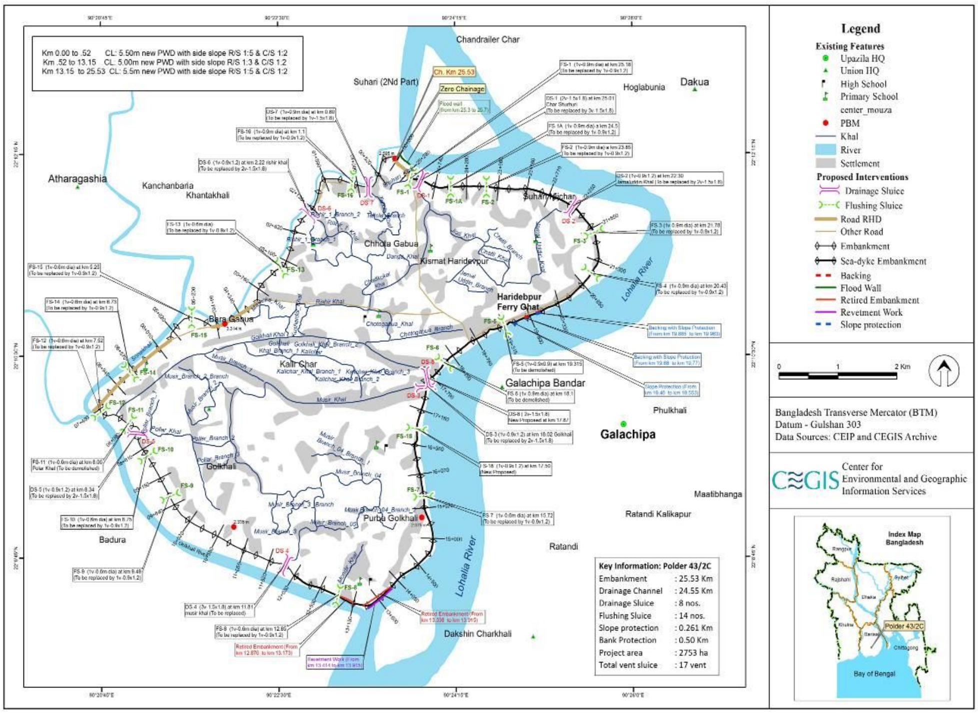
FINAL REPORT

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

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



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

ENVIRONMENTAL IMPACT ASSESSMENT POLDER- 43/2C FOR PACKAGE-2

February 2017

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EIA Study Team

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Abbreviations and Acronyms

ASA	Association for Social Advancement
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorology Department
BoQ	Bill of Quantity
BRDB	Bangladesh Rural development Board
BRAC	Bangladesh Rural Advancement Centre
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CCP	Chittagong Coastal Plain
CDS	Coastal Development Strategy
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
CZPo	Coastal Zone Policy
DAE	Department of Agricultural Extension
DCSC	Design and Construction SupervisionConsultant
DO	Dissolved Oxygen
DoE	Department of Environment
DPHE	Department of Public Health engineering
DPM	Design Planning & Management Consultants
DTW	Deep Tubewell
EA	Environment Assessment
ECA	Environment Conservation Act
ECC	Environmental Clearance Certificate
ECoP	Environmental Code of Practice
ECR	Environment Conservation Rules
ECRRP	Emergency 2007 Cyclone Recovery and Restoration Project
EDS	Environmental Data Sheet
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ES	Environmental Supervisor
ESBN	Estuarine Set Bag Net

FAO	Food and Agriculture Organization
FGD	Focus group Discussion
FRSS	Fisheries Resources Survey System
FWIP	Future-with-Project
FWOP	Future-without-Project
GIS	Geographical Information System
GoB	Government of Bangladesh
GTPE	Ganges Tidal Plain East
GTPW	Ganges Tidal Plain West
GWPM	Guidelines for Participatory Water Management
HTW	Hand Tubewell
HYV	High Yielding Variety
IDA	International Development Association (World Bank)
IEE	Initial Environmental Examination
IESCs	Important Environmental and Social Components
IS	Institutional Survey
IUCN	International Union for Conservation of Nature
KAL	Kranti Associates Ltd. Bangladesh
KII	Key Informant Interview
KMC	Knowledge Management Consultants Limited
LLP	Low Lift Pump
MC	Main Consultant (for CEIP-I Feasibility study)
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
NGO	Non-Governmental Organization
NOC	No Objection Certificate
N,P,K	Nitrogen, Phosphorous, Potassium
NWRD	National Water Resources Database
OP	Operation Policy
O&M	Operation and Maintenance
PAP	Project Affected Person
PCM	Public Consultation Meeting
PCD	Project Concept Document
pH	Measure acidity and alkalinity
PID	Project Information Document

PIO	Project Implementation Office
PL	Post Larva (fish seed)
PMU	Project Management Unit
PPE	Personnel Protective Equipment
PRA	Participatory Rural Appraisal
PRSP	Poverty Reduction Strategy Paper
PSC	Project Steering Committee
PWD	Public Works Department
RAP	Resettlement Action Plan
RCB	Reinforced Concrete Box
RCC	Reinforced Concrete Cement
RRA	Rapid Rural Appraisal
SDE	Sub-Divisional Engineer
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 Programme
UP	Union Parishad
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding
WAO	Women Affairs Office
WARPO	Water Resources Planning Organization
WB	World Bank
WMA	Water Management Association
WMF	Water Management Federation
WMG	Water Management Group
WMIP	Water Management Improvement Project
WMO	Water Management Organization
YDD	Youth Development Department

Glossary

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

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

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

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

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

B Aus: Broadcasted rain-fed Aus paddy (grown during March-July).

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

Bazar: Market

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

Bepari: Middleman in the marketing chain who transports the products to the other places, use of term depends on the location, sometimes also used synonymously with retailer.

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.

Faria: Local trader/agent/intermediary.

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.

Haat: Market place, where buying/selling is carried out either once, twice or thrice a week, however not every day.

Jaal: Different types of fishing net to catch fish from the water bodies.

Jolmohol: Section of river, individual or group of *beel*s (depression), or individual pond owned by the government but leased out for fishing. They are also called Jalkar, or Fishery.

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

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

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

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

Kua/Kuri: Thisis a small ditch in agricultural farm that retain waterduring dry period. Also used as fish-trap. This also refers to deeper sites in the beel areas wherein the water is retained all throughout the year. These are sites for the natural spawning of native fishes.

Kutcha Toilet: The earthen made latrineconsists of a hole/ditch without cover.

Mahajan: Powerful intermediary in the value chain or traditional money lender.

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

Pucca: Well constructedbuilding using modern masonry materials.

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

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

Seasonal Khal: The khals, where water is not available round the year round.

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

T. *Aman*: Paddy grown by transplanting of young plants grown in seed bed during kharif-2 mainly.

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 m2	= 10.77 ft2
1 Decimal	= 435.60 ft2
1 Decimal	= 40.47 m2
1 Katha	= 1.653 Decimal
1 Bigha	= 33 Decimal (Sometimes, the area of Bigha changes)
1 Bigha	= 20 Katha
1 Acre	= 3 Bigha
1 Acre	= 60 Katha
1 Acre	= 100 Decimal
1 Acre	= 4046.825 sq. meter
1 Hectare	= 247 Decimal
1 Hectare	= 10,000 sq. meter
1 Hectare	= 2.47 Acre
1 metric ton	= 1000 Kilogram
1 kilometer	= 1000 meter
1 meter	= 1000 millimeter
1 inch	= 25.4 millimeter
1 foot	=0.3048 meter
1 million cubic meter	= 1,000,000 cubic meter

Executive Summary

The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase-1 (CEIP-1), under which seventeen polders will be rehabilitated and improved in the coastal area of the country. The GoB has obtained financial assistance from the World Bank (WB) for this Project. In accordance with the national regulatory requirements and WB safeguard policies, Environmental Impact Assessments (EIAs) of four polders have already been carried out in the first package. This document presents the EIA report of Polder- 43/2C, which is one of these six polders of Package- 2.

Background

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

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

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

Location and Synopsis of Rehabilitation Work

The location of Polder- 43/2C is in Galachipa Upazila under Patuakhali district of Bangladesh. The administrative and management control lies with Patuakhali O&M Division under southern zone of BWDB.

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 and water logging. The key improvement works to be carried out in the polder are: Re-sectioning of embankment (25.53 km); Retirement of embankment (874m); bank protection works (500 m); slope protection works (261m); construction of 8 Drainage Sluices (7 to be replaced and construction of 1 new Sluice); construction of 14 Flushing Sluices (replacement); Slope protection (0.261 km); Bank protection (0.50 km); re-excavation of 24.55 km canals and afforestation on total 13.43 ha in offshore and embankment slope areas.

The Bangladesh Water Development Board is the implementing agency of this project.

Policy, Legislative and Regulatory Framework

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

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

Environmental and Existing Conditions

Polder- 43/2C lies in the flat agro-ecological zone of the Ganges Tidal Floodplain in the southern region of Bangladesh. The soil texture varies from clay to clay loam in the Polder. Non-calcareous grey floodplain soil is the major soil type in the polder. Acid sulphate soils also occupy significant part of the area where it is extensively acidic during dry season. In general, most of the top soils are acidic and sub-soils are neutral to mildly alkaline.

Climate of the polder area is typical monsoon with four seasons: the Dry/winter from about December to March, the pre monsoon lasting from April to May, the monsoon from June to September and the post monsoon from October to November. The average annual rainfall is about 2,669 mm of which around 74% (1,968 mm) is mainly concentrated during the monsoon season which lasts from June till the end of September. The mean monthly minimum and maximum temperature varies from 13°C to 31°C respectively. The summer begins from April through May with a mean temperature of about 33°C. Relative humidity rises above 89% in monsoon (June to September) and starts decreasing from post monsoon season following the monsoon rainfall.

Most of the khals have silted up. Local people opined that Musir khal, Rishir khal, Jamaluddin khal and Pollar khal have been silted up by around 1.5 m to 2.0 m in the last decade because of the sluice gates placed at the canal openings were damaged, that leading toincreased siltation. Due to the reduced drainage capacity of the khals, rainwater often inundates the agricultural fields for a period of 4~5 days, and affects the Kharif-II crops. Tidal flooding is very common in the project area. At present, tidal flooding occurs inside the Polder in almost every year and inundates about 25 ~35 % of the total polder area. Purba Golkhali, Golkhali, Bara Gabua and Kalirchar mauzas are mainly affected by tidal flooding.

From spatial analyses using the satellite imageries of different time frame (1988, 2003 and 2014), it has been found that around 100 ha of lands have been eroded from the Purba Golkhali point in last 26 years and around 20 ha of lands have been eroded from the floodplain portions of Horidevpur char. Furthermore, all samples collected were found with zero salinity. The local people opinedthat no surface water salinity exists in the area during the dry season

(December to February). March and April are the two months when the surface water system in the outer portion of the polder becomes slightly saline.

The soil salinity levels are 1.01 to 7.57 (ds/m) in the top soil (depth of 0-15 cm) in all agricultural land. It indicates that, respective agricultural land suffers from non-saline to very slightly saline.

The 43/2C polder area is situated within the Ganges Floodplain bio-ecological zone. No Ecologically Critical Area or designated protected area is located within or near the polder area. The area is tidal in nature. A number of mangrove vegetation and bush are found along the marginal lands of canals shoreline. The most dominant mangrove species are Gewa (*Excoecaria agallocha*), Kakra (*Bruguiera gymnorrhiza*), Ora (*Sonneratia caseoloaris*), Golpata (*Nipa fruticans*) and Hargoza (*Acanthus illicifolius*).

The gross area of the polder is 2,753 ha of which net cultivable area is 2,000 ha. Three classes of land type i.e. highland, medium highland and medium low land have been identified in the polder area. Medium high land is dominant which comprises 66.5% of NCA. Total cropped area is 3,465 ha of which rice occupied 2,610 ha and the rest 855 ha is covered by non-rice crops. Among the rice, Lt. Aus, HYV Aus, Lt. Aman, HYV Aman, HYV Boro, Local Boro are being grown on 565 ha, 410 ha, 1,000 ha, 550 ha, 65 ha and 20 ha respectively. Non-rice crops include Orchard, Summer Vegetable, Pulses, Potatoes, Winter Vegetables, Spices, Oil seeds, and Watermelon. Total crop production is 13,805 metric tons of which rice production is 5,648 metric tons and non-rice production is 8,157metric tons. Among the rice crops, the contributions of Lt. Aus, HYV Aus, Lt. Aman, HYV Aman, HYV Boro and Local Boro are about 16%, 20%, 35%, 24%, 4% and 1%, respectively.

Fish habitat in this Polder area is mainly classified into two types: open water or capture fisheries and closed water or culture fisheries. Fisheries resources of the polder area are diversified with fresh and brackish water fish habitats. The open water fish habitat of the polder includes the surrounding external rivers and internal khals. The fish habitat in the project area is estimated 753 ha of which 731 ha is capture fish habitat. Various types of fish culture systems have been adopted by the local people including mono-, poly-, and mix-culture. The area under culture habitat is 22 ha. The estimated total fish production of the Polder area is 115MT. The major part of the fish production (about 68%) is coming from capture fisheries while the rest of the production (about 32%) comes from culture fisheries.

The Polder area is the home of 33,968 people belonging to 7,548 households. Of the total population, 16,610 (48.9%) are male and 17,358 (51.1) female. The average household size is 4.5, which is equal to that of the national average of 4.50. The average population density is 475 per square kilometer, which is lower than that of national average (1,055).Literacy rate, based on the definition “ability to write a letter in any language” is 45.6%, where for male it accounts to 47.5% and female 43.8%. Out of total population, 4,925 (14.5%) are economically active of which 2,433 (49.4%) employed, and the remaining are engaged in household work and looking for work. 11% households are under grid electricity coverage. Rural Electrification Board is the main electricity provider. The coverage of solar energy is found nominal in the entire study area. About 50% of the households in the polder area use non-sanitary latrines, 34% use non water-sealed sanitary latrines, 11% use sanitary water-sealed latrines and 5% households still have no sanitation facilities either owned or shared basis. Collection of drinking water from tube-well is dominant (99%) throughout the study area.

PotentialImpacts and Their Mitigation

Pre-Construction Phase

The potential environmental and social impacts during the pre-construction phase are mainly associated with acquisition of land for the construction of retired embankments.Land acquisition will affect homesteads, agricultural and orchards etc. About 10.73 hectares of land will be acquired. A total 71,218 number of trees of different species of different sizes are to be cut for re-sectioning of embankment and construction of structures. Moreover, about 39 Common Properties will be affected in Polder 43/2C.

During Construction Phase

The contractor's camps will generate domestic solid wastes and waste water including sewage. The 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. Improper disposal of these wastes can potentially contaminate the soil and water resources of the area. Soil and water contamination can potentially 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 cause additional sedimentation in the rivers. Similarly, sediment load in the channels may increase if they are excavated without bailing out water from them. Excavated material if left along their banks may again flow back to the channels thus increasing their sediment load. All tall trees of the proposed sites have already been cut down which damaged the embankment slopes. The seasonal undergrowth vegetation (i.e.: grasses and wild herbs) would be damaged permanently where CC blocks would be placed. It is also suspected that the undergrowth vegetation at CC Block manufacturing/ casting yards will be damaged if the contractor has no other alternative to select vegetative places.

The bank side of the Lohalia River has been found as the feeding, nursing and spawning ground, especially for Paissa, Gulsha Tengra, Bagda, etc. It is suspected that the activities of bank revetment and slope protection (earth work) will partially (if implemented in the dry season) and fully (if implemented in the rainy season) disturb the feeding, nursery and even spawning ground of these fish species.Migration behaviour of 26 fish species towards feeding, nursing, spawning and breeding might be hindered or fully hampered if the replacement of these sluice gates are made in the dry season and in the rainy season respectively, the habitat of about 1 km around the sluice gates (500 m upstream and 500 m downstream).

Most of the construction activities will be implemented during the dry season, when the 21 benthic fauna would be more vulnerable condition.

It is estimated that about 65 ha of land is under HYV Boro rice cultivation. Presently, 99,415 kg of chemical fertilizers and Tk 786,000 for pesticides are required for cultivation of Boro and Aus rice. According to the initial estimates, about 2.93 Mm^3 of water would be available from the internal canal system, after the completion of the proposed project. This would allow expansion of area under cultivation of Boro, whichwill be 380 ha. Specifically, Boro cultivation would be expanded in the medium high land. Runoff from these cultivation fields may potentially pollute the water bodies and even the drinking water sources thus causing health hazards to the communities.

Project Operation Phase

The cropped area would be changed after the implementation of interventions.. The cropped area would be 3,850 ha of which rice cropped area would be 3,260 ha and non-rice cropped area would be 590ha. The crop production is considered to increase significantly. The total crop production is estimated to20,604 tons of which rice would be 10,559 tons and non-rice would be 10,045 tons. The rice and non-rice percentage increase in production would be 87% and 23%, respectively. Rice production would be increased mainly due to protection of agricultural land from river bank erosion, construction of structure and repair/replacement of structure with adoption of modern technology in crop production, change in cropping pattern etc. Crop production would be increased due to expansion of T. Aus (HYV), T. Aman (HYV), Boro (HYV), Watermelon and winter vegetables cultivation area.

Increase of agriculture production and reduction of drainage congestion will increase the income of the people for which it is expected to improve the livelihood of the people; and it is expected that fish production from water bodies (river and khals) would slightly improve due to re-excavation of canals. Moreover, bank revetment and slope protection would strengthen the tendency of practicing Gher (Golda), homestead pond and improved fish culture in the polder area.

Analysis of Alternatives

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

In present situation, Polder 43/2C is extremely vulnerable to cyclones, storm surges, wave action, and climate change effects.The Polder is not in a state to provide required services particularly protection against tidal inundation, drainage, and minimizing the impact of cyclonic surges. The Polder area is vulnerable to submergence of the embankments during the monsoon.The transportation system inside the Polder is presently in dire state and would further deteriorate, sufferings of local people would further increase if no investment were done in future. The agricultural area is being reduced due to scarcity of ground water during the periods of low rainfall.The farmers are facing crisis of irrigation from the month of January to April (due to salinity) and May to August due to flooding). The silted water channels are resulting the declining of fisheries and increasing environmental pollution. The proposed interventions under CEIP-1 have been designed to address the above problems of the Polder. If these interventions are not implemented, the present poor state of the Polder will be further degraded, and therefore the 'no-project' alternative is not a recommended option.

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

Climate Change Impact

The impacts of climate change with higher temperature and rainfall have been projected by using Regional Climate Model (RCM) and are considered RCP 4.5. The change of rainfall is found to be -11.0, +13.3, +0.8 and +7.2% for winter, pre-monsoon, monsoon and post-monsoon, respectively for 2030 and similarly for 2050 the rainfall may be changed as -0.9, +2.4, -7.3 and -26.7 % for winter, pre-monsoon, monsoon and post-monsoon, respectively.

The maximum surface air temperature is predicted to increase in 2030 and 2050 by 1.1, 0.4, 0.7, 0.9^{o}C and 1.7, 1.4, 1.3, 1.2^{o}C for winter, pre-monsoon, monsoon and post-monsoon seasons with the highest increase during winter. Similarly, the minimum surface air temperature may increase in 2030 and 2050 by 1.5, 0.9, 0.8, 1.2 ^{o}C and 2.0, 1.7, 1.4, 1.4 ^{o}C for winter, pre-monsoon, monsoon and post-monsoon seasons with the highest increase during winter in both the years.

Cumulative and Reciprocal Impacts

Polder 43/2C is surrounded by the Lohalia River fromnortheast and southeastside. The existing crest levels of the polder ranges from 3.32 to 3.60 mPWD above MSL. Re-sectioning works proposed for this polder under CEIP, to increase its crest level between 4.57 and 5.18 mPWD .This increase would reduce the possibility of overtopping due to storm surges. The other CEIP polders (41/1, 40/2 and 48) are far away from this polder. As a result the interventions of those would have negligible impact on Polder 43/2C. From model study it is found that there will be negligible impact on the surrounding polders due to rehabilitation of the Polder 43/2C. Polder 43/2C is located within the GDA, and bears significant sensitivity towards the proposed Ganges Barrage. The most significant impact of the barrage on Polder 43/2C would be the reduction of surface water salinity in its adjoining river system. However, the activity of the of the proposed Payra sea port will have impact on the river system as well as its surrounding environment.

Both quantitative assessments and qualitative judgments have been carried out. In total 38 storm surge model simulation results have been used in determining storm level for different return period made to assess the reciprocal impacts of Climate Change and Polder improvement of Polder 43/2C. The projection of storm surge level were calculated for three south-eastern locations of the polder considering both with and without climate change. It is observed that in 10 year return period surge level may be increased by around 15% whereas in 25 and 50 year return period it may be increased around 10% and 7% respectively due to climate change. Therefore, it can be inferred that intensity and frequency of storm surges may increased in the coming years in surrounding areas (AmkholaBazar, Horidevpur, Agun Mukha) of Polder 43/2C. In 50-year projection it has been found that, the storm surge levels are higher than the existing crest level of the polder, which may cause severe inundation of the polder area.

Environmental Management Plan

The environmental management plan (EMP) provides the implementation mechanism for mitigation measures identified during the present EIA study. A comprehensive EMP, which focuses on managing the construction phase-related impacts, should suffice in managing the potential construction and operation phase impacts. The EMP will be included in the Bidding Documents. The environmental management parameter will be included in the BoQ. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting.

The total cost of EMP implementation for Polder 43/2C has been estimated as BDT 93.80 million.The contractor needs to submit an Environmental Action Plan (EAP) based on the EIA and EMF in line with the construction schedule and guideline. The EAP needs to be reviewed by the supervision consultant and cleared by BWDB and World Bank.

Extensive monitoring of the environmental concerns of the Polder 43/2C will be required as per World Bank guideline. The monitoring program will have the purpose to evaluate: (i) the extent and severity of the environmental impacts against the predicted impacts and baseline; (ii) the 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 plan is included in the EMP. The EMP stipulates the registration of monitoring results in suitable database and regular reporting of results.

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 Bazars 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 needs with respect to environmental management of the Project, in addition to defining the reporting and record keeping protocol.

Institutional Responsibility and Report Requirement

The contractor is responsible for the implementation of the EMP during construction works, Design and Construction Supervision Consultant will be primarily responsible for supervision of the implementation of the EMP. BWDB will conduct field inspections and surveys by the environmental specialist (to be employed by BWDB on regular basis) at field. S/he will report to the Senior Environmental Specialist at Head Quarter. The M&E consultant will be responsible for independent monitoring the implementation of EMP, as well as external monitoring and evaluation. DoE will be consulted if any complicated issues arise 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 Half Yearly Progress 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 effectiveness of screening, monitoring and implementation of EMP will be carried out by the third party monitoring firm along with the project component activity monitoring quarterly/bi-annually/annually. The annual Environmental Audit Report prepared by the third party monitoring firm will be shared with the safeguards secretariat.

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

Stakeholders and Disclosure Consultation and Participation

During the study period, public consultation meetings were organized with the participation of local people, representatives of local government and BWDB and other stakeholders. Local people have shown interest in the rehabilitation of the project for their existence. They have no objection from their end to implement the project, rather are found ready to help the implementing agency spontaneously. Two Public consultation (Goalkhali Union Porishod Conference room and Golachipa Upazila Conference room), and three focus group discussion (Haridebpur Bazar, Shuari Bredge Bazar and Goalkhali) meetings were held to collect stakeholder perception on the proposed interventions considering EMP measures.

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) to implement this project. It is to be mentioned that, the Site Clearance of all the 17 (seventeen) polders had been obtained from the Department of Environment (DoE), Bangladesh on the basis of the Initial Environmental Examination (IEE) reports been 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 Package-2 andPackage-3. In accordance with the national regulatory requirements and WB safeguard policies, Environmental Impact Assessment (EIA) of Package-2 for six polders have also been conducted. This EIA report of Polder- 43/2C is one of the six polders of Package- 2.

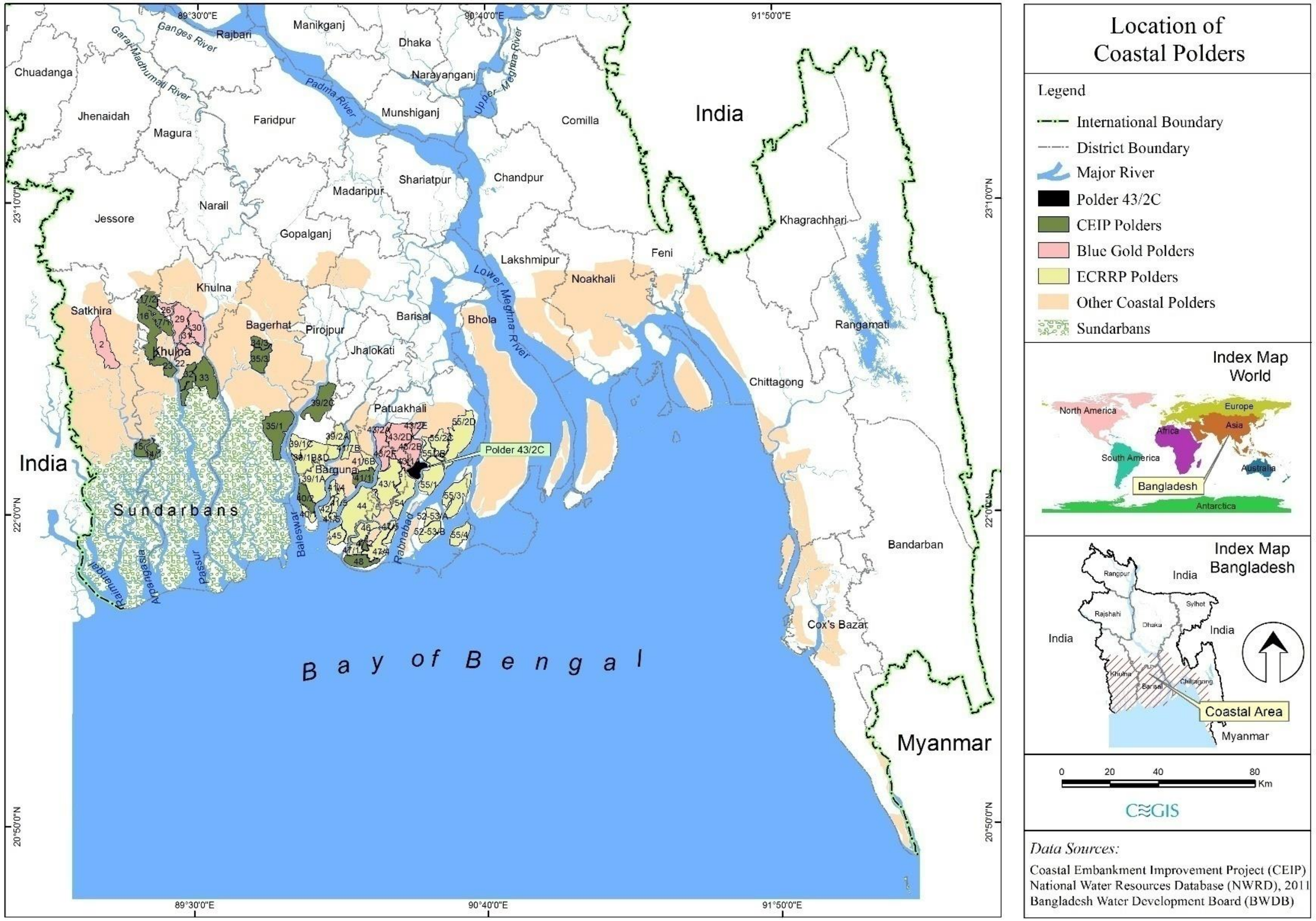
1.1 Background

2. Coastal region of Bangladesh consists of 19 districts adjoining the Bay of Bengal and 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 huge volume of sediment inflows from the upstream.

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

4. The coastal embankment system of Bangladesh was originally designed without much attention to storm surges. Recent cyclonic eventshave caused substantial damage to the embankments and further threatened the integrity of the coastal polders. In addition to breaching of the embankmentsdue to cyclones, siltation of peripheral rivers surrounding the embankments have caused the coastal polders to suffer from water logging, which has led to large scale environmental, social and economic degradation. Poor maintenance and inadequate management of the polders have also contributed to internal drainage congestion and heavy 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 reasons have led the government to re-adjust its strategy on the coastal area from only ensuring protections against high tides and also provide protection against frequent storm surges as well. The long-term objective of the government is to increase the resilience of the entire coastal population to tidal flooding as well as natural disasters by upgrading the entire embankment system. With an existing network of nearly 5,700 km longembankments 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-termprogrammatic approach.



Map 1.1: Location of Coastal Polders

1.2 Project Overview

6. The Polder- 43/2C is located in *Galachipa* upazila under *Patuakhali* District of southern Bangladesh (Map 1.2). The Polder covers a gross area of 2,753 hectare (ha) with net cultivable area of 2,000 ha. The Project aims to enhance protection against natural disasters, increase resilience during and after such disasters and improve the agricultural production by reducing drainage congestion. To meet up these objectives, the following key improvement and rehabilitation works will be carried out in Polder- 43/2C under Package- 2, CEIP-1:

Table 1.1: Key Improvement and Rehabilitation Works

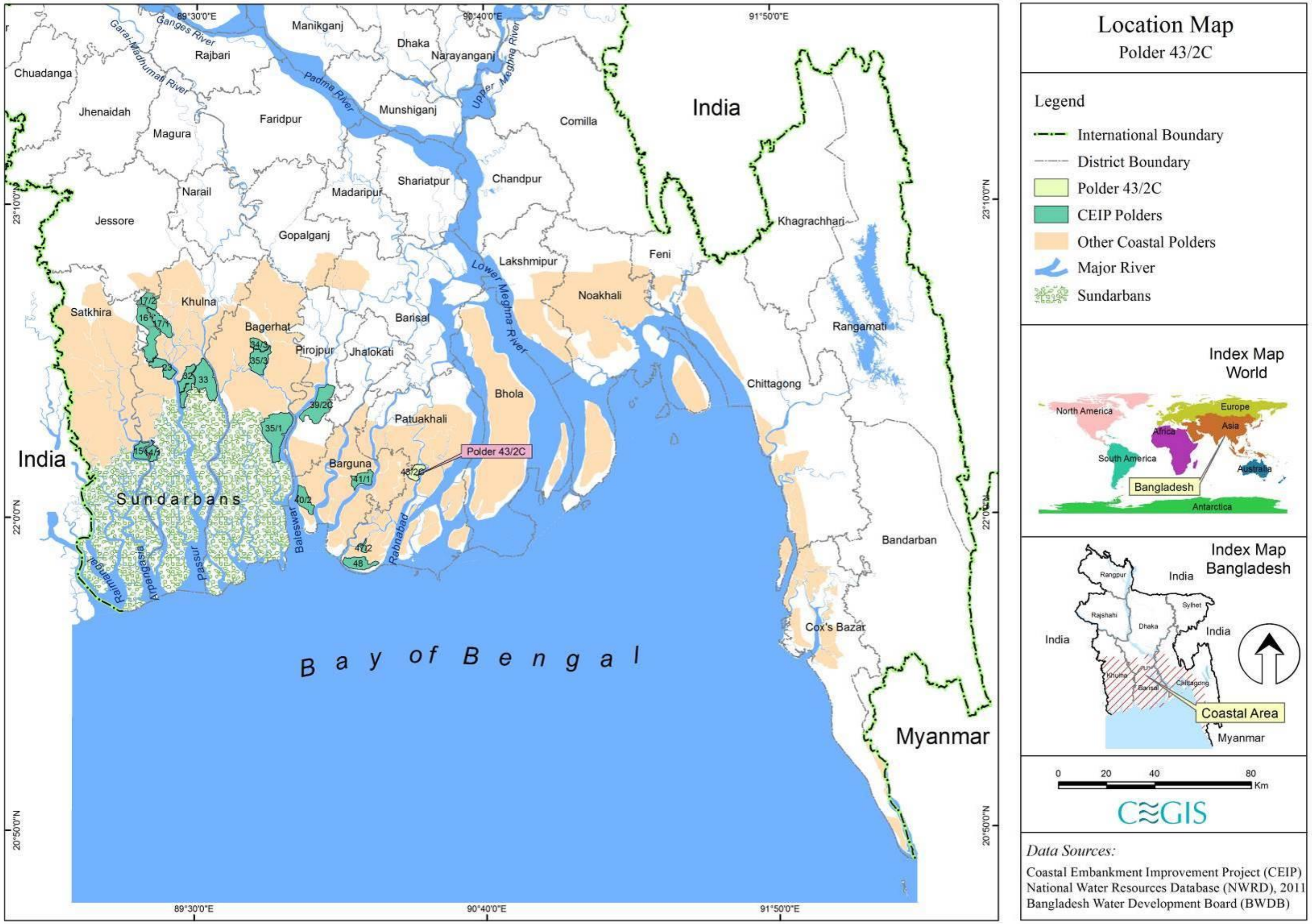
Sl.	Type of Works	Specification
1	Re-sectioning of embankment	25.53 km
	Design crest level of embankment	5.50 m, PWD (sea-dyke) and 5.00 m, PWD (interior dyke)
2	Retirement of Embankment	874 m
3	Bank protection works	500 m
4	Slope protection of embankment	261 m
5	Construction (Replacement) of Drainage Sluice	8 nos.
6	Construction (Replacement) of Flushing Sluice	14 nos.
7	Demolishing Flushing Sluice	3 nos.
8	Re excavation of drainage channel	24.55 km
9	Afforestation on the foreshore and embankment slope areas	13.43 ha

Source: Engineering and Design Team of CEIP-1

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

1.3 Regulatory and Policy Framework

8. 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 to be carried out for projects being considered for its financing. The present EIA fulfils both of these requirements.



Map 1.2: Location of Polder- 43/2C

1.4 Objectives of the Study

9. The objective of the EIA study for Polder- 43/2C is to identify and assess the potential environmental impacts of the proposed project interventions, evaluate alternatives, and design appropriate mitigation, management, and monitoring measures to be addressed in the Environmental Management Plan (EMP) 1In compliance with the national regulatory and WB environmental policies and guidelines (for further details refer Chapter 3).

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

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

1.5 Scope of work

11. The scope of works of the presentEIA for Polder- 43/2C includes the followings:

i. Carry out detail field investigation of required parameters of the environmental and social baseline, especially on the critical issues.
ii. Determine the potential impacts for the project through identification, analysis and evaluation of sensitive areas (natural habitats; sites of historic, cultural and conservation importance), settlements and villages/agricultural areas or any other identified Important Environmental and Social Component (IESCs).
iii. Determine the cumulative environmental impacts of the project, which may occur inside and outside the project area.
iv. Distinguish between significant positive and negative impacts, direct and indirect impacts, immediate and long-term impacts, and unavoidable or irreversible impacts.
v. Identify feasible and cost effective mitigation measures for each impact predicted to reduce potentially significant adverse environmental impacts to acceptable levels.
vi. Determine the capital and recurrent costs of the measures, and institutional, training and monitoring requirements to effectively implement these measures. The consultant is required to identify all significant changes likely to be generated by the project activities. These would include, but not be limited to, changes in the 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

[1]WB Operation Policy 4.01. 2011 Revision

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 in qualitative terms.

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

x. Identify the specific reciprocal 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. Preparedetail EMPalong with respective EIA separately to monitor the implementation of mitigation measures and the impacts of the project of other inputs (such as training and institutional strengthening) needed to conduct during construction and operation. Include in the plan an estimate of capital and operating costs and a description of other inputs (such as training and institutional strengthening) needed for implementing the plan.

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

xiii. Develop environmental monitoring format for regular monitoring of the project at pre-construction, construction and operational stage

xiv. Prepare the EIA report.

1.6 Structure of the Report

12. The report comprises the following chapters:

Chapter 1 (Introduction) describes the background of the project, objectives of the study, and scope of works.

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. Also given in the Chapter is a discussion on the WB safeguard policies and their applicability for the Project is also been highlighted.

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

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

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

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

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

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

Chapter 10 (Environmental Management Plan) includes the estimated costs of the mitigation measures for the impacts, 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 among others also includes mitigation plan, enhancement plan, contingency plan and the environmental monitoring plan.

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

2. Approach and Methodology

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

2.1 Overall Approach

14. The EIA study for the rehabilitation of Polder- 43/2C 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:

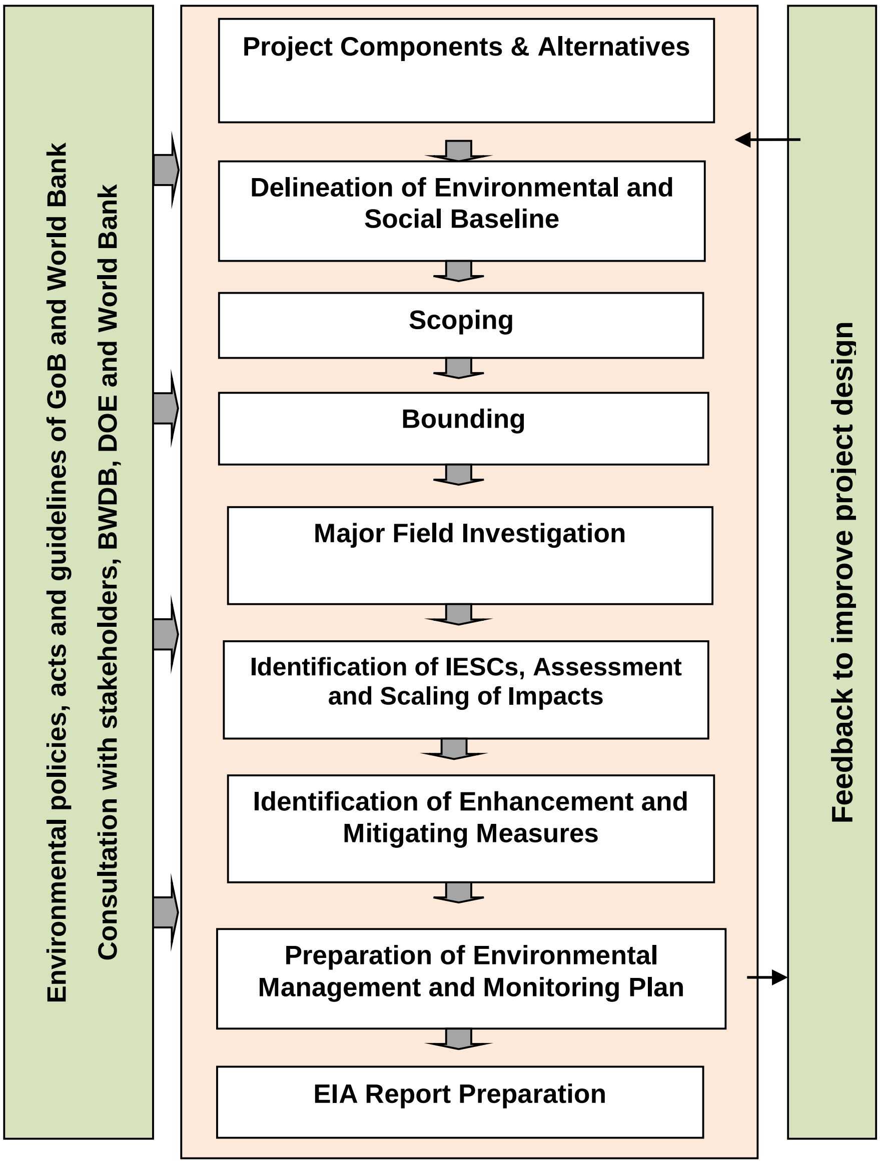


Figure 2.1: Overall approach of the EIA study

2.2 Methodology

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

2.2.1 Project Area of Influence

16. At the beginning of the study, the Project area of influence was broadly demarcated. This includes the area inside the polder where most of the Project interventions would take place, the area immediately outside the polder embankments (this area could be used for staging of construction works, material stockpiling, and/or earth borrowing), access routes 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 polder is bounded by Golkhali river in the south and southwest, Sonakhali River in the west and northwest, Lohalia River in the east and north.

2.2.2 Analysis of the Project Design and Description

17. Detailed information on the Polder- 43/2C including objective, nature and location of proposed and existing interventions, construction works, and other related aspects was obtained from the DCSC of CEIP-1.

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

19. Since the location of most of the 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.

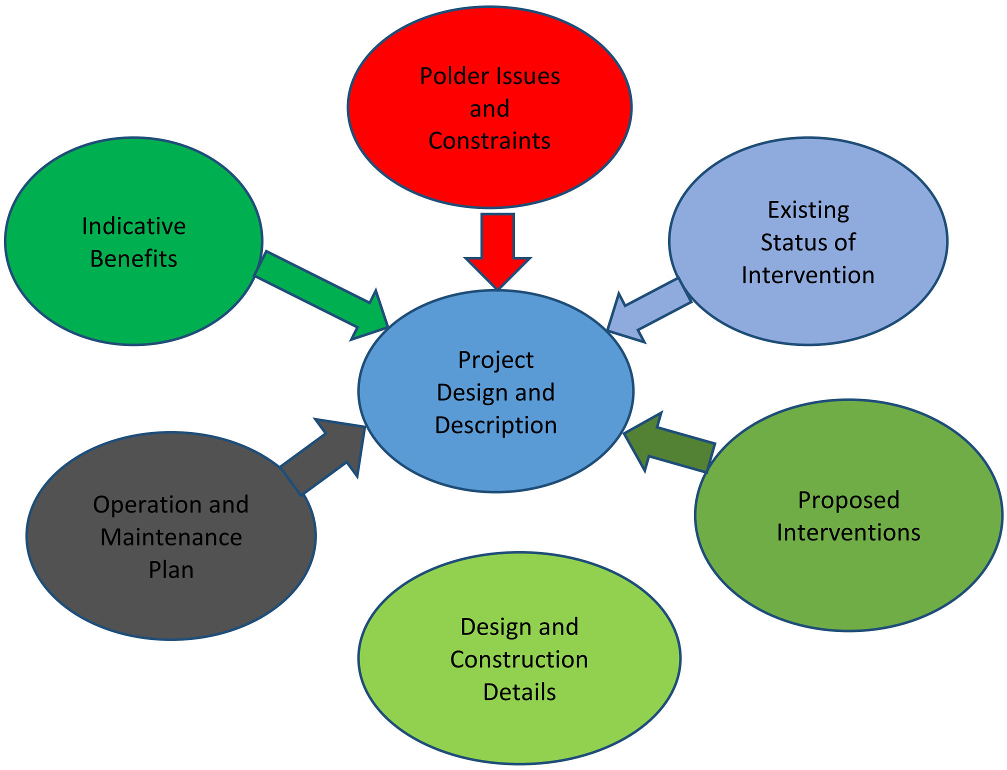


Figure 2.2: Aspects to be addressed in the Project Design and Description

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 2.2 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.

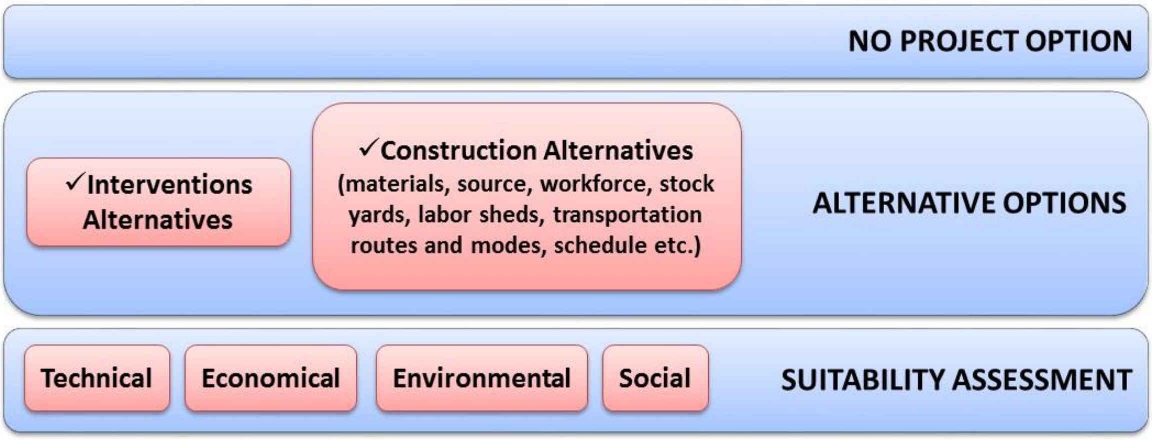


Figure 2.3: Concept of Alternative analysis to be used in the EIA study

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

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 (Attached in Appendix A) and approved by the Detailed Design, Construction Supervision and Project Management Support Consultant (DCSC) and used to register the information obtained from different stakeholders.

Physical Environment

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

Water Resources and Metereology

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

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

Land and Soil Resources

27. 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 was collected from Upazila[2] Land and Soil Resources Utilization Guide of Soils Resources Development Institute (SRDI). The secondary data of these parameters was verified at field level through physical observations as well as consultations with the local people and officials of the Department of Agriculture Extension (DAE) during field visit.

Biological Environment

Agricultural Resources

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

29. Total crop production = damage free area × normal yield + damaged area × damaged yield.

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

30. The crop damage (production loss) was calculated using the following formula:

31. Crop production loss = Total cropped area × normal yield - (damaged area × damaged yield + damage free area × normal yield).

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

Ecological Resources

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

34. Field investigation methods included physical observation; transect walk, habitat survey and consultations with local people. Public consultation meetings were carried out through FGD and Key Informants Interview (KII) methods. Inventory of common flora and fauna and their status was developed based on field surveys and from the speciesdatabase of Bangladesh National Herbarium and the Status of Vertebrates/ Red List of International Union for Conservation of Nature (IUCN).

Fish and Fisheries

35. 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.

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

37. 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 collected.

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

Livestock Resources

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

Socio-cultural Environment

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

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

- Institutional surveys was conducted for primary data collection from district and upazila level.

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

2.2.5 Climate Change

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

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

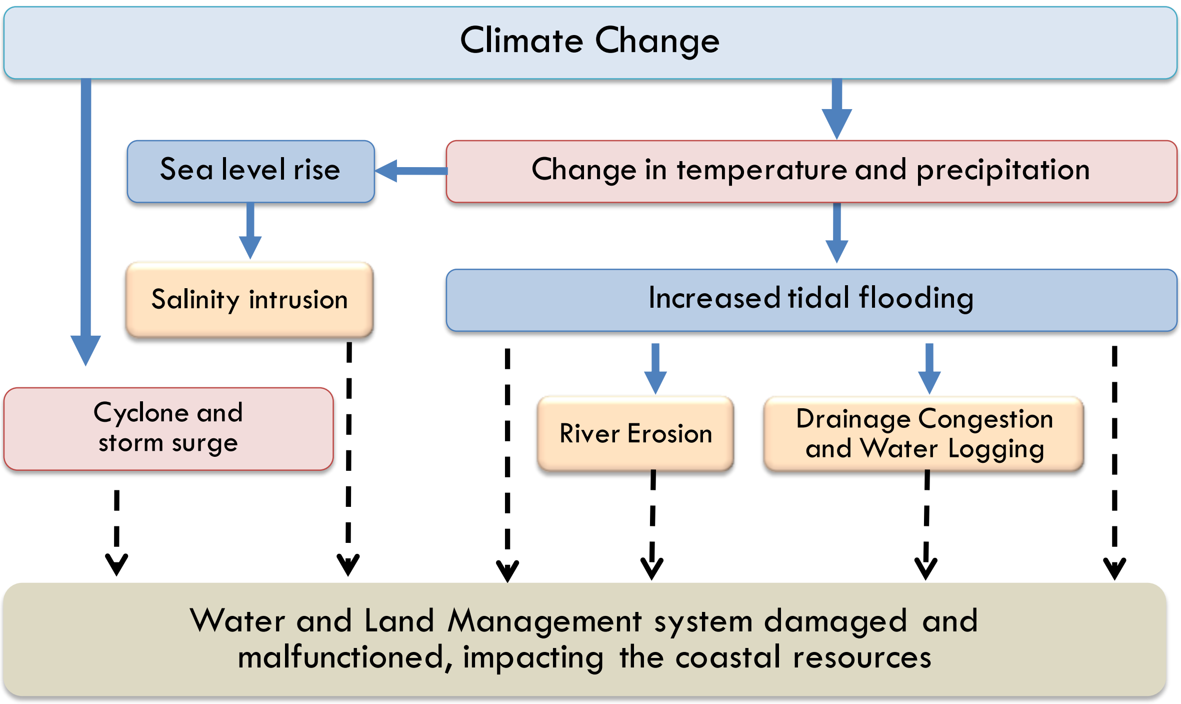


Figure 2.4: Typical diagram of climate change impacts in coastal areas

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

2.2.6 Scoping

45. 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 intervention,was prepared. In the second stage, village scoping sessions were held where opinions of the stakeholders were obtained on their perception about the environmental and social components, which could be impacted by the project interventions. With the help of the professional judgments of the multidisciplinary EIA team as well as the opinions of the stakeholders, the preliminary list of the important environmental and social components was finalized.

2.2.7 Assessment and Scaling of Impacts

46. At this stage, attempts were made to assess the impacts of the proposed interventions of the polder quantitatively. Alternatively, impacts were assessed qualitatively when quantification was not feasible. The impacts of proposed interventions, considering the climate-change scenario of RCP 8.5 for 2050, were estimated on the basis of differences between the future-without-project (FWOP) condition and the future-with-project (FWIP) condition. The future-without-project (FWOP) conditions were generated through trend analysis and consultations with the local people. This reflected conditions of IESCs in absence of the proposed interventions under the polder area. Changes expected to be brought about due to proposed interventions under the Project were assessed to generate the Future-with-Project (FWIP) condition. Comparison and projection methods were used for impact prediction.

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

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 also 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 been identified according to the categories outlined in Table2.1.

Table 2.1: Parameters for Determining Magnitude

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

Parameter	Major	Moderate	Minor	Negligible/Nil
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.

Table2.2: Criteria for Determining Sensitivity

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

Assigning Significance

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.

Identification of Enhancement Measures

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

2.2.8 Preparation of Environmental Management and Monitoring Plan

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

2.2.9 EIA Report Preparation

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

3. Policy, Legal and Regulatory Framework

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

3.1 Relevant National Policies, Strategies and Plans

3.1.1 National Environment Policy, 1992

62. 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

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

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

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

3.1.2 National Environment Management Action Plan, 1995

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

3.1.3 National Water Policy, 1999

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

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

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

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

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

69. The National Water Management Plan (NWMP) 2001, approved by the National Water Resources Council in 2004, envisions to establish an integrated development, management and use of water resources in Bangladesh over a period of 25 years. WARPO has been assigned to monitor the national water management plan. The major programs in the Plan

have been organized under eight sub-sectoral clusters: (i) Institutional Development, ii) Enabling Environment, (iii) Main River, (iv) Towns and Rural Areas, v) Major Cities; (vi) Disaster Management; (vii) Agriculture and Water Management, and (viii) Environment and Aquatic Resources. Each cluster comprises of a number of individual programs, and a total of 84 sub-sectoral programs have been identified and presented in the investment portfolio. Most of the programs are likely to be implemented in coastal areas.

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

3.1.5 Coastal Zone Policy, 2005

71. 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.

72. 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.

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

3.1.6 Coastal Development Strategy, 2006

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

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

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

3.1.7 National Land Use Policy (MoL, 2001)

76. The National Land Use Policy (NLUP), enacted in 2001, aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities. The NLUP urges that increasing the land area of the country may not be possible through artificial land reclamation processes, which are cost-effective only in the long run. Therefore, land use planning should be based on the existing and available land

resources. The policy suggests establishing land data banks where, among others, information on accreted riverine and coastal chars will be maintained. Among the 28 policy statements of NLUP, the following issues are relevant to coastal area:

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

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

3.1.8 National Agriculture Policy, 1999

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

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

3.1.9 National Fisheries Policy, 1996

80. 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.

81. The policy suggests following actions:

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

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

3.1.10 National Forest Policy, 1994

83. The Forest Policy 1994 recognizes the importance of biodiversity for environmental sustenance. The policy explicitly mentions that habitats for the wildlife and vegetation will be

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

3.1.11 Private Forest Policy 1994

84. The policy suggested for extended effort to bring about 20% of the country's land under the afforestation programs of the government and private sector by year 2015 by accelerating the pace of the program through the coordinated efforts of the government and NGOs and active participation of the people in order to achieve self-reliance in forest products and maintenance of ecological balance. The policy viewed equitable distribution of benefits among the people, especially those whose livelihood depend on trees and forests; and people's participation in afforestation programs and incorporation of people's opinions and suggestions in the planning and decision-making process. The people-centered objectives of the policy are: creation of rural employment opportunities and expansion of forest-based rural development sectors, and prevention of illegal occupation of forest lands and other forest offences through people's participation. The policy statements envisage: massive afforestation on marginal public lands through partnerships with local people and NGOs; afforestation of denuded/encroached reserved forests with an agroforestry model through participation of people and NGOs; giving ownership of a certain amount of land to the tribal people through forest settlement processes; strengthening of the Forest Department; strengthening of educational, training and research facilities; and amendment of laws, rules and regulations relating to the forestry sector and if necessary, promulgation of new laws and rules. Thus, over time the policy has shifted somewhat from total state control to a management regime involving local communities in specific categories of forests.

85. Because of limited amount of forestland, the policy underscores for effective measures for afforestation in rural areas, in the newly accreted char in the coastal areas and in the denuded Unclassed State Forest areas of Chittagong Hill Tract and northern zone of the country including the Barind tract. The policy also encourages the private sector participation in afforestation.

3.1.12 National Livestock Development Policy, 2007

86. The National Livestock Development Policy (NLDP) has been prepared to address the key challenges and opportunity for a comprehensive sustainable development of the livestock subsector by creating an enabling policy framework. Among 60 or more policy statements, the following two policy statements address the coastal zone:

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

87. 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.

3.1.13 Guidelines for Participatory Water Management 2014

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

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

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

3.2 National Environmental Laws

90. The key national policies, strategies, and plans relevant to environmental management are briefly discussed below:

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

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

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

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

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

94. The ECA 1995 was amended in 2010, which provided clarification of defining wetlands as well as Ecologically Critical Areas and included many important environmental concerns such as conservation of wetlands, hill cutting, ship breaking, and hazardous waste disposal. This amendment empowered the government to enforce more penalties than before.

Moreover, affected persons were given provision for putting objections or taking legal actions against the polluters or any entity creating nuisance to affected person.

3.2.2 Bangladesh Environment Conservation Rules (ECR), 1997

95. 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.

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

97. 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.

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

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

3.2.3 Bangladesh Environment Court Act, 2010

100. Bangladesh Environment Court Act, 2010 has been enacted to resolve the disputes and establishing justice over environmental and social damage raised due to any development

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

3.2.4 The Forest Act, 1927 & Amendment Act 2000

101. 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.”

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

3.2.5 Private Forest Ordinance (PFO), 1959

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

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

3.2.6 Social Forestry Rules, 2004 and Amendments

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

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

3.2.7 The Embankment and Drainage Act 1952

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

107. 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.

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

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

109. 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.

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

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

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

3.2.10 Antiquities Act, 1968

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

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

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

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

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

(a) the Director, who shall also be its Chairman ;
(b) two members of the National Assembly of Pakistan, one being from each Province ; and
(c) three other persons having special knowledge of antiquities.

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

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

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

116. Dealing in antiquities.

(i) No person shall deal in antiquities except under and in accordance with a license granted by the Director.

(ii) Every dealer shall maintain a register in such manner and form as the Director may prescribe from time to time.

(iii) A license granted under sub-section (1) may be cancelled by the Director for the breach of any condition of the license.

(iv) The Director may, with a view to securing compliance with the provisions of this section.

a. require any person dealing in antiquities to give such information in his possession with respect to any business carried on by him as the Director may demand ;

b. inspect or cause to be inspected any book, register or other document belonging to or under the control or any person dealing in antiquities ; and

c. enter and search, or authorize any officer subordinate to him to enter and search, any premises and seize, or authorize any such officer, to seize, any antiquity in respect or which he has reason to believe that a breach or any condition or the license has been committed.

117. Prohibition of movement of antiquity.

(i) No person shall transport an antiquity from one place in Pakistan (present Bangladesh) to another with the object of exporting it in contravention of section 22.

(ii) Whoever contravenes the provisions of sub-section (1) shall be punishable with imprisonment for a term, which may extend to three months, or with fine, or with both.

(iii) The court trying an offence under sub-section (2) may direct that any antiquity in respect of which the offence has been committed shall be forfeited to the Central Government.

3.2.11 Bangladesh National Building Code, 2006

118. Part-7, Chapter -1 of the Bangladesh National Building Code (BNBC) clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety of the workmen. According to section 1.2.1 of chapter 1 of part 7, “In a construction or demolition work, the terms of contract between the owner and the contractor and between a consultant and the owner shall be clearly defined and put in writing. These however will not absolve the owner from any of his responsibilities under the various provisions of this Code and other applicable regulations and bye-laws. The terms of contract between the owner and the contractor will determine the responsibilities and liabilities of either party in the concerned matters, within the provisions of the relevant Acts and Codes (e.g.) the Employers' Liability Act, 1938, the Factories Act 1965, the Fatal Accident Act, 1955 and Workmen's Compensation Act 1923”. (After the introduction of the Bangladesh Labor Act, 2006, these Acts have been repealed).

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

120. Part-7, Chapter-3 of the Code has clarified the issue of safety of workmen during construction and with relation to this, set out the details about the different safety tools of

specified standard. In relation with the health hazards of the workers during construction, this chapter describes the nature of the different health hazards that normally occur in the site during construction and at the same time specifies the specific measures to be taken to prevent such health hazards. According to this chapter, exhaust ventilation, use of protective devices, medical checkups etc. are the measures to be taken by the particular employer to ensure a healthy workplace for the workers.

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

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

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

3.2.12 Standing Orders on Disaster, 2010

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

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

3.2.13 National Adaptation Programme of Action (NAPA)

126. In 2005, the Ministry of Environment and Forest (MoEF) prepared the National Adaptation Program of Action (NAPA) for Bangladesh. The basic approach for the NAPA preparation was in accordance with the sustainable development goals and objectives of the country where it has recognized the necessity of addressing climate change and environmental issues and natural resource management. The NAPA is the beginning of a long

journey to address adverse impacts of climate change including variability and extreme events and to promote sustainable development of the country. There are 15 adaptation strategies suggested to address adverse effects of climate change. Among the 15 adaptation strategies, the following strategies address the coastal region for reducing climate change induced vulnerability.

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

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

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

128. 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.

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

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

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

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

3.2.16 Constitutional Right of the Tribal Peoples Rights

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

3.2.17 Ethnic Minority Rights in PRSP 2005

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

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

3.2.18 Acquisition and Requisition of Immovable Property Ordinance, 1982

133. The principal legal instrument governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable Property Ordinance, 1982 (Ordinance II of 1982 with amendments up to 1994) and other land laws and administrative manuals relevant to land administration in Bangladesh. According to the Ordinance, whenever it appears to the GoB that any property in any locality is needed or is likely to be needed for any public purpose or in the public interest, the Government can acquire the land provided that the property is not used by the public for the purpose of religious worship, graveyard and cremation ground. The 1982 Ordinance requires that compensation be paid for (i) land and assets permanently acquired (including standing crops, trees, houses); and (ii) any other damages caused by such

acquisition. The Deputy Commissioner (DC) determines (a) market value of acquired assets on the date of notice of acquisition (based on the registered value of similar property bought and/or sold in the area over the preceding 12 months), and (b) 50% premium on the assessed value (other than crops) due to compulsory acquisition. The 1994 amendment made provisions for payment of crop compensation to tenant cultivators. Given that people devalue land during title transfer to minimize tax payment, compensation for land paid by DC including premium largely remains less than the actual market price.

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

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

- Avoid or minimize resettlement: The law only implicitly discourages unnecessary acquisition, as lands acquired for one purpose cannot be used for a different purpose. However, there is no mechanism to monitor if this condition is actually adhered to.
- Eligibility for compensation: The law stipulates compensation only for the persons who appear in the land administration records as the owners. It does not recognize the rights of those, such as squatters, who do not possess legal title to the lands they live in or make a living from.
- Compensation: The law provides compensation for lands and other objects built and grown on them (structures, trees and orchards, crops and any other developments like ponds, built amenities, etc.). No provisions are there to assess and restore lost income stream or income sources that acquisition causes to the affected persons, be they legal titleholders or others like squatters, tenants and employees of affected businesses.
- Compensation standards: Although the law stipulates 'market prices' of the acquired lands as the just compensation, the legal assessment method almost always results in prices that are far below the actual market prices4. Certain pricing standards, which are regarded as unrealistic are used to assess other losses like structures and various built amenities, trees, crops and the like.
- Relocation of households and other establishments: No legal obligation is there to relocate, or assist with relocation of, those whose homesteads have been acquired or

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

whose place of residence or livelihoods has been affected. Such persons/households, be they titleholders or squatters, are left on their own.

- Ensuring payment of compensation: Lands are legally acquired and handed over to the project execution agency as soon as the acquisition authority identifies the owners (or 'awardees'), by examining the records, and sends a legal notice advising them to claim the compensation (or 'awards'). It is the obligation of the affected landowners to prove, by producing an array of documents that the acquired lands legally belong to them. As gathering these documents is a long, expensive and cumbersome process, many landowners may remain unable to claim their awards[5].
- Socioeconomic rehabilitation: The law shows no concern whatsoever about the long-term socioeconomic changes the affected persons and households might undergo in the post-acquisition period. There is no provision in the law except compensation for ensure economic rehabilitation and social reintegration of the displaced persons.

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

137. 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.

3.2.19 Bangladesh Labour Act, 2006 (XLII of 2006)

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

- Serious bodily injury
- Condition of employment
- Payment of wages
- Stoppage of work
- Death benefit
- Prohibition of employment of children and adolescent
- Cleanliness
- Dust and fume
- Disposal of waste and effluents

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

- Drinking water
- Latrines and urinals
- First aid appliance
- Weekly hours

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

3.2.20 Bangladesh Water Act, 2013

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

141. As per this Act, all forms of water (e.g., surface water, ground water, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people. The private landowners will be able to use the surface water inside their property for all purposes in accordance with the Act. A worthwhile initiative is the requirement for permits/licenses for large scale water withdrawal by individuals and organizations beyond domestic use. Without prior permission issued by the Executive Committee, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor they will be allowed to build any structure that impede the natural flow of rivers and creeks.

3.2.21 National River Protection Commission Act 2013

142. The National River Protection Commission Act helps the government to 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.

143. 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 of 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.

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

3.2.22 The Constitution

145. 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."

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

3.2.23 Other Relevant Acts

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

Table 3.1: Laws and Acts

Act/Law/Ordinance	Brief Description of Laws and Acts	Responsible Agencies
The Vehicle Act (1927) and the Motor Vehicles Ordinance (1983)	Provides rules for exhaust emission, air and noise pollution and road and traffic safety	Road Authority
Rules for Removal of Wrecks and Obstructions in inland Navigable Water Ways (1973)	Rules for removal of wrecks and obstructions	BWTA
The Water Supply and Sanitation Act (1996)	Regulates the management and control of water supply and sanitation in urban areas.	MoLG, RD&C
The Protection and Conservation of Fish Act (1950)	Deals with the protection/conservation offishes in Government owned water bodies	DoF

3.3 International Treaties Signed by GoB

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

Table 3.2: Treaty or Convention and Responsible Agency

Treaty	Year	Brief Description of Treaty and Convention	Relevant Departments
Protection of birds (Paris)	1950	Protection of birds in wild state	DoE/DoF
Ramsar Convention	1971	Protection of wetlands	DoE/DoF
Protocol Waterfowl Habitat	1982	Amendment of Ramsar Convention to protect specific habitats for waterfowl	DoE/DoF
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural monuments	DoA
CITES convention	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	DoE/DoF
Bonn Convention	1979	Conservation of migratory species of wild animals	DoE/DoF
Prevention and Control of Occupational hazards	1974	Protect workers against occupational exposure to carcinogenic substances and agents	MoH
Occupational hazards due to air pollution, noise &vibration (Geneva)	1977	Protect workers against occupational hazards in the working environment	MoH
Occupational safety and health in working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	MoH
Occupational Health services	1985	To promote a safe and healthy working environment	MoH

Treaty	Year	Brief Description of Treaty and Convention	Relevant Departments
Convention on oil pollution damage (Brussels)	1969	Civil liability on oil pollution damage from ships	DoE/MoS
Civil liability on transport of dangerous goods (Geneva)	1989	Safe methods for transport of dangerous goods by road, railway and inland vessels	MoC
Safety in use of chemicals during work	1990	Occupational safety of use of chemicals in the work place	DoE
Convention on oil pollution	1990	Legal framework and preparedness for control of oil pollution	DoE/MoS
Vienna Convention	1985	Protection of the ozone layer	DoE
London Protocol	1990	Control of global emissions that deplete ozone layer	DoE
UN framework convention on climate change (Rio de Janeiro)	1992	Regulation of greenhouse gases emissions	DoE
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of bio-diversity, sustainable use of its components and access to genetic resources	DoE
International Convention on Climate Changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases	DoE
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

149. The environmental legislative basis for approval of the CEIP-1 project is the Environmental Conservation Act 1995 (ECA'95) and the Environmental Conservation Rules 1997 (ECR'97). DoE), under MoEF is the regulatory body responsible for enforcing the ECA'95 and ECR'97. According to the Rule 7 (1) of the Environmental Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every project, in consideration of their site and impact on the environment, will be classified into the four categories and they are: Category I (green), Category II (Orange-A), Category III (Orange B) and Category IV (Red). According to the categorization, all construction/reconstruction/expansion of flood control embankment/polder/dykes etc. falls under Red Category. Therefore, the CEIP-1 Project intervention in Polder 43/2C falls under the ‘Red’ category.

150. 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)

151. 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:

152. 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

153. Legislative bases for EIA in Bangladesh are the Environmental Conservation Act1995 (ECA'95) and the Environmental Conservation Rules 1997 (ECR'97).

154. Departmentof 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.

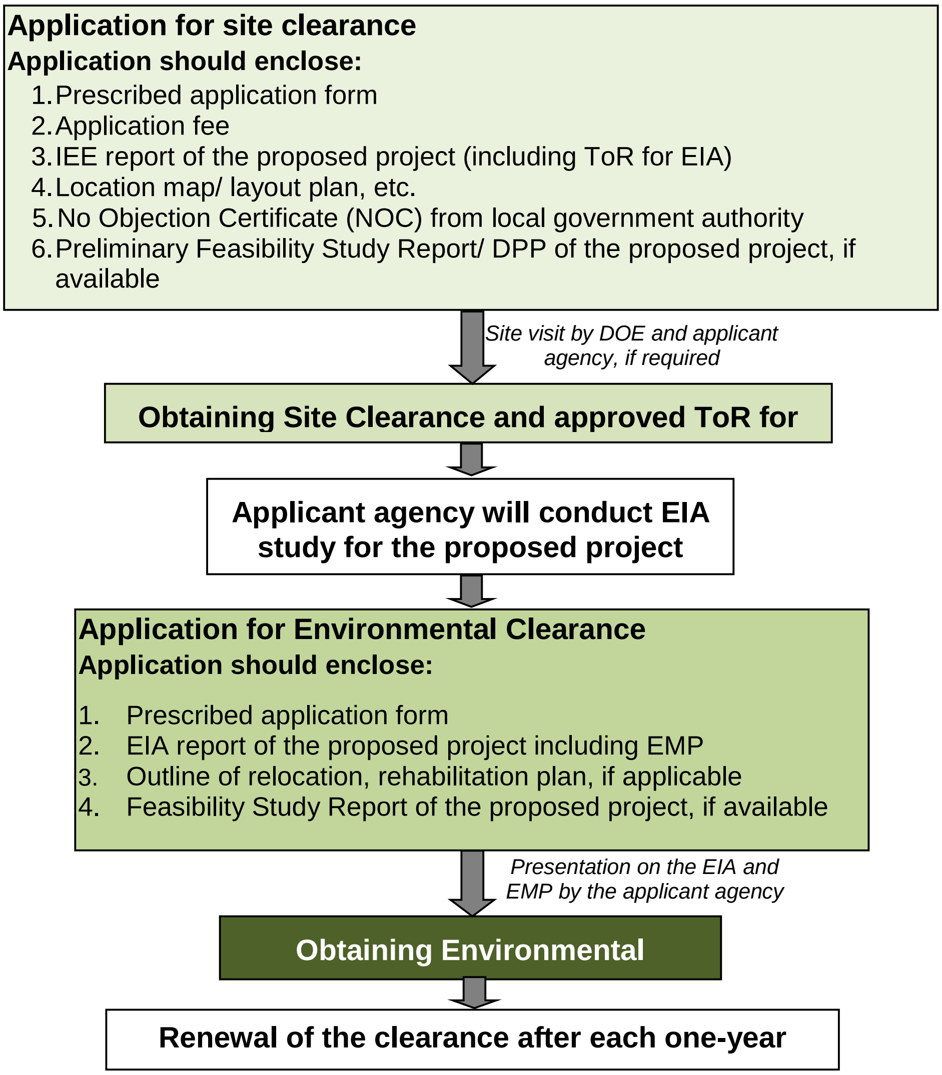


Figure 3.1: Process of obtaining Clearance certificate from DoE

3.6 World Bank's Environmental Safeguard Policies

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

3.6.1 Environmental Assessment (OP 4.01)

156. EA requirement. The World Bank requires environmental assessment (EA) of projects proposed for Bank support to ensure that they are environmentally sound and sustainable, and thus to improve decision making. The Bank Policy OP 4.01 considers that EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. EA takes into account the natural environment (air, water and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples and physical cultural resources); and trans-boundary and global environmental aspects. The Bank Policy also envisages that the borrower Government is responsible for carrying out the EA and the Bank advises the borrower on the Bank's EA requirements.

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

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

159. 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.

160. 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.

161. 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.

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

163. 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)

164. 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.

165. 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) to prevent any potential impacts of the Project on the nearby foreshore area.

3.6.3 Water Resources Management (OP 4.07)

166. 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.

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

3.6.4 Physical Cultural Resources (OP 4.11)

168. 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:

- 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.

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

3.6.5 Forestry (OP 4.36)

170. 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.

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

3.6.6 Projects on International Waterways (OP 7.50)

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

3.6.7 Pest Management (OP 4.09)

173. 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.

3.6.8 Indigenous Peoples (OP 4.10)

174. 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:

- self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;

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

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

176. 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.

177. 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.

3.6.9 Involuntary Resettlement (OP 4.12)

178. 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.

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

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

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

3.6.10 Projects in Disputed Areas (OP 7.60)

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

182. The Bank may proceed with a project in a disputed area if the governments' concerned authority agrees that, pending the settlement of the dispute, the project proposed for country A should go forward without prejudice to the claims of country B.[6]

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

3.6.11 Safety of Dams (OP 4.37)

184. 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.

3.6.12 Public Disclosure of Information (BP 17.50)

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

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

3.6.13 Environment, Health and Safety Guidelines

187. The Environment, Health, and Safety (EHS)[7] 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

188. The project interventions for Polder -43/2C fall under Category A, due to the complexity of environmental issues associated with project activities involving major civil works by reconstruction and rehabilitation of the coastal embankment to protect against tidal flooding and storm surges. Since the coastal area is of high ecological sensitivity and vulnerability, certain negative environmental impacts may occur during the implementation and operational phase on overall polder system. There may be localized impact on the natural habitats especially on the fish spawning site and protected areas, during the implementation of the civil works.

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

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

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

effect whatsoever on the upper riparian water usage or availability. Hence, International Waterways (OP 7.5) is not expected to be triggered.

4. Description of the Project

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

4.1 General

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

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

Coastal Embankment Project

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

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

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

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

The CEIP Initiative

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

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

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

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

200. The Polder- 43/2C is one of the polders to be rehabilitated under the CEIP-1.

4.2 Overviewof Polder-43/2C

201. The Polder 43/2C is located in Galachipa upazila under Patuakhali District of Bangladesh (Map. 4.1) and 47 km away from the Sundarbans. The administrative and management control lies with Patuakhali BWDB O&M Division under the southern zone. It covers only two unions namely Golkhali and Amkhola under Galachipa upazila. The polder is bounded by Golkhali river in the south and southwest; Sonakhali river in the west and northwest, Lohalia River in the east and north. It covers grossa gross area of 2,753 ha of which net cultivable area is 2,000 ha.

202. Polder 43/2C is a sub polder of the original Polder 43/2, which was constructed in 1960 under the Coastal Embankment Project (CEP). The construction of polder 43/2Cwas completed in the year of 1986-87 after starting in the year 1983-84. The original concept of the polderingwas to protect the agricultural lands from salinity intrusion and prevent tidal flooding from the Bay of Bengal and its surrounding rivers (Lohalia, Golkhali and Sonakhali).

4.3 Objective of the Project

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

4.4 Water Management Problems and Issues in Polder- 43/2C

204. Polder- 43/2C, like other polders in the coastal area of Bangladesh, was designed originally to protect the inner area against the highest tides, without much attention to storm surges. Many segments of the embankment have been damaged mainly for overtopping of cyclones and storm surges induced Sidr(2007) and Aila (2009). In many places, the riverside slope and berm along the bank of Lohalia River are severely affected and damaged by bank erosion and wave action while other portions of the embankment is now under-sectioned relative to the original section design and in a deteriorated condition. In addition, excessive rainfall, continuous weathering and lack of proper maintenance also caused subsidence of embankment and unstabledtheside slope. The entire length of the embankment therefore,needs to be re-sectioned as per CEIP design.

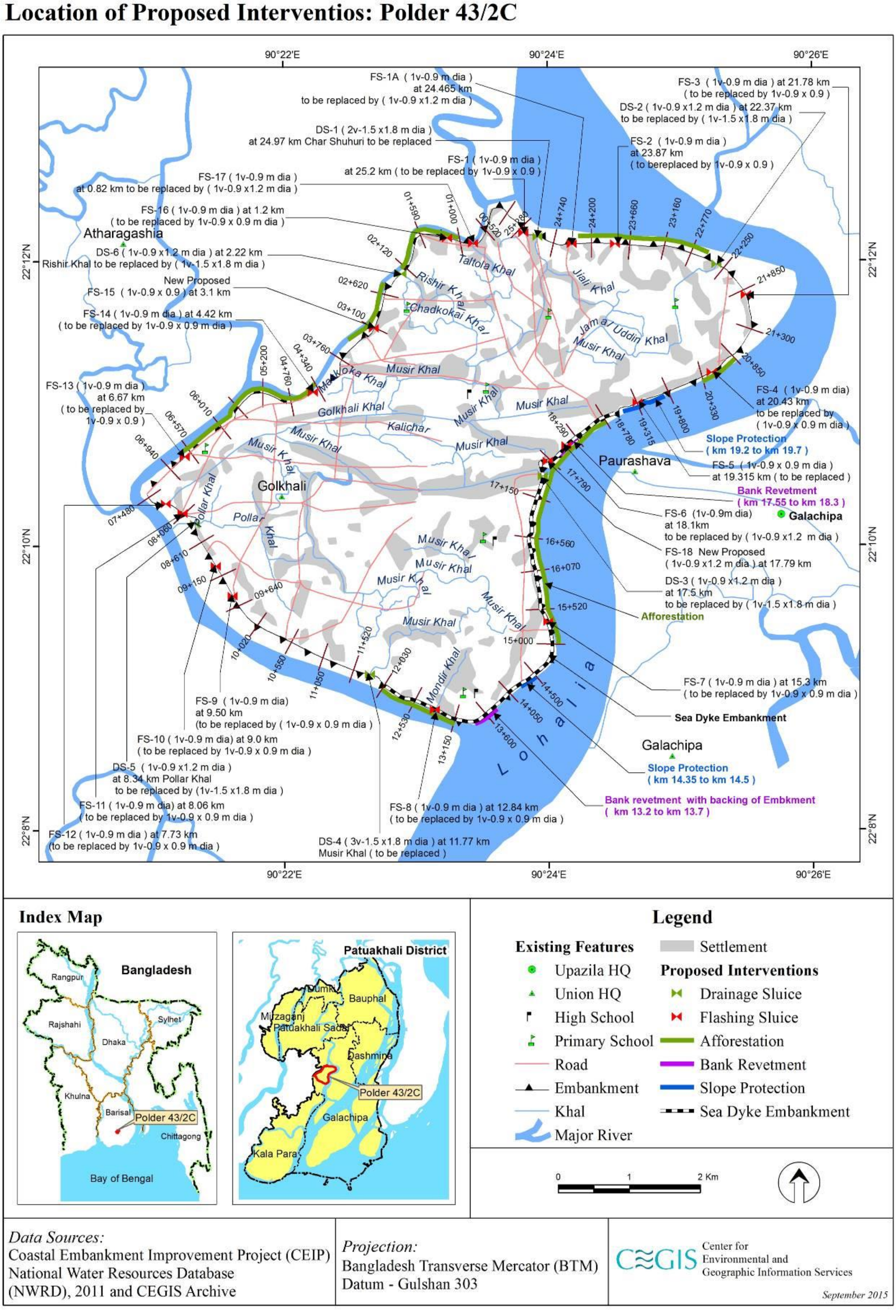
205. The elevation of most of the cultivable land inside the polder is between 1.21mPWD to 2.20 mPWD (Source: FinnMap). There are some low pockets where land elevation is less than 1.06 mPWD. Most of the paddy fields are submerged during monsoon and sometimes even in the dry season during high tide. Tidal water and runoff from consecutive rainfall remains stagnant at a depth of about 0.3m to 0.9m over the land during monsoon and delays the cultivation of T-Aman. Sometimes T. Aman seedlings are damaged due to drainage congestion. Besides, long term drainage congestion (8-10 days) causes health hazard tolocal inhabitants specially the children, due to increases water borne diseases, mosquitoes and venomous animal and insects.

206. The existing structures are in a dilapidated condition. The gates are not functioning properly and drainage as well as flushing of water take place without any proper control. The gates are corroded by saline water and concrete surfaces of the structures are in deplorable condition.At some places, the reinforcement is found to be exposed, which has been rusted. The loose apron on both C/S and R/S are either badly damaged or been washed away. Almost all structures are not in repairable condition, which needs to be replaced. Sedimentation is also a problem in the polder area. Bed level of most of the internal khals/channels have been raisedfrom sedimentation,whichhave reduced the conveyance capacities.The study team identified the following key water management problems and issues in Polder- 43/2C on the basis of opinions provided by the local people/stakeholders during the field investigation carried out in June 2015.

- Lack of regular repair and maintenance of water control structures and embankments;
- Inadequate allocation of budget and its inefficient use;
- Improper and unauthorized gate operation for fishing, shrimp/ prawn farming
- High rate of siltation in peripheral rivers specifically Lohalia river which hinders natural overland drainage;
- Inadequate plantation in the foreshore and lack of coastal green belt;
- Decrease carrying capacity of khals through illegal encroachment;
- Absence of land use zoning plan in union level; and
- Absence of functional community organizations for operation and co-management of the polder system.

207. Water related problems like drainage congestion, sedimentation in internal drainage channels, shortage of irrigation water during dry period and tidal flooding have severely increased in this area. As a result, the life and livelihood of polder's community have been disrupted. In this situation, re-sectioning of the entire embankment as per design (crest level) and replacement of hydraulic structures of Polder 43/2C under the CEIP-1, can improve the socio-economic condition as well as quality of life of the people.

208. An Index Map (Map 4.1) shows the alignment of the embankment, drainage sluice, drainage channels etc.



Map 4.1: Location of the existing embankment and structures of the Polder- 43/2C

4.5 Present Status of Water Management Infrastructures

209. There are some typical water management infrastructures such as peripheral embankments, drainage and flushing sluices, drainage khals etc. in Polder- 43/2Cto protect polder areas, including agricultural products, homesteads, orchards and other economically valuable areas and the people located within this polder. Based on field investigation carried out in June 2015, coupling with the information received from the DCSC, the study team gathered the following information regarding the status of existing infrastructure.

4.5.1 Embankments

210. Present status and required works for embankments of Polder- 43/2C are as follows:

211. The embankment reaches from Ch 0+000 km to Ch. 0+520 km, and Ch. 13+150 km to Ch. 25+25.53 km include sea-dykes. Thereafter, from Ch.0+520 km to Ch. 13+150 km are interior dykes. At present, the polder is directly vulnerable to cyclones and storm surges from the Bay of Bengal, which may enter through the large Lohalia estuary. Many segments of the embankment have been damaged for overtopping of surge during Sidr (2007) and Aila (2009).

212. During field investigation, three erosion hotspots have been found along the bank of Lohalia River. The riverside slope of embankments at Ch.14+350 km to Ch. 14+500km and Ch. 18+600 km to Ch. 19+700 km isbeing eroded due to severe wave action of the River Lohalia. A total length of 1,250 m of embankment of this reach need to be protected by providing slope protection works with CC block and thick afforestation in the foreshore area as per CEIP design.

Picture 4.1 Erosion at Ch 14.530 km to 14.50 km

Picture 4.2 : Erosion at Ch 18.60 km to 19.70 km

213. The embankment from Ch. 13+200 km to Ch. 14+000 km has been breached due to severe erosion of Lohalia River. Therefore, the embankment of this reach needs to be retired keeping sufficient set back (approximate 100 meters) distance with bank revetment/protective work.


Picture 4.3: Erosion at Ch 13.20 to Ch14.00

214. It is observed during field observation in June 2015, that almost 80% (20.58 km unpaved out of 25.53 km)of the peripheral embankment is unpaved, which hampers communication during wet season. Recently, around 3.35 km metal road from Gazipur Bazar to Julekhar Bazar has been constructed by RHD on BWDB embankment but the crest level of the metal road is lower than thedesigned crest level of CEIP-1.

Picture 4.4: Unpaved embankment cum road

Picture 4.5: RHD Road under construction on Embankment at Ch. 6.10 km to 7.78 km

215. From the status of existing embankment, it can be understood that the entire length of embankment shall be re-sectioned throughmechanical compaction as per newly designed crest level in consideration of wave surge, cyclone surge and climate change scenarios.

4.5.2 Water Control Structures

216. There are 7 numbers of Drainage Sluices and 16 numbers of Flushing Sluices in Polder- 43/2C. Physical condition of the structures is in poor condition due to lack of operation and maintenance. The concrete surface (barrel & pipe section) of the structures has deteriorated due to prolonged exposure to salinewater. A number of gates have been corroded and the loose aprons have been damaged as well. A few number ofsluices were found with no gates where people built wooden gate to control the flow. Furthermore, the structures are

mismanagedby the local communities. Local people opined that,most of the gates are operated based on the local peoplesdetermination rather than water management interest.

217. Most of the Drainage and Flushing structures are beyond repairable stage. To achieve long term benefit from the polder area, Drainage cum Flushing regulatorshave to be replaced. The present condition of the structures along with the required remedial measures is presented in Table 4.1 below; some photographs of these structures are provided in Pictures 4.6 to 4.15.

Table 4.1: Status of Existing Water Control Structures and Recommendations for Improvement

Sl.	Structure	Chainage	Type and size	Observations	Rehabilitation Needs
Drainage Sluice					
1	DS-1	Ch. 24+970	RCB (2V-1.5mX1.8m) (Char Shuhuri)	➢Constructed in 1985-86 ➢Loose aprons and vertical lift gates havedamaged ➢Sluice is under ventage.	Need to be replaced by 4V- 1.5m X 1.8m with provision for drainage and flushing.
2	DS-2	Ch. 22+375	RCB (1V-0.9mX1.2m) (Jamal Uddin Khal)	➢Constructed in 1985-86 ➢Loose aprons and railings have been damaged ➢Gates have collapsed and corroded ➢Sluice is under ventage.	Need to be replaced by 1V- 1.5m X 1.8m with provision for drainage and flushing.
3	DS-3	Ch. 17+500	RCB (1V-0.9mX1.2m) (Ghol Khali)	➢Constructed in 1985-86 ➢Loose apronsare damaged and concrete surface is in deplorable condition ➢Gate has collapsed and corroded ➢Sluice is under ventage and drainage congestion occurs.	Need to be replaced by 2V- 1.5m X 1.8m with provision for drainage and flushing.
4	DS-4	Ch. 11+770	RCB (3V-1.5mX1.8m) (Musir Khal)	➢Constructed in 1984-85 ➢Loose aprons have been damaged ➢Gate has been lost ➢Concrete surface is in deplorable condition	Need to be replaced by 3V- 1.5m X 1.8m with provision for drainage and flushing.
5	DS-5	Ch. 8+340	RCB (1V-0.9mX1.2m) (Pollar Khal)	➢Constructed in 1984-85 ➢Loose aprons have been damaged ➢Gates havecollapsed and corroded ➢Sluice in dilapidated condition. ➢Drainage congestion occurs.	Need to be replaced by 1V- 1.5m X 1.8m with provision for drainage and flushing.
6	DS-6	Ch. 2+220	RCB (1V-0.9mX1.2m) (Rishir khal)	➢Constructed in 1985-86 ➢Loose aprons and railing have been damaged	Need to be replaced by 1V- 1.5m X 1.8m with provision for drainage and flushing.

Sl.	Structure	Chainage	Type and size	Observations	Rehabilitation Needs
				➢Gate has collapsed and corroded ➢Sluice in dilapidated condition. ➢Sluice is under vantage and drainage congestion takes place.	
7	DS-7	Ch. 0+820	RCP (1V-0.9 dia) (Taltola khal)	➢Constructed in 1990. ➢Loose aprons and railing have been damaged ➢Gate has been collapsed and corroded ➢Sluice is under ventage and drainage congestion occurs.	Need to be replaced by 1V- 1.5m X 1.8m with provision for drainage and flushing.
Flushing Sluice					
1	F/S - 1	Ch. 25+200	RCP (1V – 0.9 m dia)	➢Pipe , railing and loose aprons have damaged ➢Gate has been corroded and gear box is missing.	Need to be replaced by RCB 1V- 0.9m X 1.2m
2	F/S – 1A	Ch. 24+465	RCP (1V – 0.9 m dia)	➢Pipe and loose aprons have been damaged ➢The structure is in deplorable condition	Need to be replaced by RCB 1V- 1.5m X 1.8m
3	F/S - 2	Ch. 23+870	RCP (1V – 0.9 m dia)	➢Constructed in 1990 ➢Loose aprons have damaged ➢Gate and gear box is missing ➢Sluice is in dilapidated condition.	Need to be replaced by RCB 1V- 0.9m X 1.2m
4	F/S - 3	Ch. 21+780	RCP (1V – 0.9 m dia)	➢Constructed in 1990 ➢Loose aprons have been damaged ➢Gate and gear box is missing	Need to be replaced by RCB 1V- 0.9m X 1.2m with provision for drainage and flushing.
5	F/S - 4	Ch. 20+430	RCP (1V – 0.9 m dia)	➢The structure is fully damaged.	Structure not needed anymore
6	F/S - 5	Ch. 19+315	RCB (1V-0.9m X 0.9m)	➢Loose apron has damaged ➢Gate has been corroded and gear box is missing ➢Sluice in dilapidated condition.	Structure is not needed
7	F/S - 6	Ch. 18+100	RCP (1V – 0.9 m dia)	➢Loose aprons havedamaged ➢Gate has been corroded	Structure is not needed
8	F/S - 7	Ch. 15+300	RCP (1V – 0.6 m dia)	➢Constructed in 1990 ➢Loose apron and gate has been damaged ➢Sluice in dilapidated condition.	Need to be replaced by RCB 1V- 0.9m X 1.2m with provision for drainage and flushing.
9	F/S - 8	Ch. 12+840	RCP (1V – 0.9 m dia)	➢Constructed in 1990 ➢Gate has corroded and damaged ➢C/S bed level is higher than the R/S due to siltation.	Need to be replaced by RCB 1V- 0.9m X 1.2m with provision for drainage and flushing.

Sl.	Structure	Chainage	Type and size	Observations	Rehabilitation Needs
10	F/S - 9	Ch. 9+500	RCP (1V – 0.9 m dia)	➢Constructed in 1990 ➢Loose aprons and gate havedamaged and corroded ➢The structure is in deplorable condition and the diversion channel have been silted up	Need to be replaced by RCB 1V- 0.9m X 1.2m with provision for drainage and flushing.
11	F/S - 10	Ch. 9+000	RCP (1V – 0.9 m dia)	➢Pipe and loose apron have been damaged. ➢The gate has corroded and collapsed ➢Gear box is missing.	Need to be replaced by RCB 1V- 0.9m X 1.2m
12	F/S - 11	Ch. 8+060	RCP (1V – 0.9 m dia)	➢Pipe and loose apron have been damaged. ➢Gate and gear box has been missing ➢Diversion channel has been silted up	Need to be replaced by RCB 1V- 0.9m X 1.2m
13	F/S - 12	Ch. 7+730	RCP (1V – 0.9 m dia)	➢Loose aprons have been damaged. ➢Diversion channel has been filled up with bushes and debris. ➢Gate and gear box has been missing	Need to be replaced by RCB 1V- 0.9m X 1.2m
14	F/S - 13	Ch. 6+670	RCP (1V – 0.6 m dia)	➢The structure is in deplorable condition.	Need to be replaced by RCB 1V- 0.9m X 1.2m
15	F/S - 14	Ch. 4+420	RCP (1V – 0.6 m dia)	➢The structure is damaged.	Need to be replaced by RCB 1V- 0.9m X 1.2m
16	F/S -15	Ch. 3+100	RCP (1V – 0.6 m dia)	➢There is no structure at this location but farmers are demanding winter irrigation facilities to cultivate Rabi/Boro crops.	Need to construct a new RCB 1V- 0.9m X 1.2m
17	FS - 16	Ch. 1+200	RCP (1V – 0.9 m dia)	➢The structure is damaged.	Need to be replaced by RCB 1V- 0.9m X 1.2m

Source: Design Team of CEIP-1

Picture 4.6: DS-3 (1V-0.9m X 1.2m) Sluice at WAPDA Boderhut on Golkhali khal (Ch. 17.50 km)

Picture4.7: DS-4 (3V-1.5m X 1.8m) Sluice at Purbo Golkhali on Musir khal (Ch. 11.77 km)

Picture4.8: DS-5 (1V-0.9m X 1.2m) Sluice at Alir Bazar on Pollar Khal (Ch. 8.34 km)

Picture4.9: DS-2 (1V-0.9m X 1.2m) Sluice at Jamal uddin khal (Ch. 22.375 km)

Picture4.10: FS-1 (1V-0.9m dia) Flushing Sluice at Char Shuhari on Shuhari Khal (Ch. 25.20 km)

Picture4.11: FS-11 (1V-0.9m dia) Flushing Sluice at Golkhali (Ch. 8.06 km)

Picture4.12: FS-8 (1V-0.9m dia) Flushing Sluice at Ch. 12.84 km

Picture 4.13: River bank erosion at Ch. 14.35 km to 14.5 km

Picture 4.14: Worst embankment at Ch. 13.20 km to 14.0 km

Picture 4.15: River bank erosion at Ch. 19.20 km to 19.70 km

4.6 Proposed Rehabilitation/Improvement Activities in Polder43/2C

218. The proposed interventions in Polder- 43/2C under CEIP-1 are listed in Table 4.2. It is mentionable thatdrainage 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. Map 4.2 below and are been detailed in the following sections:

Table 4.2: Proposed Interventions in Polder-43/2C

Sl.	Type of Works	Specification
1	Re-sectioning of embankment	25.53 km
	Design crest level of embankment	5.50 m, PWD (sea-dyke) and 5.00 m, PWD (interior dyke)
2	Retirement of Embankment	874 m
3	Bank protection works	500 m
4	Slope protection of embankment	261 m
5	Construction (Replacement) of Drainage Sluice	8 nos.
7	Construction (Replacement) of Flushing Sluice	14 nos.
8	Demolish of Flushing Sluice	3 nos.
9	Re excavation of drainage channel	24.55 km
10	Afforestation on the foreshore and embankment slope areas	13.43 ha

Source: CEIP-1 Design Team, 2015

4.6.1 Works on Embankments

219. A total of 25.53 km of embankments will be re-sectioned and their height will be increased as per design. The side slopes of the embankment will also be rehabilitated. Besides, 874 m of the embankment will be retired as per the same crest level and sides slope. Table 4.3 shows detail information on the works to be carried out on the embankment. Additional emphasis will be given during re-sectioning of the embankment. Crest level and R/S side slope of the sea dyke have been redesigned as 5.50 mPWD and 1:5 respectively, which are higher than the other portion of embankment.

Table 4.3: Detail of Works on Embankments

SL no	Description	Chainage (km)	Proposed crest level mPWD	Side slope	Length
1	Re-sectioning of embankment	0.00 to 0.50	5.00	R/S 1:5 and C/S 1:2	0.52 km
		0.50 to 13.0	5.00	R/S 1:3 and C/S 1:2	12.63 km
		13.00 to 25.15	5.50	R/S 1:5 and C/S 1:2	12.38 km
2	Retirement of Embankment	12.876 to 13.173	5.00	R/S 1:3 and C/S 1:2	0.297 km
		and 13.338 to 13.915	5.50	R/S 1:5 and C/S 1:2	0.577 km

Source: CEIP-1 DCSC Design Team, 2015

Description of construction activities

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

221. The earth will be placed in layers of 150 mm thickness with soil (minimum 30 percent clay, 0-40 percent silt, 0-30 percent sand) compacted mechanically to attain 85 to 90 percent of maximum dry density at optimum moisture content to avoid air pocket.

222. Before the commencement of construction activities for embankment works, labor sheds will be constructed with proper sanitation and other essential facilities. A suitable site shall be selected and prepared by cleaning bushes, weeds, and trees for this purpose. Alignment of embankments will be fixed with adequate base width. Base stripping and removal of trees and weed will be carried out as per instruction of the Engineer in charge. The tools required for 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 in layers. At the same time, each layer (of 1.5 feet) of dumped soil will be compacted mechanically by a compacting machine. The sloping and shaping of embankment will be developed after proper compaction of layers. The side slopes will then be turfed with grass and proper watering will be provided.

4.6.2 Construction (Replacing and new) of Drainage Sluices

223. A total number of seven (7) existing Drainage Sluices will be replaced under the proposed rehabilitation works of Polder- 43/2C. Furthermore, one (1) new drainage cum Flushing Sluice will be constructed at Ch. 17+870 km. The summary of design information of the proposed works in these drainage sluices is given in Table 4.4.

Table 4.4: Detail of Works in Drainage Sluices

Sl.	Name of drainage sluices	Chainage (at km)	Khal Name	Name of outfall river/Khal	Lowest Tide level (mPWD)	Lowest elevation of basin (mPWD)	Existing Sill Level (mPWD)	Proposed Sill level (mPWD)	Remarks
01	DS-7 (1v-1.5m x 1.8m)	0.80	Taltola khal	Sona khal	-1.040	0.71	0.085	-0.20	Replacement of structure is proposed
02	DS-6 (1v-1.5m x 1.8m)	2.22	Rishir Khal	Sona khal	-1.040	0.71	-0.242	-0.20	Replacement of structure is proposed
03	DS-5 (1v-1.5m x 1.8m)	8.34	Pollar Khal	GolkhaliKhal	-1.152	0.71	0.047	-0.20	Replacement of structure is proposed
04	DS-4 (3v-1.5m x 1.8m)	11.81	Musir khal	GolkhaliKhal	-1.152	0.71	-1.485	-0.20	Replacement of structure is proposed
05	DS-3 (1v-1.5m x 1.8m)	18.02	Musir khal	Lohalia River	-1.040	0.71	-0.150	-0.20	Replacement of structure is proposed
06	DS-8 (2v-1.5m x 1.8m) (Proposed)	17.87	Chotogabua khal	Lohalia River	-1.040	0.71		-0.20	New structure is proposed
07	DS-2 (1v-1.5m x 1.8m)	22.30	Jamal uddin Khal	Lohalia River	-0.983	0.71	-0.602	-0.20	Replacement of structure is proposed
08	DS-1 (2v-1.5m x 1.8m)	25.01	Char Shurhuri Khal	Lohalia River	-0.983	0.71	-1.890	-0.20	Replacement of structure is proposed

Source: CEIP-1 Design Team, 2015

Description of Drainage Sluice construction activities

224. During pre-construction activities for construction of Drainage Sluices i.e. construction of labor shed, development of sanitation safe drinking water and other facilities. will be done. During this period, required construction materials (sand, cement, wood, shuttering materials etc.) will be procured by the contractor as per tender schedule. Meanwhile, a suitable site will be selected and prepared for construction of the sluices. Before starting the construction of Drainage Sluices, ring bundhs and diversion channels will 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 (replacing and new) of Flushing Sluices

225. A total number of 14Flushing Inlets will be replaced under the proposed project in Polder-43/2C. Besides, one (1) Flushing Sluice will be newly constructed and three old Flushing Sluices will be demolished. Previously, Most of the Flushing Sluices were constructed as Reinforced Concrete Pipe (RCP) sluices with 0.9 m to 0.6 m diameter, which are presently in poor condition and need to be replaced by Reinforced Concrete Box (RCB) (1v-0.9mx1.2m) structures, with provisions for both flushing and drainage. The number of flushing sluices can be reduced by demolishing 3 pipe-sluices, which are not presently being used. Details information of flushing sluices are given in Table 4.5.

Table 4.5: Detail of Works in Flushing Sluices

Sl.	Structure	Chainage	Type and size	Proposed work
1	F/S - 1	Ch. 25+180	RCP (1V – 0.9 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
2	F/S-1A	Ch. 24+500	RCP (1V – 0.9 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
3	F/S - 2	Ch. 23+850	RCP (1V – 0.9 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
4	F/S - 3	Ch. 21+780	RCP (1V – 0.9 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
5	F/S - 4	Ch. 20+430	RCP (1V – 0.9 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
	F/S-18	Ch.		
6	F/S - 7	Ch. 15+300	RCP (1V – 0.6 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
7	F/S - 8	Ch. 12+840	RCP (1V – 0.9 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
8	F/S - 9	Ch. 9+500	RCP (1V – 0.9 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
9	F/S - 10	Ch. 9+000	RCP (1V – 0.9 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
10	F/S - 12	Ch. 7+730	RCP (1V – 0.9 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
11	F/S - 13	Ch. 6+670	RCP (1V – 0.6 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed

Sl.	Structure	Chainage	Type and size	Proposed work
12	F/S - 14	Ch. 4+420	RCP (1V – 0.6 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
13	F/S -15	Ch. 3+100	RCP (1V – 0.6 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed
14	-	Ch. 1+800	-	Newly proposed(1V- 0.9m X 1.2m)
15	FS - 16	Ch. 1+200	RCP (1V – 0.9 m dia)	Replacement of structure by RCB 1V- 0.9m X 1.2m is proposed

Source: CEIP-1 Design Team, 2015

Description of Flushing Sluice construction activities

226. Before starting the construction activities of Flushing Sluices, a labor shed will be constructed with proper sanitation and other facilities. The required construction materials (sand, cement, wood, shuttering materials etc.) will be procured simultaneously. A suitable site for the structure will then be selected and prepared accordingly. 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 in the upstream 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 channel the flow through the flushing gates.

4.6.4 Re-excavation of Drainage Channels

227. A total of 24.55 km length of drainage channels from seven (07) khalsof the polder will be re-excavated to continue water flow and decrease the drainage congestion (Table 4.7). An estimated volume of 0.0296 million cubic meters of soil/silt will be excavated. The excavated soil will be used for strengthening the *khal* banks. Local people may be encouraged to take earth from the spoils, as well. The spoil may be used for raising the plinth level of their earthen kacha houses as well as individual house yards. If the excavated materials are found suitable, the Contractor can use the materials for construction of embankments upon prior approval by the DCSC. The water channels to be re-excavated under the project are listed in Table 4.6. Figure 4.1 show the conceptual layouts of proposed dumping technique. Compartmental dumping spots will be created along the sides of the excavated khals, allowing any runoff from de-watering of the spoils and from precipitation to drain into the excavated khals.

Table 4.6: Channels (khals) to be Re-excavated

Sl.	Khal Name	Length (Km)
1	Golkhali khal	5.25
2	Jamaluddin	3.95
3	Musir khal	8.50
4	Pollar khal	2.50
5	Rishir khal-1	1.50
6	Suhuri khal	0.30
7	Taltola khal	2.55
	Total	**24.55**

Source: CEIP-1 DCSCDesign Team, 2015

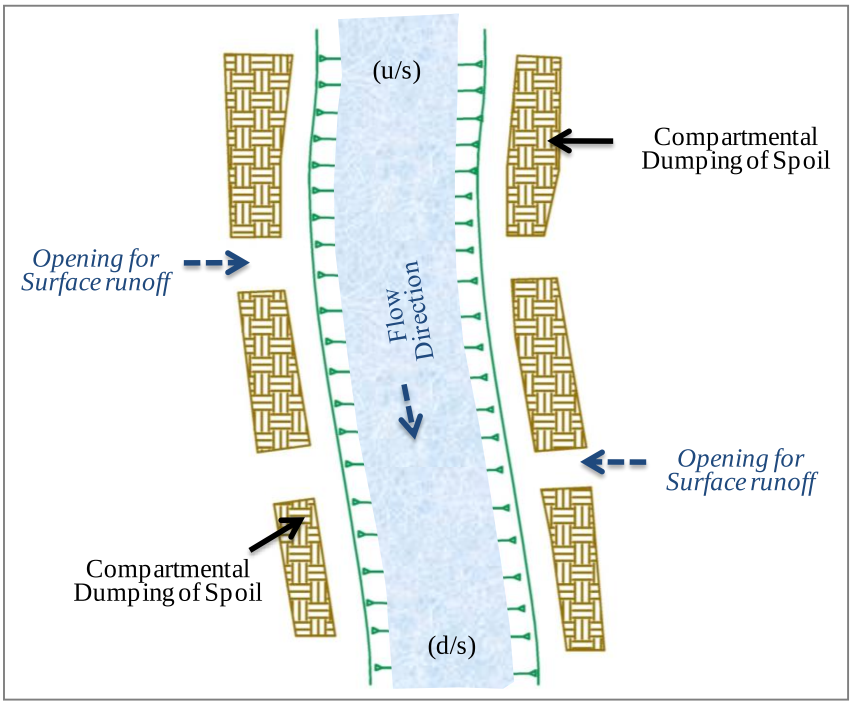


Figure 4.1: Plan form of a typical khal to be re-excavated

Description of construction activities

228. For re-excavation of the drainage channels, the required tools will have to be procured at first. A schematic diagram showing the centreline and layout plan will be made for the re-excavation and the design depth and width of excavation will be noted. The entire channel will be divided into a number of reaches. The excavation will be started from the upstream of the channel. Cross dams will be built in the reach, and soil will be removed from the channels up to the required depth and width..The plan for the excavation will have to be approved by the DCSC before excavation starts. Both manually and mechanically (excavator) methods will be used for excavation of drainage khals. No dredging operation will be carried to removal of sedimentation from the khals. The excavated soil/sludge will be disposed into the approved disposal sites. After completing excavation of one reach, the next reach downstream would be excavated using the same procedures.

4.6.5 Bank Protection and Slope Protection Works

229. Bank protection for a total length of 500 m works will be carried out from chainage 13.42 km to 13.92 km under Polder 43/2C. In addition, a total of 261 m slope protection of embankment along the Lohalia River will be carried out from chainage 19.46 km to 19.553, 19.68 km to 19.77 km and 19.885 km to 19.963 km (Refer Map 4.2).

Description of construction activities

230. The construction activities involved in the bank protection and slope protection works are: the construction of labor shed, installation of tube well, creation of sanitation facility and procurement of construction materials (sand, cement, wood, shuttering materials etc.). The slope of the river bank as per design will be developed 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 construction of CC blocks, Geo-textile bags will be placed along the slope and CC blocks will be placed on it. A launching apron will be prepared with CC blocks along with dumping of CC blocks in assorted form completed up to the toe of the river banks. Finally,

turfing will be done on the slope or crest of the embankment. Proper drainage provision will be kept to avoid formation of rain cuts due to surface run off.

4.6.6 Afforestation

231. Foreshore and embankment slope afforestation is proposed under the interventions. The areas selected for afforestation in Polder- 43/2C are shown in detail in Map 4.2. A total of 71,218 nos of trees will need to be cut from the RoW (Source RAP Report). About 8.40 ha slope area is available along 25.7 km of 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 5.03 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).

232. 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.

233. 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 *Tamarindusindica*(Tatul) &*Acacia nilotica* (Babla) at a spacing of 2M (6 ft) apart. The upper row will be at a distance of 6 to 8 feet i.e. 2 to 3M from the lower row. The upper row will be planted with *Borassus flabellifer* (Tal), *Cocos nuciferal* (Narikal) and *Phoenix sylvestris* (Khajur) at a spacing of 2 M (6 feet) apart, but staggered with the lower row plants. The *Tamarindus indica* (Tatul) and *Acacia nilotica* (Babla) seedlings will be raised in 10” X 6” poly bags. Before plantation, a temporary nursery will be established in the polder area to ensure the availability of seedlings. Nursery costing has been shown separately in Feasibility Report. The *Borasus flabellifer* (Tal), *Cocos nuciferal* (Narikal) and *Phoenix sylvestris* (Khajur) seedlings will be purchased from nurseries. Planting of 2,500 seedlings will make one hectare Plantation. An estimated, a total of 21,000 nos of saplings will be planted along the 8.40 ha area of embankment slope.

234. The available foreshore area of the polder will be planted with suitable mangrove species. Keora (*Sonneratia apetala*), Baen (*Avicennia officinalis*), Chaila/Ora *(Sonneratia caseolaris*), Kankra (*Bruguiera gymnorhiza*), Gewa (*Excoecaria agallocha*), Bhola (*Hibiscus tiliaceous*) and Golpata (*Nypa fruticans*) has been selected as the suitable species for this polder. Average distance between two saplings will be 1.5 m. accordingly; more than 22,300 mangrove saplings will be planted in 5.03 ha of available foreshore area.

235. In addition, another afforestation program to be included in the Polder for sustenance of green environment of the Polder and restoration of proper eco-balance. It is observed that, in total 71,218 nos. of trees to be felled in Polder 43/2C, which will require plantation of total 213,654 (71,218 x 3) trees in the area, according to practice of DoE (according to DoE, 3 plants to be planted for 1 tree felled). Since, 21,000 saplings will be planted in 8.40 ha of embankment slope and 22,300 mangrove plants at 5.03 ha of foreshore area and the remaining 170,354 (213,654-21,000-22,300) nos. saplings to be distributed among the local inhabitants to be planted at suitable locations identified by the community members (for this purpose, the required cost is included in cost of estimates for environmental Management and Monitoring in Table 10.5).

Table 4.7: Detail works of afforestation in slope and foreshore

Sl	Description	Chainage (km)	Length (km)	Total Afforested area (ha)
1	Slope Plantation	-	33.81s	8.40
2	Foreshore Afforestation including Golpata Plantation	Chainage from 01.00 km to 02.00 km , 02.50 km to 03.50 km , 04.50 km to 06.50 km , 12.00 km to 13.00 km , 15.00 Km to 17.00 km , 18.00 km to 18.50 km , 20.00 km to 20.50 km , 22.50 km to 24.50 km.	10.00	5.03
	Total Area (ha)			**13.43**

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

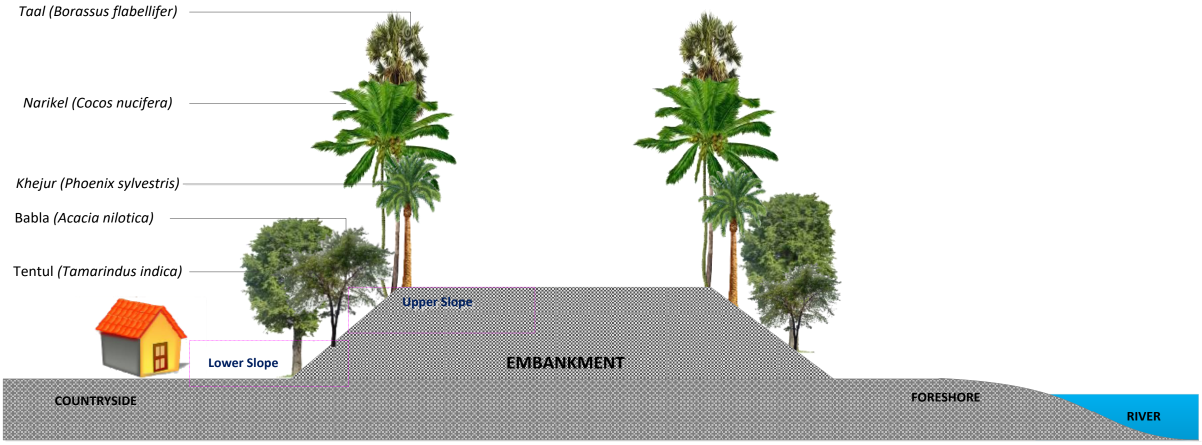


Figure 4.2: Typical cross section of Embankment slope and Foreshore Afforestation

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

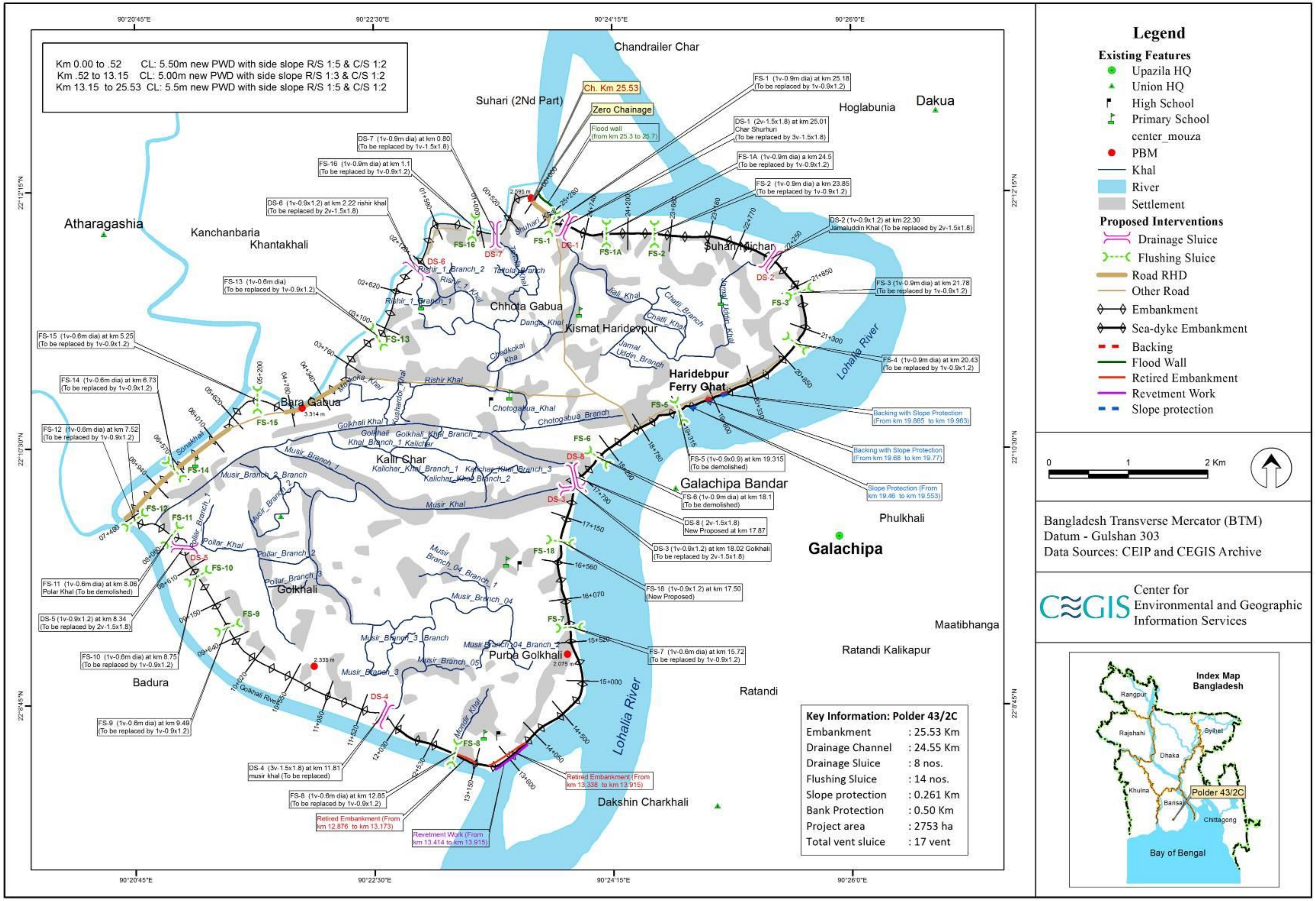
237. Detail Plantation establishment Matrix is presented in following Table:

Table 4.8: Detail Information on Plantation Program

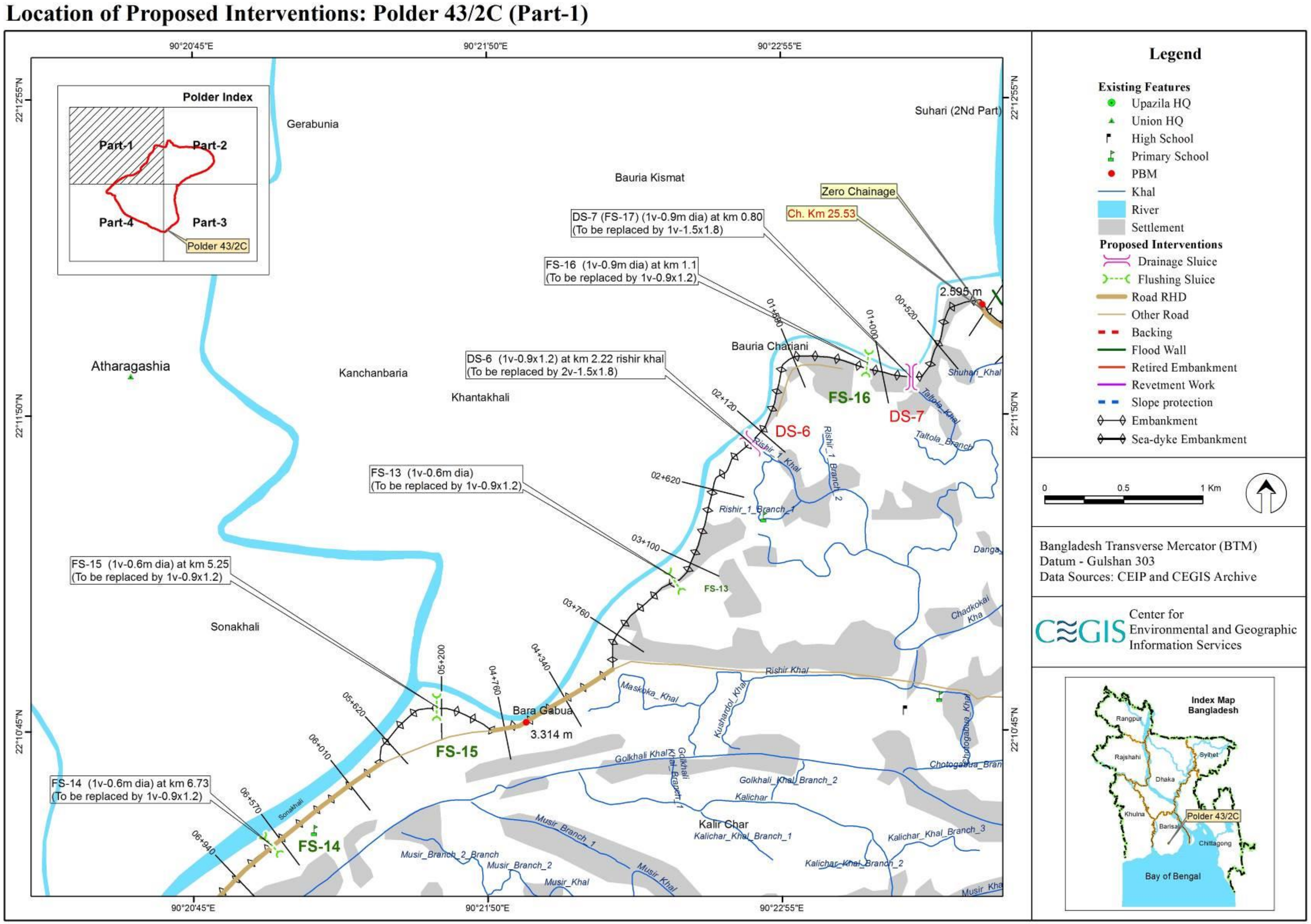
Item of works	Timescheduleforthegiventype					
	Golpata (Nypa) Plantation	**Chailla, Kankra, Gewa Plantation**	**Keora Baen Plantation**	**Embankment Slope Plantation.**	**Additional Plantatation**	**Additional Plantatation**
Selection of site, survey the site and prepare plantation site map.	March	January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

Item of works	Timeschedulefor thegiventype					
	Golpata (Nypa) Plantation	Chailla, Kankra, Gewa Plantation	Keora Baen Plantation	Embankment Slope Plantation.	Additional Plantatation	Additional Plantatation
Second weeding	November 1st week	June 3rd week	June 1st week. 1st year.	July 1st week, 1st year, to be done by the watcher free of charges.		
Third weeding	May 1st week next year	July 2nd week	June 4th week. 1st year.	May 1st week, 2nd year, to be done by the watcher free of charges.		
Fourth weeding	n.a.	August 4th week.	May 1st week. 2nd year.	August 1st week, 2nd year, to be done by the watcher free of charges.		
Sapling Distribution	-	-	-		July, last week	July, last week
Fifth weeding with light pruning if necessary.	n. a.	April 1st week next year.	October 1st week. 2nd year.	n. a.		
Sixth weeding (Climber cutting)	n. a.	June 1st week next year.	n. a.	n. a.		
Seventh weeding (Climber cutting)	n. a.	August 1st week. Next year.	n. a.	n. a.		
Pruning.	n. a.	n. a.	n. a.	n. a.		
Watching	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.		

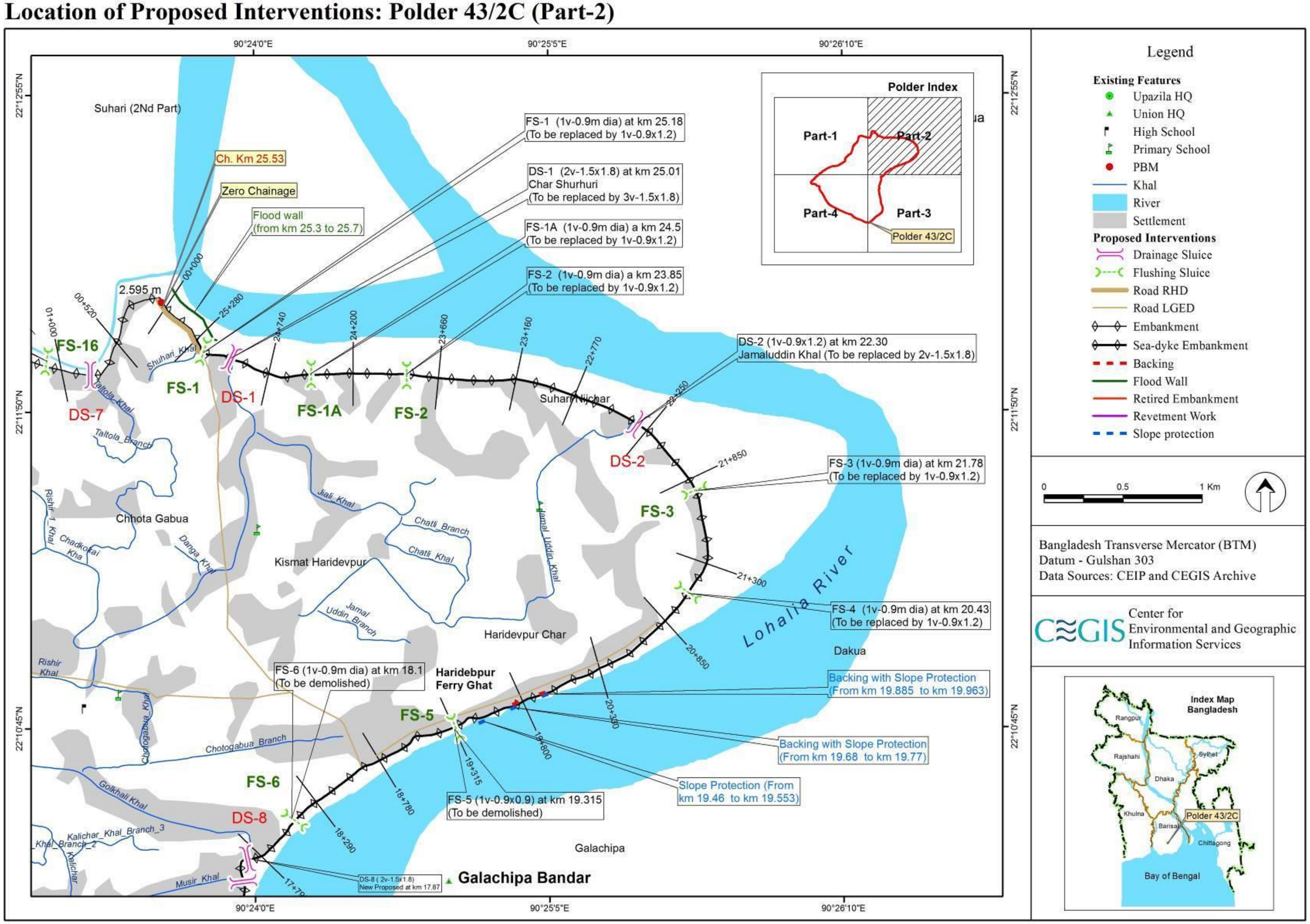
Source: Feasibility Report of CEIP, Volume III: Afforestation Report, September 2013



Map 4.2: Location of Proposed Interventions in Polder- 43/2C

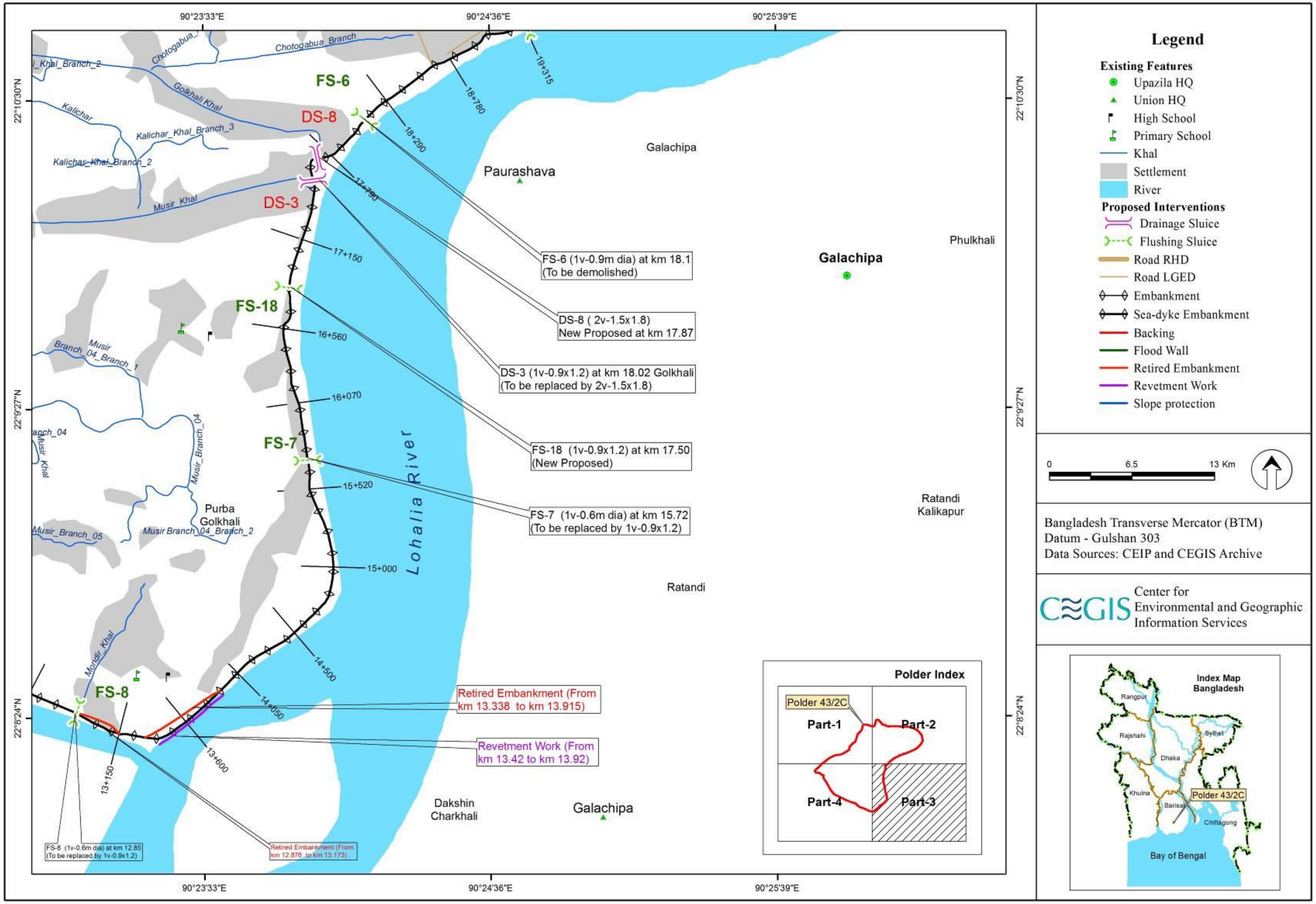


Map 4.2 (Part 1): Location of Proposed Interventions in Polder- 43/2C

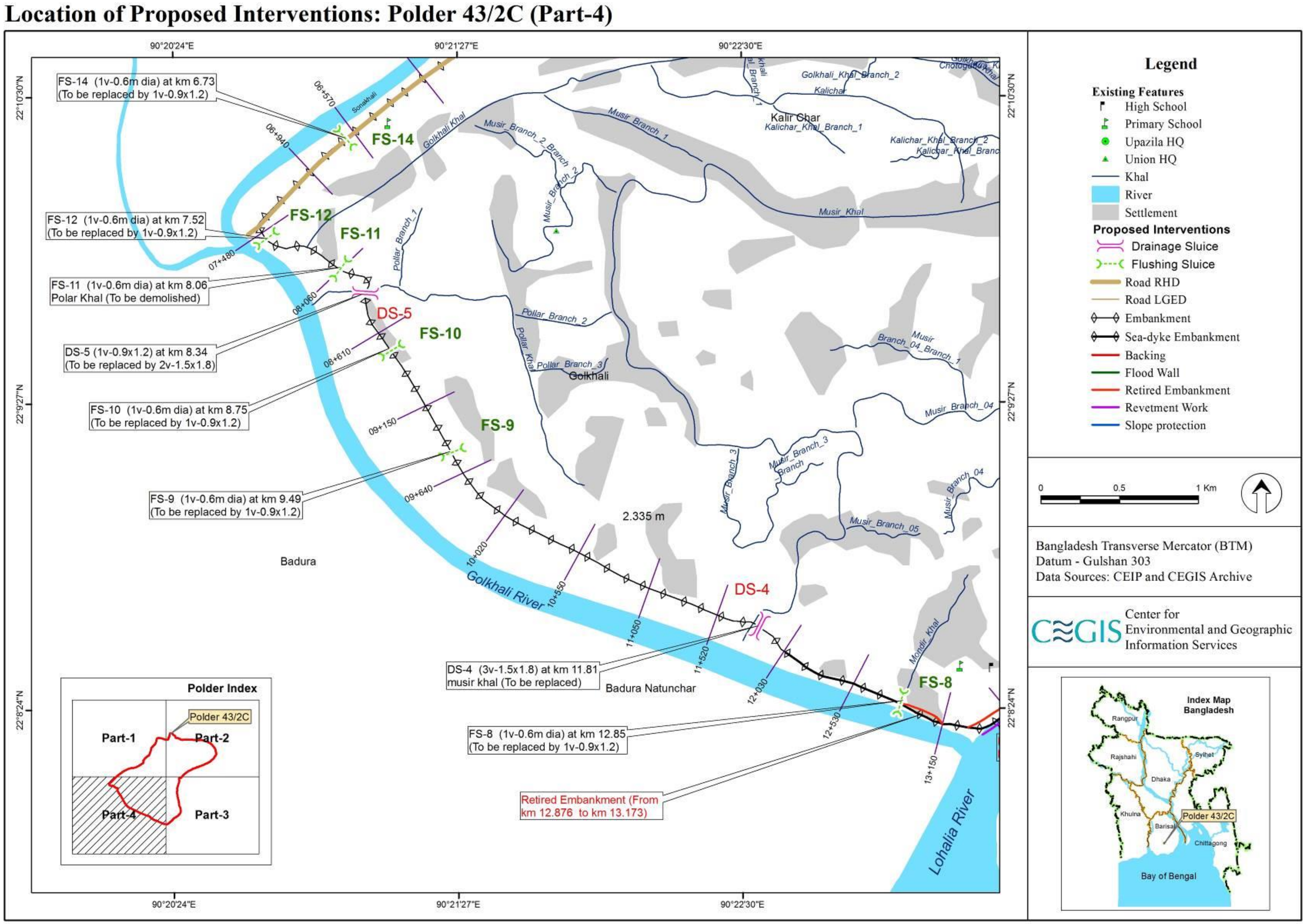


Map 4.2 (Part 2): Location of Proposed Interventions in Polder- 43/2C

Location of Proposed Interventions: Polder 43/2C (Part-3)



Map 4.2 (Part 3): Location of Proposed Interventions in Polder- 43/2C



Map 4.2 (Part 4): Location of Proposed Interventions in Polder- 43/2C

4.7 DCSCConstruction Details

4.7.1 Construction Schedule

238. The rehabilitation of Polder-43/2C 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

239. Technical and nontechnical manpower will be required for the construction works. They will include engineers, technicians, supervisors, surveyors, mechanics, foremen, machinery operators, drivers, EMP monitoring specialist and un-skilled labor. Around 60 to 70 percent of labor will be engaged from the local area and remaining will be from outside. The estimated manpower requirement is presented in Table 4.10.

Table 4.10: Required Manpower for Construction Works

Sl	Required Manpower	Number
1	Engineer	1
2	Machinery Operators	20
3	Mechanics	1
4	Surveyor	1
5	Skilled labour	2000
6	Unskilled labour	20000

Source: Engineering Team of CEIP-1, 2015

4.7.3 Construction Material

240. The construction materials required for re-sectioning and retired embankment, water control structures and flushing sluices, and bank protection work will include oil, cement, steel, brick and sand. Estimated quantities of these materials are presented in Table 4.11.

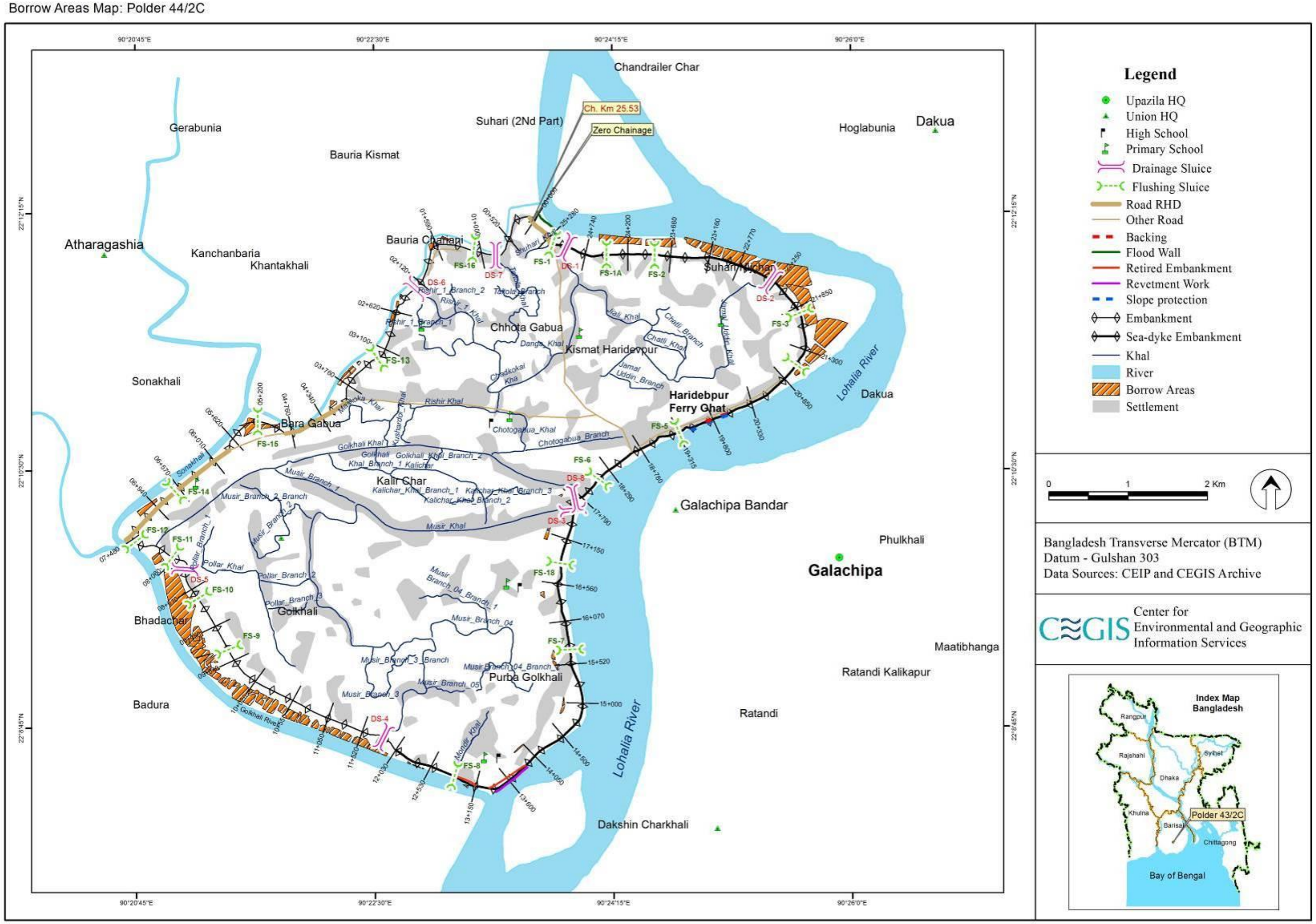
Table 4.11: Construction Materials

	Description	Quantity	Sources
Re-sectioning and construction of retired embankment			
a	Earth work	1000000 m^3	Borrow pits, spoils from re-excavation of drainage channels
Construction of sluices and flushing inlets			
a	Cement	1,20,000 bag	To be procured from local market
b	Sand	3000 m^3	To be procured from Barisal
c	Stone	6000 m^3	To be procured from Barisal
d	Steel	1000 Ton	To be procured from Barisal
Bank protection			
a	Concrete Blocks	14 00 000 nos	To be made at construction site during construction

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

Earth from borrow pit area

241. The earth for rehabilitation of the embankment will be collected mainly from the offshore borrow areas of Polder 43/2C.The EIA team of CEGIS has identified the available borrow areas during field investigation considering the minimum set back distance of 15 m from the toe of the embankment. The required earth for the embankment could be obtained from the identified borrows areas. The depth of the borrow areas shall not be more than 1.5 m. 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. 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 resored within 5 to 10 years after excavation. The identified borrow areas for earthwork of the embankment is shown in Map 4.3.



Map 4.3: Map showing the available Borrow pit area of the Polder-43/2C

4.7.4 Construction Machinery

242. A large number of construction machinery and equipment would be needed for the construction activities in the Polder. A tentative list of these machinery and equipment presented below:

Table 4.12: List of Construction Equipment and Machinery

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

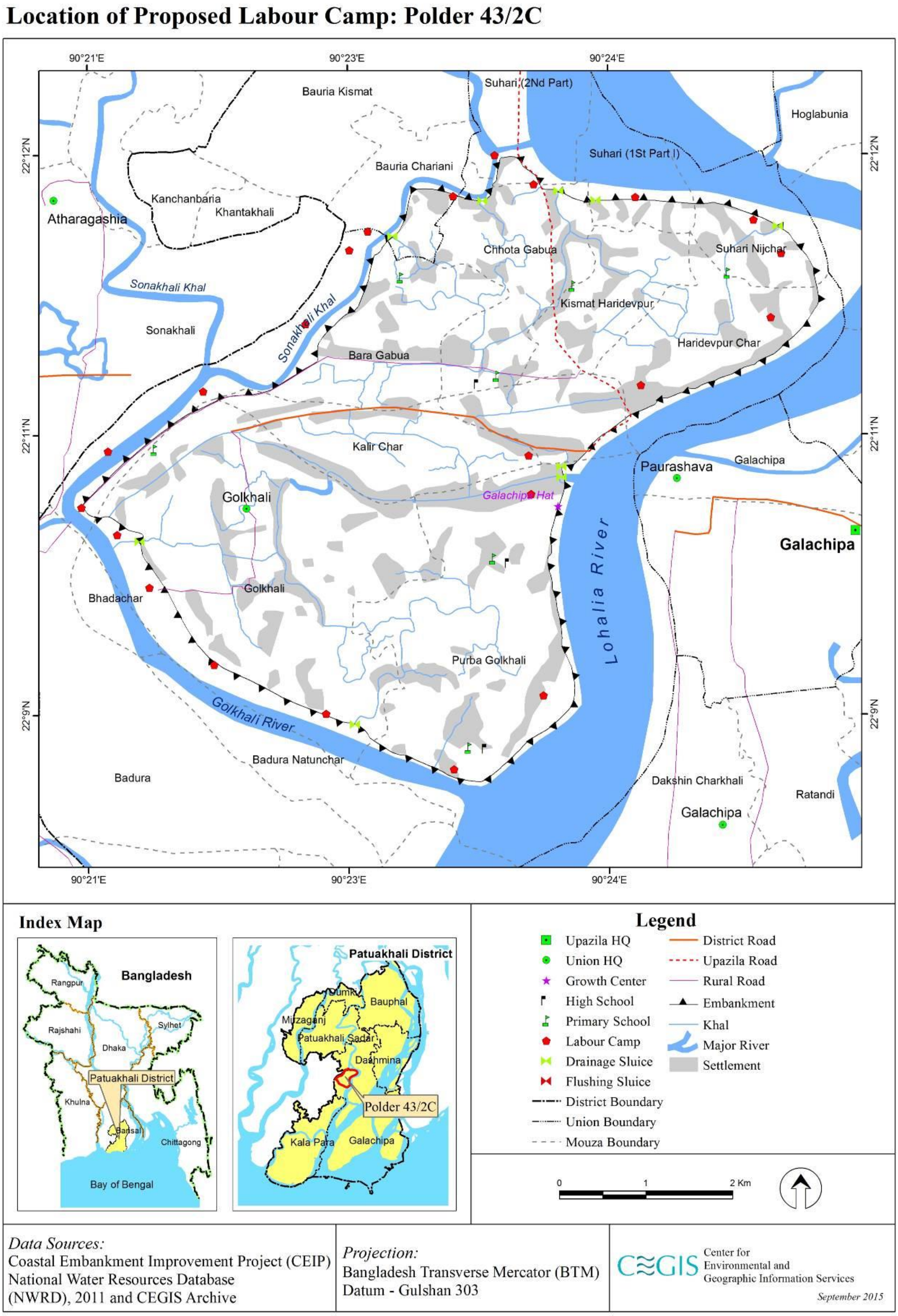
Source: Engineering/Procurement Team of CEIP-1, 2015

4.7.5 Construction Camps

243. A total number of 22 labor camps will be established during the construction period. The camps will be set up for embankment works, construction of drainage sluice works, flushing sluice works, bank protection works and flood wall. The Contractor will select the location of the camp through consultation with the Chairman of the local Union Parishad and the community inside the polder and to obtain permission from the DCSCbefore constructing them. The location of labour camps are shown in Map 4.4

Drinking Water and Sanitation System of Camps

244. At each labour camp/construction site, a tube well will be installed for obtaining drinking water for camps and for construction activities. Latrines with septic tanks along with safe disposal of sewage will be constructed for sanitation at each labour camp/construction site as well.



Map 4.4: Map showing the locations of proposed labour camps

4.7.6 Vehicular Traffic during Construction

245. The major quantities of earth will be transported locally to the construction sites from borrow pits using mechanical equipment like excavators, pay loaders, dump trucks, trolleys, with some minor quantities foreseen transported manually.

246. The materials would be collected from the stockyard at Horidevpur Ferry Ghat and then would be transported using dump trucks, smaller carts, non-motorized vans and other smaller vehicles. The heavy trucks or other vehicles will be used for collection of construction materials from Barisal. These trucks will moved through district road.

247. The equipment and construction materials including hard rock dumping materials and sluice gate equipment will be transported from Khulna on water vessels through water way.

4.8 Project Implementation Arrangements

Overall Project Management:

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

Project Steering Committee (PSC):

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

Project Management Unit (PMU):

250. BWDB will set up a PMU to oversee the development and management of the project. The PMU will be led by a project director appointed by BWDB. The PD will have the rank of Chief Engineer, and will report directly to the Director General (DG). The PMU will have a central project office located at the headquarters of 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.

Procurement and Finance Unit:

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

Engineering Unit:

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

Social, Environment and Communication Unit:

253. The Social, Environment and Communication unit will supervise compliance with the Environmental Management Plan and Social Action Program and together with the engineering unit implement the communication strategy. The unit will include a Sr. Environmental Specialist, a Sr. Social Specialists, a Sr. Forestry Specialist a Revenue Staff and a Communication Specialist.

Field Offices:

254. Each Field Office will be staffed with one Project Manager/Executive Engineer (XEN), two Sub-Divisional Engineers (SDEs) and two Assistant Engineers (AEs). In addition, an environmental specialist, two social specialist and a revenue staff will work across all three field offices.

255. The PMU will be supported by the following consultancy:

- An *experienced NGO* will be mobilized by the PMU to implement the social afforestation the EMP; the Social Action Plan including the mobilization of Water Management Organization; the RAP and the EMP.
- A *Design and Construction Supervision Consultancy (DCSC)* that will assist the PMU in preparing the detail design of the remaining polders and supervise all the construction. For civil works contracts, the Project Director will serve as the *Employer*, and the DSC Consultant will serve as the *Engineer* for construction supervision. At the site, a *Resident Engineer*, appointed by the consultant, with a team of specialists and inspectors will supervise the Contractor.
- A Third Party Monitoring and Evaluation Consultants will provide support in monitoring project impacts and supervise the implementation of the EMP/RAP and will report to the PMU.
- *Procurement Panel.* A Procurement Panel will be appointed by BWDB to oversee the procurement process of large value contracts subject to prior review under the project. The panel consists of two international/expatriate specialists and one national specialist.

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

257. *An Independent Panel of Expert (IPOE).* BWDB will also appoint an IPOE 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 field of: morphology/river engineering; tidal river management/sediment specialist; geotechnical specialist, social specialist and environment/polderization specialist.DCSCOperation and Maintenance Plan.

4.9 Water Management and Operational Plan

4.9.1 Introduction

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

259. The polders have been playing a vital role in safeguarding the coastal area; ensuring securityand increasing agricultural production; improving livelihoods of the people and mitigating environmental damages. However, the polders areas are vulnerable to storm surges; high tides; annual floods; land erosion and drainage congestion. In many cases, the structures as built have not been found adequate to cope with the 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 water to flow both directions. So maintenance of the polder system with embankments and structural elements has become of paramount importance. 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 ascertain the security of the coastal people. The Coastal Embankment Improvement Program (CEIP) is one of the latest such interventions to address a systematic restoration and upgrading of the polder systems in the coastal region. Under this long term phased program of polders improvement, Operation and Maintenance issues with special reference to Local Government Institutions (LGIs) as well as local stakeholders participation and need based budgeting will continue to remain at the apex.

4.9.2 Approach and Methodology

(a) Approach

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

Community Participation in Operation and Preventive Maintenance

261. Polders need to be taken care of its every day wear and tear quite effectively. Past experiences show that, preventive maintenance of polders (embankments, structures, canals etc.) through community participation are 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 be some cohesive forces to unite the people together, which can

be ensured through building of institutions. When there is a common platform to think on any particular issue leading to some common interests and are tied with some goals to achieve in the long run, the united people can work effectively and yield the desired results.

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

263. **Firstly**, a formal institutionalization process should be undertaken to organize the local stakeholders in a common platform i.e. Water Management Organizations (WMOs).

264. **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 usufructuary rights will be allowed to any of the functional groups.

265. **Thirdly,** the advantages allowed to any of the groups under WMOs should not be treated as the permanent arrangement but a simple performance based contract. Direct monetary assistances on a regular basis make people irrational and idle; they start behaving oppositely when such benefits are restrained. The members of the functional groups under WMOs will be clearly informed at the beginning that the contracts are not perpetual rather performance based and will be renewed after certain period.

Annual Evaluation of the O&M activities done by WMOs

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

267. It is wiser to remove person who will be found worthless and ineffective in accomplishing their duties. Continuous guidance and monitoring the performance of WMGs vis-a-vis the functional groups by BWDB field staffs will make them more accountable and eventually some improvements will become apparent in the preventive maintenance program. The Local Government Institutions (LGIs) i.e. Union Parishad leaders / representatives (i.e. the Ward Members) will be involved for active support and cooperation during the process of this joint verification assessment.

Prioritization of Maintenance Works

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

Interaction with Local Government Institutions and Stakeholders

269. 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.

270. 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

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

4.9.3 Methodology

Meetings with Local Stakeholders at site

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

Priority of Maintenance Works and preparation of Work Authorization

272. The most important step of O&M planning is the prioritization of the proposed works especially when there is anticipated shortfall in funding. The list of maintenance works normally considered necessary to be undertaken in a polder for a particular period may be large; but depending on the available fund for O&M, many items of the list have to be curtailed. The list thus becomes short and shorter based on priority. The criterion for prioritization or "Budget Cuts" should be applied quite judiciously i.e. coming down from the items of major periodic maintenance to the items of minor periodic maintenance. Preventive maintenance works should be left untouched (Figure 4.3) because adequate preventive and minor periodic maintenance push down the need ofrehabilitation; infrastructure remains in good condition.

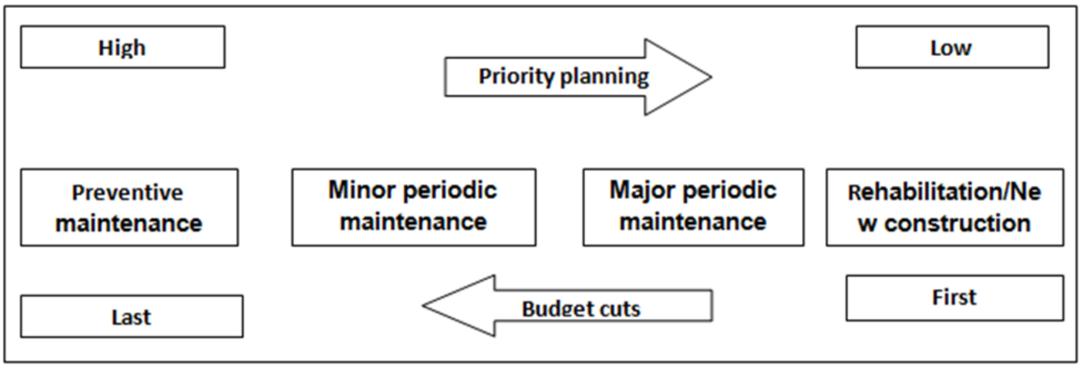


Figure 4.3: Priority Budgetingfor O&M

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

4.9.4 Operational Plan

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

(i) Operational Activities

275. 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)

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

(a) Regulation of gates

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

278. 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 sectionto address Beneficiaries Participation in coastal polders.

279. The gates of each drainage sluice / regulator must be operated flowing certain fixed rules regarding 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.

280. Flap Gates of regulators should remain in place at all times except during maintenance and flushing. 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.

281. 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 changes over time.

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

(b) Frequent Watching of Embankments

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

284. 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

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

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

286. 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

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

(ii) Planning of Operation

288. The objective of structures operation is to maintain control over water levels in the polder channels to ensure integrated water management. This means that the operation of water management structures should be directly linked to agricultural requirements and on-

farm water management conditions keeping the eyes open on the requirements of other users also like fisher folk community, navigators/boatmen, salt growers (if applicable) and general water users for domestic purpose. 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.

289. The decision making process involved in structure operation is shown in Figure 4.4. This illustrates schematically the procedural steps necessary to translate water management needs into actual structure operation. The water management plan drawn over a season provide the framework upon which water levels in the drainage channels i.e. operation targets and day-to-day structure operation needs will be based. However, actual field water levels may diverge from the water management targets due to some unpredictable factors like rainfall or other causes. During the cropping season, monthly, weekly or daily operational adjustments will be required. Routine monitoring of water management and hydrological conditions will supply data that together with the water management plan, will dictate the need of adjusting the operational measures.

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

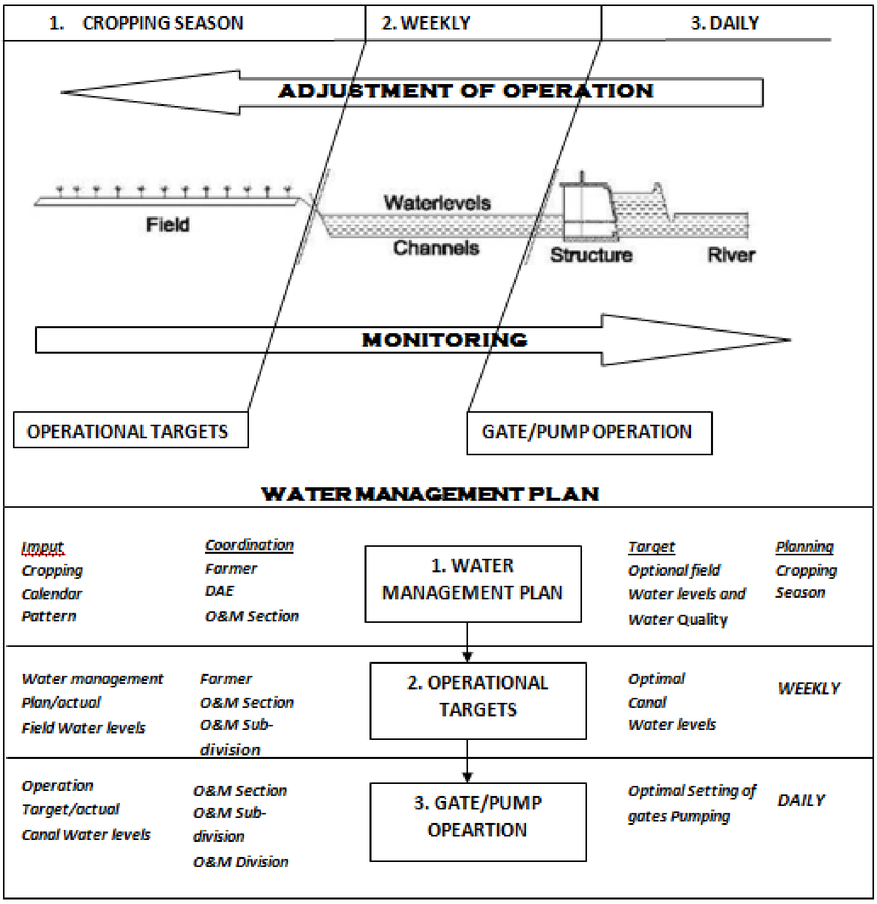
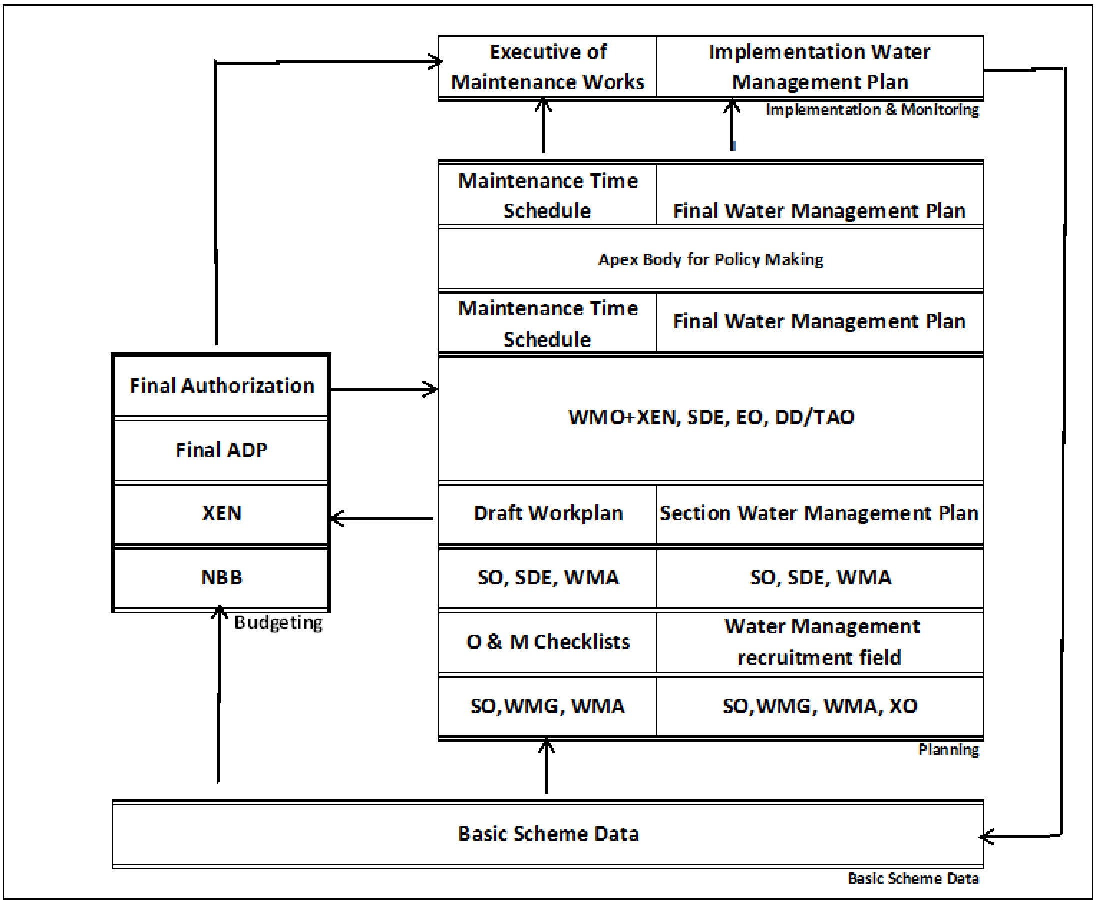


Figure 4.4: Decision making in operation

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

291. In the coastal polders both the drainage and water conservation requirements are equally important; in the wet season drainage will get priority while in the dry season, conservation of sweet water inside the polder becomes the predominant factor. The seasonal water management plan must therefore emerge covering the polder as a whole and on the basis of the requirements of all water users. The plan will have to be prepared jointly by the BWDB's O&M offices, the leaders of WMGs / WMAs and DWM of BWDB. Draft water management plans will be drawn up at the user level i.e. at WMGs (Figure 4.5, Planning Procedure); these will be combined into water management plans at WMA (Sub-Division level). In large polders, the plans will be compiled by the Executive Engineer (in support and cooperation of the WMF- if it exists) and DWM to produce the final WM plan. This needs to be prepared well ahead of the cropping season so that critical farm operation (e.g. seed bed preparation, shrimp or salt production requirements) can be carried out in line with the plan.



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

Figure 4.5: Standard Planning Procedure

292. 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.

293. In fact the WM Plan is a formal agreement between the BWDB's O&M offices and the water users' platforms (WMG or WMA) ensuring 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:

294. 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:

295. 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

296. 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.

297. In the coastal polders, the works, which only directly serve the 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.

(i) Preventive of Routine Maintenance

298. The objective of preventive maintenance is to keep the overall polder system including all its elements in good functional order thereby reducing the need of periodic maintenance eventually avoiding high rehabilitation costs. The works are simple, cheap and cost effective

and can be implemented through community-based functional groups such as EMGs, CMGs, and SMGs. Preventive maintenance is carried out throughoutthe 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.

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

(ii) Periodic Maintenance

300. 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.

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

(b) 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;

(c) 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.

302. The periodic maintenance interventions have been spelled out precisely in Table 4.13 below:

(iii) Emergency Maintenance

303. 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 4.13: Types and Classification of Maintenance Works

Sl. No	DescriptionofMaintenance Works	Implementation Mode									
		Classification byType of Maintenance			Community Based Functional Groups under WMOs						LCB
		I	II	III	EMG	ES	CMG	SMG	LCS	PIC	
	Embankment										
1	Incidental earth works:Minor filling 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,up keep of paths to facilitate inspection of trees, clearing around trees, application of fertilizer, harvesting of produce from trees, replanting and replacement of diseased/ moribund/dead trees.	√			√	√					
4	Minor earth works: Shaping or minor fillings of crestandslope but not re-sectioning so as to bring it back in as hape that allows ESs to settle and trees to be planted.		√						√	√	
5	Major earthworks: Re-sectioningor 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 ofsmallpartitiondyke		√			√			√		
7	Emergency closing of breached section			√					√		√
	Structure										
8	Cleaning and greasing of moving and/or sliding parts and seal	√						√	√		
9	Removing silt and debris (waterhyacinth, aquatic weeds and others) near intake	√							√		
10	Checking and tightening nuts and bolts	√						√	√		
11	Brushing cheep edor loose paint ruston metal parts; and painting	√						√	√		
12	Patchingminor damages or minor brick		√								√
13	Replacing rubber seal of gate,positioning		√					√			√
14	Repairing or replacing damaged metal works /hinges,lifting devices for flap or Vertical sliding gates		√					√			√
15	Repair defective block works(aprons)		√								√
16	Replacing stop logs, flap gate orvertical		√	√							√

Sl. No	DescriptionofMaintenance Works	Implementation Mode									
		Classification byType of Maintenance			Community Based Functional Groups under WMOs						LCB
		I	II	III	EMG	ES	CMG	SMG	LCS	PIC	
17	Repair headwalls,wingwalls,aprons of		√								√
18	Protective Works Re-positioning/replacing of incidentally displaced blocks/ boulders /concrete frames/ small repairtos and/gravel filter		√								√
19	**Channels** Cleaning khal and outfall drains and de- silting outfall drains	√					√				
20	Re-excavation of khal		√						√		
21	Removing cross dams (used as access roads, flashing bunds or water retention)		√			√					

Source: Engineering Team of CEIP-1

Notes:EMG-Embankment Maintenance Group; ES- Embankment Settlers; CMG- Canal Maintenance Group; SMG- Structural Maintenance Group; LCS- Landless Contracting Society ; PIC- Project Implementation Committee; LCB- Local Contract Bidding; Maintenance Class; I- Preventive or routine maintenance; II-periodic Maintenance; III- Emergency Maintenance.

(iv) Planning of Maintenance

304. 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 minimumannual planning because Embankment Maintenance Groups and Canal Maintenance Groups go ahead in a continuous process. Emergency maintenance cannot be planned, as this is 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. Theselection depends on the project inventory; the O&M checklists filled in by the farmers under the guidance of the Section Officer; and monitoring data produced by BWDB. A clear dichotomy is apparent here; monitoring focuses on the elements of the infrastructure while the O&M checklists help identify the water management bottlenecks and support the system approach. Another important issue in the maintenance planning is the timing of maintenance i.e. when certain works need to be carried out without hampering water management, and if it hampers in any area, all these should be reflected in the seasonal water management plan.This concerns mainly the periodic maintenance works.At hird planning activity is a part of the implementation phase and concerns the drawing up of physical work plans prior to the start of the works; this is infactanactivity between the contractor and the O&M Offices.The O&M field staff should monitor for strict follow up of schedule for executing these physical workplans.

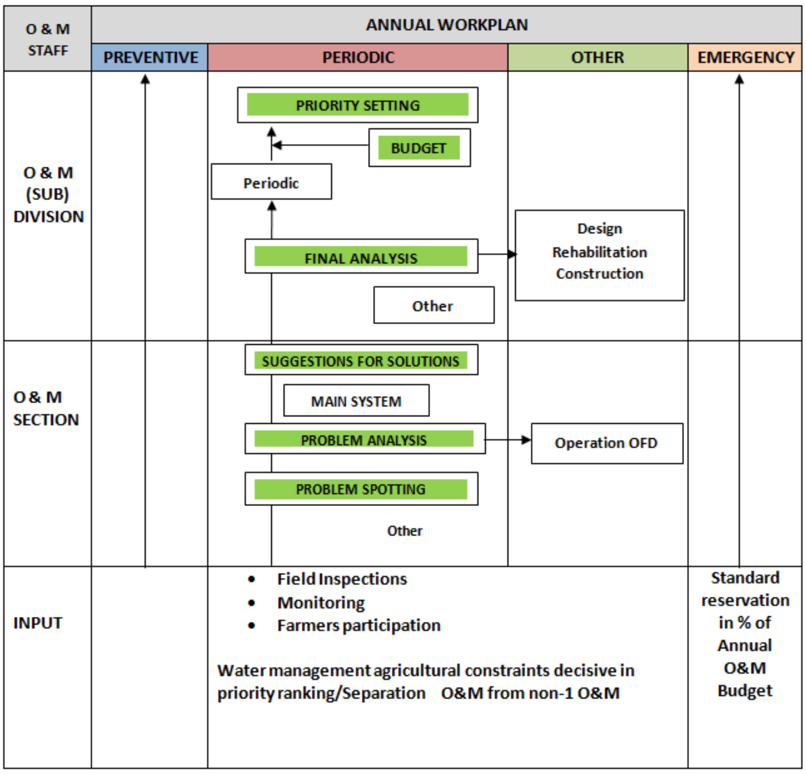


Figure 4.6: Decision Making in Maintenance

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

4.9.6 Rehabilitation works

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

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

307. Table 4.14 below depicts the Type of Rehabilitation works:

Table 4.14 Type of Rehabilitation Works

Sl. No.	Description of Maintenance Works	ImplementationMode						
		CommunityBased FunctionalGroups underWMOs						LCB
		EMG	ES	CMG	SMG	LCS	PIC	
1	Embankment Constructionof newor retired embankment,closing of breach(notemergent);					√		√
2	Structures Big repair or replacing of lifting mechanisms for flapgates or verticals lide gates;							√
3	New protective works(CCblocks/boulders),bigrepairof block works(aprons);							√
4	Repair of head walls/wing walls/aprons							√
5	Protective works Bigrepair,remodelling gate largescale,replacement of blocks/boulders/concrete frames,substantial fillings of sand/gravel bed and major renovation to geo-textile;							√
6	Channels Excavationof new Khals					√	√	√

Source: Engineering Team of CEIP-1

4.9.7 Local Participation in O & M and Water Management

308. Local stakeholders' participation in the development and maintenance of water resources sub-projects / polders is a much discussedissue. 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. Until now the provisions of local level participation in the National Water Policy and in the Guidelines for Participatory Water Management that stressed the need for organizing the local stakeholders by themselves with LGIs (i.e. Union Parishad at the grass-root level) playing the roles of coordinating agencies could not succeed in drainage sub-projects for the benefit is not tangible. The challenge of shifting the responsibilities of O&M to beneficiaries' organizations in drainage sub-projects especially in coastal polders yet remains as a big question.

a. Institutions for Participation

309. 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.

310. 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 provided 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 was 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).

Current Status of Participation in CEIP-1 Polders

311. At present, no beneficiaries' organizations exist in any of the 17 polders selected for improvement under CEIP-1. 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 following the norms prevailing at the 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.

312. 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.

313. Although there are experiences of forming WMOs in some of the irrigation sub-projects of BWDB; no was taken to form the WMOs following GPWM provisions. The scopes were very

limited in the CERP/PWP polders to build up institutions for Water Management /O&M as no manpower neither in BWDB or in the TA team were provided to support the task of building beneficiaries' under this program. 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.

314. The main difficulties that still persist in the formation of WMOs in the coastal polders are with the registration of primary level organizations i.e. Water Management Groups (WMGs) at the lowest tier. The polders are FCD type of sub-projects dealing with salinity prevention and drainage as the major activities; benefits accrued to the local stakeholders are not tangible enough. For the WMOs of FCDI sub-projects, registration at the levels of WMGs and WMAs are allowed under the Cooperative Legal Framework and for the WMOs of FCD sub-projects/polders, this has been left open to the choice of beneficiaries (Huda, Shamsul ATM 2006). They either can opt for registration as the Cooperative Societies like those in the FCDI sub-projects or could beregistered 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 still remains. Afterwards, the polders faced at least two severe cyclonic storms "Sidr" and 'Aila'.

i. Institutional framework for Participation

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

316. 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 be 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):

317. This organization, at the grass-root level will provide the platform for all those who live inside or adjacent (close vicinity) to the polder and will be treated as the primary society. The entire command area of the sub-project/polder will be sub-divided into few Units preferably on the basis of hydrological consideration and each of these Units will have one WMG. The size of the units may vary depending on the land topography, actual alignment of the existing roads, canals or embankment, and location of structure, turn-outs or even the field channels. Preferably, the size of such hydrological Units should vary within the range of 500 ha to 1500 ha. The areas of the Units so demarcated usually comprise 2 or 3 villages and part thereof. One WMG may therefore include several hundreds to a few thousand as its primary members.

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

319. 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 be assembled together to elect the 12member Executive Committee (EC) through a standard franchise procedure. The elected EC will be treated as the legal management body of the WMG concerned.

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

Water Management Association (WMA):

321. 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.

322. 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 them. Each of the organizations has specific responsibilities to perform; these are summarized in a table below:

Water Management Federation (WMF):

323. This is conceived as the supervisory type of organization functioning at the apex level of the hierarchy and is needed to establish linkages with other higher level organizations for support and mobilization of resources. The WMFs may exist on the basis of actual functioning strength of WMGs and WMAs. Usually in a district or in a bigger hydrological basin comprising of several districts may have one or more federating bodies functioning at the top level of the hierarchy. The office bearers of the WMF, the 5-member federating body will be selected from among the MC members of WMAs. Important personalities in the area like Member of

Parliament or local leader may be nominated as the chair-person of the WMF and other members (not exceeding 04 nos.) may come from the WMAs by virtue of their importance in controlling the numbers of WMGs etc. Duties and responsibilities of WMOs are provided in the following Table:

Table 4.15: Duties and Responsibilities of WMOs at different tiers

WaterManagement Group (WMG)	Water Management Association (WMA)	Water Management Federation (WMF)
Initiation ofStakeholders activities through preliminary discussions, meetings andmotivational exercises	Preparation of budgets and participation in all 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 of the WMGswith implementingagencies orLGIsasappropriate	Coordinationofstakeholders ‘activitiesin watermanagement
Participationthroughoutthe project cycle	Formal representation of the beneficiaries and project affected people on all issues related to water management	Formal representation of the beneficiaries and project affected people on all issues related to water management
Preparation of annual crop production as well as O&M plans	Preparation of annual crop production/ O&M plans and/or collate the plans emanating from the WMGs	Preparation of annual crop production/ O&M plans and/or collate the plans emanating from the WMAs
Mobilization of local resources and collection of members' contribution towards and recurring costs	Collection of beneficiary contribution towards investment and operation costs and collection of consolidated contributions from WMGs as appropriate	Collection, where applicable, of beneficiary contribution towards polder level operation and maintenance
Maintenance of accounts	Supervision and guidance to WMGs on maintaining the accounts	Financial oversight
Work with implementing agencies, NGOs, CBOs and LGIs	Participation in 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

324. 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 be 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

325. ESs are families selected from squatters and project affected persons who do not have any land or lost it forland 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 at the toe of the embankment. The maintenance activities include small earthworks, new plantation, re-plantation or enrichment in planting and maintenance of vegetation cover. ESs may be engaged in embankment maintenance activities through a contract agreement for certain period. Unlike CERP, they will simply enjoy the settlement facility and use fractuary rights of the plantation on embankment slopes and toes.

EMG - Embankment Maintenance Group

326. 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

327. 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 executing25% 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

328. 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

329. Over the last few decades there has been a tremendous growth of non-government organizations popularly termed as NGOs taking part in various development activities at the grass-root level. For the purpose of re-structuring or in some cases re-orienting the water management organizations in the coastal polders, the services of experienced

NGOs would prove worth enough. Besides, they can also work with the CBOs in accomplishing maintenance activities of the embankments. These are discussed in the following sub-sections:

Organizing the WMOs

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

Ensuring CBOs involvement in Preventive Maintenance

331. 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

332. 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 foot-holds to become sustainable. Therefore, the capacity development initiatives for the individuals as well as for these organizations are inevitable. Addressing the issues of capital building, integration of sufficient resources across the community, implementation of IGA activities and skills development programs should be best looked into by the experienced NGOs.

New Plantation and Re-enforcing the Vegetative Covers

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

d. Relationship with LGIs and Local Administration

334. 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 coexistence of WMOs with the LGIs and local administration system.

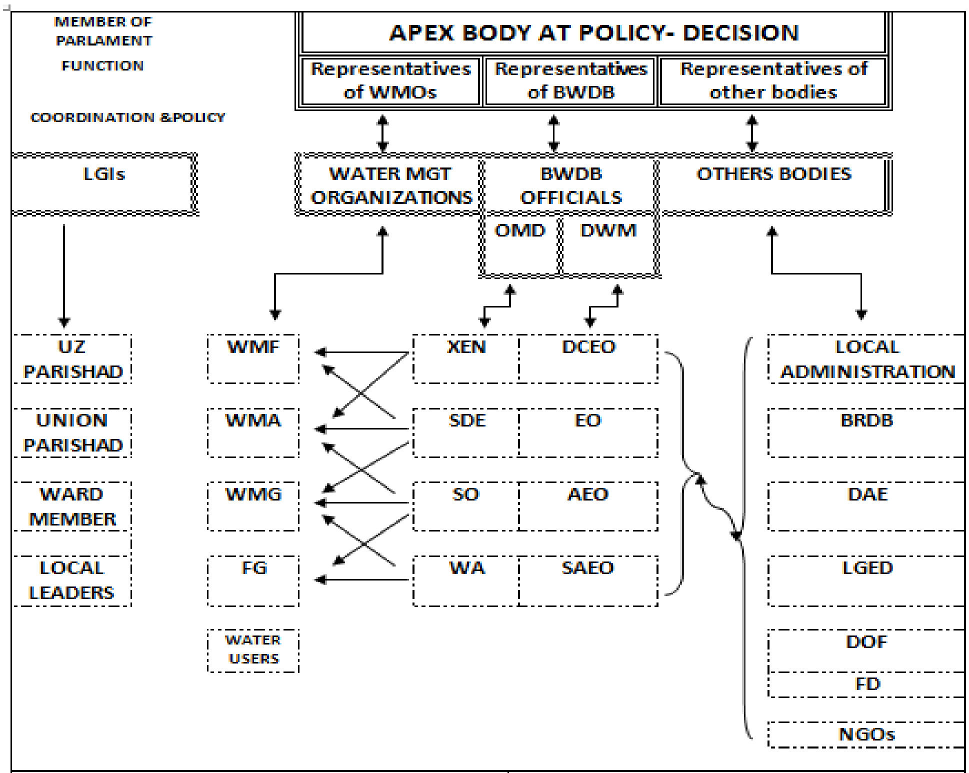
Cooperation of LGIs

335. 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. Therefore, to get the polder community taking part in operation and maintenance of the polder infrastructure and water management activities is not straight forward like that in the irrigation or FCDI types of subprojects.

336. Apart from the farm families living inside the polder, the embankment settlers; landless section; aboriginals; and people of other trades like fishermen, boatmen etc. behave differently and their perceptions towards the polder infrastructure are also diverse in nature. However, the local leaders like UP Chairmen, Ward Members and village leaders have decent acceptability among the local community. It is therefore, required that the LGIs should have specific roles in WMOs; especially the Ward Members will be given the responsibilities to coordinate the formation of WMGs and different functional groups like EMGs, CMGs, SMGs, and also LCSs. Besides, they will also take part in the process of participatory planning and implementation of maintenance activities. Especially at the stage of implementing preventive and minor periodic maintenance works, there should have the provision of LGIs' intervention in conflict resolution and ensuring peaceful co-existence of all groups / sub-groups within the WMGs /WMAs.

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



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

Figure 4.7: Inter-relationshipbetween WMOsandthe LGIs

Support from Local Administration

338. 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 things happen more or less contrary to the expectations of the inhabitants of remote polders. The Water Management Organizations (WMOs) and BWDB's O&M section in particular should trigger some of the key points in the whole affairs of local participation to get the local administration more attentive and involved. These are as under:

Participation in the Union Parishad and Upazila Parishad Review Meetings

339. 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".

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

341. 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

342. The total cost of the project has been calculated to be Tk. 1,180,429,480 (Taka one hundred eighteen crore four lac twenty nine thousand four hundred eighty) only.

4.11 Need of Resettlement Action Plan (RAP)

343. Any development project that requires land acquisition may entail some impacts on people or commercial units and may bring about the changes in the patterns of use of land or other natural resources. For this reason, resettlement program addresses loss of affected people or commercial units for statutory compensation payment to the affected units. In this respect, Resettlement Plan must be prepared to ensure that the affected people or commercial units receive fair and adequate compensation and rehabilitation if needed. It is noted that the Resettlement Action Plan (RAP) is conducted by another sub-consultant of CEIP for the Polder- 43/2C project.

4.12 No Objection Certificate

344. The Polder- 43/2C is located in the southern hydrological zone in Galachipa Upazila of Patuakhali District. The unions in the polder include: a) Amkhola and Golkhali unions under Galachipa upazila. Under these unions no archaeological sites or any cultural heritage are known to exist which might affect the normal activities of the polder after rehabilitation. The No Objection Certificates (NOCs) from the union chairmen have been obtained and are attached in Appendix -2.

5. Environmental Baseline and Existing Conditions

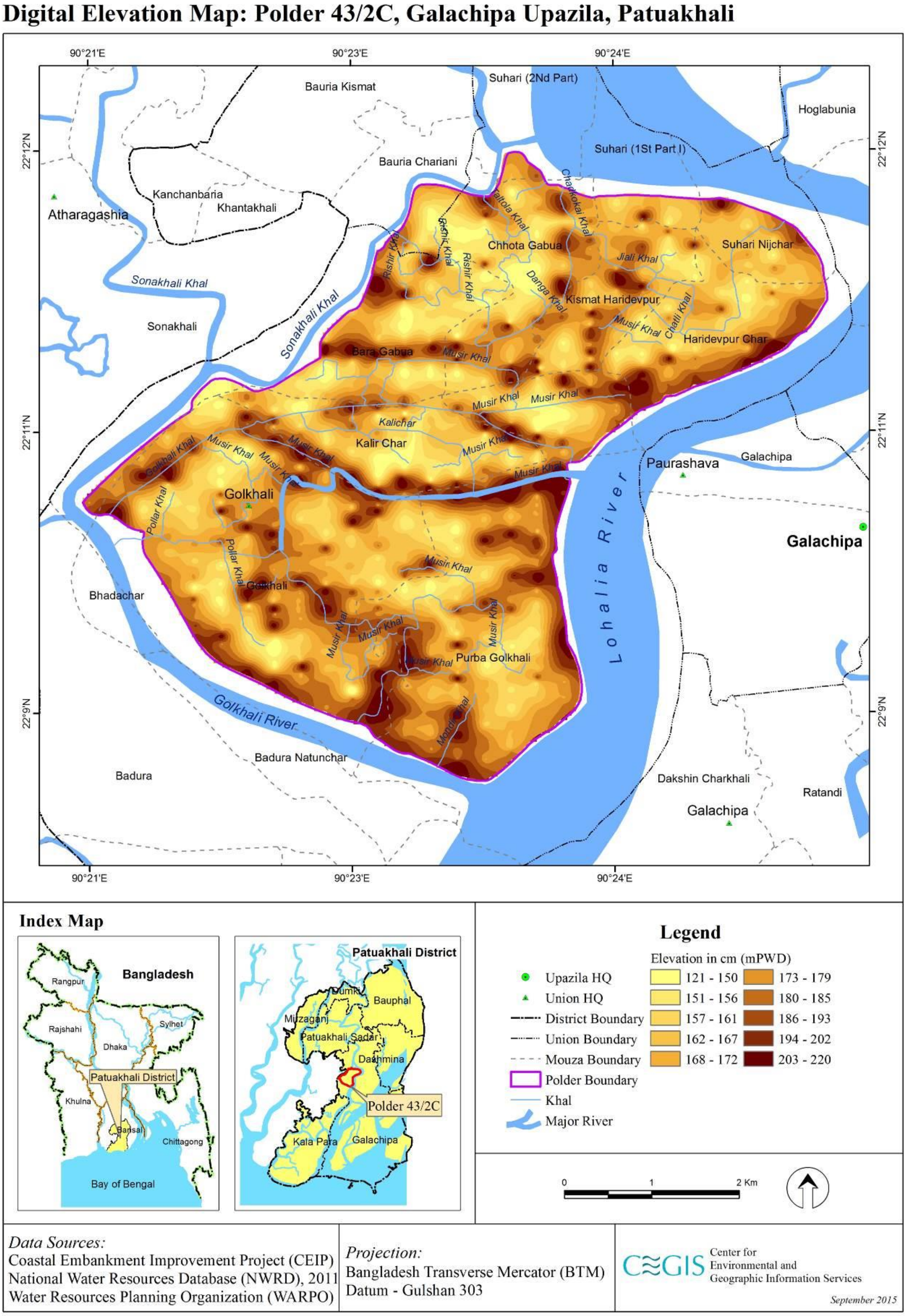
5.1 Physical Environment

5.1.1 Geology

345. Polder- 43/2C is situated in a low-lying coastal region. From Spatial analysis, it has been observed that the polder is composed of tidal deltaic deposit. The major portion of this deltaic sediment is deposited in subaqueous form in the permanent body of water where tidal waves and currents aid in the 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

346. The land slope of the study area is a flat landscape and low topography. The elevations are more or less similar, with a very minor downward sloping from north to south. The area is interspersed with intensive network of rivers and khals. Land elevation inside the polder area varies from 1.21 to 2.20 m, PWD (from Mean Sea Level). From the Digital Elevation Model it is found that around 78% lands of the areas have elevation between 1.21 to 1.81 m above MSL, whereas, 22% have elevations between 1.82 to 2.20 m above MSL. The Digital Elevation Model of the study area is given in Map 5.1.



Map 5.1: Digital Elevation model of the study area

5.1.3 Seismicity

347. Bangladesh is one of the seismically active regions of the world, experiencing numerous earthquakes since last 200 years. The 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-43/2C falls under Zone-III, which is characterized by Low earthquake prone site and has a basic seismic coefficient of 0.04g. Map 5.2 shows the seismic zone map of the study area.

Earthquake Zone Map: Polder 43/2C

Map 5.2: Project site shown on seismic zone map

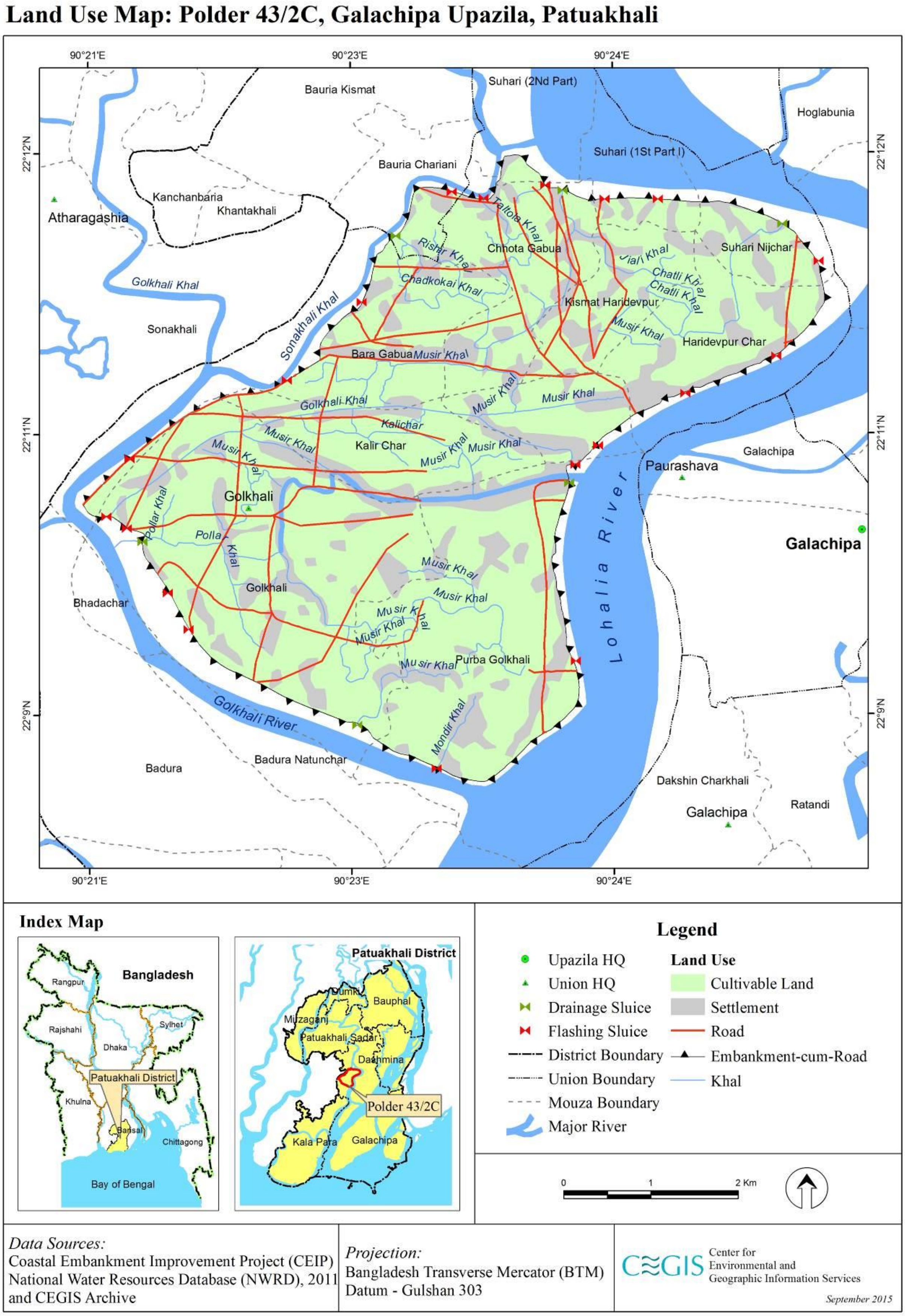
5.1.4 Land Use

348. The gross study area is about 2,753 ha of which 2000 ha is net cultivable area (NCA). The NCA is about 73% of the gross area. The coverage of settlements and water bodies are 753 ha (27%) of the gross area. Detailed land use of the polder area is presented in Table 5.1:

Table 5.1: Detailed land use in the Polder area

Land use	Area (ha)	% of area
Net cultivable area (NCA)	2000	73
Single crop	825	41.25
Double crop	885	44.25
Triple crop	290	14.50
Others (settlement and water bodies)	753	27
Total gross area	**2,753**	**100**

Sources: CEGIS estimation in 2015 from SOLARIS-SRDI-2006



Map 5.3: Land use of the Polder area

5.1.5 Soil Properties

a. Agro-ecological zone

349. There are 30 agro-ecological zones and 88 sub zones in Bangladesh as part of Land Resources Appraisal of Bangladesh for agricultural development (FAO/UNDP, 1988; BARC, 2012). The Polder- 43/2C comprises of one Agro-ecological zone, namely Ganges Tidal Floodplain (AEZ-13). The characteristics of this AEZ are discussed briefly.

Ganges Tidal Floodplain

350. This region occupies an extensive area of tidal floodplain land in the south-west region of the country. The entire Polder-43/2C area is covered by this agro-ecological zone. The greater part of this region has smooth relief having large area of salinity. There is general pattern of grey, slightly calcareous, heavy soils on river banks and grey to dark grey, non calcareous, heavy silty clays in the extensive basins. Non-calcareous Grey Floodplain soil is the major component of General Soil Types. Acid Sulphate soils also occupy significant part of the area where it is very strongly acidic during dry season. In general, most of the top soils are acidic and sub-soils are neutral to slightly alkaline. Soils of the Sundarban area are alkaline. General fertility level is high with low to medium organic matter content and very high CEC and K status. There are limitations of high exchangeable Na and low Ca/Mg ratio. The Zn status is low to medium and the B and S status is medium to optimum. Physic-chemical properties of soils of AEZ-13 are presented in Table 5.2.

Table 5.2:Physio-Chemical Properties of Soils of AEZ-13

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

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

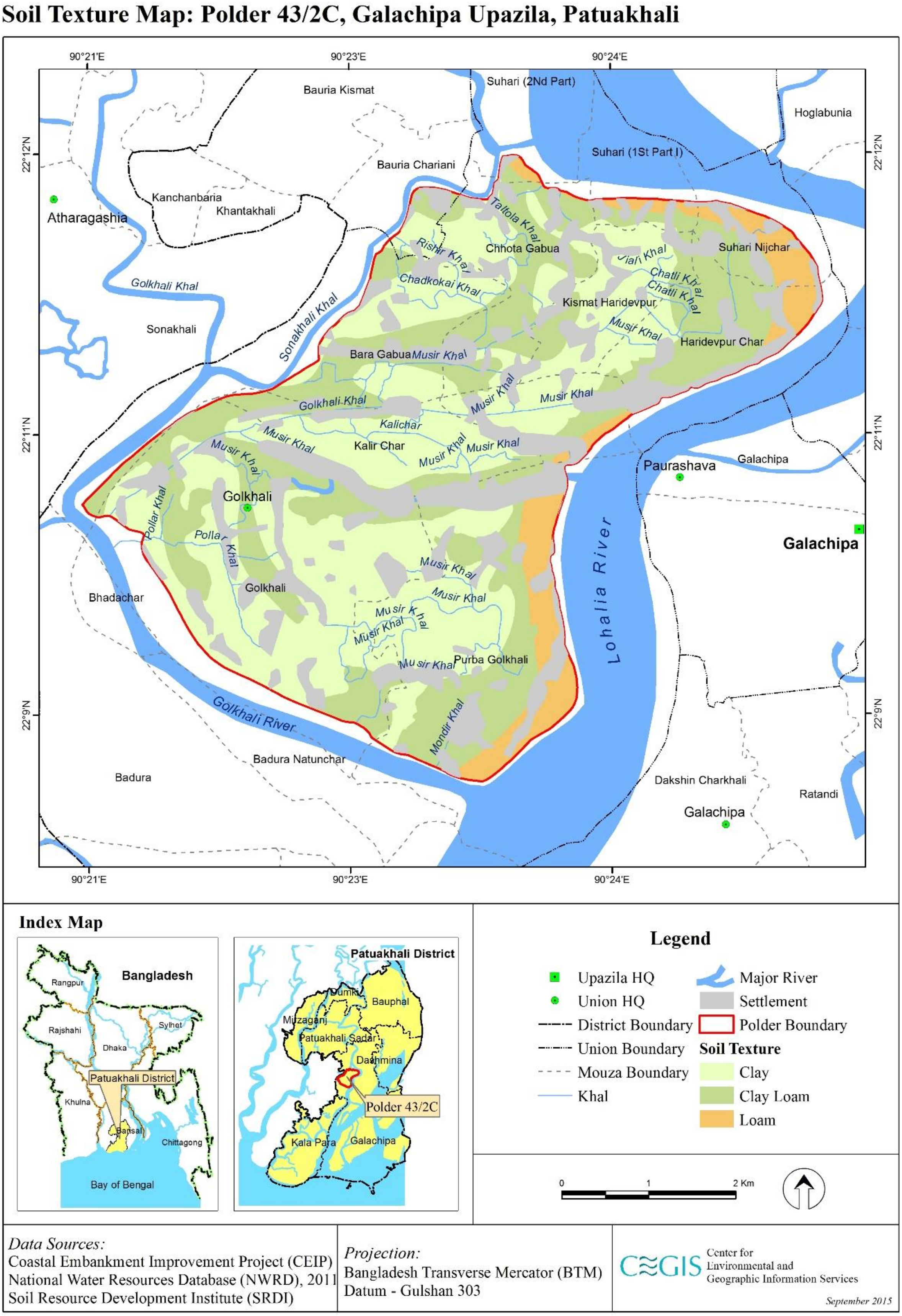
b. Soil Texture

351. Soil texture is the relative proportions of sand, silt and clay. It is very important for soil characteristic that guides crop selection, crop production and field management. Detailed distribution of soil texture is presented in Table 5.3.

Table 5.3: Detailed soil texture of the Polder area

Texture	Area (Ha)	% of NCA
Clay	1,019	51
Clay Loam	794	40
Loam	187	9
Total	2,000	100

Sources: CEGIS estimation in 2015 from SOLARIS-SRDI, 2006



Map 5.4: Soil Texture of the Polder area

Land Type

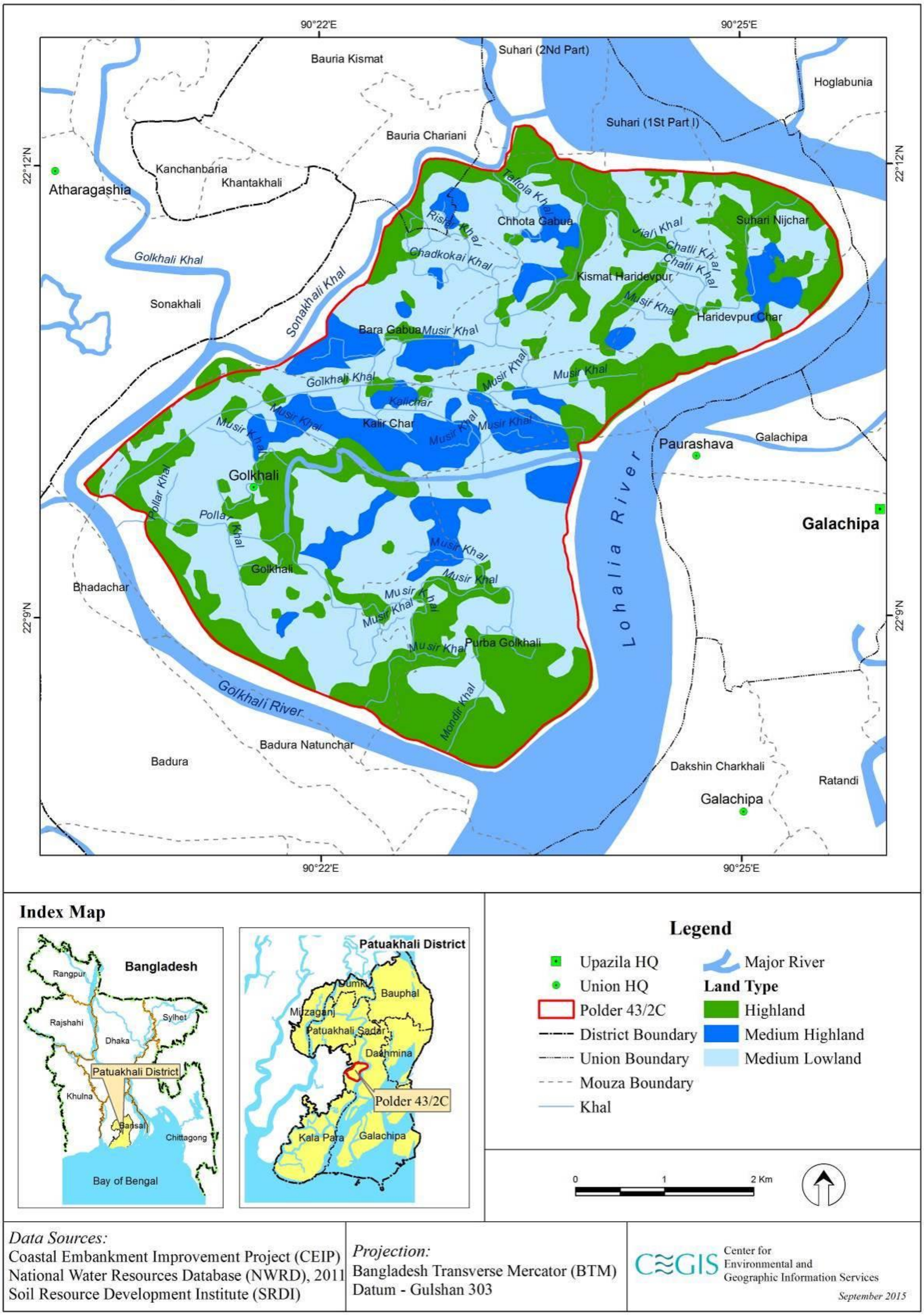
352. Polder- 43/2C is located in the coastal area, which consists of extremely low and flat land. The land level is 1 (one) meter above the mean sea level (MSL). Land type classifications are based on depth of inundation on agricultural land during monsoon season due to normal flooding. In terms of depth of flooding, five classes of land type are recognized by Soil Resource Development Institute (SRDI), 1988. In the study area, three classes of land type have been identified on the basis of field survey and modelling report of IWM. Detailed distribution of land type of the Polder area is presented in Table 5.4.

Table 5.4: Distribution of land type in the Polder area

Land Type	Description	Flooding characteristics	Area (ha)	% of NCA
F0	Highland	None flooded to intermittent or Land which is above normal flood-level.	270	13.5
F1	Medium Highland	Land, which is normally flooded up to about 90 cm deep during the flood season. This class has been subdivided into two classes: MH-1, normally flooded up to about 30 cm deep; and MH-2, normally flooded up to between 30-90 cm deep.	1330	66.5
F2	Medium Lowland	Land which normally is flooded up to between 90 cm and 180 cm deep during the flood season	400	20
Total			**2,000**	**100**

Sources: CEGIS estimation in 2015 from SOLARIS-SRDI-2006

Land Type Map: Polder 43/2C, Galachipa Upazila, Patuakhali



Map 5.5: Land type of the Polder area

5.1.6 Climate

353. The project influence area under the Polder- 43/2C has a typical monsoon climate that is characterized by four seasons the Dry/winter from about December to March, the pre monsoon lasting from April to May, the monsoon from June to September and the post monsoon from October to November. Meteorological data for last 32 years has been collected from BMD station in Patuakhali and analyzed to get the overall conditions of the study area. Patuakhali station is situated at about 15.7 km northern side of Polder- 43/2C. Summary of the analysis of climatic parameters are given in following sections:

a. Rainfall

354. The average annual rainfall of this area is about 2,669 mm of which around 74% (1,968 mm) mainly concentrated during monsoon season which last from June till the end of September. Besides, about 13% (346 mm) and 10% (267 mm) of total annual rainfall occur during pre-monsoon and post-monsoon respectively. The period from December to March is significantly dry with less than 3% of the annual total. The pre-monsoon period is associated with local Tornado and sometimes with cyclonic storms due to depressions in the Bay of Bengal. The hyetograph shows that the average highest and lowest values of rainfall are usually observed during the months of July (598 mm) and December (4 mm) respectively.Figure 5.1 shows the AverageMonthly Rainfall at Patuakhali BMD station.

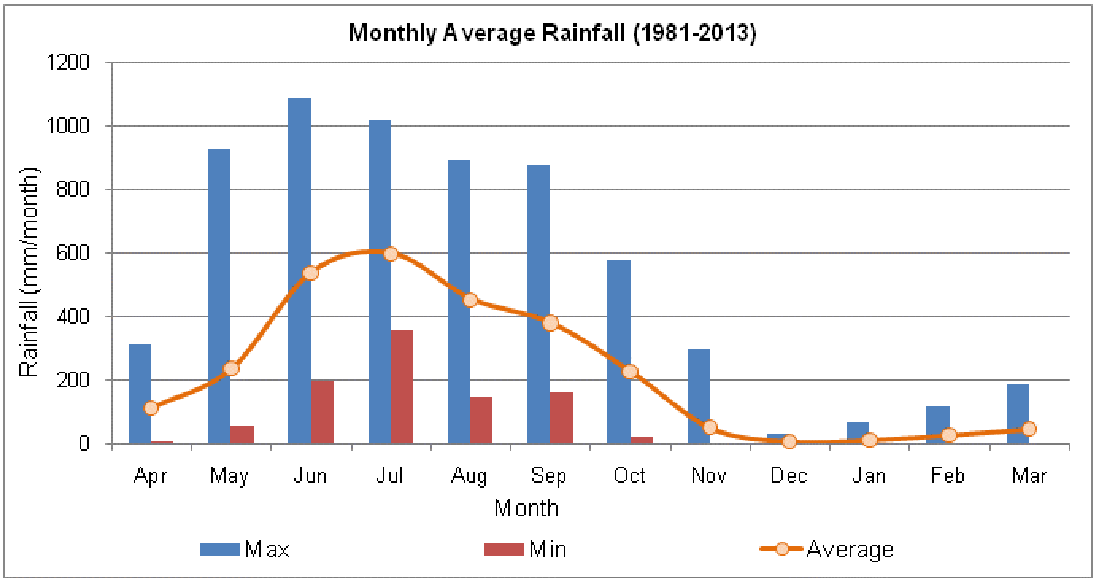


Figure 5.1: Average Monthly Rainfall at Patuakhali BMD station

b. Temperature

355. The normal average winter temperature ranges from a minimum of 13°C to a maximum of 25°C. The winter season is characterized by low temperature, low humidity and high solar radiation. The summer from April through May has a mean temperature of about 33°C. The hot summer (pre-monsoon) receives some rainfall with occasional heavy thunderstorms and hailstorms. The monsoon season begins in June and continues up to September with maximum temperature usually around 31°C with high humidity and low solar radiation due to extensive cloud cover. The results of monthly average maximum and minimum temperature variations of the polder are shown in Figure 5.2.

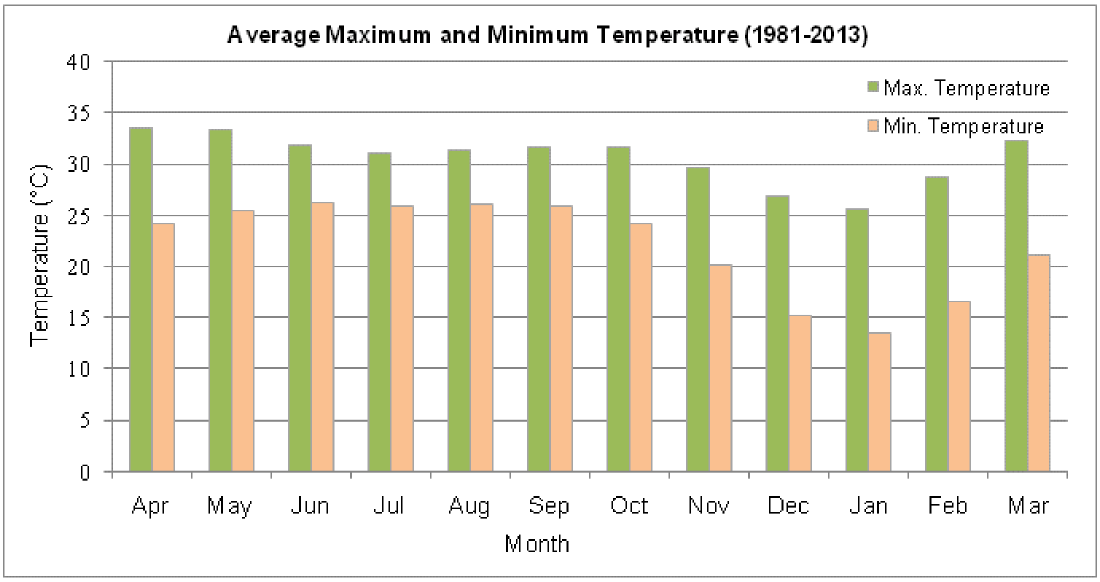


Figure 5.2: Average of Maximum and Minimum Temperatures at Patuakhali BMD Station

c. Relative Humidity

356. Variation of monthly relative humidity, as recorded by the Patuakhali BMD station (1981~2013) is shown in Figure 5.3. A significant fluctuation has been observed as relative humidity values start to increase from April (start of summer) due to the increase in atmospheric water vapours coupled with temperature rise. Relative humidity rises above 89% in monsoon (June to September), and starts decreasing from post monsoon season following the monsoon rainfall. In the coastal areas, relative humidity values are usually higher than the other parts of the country. This is because of having a greater extent of water bodies, leading to increased evaporation.

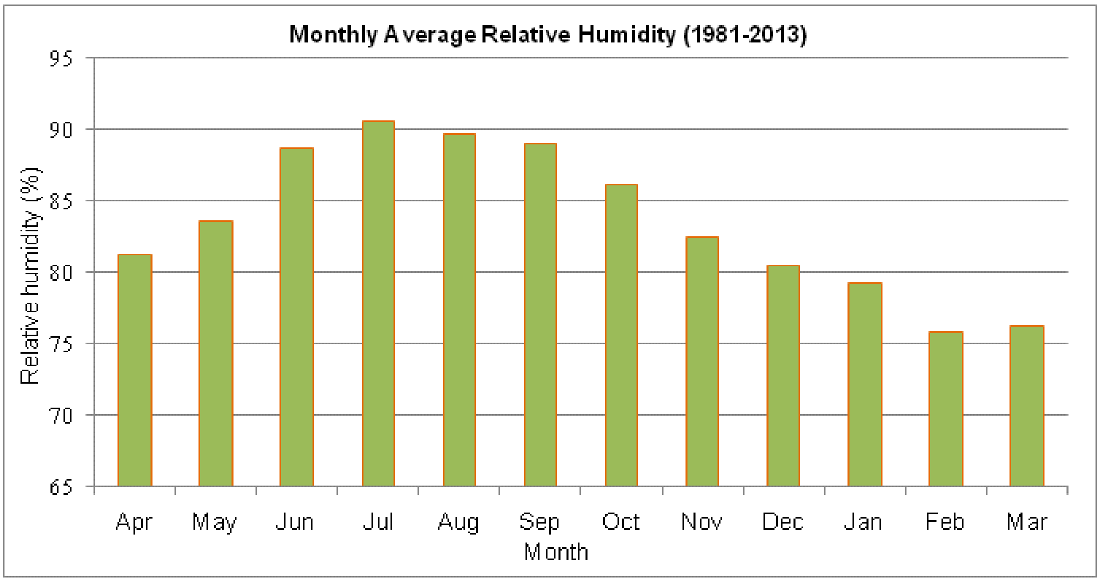
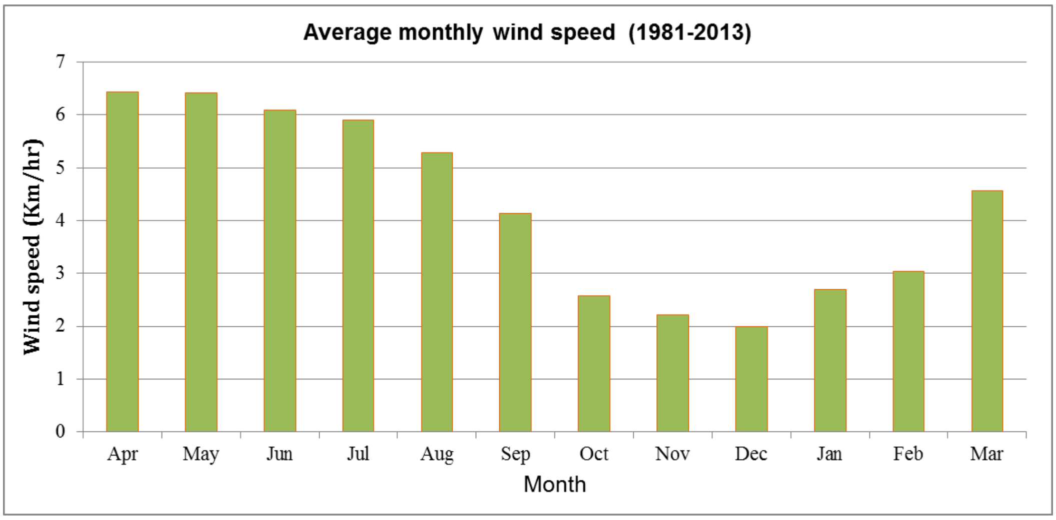


Figure 5.3:Average Relative Humidity at Patuakhali BMD station

d. Wind Speed

357. Historical data on wind speed for the last 32 years (1981-2013) has been collected from the BMD station at Patuakhali. Wind speed is the highest in April (around 6.44 km/hr) and the lowest in December (around 1.99 km/hr). During cyclone Sidr (2007) and Aila (2009), 1 minute sustained wind speeds were recorded as 260 kph and 120 kph respectively. Sidr caused maximum damage due to its high wind speed. Figure 5.4 shows the monthly wind speed of the study area.

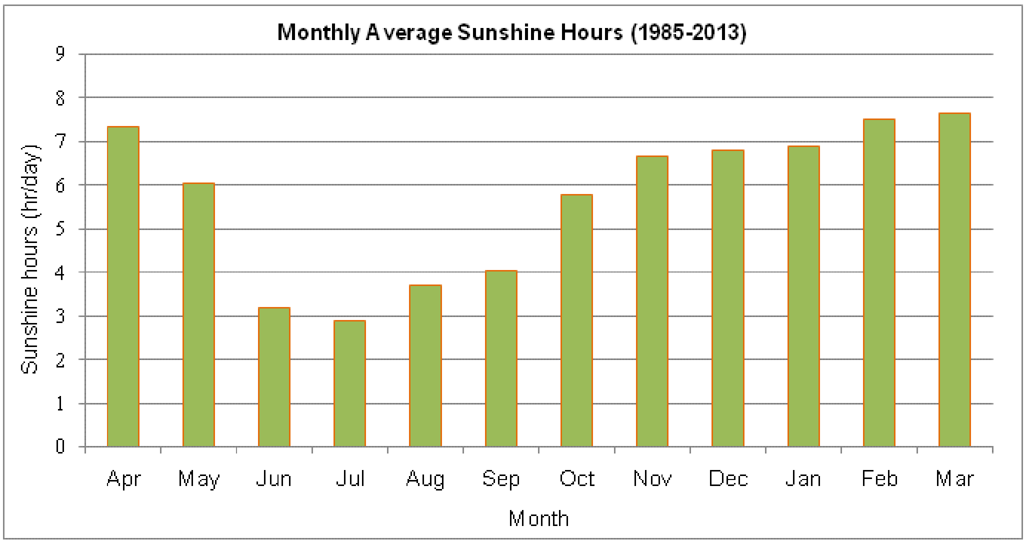


Source: BMD, 2013

Figure 5.4: Variation of average wind speed at Patuakhali BMD station

e. *Sunshine* Hours

358. The average sunshine hour data has also been collected from Patuakhali BMD station (1985-2013). 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) (monsoon) the values drop below 4 hours.



Source: BMD, 2010

Figure 5.5: Monthly variation of average sunshine hours at Patuakhali BMD station

5.1.7 Water Resources System

359. The existing water resources system of the polder (Map 5.4) area meets the demand of the surrounding ecosystem. It is the source of water supply, and plays an indispensable role in attenuating and regulating drainage, recharge into the aquifer, and maintaining the environment for aquatic habitats.

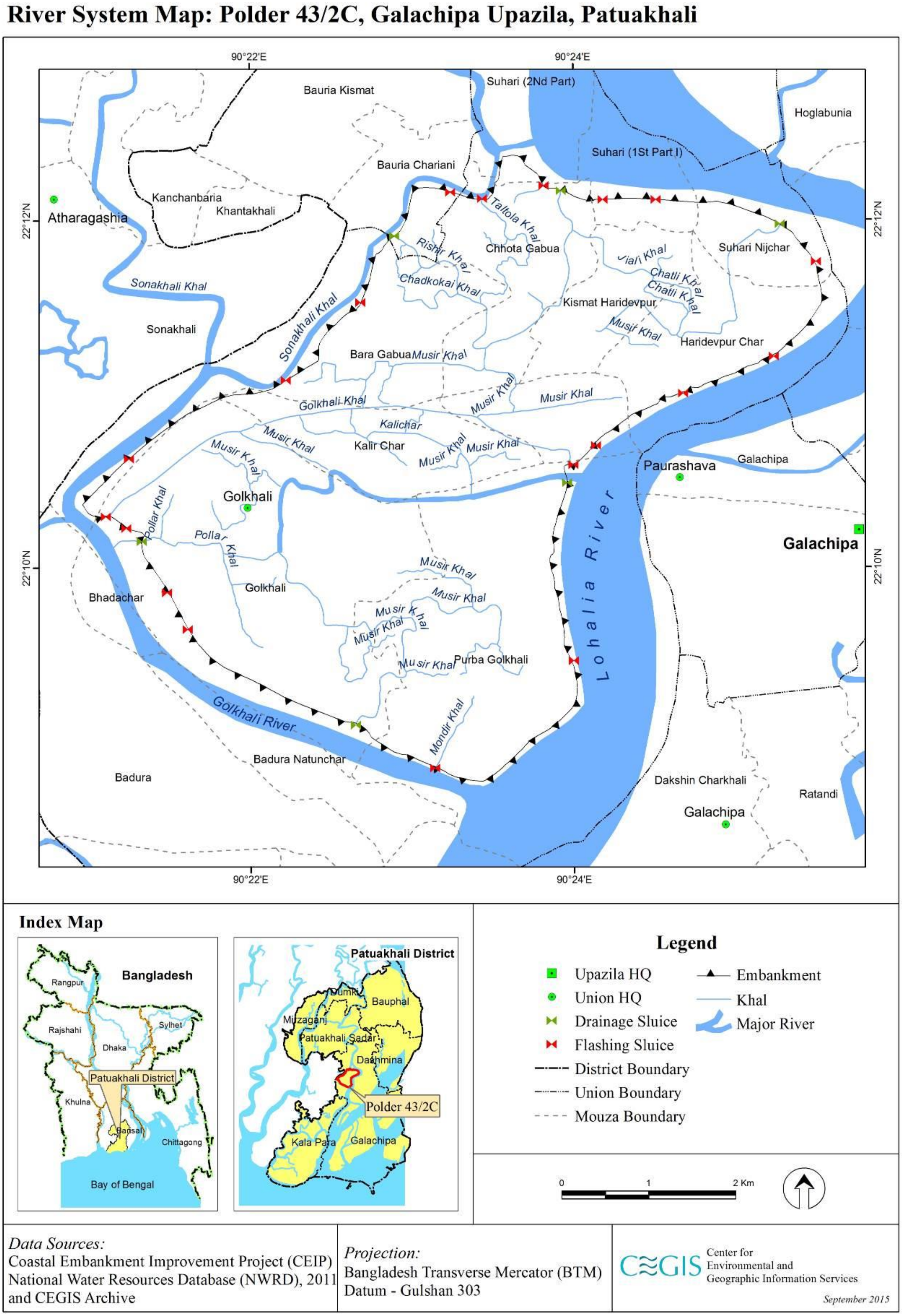
a. Major Rivers and Khals

360. The Polder- 43/2C is about 40 km away from the Bay of Bengal and undergoes to diurnal tidal influence. The polder is surrounded by the Golkhali River (Picture 5.2) to the south and southwest; Sonakhali Khal to the west and northwest, Lohalia River to the east and north. The flow direction of these rivers is from North to South.

361. The main river of the study area is Lohalia (Picture 5.1) and is directly fed by the oceanic tides. The offtake of the Lohalia River is Tetulia (Barisal) at Bakerganj upazila under Barisal district and drains into the Ramnabad River in Patuakhali district.The river is perennial in nature. The length of the river Lohalia is approximately 93.0 km; width is minimum 127m, maximum 1417 m and average 325 m. It is a tidal river and the maximum average variation of water level is 2.5 m between high tide and low tide.BIWTA declared this river as a class III route of Bangladesh(*Bangladesh Rivers, August 2011, BWDB*).The river system of the area is shown in Map 5.6.

Picture 5.1: Lohalia River

Picture 5.2: Golkhali River



Map 5.6: River System of the Polder Area

b. Hydrological Connectivity

362. *The water resources system of the polder area is mainly governed by the Lohalia River, which*feeds the peripheral Golkhali River and Sonakhali River. In addition, there are numerous khals inside the polder area namely Musir khal, Pollar khal, Golkhali khal, Rishir khal, Taltola khal, Shuhari khal, Jamaluddin khal, Jiali khal and other khals (Picture 5.3-5.8) which outfall in the surrounding rivers. These khalshave tidal effects, which flow from northeast to southwest and control the main drainage system and supplementary irrigation during monsoon. The internal water courses of the polder facilitate the flow circulation inside the polder. During high tide, the flow direction of the khals is from *Lohalia River* to these khals inside polder whereas at low tide period, tidal water recedes through the peripheral water courses and reaches the Bay of Bengal.

363. During the rainy season, these khals are used to drain the surplus water out of the polder.However, in recent years, most of the khals have been silted up due to increased siltation. Local people opined that *Musir khal, Rishir khal, Jamaluddin khal and Pollar khal* has been silted up by around 1.5 m to 2.0 m in last decade because of the damaged sluice gates placed at the khal openings, which leadthe siltation process. This also hampers the flow circulation inside the polder area.

Picture 5.3: Sonakhali khal

Picture 5.4: Golkhali khal

Picture 5.5: Jamaluddiin khal

Picture 5.6: Mushir khal

Picture 5.7: Pollar khal

Picture 5.8: Taltola khal

5.1.8 Hydrological Setting

a. Surface Water Levels

364. The surface water level is an important issue of water resources. The available surface water levels data of two BWDB stations at Galachipa (Station ID: 185) and at Patuakhali (Station ID: 184) of Lohalia River were collected for the years 1968 to 1988 (Figures 5.6 and 5.7). The Patuakhali station (Station ID: 184) is situated at 40 km upstream on Lohalia at Idrakpur mauza of Lohalia union whereas, Galachipa station (Station ID: 185) is adjacent to the study area. Water levels during high tide range from 1.35 to 2.37 m +PWD at Galachipa, and 0.97 to 1.86 m +PWD at Patuakhali. On the other hand, the low tidal water levels range from 0.17to 0.59 m below the MSL at Galachipa, and to 0.47 to 0.68 m below MSL at Patuakhali.

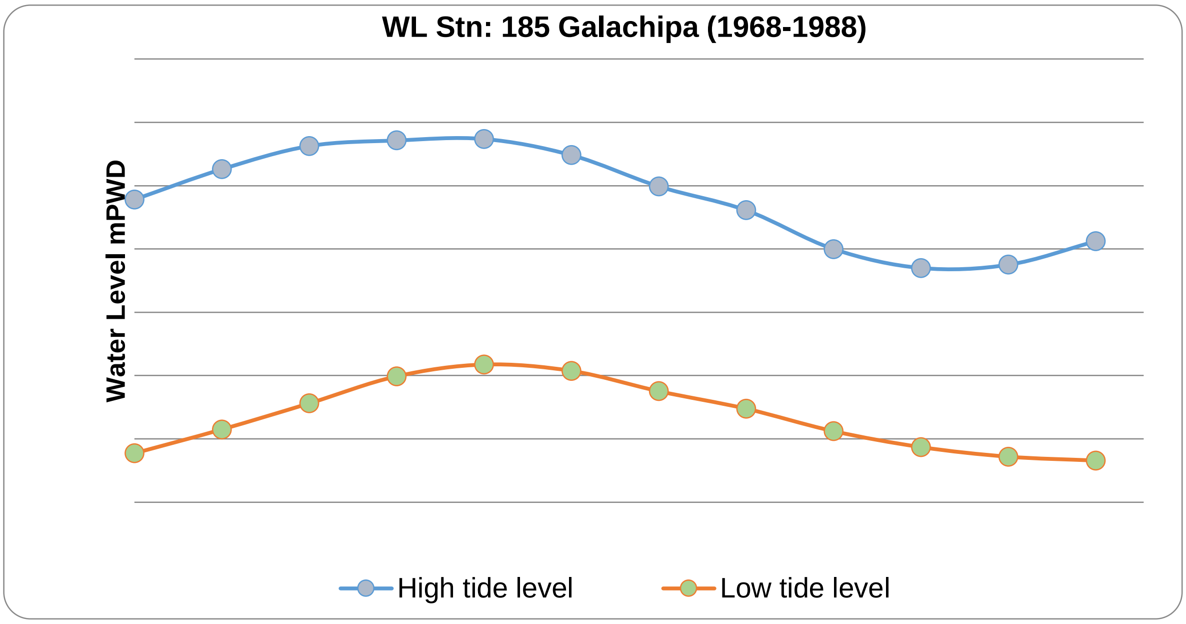


Figure 5.6: Surface water level at Galachipa (Lohalia River)

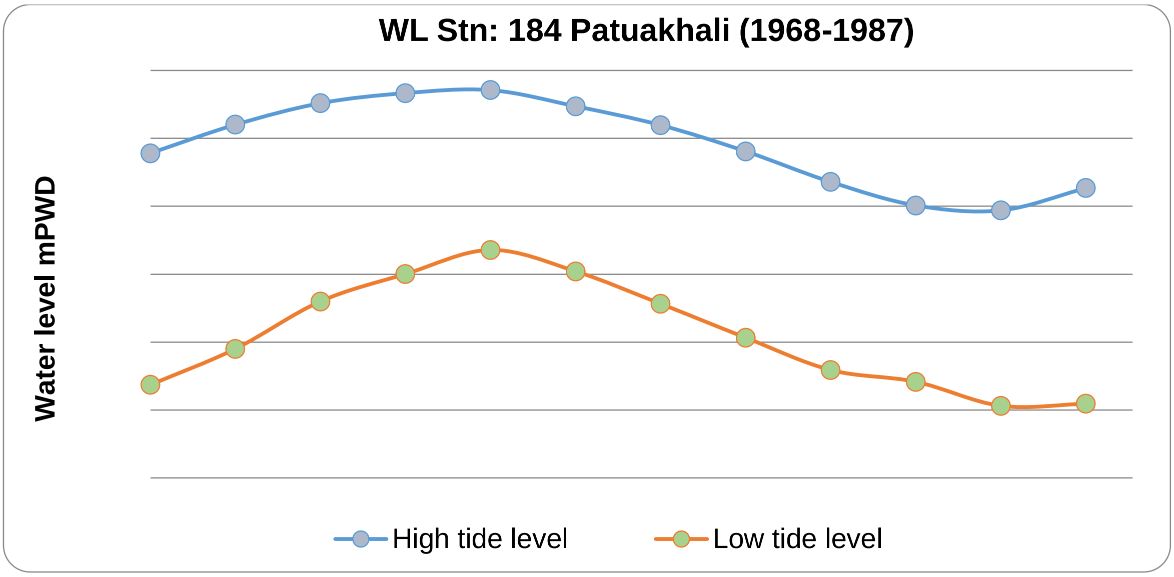


Figure 5.7: Surface water level at Patuakhali (Lohalia River)

b. Groundwater Table

365. As other parts of the country, the project influence area also receives sufficient amount of rainfall and there is good availability of groundwater used by hand pumps for drinking and domestic purposes. Monthly variation in ground water level from the year 1977 to 2013 has been analyzed from the BWDB ground water observation well PAT001 (Well ID: 17857001) in PAT001 station the GWT at Galachipa upazila. The fluctuation of ground water table is fair whereas lowest and highest values (GWT) are found in March and September respectively. The monthly variation of average ground water level at Galachipa Upazila is shown in Figure 5.8.

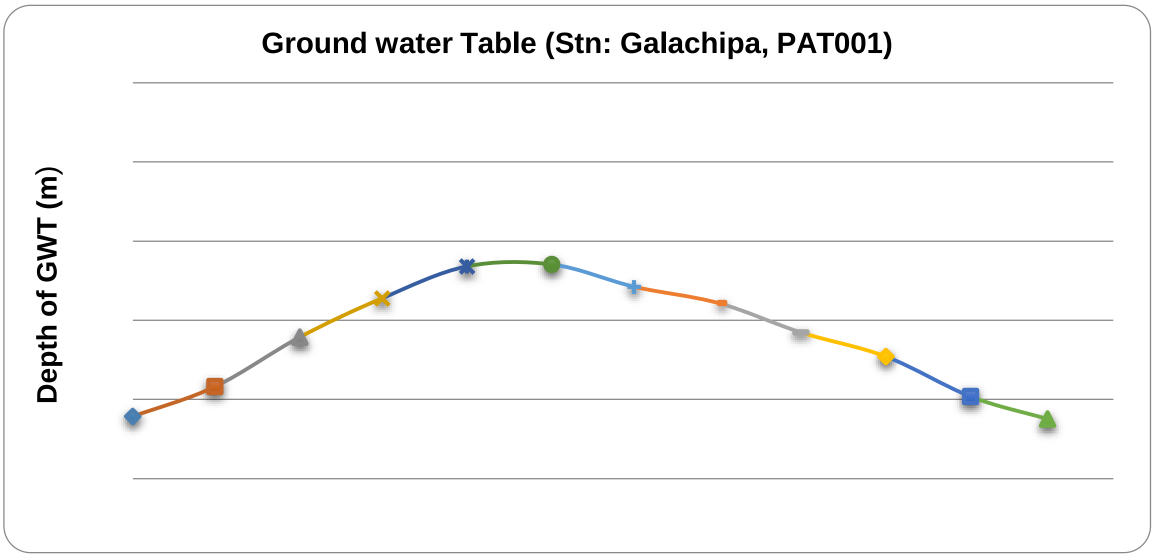


Figure 5.8: Average monthly variations of GWT

366. The Ground Water Table (GWT) measured at the aforementioned location at ten year intervals are shown in Table 5.5. Values are analysed for the months of March (Considered as dry period) and September (considered as wet period). In the dry season, increased dependency of the local people on ground water as well as no recharge lowers the GWT.

During monsoon, the higher availability of surface water leads to higher recharge of ground water sources.

Table 5.5: Ground Water Tables (GWT) shown at ten year intervals

New ID	Location	1980		1990		2000		2010	
		Mar	Sep	Mar	Sep	Mar	Sep	Mar	Sep
PAT001	Galachipa	1.52	1.3	1.16	0.62	1.26	0.61	1.21	0.17

Source: NWRD, 2015

c. Aquifer System

367. 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 43/2C) has fallen under coastal area, which belongs to deeper aquifer of the country. The brief characteristics of this aquifer system is described below:

368. The deeper aquifer: The deeper unit is separated from the overlying main aquifer by one or more clay layers of varied thickness and extent. Deep aquifers are generally based on depth and in some areas the aquifers which water have no access of water vertically upward or downward but flows very slowly along the dips and slopes of the aquifers (Figure5.8 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 5.5 (a). From the Table 5.5 (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.

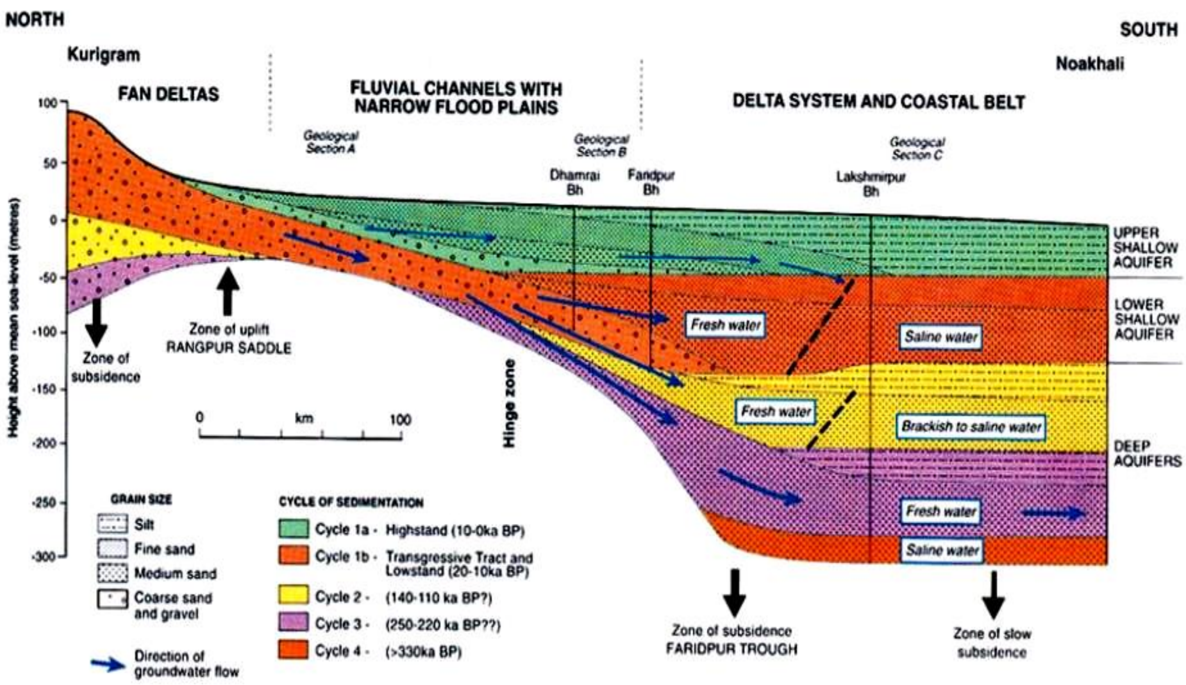


Figure 5.8-a: Hydrogeological Cross Section from North to South across Bangladesh.

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

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

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

369. Further, the lithology of coastal aquifer is presented in Figure-5.8 b below:

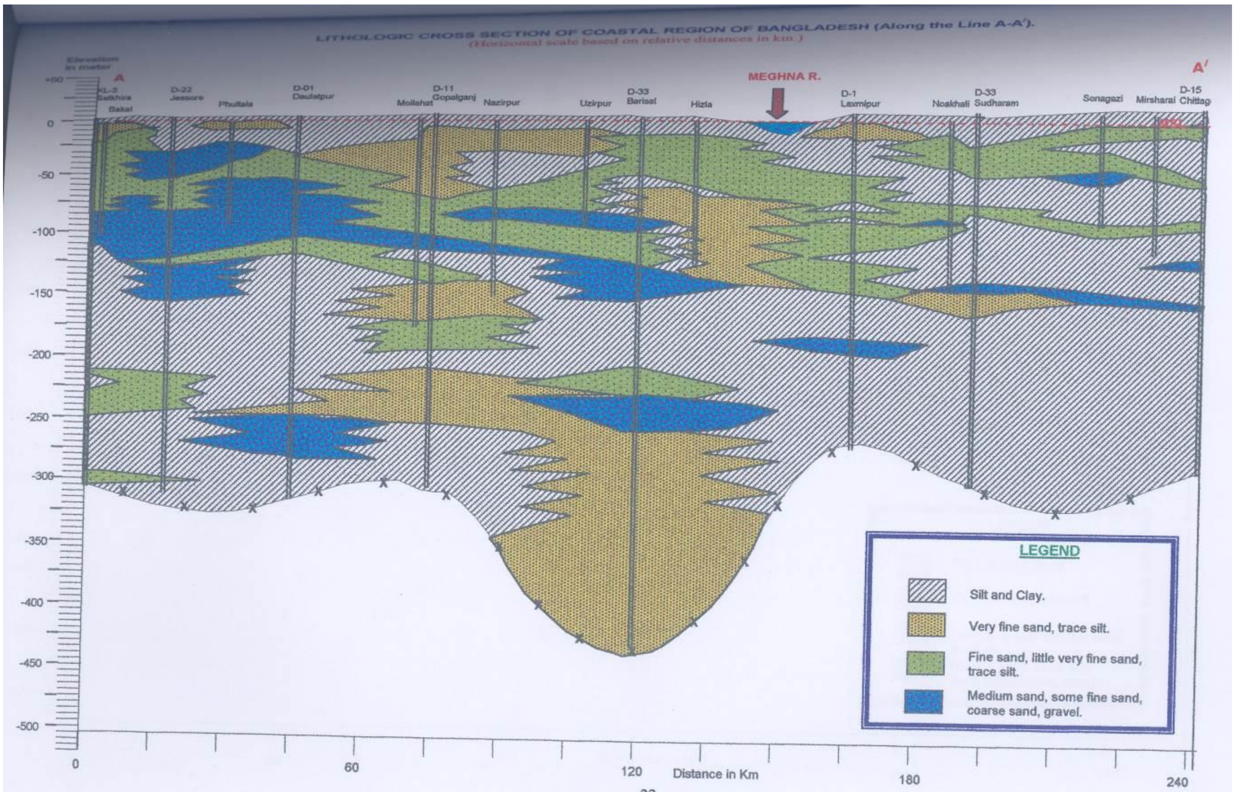


Figure 5.8-b: Lithological Cross-section of the coastal aquifer

370. Furthermore, based on the lithology and other characteristics of the aquifer the entire country has been divided into 15 potential groundwater development zones (Figure 5.8 c). The study area has fallen under zone N (Table 5.5-b) which has been characterized as Floodplains of GBM with brackish & saline water problems.

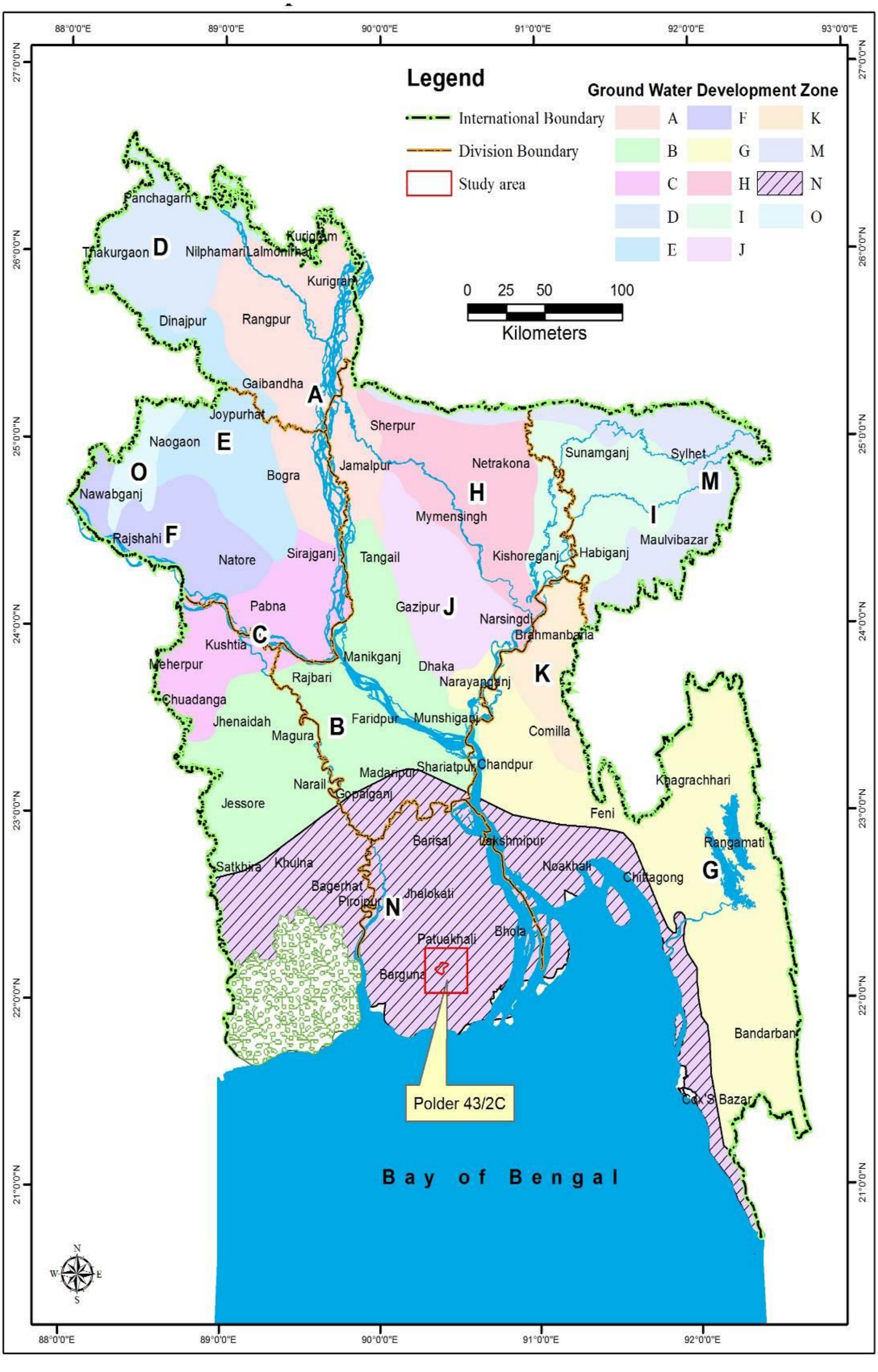


Figure 5.8-c: Potential groundwater development zones

Table 5.5-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 cusec for deep wells	---
D	Most northwestern region (Dinajpur)	Coarse detrital piedmont deposits, top silt clay	T= high	Suitable for groundwater development
E	Bogra and Rajshahi	Older alluvial clay	1-2 cusec for deep wells	---
F	Southern and western parts of Rajshahi	Same as zone C	---	Lowest recharge
G	Southwestern section of Camilla& northern part of Noakhali	Floodplain deposits of the Meghna	2 cusec for deep wells	Suitable for deep wells
H	Most of Mymensingh, eastern Jamalpur & a small part of NW Dhaka	Floodplain deposit of the Old Brahmaputra	2 cusec for deep wells	Suitable for deep wells; high recharge
I	Plains of Sylhet district	Top part silt & clay	One cusec for deep wells	High rainfall, high recharge
J	Parts of Dhaka, Tangail & Mymensingh	Top part Madhupur Clay	1-2 cusec (200 mm recharge /Year)	Suitable for deep wells
K	Eastern part of Comilla	Estuarine silt	2 cusec	Suitable for deep wells
L	Chittagong & Noakhali	Piedmont deposits & estuarine deposits	T= 40 m^2/day	Not favourable for extensive withdrawal
M	Hilly areas of Sylhet& Mymensingh& Ctg. Hill Tracts	Tertiary sediments	Low transmissivity	Not favourable for extensive withdrawal
N	Coastal areas of Barisal, Patuakhali , most of Khulna, Noakhali & Chittagong	Floodplains of GBM	1,000-3,000 m^2/day	Brackish & saline water problems
O	Western Rajshahi district	Thick Madhupur clay on the top part with thin sand layers	---	Limited scope for development

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

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

mechanism and Lateral intrusion mechanism of coastal aquifer has been shown in Figure-5.8 d and Figure-5.9below:

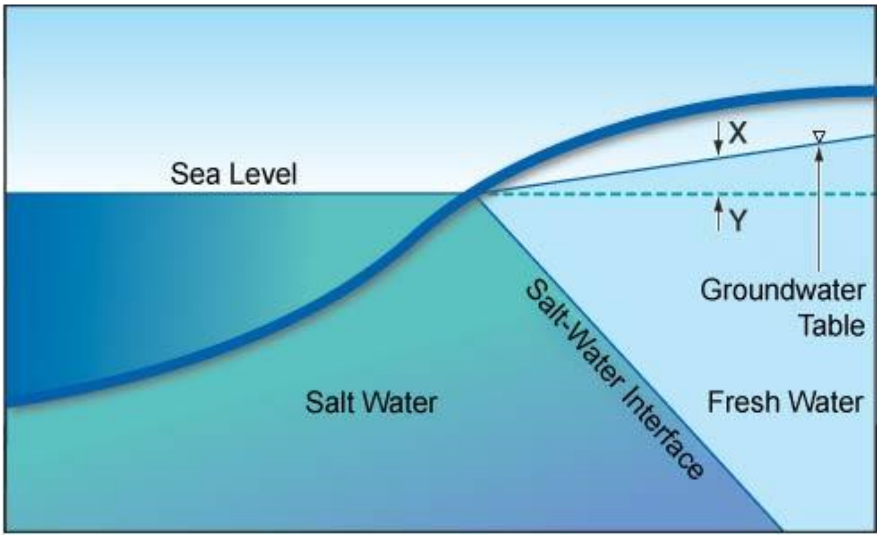


Figure 5.8-d: Seawater intrusion mechanism for homogeneous and unconfined coastal aquifer

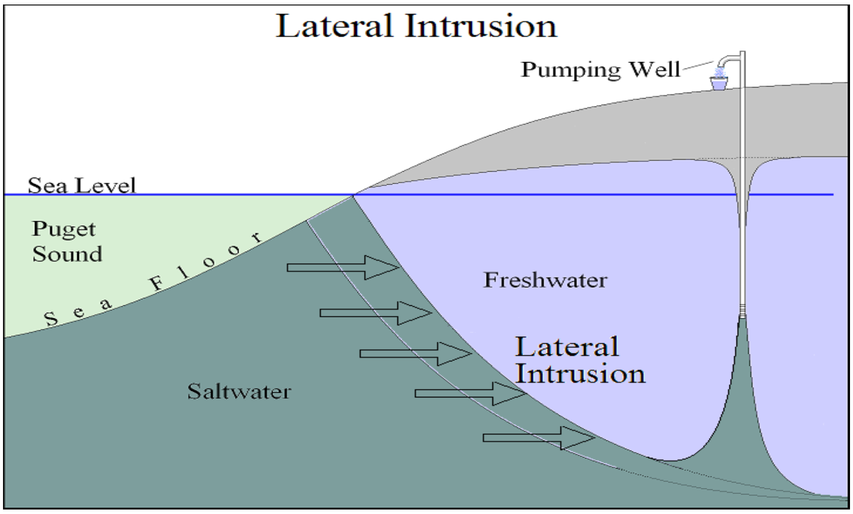


Figure 5.9: Lateral intrusion mechanism of coastal aquifer

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

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

5.1.9 Water Resources Issues and Functions

Drainage congestion has been identified as the major problem in the polder area. It is evident from the field visit and consultation with local people that the polder encounter various problems like tidal and storm surges flooding, navigation and water use.

a) Drainage Congestion and Water Logging

373. Drainage congestion is a major problem inside the polderarea and its intensity varies from place to place. Almost all the khals inside the polder, which are directly connected to the peripheral rivers, suffer from severe drainage congestion. Severely affected khals are *Mushir khal, Rishir khal, Golkhali khal and Pollar khal*. A total of about 84% (2314 mm) of total annual rainfall occurs during monsoon and post-monsoon periods. As a result, these internal khals cannot cope with the increased rainfall occurrences, leading to moderate to severe drainage congestion problems. Local people opined that, around 527 ha (20% of total polder area) suffers from *moderate drainage congestion*[8] problems. From the field investigation during June 2015 and using Digital Elevation Model (DEM), the Mouza wise drainage congestion area (approximately) is shown in Table 5.6.

Table 5.6: Mauza wise drainage congestion area

SL	Union name	Mauza name	Affected area (ha)
1	Golkhali	Badarpur	29
2		Bara Gabua	61
3		Chhota Gabua	54
4		Golkhali	176
5		Horidevpur Char	3
6		Kalir Char	81
7		Kismat Horidevpur	11
8		Purba Golkhali	97
9		Suhari (1St Part)	13
10		Suhari Nijchar	2
		Total	**527**

Source: Field Survey, 2015

374. Such drainage congestion problems mostly affect the agriculture and production sector. Due to the reduced drainage capacity of khals, rainwater often inundates agricultural fields for a period of 4~5 days and affects the Kharif-II crops.

375. The main drainage dynamic of the polder is mainly governed by seven (07) drainage sluices associated with other internal khals. At present, the internal khals are silted up because of the damaged sluice gates at the khal openings. Some of the gates (*Musir khal, Pollar khal, Rishir khal etc*.) became non-functional due to poor maintenance, leading to siltation adjacent to the khal openings. The rate of sedimentation in the khals and bank side deposition is steadily increasing and the cumulative sedimentation causes rise of bed level of the internal khals. Since the khals are deposited with silt, their water conveyance capacity is decreasing affecting quick drainage from the polder area. Besides, the 17 flushing inlet in the polder are in deplorable condition,which also create drainage congestion.

a) Tidal and storm surge flooding

376. Cyclones have been hitting the coasts of Bangladesh very frequently in the recent decades. From 1901-1957 only 11 cyclones had hit the coastal areas of Bangladesh, while from 1957 to 2009 a total number of 55 cyclones have hit the area. Therefore, in the last 52 years, the number of cyclones hitting coastal areas of Bangladesh has increased 5 times

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

compared to the previous 57 years (BMD). The recent most devastating cyclones hit the study area were Sidr (2007) and Aila (2009).

377. The devastating cyclone Sidr (*2007*) directly hit the polder area and affected about 50% of the total area. During this cyclone, surge water entered into the polder area by overtopping (about 1-1.5 feet water on embankment) the left bank of Lohalia River and Golkhali River and damageda number of segments of the flood control embankment mentioned in the map 4.1. At that time, the water level inside the polder from the ground surface was 3-4 feet. As a result, the sea-dyke, interior-dyke and marginal-dyke of the polder was damaged and aggravated continued with time due to weathering and regular tidal wave action. At present, the total length of embankment of the polder is under intense threat of cyclone surges, tidal wave action and river erosion. Tidal motion dominates during pre-monsoon and post-monsoon. However, non-saline/fresh water of the rivers playvery important role for supplementary irrigation, especially during monsoon.

378. Tidal flooding is very common in the project area. At present, tidal flooding occurs inside the Polder almost every year and inundates about 25 – 35 % of the total polder area. Purba Golkhali, Golkhali, Bara Gabua and Kalirchar mauzas are mainly affected by tidal flooding. The main reasons for flooding are heavy rainfall and tidal water intrusion through the damaged gates.

Navigation

379. The peripheral rivers and Khals (Lohalia and Golkhali) of Polder- 43/2C are used as waterway communication (Picture 5.9-5.10). Small trawlers carrying passengers and sand have been frequently found to navigate through the river. However, very little navigation takes place inside the polder as only small fishing boats are found to navigate through the internal khals.

Picture 5.9:Navigation along Lohalia river at Suhari

Picture 5.10:Navigation along Lohalia river at Horidevpur Char

b) Water Use

Domestic Use

380. The standard value of average daily demand of water for domestic and drinking purposes in rural areas is considered as 50 lpc (Ahmed and Rahman, 2010). During field survey in Polder- 43/2C, it was found that the average daily domestic use of water is around 40 lpc. The study found that around 834 m^3 of water is consumed daily by the total number of 20,845 people living in the polder. Local people opined that they prefer Deep Tube Wells (DTWs) as drinking water sources to meet up their daily requirements. For other domestic uses, shallow tube well and surface water sources (pond) are used. Overall, water availability in Polder- 43/2C is not a major concern as local people claimed that they have sufficient surface and groundwater sources to meet up their daily needs for drinking and domestic purposes.

Irrigation use

381. The local farmers in Polder- 43/2C practice Lt. Aus and summer vegetable in Kharif-I (March-June) season, T. Aman (both local and HYV)) in Kharif-II season (July-October) and some dry land crops (Orchard, Watermelon, Potato, Spices, Oil seeds crop, Pulses, Vegetables) in Rabi (November-February) season. The rain-fed irrigation is sufficient during Kharif-I and Kharif-II seasons for Lt. Aus, HYV Aman and Lt Aman crops, whereas surface water irrigation is provided only for Watermelon and Potato crops during Rabi season. Water is also required for other *Rabi* season crops (Orchard, Watermelon, Potato, Spices, Oil seeds crop, Pulses, Vegetables) but no irrigation is required for these crops as sufficient soil moisture is available during the season.

382. Previous CEGIS studies have inferred that around 300 mm of water is usually required for each ha area of Aus and Aman cultivation. Around 200 mm of water is required for each ha for watermelon and other *Rabi* season crops practiced in the area. Using these pragmatic standards of water requirements, the study infers that approximately 2.93m^3 of water would be required during each Rabi season to ensure effective supplementary irrigation. The surface water irrigation coverage is around 3% of the NCA of Polder- 43/2C and local people claimed that the low water availability marked by the reduced water carrying capacity of khals and poor functioning of water control structures are the major reasons for which more areas cannot be irrigated during the Rabi season. Irrigation through LLPs is a very costly intervention (exacting BDT 4,500 to BDT 5,000 per ha areas), for which cultivation of boro crops is not common as it requires almost 10 times more water than that required for watermelon cultivation.

Table 5.7: Irrigation water requirements in Polder- 43/2C

Season	Lt. Aus (ha)	HYV Aus (ha)	Lt. Aman (ha)	HYV Aman (ha)	Boro (ha)	Orchard, potatoes, spices, water melon, vegetables	Water requirement (mm/ ha)	Water Used (Mm3)	Type of irrigation
Kharif-I (March - June)	565	410	-	-		-	300	2.925	No supplementary irrigation is required as rainwater is sufficient
Kharif-II (July - October)	-		1,000	550		-	300	4.65	No supplementary irrigation is required as rainwater is sufficient
Rabi (November – February)	-		-	-	65	-	2000	1.3	Surface water irrigation is provided using LLP and other traditional methods.
	-		-	-		815	200	1.63	

Source: CEGIS Estimation, June 2015

5.1.10 River morphology and dynamics

Historical Erosion-Accretion Analysis along Galachipa River

383. Erosion is the process where the bankline moves towards the land where accretion is the process where the bankline moves towards the river.. Historical satellite images for the year 1997 and 2015 were analyzed to understand the historical erosion-accretion of the adjacent river of the Polder- 43/2C. Bankline delineation was done from the satellite images and by superimposing the banklines of different two years erosion/accretion was assessed. The 17 km reach around the Galachipa River has undergone erosion of an estimated 106.25 hectares at the rate of 5.90 hectares per year while the accretion was 40.85 hectares at the rate of 2.27 hectares per year. The amount of erosion is comparatively higher than the accretions in this reach (Map 5.7-a).

384. River bank erosion is very active in this area (Picture 5.12-5.13). During field investigation, three erosion hotspots have been found along the left bank of Lohalia River.The riverside slope of embankments at Ch. 13+200 km to Ch. 14+000 km and Ch.14+350 km to Ch. 14+500km of Purba Golkhali mauza and Ch. 18+600 km to Ch. 19+700 km of Horidevpur Char mauza has been damaged (refer map 4.1 for chainage numbers)due to severe wave action of the River Lohalia.

385. The embankment at Purba Golkhali, from Ch. 13+200 km to Ch. 14+000 km embankment is under threaten of severe bank erosion. Local people informed that, the location is unstable and is being eroded for some 5~6 years. A total length of about 75 m length of embankment has been breached (Date: 25 June, 2015) due to heavy rainfall and severe wave action of Lohalia river.


Picture 5.11: River bank erosion at Purba Golkhali Ch. 13+450 km

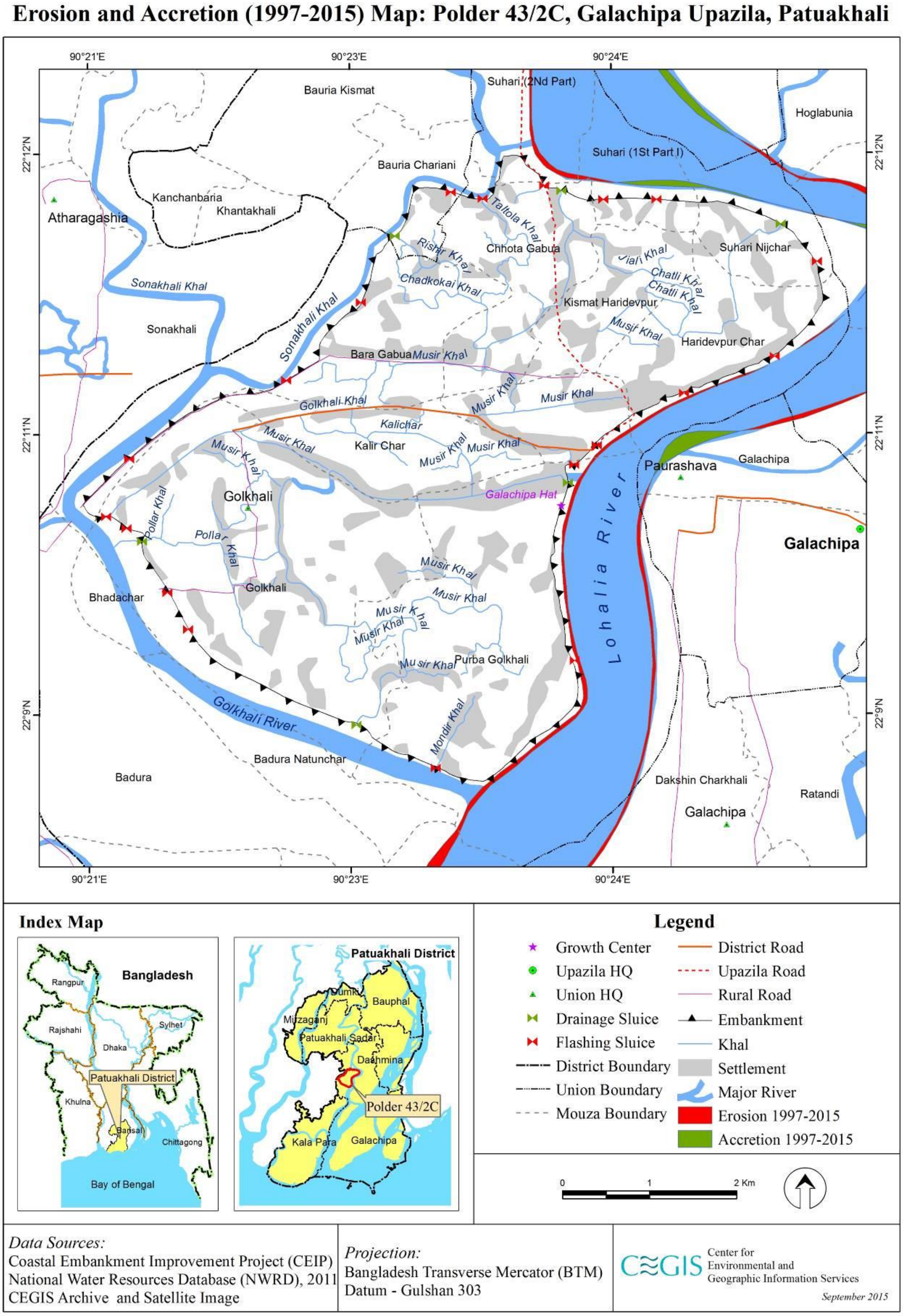
Picture 5.12: Erosion at Purba Golkhali Ch. 14+000 km to Ch. 14+350 km

Picture 5.13: Erosion at Horidevpur Char Ch. 18+600 km to Ch. 19+700 km

386. During field inspection, at Ch. 14+000 km and Ch.14+350 km at Purbo Golkhali mauza and Ch. 18+600 km to Ch. 19+700 km at Horidevpur Char mauza; no breach was observed, but there is no setback distance along the riverside floodplain. Local people at Horidevpur char opined that, due to severe wave action from Lohalia river the erosion process is very active. Hence, slope protection work is needed at this point.

387. From spatial analyses using the satellite imageries of different time frame (1988, 2003 and 2014), it has been found that around 100 ha of lands have been eroded from the Purba Golkhali point in last 26 years and around 20 ha lands have been eroded from the floodplain portions of Horidevpur char.

388. Without rehabilitation and erosion protection works, existing flood control embankment, drainage and flushing infrastructure, agricultural lands and other natural resources will remain exposed to river erosion with serious consequences on society, economy and environment.



Map 5.7 (a): Erosion-Accretion along the Galachipa River

5.1.11 Environmental quality and pollution

a. Air Quality

389. The national standards for air quality are given in Table 5.8-a.

Table 5.8-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 (µg/m^3)	150	65	-	365	-
	Annual (µg/m^3)	50	15	-	-	100
WHO	24h average (µg/m^3)	50	25	-	-	200 (1h average)
	Annual (µg/m^3)	20	10	-	-	40

Source: Bangladesh National Ambient Air Quality Standard

390. **Table 5.8-b** shows the air quality data measured inside the polder in Galachipa upazila under Patuakhali 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. The relative high values may be due to large number of diesel vehicles used for internal communication, besides most of the passenger bearing and fishing boats are also mechanized.

Table 5.8-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
Galachipa (Polder 43/2C)	92.0	67.5	21.9	91.7	0.266

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

b. Water quality

391. Five major water quality parameters (pH, TDS, Temp., DO and Salinity) were measured on site in June 2015, from five different sampling locations of the polder. One of the five samples was collected from a Deep Tube Well (DTW) at Char Shuri Primary school. The other four samples were all collected from different surface water sources (three from outside the polder and one from inside the polder). The results of the in-situ water quality measurements are shown in Table 5.9-a below:

Table 5.9-a: Salinity levels in different locations

Location	Sampling Water Source	GPS readings	pH	TDS (ppm)	Temp. (ºC)	DO (mg/l)	Salinity (ppt)
WAPDA Bader hat at Golkhali Sluice (DS-3)	Lohalia River, outside the polder	22°10’14.8”N 90°23'49.2”E	7.42	896	27.9	5.9	0
Musir khal near DS-4	Inside the polder	22°09’03.0”N 90°22'43.1”E	7.29	493	28.1	4.8	0
Polder khal at Alir Barzar near DS -5	Outside polder	22°9’52.6”N 90°20'48.0”E	7.52	778	26.2	5.6	0
Danga khal near DS-1	Inside polder	22°11’52.7”N 90°23’49.0”E	7.20	578	25.3	5.2	0
Char Shuri primary school	Deep Tube Well, inside the polder	22°11’41.1”N 90°25'3.1”E	7.10	139	24.1	4.1	0

Source: CEGIS field survey, June 2015

392. The p^H values found are higher than the neutral value (p^H=7) which means that the water in these locations areslightly alkaline in nature during June. The polder is situated along the bank of Lohalia River, which are directly connected with the Bay of Bengal. This eventually results in reduced sediment transportation near the polder, for which the values of TDS were found low inside the polder but moderately high in the Lohalia river. The Values of DO are mostly found close to the standard values set by the DoE for both irrigation (5 to 6 mg/l) and fishing (5 mg/l), although it has the lowest content in the deep tube well water. Temperature values varied within a typical range for different locations as samplings were made in different time of the day. No salinity was found in any of the water samples. It can be inferred that due to the increased amount of freshwater discharge from the upstream; Meghna River system towards the rivers of the South Central hydrological region, surface water has been found to be free of salinity.

393. In addition, surface water quality has also been measured in dry season (February, 2016), when salinity level is thought to be increased along with changes of other qualities.Table 5.9-b shows the water quality in dry season of the same parameters of surface water.

Table 5.9-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)
Lohalia River	Horidevpur ferry ghat	22°10'36.92"N 90°24'17.80"E	8.2	167	23.2	8.5	0
Musir khal	Purba Golkhali	22° 8'44.59"N 90°22'23.00"E	8.1	178	24.2	8.3	0
Poller khal	Alir Bazar	22° 9'53.06"N 90°20'57.10"E	8.2	176	23.5	8.1	0
Danga khal	Chhoto Gabua	22°12'3.06"N 90°23'45.31"E	8.2	167	24.2	8.3	0
Tubewell	Horidevpur ferry ghat	22°10'38.20"N 90°24'15.29"E	7.9	600	25.5	2.2	0
DoE Standard Value (Bangladesh)			***6.0-9.0***	***2100***	***20-30***	***4.5-8.0***	***-***

Source: CEGIS field survey, February 2016

394. It is found from the above Table that the pH of the water samples turned more alkaline during dry period than during the monsoon. The TDS value reduced during dry season than the values of wet season. Temperature has lower values during dry season, excepting that of the HTW. It is interesting to note that, DO value is quite high in the surface water during the dry season. However, no salinity has been found during dry season even, which accords with the statement of the local people that no salinity occurs in the area during dry season.

c. Noise quality

395. The national standards for noise level of the different area category are given in Table 5.10.

Table 5.10: Bangladesh Standards for Noise level

Sl. No.	Area Category	Standard Values (all values in dBA)	
		Day	Night
1	Silent Zone	45	35
2	Residential area	50	40
3	Mixed area (basically residential and together used for commercial and industrial purposes)	60	50
4	Commercial area	70	60
5	Industrial area	75	70

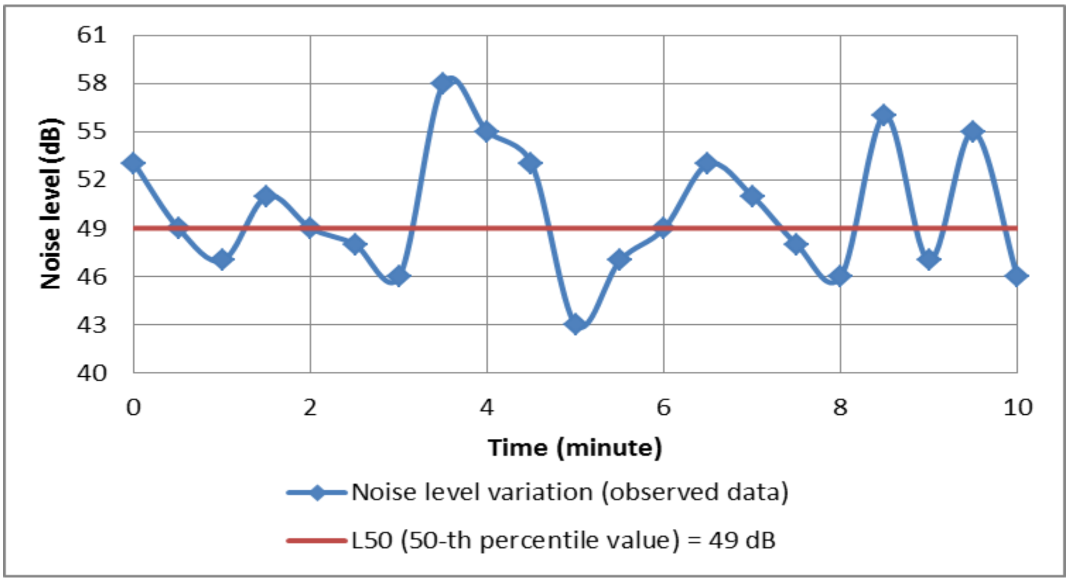
Source: Environment Conservation Rules, 1997 (Page 3127, Bangladesh Gazette, 28 August 1997) (translatedfrom Bengali)

396. Silent zones are areas up to a radius of 100 meter around hospitals, educational institutes or special establishments declared or to be declared as such by the Government. Use of vehicular horn, other signals and loudspeakers is prohibited in silent zones.

Note:

1. The time from 6 a.m. to 9 p.m. is counted as daytime.
2. The time from 9 p.m. to 6 a.m. is counted as nighttime.
3. Area up to a radius of 100 meters around hospitals or educational institutions or special institutions/ establishments identified/to be identified by the Government is designated as Silent Zones where use of horns of vehicles or other audio signals, and loudspeakers are prohibited.

397. During field inspection, sound levels were measured at Alir Bazar(Figure 5.10) with 10 minute sampling periods. L_{50}(50-th percentile value) value was computed with the observed sound levels. For a normal time series distribution of sound levels, L_{50} is assumed to be equal to Leq, which is the Equivalent Noise Level. In the study area, the L_{50} value was found as 49 dB, which is lower than the standard Leq value for residential zone, set by ECR, 1997 (50 dB). As the project implementation works are to be carried out manually i.e. without the use of any typical heavy loading vehicle, it can be assumed that the sound levels generated from the construction sites due to project implementation works would have very minor contributions in the equivalent noise levels of the polder.



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

Figure 5.10: Variation of sound levels for 10 minute sampling period at Alir Bazar (22º09'53.2''N and 90º20'56.6''E)

d. Soil quality

398. Soil samples were collected from three locations in one depth i.e. top soil (0-15 cm) inside the polder area on 24th and 25th June, 2015. Collected soil samples were handing over at Soil Resource Development Institute (SRDI), Dhaka to analyze the Soil salinity (EC), Soil reaction (pH), Organic Matter (OM), Nitrogen (N), Phosphorus (P), Potassium (K), Sulfur (S) and Zinc (Zn) and Entomology Division, BARI, Gazipur to detect pesticide residues. The methods are using for soil quality analysis is presented in the following table:

Methods using for soil quality analysis

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

Sources: SRDI and BARI Laboratory

399. The soil salinity levels are 1.01 to 7.57 (ds/m) in the top soil (depth of 0-15 cm) in all agricultural land. It indicates that, respective agricultural land suffers from non saline to very slightly saline. The pH levels are observed at 7.4 to 7.7 in all the land. It indicates that, pH level was slightly alkaline in nature and ranges within the limit in all agricultural land. The Organic Matter (OM %) are 1.12 to1.98 in all the agricultural land. OM status is low to medium (≤1.0-1.7%) in all the agricultural land (BARC, 2012). In case of Nitrogen (N) level, it was found that 0.07-0.11% in all locations of the soils. The N level observed very low to low in nature. Potassium (K) level ranges from 0.08-0.17(meq/100g) in all locations. The K level observed

very low to low in nature. Concentration of Phosphorus (P) was found, 6.90-29.30(µg/g) in all locations, which The P level ranges from low to very high in all locations. In case of Sulphur (S) itwas found, 9.20– 40.96 (µg/g) in all locations. The S level ranges from low to very high. The Zinc (Zn) levels are 0.77-1.40(µg/g) in all locations. The level of Zn was very low to optimum in nature. The analyzed result shows that no pesticide (Furadan) exists in the soil samples. Soil quality of the agricultural land is presented in Table 5.11 and the standard of chemical properties of soil is also presented in appendix-2.

Table 5.11: Chemical Properties of Soil on Agriculture Land

Location (Mouza / Village)	GPS reading	Land use	Depth (cm)	EC (ds/m)	pH	OM	N	K	P	S	Zn	Carbofuran (ppm)
						%		meq/ 100g	µg/g			
Purbo Golkhali	220 10’ 0.1’’ N 90 25’ 6.0 E	Fallow-Lt.Aman-Pulse	0-15	1.01	7.4	1.12	0.07	0.08	29.30	9.20	0.77	*ND
Dakshin Purbo Golkhali	220 08’ 24.5’’ N 900 23’ 16.2’’ E	Lt.Aus-HYVAman-Pulses	0-15	2.10	7.4	1.98	0.11	0.17	23.39	40.96	1.40	*ND
Alir Bazar	220 09’ 53.2’’ N 900 20’ 54.6’’ E	Fallow-Lt. Aman-Potato	0-15	7.57	7.7	1.37	0.08	0.15	6.90	23.24	0.90	*ND

Sources: SRDI and BARI laboratory test, August; 2015

**ND = Not detected*

5.2 Biological Environment

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

5.2.1 Bio-ecological Zone

401. Twenty five (25) bio-ecological zones (IUCN, 2002) have been identified by IUCN-The World Conservation Union in Bangladesh. These bio-ecological zones can be classified as major ecosystems of the country. The 43/2C polder area encompasses one of these bio-ecological zones, namely the Ganges Floodplain.

5.2.2 Ecosystems

a. Terrestrial Ecosystem

i. Terrestrial Flora

402. There is no natural/reserved forest within or adjacent to Polder - 43/2C. Existing vegetation in thepolder are divided as *homestead vegetation, crop field vegetation and road side vegetation*.

Settlement/Homestead vegetation

403. Ninety percent(90%) of the homestead vegetation is man-made those are usually planted for the household benefits. Rest of vegetation is considered as self-propagating.Homesteadvegetation is dominated byNarikel (*Cocos nucifera*), Taal (*Borassus flabeliffer*), and Khejur (*Phoenix sylvestris*). Mango (*Mangifera indica*), Boroi (*Zizyphus mauritiana*), Supari (*Areca catechu*), Bansh (*Bambusa Spp.),* Chambol (*Albizia richardiana*), Mahogoni (*Swietenia mahogon*) and Raintree (*Samanea saman*). In the polder area, the exotic species of Akashmoni *(Acacia auriculiformes)* is observed during field visit. Table 5.12 provides a list of major tree species within the homestead vegetation in the polder area. Settlement vegetation is also providing shelter for various terrestrial fauna.

Table 5.12: Major trees species within the homestead area

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

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

Source: CEGIS Field Survey, 2015

Note: Local Stratus: C= Common, VC = Very Common, O = Occasionally, R= RareHabit: T= tree, H= Herb, S= Shrub, V=Vine; VC= Very Common, C= Common, UC= Uncommon, CL=Clump

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

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

405. Crop field vegetation

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

407. A part of the crop fields being seasonal (March-June) remain fallow for 3-4 months of a year. During this period,the fallow land is covered by grassy vegetation with some wild herbs. Durba (*Cynodon*sp.) is prevalent with *Echinocola, Brachiara, Digiteria, Hemarthrira, cyperus* and *Paspalum* sp. The seasonal fallow lands have important roles in ecosystem functioning as support for grazing for cattle, feeding and breeding habitats of many arthropods, reptiles and avifauna.

Embankment /Roadside vegetation

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

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

410. Table 5.13provides a list of major tree species within the embankment/ road side vegetation in the polder area.

Table 5.13: List of plant species found in the embankment/roadside of the polder area

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

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

ii. **Terrestrialfauna**

411. There are diversified terrestrial fauna with different species in the polder area. The major terrestrial fauna are different types of mammals, birds, reptiles and amphibians. The major fauna of different species with their habitat is shown in the Table 5.14.

Table 5.14: List of terrestrial fauna of the polder area

Types of Species	Name (generic name)	Habitat
Mammals	Large Bandicoot Rat (Bandicota indica), House Mouse (Mus musculus), Asian House Shrew (Mus murinus), Bengal Fox (Vulpes bengalensis), Indian Flying Fox (Pteropus giganteus), Indian Pipistrelle (Pipistrellus coromanda), Common Mongoose (Herpestes edwardsii), Jackal (Canis aureus) and Large Indian Civet (Viverra zibetha) . **Gangetic River Dolphins** (Platanista gangetica), **Common Otter** (Lutra lutra) also found surfing in the Sonatala River system.	Mostly in bamboo thickets, cropped fields or barren land, bushy areas.
Birds	Oriental Magpie Robin (Copsychus saularis), Spotted Dove (Streptopelia chinensis), Red-vented Bulbul (Pycnonotus cafer), Common Myna (Acridotheres tristis), Black Drongo (Dicrurus macrocercus), Common Kingfisher (Alcedo atthis), White-throated Kingfisher (Halcyon smyrnensis), Garganey (Anas querquedula), Eurasian Wigeon (Anas penelope), Eurasian Teal (Anas crecca), Northern Shoveler (Anas clypeata), Pin-tailed Snipe (Gallinago stenura) and Black-tailed Godwit (Limosa limosa). Other birds available are Rufous Treepie (Dendrocitta vagabunda), Asian Koel (Eudynamys scolopacea), Greater Coucal (Centropus sinensis), Black-hooded Oriole (Oriolus xanthornus), White-bellied Sea Eagle (Halieetus leucogaster) and Blue-throated Barbet (Megalaima asitica).	Terrestrial birds habitat can be divided into two major groups: birds observed in floodplains and wetland, and birds observed in dry habitat such as homestead, open woodland, scrub and grass land.
Reptiles	Common Garden Lizard (Calotes versicolor), Spotted House Lizard (Hemidactylus frenatus), Brahminy Skink (Eutropis carinatus), Ring Lizard (Varanus salvator), Indian Roofed Turtle (Pangshura tecta), Black Turtle (Melanochelys trijuga), Checkered Keelback (Xenochrophis piscator), Common Smooth Water-snake (Enhydris enhydris), Annulated Sea Snake (Hydrophis cyanocyntus) and Spectacled Cobra (Naja naja), Gui Sap/Bengal Monitor(Varanus bengalensis)	Habitats belongs to these species are homestead, cropland and garden vicinity.
Amphibians	Indian Common Toad (Bufo melanostictus), Indian Bullfrog (Hoplobtrachus tigerinus), Skipper Frog (Euphlyctis cyanophlyctis), Ornate Narrow-mouthed Frog (Microhyla ornata) and Cricket Frog (Feservarya limnocharis).	Wetland areas and the dried areas

Source: Field visit & Local people interview, June, 2015

b. Aquatic ecosystem

412. The Polder- 43/2C is surrounded by river systems. A vast area is considered as aquatic habitat, which is inundated by monsoon rain or sea water during tidal surge. The polder area holds mainly agricultural lands along with some perennial and seasonal wetlands. Major portion of the agricultural lands are under paddy cultivation. During monsoon, the croplandsare converted into seasonal wetlands.

413. The aquatic ecosystem is classified into two categories on the basis of duration of holding water: seasonal and perennial wetlands.

i. Seasonal wetland

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

ii. Perennial wetland

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

416. The aquatic biology of the studied area can be divided into two groups: flora and fauna. The findings of these two groups are described below:

a. Aquatic flora

417. Floral composition of the aquatic ecosystem is rich with different types of species in the polder area. Available species observed during the survey are described in the following sections(Table 5.15).

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

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

420. Sedges and meadows plants are the amphibian species. This type of vegetation has the highest species diversity and one of the most important wetland's plant communities in the polder area. This type includesPanikola (*Ottelia alismoides),* Jhangi (*Ceratophyllum desmersum*), Dhol kolmi (*Ipomoea aquatica*) and Kochu *(Colocasia* sp.). Another brackish water floral species are common in the tidal flood plain and Mangrove area is Hogla (*Typha elephantalis*), Chaila gash *(Hemarthria protensa).*

421. Mangrove vegetation: The area is tidal in nature. A good number of mangrove vegetation and bush are found along the marginal lands of canals shoreline. The most dominant mangrove species are Gewa (*Excoecaria agallocha*), Kakra (*Bruguiera gymnorrhiza*), Ora (*Sonneratia caseoloaris*), Golpata (*Nipa fruticans*) and Hargoza (*Acanthus illicifolius*).

Table 5.15: List of plant species found in the wetlands of the polder area

Local/English Name	Scientific Name	Abundance
Kutipana	*Azolla pinnata*	H
Kakra	*Bruguiera gymnorrhiza*	L
Kochu	*Colocasia esculenta*	M
Kochuripana	*Eichhornia crassipes*	H
Helencha	*Enhyra flactuans*	M
Chaila gash	*Hemarthria protensa*	H
Jhangi	*Hydrilla verticillata*	M
Dhol Kolmi	*Ipomoea aquatica*	H
Khudipana	*Lemna perpusilla*	H
Fern	*Lindsaea ensifolia*	M
Bishkatali	*Polygonum barbatum*	M
Shapla/Poddo	*Nymphaea nouchali* *Nymphaea stellata*	M
Golpata	*Nypa fruticans*	H
Topapana	*Pistia stratiotes*	H
Karanja/Chimti	*Pongamia pinnata*	M

Local/English Name	Scientific Name	Abundance
Kuripana	*Salvina cucullata*	H
Choila/Ora	*Sonneratia caseolaris*	H
Hogla	*Typha elephantalis*	H
Bicha	*Vallisneria spiralis*	L
Water fern	*Azolla sp, Salvinia sp*	M
Panikola	*Ottelia alismoides*	L

Sources: CEGIS Field Survey, June 2o:. Note: Abundance Code, H= High, M= Medium, L= Low

b. Aquatic fauna

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

423. The aquatic fauna are diversified compared with other polder area because of having an area rich with mud flats in the project periphery. This type of habitat is very important for waders. Available species in the habitat are Indian Bullfrog (*Hoplobtrachus tigerinus*), Skipper Frog (*Euphlyctis cyanophlyctis*), Ornate Microhylid (*Microhyla ornata*), Cricket Frog (*Feservarya limnocharis*), Spotted Flapshell Turtle (*Lissemys punctata*), and Indian Roofed Turtle (*Pangshura tectum*).

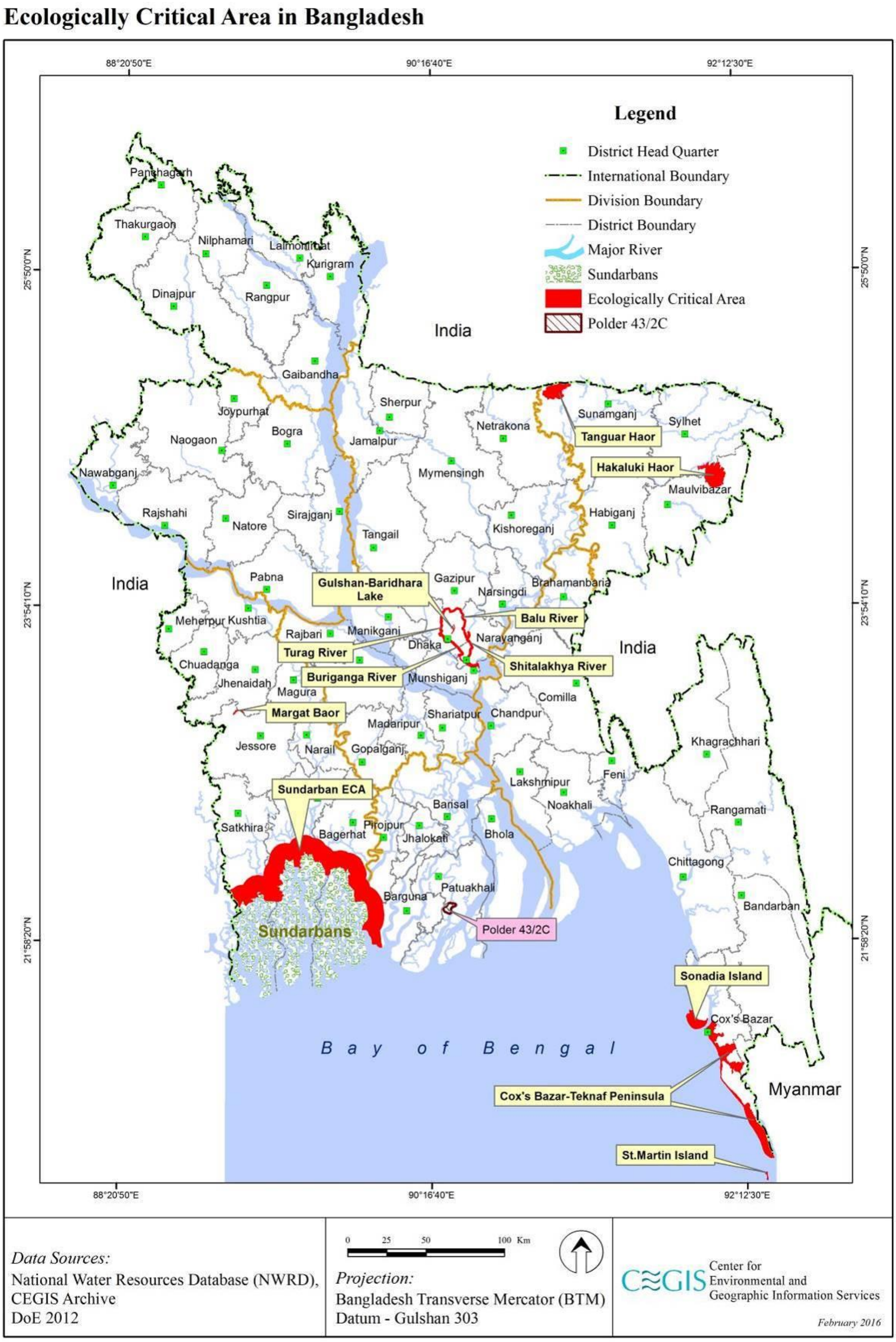
424. Aquatic snakes include Checkered Keelback (*Xenochrophis piscator*), Kal Keotey/ Common Krait (*Bungarus caeruleus)* and Common Smooth Water Snake (*Enhydris enhydris*). Among waders, Common Snipe (*Gallinago gallinago*), Common Kingfisher (*Alcedo atthis*), Great Egret (*Casmerodius albus*), White-breasted Waterhen (*Amaurornis phoenicurus*), Little Cormorant (*Phalacrocorax niger*), Indian Pond Heron (*Ardeola grayii*), Little Egret (*Egretta garzetta*), Garganey (*Anas querquedula*), Eurasian Wigeon (*Anas penelope*), Eurasian Teal (*Anas crecca*), Northern Shoveler (*Anas clypeata*), Pin-tailed Snipe (*Gallinago stenura*) and Black-tailed Godwit (*Limosa limosa*) were found to be very common.*(Source: Field visit & Local people interview, June, 2015)*

c. Importance of polderization for the existing ecosystems and occurrence of indicator species

425. 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 (Sonneratiaappetala), and Ora (Sonneratiacaseolaris) indicate the saline water conditions and soil salinity of khal banks and foreshore areas of the polder. Existence of these plants inside the polder area is an indication of soil and water salinity. On the other hand, fresh water shells (bivalves) indicate a fresh water environment and are found in most of the homestead ponds and stagnant parts of the khals inside the polder. Bivalve species are sensitive to water salinity. So, any significant change of these plant and animal population indicates a change of water salinity due to malfunctioning of water control structures like sluices.

Protected areas

426. In 1999, the Department of Environment(DoE) circulated not to propose any development projects within 10 Km of any ECAs. The polder is not within or near restricted area (Map 5.8).



Map 5.8: Ecologically Critical Area in Bangladesh

Ecosystem services

a. Output of ecosystem services

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

428. Here, goods refer to items given monetary value, whereas the services from ecosystems are valued, but are rarely bought or sold. Ecosystem "goods" includes foods, construction materials, medicinal plants and tourism.

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

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

431. The table 5.16 below presents few tangible ecosystem goods (but not limited to) from different common plants of the polder areas.

Table 5.16: Ecosystem product and its services within the polder area

Goods/Services/ Purpose	Source	Plants Parts used
Food	Supari (*Areca catechu*),Narikel (*Cocos nucifera*), Aam(Mangifera indica), Kola (*Musa sp*), Safeda (*Manilkara zapota*), Payara (*Psidium guajava*), etc	Fruit
	Helencha (Enhydra fluctuans) and Kolmishak (Ipomoea aquatica)	Leaf and stem
Fodder	Kochuripana, (*Eichhornia crassipe*), Phutku (*Hygroryza aristata*) etc.	Leaf and stem
Wood, timber	Aam (*Mangifera indica*), Bot (Ficus benghalensis), Babla (Acacia nilotica), Mahogany (*Swietenia mahagoni*),	Trunk
Medicine	Mahogany (*Swietenia mahagoni*), Tulshi (*Ocimum americanum*), Sezi (*Euphorbia antiquoram*), Bel (*Aglemarmelos*), Nim (*Azadirachta indica*)	Roots, Leaf, Stem
Thatching and mat making	Cyperus platystylis, Supari (*Areca catechu*), Narikel (*Cocos nucifera*), Bash (*Bamboosa sp.*), Bel (*Aglemarmelos*), Tal (*Boassus flabelifer*) and Hogla (*Typha elephantalis*),	Thatching and fencing for huts and as protective screen in homestead.
Fuel	Babla (*Acacia nilotica*), Akashmoni (*Acacia auriculiformis*), Boroi (*Zizyphus sp*), Gab (*Diospyros perigrina*), Jhau (*Casuarina equisetifolia*) etc.	Brunches, Leaf
Biofertilizer/Guano	Kochuripana,	As compost,
Hydroponics	Kochuripana to make baira (floating platforms)	to grow seedlings and vegetables
Bio-gas	Kochiripana, Khudipana (*Lemna and Spirodela spp.*) and other aquatic plants.	All parts of the pant

Goods/Services/ Purpose	Source	Plants Parts used
Erosion Protection	Dholkolmi (Ipomoea fistulosa), Chaila gash (Hemarthria protensa)	Against wave action, erosion and storm

Sources: CEGIS Field Survey, June 2015.

b. Present threats on ecosystem

432. Tidal flood, drainage congestion, river bank erosion (Picture 5.14-5.17) is the main threats for ecosystem sustainability according to the field survey.

433. Most of the wetlands, especially khals were found silted up. Non-functioning of water control structures like regulators, drainage sluice and flashing sluice causes insufficient drainage, which create drainage congestion. So poor drainage system is the main problem, which severely impacts the surrounding vegetation specially, crop land vegetation.

Picture 5.14: Home stead vegetation is risk due to river bank erosion

Picture 5.15: Embankment/road side vegetation is damage by river bank erosion

Picture 5.16: Silted up khal by free floating plant

Picture 5.17: Crop field vegetation is affected by drainage congestion

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

435. Embankment breachesevery year due to river bank erosion.For which this embankment cannot protect flood inflation and caused flood water inundation that adversely

impacts the surrounding vegetation. Consequently, faunal population and diversity is also decreasing due to habitat destruction.

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

437. Local farmers reported that Mammals' population is very low in the polder area. Big mammals have already disappeared, because of reduction of jungle area and intervention of different human activities.

438. Several species are listed in the IUCN *Red Data Book with status. This status has been compared with field observation* in the following table considering that of the polder area:

Table-5.16.a: Status of local wild life declared vulnerable/endangered in IUCN Red Data Book

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

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

5.2.3 Fish Habitats

439. Fisheries resources of the polder area are diversified with different fresh and very slight brackish water fish habitats. Open water fish habitat of the polder includes surrounding external rivers and internal khals, such as *Lohalia River and internal khals, which* are acting as major arteries of fish migration into the polder area. Various inter-connected water bodies, fishing activities, fish demand, access to the market, etc are playing vital role in maintaining moderate fisheries productivity in the polder area in respect of national fisheries productivity. The cultures of fish ponds are almost traditional in practice. The identified fisheries problems are morphological changes, loss of connectivity, indiscriminate fishing, and reduction of breeding, spawning, nursing and feeding ground, lack of quality fish seed for culture, lack of trained fish farmer and presence of viral disease, siltation problem and loss of connectivity especially, in dry season.

440. Fish habitat in this Polder area is mainly classified into two types, such as, open water or capture fisheries (Picture 5.18) and closed water or culture fisheries.

Capture Fisheries

441. Fish habitats of the project area are shown in Table 5.17. Fish habitat in the project area is 753 ha of which 731 ha is capture fish habitat of the project area.

Table 5.17: Fish habitat status of the project area

Sl. No.	Fishery category	Habitat type	Area (Ha)
1	Capture	Water bodies	731
		Total	*731*
2	Culture	Golda Culture	5
3		Fish pond (Homestead)	10
4		Fish pond (Improved culture)	7
		Total	*22*
		Grand Total	753

Source: Draft Final of Fisheries Report andDCSC

DS-1: Danga khal

DS-3: Munshir Khal

DS-4 (Inside): Musir Khal

DS-4 (Outside): Musir Khal

DS-5 (Inside): Pollar Khal

DS-5 (Outside): Pollar Khal

DS-8: Mondir Khal

Bank Revetment: Bank-side of Lohalia River

Picture 5.18: Major capture fish habitat in the polder area

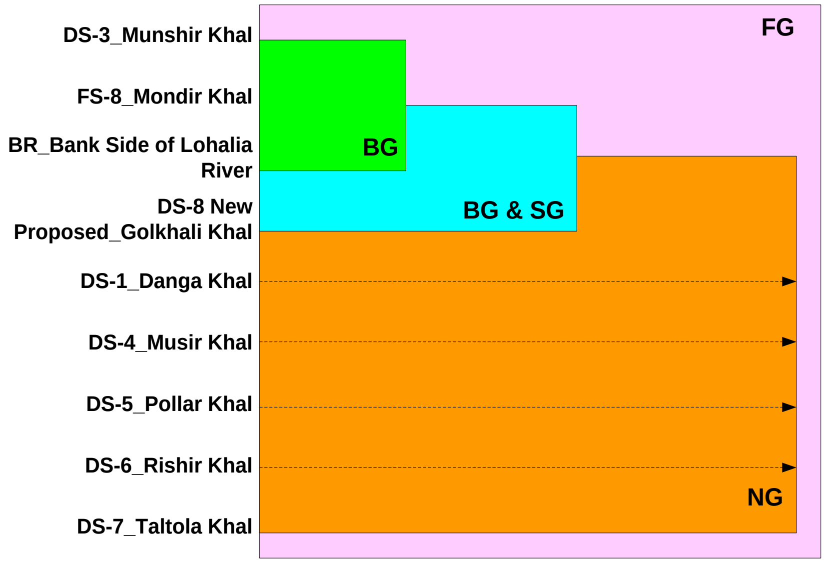
442. The Polder area has a number of seasonal and perennial canals/khals. Among those some are breeding ground, some are spawning ground and some are nursery grounds. Moreover, all of these are used as the feeding ground. However, depth of seasonal canals of the project area is reducing day by day and becoming insufficient for sheltering fish juveniles as these are being silted up. Local people reported that siltation rate in the internal fish habitats in the Polder area is 2-3 cm per year. The following table shows the habitat use of the identified khals of associate interventions (Table 5.18).

Table 5.18: Habitat use of different identified khals by different age class of different fish species

Sl	Intervention	Habitat	Age Class*
1	Bank Revetment	Bank Side of Lohalia River	Adult and Brood
2	DS-1	Danga Khal	Age-1 Adult, Adult and Brood
3	DS-3	Mushir Khal	Age-1 Juvenile, Young and Adult
4	DS-4	Musir Khal	Juvenile and Adult
5	DS-5	Pollar Khal	Age-1 Juvenile, Young, Age-1 Adult, Adult and Brood
6	DS-6	Rishir Khal	Juvenile, Age-1 Adult, Adult and Brood
7	DS-7	Taltola Khal	Age-1 Juvenile, Young, Adult and Brood
8	DS-8 New Proposed	Bank Side of Lohalia River	Juvenile, Adult and Brood
9		Golkhali Khal	Juvenile, Adult and Brood
10	FS-8	Mondir Khal	Age-1 Juvenile, Young Adult and Brood
11	Slope Protection	Lohalia River	Fry, Adult and Brood

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

443. Moreover, through investigating habitat use of different age classes of different fish species, the identified khals have further been clustered as the breeding ground (BG), spawning ground (SG), nursery ground (NG) and feeding ground (FG) as shown in the following figure (Figure 5.11).



Source: CEGIS field survey, 2015

Note: BG: Breeding Ground; SG: Spawning Ground; NG: Nursery Ground and FG: Feeding Ground

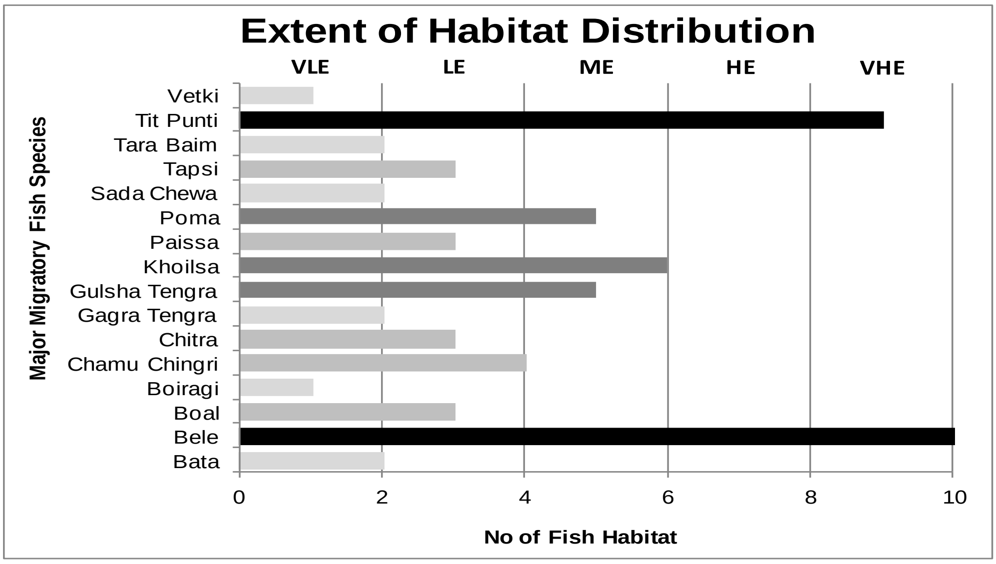
Figure 5.11: Habitat classification of Intervention-specific fish habitat

5.2.4 Fish migration

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

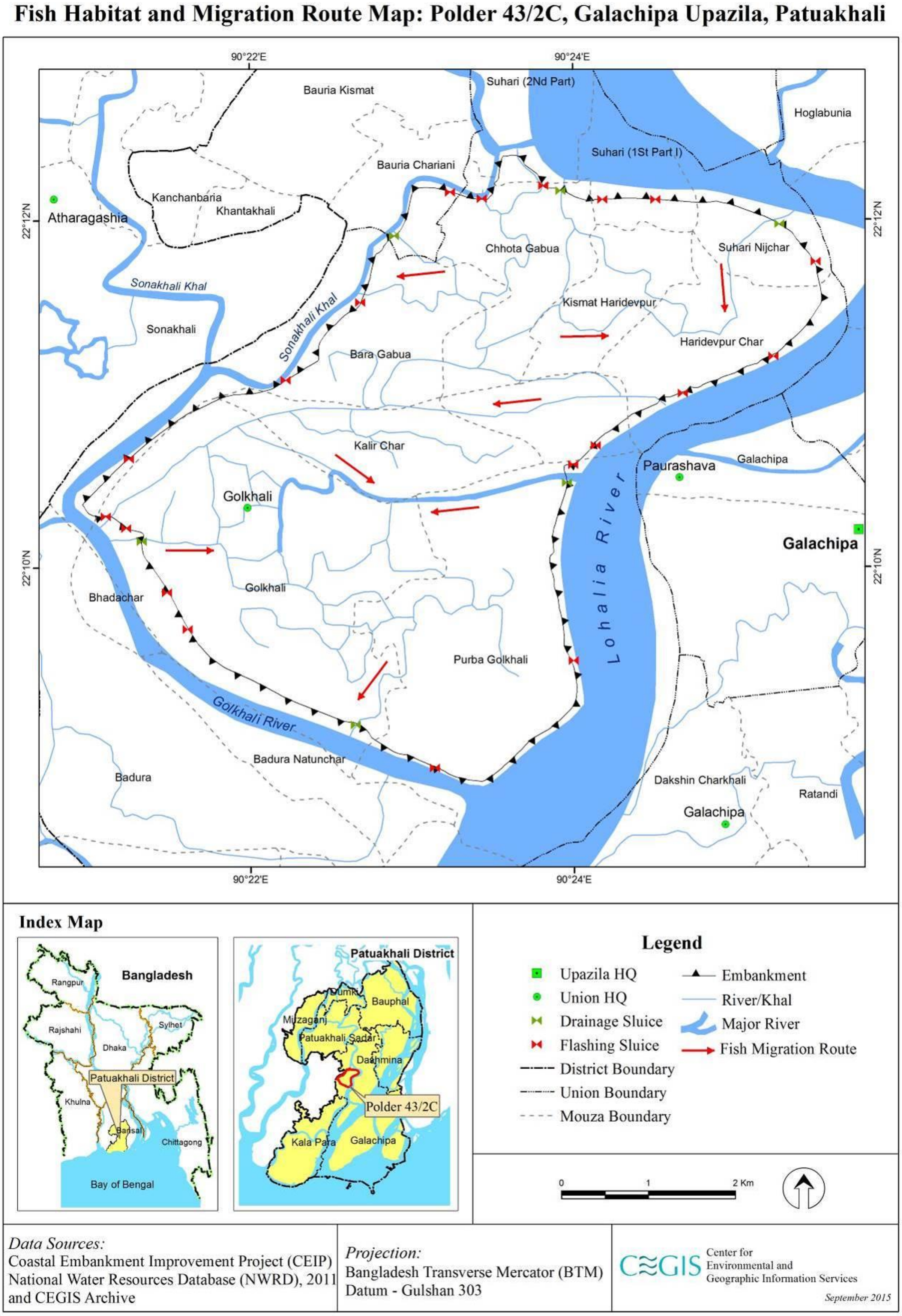
444. Overall fish migration status is poor to moderate in the polder area. It has been found that only two species, *Tit Punti* and *Bele* are highly distributed among the internal khals. On the other hand, *Vetki, Tara Baim, Sada Chewa, Gagra Tengra, Boiragi* and *Bata* are very strictly distributed (Figure 5.12). It has been reported by the local people that peripheral rivers along with internal rivers and khals of the Polder area are silted up naturally and structures on the khals cause reduction of the length of successive migration routes.

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



Source: Catch Assessment Survey, CEGIS, 2015; Note: VLE: Very Low Extent; LE: Low Extent; ME: Moderate Extent; HE: High Extent and VHE: Very High Extent

Figure 5.12: Extent of habitat distribution of major migratory fish species in the polder area



Map 5.9: Fish Habitat and Migration Route of Polder- 43/2C

446. Both the fresh and saline water fishes migrate from river to the Polder area through open and regulated khals for meeting their various purposes. Many fish species migrate horizontally to these water bodies as part of their life cycle. . It has been found that migration pattern in respect of purpose and timing of migration varies with different water bodies controlled by different water control structures. It has also been stated from the local fishermen some major species, like *Puntius ticto*, have been changing their migration pattern through decreasing their purposes after establishing water control structures. It results in decreasing fishing at the associate khals. The following table shows the purposes of migration during major migratory fish species (Table 5.19).

Table 5.19: The purpose and timing of migration for some major migratory fish species

Sl	Fish Species	Habitat	Purpose	Timing
1	Bata	Bank Side of Lohalia River	Feeding	All the Year Round
2	Bele	Bank Side of Lohalia River	Feeding and Nursing	
3		Danga Khal	Nursing	Falgun-Choitra
4		Golkhali Khal	Feeding	All the Year Round
5		Mondir Khal	Nursing	Falgun-Choitra
6		Musir Khal		
7		Rishir Khal		
8		Taltola Khal		
9	Boal	Bank Side of Lohalia River	Feeding	All the Year Round
10		Mondir Khal	Nursing	Ashar-Aswin
11	Boiragi	Lohalia River		
12	Chamu Chingri	Bank Side of Lohalia River	Feeding	All the Year Round
13		Danga Khal		
14		Lohalia River		
15		Rishir Khal		
16	Chitra	Golkhali Khal	Nursing	Ashar-Aswin
17		Musir Khal		
18	Gagra Tengra	Bank Side of Lohalia River	Feeding and Breeding	Boisakh-Aswin
19		Lohalia River		
20	Golda Chingri	Lohalia River	Breeding, Spawning and Nursing	Boisakh-Aswin
21	Gulsha Tengra	Bank Side of Lohalia River	Breeding	Boisakh-Ashar
22		Danga Khal	Feeding	Boisakh-Aswin
23		Lohalia River	Breeding	Boisakh-Ashar
24			Nursing	Ashar-Aswin
25		Pollar Khal	Nursing and Feeding	
26	Khoilsa	Danga Khal	Feeding	All the Year Round
27		Mondir Khal		
28		Mushir Khal		
29		Rishir Khal		
30		Taltola Khal		
31	Paissa	Bank Side of Lohalia River		Boisakh-Kartik
32		Pollar Khal		
33		Rishir Khal	Nursing	Ashar-Aswin
34	Phaha	Lohalia River		Boisakh-Joistha
35	Poma	Bank Side of Lohalia River	Breeding and Spawning	Falgun-Choitra
36			Nursing and Feeding	Falgun-Aswin
37		Golkhali Khal	Feeding	
38		Lohalia River	Breeding and Spawning	Falgun-Choitra
39			Nursing	
40		Bank Side of Lohalia River	Feeding	Ashar-Aswin

Sl	Fish Species	Habitat	Purpose	Timing
41	Sada Chewa	Lohalia River		
42	Tapsi	Bank Side of Lohalia River		All the Year Round
43		Lohalia River		
44			Nursing	Ashar-Aswin
45	Tit Punti	Danga Khal	Breeding and Spawning	Choitra-Aswin
46			Feeding	All the Year Round
47		Golkhali Khal	Spawning	Ashar-Aswin
48		Mondir Khal	Breeding and Spawning	Choitra-Aswin
49		Mushir Khal	Feeding	All the Year Round
50		Pollar Khal	Breeding and Spawning	Choitra-Aswin
51		Rishir Khal		
52		Taltola Khal		
53	Vetki	Bank Side of Lohalia River	Spawning	Ashar-Aswin

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

5.2.5 Fish biodiversity and composition

447. The Polder area is very poor to moderate in fish biodiversity (Picture 5.19) though the biodiversity of fishes has the declining trend over the years. Pollutants, agrochemicals and pesticides coming from paddy fields, obstruction in fish migration routes, morphological changes of internal khals, siltation of fish habitats, squeezing of spawning and feeding grounds and further expansion of both culture fishery and *Aman* cultivation are responsible for gradual decline of fish abundance and biodiversity.

Picture 5.19: Fish catch of the Polder area

448. The Polder area comprises an assemblage of both fresh and brackish water fish species (Picture 5.21). The available fish species are *bagda* and *golda chingri*, *bele, tengra, poma, motka chingri, vetki, tit puti. baim* etc. (Table 5.20).

Table 5.20: Available fish biodiversity of the Polder area

Sl.	Group/ Guild	Local Name	Scientific name	Fish Habitat		
				River and Khal	Floodplain and Beel	Pond
1	Major carps (include four	Rui	Labeo rohita	P	P	P
		Catla	Catla catla	P	P	P
		Mrigel	Cirrhinus cirrhosus	P	P	P

Sl.	Group/ Guild	Local Name	Scientific name	Fish Habitat		
				River and Khal	Floodplain and Beel	Pond
	species and orderly)	Kalibaus	L calbasu	P	P	P
2	Large catfish (six species and orderly)	Boal	Wallago attu	P	A	A
		Pangas	Pangasius pangasius	A	A	P
3	Small catfish (mostly commercially important)	Magur	Clarias batrachus	P	P	P
		Singi	Heteropneustes fossilis	P	P	P
		Tengra	Mystus tengara	P	P	A
		Gulsa Tengra	Mystus cavasius	P	P	A
4	Herring (Highly valued)	Ilish	Tenualosa ilisha	P	A	A
5	Snakeheads	Shol	Channa striatus	P	P	A
		Gazar	Channa marulius	P	P	A
		Taki	Channa punctatus	P	P	A
		Cheng	Channa orientalis	P	P	A
6	Knife fishes	Foli	Notopterus notopterus	P	P	A
7	Needle fishes	Kaikka	Xenentodon cutcutia	P	P	A
	Minnows, Rasboras and Barbs	Punti	Puntius spp.	P	P	P
		Chela	Salmostoma bacaila	P	P	A
		Mola	Amblypharyngodon mola	P	P	A
		Gutum	*Lepidocephalus guntea*	P	P	A
	Anchovies and Sardines	Phasa	*Setipinna phasa*	P	A	A
		Kachki	*Corica soborna*	P	A	A
		Chapila	*Gudusia chapra*	P	P	A
	Spiny eels	Baim	*Mastacembelus aculeatus*	P	P	A
	Climbing perch	Koi	*Anabas testudineus*	A	P	P
		Kholisa	*Colisa fasciatus*	P	P	A
	Mud perch	Bheda	*anabas*	P	P	A
	Glass fishes	Chanda	*Chanda spp.*	P	P	A
8	Prawns	Golda chingri	*Macrobrachium rosenbergii*	P	P	P
		Gura chingri	*Leander styliferus*	P	P	P
9	Exotic introductions (Five carps, two cichlids and one barb)	Silver carp	*Hypophthalmichthys molitrix*	A	A	P
		Mirror carp	*Cyprinus carpio var. specularis*	A	A	P
		Grass carp	*Ctenopharyngodon idella*	A	A	P
		Thai barb	*Barbodes gonionotus*	A	A	P
		Telapia	*Oreochromis mossambicus*	A	A	P
		Nilotica	*Oreochromis niloticus*	A	A	P

Source: CEGIS field observation, Here, A=Absent and P=Present

449. Different fish species have different habitat preferences and having different sensitivities to the physical condition of the area. The larger catfishes like *Wallago attu*, *Pangasisus pangasius*, etc, prefer deeper water having connectivity with the large river and drainage canal (particularly for *Wallago attu*). These are sensitive to warm water and shallow

water habitat. They breed when they get new water in the next season. If sluices are not functioning properly then the large catfish population will be declined.

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

451. 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).

452. Moreover, in the investigation period of June, evenness in the fish composition has been analyzed applying Shannon - Weiner Diversity Index. The highest evenness in fish composition has been found in Rishir khal, while the lowest in Munshir khal (Table 5.21). It has also been found in case of Rishir Khal and Mondir khal that four fish species are dominant out of 6 and 12 fish species, which are supposed to improve the species evenness in the fish composition (Figure 5.13). On the other hand, in case of Munshir khal and Musir khal, Pollar khal and Taltola khal, fish composition is highly dominated by one fish species (Khoilsa and Vadrakatali Chingree respectively) causing lowest evenness in fish composition.

Table 5.21: Species evenness and richness in the intervention specific fish habitat

Sl	Site	Species No	Dominated Fish Number**	SI*	SWDI**
1	Bank Side of Lohalia River	14	3	0.60	0.49
2	Danga Khal	7	3	0.70	0.72
3	Golkhali Khal	6	2	0.56	0.52
4	Mondir Khal	12	4	0.77	0.71
5	Munshir Khal	5	1	0.04	0.08
6	Musir Khal	3	1	0.04	0.10
7	Pollar Khal	10	2	0.85	0.14
8	Rishir Khal	6	4	0.76	0.89
9	Taltola Khal	6	2	0.99	0.20

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

453. **Indicative fish species**Indicative fish species include Chamu Chingree, Motka Chingree and Tit Punti, Cheng which are sensitive to salinity, If salt water increases slightly in the internal khals, fresh/brackish fish species especially cheng and Tit punti change their habitat.

Culture fisheries

454. Aquaculture practice is expanding gradually in the polder area. Various types of fish culture systems have been adopted by the local people including mono-, poly-, and mix-culture.Exclusively poly-culture practice has been adopted by the local people. Estimated area under culture habitat is 22 ha. Depth of water level of culture fish pond ranges from 1 meter to 1.5 meter. Most of these are extensive culture in practice (Picture 5.20).

Picture 5.20: Homestead pond in the project area

5.3 Human and Economic Development

5.3.1 Fish production

455. The estimated total fish production of the Polder area is 115MT. Bulk of the fish production (about 68%) is coming from capture fisheries while the rest of the production (about 32%) is coming from culture fisheries habitats (Table 5.22).

Table 5.22: Fish production in the project area

Sl. No.	Fishery category	Habitat type	Production (Ton)
1	Capture	Water bodies	78
		Total	*78*
2	Culture	Bagda/Golda gher	3
3		Fish pond (Homestead)	13
4		Fish pond (Improved culture)	21
		Total	*37*
		Grand Total	115

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

456. The highest catch has been observed in the drainage sluice associated with Musir Khal, and lowest catch in the drainage sluice associated with Munshir Khal (Table 5.23). However, highest minimum productivity level has been reported in case of newly proposed drainage sluice associated with Golkhali Khal. These indicated that fish production function is highly seasonal.

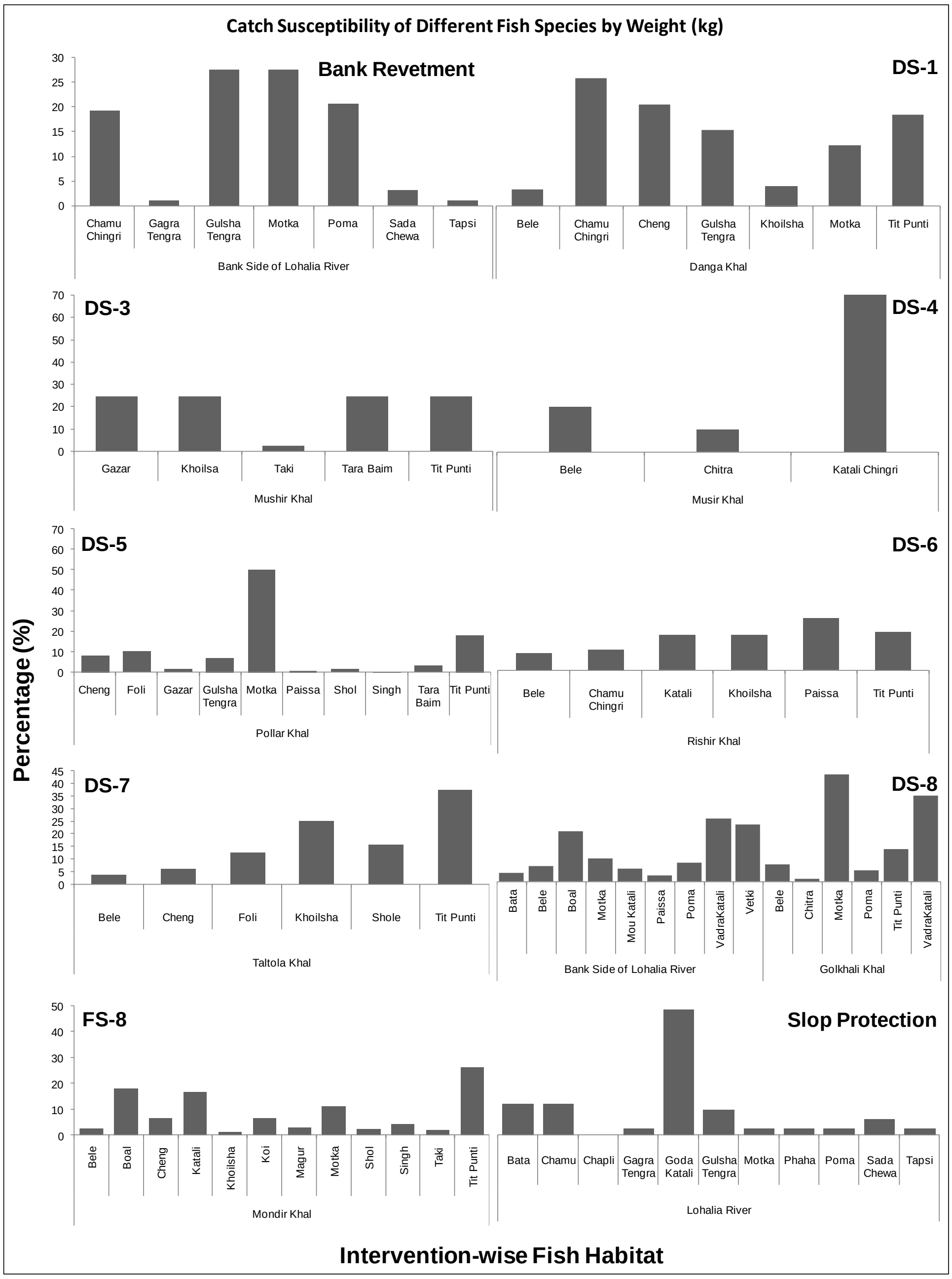
457. As per consultation with local fishermen, fish traders and local fisheries officials fish production is directly linked with the livelihood of the dependent fishermen community of the area. If production declines due to bad functioning of the polders and sluices, the livelihood of the area will be affected and the economy of the area as well.

Table 5.23: Minimum catchability and productivity per haul in the intervention associate fish habitat

Sl	Intervention	Minimum Catchability (kg/Year)	Minimum Productivity per haul (Kg/hl)
1	Bank Revetment	94	1.04
2	DS-1	331	0.98
3	DS-3	5	0.04
4	DS-4	352	0.06
5	DS-5	60	1.00
6	DS-6	29	0.95
7	DS-7	48	0.03
8	DS-8 New Proposed	177	2.14
9	FS-8	112	0.02
10	Slope Protection	72	0.42

Source: CEGIS field visit, 2015

458. Catch susceptibility of different fish species varies with the use of fishing gears in the intervention located khals. The following figure shows the matrix of fish susceptibility to fishing at different intervention specific fish habitat (Figure 5.13).



Source: Catch Assessment Survey, CEGIS (2015)

Figure 5.13: Catch susceptibility of different fish species (by Weight) in the intervention specific fish habitats

5.3.2 Fishing efforts

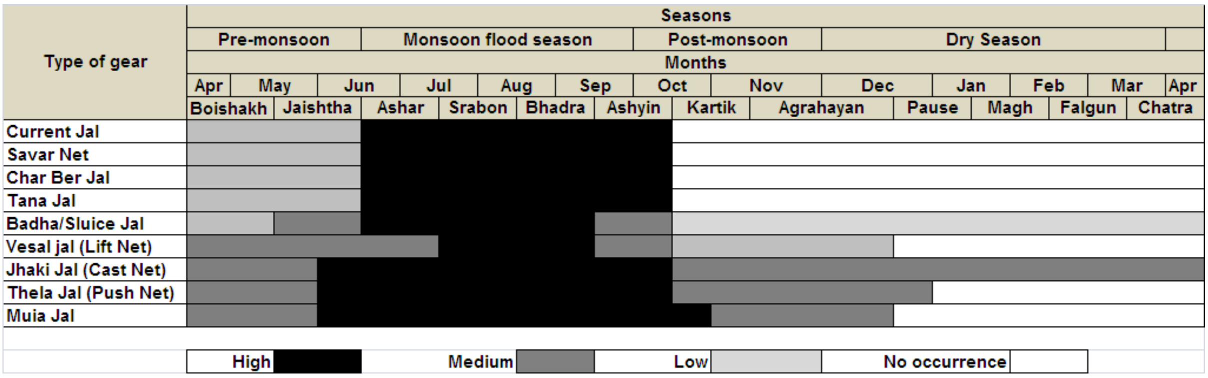
a. Fisher number

459. The total number <u>fisher households in the polder area isabout 200</u>. In the polder area, commercial fishers mostly come from the Muslim community (85%). Field investigation revealed that in addition to fishers engaged in commercial fishing, a good number of households are involved as part time and subsistence fishing. The fishers perform fishing in the nearby rivers and khals. The available fisheries occupations of the area are fisher, fish farmer, fish labor, fish trader, etc. <u>Moreover, more than 15% households have ponds in the project area</u>.

b. Fishing Season

460. Capture fishing is the major fishery of the polder area. Fishing in khals starts in May and continues up to October. Rest of the time they are mainly engaged in other fisheries activities (like fish traders). The seasonality of major fishing is furnished in the table 5.23.

Table 5.24: Fishing seasonality of the project area



Source: CEGIS field investigation, 2015

c. Fishing Gear and Crafts

461. The commercial fishers usually catch fish in the nearby rivers and connecting khals using country boat and dingy boats.Eight types of nets/gears have been observed to be used for fishing in the polder area (Table 5.14). These are: (1) *Jhaki jal*, (2) *Vesal jal*, (3) Current jal, (4) *Muia jal*, (4) *Thela jal*, (5) *Badha*/Sluice *jal*, (6) *Tana jal*, (7) *Char Ber Jal*, (8) *Savar Net*, etc. Only 20 to 25% of fishers have fishing boats and around 70% fisher have fishing gears/nets.Among these gears, *Badha*/Sluice *jal (Picture 5.21)* is the mostly used especially for fishing in the interventions location by creating bundh at the mouth of drainage channel (Table 5.25).

Table 5.25: Major gears used in the intervention specific fish habitat in the project area

Sl	Habitat	Name of Gear	Haul Duration (hr/haul)	Haul No	Operated Person (No)
1	Bank Side of Lohalia River	Char Ber Jal	12	1	2
2	Danga Khal	Sluice Jal	6	1	1
3		Vesal Jal	2	4	1
4	Mushir Khal	Sluice Jal	6	1	1
5	Musir Khal	Jhaki Jal	1	20	1
6		Sluice Jal	4	1	1
7	Pollar Khal	Sluice Jal	12	1	1
8	Rishir Khal	Tana Jal	6	1	2
9	Taltola Khal	Jhaki Jal	1	20	1
10	Bank Side of Lohalia River	Char Ber Jal	12	1	2
11	Golkhali Khal	Tana Jal	2	1	2
12	Mondir Khal	Jhaki Jal	1	50	1
13		Sluice Jal	4	1	1
14	Lohalia River	Char Ber Jal	12	1	2
15		Savar Net	4	1	1

Source: CEGIS field visit, 2015

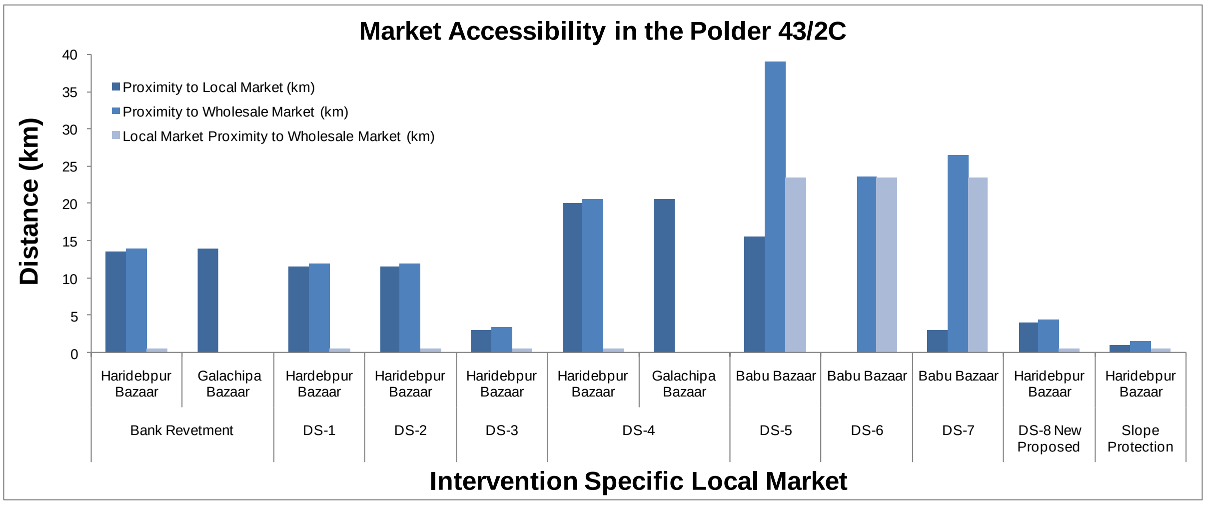
Fishing by Vesal Jal

Fishing by Badha/Sluice Jal

Picture 5.21: Major fishing gears in the polder area

5.3.3 Fish Marketing -Post harvest facilities and damage

462. Market accessibility is poor in this polder area due to the low proximity (inversely related to distance between two supply chains) to local fish market, lack of specific wholesale fish market, poor infrastructure (road), limited transportation vehicles and vessels. The local fishers sell bulk of their catch directly to the local fish market. Lowest proximity to local fish market has been observed in case of DS-4 where the fishers transport their fish by engine boat (Figure 5.14).Fishes are directly sold from the local fish market to the nearby Galachipa wholesale fish market. Moreover, the fishers directly sell their fish to the wholesale market in Galachipa. No structured fish landing centers are found in the area. Ice factories are observed in HoridevpurBazar (like Hazi Enterprice) in the project area.



Source: Market Survey, CEGIS (2015)

Figure 5.14: Market accessibility in view of proximity to local fish markets and wholesale fish markets

Fisher Lifestyle

463. The average daily income of professional fishers, part-time fishers and subsistence fishersare Tk. (250 to 400) Tk. (200 to 300) and Tk. (100 to 150) respectively. Consequently, they are changing their occupation. People’s involvement in fish culture is mostly in traditional culture methods.

5.3.4 Fisheries Management

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

5.3.5 Agricultural Practices

465. Farming practices largely depend on the cropping seasons. In the polder area, there are three cropping seasons per year. They are Kharif-I, Kharif-II and Rabi seasons. The Kharif-I start from March and ends in June. This season is characterized by the uncertainty of weather of alternating dry and wet spells. T. Aus and summer vegetables are grown in this season. The Kharif–II starts from July and ends in October. This season comprises wet and cloudy environment and heavy rainfall of uneven distribution, low solar radiation, high temperature and humidity. T. Aman is grown in the Kharif -II season. The Rabi season starts from November and ends in February. During this season, crops are favoured with high solar radiation, low humidity and temperature, but lack of adequate soil moisture depresses the crop yield. Wide ranges of crops are grown in this season. Watermelon, Potato, Spices, Oil seeds, Pulses, Vegetables and Boro rice are grown in this season. Boro is grown under irrigated condition with the help of the low lift pumps (LLPs). However, there are occasional overlaps such that Kharif-I season crops such as vegetables are harvested in Kharif-II season, Kharif-II season crops (HYV Aman) are generally harvested in Rabi season and Rabi season crops (HYV Boro) are harvested in Kharif-I season.

5.3.6 Present Cropping Patterns and Intensity

466. The dominant cropping pattern in the medium high land is Fallow-Lt. Aman-Fallow and Lt. Aus- Lt. Aman-Fallow, which occupies about 25% and 16% of the NCA. In medium low land, dominant cropping pattern is Fallow- Fallow- Pulses, which occupy about 15.7% of the NCA. Detailed cropping patterns by land type are presented in Table 5.26. The overall cropping intensity of the polder area is 173%.

Table 5.26: Detailed cropping patterns by land type in the Polder area

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-Feb.)	Area (ha)	% of NCA
High land (F0)	Orchard	Orchard	Orchard	10	0.5
	Vegetables	Lt. Aman	Fallow	40	2.0
	Lt. Aus	Lt. Aman	Potato	60	3
	Lt. Aus	Lt. Aman	Spices	40	2
	Lt. Aus	Fallow	Vegetables	40	2
	HYV Aus	Lt. Aman	Fallow	40	2
	Lt. Aus	HYV Aman	Vegetables	40	2
Sub-Total				270	13.5
Medium High land (F1)	Lt. Aus	Lt. Aman	Fallow	320	16
	HYV Aus	HYV Aman	Oil seeds	150	7.5
	HYV Aus	HYV Aman	Fallow	200	10
	Fallow	Lt. Aman	Fallow	500	25
	Fallow	HYV Aman	Water melon	160	8
Sub-Total				1330	66.5

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-Feb.)	Area (ha)	% of NCA
Medium low land (F2)	Lt. Aus	Fallow	HYV Boro	65	3.2
	HYV Aus	Fallow	Local Boro	20	1.0
	Fallow	Fallow	Pulses	315	15.7
Sub-Total				400	20
Grand Total				**2,000**	**100**
Cropping intensity= 173 %					

Source: DCSC and field investigation, 2015

Picture 5.22: View of T. Aus rice field in the Polder area

Picture 5.23: View of granular pesticide used in the Polderarea

Picture 5.24: View of Soil sample collector in the Polder area

Picture 5.25:View of T. Aman rice seedbed in the Polder area

5.3.7 Cropped Area and Production

467. Detailed cropped area, crop production and yield rate are presented in Table 5.27.

Cropped Area

468. Total cropped area is 3,465 ha of which rice occupied 2,610 ha and the rest 855 ha is covered by non-rice crops. The rice and non-rice cropped area are 75.5% and 24.5% of the total cropped area, respectively. Among the rice crops, Lt. Aus, HYV Aus, Lt. Aman, HYV Aman, HYV Boro, Local Boro are commonly grown in the polder area (Table 5.27).

Crop Production

469. Total crop production is 13,805 metric tons of which rice production is 5,648 metric tons (Table 6.6) and non-rice production is 8,158 metric tons. Among the rice crops the contributions of Lt. Aus, HYV Aus, Lt. Aman, HYV Aman, HYV Boro and Local Boro are about 16%, 20%, 35%, 24%, 4% and 1% respectively. Total non-rice crop production is about 7,060 metric ton (Table 5.27)

Table 5.27: Present cropped area, yield and production in the study area

Name of crops	Cropped area (ha)	Yield (ton/ha)	Production (metric ton)
Lt. Aus	565	1.6*	904*
HYV Aus	410	2.7*	1,107*
Lt. Aman	1,000	2.0*	2,000*
HYV Aman	550	2.5*	1,375*
HYV Boro	65	3.5*	228*
Local Boro	20	1.7*	34*
Total rice	2,610		5,648*
Orchard	10	13.5	135
S. Vegetables	40	12.5	500
Pulses	315	1.5	473
Potatoes	60	15.5	930
W. Vegetables	80	12.5	1,000
Spices	40	3.5	140
Oil seeds	150	1.2	180
Watermelon	160	30.0	4,800
Total non-rice	855		8,158
Grand Total	3,465		13,805

*Source: DCSC and field information, 2015; *Indicates cleaned rice*

Crop Damage

470. The scenarios of crop damage during 2007-2011 and 2013 are presented in Table 5.26, which shows that crops were damaged by cyclone Sidr in 2007, by cyclone Aila in 2009 and by cyclone MOHASEN in 2013. In 2008, 70% of Vegetables/Pulses and 70% of watermelon were damaged due to heavy rainfall. Farmers reported that 20% of T. Aman and Vegetables crops were damaged by tidal flood or drainage congestion in the year 2010. In 2013, 25% and 20% Pulses and Spices respectively were damaged by MOHASEN. Detailed information on data crop damage along with the reason is presented in Table 5.28.

Table 5.28: Crop area damaged by different means and losses during 2007-2011 and 2013

S.L.	Crops	Damage (%)	Year	Reason of damage
1.	HYV Aman	80	2007	Sidr
	W. Vegetables	80	2007	Sidr
	Fruits	30	2007	Sidr
2.	Watermelon	70	2008	Heavy rainfall
	Vegetables/Pulses	70	2008	Heavy rainfall and Pests
3.	Watermelon	90	2009	Aila
	Spices/Pulses	80	2009	Aila
4.	T. Aman	20	2010	Water logging
	Vegetables/Fruits	15	2010	pests
5.	T. Aman	20	2011	pests
	Vegetables	15	2011	pests

S.L.	Crops	Damage (%)	Year	Reason of damage
	Fruits	20	2011	pests
6.	Pulse	25	2013	MOHASEN
	Spices	20	2013	MOHASEN

Source: DCSC and field information, 2012 and June 2015

5.3.8 Agricultural Inputs

471. Seed, labor, fertilizer, pesticides and irrigation are the major inputs for crop production in the study area. Detailed are narrated below.

Seeds

472. The role of seeds is very important for growing crops. Selection of seeds has to be made carefully. More than 85% germination rate, free from disease infestation and high yield potential need to be considered. Good quality vegetable seeds are not available in the market. Most of the farmers use their own seeds in case of local variety such as T.Aus and T.Aman. The quality of seeds available with the private dealer are poor and market pricesare very high. Farmers use higher or lower quantity of seeds than the recommended dose.

Fertilizer

473. Not all kind of chemical fertilizers are available in local dealer shops. Moreover, prices of available fertilizers are very high. The polder farmers used chemical fertilizers such as Urea, TSP and MPin different crops. Urea is used in higher quantity than other chemical fertilizers. Farmers do not use organic manure or compost.

Pesticides

474. The use of pesticides depends on the degree of pest infestation. Most of the farmers apply pesticides in all crops such as Lt. Aus, HYV Aus, Lt. .Aman, HYV Aman, HYV Boro, Potatoes, summer and Winter Vegetables and spices. They spend about Taka 500-3000/- against pest control in each crops. The highest quantity of pesticides isnormally applied in Watermelon, vegetables and potato fields. The polders farmer'sapply pesticides once twice or more in their fields. They use pesticides either under or overdose and do not maintain waiting period. This may be due to lack of knowledge on pesticides application. The major insects as reported by the farmers are Stem borer, Leaf folder, Rice hispa, Green leaf hopper, Ear cutting cater pillar, Fruit fly and Cut worm. Local farmer reported that they use different types of pesticides such as Furadan 3G, Basudin, , Virtako40WG , Tufgor, Rovral and Ridomil powder etc. prevent pest infestation in crop fields.

Irrigation

475. Irrigation coverage is limited of the study area and is about 3.2% of the NCA during dry season. Surface water is being used for irrigation. Rivers (Lohalia, Golkhali), Khals (Boro Gabur, Mondir, Muchir, Taltoli) and beels are the main sources of surface water irrigation. Low Lift Pumps (LLPs) and small type of irrigation equipment, traditional mode like sewing basketsare used for lifting irrigation water. The availability of irrigation water is declining due to siltation of the rivers, beels and khals. Lt. Aus, HYV Aus, Lt. Aman and HYV Aman are cultivated under rain-fed condition. Sometimes, supplementary irrigation is provided to W. Vegetables, Watermelon, Spices and Potatoes.

476. Level of inputs used by the farmers in Polder- 43/2C is presented in Table 5.29.

Table 5.29: Present level of inputs used within Polder- 43/2C

Crop Name	Seed used (Kg/ha)	Fertilizer (Kg/ha)			Irrigation cost (Tk)	Pesticide (Tk/ha)	Percent farmers using Power tiller	Cost power tiller
		Urea	TSP	MP				
Lt. Aus	37	75	20	15	-	1,000	90	2,900
HYV Aus	35	82	40	42	-	1,600	90	2,900
Lt. Aman	30	85	70	40	-	1,000	90	2,900
HYV Aman	30	120	50	40	1,000	1,200	90	2,900
HYV Boro	40	217	178	100	3,500	2,000	90	2,900
Local Boro	30	200	160	100	3,000	1,500	90	2,900
Chilli	1-1.5	40	30	20	1,500	500	90	2,900
Pulses	25	35	90	55	-	1,000	90	2,900
Potatoes	1,500	75	60	35	1,300	2,000	90	2,900
S. Vegetables	4	70	50	40	-	1,700	90	2,900
W. Vegetables	5	150	75	60	1,800	1,500	90	2,900
Spices	10	50	40	30	200	1,500	90	2,900
Oil seeds	8	80	50	35	500	500	90	2,900

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

Labour

477. The cultural practices for crop production in the study area are manual. So, agricultural labour is considered as one of the essential inputs for crop production. The labour requirement is not equal throughout the year. The number of labour requirement varies from crop to crop. The number of labour on average used in the Polder area is presented in Table 5.30.

Table 5.30: Labor Used in the Polder Area

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

Source: CEGIS Assessment from field information, 2012

5.3.9 Livestock and Poultry

478. Livestock and poultry, is an essential element for an integrated farming system, and play an important role in the economy of Polder- 43/2C. Livestock have a significant rate in cultivation, thrashing 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 5.31.

Table 5.31: Number of Livestock and Poultry of the Polder Area

Name of Livestock/poultry	Present number
Cow/Bullock	7,410
Buffalo	1,230
Goat	2,516
Sheep	650
Duck	16,300
Chicken	37,637
Total	65,743

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

479. The farmers during field visit in June 2015 informed that there is only one dairy farm and three poultry farms in the Polder area. About 10-12 numbers of cows are being reared in the dairy farm. Average number of poultry (chicken) in each farm ranges from 400-500. The overall farm management is good, but food and fodder crisis arises in the rainy season due to shortage in the market.

480. The owners of the livestock population are facing problems in respect of non-availability of fodder and feeds during the months of July to November due to unavailability of grazing land. Rice straw is the main fodder. Oil cake, bran, Grass, etc. are 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 wastes become feed to the poultry.

Picture 5.26: Livestock in the polder area

Picture 5.27: Poultry (duck) in the Polder area

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

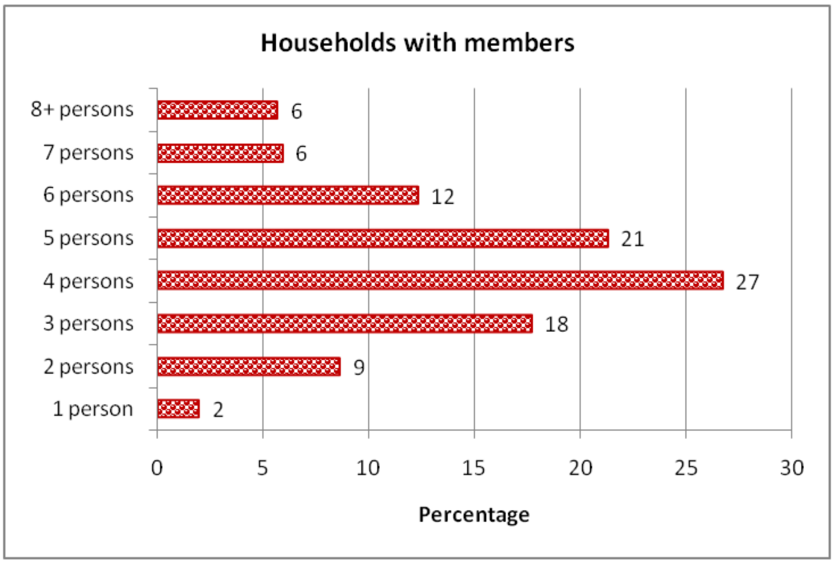
5.4 Socio-cultural Environment

482. Baseline on the state of socio-economic environment is sketched out for the entire Polder-43/2C. Thus, the polder covers only one union namely Golkhali of Galachipa upazila under Patuakhali district. The union has 16 mouzas and 16 villages.

5.4.1 Demography

483. The Polder area is the home of 33,968 people belonging to 7,548 households. Of the total population; 16,610 (48.9%) are male and 17,358 (51.1) female. The average household size is 4.5, which is equal to the national average of 4.50 [BBS, (HIES) 2010[9]]. The average population density is 475 per square kilometer, which is lower than that of national average (1,055) (Housing and Population Census, BBS, 2011, CEGIS estimation, 2015[10]).

484. Households with four members are the dominant category in the polder area; 27% households belong to this category (figure 5.15). Although average household size is 4.5, 45% households have 5 or more members.



Source: Housing and Population Census, BBS, 2011

Figure 5.15: Distribution of households comprising member in each

Age Structure

485. The highest number of population (23%) in the Polder area belongs to age category of 30 to 49 years old. The lowest 3% population belongs in 60 to 64 years category. Age groups of 0-14 years is defined as children, 15-24 years as early working age, 25-54 years as prime working age, 55-64 years as mature working age and 65 years and over as elderly people (source: World Fact Book, CIA[11]). 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 for more investment in health sector.

486. According to the international standards, the "economically active population" comprises all persons of either sex who furnish the supply of labour for production of goods

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

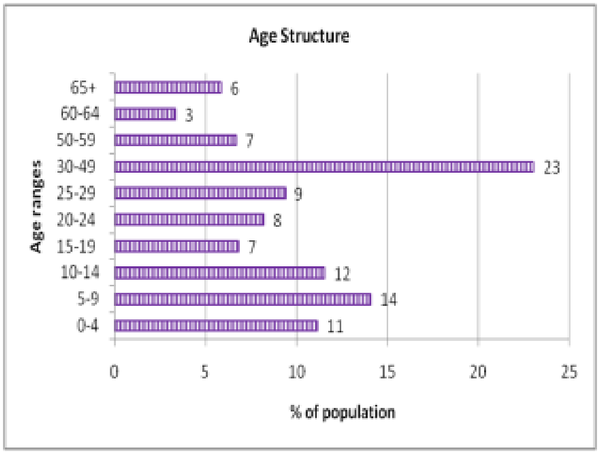
[10] This estimation is based on BBS, 2011 Census data and 1.37 linear national growth rate

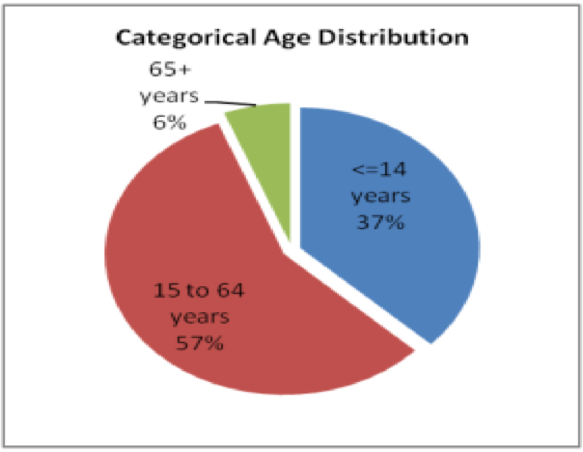
[11] Retrieved on 19/3/2015 from https://www.cia.gov/library/publications/the-world-factbook/docs/notesanddefs.html

and services as defined by the United Nations systems of national accounts and balances, during a specified time reference period (Ralf Hussmanns et. al, 1992[12]). This definition is adopted by the International Labour Organization (ILO) and categorized population of 15 to 64 years category as labour force whereas populations below 14 years and above 65 years are considered as dependent.

487. The population data when analyzed to ascertain the size of (potentially) active working population then it appears that 57% percent population who are in the age bracket of 15-64 can be classified under this category. Conversely, there are 43% population who are defined as economically inactive comprising of elderly people (6%) and children (37%) (figure 5.16).

488. Estimating total dependency ratio[13] it is found that 75 in which child dependency ratio is 65 and aged dependency ratio is 11. It illustrates that total 75 persons are dependent among 100 labour forces in which 65 out of 100are children and 11 out of 100 are elderly people.





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

Figure 5.16: Age structure of the studied population

Figure5.17: Categorical distribution of studied population

5.4.2 Education

489. There are 26 government primary schools, 5 registered high schools, 5 Dakhil Madrasahs[14]. There is no college in the Polder area. Accessibility to these institutions is very much limited due to several reasons-such as poor communication facilities, higher poverty rate, inadequate health care and nutrition services etc.

490. School attendance rate (Figure 5.18) is measured by BBS from 3 years to 29 years by six clusters of age groups. 3 to 5 years is defined as preschool attendance, 6 to 10 as primary, 11 to 19 years as secondary and higher secondary and finally 20 to 29 years as higher as well advanced level attendance at educational institutions. Comparative picture of attending

[12] Ralf Hussmanns et. al, 1992; *Surveys of economically active population, employment, unemployment and underemployment;* International Labour Office, Geneva.

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

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

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

[14] Data retrieved from http://golkhaliup.patuakhali.gov.bd/node/973258 and also verified in field visit.

and not attending rate shows that net attendance rate is the highest (19.1%) at primary level after which the rate starts declining. The secondary level shows the threshold point from which not attending rate moves upward and attending rate starts sliding. This trend is true for higher as well as advanced level studies.

Picture 5.28: Educational institution in the Polder area

Picture 5.29: Playground of school is flooded due to heavy rain and tidal flood

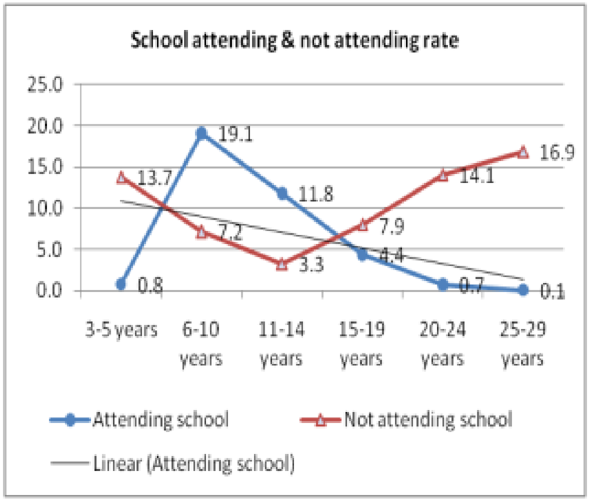


Figure 5.18: Portrayal of school attending and not attending rate in terms of age groups

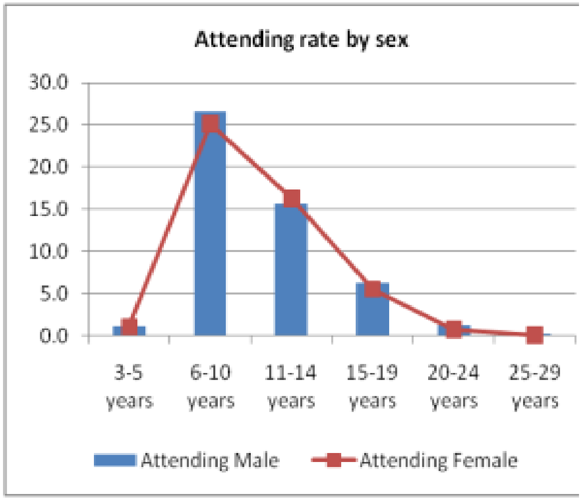
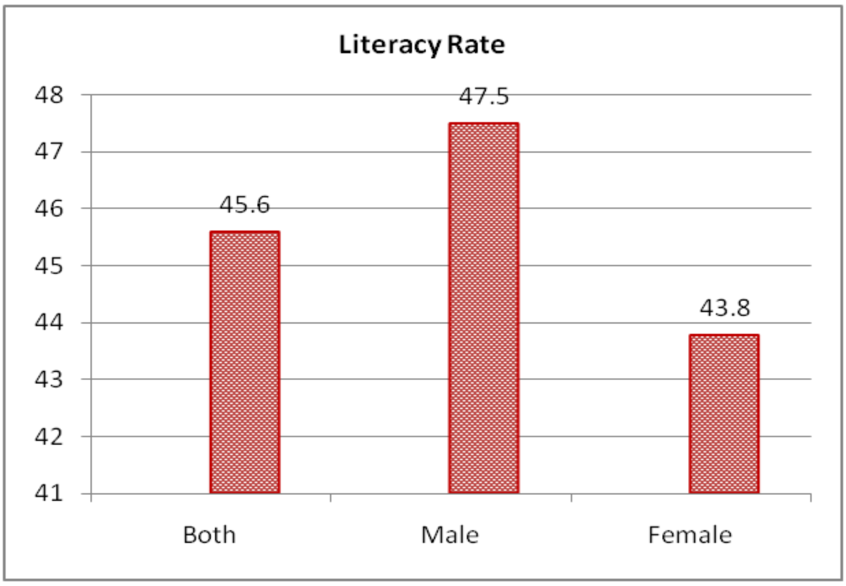


Figure 5.19: Comparative picture of male-female attendance rate

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

491. Male-female attendance ratio is almost equal with a little difference at primary level in which female attendance is comparatively higher than that of males (Figure 5.19). Field findings confirm that female attendance at this stage is higher because of existing scholarship program, and the parents consider this basic schooling as an investment for securing a good marriage of their girl child. <u>It has also been observed and our data confirms that after completion of primary education, most of the girls get married and therefore the attendance rate gradually starts decreasing.</u> However, male attendance rate also starts decreasing due to their involvement in income generating activities. Prevalence of child labour in the study area is on average 4.40%, of which boys is 6.20% and girls is 2.20% (Source: Progotir Pathey, MICS, 2009). This rate is noticeably higher than that of national average which to total in

2.30%, for boys 2.90% and for girls 1.70%. Field findings also proved that impoverishment of local people pushed them toward livelihood harnessing at their early age.



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

Figure 5.20: Literacy rate among the studied population

492. Literacy rate (Figure 5.20), based on a definition “ability to write a letter in any language” is 45.6%, where for male it accounts to 47.5% and female 43.8%. The rate of literacy reported above is for population of 7 years and over ages.

5.4.3 Public Health

Prevalence of diseases

493. Field findings show that waterborne diseases, coldness, fever, respiratory and skin diseases (Picture 5.30 - 31) are dominant throughout the study area. The prevalence is due to drainage congestion in the Polder area. Field data confirms that water in polder area remains stagnant in linked canals and ditches round the years, whichspread bad fragrance leading to air pollution. It eventually increases respiratory diseases particularly to children. This stagnant waterbodies appeared to be the abode of mosquitoes that leads to prevalence of fever. Local people sometimes tend to wash their hands and legs with this stagnant water and children also take bath. It eventually leads them to skin disease as this water is already contaminated.

Picture 5.30: Water become stagnant inside the polder closing the sluice

Picture 5.31: Sign of skin disease being affected with stagnant water

494. However, during wet season waterborne and coldness are very common. Water congestion takes acute form during this period as high tide pushes water inside the polder area and heavy rainfall add extra water. Most of the internal roads networks, courtyard and in some cases kitchens are flooded for at least 6 hours a day (time of high tide). This dampens the floor of houses and increases coldness.

Access to health services

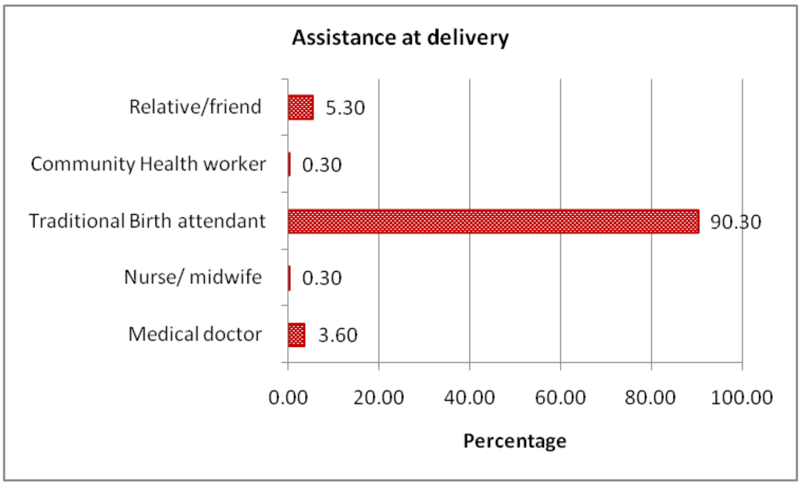
495. Access to health services and facilities refer to the availability and adequacy of supply, affordability, physical accessibility and socio-cultural acceptability. Field data shows that there is no community clinic in the study area. Therefore, they are to receive health services from peripheral Upazila Health Complexes (UHC) located at Galachipa upazila.

496. Field data shows that the existing services are almost inaccessible for local people therefore, a substantial number of populations tend to receive services from the local phermasist and/or "village doctors" either self-educated or locally trained who have the minimum basic knowledge about health and medicines. This inaccessibility exacerbated due to poor communication network and lack of services and facilities.

Child and Mothers' Health

497. Infant mortality rate (IMR) in upazila in which the polder area is situated is 45. IMR is defined as the number of deaths of infants under one year old exact per 1,000 live births. On the other hand, the under five mortality rate (U5MR) is 58; it also indicates the number of deaths of infants under five years old per 1,000 live births. This rate is comparatively lower than that of national average which is 49 for IMR and 64 for U5MR (source: Progoti Pathey, MICS, 2009).Though this scenario represents the entire upazila; it is very common for Golkhali union. The child mortality is due to malnutrition, having scarcity of trained attendants at delivery, and more importantly lack of health services due to poor communication facilities. The susceptibility of aforementioned diseases is acute for children and pregnant women.

498. It is found in the entire upazila that about 90% women aged 15-49 years with a birth in the 2 years preceding the survey can breastfeed their baby within one hour of birth and about 97% can breastfeed within one day of birth. The following figure shows that the highest percentage (90.30%) of delivery are assisted by traditional birth attendants (Figure 5.22), about 5.30% by relatives/friends, only 3.60% by medical doctors. This scenario is common for the polder area.



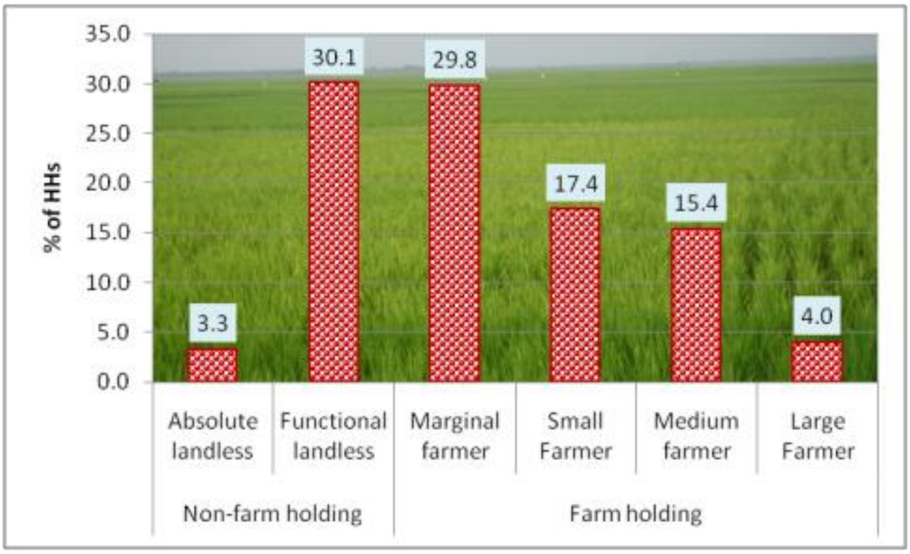
Source: Progotir Pathey, MICS, 2009

Figure 5.21: Percentage of women aged 15-49 with a birth by type of personnel assisting with the delivery

5.4.4 Ownership and utilization of land

499. The Census of Agriculture, 2008 conducted by BBS classified land holdings into two broad categories - (i) farm-holdings and (ii) non-farm holdings. A farm holding is defined as being an agricultural production unit having cultivated land equal to or more than 0.05 acre. Conversely, non-farm holding includes landless households and households having lands up to 0.04 acre. The study area shows that out of total holdings 67% is farm-holding and the rest 33.50% is non-farm holding.

500. According to BBS 2008 data on land holding distributions, 3.3% households are absolutely andless in the study area,i.e. they have no land either homesteads or cultivated. 30.1% households belong to functional landless category, who have lands upto 0.04 acres. Among them 22.5%, households have only homestead lands and 7.6% have homesteads plus farmland within the limit of 0.04 acre. These households mainly own land adjacent to their homestead and are being used as kitchen garden that are primarily used by the female members for household consumption.



Source: The Census of Agriculture, 2008, BBS

Figure 5.22: Households by land holdings

501. On the other hand, farm holding distribution shows that 29.8% households belong to marginal farmers (0.05 to 0.99 acre), 17.4% belong to small farmer (1.00 to 2.49 acre), 15.4% belong to medium farmers (2.5 to 7.49 acre) and 4% belong to large farmer (7.5+ acre) categories. It is evident that land fragmentation decreases the holding size for which; large and medium farmers are gradually being converted to marginal farmers.

502. The entire land holdings can be categorized into three classes such as “owned land”, “land given to others” and “land taken from others”. It is found in the study area that about 68% holdings are under owned category; which means the land owned by holder including members of his/her family having a title to the land with right to determine nature and extent of its use and to transfer the same. On the other hand, about 14% holdings are found to be given by the owners to others in terms of lease and/or rent for a limited time on payment either in cash of kind or both. About 18% holdings are found to be taken by the farmers from others in terms of sharecropping and/or lease on other terms (BBS, 2008).

503. Field findings confirm that the “land given to others” and “land taken from others” takes into two form: one is *adha-bhaga* (distribute crops equally between land owners and farmers),

and other one is *kot-kawla* (leasing land on payment in cash). In *adha-bhaga* category, the land owner gives land to the farmers. Conversely, farmers cultivate the land with all input supplies except seeds. The cost of seeds in this condition is carried both by the farmers and land owners. After harvesting, crops are distributed equally between the farmers and land owners. However, in *kot-kawla* system the land owners gives land to others with taka 2,000 to 2,500 per decimal. The land receiver cultivates lands until the land owners repaid his/her paid amount.

5.4.5 Occupations and livelihoods

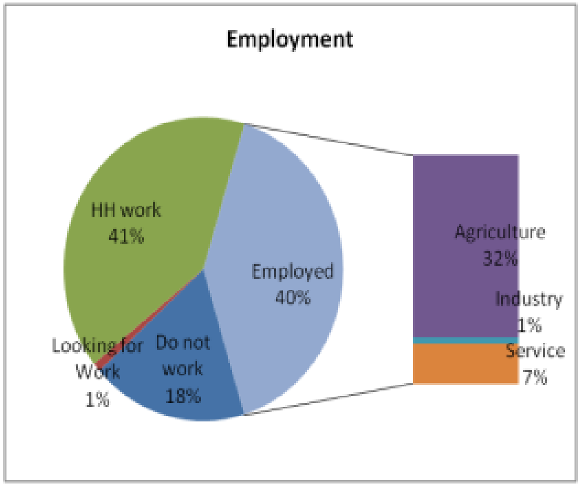
504. Out of total 33,968 population, 4,925 (14.5%) are economically active which include 2,433 (49.4%) employed, 34 (0.7%) are looking for work, and 2,458 (49.9%) engaged in household work. The economically active population includes those who are aged 7 and over and not attending school at reference period of Housing and Population Census, 2011. Therefore, the definition include employed, looking for work and household work categories and exclude children below 7 years, attending school population, physically challenged and elderly people who are not engaged in income generation works at reference period. Here household work particularly for women participation is accounted in terms of household activities as well as alternative income generation such as livestock rearing, poultry farming etc.

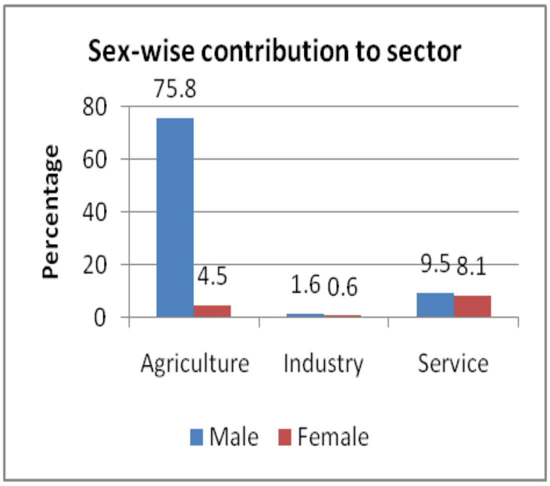
505. The education status confirms that whereas not attending males are engaged in employment, females are getting married and in turn, contributed to the highest participation in household work (47.4%). Therefore, women participation in direct income generating activities (employed category) is negligible (6.5%). The employed category (Figure 5.23) also includes child labour as it was accounted from 7 years old population. Therefore, non-attending children aged between 7 to 15 years were included in this category, which is documented in [paragraph 5.4.1of education section].

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

Figure 5.23: Employment status among the studied population

506. Distribution of employed population at reference period of the 2011 census shows that 32% are engaged in agricultural activities, 1% in industries and 7% in service (Figure 5.24). Agricultural activities includes broadly crop farming, fishery and livestock and poultry farming. It is evident that the study area is agrarian based as it provides mainstay of livelihood. Males are the main group dominating this sector. Females' main involvement in service sector for income generation.





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

Figure 5.24: Employment status by field of activities

Figure 5.25: Sex-wise contribtuion to sectoral activities

5.4.6 Labor market

507. The employment[15] rate[16] in the study area is 40.5 whereas the unemployment rate[17] is 59.5. It is evident that more than half of the total economically active population is still unemployed. Most of the unemployment populations are females who are solely involved in household work, and only 0.5% populations are looking for work (see paragraph….of occupations and livelihood section).

508. Data confirms that agriculture the main sector generating employment for the local people (see paragraph 5.4.5, occupations and livelihood section). In agricultural sector, almost all labourers come from the local villages. A nominal number of labourer comes from Rangpur district during harvesting time. A group of labourers work under a sarder, each worker is given 350 Taka without food supplement and *sardar* receive taka 10 per labourer.

5.4.7 Standard of living

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

510. Data shows that only 11% households are under grid electricity coverage. Rural Electrification Board (REB) is the main electricity provider. The coverage of solar is found nominal in the entire study area.

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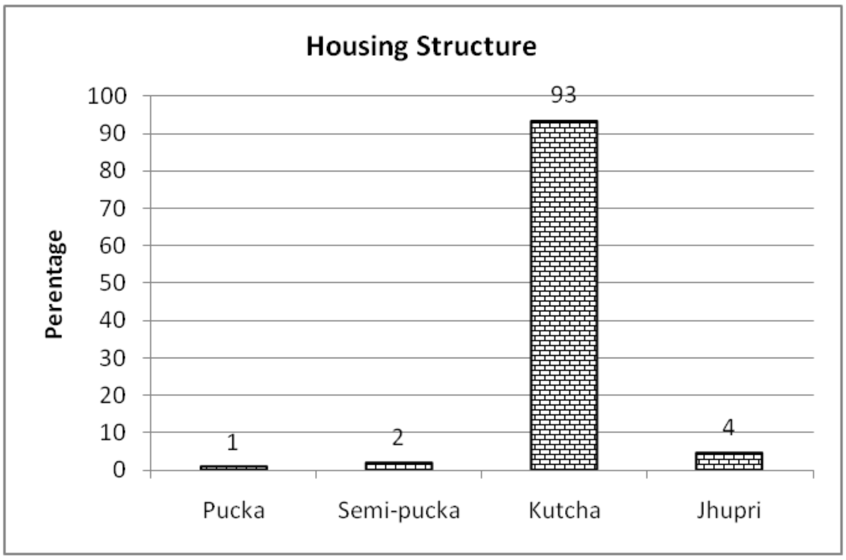
[15]The ILO defines employed persons of those who, (1) do any work at all as paid employees, work in their own business or profession or on their own farm, or work 15 hours or more as unpaid workers in a family-operated enterprise; and (2) all those who do not work but had jobs or businesses from which they were temporarily absent due to illness, bad weather, vacation, childcare problems, labor dispute, maternity or paternity leave, or other family or personal obligations — whether or not they were paid by their employers for the time off and whether or not they were seeking other jobs.

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

[17] Unemployment Rate= 100-Employment Rate

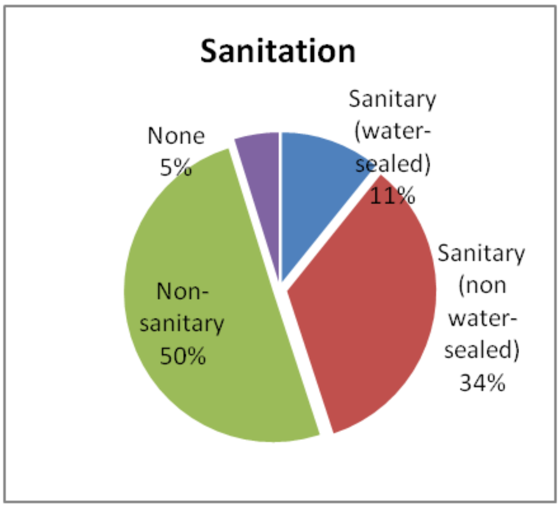
511. The study area shows the predominance of kutcha houses (93%) compared to other three types of houses such pucca, semi-pucca and jhupri. Only 2% houses are semi-pucca, one percent are pucca and 4% percent are still jhupri. Field data confirms that prevalence of extreme poverty push them to live in kutcha houses (Figure 5.26).

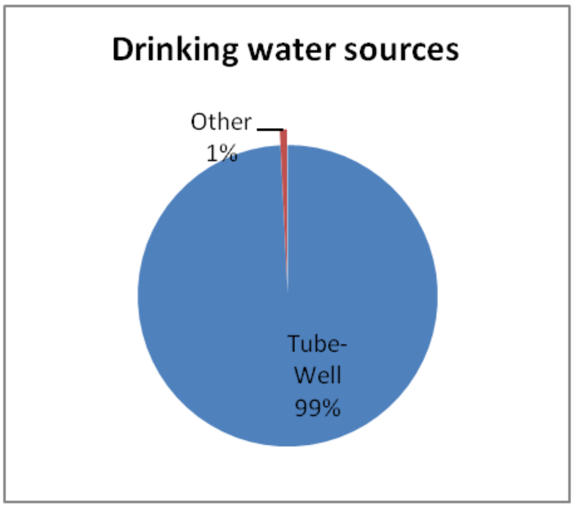


Source: Housing and Population Census, BBS, 2011, CEGIS estimation, 2015

Figure 5.26: Housing condition in the study area

512. In the study area 50% households use non-sanitary latrines, 34% use non water-sealed sanitary latrines, 11% use sanitary water-sealed latrines and 5% households still have no sanitation facilities either owned or shared basis. Field findings confirmed that non-sanitary latrines are prevailing among kutcha houses. (Figure 5.27).





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

Figure 5.27: Distribution of households by sanitation facilities

Figure 5.28: Distribution of households by sources of drinking water facilities

513. Collection of drinking water from tube-well is dominant (99%) throughout the study area. However, one percent households are still depend on open water bodies as sources of drinking water. These houholds are basically the poorest and have no access to tube-wells (Figure 5.28).

514. Fire wood and chips are the only source of fuel consumption in the entire study area. People purchase firewood from saw-mill and use round the year. They also store chips during

crop harvesting time for cooking in wet season. Poor people who cannot afford usually collect leaves from neighbours' gardens and chips from the paddy fields.

5.4.8 Poverty

515. For the study area, poverty has been measured following the Multidimensional Poverty Index (MPI) method. The process is intended to identify multiple deprivations at the household level in three broad dimensions such as education, health and standard of living. The total 10 standard indicators along with threshold are described by Alkire and Santos, 2010[18]. Of them, total 8 indicators were selected to be analysis for this study based on data availability and accordingly adapted to the prescribed methodology (for detail methodology see Appendix-1). The indicators and the thresholds for defining poverty are presented in the following table (Table-5.32):

Table 5.32: Indicators thresholds along with data sources for MPI calculation

Dimensions	Indicators	Definitions/threshold	Data sources
Education	School attainment	No household member has completed at least six years of schooling.	Housing and Population Census, 2011, BBS
	School attendance	A school-age child (up to grade 8) is not attending school.	Housing and Population Census, 2011, BBS
Health	Child mortality	A child has died in the household within the five years prior to the survey	Progothir Pathey, MICS, 2009, BBS
Standard of living	Electricity	Having no access to electricity	Housing and Population Census, 2011, BBS
	Drinking water	Having no access to clean drinking water or if the source of clean dirking water is located more than 30 minutes away by walking	Housing and Population Census, 2011, BBS
	Sanitation	Having no access to improved sanitation or if improved, it is shared	Housing and Population Census, 2011, BBS
	Cooking fuel	Using "dirty" cooking fuel (dung, wood or charcoal)	Field investigation, CEGIS, 2015
	Housing	Having a home with dirt floor	Housing and Population Census, 2011, BBS

516. Analysing poverty status it is found that about 29% households are multidimensional poor (index value 0.29 out of 1= MPI). About 51% populations are living in these poor households (poverty head count=H) and on average 57% poor people are deprived of any indicator (intensity of deprivation=A).

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

Table 5.33: State of Multidimensional poverty

Dimensions	Indicators	Deprivation per indicator(%)	Contribution of deprivation in dimension to overall poverty (%)
Education	School attainment	51	49.4
	School attendance	43	
Health	Child mortality	6	6.8
Standard of living	Electricity	89	43.8
	Drinking water	1	
	Sanitation	89	
	Cooking fuel	100	
	Housing	97	

Source: CEGIS calculation

517. Illustrating contribution of deprivation in dimension to overall poverty, the highest deprivation (49.4%) is found in education dimension. Considering the two dimension, it is found that 51% household members have not completed at least six years of schooling, and 43% school-age children (up to grade 8) are not attending school.

518. The second highest deprivation is found in standard of living dimension (43.8%) as 89% populations have no access to improved sanitation facility (water-seal sanitation), 97% are living on dirt, floored households (considering kutcha and jhupri), 100% are using dirt fuel (considering all types of traditional fuel), 89% households have no grid electricity coverage and one percent households still collect drinking water from unsafe sources (ponds, river etc.).

519. In case of health dimension, only one indicator (child mortality) is considered, as nutrition data is not available. It contributes 6.8% in overall poverty as 6% children are found to be died in the households within the five years prior to the survey (considering both IMR and U5MR) (Table 5.33).

5.4.9 Institutions and infrastructure

Market

520. There are 10 local markets in the study area called as hat-Bazar. Most of the hat-Bazars are located at vicinity of embankments. People usually avail market facilities from peripheral market notably Galachipa upazila.

Transport network

521. There are 10 km pucca roads, 5 km brick soling roads and 70 km kutcha roads (Picture 5.32)in the polder area. Some roads are developed by Local Government Engineering Department (LGED). Additionally, there is another road underconstruction by Roads and Highways Department (RHD) from Julekha Bazar to Haridebpur Ferry Ghat.

522. The entire polder is scattered island demarcated by Lohalia, Golkhali and Sanakhali rivers. Therefore, people have to communicate to other areas particularly to the upazila headquarter using waterways. Haridebpur Ghatis the main point through which people usually move to other places through Ferry and/or engine boat.

Picture 5.32: Roadway in the polder area

5.4.10 Vulnerability

523. The polder area is vulnerable to natural disaster notably;the cyclonic storm, storm surges, tidal flooding, heavy rainfall and erosion. In some areas, embankments are so vulnerable which may be eroded within short time. Tidal flood water enters into the polder as there is no functional gate of any drainage and flushing sluices. This water is coincided with heavy rainwater and in turn, makes drainage congestion that eventually inundates the internal road networks, homesteads, playground and educational institutions. Being a coastal area, cyclonic storm is very common in the study area. Substantial aftermath was taken place with very severe cyclonic storm namely Sidr; of them, human and non-human asset loss is mentionable.

5.4.11 Social structure

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

525. In social relation, males are considered as the main livelihood earner whereas females are usually confined to household chores. In agriculture sector, females' contribution is supplementary aiming to aid their male partner in preparation of raw paddy to rice. Furthermore, kitchen garden is main task done by women. In decision making both in society and family, males are the main contributors. Peoples reported that as female literacy rate is gradually increasing, they are now contributing, although trivial, in household income particularly in service sector such as teaching, factory worker etc.

6. Environmental Impacts and Mitigation Measures

6.1 Preamble

526. This Chapter identifies the impacts of project activities on environment, which may potentially take place in various Project phases, and also suggests appropriate mitigation measures to avoid, offset, reduce or enhance, or compensate these impacts. Potential Intervention, which may cause potential environmental impacts during pre-construction, construction, and post-construction stages have been identified in Chapter 4. The project influence area has been identified in Article 2.2.1 of Chapter 2. The following detailed investigations have been carried out to assess the magnitude of these impacts:

- Census survey to assess the extent of land acquisition and resettlement, loss of vegetation, occupation, income and poverty levels of the affected households, etc;
- Developed Polder drainage model using the existing calibrated and validated Southwest Regional Model as base model has been used to understand the impact of project intervention to improve the existing drainage system and impact of climate change considering 5th assessment report of IPCC with the existing drainage system and with modified drainage system;
- Environmental quality baseline monitoring of air, noise, surface water, groundwater and soil;
- Ecological surveys comprising vegetation, wildlife and fisheries covering both mainland and offshore area;
- Offshore surveys comprising socioeconomic status and environmental settings,
- Expert consultations, focus group discussions, and public consultations.

527. It is noted that the impact of proposed interventions on drainage, flooding, river dynamics has also been analyzed through modeling conducted by IWM 2016.

6.2 Impact Screening

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

- High negative (adverse) impact;
- Moderately (medium) negative impact
- Low negative impact;
- Insignificant impact;
- High positive (beneficial) impact;
- Low positive impact; and
- Moderately (medium) positive impact

- High positive impact
- No impact.

529. The matrix is provided in Table 6.1 (next page).The negative impacts predicted in this manner are the ‘unmitigated’ impacts. Appropriate mitigation measures have been recommended as part of this EIA, thus reducing the occurrence possibility and severity of the potentially adverse impacts.The potentially negative impacts identified through this process are discussed in the subsequent sections.

Table 6.1: Environmental Screening Matrix

	Physical							**Biological**		**Social and Socioeconomic**											
Project Phases and Activities	Soil Erosion	Air Quality	Soil and water contamination	Groundwater Quality	Drainage /Waterlogging	Sedimentation	Water Availability and Consumption	Natural Vegetation	Aquatic Habitat	Resettlement	Blocked Access Routes	Noise and Vibration	Impacts on Agriculture and grazing	Impacts on Fisheries	Flooding	Vehicular Traffic	Social Conflict	Damage to Infrastructure	Public Health	Gender and Cultural Issues	Employment Opportunities
Design Phase and Pre-Construction Phase																					
Land Acquisition	0	0	0	0	0	0	0	0	0	HN	0	0	0	0	0	0	0	0	0	0	0
Contractor Mobilization	MN	MN	MN	0	0	0	0	MN	MN	0	MN	MN	MN	MN	0	HN	0	HN	MN	MN	MP
Construction Camp Establishment	MN	MN	MN	0	0	0	0	MN	MN	MN	MN	MN	MN	MN	0	MN	0	MN	MN	MN	MP
Construction Phase																					
Equipment / Material Transportation	MN	MN	MN	0	0	0	0	0	0	0	MN	MN	MN	MN	0	MN	0	MN	MN	MN	MP
Operation of Construction Camp	HN	MN	HN	MN	0	0	MN	0	MN	0	MN	MN	0	MN	0	MN	0	MN	HN	MN	MP
Site Clearance	MN	MN	MN	0	0	0	0	MN	MN	0	MN	MN	MN	MN	0	MN	0	MN	MN	MN	HP
Borrow and disposal area management	HN	MN	HN	0	0	0	0	MN	MN	0	MN	MN	HN	MN	MN	MN	0	MN	HN	MN	HP
Excavations of water channels	MN	MN	HN	0	MN	MN	0	MN	HN	0	MN	MN	0	HN	MN	MN	0	MN	MN	MN	HP
Re-sectioning of Embankments	HN	MN	MN	0	0	0	0	MN	0	0	HN	MN	MN	0	MN	MN	0	MN	MN	MN	HP
Installation/replacement/repair of Regulators	HN	MN	MN	0	0	0	0	0	MN	0	HN	MN	0	MN	HN	MN	0	MN	MN	MN	HP
Demobilization	MN	MN	MN	0	0	0	0	MN	MN	0	MN	MN	MN	MN	0	HN	0	HN	MN	MN	MP
Operation Phase																					
Operation of Regulators	MN	0	HN	0	HP	0	MN	0	MN	0	0	0	HN	HN	HN	0	HP	0	0	0	MP
Repair and Maintenance	MN	0	MN	0	HP	0	0	0	MN	0	MN	MN	HN	HN	HN	MN	0	0	0	0	MP
Monitoring	0	0	0	0	HP	0	0	0	0	0	0	0	0	0	0	MN	0	0	0	0	MP

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

6.3 Impacts during Pre-construction phase

530. Site development involves the following activities:

- Mobilization of equipment, construction material/vehicles;
- Clearing of sites;
- Establishment of temporary construction yards and labor sheds with sanitation and safe drinking water facilities.
- Establishment of temporary stockyard for construction; and
- Take initiative for RAP.

531. The activities will cause the following environmental impacts:

6.3.1 Damages of properties due to Project Intervention and Land Acquisition

Impact

532. It is estimated that about 10.73 ha of land would beacquired. The details of acquired land are 2.94 ha of homestead, 2.29 ha of Vita/Highland, 2.99 ha of crop land, 1.80 ha of orchard and 00.53 ha commercially used land. Moreover, primary and secondary structures, social network (like somiti, club office etc.) and business centre (shops) will be affected.The proposed Polder- 43/2C will be developed through construction of retirements of embankment at a number of segments, water regulatory structures etc. Presently, Planning and Design consultant has prepared Land Acquisition and Resettlement Action Plan as per guidelines of acquisition and requisition of immovable property ordinance, 1982 (Ordinance II of 1982). In this case, the detail of the land acquisition plan, process and cost including the list of the PAPs are incorporated in the RAP report 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- 43/2C are presented in Tables 6.2 to 6.6.

Table 6.2: Land to be Acquired

Type of land use	Quantity (ha)
Homestead	2.94
Vita/ Highland	2.29
Crop land	2.99
Orchard/ Forest land	1.80
Pond	0.18
Commercially used	0.53
Total	10.73

Source: Socioeconomic survey conducted by KMC in 2016

Table 6.3: Primary Structures to be affected

Description	Covered Area (square feet)
Pucca	11013
Semi-pucca	15184
Tin	139165
Kutcha	31445
Thatched	17118
Total	213,926

Source: Socioeconomic survey conducted by KMC in 2016

Table 6.4: Secondary Structures to be Affected

SL.	Description	Quantity
01	Pucca Floor (sft.)	77
02	Gate (sft.)	231.83
03	Mehrab (sft)	225.16
04	Boundary wall (rft.)	169.99
05	Grave wall (rft.)	727.96
06	Stairs of House (rft.)	84.4
07	Tin made Boundary wall (rft.)	85
08	Pucca Latrine (No.)	6
09	Slab Latrine (No.)	195
10	Kutcha Latrine (No.)	6
11	Tube Well (No.)	37
12	Pillar (No)	10
13	Urinal Place (No.)	10
14	Ablutions Bench (No.)	22.8
15	Shahid Minar (No.)	2
16	Machine (no.)	13
17	Septic Tank (Cft.)	1185

Source: Socioeconomic survey conducted by KMC in 2016

Table 6.5: Trees to be Affected

Types	Big	Medium	Small	Plant	Total
Fruit trees	4243	3008	3632	5065	**15948**
Timbers trees	3227	6987	7077	5863	**23154**
Medicinal	183	494	269	90	**1036**
Banana	6178	4871	3247	3685	**17981**
Bamboo	4184	3887	4104	924	**13099**
Total	**18015**	**19247**	**18329**	**15627**	**71218**

Source: Socioeconomic survey conducted by KMC in 2016

Table 6.6: Common Properties to be Affected

Description	Quantity
School/Pathshala	1
Govt. Office	3
Mosque	17
Somiti	3
Tubewell	12
Grameen Bank Center	2
Private Organization	1
Total	39

Source: Socioeconomic survey conducted by KMC in 2016

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

Mitigation

534. 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 and livelihood; 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

535. The impacts associated with the involuntary resettlement are likely to be addressed with the help of the above mitigation measures, and the significance of residual impact is considered to be Moderate.

6.3.2 Noise Quality

Impact

536. The noise level at the settlement sites will be deteriorated by mobilization of construction vehicles, materials, equipment and man-power. Traffic volume will be increased both in the roads and watercourses.The increased traffic volume is expected to intensify the noise level leading to noise pollution. Therefore, settlements surrounding the embankment and rivers will be affected by sound pollution.

537. The significance of this unmitigated impact has been assessed as Moderateon the basis of impact magnitude and receptor sensitivity.

Mitigation

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

- The contractors need to be conscious about using hydraulic horns and avoid unnecessary honking. The contractors should be encouraged to move all construction equipment, machineries and materials during day time.

Residual Impacts

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

6.3.3 Preparation of facilities for contractor(s) and labor force

Impact

540. Construction of temporary site facilities for contractors and labor forces includes land cleaning, levelling, excavation and building construction. During site development activities, the Polder may be potentially affected by air and water contamination, noise generation, safety hazards, hindrance to local communities and other relevant impacts.Map 6.1.shows the key

locations in the Project area where these impacts are likely to take place. Mostly, all labor force facilities and sheds will be implemented in theperiphery of the embankment, which may create nuisance for the students of nearest twelve (12) schools and madrasha.

541. The significance of this unmitigated impact has been assessed as Moderateon the basis of impact magnitude and receptor sensitivity.

Mitigation

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

- Contractor will prepare site establishment plan and obtain approval from the DCSC
- The approval for location of temporary facilities will be obtained from the DCSC
- Deforestation will be minimized as far as possible during site facilities development;
- Photographic record will be maintained to keep the pre-construction condition of the area;
- Site facilities will be established at a safe distance from communities and schools;
- Contractor will prepare and implement pollution control and waste management plans;
- No untreated wastes will be released on ground or in water;
- Exhaust emissions from vehicles and equipment will comply with standards;
- Vehicles, generators, and 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; and
- Liaison will be maintained with the local communities.

Residual Impacts

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

6.3.4 Increased Vehicular Traffic during Mobilization

Impact

544. During mobilization, equipment, machineries, materials and manpower will be transported to the Polder resulting in additional traffic on roads and in waterways. This traffic may potentially cause traffic congestion particularly at peripheral road cum embankment and Horidevpur Ferry terminal. Map6.1 shows the key locations in the Polder area where this impact is likely to take place. *This increased traffic may affect movement of students and guardians of nine (9) schools and madrasha namely Char Suhuri primary school, Horidevpur High school, Horidevpur government primary school, Bara Mullagovernment primary school, Dakhin purbo Golkhali government primary school, Dakhin purbo Golkhali High school, Abtedia Hasania Madrasha, Golkhali High school, Golkhali government primary school and Bara Gabua government primary school which are located within 0.5-1.0 km of embankment.* Besides, six (06) important rural markets on BWDB embankment; Shuari Bridge Bazar at Ch. 0.00 km, Bou Bazar at Ch. 2.22 km, Julekhar Bazar at Ch. 4.76 km, Alir Bazar at Ch 11.77

km, Wapda Bader hat at Ch. 17.50 km and Horidevpur Bazar at Ch. 18.78 km will face traffic congestion.

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

Mitigation

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

- The contractor will prepare a traffic management plan (TMP) and obtain approval from the DCSC. The TMP will be shared with the communities and will be finalized after obtaining their consent;
- The TMP will address the existing traffic congestion particularly at the Horidevpur Bazar and Suhuri Bridge Bazars and alsoduring schools time. Project-related traffic will be minimized during the peak traffic hours (from 8 am to 2 pm).
- Ensure minimal hindrance to local communities and commuters; and
- Regular Liaise to be made with local communities and concerned authorities
- Provision of training on vehicular traffic moving pattern and management system are to be ensured by the contractor for the local stakeholders using multimedia presentation and showing videos at different places of the polder.

Residual Impacts

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

6.3.5 Changes of Land use

Impact

548. The polder is partially embanked by the southern dyke, which is located at the right bank of the Lohalia River.The proposed intervention would change the land use pattern of the area. Here, land would be needed to establish temporary facilities including construction camp (labor shed) and borrow areas. It is estimated that about 25 labor sheds would be constructed to established temporary facilities for the rehabilitation works. All the labor sheds will be constructed in the requisite land. It is noted that land will not be changed because this land will be used for construction of labour camps as a temporary facilities and it would be brought back to original use.

549. The borrow pit area are mainly keptfallow during dry season. In wet season, these borrow pitarea are used scattered for seedbed or grazing of livestock by the dwellers of the polder.

550. 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 within one or two years due to tidal inundation.

Mitigation

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

- Establish all the construction camps within the area owned by BWDB;
- Pay compensation/rent if private property is acquired on temporary basis, which instructions of which should be specified in the tender documents;
- Construct labor shed/camp at government khas land/ non-agricultural land; and
- Avoid impacts on local stakeholders.
- A site specific camps management plan will be prepared by the Contractor for each camp as part of the Construction Environmental Action Plan to be followed upon approval by the Design and Supervision Consultant (DSC) and PMU.

Residual Impacts

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

6.3.6 Cutting of trees

Impacts

553. A total 71,218 number of trees of different species and varying sizes are to be cut for re-sectioning of embankment, construction of structures, establishment of temporary labour camps and other temporary facilities in Polder 43/2C. In addition, material stockpiling, material borrowing, and waste disposal can potentially affect the natural vegetation and trees. The details of the species composition is provided in the RAP Report.

Mitigation

554. 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 cutting;

- The Contractor will prepare a tree cutting plan and re-plantation plan, and will carry out compensatory tree plantation towards the end of the construction phase. A plant nursery should be established for this purpose with selected tree species (egg, *Narikel, Taal, Tentui* and *Babla*) in the beginning of the Project.
- The Contractor will prepare a site specific spoil management and disposal plan for implementation during construction upon approval by the DSC Consultant and PMU, ensuring collection of earthen materials and dumping of spoils at low or less vegetated areas. Consider minimum vegetation loss as much as possible to for the construction of labour camps and allied facilities.
- Implement an additional social afforestation programme at homestead platforms, khal dykes, graveyards, institution grounds and other available lands to compensate tree felling for embankment construction.
- Ensure proper implementation of afforestation on available land, primarily on embankments with local floral species after completion of construction works.

555. Give proper compensation to the tree owners against tree cut down specially for fruit yielding trees;

Residual Impacts

556. The impacts associated with cutting of treesare likely to be adequately addressed with the help of the above mitigation measures and the significance of residual impact will be Moderate.

6.4 Impacts during construction phase

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

- Mobilization of equipment, construction materials and vehicles;
- Placement and compaction of earth for flood control embankment/sea dyke;
- Re-excavation of canals;
- Demolition of non-repairable hydraulic structures;
- New construction/replacement of water control structures ; and
- Disposal of canal excavated spoil earth.

558. The activitiesstated above will cause the following environmental impacts:

6.4.1 Drainage congestion during replacement of drainage regulators

559. In construction phase, particularly during dismantle/replacement of hydraulic structures the drainage channels may be blocked or clogged causing temporary water logging in the surrounding areas and negatively affect the cultivation and the associated communities. The major drainage channels in the study area are Shuhurikhal (DS-1 at Ch. 24.97 km), GolkhaliKhal (DS-3 at Ch. 17.5 km), Mushirkhal (DS-4 at Ch. 11.77 km) and Rishirkhal (DS-6at Ch. 2.22 km) which drain out land run off water from the catchment areas of the canals. The catchment area of the canals are approximately 950-1000 ha. The drainage capacity of these canals havealready been reduced due to siltation, which creates drainage congestion during pre-monsoon, and monsoon. If the replacement of hydraulic structures diversion channels are to be developed to allow the natural flow and runoff of the catchment area of the respective structures are to be allowed otherwise, the upstream area of the above mentioned areaswill face major drainage congestion problem and create water logging.Furthermore, Chhota Gabua, Bara Gabua, Purba Golkhali and Badarpur mauzas are also likely to undergo water logging during post monsoon season.After completion of the construction activities, this temporary water logging will disappear. Additionally, spoil earth from the re-excavation of khals would create disturbance to the natural drainage system.

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

Mitigation

561. The following mitigation measures are belong suggested to address the above concerns:

- Contractor will have to construct diversion channels before construction of each regulator particularly at Mushirkhal, Golkhalikhal, Rishirkhaland Shuhurikhal because these are the major drainage channels in the Polder;
- Sequence of works at the regulators and in the water channels will have to be carefully planned to avoid drainage congestion;
- Contractor must ensure a dedicated spot for dropping or discharging construction wastes during construction activities to avoid of being clogged the drainage system.

Residual Impacts

562. The impacts associated with water logging are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Low. Besides, drainage congestion and temporary water logging will disappear after completion of the hydraulic structures.

6.4.2 Hindrance for pedestrians and vehicles movement during re-sectioning of embankment

Impacts

563. There are six markets on the BWDB flood control embankment and these area Shuari Bridge Bazar at Ch. 0.00 km, Bou Bazar at Ch. 2.22 km, Julekhar Bazar at Ch. 4.76 km, Alir Bazar at Ch 11.77 km, Wapda Bader hat at Ch. 17.50 km and Horidevpur Bazar at Ch. 18.78 km.These markets play an important role by providing source of livelihood of the Polder inhabitants as well as meeting the daily needs of the people. During hat day and marketing time, all the stakeholders use the embankment as road for carrying their goods for buying and selling and other purposes. Construction activities like re-sectioning of embankment, replacement/ dismantling of hydraulic structure along the embankments are likely to disrupt the markets and other relevant activities.Besides, construction activities will also cause temporary disturbance in the movement of local people as the internal roadways are not sufficient enough to provide alternate means of transportation. Local people will suffer due to their limited roadway movements. This will affect their economy and earning options as well.

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

Mitigation

- Re-sectioning work should be carried out segment wise;
- Alternative road can if not available are to constructed by the contractor;
- Earth work for re-sectioning <u>of embankment during hat day</u> can be shortened for easy movement of local people;
- Water way can be used especially along the Galachipa river during construction period;
- All the works will be conducted in presence of Union Parishad Chairman and members; and
- Project Implementation Officer (PIO) will be informed during construction and completion of earth works of embankment.

Residual Impacts

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

6.4.3 Noise and Vibration

Impact

566. 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. Moreover, noise may also be generated from the side camps.Increase of noise levels may cause disturbance, nuisance and even health hazards to the nearby communities as well as for the construction workers. In particular, the settlements near the work areas will be exposed to noise and vibration generated by the Project activities. <u>Therefore, sensitive receptors including nine schools along the embankment are likely to be more severely affected by noise. Twenty</u>

sixschools are located along the existing embankment of which nine (9) are very close to the embankment. The students of these schools may face serious noise and vibration problem during school time. The following table shows the noise level to be expected from the equipment. According to ECR'97, 60 dBA is allowable limit for mixed area in Bangladesh.

Table 6.7: Standard Noise level of differentequipment

SL	Equipment	Noise Level (7m away (dBA)
1	Bull-dozer	85
2	Excavator	80
3	Compactor	85
4	Concrete Mixer	85
5	Generator	81
6	Scraper	86

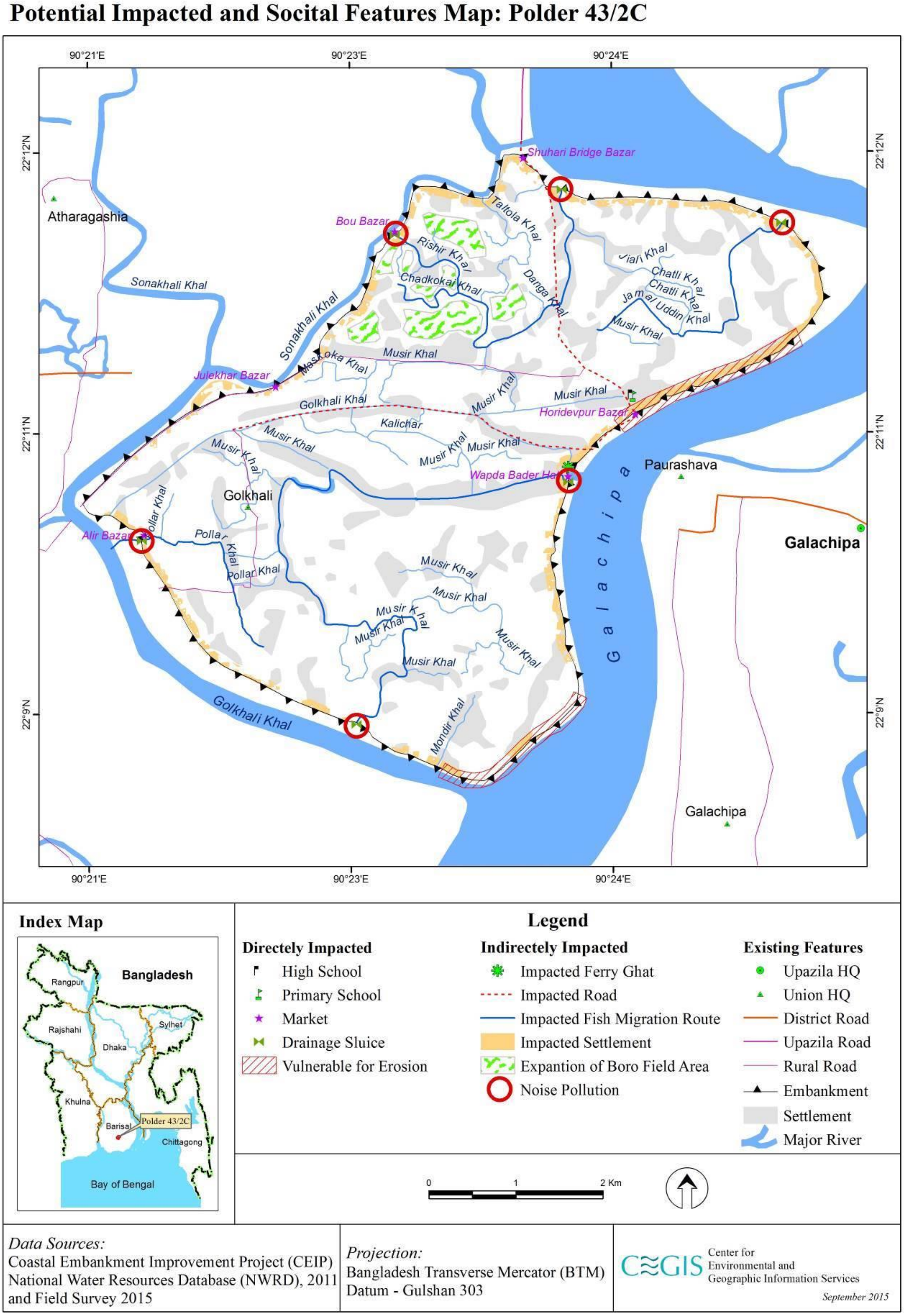
Source: CEIP Report, 2013

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

Mitigation

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

- The Contractor will prepare site specific pollution control plans for noise control for each construction site as well as a traffic management plan to be implemented upon approval by the DSC Consultant and PMU, for:
- Restricting/limiting construction activities during the day time.
- Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards.
- Vehicles and machinery will have proper mufflers and silencers.
- Provision of noise barriers are to be developed at schools and other sensitive receptors, as needed.
- Provisions of PPE (ear muffs and plugs) to labor are to be ensured.
- The construction crew will be instructed to proper use the equipment, to minimize noise levels.
- Camps will be located at a safe distance from communities.
- Liaison with the communities will be maintained and grievance redress mechanism will be established at the working site.
- Camps will be located at a safe distance from communities; and
- Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.



Map 6.1: Key Potential Impacts in Polder 43/2C

Residual Impacts

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

6.4.4 Damage to Local Infrastructure

Impact

570. During construction of all interventions, both road and water way will be used for carrying construction materials to project stockyard site. There could be some unintentional damage to the roads, electricity lines, water channels, jetties, and other structures during the construction activities, transportation of equipment and material, and associated vehicular traffic.

Mitigation

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

- The condition of the infrastructure being used for the construction and transportation activities will be regularly monitored; and
- All damaged infrastructure will be restored to original or better condition.

Residual Impacts

572. The impacts associated with damage to infrastructure 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 Soil and water contamination due to wastes

Impact

573. The soil and surface water quality, during construction may becontaminated by construction materials, demolition debris, fuel both from transportation vessel and construction machineries (piling machine, pump etc.). The contractor's camps will generate domestic solid waste and waste water including sewage.The workshops will generate oily water, waste oils, oily rags and other similar wastes. The stores and warehouse will generate solid waste such as empty cement bags, cardboards and wooden crates.

574. Improper disposal of these waste streams can potentially contaminate the soils and water resources of the area. Soil and water contamination can potentially have negative impacts on the local community, natural vegetation, agriculture and biological resources of the area including aquatic flora and fauna. Borrowing material from the river banks may potentially cause increased turbidity in the rivers. Furthermore, release of effluents, soiland/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. Map6.1 shows the key location where these impacts are likely to take place.

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

Mitigation

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

- Contractor must follow the pollution control plan under Environmental laws.
- Workshops will have oil separators/sumps to avoid release of oily water;
- Avoid repairing vehicles and machinery in the field;
- Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination;
- Contractor will ensure that, there is no leakage, spillage or release of fuel, oil or any other affluent/waste on the ground or in the water from its construction machinery, vehicles, boats, launches and barges. Contractor will regularly monitor the condition of its fleet;
- Materials borrowing from the river banks will be carried brought from a significant distance from the water line, minimizing the possibility of loose soil to wash away in the river;
- Contractor will locate camps away from communities and drinking water sources;
- Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal);
- Avoid releasing untreated wastes on ground or in waterbodies;
- Recycle spoil and excavated material where possible;
- Dispose spoil at designated areas with community consent; and
- Construction material, demolition debris and excavated soil/silt will not be allowed to enter water bodies.

Residual Impacts

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

6.4.6 Sedimentation

Impact

578. Borrowing material from the river banks may cause additional sedimentation in the rivers. Similarly, sediment load in the channels may increase if they are excavated(0.08 M m^3)without bailing out water from them. Excavated material if left along their banks may again go back to the channels thus increasing their sediment load. In addition, construction material, loose earth/soil, demolition debris and other materials may enter the river or other water bodies along with runoffcausing further increased sediments in them. Run off from construction sites, camps and other temporary facilities may enter water bodies increasing their sediment load.

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

Mitigation

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

- The Contractor will prepare a site specific sediment and erosion control plan for each construction site, as well as a spoil management and disposal plan to be implemented upon approval by the DCS Consultant and PMU. Here the:

- Contractor will protect embankment slopes.
- Contractor will excavate channels after dewatering the same.
- Contractor will not leave excavated earth and silt on channel banks.
- Contractor will implement measures to protect channels from run-off from work areas and camps.
- Contractor will obtain borrow material from river banks in a manner not to increase siltation in rivers, and will not leave loose soil after excavation.

Residual Impacts

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

6.4.7 Increased Inland and Waterway Traffic

Impact

582. Transportation of construction materials is a key concern during the Project as the Polder 43/2C is located in a remote area of Galachipa Upazila. A couple of options are available for carrying construction materials to the Project stockyards. The first option would be to involve water way transportation along Lohalia River from the Patuakhali launch ghat to Horidevpur Ferry ghat.Water vessels could be used for carrying materials to each intervention.

583. The second option would be touse of road transportation from Patuakhali headquarter viaSuhari Bridge to inside the Polder through truck and pick-up van. Material transportation along the major roads and waterways may not create a significant problem. However, additional traffic at small ferry ghat such as the one at Horidevpur ferry jetty (ghat) may cause traffic congestion and hindrance to other commuters and transporters.Increased amount of waterway traffic would also increase the noise level of the area.

584. The significance of these potential impacts has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Mitigation

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

- Contractor will prepare a site specific traffic management plan to be implemented upon approval by the DCS Consultant and PMU. That may address:
- Use of transportation of material and machinery by waterways to minimize disturbance to land and ferry traffic to the largest extend possible.
- Contractor to establish new, temporary jetties as and where needed (egg, at Charkhali ferry ghat).
- Liaison to be maintained with community and Horidevpur ferry ghat Authority.

Residual Impacts

586. The impacts associated with additional traffic on roads and along water ways are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Low.

6.4.8 Loss of crop production

Impacts

587. About 1.8 ha of land is likely to be required for construction of retired embankment along theLohalia River. This land includes single, double and triple cropped areas (Ch 13.2 km- 14.00 km). Single cropped land 0.18 ha, which are doubles cropped area 1.44ha and triple cropped area 0.18 ha. The losses of production from this land are given in Table 6.9and value of crops is presented in Table 6.10. During collection of earth from the Borrow pit areas, no agriculture land will be impacted in the Polder area as all spoil earth would be collected from offshore area through manual excavation through dredging from and rivers of Lohalia, and Golkhali khal, Musir khal, Pollar khal, Rishir khal and Taltola khal.

588. In addition, construction activities, movement of construction machinery, project related vehicular traffic, material borrowing, material stockpiling, waste disposal or camp establishment can potentially damage crops or affect the cultivated land.The significance of this potential unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Table 6.8: Loss of crop production under the acquired land

Name of Crops	Area (ha)	Yield (T / ha)	Production loss (m. Ton)
T. Aus (HYV)	0.54	2.7	1.5
T. Aman (HYV)	0.72	2.5	1.8
T. Aman(Local)	1.08	2.0	2.1
Pulses	1.44	1.5	2.1
Total	**3.78**		**7.5**

Source: CEGIS assessment from field information; June, 2015

Table 6.9: Cost of crop production and value of crops in the acquired land

Crop name	Crop Area (ha)	Yield (T/ha)	Production (ton)	Production cost (ha/Tk.)	Total Production cost (Tk.)	Value of crops (Tk)	Benefit (Tk.)
HYV Aman	0.72	2.5	1.8	60000	43200	54000	10800
Lt. Aman	1.08	2	2.16	45000	48600	75600	27000
HYV Aus	0.54	2.7	1.46	59900	32346	43740	11394
Pulse	1.44	1.5	2.16	47340	68170	108000	39830
Total	**3.78**	-	**7.58**	-	**192316**	**281340**	**89024**

Source: CEGIS assessment based on field information; June, 2015

Mitigation

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

- Compensation to be made for crop damage;
- Contractor should avoid crop fields during construction;
- Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps;
- Contractor should ensure that no movements vehiclesthroughcrop fields;
- Contractor should ensure that no material is dumped on the crop fields; and
- Contractor should maintain liaison with communities.

- Contactor will prepare site specific spoil management and disposal plans for each site to be followed upon approval by the DCS Consultant and PMU.

Residual Impacts

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

6.4.9 Affects on irrigation

Impact

591. Construction activities particularly on regulators and water channels can potentially disrupt the crop irrigation during both wet and dry season, thereby negatively affecting cultivation and productivity. The works on sluices can cut off the incoming water from the river, while the excavation works in water channels can affect water conveyance through them.

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

Mitigation

593. The following mitigation measures are being implemented to address the above concerns:

- Contractor will construct diversion channels before construction of each regulator ;
- Sequence of work at the regulators and in the water channels will be carefully planned to avoid irrigation disruption;
- Contractor will ensure that the ongoing irrigation will not be hampered;
- Contractor will maintain liaison with communities; and
- Contractor will work during dry season.

Residual Impacts

594. 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.

6.4.10 Loss of Floral Habitat

Impacts

595. Re-sectioning of the embankment will damage undergrowth vegetation both at embankment slopes and 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 years. Therefore, it is expected that the damaged sites will recover within 1 to 2 years by natural regeneration of herbs and shrubs. Existing big trees at the embankment slopes will not be felled down most of the cases. For this reason, this negative impact is temporary and recoverable. The significance of this potential unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Mitigation

596. The following mitigation measures are being implemented to address the above concerns:

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

Residual Impacts

597. With the help of the above mitigation measures, the impacts associated with re-sectioning of embankment will be mitigated and the significance of residual impact will be low.

6.4.11 Loss of Aquatic Habitat

Impacts

598. Minor vegetation damage is expected at the proposed bank revetment sites. All the tall trees of the proposed sites have already been cut which damaged the embankment slopes. Only seasonal undergrowth vegetation (i.e.: grasses and wild herbs) would be damaged permanently where CC blocks would be placed. Here it is suspected that the undergrowth vegetation at CC Block manufacturing/ casting yards will be damaged if the contractor has no other alternative to select vegetative places.

599. Re-excavation work will damage existing aquatic flora and fauna of proposed khal for withdrawal of soil from khal bed. In addition, existing bank line vegetation will be damaged due to dumping of soil along both sides of the khal. However, the temporary deterioration of habitat quality during construction phase will be back within 2-4 years by regeneration of all existing aquatic plants. However, vegetation composition will change due to change of khal depth and velocity. Abundance of free floating species will be low during monsoon for regular velocity and high during dry season. On the other hand, there is little scope to grow rooted floating plants inside the khal for the same causes.

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

Mitigation

601. The following mitigation measures are being implemented to address the above concerns:

- To choose barren land for CC Block manufacturing and material storing.
- Implement plantation with native species at countryside slope of the embankment to arrest vegetation loss.
- Keep the deepest points of the khal undisturbed as much as possible.
- Create new habitat adjacent to the existing habitat before re-excavation of khal.
- Excavated spoilsare to be used for khal dyke re-sectioning.
- Ensure use of minimum land to the extent possible for excavator/ labor movement.
- Plantation to be implemented along the dumping sites of indigenous plant species.

Residual Impacts

602. The residual impacts associated with revetment of embankment will be low with the help of above mitigation measures.

603. The residual impacts associated with khal re-excavation will be moderate which is expected to recover successively within few years by natural regeneration of marginal plants with the help of above mitigation measures.

6.4.12 Impacts on Feeding and Spawning Ground of Fish Habitat

Impact

604. The bank side of the Lohalia River has been found as the feeding, nursery and spawning ground, especially of Paissa, Gulsha Tengra, Golda, Boal etc. (Table 6.10). It is suspected that because of the activities of bank revetment and slope protection (earth work) will partially be implemented (if in the dry season) or fully disturb (if implemented in the rainy season) the feeding, nursery and even spawning ground of these fish species. Consequently, fish catch at that location will decline as well as earning of fihsermen will be affected through decreasing accessibility to fishing ground in respect of catchability as a result of the fish behaviour due to losing feeding, nursery and spawning ground (Hilborn and Walters, 1992).

Table 6.10: Use of bank side of Lohalia River by some major fish species

Sl	Fish Species	Purpose	Timing
1	Bata	Feeding	All the Year Round
2	Bele	Feeding and Nursing	
3	Boal	Feeding	
4	Boiragi		
5	Chamu Chingri		
6	Gagra Tengra	Feeding and Breeding	Boisakh-Aswin
7	Golda Chingri	Breeding, Spawning and Nursing	
8	Gulsha Tengra	Breeding	Boisakh-Ashar
9		Nursing	Ashar-Aswin
10	Paissa	Feeding	Boisakh-Kartik
11	Phaha	Nursing	Boisakh-Joistha
12	Poma	Breeding and Spawning	Falgun-Choitra
13	Sada Chewa	Feeding	Ashar-Aswin
14	Tapsi		All the Year Round
15		Nursing	Ashar-Aswin
16	Vetki	Spawning	

Source: CEGIS Field Survey, 2015

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

Mitigation

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

- Earth work should be carried out in the dry season (December-January);
- Sequence of work at the bank side of Lohalia river will be carefully planned to minimize impacts on spawning and subsequently nursery ground of fish; and

- Contractor will maintain liaison with experienced fishers.

Residual Impacts

607. The impacts on spawning and nursery ground are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be minimum.

6.4.13 Impacts on Migration Behaviour

Impact

608. Eight (8) drainage sluice gates are proposed to be replaced by new ones which are used to regulate the water availability and water quality of associated khals. These khals are found to be used as the feeding, nursing, spawning and even breeding ground by different fish species in different seasons (Table 6.11). It is apprehendedthat the migration behavior of the following fish species towards feeding, nursing, spawning and breeding grounds might somewhat be hindered (if in the dry season) or fully hampered (if in the rainy season)due to replacement of these sluice gates, the habitat of about 1 km around the sluice gates (500 m upstream and 500 m downstream). On the other hand, due to non-functioning of existing regulators adverse impact has been noticed like sedimentation, drainage congestation, loss of irrigated area etc. As a result of new construction of infrastructures/regulators , these problems will be removed.

Table 6.11: Migration purpose towards the use of fish habitat (khals) by some major fish species

Sl	Fish Species	Habitat	Purpose	Timing
1	Bele (*Glossogobius giuris*)	Danga Khal	Nursing	Falgun-Choitra
2		Golkhali Khal	Feeding	All the Year Round
3		Mondir Khal	Nursing	Falgun-Choitra
4		Musir Khal		
5		Rishir Khal		
6		Taltola Khal		
7	Boal (*Wallago attu*)	Mondir Khal		Ashar-Aswin
8	Chitra (*Scatophagus argus*)	Golkhali Khal		
9		Musir Khal		
10	Gulsha Tengra (*Mystus cavasius*)	Danga Khal	Feeding	Boisakh-Aswin
11		Pollar Khal	Nursing and Feeding	
12	Khoilsa (*Colisa fasciatus*)	Danga Khal	Feeding	All the Year Round
13		Mondir Khal		
14		Mushir Khal		
15		Rishir Khal		
16		Taltola Khal		
17	Paissa (*Setipinna phasa*)	Pollar Khal		
18		Rishir Khal	Nursing	Ashar-Aswin
19	Tit Punti (*Puntius ticto*)	Danga Khal	Breeding and Spawning	Choitra-Aswin
20			Feeding	All the Year Round
21		Golkhali Khal	Spawning	Ashar-Aswin
22		Mondir Khal	Breeding and Spawning	Choitra-Aswin
23		Mushir Khal	Feeding	All the Year Round
24		Pollar Khal	Breeding and Spawning	Choitra-Aswin

Sl	Fish Species	Habitat	Purpose	Timing
25		Rishir Khal		
26		Taltola Khal		

Source: CEGIS Field Survey, 2015

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

Mitigation

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

- Replacement should be implemented during the dry season (December-January)
- Contractor should maintain liaison with experienced fishers.

Residual Impacts

611. The impacts on migration for spawning and breeding are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be.

6.4.14 Impacts on Benthic Fauna

Impact

612. Benthic communities play important role in food chain not only for lentic (standing water) but also for lotic (flowing) water bodies. Construction activities including re-excavation and Installation/replacement/repair of Regulators can potentially impact the benthic communities of the water bodies. Most of the construction activities will be implemented during dry season, when the benthic fauna would be more vulnerable (Table 6.12).

Table 6.12: Major benthic composition of Lohalia River and its tributary khals in the polder area

Sl	Major Group	Major Class/Order	Major Species
1	Phytoplankton	Cyanophyceae	*Anabaena fuellebornii*
2		Chlorophyceae	*Chlorella vulgaris*
3		Bacillariophyceae	*Chaetoceros pendulus*
4		Xanthophyceae	*Centritractus belanophorus*
5		Dinophyceae	*Ceratium dens*
6	Zooplankton	Protozoa	*Favella taraikaensis*
7		Cladocera	*Evadne tergestina*
8		Copepoda	*Calanus helgolandicus*
9		Rotifera	*Brachionus angularis*
10	Benthos	Coleoptera	*Corixa semistriata*
11		Crustacea	*Bathynella natans*
12		Diptera	*Ablabesmyia mallochi*
13		Ephemeroptera	*Acentrella alachua*
14		Gastropoda	*Amnicola taylori*
15		Hemiptera	*Belostoma* sp.
16		Megaloptera	*Corydalus cornutus*
17		Odonata	*Limnodrilus hoffmeisteri*
18		Oligochaeta	*Limnodrilus hoffmeisteri*
19		Bivalvia	*Corbicula fluminea*

Sl	Major Group	Major Class/Order	Major Species
20		Plecoptera	*Eccoptura xanthenes*
21		Trichoptera	*Brachycentrus lateralis*

Source: Field survey and consultation with local fishers, 2015

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

Mitigation

614. The following mitigation measuresare being suggested to address the above concerns:

- The Contractor will prepare site specific plans for pollution control and for standard operation and procedures for handling pollution spills to be implemented upon approval by the DSC Consultant and PMU.
- Sluice gate operation committee will operate the gate for fish migration during May to July; and
- Contractor will carry out khal excavation in segments thus minimizing impacts on benthic fauna.

Residual Impacts

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

6.4.15 Impacts on Stock Susceptibility to Catch

Impact

616. Re-excavations of channels and Installation/replacement/repair of regulators are two major activities in the proposed interventions in Polder- 43/2C. It is expected that fishing activities would be exponentially increased during these two activities which would in turn increase stock susceptibility to fishing in that location.

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

Mitigation

618. The followingmitigation measures are being suggested to address the above concerns:

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

Residual Impacts

619. The impact on stock susceptibilityis likely to be adequately addressed and the significance of residual impact will be Low with the help of the above mitigation measures.

6.4.16 Impacts on Communication

Impact

620. Local people use this embankment as road for carrying their goods for buying and selling and other purposes. The construction activities along the embankment will 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, machineries, material and manpower will be transported to the Polder through both road way and water way resulting additional traffic on roads and in water ways.

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

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

Mitigation

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

- Temporary arrangement of boat for navigation, and need to construct alternative means of temporary footpath for road communication;
- There-sectioning of the embankment will be carried out reach wise and along one half of the embankment, leaving the other half as vehicles and vice versa for easy movement of local people;
- Work schedule will be finalized in coordination and consultation with local representatives and communities;
- Water waysshould be used especially along the river during construction period;
- Earth work for re-sectioning of embankment can be shorted for essay movement of local people;
- All the works will be conducted in presence of Union Parishad Chairman and members; and
- Project Implementation Officer (PIO) will be informed during construction and finishing of earth works of embankment.

Residual

624. The impacts on the communication are likely to be adequately addressedwith the help of above mitigation measures and the significance of residual impact will be Low.

6.4.17 Safety and Public Health Hazards

Impact

625. The area is prone to cyclones and storm surges. Although the works will be carried out during the dry season, a certain level of safety hazards still exists for the construction staff.

626. The construction activities will involve operation of heavy construction machinery, vehicular traffic, excavation and filling operations. These activities may pose some safety hazards to the local population as well as for the construction workers. The fuel storage at the camp sites may also pose safety hazards for the construction staff as well as to surrounding population.

627. Inappropriate waste disposal at the camps and construction sites, and air quality deterioration caused by the Project's vehicular traffic and construction activities potentially pose health hazards to the construction staff and nearby population. Unhygienic condition and unavailability of safe drinking water for the construction staff will expose them to health risks. In addition, influx of construction staff can potentially expose the nearby population to communicable diseases.

628. The significance of the potential impacts are assessed as **Major** on the basis of impact magnitude and receptor sensitivity.

Mitigation

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

- Liaison will be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets will be kept in all the labor camps for obtaining weather information.
- The contractors will prepare site specific Camp management plans, an Occupational health and safety plan including training programs as well as an Emergency response plan with early warning system and training programmes to be approved by the DSC Consultant and PMU. The Plan will also include awareness raising and prevention measures, particularly against communicable diseases such as hepatitis B and C, and HIV/AIDS. Besides:
- All temporary facilities including labor camps will meet minimum safety, hygiene and sanitation requirements (safe drinking water, proper sewage disposal, solid waste management, general cleanliness, protection against disease vectors, and protection against weather elements, firefighting, and other similar essential services).
- All workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.
- The construction sites will have protective fencing to avoid any unauthorized entry, where appropriate and possible.
- Health screening of employees would be a Contractor obligation prior to labourers working on site and living in the temporary accommodation facilities. The health screening would entail normal review of physical fitness and also include a review of appropriate vaccinations. Workers would be given vaccinations as and when required.
- All site staff will undergo screening against communicable diseases. Communicable disease careers will not be employed at the working site.
- All employees need to carry out induction health and safety training prior to commencement of work. Training would include the provision of appropriate written or visual materials to reinforce learning. Where illiteracy levels are high, OHS issues need to be covered more frequently than normal in toolbox talks.
- Public awareness training and workshops on safety and health risks will be conducted for local communities prior to and during construction operations.
- Observing statutory requirements relating to minimum age for employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activities. The construction contractor(s) would not hire people under the age of 18 on permanent contracts but would include short training activities for youth to the extent possible.

- Ensure the acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work;
- Ensure that no workers are charged fees to gain employment on the Project.
- Ensure rigorous standards for occupational health and safety are in place.
- Contractor will establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.
- The contractor will adopt a Human Resource Policy appropriate to the size and workforce, which indicates the approach for management employees (this could be part requested in the tender process).
- Produce job descriptions and provide written contracts and other information that outline the working conditions and terms of employment, including the full range of benefits;
- Provide health insurance for employees for the duration of their contracts;
- Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts;
- Employ a community liaison officer (this could be full time or part of another post's responsibilities);
- Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training;
- Report regularly on the labor force profile, including gender, and location source of workers;
- Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase;
- Organize a training program and keep training registers for construction workers;
- Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy working environment taking into account the inherent risks for this type of project.
- Availability of safe drinking water will be ensured for the construction staff.
- First aid boxes will be made available at each construction site. Emergency phone numbers (including hospitals, Fire Department, and Police) will be displayed at key locations within the site. Each site will have an ambulance facility.
- Firefighting equipment will be made available at the camps and worksites.
- The camp staff will be trained for safety against firefighting.
- All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel.
- Waste management plan to be prepared and implemented in accordance with international best practice.
- Liaison with the community will be maintained.

Residual Impacts

630. The impacts associated with safety and health hazards are likely to be mostly addressed with the help of above mitigation measures and the significance of residual impact will be **Moderate**.

6.5 Impacts during operation phase

6.5.1 Increased use of agrochemicals

Impact

631. At present, about 65 ha of land is under Boro rice cultivation. Presently, 99,415 kg of chemical fertilizers and 786,000 Tk. are required for pesticides for cultivation Boro and Aus. According to the initial estimates, about 1.85 Mm^3 of water would be available from the internal canal system, after the completion of the proposed Project. This would allow expansion of area under cultivation of Boro and Aus varieties of rice in about 1,105 ha of which Boro and Aus will be 345 ha and 760 ha respectively. Specifically, Boro cultivation would be expanded in the medium high land (Table 6.14). This expansion of irrigated cultivation is likely to result in decreased soil fertility and increased use of chemical inputs including fertilizers and pesticides. Due to expansion of Boro and Aus cultivation, additional about 196,000 kg of chemical fertilizers and 2,222,000 Taka would be required for pesticide purchase in future (Table 6.16). Runoff from such cultivation fields may potentially pollute the water bodies and even drinking water sources thus causing health hazards to the communities.

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

Table 6.13: Impact on Area (ha), Fertilizers (kg) and Pesticides (kg/ml) required in Present and Future Situation

Present and Future cultivated Area and Input uses	Crop name		Total
	T, Aus (HYV)	Boro (HYV)	
Present cultivated Area(ha)	410	65	475
Fertilizerrequired(kg/ha)	164	495	**659**
Pesticide (Tk/ha)	1,600	2,000	3,600
Total Fertilizer required(kg)	67,240	32,175	99,415
Total pesticide required (Tk.)	656,000	130,000	786,000
Future cultivated area(ha)	1,170	410	1,580
Increased area (ha)	760	345	**1,105**
Total future fertilizerrequired (kg)	124,640	170,775	295,415
Future Pesticide (Tk/ha)	1,800	2,200	4,000
Total future pesticide required (Tk.)	2,106,000	902,000	3,008,000
Impact			
Fertilizers (kg)	57,400	138,600	196,000
Pesticide (Tk.)	1,450,000	772,000	2,222,000

Source: Based on Field information/data collected by CEGIS, 2015

Mitigation

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

- Capacity building and awareness raising of the farmers will be carried out to practice Integrated Pest Management (IPM) and Integrated Crop Management (ICM) – in order to minimize usage of chemical inputs;
- Farmers group will have close contact with DAE for adoption of various measures of IPM/ICM;

- Farmers will be encouraged to use organic manure to increase soil fertility while avoiding water contamination; and
- Farmers will be encouraged to cultivate leguminous crops to enhance the soil quality
- Follow Pest Management Plan (Appendix-10).

Residual Impacts

634. The 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.

6.5.2 Increase green coverage

Impacts

635. Afforestation 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 safety to habitats especially for local avifauna and fishes.

636. [Note: In the foreshore afforestation, the existing undergrowth vegetation would be damaged due to movement of labor during plantation. Careless disposal of sapling's poly bags may cause deterioration of soil quality. There may be a risk of outbreak of plant diseases to the other existing plants from the planted disease affected saplings. Water flow in creeks and strips of planted area may be interrupted for aggregation of plant or plant shoots. Inadequate distance between two saplings may hinder proper growth and cause disease outbreak.]

Mitigation

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

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

Residual Impacts

638. The residual impacts associated with implementation of coastal afforestation with the help of above mitigation measures will be Nil.

6.5.3 Reduced Fish Migration Time and Extent

Impact

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

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

Sl	Fish Species	Habitat	Remarks of Future Scenarios
1	Bele	Danga Khal	May be Shifted
2		Golkhali Khal	No Change
3		Mondir Khal	
4		Musir Khal	
5		Rishir Khal	
6		Taltola Khal	
7	Boal	Mondir Khal	Might be Shifted
8	Chitra	Golkhali Khal	May be Shifted
9		Musir Khal	
10	Gulsha Tengra	Danga Khal	
11		Pollar Khal	
12	Khoilsa	Danga Khal	No Change
13		Mondir Khal	
14		Mushir Khal	
15		Rishir Khal	
16		Taltola Khal	
17	Paissa	Pollar Khal	
18		Rishir Khal	May be hampered
19	Tit Punti	Danga Khal	No Change
21		Golkhali Khal	
22		Mondir Khal	
23		Mushir Khal	
24		Pollar Khal	
25		Rishir Khal	
26		Taltola Khal	

Source: CEGIS Field Survey, 2015

Mitigation

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

- Proper operation of sluice gate allowing timely migration of fish ;
- Core commercial fishers having more than 20 years' experience should be appointed in Operation and Maintenance of sluice gates ; and
- Adequate trainings should be provided to WMOs.

Residual Impacts

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

6.5.4 Increased Stock Susceptibility of Fish to Catch

Impact

642. Fishing activities are highly confined around the sluice gates of the proposed khals using Badha/Sluice Jal and Jhaki Jal. It is expected that installation of sluice gates will result in increasing stock susceptibility to fishing more than that of today (see Table 6.15). Longer term monitoring of fish catch assessment in canal and river is required to identify real impact from the hydraulic structure operation activities.

Table 6.15: Future scenarios of stock susceptibility to catch of some major fish identified in the field survey

Remarks of Future Scenarios	Fish Species
Very Slightly Increased	*Tit Punti*
Slightly Increased	*Bele, Cheng, Khoilsha and Motka chingri*
Increased	*Poma and Shol*
Highly Increased	*Boal, Chamu Chingri, Chitra, Foli, Gazar, Gulsha Tengra, Katali Chingri, Khoilsa, Koi, Magur, Paissa, Singh, Taki, Tara Baim and VadraKatali*

Source: CEGIS Field Survey, 2015

Mitigation

- The following measures are being suggested to address the above concerns:
- Awareness building program will be promoted to commercial and subsistence fisher around the sluice gate; and
- Monitoring cell will be formed to monitor the fishing activities to allow the tolerable limit of biological catch.

Residual Impacts

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

6.6 Positive Impact of the Project

6.6.1 Livelihood development through Increased Crop production and land use

Impact

644. Presently, total cropped area is about 3,465 ha of which rice cropped area is 2,610 ha and non-rice cropped area is 855 ha. If the project is not implemented the area will remain same as baseline or may be reduce. On the other hand, total crop production will be 13,805 tons of which rice will be 5,648 tons (41%) and non rice will be 8,158 tons (59%). Adverse impact might occur due to siltation of river and drainage channels. The production would remain same as base situation or may be decrease (Table 6.16).

Table 6.16: Impact on crop production and land use in the Polder area

Name of crops	Baseline /FWOP			FWIP			Production	% of change
	Cropped area (ha)	Yield (ton/ha)	Production (metric ton)	Cropped area (ha)	Yield (ton/ha)	Production (metric ton)	Impact (FWIP-FWOP)	
Lt. Aus	565	1.6	904	900	2.5	2,250	1,346	149
HYV Aus	410	2.7	1,107	400	3.5	1,400	293	26
Lt. Aman	1,000	2	2,000	980	3	2,940	940	47
HYV Aman	550	2.5	1,375	590	3.8	2,242	867	63
HYV Boro	65	3.5	228	380	4.5	1,710	1,482	650
Local Boro	20	1.7	34	10	1.7	17	(-17)	(-50)
Total rice	**2,610**		**5,648**	**3,260**		**10,559**	**4,911**	**87**
Orchard	10	13.5	135	10	14.5	145	10	7
S. Vegetables	40	12.5	500	40	15.5	620	120	24
Pulses	315	1.5	473	10	2	20	(-453)	(-96)
Potatoes	60	15.5	930	60	19.5	1,170	240	26
W. Vegetables	80	12.5	1000	100	18.5	1,850	850	85
Spices	40	3.5	140	40	4.5	180	40	29
Oil seeds	150	1.2	180	150	2	300	120	67
Watermelon	160	30	4800	180	32	5,760	960	20
Total non-rice	**855**		**8158**	**590**	**0**	**10,045**	**1,887**	**23**
Grand Total	**3,465**		**13805**	**3,850**	**0**	**20,604**	**6,799**	**49**

Source: Source: CEGIS Assessment based on field survey July, 2015

645. The cropped area would be changed if the project is implemented. The cropped area would be 3,850 ha of which rice cropped area would be 3,260 ha and non-rice cropped area would be 590 ha. The crop production might be boosted up significantly under the FWIP condition. The total crop production would be 20,604 tons of which rice would be 10,559 tons and non-rice would be 10,045 tons. The rice and non-rice production would be about 87% and 23% higher in FWIP than that of FWOP respectively. Rice production would be increased mainly due to protection of agricultural land from river bank erosion, construction of structure and repair/replaced of structure with adoption of modern technology in crop production, change in cropping pattern etc. Crop production would be increase due to expansion of T. Aus (LV), T. Aman (HYV), Watermelon and winter vegetables cultivation area. It is estimated that about 2.93 million cubic meter irrigation water will be available after re-excavation of khals in the Polder area, which will be used for the irrigation of expanded HYVBoro. The increased agricultural production would improve the livelihood of the people.

Enhancement

646. The following enhancement measures would be undertaken for further increase of crop production:

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

6.6.2 Enhanced Species Evenness

Impact

647. It was observed that previously about 110 freshwater fish species were available in the project area. Moreover, it has been found that species richness of species composition varies with khals, water of which are regulated by different sizes of drainage sluice. It, therefore, is suspected that species evenness of these khals would be improved with the improved water resource condition .The future changing scenarios are given in the following table (Table 6.17):

Table 6.17: Future scenarios of Species evenness in the intervention specific fish habitat

Sl	Site	Remarks of Species Evenness
1	Bank Side of Lohalia River	Increased
2	Danga Khal	Slightly Increased
3	Golkhali Khal	Increased
4	Mondir Khal	Slightly Increased
5	Munshir Khal	Highly Increased
6	Musir Khal	
7	Pollar Khal	
8	Rishir Khal	No Change
9	Taltola Khal	Highly Increased

Source: FGD and KII, CEGIS, 2015

6.6.3 Increased Fish Production

Impact

648. It has been found that habitat condition (area, water availability and water quality, fishing activities, stock susceptibility to fishing and proximity to market) are highly influential parameters to enhance fish production in the khals controlled by different drainage sluice. It is expected that fish production from waterbodies (river and khals) would slightly improve with the future improvement of drainage sluice. Moreover, bank revetment and slope protection would strengthen the tendency of practicing Gher (Bagda and Golda), homestead pond and improved fish culture in the polder area (Table 6.18).

Table 6.18: Future scenarios of Fish production in the project area

Sl. No.	Fishery category	Habitat type	Production (Ton)	Change (%)
1	Capture	Water bodies	80	2.34
		Total	80	2.34
2	Culture	Bagda/Golda Gher	3	0
3		Fish pond (Homestead)	14	0.65
4		Fish pond (Improved culture)	22	1.05
		Total	39	1.7
		Grand Total	119	4.04

Source: CEGIS Field Survey, 2015

6.6.4 Employment Generation

649. The construction work will generate substantial employment opportunities over its construction period for local people and other associated professionals. On the other hand, during construction of embankment and constructing structure will create temporary employment opportunities for labour. The employment generation represents the different way of livelihood by which people can generate their income and improve their living standard.

6.6.5 Health

650. Waterborne diseases, coldness, fever, respiratory and skin diseases are dominant throughout the study area. The prevalence is due to drainage congestion mainly in the study area. It is anticipated that this congestion problem will be mitigatedafterthe implementation of the project. Therefore, the health condition will be improved and local people will be free from various sufferings.

Gender Promotion

651. Construction work requires various types of skilled and unskilled labours, of which a portion is female. The female workers are often distressed or, and do not have any other source of income. Therefore, the substantial increased job opportunities for women in the construction works and especially in the agricultural sector during the operation phase is significantly positive.

652. Overall, the Project is considered to provide a medium to **high** positive impact on the gender situation.

Seasonal out-migration

653. The seasonal out migration of day labourers from this polder area to other areas is expected to decline due to creation of local employment opportunities in the agriculture and other sectors, respectively.

654. Overall, the Project is considered to provide a **medium** positive impact by reducing out-migration.

6.6.6 Education

655. During wet season, road networks and surroundings of many educational institutions become inundated when both students and teachers become reluctant to attend the schools. It eventually interrupts the standard of education and in some cases, it increases dropout rate. If the project is implemented, inundation problem will be solved; therefore, status of education will be improved.

6.6.7 Livelihood improvement

656. Agriculture is the main source of livelihood in the study area. Drainage congestion interrupts the production. Furthermore, there is a chance of crop damage of any failureof embankment is breached. If the project is implemented, these problems will be solved and livelihood for local people will be improved. Additionally, production will be increased for measure of irrigation facilities to be enhanced by the construction of flushing sluices.

6.6.8 Social Conflict

657. In each of the drainage and flushing sluices, local people use net for catching fish. In some cases, these nets are set permanently. The farmers stated that social conflict over this

issue often appears between fisher and farmers. Farmers urged not to have any interruption on water movement in polder area, whereas fishers intend to control water movement for the sake of catching fish. It is evident that the damaged and non-functioning drainage and flushing sluices encourages the fisher to control over water movement. However, it is expected that if these sluices are repaired and/or restructured this social conflict will be mitigated.

6.7 Risk Assessment

658. The coastal Polder 43/2C was built in 1962. The polder was designed to keep the land safe from regular tides to increase the agriculture production. Though the polderization has helped grow more food, also created some environmental and social problems.

- There is no 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 Organisation (WMO) and inadequate staff of BWDB.

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

6.7 Summary of Assessed Impacts

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

Table 6.19: Matrix of Assessed NegativeImpacts

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
A. Pre-construction Phase								
Noise quality	Short term	Local	Reversible (after construction phase)	Certain	Medium	Moderate	• The contractors need to be conscious about using hydraulic horns and avoid unnecessary honking. • The contractors should be encouraged to move all construction equipment, machineries and materials during day time.	Low
Preparation of facilities for contractor(s) and labor force	Short term	Local	Reversible (after construction phase)	Certain	Medium	Moderate	• Contractor will prepare site establishment plan and obtain approval from the DCSC. • The approval for location of temporary facilities will be obtained from the DCSC. • Deforestation will be minimized as far as possible during site facilities development; • Photographic record will be maintained to keep the pre-construction condition of the area; • Site facilities will be established at a safe distance from communities and schools;	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• No untreated wastes will be released on ground or in water; • Exhaust emissions from vehicles and equipment will comply with standards; • Vehicles, generators, and equipment will be properly tuned; • Water will be sprinkled 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; and • Liaison will be maintained with the local communities.	
Increased Vehicular Traffic during Mobilization	Short term	Local	Reversible (after construction phase)	Certain	Medium to High	Moderateto Major	• The contractor will prepare a traffic management plan (TMP) and obtain approval from the DCSC. The TMP will be shared with the communities and will be finalized after obtaining their consent; • The TMP will address the existing traffic congestion particularly at the Horidevpur Bazar and Suhuri Bridge Bazars and also during schools time. Project-related traffic will be minimized during the peak traffic hours (from 8 am to 2 pm). • Ensure minimal hindrance to local communities and commuters; and	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Regular Liaise to be made with local communities and concerned authorities	
Damages due to Project Intervention and Land Acquisition	Short term	Local	Reversible (after construction phase)	Certain	High	Major	• A Resettlement Action Plan (RAP) is prepared in accordance with the national laws and WB OP 4.12. 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	Moderate
Changes in land use (preparation of construction facilities, borrow areas, others)	Short term	Local	Reversible (after construction phase)	Certain	Low to Medium	Moderate	• Establish all facilities within the area owned by BWDB • Pay compensation/rent if private property is acquired on temporary basis • Consult communities • Avoid impacts on communities.	Very low
Clearances of vegetation	Sort term	Local	Reversible (after construction phase)	Certain	Medium to high	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 labor shed and material stock by using nearer fallow land or barren homestead yards	moderate

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Give proper compensation to the tree owners against tree felling specially for fruit yielding trees • Implement tree plantation at the damaged sites after completion of construction works	
B. Construction Phase								
Drainage congestion during replacement of drainage regulators	Short term	Local	Reversible	Likely	High	Major	• Contractor will have to construct diversion channels before construction of each regulator particularly at Mushirkhal, Golkhalikhal, Rishirkhaland Shuhurikhal because these are the major drainage channels in the Polder; • Sequence of works at the regulators and in the water channels will have to be carefully planned to avoid drainage congestion; • Contractor must ensure a dedicated spot for dropping or discharging construction wastes during construction activities to avoid of being clogged the drainage system.	Low
Hindrance for pedestrians and vehicles movement during re-sectioning of embankment	Short term	Local	Reversible	Likely	Medium	Moderate	• Re-sectioning work should be carried out segment wise; • Alternative road can if not available are to constructed by the contractor; • Earth work for re-sectioning of embankment during hat day can be	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							shortened for essay movement of local people; • Water way can be used especially along the Galachipa river during construction period; • All the works will be conducted in presence of Union Parishad Chairman and members; and • Project Implementation Officer (PIO) will be informed during construction and completion of earth works of embankment.	
Noise and Vibration	Short term	Local	Reversible	Likely	Medium	Moderate	• Demolition of the regulator particularly near the schools I should not be carried out during the school time (8 am to 1 pm); • Restricting/limiting construction activities during the day time; • Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards; • Vehicles and machinery will have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors, as needed. • Provision of PPE (ear muffs and plugs) for labor; • Construction team will be instructed to properly use the equipment, to minimize noise levels;	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Camps will be located at a safe distance from communities; and • Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.	
Damage to local infrastructure	Short term	Local	Reversible	Likely	Medium	Moderate	• The condition of the infrastructure being used for the construction and transportation activities will be regularly monitored; and • All damaged infrastructure will be restored to original or better condition.	
Soil and water contamination due to wastes	Long term	Local	Reversible	Likely	High	Major	• Contractor must follow the pollution control plan under Environmental laws. • Workshops will have oil separators/sumps to avoid release of oily water; • Avoid repairing vehicles and machinery in the field; • Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination; • Contractor will ensure that there is no leakage, spillage or release of fuel, oil or any other affluent/waste on the ground or in the water from its construction machinery, vehicles, boats, launches, and	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							barges. Contractor will regularly monitor the condition of its fleet; • Materials borrowing from the river banks will be carried brought from a significant distance from the water line, minimizing the possibility of loose soil to wash away in the river; • Contractor will locate camps away from communities and drinking water sources; • Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal); • Avoid releasing untreated wastes on ground or in water; • Recycle spoil and excavated material where possible; • Dispose spoil at designated areas with community consent; and • Construction material, demolition debris and excavated soil/silt will not be allowed to enter water bodies.	
Sedimentation	Short term	Local	Reversible	Likely	High	Medium	• Small scale Tidal River Management (TRM) will be implemented where appropriate; • Contractor will protect untreated embankment slopes; • Contractor will excavate channels after dewatering or bailing out of water from them;	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Contractor will not leave excavated earth and silt on channel banks; • Contractor will take measures to protect channels from carrying wastes and other materials along with run-off from work areas and camps; and • Contractor will borrow material from river banks in such a way so that none of the materials can follow to the rivers, and will not leave loose soil after excavation.	
Increased inland and waterway traffic	Short term	Local	Reversible	Likely	Medium	Moderate	• Contractors are to prepare and implement traffic management plan; • Contractors to establish new, temporary jetties where needed (egg, at Horidevpur ferry ghat); and • Liaison to be maintained with community and Horidevpur ferry ghat Authority.	Low
Loss of floral Habitat	Short term	Local	Reversible	Likely	Medium	Moderate	• Collect soil from barren land as much as possible • Proper turfing should be implemented at embankment slopes with local grasses (i.e. Durba (Cynodon dactylon), Mutha (Cyperus sp) and ensure regular monitoring of turf grasses till they matured	Low
Loss of aquatic Habitat	Short term	Local	Reversible	Likely	Medium	Moderate	• To choose barren land for CC Block manufacturing and material storing.	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Implement plantation with native species at countryside slope of the embankment to arrest vegetation loss. • Keep the deepest points of the khal undisturbed as much as possible. • Create new habitat adjacent to the existing habitat before re-excavation of khal. • Excavated spoils are to be used for khal dyke re-sectioning. • Ensure use of minimum land to the extent possible for excavator/ labor movement. • Plantation to be implemented along the dumping sites of indigenous plant species.	
Loss of crop production	Short term	Local	Reversible	Likely	Medium	Moderate	• Compensation to be paid for any crop damage • Avoiding agricultural land for estimating of labor camps • Avoiding crop fields during construction • No vehicular movements inside crop fields • No material dumping inside crop fields • Maintain liaison with communities.	Low
Effects on irrigation	Short term	Local	Reversible	Likely	High	Major	• Construct diversion channels during construction of all regulators	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Proper sequence of works on regulators and sluices to be prepared • Ensuring no negative impacts on crop irrigation • Maintain liaison with communities.	
Clearance of vegetation	Short term	Local	Reversible (after construction phase)	Occasional	Medium to high	Moderate	• Collect soil for re-sectioning from barren land as much as possible • Proper turfing should be provided on the slopes of the embankment with local grasses and ensure regular monitoring of turfed grasses till they are matured • Implement plantation with native species (i.e. Chambol, Mehagani, Narikel, Tal, Khejur, etc) at countryside slope of the embankment to arrest vegetation loss • Collect soil from barren land as much as possible • Avoid construction activities during favourable time of wild life movement (early morning and night) • Choose barren land for CC Block manufacturing and material storing • Use excavated spoils for khal dyke re-sectioning • Keep the deepest points of the khals untouched as much as possible.	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Create new habitat adjacent to the existing habitat before re-excavation of khal • Use minimum land to the extent possible for excavator/ labor movement • Ensure plantation along the dumping sites with indigenous plant species • Avoid vegetative land for labor and construction vehicle movement • Aware labors about plant conservation	
Impacts on Feeding and Spawning Ground of Fish Habitat	Short term	Local	Reversible	Likely	Medium	Major	• Earth work should be carried out during the dry season (December-January) • Sequence of work at the bank side of Lohalia River will be carefully planned to minimize impacts on spawning and subsequently nursery ground of fish. • Contractor will maintain liaison with experienced fishers.	Low
Impacts on Migration Behaviour	Short term	Local	Reversible	Likely	Medium	Major	• Replacement of the structures to be conducted during the dry season (December-January) Contractors should maintain liaison with experienced fishers.	Medium
Effects on benthic communities	Short term	Local	Reversible (in medium to long term)	Likely	Medium	Moderate	• Avoid to release untreated wastes on soil or in water.	Low to medium

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Khals to be excavated in segment thus minimizing impacts on benthic fauna.	
Increased Stock Susceptibility of Fish to Catch	Short term	Local	Reversible	Likely	High	High	• Replacement should be conducted during the dry season (December-January) • Close monitoring to be ensured during construction by local commercial fishers under the supervision of DoF so that allowable biological catch can be ensured.	Medium
Interrupt communication	Short term	Local	Reversible (after construction phase)	Positive	Medium to high	Medium	• The works on embankment tobe carefully scheduled to minimize impact on local markets and transportation routes. • The works on embankment be carried out in part and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. Works when completed on the first half, it will be opened for local traffic while works will be undertaken on the other half of the embankment. • Work schedule will be finalized in coordination and consultation with local representatives and communities. • Local routes should not be blocked as much as possible. If unavoidable, alternative routes will	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							be identified in consultation with local community • GRM will be put in place.	
C. Post Construction Phase								
Soil and water contamination (increased use of chemical inputs) and reduced soil fertility	Long term	Local	Reversible	Likely	High	Major	• IPM/ICM method to be followed for reducing pesticide use; • Leguminous crop cultivation. • Crop rotation should be encouraged. • Awareness building of communities to be ensured.	Moderate
Reduced Fish Migration Time and Extent	Long term	Local	Nor reversible	Likely	Medium	Moderate	• Proper sluice gate operation allowing fish migration in time. • Commercial fishers having more than 20 years' experience should be appointed in Operation and Maintenance of sluice gate Provide training to WMOs	low
Increased Stock Susceptibility of Fish to Catch	Long term	Local	Reversible	Likely	Medium	Moderate	• Awareness building program should be promoted to commercial and subsistence fishers around the sluice gate • Monitoring cells should be formed to monitor the fishing activities to allow the allowable biological catch.	Low
C. Operation Phase								
Reduced soil fertility	Long term	Local	Reversible	Likely	High	Major	• Capacity building and awareness raising of the farmers will be carried out to practice Integrated Pest Management (IPM) and Integrated Crop Management (ICM) – in order	Moderate

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							to minimize usage of chemical inputs; • Farmers group will have close contact with DAE for adoption of various measures of IPM/ICM; • Farmers will be encouraged to use organic manure to increase soil fertility while avoiding water contamination; and • Farmers will be encouraged to cultivate leguminous crops to enhance the soil quality.	

7. Analysis of Project Alternatives

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

7.1 'No Project' Alternative

662. The 'No-Project' option analysis provides a clear view of the existing situation of the Polder and helps understand the need of the proposed interventions under CEIP-1. At present the people in polder is extremely vulnerable to cyclones, storm surges, wave action, and climate change effects, as described in Chapter 8. Furthermore, this Polder is not in a state of providing desired services i.e. protection against tidal inundation, efficient drainage and minimizing the impact of cyclonic surges. About 20 percent of the Polder area is experiencing water logging. The silted water channels are resulting into water congestion, declining fisheries and increasing environmental pollution

663. The proposed interventions for Polder 43/2C under CEIP-1 are aimed to eliminate the major problems described above. To highlight present state and various aspects of the Polder and to realize the importance of the proposed interventions under the Project, the 'no project' and 'with project' scenarios are compared in Table 7.1.

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

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
Embankments (25.70 km) and design crest level (5.00 m, PWD and 5.50 m, PWD)	Present deterioratedsegments mentioned in the map 4.2 of the embankments will be further deteriorated and dropped below the design level. Therefore, cyclones, rise in surge heights due to global warming, and tidal actions will inundate the Polder, causing severe damages to the lives and property of local people.	Re-sectioned embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, reduction in loss of lives and assets caused by the natural disasters.
	Because of submergence of the embankments during monsoon, transportation system would further deteriorate inside the Polder, and sufferings of local people would further increase.	Re-sectioned embankments will provide enhanced protection to Polder, facilitating transportation within the Polder even during monsoon.
	The agricultural area will reduce further and the present crisis situation for farmers will increase from January to April (salinity intrusion) and May to August (flooding).	Re-sectioned embankments will provide enhanced protection to 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
	Continued silt deposition inside the Polder due to cyclonic surges and floods would increase and cause water logging, drainage congestion and other associated problems.	Decreased silt deposition in the Polder will result into improved drainage and navigation in internal canals/khals, increased usage of surface water for irrigation, and reduced water logging problem.
	Local farmers and labor will remain financially stressed. Livelihood opportunities will remain limited, and local people will migrate outside the Polder for employment.	Enhanced agricultural activity will increase the demand for farm workers. Local people can engage themselves in the construction works inside the Polder. Improve earnings of local people during the construction phase of the project.
	River bank erosion would further deteriorate the embankments and land resources would be damaged/ lost.	Bank revetment will provide enhanced protection against erosion by wave action, storm surges and currents, and will result into preservation of Polder and its land/agriculture resources.
	Further subsidence of the embankments and further damage to transportation routes will continue.	The bank revetment will protect the embankments and facilitate transportation within the Polder.
	Continued weakening of embankments; continuous subsidence of embankments due to traffic load and wave action; land resources would continue to be damaged.	Slope protection works will strengthen the embankments and protect them against subsidence, wave action, and wear and tear.
	Continued use of the existing drainage sluices for both flushing and drainage and would cause further damage to these structures. As a result, water logging and drainage congestion would be increased due to malfunctioning of the sluices.	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
	No dry season agriculture practice will be possible. Shrimp culture during January to May, as sweet water cannot be used in the periods of low rainfall.	Replaced flushing sluices will facilitate better agriculture practices, increase dry season rice cropping, and reduce shrimp culture - thus benefiting the poor farmers.
	Cultivable lands will further decrease in future.	New flushing sluices will facilitate increase surface water, better control on irrigation during periods of low rainfall and increase agricultural production.
	Wind and wave action during cyclones would cause further, severe damages.	Effects of cyclone surge, wave action and gusty wind could be mitigated to a certain extent, reducing the loss of lives and assets.
	Depth of water would be further decreased;drainage congestion and water logging would be further increased.	Storage capacity and depth of water bodies will increase, water logging and drainage congestion will decrease and fish habitats will increase.

7.2 Site Selection Alternatives

664. No alternative site selection is to be considered, because it is a rehabilitation project. However, a comprehensive multi-criteria analysis was made to prioritize the polder rehabilitation under CEIP-1.

7.3 Technical Alternatives

665. Once the problems being faced by the Polder and the inhabitants of the polder have been identified, several technical alternatives were considered accordingly. These alternatives include the strengthening the Polder embankment, protection of river banks, protection of embankment slope, improvement the sluices and their performance, and reducing drainage congestion and water logging. These technical alternatives are discussed in Table 7.2 below:

Table 7.2: Technical, Economic, Environmental and Social Considerations

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 be partially achieved. However, no increased protection against storm surges and sea water rise.
	Backing/minor inward shifting of embankment with slope protection	Same as above.
	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	Partial achievements of the Project objectives; decrease the Polder area; and erosion of the river bank will be continued.
	Bank Revetment (selected option)	Bank revetment will provide enhanced protection against erosion by wave action, storm surges and currents and will protect the Polder and its land/agriculture resources.
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.

Proposed Interventions	Alternative Options	Consequence
	Foreshore plantation (selected option)	Effects of cyclone surge, wave action and wind would be mitigated 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 be increased due to malfunctioning of the sluices (similar to the 'no project' scenario discussed in earlier).
	Repairing of structures (possible where there is no need of re-sizing) (selected option for some structures)	For sluices, which are beyond any repair, 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 appropriate arrangement of passages for fish and small boats.	In addition to the above advantages, the structures will facilitate fish migration and navigation through them. The cost of such structure is likely to be very high.
Rehabilitation of flushing sluices	No change in the existing structure	No dry season agriculture practice will be possible. Shrimp culture during January to May, as sweet water cannot be used in the periods of low rainfall (similar to the 'no project' scenario discussed in earlier).
	Repair of the existing structures	For sluices, which are beyond any repair, works 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 be decreased and fish habitats will increase.

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

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

Table 7.3: Technical, Economic, Environmental and Social Considerations

Intervention	Considerations			
	Technical	Financial/Economic	Environmental	Social
Re-sectioning, embankment with new design heights	Better protection against cyclone surges and water level rise	Financial savings from 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.
	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;

Intervention	Considerations			
	Technical	Financial/Economic	Environmental	Social
				increase farm labor opportunities.
Foreshore plantation	Enhance embankment protection against tidal wave action of rivers, provide erosion protection	Financial savings for reduction of damages caused by the floods and storms; increase the life span of the infrastructure and associated water control structures; improve earnings of local people through employment during bank revetment works and slope protection works.	Improve embankment stability; reduce soil erosion; enhance soil quality; improve air quality; enhance aesthetic value of the area.	Reduce loss of lives and assets which would bring poverty reduction; increase employment opportunities for local people; Increase income from timber and other plantation products.

7.4 Alternatives during Construction

667. 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

668. Two options can be planned as alternative material storage 1) Inside; 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.

669. The second option is that, therequired materials would be collected and transported from their respective sources to the Polder and then would be stored in the stock yard to be used during construction phase.

7.4.2 Material Sources

670. The sources of construction materials will be pointed out briefly here.

7.4.3 Soil for Embankments

671. For renovating of embankments, substantial amount of soil will be required. The following options are available for sourcing this material:

- Soil can be obtained from the borrow pits of the river. It is considered as one of the feasible options. Because, it reduces soil transportation requirements, minimizing any additional transportation cost, having minimal negative impacts in the borrowed areas since these areas will be silted-up within the new few seasons, and have minimum environmental and social impacts related to excavation and transportation.
- Part of the required material can be obtained from the re-excavation of the channels within the Polder, provided the quality of material are technically acceptable. About 0.27 million cubic metersof earth will be obtained from re-excavation of channels during implementation of rehabilitation works inside the Polder. This option will minimize the

cost of excavation for the borrow material, though the cost of transportation to work site will be slightly more than the first option, in addition to some environmental and social impacts such as traffic congestion and air pollution within the Polder.

672. A certain portion of soil can be sourced from borrow pits outside the Polder. It must be mutually accorded with the land owners on the basis of compensation. 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.

673. Soil from the riverside just outside the Polder embankment if not suitable, the material may be obtained from the river beds 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.

674. 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

675. 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:

- Sand could be procured from markets. This would entail consistent quality and assured supply; however, it would also entail increased transportation cost and associated environmental and social impacts including traffic congestion and air pollution.
- The second option is to obtain sand from the river beds. 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.

676. As per the Project design, the final decision regarding the sand source will depend on the material quality, either acquired on the market or dredged from rivers. The Contractor will carry out tests of the material quality from various sources, provide a plan for obtaining the required amounts of suitable quality and obtain approval from the DSC Consultant before starting obtaining the sand.

7.4.4 Alternatives for Workforce Procurement

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

- Employing majority of the manpower from within the Polder area and accepting the more skilled and technical manpower from outside. This option will reduce labor camp sizes, and decrease transportation need and associated environmental and social problems. This option will also offer employment opportunities for the local community. Thus increasing their economic condition and also increasing the local ownership of the project. In view of these advantages, this is the preferred option for manpower sourcing.

- Employing most of the manpower from outside the Polder. This can create traffic congestion requiring larger camps and labor transport. It may trigger resentment and ultimately possible resistance as consequencefrom the local community.

7.4.5 Alternatives for Mode of Transportation

678. Generally trucks are used to transport all the construction materials to main stock yard by road way. The materials will be carried from the main stock yard to the worksite mainly by river and even by road in some cases. The condition of road way inside the polder is not suitable for larger vehicles i.e. dump truck, trolley, excavator etc. Therefore carrying of earth and other construction materials will have to be made through small carts, non motorized vehicles, manual labor etc. while using road ways and small boats, trawlers in waterways.

679. Lohalia River is flowing along the east part of the Polder- 43/2C. The depth of which is about 20 meter. It remains navigable throughout the year and can be used for transportation purposes during construction.

8. Climate Change Impact

8.1 Overview

680. 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.

681. 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 river bank erosion, salinity intrusion, flood, damage to infrastructures, crop failure, fisheries destruction, loss of biodiversity, etc. along this coast. Overall impacts of climate change on Bangladesh would be significant. It was found that the population living in the coastal area is more vulnerable than the population in other areas (Alam and Laurel, 2005). Coastal resources upon which the most people are dependent and are likely to be severely affected due to climate variability and change. It is predicted that for 45 cm rise of sea level may inundate 10-15% of the land by the year 2050 resulting over 35 million climate refugees from the coastal districts.

8.2 Regional Context

682. Asia is very likely to be warm during this century; the warming is likely to be well above the global mean in Asia. Precipitation in winter is very likely to increase in South Asia. There is very likely to be an increase in the frequency of intense precipitation events in parts of South Asia where extreme rainfall and winds associated with tropical cyclones are likely to increase as well.

683. 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 is shared between China, India and Bangladesh. Therefore, 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 considered 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

8.3.1 Projection of sea level rise

684. According to IPCC AR5 Working Group 1 report, the Observed and projected relative sea level change in Bay of Bengal is presented in figure 8.5 (Figure source: IPCC AR5 Working Group 1 report). The figure shows the observed in situ relative sea level records from tide gauges (since 1970) in yellow, and the satellite record (since 1993) as purple lines. The projected range from 21 CMIP5 RCP4.5 scenario runs (90% confidence) is shown by the shaded region for the period 2006–2100, with the bold line showing the ensemble mean. The vertical bars at the right side represent the ensemble mean and ensemble spread (5 to 95%) of the likely(medium confidence) sea level change at the year 2100 inferred from RCPs 2.6 (dark blue), 4.5 (light blue), 6.0 (yellow) and 8.5 (red). According to this figure, the sea level rise in Bay of Bengal for RCP 4.5 ranges between 0.25 to 0.72 m by 2100. The average sea level rise for 2030, 2050 and 2100 are 0.12, 0.21 and 0.5 m with respect to 1986-2005 sea level. In RCP 8.5 scenario, the sea level rise is 0.62 m by 2100.

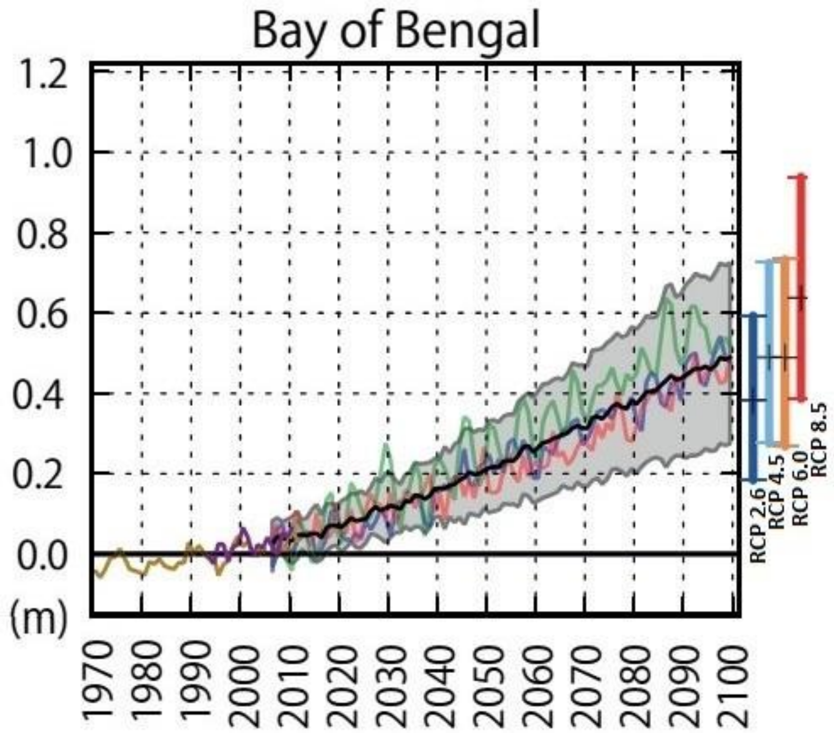


Figure 8.1: Sea level rise projections for Bay of Bengal

8.3.2 Projection of cyclonic storms

685. The available scientific evidence indicates that increased sea-surface temperature with climate change will intensify cyclone activity in the tropics and heighten storm surges (IWTC 2006; IPCC 2007; Hansen and Sato 2011). IPCC further indicates that future cyclonic storm surges and related coastal floods in Bangladesh will likely become more severe as future tropical cyclones increase in intensity (IPCC 2007). Records indicate that the greatest damage during cyclones has resulted from the inundation caused by cyclone-induced storm surges. Though time-series records of storm-surge height are scarce, existing literature indicates a 1.5 m to 9 m height range during various severe cyclones.

686. According to World Bank study (World Bank, 2010), it is estimated that a 10-year-return period cyclone in a changing climate (2050) will be more intense and cover 43 percent of the coastal zone of Bangladesh, 17 percent more than the current coverage. To approximate cyclones and related storm surges in a changing climate, this analysis considered a SLR of 27 cm (UK DEFRA, 2007), increased wind speed of 10% (Nicholls et al., 2003), and landfall during high tide to approximate cyclones in a changing climate by 2050. The results show a 69% increase in area inundated by 3 m or more depth. Figure 8.2 shows the inundation risk map for 2050 under climate change.

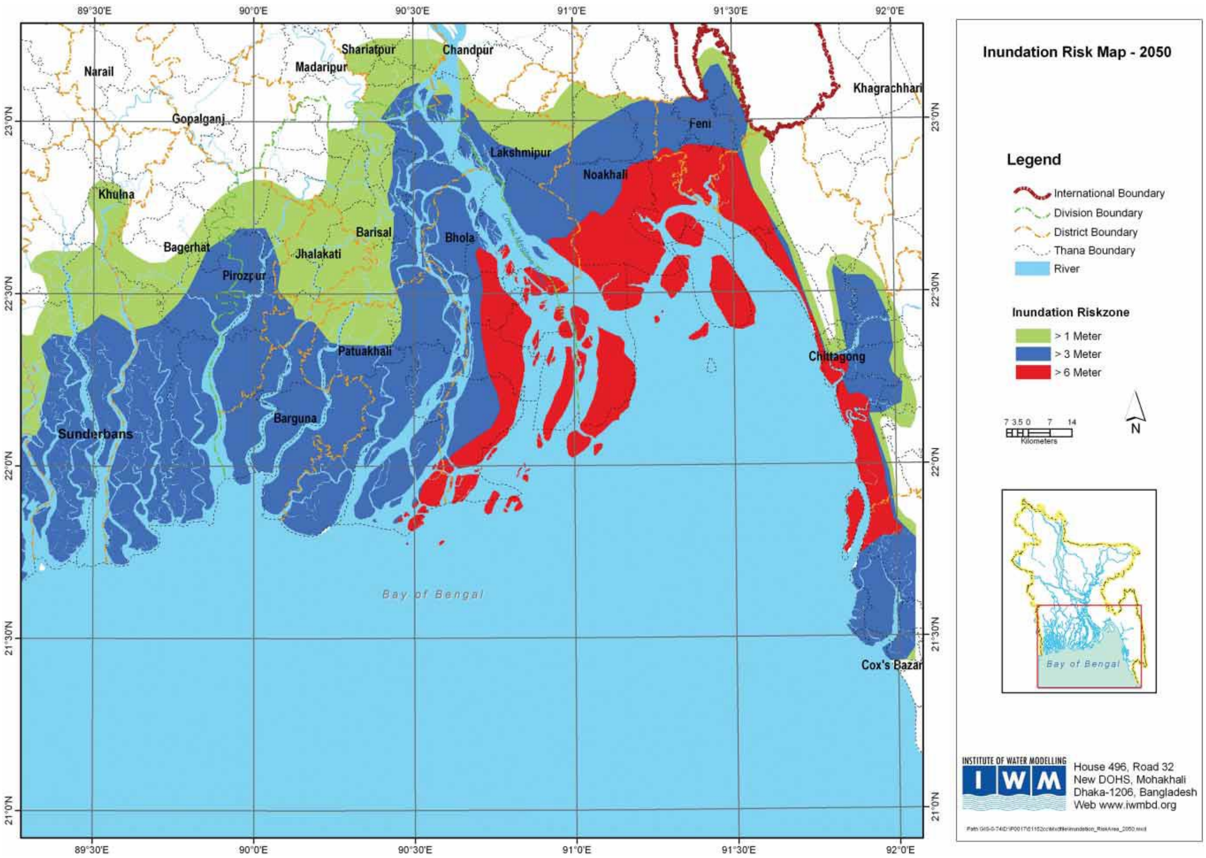


Figure 8.2: Storm surge High-risk area by 2050 under climate change

687. Regional Climate Downscaling (RCD) has an important role to play by providing projections with much greater detail and more accurate representation of localized extreme events than the GCM. South Asia Coordinated Regional climate Downscaling Experiment (CORDEX) domain data (resolution 50 km) is available at Centre for Climate Change Research (CCCR), IITM, and India. The CCCR is recognized by World Climate Research Programme (WCRP) and is responsible to generate downscaling model data over South Asia CORDEX domain. This data has been used to generate the future scenarios for rainfall and temperature over Bangladesh using RCP4.5 data set. The RCM model outputs were analyzed to find out seasonal and annual rainfall and monthly temperature over Polder area. It is assumed that the base period 1990 means averaged during the period 1981-2000 and 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. The RCP4.5 primary characteristics are given below:

688. RCP 4.5: It is a stabilization scenario in which total radiative forcing (4.5 W/m^2) is stabilized shortly after 2100, without overshooting the long-run radiative forcing target level.

8.3.3 Rainfall projections for RCP 4.5 scenario

689. Year-2030: The change of rainfall is found to be -11.0, 13.3, 0.8 and 7.2 % for winter, pre-monsoon, monsoon, post-monsoon, respectively for 2030 (Figure 8.3). On an average annual rainfall change over the Polder (43/2C) area may be changed by 2.2% for the year 2030.

690. Year-2050: The change of rainfall is observed to be -0.9, 2.4, -7.3 and - 26.7 % for winter, pre-monsoon, monsoon and post-monsoon, respectively in 2050 (Figure 8.4).). On an average annual rainfall change over the Polder (43/2C) area may be decreased by 7.7% for the year 2050.

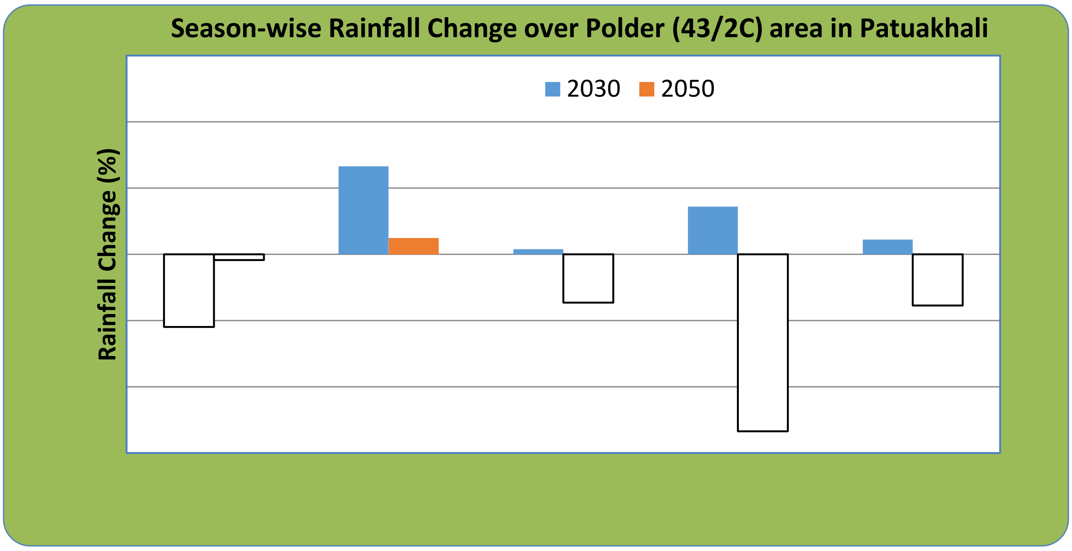


Figure 8.3: Change of seasonal rainfall (%) over Patuakhali (Polder 43/2C) for the year 2030 and 2050.

8.3.4 Projection of Maximum and Minimum Temperature over Patuakhali (Polder 43/2C) area

691. Maximum and Minimum surface air temperature projection is obtained by using a new set of scenarios RCP4.5 (Assessment Report, AR5) which is called Representative Concentration Pathway (RCP). The year of 2030 and 2050 of maximum and minimum surface air temperature projections for RCP4.5 is given below:

8.3.5 Maximum temperature projections over Polder (43/2C) area for RCP4.5 scenario

692. Year-2030: Maximum surface air temperature may change in 2030 by 1.3, 0.9, 0.5, 0.4, 0.3, 0.7, 0.5, 0.7, 0.7, 0.6, 1.2 and 1.1^{o} C for January, February, March, April, May, June, July, August, September, October, November and December, respectively (Table 8.1). Maximum surface air temperature in various months over Polder (43/2C) area may vary by 0.5 - 1.3^{o}C. On an average the maximum surface air temperature is estimated to be increased by 0.8^{o}C for the 2030.

693. Year-2050: Maximum surface air temperature may be changed in 2050 by 1.9, 1.7, 1.7, 1.4, 0.9, 1.3, 1.2, 1.5, 1.2, 1.0, 1.5 and 1.5^{o} C for January, February, March, April, May, June, July, August, September, October, November and December, respectively (Table 8.1). Maximum surface air temperature in various months over Polder (43/2C) area may be varied by 0.9 - 1.9^{o} C. On an average the maximum surface air temperature is estimated to be increased by 1.4^{o}C for the 2050.

8.3.6 Minimum temperature projections over Polder (43/2C) area for RCP4.5 scenario

694. Year-2030: The change of minimum surface air temperature is found to be 1.9, 0.9, 1.4, 0.5, 0.6, 0.9, 0.7, 0.8, 0.9, 0.9, 1.5 and 1.7^{o} C for January, February, March, April, May, June, July, August, September, October, November and December, respectively (Table 1). It is observed that the change lies between 0.5-1.9^{o} C for the period 2030 and on an average, minimum surface air temperature may increase 1.1^{o} C over Polder (43/2C) area in future for the period 2030.

695. Year-2050: The change of minimum surface air temperature is found to be 2.3, 2.2, 2.3, 1.7, 1.2, 1.4, 1.3, 1.4, 1.3, 1.2, 1.5 and 1.5^{o} C for January, February, March, April, May, June, July, August, September, October, November and December, respectively (Table 8.1). It is observed that the change lies between 1.2-2.3^{o} C for the period 2050 and on an average, minimum surface air temperature may increase 1.6^{o} C over Polder 43/2C area in future for the same period.

Table 8.1: The change of maximum and minimum surface air temperature over Polder

Scenario	Base line	Maximum Temperature Change(°C)												
		Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RCP4.5	1990 (1981-2000)	2030	1.3	0.9	0.5	0.4	0.3	0.7	0.5	0.7	0.7	0.6	1.2	1.1
		2050	1.9	1.7	1.7	1.4	0.9	1.3	1.2	1.5	1.2	1.0	1.5	1.5
Minimum Temperature Change (°C)														
RCP4.5	1990 (1981-2000)	2030	1.9	0.9	1.4	0.5	0.6	0.9	0.7	0.8	0.9	0.9	1.5	1.7
		2050	2.3	2.2	2.3	1.7	1.2	1.4	1.3	1.4	1.3	1.2	1.5	1.5

Source: Centre for climate change Research (CCCR), IITM, India

9. Cumulative and Reciprocal Impacts

9.1 General

696. Chapter 9 presents the analysis of cumulative and reciprocal impacts of the proposed Project and other projects in the area.

9.2 Cumulative Impacts of all CEIP interventions on Polder- 43/2C

697. CEIP is a multi-phased effort laid down by the GoB to refocus its strategy on the coastal area by providing extra emphasis on frequent storm surges. The embankment improvement and rehabilitation approach will be adopted forover a period of 15 to 20 years and in this regard a total number of 17 polders have been selected through a participatory screening process (Map 9.1).

698. As shown in Map 5.6, Polder- 43/2C is surrounded by the Lohalia river at north-eastern and south-eastern portion. The existing crest levels of the polder ranges from 3.32 to 3.60 mPWD above MSL. Re-sectioning works are proposed in the polders under CEIP, which would increase its crest level from 4.57 to 5.18 mPWD above MSL. This increase would reduce storm surge to enter into the polder. The other CEIP polders (41/1, 40/2 and 48) are far away from the project area of this polder as a result the interventions of those would have negligible impact on polder 43/2C.

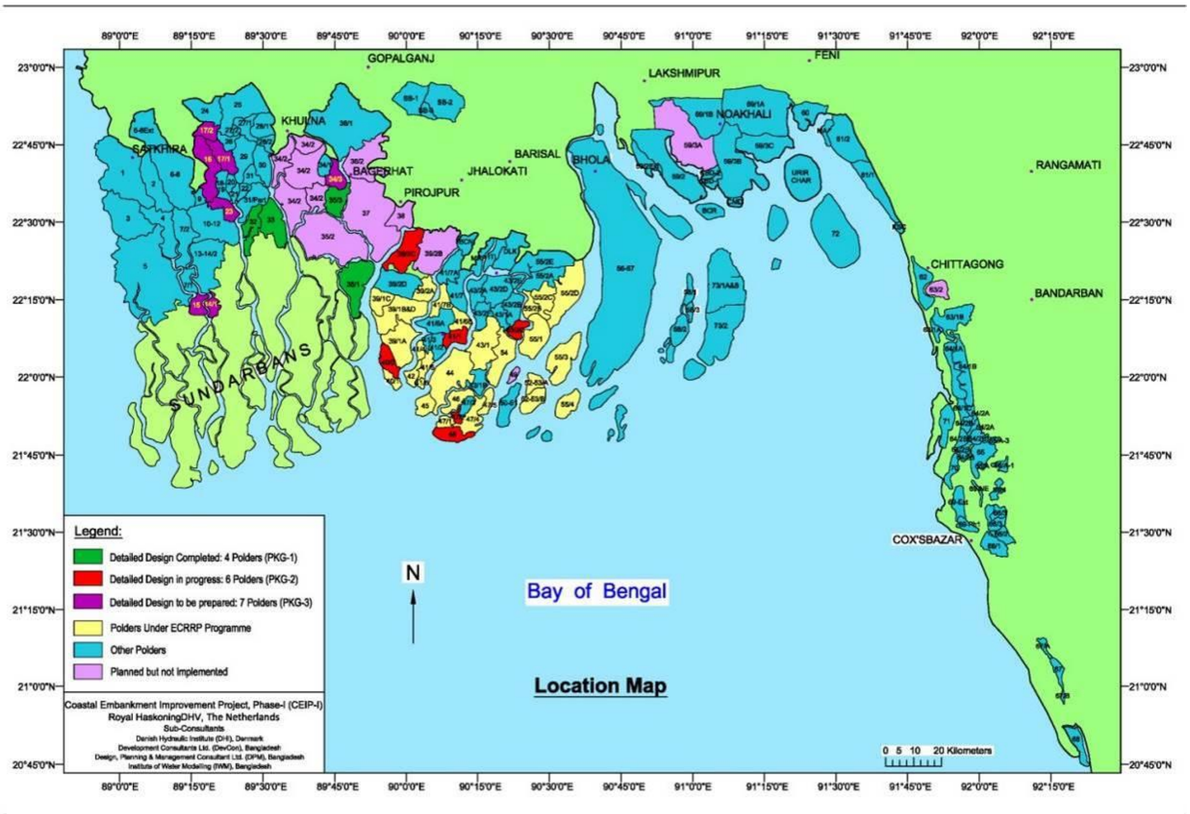


Figure 9.1: Locations of polders under CEIP-1

9.3 Synopsis of projects around Polder- 43/2C

699. Apart from CEIP interventions, there are some other development projects nearby Polder- 43/2C, implemented locally or regionally. Activities of these projects may generate cumulative impacts on this polder in future. Table 9.1 below shows a list of various projects in relevance with Polder- 43/2C, undertaken by different line agencies in Patuakhali and Barisal districts:

Table 9.1: List of water management projects

Agency	Project Name	Duration	Location	Sensitivity
National				
MoDMR	Comprehensive Disaster Management Program (CDMP), Phase II	2010- ongoing	Entire country (40 districts with direct interventions)	Negligible
BWDB	Projects under Climate Change Trust Fund	2013-ongoing	Entire country	Low
	Water Management Improvement Project (WMIP)	2010-ongoing	Entire country	Low
Regional				
DMB, BWDB, LGED	Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)	2008- ongoing	Coastal Zone	Moderate
BWDB	Blue Gold Program	2013- ongoing	Coastal zone	Moderate
	Coastal Embankment Rehabilitation Project (CERP)	1995-2004	Coastal zone	Negligible
Local				
LGED	Development of Union Parishad Connecting Roads	1999-2006	Patuakhali and Barguna	Negligible
	Participatory Small Scale Water Resources Sector Project	First (1996-2007) and Second (2010-ongoing)	Barisal, Jhalokathi, Patuakhali etc.	Negligible
DoF	Fisheries extension project	1994-2004	Patuakhali, Barguna	Negligible
DPHE	Water Supply, Sanitation, Drainage and Waste Disposal Project	1996-2007	Patuakhali and Barguna	Negligible

700. The projects (listed in Table 9.1) which have or may have moderate sensitivities on some of the environmental or social components of Polder- 43/2C are briefly discussed in the following sections:

9.4 Cumulative Impacts of Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)

701. In order to facilitate recovery from damage to livelihoods and infrastructure caused by Cyclone Sidr and to build long-term preparedness through strengthened disaster risk management, GoB implemented the 'Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)' in 13 districts (Barguna, Bagerhat, Barisal, Khulna, Bhola, Pirojpur, Jhalokati, Noakhali, Feni, Chittagong, Potualkhali, Sathkhira, Laksmipur) of Bangladesh. A major component of the activities of this project is rehabilitation of embankments and among the 35 polders considered for rehabilitation under the project, Polders 43/1, 54, 55/1 and 55/2B are located near Polder 43/2C along the downstream of Lohalia river(Map 9.1). The design crest levels of these polders are: 4.57 to 5.18 mPWD above MSL for Polder 43/1 and 4.27 mPWD above MSL for polder 54, 55/1 and 55/2B. All these polders will tend to divert the flow of Lohalia 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 Lohalia River in future. Due to the reduction of depth, the probabilities of river erosion in Polder- 43/2C may increase.

9.5 Cumulative Impacts of all Blue Gold interventions on Polder - 43/2C

702. A total number of 12 polders in Satkhira, Khulna and Patuakhali districts have been selected for implementation in its first phase. Among these, two polders (Polders 43/1A and 43/2B) are adjacent to Polder- 43/2C and therefore may generate some impacts in future. The existing crest levels of Polders 43/1A and 43/2B are 3.3 mPWD and 3~4.00 mPWD respectively above Mean Sea Level. If re-sectioning works are carried out along the periphery of these polders up to the design elevation of around 4.30 mPWD, there would be more floodplain sedimentation adjacent to the polders at the upstream. This may result in increase in sedimentation along the Lohalia river system. With reduced river sections along the upstream, tidal flow velocity might increase in the downstream which would create more pressure along the peripheral embankment of Polder- 43/2C. Moreover, if any bank protection works are carried out in future in the aforementioned polders 43/1A and 43/2B, some physical impacts like flooding and erosion may occur on Polder- 43/2C.

9.6 Reciprocal Impacts of Climate Change and Polder Improvement

703. Reciprocal impacts of Climate Change and Polder improvement refers to the impacts occurred on polder due to climate change and vice versa. IWM usedhydrodynamic 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 haveused SWRM, NAM, Water Flow Model respectively.

704. In order to evaluate the reciprocal impacts of Climate Change and Polder improvement (43/2C), 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 hydro-meteorology to assess the impact of climate change on some sensitive issues of the polder namely, water availability, flood security etc.

9.6.1 Impact of Drainage Congestion

705. Simulation of rainfall event of 5-days of 10 year is carried out for the existing drainage system without changing the regulators and khals under climate change scenario (RCP 8.5). The same projection of climate change is applied for all polders. Simulation result enables to examine the inundation depth and land class. Using the model results on water level and available Digital Elevation Model (DEM) of the study area, flood inundation depth scenario for 3 days duration showing the area of different classes of land (F_0,F_1,F_2,F_3) is prepared. In this study, it is found that coverage of dry and F_0 land is about only 10.36% using climate change scenario of RCP 8.5 (AR5). Analysis of model results on inundation suggests that existing drainage is not adequate for draining the predicted rainfall and needs polder improvement.

706. From beginning of the 21st century a new problem “water logging” (the long-term inundation of areas as a result of inadequate drainage) arose in south/south-west coastal region of Bangladesh. It has become an increasing problem in recent years for a various reasons: natural changes in river flow; increased sediment in riverbeds due to reduced sediment deposition on floodplains protected by embankments; and a lack of proper operation and maintenance of sluice gates of the polders i.e. circular embankments. Due to the permanent water congestion sudden flood is occurred during the rainy months. In the other words, the water logging situation causes recurring flood in every monsoon seasons. Among the affected areas, Polder- 43/2C is the worst hit and experiencing severe and year-round water logging.Due to the permanent water congestion sudden flood is occurred during the rainy months. In the other words, the water logging situation causes recurring flood in every monsoon seasons.

707. 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 surrounding Lohalia River and new morphological changes may be established outside the polder. Moreover, sedimentation in smaller water bodies namely Goalkhali River and Sonakhali River 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.

9.6.2 Impact of Increased Water Level

708. The rise in sea water level will affect the increase of the river water level outside of the polder area. The rainfall during the monsoon will be increased due to climate change, which will result the increase in extreme flow during monsoon that ultimately result the increase in flood water level. To understand the impact of climate change, the model was run for corresponding areas of Polder-43/2C to evaluate water level using climate change scenarios for the year 2050s as shown in Table 9.2 below:

Table 9.2: Water Level of 25 year return period for peripheral river of Polder- 43/2C under Climate Change

Sampling Point	Chainage	Peripheral river/Canal	Existing Avg. Crest level (mPWD)	Water Level (mPWD)
114	25+000	Lohalia River	3.60	3.60
113	20+500	Lohalia River		3.56
112	17+000	Lohalia River		3.51
55	13+750	Lohalia River		3.42
114a	0+820	Peripheral river / Canal		3.79
113a	2+220	Peripheral river/Canal		3.66

Sampling Point	Chainage	Peripheral river/Canal	Existing Avg. Crest level (mPWD)	Water Level (mPWD)
112a	8+340	Peripheral river/Canal		3.51
55a	11+770	Peripheral river/Canal		3.46

Source: IWM, 2016

709. It is seen that the existing crest level (3.60 mPWD) of the embankment of Polder- 43/2C is vulnerable, according to the predicted (25 year) water levels of the peripheral rivers/khals due to climate change. Therefore, a safe crest level (5.18 mPWD) has been suggested by IWM that acts as a safeguard against the upcoming threat due to climate change. Due to the higher level of polder, tidal water would not be able to enter Polder 43/2C during monsoon period. As a result the nearby areas which are not protected (Kathalia,Gazipur Bandar Bazar) from inundation and may be severely affected by cyclones and salinity intrusion in future.

9.6.3 Impact of Storm Surge Level

710. 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 three locations (South-East portion) of the Polder- 43/2C considering with and without climate change is presented in Table 9.4. It is observed that in 10 year return period surge level may be increased around 19% where as in 25 and 50 year return period it may be increased around 14% and 11% respectively. So, it can infer that surge level intensity may be more frequent in coming years in surrounding areas (AmkholaBazar, Horidevpur, Agun Mukha) of Polder- 43/2C. In 50 year projection it has been found that storm surge levels are higher than the existing crest level of the polder that may cause severe inundation inside the polder. Due to the proposed protective measures of Polder- 43/2C, storm surges may divertand cause a great threat to the surrounding polders i.e. Polder-54,Polder- 55/1 etc. Storm surge level for different return period with and without climate change effect for Polder- 43/2C is presented in Table 9.3.

Table 9.3: Storm surge level for different return periods with and without climate change

Location	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)			
			Sidar	Aila	10	25	50	100	10	25	50	100
Lohalia, Galachipa	112	3.60	4.57	2.56	2.70	3.68	4.41	5.13	3.21	4.2	4.93	5.66
	113	3.60	4.43	2.61	2.67	3.70	4.46	5.21	3.14	4.07	4.76	5.44
	114	3.60	4.24	2.63	2.67	3.65	4.38	5.11	3.13	4.04	4.72	5.39

Source: IWM, 2016

9.6.4 Impact of Wave Height due to Climate Change

711. Significant wave height during cyclonic condition for different return period withc limate change effect around the Polder - 43/2C is presented in theTable 9.4.

Table9.4: Wave height (m) for different return period with climate change condition

Station No.	Location	Significance Wave Height (m) in Different Return Period (Years) with Climate Change					
		Sidar	Aila	10	25	50	100

111	Buriswar, Barguna	1.14	0.41	0.85	1.15	1.37	1.59

Source: IWM, 2015

712. From the table 9.5, it is predicted that wave height increases in short duration return period (i.e. 10 to 25 year return period) by 35% whereas, in the long duration (25 years) it will be increased around 19%. There is less possibility of deterioration of polder 43/2C due to existing crest level against the probable wave height due to climate change. However, it may increase pressure to the other non-protective areas in future.

9.6.5 Climate Change Resilience Developed in Polder 43/2C

713. During field investigations, it was found that the local people are mostly aware of the climate change consequences and events. In recent years they are the victims of climate change induced natural disasters, frequently hitting them and causing massive loss of lives and properties.The initiatives already undertaken through different interventions by programs other than CEIP, the insight of climate resilience has been developed within the polder habitants. Through the community mobilization in CEIP program, local people have become more active towards building a climate resilient society. They are now driven by the concept of climate smart village. Most of the people who are able to afford are now re-building their houses and infrastructures on a relatively higher level. Local people claimed that they would use the excavated spoil from the internal khals for their household purpose, if available. This will allow them to have their house and other infrastructures on a re-built higher land. The local farmers are now more concerned about climate change issues as well. They regularly follow and take part in the knowledge development and capacity building programs organized by CEIP, which they believe enhanced their understanding and preparedness on flood and disaster management.

10. Development of Environmental Management Plan

714. This Chapter presents the Environmental Management Plan (EMP) for the rehabilitation activities in the Polder- 43/2C. The EMP essentially provides the implementation mechanism for the environmental and social mitigation measures discussed in Chapter 6.

10.1 EMP Objectives

715. The basic objective of the EMP is to manage, prevent and mitigate potentially adverse impacts of Project interventions. The specific objectives of the EMP are to:

- Facilitate the implementation of the environmental and social mitigation measures identified during the present EIA and discussed in **Chapter 6**.
- Assign responsibilities for project proponent, contractors, consultants and other members of the Project team for the environmental and social management of the Project;
- Define a monitoring mechanism and identify monitoring parameters to ensure effective implementation of the mitigation measures.
- 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-43/2C 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

716. The EMP components for this polder are listed below:

- Institutional Arrangement
- Mitigation Measures and Plan
- Monitoring Plan
- Documentation and reporting
- Contractual arrangements for EMP implementation
- EMP implementation cost
- Capacity building
- Grievance redress mechanism

717. These components are discussed in Sections below:

10.3 Institutional Arrangement

718. Clearly defined and functional institutional arrangements are essential for ensuring effective and sustainable implementation of the EMP, particularly the mitigation measures

identified in the EIA. An Organogram showing the institutional setup of CEIP-1 including organisation for implementation and monitoring of the EMP is shown in Figure 10.1.

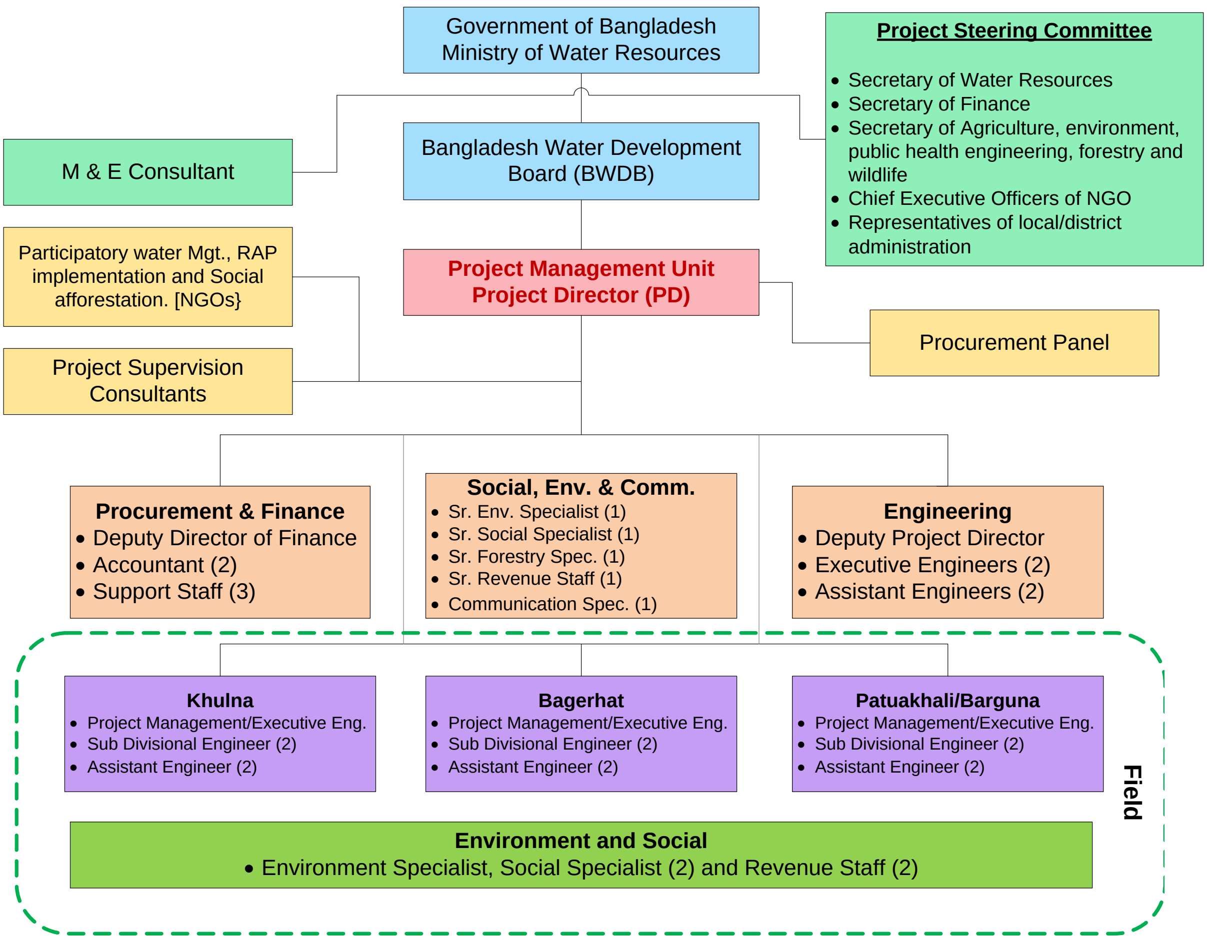


Figure 10.1: Organogram showing the institutional setup for CEIP-1

719. The institutional arrangements proposed to implement the EMP of Polder 43/2C are described below:

10.3.1 Overall Responsibility

720. The overall responsibility of EMP implementation and fulfilling other environmental obligations during the Project rests with the Project Director (PD). For this purpose, the PD will be supported by environmental and social staff of the PMU, Detailed Design and Construction Supervision Consultants (DCSC) and contractors.

10.3.2 Construction phase

Environment and Social Staff in PMU

721. As described in Section 4.8, the BWDB will set up the PMU to manage the Project implementation. The PMU will be led by theProject Director (PD). To manage and oversee

the environmental and social aspects of the Project, the PMU will have an Environment, Socialand Communication Unit (ESCU).The Unit will supervise compliance with and implementation of the EMP. The Unit will include a Senior Environmental Specialist.One environment specialist will be posted at the field level to support all three divisions. The ESCU will maintain liaison with WB safeguards team, regulatory agencies, and other stakeholders during the Project implementation. The ESCU will also coordinate with the environmental staff of the DCSC. In order to manage the EA process and EMP implementation effectively, the ESCU will be established and made operational before awarding the contract to contractor. ESCU will be responsible for updating the EIA after receiving the pending information.

Environment and Social Staff with DCSC

722. The DCSCwill be responsible for overall supervision of polder rehabilitation related activities. The DCSCwill ensure quality control and report to the PD. The DCSC will also assist the ESCU for ensuring environmental compliance and monitoring of progress including EMP and/or ECoP implementation. The DCSC will supervise the contractors, ensuring design compliance and quality of works. For supervising the EMP implementation, DCSC will have dedicated and adequately qualified and experienced environmental staff including field-based environmental monitors (EMs). The DCSC will supervise and monitor contractors to ensure compliance with the EMP. The DCSC's environmental staff will maintain coordination with the ESCU for the effective implementation of EMP and other environmental commitments and obligations of the Project.

Contractor's Environment Supervisors

723. 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

724. 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 ESCU will provide training to the BWDB people responsible for monitoring of environmental compliance. Thus, a smooth transition to BWDB will happen to ensure environmental compliance during the O&M after the project completion. These staff will be responsible to manage the environmental aspects of the operation and maintenance of polder, its water control structures and other relevant issues such as protection of key environmental resources of the older and maintain fish migration. Water Management organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (Nov 2000) and involve the beneficiary communities. WMOs will be trained by BWDB to ensure environmental management during project operation. The Environmental Management Unit of BWDB will ensure and oversee the environmental management during project implementation and operation. The Water Management Organization will also be trained and involved in EMP implementation during the operation phase.

725. An organogram on mode of implementation of Environmental Management Plan is presented in figure-10.2 as follows:

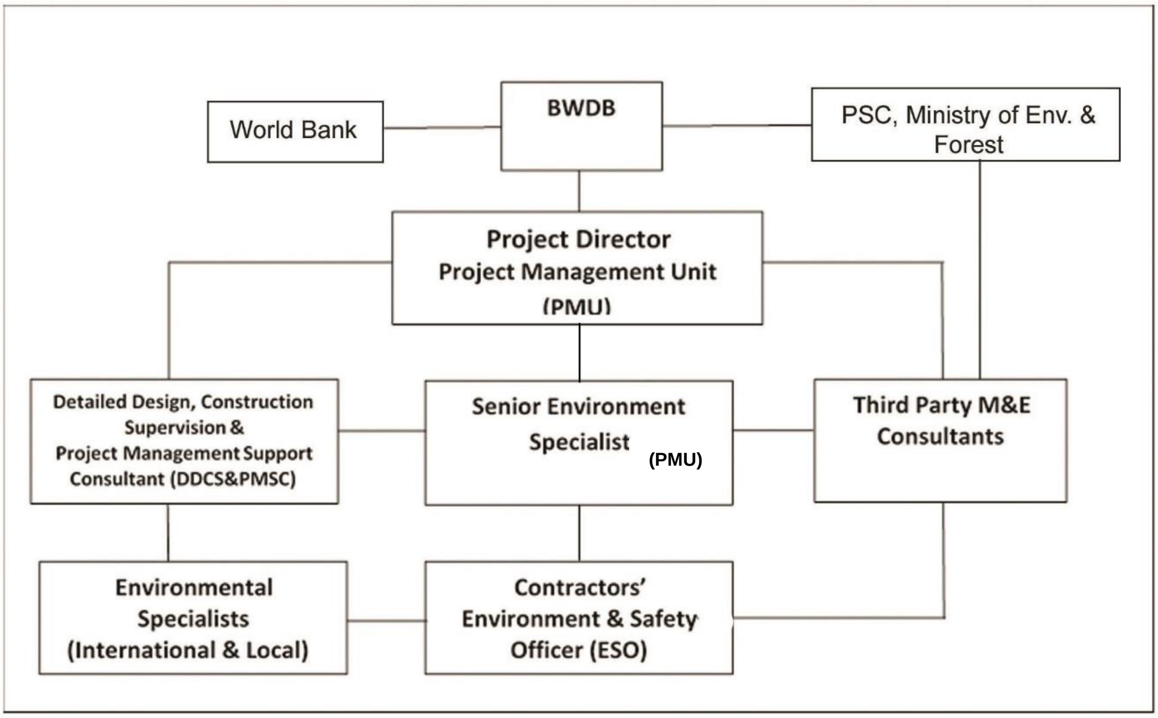


Figure 10.2: Organogram showing mode of EMP Implementation

10.4 Mitigation Measures and Plan

726. Mitigation is an integral part of impact evaluation.Mitigation where deemed to be appropriate, a proponent should strive to act upon effects, in the following order of priority, to:

- Eliminate or avoid adverse impacts, where reasonably achievable.
- Reduce adverse impacts to the lowest reasonably achievable level.
- Regulate adverse impacts to an acceptable level, or to an acceptable time period.
- Create other beneficial impacts to partially or fully substitute for, or counter-balance, adverse effects.

727. Project specific construction environmental management plans will be prepared by the Contractor and implemented upon approval by the DSC consultant and the PMU. These plans will specify precautions and mitigation measures for construction activities. Good Environmental Construction guidelines have been compiled in Appendix 10 of Environmental Management Framework.

728. Impacts identified severe in consequence category and or likelihood category will be further analyzed to identify additional mitigation measures that are potentially available to eliminate or reduce the predicted level of impact. Potential mitigation measures will include,

- habitat compensation program
- species specific management program
- engineering design solutions
- alternative approaches and methods in achieving the activity‘s objective
- stakeholders participation in finalizing mitigation measures

- construction practice, including labor safety and welfare measures.
- operational control procedures
- management systems

729. Based on the past experience, a generic Mitigation Measures for EMP has been presented in Table 10.1below 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 should be identified. • Selection of Borrow pit Areas or soil borrowing areas for earthen material collection. • No objection from land owner/Revenue authorities as applicable • Contractor shall ensure that borrow materials used for embankment filling is free of pollutants • Disposal of excess soil should be done at site with no objection from DoE and local authority
Borrowing of Earth	**Selection of Borrowing Area** • Borrowing of soil from close to the toe line on any part of the embankment is prohibited. Earth available from dredging as per design, may be used as embankment material (if necessary and applicable), subject to approval of the Engineer, with respect to acceptability of material. Borrowing to be avoided from the following areas: • Lands close to toe line and within 0.5 km from toeline. • Irrigated agricultural lands (In case of necessity forborrowing from such lands, the topsoil shall be preserved in stockpiles, although burrowing of agricultural land is discouraging). • Grazing land. • Lands within 1km of settlements. • Environmentally sensitive areas such as reserve forests, protected forests, sanctuary, wetlands. A distance of at least500 m should be maintained from such areas. • Unstable side-hills. • Water-bodies (only if permitted by the local authority, and with specific pre-approved redevelopment plans by the concerned authority and engineer-in-charge) • Streams and seepage areas. • Areas supporting rare plant/ animal species. **Documentation of Borrow Pit** • The contractor must ensure that following data base must be documented for each identified borrowing areas before commencing the borrowing activity that provide the basis of the redevelopment plan. • Chainage along with offset distance; • Area (Sq.m); • Photograph and plan of the borrowing area from allsides; • Type of access/width/kutcha/pucca etc. from theroadway;

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Soil type, Slope/drainage characteristics; • Water table of the area from the nearest well, etc; • Existing land use, for example barren / agricultural /grazing land; • Location/name/population of the nearest settlement from borrow area; • Quantity excavated (likely and actual) and its use; • Copy of agreement with owner/government; and • Community facility in the vicinity of borrow pit. • Rehabilitation certificate from the 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 following measures are requiredto be undertaken: • Adequate drainage system shall be provided to the excavated area • At the stockpiling locations, the Contractor shallconstruct sediment barriers to prevent the removal of excavated material due to runoff. The followings precautions shall be undertaken during quarry operations. Overburden shall be removed. • During excavation, slopes shall be flatter than 20 degrees to prevent sliding. • In case of blasting, the procedure and safetymeasures shall be taken as per DoE guidelines. • The Contractor shall ensure that all workersrelated safety measures are taken. • The Contractor shall ensure maintenance of crushers regularly as per manufacturer‘s recommendation. • During transportation of the material, measures shall be taken to minimize the generation of dust and to prevent accidents.
Handling Dredged Material from River Dredging	• Deposition of dredged material should be far away from the channel edge to limit damage to streamside habitats. This also allows a degree of flooding to occur on the floodplain, thereby creating opportunities for wet grassland, scrub/wet woodland, wetlands and seasonally grazed rough grass. • Apply biotechnical engineering where possible, for example geotextiles, may be used to stabilize the material and aid re-colonization. • Other possibilities include: drying and spreading the spoil over the adjacent land, which can improve soil fertility in some cases, and also to other important flora and habitats; excavating a trench and infilling it with spoil, thus minimizing disturbance to agriculture and the local environment; dumping off-site is possible but expensive, using spoil to create artificial wetlands.
ECoP 2: Water Resource & Hydrology Management	
Hazardous Waste Management	• The contractor will minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes) by following DoE/WB approved related procedures.
Ponding of water/water logging	• Ponding of water should not be allowed especially near the waste storage areas and construction camps • Discard all storage containers capable of storing of water, after use or store them in inverted positions. • Reinstate relief and landscape • Monitor drainage pattern after high down pouring and recession flood • Connect water pockets to the nearest drainage structures/canals
Soil Erosion and siltation	The Contractor shall

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Water the material stockpiles, access roads and bare soils as and required basis to minimize dust emissions. Increase the watering frequency during periods of high risk (e.g. high winds) • All working sites (except permanently occupied by the road and supporting facilities) should be reinstated to its initial conditions (relief, topsoil, vegetation cover). • Ensure that roads used by construction vehicles are swept regularly to remove sediment
Dredging	• Disturbance can be minimized if mechanical excavators work from a particular bank. If the channel is too wide, the digger must work within the channel. Disruption can be minimized by diverting the river down one side of the channel and dredging the other side while it is 'dry'. Smaller plant equipment generally limits the level of impact on bank-side and in-stream habitats.
Construction activities in water bodies	• Protect water bodies from sediment loads by silt screen or bubble curtains or other barrier. • Do not discharge cement and water used for curing cement concrete directly into water courses and drainage inlets • Monitor the water quality in the runoff from the site or areas affected by dredge plumes, and improve work practices as necessary
ECoP 3: Air Management	
Construction vehicular traffic	The Contractor should • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner • Cover haul vehicles carrying dusty materials (cement, borrow and quarry) moving between outside and the construction site • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions • Control the movement of construction traffic • Water construction materials prior to loading and transportation • Service all vehicles regularly to minimize emissions • Materials will be transported to site in off peak hours.
Construction activities	• Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. • Increase the watering frequency during periods of high risk (e.g. high winds). • Stored materials such as excavated earth, dredged soil, gravel and sand shall be covered and confined to avoid their being wind-drifted • Minimize the extent and period of exposure of the bare surfaces. • Reschedule earthwork activities or vegetation clearing activities, where practical, if necessary to avoid during periods of high wind and if visible dust is blowing off-site • Restore disturbed areas/side of the embankment as soon as practicable by plantation/vegetation/grass-turfing • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations • Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems
Odor from Construction labor Camps	• Construction worker‘s camp shall be located at least 500 m away from the nearest habitation.

Parameter/Activities	**Mitigation/Compensation Measure/Guideline**
	• The waste disposal and sewerage system for the camp shall be properly designed, built and operated so that, no odor is generated.
ECoP 3: Agriculture Management	
Loss of Top Soil	• Soil from fallow lands/ non-agricultural lands should be used in earthwork in embankments. • Collect/strip top soil before earth filling and store and reuse it for final surfacing of embankment top and tree plantation/afforestation. • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m • Remove unwanted materials from top soil like grass, roots of trees and similar others • The soil are to stockpiledwith side in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil • Locate topsoil stockpiles in areas outside the drainage lines and protect from erosion • Spread the topsoil to maintain the physio-chemical and biological activity of the soil. • The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites • Topsoil stockpiles will be monitored and corrective measure are to be undertaken any adverse condition is observed and the actions will include: • Anaerobic conditions-turning the stockpile or creating ventilation holes through the stockpile; • Erosion – temporary protective silt fencing will be erected;
Soil salinity	• Use of duckweed will remove soil salinity • Flushing with pre-monsoon rain water will reduce soil salinity. • Saline tolerant crops need to be practised. • Environmentally and socially responsive shrimp farming e.g. shrimp-rice farming system is encouraged. • Increaseof upland discharge of fresh water will push back ingress of saline water from the sea • Green manure application to be promoted • Ground water abstraction for shrimp farming should be avoided.
ECoP 4: Noise Management	
Construction vehicular traffic	• Maintain all vehicles in order to keep it in good working order in accordance with manufacturer's maintenance procedures • Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise at the work site.
Construction machinery	• Appropriately locate all noise generating activities to avoid noise pollution to local residents • Maintain all equipment in order to keep it in good working order in accordance with manufactures maintenance procedures.
Construction activity	• Notify adjacent landholders/Schools prior to any typical noise events during of daylight hours • Employ best available work practices on-site to minimize occupational noise levels • Install temporary noise control barriers where appropriate • Plan activities on site and deliveries to and from site to minimize impact • Monitor and analyze noise and vibration results and adjust construction practices as required • Avoid working during 09:00pm to 06:00 am within 500m from the existing residences.
ECoP 5: Ecology Management	
Flora	

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Vegetation Clearance	• Tree felling should be performed upon preliminary notification to the relevant authority (District Forest Office, DoE). • Preparation of maps in GIS format, cadastral description of trees to be felled, marking, and supervision of Forest Department are necessary elements of the procedure. • Provide adequate knowledge tothe workers regarding natural protection and the need of avoiding felling trees during construction • Fruit and timber trees owned by local population will be compensated at their replacement cost according to market prices
Plant Management	• Tree seedlings are planted in a way that minimizes damage to the soil, while facilitating seedling survival. Appropriate tree seedling species are selected for maintaining long-term productivity. • Focus on tree species suitable for site condition. • Prevent unreasonable species resulting in slow growth, less water and soil conservation and pest or disease outbreaks. • Local species as planting materials, since natural selection and succession are most suitable for local climates and natural conditions. • Ensure avoid single species or clone monoculture. • Choose suitable species for berm, turfing and side.
Planting	• Leave set back requirements around streams, restricted areas e.g. native vegetation, protected riparian strips, historic and heritage sites, research areas. • For nursery raising, physical and biological controls are practiced to control the pests and diseases in the nurseries. • Notto plant spread-prone species on sites where there is a high risk of uncontrollable wilding spread beyond the boundaries of the plantation. • Consider appropriate species, patterns and layout when planting areas with high visual values and/or with important recreational values
Polypropylene Bags Handling	• Make a Borrow Pit at each site for collection of poly bags • Collect all bags at the pits after plantation • If feasible, inform private sector to collect those bag for recycling
Pest Management to Nursery	• During outbreak of any deadly plant disease, develop a plan to manage pest in coordination with neighbours by identifying existing pests and diseases and the risks for the introduction of new pests and diseases. • Share the plan with Bank before application.
Water Management	• Install temporary sediment basins, where appropriate, to capture sediment-laden run-offfrom nursery • Divert runoff from undisturbed areas around the harvesting site • Stockpile of fertilizer or agro-chemical away from drainage lines • Prevent all solid and liquid wastes entering waterways by collecting solid waste, oils,chemicals, fertilizer waste and transport to an approved waste disposal site
Fauna	
Construction works in the surrounding lands	• Pre-entry survey and prevention of damage to fauna prior to start up • Limit the construction works within the designated sites allocated to the contractors • Not be permitted to destroy active 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	• Critical breeding areas of major fish species should be identified and declared as sanctuaries.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
the surrounding lands	• Creation of small lagoons and pools that may trap the fishes will be avoided. • Creation of artificial waterfalls and other barriers for migration will be avoided. • Natural river channel will be reinstated after completion of construction works
Hydraulic Structure	• Sufficient free flow will have to be guaranteed in the design and construction work to ensure free passage of migrating fishes. • Hydraulic structuresto be operated considering fish migration and spawning time • An area specific hydraulic structure operation guideline should be developed
Dredging	• Ensure that the dredging activity will create minimum sediment load in the water • Avoid dredging during spawning period of fish
ECoP 7: Socio-Economic Management	
Construction Camp Management	
Siting and Location of construction Camps (MRDI, 2011)	• The contractor shall hoist signboards at worksite mentioning the details of activities to be performed along with cost, work tenure and name and address of firm. It will also contain the address of the supervision organization, who may be informed of any grievances of the activities. • Locate the construction camps at areas, which are acceptable from environmental, cultural or social point of view. • Consider the location of construction camps away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • BWDB should endorse detailed layout plan for the development of the construction camp submitted by the contractor. The plan should indicate the definite locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters
Construction Camp Facilities	The following facilities should be provided by the contractor • Adequate housing for all workers • Safe and reliable water supply • Hygienic sanitary facilities and sewerage system. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities • Provide in-house community/common entertainment facilities, dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Solid Waste Management	• Ensure proper collection and disposal of 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.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Do not establish site specific landfill sites. All solid wastes will have to be collected and removed from the work camps and dispose in approved disposal sites
Fuel supplies for cooking purposes	• Provide fuel to the construction camps for their domestic purpose, in order to discourage them to use fuel wood or other biomass. • Conduct awareness campaigns to educate workers to protect the biodiversity and wildlife of the project area and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	• Provide adequate health care facilities within construction sites • Provide first aid facility round the clock. Maintain stock of medicines in the facility • Provide ambulance facility for the labourers during emergency to be transported to nearest hospitals. • Initial health screening of the labourers coming from outer areas • Train all construction workers in basic sanitation and health care issues and safety matters and on the specific hazards of their work • Provide HIV awareness programming, including STI (sexually transmitted infections) • Provide HIV information, education and communication for all workers on regular basis • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Regular mosquito repellent sprays during monsoon. • Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. • Place display boards at strategic locations within the camps containing messages on best hygienic practices
Payment of Wages	• The payment of wages should be as per the Minimum Wages Act, Department of Labor, and Government of Bangladesh for both male and female workers. • Display boards showing of the minimum wages at camps and major construction sites should be done in local languages at the construction and labor camp sites. • Wages should be paid to the labourers only in the presence of BWDB staff; • Contractor is required to maintain register forpayment of labor wages with entry of every labor working for him. Also, he has to produce it for verification if required and when asked by the Engineer, EMUand/or the concerned BWDB staff/Engineer‘s representative • Contractor to follow the guidelines of prevalent by-laws of Bangladesh labour Act, 2006.

Rehabilitation of Labor and Construction Camp	• After completion of construction, all construction camp facilities shall be dismantled and removed from the site. The site shall be restored to a condition in no way inferior to the condition prior to commencement of the works.
	• The activities to be carried out for site rehabilitation after completion of construction include:
	  • Oil and fuel contaminated soil shall be removed andtransported and buried in waste disposal areas.
	  • Soak pits, septic tanks shall be covered andeffectively sealed off.
	  • Debris (rejected material) should be disposed ofsuitably.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Underground water tank in a barren/non-agricultural land can be covered. However, in an agricultural land, the tank shall be removed. • If the construction camp site is on an agricultural land, preserve top soil and good earth can be spread back for a minimum 30cm for faster rejuvenation of the land. • Proper documentation of rehabilitation site is necessary. • This shall include the following: • Photograph of rehabilitated site; • Land owner's consent letter for satisfaction inmeasures taken for rehabilitation of site; and • Undertaking from contractor; • In cases, where the construction camps site is located on a private land holding, the contractor would still have to restore the campsite as per this guideline. The rehabilitation is mandatory and should be include in the agreement with the landowner by the contractor. Also, he (the contractor) would have to obtain a certificate for satisfaction from the landowner.
Damage and Loss of Cultural Properties	
Conservation of Religious Structures and Shrines	• Necessary and adequate care shall be taken to minimize impact on cultural properties which includes cultural sites and remains, places of worship including temples, mosques, churches and shrines, etc., graveyards, monuments and any other important structures as identified during design and all properties / sites / remains notified. No work shall spillover to these properties and premises. The design options for cultural property relocation and enhancement need to be prepared. • All conservation and protection measures will be taken up as per design. Access to such properties from the road shall be maintained clear and clean.
	• During earth excavation, if any property is unearthed and seems to be culturally significant or likely to have archaeological significance, the same shall be intimated to the Engineer. Work shall be suspended until further orders from the PD. The Archaeological Department shall be intimated of the same findings and the Engineer shall carry out a join inspection with the department. Actions as appropriate shall be intimated to the Contractor along with the probable date for resuming the work. • All fossils, coins, articles of value of antiquity andstructures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government, and shall be dealt with as per provisions of the relevant legislation.
Worker's Accident Risk	
Risk from Operations	• The Contractor is required to comply with all the precautions as required for the safety of the workmen as per the International Labor Organization(ILO) convention. The contractor shall supply all necessary safety appliances such as aprons, safety goggles, helmets, masks, boots, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms,

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	gangway, stairwells, excavations, trenches and safe means of entry and outlet.
Risk from Electrical Equipment	• Adequate precautions will be taken to prevent danger from electrical equipment. No materials on any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Bangladesh Standards (BS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per BS provisions and to the satisfaction of the Engineer.
Risk from Hazardous Activity	• All workers employed on mixing material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals.
Disruption to Users	
Loss of Access	• At all times, the Contractor shall provide safe andconvenient passage for vehicles, pedestrians and livestock. Works thataffect the use of existing accessesshall 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 orof properties whether public or private.
Traffic Management	• Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night. • The temporary traffic detours in settlement areasshall be kept free of dust by frequent application of water
Traffic Control and Safety	• The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the cross section.

10.5 Chance-Find Procedures for Physical Cultural Property

730. 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 archaeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;
- Protect artefacts as well as possible using plastic covers, and to take measures to stabilize the area, if necessary, properly protect artefacts;
- Prevent and penalize any unauthorized access to the artefacts; and
- Restart construction works only upon the authorization of the relevant authorities (e.g. Upazila Nirbahi Officer, Deputy Commissioner and Department of Archaeology).

10.6 Monitoring Plan

731. 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 should be included in the EMP for specific sub-projects. Moreover, for all type of monitoring, a comprehensive database of the polder specific Environmental Impact and Monitoring information should be created, which will help to evaluate the impacts easily.

732. The Monitoring activities during design/preconstruction period are:

(1) checking the contractor's bidding documents, particularly to ensure that all necessary environmental requirements have been included; and

(2) checking that the contract documents' (Construction Environmental Action Plan) references to the 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.

733. Construction environmental monitoring is a function of supervision, and the essential purpose is to ensure adherence to the EMP. The monitoring is a daily process, which ensures that departures from the EMP are avoided or quickly rectified, or that any unforeseen impacts are quickly discovered and remedied. This monitoring will be carried out by the DCSC on a regular basis. Additional monitoring will be carried out by the Environmental and Social Unit.

734. Post project monitoring evaluation will be carried to evaluate the impacts of the Project during first three (3) years of operation of the Project. Regular monitoring of the condition of the embankment, drainage structures and slope protection structures and afforestation are important from an environmental management point of view. In addition to this activities, information on the locations, type and consequences of flooding, erosion, flora and fauna mortality, availability of fish, occupational shift, migration is required. Recommended air, noise and water quality monitoring, greening and landscaping and community feedback are also included in the Monitoring Plan. The monitoring plan and details of monitoring locations for environmental condition indicators of the project during the construction and operation stage are presented in Table 10.2 and Table 10.3.

Table 10.2: Environmental Monitoring Plan during Construction and Operation of Rehabilitation and Improvement of Polders System

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
During Construction					
Sources of Material	Work Site	Possession of official approval or valid operating license of suppliers materials (Cement, soil).	Before an agreement for the supply of material is finalized.	Contractor	DCSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
Operation of borrow site	Borrow pit/site	Visual inspection of borrow site and ensuring operational health and safety	Monthly	Contractor	DCSC, M&E Consultant, BWDB
Top Soil	Storage area	Top soil of 0.15 m depth should be excavated and stored properly	Beginning of earthwork	Contractor	DCSC, BWDB
	Same as above	The stored top soils should be used as cladding material over the filled lands	Immediately after filling and compaction of dredge 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
Soil Quality (Testing of N,P,K,pH, Org. Matter, Salinity etc.)	Work Site	Sample collection and testing in Laboratory	During pre-construction, Construction and operation phases)	Contractor	DCSC, BWDB
Erosion	Side slopes of the embankments and material storage sites	Visual inspection of erosion prevention measures and occurrence of erosion	At the end of filling activity	Contractor	DCSC, M&E Consultant, BWDB
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	DCSC, BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DCSC, BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures	Daily	Contractor	DCSC, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
		(spraying of waters) are in place.			
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DCSC
Air Quality (PM10, PM2.5)	Close to School / Madrasha, Hospital & Villages	Air quality monitoring	Half Yearly	Contractor through a nationally recognized laboratory	DCSC, M&E Consultant, BWDB
Noise	Construction sites	Visual inspection to ensure good standard equipment are in use	Weekly	Contractor	DCSC, M&E Consultant, BWDB
	Construction sites	Ensure work restriction between 09:00 pm-6:00 am close to School/ Madrasha, Hospital & Villages	Weekly	Contractor	DCSC, M&E Consultant, BWDB
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample from each river of each polder	Sampling and analysis of surface water quality	Dry season	Contractor through a nationally recognized laboratory	DCSC, M&E Consultant, BWDB
Drinking Water Quality(Arsenic, Iron. Coliform bacteria and chloride of drinking water)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality	yearly	Contractor through a nationally recognized laboratory	DCSC, M&E Consultant, BWDB
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 wastesand wastes is deposited at designated site	Weekly	Contractor	DCSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
Flora and Fauna	Project area	Survey and comparison with baseline environment	Yearly	Contractor through nationally recognized institute	DCSC, M&E Consultant, BWDB
Cultural and archaeological Sites	At all work sties	Visual observation for chance finding	Daily	Contractor	DCSC, M&E Consultant, BWDB
Reinstatement of Work Sites	All Work Sites	Visual Inspection	Aftercompletion of all works	Contractor	DCSC, M&E Consultant, BWDB
Safety of workers Monitoring and reporting accidents	At work sites	Usage of Personal Protective equipment, provision of safe drinking water, hygienic sanitation and first aid facilities	Daily	Contractor	DCSC, M&E Consultant, BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, TyrbiditypH, DO, BOD, COD etc)	Water sample from each of river of each polder	Sampling and analysis of surface water quality	Dry season	BWDB through a nationally recognized laboratory	M&E Consultant
Air Quality (Dust PM10, PM2.5)	At thebaseline monitoring site	24 hours Air quality monitoring	Yearly	BWDB through a nationally recognized laboratory	M&E Consultant
Flora and Fauna specially fisheries	In the project area	Detail species assessment and compare with baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant
Agriculture	In the project area	Compare the production with the baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant

Source: MRDI, 2011, LGED, 2011

Table 10.3: Environmental Monitoring Plan during Construction and Operation of Afforestation

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
During Implementation					
Plant Selection	Nursery	Visual inspection. Type and variety of plant species to be planted for turfing on the top and slope 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 recognized laboratory	DCSC, BWDB, 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	DCSC, BWDB, M&E Consultant
	Work site and Nursery	Visual inspection of Water bars & cut-offs .sediment traps to prevent water pollution caused by run-off from harvesting areas	Beginning of work	Contractor	DCSC, BWDB, 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
Erosion	Along Alignment	Visual Inspection presence of gullies or erosion	Yearly	BWDB	M&E Consultant

Source: MRDI, 2011, LGED, 2011

Qualitative Spot Checking Indicators

735. Moreover, a rapid environmental monitoring will be carried out according to the following checklist as given below in terms of visual judgment during field visit as an indirect control to implement Environmental Mitigation plan. Table 10.4 can be followed during project construction and operation process.

Table 10.4: Spot Checking Indicator

Parameter	Visual Judgment			
	Poor	Moderate	*Satisfactory*	*Comments*
Signboard/Billboard				
Camp Site Management				
Plant Site Management				
Borrow pit Area Management				
Top Soil Preservation				
Waste Management				
Occupational Health 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				

Third Party (M&E Consultants) Validation

736. 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

10.7 Documents, Record Keeping and Reporting

10.7.1 Record Keeping

737. Proper arrangements are necessary for recording, disseminating and responding to information, which emerges, from the various environmental monitoring and management programs. They are also necessary for rendering the environmental management system “auditable”. However, the primary focus must remain on the pragmatic control of pollution, not the creation of complex bureaucratic procedures. BWDB will maintain database of the polder specific Environmental Impact and Monitoring information for keeping all type of monitoring record. ESCU will assist BWDB for keeping those records initially. The trained BWDB staff will take the responsibility of record keeping and monitoring during operation phase.

10.7.2 Monitoring Records

Quantitative Physical Monitoring

738. 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. DCSCwill regularly monitor and provide information to ESCU for updating the database. DCSCwill 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.
-

739. 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

740. A Site Inspection Checklist for recording the findings of the general site condition surveys would be developed by the respective contractors, on the basis of the Environmental Mitigation Plan described in Chapter 6 and Table 6.16, during the construction phase. The Site Inspection Checklist would be supported by sketches, as necessary.

10.7.3 Information Sources

741. A complete and up-to-date file of all relevant sources of information should be maintained by the ESCU of PMU. This file would be readily accessible and include, as a minimum, copies of the following documents:

- Current environmental permits and consents;
- Action to fulfil the requirement of annual site clearance for polder area
- All relevant national regulations, international guidelines and codes of practice;
- Manufacturers' MSDSs for all hazardous substances used on the plant;
- Manufacturers' operating manuals for all environmental monitoring equipment;
- Current calibration certificates for all equipment that requires calibration by an external organization; and
- The latest version of this Environmental Management and Monitoring Plan.

10.7.4 Non-Compliance Report

742. Any breaches of the acceptable standards specified, would be reported to the PMU using a standard form, i.e. a Non-Compliance Report (NCR).

743. A copy of each completed NCR would be held on file by DCSC, to be replaced by the reply copy when it is received. A record of corrective actions would also be made and tracked to their completion.

10.7.5 Monthly Internal Reports by DCSC

744. The DCSC will prepare a monthly report for issue to the ESCU of PMU. These reports will summarize the following:

- Progress in implementing this EMP;
- Findings of the monitoring programs, with emphasis on any breaches of the control standards, action levels or standards of general site management;
- Any emerging issues where information or data collected is substantially different from the baseline data reported in the Environmental Assessment;
- Outstanding NCRs;
- Summary of any complaints by external bodies and actions taken / to be taken; and
- Relevant changes or possible changes in legislation, regulations and international practices.

10.7.6 Half Early Progress Report by BWDB

745. BWDB will prepare the half yearly progress report on environmental management and will submit to the World Bank for review during construction phase. The progress report will summarize the information presented in monitoring plan.

10.7.7 Environmental Audit Report & Third Party Monitoring Report

746. It is expected that BWDB will havean environmental audit carried out by the Third Party M&E Consultants. Besides, an environmental audit will be carried out before the mid-term evaluation and before project closing. All Environmental Audit Reports will be shared with Bank. Environmental monitoring will be conducted during the project implementation.

747. Third Party Monitoring

748. The Third Party M&E Consultant’s Monitoring report will be shared with Bank.

10.7.8 Monitoring by World Bank

749. The World Bank would also monitor and supervise the environmental compliance time to time as part of their regular implementation support missions.

10.8 Contractual arrangements for EMP implementation

750. A fixed Budget will be assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting. The contractor needs to submit a Construction Environmental Action Plan (CEAP) based on the EIA including the EMP in line with the construction schedule and guideline. The CEAP needs to be reviewed by the supervision consultant and cleared by BWDB and World Bank.

10.8.1 Guideline to Incorporate Environmental Management in Bid Document & Preparation of EAP

- Prepare cost estimates, to be incorporated in Bid Documents.
- The EMP along with the good environmental construction guidelines to be incorporated in the bid document‘s work requirements.
- Preparation of work requirement (addendum/corrigendum to polder & hydraulic structure construction/afforestation) and

- Corrigendum / Addendum to polder/embankment specification, if any, as special provisions to be incorporated in bid document.
- Penalty clauses for not complying with EMP requirements to be incorporated. Indicative penalty clauses proposed in the CEIP-1 are presented below (Addendum to Clause 17.2 Contractor's Care of the Works of FIDIC).
  - The contractor has to follow all traffic safety measures as defined in the technical specification. Damage shall be levied at the rate Tk. 3000/- per day per location for non – conformity of traffic safety measures as per the decision of the Engineer.
  - The contractor has to follow all environmental mitigation measures as defined in the technical specification read along with the Environmental Management Plan for the specific CEIP-1 activities. Damage shall be levied at the rate Tk. 3000/- per day per location for nonconformity of Environmental Management Plan measures as per the decision of the BWDB Engineer.
  - The contractor has to ensure that prior to every monsoon season, during the construction period; all the temporary and permanent cross drainage structures are free from debris as defined in the Technical Specifications read along with the Environmental Management Plan. Damage shall be levied at the rate of Tk.3000/- per day per location for non-conformity as per the decision of the Engineer.
  - The contractor has to ensure that sufficient numbers and good quality Personnel Protective Equipment (PPE), should be provide to staff and labor all time as defined in the labor codes read along with the EMP. Damage shall be levied at the rate of Tk. 1000/- per day for non-conformity as per the decision of the Engineer.

10.8.2 Guideline for Compensation and Contingency Plan during Project Period

751. Compensation becomes necessary when project impacts cannot be mitigated satisfactorily. This can be paid in cash or kind and the emphasis should be on ensuring fairness and causing minimum inconvenience to the affected party. The most common cause of compensation payment is displacement of people and loss of productive land due to land acquisition, tree cutting, or property damage. Such impacts can rarely be fully compensated. The compensation should be given as per provision of the Resettlement Action Framework. Any disputes over the compensation should be handles by the Grievance Redress Committee.

752. In addition to the compensation, water management projects should also have a contingency plan to deal with emergencies and accidents. Such incidences encompass a whole range of situations from personal injury during operation of a machine to breaching of an embankment. Therefore, BWDB would prepare for the following emergency situations:

- Embankment failure during a flood – keep sufficient number of sand bags in reserve.
- Bank caving/erosion – keep sufficient number of concrete blocks and sand bags in reserve.
- Have an emergency evacuation plan for the people in the line of danger.
- 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 work site. Have a plan for quickly transporting a seriously injured person to the nearest hospital.

10.9 EMP Implementation Cost

753. 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 of Polder- 43/2C

Item No.	Description	BDT	In thousand US$	Responsible Agency	Time frame
1	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils	500,000	6,250	Contractor	Pre and Construction phase
2	Soil quality monitoring including N,P,K,S,Zn, salinity, organic Matter, pH etc. during pre- construction, construction and post construction period (6 samples in polder 43/2C) = 6x3 times @ Tk.5,000	90,000	1.125	Contractor	Pre construction, Construction and Post-construction phases
3	Habitat Observation for four (4) times of year (dry & wet season).	50,000	0.625	Contractor with assistance of DoF	Construction and Post-construction phases
5	Catch Assessment Survey for two (2) times of a year (dry & wet season).	142,500	1.7812	Contractor with assistance of DoF	Construction and Post-construction phases
6	Farm Survey for four (4) times of year (dry & wet season).	60,000	0.75	Contractor with assistance of DoF	Construction and Post-construction phases
7	Awareness program on plant and wild life conservation.	85,000	1.0625	Contractor	Construction phase
8	Consultancy services cost for supervision and monitoring of EMP	276,440	3.4555	BWDB	Construction and Post-construction phases
9	Training to the farmers with field demonstration regarding IPM and ICM.	80,000	1.000	Contractor with assistance of DAE	Construction and Post-construction phases
10	Awareness building up to local community for conservation of threatened fish species.	115,000	1.4	Contractor with assistance of DoF	Construction and Post-construction phases
11	Training to the fisherman/pond owner with field demonstration regarding pond culture.	40,000	0.5	Contractor with assistance of DoF	Construction and Post-construction phases

Item No.	Description	BDT	In thousand US$	Responsible Agency	Time frame
12	Release fish fry in the khals inside the Polder after completion of construction works.	37,500	0.4688	Contractor with assistance of DoF	Post-construction phases
13	Air and noise quality monitoring and analysis.	200,000	2.5	Contractor through reputed Laboratory	Pre and Construction
15	Solid and liquid waste disposal arrangement.	60,000	0.75	Contractor	Construction phase
16	Capacity building and training to the WMOs regarding gate operation, post project monitoring	900,000	11.25	BWDB	Before ending of construction works
17	Consultancy services cost for river bank erosion monitoring	1,200,000	15	Contractor with assistance of O & M of BWDB	Construction and Post-construction phases
18	Training to the Contractors regarding environmental management	100,000	1.25	M & E Consultant	Pre-construction and construction phases
	Training of Environmental awareness of local population	80,000	1.0	Contractor	Post construction phases
19	Updating EMP as per requirement.	100,000	1.25	BWDB	Construction and Post-construction phases
20	Construction of alternative or bypass channels at each construction sites.	943,158	11.7895	Contractor	Construction phase
21	Materials for net pen culture (at least 25 households in each word/council of a Union).	1,296,000	16.20	Contractor with assistance of DoF	Post-construction phases
22	Conservation and stocking of threatened fish species (at least 3 spots).	480,000	6.0	Contractor with assistance of DoF	Post-construction phases
25	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	1,400,000	17.0	Contractor , O & M, BWDB	Construction and Post-construction phases
26	Surface and ground Water quality monitoring cost (testing for pH, DO, BOD, Salinity,TDS etc. + test of As, Fe etc. for HTWs at workers' camp site) 6 samples in in polder 43/2C during pre-construction, construction and post-construction periods + water quality analysis of HTWs of 22 workers' camp=	87,400	1.093	Contractor through reputed laboratory	Construction and Post-construction phases

Item No.	Description	BDT	In thousand US$	Responsible Agency	Time frame
	(Tk.4,000x6x3) + (Tk.700X22)				
27	Additional Tree Plantation at HH and other grounds to compensate the tree cutting (planting 3 trees for cutting I tree) @ Tk.50 each tree including the cost of sapling, gabion and nursing etc. = Tk.50x170354	85,177,700	106.470	Contractor through reputed Institution	Construction and Post-construction phases
28	Water sprinkling at sectioned/newly constructed embankments (@ Tk.3,000 per km of embankment	79,212	0.99	Contractor	Pre and Construction phase
29	WMOs monitoring cost	120,000	1.500	BWDB	Post-construction / operation phase
	Total Cost	**93,699,910**	**6456**		

US$= BDT 80

10.10 EMP Updating

754. 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 continuous updating.

10.11 Grievance Redress Mechanism

755. BWDB will establish a grievance redress mechanism (GRM) as a means to ensure social accountability and to answer to queries and address complaints and grievances about any irregularities in application of the guidelines adopted in this EMF for assessment and mitigation of social and environmental impacts. Based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly, saving the aggrieved persons from having to resort to expensive, time-consuming legal action. The procedure will however not pre-empt a persons right to go to the courts of law.

10.11.1 Grievance Redress Focal Points

756. A Grievance Redress Committee (GRC) at local level will be formed for each Union with union level representation to ensure easy accessibility by the project affected persons and communities. This local GRC will be the local focal points of the project GRM. The GRM sets out the information and communications strategy to ensure that PAPs and communities are fully informed about their rights to offer suggestions and make complaints. All grievances received through the GRM process will primarily be forwarded to the GRCs. The Secretariat for each GRC will be at the office of the Executive Engineer. If any grievance is not resolved at GRC, the aggrieved person may request the convener of GRC to forward the case to the Project Director at PMU. The GRC will officially forward the cases with their comments to the Project Director. Hearing of petitions with GRCs will be held at the Convener's office or at

Union Parishad/Ward Councillor's office as agreed by the committee members. The membership of the GRCs will ensure proper presentation of complaints and grievances as well as impartial hearings and investigations and transparent resolutions.

Membership of GRC

1. Executive Engineer (BWDB Division Office) : Convener
2. Representative of the RP Implementing NGO: Member-Secretary
3. Local UP Chairman /Ward Councillor: Member
4. Teacher from Local Educational Institution (nominated by Upazila Administration): Member
5. Representative from Local Women's Group: Member
6. Representative from the PAP Group: Member

757. Members of the GRCs will be nominated by the Executive Engineer at Division level and approved by the Project Director, PMO, BWDB, Dhaka.

10.11.2 Grievance Resolution Process

758. All complaints will be received at the GRCs facilitated by the implementing agency. The aggrieved persons may opt to make complaints directly to the Project Director or Secretary of the MoWR or even to the court of law for resolution. The Member Secretary will review and sort the cases in terms of nature of grievance, urgency of resolution, and schedule hearings in consultation with the Convener. All cases will be heard within four weeks from the date of receiving the complaints.

759. If the resolution attempt at the local level fails, the GRC will refer the complaint with the minutes of the hearings to the Project Director at PMU for further review. The Project Director will assign the ESCU at PMU for review the grievance cases and assist Project Director in making decision. The ESCU will review the case records and pay field visits for cross examining and consult the GRC members and aggrieved persons, if required. If a decision at this level is again found unacceptable by the aggrieved person(s), BWDB can refer the case to the MoWR with the minutes of the hearings at local and headquarters levels. At the ministry level, decisions on unresolved cases, if any, will be made in no more than four weeks by an official designated by the Secretary, MoWR. A decision agreed with the aggrieved person(s) at any level of hearing will be binding upon BWDB. This process is shown in Figure 10.3.

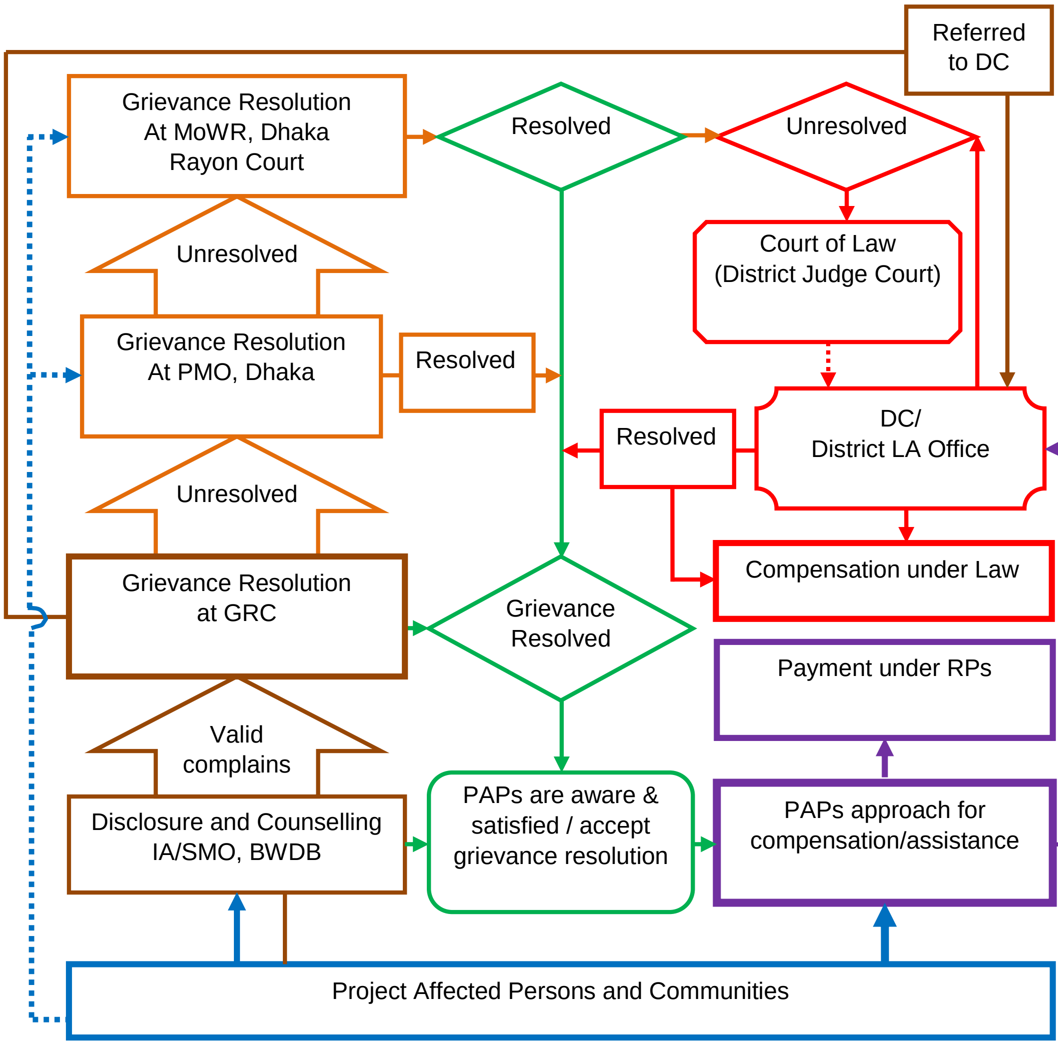


Figure 10.3: GRM Process flow Chart

760. To ensure that grievance redress decisions are made in formal hearings and in a transparent manner, the Convener will apply the following guidelines:

- Reject a grievance redress application with any recommendations written on it by a GRC member or others such as politicians and other influential persons.
- Remove a recommendation by any person that may separately accompany the grievance redress application.
- Disqualify a GRC member who has made a recommendation on the application separately before the formal hearing:
- A GRC member when is removed, appoint another person to be appointed in consultation with the Project Director.
- The Convener will also ensure strict adherence to the impact mitigation policies and guidelines adopted in this SMRPF and the mitigation standards, such as compensation rates established through market price surveys.

10.11.3 GRM Disclosure, Documentation and Monitoring

761. The affected persons and their communities will be informed of the project's grievance redress mechanism in open meetings at important locations and in PAP group meetings. Bangla translations of the EMF and the GRM in the form of information brochures will be distributed among the project affected persons. The PAPs will also be briefed about the scope of the GRC, the procedure for lodging grievances cases and the procedure of grievance resolution at the project level.

762. To ensure impartiality and transparency, hearings on complaints will remain open to the public. The GRCs will record the details of the complaints and their resolution in a register, including intake details, resolution process and the closing procedures. BWDB will maintain the following three Grievance Registers:

> **Intake Register:** (1) Case number, (2) Date of receipt, (3) Name of complainant, (4) Gender, (5) Father or husband, (6) Complete address, (7) Main grievance regarding social (loss of land/property or entitlements) or environmental, (8) Complainants' story and expectation with evidence, and (8) Previous records of similar grievances.
>
> **Resolution Register:** (1) Serial no., (2) Case no.,(3) Name of complainant, (4) Complainant's story and expectation, (5) Date of hearing, (6) Date of field investigation (if any), (7) Results of hearing and field investigation, (8) Decision of GRC, (9) Progress (pending, solved), and (10) Agreements or commitments.
>
> **Closing Register:** (1) Serial no., (2) Case no., (3) Name of complainant, (4) Decisions and response to complainants, (5) Mode and medium of communication, (6) Date of closing, (7) Confirmation of complainants' satisfaction, and (8) Management actions to avoid recurrence.

763. Grievance resolution will be a continuous process in RP implementation. The PMO and SMOs will keep records of all resolved and unresolved complaints and grievances (one file for each case record) and make them available for review as and when asked for by WB and any other interested persons/entities. The PMU will also prepare periodic reports on the grievance resolution process and publish these on the BWDB website. The format of SMF may be used for periodic grievance reporting.

10.12 Capacity Building

764. 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.

765. During the O&M phase of the Project, these trainings will continue to be conducted by BWDB staff for all relevant O&M personnel and community.

Table 10.6: Environmental Training

Contents	Participants	Responsibility	Schedule
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area.	Selected BWDB; PMU; DCSCstaff	DCSC& ESCU	Prior to the start of the Project activities. (To be repeated as needed.)
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Mitigation measures; Community issues; Awareness of transmissible diseases Social and cultural values.	PMU; DCSC; selected contractors' crew	DCSC& ESCU	Prior to the start of the field activities. (To be repeated as needed.)
EMP; Waste disposal; HSE	Construction crew	Contractors	Prior to the start of the construction activities. (To be repeated as needed.)
Road/waterway safety; Defensive driving/sailing; Waste disposal; Cultural values and social sensitivity.	Drivers; boat/launch crew	Contractors	Before and during the field operations. (To be repeated as needed.)
Camp operation; Waste disposal; HSE Natural resource conservation; Housekeeping.	Camp staff	Contractors	Before and during the field operations. (To be repeated as needed.)
Restoration requirements; Waste disposal.	BWDB core unit, Restoration teams	Contractors	Before the start of the restoration activities.
Strengthening of water management organizations(i.e. WMGs, WMAs and WMF) and beneficiaries organizations	Member of water management organizations(i.e. WMGs, WMAs and WMF) and beneficiaries organizations	BWDB, ESCU, Contractor	Before and during construction activities

766. Capacity building training programs should be undertaken in the following area:

- Training of the management level officials of BWDB, BWDB environmental compliance personnel on the overall environmental concerns and responsibilities for implementing EMP;
- Recruitment of new professionals with background on environment, if required and provide necessary training ;
- Organizing workshop, seminar with stakeholders on the environmental concerns of CEIP-1 ;

- Special training program for the contractors and workers on the EMP and their responsibilities, who will actually be involved in the construction of the project interventions. The Contractors will be provided guideline for preparation of Environmental Action Plan in line with the construction workplan;
- Training of the WMOs on successful operation of hydraulic structures; and
- Training on structured format in reporting for all stages of implementation and those of relevant agencies who are involved in EMP implementation.

767. The training programs should be arranged before implementation of the interventions in the polder area. Detail plan can be made by the proposed ESCU.

11. StakeholdersConsultation and Disclosure

768. This Chapter provides details of the consultations held with the stakeholders at the Project site and framework for consultations to be carried out during construction phase. Also included in the Chapter are the disclosure requirements for the EIA.

11.1 Overview

769. The GoB as well as international donors (e.g. the World Bank) place great importance on involving primary and secondary stakeholders for determining the environmental and social impacts associated with project implementation. In order to gather local knowledge for baseline conditions, understand perceptions of the community regarding impact significance, and propose meaningful mitigation measures, participation of stakeholders is an integral part of the EIA process. During the present EIA, an attempt has been made to consult with a full range of stakeholders to obtain their views on Project interventions.

770. According to the EIA Guidelines of the DoE, public participation is obligatory for the EIAs of the Red Category projects. Public participation through consultations in the water sector project is also mandated according to the Guidelines for the Participatory Water Management (GPWM) of the BWDB. Similarly, the World Bank's OP 4.01 requires that stakeholder consultations are carried out at least twice for the Category A projects, once shortly after environmental screening and before the terms of reference for the EA are finalized, and then once a draft EIA report is prepared.

771. The present EIA has been conducted after consulting with local communities, non-governmental organizations (NGOs) and concerned government departments/ organizations dealing particularly with related fields, thus ensuring that their views and concerns are taken into account in the study.

11.2 Objectives of Stakeholder Consultations

772. The following objectives have been served as the moving force for the design, implementation and fact findings during the participation process:

- To provide key Project information and create awareness among various stakeholders about project intervention;
- To have interaction for primary and secondary data collection with project beneficiaries, affectees and other stakeholders;
- To identify environmental and social issues such as displacement, safety hazards, employment and vulnerable persons;
- To begin establishing communication and an evolving mechanism for the resolution of social and environmental problems at local and Project level;
- To involve Project stakeholders in an inclusive manner; and
- To receive feedback from primary stakeholders on mitigation and enhancement measures to address the environmental and social impacts of the Project.

11.3 Approach and Methodology

773. Participatory approach was followed in conducting the public consultation meetings in the Polder- 43/2C. The consultants discussed first with the BWDB officials and then the Upazila Parishad Chairman (UZPC) and/or the Upazila Nirbahi Officers (UNOs) and the Project Implementation Officers (PIOs) of the polder area to share the Feasibility and EIA process of the CEIP-1. The BWDB and local government officials/representatives were consulted to identify the potential stakeholders at the Polder level. With the available support from the UNOs and/or PIOs, the union level public representatives as well as the key persons were informed about the specific consultation meetings and requested them to be present in the meeting.

774. Focus group discussions (FGD) were carried out during in the public consultation process. In order to conduct the FGD and consultation meetings, two checklists were prepared covering the aspects including an overview of the proposed CEIP-1, information on the ongoing EIA process, and seeking information on the problems of the area with their potential solutions, the local needs and demands have been discussed by giving equal opportunity to all participants attending in the meeting. During consultation meeting all relevant issues within the water resources, land resources, socio-economic resources, and disaster aspects were discussed in detail.

775. During the FGDs and consultation meetings, the EIA team displayed maps of the Project area, shared the initial concepts on proposed interventions and facilitated the response of the participants. The stakeholders of the Polder- 43/2C were asked to share their needs, problems, possible sustainable solutions and their views on the Project interventions. The stakeholders' perceived views on important environmental and social components (IESCs) and Project's impacts on them, along with perceived benefits, risks, threats and demand from the Project were identified during discussions.

11.4 Identification of Stakeholders

776. Stakeholders include all those who are being affected by policies, decisions or actions within a particular system. Stakeholders can be groups of people, organizations, institutions and sometimes even individuals. Stakeholders can be divided into primary and secondary stakeholder categories.

777. Primary Stakeholders: Primary stakeholders are people who would be directly benefited or impacted by a certain project intervention. In case of the proposed Project in Polder-43/2C, the primary stakeholders include the people living within the Project area particularly those who reside within and in the immediate vicinity of the Polder. The primary stakeholders of the Project include the farmers, fishermen, local business community as well as the households to be displaced, women groups, and caretakers of community properties. Primary stakeholders identified and consulted during the present EIA include communities to be benefitted and/or affected by the Project, local leaders, community members and other local representatives.

778. Secondary Stakeholders: This category of stakeholders pertains to those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project aspects. In this Project NGOs, concerned government departments, and line agencies fall under this category.

779. 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

780. Venue, date and time of meeting was selected through the consultation with local people, the project proponent and the consultant. These three groups select an agreed venue considering the closeness to the proposed project, easy accessibility to the venue and which is likely to be neutral. Date and time was also finalized in this way considering availability of the participants, ensuring the maximum participation, weather and compliance with the other arrangement.

Enlisting and Invitation

781. A comprehensive list of potential stakeholders was prepared through the consultation. This list was intended to cover all sorts of interest groups, occupational groups, socially acceptable and knowledgeable peoples.

782. A formal invitation was sent to them and also communicated over telephone for ensuring their presence in the meeting.

Consultation Instrument

783. Checklist: A checklist covering all possible issues to be addressed was prepared through consultation with the multidisciplinary study team. This checklist was used in the meeting to unveil peoples' perception and opinion along with suggestions (checklist is attached in Appendix 10).

784. Attendance list: An inventory of the participants was maintained in attendance sheet containing contact number. Scanned list of participants is attached in Appendix 3.

785. Camera: For visualizing the participants, photographs were taken using camera. These photos were presented in this chapter. Photos of the meeting participants are presented at the end of this chapter.

Consultation Process

786. The study team conducted the meeting. During consultation meeting, the following process was followed with sequences.

787. Greetings: At the outset, the team spelled greetings to all participants. Welcomed them for attending and stated the entire design of the meeting.

788. Introduction: The team members introduced themselves to the participants and gave detail description of the project, spelled out about the objectives and anticipated outcome of the meeting.

789. Respect to the participants: The study team showed respect to all participants. They respected not only to the individuals but also to their values, cultural practices and social structures.

790. Ensuring peoples' voice: Generally, all participants cannot participate equally. In fact, a substantial number of participants tended to remain silent in any meeting. However, the study team encouraged all to participate willingly through explaining the ethics of the study.

791. Note taking: discussed issues and opinions were written in notebook carefully. All issues were given equal importance.

792. Recapitulation and closing the session: At the end the study team recapitulated the session and responded to the quarries. Finally, the facilitator closed the session thanking the participants.

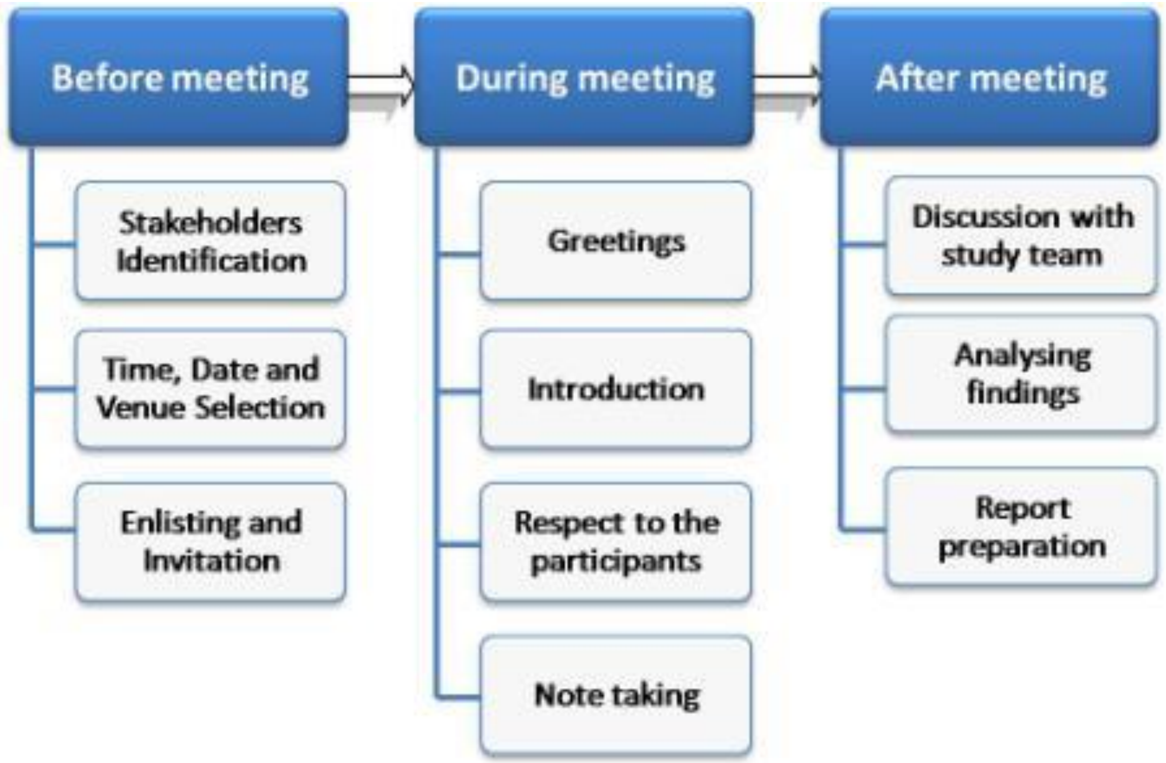


Figure 11.1: Overall consultation process

11.5 Public Consultation Meetings and FDGs

11.5.1 Consultation Process

793. A number of public consultation meetings and FGDs were conducted at different locations of the Polder- 43/2C. The details of these meetings and FDGs are presented in Table 11.1 and some photographs of these meetings are given in Pictures11.1 to .11.4.

Table 11.1: Meeting venue including time and date

Sl	District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
1	Patuakhali	Golachipa	Goalkhali	Goalkhali Union Porishod Conference room	PCM	13/08/2015	10:00
2	"	"	Golachipa	Golachipa Upazila Conference room	"	16/08/2015	10:00
3	"	"	"	Haridebpur Bazar	FGD	21/06/2015	10:00
4	"	"	"	Shuari Bridge Bazar	"	21/06/2015	15:00
5	"	"	"	Goalkhali	"	22/06/2015	12:30

11.6 Consultation Participants

794. The main participants of the consultation meetings included public representative, farmer, trader and daily-wage laborers of the Polder-43/2C and nearby areas. A total of 110 participants attended these consultations. The participant details are provided in Table 11.2 below:

Table 11.2: Participant Details

Sl	Meeting venue	Type of consultation	Type of Participants	No. of participants
1	Goalkhali Union Porishod Conference room	PCM	Secondary and Primary stakeholders	41
2	Golachipa Upazila Conference room	,,	,,	37
3	Haridebpur Bazar	FGD	Primary stakeholders	11
4	Shuari Bridge Bazar	,,	,,	11
5	Goalkhali	,,	,,	10

Picture 11.1: PCM at Golachipa Upazila Auditorium

Picture 11.2: PCM at Goalkhali Union Auditorium

11.7 Issues discussed in FGDs and Meetings

795. At the outset of the meetings and FGDs, an overview of the proposed Project including the ongoing activities of the implementing agencies and the EIA process was shared with the participants. Subsequently, the key environmental, social and socioeconomic aspects listed below were discussed.

11.7.1 Water resources

- Surface water (tidal flooding, drainage, salinity, siltation)
- Water management (flood control, drainage, irrigation)

11.7.2 Land resources

- cropping practice,
- production and yield,
- water logging and drainage congestion
- crop damage.
-

11.7.3 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)

11.7.4 Disasters

- Cyclones
- River erosion
- Associated damages

796. The sustainable and integrated solutions of the main problems being faced in the Polder:

- Water resource management
- Agriculture and fisheries management
- Land resource management
- Disaster management.

11.8 Community Concerns and Suggested Solutions

797. 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.

11.8.1 Attitude to the project

798. The communities including the persons to be affected by the Project expressed their views in favor of the Project and wanted early implementation to protect them from the tidal surges and disasters such as Aila and Sidr. They demanded adequate compensation and other benefits for the loss of their assets and livelihood, as well as alternative place for relocation of their houses and business.

Picture 11.3: FGD at Haridebpur Bazar

Picture 11.4: FGD at shuari bridge Bazar

Picture 11.5: FGD at Goalkhali

799. The outcomes of the FGDs and consultation meetings in terms of concerns and the suggested solutions were noted and organized by themes are presented in the Table 11.3 below:

Table 11.3: Community Concerns and Suggested Solutions

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
Overall	Drainage congestion, Flood, Salinity intrusion, Encroachment of internal khal, erosion, water logging due to siltation at certain parts 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. Illegal sand exhume should be stopped at Purbogoalkhali area (4no. word)
Water resources	Tidal Flooding, Storm surge, Salinity intrusion, Encroachment of internal khal, erosion,Inactive sluice gate and the khal has been silted up Height of the embankment is being eroding gradually	Re-sectioning of the embankment to protect erosion and embankment breach Damaged sluice gate, inlet, outlet and all water control infrastructures should be improved to assurewater management of the area. Internal drainage canal should be re-excavated for drainage improvement
Agriculture resources	Crop damage due to drainage congestion and water logging Lack of irrigation water during dry season due to siltation of rivers and internal khals	Repairing the embankment as per design level Re-excavation of rivers and khals as per design level. Connecting the khals with rivers. Repairing the sluices and construction of new sluice Regular operation and maintenance of the regulators.
Fishery resources	Reducing depth of internal khals and habitat quality degradation due to siltation Fish and hatchling movement disrupted due to properly operation of water control structures. Illegally control khal & water control infrastructure to catch fish Indiscriminate fishing by Sluice net Entrance of saline water	Re-excavation of khal will help to increase the richness of fish species in the polder area. Application of fisheries rules and regulation by the government strongly Repairing embankment with reasonable height. Prohibit illegally control khal & water control infrastructure to catch fish
Ecological resources	A number of trees would be felled and existing undergrowth vegetation would be damaged at construction sites for implementation of project activities Lack of foreshore afforestation accelerate bank erosion as well as destruction of embankment by tidal surge	Keep compensation to the proper owners/authorities against tree felling Implement social afforestation along the embankment slopes and foreshore areas. Proposed afforestation plan would control the vulnerabilities of embankment and protect bank erosion from tidal surge Local people should be engaged forintensive afforestation.
Socio-economic resources	Above 800 no of HHs will be displaced and their life and livelihood may be hampered. Number of four Bazars i.e. Haridebpur Bazar, Bou Bazar, Julekher Bazar, Shuari breadge Bazar are threats on river erosion due to low height of embankment Communication system is a vital issue of this polder. Main roadway communications (from HoridevpurBazar to Goalkhali village)	Rehabilitation of affected people should be done in proper way. Ensure proper resettlement of those household which may be affected by the project intervention of drainage sluice. The embankment cum road should be repaired immediately in places. After rehabilitation of embankment a maintenance and monitoring team should be formed for proper take care of it.

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
	are extremely poor condition (existing embankment cum road) during monsoon period. Lack of adequate expertise and experienced manpower to carry out the O&M of the polder and the numbers of field staffs are also insufficient and inadequate in some places of the polder with respect to the actual requirement. Capturing open water bodies by rural power elites Rural power elite captured illegally open water bodies i.e. khals for their own purpose.	Strengthening of WMGs so that mass people have access to open water bodies easily. Should be proper maintenance for re functioning of water control infrastructure Gate operator (locally called gate khalashi) should be requited Illogical use of Govt. resource needs to be stoped because its hamparing daily life style to the people such as, Navigation, by flooding etc.

11.9 EIA Disclosure

800. The EIA report and Bengali translation of its executive summary was disclosed to the public on 7th December (from 10:00am to 13:00pm), 2016 in Kalapara Upazila, Patuakhali. The main aim of the meetings was to present the findings of the final draft report on FS and EIA and having feedback from the local stakeholders attended. The report was also finalized through incorporation of comments and suggestions got from the meetings.

801. The participants of the PDM include Upazila Chairman, Kalapra, Upazila Nirbahi Officer (UNO), other concerned government officials, Journalists, NGO representatives, environmentalists and activists, local stakeholders and other representatives of CEGIS. A total of 54 participants attended thepublic disclosure meetings. The findings of the Public Disclosure Meeting (PDM) and some photographs of the meeting are given in Picture 11.6

Picture 11.6: PDM at Upazila Auditorium, Kalapara, Patuakhali

Findings of the PDM:

802. The communities including the persons to be affected of Polder 43/2C 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:

- There is a lack of co-ordination between the Bangladesh Water Development Board (BWDB) and the Ministry of Water Resources, which is affecting the project.
- Effective monitoring should be maintained during the construction of the project activities.
- The intrusion of saline water might be controlled by the improvement of embankment.
- Need awareness building among the communities about water management;
- Ensure proper compensation for affected people
- O & M for embankments and sluice gates in the polder area
- Need formation of Water Management Organizations (MWOs) to manage properly water control structures
- New embankment is required to be constructed by developing village road.

National Disseemination Seminar

803. A dissemination seminar on the “Environmental Impact Assessment (EIA)” under Package-2 of CEIP-1 was held at Spectra Convention Centre, Gulshan 1, Dhaka on 25 January 2017. Mr. Anisul Islam Mahmud, M.P, Hon’ble Minister, Ministry of Water Resources Government of the People's Republic of Bangladesh graced the occasion as the chief guest and Mr. Muhammad Nazrul Islam, BirProtik, M.P, Hon’ble State Minister, Ministry of Water Resources, Government of the People's Republic of Bangladesh were 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.

804. 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 11.7: Chief Guest, Guest of Honour, Special Guests and Project Director

Picture 11.8: Welcome Speech by the Project Director of CEIP-1

Picture 11.9: Presentation of EIA findings by Mr. Malik Fida Abdullah Khan, Deputy Executive Director (Operation), CEGIS

Picture 11.10: View of Participants of the Seminar

Picture 11.11: A view of open discussion

Picture 11.12: Special Guestdelivering his speech

Picture 11.13: Special Guestdelivering his speech

Picture 11.14: Guest of Honour delivering his speech

Picture 11.15: Chief Guestdelivering his speech

Picture 11.16: Closing remarks by the Chair

805. 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 also present in the seminar.

806. 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 minutes of the dissemination seminar containing inter-alia the comments and responses are provided in **Appendix-13**

11.10 Framework for Consultations during Project Implementation

807. The stakeholder consultation is a continued process and should be maintained throughout the project. The consultations carried out during the present EIA and reported in this Chapter are essentially a first step in this process. During the subsequent project phases as well, participation of the project stakeholders need to be ensured. Table 11.4 charts out the proposed participation framework during different project Phases.

Table 11.4: Participation Framework

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
Project Design Phase	Meetings with institutional stakeholders (carried out during the present EIA and RAP preparation); meetings with grass root stakeholders (carried out during the present EIA and RAP preparation)	Institutional stakeholders; Grass root stakeholders, including the communities to be affected by the Project.	EIA consultant.
Project Construction Phase	Information disclosure (sharing of the project objectives, project components, major benefits, potential impacts, mitigation measures and Resettlement Plan with the affected communities and other stakeholders).	Institutional stakeholders; Grass root stakeholders, including the communities to be affected during the project implementation.	BWDB; Supervision Consultants; Contractors
	Consultations and liaison	The communities around the work sites, borrow areas, and access routes	BWDB; Supervision Consultants; Contractors
	Grievance Redressal Mechanism and Social Complaint Register (discussed later in the document).	The affected communities.	BWDB; Supervision Consultants; Contractors
	Consultations with the communities during Compliance Monitoring and Effects Monitoring (discussed later in the document).	Affected communities.	BWDB; Supervision Consultants; Contractors
	Consultations with the project affectees / communities during the external monitoring (discussed later in the document).	Affected communities.	External monitoring consultants.
	Consultations with the project affectees / communities during the site visits by the WB monitoring mission.	Project site staff; Contractors; Affected communities.	WB monitoring mission.
Project Operation Phase	Community participation in O&M activities (see Section 4.9)	Institutional stakeholders; Grass root stakeholders, including the beneficiary communities.	BWDB

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Appendix 1: Construction Schedule

Table: 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	Retirement of embankment (km)												
3	Construction of Drainage Sluices (Nos)												
4	Construction of Flushing sluice (Nos)												
5	Bank and Slope Protection Works (km)		Manufacture of cc blocks and procurement of hard rock										
6	Re-excavation of Drainage Channels (km)												
7	Repairing of Drainage Sluices and Flushing Inlets												
8	Constructing Roads												
9	Other works, including surveys, quality checks, testing, inspections and the like												

Part B

Sl No	Description	Year Two								Year Three			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)					Turfing							
2	Retirement of embankment (km)												
3	Construction of Drainage Sluices (Nos)												
4	Construction of Flushing Inlets (Nos)												
5	Bank and Slope Protection Works (km)												
6	Re-excavation of Drainage Channels (km)												
7	Repairing of Drainage Sluices and Flushing Inlets												
8	Constructing Roads												
9	Other works, including surveys, quality checks, testing, inspections and the like												

Part C

Sl No	Description	Year Three								Year Four			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)												
2	Construction of embankment (km)												
3	Construction of Drainage Sluices (No)												
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: Engineering Team of CEIP-1, 2015

Appendix 2: No Objection Certificate

২ নং গোলখালী ইউনিয়ন পরিষদ
গলাচিপা, পটুয়াখালী

স্মারক নং- তারিখ-

অবস্থানগত/পরিবেশগত ছাড়পত্রের স্থানীয় কর্তপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্রের ছক

১। আবেদনকারীর নাম ঃ প্রকল্প পরিচালক, সিইআইপি-১ (CEIP-1), বাংলাদেশ পানি উন্নয়ন বোর্ড ।

২। পিতা/স্বামীর নাম ঃ প্রযোজ্য নয়

৩। আবেদনকারীর ঠিকানা ঃ প্রকল্প পরিচালক, সিইআইপি-১ (CEIP-1), বাংলাদেশ পানি উন্নয়ন বোর্ড
হাউস নং-১৫,রোড নং-২৪,গুলশান-২ ঢাকা-১২১২।

৪। প্রকল্পের অবস্থানগত ঠিকানা ঃ পোল্ডার ৪৩/২সি, পটুয়াখালী জেলা গলাচিপা উপজেলায় অবস্থিত।

৫। প্রকল্পের তফছিল ঃ

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
পটুয়াখালী	গলাচিপা				মাঝারি উচু ভূমি	হেক্টর

৬। প্রকল্পের কার্যক্রম ঃ বাঁধ উচুঁকরন, স্লুইজ গেট ও রেগুলেটর মেরামত, খাল পূনঃখনন ইত্যাদি।

উপরোক্ত তথ্যাদির আলোকে পোল্ডার ৪৩/২সি পূর্নবাসন প্রকল্প বাস্তবায়নের জন্য নিম্নেবর্ণিত অনাপত্তি প্রদান করা হলো।

শর্তাবলী ঃ

১। প্রকল্প/ স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষণ আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে।
২। পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত ছাড়পত্র গ্রহণ করতে হবে।
৩। কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তার নিশ্চিত করতে হবে।
৪। উপযুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে। এবং অগ্নিকান্ড কিংবা অন্য কোন দূর্ঘটনার সময় জরুরী নির্গমন ব্যবস্থা থাকতে হবে।
৫। বায়ু ও শব্দ দূষন করা যাবে না।
৬। প্রকল্প সৃষ্ট তরল বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না।

উপরে উল্লিখিত যে কোন শর্ত লঙ্গন করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক কারখানা/প্রকল্পের বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

তারিখ ঃ

স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও সীলঃ
গোলাম গাউস তালুকদার (নিপু)
চেয়ারম্যান
২নং গোলখালী ইউনিয়ন পরিষদ

Appendix 3: Standard for Physio- 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	22.51-30.00	30.1-37.5	>37.5
K (meq/100g)	≤0.09	0.091-	0.181-0.27	0.271-0.36	0.361-0.45	>0.45
s(µg/g)	≤7.5	7.51-15.0	15.1-22.5	22.51-30.00	30.1-37.5	>37.5
Zn(µg/g)	≤0.45	0.451-0.9	0.91-1.35	1.351-1.8	1.81-2.25	>2.25

Sources: Fertilizer Recommendation Guide, BARC, 2012

Appendix 4: List of Participants of PCM

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান: উপজেলা পরিষদ মিলনায়তন, গলাচিপা

সময়:

তারিখ: ১৬/০৮/২০১৫

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১.	কাজী মো: মাহমুদুর রহমান	UNO গলাচিপা	01733334154	
২.	নাসরিন সুলতানা	উপজেলা চেয়ারম্যান	01712232332	নাসরিন
৩.	[illegible]	ভাইস চেয়ারম্যান	01720529198	
৪.	ডা: এম. এম. [illegible]	মেডিকেল অফিসার UHC. Galachipa	01711315858	
৫.	মো: ইউনুস হাওলাদার	[illegible]	01755093776	
৬.	[illegible]	উপজেলা মৎস্য অফিসার	01710964136	
৭.	[illegible]	ইউপি সদস্য গোলখালী	01719935195	
৮.	ফিরোজা বেগম	ইউপি সদস্য গোলখালী	01703747859	ফিরোজা
৯.	[illegible]	ইউ: পি: গোলখালী	01737494471	01737392271
১০.	মো: [illegible]	ইউ পি	01713822212	মো: [illegible]
১১.	মো: আব্দুল [illegible]	UAS উপজেলা কৃষি অফিস	0171-257140	
১২.	মো: [illegible]	ইউপি সদস্য	01718432463	
১৩.	মো: [illegible]	ইউ পি সদস্য	01721722927	
১৪.	[illegible]	[illegible]	01720095455	
১৫.	মাহজিদা আক্তার	মহিলা বিষয়ক অধিদপ্তর প্রতিনিধি (জেন্ডার প্রোগ্রাম)	01729646902	
১৬.	[illegible] বিশ্বাস	উপজেলা [illegible] কর্মকর্তা	01787-922928	
১৭.	মো: [illegible] ইসলাম	উপজেলা শিক্ষা অফিসার	01716-315256	
১৮.	মোসা: রাবিয়া বেগম		01756856623	রাবিয়া

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উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক
মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান ঃ উপজেলা পরিষদ মিলনায়তন, গলাচিপা
সময় ঃ
তারিখঃ ১৬/০৭/২০১৫

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
২০.	আবদুল মান্নান	উপজেলা কৃষি অফিসার	01716-066265	[illegible]
২১.	মোঃ তৌহিদুল ইসলাম	[illegible]	01777995238	[illegible]
২২.	মোঃ আনিসুল ইসলাম	PIO	01717-956847	[illegible]
২৩.	মোঃ মামুন	[illegible]	0171628907	[illegible]
২৪.	মোঃ মিলন	[illegible]	01728407[illegible]	মিলন
২৫.	মান্নান	"		মান্নান
২৬.	সাইদুল	"		সাইদুল
২৭.	ইসমাইল	"		ইসমাইল
২৮.	তারা মিয়া	"		তারা মিয়া
২৯.	[illegible]	"		
৩০.	মোঃ [illegible]	"		
৩১.	[illegible]	"		
৩২.	[illegible]	"		
৩৩.	[illegible]	[illegible]	01716-558132	[illegible]
৩৪.	মোঃ [illegible]		01734348332	[illegible]
৩৫.	মোঃ [illegible]	[illegible]	01737392271	[illegible]
৩৬	মোঃ [illegible]	"	01713822212	[illegible]
৩৭.	মোঃ [illegible] মিয়া	[illegible]	01743394530	[illegible]

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স্থানঃ গোলখালী ইউনিয়ন পরিষদ, কলাপাড়া

সময়ঃ

তারিখঃ ১৬/০৮/২০১৫

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১	[illegible]	চেয়ারম্যান গোলখালী ইউপি	01720529198	[illegible]
২	[illegible]	[illegible]	01716858137	[illegible]
৩	মোঃ [illegible]	ইউপি সদস্য	01734348328	[illegible]
৪	[illegible]	গোলখালী	01720095455	[illegible]
৫	মোঃ জালাল [illegible]	বড় [illegible]	01749324910	[illegible]
৬	মোঃ নূরুল [illegible]	গোলখালী	01818486609	[illegible]
৭	মোঃ সিরাজুল ইসলাম	গোলখালী	01746235677	[illegible]
৮	সাজেদা [illegible]	গোলখালী	01745200198	সাজেদা
৯	ফৌজিয়া সুলতানা [illegible]	নিয়ামত হরিদেবপুর	01727887026	[illegible]
১০	মোঃ জাহিরুল ইসলাম	পূর্ব গোলখালী	01926563367	[illegible]
১১	[illegible]	পূর্ব গোলখালী	017399828 96	[illegible]
১২	মোসাঃ তাজনাহার বেগম	[illegible]	01760055007	[illegible]
১৩	[illegible]	ইউপি সদস্য	01719935195	[illegible]
১৪	[illegible]	ইউপি সদস্য	01713962861	[illegible]
১৫	মোঃ [illegible] ইসলাম	ইউপি সদস্য	01721722927	[illegible]
১৬	মোঃ সুলতান হাং	ইউপি সদস্য	0173739922	[illegible]
১৭	মোঃ [illegible]	ইউপি	01712822212	[illegible]
১৮	মোঃ নূরুল ইসলাম	[illegible] ইউনিয়ন পরিষদ সচিব	01725961111	[illegible]

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স্থানঃ গোলখালী- ইউনিয়ন পরিষদ, গলাচিপা
সময়ঃ

তারিখঃ ১৬/০৮/২০১৩

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯	মো: কুদ্দুস মিয়া	চর হরিদেবপুর		[illegible]
২০	মো: মাহবুব	চর হরিদেবপুর		[illegible]
২১	মো: ছিদ্দিক খাঁ	চর হরিদেবপুর		[illegible]
২২	মতিউর রহমান	গোলখালী	01774639716	মতিউর রহমান
২৩	মো: হালিম মিয়া	বদর পুর	01719659635	[illegible]
২৪	মো: হানিফ মোল্লা	[illegible]	01745451936	[illegible]
২৫	আজিজুল ইসলাম	গোলখালী		[illegible]
২৬	আ: ছালাম	গোলখালী		[illegible]
২৭	~~[illegible]~~ মোস্তফা হোসেন	চর হরিদেবপুর	01730189135	[illegible]
২৮	মো: হাবিব মৃধা	সুহরী ইউ	01743394530	[illegible]
২৯	মো: জুল ইসলাম	হলদিয়া চর	01787243579	[illegible]
৩০	~~[illegible] ইসলাম~~ মো: [illegible] হোসেন	সাবেক গোলখালী	01766441933	[illegible]
৩১	ডা: [illegible]	বদর পুর	01735357090	[illegible]
৩২	মো: সফিকুল ইসলাম	Suparvisor KMIE	01712401350	[illegible]
৩৩	করিম			করিম
৩৪	মো: হক [illegible]	সুহরী ইউ [illegible]	01742404430	[illegible]
৩৫	মোসা: রাবিয়া বেগম	[illegible]	01756856623	[illegible]
৩৬	মোসা: [illegible] বেগম	[illegible]	01703797859	[illegible]

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House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক মতবিনিময় সভা অংশগ্রহণকারীদের তালিকা

স্থান ঃ গোলখালী ইউনিয়ন পরিষদ, গোলাচিপা

সময় ঃ

তারিখঃ

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৩৭	পবিত্র চক্রবর্তী –	সুহুরী –		পবিত্র চক্রবর্তী
৩৮	কৃষ্ণদেব চন্দ্র হল –	সুহুরী –		[illegible]
৩৯	মো: শফিকুর রহ –	সুহুরী		মো: শফিকুর
৪০	আবু হেলাল –	সুহুরী –		আবু হেলাল
৪১	আনোয়ার আলী	গোলখালী –		আনোয়ার

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স্থান ঃ ~~[illegible]~~ [illegible] উপজেলা পরিষদ মিলনায়তন

সময় ঃ

তারিখঃ ০৭/১২/২০১৬

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
০১	মো: [illegible]	[illegible]	01712512887	[illegible]
০২	[illegible]	[illegible]	01717325640	[illegible]
০৩.	আব্দুল মতিন	চেয়ারম্যান	0172-3848256	[illegible]
০৪.	[illegible]	[illegible]	01824805440	[illegible]
০৫	মো: [illegible] হোসেন	[illegible]	01716400378	[illegible]
০৬	[illegible]	[illegible]	0195070058	[illegible]
৭	মো: [illegible]	[illegible]	01720462768	[illegible]
৮/	[illegible]	"	০১৭৫১০৬৯০১১	[illegible]
৯।	আবদুল্লাহ আল মামুন	[illegible]	01718815559	[illegible]
১০/	[illegible]	[illegible]	01726562640	[illegible]
১১/	[illegible]	"	01758923142	[illegible]
১২/	[illegible]	[illegible]	01748250946	[illegible]
১৩/	মো. [illegible]		01715851834	[illegible]
১৪/	মো: [illegible]	[illegible]	01722955581	[illegible]
১৫/	[illegible]	[illegible]	01712798223	[illegible]
১৬	মো: [illegible]	U.T	01724496120	[illegible]
১৭	মো: [illegible] আলম	উপজেলা LGED [illegible]	01733330069	[illegible]
১৮	[illegible]	উপজেলা মহিলা বিষয়ক কর্মকর্তা	01720494734	[illegible]

Table : List of participants

SL	Name	Gender	Occupation	Age	Address/Mobile No
1	Md. Anis Bepari	M	Farmer	52	Haridebpur
2	Mr. Bajlu Mia	M	Farmer	47	Haridebpur
3	Md. Shakhawat Hossain	M	Farmer	48	Haridebpur
4	Md. Mominuddin	M	Farmer	75	Haridebpur
5	Md. Munsi Benzir	M	Farmer	42	Haridebpur
6	Md. Bayzid	M	Farmer	32	Haridebpur
7	Mr. Rais	M	Day Labor	32	Haridebpur
8	Mr. Rabiul	M	Day Labor	35	Haridebpur
9	Md. Sharif Sarkar	M	Day Labor	22	Haridebpur
10	Md. Rafiqul Islam	M	Day Labor	28	Haridebpur
11	Md. Kabir Kazi	M	Day Labor	30	Haridebpur
12	Md.Polash Sheikh	M	Business	30	Shuari Bridge
13	Md. Abdul Gafur	M	Business	38	Shuari Bridge
14	Md. Shawkat Ali	M	Business	50	Shuari Bridge
15	Md. Nannu	M	Business	32	Shuari Bridge
16	Md. Akram Hossain	M	Business	48	Shuari Bridge
17	Md. Matin Sardar	M	Business	55	Shuari Bridge
18	Mr. Alok Acharjee	M	Business	48	Shuari Bridge
19	Mr. Basudeb Acharjee	M	Business	50	Shuari Bridge
20	Md. Abu Bokkar Molla	M	Business	70	Shuari Bridge
21	Md. Nazrul Islam	M	Business	35	Shuari Bridge
22	Md. Mizanur Rahman	M	Business	32	Shuari Bridge
23	Md. S.M.Sohash	M	Business	36	Goalkhali
24	Md. Daudul Alam	M	Business	48	Goalkhali
25	Md. Abu bokkar	M	Student	20	Goalkhali
26	Md. Monirul	M	Student	22	Goalkhali
27	Md Belal Molla	M	Service	50	Goalkhali
28	Md. Farhad	M	Service	35	Goalkhali
29	Md. Kawsar	M	Driver	35	Goalkhali
30	Md. Tafsiruddin Mridha	M	UP member	40	Goalkhali
31	Md. Rezaul Karim	M	Van Puller	28	Goalkhali
32	Md. Masud	M	Mason	25	Goalkhali

Appendix 5: List of Perticipants of PDM at Kalapara Upazila, Patuakhali

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

স্থান : ~~[illegible]~~ কলাপাড়া উপজেলা পরিষদ মিলনায়তন

সময় : ১০.৩০ (সকাল) তারিখঃ ০৭/১২/২০১১

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১.	আবু [illegible]	চেয়ারম্যান কলাপাড়া উপজেলা	01714504729	[illegible] ৭.১২.১১
২.	এ.বি.এম. সাদিকুর রহমান	UNO, কলাপাড়া	01733334155	[illegible] ৭/১২/১১
৩.	বিপুল হাওলাদার	মেয়র কলাপাড়া পৌরসভা	01712877242	[illegible] ৭/১২/১১
৪.	[illegible]	[illegible]	01718690725	[illegible]
৫.	[illegible] মাহমুদ	[illegible]	01819459528	[illegible] ৭/১২/১১
৬.	মো: [illegible]	[illegible] NSS, কলাপাড়া	01757683272	[illegible] ৭/১২/১১
৭.	মো: [illegible]	[illegible] CODEC	01718787743	[illegible]
৮.	[illegible]	[illegible]	01755532470	[illegible]
৯.	S. M. Mehedi Hasan	DRM Analyst, World Bank	01827525068	Mehedi
১০.	মো: [illegible]	[illegible]	01725651141	[illegible]
১১.	মো: [illegible]	U.P - [illegible]	01758053259	[illegible]
১২.	[illegible]	[illegible]	01755668824	[illegible]
১৩.	[illegible]	প্রতিনিধি দৈনিক যুগান্তর	01712689367	[illegible]
১৪.	[illegible]	প্রতিনিধি দৈনিক কালের কন্ঠ	01711144770	[illegible]
১৫.	[illegible]	প্রতিনিধি দৈনিক [illegible]	01715042623	[illegible]
১৬.	[illegible]	[illegible]	01712699815	[illegible]
১৭.	[illegible]	[illegible]	0171511588	[illegible]
১৮.	[illegible]	[illegible]	01720208028	[illegible]

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স্থান ঃ কলাপাড়া ~~বরগুনা সদর~~ উপজেলা পরিষদ মিলনায়তন

সময় ঃ

তারিখঃ ০৭/১২/২০১৬

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯.	হুমায়ুন কবীর	[illegible]	01718440023	[illegible]
২০.	শ্রী অরুণ কুমার মন্ডল	[illegible] প্রতিনিধি	01728467047	[illegible]
২১.	রফিক বিশ্বাস	[illegible]	01739024476	[illegible]
২২.	মো: আছাদ উজ্জামান খান	সহ: পরিচালক [illegible]	01712200742	[illegible]
২৩.	কামরুল ইসলাম	[illegible]	01711316365	[illegible]
২৪.	আ: ছালাম তালুকদার	চেয়ারম্যান [illegible] ইউ/পি	01715097407	[illegible] 7/12/16
২৫.	[illegible]	U.P.D.O	[illegible]	[illegible] 7/12/16
২৬.	রাজীব [illegible]	[illegible]	01725023742	[illegible]
২৭.	মো: রফিকুল ইসলাম	[illegible]	01717886116	[illegible]
২৮.	মো: [illegible]	[illegible]	01735032545	[illegible]
২৯.	মো: [illegible]	[illegible]	01718272044	[illegible]
৩০.	উজ্জ্বল কুমার সাহা	Ecologist, CEGIS	01911686717	Ujjal Saha
৩১.	[illegible] রহমান	Socio-Economist CEGIS	01713-865525	[illegible]
৩২.	মো: আমিনুল ইসলাম	URDO-BRDB	01714-244355	[illegible]
৩৩.	ডা: মো: হাবিবুর রহমান	ULO	01718623474	[illegible]
৩৪.	সুমন চন্দ্র দেবনাথ	PIO	01912-940894	[illegible]
৩৫.	মো: [illegible]	UPHE	01740978118	[illegible]
৩৬.	মো: [illegible]	UAO	01716349939	[illegible]

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Appendix 6: Photo Album


Picture1: Non-functioning DS1(Char Shuhuri)


Picture 2:DS3 (Ghol Khal)


Picture 3: Damaged FS1


Picture 4: Non-functioning FS11


Picture 5: River bank erosion


Picture 6: River bank erosion

Picture 7: Location proposed FS

Picture 7: Location of proposed FS

Picture 7: Pucca road inside the polder

Picture 8: Kutcha road inside the polder

Picture 9: Breached Embankment

Picture 10: Location bank revetment works

Picture 11: View of Public Consultation meeting (Golachipa Union Parisad)

Picture 12: View of Public Consultation meeting (Golachipa Union Parisad)

Picture 14: View of Public Consultation meeting (Golachipa Union Parisad)

Picture 15: View of Public Consultation meeting (Golkhali Union Parisad)

Picture 16: View of Public Consultation meeting (Golkhali Union Parisad)

Picture 17: View of Public Consultation meeting (Golkhali Union Parisad)

Appendix 7: DoE's Approved Terms of Reference (ToR)

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207
www.doe-bd.org

Memo No : DoE/Clearance/5196/2013/ 125 Date: 05/06/2013

Subject: Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I).

Ref: Your Application dated 31/03/2013.

With reference to the above mentioned subject, the Department of Environment (DOE) hereby accords Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I) at Satkhira, Khulna, Bagerhat, Pirojpur, Patuakhali and Barguna Districts subject to fulfilling the following terms and conditions.

I. This clearance shall only be applicable for the development of the infrastructure of the said project.

II. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) report considering the overall activity of the said Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE).

III. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)

4a. Project activities:
- A list of the main project activities to be undertaken during site clearing, construction as well as operation
- Project Plan, Design, Standard, Specification, Quantification, etc.

4b. Project schedule: The phase and timing for development of the Project

4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.

4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.

5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
   - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
   - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
   - Environment Quality : Air, Water, Soil and Sediment Quality
   - Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions
6. Socio-economic environment should include, inter alia, following:
   - Population: Demographic profile and ethnic composition
   - Settlement and housing
   - Traffic and transport
   - Public utilities: water supply, sanitation and solid waste
   - Economy and employment: employment structure and cultural issues in employment
   - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.
7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).
   In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the

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scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. 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 8: Comments and Respesponses

Comments and Responses on EIA report of Polder 43/2C

Chapter	Pages, articles	Comments	Response
Executive summary	Location and synopsis of rehabilitation work (page – xxv) Environmental and existing condition (xxvi)	➢ The gross area of polder is mentioned as 2753 ha of which cultivable land is 200 ha. However in page xxvi says total cropped area is 3465 ha of which 2610 is occupied by rice and the rest 855 ha is covered by non-rice crop. Please provide the correct information.	All information are correct. Total cropped area is higher than the gross area as this includes crops grown in Kharif-I, Kharif-II and Rabi seasons
	Climate change impact (Page- xxix)	➢ It is written that, increasing trend is observed for all seasons but the value for pre-monsoon (-8.133 mm/year) and monsoon (-1.12 mm/year) is negative. For any increasing trend, how the value could be negative? ➢ What does the sentence mean “climate of the study area is typical monsoon considering three seasons”?	This section has been revised according to the text.
Approach and methodology		Page 9, 10 are missing in the document.	The pages were not given earlier by mistake . Corrected, thanks.
Policy, legislative and regulatory framework		The followings are not given which are mentioned in EMF: 1) Private Forest Ordinance (PFO), 1959 2) Private Forest Policy 1994 3) Social Forestry Rules, 2004 and Amendments 4) Antiquities Act, 1968 5) Bangladesh Labor Act, 2006 6) Bangladesh National Building Code, 2006	The policies as mentioned in the comments are incorporated in the respective chapter (Chapter 3)
Description of the Project	Pg 49-53	The dimensions and information are wrong in map 4.1. It should be corrected according to table 4.2. (DS-2, F/S – 1A, F/S – 2, F/S – 3 and many more. Please check all the details in map with table)	Corrected maps with updated information along with chainage have been provided in the report

Chapter	Pages, articles	Comments	Response
	Pg 61, table 4.4	For chainage 0.52 to 13.15, R/S is 1:5	The information of the table has been revised on the basis of the updated information received from the DCSC.
	pg 62, article 4.5.2	No information of DS-1A is given in Table 4.2 but given in table 4.5. It should be given in table 4.2.	Updated information received from DCSChas been included in Table 4.5
	Pg 63, table 4.6	Any information about FS-1A is not given in table 4.6 but in table 4.2. Is this FS available or not?	Updated information received from DCSC has been included in Table 4.6
	Pg 64, art 4.5.4	The number of available water channels and no of water channels need to be excavated are missing in paragraph 190.	This issue has been incorporated in the report (article 4.5.4 and table 4.7)
	Pg 65	The excavated soil dumping locations need to be provided.	It has been described in the respective section (article 4.5.4)
	Pg 66, table 4.7	Construction of retired embankment (km)	The length of retired embankment has been included in table 4.4
	Pg 69	The location of construction camps need to be provided.	The location of construction camp has been shown in Map 4.4
Environmental Baseline and Existing Conditions	Pg 79, art 5.1.2	From map 5.1, it is clear that inside the polder, some locations are higher than 2.20 m above MSL which is not mentioned here.	This area was artificially raised area (Top of the embankment); so, this area has not mentioned.
	Pg 81, Para 255	The zoning co efficient in the map 5.2 are according to BNBC 1993 not 2010.	It has been considered and corrected
	Pg 84, map 5.3	In map highland is not shown, only two classifications are shown.	Corrected map on the basis of classification of land has been inserted in the report
	Pg 87, climate	260 The project influence area under the Polder 43/2C has a typical monsoon climate that is characterized by four seasons. But in executive summary it has three seasons. Which one is correct?	Actually, the Polder 43/2C has a typical monsoon climate that is characterized by four seasons. In executive summary, has been corrected accordingly
		Same time range will help to reflect the actual condition. If data are not available then it need to be mentioned. On the availability of data, a uniform time range should be used.	Only the sunshine hour data is not available before 1985 as the BMD is measuring sunshine hours since 1985.

Chapter	Pages, articles	Comments	Response
	Pg 88, Relative Humidity	263 Variation of monthly relative humidity, as recorded by the Patuakhali BMD station (1978~2011) is shown in Figure 5.3. Fig 5.3: the time range is (1981-2013). Which one is correct?	Anomalies of the figure have been removed. In 1981-2013 time period has been used for analyses and this chapter has been revised.
	Pg 89, wind speed	Wind speed is the highest in April (around 155 kph) and the lowest in December (around 49.7 kph). Figure 5.4, the unit is km/day. Which is the correct one?	The figure has been converted as per comments, the wind speed in km/d has been converted into km/hr.
	Pg 90, Major Rivers and Khals	In map 5.4, Lohaila is not identified. • Golkhali River, Sonakhali River are introduced as khal in map. Are they khal or river?	Map of river system of the Polder area has been corrected/updated and incorporated in report.
	Pg 93, Surface Water Levels	• Not recent data were used for surface water level analysis. • the low tidal water levels range from 0.17 to 0.59 m below the MSL at Galachipa, and to 0.47 to 0.68 m below MSL at Patuakhali.	Surface water level data of those station is available from 1966-1988.
	Pg 93, Surface Water Levels, fig 5.6	• The graph shows negative value for minimum, but not mentioned in the text. • The graphs should be submitted in a format so that any value can be checked, not in picture format.	The values below MSL are indicated as negative for which the value i.e. Below MSL 0.17 and is indicated as (-) 0.17 mPWD.
	Pg 94, Groundwater Table	The variation pattern of values are fairly low, with lowest and highest values found in March and September respectively	The problem could not be addressed. However, the statement has been revised in order to make lucid.
	Pg 95, Table 5.4	New ID of what? Is it PAT001?	PAT001 is the observation well ID, New ID column in Table 5.4 has been replaced.
	Pg 101, para 285	Besides, there arenumber of flushing inlet in the polder which is in deplorable condition which also creates drainage congestion. In table 4.1, the number of flushing inlets (existing) is mentioned 2. If pipe inlet is also included, then the no will be 17 but not 16. What is the correct information?	The number of flushing inlets have been revised on the basis of updated information

Chapter	Pages, articles	Comments	Response
	Pg 107, para 297	“The local people claimed that no surface water salinity exist in the area in the dry season (December to February).” The study was taken place in June. If this local people information is correct then there have to be saline water during the time of study. In rainy season, due to heavy water flow, the salinity values are not showing the proper result. The salinity should be tested after the monsoon which will give the proper result and then incorporate in the report.	The water quality is again measured in dry season (February, 2016) to remove the confusion of statement. The measured the result reveal that salinity in this period is found to be nil as is mentioned in Table 5.9-b
Environmental Impacts and Mitigation Measures	Pg 160, para 441	Map should be provided by identifying borrow pit areas.	The borrow pit areas have been shown in Map 4.3
	Pg 161, Table 6.3	English/scientific name should be used.	These have been included in the table 6.8
	Pg 164, para 455	“Contractor will ensure that drainage channels are not obstructed or clogged by the construction activities; and Contractor will ensure that construction activities do not create any water ponding near cultivation fields.” These are not mitigation measures. What should be done, or what steps should be done to avoid this occurrence is mitigation.	This point has been edited and Incorporated in the report
	Pg 164, para 456	“The impacts associated with water logging are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Low.“ How the residual will be low from major impacts with these steps? It would be moderate.	As any other factors which might have impact on the drainage system, would not be recognized, that’s why It was concluded as low.
	Pg 166, para 463	“Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards” but how is not mentioned.	It has been addressed in the report (Table 5.10)

Chapter	Pages, articles	Comments	Response
	Pg 169, para 471	Who is responsible for the pollution control plan?	Contractor/Implementing agency are responsible for the pollution control plan under Environmental laws.
		Any technique or method for disposing contaminated soil appropriately? Not described properly.	The statement has been discarded considered to be irrational.
		"Release untreated wastes on ground or in water" Is it mitigation? How?	Corrected
	Pg 175, Table 6.8	English/scientific name should be used	These have been included in the table 6.13
	Pg 186, Table 6.16	Many points are missing in the table for each phase. Pre-construction Phase: • Noise quality, • preparation of facilities for contractors and labor force, • increased vehicular traffic, • damages due to project intervention and land acquisitionconstruction Phase: • drainage congestion • problem for pedestrians and vehicles movementnoisedamage to local infrastructure • soil water contamination • sedimentation • increased traffic • loss of floral & aquatic habitatPost Construction Phase: • Livelihood development • Soil fertility • Green coverage	It has been checked and included in the report. Thanks.
Analysis of Project Alternatives	Pg 199, art 7.4.2	The sources of construction materials are not included here.	The sources of materials have already been included in Table-4.11 of the report
Climate Change Impact	Pg 201	"Monthly and annual mean data of maximum and minimum surface air temperature, sunshine hour, relative humidity and monthly and annual rainfall over Patuakhali has been used	As per reviewer's suggestion, CEGIS has used the updated data for mentioning the parameters.

Chapter	Pages, articles	Comments	Response
		for the period of 1975-2004 in this study." But updated and recent data should also be used to get the scenario properly.	
	Pg 201, rainfall	How negative values can indicate increasing trend?	Appropriate correction has been made
	Pg 206, para 587	"The change of rainfall is observed to be -0.9, 2.4, -7.3 and -26.7 % for winter, pre-monsoon, monsoon and post-monsoon, respectively in 2050 (Figure 8.4)." How monsoon value can be negative?	It is the projected value by Climate Model using RCP4.5. It is difficult to explain and many things are involved with as it such as pressure, wind, humidity and so on.
Development of Environmental Management Plan	Pg 221, 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)." But the process or any technique is not mentioned.	This has been revised accordingly
	Pg 230, Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	In frequency, it is mentioned that surface water will be tested in two times a year. But is must be mentioned that the testing time should exclude rainy season or monsoon as the water is diluted at that time due to heavy water flow. So the test result will be misleading at that time.	This has been properly mentioned in the report

Chapter	Pages, articles	Comments	Response
Chapter 4, Description of the Project	Pg-81(ii) “Planning of Operation”	• In the light of our recent discussions on mitigating impact on fisheries via design and/or operational plans for water control structures, I would make one comment on the subsection ii “Planning of Operation” which starts on page 81. It is a well-written section and includes the demands of the various stakeholders, but fails to mention the ecological requirements of the fish spawning season. Specifically, how these will be handled and who will be champion of this need-i.e., who will ensure that fish spawning needs are looked after in the operational planning and decision-making with respect to water control structure operation. This will be consistent with Table 10.1, which states, under “Fishery Management” Section: • Sufficient free flow will have to be gurranteed in the design and construction work to ensure free passage of migrating fishes • Hydraulic structures to be operated considering fish migration and spawning time • An area specific hydraulic structure operation guideleine should be developed.	This issue will be decided in a meeting by all concerned personnel and will be incorporated in all the EIA reports accordingly

Appendix 9: Comments by Mr. Marcelo (WB) and Responses by CEGIS

All comments for Polder 47/2 are not applicable for other Polders. Relevant comments have been addressed for Polder 43/2C

Sl.	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	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
5	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

Sl.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
6	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
7	To what extent the local participation schemes have consulted, accepted by stakeholders involved and implemented? Is there capacity to do that? Who is going to deliver training?	The previous experience of local participation in water management. In case of CEIP, stakeholder involvement, capacity, training issues have already been discussed.
8	I have not seen the connection between seismicity and embankments analyzed in other sections of the document. Is it correct to assume the low risk discussed in the EIA?	Yes, it is correct, the polder falls in low risk area.
9	The document mixes two different concepts. Land use and soil productivity. It would be good to fix it 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	A strong statement that needs to be explained or clarified. It says that the EXISTING water system of the polder meets the demands of the surrounding system. If this meets the demand which is the added value of the proposed intervention?	This paragraph has been rephrased.
12	The 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.
13	Section 5.2.1. It is important to clarify the implications of this classification for the project and what does it means that it have been identified by IUCN. This needs to be handled with care to avoid confusions with the WB natural habitats concept.	The whole Bangladesh has been divided into 25 Bio-ecological zones by IUCN depending on the biodiversity in the respective area.
14	Para 425. Reports about the ecological importance of coastal areas. It is not clear in the rest of the document the impacts on these areas.	This section has been revised
15	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-5.16.a [section 5.2.2].

Sl.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
16	The section 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
17	Para 390. This section does not explain how culture fisheries rely on water level fluctuations.	Kindly note that culture fisheries in Bangladesh in general require at least 1 m depth. If water fluctuates and become less than 1 m then the concern habitat will be less productive.
18	Section 5.2.4. It should explain the importance of the migrations, if it is seasonal, etc.	Fish is highly influenced by environmental factors, such as, water temperature, rainfall, water quality, etc. Moreover, these interactions are species specific. The various physiological condition needs appropriate environment. To meet up various biological purposes, like feeding, breeding, spawning, etc., fish normally migrate from one habitat to other suitable habitat.
19	Para 445. It would be important to explain how the bad functioning of the polder, sluices, etc. has favored the fish migration. This should be the baseline to explain how the project intervention would impact on that and how this is related to the economic activity.	Fish migration is impeded by the malfunctioning of the polder, sluices, etc. Once when the polders and the sluices were functioning well fisheries activities were there and some people were dependent on it for carrying their livelihood. After bad functioning of the polders and sluices fisheries activities reduced substantially.
20	Table 5.19 and associated paragraphs. The table presents a static description. The report should indicate if there is any associated sensitivity, the use of the habitat, preferences, etc.	Different fish species have different habitat preferences and having different sensitivities to the physical condition of the area. The larger catfishes like *Wallago attu*, *Pangasisus pangasius*, etc, prefer deeper water having connectivity with the large river and drainage canal (particularly for *Wallago attu*). These are sensitive to warm water and shallow water habitat. They breed when they get new water in the following season. If sluices are not functioning properly then the large catfish population will be declined. Smaller catfishes (*Clarius batrachus, heteroneustes fossilis, Mystus tengara,* etc.) prefer shallower habitat. They usually breed in the ditches and borrow pits. Snakeheads also inhabit in the drainage canal and in the pond.
21	Section on 5.2.5 on fish and biodiversity composition needs to be supported by the scientific information that demonstrates that the project area is very poor to moderate in fish biodiversity which does not seem to be the case of what I presented in Table 5.9b.	This has already been mentioned in section 5.2.8 (para 4.4 and Table 5.20). Shannon-Weiner Diversity Index and Sympson's Index has been used to analyze the fish diversity. The Table 5-20 describes the fish biodiversity status of the area, It is done based on the regularly caught major fish species. It is seen that Lohalia River has high species dominance while in the Mondir Khal Khal the species dominance is moderate. Though water

Sl.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
		quality mentioned in the Table 5-9b, the parameters are showing well within the permissible limit but timely availability of water due to malfunctioning of the polders and sluices is scarce. For this reason, species diversity is considered poor to moderate.
22	Section 5 on fish production. It would be important to explain how sensitive this activity is to polder management. In the same line, we would like to know if the stakeholders related to this activity were consulted.	Fish production is directly linked with the livelihood of the dependent fishermen community of the area. If production declines due to bad functioning of the polders and sluices, the livelihood of the area will be affected and the economy of the area as well. Yes, local people including fishermen, fish traders and local fisheries officials were consulted during collection of fish data and analysis was done based on those information.
23	Para 474 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.
24	Has the Bank reviewed the RAP?	Yes, the RAP report has been reviewed by World Bank
25	How the potential impact on social network would be addressed?	This issue has been addressed in the respective paragraph
26	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.
27	What is the meaning of proper compensation?	Omitted this sentence
28	If I am not wrong, the baseline has identified only one market and this para. Mentions more than that, or these are different markets?	This anomaly has been removed from the baseline and updated accordingly
29	Does the RAP addresses the economic displacements of certain activities due to disruptions, etc?	It has been checked and addressed in the report.
30	Has any model being applied to estimate the impact of sedimentation? Is it going to do after the EMP and before initiating the sediments removal?	No, sedimentation model has not been applied because it is beyond of scope of ToR
31	Which is the impact of dewatering channels?	Dewatering is not essential for excavator cutting , it is only for manual excavation
32	On one had the EIA says there will be no impact on crops but on the other, suggests to compensate if that happens.	Rightly mentioned but crop damaged will not be occurred due to borrow pit while transportation of earth materials may cause crop damage in the surrounding area.
33	What other indirect impacts are related to the direct destroy of feeding, nursery and spawning ground of fish habitats?	It has been considered
34	There is not mention to water related diseases such as Malaria.	There is no Malaria disease in the polder area.

Sl.	Comments by Marcelo Hector Acerbi (WB)	Responses by CEGIS
35	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
36	How is determine the final disposal of sediments removed from khals as part of dredging operations? Is the quality of the sediment determined?	No dredging operation will be carried for removal of sedimentation from khals.
37	The mitigation measures are interesting but how are they going to be implemented?	Water management Organization (WMO) will implement these measures with guidance of BWDB in association of DAE (Department of Agriculture Extinction)
38	I like the idea of the involvement of experienced fishermen to guide the sluices operations. How is it going to be implemented?	Water management Organization (WMO) will implement these measures with guidance of BWDB
39	Which is the timeframe for the potential land use changes. The topic needs to be discussed so the reader can have an idea about the implications of land type changes.	Agreed, after 3-5 years of implementation of the project land use will be changed which is also applicable for crop production.
40	We need a scientific reference to support the statement related to increased fish production.	As comment is not clear, response could not be addressed
41	The WB 2010 report is not mentioned in the list of references.	It has been included in the list of references
42	This is an important item and it is not clear which is the cumulative impact?	This chapter has already been revised
43	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 accordingly.
44	The issue of cultural heritage which was not included as part of the baseline and impact analysis.	As there is no cultural heritage in the polder, there will be no impact on cultural heritage.
45	Malaria risk has not been considered as part of the baseline.	There is no risk of malaria in the surrounding areas.
46	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.
47	I do not understand. The draft was never disclosed? So which is the basis for a meaningful consultation process.	Regional level disclosure meeting will be conducted in the first week of December,2016

Appendix 10: Pest Managemnet 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

4. Chemical control management

Chemical control method shod be applied only when the other control methods fails to control the pest. That means pesticides should be used only as a last resort and in doing so right pesticide with right dose at right time and with right method of application should be taken in to consideration. Pesticides should be handled with proper care because all pesticide are poisonous.

Appendix 11: Checklist for consultation Meetings

Environmental Impact Assessment (EIA) under CEIP-1

Issues of the Public/Stakeholder Consultation Meeting

The possible issues that would be discussed in the public consultation meetings are:

1. Productivity (e.g. agriculture and fishery)
2. Livelihood options
3. Vulnerability issues
4. Ecological imbalance
5. Resource redistribution
6. People's perception, opinion and attitude
   - 6.1. Major problems
     - 6.1.1. Problems in productivity
     - 6.1.2. Problems in service and facilities
     - 6.1.3. Infrastructural problems
   - 6.2. Attitude of the people towards the project
   - 6.3. Impact (positive and negative) of the project and mitigation measures
     - 6.3.1. Alternative sites
     - 6.3.2. Mitigation measures for planners
     - 6.3.3. Mitigation measures of implementing agency
7. Income restoration and generation issues
   - 7.1. Current income generating activities
   - 7.2. Type of occupation
   - 7.3. Income-generating activities
   - 7.4. Current market situation (job opportunities, competition, land price and market price situation)
   - 7.5. Skill development and IGA
8. Social development support
   - 8.1. Name of NGOs prevailing in the study area
   - 8.2. Social safeguard and safety nets
   - 8.3. Community interventions
9. Gender issues
   - 9.1. Unemployment of female labor force
   - 9.2. Literacy rate of female students
   - 9.3. Anticipated changes in the wage rate
   - 9.4. Health issues of women
10. Participation of women in service and facilities

FGD issues

The possible issues that would be discussed in the focus group discussions are:

1. People's perception, opinion and attitude
   - 1.1. Initial discussion about the selected Important Social Components (ISCs)
   - 1.2. Attitude of the people towards the project
   - 1.3. Impact (positive and negative) of the project and mitigation measures
2. Demographic distribution

   2.1. Population distribution
   2.2. Major age group
   2.3. Dependency ratio/status)
3. State of Education
   3.1. Impact of illiteracy
   3.2. Variation in school Attendance between girls and boys
   3.3. Variation in drop-out between girls and boys
4. Health Situation
   4.1. Prevalent diseases
   4.2. People's health seeking behavior
   4.3. Local health facilities
5. Employment and Occupation
   5.1. Existing occupations in the locality
   5.2. Major occupations
   5.3. Reasons of unemployment
   5.4. Impacts of unemployment
   5.5. Occupation problems/conflict
   5.6. Impacts of variation in water level on employment
6. Service and Facilities)
   6.1. Existing housing tenancy and structure
   6.2. Drinking water and sanitation facilities in the locality
   6.3. Energy Facility
   6.4. State of market Facility
7. Gender Issues
   7.1. Unemployment of female labor force
   7.2. Literacy rate of female students
   7.3. Anticipated changes in the wage rate
   7.4. Health issues of women
   7.5. Participation of women in service and facilities
   7.6. Women leadership
8. Poverty and food security status
   8.1. Number of working days, disaggregated by seasons and occupations
   8.2. Status of subsistence, disaggregated by seasons
   8.3. Usual food menu
   8.4. Adaptation strategies during poverty state
9. Ethnicity
   9.1. Major ethnic groups
   9.2. Cultural conflict and coexistence
   9.3. Potential impacts of project on ethnic groups
10. Archaeological/heritage sites
   10.1. Major archaeological/heritage sites
   10.2. Cultural values
   10.3. Potential impacts of project

Appendix 12: Gate Operation Plan (Bengali)

পোল্ডারের স্লুইস গেট পরিচালনার ক্ষেত্রে নিয়মাবলী

অতীতে পানি উন্নয়ন বোর্ডের কর্মচারীর মাধ্যমে স্লুইস গেটগুলো পরিচালিত হতো। বাজেট স্বল্পতার কারণে সে পদগুলো এখন স্থগিত করা হয়েছে। বর্তমানে গেটগুলো পরিচালনার দায়িত্ব সুবিধাভোগীদের উপর অর্পন করা হয়েছে। প্রতিটি পোল্ডাওে এ জন্য পানি ব্যবস্থাপনা সংস্থা (WMG, WMO, WMA) গঠন করা হয়। কৃষি উন্নয়ন ও মৎস্য সম্পদের কথা বিবেচনা করে পোল্ডার ৪৩/২সি এর গেটপরিচালনায় পানি ব্যবস্থাপনা সংস্থাগুলোকে নিম্নোক্ত বিষয়গুলো বিবেচনা করতে হবে:

- কৃষি ও মৎস্য সম্পদ ব্যবস্থাপনার সাথে সামঞ্জস্য রেখে একটি নির্দিষ্ট নিয়মের মধ্য দিয়ে প্রতিটি রেগুলেটরের গেট অবশ্যই নিয়ন্ত্রিণ করতে হবে ;
- প্রকৃত পানি ব্যবস্থাপনা বিশেষ করে কৃষি ও মৎস্য সম্পদের প্রয়োজনীতার ভিত্তিতে পানি উন্নয়ন বোর্ডের পরিচালনা ও রক্ষণাবেক্ষণ শাখা সুবিধাভোগী সংস্থা, কৃষি সম্প্রসারণ অধিদপ্তর এবং মৎস্য অধিদপ্তরের মাঠ কর্মীদের যৌথ পরামর্শক্রমে গেট পরিচালনা করতে হবে;
- শুধুমাত্র মেরামত ও ফ্ল্যাশিং ব্যতীত রেগুলেটরের ফ্ল্যাপ একটি নির্দিষ্ট স্থানে সব সময় একই অবস্থানে রাখতে হবে;
- খালে পানি সংরক্ষণ করে কৃষি কাজে সেচের জন্য বর্ষার পূর্বে (মার্চ - মে) গেট বন্ধ রাখতে হবে;
- বর্ষার সময় (জুলাই -সেপ্টেম্বর) গেট সাধারণত বন্ধ থাকবে তবে পোল্ডারের ভিতর ও বাহিরের পানির স্তর একটি নিরাপদ লেভেলের বাইরে যাতে চলে না যায় সেদিকে লক্ষ্য রাখতে হবে। এক্ষেত্রে, প্রতিদিনের বৃষ্টিপাত, নদীর অবস্থা,নদীর এবং পোল্ডারের ভিতরের পানির লেভেল বিবেচনা করে যথাযথ সিদ্ধান্ত নিতে হবে;
- মাছের সর্বোচ্চ প্রজননের সময় ডিমসহ মা মাছ (ব্রুড মাছ) ও মাছের পোনা অভিগমনের বিষয় বিবেচনা করে মে হতে জুন মাস পর্যন্ত গেট খোলা রাখতে হবে;
- বর্ষাপরবর্তীসময় (অক্টোবর-নভেম্বর) গেট এমনভাবে পরিচালনা করতে হবে যাতে খালে শুষ্ক মৌসুমেও পর্যাপ্ত পানি থাকে। এক্ষেত্রে লক্ষ্য রাখতে হবে যেন খালের পানি তীর উপচে না যায় এবং কৃষি কার্যক্রম ব্যাহত না হয়;
- ফ্ল্যাশিং স্লুইস ও পাইপ ইনলেট পরিচালনার ক্ষেত্রেওএকই নিয়ম অনুসরণ করতে হবে;
- কৃষি কার্যক্রম, শষ্যের নমুনা ও ধরণ, মাছের প্রজনন সময় ও অভিগমন ইত্যাদি পরিবর্তনশীল বিধায় সময়ের সাথে সুবিধাভোগী সংস্থার (কৃষক, মৎস্যজীবি,মৎস্যচাষি) সাথে নিয়মিত পরামর্শ করতে হবে;
- কৃষি ও মৎস্য উভয় সম্পদ বিবেচনায় নিয়ে পানি ব্যবস্থাপনা সংস্থাগুলোকে (WMG, WMO, WMA) সমন্বিত পানি ব্যবস্থাপনার উপর প্রশিক্ষণ প্রদান করতে হবে।

Appendix 13: Minutes of the National Dissemination Seminar held on 25 January, 2017

Minutes of the National Dissemination Seminar held on 25 January, 2017 on the Environmental Impact Assessment (EIA) study Reports under Package-2 of CEIP-1

A dissemination seminar on the "Environmental Impact Assessment (EIA) under Package-2 of CEIP-1 was held at Spectra Convention Centre, Gulshan 1, Dhaka on 25 January 2017. Mr. Anisul Islam Mahmud, M.P, Hon'ble Minister, Ministry of Water Resources, Government of the People's Republic of Bangladesh, graced the occasion as the chief guest and Mr. Muhammad Nazrul Islam, Bir Protik, M.P, Hon'ble State Minister, Ministry of Water Resources, Government of the People's Republic of Bangladesh was present as the Guest of Honour. Dr. Zafar Ahmed Khan, Senior Secretary, Ministry of Water Resources Government of the People's Republic of Bangladesh and Engr. Md. Waji Ullah, Executive Director, CEGIS were the special guests in the seminar. The meeting was chaired by Mr.Md. Mahfuzur Rahman, Additional Director General (West region), BWDB. The photographs of the seminar is provided herewith as Appendix A.

The program started with registration of the participants at 9:30 am. Thereafter, the seminar commenced at 10:00 am through recitation from the holy Quran. Mr. Md. Delwar Hossain, Project Director, CEIP-1, BWDB delivered the welcome speech. After that Mr. Malik Fida Abdullah Khan, Deputy Executive Director (Operation), CEGIS presented the findings of the Environmental Impact Assessment (EIA) study of six polders under package-2 of CEIP-1.

About 100 NationalExperts from multi-disciplinary fields such as engineers, agriculturists, economists, environmentalist, sociologists and others as well as local stakeholders were present in the seminar. Besides, three international Environmentalists were present in the seminar. A List of participants attending the seminar is given as Appendix-B.

After the presentation, the floor was openedto the participants for their comments/suggestions on the study. Many valuable comments and suggestions received from the Honourable Chief Guest, Guest of Honour, special guests and participantswhich are furnished below.

1. Mr. Anisul Islam Mahmud, M.P, Honourable Minister, MoWR stated that the provisionfor re-excavation/dredging of peripheral rivers of the polders should be included under the CEIP project.

2. Dr. Zafar Ahmed Khan, Senior Secretary, MoWR informed that the Government of Bangladesh has specific development targets by 2021 and 2041. As such the polder rehabilitation process, should be considered on the basis of past experience and future challenges particularly climate change issue. He saidthat we should think about WMO for polder maintenances and how this association can work properly.He further added that we have gathered various ideas and knowledge from today's dissemination seminar on Coastal Embankment Improvement Project, Phase-1,(CEIP-1) which may play vital role for decision making in future for effectiveness of this project.

3. Mr. Md. Habibur Rahman, PD, ECRRP, BWDB informed that the polder rehabilitation plan is good initiative which has already been done by ECRRP. At present, CEIP-1 polder rehabilitation works should be conducted considering climate change scenarios and sea level rise. He also mentioned that polder works should have scope for green belt along the polder

which should be monitored by Water Management organization (WMO) for proper maintenances of the polders.

4. Mr. K.M. Fakhrul Islam, Chief Engineer, Central Zone, BWDB made questioned How WMO will be involved in the rehabilitation work of all polders? In addition, he also told that sufficient training programs should be introduced for the WMOs of the polder.

5. Dr. Khondaker Azharul Haq, President, Bangladesh Water Partnership (BWP) expressed that the presentation is quite good but why only few polders have been considered for rehabilitation out of 139 polders. We should take initiatives for engaging NGOs/private sector for monitoring of the polder maintenance as the WMO does not sustain in most of the cases. Coastal polders are very vulnerable due to climate change. So we should look for new operation system for polder rehabilitation.

6. Mr. Md. Zaid Hussain Bhuiya, Deputy Chief Conservator of Forest (DCCF), Department of Forest suggested that Social forestry based green belt system should be included in polder rehabilitation work process. He also proposed to initiate social forest co-management system along embankment and also in the protected areas.

7. Mr. Giasuddin Ahmed Chowdhury, Deputy Team Leader, Delta Plan Project, Mott McDonald suggested that internal water management system is very important for rehabilitation of the polders. The polder works should include plan for eco system service providers.

8. Mr. Abani Kumar Thakur, DCCF, Department of Forest (DoF) mentioned that we know that coastal Greenbelt is a measure to prevent coastal erosion and reduce other natural hazards by planting trees and creating forests along the coasts. As such more exclusive green belt project should be implemented which has recently been studied by DoF.

9. Mr. Mohammad Alamgir, Principal Scientific Officer, WARPO commented that fish management plan is still missing in CEGIS power point presentation. Thus he insisted a comprehensive plan including polder rehabilitation work along with fish management plan.

10. Professor Dr. KB Sajjadur Rasheed, Environmentalist and Advisor, CEGIS expressed that CEGIS presentation was good for understanding. He enquired whether the crest level of the embankment of the polder has been designed considering climate change scenario.

11. Mr. Mahbub Murshed, Reporter, The Daily Naya Diganta informed that in future, the Koshi dam in Nepal and Ganges Barrage in Bangladesh would be constructed which will be the source of huge quantity of fresh water to the south western region of Bangladesh. Whether this issue has been considered in the study?

11. Mr. Md. Harun ur Rasheed, BWDB suggested that aseparate tree plantation plan should be included here for cutting of trees in the polder during intervention works. He also said why WMO are not working successfully in Bangladesh which is successfully working in other countries of the world?

12. After the comments and suggestions from the floor, the Chief Guest, Guest of Honour , Special Guests and Chairperson of the seminar delivered their valuable speeches .

13. The comments and responses are given as Appendix-C

Dr. Maminul Haque Sarker, Deputy Executive Director (Development) gave vote of thanks to theChief Guest, Guest of Honour , Special Guests and Chair, participants and representatives of media for their kind presence and active participation in the seminar.

Appendix A: Photographs of Seminar

Chief Guest, Guest of Honour, Special Guests and Project Director

Welcome Speech by the Project Director of CEIP-1

Presentation of EIA findings by Mr. Malik Fida Abdullah Khan, Deputy Executive Director (Operation), CEGIS

View of Participants of the Seminar

A view of open discussion

Special Guestdelivering his speech

Special Guestdelivering his speech

Guest of Honour delivering his speech

Chief Guestdelivering his speech

Closing remarks by the Chair

Appendix-B: List of Participants of Seminar

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
1	Dr SMA Rashid	IWM/CEIP	rashidsma@yahoo.co.uk 01717318906	Titon 01914618745	[signature] 25/01/17
2	Abu Bakr Siddique	CEIP-1	abs-1947@yahoo.com 01795095607		[signature]
3	Henk Blok	CEIP-1	henk.blok@nhdhv		[signature]
4	Md. Mahfuzur Rahman ADG (West Region)	BWDB	01741-382792		[signature]
5	A.K. Manzur Hasan Chief Engr ~~BWDB~~	BWDB	01711175477	Jewel. 01921985023	[signature]
6	Mollah Rezaul Alam Adviser Water Resou	CEGIS	01715406565		[signature]

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
7	SYED ALI AHSAN PS TO SENIOR SECRETARY (C.D-S)	MOWR	ahsan.en@gmail.com 01711431009	MAHFUL 01915531903	
8	Ebrahim Ahmed	CEGIS	ebrahimahmed@yahoo.com	01675507173	
9	Md Zaid Hussain Bhuiyan Deputy chief Conservator of Forest	FD	dccf-edtw@bforest.gov.bd	01712-074350	
10	Md. Delwar Hossain PD/CEIP-1	BWDB.	Pdpmuceip@gmail.com	Rashed. 0172-388698	
11	MD CHAN MIA	P.I.D	chanmiapid09@gmail.com	01712223881	
12	Md. Abdul Hannan XEN, CEIP, BWDB	BWDB	xen.ceip1-khulna@gmail.com	Taleb	25/1/17

2

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
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Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
13	Jahangir Alam PRO, MOWR	MoWR	pro@mowr.gov.bd 01935105856	Shafiqul Islam 01728912590	25.01.17
14	Md. Nowruzzaman Asst. Director	MOWR	01911282278		
15	Md. Habibur Rahman	CEIP-1	01199808796	Pranjal	
16	Subrata Kr Mondal	CEGIS	01715669850		25/1/17
17	Dilruba Ahmed	CEGIS	dahmed@cegisbd.com		25.01.17
18	Md. Anwar Kadir SDE	JRC	01817527677 anwarkadir07@gmail.com	Saiful 01739259635	25-01-17

3

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 Time: 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
19	Md. Azizul Haque Adviser	CEGIS			[illegible]
20	Md. Maqbul-E-Elahi	CEGIS			[illegible]
21	Jalal Ahmed Choudhury	CEGIS		01938242287	Jalal
22	K Bab Ramak	CEGIS		01730320305	[illegible]
23	Mir Sajjad Hossain	CEGIS			[illegible]
24	Sakib Mahmud	IWA		01852833381	[illegible]

4

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 Time: 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
25	Audun Hetland Ramboll CEIP Snr/l Environment Specialist	DHI			[illegible]
26	MOTAHER HOSSAIN CE. Ganges Barrage	BWDB	motaher_hossain@yahoo.com		[illegible]
27	Md. Abdur Rahman Akanda ADG(P)	BWDB			[illegible]
28	Md. Mahbubur Rahman	CEIP			[illegible]
29	Md. Abul Kausar SE/BWDB	BWDB	sani_kausar@yahoo.com	Md. Ahsanullah vehicle no: 3083	[illegible]
30	GERARD PICHEL	RHDHV	fattyzebra@gmail.com		[illegible]

5

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
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Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
31	Mobahar Bin Ansari	Jr. Specialist	mansari@cegisbd.com 01718 244298		Mobahar
32	Muhammad Azizur Rah[illegible]	PLA	mazizur@[illegible].com		[illegible]
33	Glandsly Chong	BDP2100			[illegible]
34	Saika Nowshin Junior consultant	CEGIS	nowshin.sait-@gmail.com 016 7601 6625		[illegible]
35	Shihab Monjur Research consultant	CEGIS	shihab186@live.com 01735263323		S.Monjur
36	A K M Hasan	CEGIS	01911364049		[illegible]

6

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
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Date: 25 January, 2017 **Time:** 9.00 to 1.30
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Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
37	Kazi shahidur Rahman Sub-divisional Engr	JRC	shahid.[illegible].com 01712831502		[illegible]
38	Khair Reporter	Metar	01916143317		[illegible]
39	Md. Sarfaraz Wahed	CEGIS	01712209369		[illegible]
40	Faria Tuz Zahura	CEGIS	01675489599		[illegible]
41	Dr. Maminul Haque Sarker	CEGIS	01817606761		[illegible]
42	Asma Akter	CEGIS			Asma

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Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
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Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
43	Mohad. Hassan	Deputy Manager	01711260139	-	Mohad.
44	Khaleda Saladin	CEGIS			Saladin
45	K. Kamil Hana	CEGIS			
46	Dr. Ashadul Alam Sr. Env. Specialist	PMU, CEIP-I BWDB	01747215770		25.01.2017
47	Shaheen Afroze	CEGIS	01715304133		25/01/2017
48	Chaitanya Kumar Das Director Field service wing DAE	DAE	01718956169 kbdaldas@yahoo.com	Lookman	25.1.17

8

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
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Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
49	Jan T. Twarowski Team Leader M+E Consultants	Sheladia Associates USA	jant@sheladia.com	Ali	Jan T
50	Dr. Kazi Noor Newaz Advisor,	CEGIS	nnewaz@cegisbd.com		
51	Dr. Sajid	C3ER BRAC Uni	sajid_ru@yahoo.com	01921X983934	
52	Dr. Monowar Hossain	IWM	mnh@iwmbd...	[illegible]	
53	Md. Gulzer Hossain	CEIP-I		-	
54	ANISUR KAWSAR WAWE SI	BETS			

9

Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
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Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
55	K. M. Aminul Haque	BWDB	01552391776	Dhalu	[illegible]
56	Jasim Uddin Ahmed	BWDB/Hq	01716209774		[illegible]
57	Dr. AZHARUL HAQ	BWP	01819212996	Iskander	[illegible]
58	Dr. Ashraful Alam	CEGIS	01818290847		[illegible]
59	Md. [illegible]	CEGIS	01715712614		[illegible]
60	Anjuman Ara Baby	CEGIS	01711-377-306	—	[illegible]

10

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Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
61	Md. Khalequzzaman Chief Planning	BWDB	01822812662 cplan.wdb@yahoo.com	Zahangir	[illegible]
62	Md. Abu Hasnat	CEGIS	01911597899		[illegible]
63	AKM Tahmidul Islam	BWDB	01712172124	Selim	[illegible]
64	Abani B. Thakur DCCF	Forest Dept.	01720543473	Nur Mohammad	[illegible]
65	Md. Harun ur Rashid	BWDB	01711383744	Harun 6205 [illegible] DC-2	[illegible]
66	RAKSHANDA RABBIN	CEGIS			

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Dissemination Seminar on
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Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
67	Md Habibur Rahman PD/ECRRP	BWDB	01712008322	Md. Suman	
68	MD. SHAHJAHAN- X-DG, WARPO		01715078833		
69	Mihir Biswas	BAPA	01700678223		
70	[illegible] Ali	BTV	01911988790	Sovit	
71	MUSA NURUR RAHMAN SUPERINTENDING ENGR	BWDB	01715740505	Oli	25.1.17
72	Mohammad Alamgir Principal Scientific Officer	WARPO	01556555689		

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Dissemination Seminar on
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Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (If any)	Signature
73	Md. Jahid H Jahangir former Member, JRC				
74	[illegible]	BTV		01712354990 [illegible]	
75	A. Latif	Gm		01710089153 [illegible]	
76	Syed Mahbub Murshed	Forum Naya Diganta		own # 01718417181	
77	Mantu Kumar Poddar Joint Chief	Ministry of Water	aditya_suditya @yahoo.com	01772643441 Mr. Razzak Driver.	
78	Mohammad Abdur Rashid	CEGIS			

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Dissemination Seminar on
Environmental Impact Assessment (EIA) under Package-2 of CEIP
Venue: Spectra Convention Centre, House 19, Road 7, Gulshan-1
Date: 25 January, 2017 **Time:** 9.00 to 1.30
Organized by: CEGIS

Registration Form

Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
79	Fakhrul Islam Chief Engineer Central Zone, DHK	BWDB	fakhrulbwdb@yahoo.com 01670-757384	Monju 01774-218775	[signature]
80	AKM SAHADAT HOSSAIN SE, IWRM	LGED	sahadat_ld@yahoo.com 01712209197	JAHID	[signature]
81	Md. Zahid Hasan Dhali	CEGIS	zahiddhali@yahoo.com 01816399598		Zh
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Sl. No.	Name with Designation	Organization	E-mail address & Mobile Number	Name & Mobile No. of Driver (if any)	Signature
85	Mirza Golam Shaukat	CEGIS	01729-088049		
86	Dr. Engr. Md. Lutfor Rahman	RRI	01715-039646	Paritosh kumar Biswas	[signature] 25/01/17
87	Komol Kumar Saha Ecologist	CEGIS	[illegible]@gmail.com 01911686787		Komol Saha
88	Muhammad Shahidur Rahman	CEGIS	shahidurrahman03@gmail.com 01713-865525		[signature]
89	Ashoke Kumar Das Fisheries Expert	CEGIS	ashoke@cegis bd.com	-	[signature]
90	Md. Shakil Ahmed	CEGIS	sahmed@cegisbd.com		[signature]

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91	SHAHED	BTV	—	—	
92	Badal Md. Faruque principal Specialist	CEGIS	BFARUQUE@CEGISBD.COM 01715111661		
93	Motaleb H. Sarker Director Ecology	CEGIS	0171501544		
94	[illegible] Mamun	Somoy TV	0196444127		
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Appendix-C: Comments and Suggestions

Sl.	Comments/suggestions	Responses
1	**Mr. Anisul Islam Mahmud, M.P, Honourable Minister, MoWR** The provision for re-excavation/dredging of peripheral rivers of the polder should be included in the polder rehabilitation activities	The provision for re-excavation/dredging of peripheral rivers in Polder 48 from km. 9.00 to km 17.00 (Mohipur Khal) and Polder-41/1 from km. 15.00 to km 20.00 (Bashbonia Khal) have been made as these rivers are narrow and shallow in depth. On the other hand, the peripheral rivers of other polders in this package are wide and deep. As such, re-excavation/dredging has not been considered.
2	**Dr. Zafar Ahmed Khan, Senior Secretary, MoWR** The Government of Bangladesh has specific development targets by 2021 and 2041. As such the polder rehabilitation process should be considered on the basis of past experience and future challenge particularly climate change issue. He said that we should think about WMO for polder maintenances and how this association can work properly.	The coastal polder since it implementation have appreciably contributed to the food production in Bangladesh as well as provided safety to the people of the polders against saline water intrusion and tidal surges. The rehabilitation of the polder is being done considering climate change scenarios and other current water management concepts. As such, the rehabilitation of the

Sl.	Comments/suggestions	Responses
	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.	polder would greatly contribute to the development targets of 2021 and 2041. The involvement of the WMA for operation of the polder have been emphatically suggested in the study. In this regard, capacity building and training to the WMOs regarding gate operation, post project monitoring etc. has been included for their involvement in the project operation phase.
3	**Md. Habibur Rahman, PD, ECRRP, BWDB** The polder rehabilitation plan is good initiative which has already been done by ECRRP. At present, CEIP polder rehabilitation work should be conducted considering climate change impact and sea level rise. He also mentioned that polder works should have scope for green belt along the polder which should be monitored by Water Management organization (WMO) for proper maintenances of the polder.	It has already been considered in the study.
4	**K.M. Fakhrul Islam, Chief Engineer, Central Zone, BWDB** How WMO will be involved in the rehabilitation work of all polders?	As per bid document of CEIP-1, there is no scope for involvement of WMO in rehabilitation works because the polder construction works will be implemented by the contractor, engaged through the International bidding process. However, capacity building and training to the WMOs regarding gate operation, post project monitoring etc has been included for their involvement in the project operation phase.
5	**Dr. Khondaker Azharul Haq, President, Bangladesh Water Partnership (BWP)** The presentation is quite good but why only few polders have been considered for rehabilitation out of 139 polders. We should take initiatives for engaging NGOs/private sector for monitoring of the polder maintenance as the WMO does not sustain in most of the cases. Coastal polders are very vulnerable due to climate change. So we should look for new operation system for polder rehabilitation.	A total of 17 most vulnerable polders have been selected for rehabilitation under CEIP-1. During selection of polders, a screening matrix in the form of multi -criteria analysis has been done considering the physical condition of the structures as well as environmental, social and economic conditions of the polder area. BWDB has planned to rehabilitate the remaining vulnerable polders after successful completion of rehabilitation works of polders under Phase-II, on priority basis. Climate change issue has been considered in rehabilitation of the polders.
6	**Md. Zaid Hussain Bhuiya, Deputy Chief Conservator of Forest (DCCF), Department of Forest** Social forestry based green belt system should be included in polder rehabilitation works process. He also proposed to	It has been considered in the project

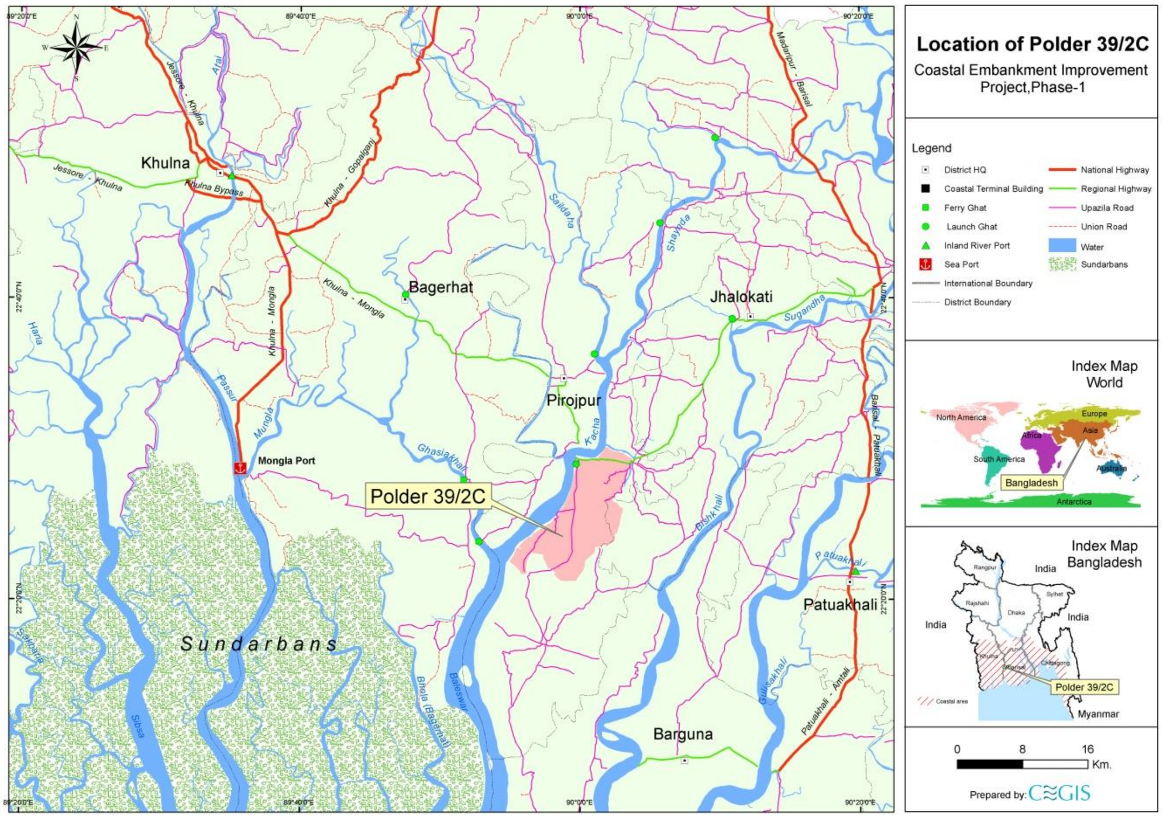
Sl.	Comments/suggestions	Responses
	initiate social forest co-management system along embankment and also in the protected areas.	
7	**Mr. Giasuddin Ahmed Chowdhury, Mott McDonald** Internal water management system is very important for rehabilitation of the polders. The polder works should include plan for eco system service providers	To ensure fresh water availability as well as enrichment of ecosystem inside the polder, provision for internal khal re-excavation has been considered in this project. The plan for eco-system service provider has also been made in the study.
8	**Abani Kumar Thakur, DCCF, Department of Forest (DoF)** We know that coastal Greenbelt is a measure to prevent coastal erosion and reduce other natural hazards by planting trees and creating forests along the coasts. As such more exclusive green belt project should be implemented which has recently been studied by DoF.	The rehabilitation of the polders inter-alia includes foreshore afforestation program, The green belt project may be implemented in future.
9	**Mohammad Alamgir, Principal Scientific Officer, WARPO** Fish management plan is still missing in CEGIS power point presentation. Thus he insisted a comprehensive plan including polder rehabilitation work along with fish management plan.	The detailed fishery management plan has been provided in the study which could not be presented in the dissemination seminar due to time limit.
10	**Professor Dr. KB Sajjadur Rasheed, Environmentalist and Advisor, CEGIS** CEGIS presentation was good for understanding. He enquired whether the crest level of the embankment of the polder has been designed considering climate change scenario.	Yes, the crest level of the embankment has been designed considering the climate change scenarios.
11	**Mr. Mahbub Murshed, Reporter, The Daily Naya Diganta** In future, the Koshi dam in Nepal and Ganges Barrage in Bangladesh would be constructed which will supply huge amount of fresh water to the south western region of Bangladesh. Whether this issue has been considered in the study ?	In the cumulative impact assessment of the EIA study, Ganges Barrage has been considered.
12	**Md. Harun ur Rasheed, BWDB** A separate tree plantation plan should be included here for cutting trees in the polder during intervention works. He also said why WMo are not working successfully in Bangladesh which is successfully working in other countries of the world?	A detailed tree plantation plan has been provided in the study report. The involvement of the WMO for operation of the polder has been emphatically suggested in the study. In this regard, capacity building and training to the WMOs regarding gate operation, post project monitoring etc. have been included for their involvement in the project operation phase.

Government of the People's Republic of Bangladesh

Ministry of Water Resources

Bangladesh Water Development Board

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



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

ADDENDUM TO

ENVIRONMENTAL IMPACT ASSESSMENT POLDER- 43/2C FOR PACKAGE-2

February 2017

The following recommendations are considered to ensure that all 6 EIA Reports in CEIP Package-2 fully cover environmental risks and impacts under the project and clearly communicate those risks and impacts and corresponding mitigation measures and that it's an effective management tool.

Strategic/Sectoral Assessment: The rationale of Coastal Zone Policy states three reasons as the basic principles:

a) Coastal zone is lagging behind in socio-economic developments
b) Poor initiatives to cope with disasters
c) Coastal zone has potential to contribute to national development.

The CEIP-1 Project fulfils all the three features/ criteria to be selected as development area.

Strategic or Sectoral Environmental Assessment in relation to the Coastal Zone Policy (2005) and the Coastal Development Strategy (2006) was not considered because the Coastal Development Strategy defines 9 priorities which mainstream environmental considerations, i.e. the following relevant ones:

-ensuring fresh and safe water availability

-safety from man-made and natural hazards

-improving of livelihood conditions of the polder dwellers

-environmental mitigation and conservation.

The CEIP-1 Project is conceived as a water infrastructure Project, aiming to retrofit the sluices, embankment, canals and bank protection with climate change impacts mitigation. In that sense, sustainability is incorporated. No fundamental modification of the basic concept of polderization is operated. When the 139 coastal polders were designed/built in 1970s, this all was done in a purely civil engineering approach. Ever since, IPCC report has been published and it has given impetus to more eco-engineering approach in design and construction. Idem ditto for the designs and construction under BWDB, however with core focus on water management infrastructures improvement (raison d'être of BWDB agency). This CEIP-1 Project design is adapted to the climate resiliency objectives with design of the infrastructures alone and its environment-compliant implementation. As the 139 Polders have undergone so many rounds of rehabilitations over the past 50 years, this is the living proof that the coastal polders have sustained half a century. This CEIP-1 brings in climate resiliency as added value to design and construction.

It can be assured that the CEIP-1 Project does not and will not worsen the present coastal situation whatsoever. Moreover, the said infrastructures are built inside the perimeter of the polders and no construction is done to protrude onto the surrounding rivers and existing waterscape/landscape systems and other surrounding sensitive ecosystems. On the operational level at construction sites, mitigation measures have been inserted in the EMP/EAP manual of all Contractors. This is a sufficient safeguard measure for pre, during, and post-construction stages.

Selection Criteria: All the 17 Polders in CEIP-1 including Polder 41/1 out of total 139 were selected by multi-criteria analysis based on physical conditions of existing infrastructures of the Polders. The physical conditions mainly include breach of embankment, overtopping, river erosion, wave action, internal drainage congestion etc. which relates to environmental components.

Past Experiences: In the tidal estuarine dynamics of the South West region of the country, a large scale water logging problem has been created through these polders.

CEGIS has recommended Tidal River Management (TRM) for sustainable solution of water logging problem.

Prior to the proposed interventions, polder areas faced several environmental adverse impacts as follows:

In general, the natural flow of rivers has been restricted for the construction of the Polders causing siltation of the river bed which create obstacles of navigation as well as drainage congestion.

There is no organized track record of the Government in managing such impacts but observation of the polders indicates that there has been increased siltation; reduction of open water fisheries, birds, wild animals; Reduction of soil fertility; deterioration of Water quality over time.

Brownfield vs. Greenfield: The Project mostly entails outright rehabilitation worksof infrastructure where their spatial domain already exists. The structure as indicated in Table 4.3 of EIA Reports is being replaced on the footprint of existing old structures. There are about 4.0 km of new embankment to be constructed; rest of the embankment is re-sectioning of the existing embankment. Hence, very few new impacts are likely to arise.

Gap Analysis: The differences between GOB/Local legal safeguards policies and the WB safeguards policies are highlighted in the Table below:

Comparison between GoB and WB Guidelines

After reviewing the laws of GOB and World Bank Safeguards guidelines, it is necessary to identify the similarities and differences between those so that the more stringent requirements can be applied for the Projects. In general OP 4.01 and OP 4.12 requirements are more comprehensive when compared with the requirements of Bangladesh legal system. The differences have been addressed by the measures proposed by the EIA reports and to be adopted by the Project. Table below lists some key comparisons between GOB and World Bank Safeguards guidelines.

Table: Comparison between GOB and World Bank Safeguards Guidelines

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
1	Type of Environmental Analysis	Project specific	Project specific, regional and sectoral
2	Basis for Categorization	Currently, screening criteria available only for industrial projects, where assessment is done based on: • Level of pollution emission • Type of project and location • Scale of project • Operational activities Non–industrial projects are reviewed on a case by case basis by DOE	Detailed screening criteria for all projects based on • Sensitivity • Nature and magnitude of potential impacts

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
3	EA Outputs	Since detailed rules and regulations for EA have not been prescribed, EA outputs are not specified. However, the industrial sector guidelines, the water sector guidelines and the road sector guidelines have specific EA output requirements, such as: • Baseline survey • IEE/EIA Report • Site clearance • Risk analysis and management • Analysis of alternatives	• EA Report • Analysis of alternatives • Environmental Management Plan
4	Public Consultation	No special mention is made for public consultation in BECA. Sectoral guidelines mentioned above have prescribed consultation.	Mandatory at the stage of • Preparation of EA • Project appraisal • Project design • Project implementation and monitoring
5	Disclosure of Information	BECA makes no reference to disclosure. The Sectoral guidelines prescribe some provisions for disclosure	Mandatory at • Summary of project description an potential adverse impact • Summary of EA report and conclusion • EA report
Social/Resettlement		**1982 ORDINANCE**	**OP 4.12**
6	Coverage	Legal owners Share-croppers Tenants	All affected parties, including squatters and illegal occupant
7	Compensation	Based on market values over previous 12 months No provision for restoration of income streams	Replacement cost at current market price Requires livelihood restoration component.
8	Uses of material from dismantled structures	Material is to be auctioned after being compensated for it	Material can be taken and re-used by affected party
9	Minimization of impacts	Discourages unnecessary acquisition but no mechanisms to monitor	Alternative analysis required to justify avoidance and/or mitigation of impacts
10	Cut-off dates	Not addressed	Important to ensure that squatters are included in compensation and to prevent rent-seeking behavior of additional squatters settling onto project land

Sl	Criteria	Requirements as per GoB law	Requirements as per OP 4.01
11	Consultation	No consultation required	Consultation as core issue in RAP preparation and implementation
12	Livelihood restoration	Not addressed	Livelihood restoration component and attention to post-resettlement required

Construction Camps: All Labor Sheds/camps will be built for the workers, although most of the local workers from the surrounding villages who prefer to stay in their houses. During construction of camps for accommodation of workers internationally recognized guidelines such as IFC/EBRD workers accommodation guidelines will be ensured.

Traffic Management: There are some bazars (markets) and shops beside the embankment of the Polders, which are important for socio-economic and livelihood of the people of the polder area. The construction activities along the embankment may temporarily disrupt the market activities causing hindrance to movement of the local people, who will suffer due to their limited roadway movements during construction.

Mitigation measures:

- The works on the embankment will be carefully scheduled in consultation and coordination with local representatives to minimize the impacts on local markets and transportation routes.
- The embankment works will be carried out in segments and the soil will be placed linearly on half of the embankment, leaving the other half to be used as track. After the completion of the first half, it will be opened for the local traffic and then the work for the other half of the embankment will be undertaken.
- Local routes will be kept free, as far as possible, if unavoidable, alternative routes will be identified in consultation with the local community.
- The Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock.
- The works shall not interfere unnecessarily or improperly with conveyance of public to use public or private roads or footpaths.
- Special consideration will be given for preparation of the traffic control plan to the safety of pedestrians and workers at night.
- The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the cross section.

In regards to the increase of Vehicular Traffic during mobilization – EIAs include procedures to ensure: adequate signaling for traffic and pedestrian safety, speed limits for project-related trucks when crossing heavily populated areas and dust control measures and to manage noise levels. This also applies to 6.4.5 Hindrance of Pedestrian and Vehicular Movement. These aspects are comprehensively covered by the EHS Guidelines, as per the said web-link:

http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

Mangrove Afforestation: Afforestation for polders 41/1, 40/2, 47/2 and 43/2C is envisaged. Mangrove vegetation has immense contribution to protect the embankments and char land from tidal surge, provides fuel and thatch materials to the local inhabitants as well as creates ideal habitats for the local avifauna and other wild animals. Given the importance of mangroves, and the fact that survival rates of replanted mangroves tends to be very low, Mangrove afforestation will be carried out as per a specific afforestation plan volume-V Part-C (1- Forestry). These activities will be guided by a Sr. Forestry Expert for which there is a provision under PMU.

EHS Guidelines: Section on *Environment, Health and Safety Guidelines* for all 6 EIAs polder will follow the EHS Guideline 1 (General). The link to the document is as follows:

http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

Pesticides: The CEIP-1 is basically an infrastructure improvement project and not an agricultural project. The handling of pesticides is not a part of project activities. Although intensive afforestation is a part of project activity, the provision of nursery is not included in project activities. The interventions under the proposed project may result in an increased availability of irrigation water through cleaning and excavation of watercourses in the Polder. This increased water availability can in turn potentially increase the usage of agro-chemical fertilizers and pesticides. To address this eventuality, linkages will be developed with the up-coming Consultancy Services (NGO), the TOR is consistent with Integrated Pest Management policy that would address the indirect impact highlighted by the EIAs.

The Department of Agriculture Extension (DAE) is mandated for all types of agricultural extension activities including the preparation and implementation of Integrated Pest Management Plan (IPMP) and Integrated Crop Management Plan (ICMP). The DAE conducts capacity building both for IPMP& ICMP. The scope of project activities did not include DAE. The DAE will start its activities after successful completion of the project.

However, the pollution will be cross checked through testing of soil and water parameters as approved by ECR, 1997, DOE, Bangladesh throughout the Project period (see table below).

Table: Standards for Inland Surface Water

Sl. No.	Designated best use classification	Values			
		pH	BOD (mg/l)	DO (mg/l)	Total Coliform (number/100m l)
A.	Source of drinking water for supply only after disinfecting	6.5-8.5	2 or less	6 or above	50 or less

Sl. No.	Designated best use classification	Values			
		pH	BOD (mg/l)	DO (mg/l)	Total Coliform (number/100m l)
B.	Water usable for recreational activity	6.5-8.5	3 or less	5 or more	200 or less
C.	Source of drinking water for supply after conventional treatment	6.5-8.5	6 or less	6 or more	5000 or less
D.	Water usable by fisheries	6.5-8.5	6 or less	5 or more	----
E.	Water usable by various process and cooling industries	6.5-8.5	10 or less	5 or more	5000 or less
F.	Water usable for irrigation	6.5-8.5	10 or less	5 or more	1000 or less

Source: Standards for Water Schedule 3 of Environment Conservation Rule 1997

Periodic Maintenance Works: The BWDB monitoring unit has postings of 4 Assistant Chiefs and 2 Deputy Chiefs to oversee the overall environmental compliance of BWDB implemented projects. Under CEIP-1, the Environment Social Communication Unit will provide training to the BWDB people responsible for monitoring of environmental compliance. Thus, a smooth transition to BWDB will happen to ensure environmental compliance during the O&M after the project completion. These staff will be responsible to manage the environmental aspects of the operation and maintenance of polder, its water control structures, and other relevant issues such as protection of key environmental resources of the older and maintain fish migration. Water Management Organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (November 2000) and involve the beneficiary communities. WMOs will be trained by BWDB to ensure environmental management during project operation. The Environmental Management Unit of BWDB will ensure and oversee the environmental management during project implementation and operation. The Water Management Organization will also be trained and involved in EMP implementation during the operation phase.

Mitigation Measures: Chapter 6 addresses location specific impacts and mitigation measures. Whereas, Table 10.1usually presents measures for environmental code of practices based on the experience and generic mitigation measures for EMP. Table 10.1 also uses in conjunction with polder specific measures. Thus, measures mentioned in Chapter 6 are not concur with each and every code of practices in the Table 10.1.