreturnperiodwithclimatechangeeffectaroundthe Polder-40/2 ispresentedintheTable9.4.

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

Station No.	Polder no. and location	Significance wave Height (m) in Different Return Period (Years) with Climate Change					
		Sidar	Aila	10	25	50	100
34	Patharghata, Baleswar River	1.2	1.28	1.74	2.32	2.69	3.04
105	Patharghata, Baleswar River	1.32	1.54	1.82	2.41	2.78	3.11
106	Patharghata, Baleswar River	1.68	1.77	1.69	2.38	2.84	3.27
107	Patharghata, Bishkhali River	2.8	1.47	1.44	2.14	2.64	3.13
108	Patharghata, Bishkhali River	2.26	1.37	1.07	1.72	2.24	2.79

Source: IWM, 2016

648. From the above table, it is predicted that wave height increases in short duration return period (i.e. 10 to 25 years return period) by up to 60% whereas in the long duration (25 years) it will be increased by up to 30%. There is less possibility of deterioration of polder for the probable wave height for climate change due to sufficient crest level (4.5 mPWD) of Polder- 40/2. However, the higher crest level may increase the pressure that may inundate the other non-protected areas (southern portions of the polder) in future. Specially, agricultural land and local water bodies may be the primary target.

9.3.5 Climate Change Resilience Developed in Polder -40/2

649. 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 developed within the polder habitants. Through the community mobilization in CEIP program, local people became more active towards building a climate resilient society. They are now driven by the concept of climate smart village. Most of the people who are able to afford are now re-building their houses and infrastructures on a relatively higher level. Local people claimed that they would use the excavated spoil from the internal khals for their household purpose if available. This will allow them to have their house and other infrastructures on a re-built higher land. The local farmers are now more concerned about climate change issues as well. They regularly follow and take part in the knowledge development and capacity building programs organized by CEIP-1, which they believe have enhanced their understanding and preparedness on flood and disaster management.

10 Environmental Management Plan

650. This Chapter presents the Environmental Management Plan (EMP) for the CEIP-1 activities in the Polder-40/2. The EMP essentially provides the implementation mechanism for the environmental and social mitigation measures discussed in Chapter 6.

10.1 Objectives of EMP

651. The basic objective of the EMP is to manage, prevent, and mitigate potentially adverse impacts of Project interventions in the Polder-40/2. 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.

The EMP should be included in all the bid documents of Polder-40/2 and will become a part of the civil works contract. The strict implementation of the EMP and project management's strict enforcement of the adequate construction practices and standards will greatly reduce the negative impacts of the Project.

10.2 EMP Components

652. The EMP components are listed below:

- Institutional Arrangement
- Mitigation Measures and Plan
- Monitoring Plan
- Documentation and reporting
- Contractual arrangements for EMP implementation
- EMP implementation cost
- Capacity building
- Grievance redress mechanism

653. These components are discussed in following sections:

10.3 Institutional Arrangement

654. Clearly defined and functional institutional arrangements are essential for ensuring effective and sustainable implementation of the EMP, particularly the mitigation measures

identified in the EIA. An Organogram showing the institutional setup of CEIP-1 including organization for implementation and monitoring of the EMP is shown in Figure 10.1.

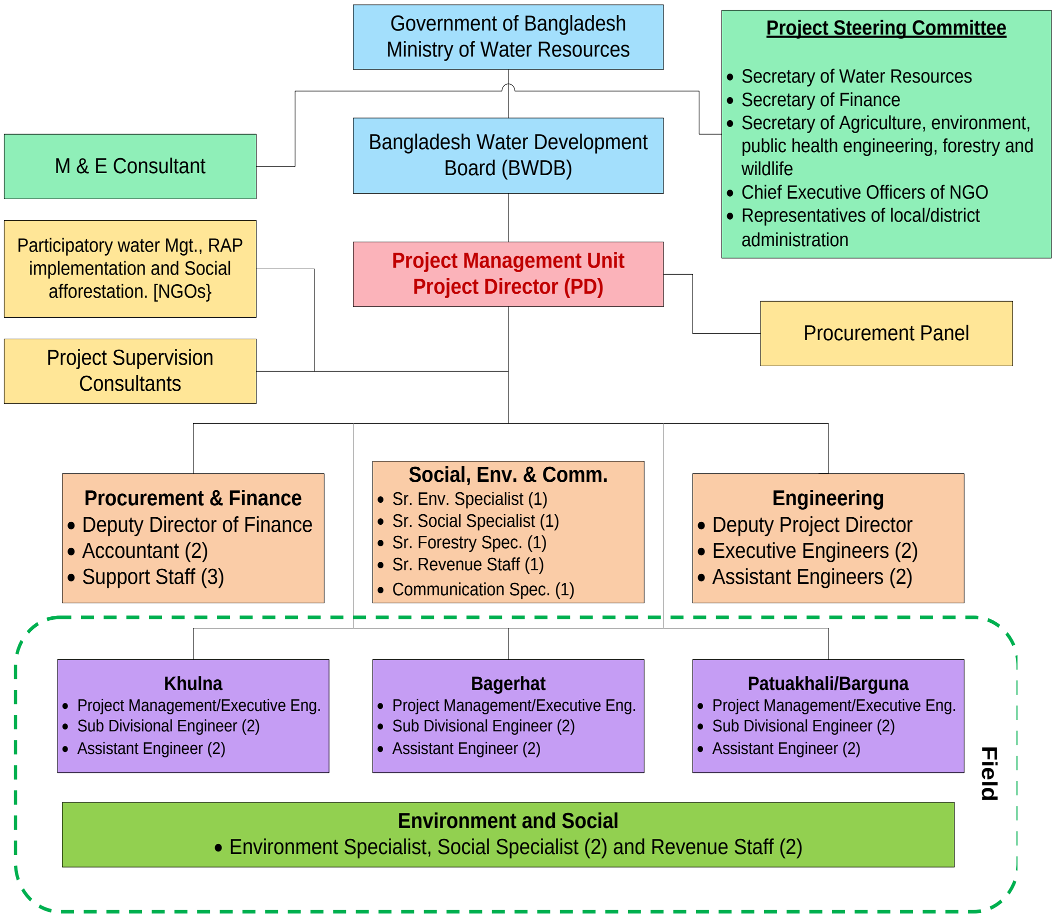


Figure 10.1: Organogram showing the institutional setup for CEIP-1

655. The institutional arrangements proposed to implement the EMP of Polder - 40/2 are described below:

10.3.1 Overall Responsibility

656. The overall responsibility of EMP implementation and fulfilling other environmental obligations regarding the Project rests with the Project Director (PD). For this purpose, the PD will be supported by environmental and social staff of the PMU, Detailed Design, Construction Supervision and Project Management Supervision Consultants (DCSC) and contractors.

10.3.2 Construction phase

<u>Environment and Social Staff in PMU</u>

657. As described in Section 4.8, the BWDB will set up the PMU to manage the implementation of the Project. The PMU will led by the Project Director (PD). To manage and oversee the environmental and social aspects of the Project, the PMU will have an Environment, Social, and Communication Unit (ESCU). The Unit will supervise compliance with and implementation of the EMP. The Unit will include a Senior Environmental Specialist. One Environmental Specialist will be posted at the field level to support all the three

Divisions. The ESCU will maintain liaison with WB safeguards team, regulatory agencies, and other stakeholders during Project implementation. The ESCU will also coordinate with the environmental staff of the DDCS&PMSC. In order to manage the EA process and EMP implementation effectively, the ESCU will be established and made operational before awarding the contract to contractor. ESCU will be responsible for updating the EIA after receiving the pending information. The mode of EMP implementation is given in Figure-10.2.

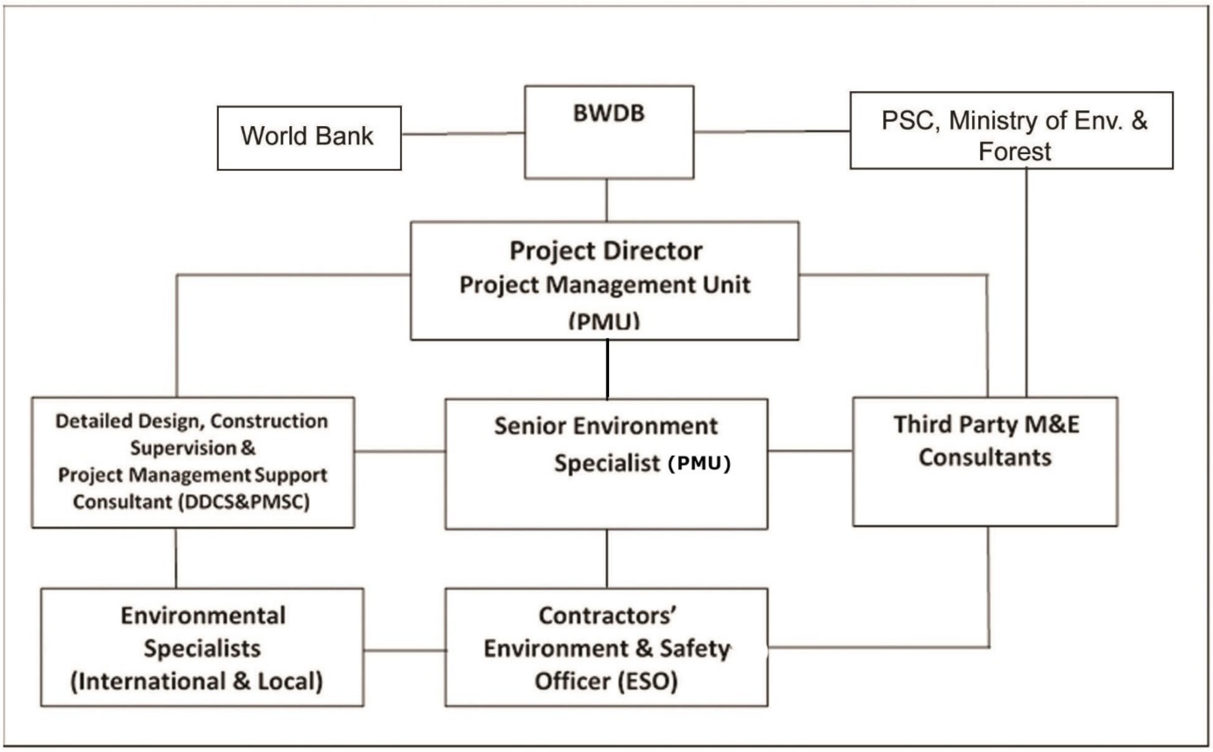


Figure 10.2: Organogram showing mode of EMP Implementation

Environment and Social Staff with DCSC

658. The Contractor is responsible for implementing the EMP during construction and DCSC will be responsible for supervision of EMP implementation. The BWDB employed Environment Specialist will conduct field inspection and survey on regular basis and report to Senior Environment Specialist of Head quarter. The M&E Consultants will be responsible for independent monitoring the implementation of EMP, external monitoring and evaluation. 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 EMs will supervise and monitor contractors to ensure compliance with the EMP. The DCSC consultants' environmental staff will maintain coordination with the ESCU for the effective implementation of EMP and other environmental commitments and obligations of the Project. The WB can also visit the polder area to monitor the quality of EMP implementation as and when required.

Contractor's Environment Supervisors

659. The construction contractors will have adequate number of dedicated, properly qualified and experienced, site-based Environment Supervisors (ESs) at the construction

sites. The ESs will be responsible to implement various aspects of the EMP particularly the mitigation measures to ensure that the environmental impacts of the construction works remain within acceptable limits. The ESs will maintain coordination with the DCSC at the site level. The ESs will also be responsible to conduct environmental trainings for the construction crew.

10.3.3 Post-construction Phase

660. BWDB core unit has posts of four Assistant Chief and two Deputy Chief to oversee the overall environmental compliance of BWDB implemented projects. Under CEIP-1, the ESCU will provide training to the BWDB officials, responsible for monitoring of environmental compliance, so that, smooth transition to BWDB will take place to ensure environmental compliance during O&M after the project completion. These staff will be responsible to manage the environmental aspects of the operation and maintenance of Polder, its water control structures, and other relevant issues such as protection of key environmental resources of the Polder and fish migration. Water Management organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (Nov. 2000) and involve the beneficiary communities. WMOs will be trained by BWDB to ensure environmental management during project operation. 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 operation phase.

10.4 Mitigation Measures and Plan

661. Mitigation is an integral part of impact evaluation. Where mitigation is deemed appropriate, a proponent should strive to act upon effects, in the following order of priority, to:

- Eliminate or avoid adverse impacts, where reasonably achievable.
- Reduce adverse impacts to the lowest reasonably achievable level.
- Regulate adverse impacts to an acceptable level, or to an acceptable time period.
- Create other beneficial impacts to partially or fully substitute for, or counter-balance, adverse effects.

662. Mitigation measures will consider starting with Environmental Assessment process. It is important to keep good integration between the EIA team and project design engineers. Project specific environmental construction guidelines should develop. These guidelines will specify precautions and mitigation measures for construction activities, and to be included with the EMP.

663. Impacts identified severe in consequence category and or likelihood category will 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 in achieving the activity‘s objective
- stakeholder’s participation in finalizing mitigation measures

- Construction practice, including labor safety and welfare measures.
- operational control procedures
- management systems

664. Project specific construction environmental management plans will be prepared by the Contractor and implemented upon approval by the DSC Consultants and the PMU. These plans will specify precautions and mitigation measures for construction activities. Based on the experience, a generic Mitigation Measures for EMP has been presented in Table 10.1 below for reference. This can be used as a reference material for comprehending the scope of the EMP. Table 10.1 will be used in conjunction 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 identified. • Selection of borrow pit areas for earthen material collection. • No objection from land owners as well as Revenue authorities as applicable • Contractor shall ensure that borrow pit 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 earth from a close area of the toe line on any part of the embankment is prohibited. Earth available from dredging as per design, may be used as embankment material (if necessary and applicable), subject to approval of the Engineer, with respect to acceptability of material. Borrowing is to be avoided from the following areas: • Lands close to the 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, although borrowing of agricultural land need to be avoided. • Grazing land. Lands within 1km of settlements. • Environmentally sensitive areas such as reserve forests, protected forests, sanctuary, wetlands. A distance of at least 500 m will be maintained from such areas. • Unstable side-hills. • Water-bodies (only if permitted by the local authority and with specific pre-approved redevelopment plans by the concerned authority and Engineer-in-charge) • Streams and seepage areas. • Areas supporting the rare plant/ animal species. **Documentation of Borrow Pit** The contractor must ensure that the following data base are documented for each identified borrow areas before commencing the borrowing activity that provide the basis of the redevelopment plan. • Chainage along with offset distance; • Area (Sq.m); • Photograph and plan of the borrowing area from all sides;

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Type of access/width/kutcha/pacca etc. from the roadway; • Soil type, Slope/drainage characteristics; • Water table of the area or identify from the nearest well, etc; • Existing land use, for example barren / agricultural /grazing land; • Location/name/population of the nearest settlement from borrowing area; • Quantity excavated (likely and actual) and its use; • Copy of agreement with owner/government; • Community facility in the vicinity of the borrow pit. • Rehabilitation certificate from the land owner along with at least four photograph of the rehabilitated site from different angles.
Excavation operation and Management of Excavated Material	To minimize the adverse impact during excavation of material the following measures are 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 erosion of excavated material due to runoff. The followings precautions shall be undertaken during quarry operations. • Overburden shall be avoided. • 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 sufficient safety measures of all workers will be 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 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. • Where possible biotechnical engineering, for example geo textiles, may be used to help in stabilizing the material and aid re-colonization. • Other possibilities include: drying and spreading of the spoil over adjacent land, which can improve soil fertility in some cases, but may also smother important flora and habitats; excavating a trench and filling it with spoil, thus minimizing disturbance to agriculture and the local environment; dumping off-site is possible but expensive, using spoil to create artificial wetlands.
Contamination of soil by fuel and lubrication	Ensure leack proof carriers (i.e containers, barrels or lorries) for oil and lubricants carrying
ECoP 2: Water Resource & Hydrology Management	
Hazardous Waste Management	The contractor will minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes).
Ponding of water/water logging	• No ponding of water especially near the waste storage areas and construction camps is to be allowed • Discard all the storage containers which are capable of storing of water, after use or store them in inverted position • Reinstate relief and landscape • Monitor drainage pattern after high down pouring and recession flood • Connect water pockets to the nearest drainage structures/canals

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Soil Erosion and siltation	The Contractor shall • Water the material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds) • All the work sites (except permanently occupied by the road and supporting facilities) will be reinstated to its initial conditions (relief, topsoil, vegetation cover). • Ensure that roads used by construction vehicles are swept regularly to remove sediment
Dredging	• Disturbance can be minimized if the mechanical excavators are used from one bank. If the channel is too wide, the digger must work within the channel. Disruption can be minimized by diverting the river down to one side of the channel and dredging the other side while it is 'dry'. Smaller plant equipment generally limits the level of impact on bank-side and in-stream habitats.
Construction activities in water bodies	• Protect water bodies from sediment loads by silt screen or bubble curtains or other barrier. • No cement and water used for curing the cement concrete is to be discharged 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 before loading and being transported • 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 as and when required to minimize the potential 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 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 avoid during periods of high wind and if visible dust is blowing off-site • Restore disturbed areas/side of the embankment as much as practicable by plantation/vegetation/grass-turfing • Establish adequate locations for storage, mixing and loading of construction materials, in such a way that dust dispersion is prevented for 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 least500 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	

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Loss of Top Soil	• Soil from fallow lands/ non-agricultural lands will be used in earthwork of the embankments • Collect/strip top soil before earth filling and store for reusing them during final surfacing of embankment top and tree plantation/afforestation. • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m • Remove unwanted materials from top soil like grass, roots of trees and similar others • The stockpiles will maintain slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil • Locate topsoil stockpiles in areas outside drainage lines and protect 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 any adverse conditions if identified are to be minimized through corrective actions which will include: • Anaerobic conditions-turning the stockpile or creating ventilation holes through the stockpile; • Erosion – temporary protective silt fencing will be erected;
Soil salinity	• Use of duckweed will remove soil salinity • Flushing with pre-monsoon rain water will reduce soil salinity. • Salinity tolerant crops need to be cultivated. • Environmentally and socially responsive shrimp farming e.g. shrimp-rice farming system to be encouraged. • Increase upland discharge of fresh water will push back ingress of saline water from the sea • Green manure application is 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 condition in accordance with manufactures maintenance procedures • Organize the loading and unloading of trucks and handling operations for minimizing construction noise at the work site.
Construction machinery	• Select appropriate site for all noise generating activities to avoid noise pollution to local residents • Maintain all equipment in order to keep it in good working condition in accordance with manufactures maintenance procedures.
Construction activity	• Notify adjacent landholders/educational institution prior to any typical noise events outside of daylight hours • Employ best available work practices on-site to minimize occupational noise levels • Install temporary noise control barriers where appropriate • Plan activities on site and deliveries to and from site to minimize impact • Monitor and analyze noise and vibration results and adjust construction practices as required. • Avoid working during 09:00pm to 06:00 am within 500m from residences.
ECoP 5: Ecology Management	
Flora	
Vegetation Clearance	• Tree felling will be performed upon preliminary notification to the relevant authority (District Forest Office, DoE).

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• 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 avoiding felling trees during construction • Fruit and timber trees owned by local population will be compensated at their replacement cost according to market prices
Plant Management	• Tree seedlings are planted in a way that minimizes damage to the soil, while facilitating seedling survival. Appropriate tree seedling species are to be selected for maintaining long-term productivity. • Focus on tree species suitable for site condition • Prevent unreasonable species resulting slow growth, less water and soil conservation and pest or disease outbreaks • Local species as planting materials, since natural selection and succession are most suitable for local climates and natural conditions • Single species or clone monoculture are to be avoided • Choose suitable species for berm and turfing
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. • Do not plant spread-prone species on sites where there is a high risk of uncontrollable wilding spread beyond the boundaries of the plantation. • Consider appropriate species, patterns and layout when planting areas with high visual values and/or with important recreational values
Polypropylene Bags Handling	• Make a Borrow Pit at each site for collection of poly bags • Collect all bags at the pits after plantation • If feasible, inform private sector to collect those bag for recycling
Pest Management to Nursery	• During outbreak of any deadly plant disease develop a plan to manage pest in coordination with neighbors by identifying existing pests and diseases and the risks for introduction of new pests and diseases. • Share the plan with financial 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 against entering the 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 the start up of works • Limit the construction works within the designated sites allocated to the contractors • Not be allow any destruction of nests or eggs of migratory birds • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching.
ECoP 6: Fisheries Management	
Construction works in the rivers and on the surrounding lands	• Critical breeding areas of major fish species will be identified and declared as sanctuaries. • Creation of small ditches and pools that may trap the fishes will be avoided. • Creation of artificial waterfalls and other barriers for migration will be avoided. • Natural river channels are to be reinstated after completion of construction

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	works
Hydraulic Structure	• Sufficient free flow will have to be guaranteed in the design and construction work to ensure free passages of migrating fishes. • Hydraulic structure will be operated considering fish migration and spawning time • A guideline for area specific hydraulic structure operation will be developed
Dredging	• Ensure that the dredging activity will create minimum sediment load in the water • Avoid dredging during spawning period of fish
ECoP 7: Socio-Economic Management	
Construction Camp Management	
Siting and Location of construction Camps (MRDI, 2011)	• The Contractor will hoist a signboard/billboard at worksite mentioning the details of activities to be performed along with cost, working period along with name and address of firm. It will also contain the name and address of supervision organization, who may informed of any grievances with the activities. • Locate the construction camps in the areas, which are acceptable from environmental, cultural or social point of view. • Consider the location of construction camps far away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • BWDB will endorse detailed layout plan for the development of the construction camp submitted by the contractor. The plan will show the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed about the set up of camp facilities, so as to maintain effective surveillance over public health, social and security matters
Construction Camp Facilities	The following facilities will have to be provided by the contractor • Adequate housing for all workers • Safe and reliable water supply • Hygienic sanitary facilities and sewerage system. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities • Provide in-house community/common entertainment facilities, dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Solid Waste Management	• Ensure proper collection and disposal of organic and inorganic 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 waste will be collected and removed from the work camps and disposed in approved disposal sites
Fuel supplies for cooking and heating purposes	• Provide fuel to the construction camps for their domestic purpose, in order to discourage use of fuel wood or other biomass. • Conduct awareness campaigns to educate workers to protect the biodiversity and wildlife of the project area, and relevant government regulations and punishments on wildlife protection.
Health and	• Provide adequate health care facilities within construction sites • Provide first aid facility round the clock. Maintain stock of medicines in the

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Hygiene	facility • Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outside areas • Train all construction workers regarding basic sanitation and health care issues and safety matters, and on the specific hazards of the work • Provide HIV awareness programming, including STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Assure regular mosquito repellant sprays during monsoon. • Conduct short training sessions on best hygiene practices and make of mandatorily participation by all workers. • Place display boards at strategic locations within the camps containing messages on best hygienic practices
Payment of Wages	• The contractor to follow the guidelines stated in the by-laws of Bangladesh Labour Act, 2006. • 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 the minimum wages on board at camps and major construction sites in local languages. • Equal wage for female and male workers to be ascertained for gender equity. • Wages will be paid to the laborers only in presence of BWDB staff; • Contractor is required to maintain register for payment of labor wages with entry of every labor working for him. It should be produced for verification if and when asked by the DCSC, Engineer, EMU and/or the concerned BWDB staff/ Engineer‘s representative.
Rehabilitation of Labor and Construction Camp	At the completion of construction, all construction camp facilities shall be dismantled and removed from the site. The site shall be restored to a condition in no way inferior to the condition prior to commencement of the works. Various activities to be carried out for site rehabilitation and include: • Oil and fuel contaminated soil shall be removed and transported or buried in waste disposal areas. • Soak pits, septic tanks shall be covered and effectively sealed off. • Debris (rejected material) will be disposed off suitably. • Underground water tank in a barren/non-agricultural land can be covered. • If the construction campsite is on an agricultural land, the top soil should be preserved and good earth can be spread back for a minimum 30cm for faster rejuvenation of the land. • Proper documentation of rehabilitation site is necessary. This shall include the following: • Photograph of rehabilitated site; • Land owner consent letter for satisfaction in measurements taken for rehabilitation of site; and • Undertaking from contractor; In cases, where the construction camps site is located on a private land holding, the contractor should still have to restore the campsite as per this guideline. The rehabilitation is mandatory and will be include in the agreement with the landowner by the contractor. A certificate of satisfaction from the landowner should have to be obtained.
Damage and Loss of Cultural Properties	

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Conservation of Religious Structures and Shrines	• All necessary and adequate care should be taken to minimize impact on cultural properties which includes cultural sites and 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. Cleanliness at the access to such properties along with the road should be maintained.
	• 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 decision from the PD. The Archaeological Department shall be intimated about the chance of such findings and the Engineer shall carry out a join inspection with the department. Actions as appropriate shall be intimated to the Contractor along with the probable date for resuming the work. • All fossils, coins, articles of value of antiquity and structures along with all other things of geological or archaeological interest discovered on the site shall be the property of the Government, and shall be dealt with as per provisions of the relevant legislation.
Worker's Accident Risk	
Risk from Operations	• The Contractor is required to comply with all the precautions as required for the safety of the workers as per the International Labor Organization(ILO) convention. The contractor shall supply all necessary safety appliances such as aprons, safety goggles, helmets, masks, boots, etc., to the workers and staff. The contractor has to comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and outlet.
Risk from Electrical Equipment	• Adequate precautions will have to be taken to prevent any danger from electrical equipment. No materials on any of the sites will be 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 machineries to be used in the construction will conform to the relevant Bangladesh Standards (BS) codes, will be free from patent defect, will be in good working condition, 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, who are engaged in welding works, would be provided with welder's protective eye-shields. Stonebreakers 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 all anti-malarial instructions given to him by the Engineer and the EMU, including filling up of the borrow pits whichhave 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 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	• Special consideration shall be given in preparation of the traffic control plan to the safety of pedestrians and workers at night

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Management	• The temporary traffic detours in settlement areas shall be kept free from dust by frequent application of water
Traffic Control and Safety	• The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the cross section.

10.5 Chance-Find Procedures for Physical Cultural Property

665. The Contractor will be responsible for familiarizing themselves with the following “Chance Finds Procedures” in case of culturally valuable materials are uncovered during excavation or any project activities as per Antiquities Act, 1968 which includes:

- Stop work immediately following the discovery of any materials with possible archeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;
- Protect artifacts as well as possible using plastic covers, and to take measures to stabilize the area, if necessary, properly protect artifacts;
- Prevent and penalize any unauthorized access to the artifacts; and
- Restart construction works only upon the authorization of the relevant authorities (e.g. Upazila Nirbahi Officer, Deputy Commissioner and Department of Archeology).

10.6 Monitoring Plan

666. Extensive monitoring of the environmental concerns of the CEIP-1 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.

667. The Monitoring activities during design/preconstruction period are:

- Checking the contractor’s bidding documents, particularly to ensure that all necessary environmental requirements have been included; and
- Checking that the contract documents’ (Environmental Action Plan) references to environmental mitigation measures requirements have been incorporated as part of contractor’s assignment and making sure that any advance works are carried out in good time.

668. Environmental monitoring during construction phase is a function of supervision and the essential purpose is to ensure adherence to the EMP. The monitoring is a regular process, which ensures that departures from the EMP are avoided or quickly rectified, or that any unforeseen impacts are quickly discovered and remedied. This monitoring will carried out by the DDCS&PMSC on a regular basis. Additional monitoring will carried out by the Environmental and Social Unit.

669. Post project monitoring evaluation will carried to evaluate the impacts of the Project during first three (3) years of operation of the Project. Regular monitoring of the condition of the embankment, drainage structures and slope protection structures and afforestation are important from an environmental management point of view. In addition to this, information on the locations, type and consequences of flooding, erosion, flora and fauna mortality, availability of fish, occupational shift, migration is required. Recommended air, noise and water quality monitoring, greening and landscaping and community feedback are also included in the Monitoring Plan. The monitoring plan and details of monitoring locations for environmental condition indicators of the project during construction and operation stage are presented in Table 10.2 and Table 10.3

Table 10.2: Environmental Monitoring Plan during Construction and Operation of Rehabilitation and Improvement of Polders System

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
During Construction					
Sources of Material	Work Site	Possession of official approval or valid operating license of suppliers of materials (Cement, soil).	Before the agreement for the supply of material is finalized.	Contractor	DCSC, M&E Consultant, BWDB
Operation of borrow pit site	Borrow pit/site	Visual inspection of borrow pit site and ensuring operational health and safety	monthly	Contractor	DCSC, M&E Consultant, BWDB
Top Soil	Storage area	Top soil of 0.15 m depth will be excavated and stored properly	Beginning of earthwork	Contractor	DCSC, BWDB
	Storage area	The stored top soils will be used as cladding material over the filled lands	Immediately after filling and compaction of earth materials	Contractor	DCSC BWDB
	Work Site	Some of the top soil are placed on top and berm of embankment for turfing and plantation	At the end of filling activity	Contractor	DCSC, BWDB
Workers; Health Safety	Workers' camp site/ work site	Use of PPE by workers, provision of safe drinking water, sanitation and first aid facilities and	Daily	Contractor/workers	DCSC, BWDB
Erosion	Side slopes of the embankments and material storage sites	Visual inspection of erosion prevention measures and occurrence of erosion	At the end of filling activity	Contractor	CS, M&E Consultant, BWDB
Hydrocarbon	Constructi	Visual Inspection of	Monthly	Contractor	DCSC,

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
and chemical storage	on camps	storage facilities			BWDB
Traffic safety	Construction area	Visual inspection to observe whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DCSC BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Daily	Contractor	DCSC, BWDB
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DCSC
Air Quality (PM_{10}, $PM_{2.5}$)	Close to School/ Madrasha, Hospital &Villages	Air quality monitoring	Yearly	Contractor through a nationally reputed laboratory	DCSC, M&E Consultant, BWDB
Noise	Construction sites	Visual inspection to ensure good standard equipment are in use	Weekly	Contractor	DCSC, M&E Consultant, BWDB
	Construction sites	Ensure restriction of work between 09:00 p.m.-6:00 a.m. close to School/ Madrasha, Hospital & Villages	Weekly	Contractor	DCSC, M&E Consultant, BWDB
Physical and chemical qualities of soil (soil texture, N.P.K organic matter, pH, salinity etc)	Construction sites	Soil sample collection and laboratory analysis	Yearly	Contractor	DCSC, M&E Consultant, BWDB
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample from the river of each polder	Sampling and analysis of surface water quality	Yearly	Contractor through a nationally reputed laboratory	DCSC, M&E Consultant, BWDB
Drinking Water Quality (Arsenic, Iron, TDS,	Sources of drinking water at constructio	Sampling and analysis of water quality	yearly	Contractor through a nationally reputed	DCSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Turbidity, pH, FC, as of groundwater etc)	n camp/site			laboratory	
Sanitation	Construction camp/site	Visual Inspection	Weekly	Contractor	DCSC, M&E Consultant, BWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid waste and other depositions at designated site	Weekly	Contractor	DCSC, M&E Consultant, BWDB
Flora and Fauna	Project area	Survey and comparison with baseline environment	Yearly	Contractor through nationally reputed institute	DCSC M&E Consultant, BWDB
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	Aftercompletion of allworks	Contractor	DCSC, M&E Consultant, BWDB
Safety of workers Monitoring and reporting accidents	At work sites	Use of Personal Protective equipment (PPE) like	Monthly	Contractor	DCSC, M&E Consultant, BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample on each river of each polder	Sampling and analysis of surface water quality	Yearly	BWDB through a nationally reputed laboratory	M&E Consultant
Air Quality (Dust PM_{10}, $PM_{2.5}$)	At the baseline monitoring site	24 hours Air quality monitoring	Yearly	BWDB through a nationally reputed laboratory	M&E Consultant
Flora and Fauna specially fisheries	In the project area	Detail species assessment and compare with baseline	Yearly	BWDB through a nationally reputed institution	M&E Consultant
Agriculture	In the project area	Compare the production with the baseline	Yearly	BWDB through a nationally reputed institution	M&E Consultant
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant

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, BWDB, M&E Consultant
Water Quality	Water bodies near nursery	Odor and chemical testing	Half yearly	Contractor through nationally reputed laboratory	DCSCBWDB, M&E Consultant
Waste Management	Work site and Nursery	Visual inspection of collection, transportation and disposal of grasses, debris and is deposited at designated site	Weekly	Contractor	DCSCBWDB, M&E Consultant
	Work site and Nursery	Visual inspection of Water bars & cut-offs. sedimenttraps to prevent water pollution caused by run-off from harvesting areas	Beginning of works	Contractor	DCSCBWDB, M&E Consultant
Nursery Embankment Management	Nursery	Visual inspection of height of embankment, possibility of water logging and connection to the waterbodies	Beginning of each nursery	Contractor	DCSC, BWDB, M&E Consultant
During Operation and Management					
Multilevel belt of trees	Polder top and along the polder	Visual inspection	yearly	BWDB through nationally recognized institution	M&E Consultant
Flora and Fauna	In the project area	Detail species assessment and compare with baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Erosion	Along Alignment	Visual Inspection presence of gullies or erosion	Yearly	BWDB	M&E Consultant

10.6.1 Qualitative Spot Checking Indicators

670. Moreover, a rapid environmental monitoring will carried out as per following checklist in terms of visual judgment during field visit as an indirect control to implement Environmental Mitigation plan. Table 10.4 can followed during project construction and operation process.

Table 10.4: Spot Checking Indicator

Parameter	Visual Judgment			
	Poor	Moderate	*Satisfactory*	*Comments*
Signboard/Bilboard				
Camp Site Management				
Plant Site Management				
Borrow pit Area Management				
Top Soil Preservation				
Waste Management				
Occupational Healtth and Safety (a) Accommodation facility (b) Safe water supply (c) Sanitation facility (d) First aid facilities (e) Provision and use of PPE				
Stockpiling of construction materials				
Reporting and Documentation				

10.7 Third Party (M&E Consultants) Validation

671. BWDB will engage independent consultants to conduct a third party validation (TPV) of the EMP implementation on yearly basis during the construction phase. During the TPV, the consultants will review the implementation and effectiveness of various EMP activities including mitigation measures, environmental monitoring, trainings, and documentation. The consultants will also identify gaps and non-compliances in EMP implementation and propose actions for their remedy.

10.8 Documentation, Record keeping and Reporting

10.8.1 Record Keeping

672. Proper arrangements are necessary for recording, disseminating and responding to information, which emerges, from various environmental monitoring and management programs. They are also necessary for rendering the environmental management system "auditable". However, the primary focus must remain on the pragmatic control of pollution,

not creation of complex bureaucratic procedures. BWDB will maintain database of the polder specific Environmental Impact and Monitoring information for keeping all type of monitoring record. ESCU will assist BWDB for keeping these records initially. The trained BWDB staff will take the responsibility of record keeping and monitoring during operation phase.

10.8.2 Monitoring Records

Quantitative Physical Monitoring

673. 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.

674. The monitoring data would be continually processed as it is received, so as to avoid a buildup of unprocessed data.

General Site Inspections and Monitoring

675. A Site Inspection Checklist for recording the findings of the general site condition surveys would be developed by the respective contractors, based on the Environmental Mitigation Plan described in Chapter 9 and Section 11.4, during the construction phase. The Site Inspection Checklist would be supported by sketches, as necessary.

10.8.3 Information Sources

676. The ESCU of PMU will maintain a complete and up-to-date file of all relevant sources of information. This file would be readily accessible and include, as a minimum, copies of the following documents:

- Current environmental permits and consents;
- Action to fulfill the requirement of annual site clearance for polder area
- All relevant national regulations, international guidelines and codes of practice;
- Manufacturers’ MSDSs for all hazardous substances used on the project;
- Manufacturers’ operating manuals for all the environmental monitoring equipment;
- Current calibration certificates for all equipment that requires calibration by an external organization; and
- The latest version of Environmental Management and Monitoring Plan.

10.8.4 Non-Compliance Report

677. Any breach of the acceptable standards specified, would reported to the PMU using a standard form, i.e. a Non-Compliance Report (NCR).

678. A copy of each completed NCR would kept maintained on file by DCSC to be replaced by the reply copy when it is received. A record of corrective actions would also make and tracked to their completion.

10.8.5 Monthly Internal Reports by DDCS&PMSC

679. The DCSC will prepare a monthly report for issuance to the ESCU of PMU. These reports will summarize the followings:

- Progress of implementation 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 issues where information or data collected is substantially different from the baseline data reported in the Environmental Assessment;
- Outstanding NCRs;
- Summary of any complaints by external bodies and actions taken / to be taken; and
- Relevant changes or possible changes in legislation, regulations and international practices.

10.8.6 Bi-annual Environmental Monitoring Report by BWDB

680. ESCU of BWDB will prepare the Bi-annual Environmental monitoring report during construction phase and will submit to the World Bank for review during construction phase. The monitoring report will include the status of environmental monitoring and the plan for the next six months. The report will summarize the information presented in Table 10.2, 10.3 and 10.4.

Environmental Audit Report & Third Party (M&E consultants) Monitoring Report

681. It is expected that BWDB will conduct annual environmental audit. In addition, the environmental audit will carried out before the mid-term evaluation and before project closing. All Environmental Audit Report will shared with Bank. Environmental monitoring will be conducted during the project.

Third Party Monitoring

682. The Third-Party Monitoring will monitor the quality of environmental compliance and will share with Bank.

Donar Agency/WB Monitoring

The Donar Agency/WB will also monitor time to time the quality of environmental compliance as part of regular implementation support mission.

10.9 Contractual arrangements for EMP implementation

683. Most of the contractors do not have any clear understanding about the need of environmental management, some quoted very low price for implementation of EMP and eventually cannot implement EMP as per design. To avoid this problem, fixed Budget will be assigned for EMP implementation. The contractors may need orientation on the requirement

of the EMP in the pre-bidding meeting. The contractor needs to submit an Environmental Action Plan (EAP) based on the EIA in line with the construction schedule and guideline. The EAP needs to reviewed by the supervision consultant and cleared by BWDB and World Bank.

10.9.1 Guideline to Incorporate Environmental Management in Bid Document & Preparation of EAP

- Prepare cost estimates, to incorporate in the Bid Documents.
- Environmental Management Plan along with 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)
- Corrigendum / Addendum to polder/embankment specification, if any, as special provisions to incorporated in the bid documents.
- Penalty clauses for not complying with EMP requirements to incorporated. Indicative penalty clauses proposed in the CEIP-1 are presented below (Addendum to Clause 17.2 Contractor 's Care of the Works of FIDIC):
    - ➢ The contractor has to follow all traffic safety measures as defined in the technical specification. Damage shall be levied at the rate Tk. 3000/- per day per location for non – conformity of traffic safety measures as decision of the Engineer.
    - ➢ The contractor has to follow all environmental mitigation measures as defined in the technical specification along with the Environmental Management Plan for the specific CEIP-1 activities. Damage shall be levied at the rate Tk. 3000/- per day per location for nonconformity of Environmental Management Plan measures as per decision of the Engineer/Supervisor
    - ➢ The contractor has to ensure that prior to every monsoon season, during the construction period; all temporary and permanent cross drainage structures are free from debris as defined in the Technical Specifications 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/Supervisor
    - ➢ The contractor is to ensure that sufficient numbers and good quality Personnel Protective Equipment (PPE), will be provide to staff and labor all time as defined in the labor codes read along with the EMP. Damage shall be levied at the rate of Tk. 1000/- per day for non-conformity as per the decision of the Engineer/Supervisor

10.9.2 Guideline for Compensation and Contingency Plan during Project Period

684. Compensation becomes necessary when project impacts cannot be satisfactorily mitigated. 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 give as per provision of the Resettlement Action Framework. Any disputes over the compensation will handled by the Grievance Redress Committee.

685. 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 should be prepared for the following emergency situations:

- Embankment failure during a flood – keep sufficient number of sand bags in reserve.
- Bank caving/erosion – keep sufficient number of concrete blocks and sand bags in reserve.
- Have an emergency evacuation plan for the people in the line of danger.
- 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 transfer of a seriously injured person to the nearest hospital.

10.10 EMP Implementation Cost

686. 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	Cost (BDT)	Cost Thousand US$	Responsible Agency	Timeframe
1	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils	1,000,000	12.00	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 periods,10 samples in polder 40/2= 10 samplesx3 times @ Tk.5,000	150,000	1.88	BWDB in collaboration with DAE	Pre- construction, construction and post construction period
3	Habitat Observation for four (4) times of year (dry & wet season).	50,000	0.63	BWDB in collaboration with Upazila Fisheries Office	Construction and post construction period
4	Construction of fish sanctuary in perennial khals	100,000	1.25	BWDB in collaboration with Upazila Fisheries Office	Post construction period
5	Catch Assessment Survey for two (2) times a year (dry & wet season).	142500	1.78	BWDB in collaboration with Upazila Fisheries Office	Construction and post construction period
6	Farm Survey for four (4) times of year (dry & wet season).	60,000	0.75	BWDB in collaboration with Upazila Fisheries Office	Construction and post construction period
7	Awareness program on plant and wild life conservation.	140,000	1.75	BWDB in collaboration with Forest Office	Construction and post construction period
8	Consultancy services cost for supervision and monitoring of EMP	276,440	3.56	DCSC	Construction and post construction period
9	Training to the farmers with field demonstration regarding IPM and ICM.	80,000	1.00	BWDB in collaboration with DAE	Post construction period
10	Awareness building up to local community for conservation of threatened fish species.	40,000	0.50	BWDB in collaboration with Upazila Fisheries Office	Construction and post construction period
11	Training to the fisherman/pond owner with field demonstration regarding pond culture.	40,000	0.50	BWDB in collaboration with Upazila Fisheries Office	Post construction period
12	Release fish fry in the khals inside the Polder after completion of construction works.	90,000	1.13	BWDB in collaboration with Upazila Fisheries Office	Post construction period

Item No.	Description	Cost (BDT)	Cost Thousand US$	Responsible Agency	Timeframe
13	Air and noise quality monitoring and analysis.	200,000	2.50	BWDB in collaboration with DoE	Construction period
14	Solid and liquid waste disposal arrangement.	80,000	1.00	BWDB	Construction period
15	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1,200,000	15.00	BWDB	Construction and post construction
16	Consultancy services cost for river bank erosion monitoring	1,200,000	15.00	BWDB	Post construction period
17	Training to the Contractors regarding environmental management	100,000	1.25	BWDB in collaboration with DoE	Pre construction period
18	Training of Environmental awareness of local population	120,000	1.50	BWDB in collaboration with DoE	Pre construction period
19	Updating EMP as per requirement.	100,000	1.25	BWDB	Post construction
20	Construction of alternative or bypass channels at each construction sites.	1,061,053	13.26	BWDB and Contractor	Pre-construction period
21	Materials for net pen culture (at least 25 households in each word/council of a Union).	1,296,000	16.20	BWDB in collaboration with Upazila Fisheries Office	Post construction period
22	Conservation and stocking of threatened fish species (at least 3 spots).	480,000	6.00	BWDB in collaboration with Upazila Fisheries Office	Post construction period
23	Monitoring of Aquatic mammal movement (Surfing, diving, migration, etc.).	100,000	1.25	BWDB in collaboration with Upazila Fisheries and Forest Office	Construction and post construction period
24	Campaigning and providing training on improved culture practices as well as the rice cum golda farming.	200,000	2.50	BWDB in collaboration with Upazila Fisheries Office	Post construction period
25	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	2,400,000	30.00	BWDB	Post construction period
26	Surface and ground Water quality monitoring cost (testing for Turbidity, pH, DO, BOD, Salinity etc. + test of as, Fe etc. for HTWs at workers' camp site), 10 samples in polder 40/2 during pre-construction, construction and post-construction periods + water quality analysis of HTWs of 33 workers' camp= (Tk.4,000x10x3x) + (Tk.700X33).	143,100	1.79	BWDB in collaboration with DAE	pre-construction, construction and post-construction
27	Additional Tree Plantation at HH and other grounds to compensate the tree cutting (planting 3 trees	16,456,950	205.71	BWDB in colaboration with Forest	Post construction period

Item No.	Description	Cost (BDT)	Cost Thousand US$	Responsible Agency	Timeframe
	for cutting I tree) @ Tk.50 each tree including the cost of sapling, gabion and nursing etc).			Office	
28	Water sprinkling at resectioned/newly constructed embankments (@ Tk.3,000 per km of enbankment	106,740	1.33	BWDB and Contractor	Construction period
29	WMOs monitoring cost	240,000	3.00	BWDB	Post construction period
	Total	**27,652,783**	**345.27**		

US$= 80 BDT

10.11 Updating EMP

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

10.12 Grievance Redress Mechanism

688. BWDB will establish a grievance redress mechanism (GRM) as a means to ensure social accountability and to answer the queries and address complaints and grievances about any irregularities in application of the guidelines adopted in this EMF for assessment and mitigation of social and environmental impacts. Based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly, saving the aggrieved persons from having to resort to expensive, time-consuming legal action. The procedure will however not pre-empt a person’s right to go to the courts of law.

10.12.1 Grievance Redress Focal Points

689. A Grievance Redress Committee (GRC) at local level will 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 informed about their rights to offer suggestions and make complaints. All grievances received through the GRM process will primarily forward 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, Dhaka. The GRC will officially forward the cases with their comments to the Project Director. Hearing of petitions with GRCs will arranged at the Convener’s office or at Union Parishad/Ward Councillor’s office as agreed by the committee members. The membership of the GRCs will ensure proper presentation of complaints and grievances as well as impartial hearings and investigations and transparent resolutions.

Membership of GRC

1.	Executive Engineer (BWDB Division Office)	:	Convener
2.	Representative of the RP Implementing NGO	:	Member-Secretary
3.	Local UP Chairman /Ward Councillor	:	Member
4.	Teacher from Local Educational Institution (nominated by Upazila Administration)	:	Member
5.	Representative from Local Women's Group	:	Member
6.	Representative from the PAP Group	:	Member

690. Members of the GRCs will nominated by the Executive Engineer at Division level and approved by the Project Director, PMU, BWDB, Dhaka.

10.12.2 Grievance Resolution Process

691. All complaints will receive 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 out the cases in terms of nature of grievance, urgency of resolution, and schedule hearings in consultation with the Convener. All cases will heard within four weeks from the date of receiving the complaints.

692. 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 the aggrieved person again find decision at this level unacceptable, BWDB can refer the case to the MoWR with the minutes of the hearings at local and headquarters levels. At the ministry level, an official designated by the Secretary, MoWR, will make decisions on unresolved cases, if any, in no more than four weeks. A decision agreed with the aggrieved person(s) at any level of hearing will be binding upon BWDB.

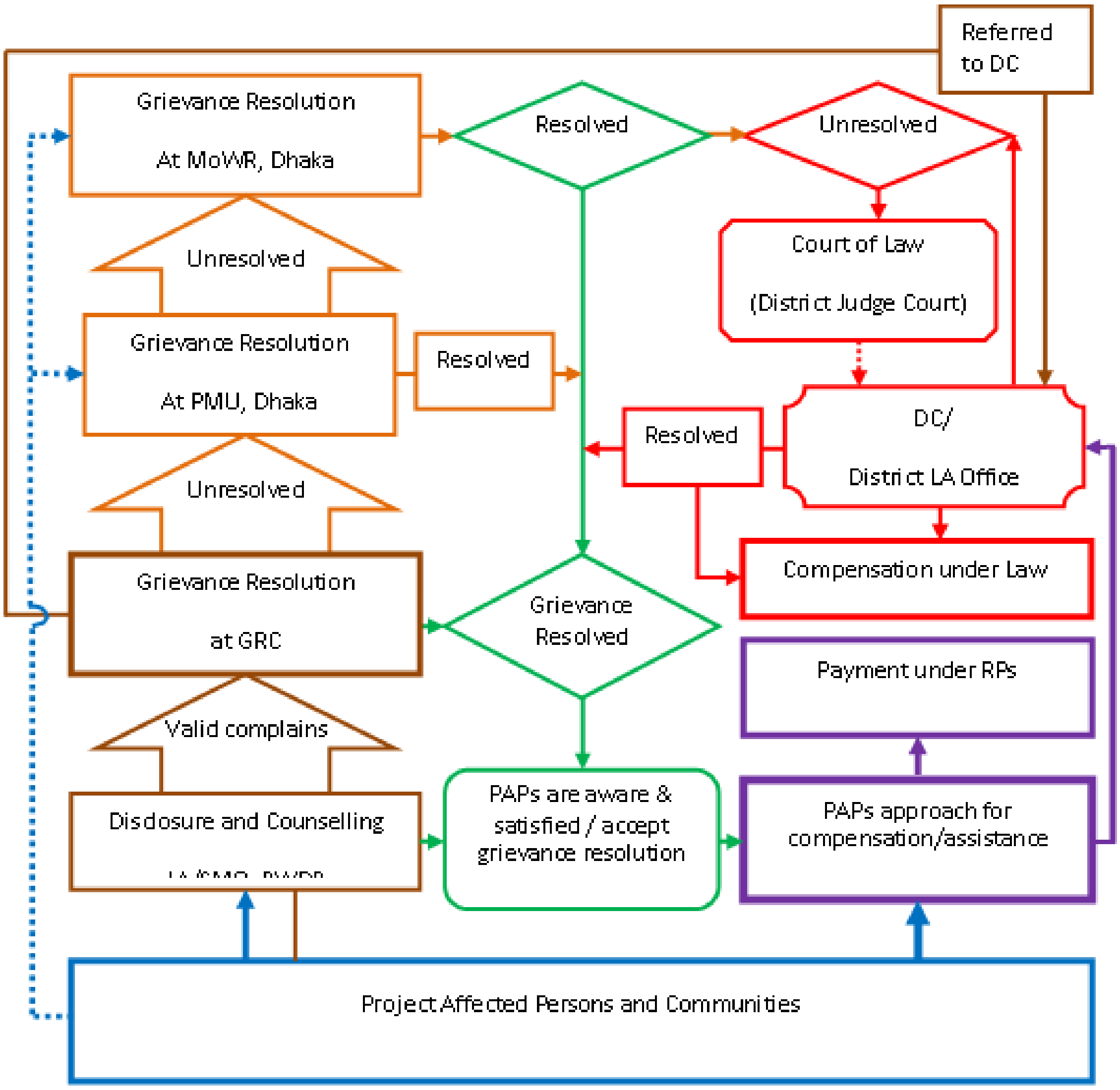


Figure 10.3: GRM Process Flow Chart

693. 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 of the area.
- Remove a recommendation by any person that may separately accompany the grievance redress application.
- Disqualify a GRC member who has made a recommendation on the application separately before the formal hearing:
- When a GRC member removed, another person tobe appointed prior to consultation with the Project Director.
- The Convener will also ensure strict adherence to the impact mitigation policies and guidelines adopted in this SMRPF and the mitigation standards, such as compensation rates established through market price surveys.

10.12.3 GRM Disclosure, Documentation and Monitoring

694. The affected persons and their communities will inform 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 distributed among the project-affected persons. The PAPs will also brief on the scope of the GRC, the procedure for lodging grievances cases and the procedure of grievance resolution at the project level.

695. 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) name of 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.

696. Grievance resolution will be a continuous process in RP implementation. The PMU and SMOs will keep records of all resolved and unresolved complaints and grievances (one file for each case record) and make them available for review as and when asked for by the 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.

10.13 Capacity Building

697. Since the effectiveness of the Environmental Assessment & implementation depends considerably on the understanding and preparedness of their Engineers and in particular their Environmental Team (Consisting of Contractor Environmental specialist, Consultant environmental specialist and ESCU of BWDB). It is important that, the project authority makes effort to sensitize the Engineers and Environmental Team on management of environmental issues, provides guidance and encourages them to build requisite capacities. Table 10.6 provides a summary of various aspects of the environmental and social trainings to be conducted at the construction site. PMU may revise the plan during the Project implementation as required.

698. During the O&M phase of the Project, BWDB staff will continue these trainings 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; DC &DDCS &PMSC staff	DC &DCSC& ESCU	Prior to the start of Project activities. (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; DC &DDCS &PMSC; selected contractors' crew	DC &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 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 beneficiary's organizations	BWDB, ESCU, Contractor	Before and during construction activities

699. Capacity building training programs will be undertaken in the following area:

- Training of the management level officials of BWDB, BWDB environmental compliance personnel on the overall environmental concerns and responsibilities for implementing EMP.
- Recruitment of new professionals with background on environment, if required and provide necessary training.
- Organizing workshop, seminar, with stakeholders on the environmental concerns of CEIP-1

- Special training program for the contractors and workers on the EMP and their responsibilities, who will actually be involved in the construction of the project interventions. The Contractors will provide guideline for 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 of the relevant agencies involved in EMP implementation.

700. The training programs will be arranged before implementation of the interventions in the polder area. Detail plan can be made by the proposed ESCU of BWDB.

11 Stakeholder Consultations and Disclosure

701. This Chapter provides details of the consultations held with the stakeholders at the Project site and framework for consultations to carry out during construction phase. The disclosure requirements for the EIA are also included in this Chapter.

11.1 Overview

702. The GoB as well as international donors (World Bank) place great importance in 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 field visits of present EIA, an attempt has made to consult with a full range of stakeholders to obtain their views on the Project interventions.

703. 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 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 again a draft EIA report is prepared.

704. The present EIA report include consultation with local communities, non-governmental organizations (NGOs) and concerned government departments/ organizations dealing particularly with related fields and thus, ensuring accommodation of their views and concerns in the study.

11.2 Objectives of Stakeholder Consultations

705. The following objectives have served as the moving force for the design, implementation and fact findings during the participation process:

- To provide key Project information and create awareness among various stakeholders about project intervention;
- To have interaction for primary and secondary data collection with project beneficiaries, affectees, and other stakeholders;
- To identify environmental and social issues such as displacement, safety hazards, employment, and vulnerable persons;
- To begin establishing communication and evolving mechanism for the resolution of social and environmental problems at local and Project level;
- To involve Project stakeholders in an inclusive manner; and
- To receive feedback from primary stakeholders on mitigation and enhancement measures to address the environmental and social impacts of the Project.

11.3 Approach and Methodology

706. Participatory approach has been followed in conducting the public consultation meetings in the Polder- 40/2. The consultants first discussed 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 consulted to identify the potential stakeholders at the Polder level. With supports from the UNOs and/or PIOs, the union level public representatives as well as the key persons informed about the specific consultation meetings and requested them to be present in the meeting.

707. Focus group discussions (FGD) carried out during in the public consultation process. In order to conduct the FGD and consultation meetings, two checklists were prepared covering the aspects including an overview of the proposed CEIP-1.Information on the ongoing EIA process, and seeking information on the problems of the area with their potential solutions, the local needs and demands have been discussed by giving equal opportunities to all participants attending the meeting. During consultation meeting, all relevant issues within the water resources, land resources, socio-economic resources and disaster aspects were discussed in detail.

708. During the FGDs and consultation meetings, the EIA team displayed maps of the Project area, shared the initial concepts of the proposed interventions and facilitated the response of the participants. The stakeholders of the Polder- 40/2 requested to share their needs, problems, possible sustainable solutions, and their views on the Project interventions. The stakeholders' perceived views on important environmental and social components (IESCs) and the impacts of the interventions on them, along with perceived benefits, risks, threats and demand from the Project identified during discussions.

11.4 Identification of Stakeholders

709. Stakeholders include all those who will be affected and are being affected by policies, decisions or actions within a particular system. Stakeholders are the groups of people, organizations, institutions and sometimes-even individuals. Stakeholders can divided into primary and secondary categories.

Primary Stakeholders

710. Primary stakeholders are the people who would be directly benefited or impacted by a certain project intervention. In case of the proposed Project in Polder- 40/2, 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 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

711. This category of stakeholders pertains with those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project aspects. In this Project NGOs, concerned government departments, and line agencies fall under this category.

712. Secondary stakeholders for the Project include local government institutions (LGI), Bangladesh Water Development Board, the Ministry of Water Resources, Department of Forest, other government agencies, academia, NGOs, the World Bank and general public at large.

Time, Date and Venue Selection

713. Venues, dates and times of meeting were selected through consultation with local people, the project proponent and the consultant. These three groups discussed and selected the venue considering the closeness to proposed project, easy accessibility to the venues and which is likely to be neutral. Dates and times were finalized in the similar way considering availability of the participants, ensuring the maximum participation, weather and compliance with the other arrangement.

Enlisting and Invitation

714. Comprehensive lists of potential stakeholders were prepared through consultation. This lists were intended to cover all types of interest groups, occupational groups, socially acceptable and knowledgeable peoples.

715. Formal invitations were sent to them and also communicated over telephone for ensuring their presence in the meeting.

Consultation Instrument

Checklist:

716. 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:

717. An inventory of the participants was maintained in attendance sheet containing contact number. Scanned list of participants is attached in Appendix E.

Camera:

718. For visualizing the participants, photographs were taken using camera. These photos were presented in this chapter. Photos of the participants of the meeting are presented at the end of this chapter.

Consultation Process

719. The study team conducted the meeting. During consultation meeting, the following processes were followed with sequences.

Greetings:

720. At the outset, the team spelled greetings to all participants. Welcomed them for attending and stated the entire design of the meeting.

Introduction:

721. The team members introduced themselves to the participants and gave detail description of the project, spelled out about the objectives and anticipated outcome of the meeting.

Respect to the participants:

722. The study team showed respect to all participants. They respected not only to the individuals but also to their values, cultural practices and social structures.

Ensuring peoples' voice:

723. Generally, participants cannot participate equally. In fact, a substantial number of participants tended to remain silent in any meeting. However, the study team encouraged all to participate willingly, explaining the ethics of the study.

Note taking:

724. Discussed issues and opinions were written in notebook carefully. All issues were given equal importance.

Recapitulation and closing the session:

725. At the end the study team recapitulated the session and responded to the quarries. Finally, the facilitator closed the session thanking the participants.

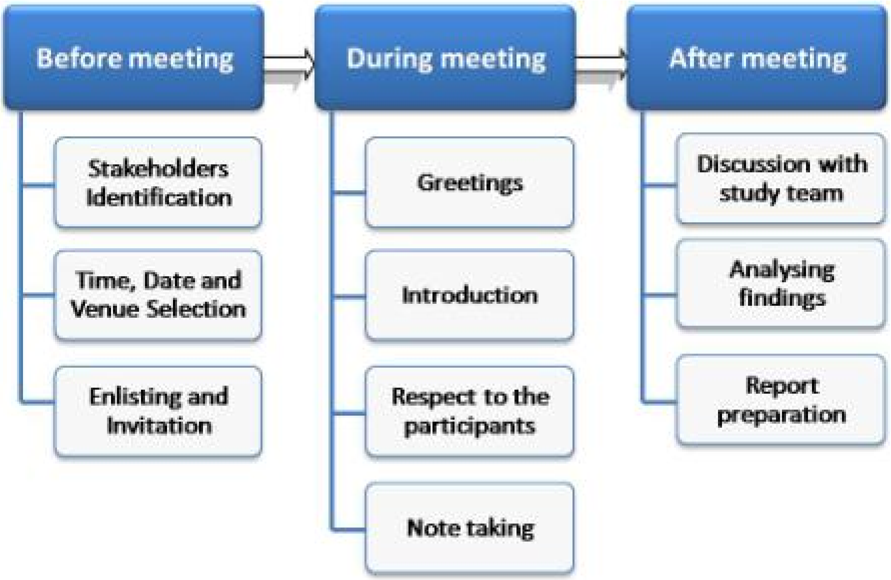


Figure 11.1: Overall consultation process

11.5 Public Consultation Meetings and FDGs

11.5.1 Consultation Process

726. A number of informal consultation meetings and FGDs were conducted at different locations of the Polder- 40/2. The details of these meetings and FDGs are presented in Table 11.1 and some photographs of these meetings are given in Photo 11.1 to 11.16

Table 11.1: Meeting venues with time and date

Sl	District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
1	Barguna	Pathargahata	Patharghata	Patharghata Upazila Auditorium	PCM	18/08/15	12:00 pm
2	Barguna	Pathargahata	Pathagahata	Patharghata UP Auditorium	PCM	13/05/15	11:00 am
3	Barguna	Pathargahata	Pathagahata	Charduani UP Auditorium	PCM	19/05/15	15:00 am
4	Barguna	Pathargahata	Patharghata	Hoglapasha	FGD	21/06/15	10:00 am
5	Barguna	Pathargahata	Charduanti	Charduanti	FGD	21/06/15	12:00

Sl	District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
				bazar			pm
6	Barguna	Pathargahata	Patharghata	Munshirhat bazar	FGD	21/06/15	2:00 pm
7	Barguna	Pathargahata	Pathagahata	Ganpara bazar	FGD	22/06/15	10:00 am
8	Barguna	Pathargahata	Pathagahata	Khalifa bazar	FGD	22/06/15	12:00 pm

11.5.2 Consultation Participants

727. The main participants of the consultation meetings included public representatives, farmers, traders and daily-wage laborers of the Polder- 40/2 and nearby areas. A total of 60 participants attended these consultations. The participant details are provided in Appendix 5 Table 11.2 below

Table 11.2: Participant Details

Sl	Meeting venue	Type of consultation	Type of Participants	No. of participants
1	Hoglapasha	FGD	Primary stakeholders	12
2	Charduanti bazar	FGD	Primary stakeholders	15
3	Munshirhat bazar	FGD	Primary stakeholders	08
4	Ganpara bazar	FGD	Primary stakeholders	13
5	Khalifa bazar	FGD	Primary stakeholders	12


Photo 11.1: PCM at Patharghata Upazila Auditorium

Photo 11.2: PCM at Pathaghata Union Auditorium

Photo 11.3: PCM at Charduani Union Auditorium

11.6 Issues discussed in FGDs and Meetings

728. At the outset of the meetings and FGDs, an overview of the proposed Project including the ongoing activities of the implementing agencies and the EIA process are shared with the participants. Subsequently, the key environmental, social, and socioeconomic aspects were discussed listed below.

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

729. At the outset, the study team gave a brief description about the project. The participants also stated that the project authority informed them frequently about this project. However, the stated description by the study team made them clear about the objectives and process of the project.

11.7.1 Attitude to the project

730. The communities including the persons to be affected by the Project expressed their views in favor of the Project and wanted early implementation to protect them from the tidal surges and disasters such as Aila and Sidr. They demanded adequate compensation and other benefits for the loss of their assets and livelihood, as well as alternative place for relocation of their houses and business.

Photo 11.4: FGD at Hoglapasha and Charduanti bazar


Photo 11.5: FGD at Munshirhat bazar and Ganpara bazar


Photo 11.6: FGD at Khalifa bazar

731. 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.

Table 11.3: Community Concerns and Suggested Solutions

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
Overall	- Drainage congestion, Salinity intrusion, water logging due to siltation at certain portions of the polder and poor communication system are the main community concerns in the polder area.	- Comprehensive rehabilitation of the polder should be taken up at the earliest with the active involvement of the local community.
Water resources	- Tidal Flooding, Storm surge, salinity intrusion, erosion	- Re-sectioning of the embankment to protect erosion and breaches - Proper maintenance and management of the water control structures should be ensured
Agriculture resources	- Crop damage due to drainage congestion and water logging. - Siltation of rivers and internal khals. - Lack of fresh water during dry season.	- Re-excavation of rivers and khals as per design. - Connecting the khals with rivers. - Repairing of the sluices - Repair the embankment as per design. - Regular operation and maintenance

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
		the regulators.
Fisheriesresources	- Reducing depth of internal khals and habitat quality degradation due to siltation - Hatchling and fish movement disrupted due to properly operation of water control structures. - Indiscriminate fishing by Sluice net - Entrance of saline water	- Re-excavation of khal will help to increase the richness of fish species in the polder area. - Application of fisheries rules and regulation by the government strongly - Repairing embankment with reasonable height.
Ecological resources	- A number of trees would be cut down and existing undergrowth vegetation would be damaged at construction sites for implementation of project activities - Lack of foreshore afforestation accelerate bank erosion as well as destruction of embankment by tidal surge	- Provide compensation to the proper owners/authorities against tree felling - Implement social afforestation along the embankment slopes - Proposed afforestation plan would arrest the vulnerabilities of embankment and protect bank erosion from tidal surge
Socio-economic resources	- At least 1000 nos of HHs will be displaced and their life and livelihood may be hampered. - Communication system is the vital issue of this polder. - 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. - Deplorable health condition due to lack of access to go to the trained physicians. - Poor housing condition of the people of the polder.	- Ensure proper resettlement of the households which may be affected by the project intervention of drainage sluice. - The embankment cum road should be repaired immediately. - Strengthening of WMGs so that mass people can access to open water bodies easily. - The Government should rehabilitate the affected farmers who are affected by salinity intrusion; - Need awareness building about water management, health and sanitation among the communities;

11.8 *Consultations* during RAP Preparation

732. A number of stakeholder consultations were conducted in the Project area while preparing the resettlement action plan (RAP) for the proposed Project in the Polder 40/2. These are discuss below.

733. The local persons who would potentially affected by the Project along with local community leaders and other stakeholders are consulted through group meetings and personal contacts. The opinions of different stakeholders regarding the Project were sought and considered in preparation of the RAP. Different types of stakeholders including concerned UP chairmen/members, teachers, imams (prayer leaders), local community leaders, political leaders, farmers, shopkeepers, and other people to be affected by the Project were invited to attend these sessions. The salient details of these consultations of Polder- 40/2 are presented in Table 11.4.

11.9 EIA Disclosure

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.

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. A total of 52 participants attended the public disclosure meetings (Appendix-6). The findings of the Public Disclosure Meeting (PDM) and some photographs of the meeting are given in Photo 11.7

Photo 11.7: PDM at Upazila Auditorium, Barguna Sadar, Barguna

Findings of the PDM:

734. The communities including the persons to be affected of Polder 40/2 by the Project expressed their views in favour of the Project and wanted early implementation to protect them from natural disasters. They demanded following actions to be taken immediately. These are:

- The embankment of Polder 40/2 is inside the Patharghata town which is the only way for the communication of the people. The proposed floodwall 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 floodwall 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 switch gates have been mal-functional. 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
- O & M for embankments and sluice gates in the polder area
- Need formation of Water Management Organizations (MWOs) to manage properly water control structures
- New embankment is required to be constructed by developing village road.
- Peripheral rivers should be re-excavated.

National Dissemination Workshop

735. 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.

736. 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 11.11: Chief Guest, Guest of Honour, Special Guests and Project Director

Picture 11.12: Welcome Speech by the Project Director of CEIP-1

Picture 11.13: Presentation of EIA findings by Mr. Malik Fida Abdullah Khan, Deputy Executive Director (Operation), CEGIS

Picture 11.14: View of Participants of the Seminar

Picture 11.15: A view of open discussion

Picture 11.16: Special Guestdelivering his speech

Picture 11.17: Special Guestdelivering his speech

Picture 11.18: Guest of Honour delivering his speech

Picture 11.19: Chief Guestdelivering his speech

Picture 11.20: Closing remarks by the Chair

737. 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.

738. 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.

The comments and responses of the seminar are provided in **Appendix-14.**

11.10 Framework for Consultations during Project Implementation

739. The stakeholder consultation is a continuous process and should be maintained throughout the project. The consultations carried out during the present EIA and reported in this Chapter are essentially the first step of this process. During the subsequent project phases as well, participation of the project stakeholders need to be ensured. Table 11.4 charts out the proposed participation framework during different project Phases.

Table 11.4: Participation Framework

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
Project Design Phase	Meetings with institutional stakeholders (carried out during the present EIA and RAP preparation); meetings with grass root stakeholders (carried out during the present EIA and RAP preparation)	Institutional stakeholders; Grass root stakeholders, including the communities to be affected by the Project.	EIA consultant.
Project Construction Phase	Information disclosure (sharing of the project objectives, project components, major benefits, potential impacts, mitigation measures and Resettlement Plan with the affected communities and other stakeholders).	Institutional stakeholders; Grass root stakeholders, including the communities to be affected during the project implementation.	BWDB; Supervision Consultants; Contractors
	Consultations and liaison	The communities around the work sites, borrowpit areas, and access routes	BWDB; Supervision Consultants; Contractors
	Grievance Redressal Mechanism and Social Complaint Register (discussed later in the document).	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 (Section 4.9)	Institutional stakeholders; Grass root stakeholders, including the beneficiary communities.	BWDB

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Appendix 1: Contruction Schedule

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												

Construction Schedule: 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												

Construction Schedule: 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-1 DESIGN Study, 2015

Appendix 2: No Objection Certificates

আল্লাহ সর্বশক্তিমান

এম. কামরুল ইসলাম

চেয়ারম্যান

৩ নং চরদুয়ানী ইউনিয়ন পরিষদ

পোষ্ট ঃ জ্ঞানপাড়া, উপজেলা ঃ পাথরঘাটা, জেলা ঃ বরগুনা। মোবাইল ঃ ০১৭১৩-৯৬১৯১৭

সূত্র :

তারিখ ঃ ২৬/০৫/১৫

অবস্থানগত/পরিবেশগত ছাড়পত্রের স্থানীয় কর্তপৰ 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 ঃ ৪০/২ বরগুনা জেলার পাথরঘাটা উপজেলায় অবস্থিত।
৫। প্রকল্পের তফছিল ঃ

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
বরগুনা	পাথরঘাটা				মাঝারি উচু ভূমি	হেক্টর

৬। প্রকল্পের কার্যক্রম ঃ বাঁধ উচুঁকরন, স্মুইজ গেট ও রেগুলেটর মেরামত, খাল পূনঃখনন ইত্যাদি।

উপরোক্ত তথ্যাদির আলোকে পোল্ডার ৪০/২ পূর্নবাসন প্রকল্প বাস্ত্ববায়নের জন্য নিম্নেবর্ণিত অনাপত্তি প্রদান করা হলো।

শর্তাবলী ঃ

১। প্রকল্প/ স্থাপন ও পরিচালনার ৰেত্রে পরিবেশ সংরৰণ আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে।
২। পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত ছাড়পত্র গ্রহণ করতে হবে।
৩। কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তার নিশ্চিত করতে হবে।
৪। উপযুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে। এবং অগ্নিকান্ড কিংবা অন্য কোন দূর্ঘটনার সময় জরম্নরী 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 উলিস্নখিত যে কোন শর্ত লঙ্ঘন করলে যথোপযুক্ত কর্তৃপৰ কর্তৃক কারখানা/প্রকল্পের বিরম্নদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

তারিখ ঃ

স্থানীয় কর্তৃপৰের স্বাৰর ও সীলঃ

এম কামরুল ইসলাম
চেয়ারম্যান
৩নং চরদুয়ানী ইউনিয়ন পরিষদ কার্যালয়
পাথরঘাটা, বরগুনা।

আপনার সন্তানকে স্কুলে পাঠান।

গাছ লাগান পরিবেশ বাঁচান।

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

Nutrientelement	VeryLow	Low	Medium	Optimum	High	Veryhigh
OM (%)	<1.0	1.0-1.7	1.8-3.4	-	3.5-5.5	>5.5
N(%)	≤0.09	0.091-0.18	0.181-0.27	0.271-0.36	0.361-0.45	>0.45
P(µg/g)(Olsenmethod)	≤7.5	7.51-15.0	15.1-22..5	22. .51-	30.1-37.5	>37.5
K (meq/100g)	≤0.09	0.091-0.18	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: Wildlife Species Composition

Table 1: Wildlife composition of the polder

Scientific Name	Common Name	Local Name	Status		CITES Appendix	Habitat Preference inside Project
			Local	IUCN		
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			,,
Mus musculus	House Mouse	Nengti indur	C			‘’
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		II	HF, MF
Family Vespertilionidae						
Pipistrellus coromandra	Indian Pipistrelle	Khudi Chamchika	C			HF, MF
Order Carnivora						
Family Canidae						
Canis aureus	Jackal	Pati Shail	R	VU		HF, CF
Family Herpestidae						
Herpestes edwardsi	Common Mongoose	Bara Beji	C	VU	III	HF, EM
Family Viverridae						
Viverricula indica	Small Indian Civet	Khatash	R		III	HF
Family Felidae						
Felis chaus	Jangle Cat	Bon Biral	R	EN	II	HF, EM, CF
CLASS REPTILIA						
Order Testudines						
Family Emydidae						
Hardella thurjii	Brahminy Turtle	Kali Kaitta	VR	EN	II	EN
Kachuga tecta tecta	Common Roof Turtle	Kori Kaitta	R	EN	II	EN
Family Trionychidae						
Lissemys punctata punctata	Flap-shelled Spotted Turtle	Sundi Kachap	R	VU	III	WL

Scientific Name	Common Name	Local Name	Status		CITES Appendix	Habitat Preference inside Project
			Local	IUCN		
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 Varanidar						
Varanus bengalensis	Bengal Monitor	Gui Shap	O	VU	I	HF, MF
Varanus flavescens	Yellow Common Monitor	Shona Gui	O	EN	I	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 cerasogaster	Dark-bellied Marsh Snake	Kalo Mete Dora	R	VU		HF, WL
Xenochrophis piscator	Checkered Keelback	Dhora Sap	C			HF, WL
Family Colubridae						
Ahaetulla nasutus	Common Vine Snake	Laodoga	C	VU		HF, CF, MF
Ptyas mucosus	Rat Snake	Daraj/Darash	C		II	HF, CF
Family Homalopsidae						
Cerberus rhynchops	Dog-faced Water Snake	Jalbora	C	VU	WL, CF	
Enhydris enhydris	Smooth Water Snake	Pyna Sap	C		WL	
Family Elaphidae						
Bungarus caeruleus	Common Krait	Kal Keotey	R		R	HF
Bungarus fasiciatus	Banded Krait	Sankini	VR		VR	HF, MF
Naja naja kaouthia	Monocellate Cobra	Gokhra	R	VU		HF
Naja naja naja	Binocellate Cobra	Khoia Gokhra	R	EN	II	HF
	CLASS AMPHIBIA					
Order Anura						
Family Bufonidae						

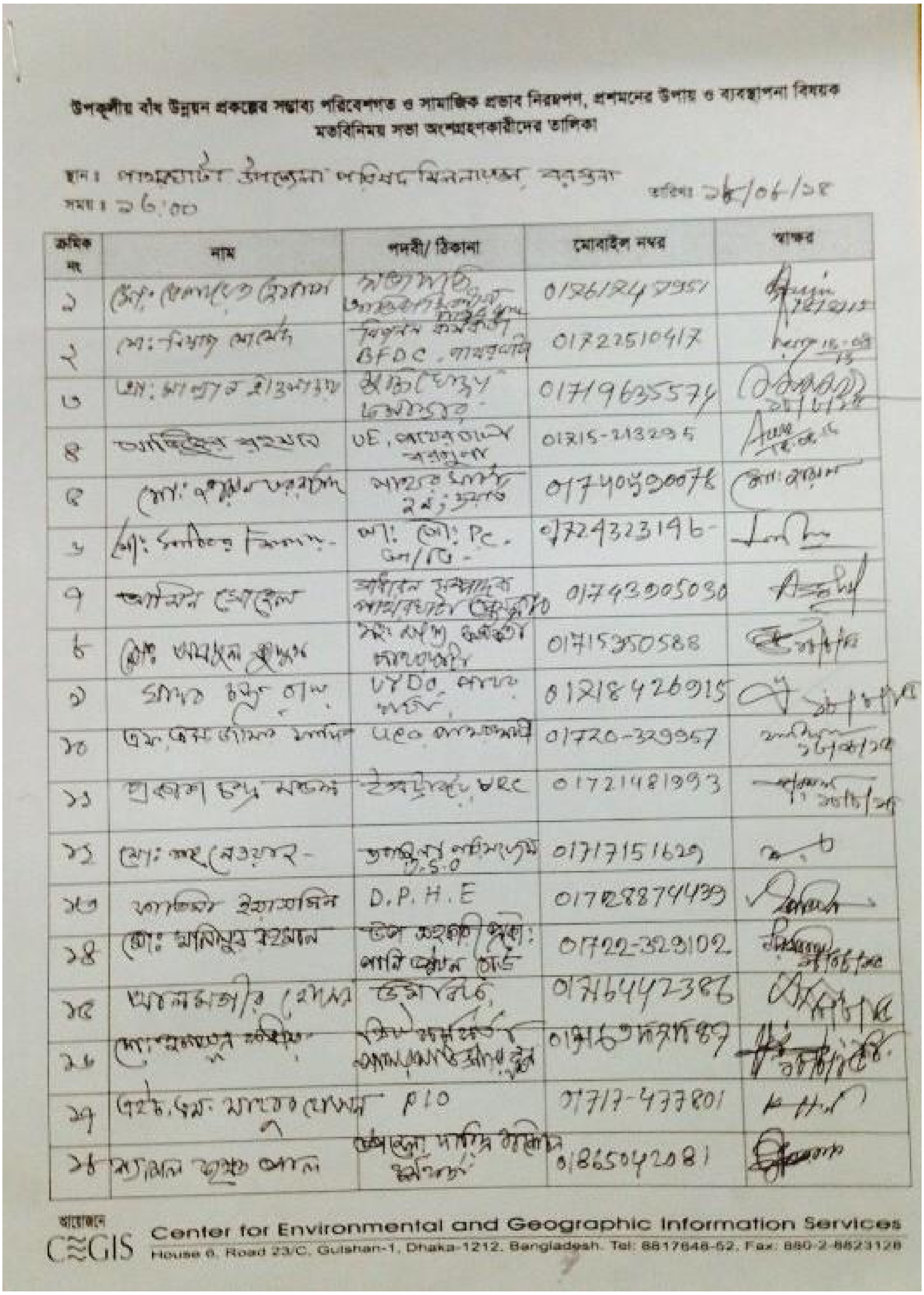
Scientific Name	Common Name	Local Name	Status		CITES Appendix	Habitat Preference inside Project
			Local	IUCN		
Bufo melanostictus	Common Toad	Kuno Bang	VC			HF, EM
Family Ranidae						
Euphlyctis hexadactylus	Green Frog	Sobuj Bang	O		II	HF, CF
Hoplobactrachus tigerinus	Bull Frog	Sona Bang	VC			CF
Rana cyanophlyctis	Skipper Frog	Kotkoti Bang	C			WL
Rana limnocharis	Cricket Frog	Jhi Jhi Bang	C			HF, CF
Rana temporalis	Tree Frog	Gecho Bang	O			HF, MF

Note:

- Local Status Code:: “C”=Common, “VC”= Very Common, “O”=Occasional, “R”=Rare, “VR”=Very Rare
- IUCN Status Code: VU = Vulnerable, EN=Endangered
- Habitat Preference Code: HF=Homestead Forest, “CF”=Cropfields, “MF”=Mangrove Forest, “WL”=Wetland

Appendix 5: List of participants of PCM

Participant List 1: Participants list of PCM at Patharghata Upazila Auditorium



উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক
মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান: পাথরঘাটা উপজেলা পরিষদ মিলনায়তন, বরগুনা
সময়: ১৮:০০
তারিখ: ১৮/০৮/১৮

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১	[illegible]	[illegible]	01726124 7951	[illegible]
২	[illegible]	[illegible] BFDC, পাথরঘাটা	01722510417	[illegible]
৩	[illegible]	[illegible]	01719635574	[illegible]
৪	[illegible]	UE, [illegible]	01315-213295	[illegible]
৫	[illegible]	[illegible]	01740530078	[illegible]
৬	[illegible]	[illegible] PC.	01724323196	[illegible]
৭	[illegible]	[illegible]	01743505030	[illegible]
৮	[illegible]	[illegible]	01715350588	[illegible]
৯	[illegible]	VDO, [illegible]	01218426915	[illegible]
১০	[illegible]	UEO [illegible]	01720-329957	[illegible]
১১	[illegible]	[illegible] VRC	01721481993	[illegible]
১২	[illegible]	[illegible]	01717151629	[illegible]
১৩	[illegible]	D.P.H.E	01728874439	[illegible]
১৪	[illegible]	[illegible]	01722-323102	[illegible]
১৫	[illegible]	[illegible]	01716447386	[illegible]
১৬	[illegible]	[illegible]	[illegible]	[illegible]
১৭	[illegible]	PIO	01717-477801	[illegible]
১৮	[illegible]	[illegible]	01865042081	[illegible]

আয়োজনে
CEGIS Center for Environmental and Geographic Information Services
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উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান: পাথরঘাটা উপজেলা পরিষদ মিলনায়তন বরগুনা

তারিখ: ১৬/০৮/১৫

সময়: ১০:০০

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯	মো: [illegible]	[illegible]	01716793370	[illegible]
২০	Ismail Hossain	[illegible]	01712-410625	[illegible]
২১	Abul Kalam Azad	ULO Represen.	01719782787	[illegible]
২২	মো: [illegible]	[illegible]	01935006488	[illegible]
২৩	মো: [illegible]	[illegible]	01712953076	[illegible]
২৪	[illegible]	UPDO.	01718-959900	[illegible]
২৫	মো: [illegible]	[illegible]	[illegible]	[illegible]
২৬	মো: [illegible]	[illegible]	[illegible]	[illegible]
২৭	মো: [illegible]	[illegible]	01710501562	Ashraf
২৮	মুহাম্মদ [illegible] রহমান	প্রফেসর [illegible]	01713865523	[illegible]
২৯	মো: [illegible]	UAS	01716332638	[illegible]
৩০	[illegible]	Jr. Specialist CEGIS	01718 244298	[illegible]
৩১	মুহা: [illegible] রহমান	Professor	01713865523	[illegible]
৩২				
৩৩				
৩৪				
৩৫				
৩৬				

আয়োজনে

CEGIS Center for Environmental and Geographic Information Services
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

Participant List 2: Participants list of PCM at Patharghata Union Auditorium

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক
মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান: পাথরঘাটা ইউনিয়ন পরিষদ
সময়: ১১:০০

তারিখঃ ২৩/৮/২০১২

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১	মোঃ আসাদুজ্জামান	চেয়ারম্যান	01718861301	[illegible]
২	মোঃ [illegible]	U.P সদস্য ২ নং ওয়ার্ড	01785200018	[illegible]
৩	মোসাঃ জয়নব	U.P সদস্য	[illegible]	[illegible]
৪	[illegible]	[illegible]	01788958008	[illegible]
৫	মোঃ [illegible]	[illegible]	01739614244	[illegible]
৬	মোঃ [illegible]	[illegible]	01797145797	[illegible]
৭	মোঃ আঃ বারেক	[illegible]	01738813801	[illegible]
৮	মোঃ [illegible]	[illegible]	01815-814608	[illegible]
৯	মোঃ [illegible]	ঐ	01740590028	[illegible]
১০	শ্রী দুলাল মিস্ত্রী	[illegible], F.F	[illegible]	[illegible]
১১	মোঃ আবুল কালাম	UPSA [illegible]	[illegible]	[illegible]
১২	[illegible]	F.F. [illegible]	01742101807	[illegible]
১৩	[illegible]	U.P. [illegible]	01812009122	[illegible]
১৪	নজরুল ইসলাম	[illegible]	01705523744	[illegible]
১৫	মোঃ [illegible]	[illegible]		[illegible]
১৬	মোঃ [illegible]	[illegible]	01799365682	[illegible]
১৭	মোঃ [illegible]	[illegible]	01747707926	[illegible]
১৮	মোঃ [illegible]	[illegible]	01786501262	[illegible]

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উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক
মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান: [illegible]
সময়: ১১:০০

তারিখ: ২৩/৮/২০১৫

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯	মোঃ [illegible]	ব্যবসা	01752905537	[illegible]
২০	[illegible]	[illegible]	01732424918	[illegible]
২১	[illegible]	[illegible]	01718135962	[illegible]
২২	[illegible] মাসুদ	[illegible]	01751569269	মাসুদ
২৩	[illegible]	[illegible]	01744491138	[illegible]
২৪	[illegible]	[illegible]	01729973946	[illegible]
২৫	[illegible]	ব্যবসা	01725728651	[illegible]
২৬	মোঃ [illegible]	[illegible]	01725679829	[illegible]
২৭	[illegible]	[illegible]	01710620325	[illegible]
২৮	মোঃ [illegible]	[illegible]	01721336686	[illegible]
২৯	[illegible]	[illegible]	01718557633	[illegible]
৩০	মোঃ [illegible]	[illegible]	01735200018	[illegible]
৩১	[illegible]	[illegible]	01719689665	[illegible]
৩২	আসমা [illegible]	[illegible]	01710232718	[illegible]
৩৩	রেহানা	[illegible]	01752146395	[illegible]
৩৪	[illegible]	[illegible]	01815228401	[illegible]
৩৫	মোঃ [illegible]	[illegible]	01746766265	[illegible]
৩৬	মোঃ [illegible]	[illegible]	01758531330	[illegible]

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মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান : [illegible]

সময় : ১১:০০

তারিখঃ [illegible]/০৮/১৮

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৩৭	[illegible]	[illegible]	01754428945	[illegible]
৩৮	[illegible]	[illegible]	0178289[illegible]	[illegible]
৩৯	[illegible]	[illegible]	01728825[illegible]	[illegible]
৪০				

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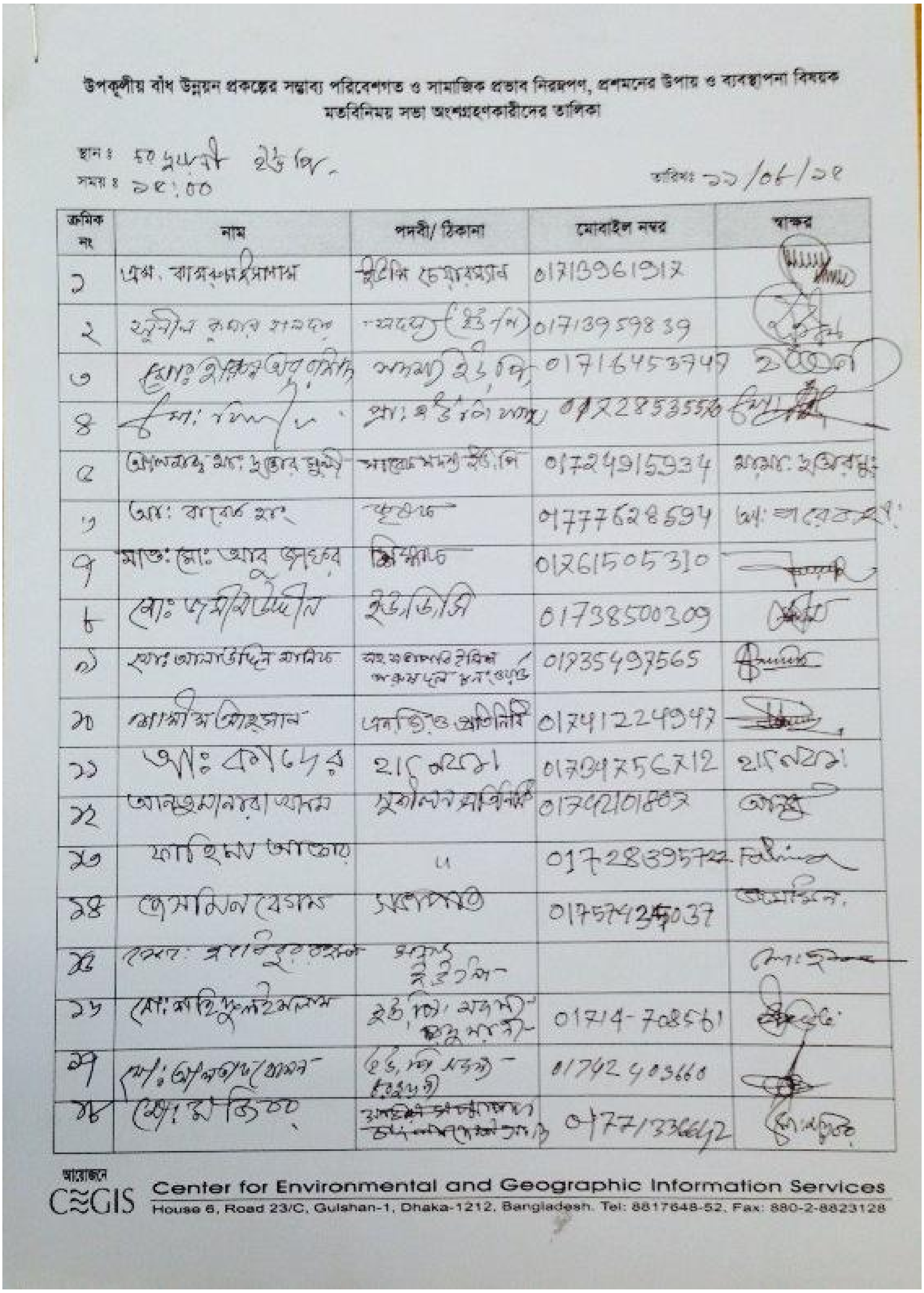
Participant List 3: Participants list of PCM at Charduani Union Auditorium



উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক
মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান: চরদুয়ানী ইউ/প.
সময়: ১৫:০০

তারিখ: ১১/০৬/১৫

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১	[illegible]	[illegible] চেয়ারম্যান	01713961312	
২	সুনীল কুমার [illegible]	সদস্য (ইউ/প)	01713959839	
৩	মোঃ [illegible]	সদস্য ইউ, পি,	01716453747	
৪	মো: [illegible]	প্রা: [illegible]	01722853556	
৫	[illegible]	[illegible] ইউ.পি	01724915934	
৬	আ: [illegible]	[illegible]	01777628694	
৭	মাও: মো: আবু জাফর	[illegible]	01261505310	
৮	মো: [illegible]	ইউডিসি	01738500309	
৯	[illegible]	[illegible]	01735497565	
১০	[illegible]	[illegible]	01741224947	
১১	[illegible]	[illegible]	01734756712	
১২	[illegible]	[illegible]	01742101852	
১৩	[illegible] আক্তার	"	01728395722	
১৪	জেসমিন বেগম	[illegible]	01757425037	
১৫	[illegible]	[illegible]		
১৬	মো: [illegible]	[illegible]	01714-708561	
১৭	মো: [illegible]	[illegible]	01742 403660	
১৮	মো: [illegible]	[illegible]	01771336612	

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মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান: চরদুয়ানী ইউনিয়ন
সময়: ১৫:৩০

তারিখ: ২৯/০৮/১৫

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯	মো: [illegible]	[illegible]	01734423805	[illegible]
২০	মো: তোফিক হোসেন	চরদুয়ানী	01713539496	[illegible]
২১	মো: [illegible]	[illegible] বাড়ি	01779425067	[illegible]
২২	মো: কবির	দক্ষিণ জ্ঞানপাড়া	01747419765	মো: কবির
২৩	আ: [illegible]	সা: চরদুয়ানী	0175687[illegible]	[illegible]
২৪	মো: আজিজুল	সা: চরদুয়ানী	01703218133	মো: আজিজুল
২৫	মো: ফরিদ উদ্দিন	জ্ঞানপাড়া	01735207214	[illegible]
২৬	মো: [illegible]	[illegible]	01729409001	[illegible]
২৭	সুলতান	দক্ষিণ জ্ঞানপাড়া		সুলতান
২৮	নুরহোসেন	[illegible]		নুরহোসেন
২৯	মো: খলিলুর রহমান	মাঝের খাল		খলিল
৩০	মো: [illegible]	[illegible] বাড়ী		মো: [illegible]
৩১	কামাল	"	01747129861	
৩২	[illegible]	"	01748216969	
৩৩	সুলতান	[illegible]	01795213740	সুলতান
৩৪	জাকির	[illegible]	0173118330	জাকির
৩৫	[illegible]	"	01735-866332	[illegible]
৩৬	মো: জলিল	[illegible]	01724-139589	জলিল

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Participant List 4: List of FGD's participants

SL	Name	Gender	Occupation	Age	Address/Mobile No
1	Rubbal	M	Fisherman	21	01923439127
2	Md.Abu zafar	M	Fisherman	30	01790165171
3	Rafiqul Islam	M	Fisherman	32	01774826056
4	Salam munshi	M	Business	38	01745320917
5	Md.Anis akand	M	Business	41	01725681036
6	Jamal Hossain	M	Fisherman	33	01736594359
7	Kholil Farazi	M	-	40	01735997220
8	Belal Hossain sentu	M	Agriculture	32	01746843653
9	Askander	M	Business	37	01732033907
10	Md.Nurul islam	M	Driver	29	01724214631
11	Abdul kuddus	M	Agriculture	65	-
12	Sujan Majumdar	M	Fisherman	32	-
13	Pankaj malakar	M	Business	38	01733008382
14	Md.Nasir khondokar	M	Business	32	01749789453
15	Md.Mofazzel Hossain	M	Business	30	01795692050
16	Dulal Rai	M	Gram doctor	34	01718873996
17	Alamgir hossain	M	Business	47	01761518716
18	Faruk hossain	M	Business	47	01723679813

Appendix 6: List of Participants Attended in PDM Held at Barguna Sadar Upazila, Barguna

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
১	অলিউর রহমান	SAAE	01718452247	
২	[illegible]	[illegible]	01713469104.	
৩	আশরাফুল ইসলাম	UNO বরগুনা সদর	01733348025	
৪	শারমিন সুলতানা	মহিলা ভাইস চেয়ারম্যান বরগুনা সদর	01732454212	
৫	মো: মুজিবুর রহমান	ভাইস চেয়ারম্যান বরগুনা সদর	0171761399	
6.	S. M. Mehedi Hasan	DRM Analyst, World Bank	01822525068	mehedi
7.	মো: [illegible]	চেয়ারম্যান ৬নং ফুলঝুড়ি	01716044848	
8.	[illegible] উদ্দিন	চেয়ারম্যান [illegible]	01712948180	
9.	আবু হেনা মোস্তফা জামান	চেয়ারম্যান, ৭নং [illegible]	01712897560	
10.	মো. আ. রাজ্জাক	সহকারী [illegible]	01719075009	
১১	[illegible]	SAE, DPHE Barguna	01718736986	

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স্থান ঃ বরগুনা সদর উপজেলা পরিষদ মিলনায়তন

সময় ঃ সকাল-১০টা

তারিখ ঃ ০৮/১২/২০১৩

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১২	নাজমুল আহসান	ইউপি সদস্য ৭, ৮, ৯ নং ওয়ার্ড	01757449438	
১৩	মো: মাহবুব হোসেন	ইউপি সদস্য ৮ নং ওয়ার্ড	01713950997	
১৪	মো: খলিলুর রহমান	স্যানিটারি ইন্সপেক্টর UHFPO অফিস	01717276216	
১৫	তালুকদার মো: মোস্তাইন	প্যানেল চেয়ারম্যান [illegible]	01720966733	
১৬	লিটন চন্দ্র মজুমদার	সচিব, [illegible]	01750-300067	
১৭	সুলতান রফিকুল আলম	সমাজকর্মী	01710703690	
১৮	মো: মনিরুজ্জামান খান	সমাজকর্মী	01717313199	
১৯	তপন কুমার রায়	ইউ.আর.ডি.ও (প্র:)	01710703701	
২০	মো: হুমায়ুন কবির	SAE PIO office বরগুনা	01746766419	
২১	মো: জাহাঙ্গীর কবির	চেয়ারম্যান ৬ নং [illegible]	01716044848	
২২	মো: জামাল উদ্দিন খান	নির্বাহী অফিসার [illegible]	01712568463	
২৩	মোসা: ডলি	U.P সদস্য ৭ নং [illegible]	01775475896	
২৪	[illegible]	[illegible]	0172215472923	
২৫	মো: জাহিদুল ইসলাম রাজন	২ নং গৌরিচন্না ইউনিয়ন	0173908978	
২৬	সহীদ ইলিয়াস উদ্দিন	চেয়ারম্যান ১নং [illegible]	01712948180	
২৭	আবু রায়হান সালেহ	সাধারণ সম্পাদক [illegible]	01740860790	
২৮	আশিষ রঞ্জন রায়	উপজেলা কৃষি অফিস	01710862998	
২৯	মো: হাসান	কৃষক	01782597539	হাসান

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 ১০ টা তারিখ : ০৮/১১/২০১৬

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৩০	মো: হাফিজুর রহমান	উপজেলা পরিসংখ্যান অফিসার (ভা:)	01716528177	[illegible]
৩১	মো: আলফাজ উদ্দিন শেখ	সিনিয়র উপজেলা মৎস্য কর্মকর্তা	01795126051	[illegible]
৩২	S M SOHEL	UAS VSEO	01738194552	Sohel
৩৩	বিপ্লব কুমার দাস	UYDO	0171968727[illegible]	[illegible]
৩৪	মো: আব্দুল মান্নান	VEO	01714714143	[illegible]
৩৫	মো: তৌহিদ	UAO	01748021521	[illegible]
৩৬	মো: মহিবুল ইসলাম	প্যানেল চেয়ারম্যান ৪নং [illegible]	012150199[illegible]0	[illegible]
৩৭	মো: ফজলুল হক	UP member 3 No. 4 No. WARD	01753484897	[illegible]
৩৮	মো: ইসলাম [illegible]	[illegible]	01710703318	[illegible]
৩৯	মো: [illegible]	চেয়ারম্যান	01712892565	[illegible]
৪০	[illegible]	মেম্বার [illegible]	01716862728	[illegible]
৪১	[illegible]	[illegible]	01712955016	[illegible]
৪২	ড: মাহমুদুর রহমান	CEGIS	01818290847	[illegible]
৪৩	Md. Ashraful Alam	CEGIS	01710501562	Ashraf

CEGIS Center for Environmental and Geographic Information Services
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

স্থান ঃ বরগুনা সদর উপজেলা পরিষদ মিলনায়তন

সময় ঃ সকাল ১০টা

তারিখ ঃ ০৮/১২/২০১৬

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৪৪	মো: [illegible]	U.N.O অফিস	01716136145	[illegible]
৪৫	মো: [illegible]	U.N.O অফিস	01728367606	[illegible]
৪৬	মো: [illegible]	U.N.O অফিস	01726120668	[illegible]
৪৭	মো: [illegible]	U.N.O অফিস	01774913095	[illegible]
৪৮	[illegible]	[illegible]	01714906681	[illegible]
৪৯	[illegible]	[illegible]	01912396042	[illegible]
৪৮	~~[illegible]~~ মো: [illegible]	~~U.N.O [illegible]~~ A	01920249175	[illegible]
৪৯	[illegible]	C. A	01732776222	[illegible]
৫০	মো: [illegible]	U.N.O অফিস	01796462857	[illegible]
৫১	মো: [illegible]	U.N.O অফিস	01724171626	[illegible]
৫২	মো: [illegible]	ıı	01709241088	[illegible]

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Appendix 7: Photo Album

Non-Functioned Drainage Sluice (DS1)

Non-Functioned DS4 (4)

DS3 (5) Embankment Breached/Eroded

River bank erosion

Embankment cum road (Kutcha)

Embankment cum road(surface paving)

Road intersection with embankment

Housing pattern in the polder area

Typical Housing of villagers

Brackish water fisheries

Main Agricultural crop

Common vegetation

Polder visit and consultation with local people

Polder visit and consultation with local people

View of public consultation meeting at Char Duari Union Parishad

View of public consultation meeting at Patharghata Upazilla

View of public consultation n meeting at Patharghata Union Parisad

View of public consultation meeting at Patharghata Union Parisad

Appendix 8: DoE's Approved Terms of Reference (ToR)

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207
www.doe-bd.org

Memo No : DoE/Clearance/5196/2013/ 125 Date: 05/06/2013

Subject: Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I).

Ref: Your Application dated 31/03/2013.

With reference to the above mentioned subject, the Department of Environment (DOE) hereby accords Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I) at Satkhira, Khulna, Bagerhat, Pirojpur, Patuakhali and Barguna Districts subject to fulfilling the following terms and conditions.

I. This clearance shall only be applicable for the development of the infrastructure of the said project.

II. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) report considering the overall activity of the said Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE).

III. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)

4a. Project activities:
- A list of the main project activities to be undertaken during site clearing, construction as well as operation
- Project Plan, Design, Standard, Specification, Quantification, etc.

4b. Project schedule: The phase and timing for development of the Project

4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.

4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.

5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
   - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
   - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
   - Environment Quality : Air, Water, Soil and Sediment Quality
   - Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions
6. Socio-economic environment should include, inter alia, following:
   - Population: Demographic profile and ethnic composition
   - Settlement and housing
   - Traffic and transport
   - Public utilities: water supply, sanitation and solid waste
   - Economy and employment: employment structure and cultural issues in employment
   - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.
7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).
   In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the

1/2

scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Descriptic 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.

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Appendix 9: Comments and Responses

Comments and Responses on the EIA of Polder 40/2

Chapter	Pages, articles	Comments	Responses
Executive Summary	Pg xxv	In accordance with the national regulatory requirements and WB safeguard policies, Environmental Impact Assessments (EIAs) of the first batch of five polders have been carried out. This document presents the EIA report of Polder 40/2, which is inpackage 2.	This paragraph has already been corrected
	Baseline Conditions, xxvii	"(I think these are mentioned in the study area chapter. Aren't these too detail information being provided for executive summary?)" How any comment of anyone is available in the executive summary?	This paragraph has been corrected
	Pg xxviii	In pre-construction phase, it is stated that about 611 matured trees will be affected for construction of drainage and flushing sluices. But in the description of "during-construction phase", it is stated that "As all the tall trees at proposed sites have already felled while damage the embankment slopes, so no big tree is exist there." No consistency is available about the number of trees. Which is the correct one?	The first statement is applicable for construction of structures. The sites for construction of new sluices need to cut/damage all types of floral species while trenching. 611 matured trees have been counted from probable locations of the proposed structures during field visit by CEGIS Team. On the other hand, the second statement is addressed for bank revetment sites where no tall trees exist as been previously damaged by tidal surge and wave actions. So, both statements are correct and mentioned appropriately.
	Pg xxix, Project operation phase	The 1st paragraph of project operation phase is general description, not the impact of project operation phase. Need to be excluded.	This paragraph has been excluded from the executive summary
Description of the Project	Table 4.2, Table 4.5	The details of proposed structures need to be provided.	Details of proposed structures have been provided in Tables (4.3 to 4.7)
	Pg 45-58	There are mismatch(wrong chainage, wrong existing structure dimension, wrong replaced structure	Corrected information have been shown in tables (4.3 to 4.7) and maps (4.1 to 4.5) with chainage

Chapter	Pages, articles	Comments	Responses
		dimensions) with the information of tables (4.2,4.5,4.6) with maps (map 4.1-4.5)	
	Pg 52	Dumping location of excavated soil is not provided.	It has been described in the respective section (article 4.6.4)
	Pg 52	For afforestation, how and who selected the location is not mentioned. Only chainage and length is provided. Detailed plan for afforestation should be added.	This plan have already been included in the revised version of the report
	Table 4.10, pg 60	For polder 40/2, the number of skilled labor and unskilled labor is 5000 and 25000 respectively whereas for polder 43/2C, the number is 2000 and 20000 respectively. What is the basis of determining the number of labor and why the number is higher for polder 40/2?	The number of skilled and un-skilled labour is mainly estimated on the basis of volume of earth works and number of structures to be constructed. The length of embankment of polder 40/2 it is 35 km whereas for polder 43/2C is 25 km. Moreover, the number of structures to be replaced and the length of re-excavation of khals in Polder 40/2 is higher than those of Polder 43/2C. therefore, the requirement of labour for Polder 40/2 is higher than Polder 43/2C
	Pg 60	Locations of borrow pits should be selected and mentioned in this report.	The location of borrow pits have been selected and shown in the map 4.6
	Pg 61	The locations of labor camp need to be selected. The locations of 35 tube wells and latrines with septic tanks need to be provided so that the environmental issues can be checked.	The location of labour camps/sheds have been selected and shown in the map 4.7. As tube-wells and latrines with septic tank will be constructed at the premises of the labour camp. Contractor will select the appropriate location to establish of those facilities through consultation with Detailed Design, Construction Supervision and Project Monitoring Support Consultants (DDCS&PMSC)
Environmental Baseline and Existing Conditions	Pg 73	Polder 40/2 falls under zone I not under zone III.	It has been considered and corrected as per comments
	Pg 83	Time range for temperature is not mentioned in write up.	It has been considered and corrected
	Pg 88	Same time period (2000-2013) should be taken to analyze annual variation of GWT	Some anomalies are found in the data. So this portion has been omitted.
	Pg 89, fig 5.8	If March is the dry period, then how the trend line shows an increasing trend? It is right? Is any lacking in data available?	There has been an anomaly in the data. So this portion has been removed.
	Pg 97, table 5.5	Values of ambient air quality parameters in the project area are not inserted in table. The table is blank.	The value of ambient air quality has been inserted in report.

Chapter	Pages, articles	Comments	Responses
Environmental Impacts and Mitigation Measures	Pg 139-140	When the details of damages of structures due to project interventions are filled up in table (6.2 to 6.6), then how mitigations measures and residual impact can be determined. When it is said that, tables will be filled up after RAP, then mitigation and residual impact should be given after that.	The blank tables have been filled on the basis of the information from RAP. Accordingly, mitigation and residual impact have also been analyzed.
	Pg 142, art 6.3.3	Who is responsible for providing training on vehicular traffic moving pattern and management system? It is not mentioned properly. The residual impact is “low” after mitigation but the impact before mitigation is not mentioned. Without the previous impact, how the residual impact can be identified?	The trainer has been identified and specified in the text. The status of the previous impact has also been provided.
	Pg 142, art 6.3.4	It is written that all construction camps will be constructed area owned by BWDB. What are those locations? Did BWDB agree with this? If these sheds are far from the working location then what measures will be taken? Specific locations need to be provided for labor sheds.	As per consultation with DDCS & PMSC, the distance of the construction cam has been measured. The labour shed will be constructed at the BWDB owned land. The location of construction camps are shown in Map.
	Pg 146, art 6.4.1	In the mitigation measures, it is mentioned that “Ensure that the drainage channels are not been obstructed or clogged for the construction activities.” Who is responsible for this is not mentioned. From “major” the impact would be “moderate” not “low”.	Actually, the Contractor will ensure that drainage channels will not be obstructed or clogged by the construction activities. It has been mentioned in the report.
	Pg 151, art 6.4.9	The mitigation measures for disturbance of construction activities due to natural hazards are not explained properly.	The article has been revised accordingly
	Pg 157, art 6.5.2	“An ongoing program of de-silting of water channels will be considered with full community involvement and participation.” How water channels will be de-silted? Any specific method?	It has already been mentioned in the same report.

Chapter	Pages, articles	Comments	Responses
Analysis of Project Alternatives	Pg 181, art 7.4.2	The sources of soil for Embankments are not mentioned exactly. The locations of borrow pits should be selected before conducting the EIA.	Borro pit is the main source of soil which has been mentioned in the report. The location of Borrow pits area have also been shown in Map (Map 4.6)
Environmental Management Plan	Pg 209, Soil salinity	How flushing with pre-monsoon rain water can reduce soil salinity?	Because the flushing water allow the salt to be leached from the soil, however it may notbe in large scale but if water is treated to be converted to magnetized, then magnetized water flushing makes the salty soil broken into the soil crystals twice as fast as un-magnetized water.
	Pg 216	For surface water quality, the frequency is half yearly. It should be mentioned that quality should be checked except wet season. Because of heavy water flow in wet season, the concentration could be diluted.	It has been considered and mentioned in the report
	Pg 222, art 10.10	➢ One column is for Cost in Million BDT and another column is for Cost "000" US$. What does it mean? ➢ For training to the farmers, the cost is 0.5 million BDT, and in US$ 6.25. How it is possible?	Budget for training to the farmers have been revised. The cost of trainings have been revised and corrected. Thanks.

Responses of Comments byThe Third Party M&E Consultants (International)

Chapter	Page, articles	Comments	Responses
Table of Contents	Section 3.2.22, section 3.3, section 3.4, section 3.5 and section 4	Page number mistake	The page numbers have been corrected. Thanks.
Chapter4: Description of the Project	Setion 4.8, page 67 2nd and 3rd bullets	To be revised to to reflect properly the scopes of work Design and Supervision Consultants	The scopes of work of newly designated DDCS&PMSC (Detailed Design, Construction Supervision and Project Management Support Consultant) has been revised. It has been also shown in figure 10.2, along with the responsibilities/ activities of different agencies In chapter 10.3 with heading 'Environment and Social Staff with DDCS&PMSC', M&E Consultant and ESCU in EMP implementation'Thanks.
Chapter 8: Climate Change		There is no mention of Renewable Energy Initiative (solar, wind etc.) in CEIP-I and afforestation of mangrove in selected areas. Mongrove nursery in coastal area should be encouraged ……..for the afforestation works.	There is no provision of any initiative for Renewable energy (solar, wind etc.) in CEIP-I. It has been mentioned inchapter 4.6.6 Afforestation that about 31,000 manggrove saplings will be planted in 6.96 ha of foreshore areas.
Chapter 10: Environmental management Plan &Monitoring Plan	Monitoring plan 10.6 Section 10.2, 10.3, 10.4	There is no mention of soil physical and chemical test parameter, no mention of test to be undertaken, collection of samples regularly	The tests of soil and water to be undertaken along with parameters have been mentioned in Table-10.5 in chapter 10.10 along with frequency of testing. Moreover, test results of various soil and water parameters have been incorporated in 5.7, 5.6a & 5.6b respectively. Thanks.
		Establishing temporary labor camps and other construction activities will require adherence to "Guideline for Contractor' as specified in the cpntract and site specific Environmental Action Plans that contractor must follow and obligated to perform as directed.. However, M/E Cansultants have not been provided the Contractor's contract-	According to Chapter 4.7.5, 33 nos. of labour camps to be established by the contractor at suitable location in consultation with local leaders and community and according to chapter 4.7.6 provision of safe drinking water and proper sanitation facility to be eshtablished by the contractor. The cotractor's contract is available

Chapter	Page, articles	Comments	Responses
		and of particular relevance here, have not seen the environmental part of the document.	with the CEIP-I office and can be provided to M&E consultant whenever it is required.
Figure 10.1		Figure 10.1 outlining the GRM process is not clear…..	The figure has been cleared. Thanks.
Table-10.4		Correction of “top soil prevetion”	Correction done with “top soil preservation’. Thanks.
General		The report of EIA of polders 40/2 and 41/1 are descriptive and long. ………It might be better in future to have the main report to be bit shorter and focused on the major issues concerns that need mitigation during and after construction phase of the project, with the balance ……included in the annexes.	Thanks. This is an appreciable idea for formulation of an EIA report, which may be followed for the future project (polders), i.e. package three of CEIP-I.

Appendix 10: Comments by Mr. Marcelo (WB) and Responses by CEGIS

The comments provided for 47/2 are not exactly same other reports. As such, common comments as per Polder 47/2 have been followed Polder 40/2

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
1	Overall: the reports needs of a better correlation among baseline, analysis of impact and mitigation measures. This is not very well articulated. Some issues raised by the baseline are not addressed by the impact analysis and vice versa, etc.	Baseline data and information of physical, environmental, biological and social resources of the study area have been collected and incorporated in the report. Most of these bassline have been used in the EIA study.
2	Overall: is there a study (model) that has analyzed how the polder system works with and without the proposed intervention? This is an important analytical piece to determine if the proposed intervention would address the already existing issues. There are multiple factors and scenarios that could be backed with the project implementation (erosion, salinity, flooding, soil productivity, hydrodynamics, etc.) that need to be backed a solid analytics. Where is the water management plan and the operational targets? Have they been prepared? These are critical pieces to feed the EIA report.	Both with and without proposed interventions have been considered in model and this EIA studies Drainage modelling of the coastal polder has been carried out by IWM to find out the design parameters for drainage canal systems, drainage regulator, river bank, slope protection works. Climate resilient coastal embankment crest level has been design considering the combined effects of cyclone storm surge effects and cyclone induced wind wave. The model has been developed and simulated considering climate change condition. The impact of proposed interventions on drainage, flooding, river dynamics has also been analyzed through modeling. The model results have been utilized in the EIA study. The water management plan and the operational plan have been elaborately provided in section 4.10 (**re-name Water Management and Operational Plan**) which mainly focuses on water management and operational plan after the implementation of the proposed interventions.
3	It is clear that the proposed intervention will take place in a system that was modified in the past, that is not working properly well and that the social and physical environment is being affected. Therefore the proposed project is absorbing those liabilities.	Agreed
4	Description of construction activities. It is not explained how is the	Transportation modes for carrying construction instruments and materials to

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
	necessary transport movement to get to the various project sites with machinery and ancillary interventions.	the site has been described in article 7.3.7.
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 by the EIA such as surge flooding, drainage congestion and water logging, salinity, navigation, water use, sedimentation and erosion. The report needs to be specific on these aspects which are key.	All the issues and key issues have been addressed. But have not been prioritized.
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	The whole Bangladesh has been divided into 25 Bio-ecological zones by IUCN depending on the biodiversity in the respective area.

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
	been identified by IUCN. This needs to be handled with care to avoid confusions with the WB natural habitats concept.	
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-a [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 other, suggests to compensate if that happens.	Rightly mentioned but crop damaged will not be occurred due to borrow pit while transportation of earth materials may cause crop damage in the surrounding area.
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)

Sl. No.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
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 11: 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 balasnced fertilizer
- Water management by planting at appropriate distance

4. Mechanical & physical control management

- By cutting infected leaves or plant parts
- By using hand net
- By perching in the field
- By using light trap

5. Chemical control management

Chemical control method shod be applied only when the other control methods fails to control the pest. That means pesticides should be used only as a last resort and in doing so right pesticide with right dose at right time and with right method of application should be taken in to consideration. Pesticides should be handled with proper care because all pesticide are poisonous.

Appendix 12: Checklist for Consultation Meetings

Environmental Impact Assessment (EIA) under CEIP-1

Issues of the Public/Stakeholder Consultation Meeting

The possible issues that would be discussed in the public consultation meetings are:

1. Productivity (e.g. agriculture and fishery)
2. Livelihood options
3. Vulnerability issues
4. Ecological imbalance
5. Resource redistribution
6. People's perception, opinion and attitude
    - 6.1. Major problems
        - 6.1.1. Problems in productivity
        - 6.1.2. Problems in service and facilities
        - 6.1.3. Infrastructural problems
    - 6.2. Attitude of the people towards the project
    - 6.3. Impact (positive and negative) of the project and mitigation measures
        - 6.3.1. Alternative sites
        - 6.3.2. Mitigation measures for planners
        - 6.3.3. Mitigation measures of implementing agency
7. Income restoration and generation issues
    - 7.1. Current income generating activities
    - 7.2. Type of occupation
    - 7.3. Income-generating activities
    - 7.4. Current market situation (job opportunities, competition, land price and market price situation)
    - 7.5. Skill development and IGA
8. Social development support
    - 8.1. Name of NGOs prevailing in the study area
    - 8.2. Social safeguard and safety nets
    - 8.3. Community interventions
9. Gender issues
    - 9.1. Unemployment of female labor force
    - 9.2. Literacy rate of female students
    - 9.3. Anticipated changes in the wage rate
    - 9.4. Health issues of women
10. Participation of women in service and facilities

FGD issues

The possible issues that would be discussed in the focus group discussions are:

1. People's perception, opinion and attitude
   1.1. Initial discussion about the selected Important Social Components (ISCs)
   1.2. Attitude of the people towards the project
   1.3. Impact (positive and negative) of the project and mitigation measures
2. Demographic distribution
   2.1. Population distribution
   2.2. Major age group
   2.3. Dependency ratio/status)
3. State of Education
   3.1. Impact of illiteracy
   3.2. Variation in school Attendance between girls and boys
   3.3. Variation in drop-out between girls and boys
4. Health Situation
   4.1. Prevalent diseases
   4.2. People's health seeking behavior
   4.3. Local health facilities
5. Employment and Occupation
   5.1. Existing occupations in the locality
   5.2. Major occupations
   5.3. Reasons of unemployment
   5.4. Impacts of unemployment
   5.5. Occupation problems/conflict
   5.6. Impacts of variation in water level on employment
6. Service and Facilities)
   6.1. Existing housing tenancy and structure
   6.2. Drinking water and sanitation facilities in the locality
   6.3. Energy Facility
   6.4. State of market Facility
7. Gender Issues
   7.1. Unemployment of female labor force
   7.2. Literacy rate of female students
   7.3. Anticipated changes in the wage rate
   7.4. Health issues of women
   7.5. Participation of women in service and facilities
   7.6. Women leadership
8. Poverty and food security status
   8.1. Number of working days, disaggregated by seasons and occupations
   8.2. Status of subsistence, disaggregated by seasons
   8.3. Usual food menu
   8.4. Adaptation strategies during poverty state
9. Ethnicity
   9.1. Major ethnic groups
   9.2. Cultural conflict and coexistence
   9.3. Potential impacts of project on ethnic groups
10. Archaeological/heritage sites
   10.1. Major archaeological/heritage sites
   10.2. Cultural values
   10.3. Potential impacts of project

Appendix 13: Gate Operation Plan (Bengali)

পোল্ডারের স্লুইস গেট পরিচালনার ক্ষেত্রে নিয়মাবলী

অতীতে পানি উন্নয়ন বোর্ডের কর্মচারীর মাধ্যমে স্লুইস গেটগুলো পরিচালিত হতো। বাজেট স্বল্পতার কারণে সে পদগুলো এখন স্থগিত করা হয়েছে। বর্তমানে গেটগুলো পরিচালনার দায়িত্ব সুবিধাভোগীদের উপর অর্পন করা হয়েছে। প্রতিটি পোল্ডাওে এ জন্য পানি ব্যবস্থাপনা সংস্থা (WMG, WMO, WMA) গঠন করা হয়। কৃষি উন্নয়ন ও মৎস্য সম্পদের কথা বিবেচনা করে পোল্ডার ৪০/২ এর গেটপরিচালনায় পানি ব্যবস্থাপনা সংস্থাগুলোকে নিম্লোক্ত বিষয়গুলো বিবেচনা করতে হবেঃ

- কৃষি ও মৎস্য সম্পদ ব্যবস্থাপনার সাথে সামঞ্জস্য রেখে একটি নির্দিষ্ট নিয়মের মধ্য দিয়ে প্রতিটি রেগুলেটরের গেট অবশ্যই নিয়ন্ত্রিণ করতে হবে ;
- প্রকৃত পানি ব্যবস্থাপনা বিশেষ করে কৃষি ও মৎস্য সম্পদের প্রয়োজনীতার ভিত্তিতে পানি উন্নয়ন বোর্ডের পরিচালনা ও রক্ষণাবেক্ষণ শাখা সুবিধাভোগী সংস্থা, কৃষি সম্প্রসারণ অধিদপ্তর এবং মৎস্য অধিদপ্তরের মাঠ কর্মীদের যৌথ পরামর্শক্রমে গেট পরিচালনা করতে হবে;
- শুধুমাত্র মেরামত ও ফ্ল্যাশিং ব্যতীত রেগুলেটরের ফ্ল্যাপ একটি নির্দিষ্ট স্থানে সব সময় একই অবস্থানে রাখতে হবে;
- খালে পানি সংরক্ষণ করে কৃষি কাজে সেচের জন্য বর্ষার পূর্বে (মার্চ - মে) গেট বন্ধ রাখতে হবে;
- বর্ষার সময় (জুলাই -সেপ্টেম্বর) গেট সাধারণত বন্ধ থাকবে তবে পোল্ডারের ভিতর ও বাহিরের পানির স্তর একটি নিরাপদ লেভেলের বাইরে যাতে চলে না যায় সেদিকে লক্ষ্য রাখতে হবে। এক্ষেত্রে, প্রতিদিনের বৃষ্টিপাত, নদীর অবস্থা,নদীর এবং পোল্ডারের ভিতরের পানির লেভেল বিবেচনা করে যথাযথ সিদ্ধান্ত নিতে হবে;
- মাছের সর্বোচ্চ প্রজননের সময় ডিমসহ মা মাছ (ব্রুড মাছ) ও মাছের পোনা অভিগমনের বিষয় বিবেচনা করে মে হতে জুন মাস পর্যন্ত গেট খোলা রাখতে হবে;
- বর্ষাপরবর্তীসময় (অক্টোবর-নভেম্বর) গেট এমনভাবে পরিচালনা করতে হবে যাতে খালে শুষ্ক মৌসুমেও পর্যাপ্ত পানি থাকে। এক্ষেত্রে লক্ষ্য রাখতে হবে যেন খালের পানি তীর উপচে না যায় এবং কৃষি কার্যক্রম ব্যাহত না হয়;
- ফ্ল্যাশিং স্লুইস ও পাইপ ইনলেট পরিচালনার ক্ষেত্রেওএকই নিয়ম অনুসরণ করতে হবে;
- কৃষি কার্যক্রম, শষ্যের নমুনা ও ধরণ, মাছের প্রজনন সময় ও অভিগমন ইত্যাদি পরিবর্তনশীল বিধায় সময়ের সাথে সুবিধাভোগী সংস্থার (কৃষক, মৎস্যজীবি,মৎস্যচাষি) সাথে নিয়মিত পরামর্শ করতে হবে;
- কৃষি ও মৎস্য উভয় সম্পদ বিবেচনায় নিয়ে পানি ব্যবস্থাপনা সংস্থাগুলোকে (WMG, WMO, WMA) সমন্বিত পানি ব্যবস্থাপনার উপর প্রশিক্ষণ প্রদান করতে হবে।

Appendix 14: Comments and Responses of Dessimination Seminar

Responses on Comments/suggestion of the Dissemination Seminar on EIA study under Package-2

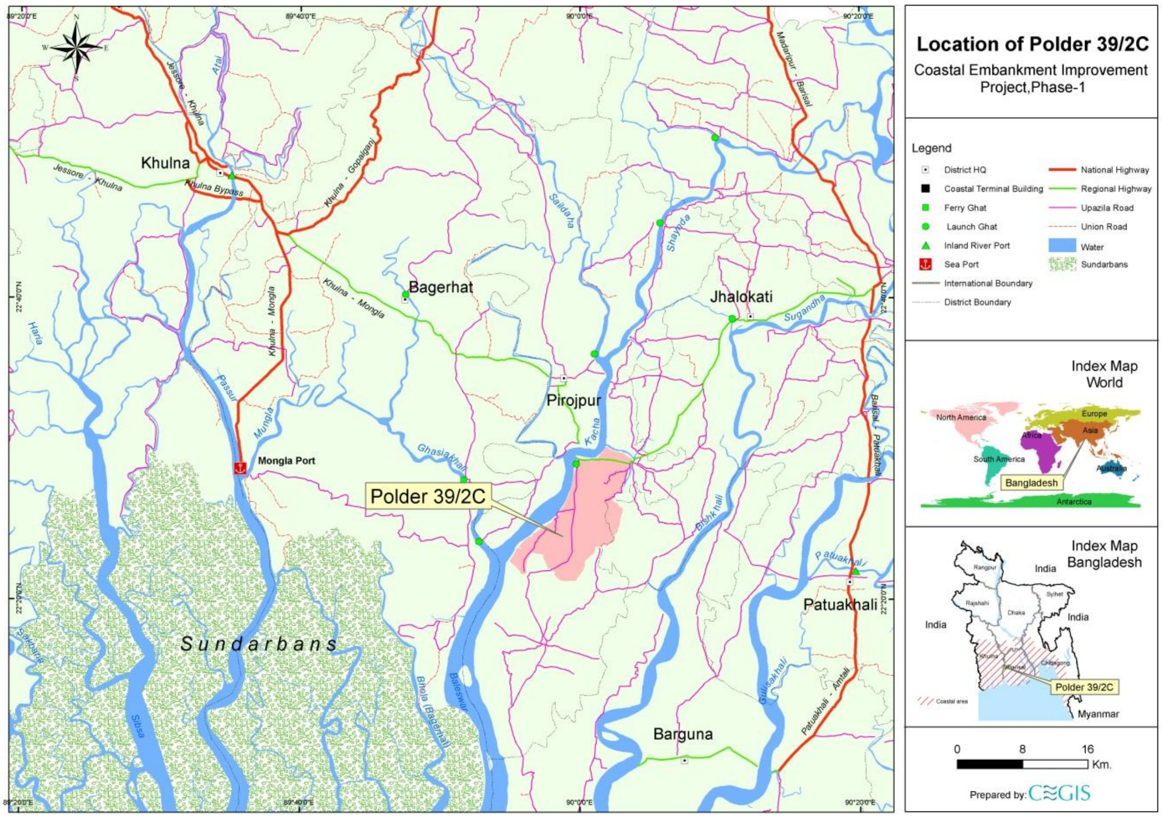
Sl.	Comments/suggestions	Responses
1	**Mr. Anisul Islam Mahmud, M.P, Honourable Minister, MoWR** The provision for re-excavation/dredging of peripheral rivers of the polder should be included in the polder rehabilitation activities	The provision for re-excavation/dredging of peripheral rivers in Polder 48 from km. 9.00 to 17.00 (MohipurKhal) and Polder-41/1 from km. 15.00 to 20.00 (BashboniaKhal) 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 its implementation have appreciably contributed to the food production in Bangladesh as well as provided safety to the people of the polders against salt water intrusion and tidal surges. The rehabilitation of the polder is being done considering climate change scenario and other current water management concepts. As such, the rehabilitation of the polder would greatly contribute to the development targets of 2021 and 2041. The involvement of the WMA for operation of the polder have been emphatically suggested in the study. In this regard, capacity building and training to the WMOs regarding gate operation, post project monitoring etc. has been included for their involvement in the project operation phase.
3	**Md. Habibur Rahman, PD, ECRRP, BWDB** The polder rehabilitation plan is good initiative which has already been done by ECRRP. At present, CEIP polder rehabilitation work should be conducted considering climate change impact and sea level rise. He also mentioned that polder works should have scope for green belt along the polder which should be monitored by Water Management organization (WMO) for proper maintenances of the polder.	It has already been considered in the study
4	**K.M. Fakhrul Islam, Chief Engineer, Central Zone, BWDB** How WMO will be involved in the	As per bid document of CEIP, there is no scope for involvement of WMO in rehabilitation works because the polder construction works will be

Sl.	Comments/suggestions	Responses
	rehabilitation work of all polders?	implemented by the contractor, engaged through the International tendering process. However, capacity building and training to the WMOs regarding gate operation, post project monitoring etc has been included for their involvement in the project operation phase.
5	**Dr. Khondaker Azharul Haq, President, Bangladesh Water Partnership (BWP)** The presentation is quite good but why only few polders have been considered for rehabilitation out of 139 polders. We should take initiatives for engaging NGOs/private sector for monitoring of the polder maintenance as the WMO does not sustain in most of the cases. Coastal polders are very vulnerable due to climate change. So we should look for new operation system for polder rehabilitation.	A total of 17 most vulnerable polders have been selected for rehabilitation under CEIP-1. During selection of polders, a screening matrix have been analyzed considering the physical condition of the structures as well as environmental, social and economic conditions of the polder area.BWDB has planned to rehabilitate other polders after successful completion of rehabilitation works of polders under Phase-1, based on priority if fund is available. Climate change issue has been considered in rehabilitation of the polders.
6	**Md. Zaid Hussain Bhuiya, Deputy Chief Conservator of Forest (DCCF), Department of Forest** Social forestry based green belt system should be included in polder rehabilitation work process. He also proposed to initiate social forest co-management system along embankment and also in the protected areas.	It has been considered in the project
7	**Mr. Giasuddin Ahmed Chowdhury, Mott McDonald** Internal water management system is very important for rehabilitation of the polders. The polder works should include plan for eco system service providers	To ensure fresh water availability as well as enrichment of ecosystem inside the polder, provision for internal khal re-excavation has been considered in this project. The plan for eco-system service provider has also been made in the study.
8	**Abani Kumar Thakur, DCCF, Department of Forest (DoF)** We know that coastal Greenbelt is a measure to prevent coastal erosion and reduce other natural hazards by planting trees and creating forests along the coasts. As such more exclusive green belt project should be implemented which has recently been studied by DoF.	The rehabilitation of the polders inter-alia includes foreshore afforestation program, The green belt project may be implemented in future.
9	**Mohammad Alamgir, Principal Scientific Officer, WARPO** Fish management plan is still missing in CEGIS power point presentation. Thus he insisted a comprehensive plan including polder rehabilitation work along with fish management plan.	The detailed fishery management plan has been provided in the study which could not be presented in the dissemination seminar due to time limit.
10	**Professor Dr. KB Sajjadur Rasheed, Environmentalist and Advisor, CEGIS**	Yes, the crest level of the embankment has been designed considering the climate change

Sl.	Comments/suggestions	Responses
	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.	scenario
11	**Mr. Mahbub Murshed, Reporter, The Daily NayaDiganta** 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 inthe 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- 40/2 FOR PACKAGE-2

February 2017

Royal HaskoningDHV Enhancing Society Together DevCon Leading Today for Tomorrow dpm IWM DHI

The following recommendations are considered to ensure that all 6 EIA Reports in CEIP Package-2 fully cover environmental risks and impacts under the project and clearly communicate those risks and impacts and corresponding mitigation measures and that it's an effective management tool.

Strategic/Sectoral Assessment: The rationale of Coastal Zone Policy states three reasons as the basic principles:

a) Coastal zone is lagging behind in socio-economic developments
b) Poor initiatives to cope with disasters
c) Coastal zone has potential to contribute to national development.

The CEIP-1 Project fulfils all the three features/ criteria to be selected as development area.

Strategic or Sectoral Environmental Assessment in relation to the Coastal Zone Policy (2005) and the Coastal Development Strategy (2006) was not considered because the Coastal Development Strategy defines 9 priorities which mainstream environmental considerations, i.e. the following relevant ones:

-ensuring fresh and safe water availability

-safety from man-made and natural hazards

-improving of livelihood conditions of the polder dwellers

-environmental mitigation and conservation.

The CEIP-1 Project is conceived as a water infrastructure Project, aiming to retrofit the sluices, embankment, canals and bank protection with climate change impacts mitigation. In that sense, sustainability is incorporated. No fundamental modification of the basic concept of polderization is operated. When the 139 coastal polders were designed/built in 1970s, this all was done in a purely civil engineering approach. Ever since, IPCC report has been published and it has given impetus to more eco-engineering approach in design and construction. Idem ditto for the designs and construction under BWDB, however with core focus on water management infrastructures improvement (raison d'être of BWDB agency). This CEIP-1 Project design is adapted to the climate resiliency objectives with design of the infrastructures alone and its environment-compliant implementation. As the 139 Polders have undergone so many rounds of rehabilitations over the past 50 years, this is the living proof that the coastal polders have sustained half a century. This CEIP-1 brings in climate resiliency as added value to design and construction.

It can be assured that the CEIP-1 Project does not and will not worsen the present coastal situation whatsoever. Moreover, the said infrastructures are built inside the perimeter of the polders and no construction is done to protrude onto the surrounding rivers and existing waterscape/landscape systems and other surrounding sensitive ecosystems. On the operational level at construction sites, mitigation measures have been inserted in the EMP/EAP manual of all Contractors. This is a sufficient safeguard measure for pre, during, and post-construction stages.

Selection Criteria: All the 17 Polders in CEIP-1 including Polder 41/1 out of total 139 were selected by multi-criteria analysis based on physical conditions of existing infrastructures of the Polders. The physical conditions mainly include breach of embankment, overtopping, river erosion, wave action, internal drainage congestion etc. which relates to environmental components.

Past Experiences: In the tidal estuarine dynamics of the South West region of the country, a large scale water logging problem has been created through these polders.

CEGIS has recommended Tidal River Management (TRM) for sustainable solution of water logging problem.

Prior to the proposed interventions, polder areas faced several environmental adverse impacts as follows:

In general, the natural flow of rivers has been restricted for the construction of the Polders causing siltation of the river bed which create obstacles of navigation as well as drainage congestion.

There is no organized track record of the Government in managing such impacts but observation of the polders indicates that there has been increased siltation; reduction of open water fisheries, birds, wild animals; Reduction of soil fertility; deterioration of Water quality over time.

Brownfield vs. Greenfield: The Project mostly entails outright rehabilitation worksof infrastructure where their spatial domain already exists. The structure as indicated in Table 4.3 of EIA Reports is being replaced on the footprint of existing old structures. There are about 4.0 km of new embankment to be constructed; rest of the embankment is re-sectioning of the existing embankment. Hence, very few new impacts are likely to arise.

Gap Analysis: The differences between GOB/Local legal safeguards policies and the WB safeguards policies are highlighted in the Table below:

Comparison between GoB and WB Guidelines

After reviewing the laws of GOB and World Bank Safeguards guidelines, it is necessary to identify the similarities and differences between those so that the more stringent requirements can be applied for the Projects. In general OP 4.01 and OP 4.12 requirements are more comprehensive when compared with the requirements of Bangladesh legal system. The differences have been addressed by the measures proposed by the EIA reports and to be adopted by the Project. Table below lists some key comparisons between GOB and World Bank Safeguards guidelines.

Table: Comparison between GOB and World Bank Safeguards Guidelines

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
1	Type of Environmental Analysis	Project specific	Project specific, regional and sectoral
2	Basis for Categorization	Currently, screening criteria available only for industrial projects, where assessment is done based on: • Level of pollution emission • Type of project and location • Scale of project • Operational activities Non–industrial projects are reviewed on a case by case basis by DOE	Detailed screening criteria for all projects based on • Sensitivity • Nature and magnitude of potential impacts

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
3	EA Outputs	Since detailed rules and regulations for EA have not been prescribed, EA outputs are not specified. However, the industrial sector guidelines, the water sector guidelines and the road sector guidelines have specific EA output requirements, such as: • Baseline survey • IEE/EIA Report • Site clearance • Risk analysis and management • Analysis of alternatives	• EA Report • Analysis of alternatives • Environmental Management Plan
4	Public Consultation	No special mention is made for public consultation in BECA. Sectoral guidelines mentioned above have prescribed consultation.	Mandatory at the stage of • Preparation of EA • Project appraisal • Project design • Project implementation and monitoring
5	Disclosure of Information	BECA makes no reference to disclosure. The Sectoral guidelines prescribe some provisions for disclosure	Mandatory at • Summary of project description an potential adverse impact • Summary of EA report and conclusion • EA report
Social/Resettlement		**1982 ORDINANCE**	**OP 4.12**
6	Coverage	Legal owners Share-croppers Tenants	All affected parties, including squatters and illegal occupant
7	Compensation	Based on market values over previous 12 months No provision for restoration of income streams	Replacement cost at current market price Requires livelihood restoration component.
8	Uses of material from dismantled structures	Material is to be auctioned after being compensated for it	Material can be taken and re-used by affected party
9	Minimization of impacts	Discourages unnecessary acquisition but no mechanisms to monitor	Alternative analysis required to justify avoidance and/or mitigation of impacts
10	Cut-off dates	Not addressed	Important to ensure that squatters are included in compensation and to prevent rent-seeking behavior of additional squatters settling onto project land

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
11	Consultation	No consultation required	Consultation as core issue in RAP preparation and implementation
12	Livelihood restoration	Not addressed	Livelihood restoration component and attention to post-resettlement required

Construction Camps: All Labor Sheds/camps will be built for the workers, although most of the local workers from the surrounding villages who prefer to stay in their houses. During construction of camps for accommodation of workers internationally recognized guidelines such as IFC/EBRD workers accommodation guidelines will be ensured.

Traffic Management: There are some bazars (markets) and shops beside the embankment of the Polders, which are important for socio-economic and livelihood of the people of the polder area. The construction activities along the embankment may temporarily disrupt the market activities causing hindrance to movement of the local people, who will suffer due to their limited roadway movements during construction.

Mitigation measures:

- The works on the embankment will be carefully scheduled in consultation and coordination with local representatives to minimize the impacts on local markets and transportation routes.
- The embankment works will be carried out in segments and the soil will be placed linearly on half of the embankment, leaving the other half to be used as track. After the completion of the first half, it will be opened for the local traffic and then the work for the other half of the embankment will be undertaken.
- Local routes will be kept free, as far as possible, if unavoidable, alternative routes will be identified in consultation with the local community.
- The Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock.
- The works shall not interfere unnecessarily or improperly with conveyance of public to use public or private roads or footpaths.
- Special consideration will be given for preparation of the traffic control plan to the safety of pedestrians and workers at night.
- The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the cross section.

In regards to the increase of Vehicular Traffic during mobilization – EIAs include procedures to ensure: adequate signaling for traffic and pedestrian safety, speed limits for project-related trucks when crossing heavily populated areas and dust control measures and to manage noise levels. This also applies to 6.4.5 Hindrance of Pedestrian and Vehicular Movement. These aspects are comprehensively covered by the EHS Guidelines, as per the said web-link:

http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

Mangrove Afforestation: Afforestation for polders 41/1, 40/2, 47/2 and 43/2C is envisaged. Mangrove vegetation has immense contribution to protect the embankments and char land from tidal surge, provides fuel and thatch materials to the local inhabitants as well as creates ideal habitats for the local avifauna and other wild animals. Given the importance of mangroves, and the fact that survival rates of replanted mangroves tends to be very low, Mangrove afforestation will be carried out as per a specific afforestation plan volume-V Part-C (1- Forestry). These activities will be guided by a Sr. Forestry Expert for which there is a provision under PMU.

EHS Guidelines: Section on *Environment, Health and Safety Guidelines* for all 6 EIAs polder will follow the EHS Guideline 1 (General). The link to the document is as follows:

http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

Pesticides: The CEIP-1 is basically an infrastructure improvement project and not an agricultural project. The handling of pesticides is not a part of project activities. Although intensive afforestation is a part of project activity, the provision of nursery is not included in project activities. The interventions under the proposed project may result in an increased availability of irrigation water through cleaning and excavation of watercourses in the Polder. This increased water availability can in turn potentially increase the usage of agro-chemical fertilizers and pesticides. To address this eventuality, linkages will be developed with the up-coming Consultancy Services (NGO), the TOR is consistent with Integrated Pest Management policy that would address the indirect impact highlighted by the EIAs.

The Department of Agriculture Extension (DAE) is mandated for all types of agricultural extension activities including the preparation and implementation of Integrated Pest Management Plan (IPMP) and Integrated Crop Management Plan (ICMP). The DAE conducts capacity building both for IPMP& ICMP. The scope of project activities did not include DAE. The DAE will start its activities after successful completion of the project.

However, the pollution will be cross checked through testing of soil and water parameters as approved by ECR, 1997, DOE, Bangladesh throughout the Project period (see table below).

Table: Standards for Inland Surface Water

Sl. No.	Designated best use classification	Values			
		pH	BOD (mg/l)	DO (mg/l)	Total Coliform (number/100m l)
A.	Source of drinking water for supply only after disinfecting	6.5-8.5	2 or less	6 or above	50 or less

Sl. No.	Designated best use classification	Values			
		pH	BOD (mg/l)	DO (mg/l)	Total Coliform (number/100m l)
B.	Water usable for recreational activity	6.5-8.5	3 or less	5 or more	200 or less
C.	Source of drinking water for supply after conventional treatment	6.5-8.5	6 or less	6 or more	5000 or less
D.	Water usable by fisheries	6.5-8.5	6 or less	5 or more	----
E.	Water usable by various process and cooling industries	6.5-8.5	10 or less	5 or more	5000 or less
F.	Water usable for irrigation	6.5-8.5	10 or less	5 or more	1000 or less

Source: Standards for Water Schedule 3 of Environment Conservation Rule 1997

Periodic Maintenance Works: The BWDB monitoring unit has postings of 4 Assistant Chiefs and 2 Deputy Chiefs to oversee the overall environmental compliance of BWDB implemented projects. Under CEIP-1, the Environment Social Communication Unit will provide training to the BWDB people responsible for monitoring of environmental compliance. Thus, a smooth transition to BWDB will happen to ensure environmental compliance during the O&M after the project completion. These staff will be responsible to manage the environmental aspects of the operation and maintenance of polder, its water control structures, and other relevant issues such as protection of key environmental resources of the older and maintain fish migration. Water Management Organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (November 2000) and involve the beneficiary communities. WMOs will be trained by BWDB to ensure environmental management during project operation. The Environmental Management Unit of BWDB will ensure and oversee the environmental management during project implementation and operation. The Water Management Organization will also be trained and involved in EMP implementation during the operation phase.

Mitigation Measures: Chapter 6 addresses location specific impacts and mitigation measures. Whereas, Table 10.1usually presents measures for environmental code of practices based on the experience and generic mitigation measures for EMP. Table 10.1 also uses in conjunction with polder specific measures. Thus, measures mentioned in Chapter 6 are not concur with each and every code of practices in the Table 10.1.