FINAL REPORT

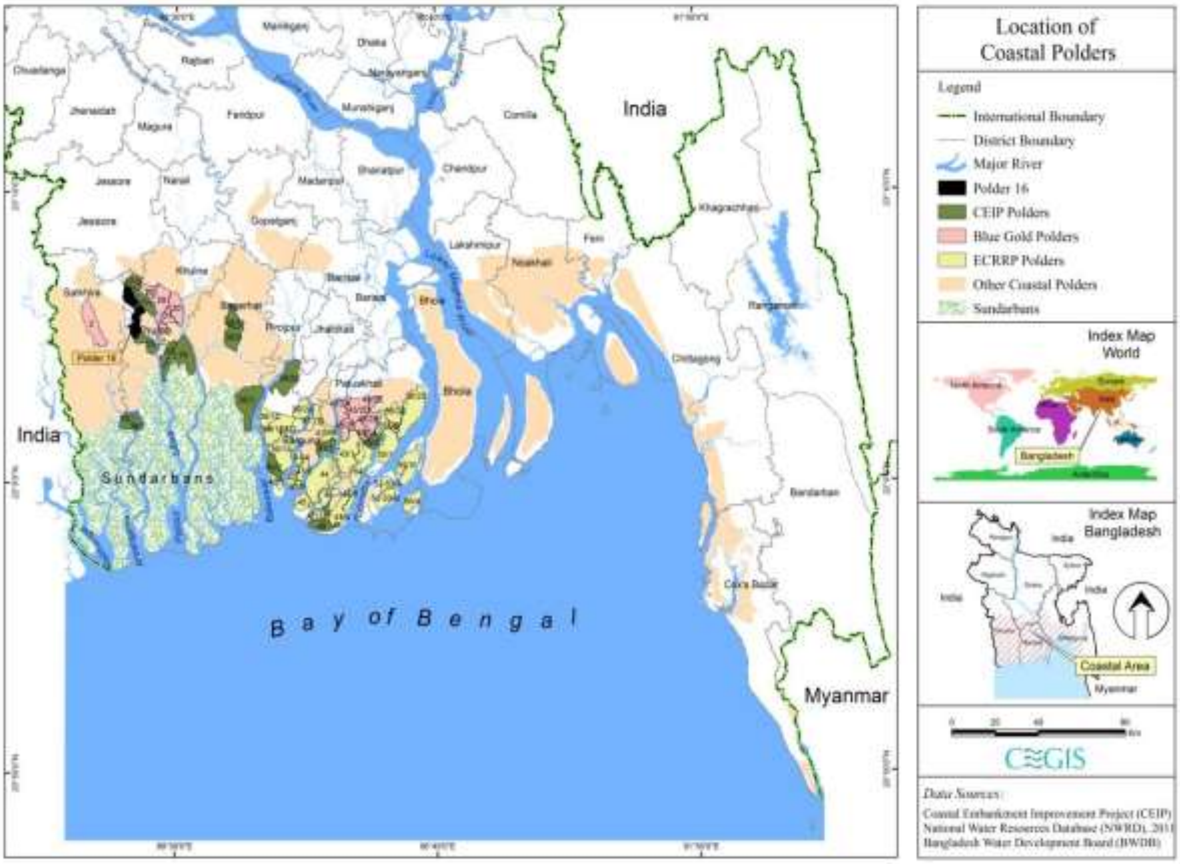
Government of the People's Republic of Bangladesh

Ministry of Water Resources

Bangladesh Water Development Board

COASTAL EMBANKMENT IMPROVEMENT PROJECT

PHASE-1



PACKAGE-3

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OF

POLDER-17/2

May, 2021

CEGIS Center for Environmental and Geographic Information Services

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Abbreviations and Acronyms

ADB	Asian Development Bank
ASA	Association for Social Advancement
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorology Department
BP	Bank Procedures
BRDB	Bangladesh Rural development Board
BRAC	Bangladesh Rural Advancement Centre
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CBD	Convention on Biological Diversity
CCP	Chittagong Coastal Plain
CDS	Coastal Development Strategy
CDP	Coastal Development Partner
CEGIS	Center for Environmental and Geographic Information Services
CEIP	Coastal Embankment Improvement Program
CEIP-1	Coastal Embankment Improvement Project, Phase- 1
CERP	Coastal Embankment Rehabilitation Project
CES	Consulting Engineering Services
CAFOD	Catholic Fund for Overseas Development
DAE	Department of Agricultural Extension
DC	Deputy Commissioner
DDCS&PMSC	Detailed Design Construction Supervision and Project Management Support Consultant
DevCon	Dev Consultants Ltd
DFID	Department for International Development
DOE	Department of Environment
DPHE	Department of Public Health engineering
DPM	Design Planning & Management Consultants
DTW	Deep Tubewell
DWM	Directorate of Water Management
EA	Environment Assessment
EAP	Environmental Action Plan
ECA	Environment Conservation Act
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules
ECRRP	Emergency 2007 Cyclone Recovery and Restoration project
EDS	Environmental Data Sheet
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment

EMF	Environmental Management Framework
EMP	Environmental Management Plan
ES	Environmental Screening
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
GO	Government Organization
GTPE	Ganges Tidal Plain East
GTPW	Ganges Tidal Plain West
ha	Hectare
HTW	Hand Tubewell
HYV	High Yielding Variety
IDA	International Development Association (World Bank)
IEE	Initial Environmental Examination
IESCs	Important Environmental and Social Components
ILO	International Labour Organization
IPMP	Integrated Pest Management Plan
IS	Institutional Survey
IUCN	International Union for Conservation of Nature
IWM	Institute of Water Modelling
JICA	Japan International Cooperation Agency
KCC	Khulna City Corporation
KII	Key Informant Interview
KJDRP	Khulna-Jessore Drainage Rehabilitation Project
LLP	Low Lift Pump
MC	Main Consultant (for CEIP-1 Feasibility study)
MDP	Meghna Deltaic Plain
MSDSs	Material Safety Data Sheets
MOEF	Ministry of Environment and Forest
MOWR	Ministry of Water Resources
MSL	Mean Sea Level
NCA	Net Cultivated Area
NGO	Non-Governmental Organization
NOC	No Objection Certificate
NWRD	National Water Resources Database
O&M	Operation and Maintenance
OP	Operational Policies
PAP	Project Affected Person
PCM	Public Consultation Meeting
PCD	Project Concept Document

PID	Project Information Document
PIO	Project Implementation Office
PL	Post Larva (fish seed)
PRA	Participatory Rural Appraisal
PWD	Power Works Datum
PRSP	Poverty Reduction Strategy Paper
RCB	Reinforced Concrete Box
RRA	Rapid Rural appraisal
SEA	Strategic Environmental Assessment
SEO	Secondary Education Office
SLR	Sea Level Rise
SMRPF	Social Management & Resettlement Policy Framework
SRDI	Soils Resources Development Institute
SSO	Social Service Office
STW	Shallow Tubewell
TDS	Total Dissolved Solids
TOR	Terms of Reference
UFO	Upazila Fisheries Office
UNDP	United Nations Development Program
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding
WAO	Women Affairs Office
WARPO	Water Resources Planning Organization
WMIP	Water Management Improvement Project
WB	World Bank
WMO	Water Management Organization
YDD	Youth Development Department

Glossary

Aila:	Major Cyclone, which hit Bangladesh coast on May 25, 2009
Aman:	Group of rice varieties grown in the monsoon season and harvested in the post-monsoon season. This is generally transplanted at the beginning of monsoon from July-August and harvested in November-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:	Boardcast Aus.
Bagda:	Shrimp (*Penaeus monodon),* brackish water species.
Baor:	Baor dead arm of a river in the Moribund Delta as in the case of the Ganges; also called oxbow lake. It appears as a saucer shaped depression. The term baor is synonymous to beel, familiar in the southwestern part of Bangladesh.
Bazar:	Market
Beel:	A saucer-shaped natural depression, which generally retains water throughout the year and in some cases seasonally connected to the river system.
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 low-lying *beel*s.
Haat:	Market place where market exchanges are 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 houses used 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: This is a small ditch in agricultural farm that retain water during dry period. Also used as fish-trap. This also refers to deeper sites in the beel areas wherein the water is retained all through the year including the dry periods. These are sites for the natural spawning of native fishes.

Kutcha Toilet: The earthen made latrine consist of a hole 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 constructed building using modern masonry materials.

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

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

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

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

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

Upazila: Upazila is an administrative subdivision of a district.

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

Units Conversion

1 m^2	= 10.77 ft^2
1 Decimal **(শতাংশ)**	= 435.60 ft^2
1 Decimal **(শতাংশ)**	= 40.47 m^2
1 Katha**(কাঠা)**	= 1.653 Decimal**(শতাংশ)**
1 Bigha **(বিঘা)**	= 33 Decimal**(শতাংশ), The area of Bigha changes in some locations**
1 Bigha **(বিঘা)**	= 20 Katha **(কাঠা)**
1 Acre **(একর)**	= 60 Katha **(কাঠা)**
1 Acre**(একর)**	= 100 Decimal**(শতাংশ)**
1 Hectare **(হেক্টর)**	= 247 Decimal**(শতাংশ)**
1 Hectare **(হেক্টর)**	= 2.47 Acre**(একর)**

Executive Summary

The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase-1 (CEIP-1), under which 17 Polders will be rehabilitated and improved in the coastal area of the country. The GoB is seeking financial assistance from the World Bank (WB) for this Project. In accordance with the national regulatory requirements and WB safeguard policies, the rehabilitation and improvement activities of 17 Polders will be implemented with three packages. EIA and EMP study for package one (Polders 32, 33, 35/1 and 35/3 and package two (Polders 43/2C, 47/2, 48, 40/2, 41/1 and 39/2C) have already been done. Polders 14/1, 15, 16, 17/1, 17/2, 23 and 34/3 are included in Package 3. In Phase-1 of CEIP Package-3 could not be implemented which are decided to implement in the next phase. In accordance with the national regulatory requirements and WB safeguard policies, EIA and EMP studies of seven Polders under Package 3have been carried out. This document presents the EIA report of Polder-17/2, which is one of these seven Polders of Package-3. It may be mentioned that preliminary 17 Polders were selected for rehabilitation in feasibility study considering physical conditions as well as damages of the Polder. Afterwards, these Polders were selected through screening matrix. In environmental point of view, a multi-criteria analysis was conducted which has been mentioned in Strategic Environmental Assessment (SEA) report for CEIP-1. The implementation of this EIA of Polder 17/2 would be moved to a potential second phase of the Project together with additional polders under design. The source of financing for the second phase is not yet determined.The EIA will be updated ahead of starting of physical work of potential second phase as per requirement of change of situation with passage of time

Background

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

The Polders were originally designed without proper attention to storm surges. Recent cyclonescaused substantial damage to the embankments and further threatened the integrity of the coastal Polders. In addition to breaching of the embankment due to cyclones, siltation of peripheral rivers surrounding the embankment caused coastal Polders to suffer from water logging, which led to large scale environmental, social and economical degradation. However, environmental consequences were not virtually considered in the Polder. 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.

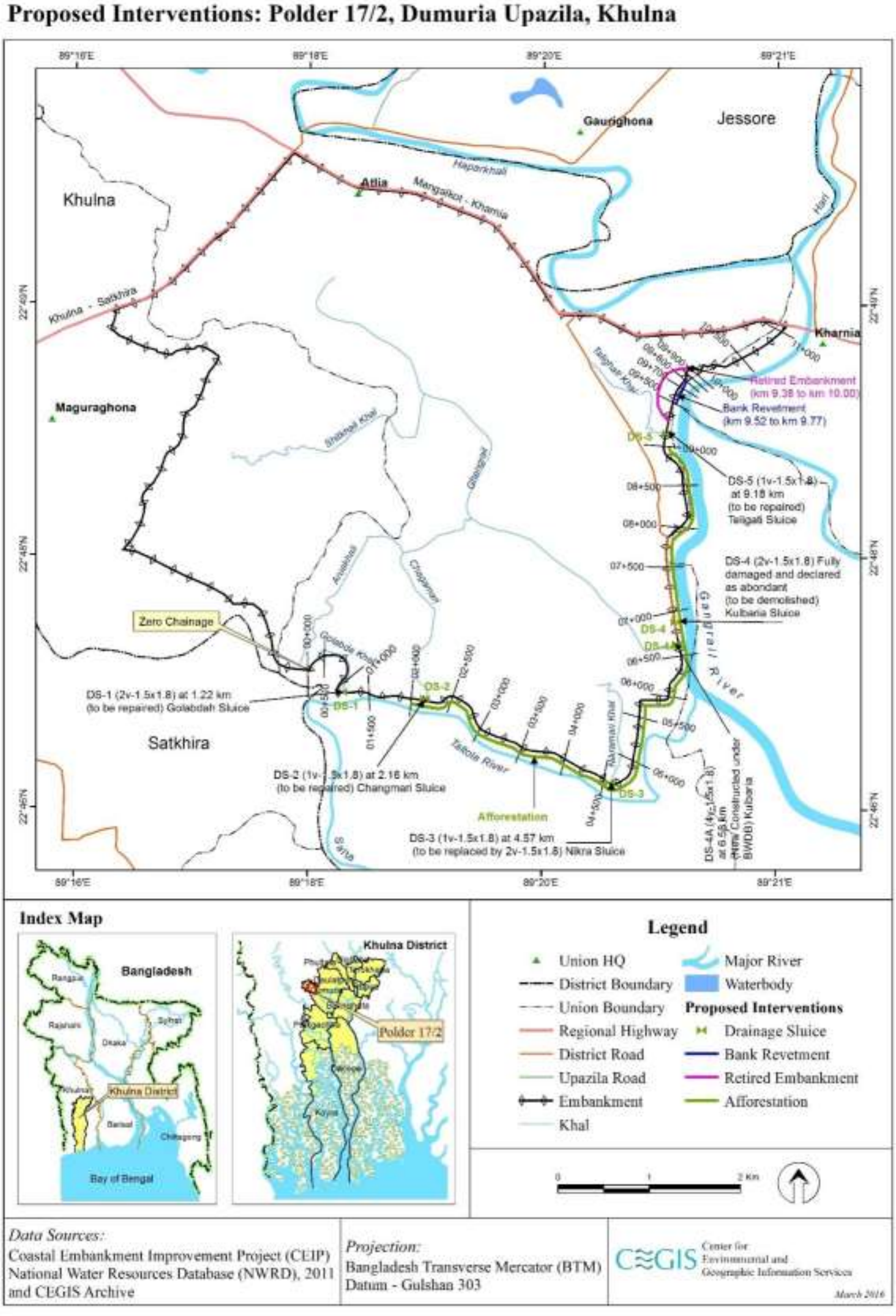
The above reasons led the Government to re-focus its strategy on the coastal area regarding high tides, storm surges and environment. The long-term objective of the Government is to increase the resilience of the entire coastal population from tidal flooding as well as natural disasters by upgrading the whole embankment system. With an existing network of nearly 5,700 km long embankments in 139 Polders, the magnitude of such a project is daunting and requires prudent planning. Hence, a multi-phased approach of embankment improvement and rehabilitation will be adopted over a period of 15 to 20 years. The proposed CEIP-1 is the first phase of this long-term program.

Location and Synopsis of Rehabilitation Work

Polder is located in Dumuria Upazila under Khulna District of southwestern Bangladesh. The Polder covers a gross area of 2,826 ha of which net area 1,551 ha. The Project aims to enhance protection against natural disasters, increase resilience during and after such disasters, and improve agricultural production by reducing drainage congestion. To meet up these objectives, the following key improvement and rehabilitation works will be carried out in Polder-17/2 under Package-3, CEIP-1

Type of Work	Length	Description of activities/works
Re-sectioning of embankment	10.38 km	Strengthening, widening and raising of existing embankment. Re-sectioning of entire embankment will be executed.
Construction of retired embankment	0.62 km	Whenever a portion of the existing embankment is subject to erosion, retired embankment is to be constructed at a safe distance from the river towards country side to link with the existing embankment on both sites. The retired embankment will be constructed from Ch 9+380 to 10+000
Construction/ repair of drainage sluices	4 nos. (construction: 1 and repair: 3)	A single (01) existing drainage sluices (D/S) will be replaced and three (03) sluices will be repaired under the proposed rehabilitation works of the Polder.
Slope protection	0.25 km	Slope protection work will be carried out at a stretch of 0.25 km from Ch 9.520 to Ch 9.770
Re-excavation of drainage channels	11.85 km	Five (5) drainage channels with a total length of 11.85 km will be re-excavated to ease water flow and reduce drainage congestion in the Polder area
Afforestation	8.85 ha	Afforestation will be implemented within the Polder to ensure the environmental sustainability as well as protection of embankment from erosion and tidal action

Designed crest level of embankment varies from 4.92 to 5.04 mPWD which has been assesd through mathmetical modeling concedering storm surge level and monsoon water level for 25-year return period under climate change scenarios. Sideslope of mbankment will be R/S 1:3 and C/S 1:2 respectively.


Proposed Interventions: Polder 17/2, Dumuria Upazila, Khulna
Gaurighona
Jessore
Khulna
Atlia
Mangalkot - Khamia
Haparkhali
Khulna - Satkhira
Maguraghona
Kharnia
Retired Embankment (km 9.38 to km 10.00)
Bank Revetment (km 9.52 to km 9.77)
DS-5 (1v-1.5x1.8) at 9.18 km (to be repaired) Teligati Sluice
DS-4 (2v-1.5x1.8) Fully damaged and declared as abondant (to be demolished) Kulbaria Sluice
Gangrail River
Zero Chainage
DS-1 (2v-1.5x1.8) at 1.22 km (to be repaired) Golabdah Sluice
Satkhira
DS-2 (1v-1.5x1.8) at 2.16 km (to be repaired) Changmari Sluice
Afforestation
DS-3 (1v-1.5x1.8) at 4.57 km (to be replaced by 2v-1.5x1.8) Nikra Sluice
Index Map
Bangladesh
Khulna District
Polder 17/2
Bay of Bengal
Legend
Union HQ
District Boundary
Union Boundary
Regional Highway
District Road
Upazila Road
Embankment
Khal
Major River
Waterbody
Proposed Interventions
Drainage Sluice
Bank Revetment
Retired Embankment
Afforestation
Data Sources:
Coastal Embankment Improvement Project (CEIP)
National Water Resources Database (NWRD), 2011
and CEGIS Archive
Projection:
Bangladesh Transverse Mercator (BTM)
Datum - Gulshan 303
CEGIS Center for Environmental and Geographic Information Services
March 2016

Technical and nontechnical manpower will be required for the construction works. Tentively, 220 manpower will be required during construction period of which 78 is skilled and 142 (including local and outside) is non-skilled/labour manpower. The skilled manpower will include senior professionals, Engineers, Technicians, Supervisors, Surveyors, Mechanics, Foremen, Machinery operators, Drivers mainly. A construction camp will be constructed inside the polder. It is mentoined here that labor sheds/camps will be constructed for house workers (skilled labour). There would be no requirement of labour camp for un-skilled labour because they will be recruited from the local area. But temporary labour camp for local labour during preparing of CC block will be established.

After implementation of the proposed interventions, local stakeholders' participation in the development and maintenance of this polder will be ensured. Three tier organizational structure comprising Water Management Groups (WMG) at the lowest level, Water Management Associations (WMA) at the mid and Water Management Federation (WMF) at the apex will be formed. The combination of groups, associations and federations in a particular sub-project is together termed as the Water Management Organization (WMO). Moreover, Community Based Organizationsoften termed as CBOs can also play a vital role in maintenance activities. CBO include ES (Embankment Settler); EMG (Embankment Maintenance Group); LCS (Landless Contracting Society); and CMG (Canal Maintenance Group).

Regulatory and Policy Framework

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

Baseline Conditions

The total area of Polder-17/2 is 2,826 ha of which 1,551 ha (55% of gross area) is Net Cultivable Area (NCA). There are two land types (F_0 and F_1) in the Polder areas. Soil texture is the relative content of particles of various sizes, such as sand, silt and clay in the soil. Texture is an important soil characteristic that determines crop selection, crop production and also field management. It influences many other properties of great significance to land use and management. The Polder area soil has two type of texture, clay and clay loam. The availability of soil moisture varies depending on the soil characteristics. Three types of soils with high, medium and low moisture contents are available in the Polder area.

Meterologically, the Polder area is located inKhulna BMD station. The highest rainfall has been recorded in the month of June (846mm) however, similar intensity of rainfall has also been observed in September (843 mm). Wet season ranges from the month of June (331 mm) to September (294 mm) which express the monthly average rainfall. The dry season lasts from November to April. There is a variation of temperature all the year round but not so widely in the study area. By analysing thirty years (1983-2013) of temperature data from BMD station Khulna, the mean maximum temperature ranges from 26.68^0C to 36.71^0C where the highest temperature has been recorded in the month of August (36.710C). The Polder is surrounded by two rivers named Gangrail River in the east direction of the Polder and Taltola River in the south direction. The offtake of Gangrail River is Bhodra River and the outfall is large Gangrail River. It is a tidal river and has diurnal effect on the peripheral khals i.e gangrail khal of the Polder. Apart from this, the offtake of the Taltola River is Salta River (south direction) and the outfall is Bhodra

River. At present, the capacity of Taltola River has reduced due to siltation and supply of very poor quantity of water to the peripheral khals.

The Bhodra River has dominated the hydrological features of this region whose offtake is Kobadak River. The tidal effect (from Bay of Bengal) of Bhodra river has influenced the Gangrail River and consequently the peripheral khals i.e. Gangrail khal, Telegati khal etc. During dry season the drainage khals are usually blocked off by the sluice gates due to prevention of saltwater entry, whereas in wet season, these khals are used to drain the surplus water out of the Polder area. However, in recent years, due to the damage of most of sluice gates maximum khals carry saltwater during dry season. Moreover, the khals are used illegally by some local dominant persons for shrimp culture and some artificial drainage khals have dug by them in the Polder area.

Drainage congestion is a common phenomenon in some of the portions of the Polder area. Both the Gangrail and Taltola River have tidal influence that inundates the drainage khals. Over the years, siltation makes the existing drainage khals incapable for drainage excess rainwater in monsoon period.

The Polder area occupies two Bio-ecological zones, i.e. Ganges Floodplain (1689 ha.) and Saline Tidal Floodplain (1137 ha.). Major portion of the study area falls over the zone namely Ganges Floodplain (60%), and restof the part falls over Saline Tidal Floodplain (40%). The major terrestrial habitat patterns in the study area are: Homesteads, Crop field, Road and embankment side vegetation.

North- South part of the Polder area possesses low dense vegetation, terrestrial species diversity both flora and fauna are deteriorating due to deforestation, expansion of shrimp farming, water logging, salinity intrusion etc. As a result, water bird, small mammals and reptiles are relocating from this area. Local people informed about increasing death of wild life due to food crisis and habitat loss. Total four number of brick fields arelocated in khornia village havealso negative impact on terrestrial ecosystem. Brick fields are using fuel wood (e.g. Bamboo, Tal, Narikel, Khejur, Assath etc) and coal for burning bricks. Coconut trees, Tal trees, Mango trees and other fruit yielding trees are all affected by the emission from brickfields in this area. Crops and fruits productions are also affected by the tons of smoke coming out of the chimneys.

The estimated total fish production of the Polder area is about 350.50 MT. Most of the fish production (about 95.58%) is from culture fisheries and very few (4.42%) is from the capture fisheries. Capture fisheries production is gradually declining over the year in the Polder area due to natural changes in river flow, disturbance in spontaneous fish migration, inadequate water in the rivers resulting from increased sedimentation in riverbeds due to reduced sediment deposition on floodplains protected by embankments and lack of proper operation and maintenance of sluice gates of the Polder.

The Polder area has belonged to5,895 households and the population size is 25,078 of which 12,753 are male and 12,325 are female. The rate of school attending both for male and female is equal in pre-school and primary level. However, attendance of female students started reducing from secondary level that comprises age structure 15 to 29 years. Almost 5,880 people (22.3%) of all workforces are economically active of which 9797 (39.1%) are Employed, 73 (0.3%) are looking for work, Household work 11,087 (44.2%) and rest of the people (4,120) are in do not work category. Females are less engaged in financial activities (3.5%) compared to males. Majority of females are engaged in household activities. Standard of living indicates the level of wealth, comfort, material goods and necessities available to the studied population. This section defines it narrowly and necessarily includes people' access to electricity, sanitation facilities, safe drinking water availability, housing condition and fuel consumption. There are some large mass graveyards in Bangladesh. 'Chuknagar Baddhavumi' is one of them (where huge number of human lives have been killed and buried by the Pakistani Army during 1971).

Potential Impacts and their Mitigations

Impacts during Pre-construction phase

The potential environmental and social impacts associated with the **pre-construction phase** of the project includedeterioration of environmental quality from , clearance of vegetation and increased vehicular traffic as follows:

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
	Pre-construction Phase	
Environmental Quality (Air and Noise)	Establishment and construction of site facilities in the Polder may potentially cause noise generation. In addition, noise level around the construction sites and in settlement areas will be increased for mobilization of equipment, machineries, construction materials and manpower. Besides, the ambient air quality around the construction site and nearby areas due to exhaust emission from truck/trawler/engine boats containing particulate matter and other ingredients. Fugitive dust emissions from the material stockyards would also deteriorate the ambient air quality of the locality.	● Construction material (sand etc.) should be covered while transporting and stock piled. ● The contractors need to be cautious to avoid unnecessary honking of material carrying trawler. ● The contractors should be encouraged to move all construction equipment, machinery and materials during day time instead of night. ● Stockyard should be covered during non-working period. ● Exhaust emissions from vehicles and equipment should comply with standards. ● Vehicles, generators and equipment should be properly tuned. ● Water will be sprinkled as and where needed to suppress dust emissions. ● Speed limits should be enforced for vehicles on earthen tracks. ● Vehicles and machinery should have proper mufflers and silencers.
Vegetation	Preparation of construction sites, labor sheds and material stock yards is expected to damage vegetation where the land will be used for these purposes (Details will be illustrated after getting RAP Report).	● Habitat will be restored by planting trees, grasses at the damaged sites after completion of construction works
Vehicular traffic	During contractor mobilization, some equipment, machinery, material, and manpower will have to be transported to the Polder by road or waterway resulting in additional traffic on roads and in waterways. This traffic may potentially cause traffic congestion particularly in roads and jetties. Moreover, most of the schools are located near the embankment approximately within 100 m to 500 m and two important bazaars (Ghorilal Bazaar, Jhorshing Bazaar) are	● The contractor will prepare a traffic management plan (TMP) and obtain approval from the DDCS&PMSC. ● The TMP will be shared with the communities, stakeholders and will be finalized after obtaining their consent. ● The TMP will address the existing traffic congestion particularly at the Ghorilal and Jhorshing Bazaars. ● Ensure minimal hindrance to local communities and commuters.

	also located beside the embankment which will face traffic congestion during *Haat* time.	• Work schedule will be finalized in coordination and consultation with local representatives and communities. Specifically, Union Parishad members of the Polder. • The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes and works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. • The works of the second half will be started after completion of first half. • Vehicular traffic should be limited in the Polder area and the embankment during off peak time. Appoint signalman during School time (10:00am to 13:00pm) and weekly market days (Hatbar)
Land use	Land would be needed to establish temporary facilities including construction camp i.e labor shed and borrow pit areas. It is estimated that about 12 labor sheds would be constructed to established temporary facilities for the rehabilitation works. Therefore, land use will be changed temporary.	• Establish the construction camps within the area owned by BWDB, wherever available. • Compensation/rent are to be paid if private property is acquired on temporary basis, the instructions should be specified in the tender document. • Construct labor shed/camp at government khas land. • Avoid impacts on local stakeholders.

Impacts during-construction phase

The potential impacts during construction phase include air pollution, noise pollution, disruption of drainage system, loss of crop production, disruptionof irrigation, damage to fish habitat and other aquatic fauna, clearance of vegetation, traffic congestion, conflict between local and outside labours, disturbance of local communication and causing safety hazards as follows:

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Noise and Vibration	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. The sensitive receptors including seven schools which are located close to the embankment (within 500 m) are likely to be more severely affected by noise.	• Demolition of the regulators should not be carried out during school time (8 am to 1 pm) particularly near the schools; • Restricting/limiting construction activities during day time; • Noise levels from vehicles, equipment and machinery to comply with the national and WB noise standards; • Vehicles and machinery should have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors, as needed; • Provision of PPE (ear muffs and plugs) to labor;

		• The construction crew should be instructed to use proper equipment, to minimize noise levels; • Camps should have to be located at safe distances from communities
Air Quality	Construction machinery and Project vehicles will release exhaust emissions, containing carbon monoxide (CO), sulphur dioxide (SO_2), oxides of nitrogen (NO_X), and particulate matter (PM).These emissions can deteriorate the ambient air quality in the immediate vicinity of the Project sites (particularly along the embankment, and around the channel excavation sites and borrow pit areas).Furthermore, construction activities such as excavation, levelling, filling and vehicular movement on unpaved tracks may also cause fugitive dust emissions.	• Exhaust emissions from vehicles and equipment should comply with standards. • Proper tuning of vehicles, generators and equipment should be carried out, to minimize exhaust emissions. • Construction materials (sand/soil) should be kept covered while transporting and stock piled. • Regular water sprinkling should be carried out as and where needed, particularly on the earthen tracks near communities. • Vehicle speed should be low (15 km per hour) on earthen tracks particularly near communities and school. • Vehicles and other machinery should be turned off when idle • Good quality fuel should be used for minimizing exhaust emissions. • Camps should be located at safe distance from communities and schools.
Soil and Water Contamination	Construction materials, demolished debris, fuel both from transportation vessel and construction machineries (piling machine, pump etc.) may degrade the soil and water quality. The construction workers will generate domestic solid waste and waste water including sewage. The amount of domestic wastewater generated by the construction workers is assumed to be equal to the amount of water usage. Oily water, waste oils, oily rags and other similar wastes will be generated from workshop. The stores and warehouse will generate solid waste such as empty cement bags, cardboards and wooden crates. Improper disposal of these waste streams can potentially contaminate the soils and water resources of the area. Soil and water contamination can potentially have negative impacts on the local community, natural vegetation, agriculture and biological resources of the area including aquatic flora and fauna. Borrowing material from the river banks may potentially cause increased turbidity in the rivers.	• Prepare and implement pollution control plan; • Workshops should have oil separators/sumpsto avoid release of oily water; • Avoid repairing of vehicles and machinery in the field; • Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination; • Dispose contaminated soil appropriately ensuring that it does not contaminate water bodies or affect drinking water sources; • Contractor should 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 should regularly monitor the condition of its fleet; • Material borrowed from the river banks should be carried out sufficiently away from the water edge, minimizing the possibility of loosing soil and wash out in the river; • Contractor should locate camps far away from communities and drinking water sources; • Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal); • Release treated wastes on ground or in water; • Recycle spoil and excavated material where possible; • Dispose spoil at designated areas with

		community consent; and ● Construction material, demolished debris and excavated soil/silt should not be allowed to enter the water bodies.
Drainage Congestion	The Project activities particularly on drainage sluices and in water channels may block or clog the drainage channels, potentially causing drainage congestion in the surrounding areas and negatively affecting the cultivation and the associated communities. The project works on the drainage sluices are likely to worsen the situation and exacerbate the drainage congestion problem. In addition, excavation of existing khals in the Polder is likely to disturb the drainage which takes place through these channels.	● Construct diversion channels before replacement of drainage sluices. ● Sequence of work on the drainage sluices and on the water channels should be carefully planned to avoid drainage congestion. ● Contractor should ensure that drainage channels are not obstructed or clogged by the construction activities which do not causes any drainage congestion situation in the crop fields.
Agriculture crop production	Borrow pits will generally be established on private land after agreement between the contractor and the private land owner, typically involving some compensation from the contractor to the land owner. During collection of earth from Borrow pits, agriculture crop production will be lost.	● It should be considered a priority to establish borrow-pits in foreshore areas ● Compensation would be made for any crop damage; ● Resettlement Action Plan should be prepared and should also be implemented accordingly ● Contractor would avoid cultivable fields during construction; ● Contractor would avoid agricultural land for material borrowing, material stockpiling and labor camps; ● Contractor would ensure that no vehicular movements take place through the cultivable fields; ● Contractor would ensure that no material is dumped on the cultivation fields; ● Re-excavated soil of canals should not be dumped in agricultural land and ● Contractor would maintain liaison with the local communities; ● Contactor will prepare site specific spoil management and disposal plans for each site to be followed upon approval by the DDCS&PMS Consultant and PMU.
Irrigation	Construction activities particularly on construction of drainage sluices (1 no.), repairing of Drainage Sluice (3 nos.), Demolish of drainage sluices (1 no) and re-excavation of drainage channel (11.85 km) can potentially disrupt the crop irrigation temporarily during both wet and dry season which would negatively affect cultivation.	● Contractor should construct diversion channels before construction/replacement of each regulator; ● Sequence of work of the regulators and the water channels would be carefully planned to avoid irrigation disruption; ● Contractor would ensure having no negative impacts on crop irrigation; ● Contractor would maintain liaison with the local communities; and ● Contractor would work during dry season.
Fish Feeding and spawning ground	Polder 17/2 is bounded by Salta and Gangrail River on the eastern part of the Polder. As per consultation with local fishers during field visit it is learnt that, the bank sides of these rivers have been reported as the feeding, nursery and spawning ground of brackish water fish	● Earth work should be conducted during the dry season (November-May) ● Sequence of work at the bank sides of Salta and Gangrail rivers will be planned considering local fisheries condition to minimize impacts on spawning and subsequently nursery ground of fish.

	species like *Chewa, Pairsha, Gulsha Tengra, Bagda, chingri*, etc. It is expected that activities of bank revetment would cause the partial destruction (if in the dry season) and full destruction (if in the rainy season) of the feeding, nursery and even spawning ground of these fish species.	Contractor will maintain liaison with experienced local fishermen. *The contractor will maintain proper sequence of work so that the earth work part of the revetment work could be done within minimum period as far as possible.*
Fish habitat and migration	Four drainage sluices, two additional drainage sluices and 4 flushing inlets will be constructed under this project to remove the drainage problems in the Polder area. But flushing inlets will be built on the khals which would impede fish migration in the Polder area. The impact magnitude of such activities on fish migration is assessed as Major. Similarly, *khal* re-excavation would also hamper fish migration temporarily during this phase, impact magnitude of which thus is assessed as Major. Fish species particularly the smaller ones are expected to take part in drifting migration with tides through diversion channels. These species are: Pairsa, Vetki (juvenile), Chingri, Gulsa, etc.	• Construct diversion channels before construction of regulator considering fish migration period e.g. May, June, July and August • Most of the Small Indigenous Species (SIS) of fish spawn during the period of November to April and keep important role in the recruitment to next progeny. For this reason, limit the construction and re-excavation activities in the shallow area and/or maintain the alignment of bank side to keep space in other side for accomplishing migration to meet up the biological needs like spawning, feeding etc. • Dismantle the bunds and other obstructions built for supporting the construction of structures as soon as the construction is over. • In case of manual re-excavation of khals, compartment would be built and bailing out of water from one compartment to another for less damage to fish and excavate in cascading manner. • Re-excavation of drainage khals will follow the construction of regulators by spanning a shortest possible time. Re-excavation of Khals should be implemented by maintaining the alignment of side so that fish can utilize the space on the other side for its migration. As a result, construction activities will have minimum hindrance to fish migration. • Contractor will maintain liaison with fishers and farmers so that they could realize the issue for minimum impact to the shrimp farming and paddy cultivation.
Social unrest	• A numbers of skilled and unskilled labors will be required for the construction activities. Most of the labor will be needed for re-sectioning of embankment and constructing retired embankment. It is envisaged that about 60 percent construction workers will be recruited from within the Polder area while the remaining from other areas. The presence of outside laborers in the area may create friction and conflict between the local labor and outside labor., and between local community and outside labor. • Presence of number of labors from	• Proper awareness programs will have to be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, Upazila Nirbahi Officer (UNO) and BWDB local officials. • Cultural norms of the local community will have to be respected and honored. • GRM will be established to address the grievances of local as well as outside laborers. • Careful use of local natural resources and project resources, fuel, fuel-wood and electricity. • Restrictions to be imposed in consumption of

	outside can potentially cause encroachment in the privacy of local population particularly women and hence their mobility can be negatively affected.	alcohol and drugs. • Safe driving practices. • Respect for the local community and its cultural norms in which laborers are working. • Avoid construction activities during prayer time.
Hindrance for pedestrian and vehicle movement	• Construction activities along the embankments are likely to disrupt the activities of these market because four main markets are located in the Polder near the embankment. These markets play important roles by providing sources of livelihood for the Polder inhabitants as well as meeting the daily needs of the people. In addition, the tracks (mostly brick soled) on the embankments are the key transportation routes both for pedestrians and vehicles in the Polder connecting the communities and the markets. The construction activities along these embankments will result in removal of these tracks thus causing communication and transportation problems to the local population.	• The works on embankment will be carefully scheduled to minimize the impacts on local markets and transportation routes. • The embankment works will be carried out segment wise and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. When the works of the first half are completed, it will be opened for local traffic and the works of the other half will be undertaken. • Work schedule will be finalized in coordination and consultation with local representatives and communities. • Local routes will not be blocked as far as possible. If unavoidable, alternative routes will be identified in consultation with local community. • No unauthorized entry of the local people/unwanted personnel at the camp site/work site will be allowed. • Work sites and movement routes to be clearly demarcated, with appropriate warning signs (in Bangla and Chinese) at strategic locations. • GRM will be put in place.
Vegetation	• Re-sectioning of embankment will damage all undergrowth vegetation both at embankment slopes and the sites from which the soil would be collected. been covered with concrete blocks for slope protection. Embankment toes at Sakbaria, Matiabhanga, Gharilal and Jorshing villages follow strips of dense but small size (not more than 3m height and DBH 4cm) Gewa (Excoecaria agallocha) plants. These strips have been created naturally by germination of floating seeds from nearer mangrove forest. These saplings will be cut down/damaged during embankment re-sectioning. • Collection of soils from foreshore area will also cause vegetation damage of these locations. Most of the foreshore area of this Polder is under plantation program by Climate Resilient Ecosystems and Livelihood (CREL) Project.	• Collect soil from barren land and alternate source like riverbed or nearby burrowpits at countryside as much as possible. • Keep close liaison with CREL Project Authority and Forest Department during implementation of earth works. • Needs approval from the DDCS&PMSC for vegetation clearance, if needed • Create plant strips with same species at the toe of the embankment after completion of earthwork. The community members may be involved for protection of the saplings. • Proper turfing should be made on the embankment slopes with local grasses (i.e., Durba (Cynodon dactylon), Mutha (Cyperus rotundus)) and ensure regular monitoring of turfed grasses till they matured. • The top-soil at the construction and rehabilitation sites should be stored and used for plantation activities. • Choose barren land for CC Block manufacturing and material storing. • Implement plantation with native species along countryside slope of the embankment after finishing of construction works.
Fish Movement	Most of the brackish and freshwater fish species migrate through the khals at some	• Construct diversion channels before construction of regulator considering fish

and Migration	stages of their life cycle for spawning, nursing and feeding purpose. River resident fishes migrate from the adjacent rivers to the polder area through the existing khals during pre-monsoon and monsoon periods. The migratory route for fishes would be obstructed due to construction and repairmen of drainage sluice gates and re-excavation of 11.85 km connecting khals. As a result, lateral movement and migration of most of the brackish and freshwater fish species would be directly hampered.	migration period e.g. May, June, July and August ● Most of the Small Indigenous Species (SIS) of fish spawn during the period of November to April and keep important role in the recruitment to next progeny. For this reason, limit the construction and re-excavation activities in the shallow area and/or maintain the alignment of bank side to keep space in other side for accomplishing migration to meet up the biological needs like spawning, feeding etc. ● Dismantle the bunds and other obstructions built for supporting the construction of structures as soon as the construction is over. ● In case of manual re-excavation of khals, compartment would be built and bailing out of water from one compartment to another for less damage to fish and excavate in cascading manner. ● Re-excavation of drainage khals will follow the construction of regulators by spanning a shortest possible time. Re-excavation of Khals should be implemented by maintaining the alignment of side so that fish can utilize the space on the other side for its migration. As a result, construction activities will have minimum hindrance to fish migration. ● Contractor will maintain liaison with fishers and farmers so that they could realize the issue for minimum impact to the shrimp farming and paddy cultivation
Timber/ fruit tree	The embankment/ polder road is dominant with timber tree like Babla (*Acacia nilotica)*, Akashmoni *(Acacia auriculiformis)* etc. About one sixty-two (162) number of treesof different size and height will be damaged/cut down for construction of water control structures (replace).	● Give proper compensation to the tree owners against tree felling. It is mentioned here that a detail Resettlement Action Paln (RAP) is being prepared for Package-3 under CEIP. According to plan, payment to owners against tree felling will be established. ● Implement plantation with native species (i.e Sirish (Albizia lebbeck), Narikel (Cocos nucifera), Tal (Boassus flabelifer), Khejur (Phoneixsy lvestirs), etc) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works. ● Avoid construction activities during favorable time of wild life movement (early morning and night)
Aquatic flora and fauna	All proposed khals are shallow and no aquatic vegetation is observed because of tidal flow and salinity. But this type of wetland to support with success saline tolerant fauna as well as a number of crabs, fishes (details fisheries section), mudskippers and shorebirds like Skipper frog, Bullfrog, Kingfisher, Egret, common aquatic snake, etc. The proposed interventions namely khal re-excavation would damage the aquatic flora and	● Keep untouched the deepest points of the khal as much as possible. ● Use excavated soil spoils for khal dyke re-sectioning ● Implement tree plantation with local species at the khal bank side after re- excavation work where excavated soil dumped khal bank side. ● Use minimum land as much as possible for excavator/ labor movement

	fauna.	
Safety and Health Hazards	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. 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. 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.	● The contractors should prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants. The Plan should also include awareness building and prevention measures, particularly for communicable diseases such as hepatitis B and C, and HIV/AIDS. ● The WBG's EHS Guidelines should be included in the contract documents and that should be followed during construction. ● Each contractor should prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan should be submitted to the Construction Supervision Consultants for review and approval; ● 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. ● Liaison should be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets should be kept in all the labor camps for obtaining weather information. ● The construction sites should have protective fencing to avoid any unauthorized entry, where appropriate and possible ● Health screening of employees would be a Contractors obligation prior to laborers 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 where required; ● The WBG's EHS Guidelines will be included in the contract documents. Each contractor will prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan will be submitted to Construction Supervision Consultants for review and approval; ● All employees need to provide induction training on health and safety prior to commencement of work. OHS issues would be part of the employee training plan. Training would include the provision of appropriate written or visual materials to reinforce learning. Illiteracy levels where high, the OHS issues should be covered more frequently than normal in toolbox talks; ● The labour shed/camps for accommodation of workers should be constructed according to the IFC/EBRD workers accommodation

		guidelines. ● Public awareness training and workshops on safety and health risks should 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) should 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 the rigorous standards for occupational health and safety are in place; ● Contractor should establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. ● The contractor should 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; ● Develop a recruitment process community employee that involves local authorities in clearly understood procedures; ● Employ a community liaison officer (which 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; ● Regularly report the labor force profile, including gender, and location source of workers; ● Report regularly the labor and working condition key performance indicators, for

		instance hours worked (regular and overtime) during period and cumulatively, hours lost, number and type of accidents, near misses, site audits and meetings; trainings, and use of labor grievance mechanism; ● Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase; ● Organize 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 work environment taking into account the inherent risks for this type of project. ● Availability of safe drinking water should have to be ensured for the construction staff. ● First aid boxes should have to be made available at each construction site. Emergency phone numbers (including hospitals, Fire services, and Police) should have to be displayed at key locations within the site. Each site should be occupied with an ambulance. ● Firefighting equipment should have to be made available at the camps and worksites. ● Waste management plan is to be prepared and implemented in accordance with international best practice. ● Liaison with the community should have to be maintained.
Natural hazard	Historically, this area is vulnerable to cyclone, storm and tidal surges. As per construction schedule, the development activities of the proposed new polder will be conducted from October to May while most of the cyclone and storm surges are occurred in this area. According to previous record of occurrence of cyclone and storm surges, October to November and April to May are the pick months of occurrence of cyclone and storm surges. It is suspected that the construction activities during this period may hamper as well as the workers may be injured	● Weather signals should have to be considered by the contractor during construction works. ● Radio and television should have to be kept in all labor sheds for getting weather information through these media. ● Ensure rigorous standards for occupational health and safety are in place. ● Having the Contractor establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.

Impacts during operation phase

During operation phase, the project would have positive and negative impacts on environmental and social components. The negative/adverse impacts with mitigation measures are described as follows:

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Embankment	Embankment failure or breaching of	● Regular monitoring and rigorous

Failure	embankment is a common threat in the coastal region that is caused due to runoff, wave action, tidal surge and unauthorized activities like entering saline/brackish water through pipies across the embankment by local people making the embankment weak. Lack of regular maintenance has created weak point at the sensitive locations of the embankment where the set back is less than 15m to 25m. Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously have accelerated the risk of embankment failure.	maintenance of the embankment and existing water control structures especially along the southern and western side of the Polder should be ensured. This monitoring will particularly be carried out before and after monsoon season. • Proper dumping and compaction of soil should be ensured during re-sectioning of the embankment. • Side slope protection works should be maintained with proper design. • Available cyclone and flood shelter should be prepared as a contingency measure during emergency situation. • WMG should develop fund for such emergency situation. • Structural measures like geo bag and sand bag should be kept in the Upazila office for emergency need.
Agro chemicals	Implementation of the project interventions especially re-excavation of channels would cause expansion of area under irrigated cultivation of Boro (HYV) and T.Aus (Local) varieties of rice. The expansion of irrigated area would increase use of chemical inputs including fertilizers and pesticides. Runoff from such cultivation fields might potentially pollute the water bodies and even drinking water sources thus causing health hazards to the communities.	• 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/WMO would have close contact with DAE for adoption of various measures of ICM. • Farmers would be encouraged to use organic manure to increase soil fertility while avoiding water contamination. and • Farmers would be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.
Salinity intrusion	Mal-operation and leakage of regulators will result in salinity intrusion during dry season, causing severe damage to the soil, water resources, and crops in the Polder. The proposed project has been designed to address such damages which are currently caused by the salinity intrusion. Mishandling and poor maintenance of these control structures will undermine the very objective of the Project.	Regular monitoring and careful maintenance of the water control structures will be ensured. Standard operating procedures will be prepared and implemented for the water control structures. These procedures will be translated in bangle as well. • Capacity building of WMOs will be carried out.
Fish migration time and extent	The improved drainage sluices would thus hamper the migration behaviour of above-mentioned fish species as well as other aquatic fauna. Moreover, the migration of *Pairsa, Vetki, Gulsha, Tengra, Chingri*, etc., would be very much restricted with the replacement of the proposed drainage sluices.	Follow sluice gate operation manual (Appendix-E) for allowing fish migration; Construct fish pass for fish migration Provide training to WMOs for fish friendly operation of sluices; Transferring/stocking juvenile fish from

		rivers to the Polder.

Cumulative Impacts

The cumulative impact of several existing and ongoing projects, as well as the proposed project of CEIP-1 around the proposed rehabilitation Polder, will be assessed. Such projects may have impacts on the hydrological network, flooding situation, life and livelihood of people, environmental quality, natural ecosystem, flora-fauna, etc. of Polder 17/2 were considered in this study. Apart from CEIP interventions, there are some other development projects in the region of Polder 17/2, implemented locally or regionally. Impact on hydrology and flooding situation due to construction and implantation of proposed and existing projects were assessed.

Polder 16 and Polder 17/1 are located very adjacent to the Polder-17/2 at South directions which are also considered for improvement planning. Both Polders are situated at the downstream of Polder-17/2. The Gangrail river is flowing at downstream of Polder-17/2 to Polder 17/1. The tendency of storm surge effect is higher to Polder 17/1 than others. However, the protective works i.e. higher crest level, slope protection work of Polder 17/1 may divert flow direction to Polder-17/2 through Gangrail River.

Polder 26 under Blue Gold program is very adjacent to Polder-17/2 in the South-East direction and therefore may generate some impacts in future. The protective works i.e. higher crest level, slope protection of Polder 26 may create induced hydraulic pressure to Polder-17/2. The Gangrail River interact these two polders closely. The tidal effect of Gangrail River may affect the embankment of Polder-17/2 through several perennial canals i.e. Gangrail and Telegati canal. Therefore, the project may impact on hydrology and flooding situation in the surrroung of the polder.

A small amount of sand and cement can be procured from the local market adjacent to the Polder or Khulna during executions of construction works. No significant impact will be caused due to sand procurement of sand and cement from the local market.

The socio-economic condition of Polder 17/2 will be ameliorated due to the overall development of this region, i.e., construction works of Polder 17/2 will attract labors from outside as well as local people will also get a working opportunity.

Shrimp culture in Polder-17/2 during dry season is a very common practice like other surrounding Polders. The shrimp culture is not labor intensive, thus creates more unemployment problem. In the dry season, a number of places in the embankment were cut down to allow the entry of saline water through Telegati, Gangrail khal etc which may bereduced the strength of the embankment by creating weak points.

Risk Assessment

From the study, it is expected that the project interventions would have positive and potential adverse impacts which have been identified and quantified as well as their mitigation measures have also been suggested in this report. Yet, challenges or risk do remain in three sectors, these relate to (a) navigation (b) water management organizations (WMO) and (c) Fish migration and movement as briefed below:

Issue	Risk	Mitigation Measures
Fish Migration and movement	*The peak velocity considered in designing of drainage sluices ranges from 3-4 m/s. The sustainable velocities of the indicative fish species are estimated in the range of 0.46 m/s to 1.1 m/s and burst velocities are in the range of 1.75 m/s to 4.2 m/s (Section 6.2.10).* *The peak velocity of the sluice gate would hamper to fish migration and movement inside the polder.* *It is noted that burst velocities of fish are applicable for capturing prey as the duration is only for seconds*	• The fish pass friendly aspects in the structures to be constructed in the Polder for the proper management of water. • The structure may be done either by constructing drainage sluices by maintaining the velocities passable for the mentioned indicative fish species or by constructing fish pass structure. • In case of sluice gates, based on catchment flow optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes. • In constructing fish pass, fish swimming speed or velocity and depth preference should be considered. In case of the indicative fishes velocities are mentioned in Table 6.14 and the depth preferences are as follows: Plotosus canius: 2-10 m; Liza Parsia: 1.5-10 m; Mystus gulio: 1.5-10
Function of Water Management Association	*At the moment, there are no active WMOs on site, and their activities are almost non-existent. The disrepair and lack of maintenance of the Polder in the past due to financial inadequacies of the WMOs as well as insufficient support from the BWDB had contributed to the general decay of the Polder's structure and utility. In the past, there was usually no fund allocated for the WMOs' functions and needs.*	• Ensure the organization/formation of the WMOs before operation of the gates, training them in the operation of structures etc., as well as in records/accounts keeping, and collaboration with NGOs, and CBOs, and most importantly. This would help in developing ownership of the WMA for realization of benefits from the Polder without hampering the hydrological and environmental settings of the Polder • In addition to activation of WMOs, BWDB may recruit sluice khalashi for each of the Drainage Sluices for smooth operation of the gates as per initial practice • provide budgetary allocation in the post-operation phase for the O & M related tasks of the WMOs • Borrow pit, embankment slope, water bodies in the khas land may be provided to the WMOs as an income generating sources for

		their sustainability.
Navigation	*Drainage sluices and sluice gates are provided in the Polder, which are being rehabilitated under this project. The gates in those structures are also operated in regular intervals to restrict salinity intrusion. However, such gates or boat passes in the embankment for allowing navigation through the embankment to and from the Polder would allow large volumes of saline water inside the Polder and may damage the soil, water and land – destroying crops.*	• In order to maintain navigation scenario, an arrangement may be made for lifting of small size country boat from one side to other side i.e. river side to country side and vise-versa for navigation purposes. • This arrangement will not allow entry of saline water inside the Polder, and thus would not damage soil, water, land and crops.

Environmental Management Plan (EMP)

The environmental management plan (EMP) provides the implementation mechanism for the mitigation measures identified during preparation of the present EIA. A comprehensive EMP which focuses on managing construction phase-related impacts should suffice in managing the potential construction and operation phase impacts. The EMP will be attached with the Bidding Document. The environmental management parameter will be included in the BoQ. Since most of the contractors do not have clear understanding on the need of environmental management, some tend to quote very low price for implementation of EMP and eventually cannot implement EMP as per design. To avoid this problem, Fixed Budget will be assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting. The total cost of EMP implementation for Polder-17/2 has been estimated as BDT 4.5 million. The contractor needs to submit an Environment, Social Management Plan (ESMP) based on the EIA and EMF in line with the construction schedule and guideline. The ESMP needs to be reviewed by the DDCS&PMSConsultant and cleared by BWDB and World Bank. The tentative cost for Environmental Management is mentioned as follows:

Tentative Cost Estimates for Environmental Management

Item No.	Description	Cost Million BDT	Cost Million $	Responsible Agency	Timeframe
1.	Construction of alternative or bypass channels at each construction sites.	5.6	0.07	Contractor	During pre-construction and construction
2.	Installation of fugitive particulate matter system and Spraying water on embankment/road	0.5	0.00625	Contractor	During pre-construction and construction
3.	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites	Budget included in RAP		Contractor	During pre-construction

Item No.	Description	Cost Million BDT	Cost Million $	Responsible Agency	Timeframe
	/damage to dredge spoils				
4.	Awareness program on plant and wild life conservation.	0.02	0.00025	BWDB	During post-construction
5.	Consultancy services cost for supervision and monitoring of EMP	1	0.01	BWDB	During post-construction
6.	Training to the farmers with field demonstration regarding IPM and ICM.	0.4	0.005	BWDB with help of DAE	During post-construction
7.	Training to the fisherman/pond owner with field demonstration regarding pond culture.	0.04	0.0005	BWDB & WMO with help of UFO	During post-construction
8.	Solid and liquid waste disposal arrangement.	100,000	1.25	BWDB	
9.	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1	0.0125	BWDB	During post-construction
10.	Updating EMP as per requirement.	1	0.0125	BWDB	During post-construction
11.	Establishment of Fish Sanctuaries in khals for the Conservation of indigenous Fishes and stocking of Threatened Fish species and Brood Stock of Indigenous Small Fish Species (2 Nos. Sanctuaries-One sanctuary in each khals @ 0.1 million BDT)	0.04	0.0005	BWDB with cooperation of DoF	During operation
12.	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	1	0.0125	Contractor, BWDB	During construction and post-construction
13.	Training to WMA on “Integrated water Management and Operation and Management of Sluice Gates”	1.5		BWDB	During operation
14.	Compensation for trees	Budet Included in Afforestation		BWDBwith a consultation of Forest	During construction

Item No.	Description	Cost Million BDT	Cost Million $	Responsible Agency	Timeframe
		Plan		Department	
15.	WMOs monitoring cost	1	0.00625		
16.	Construction of fish pass friendly structure (one fish pass) Optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes	61	0.690112652	Contractor, BWDB	During construction
Total Cost		**74**	**0.826**		

Extensive monitoring of the environmental concerns of the Polder will be required as per World Bank guideline. The monitoring program will help to evaluate: (i) the extent and severity of the environmental impacts against the predicted impacts and baseline; (ii) the performance of the environmental protection measures or compliance with pertinent rules and regulations; (iii) trends in impacts; and (iv) overall effectiveness of the project environmental protection measures. The monitoring plans will be included in the EMP for specific sub-projects. Moreover, for all types of monitoring, a comprehensive database of the Polder specific Environmental Impact and Monitoring information will be created, which will help to evaluate the impacts easily.

The monitoring plan during during construction and during operation phases is presented in a tabular form as follow

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Pre-Construction phase					
Labor health and sanitation facilities	Work sites	Visual observations, digital camera and checking record book	Twice in project implementation period	BWDB, Contractor	BWDB, Consultant
Construction phase					
Sources of Material	Work Site	Possession of official approval or valid operating license of materials suppliers (Cement, soil).	Before an agreement for the supply of material is finalized.	Contractor	DDCS & PMSC and M&E Consultants, BWDB
Operation of borrow site	Borrow pit/site	Visual inspection of borrow site and ensuring operational health and safety	monthly	Contractor	DDCS & PMSC and M&E Consultants, 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	DDCS & PMSC and M&E Consultants, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	DDCS & PMSC, BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DDCS & PMSC, BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Daily	Contractor	DDCS & PMSC, BWDB
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DDCS & PMSC
Noise	Construction sites	Visual inspection to ensure good standard equipment are in use	Weekly	Contractor	DDCS & PMSC and M&E Consultant, BWDB
	Construction sites	Ensure work restriction between 09:00 pm-6:00 am close to School/ Madrasha, Hospital & Villages	Weekly	Contractor	DDCS & PMSC, M&E Consultant andBWDB
	Construction sites and nearby communities	Recording noise level of work sites and nearby communities, if applicable	At the beginning and monthly	Contractor	DDCS&PMSC, M&E Consultants and BWDB
	Manually CC block preparing sites	Ensuring proper quality of equipment/vehicle to reduce noise level	Throughout	Contractor	DDCS&PMSC, M&E Consultants and 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	DDCS & PMSC, M&E Consultant andBWDB
Drinking Water	Sources of	Sampling and	yearly	Contractor	DDCS & PMSC,

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Quality(TDS, Turbidity, pH, FC, as if groundwater etc)	drinking water at construction camp/site	analysis of water quality		through a nationally recognized laboratory	M&E Consultants and BWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid wastes and wastes is deposited at designated site	Weekly	Contractor	DDCS & PMSC, M&E Consultant and BWDB
	Manually CC block preparing sites	Proper management of waste and waste water	Weekly	Contractor	DDCS&PMSC, M&E Consultants and BWDB
Water Quality	Water bodies near nursery	Odor and chemical testing	Dry season	Contractor through nationally recognized laboratory	DDCS & PMSC, M&E Consultant and BWDB
Waste Management	Work site and Nursery	Visual inspection of collection, transportation and disposal of grasses, debris and is deposited at designated site	Weekly	Contractor	DDCS & PMSC M&E Consultant andBWDB
	Work site and Nursery	Visual inspection of Water bars & cut-offs. sediment traps to prevent water pollution caused by run-off from harvesting areas	Beginning of work	Contractor	DDCS & PMSC. M&E Consultants and BWDB
Top Soil	Storage area	Top soil of 0.15 m depth should be excavated and stored properly	Beginning of earthwork	Contractor	DDCS & PMSC, BWDB
	Storage area	The stored top soils should be used as cladding material over the filled lands	Immediately after filling and compaction of dredge materials	Contractor	DDCS & PMSC, BWDB
	Work Site	Some of the top soil are placed on top and berm of embankment for	At the end of filling activity	Contractor	DDCS & PMSC and BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
		turfing and plantation			
Clearance of vegetation	Each of construction sites at embankment (11 km.) and proposed khal bank (21 km.) of both side	Survey and comparison with baseline environment	Quarterly	Contractor through nationally recognized institute	DDCS & PMSC, M&E Consultant and BWDB
Plant species selection	Nursery	Visual quality checking of selected plant species and to be planted of selected areas	Before plantation	Contractor	DDCS & PMSC, M&E Consultant and BWDB
Waste Management for afforestation	1.Afforestation sites are: a) Boyarsing, b) Monohorpur, c) Baratia, d)Kulbaria villages, 2. Nursery	Poly bags, debris etc waste materials are disposed at selected sites	Weekly	Contractor	DDCS & PMSC and BWDB
Construction and repair of drainage sluices	Construction site	Physical Observation	Weekly	Contractor	DDCS & PMSC and BWDB
Bailing out of water from khals	Construction site	Physical Observation	Weekly	Contractor	DDCS & PMSC and BWDB
Re-excavation of khals	Construction site	Physical Observation	Weekly	Contractor	BWDB
Engaged local labour in the Polder area	Polder area	Checking address to record book and National Identity Card or Chairman certificate	During routine monitoring	Contractor	DDCS & PMSC andBWDB
Sanitation	Construction camp/site	Visual Inspection	Weekly	Contractor	DDCS & PMSCM&E Consultant andBWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid waste and other depositions at designated site	Weekly	Contractor	DDCS & PMSC, M&E Consultant andBWDB
Operation phase					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD	Water sample from each of river of each Polder	Sampling and analysis of surface water quality.	Dry season	BWDB through a nationally recognized	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
etc)				laboratory	
Crop production	In the Polder area	Compare the production with the baseline	3 (Three) cropping season	BWDB through a nationally recognized institution	M&E Consultant
Soil quality	In the Polder area	Compare the soil quality with the baseline	Two (2) times of year (dry & wet season)	SRDI, BARI, DU	M&E Consultant
Soil salinity	In the Polder area	Compare the soil salinity with the baseline	Onc (1) times of year (dry season)	SRDI, BARI, DU	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
Erosion	Along Alignment	Visual Inspection presence of gullies or erosion	Yearly	BWDB	M&E Consultant
Growth and death ratio of planted saplings and turfed grasses	Proposed afforestation areas are a) Boyarsing, b) Monohorpur, c) Baratia, d)Kulbaria villages	Survey and comparison with baseline environment	Yearly	Contractor	DDCS & PMSC, M&E Consultant and BWDB
Fencing preparation		Visual inspection of fencing condition	Monthly		
Faunal diversity	Proposed afforestation area	Survey and comparison with baseline environment	Yearly		DDCS & PMSC, M&E Consultant and BWDB
Fish Species Diversity	Khals and Sluice Gates adjacent River	Catch Assessment and Physical Observation	Two times per year (dry & wet season)	BWDB/ WMA	BWDB with collaboration of DoF
Habitat Condition	Khals and Sluice Gates adjacent River	Physical Observation and Testing of Water Quality Parameter (i.e. DO, pH, Salinity and Turbidity	Quarterly four times per year (dry & wet season)	BWDB/ WMA	BWDB with Collaboration of DoF

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
		etc.)			
WMOs formation and activities	Polder area	Activities of WMOs	Every three month per year	BWDB with the help of GO/NGO	BWDB and Consultant
Fish swimming speed or velocity	In the project area	Measurement of water velocity	Once in a Week	WMO with help of UFO	M&E Consultant
Operation of fish pass	In the project area	Visual inspection and fishermen feedback	Reound the year	BWDB	M&E Consultant

BWDB will prepare a Bi-annual Monitoring Report on environmental management and will share this with the World Bank for review during construction phase. The effectiveness of screening, monitoring and implementation of the EMP along with the project component activity monitoring will be carried out by a third-party monitoring firm annually. The Annual Environmental Audit Report prepared by the third-party monitoring firm will be shared with the safeguard's secretariat. The Third-Party M&E Consultants will be responsible for independent monitoring of the implementation of EMP. The tentative cost estimates for Environmental monitoring is as follows:

Tentative Cost Estimates for Environmental Monitoring

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
1	Soil quality monitoring including N,P,K, S, Zn, salinity, organic Matter, pH etc. samples in Polder 17/2 = 6 samples x 3 times @ Tk.5,000	300,000	3.75	Contractor	During pre-construction, construction and post construction period phases
2	Monitoring of Fish Biodiversity, Fish Migration, Fish Production	800,000	10	Contractor with help of UFO	During construction and post-construction
4	Fish swimming speed or velocity and depth preference	150,000	1.8	Contractor with help of UFO	During post-construction
5	Crop Production/Farm Survey for four (4) times of year (dry & wet season).	60,000	0.75	Contractor with help of UFO	During post-construction
6	Air and noise quality monitoring and analysis.	500,000	6.25	Contractor	During construction
7	Surface and ground Water quality monitoring cost (testing for Turbidity, pH, DO, BOD, Salinity etc. + test of As, e etc. for HTWs at workers' camp site) 6	500,000	6.25	Contractor	During construction and post-construction phases

	samples in Polder-17/2 during pre-construction, construction and post-construction periods + water quality analysis of HTWs of 10 workers' camp				
8	Benthic fauna analysis	200,000	0.0025	Contractor & DOF	Before, during and regularly after construction
9	Diversity of Flora and fauna	200,000	2.5	Contractor	During construction and post-construction phases
	Total Cost	**2,710,000**	**31.3025**		

The project activity will be implemented through systematic and effective organizational structure of BWDB headquarters to field level. The Project Management Unit (PMU) will implement the project and the Project Steering Committee (PSC) under the Ministry of Water Resources will oversee and monitor overall activities. The Environmental, Social and Communication Unit (ESCU) to be established for implementation and management of 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 mitigating measures. At least one of the two environmental specialists must be on board. The specialists will prepare sub-project specific environment screening 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 EMP and ensure quality of the environmental screening.

Stakeholder Consultation and Disclosure

Three tiers of consultation process e,g FGD/Informal discussion, PCM (Public Consultation Meeting) and PDM (Public Disclosure Meeting)were conducted under this study. A Focus Group Discussion (FGD) and five (05) informal discussion were carried out at different locations of Polder. One PCM at Union level was conducted with the participation of local people, representatives of local government (Union Parishad) and representatives of the BWDB with the objective of disclosing the impacts of the project and the EMP.Local people showed interest in the project and were positive minded for its implementation which is vital for their survival. They also expressed that if the monitoring plan is implemented properly during the pre-construction, construction and post-construction periods then they would support the implementing agency positively.

A Regional level Public Disclosure Meeting (PDM) on the EIA report of Polder 17/2 was held on 26th July, 2017 in Dumuria Upazila, Khulna. The participants of the PDM included Upazila Nirbahi Officer (UNO), Upazila Chairman, Upazila Vice Chairman and other concerned government officials, Journalists, NGO representatives, environmentalists, activists, local stakeholders and other representatives. No national level disclosure meeting yet to be done.

1 Introduction

1. The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase 1 (CEIP-1) (here in after referred as ‘project’), under which 17 Polders will be rehabilitated and improved in the coastal area of the country by 3Packages. Preliminary 17 Polders were selected for rehabilitation in feasibility study considering physical conditions as well as damages of the Polder. Afterwards, these Polders were selected through screening matrix. In environmental point of view, a multi-criteria analysis was conducted which has been mentioned in Strategic Environmental Assessment (SEA) report for CEIP-1. It may be mentioned that SEA has been carried out before conducting the EIA study and IEE report was prepared and submitted to Department of Environment (DoE) and obtained site clearance. The rehabilitation and improvement activities of 17 Polders will be implemented in 3Packages.EIA and EMPs study for Package 1(Polders 32, 33, 35/1 and 35/3) and Package 2 (Polders 43/2C, 47/2, 48, 40/2, 41/1 and 39/2C) have already been done. Polders 14/1, 15, 16, 17/1, 17/2, 23 and 34/3 are included in Package 3. In accordance with the national regulatory requirements and WB safeguard policies, EIA studies of the 7Polders under Package 3have been carried out. This document presents the EIA report of Polder 17/2.

1.1 Background

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

3. In the 1960s, Polderization started in the coastal zone of the country to convert this area into permanent agricultural lands (refer Map 1.1 for coastal Polders) to increase the agriculture production. The Polders in this area are enclosed on all sides by dykes or embankments, separating the land from the main river system and offering protection against tidal floods, salinity intrusion and sedimentation. Without embankments the coastal communities would be exposed to diurnal tidal flooding. The Poldered lands are slightly higher than sea level. The Polders were designed to keep the land safe from daily tide to allow agriculture activities. 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 attention to storm surges. Recent cyclones have substantially damaged the embankments and further threatened the integrity of the coastal Polders. In addition to breaching due to cyclones, siltations of peripheral rivers surrounding the embankments have caused failures of the drainage systems, creating water logging inside the Polders. This has led to large scale environmental, social and economic degradation. Poor maintenance and inadequate management of the Polders have also caused internal drainage congestion and heavy internal siltation. Soil fertility and agriculture production are declining in of water-logged areas. Other areas suffer from salinity increase due to incursion of sea water into the Polders.

5. The above reasons have led the Government of Bangladesh (GoB) to readjust its strategy on the coastal area from only ensuring protection against high tides to providing protection against frequent storm surges as well. The long-term objective of the GoB is to increase the resilience of the entire coastal population to tidal flooding as well as natural disasters by upgrading the whole embankment system. With an existing network of nearly 5,700

km long embankments in 139 Polders, the magnitude of such a project is daunting and requires prudent planning. Hence a multi-phased approach of embankment improvement and rehabilitation will be adopted over a period of 15 to 20 years. The proposed CEIP-1 is the first phase of this long-term program.

Map 1-1: Coastal Polders

1.2 Project Overview

6. Polder is located in Dumuria Upazila under Khulna District of south-western Bangladesh (Map 1.2). The Polder covers a gross area of 2,826 ha of which net agricultural area is 1,551 ha. The Project aims to enhance protection against natural disasters, increase resilience during and after such disasters, and improve agricultural production by reducing drainage congestion. To achieve these objectives, the following key improvement and rehabilitation works will be carried out in Polder-17/2 under Package-3, CEIP-1:

Type of Work	Specification
Re sectioning of embankment	10.38 km
Design crest level of embankment	4.50 mPWD
Retirement of Embankment	0.62 km
Construction of drainage sluice	9 nos.
Repair of drainage sluice	3 nos.
Demolish of drainage sluice	1 nos
Bank protection works	0.25 km
Re excavation of drainage channel	11.85 km
Afforestation	7.00 ha

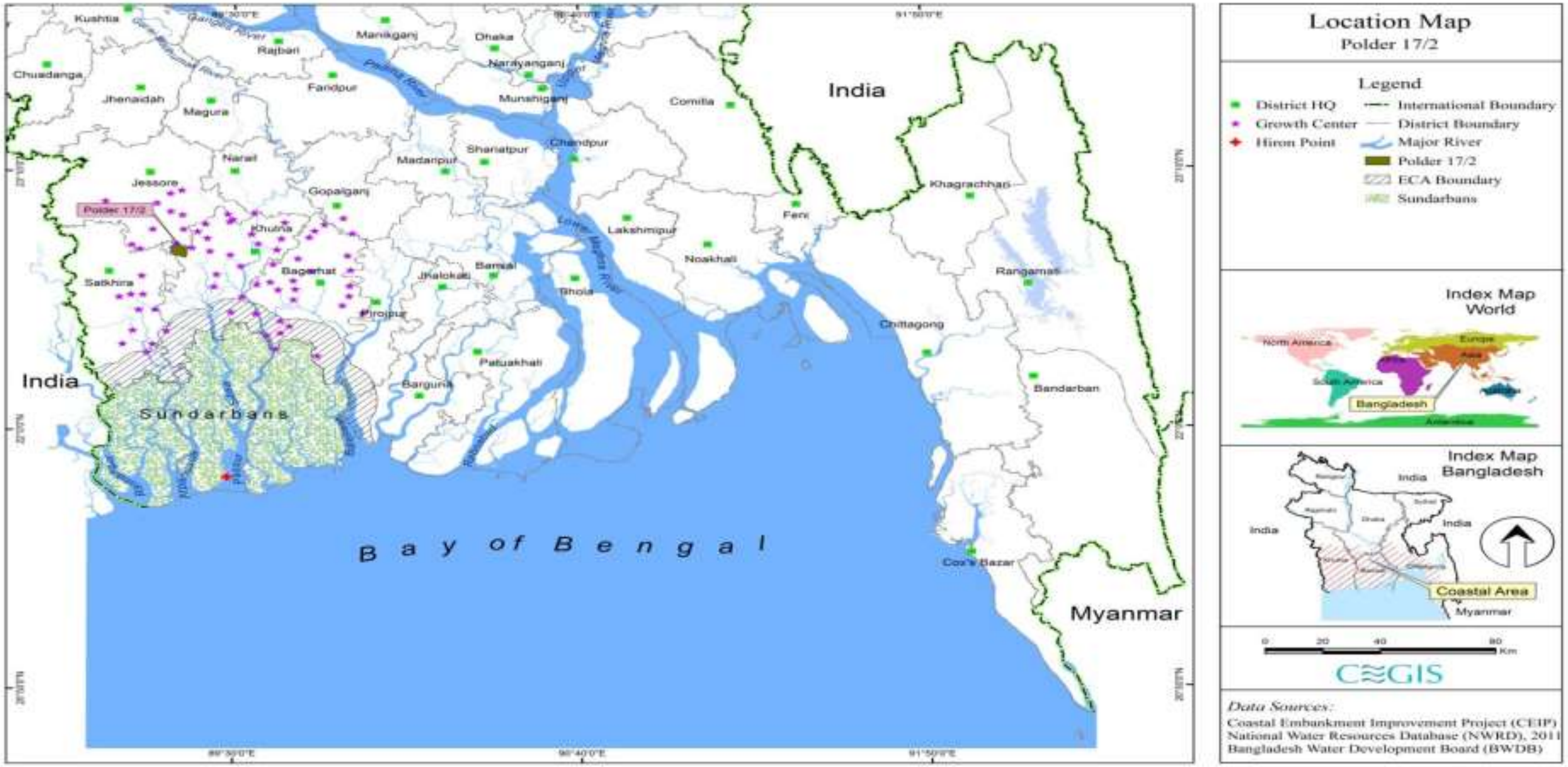
Source: CEIP, 2015

7. Other components of the CEIP-1 study will include of social action plan and environmental management plan; supervision, monitoring and evaluation of project impacts; project management, technical assistance, trainings, and technical studies; and contingent emergency response.

8. The BWDB is the implementing agency of the Project. Detailed information of the Project is presented in the project description chapter of the report.

1.3 Regulatory and Policy Framework

9. The Bangladesh Environment Conservation Act, 1995 (amended in 2002), requires that all development projects shall obtain environmental clearance from the 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 latest EIA fulfils both of these requirements.



Map 1.1-2: Location of Polder-17/2

1.4 Objectives of the Study

10. The objective of the EIA study for Polder-17/2 is to identify and assess the potential environmental impacts of the proposed project interventions, evaluate alternatives, and design appropriate mitigation and management measures as well as monitoring guidelines to be addressed in the Environmental Management Plan (EMP)[1] in compliance with the national regulatory and WB environmental policies and guidelines (for further details refer Chapter 3).

11. 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

12. The scope of work of the present EIA study for Polder-17/2 includes the following:

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

[1]WB Operation Policy 4.01. 2011 Revision

due to alteration of tidal currents, changing of fish migration routes, destruction of local habitats, and water logging.

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

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

ix. Describe alternatives that were examined in course of developing the proposed project and identify other alternatives that could achieve the same objectives. The concept of alternatives extends to the siting 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 passes should be provided to ensure free movement of fish or drainage facility should be provided to avoid water logging in the surrounding area.

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

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

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

xiv. Prepare the EIA report.

1.6 Structure of the Report

13. The report is comprised of the following chapters:

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

Chapter 2 (Approach and Methodology) presents the detailed approach and procedure followedto 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. The Chapter also includes a discussion on the WB safeguard policies and their applicability for the Project.

Chapter 4 (Climate Change Impact): describe the climate change aspects from local perspectives and the likely impacts on the project area and its surroundings.

Chapter 5 (Description of the Project) provides the simplified description of the project and its phases, key activities under three phases, manpower, equipment, and material requirements, implementation arrangements, implementation schedule, and other related aspects.

Chapter 6 (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 7 (Analysis of Alternatives) provides various alternatives considered during the feasibility and design stage of the project, and their environmental and social considerations.

Chapter 8 (Environmental Impacts and Mitigation Measures) identifies the environmental impacts that may potentially be caused by various project phases, and also proposes appropriate mitigation measures to avoid, offset, reduce, or compensate these impacts.

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

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

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

2 Approach and Methodology

14. This Chapter presents the detailed approach and methodology followed to conduct the EIA study for rehabilitation of Polder-17/2. The Chapter also describes the data sources and methodology of data collection, processing and approach used in the impact assessment.

2.1 Overall Approach

15. The EIA study for the rehabilitation of Polder-17/2 has been carried out following the approved Terms of Reference (ToR) of DoE dated 05/06/2013 (Appendix-B) and the Environmental Management Framework (EMF) for CEIP-1. The overall approach of the study is shown in **Figure 2.1**.

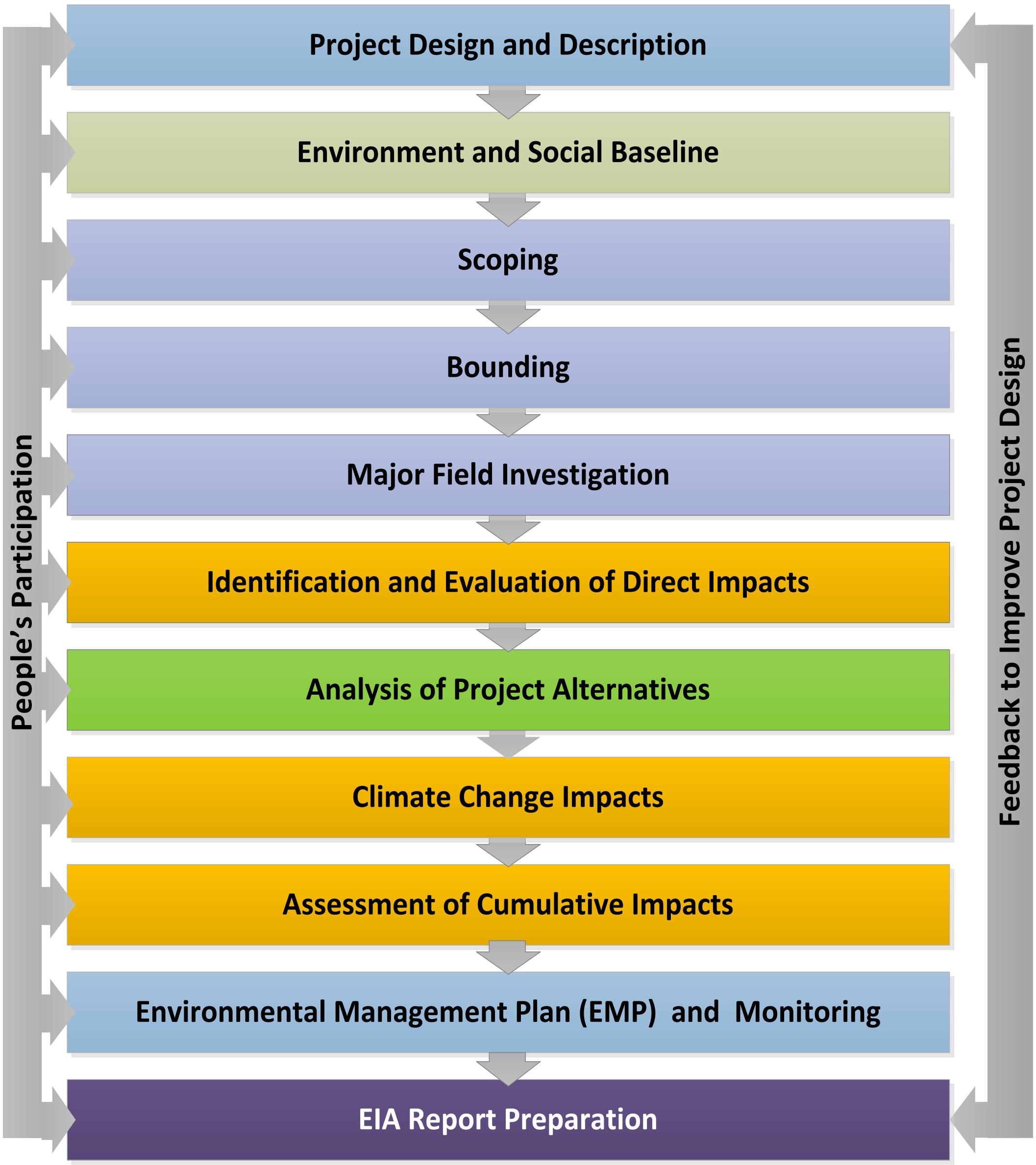


Figure 2.1: Overall approach of the EIA study

2.2 Methodology

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

2.2.1 Analysis of the Project Design and Description

17. Detailed information about the Polder-17/2 including objective, nature and location of proposed and existing interventions, construction works, and other related aspects were obtained from the Main Consultant 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.

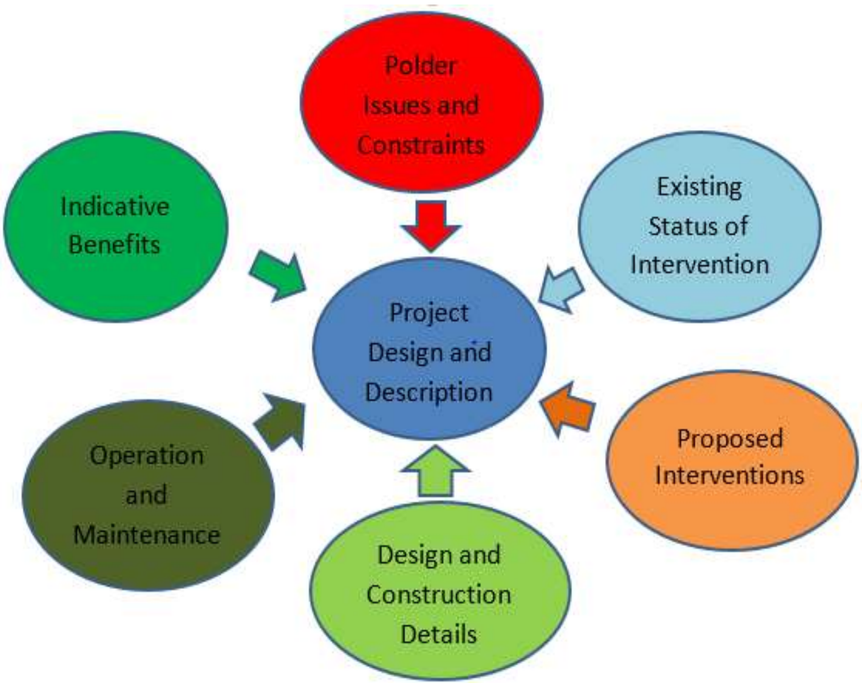


Figure 2.2: Aspects to be addressed in the Project Design and Description

2.2.2 Baseline Data Collection and Analysis

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

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

(a) ***Physical Environment***

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

Water Resources

23. Water resources 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 were collected from field and analysed. The professionals of the multi-disciplinary team received feedback from the local people. Major river systems were identified for hydrological and morphological investigation through collection and analysis of historical and current image data. Specific areas or points of interest were selected for collecting data on special hydrological and morphological aspects, water availability, drainage pattern, water quality (surface and ground water), tidal flood, risk of erosion and sedimentation.

24. Meteorological data such as temperature, rainfall, evapo-transpiration, wind speed and humidity were collected from the National Water Resources Database (NWRD) of Water Resources Planning Organization (WARPO), and subsequently analysed. The NWRD contains long series of temporal data showing daily values for meteorological stations maintained by the Bangladesh Meteorological Department (BMD).

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

Land Resources

26. The agro-ecological region of the project area was identified using secondary sources including Food and Agriculture Organization (FAO) and United Nations Development Program (UNDP) information. The land type and soil texture data were 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.

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

(b) Biological Environment

Agricultural Resources

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

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

Crop production loss = Total cropped area ×normal yield − (damaged area ×damaged yield+ damage free area × normal yield)
The crop damage data was collected from the field for the last three years.

Ecological Resources

29. The ecological component of the EIA study focused on terrestrial and riverine ecology including flora, 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.

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

Fish and Fisheries

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

32. A 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 fish ponds, commercial fish farms, and shrimp ghers.

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

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

Livestock Resources

35. Data on the present status of livestock (cow/bullock, buffalo, goat and sheep) and poultry (duck and chicken) in the Polder area was collected during field survey in consultation with the local people through PRAs and RRAs. Livestock resources data were also collected from secondary sources from Upazila Livestock Office.

(b) Socio-cultural Environment

36. The steps followed for collecting socio-cultural data are as under:

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

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

2.2.3 Scoping

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

2.2.4 Bounding

39. The influence area of the project was broadly delineated considering the external river system of the Polder. This included the area inside the Polder where most of the Project interventions would take place, 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 surrounded by river Hari to the East, Upper Salta River to the South West, Taltola River to the West and Gangrail River to the North. It is noted that project area includes Polder area whereas study area includes both project area and peripheral rivers.

40. The influence area of the project was defined in two broads categories e.g. direct influence area and indirect influence area. The direct influence area includes the area inside the Polder where most of the Project interventions activities will take place. Theindirect influencearea is located 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, and labor camps/contractor facilities if located outside the Polder. The Polder is surrounded by river Hari to the East, Upper Salta River to the South West, Taltola River to the West and Geangrail River to the North. It is noted that the indirect area of influence includes peripheral rivers, land surrounding Polders and Sundarban (up to 1 km).

Major Field Investigation

41. The EIA study team members collected intensive data on the possible impact of the project after obtaining the detailed rehabilitation plan from the project authority. The study team carried out a number of comprehensive field investigations in order to collect primary data and solicit feedback from local people. Intensive data on Baseline and IESCs were collected from the field during this stage. Information on the IESCs were collected through a mixed method including RRA, PRA and KII using checklists for water resources, land resources, agriculture, livestock, fisheries, ecosystem and socio-economic components. Intensive consultations with the local people were carried out for their feedback on the key parameters. This process helped the multidisciplinary EIA study team to qualify their professional observations. In such exercise attention was given to understand the historical status of the IESCs and the possible condition of the same against the proposed interventions.

2.2.5 Assessment and Scaling of Impacts

42. At this stage, attempts were made to assess the impacts of the proposed interventions of the Polderquantitatively. Impacts were also assessed qualitatively when quantification was not possible. The impacts of proposed interventions, considering the climate-change scenario for 2050, were estimated on the basis of differences between the future-without-project (FWOP) condition and the future-with-project (FWIP) condition. The FWOP conditions were generated through trend analysis and consultations with the local people. This reflected the conditions of IESCs in absence of the proposed interventions the Polder area. Expected changes due to proposed interventions were assessed to generate the FWIP conditions. Comparison and projection methods were used for impact prediction.

Methodology

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

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

<u>Magnitude</u>

45. 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.

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

Table 2-1: Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Negligible/Nil
Duration of potential impact	Long term (more than 15 years)	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 baselinecondition s	Baseline requires a year or so with some interventions to return to baseline conditions	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/obligat ions	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Sensitivity

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

Table 2-2: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very High	Vulnerable receptor with little or no capacity to absorb 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

Assessment of Significance

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

Table 2-3: Assessment of Potential Impact Significance

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

Mitigation Measures

49. Subsequent to the impact assessment discussed above, appropriate mitigation measures have been proposed to avoid, offset, mitigate/reduce, or compensate for the identified impacts. Generally, impacts having moderate to critical consequence significance as 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.

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

Assessment of Residual Impacts

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

Identification of Enhancement Measures

52. Wherever feasible, enhancement of 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.

2.2.6 Analysis of the Project Components and Alternatives

53. Analysis of site alternatives were not considered relevant as the Project mostly entails outright rehabilitation works of infrastructure where their spatial domains are already fixed. However, the possible alternatives of proposed interventions were analyzed on a qualitative basis, considering their environmental, social, technical and economic suitability. This would rationalize the selected interventions, and identify pathways for better design alternatives, if available. Figure 2.3 outlines the approach followed in the alternative analysis.

54. 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.

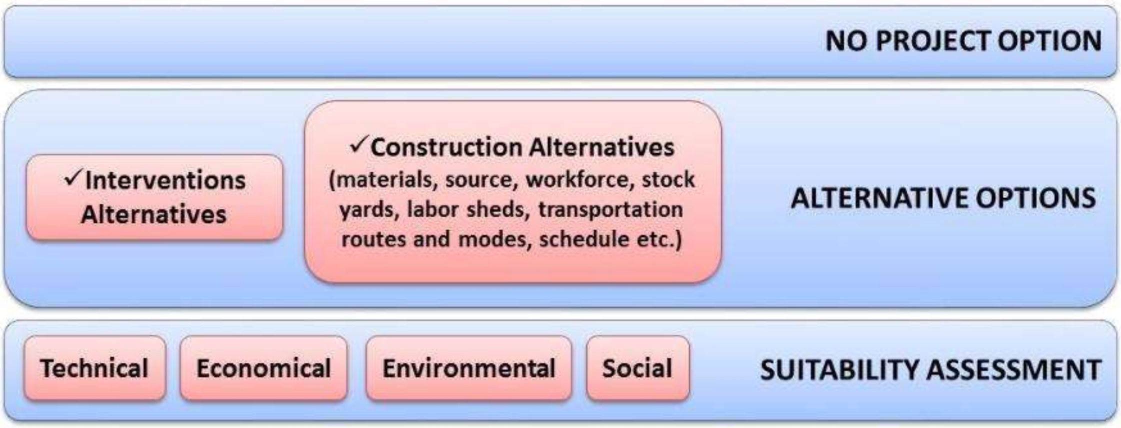


Figure 2.3: Concept of Alternative analysis to be used in the EIA study

2.2.7 Climate Change

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

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

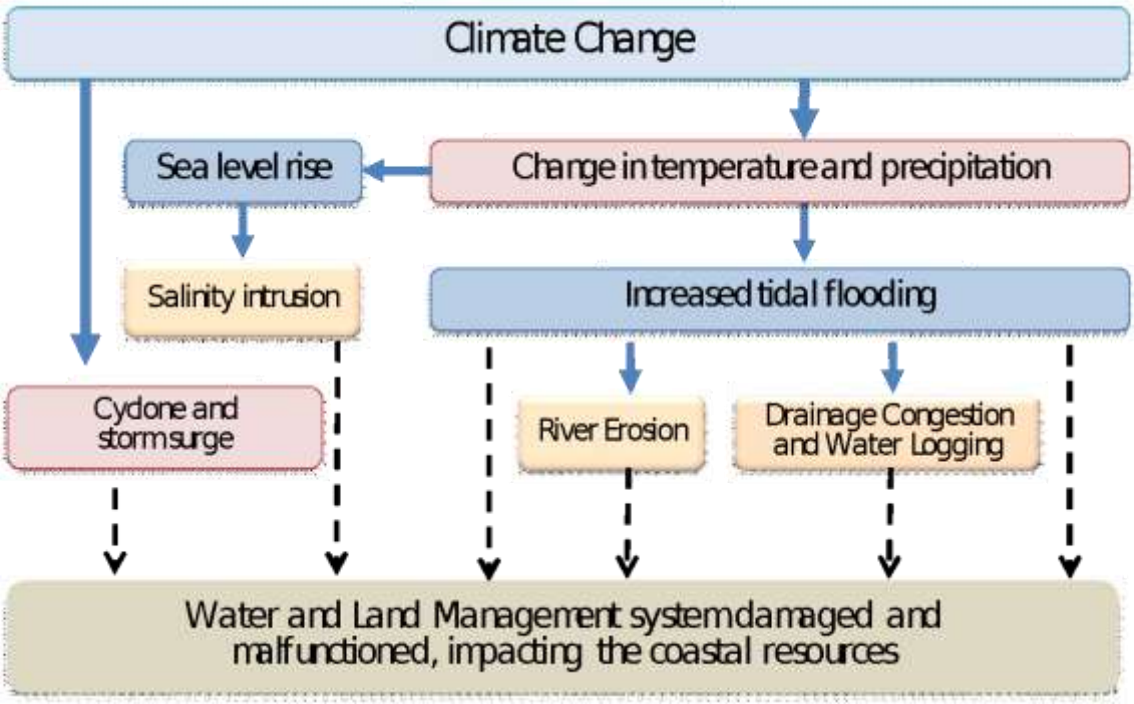


Figure 2.4: Typical process diagram of climate change impacts in coastal areas

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

2.2.8 Assessment of Cumulative and Residual Impacts

58. 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. The cumulative impact of existing and ongoing project as well as proposed project of CEIP-1 around the proposed rehabilitation Polder has been assessed. During assessing cumulative impacts, rivers/watercourses hydrology, flooding situation, flora and fauna, shrimp farming and livelihood in and around the polder has been considered under this study.

59. 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

2.2.9 Preparation of Environmental Management and Monitoring Plan

60. An EMP for the proposed Project has been prepared which comprises the mitigation/ enhancement measures with institutional responsibilities, environmental monitoring plan, training and capacity building plan, and reporting and documentation protocols (Refer Chapter 10).

2.2.10 EIA Report Preparation

61. At the end of the study, the present report has been prepared incorporating all the findings of the EIA.

3 Policy, Legal and Administrative Framework

62. This chapter presents a review of the national policy, legal, and regulatory framework relevant to the environmental and social aspects of the project. Besides, review of the WB environmental and social safeguard policies and guidelines are also incorporated in this chapter.

3.1 List of Relevant National Policies, Strategies and Plans

63. List of relevant National policies and strategies and plans are given below:

(i) National Environment Policy, 1992

(ii) National Environment Management Action Plan, 1995

(iii) National Water Policy, 1999

(iv) Guidelines for Participatory Water Management (GPWM), 2014

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

(vi) Coastal Zone Policy, 2005

(vii) Coastal Development Strategy, 2006

(viii) National Land Use Policy (MoL, 2001)

(ix) National Agriculture Policy, 1999

(x) National Fisheries Policy, 1996

(xi) National Forest Policy, 1994

(xii) Private Forest Policy 1994

(xiii) National Livestock Development Policy, 2007

3.2 National Environmental Laws

64. List of relevant national laws and regulation are given below:

(i) Bangladesh Water Act, 2013

(ii) National River Protection Commission Act, 2013

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

(iv) Bangladesh Environment Conservation Rules (ECR), 1997

(v) Bangladesh Environment Court Act, 2010

(vi) The Forest Act, 1927 & Amendment Act 2000

(vii) Private Forest Ordinance (PFO), 1959

(viii) Social Forestry Rules, 2004 and Amendments

(ix) Antiquities Act, 1968

(x) Bangladesh National Building Code, 2006

(xi) Standing Orders on Disaster, 2010

(xii) The Acquisition and Requisition of Immovable Property Ordinance, 1982

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

(xiv) Constitutional Right of the Tribal Peoples Rights

(xv) Ethnic Minority Rights in PRSP 2005

(xvi) Acquisition and Requisition of Immovable Property Ordinance, 1982

65. Deatails of the polices and laws are given in **Appendix-C**

3.3 Other Relevant Acts

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

Table 3-1: Laws and Acts

Act/Law/Ordinance	Brief Description of Laws and Acts	Responsible Agencies
The Vehicle Act (1927) and the Motor Vehicles Ordinance (1983)	Provides rules for exhaust emission, air and noise pollution and road and traffic safety.	Road Authority
Rules for Removal of Wrecks and Obstructions in inland Navigable Water Ways (1973)	Rules for removal of wrecks and obstructions	BWTA
The Water Supply and Sanitation Act (1996)	Regulates the management and control of water supply and sanitation in urban areas.	MoLG, RD&C
The Ground Water Management Ordinance (1985)	Describes the management of ground water resources and licensing of tube wells	Upazila Parishad
The Private Forests Ordinance (1959)	Deals with the conservation of private forests and afforestation of wastelands.	MoEF
The Protection and Conservation of Fish Act (1950)	Deals with the protection/conservation offishes in Government owned water bodies	DoF
The Embankment and Drainage Act (1952)	Describes the protection of embankments and drainage facilities	MoWR
The Antiquities Act (1968)	Describes the preservation of cultural heritage, historic monuments and protected sites	DoArch
Acquisition and Requisition of Immovable Property Ordinance (1982)	Describes procedures and provides guidelines to acquisition and requisition of land	MoL
Bangladesh Labor Law (2006)	Deals with occupational rights and safety of factory workers; provision of comfortable work environment and reasonable working conditions	MoL

3.4 International Treaties Signed by GoB

67. Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, such asthe 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 etc. An overview of the relevant international treaties and conventions signed by GoB is shown in Table 3.2.

Table 3-2: Treaty or Convention and Responsible Agency

Treaty	Year	Brief Description of Treaty and Convention	Relevant Depart ments
Protection of birds (Paris)	1950	Protection of birds in wild state	DoE/DoF
Ramsar Convention	1971	Protection of wetlands	DoE/DoF
Protocol Waterfowl Habitat	1982	Amendment of Ramsar Convention to protect specific habitats for waterfowl	DoE/DoF
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural monuments	DoA
CITES convention	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	DoE/DoF
Bonn Convention	1979	Conservation of migratory species of wild animals	DoE/DoF
Prevention and Control of Occupational hazards	1974	Protect workers against occupational exposure to carcinogenic substances and agents	MoH
Occupational hazards due to air pollution, noise &vibration (Geneva)	1977	Protect workers against occupational hazards in the working environment	MoH
Occupational safety and health in working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	MoH
Occupational Health services	1985	To promote a safe and healthy working environment	MoH
Convention on oil pollution damage (Brussels)	1969	Civil liability on oil pollution damage from ships	DoE/MoS
Civil liability on transport of dangerous goods (Geneva)	1989	Safe methods for transport of dangerous goods by road, railway and inland vessels	MoC
Safety in use of chemicals during work	1990	Occupational safety of use of chemicals in the work place	DoE
Convention on oil pollution	1990	Legal framework and preparedness for control of oil pollution	DoE/MoS
Vienna Convention	1985	Protection of the ozone layer	DoE
London Protocol	1990	Control of global emissions that deplete ozone layer	DoE
UN framework convention on climate change (Rio de Janeiro)	1992	Regulation of greenhouse gases emissions	DoE
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of bio-diversity, sustainable use of its components and access to genetic resources	DoE
International Convention on Climate Changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases	DoE
Protocol on biological safety (Cartagena protocol)	2000	Biological safety in transport and use of genetically modified organisms	DoE

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

68. The environmental legislative basis for approval of the CEIP-1Project is the Environmental Conservation Act 1995 (ECA'95) and the Environmental Conservation Rules

1997 (ECR'97). DoE), under MoEFis 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, has been 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 17/2 occupies the 'Red' category.

69. 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)

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

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

3.6 Detailed Steps of In Country Environmental Clearance Procedure

72. Legislative bases for EIA in Bangladesh are the Environmental Conservation Act 1995 (ECA'95) and the Environmental Conservation Rules 1997 (ECR'97). Department of Environment (DoE), under the Ministry of Environment and Forest (MoEF), is the regulatorybody 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 project/industry 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 to develop a Resettlement Plan for getting environmental clearance from DoE. The application procedure for obtaining site clearance and environmental clearance for the sub-projects of Red category is shown in Figure 3.1.

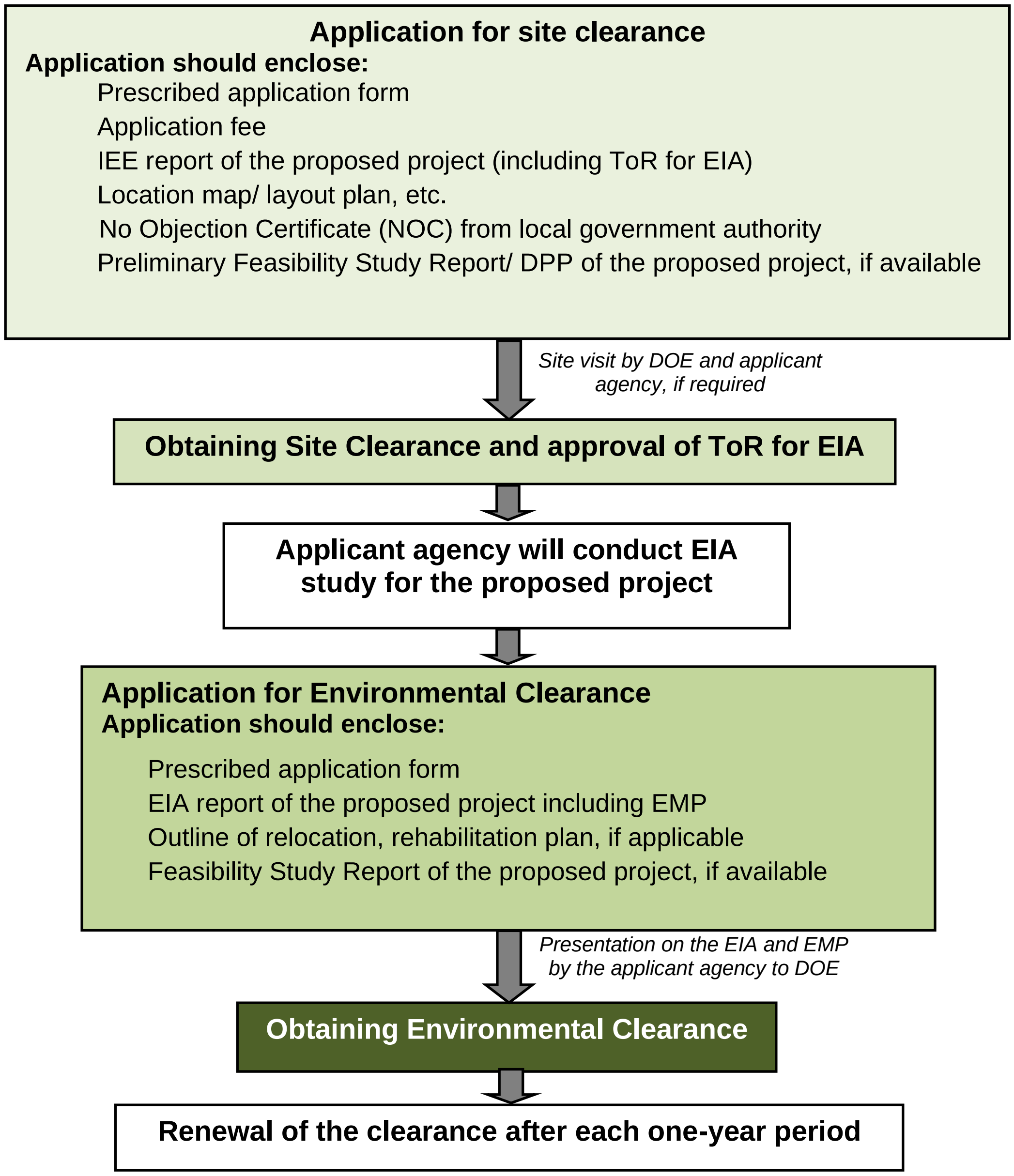


Figure 3.1: Process of obtaining Clearance certificate from DoE

3.7 World Bank's Environmental Safeguard Policies

73. 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 list of the relevant safeguards policies considered for the Project is provided below:

(i) Environmental Assessment (OP 4.01)
(ii) Natural Habitats (OP 4.04)
(iii) Water Resources Management (OP 4.07)
(iv) Physical Cultural Resources (OP 4.11)
(v) Forestry (OP 4.36)
(vi) Projects on International Waterways (OP 7.50)

(vii) Pest Management (OP 4.09)

(viii) Indigenous Peoples (OP 4.10)

(ix) Involuntary Resettlement (OP 4.12)

(x) Projects in Disputed Areas (OP 7.60)

(xi) Safety of Dams (OP 4.37)

(xii) Public Disclosure of Information (BP 17.50)

(xiii) Environment, Health and Safety Guidelines

74. The highlights of the World Bank's Environmental Safeguard Policies are given in **Appendix-C**

3.8 Implications of WB Policies on CEIP

75. The project interventions for Polder17/2fall 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.

76. 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 Project. Although no direct impacts on physical cultural resources are expected, screening mechanism incorporated into the EA process will identify subprojects with archeological, paleontological, historical, religious, or unique natural values, chance and find procedure will be followed to address physical cultural resources (OP/BP 4.11). The interventions under the proposed Project may result in an increased availability of irrigation water through cleaning and excavation of water courses in the Polder. This increased water availability can inturn potentially increase the usage of chemical fertilizers and pesticides. During regular environment monitoring inoperational 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 affect whatsoever on the upper riparian water usage or availability. Hence International Waterways (OP 7.5) is not expected to be triggered.

4 Climate Change Analysis

77. Climate is a critical factor in the lives and livelihoods of the people and socioeconomicdevelopment as a whole. Climate has shown warming of 0.89 [0.69 to 1.08] °C over the period 1901–2012 which is mainly attributed to anthropogenic activities (IPCC 2013). Further, it has projected that the global mean surface temperature may increase by 0.4°C to 1.6°C for RCP2.6, 0.9°C to 2.0°C for RCP 4.5, 0.8°C to 1.8°C for RCP6.0 and 1.4°C to 2.6°C for RCP 8.5, respectivelyby 2046-2065 (IPCC 2013). The newer findings indicate that warming is more pronounced thanexpected. The impact would be particularly severe in the tropical areas, which mainlyconsist of developing countries, including Bangladesh. Increasing temperature trends of the order of 0.60°C during last 112 years (IMD 2012) and increase in heavy rainfall events and decrease in low and mediumrainfall events (Goswami et al. 2006) over India have been observed. Changes inrainfall and temperatures have also been reported by Dash et al. (2009) and others.

78. In this context, monthly and annual mean data of maximum and minimum surface air temperature, and monthly and annual rainfall data are extracted from Regional Climate Model (RCM) forPolder-17/2 and has been used for the period of 1978-2012 for this study. It is mentioned here that there is no rain-gauge station in Polder area so climate model data has been used for this Polder for rainfall and temperature. Seasonal mean values have been computed from the monthly data of rainfall and temperature for the four meteorological seasons e.g. pre-monsoon (March-May), monsoon (June-September), post-monsoon (October-November) and winter (December-February), respectively.

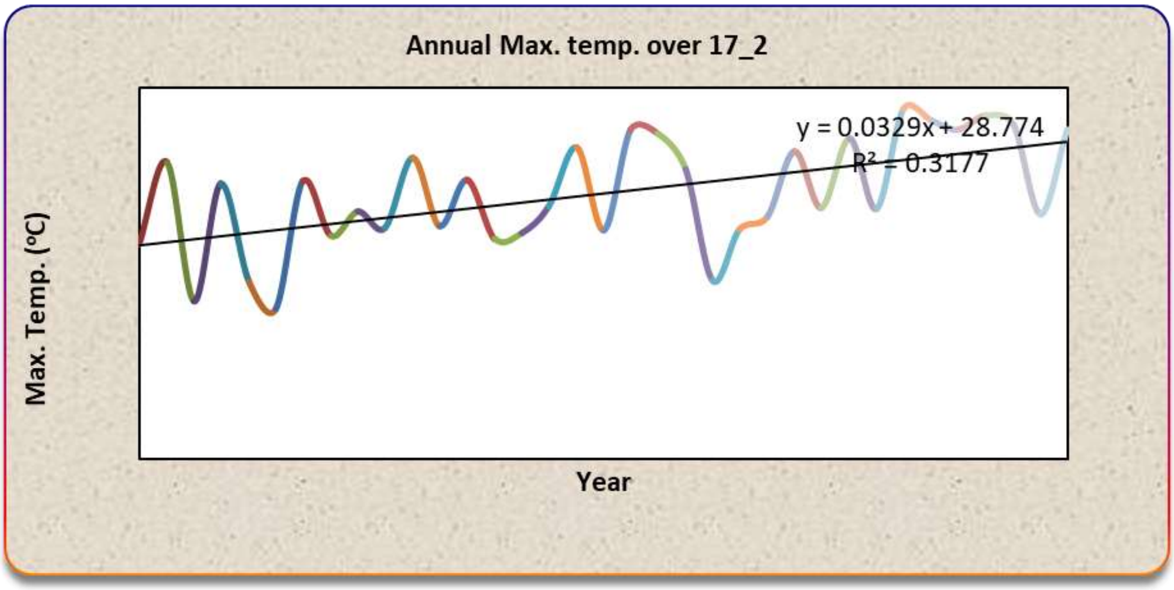


Figure 4.1: Temporal variations of mean maximum temperature over Polder-17/2during the period 1978-2012

4.1 Climate Variability Analysis

4.1.1 Annual Climate Change Trends

Annual mean maximum temperature trend

79. The time series of temporal plots of annual mean maximum temperature of Polder-17/2 shows that the temperature has the dominant increasing trend as shown in Figure 8.2. The slope of the linear trends of the regression analysis of the mean maximum temperature has been observed. The annual mean maximum temperature time series have shown increasing trends over Polder-17/2 at the rate of 0.0329ºC/year, which is statistically significant at 1% level.

Annual mean minimum temperature trend

80. The temporal plots of annual mean minimum surface air temperature has been analyzed for Polder-17/2. The yearly variation of annual mean minimum surface air temperature of Polder-17/2is shown in Figure 2 for the period 1978-2012. The results of the trend analysis of annual mean minimum temperatures have shown increasing trends over Polder-17/2at the rate of 0.0155ºC/year which isstatistically significant at 5% level.

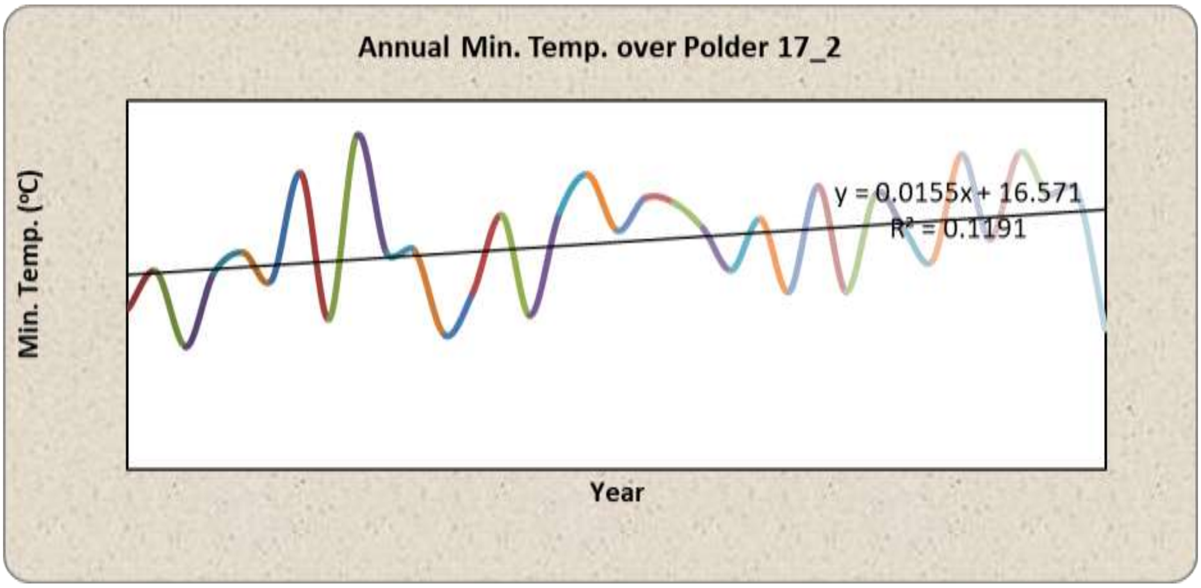


Figure 4.2: Temporal variations of annual mean minimum temperature over Polder-17/2during the period 1978-2012.

Annual total rainfall

81. The temporal plots of the annual total rainfall of Polder-17/2have drawn to investigate the nature of inter-annual fluctuations. The temporal variations of the annual total rainfall (Figure 8.3) are noticed during the period 1978-2012. It is observed that decreasing trends in the annual rainfall at the rate of -2.952 mm/year, during the same period, which is not statistically significant.

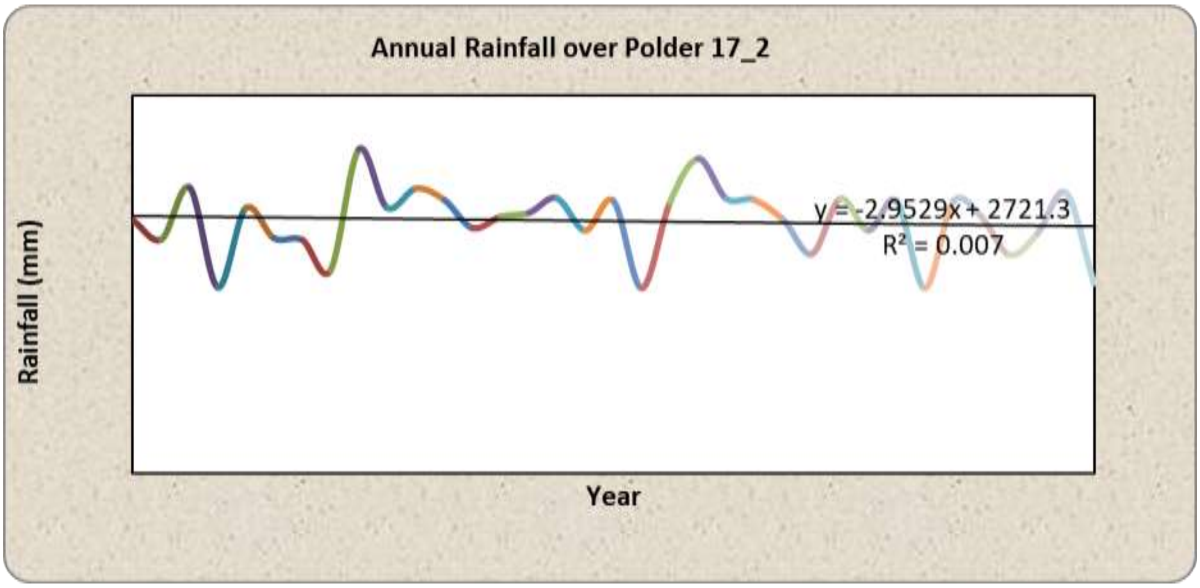


Figure 4.3: Temporal variations of annual rainfall over Polder-17/2during the period 1978-2012.

4.1.2 Seasonal climate change trends

4.1.3 Winter climate change trend

Winter means maximum temperature trend

82. The winter mean maximum surface air temperature shows aincreasing trend over Polder-17/2during the period of 1978-2012 (Figure not shown). The increasing trend is noted overPolder-17/2at the rate of 0.044ºC/year which is statistically significant at 5% level.

Winter means minimum temperature trend

83. The winter mean minimum surface air temperature showsan increasing trend over the period of 1978-2012 (Figure not shown). The increasing trend over Polder-17/2is 0.004ºC/year which is not statistically significant.

Winter season rainfall trend

84. The temporal variations of winter rainfall are obtained during the period 1978-2012. It is seen that decreasing trend in the winter rainfall is observed over Polder-17/2 at the rate of -1.023 mm/year (Figure not shown), during the above period, which is not statistically significant.

4.1.4 Pre-monsoon Climate Change Trends

Pre-monsoon mean maximum temperature trend

85. The inter-annual variability in pre-monsoon season means maximum temperature of Polder-17/2 has shown increasing trend during the period 1978-2012 (Figure not shown). The observed Increasing trend is shown over Polder-17/2 at the rate of 0.059ºC/year, which is statistically significant at 1% level.

Pre-monsoon mean minimum temperature trend

86. Mean minimum temperature in pre-monsoon season shows increasing trends over Polder-17/2during the period 1978-2012. It is observed that warming trend over Polder-17/2at the rate of 0.034^{o}C/year which is statistically significant at 1% level.

Pre-monsoon total rainfall trend

87. The temporal variations and the trend of pre-monsoon season total rainfall are obtained during the period 1978-2012 (Figure not shown). It is observed that decreasing trend in the pre-monsoon season of total rainfall over Polder-17/2at the rate of -1.42 mm/year during the same period, which is not statistically significant.

4.1.5 Monsoon Climate Change Trends

Monsoon mean maximum temperature trend

88. The Polder-17/2has shown strong warming trend of mean maximum temperature in the monsoon season during the period 1978-2012 (Figure not shown). Polder-17/2exhibits strong warming trend during the monsoon season at the rate of 0.011^{o}C/year which is not statistically significant.

Monsoon season mean minimum temperature trend

89. It is observed that the Polder-17/2has shown warming trend of mean minimum temperature in the monsoon season during the period 1978-2012 (Figure not shown). The warming trend of Polder-17/2is 0.018^{o}C/year which is statistically significant at 1% level.

Monsoon season rainfall trend

90. The temporal plot of the monsoon season rainfall has analyzed to see the nature of inter-annual fluctuations. The linear regression line has also put on the graphs. The temporal variations and the trend of monsoon season rainfall are obtained during the period 1978-2012 (Figure not shown). It is seen that increasing trend in the monsoon season rainfall are observed over Polder-17/2at the rate of 0.299 mm/year, which is not statistically significant.

4.1.6 Post-monsoon Climate Change Trends

Post-monsoon means maximum temperature trend

91. The Polder-17/2has shown warming trend for post-monsoon season mean maximum temperature during the period 1978-2012 (Figure not shown). The slightly warming temperature is noticed over Polder-17/2at the rate of 0.018^{o}C/year, which is not statistically significant.

Post-monsoon means minimum temperature trend

92. Post monsoon mean minimum temperature has shown slightly decreasing trend over Polder-17/2and decreasing trend also shows at the rate of- 0.0021^{o}C/year for the period 1978-2012, which is not statistically significant.

Post-monsoon season rainfall trend

93. The temporal variations and the trend of post-monsoon rainfall are obtained during the period 1978-2012. It is seen that decreasing trend in the post-monsoon season is observed over Polder-17/2at the rate of -0.809 mm/year (Figure not shown), which is not statistically significant.

4.2 Climate changeprojection

4.3 Projection of rainfall over Polder-17/2

94. Global warming is an important issue, with a variety of influences on agriculture, water, health and economy. It is now recognized that climate variability and extreme events affect society more than changes in the mean climate (IPCC, 2001). Human induced changes in the global climate and associated sea-level rise are widely accepted by policy makers and scientists. The IPCC concluded that the balance of evidence suggests a discernible human influence on global climate (IPCC-AR4, 2007). The exact magnitude of the changes in the global climate is still uncertain and subject to worldwide scientific studies. It is broadly recognized that Bangladesh is more vulnerable to these changes. Indeed, it has internationally been argued that Bangladesh, as a country, may suffer the most severe impacts of climate change. Bangladesh is highly vulnerable because it is a low-lying country located in the deltaic plain of the Ganges, the Brahmaputra and the Meghna and densely populated. Its national economy strongly depends on agriculture and natural resources that are sensitive to climate change and sea-level rise. The impact of higher temperature and more extreme weather events such as floods; cyclone, severe drought and sea-level rise are already being felt in South Asia and will continue to intensify (Huq et al., 1999; Ali, 1999). In this connection proper planning and sensible management of water resources are essential for this region. Long-term planning is not possible without any idea of the change of climate that may happen in future. Climate models are the main tools available for developing projections of climate change in the future (Houghton et al., 2001). In this context, regional climate model data is used to generate the future scenarios for rainfall and temperature over Bangladesh on the basis of RCP4.5. 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.

4.4 Rainfall projections using RCP4.5 scenario

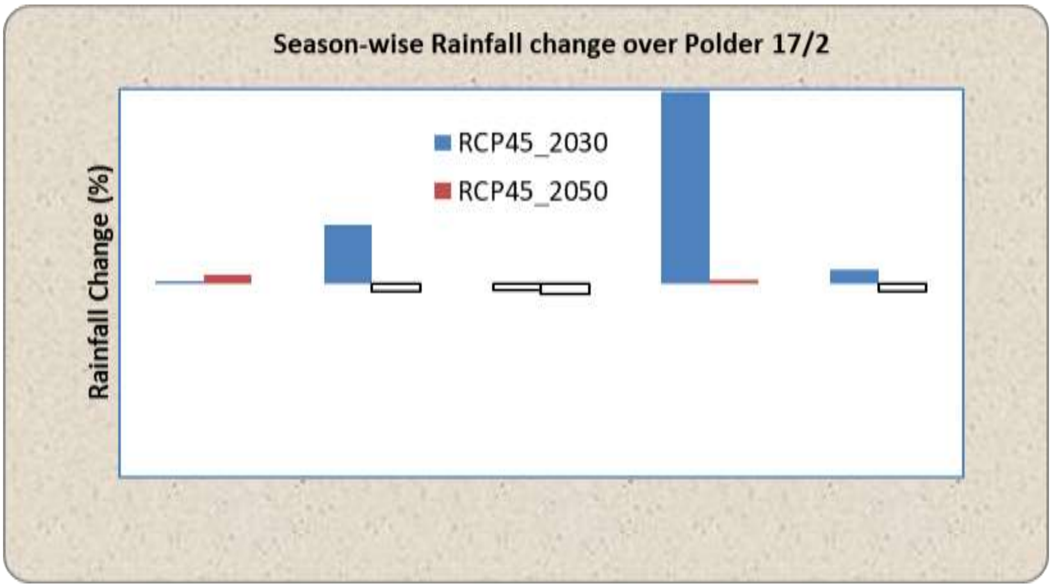


Figure 4.4: Change of seasonal rainfall (%) over Polder-17/2for the year 2030 and 2050, respectively.

95. The rainfall change is observed to be 0.5, 14.9, -1.9,49.4% and 2.1, -2.0, -2.6, 0.8% for winter, pre-monsoon, monsoon and post-monsoonfor 2030 and 2050 respectively (Figure 8.4). On an average annual rainfall change over Polder-17/2may change 3.6% and -2.3% for the year 2030 and 2050, respectively.

Projection of Maximum and Minimum Temperature over Polder-17/2

96. Maximum and Minimum surface air temperature projection is obtained using a new set of scenario RCP4.5 (Assessment Report, AR5) which is called Representative Concentration Pathway (RCP). Maximum and minimum surface air temperature projectionsfor the year 2030 and 2050 for RCP4.5 are given below:

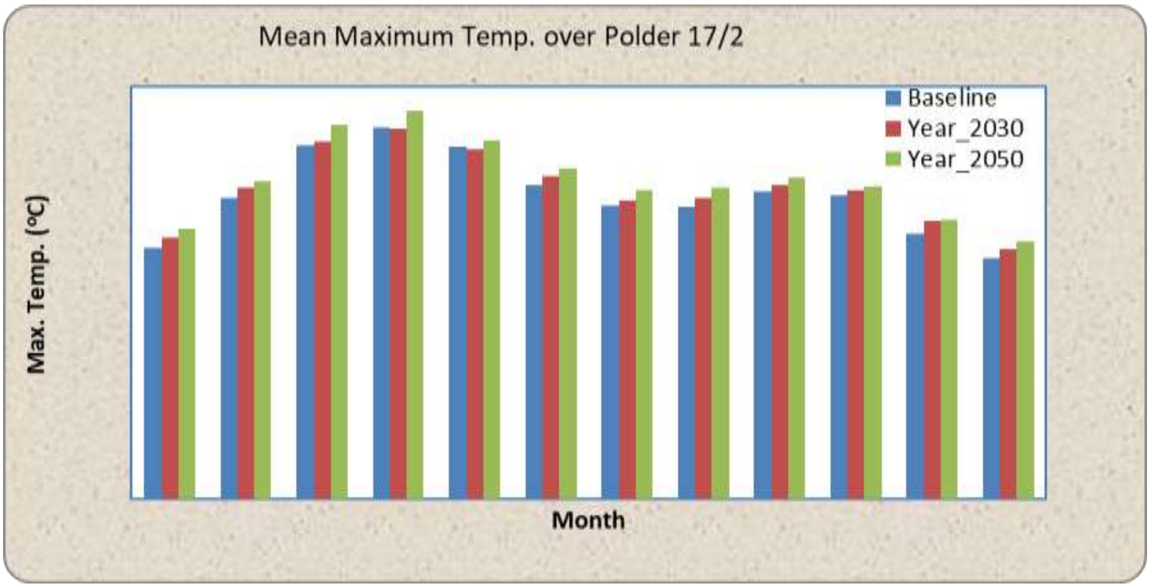


Figure 4.5: Annual cycle of projected maximum temperature with baseline over Polder-17/2 in 2030 and 2050, respectively

Maximum temperature projections over Polder-17/2 for RCP4.5 scenario

97. Maximum temperature shows the bimodal characteristics. Maximum temperature projection is obtained from the Figure 5 for the years 2030 and 2050 respectively. Maximum surface air temperature may change in 2030 by 1.0, 0.9, 0.4, -0.2, -0.2, 0.9, 0.5, 0.9, 0.7, 0.5, 1.2 and 0.9ºC for January, February, March, April, May, June, July, August, September, October, November and December, respectively. Maximum surface air temperature in various months may vary by -0.2-1.2ºC over Polder-17/2. On an average the maximum surface air temperature is estimated to be increased by 0.6ºC for the 2030.Similarly, maximum temperature may change in 2050 by 1.9, 1.6, 1.9, 1.6, 0.6, 1.7, 1.5, 1.9, 1.4, 0.8, 1.4 and 1.6º C for January, February, April, May, June, July, August, September, October, November and December, respectively. Maximum surface air temperature in various months may vary by 0.6 - 1.9º C over Polder-17/2. On an average the maximum surface air temperature is estimated to be increased by 1.5ºC for the 2050.

Minimum temperature projections over Polder-17/2 for RCP4.5 scenario:

98. Minimum temperature projection is obtained from the Figure 6 for the years 2030 and 2050 respectively. Minimum surface air temperature may change in 2030 by 1.6, 0.7, 1.9, 0.7,

0.8, 1.0, 0.9, 0.9, 1.0, 1.2, 1.7 and 2.2^{o} C for January, February, March, April, May, June, July, August, September, October, November and December, respectively. It is observed that the change lies between 0.7-2.2^{o}C for the period 2030 and on an average, minimum surface air temperature may increase 1.2^{o}C overPolder-17/2 in future for the period 2030.Similarly, minimum temperature may change in 2050 by 2.4, 1.9, 2.5, 1.9, 1.4, 1.5, 1.5, 1.4, 1.5, 1.3, 1.3 and 1.8^{o} C for January, February, April, May, June, July, August, September, October, November and December, respectively. Minimum surface air temperature in various months may vary by 1.3-2.5^{o}C for the period 2050. On an average the minimum surface air temperature is estimated to be increased by 1.7^{o}C for the 2050.

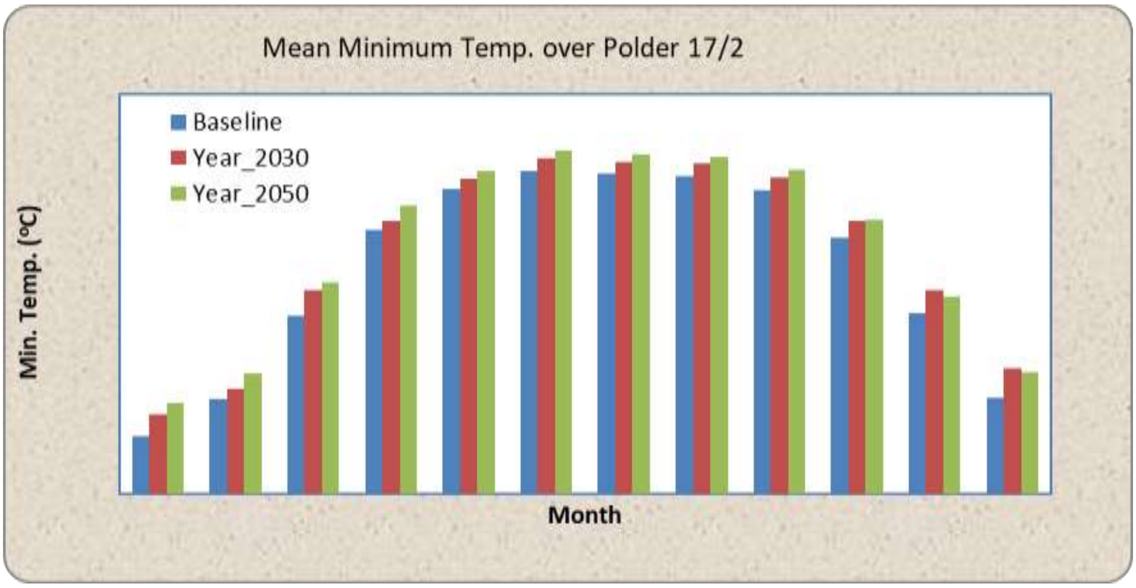


Figure 4.6: Annual cycle of projected minimum temperature with baseline over Polder-17/2 in 2030 and 2050, respectively

5 Description of the Project

5.1 General

99. The Coastal Embankment Improvement Project (CEIP) aims to safeguard the Polder from tidal flooding, salinity intrusion and climate change impacts i.e. sea level rise. The major benefit of the proposed interventions is improvement of agricultural production. The project activities, construction methodology, construction schedule and the institutional arrangements for implementation of the Project are discussed briefly in this chapter.

5.2 Overview of Polder-17/2

100. The Polder is located in Dumuria Upazilla under Khulna District. The Polder Covers the Union Parishad(U/P) namely Atlia under Dumuria Upazilla in the district of Khulna. The Polder is surrounded by the Taltola River to the South and Gangrail River to the East. Moreover, in downstream the Taltola River is connected to the Salta River (South direction). The Polder was conceived in the early 1960s. Construction of the Polder was started in 1970 and completed on 1978 under CEP. Cyclone is the main threat to cause damage of lives and properties of the Polder area. The original concept of construction of this Polder was to protect low lying coastal areas against tidal flooding and salinity intrusion, considering only the tidal effects but ignoring effects of wind, wave and cyclonic storm surges. At the present context, the Polder is under heavy threat tocyclone surge, wave surge and climate change effect. It is one of the 17 Polders selected for "Technical Feasibility studies and Detailed Design for Coastal Embankment Improvement Program (CEIP)" under the first program of project CEIP-1.

101. The entire length of embankment of the Polder is the Interior dyke having a length of 11.00 km with Side Slope C/S 1: 2 and R/S 1:3.

5.3 Objective of the Project

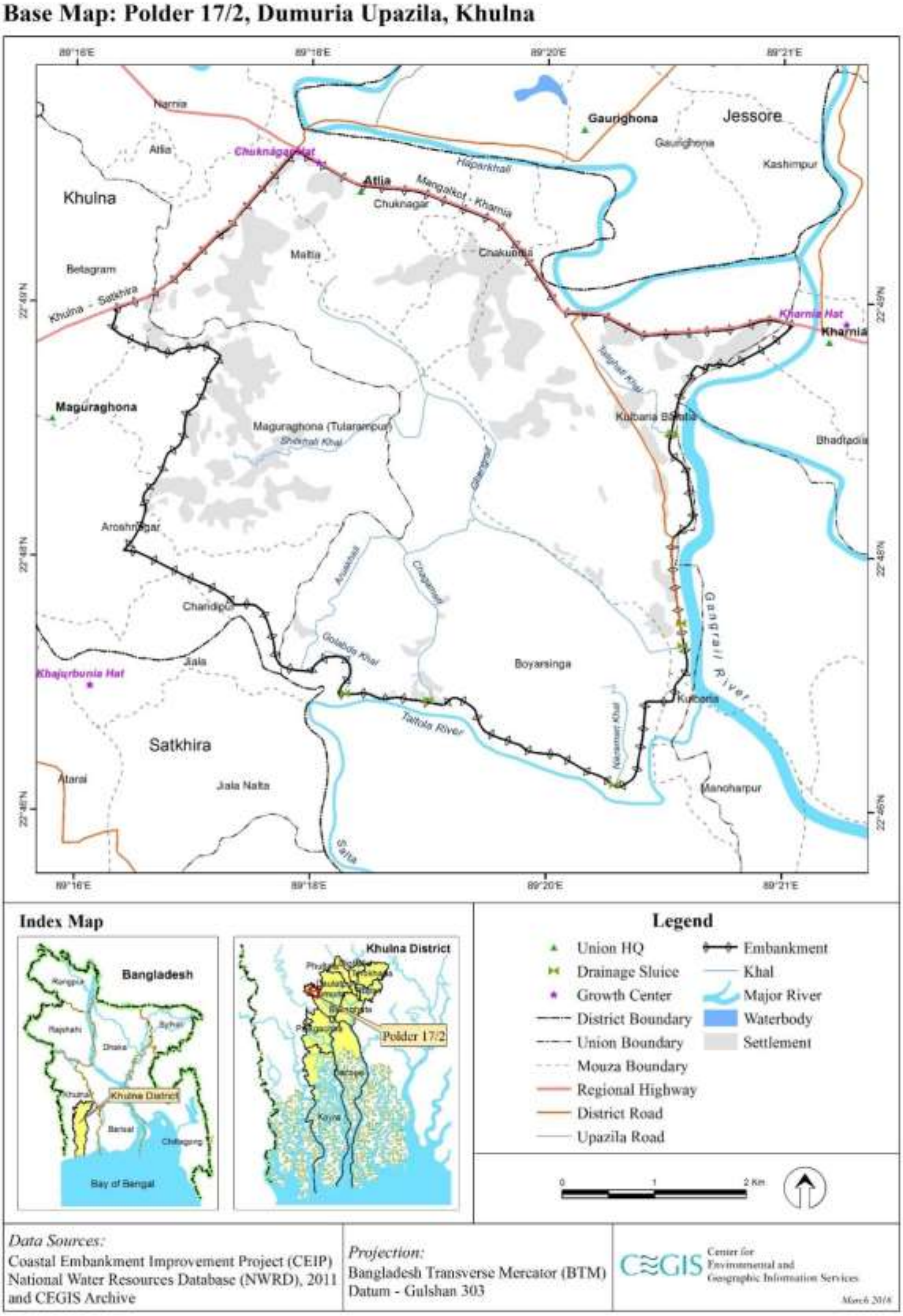
102. The overall objective of the project is to increase the resilience of the coastal population from natural disasters and climate change. This may be fulfilled through a see of specific objectives viz; (a) protect embankment from river erosion and wave action; (b) prevention of saline intrusion; (c) providing improved drainage facilities; (d) preventing sedimentation in both the agricultural land and the water resources system; (e) enhancement of scope of agricultural production; (f) reduction of vulnerability to sea level rise due to climate change; and finally (g) protect life and properties of the Polder community from storm surges.

5.4 Water Management Problems and Issues in the Polder

103. Existing condition of the embankment is moderately better than other CEIP Polders. However, re-section work is proposed for entire length of the embankment as per recommended crest level based on sea level rise due to climate change scenarios to be obtained from the model study (IWM). Drainage sluices of thePolder are in deteriorated condition and most of them have no gates. The concrete surface of the structure has eroded. The barrel portion of some of the structure has been blocked due to siltation and diversion channels have been silted up. The outfall river (Taltala River) at the outer periphery of the embankment and in between Polder-17/1 and older-17/2 from small Andharmanic gate to Teligate River (at a length of about 9 km) has been fully silted up causing drainage congestion to the adjacent area. The bed level

of the aforesaid portion of the river is almost same level to the ground level in several portions and people are cultivating crops there.

104. The internal drainage channels have silted up due to lack of maintenance for a long time. Some khals become narrow due to growth of vegetation. Moreover, water flow is being hampered through the sluices due to the presence of excess hyacinth at the entry of sluice gates. Moreover, local people use the khals as dumping zone of garbage. Some portions of these are needed to be re-excavated for efficient drainage within the Polder. An Index Map showing the alignment of the embankment, location of damages and existing structures is shown below in **Map5.1.**



Map 5-1: Base Map of Polder-17/2


Photo 5-1: Deteriorated Condition of Changamari khal


Photo 5-2: Narrow drainage khal (D/S-5) due to siltation and vegetation

105. Salinity intrusion is a common phenomenon in this Polder nonetheless, during field visit (February, 2016) no salinity has found. According to local people salinity problem lasts 4-5 months and the situation become miserable day by day for unauthorized khal excavation due to shrimp culture. The absence of adequate functioning of local water management organizations has resulted in poor operation and maintenance of the Polder and its water control structures. Based on local opinions clustered during the major field investigation carried out in February 2016, the study team identifies the following key water management problems and issues in Polder 17/2.

- High rate of siltation in peripheral rivers which hinders natural overland drainage;
- Recent cyclones and storm surges, particularly the recent cyclones of 2009 (Aila);
- Lack of timely repair and maintenance of water control structures and embankments
- Inadequate budget allocation for O&M and its inefficient use

106. Abuse of existing infrastructure for fishing, shrimp/ prawn farming through unauthorized and inappropriate inlet pipes which result in weakening of the embankments.

- Malfunctioning of water control structures.
- Unauthorized re-excavation of drainage khals by local people that is not maintained the hydrological system properly.
- Inadequate plantation in the foreshore and lack of coastal green belt;
- Absence of functional community organizations for operation and co-management of the Polder system.

5.5 Present Status of Water Management Infrastructures

107. Water Management Infrastructures are the physical interventions which ensure sustainable management, optimal use and equitable utilizationof water resources. There are some typical water management infrastructures such as peripheral embankments, drainage and flushing sluices, drainage khals etc. Based on field investigation carried out in February 2016, coupling with the information received from CEIP consultants, the study team gathered the following information regarding the status of existing infrastructurein Polder-17/2.

108. The details of the existing embankment and other hydraulic structures of the Polder are furnished in Table 5.1 below:

Table 5-1: Summary Existing Water Management Structures

Type	*Specification*
Total length of embankment	*11.00 km*
Design Crest Level	*4.27 m PWD*
Total number of Regulators	*6 nos.*
Flushing Inlets	*nil*
Gross project area	*2,826 ha*
Drainage Khals	*21 km*
Net Benefitted area	*1,551 ha*

Source: CEIP, 2015; and Image Analysis by CEGIS, 2015

5.5.1 Embankment

109. Almost the entire length of the peripheral embankment (10.38 km) is proposed for re-sectioning work. As mentioned before some portion of the embankment is better condition with bitumen carpeting but most of the portion is dilapidatedcondition. The remaining portions are presently in deteriorated (breached in some locations) condition due to attack of cyclone Aila. Specially, the length of the embankment from Ch. 0+000 to Ch. Ch. 3+500 to Ch.8+000 to Ch.11+000 is experienced highly fragile during field visit (February,2015).

Photo 5-3: (a) WAPDA road on the embankment (b) Deplorable condition of the embankment (D/S-5)

5.5.2 Retired Embankment

110. The setback distance of the river from Ch. 9+380 to Ch.10+000 has become closer to the Gangrail River and insufficient due to bank erosion of the adjacent river. This portion of the embankment is proposed as retired embankment.

5.5.3 Bank Protection Work

111. The embankment from Ch. 9+380 to Ch.10+000 has been eroded by river erosion and seriously damaged. The tender for bank protection works from Ch. 9+380 to Ch.9+520 has already been floated under Aila fund. The bank protection work (Bank revetment) for the remaining portion of the embankment from Ch. 9+520 to Ch 9+770 has been proposed under CEIP to prevent further erosion.

5.5.4 Re-sectioning of the Embankment

112. The remaining part of the embankment (Ch. 0+000 to Ch. 9+380 and Ch. 10+000 to Ch.11+000) needs to be re sectioned up to the design level. There is brick soling and bitumen carpeting on the top of the embankment at some segments constructed by LGED which has to be dismantled and to be upgraded to the CEIP design crest level.

5.5.5 Hydraulic Structures

113. There are 6 (six) drainage sluices in the Polder and no flushing inlets. It was found that diversion channels have been silted up and loose apron have been damaged in most of the cases. Gates have been corroded and vertical lift gates with lifting devices are to be replaced. In some cases, the sluice barrels have been blocked due to siltation. The present condition of the structures is shown below in tabular form.

Table 5-2: Status of existing hydraulic structures

Sl. No.	Location of Structure with Specifications	Present Condition of the Structures	Recommendation	Remarks
1	DS-1 (2v-1.5 x 1.8) RCB at Ch.1+220	There is no vertical lift gate with lifting device. The flap-gate has been corroded. Sluice connecting khal and the out-fall channel of the sluice has been silted up. Barrel portion of the structure has been blocked due to siltation.	Repairing of the structure is required.	To be repaired.
2	DS-2 (1v-1.5 x 1.8) RCB at Ch. 2+160	Railing has been damaged and flap gate has been corroded. There is no vertical lift gate with lifting device for storing water inside the Polder. Sluice connecting khal and the out fall channel of the sluice has been silted up. Barrel portion of the structure has been blocked due to siltation.	Repairing of the structure is required.	To be repaired.
3	DS-3 (1v-1.5 x 1.8) RCB at Ch. 4+575	Railing and loose apron have been damaged. Flap gate has been corroded.	The structure is proposed to be replaced with provision	To be replaced.

Sl. No.	Location of Structure with Specifications	Present Condition of the Structures	Recommendation	Remarks
		There is no vertical lift gate for storing water inside the Polder. The sluice is in deplorable condition and is not repairable.	of drainage and flushing.	
4	DS-4 (2v-1.5 x 1.8) at Ch. 6+590	The structure has been fully damaged and was declared as abundant.	There is no demand of sluice at this location as one new structure has been constructed at 6.58 km. So, the existing structure will have to be demolished.	To be demolishe d.
5	DS-4A (4v-1.5 x 1.8) at Ch.6+580.	The construction of sluice has been completed in the year of 2010-2011 and is in good condition.	It will serve the purpose.	The existing structure will serve the purpose.
6	DS-5 (1v-1.5 x 1.8) at Ch.9+180	The U/S and D/S loose apron have been damaged. Flap gate has been corroded. There is no vertical lift gate with lifting device for storing water inside the Polder. Sluice connecting khal has been silted up and the barrel portion of the structure has been blocked.	Repairing of sluice is proposed.	To be repaired.

D/S-1

D/S-2

D/S-3 *D/S-4*

DS-5

Photo 5-4: Deplorable condition of drainage sluices

5.5.6 Drainage Channels (khals)

114. A few numbers of drainage channels (Khals) are acting in this Polder area. Most of the drainage khals are suffering siltation problem and hyacinth causes water logging in several sluices. The drainage khal at D/S-1 has re-excavated due to increase capacity and abundant water supply for fish/prawn culture by local Gher owners nevertheless, it does not serve the proper requirement. Only Gangrail khals is in better condition that passes through the D/S-4 and the out fall of this khal is Gangrail River. According to CEIP, 11.85 km drainage channel has been proposed for re-excavation that will reinstate the hydrological function of the Polder area. The existing drainage channels are shown in Figure 5.1 (Google earth)

Figure 5.1: Existing Drainage Channels of Polder-17/2

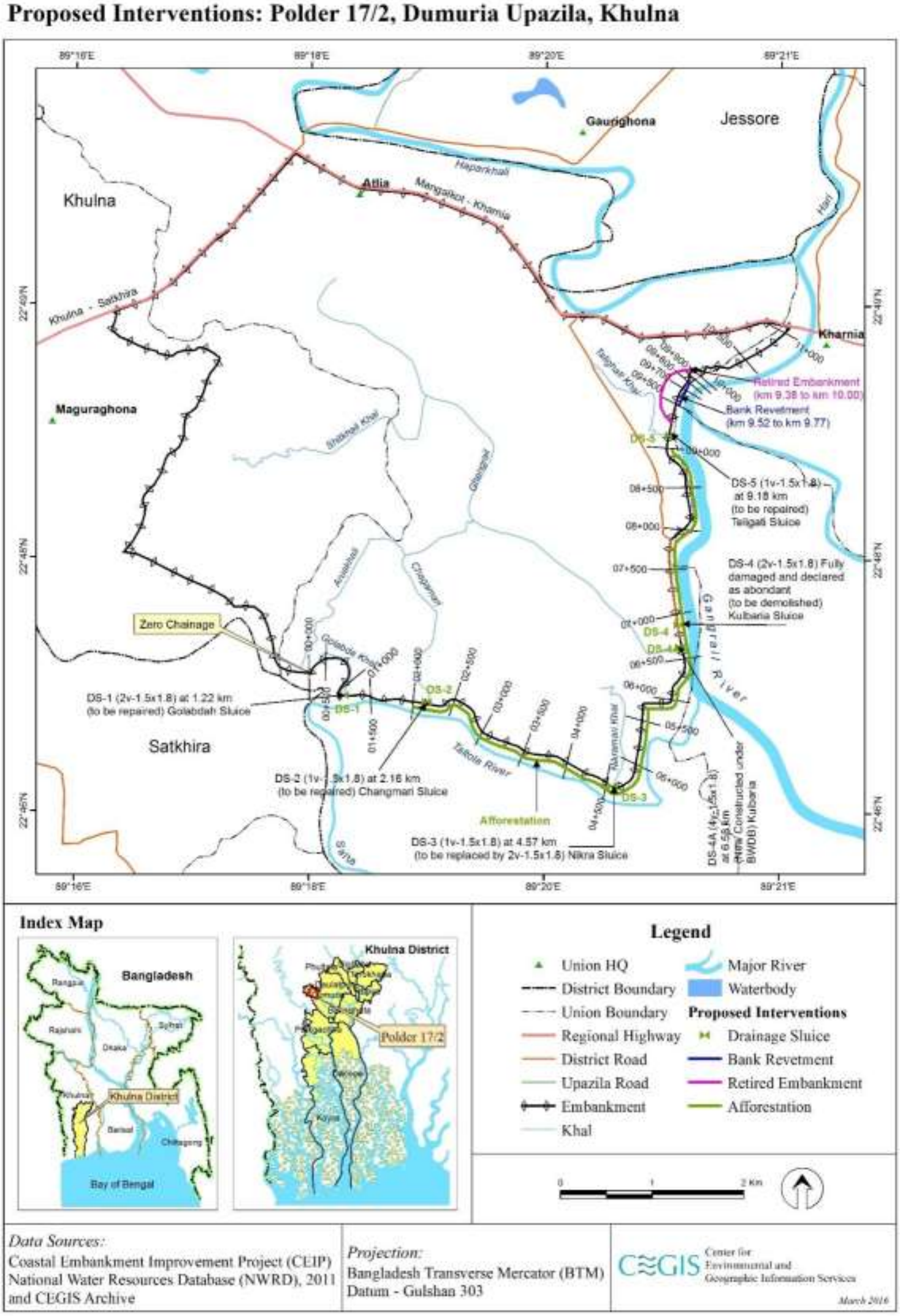
5.6 Proposed Interventions

115. The proposed interventions of Polder-17/2 (Map 5.2) under CEIP-1 are listed in **Table 5.3**. It is mentionable that drainage modelling of the coastal Polder has been carried out by IWM to find out the design parameters for drainage cannel systems, drainage regulator, river bank, slope protection works. Climate resilient coastal embankment crest level has been design considering the combined effects of cyclone storm surge effects and cyclone induced wind wave. The model has been developed and simulated considering climate change condition considering with and without interventions (IWM, 2016). The interventions have further been detailed in the following sections:

Table 5-3: Summary of Proposed Interventions in Polder-17/2

Type	*Specification*
Re sectioning of embankment	*10.38 km*
Construction of retired embankment	*0.62 km*
Design crest level of embankment	*5.20 m PWD*
Side Slope	*R/S 1:3 & C/S 1:2*
Construction of drainage sluice under CEIP	*1 no.*
Repair of Drainage Sluice	*3 nos.*
Demolishing of drainage sluice	*1 no.*
Construction of Flushing Inlets	*Nil*
Re excavation of drainage channel	*11.85 km*
Slope protection	*0.25 km*
Afforestation	*8,85 ha*

Source: CEIP, 2017



Map 5-2: Proposed Interventions of Polder-17/2

116. To implement the aforementioned project interventions, the following phase-wise activities are to be carried out (Figure 5.2). The activities under each of the interventions have further been discussed and specified in the following sections.

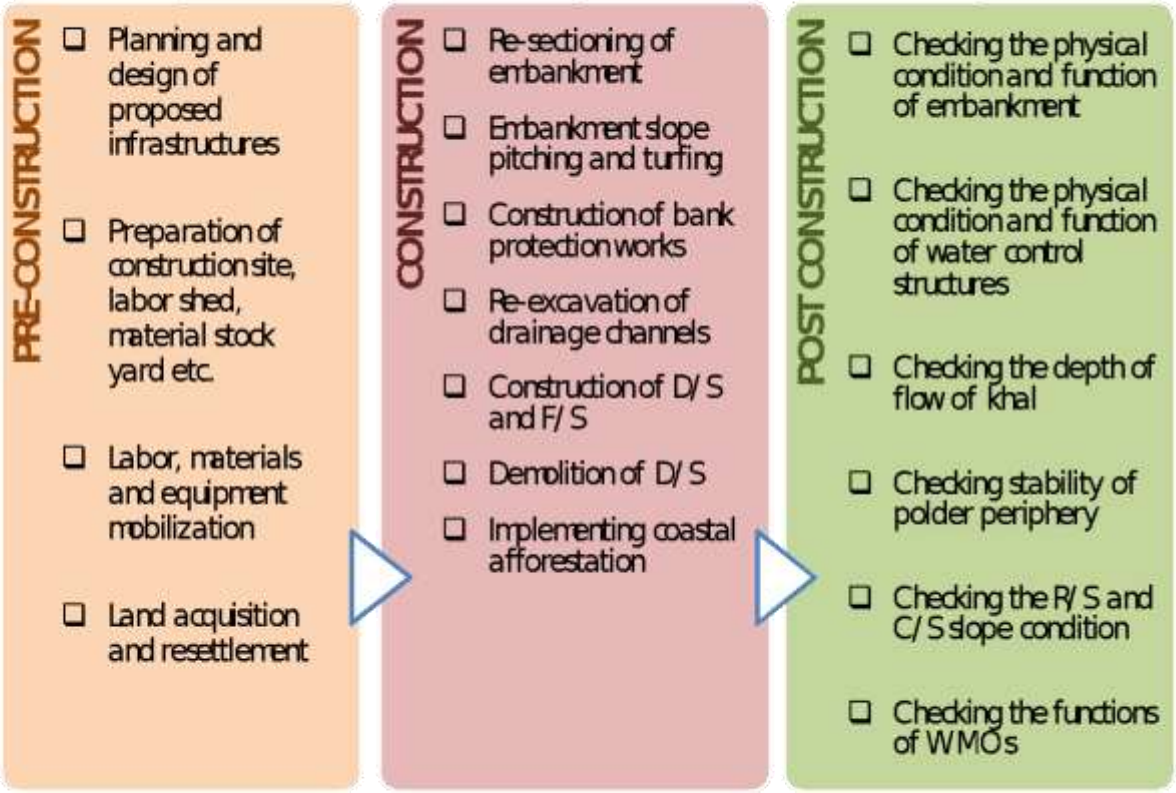


Figure 5.2: List of activities in Polder-17/2 at different project phases

5.6.1 Resectioning of Embankment

117. A total of 10.38 km. length of the embankment will be resectioned under the proposed interventions. The crest level of the embankment will also be raisedup-to 4.50 mPWD though all the length which has been assesd through mathmetical modeling concedering storm surge level and monsoon water level for 25-year return period under climate change scenarios which is shown in Table 5.4b. The side slope of the embankment in River side (R/S) and Country side (C/S) will be 1:3 & 1:2 respectively. However, a certain portion (0.62 km) of the retired embankment is also proposed. In addition, a smaller portion (250 m) of the embankment is proposed for bank protection works (bank revetment). Table 5.4a shows detail information on the works on the embankmentto be carried out and Table 5.4b shows the design parameters determining the embankment crest level counting the climate change scenario.

Table 5-4a:Detail of Works on Embankments

Sl. No	Chainage (km+m)	Length (Km)	Proposed Crest Level (mPWD)	Side slopes
Re-sectioning of Embankment				
1	0+000 to 9+380	9.38	4.50	R/S 1:3 & C/S 1:2
2	10+000 to 11+000	1.0	4.50	R/S 1:3 & C/S 1:2
Construction of Retired embankment				
3	9+380 to 10+000	0.62	4.50	R/S 1:3 & C/S 1:2
Slope protection				
4	9+520 to 9+770	0.25	4.50	R/S 1:3 & C/S 1:2

Source: CEIP, 2017

Table 5-4b: **Design Parameters for Embankment Crest Level under Climate Change Condition**

								Wave Computation								Monsoon Levels				
Point No.	Location	LDL Crest Level (mPWD)	Existing Ave. Crest Level (corrected mPWD)	Modelled Storm Surge level (corrected mPWD)	Standard Deviation (m)	Sidr Simulated surge level (corrected mPWD)	Aila Simulated surge level (corrected mPWD)	Recommended Slope	Free board for Grass or Smooth paved (Roughness coefficient 1.0)	Free board for rough Slope (Roughness coefficient 0.8)	Allowance for Subsidence	Rqd crest Levelw/o roughness + Subsidence & no std	Rqd crest Levelw/o roughness + std + Subsidence	Rqd crest Levelwith roughness + subsidence & no std	Rqd crest Levelwith roughness + Subsidence + std	25 year maximum WL in June-Sept period	Max wind wave height in June - Sept period	Free board for Grass or smooth paved(Roughness coefficient 1.0)	Rqd crest Levelw/o roughness with subsidence and freeboard	Crest Level Considering 0.90m freeboard according to Standard Design Manual, Volume 1, standard design criterion of BWDB
1	2	3	4	5	6	7	8	9	10	11	12	13 (5+10+12)	14 (13+6)	15 (5+11+12)	16 (15+6)	17	18	19	20 (17+19+12)	21 (17+0.9m+12)

Source: Design Team of DDCS&PMSC, 2019

*All values of storm surge level and monsoon water level are for 25-year return period under climate change conditions

Note 1: At Polder No. 17/2, Storm Surge is insignificant, Monsoon Water Level governs the fixation of crest level of embankment.

Note 2: According to the design manual of BWDB (Standard Design Manual, Volume 1, standard design criterion of BWDB), the required minimum freeboard is 0.9m. Accordingly the proposed crest levels are given in column 21.

Description of construction activities

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

119. Before commencement of construction activities for embankment construction, labor sheds should be constructed with proper sanitation and other required facilities. A suitable site shall be selected and prepared by cleaning bushes, weeds, trees etc. Alignment of the embankments has to be fixed with adequate base width. Base stripping and removal of trees, weeds etc. will be done as per the instruction of the Engineer in-charge. The tools required for the construction of embankments will be procured during this period. After validating the final design and preparation of site. Earth will becarried and placed on on the alighnment of enbankment. Soil will be dumped in layers. At the same time, each layer (of 1.5 feet) of dumped soil will have to be compacted by a compactor. The slope and shape of specified embankment will be developed after proper compaction in layers. Thereafter grass will be placed on the slope of the embankment. Water and fertilizer will also be provided for the proper growth of grass.

5.6.2 Construction (Replacing) or Repairing of Drainage Sluices

120. A single (01) existing drainage sluices (D/S) will be replaced and three (03) sluices will be repaired under the proposed rehabilitation works of the Polder. Furthermore, one drainage sluices will be demolished. The summary of design information of the proposed works for these drainage sluices are given in **Table 5.5.**

Table 5-5: Detail of Works in Drainage Sluices

Sl. No.	Name of drainage sluices	Chainage (at km)	Khal Name	Name of outfall river	Length of Khals (Km)	Lowest Tide level (m. PWD)	Lowest elevation of basin (m. PWD)	Existing Sill Level (m. PWD)	Proposed Sill level (m. PWD)	Remarks
01	DS-1 (2v-1.5 x 1.8)	1+220	Golabda Khal	Taltola	1.00	-1.20	-0.16	-3.25	-1.00	Repairing of structure (proposed)
02	DS-2 (1v-1.5 x 1.8) e.	2+160	Changamari khal	Taltola	1.85	-1.20	-0.19	-2.43	-1.00	Repairing of structure (proposed)
03	DS-3 (1v-1.5 x 1.8) g.	4+575	Nikaramari khal	Taltola	1.50	-1.20	-0.18	-2.65	-1.00	Replacement of structure (proposed)
04	DS-4 (2v-1.5 x 1.8) i.	6+590		Gangrail	-	-	-	-	-	To be demolished
05	DS-4A (4v-1.5 x 1.8) k.	6+580	Ganggrail khal	Gangrail	6.00	-1.10	-0.21	-2.26	-1.00	The existing structure will serve the purpose.
06	DS-5 (1v-1.5 x 1.8)	9+180	Teligati Khal	Gangrail	1.50	-1.05	0.10	-2.20	-1.00	Repairing of structure (proposed)

Source: CEIP 2015

Description of construction activities

121. During pre-construction phase of drainage sluices, construction of labor shed with sanitation and other facilities should be completed. During this period, required construction materials (sand, cement, shuttering materials etc.) will be procured by the contractor as per tender schedule. Before starting the construction of drainage sluices, ring bunds and diversion channels will have to be constructed; and site should be prepared in all respect asper instruction of the Engineer-in-charge. After that the foundation treatment required for the structure will be carried out. Thereafter reinforced works such as cutting, bending and binding of m.s rods will be performed followed by CC and RCC works 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 installed. Gates will be painted as per specification. The channels will be constructed as per design. The CC blocks for river training and pitching works made in parallel to construction of sluices will then be conducted.

5.6.3 Slope Protection Work

122. Slope protection work will be carried out at a stretch of 0.25 km from Ch 9.520 to Ch 9.770 (Refer Map 5.2).

Description of construction activities

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

5.6.4 Re-excavation of drainage khals

124. Five (5) drainage channels with a total length of 11.85 km will be re-excavated to ease water flow and reduce drainage congestion in the Polder area. An estimated volume of 0.0244 million cubic meters of soil/silt will be excavated. The excavated soil will be used for strengthening the khal banks. If the excavated materials are found suitable, the Contractor can use the materials for construction of embankments upon prior approval by the DDCS&PMSC. Moreover, the excavated soil will be used for strengthening the khal banks. As per consultation, local people are interested to take earth materials, as well. The excavated materials will be used for raising the plinth level of their earthen kacha houses as well as individual house yards, school grounds, play ground, low land, prayer grounds, community centers etc. The water channels to be re-excavated under the project are listed in Table 5.6. Figure 5.3 below shows the conceptual layouts of proposed dumping technique. Compartmental dumping spots will be created along the sides of the excavated khals, allowing any runoff from de-watering of the spoils and from precipitation to drain into the excavated khals.

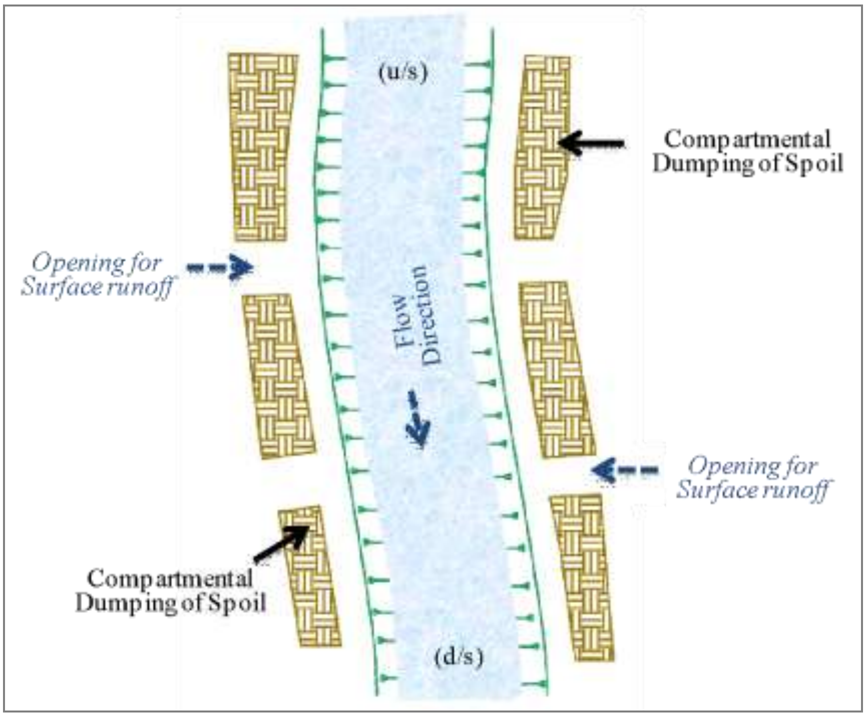


Figure 5.3: Plan form of a typical khal to be re-excavated

Table 5-6: Channels to be Re-excavated

Sl.	Name of Khal (Channel)	Length (km)
1	**Changmari khal**	1.85
2	Gangrail khal	6.00
3	Golabda khal	1.00
4	Nikramary khal	1.50
5	Talighati khal	1.50

Source: CEIP-1 Design Study Team, 2017

Description of construction activities

125. For re-excavation of the drainage channels, the required tools will have to be procured at first. A schematic diagram showing the centerline and layout plan will be prepared for re-excavation the design depth and width of excavation will also be noted in thesection of the channel. The entire channel will then be divided into a number of reaches. The excavation will be started from the downsream 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 excavated soil/sludge should be dumped at suitable places, specified by the Engineer in-charge, so that the sludge or soil will not affect the channel flow by any means. After finalizing excavation in one reach, the next reach in the downstream would be excavated following the same procedures as stated above. The entire length of the channel will thus be re-excavated.

5.6.5 Afforestation

126. Afforestation will be implemented within the Polder to ensure the environmental sustainability as well as protection of embankment from erosion and tidal action. A total of 8.85 ha area will be afforested inthis Polder.

5.6.6 Construction Schedule

127. The construction works in Polder17/2 under the CEIP-1 are expected to be completed in four years. The construction schedule is presented in Table 5.7.

Table 5-7: Construction Schedule

(Part A)

Sl.	Description	Year One								Year Two			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)												
2	Construction of Drainage Sluices / Flushing Inlets												
3	Re-excavation of Drainage Channels (km)												
4	Other works, including surveys, quality checks, testing, inspections etc.												

(Part B)

Sl.	Description	Year Two								Year Three			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)					Turfing							
2	Construction of Drainage Sluices / Flushing Inlets												
3	Re-excavation of Drainage Channels (km)												
4	Other works, including surveys, quality checks, testing, inspections etc.												

(Part C)

Sl No	Description	Year Three								Year Four			
		May	Jun	Jul	Au g	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Ap r
1	Re-sectioning of Embankment (km)												
2	Construction of Drainage Sluices/Flushing inlets												
3	Re-excavation of Drainage Channels (km)												
4	Other works, including surveys, quality checks, testing, inspections etc.												
5	Site clearance and clean up												

Design Study Finding of CEIP-1, 2015Construction Manpower Requirement

5.6.7 Construction Manpower Requirement

128. Technical and non-technical manpower will be required for the construction works. The manpower will include senior professionals, Engineers, Technicians, Supervisors, Surveyors, Mechanics, Foremen, Machinery operators, Drivers, and un-skilled laborers. The estimated manpower requirement is presented in Table 5.8. It is mentoined here that labor sheds/camps will be required for house workers (skilled labour)[3]. There would be no requirement of labour camp for un-skilled labour because they will be recruited from the local area. But temporary labour camp for local labour during preparing of CC block will be established, if required.

Table 5-8: Required manpower for construction

SL	Required Manpower	Number
1	Senior professionals	5
2	Site Engineer	6
3	Technicians	15
4	Admin/support Staff	12
6	Skill labour	40
7	Un-skill labour	220

Source: Main Consultant, 2015

[3]Lessons learnt from implementation of CEIP Package-1. PDSC observations

5.6.8 Construction Material

129. The construction materials required for re-sectioning of the embankment and construction/repair of drainage sluices/flushing inlets are soil, cement; steel, stone, sand and vertical gates. Estimated quantities of these materials are presented in Table 5.9.

Table 5-9: Details of Construction materials

Sl	Description	Quantity	Sources
Re-sectioning of embankment			
1	Earth work	17646.55 m^3	Private lands specially from river side (low excavated land will be filled up by tidal silts within one or two years), spoils from re-excavation of drainage channels
Construction of drainage sluices/flushing inlets			
2	Cement		To be procured from, cement factory (directly)
3	Sand		To be procured from Khulna, Sylhet
4	Stone		To be procured from Khulna, Sylhet or imported from neaighbour countries
5	Steel		To be procured from Khulna, Dhaka steel mill (directly)

Source: Design Study Finding of CEIP-1, 2017

130. For rehabilitation of Polder 17/2 under CEIP-1 no river protection work will be required and slope protection will be required for a stretch of 0.25 km only (Table-5.3). Moreover, some CC blocks will be required for rehabilitation/repair of sluices. Since the number of CC blocks required will be less, there will be no need of establishing automated CC block manufacturing plant in the Polder area, rather they can be prepared manually.

5.6.9 Construction Machinery

131. A number of construction machinery and equipment would be needed for the construction activities in the Polder. A tentative list of these machinery and equipment is presented Table 5.10 below:

Table 5-10: List of construction equipment and machinery

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

Source: Engineering / Procurement Team of CEIP-1

5.7 Project Implementation Arrangements

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

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

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

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

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

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

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

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

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

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

141. This institutional arrangement is effective and are being followed in Package -1 and Package-2 of CEIP-1.

5.8 Water Management and Operation Plan

5.8.1 Introduction

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

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

reference to Local Government Institutions (LGIs) as well as local stakeholders' participation and need based budgeting will continue to remain at the apex.

5.8.2 Operational Plan

144. 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 as well as aquatic biodibersity. In the coastal Polders, operation of gates mainly focuses on protecting thePolder from entry of saline water during high tides and allowing drainage of excess water from inside the Polder during low tides to minimize the depth of flooding but storing enough water on the paddy fields. The trend however changes in the dry season where the operational plan aims in storing as much water in the canal networks as possible by closing the gates. The water thus stored should have the basis of a balancing mechanism among all categories of user viz. paddy growers; salt producers (if there is any); shrimp producers (also including other fish culture practices); and also domestic users. Operation at structures should therefore be an organizational.

(i) Operational Activities

145. 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)

146. 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

147. In the past BWDB employed the Gate Operators from its own; but due to down sizing of the Manpower, this position has been abolished. 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.

148. 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 section to address Beneficiaries Participation in coastal Polders.

149. The gates of each drainage sluice / regulator must be operated following certain fixed rules regarding timings. BWDB's 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.

150. Flap Gates of regulators should remain in place at all times except during maintenance and flushing. During pre-monsoon period, the vertical lift gates of each regulator should remain closed for retention of water for irrigating Aus crops by LLPs. During monsoon (July to

September), the vertical lift gates should normally remain closed; but may be opened to regulate the water levels inside the Polder and should not be allowed to exceed the stated maximum permissible level for safety reasons. In order to achieve this, discharges into the river should commence depending on the river levels and should be stopped soon after after the permissible levelis 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 etc. However, the frequency and type of this decision making process will vary with the seasonal conditions.

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

152. 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.

(b) Frequent Watching of Embankments

153. This is a typical monitoring activity to be carried out by the BWDB O&M staff. It is intended mainly to detect weak sections, rat holes, 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.

(c) Regular Checking of Structures

154. 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) Survey (of Physical Conditions o of embankment & structures and Engineering survey)

155. 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

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

(ii) Planning of Operation

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

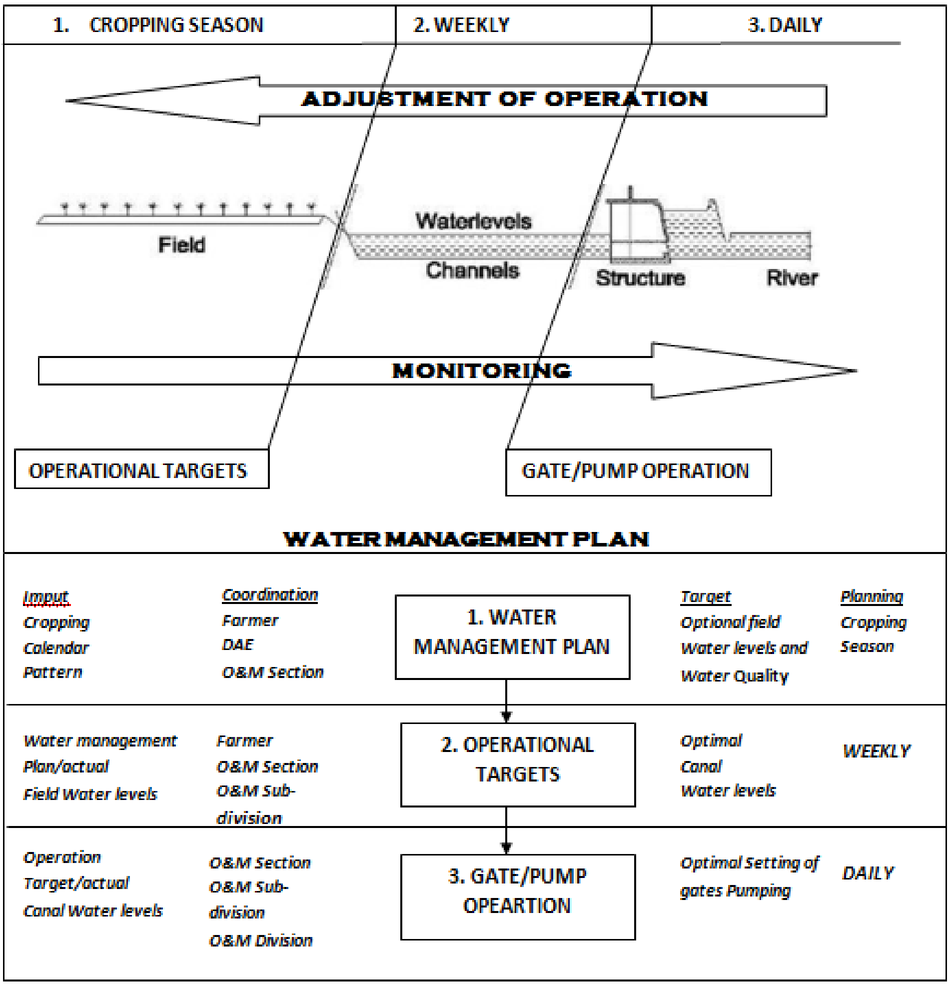


Figure 5.4: Decision making in operation

5.8.3 Maintenance Works

158. 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.

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

(i) Preventive or Routine Maintenance;
(ii) Periodic Maintenance;
- Minor Periodic Maintenance
- Major Periodic Maintenance

(iii) Emergency Maintenance;

(i) Preventive or Routine Maintenance;

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

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

(ii) Periodic Maintenance

161. 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.

162. 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:

(a) Minor Periodic Maintenance Works:

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

(b) Major Periodic Maintenance Works:

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

163. The periodic maintenance interventions have been spelled out precisely in Table 4.6

(iii) Emergency Maintenance

164. 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 5.11indicates each type of emergency maintenance works.

Table 5-11: Types and Classification of Maintenance Works

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

Sl. No.	Description of Maintenance Works	Implementation Mode									
		Classification by Type of Maintenance			Community Based Functional Groups under WMOs						LCB
		I	II	III	EMG	ES	CMG	SMG	LCS	PIC	
15	Repair defective block works (aprons)		√								√
16	Replacing stop logs, flap gate or vertical		√	√							√
17	Repair head walls, wing walls, aprons of structures		√								√
18	**Protective Works** Re-positioning/replacing of incidentally displaced blocks/ boulders /concrete frames, small repair to sand/gravel filter		√								√
19	**Channels** Cleaning khal and outfall drains and de-silting outfall drains	√					√				
20	Re-excavation of khal		√						√		
21	Removing cross dams (used as access roads, flashing bunds or water retention)		√			√					

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

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(iv) Planning of Maintenance

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

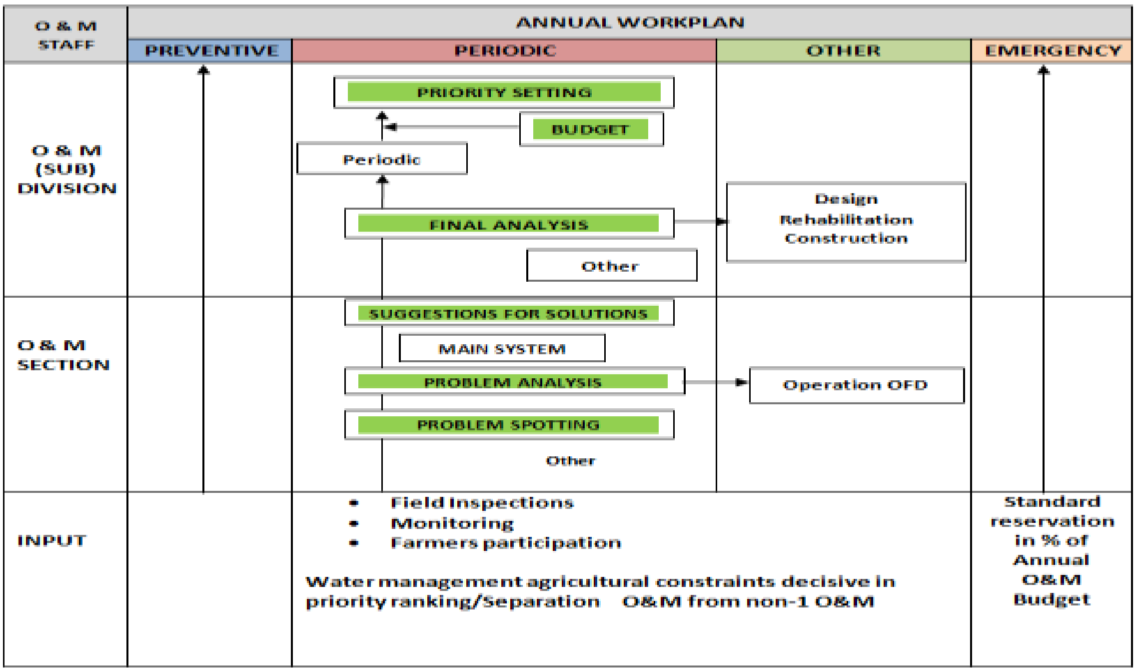


Figure 5.3: Decision Making in Maintenance

5.8.4 Project Cost

166. The implementation cost for rehabilitation of Polder 17/2 under CEIP-1 is TK.4,905 Lakh (Taka 49 crore 5 lakh).

6 Environmental Baseline and Existing Conditions

6.1 Physical Environment

167. The baseline condition of Water Resources, Agriculture Resources, Fisheries, Ecology and Socio-Economic Resources prevailing in the Polder area has been established by collecting data from primary as well as secondary sources. The secondary sources include Bangladesh Water Development Board (BWDB), National Water Resources Database (NWRD), Department of Public Health Engineering (DPHE), Bangladesh Meteorological Department (BMD) and Bangladesh Bureau of Statistics (BBS). Primary data are collected during field visits in the Polder area.

6.1.1 Geology

168. The Polder-17/2 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.

6.1.2 Topography

169. The land slope of the study area is a flat landscape and low topography. The elevations are deviated moderately, with a 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 0.78 to 3.42 m, PWD (from Mean Sea Level. From the Digital Elevation Model, it is found that around 68% lands of the areas have elevation between 0.78 to 2.15 m above MSL, whereas 32% have elevations between 2.16 to 3.42 m above MSL.

6.1.3 Seismicity

170. 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 5.1). Accordingly, the Polder-17/2 area falls under Zone-III, which is characterized by Low earthquake prone site and has a basic seismic coefficient of 0.04g (**Map 6.1**).

Map 6-1: Earthquake Zone Map

6.1.4 Soil Properties

Agro-ecological Zones (AEZ)

171. The Land Resources Appraisal of Bangladesh for agricultural development divides Bangladesh into 30 agro-ecological zones and 88 sub zones. The zonation relates to physiographic characteristics (land forms and parent materials), soil properties, soil salinity, depth and duration of seasonal flooding, agro-climatology(length of kharif and Rabi growing seasons, length of pre-kharif transition period, number of days below certain winter critical temperatures (<15^0C) and number of days with extremely high summer temperature (>40^0C), which are relevant for land use and for the assessment of present and future agricultural potential (FAO/UNDP,1988, BARC,2012). The Polder17/2 comprises of two Agro-ecological zones, namely: High Ganges River Floodplain and Ganges Tidal Floodplain, characteristics of which is briefly discussed.

High Ganges River Floodplain (AEZ-11)

172. This region includes the western part of the Ganges River Floodplain, which is predominately high land and medium high land. Most areas have a complex relief of broad and narrow ridges and inter-ridge depressions, separated by areas with smooth broad ridges and basins.

173. There is an overall pattern of olive-brown silt loams and silty clay loams on the upper parts of the floodplain ridges and dark grey mottled brown, mainly clay soils on ridge sites and in basins. Most ridge soils are calcareous throughout the profile. General Soil Types predominately include Calcareous Dark Grey Floodplain soils and Calcareous Brown Floodplain soils. Organic matter content in brown ridge soils is low, but higher in dark grey soils.

174. In general, top soils are slightly acidic to slightly alkaline in reaction, but there is a significant lowering of soil pH in high land in the recent years and in some places top soils become strongly acidic. Sub-soils are slightly alkaline in reaction. General fertility level is low including N, P, S and B although CEC is medium. The K- bearing minerals are medium to high, but the Zn status is low to medium.

Ganges Tidal Floodplain (AEZ-13)

175. This region occupies an extensive area of tidal floodplain land in the south-west of the country. The entire Polder17/2 area is covered by this agro-ecological zone. This region occupies an extensive area of tidal floodplain land in the south-west part of the country. The greater part of this region has smooth relief having large area of salinity. There is general pattern of grey, slightly calcareous, heavy soils on river banks and grey to dark grey, non calcareous, heavy silty clays in the extensive basins. The entire zone is vulnerable to tropical cyclones.

176. Non-calcareous Grey Floodplain soil is the major component of General Soil Types. Acid Sulphate soils also occupy a significant part of the area where it is very strongly acidic during dry season. In general, most of the top soils are acidic and sub-soils are neutral to slightly alkaline. General fertility level is high with low to medium organic matter content and very high CEC and K status. There are limitations of high exchangeable Na and low Ca/Mg ratio. The Zn status is low to medium while the B and S status are medium to optimum.Land use

177. The total area of the proposed integrated water management project of Polder-17/2 is 2,826 ha of which 1,551 ha is Net Cultivable Area (NCA). The net cultivable area is 55% of the total gross area. The remaining 45% is covered by gher(fishery), settlements with homestead vegetation and canals, ditches, ponds, embankments and roads, respectively. About 554 ha (about 20% of NCA) is underice cum gher. Detailed land use of the Polder area is presented in Table 6.1and Map 6.2.

Table 6-1: Present Land Use of the Polder Area

Land Use	Area (ha)	% of the Gross area
Agriculture Land	1,551	55
Brick-Field	1	0
Canal	122	4
Gher	554	20
Inter Tidal Area	8	0
Pond	40	1
Road	39	1
Settlement with Homestead Vegetation	511	18
Grand Total	**2,826**	**100**

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006, Rapid eye image analysis, February, 2016

6.1.5 Land type

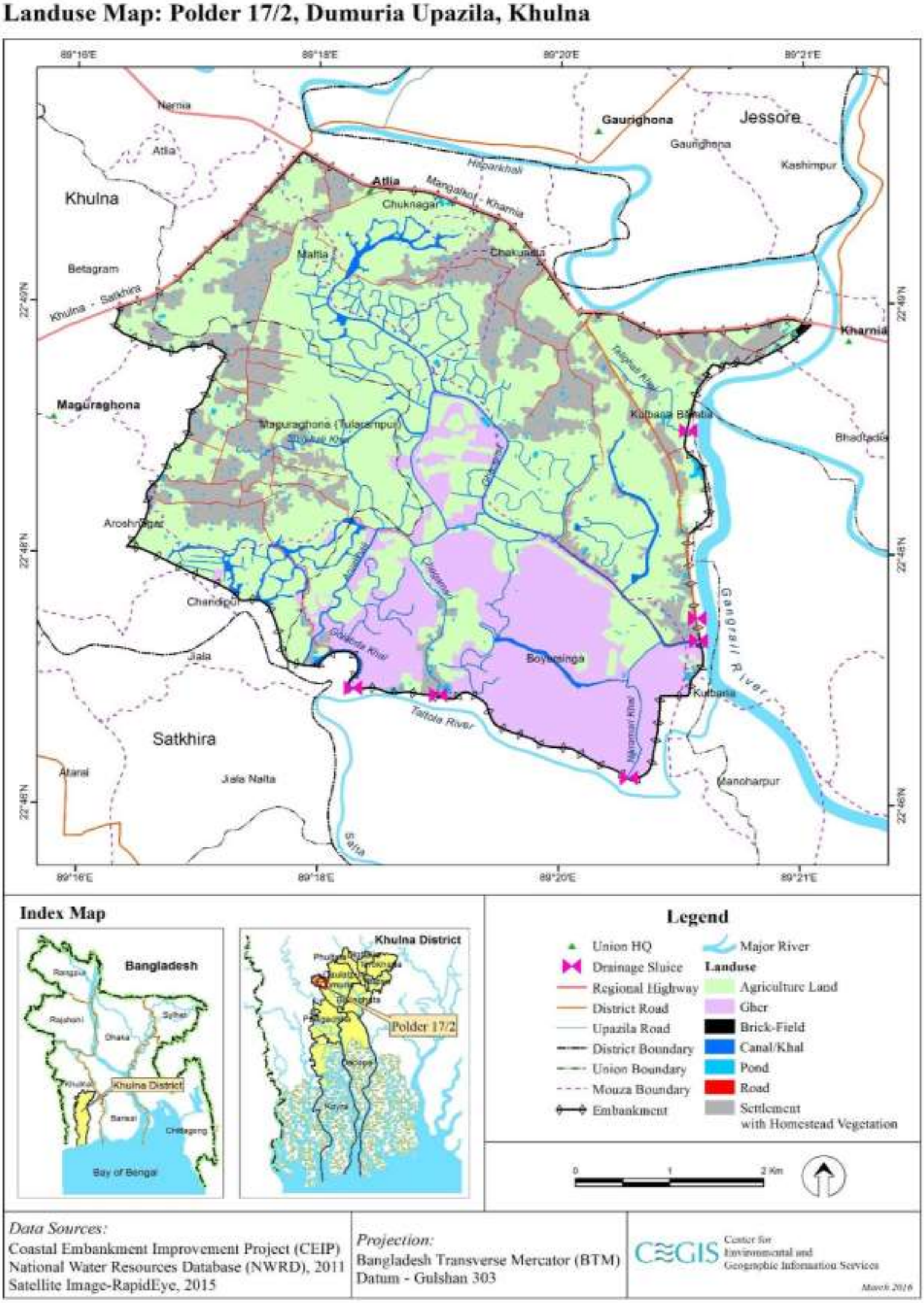
178. Land types are classified based on the depth of inundation during the monsoon season. The land type is very important for utilization of lands for crop production.

179. Around 27% and 73% of the NCA of the Polder area (Polder 17/2) fall under high land and medium high land, respectively. Details of the land classification and distribution of land types in Polder17/2 are presented in Table 6.2.

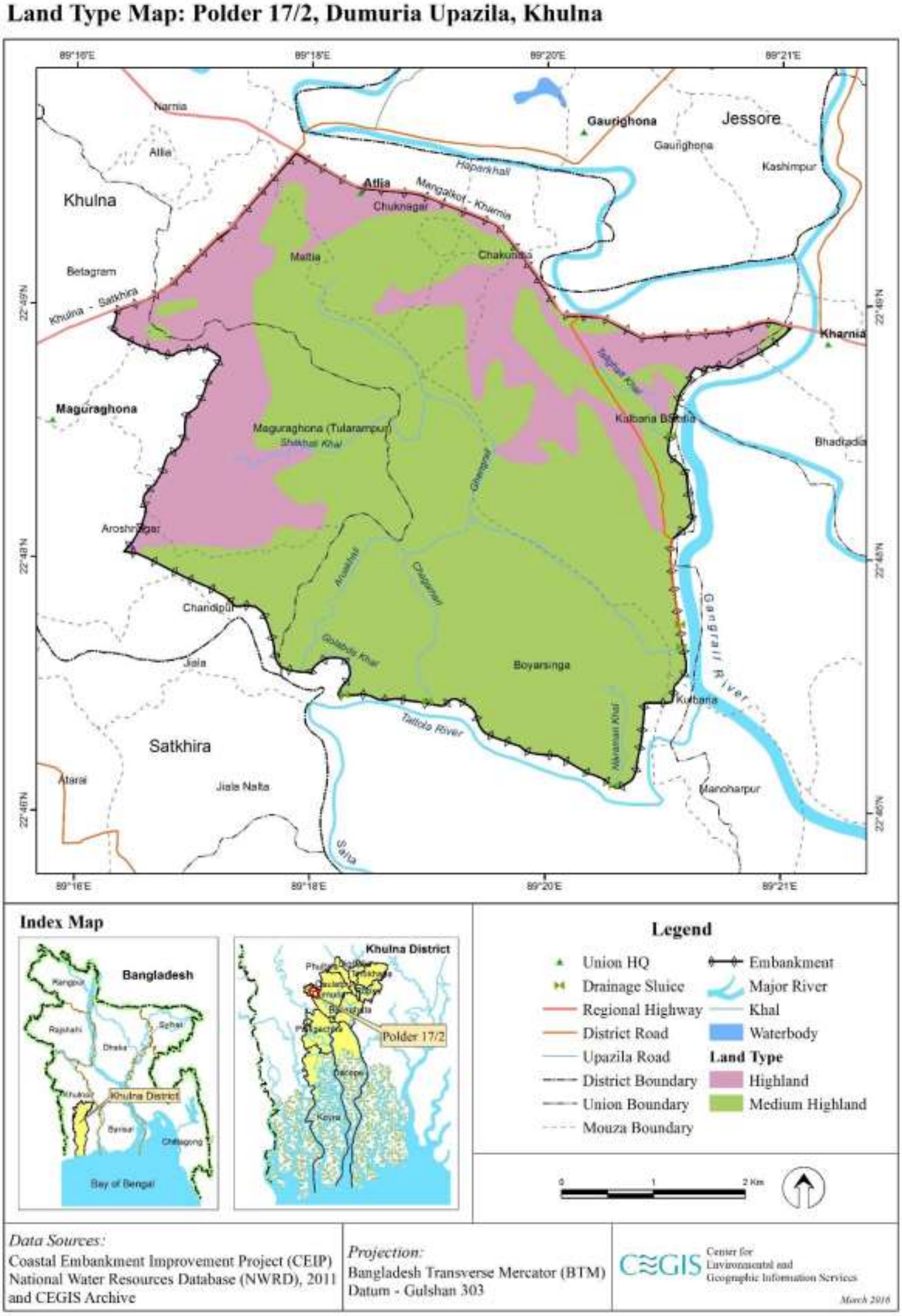
Table 6-2: Detailed land type of Polder area

Land Type	Flooding depth and characteristics	Polder area	
		Area (Acre)	% of NCA
F_0	Intermittently flooded up to 30 cm in the monsoon season.	423	27
F_1	Seasonally flooded by 30-90cm in the monsoon season.	1128	73
	Total:	1551	**100**

Source: Master Plan Organization, Technical Report No-1, 1987 and field observation, February 2016.



Map 6-2: Land use of the Polder area



Map 6-3: Land Types of Polder 17/2

6.1.6 Soil Texure

180. Soil texture relates to the relative proportions of sand, silt and clay. Soil texture is an important soil characteristic that guides crop selection, crop production and also field management. The surface soil texture in the project area varies from clay-to-clay loam, see Table 6.3.

Table 6-3: Present land use of the Polder area

Soil Texture	Area (ha)	% of NCA
Clay	1,107	71
Clay Loam	444	29
Grand Total	1,551	100

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006

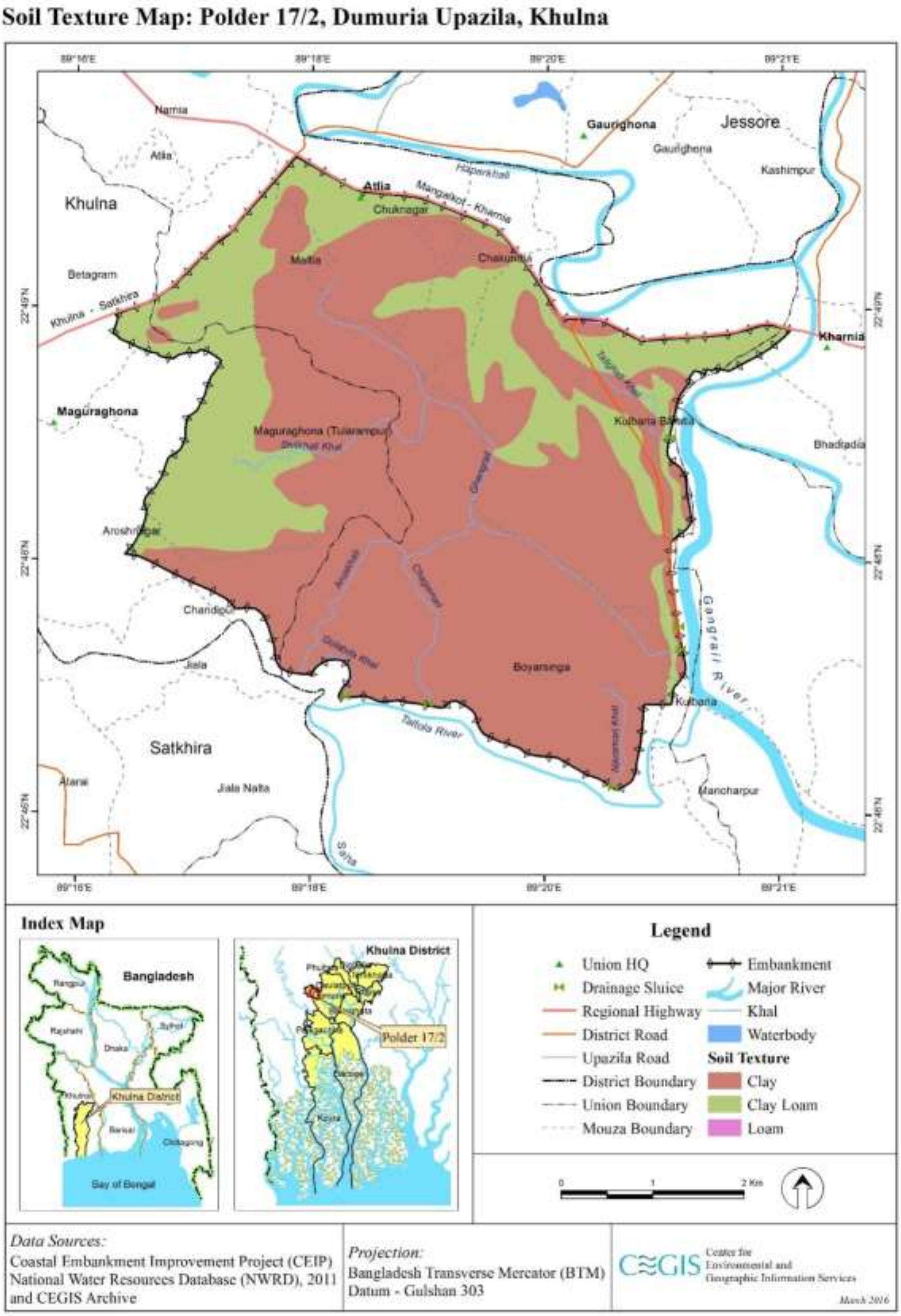
6.1.7 Drainage Characteristics

181. For the agricultural crop production drainage characteristics play an important role. The drainage characteristics have been divided into six classes from the agriculture point of view e.g. Excessively Drained, Well Drained, Moderately Well Drained, Imperfectly Drained, Poorly Drained and Very Poorly Drained (SRDI; 1988). In Polder17/2, 67% of the agricultural land is poorly drained while 33% is imperfectly drained (CEGIS Assessment based on SOLARIS–SRDI; 2006). Details are presented in Table 6.4 and Map 6.5

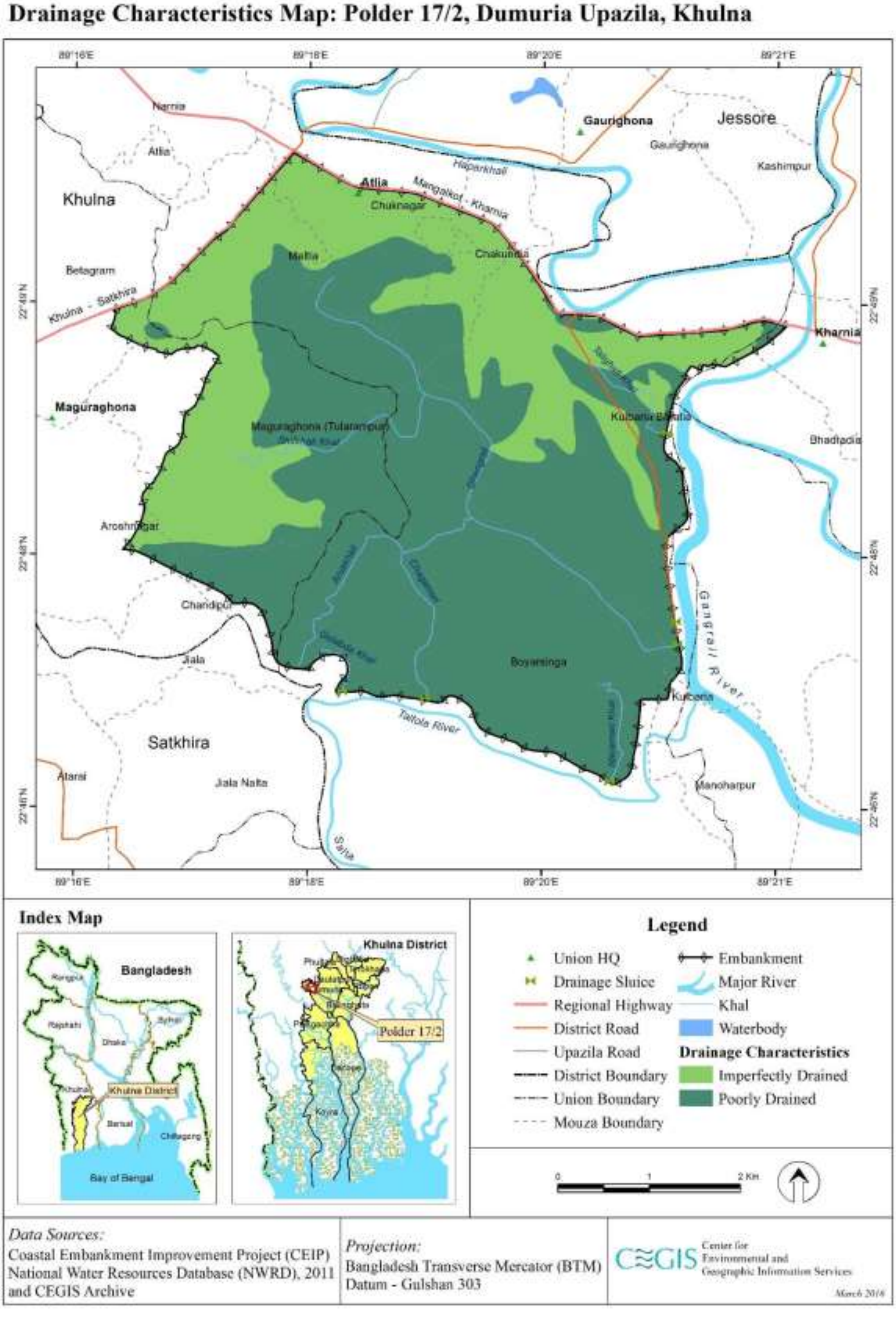
Table 6-4: Detailed Drainage Characteristics of Soil in the Polder Area

Drainage	Characteristics	Area(ha)	% of Area
Imperfectly Drained	Water is drained from soil badly or slowly. This soil often remains wet in rainy season due to rainfall. In normal situation, water does not stand on land for more than 15 days at a stretch. In rainy season, groundwater stands within 1 meter at least for some time.	508	33
Poorly Drained	The soil remains under water from 15 days to 7/8 months. Water is drained from the soil slowly. In most cases, the land remains wet/ water logged for a considerable period of time after the rainy season.	1,043	67
	Total	**1,551**	**100**

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006



Map 6-4: Soil Texture of the Study Area



Map 6-5: Drainage Characteristics of the Study Area

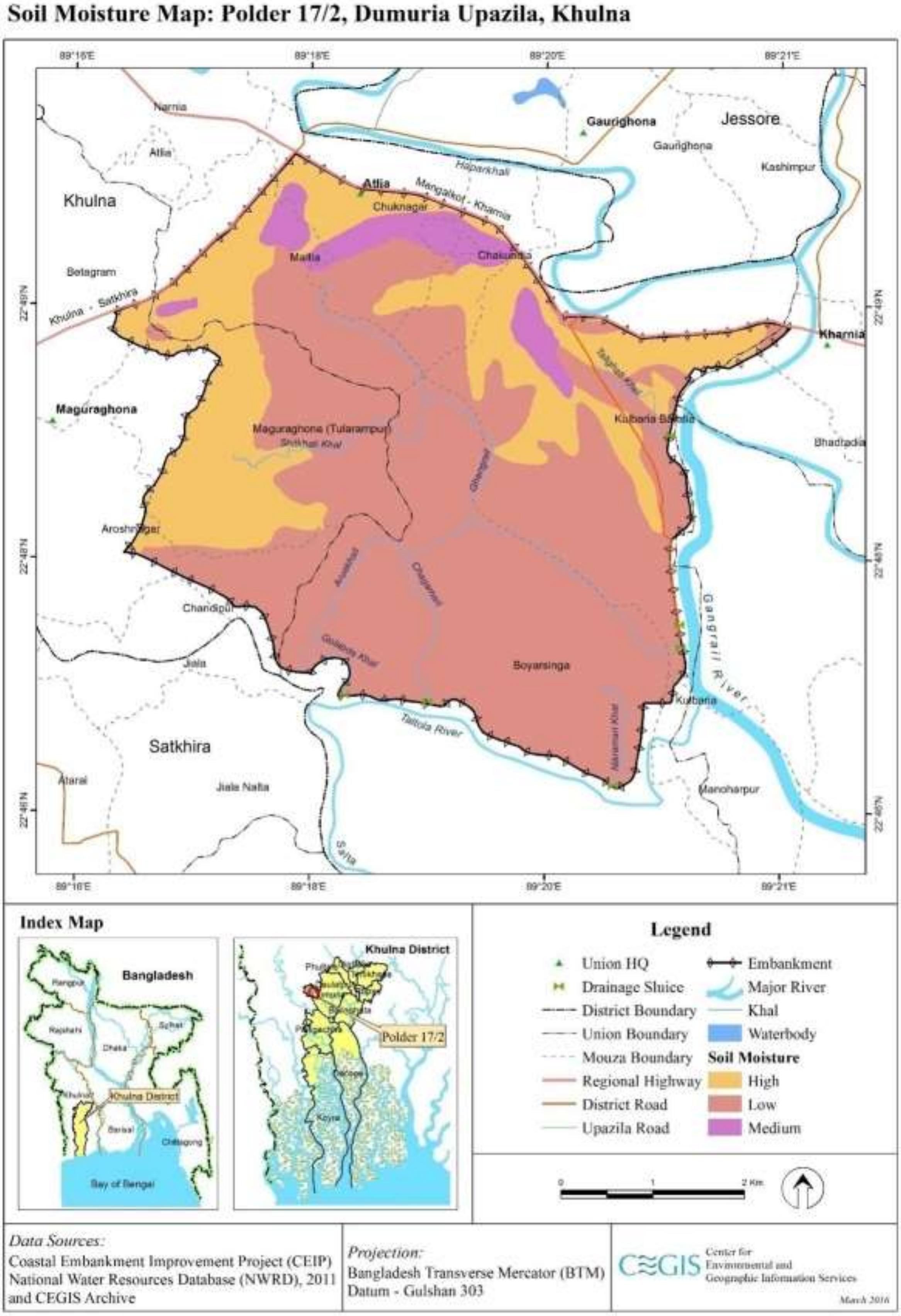
6.1.8 Available Soil Moisture

182. Soil moisture varies depending on the soil characteristics. Growth of plantsand crop production dependon the soil moisture from which plants uptake essential nutrients and water. In Polder17/2 thesoil moisture is generally low and in partial area it is high (CEGIS Assessment based on SOLARIS–SRDI; 2006). Details of the soil moisture are presented in Table 6.5 and Map 6.6.

Table 6-5: Detailed Distribution of Available Soil Moisture in the Polder Area

Classification of soil based on available soil moisture	Characteristics	Area(ha)	% of NCA
High	Plant extractable soil moisture remained in the field level for two to three months.	426	27
Medium	Plant extractable soil moisture remained in the field level for one to two months.	82	5
Low	Plant extractable soil moisture remained in the field level less than one month.	1,043	67
	Total	**1,551**	**100**

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006



Map 6-6: Soil Moisture of the Study Area

6.1.9 Soil Quality

183. Soil sample were collected from the Polder area at Murobunia (22°46'42.12"N, 89°19'48.55"E), Kulbaria (22°48’47’’N, 89°20'08.4"E) and Baratia (22°44'20.1"N, 89°19'58.3"E) on 2nd February, 2016 for analyzing chemical properties of soil. The existing cropping pattern is Fallow–Fallow–HYV Boro, Fallow-Local Aman-Fallow and Fallow-HYV Aman-Oilseeds respectively of the soil sampling locations. The samples were collected from top soil (depth: 0-15 cm from surface) and analyzed Electrical Conductivity (EC), Soil Reaction (PH), Organic Matter (OM), Nitrogen (N), Potassium (K), Phosphorus (P), Sulphur (S) and Zinc (Zn) from laboratory of SRDI, Dhaka. The soil quality test result with methods by location is presented in Table 6.6.

Table 6-6: Chemical Properties of Soil on Agriculture Land

Parameters	Unit	Padhopukur	Boro Angtihara	Jorshing	Method
EC	ds/m	5.70	10.01	1.23	Glass Electrode
p^H	-	8.5	7.2	8.0	Glass Electrode
OM	%	1.52	3.10	1.05	Wet Oxidation
N	%	50.08	0.18	0.06	Kjeldahl distillation
K	meq/100gm	0.64	1.06	0.25	Olsen/ Bray and Kurtz
P	µg/g	20.81	11.92	71.73	NH4OAc
S	µg/g	244.80	467.60	10.14	CaH2PO4 Extracting
Zn	µg/g	1.45	1.82	2.17	DTPA Extraction
Pesticide residue		0	0	0	

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

Soil Salinity

184. CEGIS estimaties from SRDI, SRMAF Project, Ministry of Agriculture, 2009, reveals that over the period’s soil salinity of the area inside the Polder increased gradually. Local farmers reported that most of the water control structures are not functioning properly. As a result, theycannot preventintrusion of saline water inside the Polder. Some farmers and SAAOs of DAE reported that the soil and water salinity gradually increase with dryness from January and reaches maximum level in the month of March-April and then decreases due to onset of monsoon rainfall. Detailed soil salinity of 1973, 2000 and 2009 of the Polder area is presented in Table 6.7.

Table 6-7: Detailed soil salinity in the Polder area

Salinity Class	EC (dS/m)	1973		2000		2009	
		Area(ha)	%	Area(ha)	%	Area(ha)	%
No Data	-	438	28	-	-	-	-
Non Saline with some Very Slightly Saline (S1)	2.0 - 4.0	1113	72	558	36	816	53
Very Slightly Sline with some Slightly Saline (S2)	4.1 - 8.0	-	-	419	27	735	47
Slightly saline with some moderately saline (S3)	8.1 - 12.0	-	-	574	37	-	-
Moderately saline with some strongly saline (S4)	12.1 - 16.0	-	-	-	-	-	-
Strongly saline with some very strongly saline (S5)	> 16.0	-	-	-	-	-	-
Total		**1551**	**100**	**1551**	**100**	**1551**	**100**

Source: SRDI, SRMAF Project, Ministry of Agriculture, 2009

6.1.10 Climate

185. Ambient mean temperature of Polder17/2 is about 18^0C-19^0C in winter and 28^0C-29^0C in summer and the annual average rainfall is around 2000 mm. Monsoon occurs from June to September and during this period very heavy rainfall.

186. Tropical cyclones and storms do occur during summer in the month from April to June and then from September till December. These cyclones and storms are not a frequent occurrence but possess serious devastation for the people of the Polder area.

Rainfall

187. The Polder is located near the Khulna BMD station. Monthly rainfall of this station for thirty years is shown in Fig. 6.1 as average, maximum and monthly variation wise. The hyetograph shows that the highest rainfall has recorded in the month of June (846 mm) and, similar intensity of rainfall has also observed in September (843 mm). The average rainfall during month of June to September varies from 331 mm 294 mm.

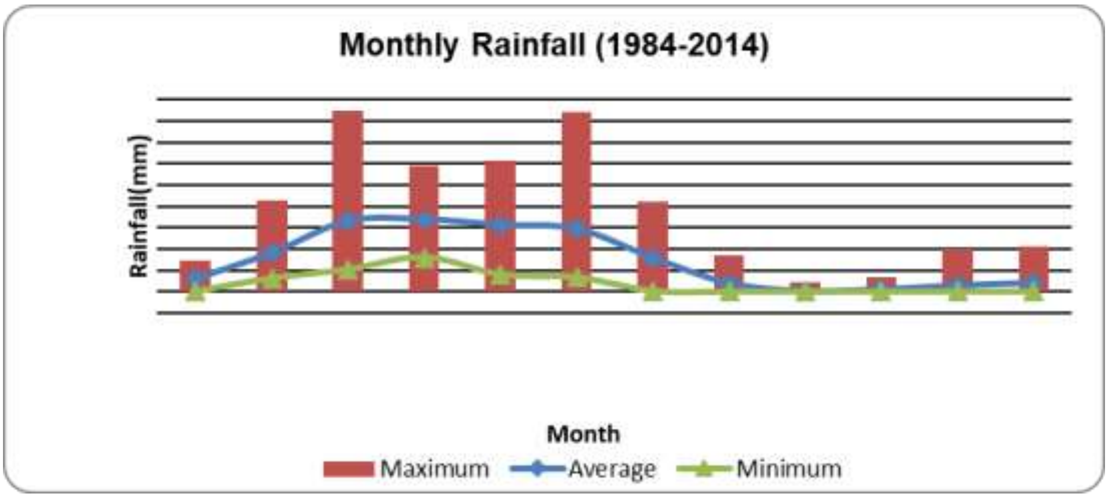


Figure 6.1: Monthly rainfall of Khulna BMD station (1984-2014)

Temperature

188. Temperature data of the last 34 years (1980-2013) from the BMD station in Khulna shows that the monthly maximum average temperature varies from 26.68°C (January) to 36.71 °C (May), whereas the monthly minimum temperature varies between10.0°C (January) to 36.71°C (August) The highest maximum temperature recorded in the last 34 years is 36.71°C, which occurred in the month of May, 2012 while the lowest minimum temperature of10.0°C was recorded in the month of January, 1989. The monthly maximum and minimum temperature of last 34 years (1980-2013) are shown in Figure 6.2 below:

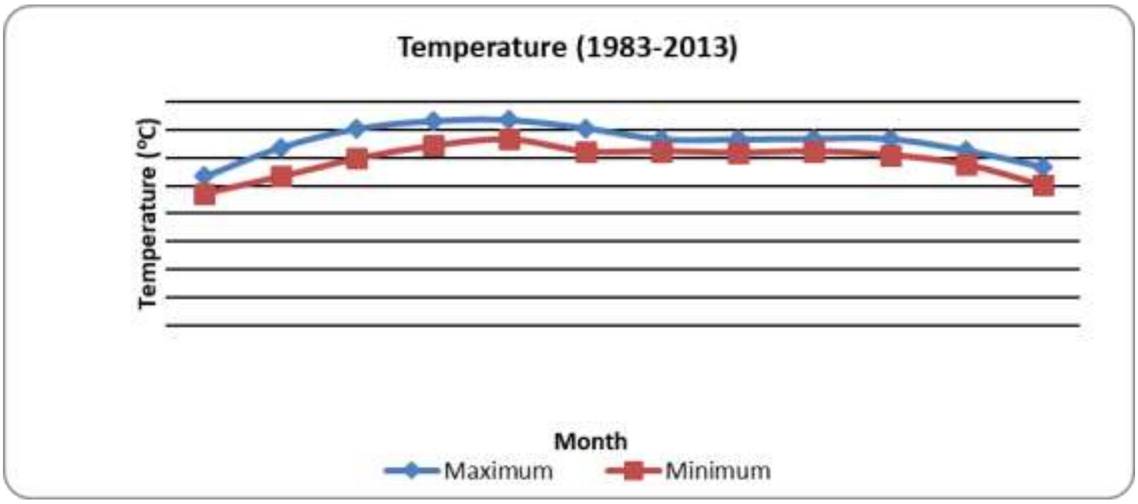


Figure 6.2: Monthly average temperature of Khulna BMD station

Sunshine

189. Monthly sunshine hour data of thirty years (1983-2013) is plotted in fig 6.3 which are collected from BMD station Khulna. Average sunshine hour per day ranges from 3.79 hr/day (July) to 8.55 hr/day (April). Monsoon period has comparatively less sunshine hour due to the increased cloud covering.

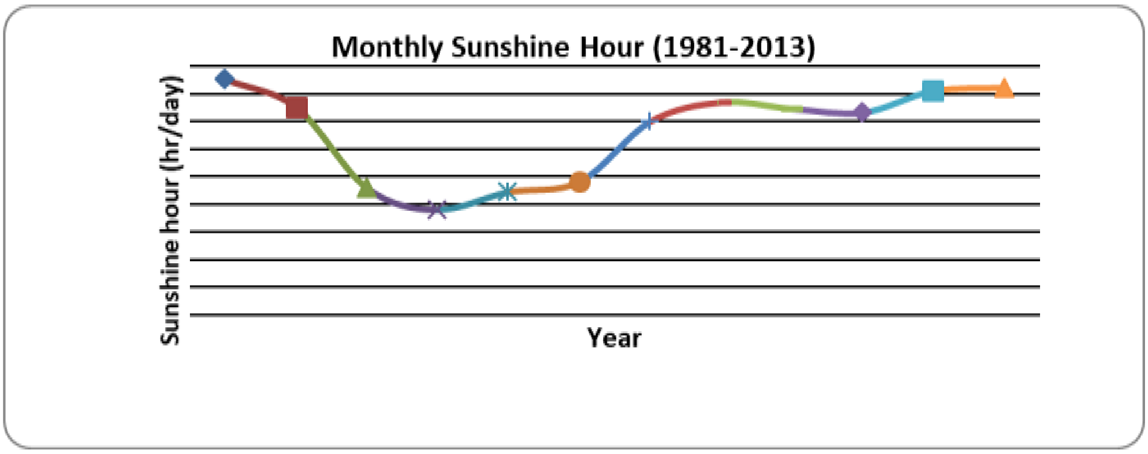


Figure 6.3: Monthly average sunshine hours per day at Khulna BMD station

Humidity

190. The monthly averagerelative humidity at the BMD station at Khulna for the last 34 years varies seasonally from 73% (March) to 88% (July).The most humid months are June, July, August, September and October with a relative humidity 1980-2013higher than 88%, Figure6.4 shows thirty years (1983-2013) monthly average relative humidity of Khulna station. Monthly average value of relative humidity varies from 73% to 88% at BMD in the month of March and July respectively.

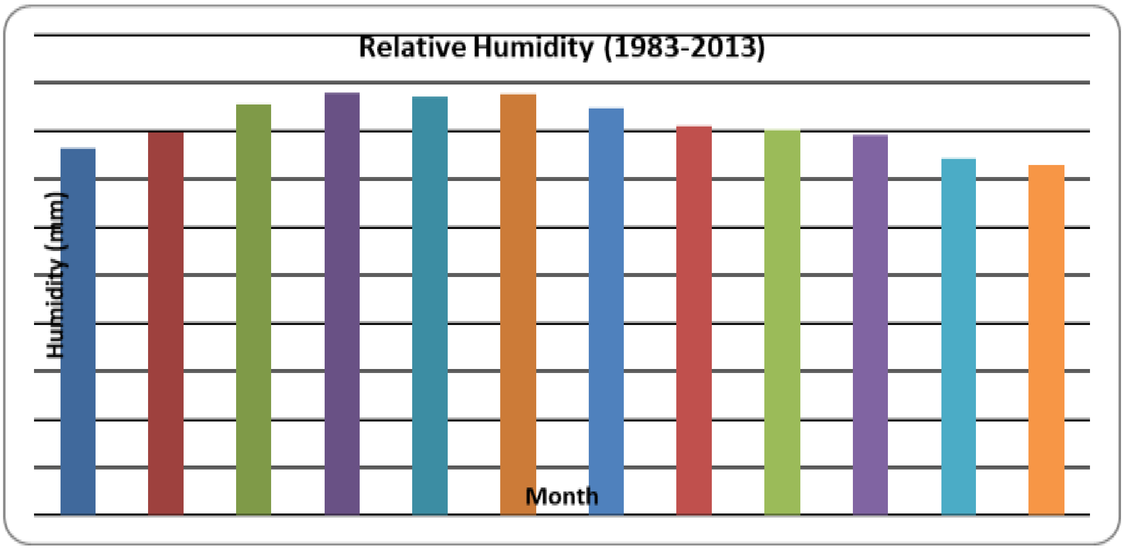


Figure 6.4: Monthly Average Humidity of BMD station Khulna

Evaporation

191. Evaporation is a transformation of water from liquid state to vapour state where temperature plays a crucial role. Moreover, it is an important component of the hydrological cycle, which influences the overall water balance on the earth surface. In fig 6.5 monthly average evaporation rates of 25 years (Khulna BMD station) is plotted. Maximum evaporation 3.92 mm/day is recorded in the month of April whereas the lowest evaporation is observed in January (1.78 mm/day). Due to less temperature less amount of evaporation is observedin winter season.

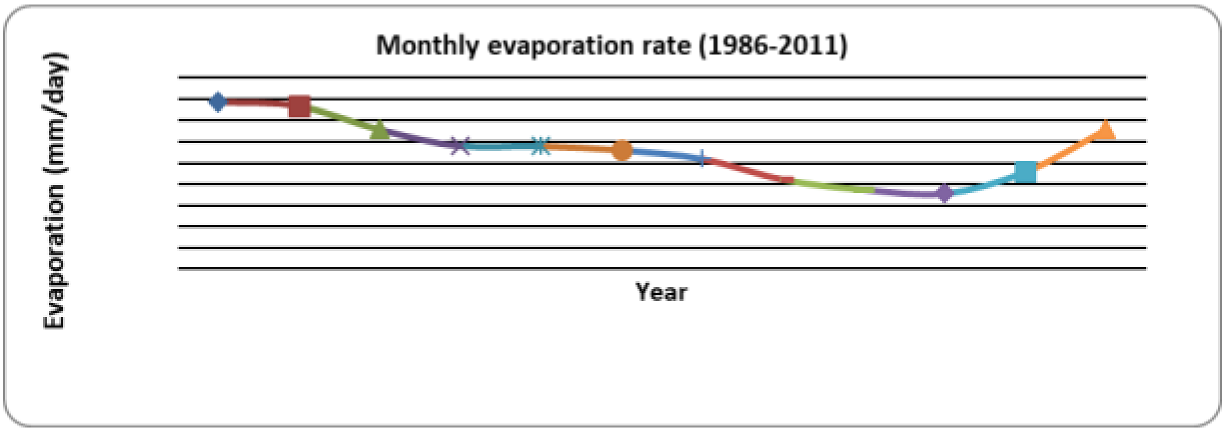


Figure 6.5: Monthly average evaporation rate at Khulna BMD station

Wind Speed

192. Historical data on wind speed for the last 34 years (1980-2013) has been collected from the BMD station at Khulna. The monthly average wind speed in Khulna region varies from 1.74 to 6.88 km/hr. The Average speed of wind is highest in April (6.88 km/hr) and lowest in November (1.74 Km/hr).

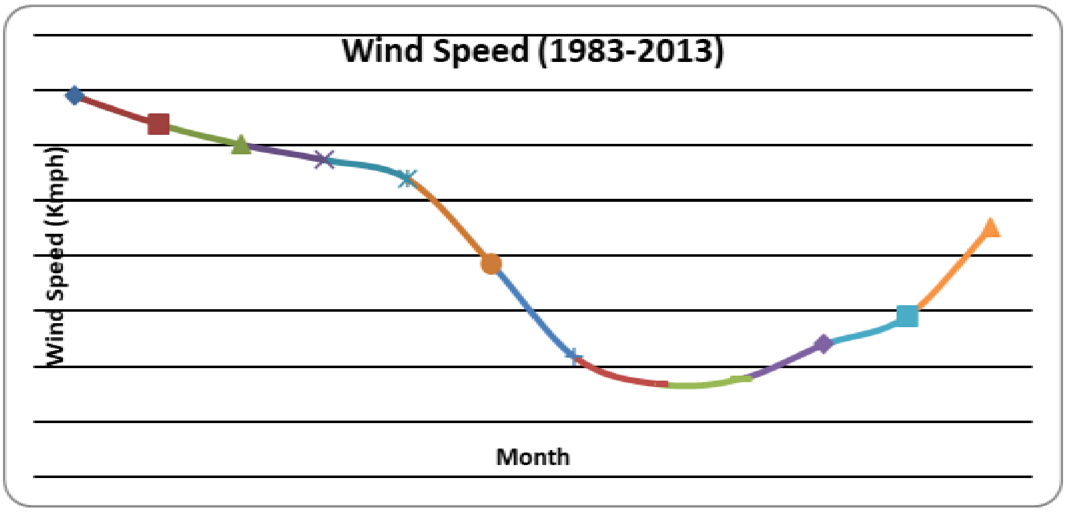


Figure 6.6: Monthly wind speed of Khulna BMD station

6.1.11 Water Resources System

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

Major Rivers and Khals

194. The Polder is surrounded by two rivers named Gangrail River in the east direction of the Polder and Taltola River in the south direction. The offtake of Gangrail River is Bhodra River and the outfall is large Gangrail River. It is a tidal river and has diurnal effect on the peripheral khals i.e ganggrail kahl of the Polder. Apart from this, the off take of the Taltola River is Salta River (south direction) and the outfall is Bhodra River. At present, the capacity of Taltola River has reduced due to siltation and supply very poor quantity of water to the peripheral khals. The bed levels of the peripheral khals have become higher than the connecting rivers that's why insufficient flow has observed (except Ganggrail khal) during field visit.

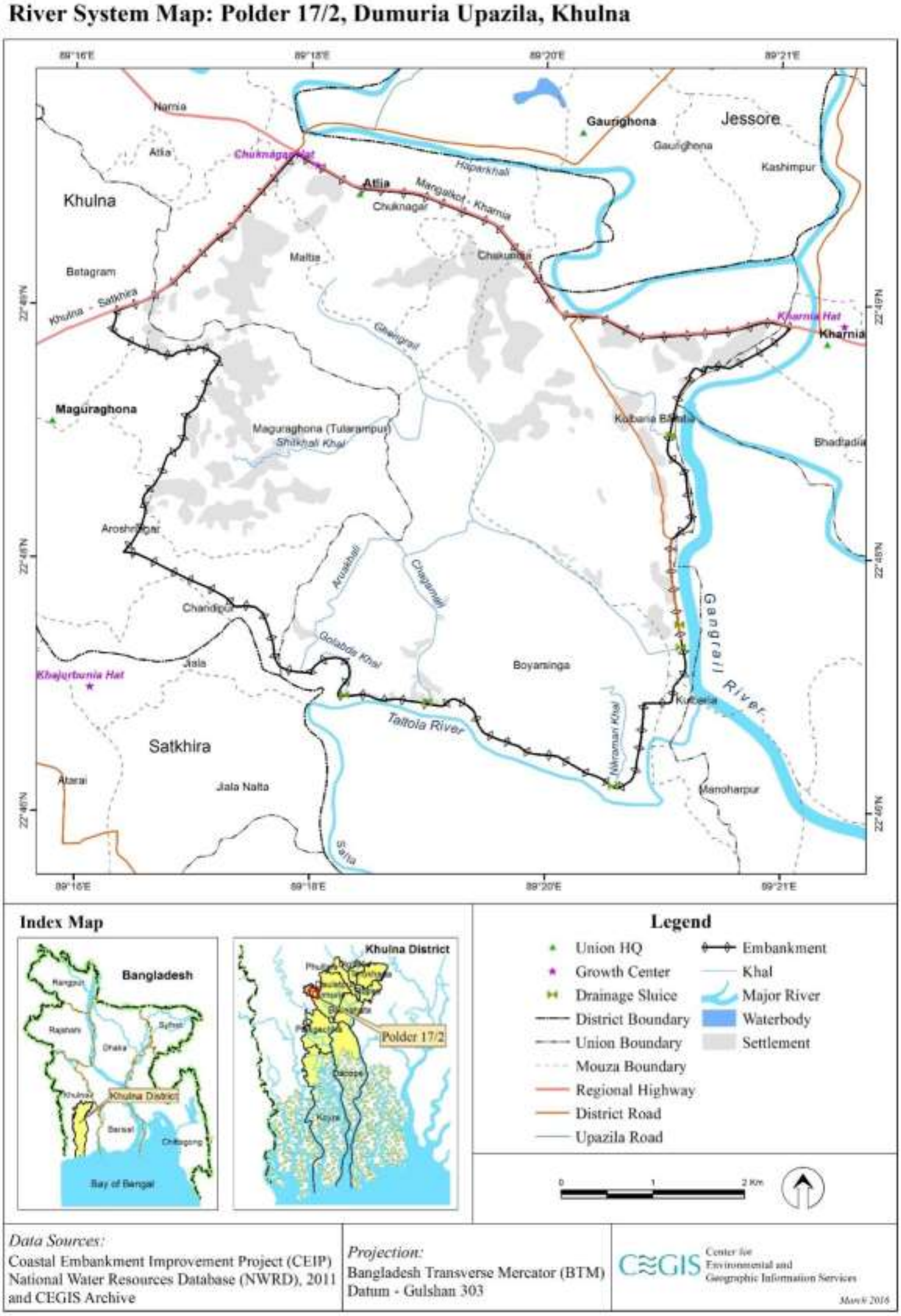
Photo 6-1: Gangrail River

Photo 6-2: Taltola River

Hydrological Settings

195. The Bhodra River has dominated the hydrological features of this region whose offtake is Kobadak River. The tidal effect (from Bay of Bengal) of Bhodra river has influenced the Gangrail river and consequently the peripheral khals i.e. Gangrail khal, Telegati khal etc. are flooded diurnally. The gangrail khal has highly tidal effect and it is distributed to Shitla khal, Maguraghana culvert and dardanga bridge. Its distributary channel is joined to the Changamari khal whose offtake is Taltola River. Taltola River is actually a distributary of Salta River and by now its flow has reduced due to siltation and less discharge from Salta River. There is significant khal acting in the south portion of the Polder named Golabdah khal. However, it is also moribund situation because of over the year's siltation and unauthorized control by local gher owners.

196. During dry season the drainage khals are usually blocked off by the suice gates due to prevention of saltwater entry, whereas in wet season, these khals are used to drain the surplus water out of the Polder. However, in recent years, due to the damage of most of sluice gates maximum khals carry saltwater during dry season. Moreover, the khals are used illegally by some local dominant persons for shrimp culture and some artificial drainage khals have dug by them in the Polder area.



Map 6-7: River System map of Polder-17/2

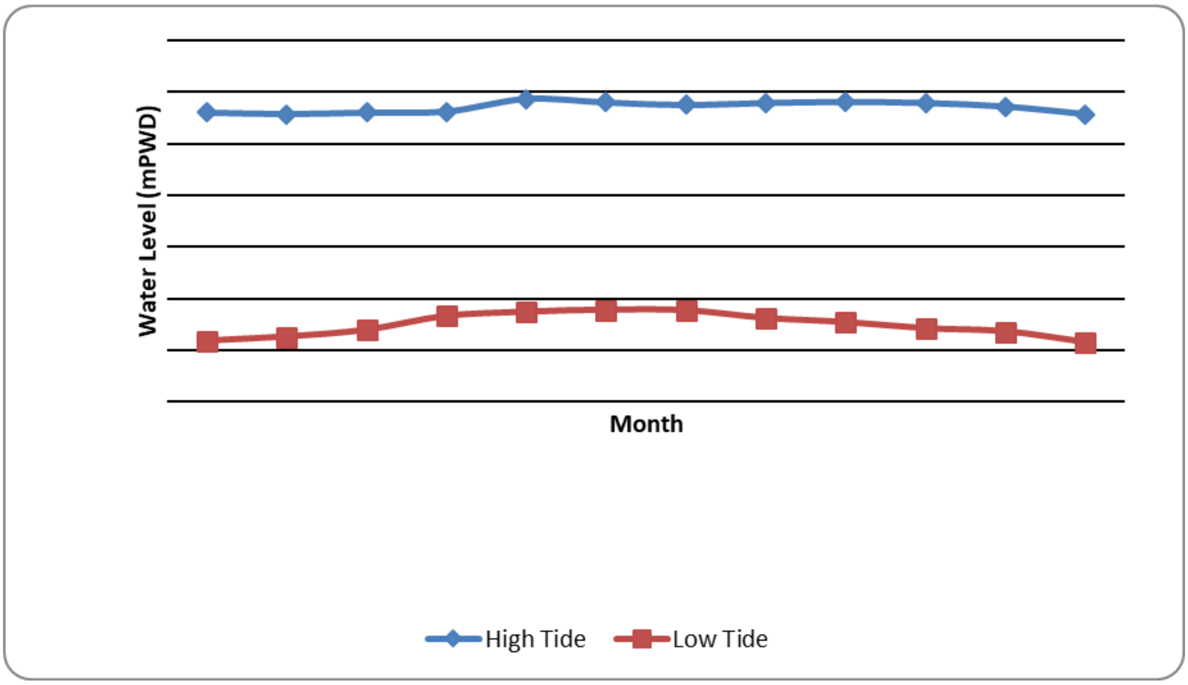

Photo 6-3: Local excavation of Telegati and Golabdah khal by Gher owners


Photo 6-4: Siltation in Changamari khal **Photo 6-5: Gangrail Khal**

6.1.12 Hydrological Settings

Surface Water Levels

197. All the rivers of this region have tidal effect which is very crucial for the hydrological settings. Monthly variation of water level (High tide and Low tide) of the Bhodra River of last twenty-nine (1980-2009) years has shown in **Fig: 6.7.** During the wet season maximum water level in high tide has recorded 2.87 mPWD in the month of September. The lowest water level (Low tide) was 1.85 m below surface (PWD) in March.Less fluctuation of water level has been observed duringboth high tide and low tide.

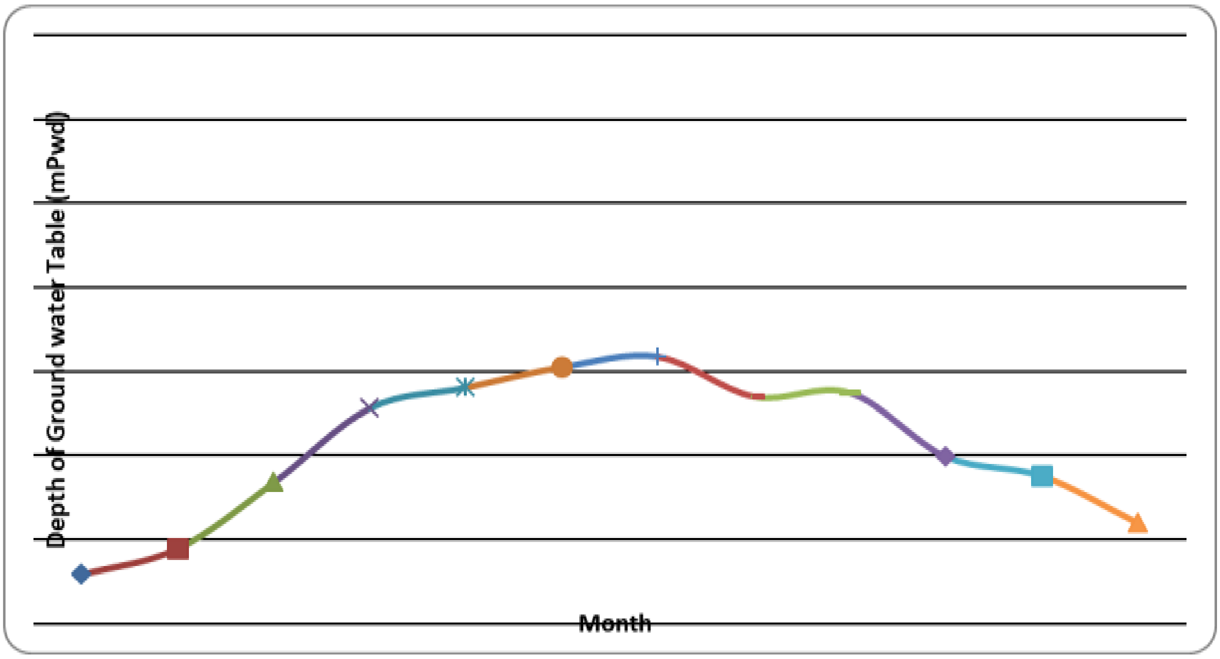


Source: BMD (SW29); 2014

Figure 6.7: Surface water level of Bhodra River (1980-2009)

Ground Water Table

198. Monthly fluctuation in ground water table for the study area has beenplotted in **Fig 6.8**. Minimum depth of water table has found 1.92m below PWD in the month of October. On the other hand, depth of water table was recorded in the month of April (3.21 m below PW



Source: BMD(KHU005); 2014

Figure 6.8: Depth of Ground Water Table (1983-2013)

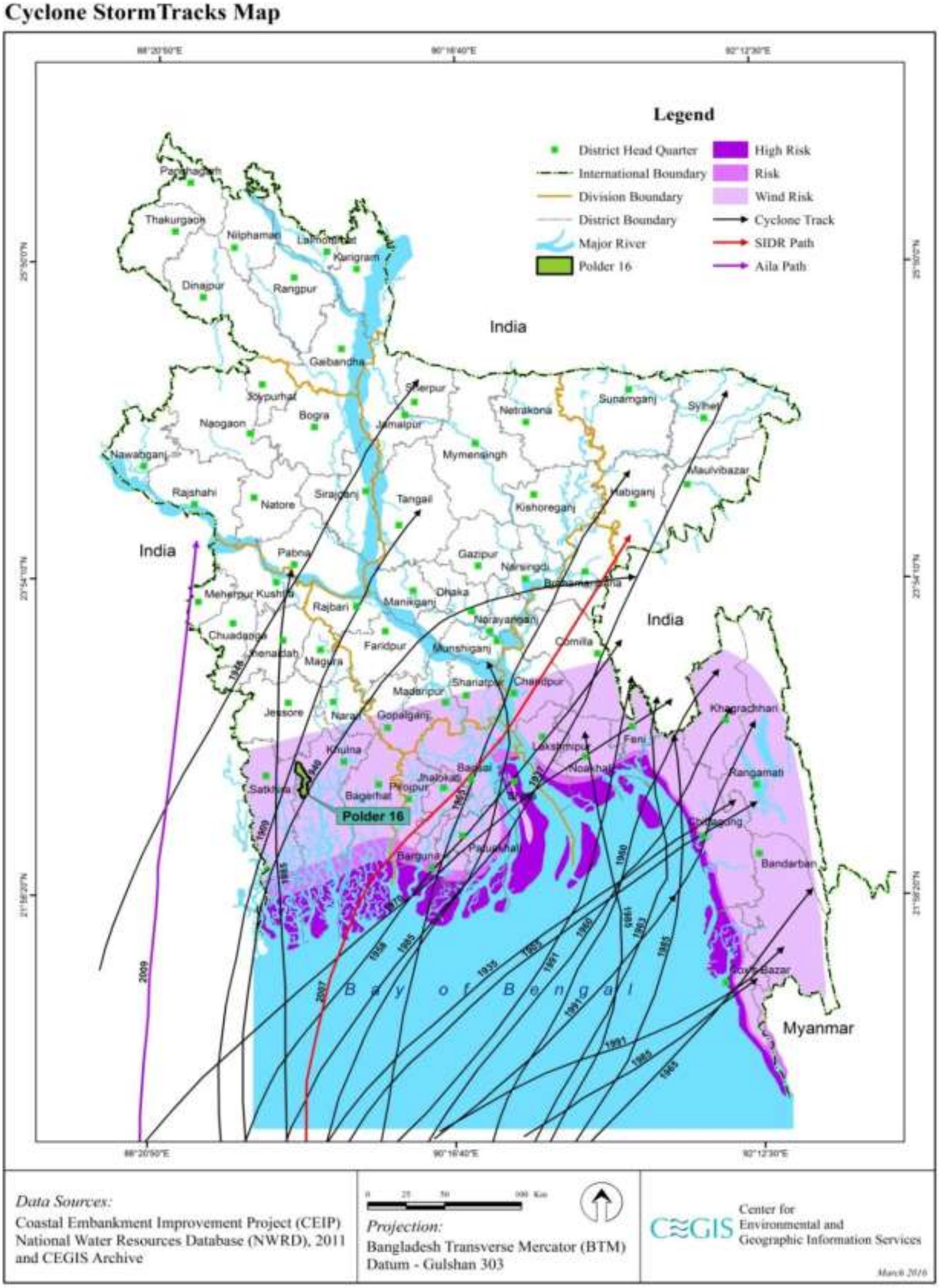
6.1.13 Water Resources Issues and functions

Tidal and Storm Surge Flooding

199. The devastating cyclone Aila struck the south-western coastal region of Bangladesh and eastern coast of the neighboring West Bengal province of India at midday on 25 May 2009.Satkhira and Khulna (Paikgacha, Dumuria etc.) were the worst hit districts, with nine other districts considerably affected. The main damage has been caused by flood water breaching the already weakened embankments throughout the affected districts. A Cyclone Storm Track area of Bangladesh has been attached herewith in map 6.8 below. Communities of Polder17/2 have reported that activities associated with shrimp farming, such as the frequent practice of opening the embankments to move saline water into shrimp ponds, has made the half-century-old earthen embankments weak, causing them to break during the tidal surge inflicted by the cyclone. Silting up of the river beds, along with rapid coastal subsidence, have also contributed to higher tidal surges and increased strain on the embankments.

200. The Polderarea remains waterlogged, causing the salinisation of soil and inland water. As a result, agriculture in the region is under serious threat and soon there will be an acute scarcity of drinking water throughout the region.

201. In recent decades, people have experienced frequent disasters like Aila. There have also been unusual phenomena in the weather patterns. Data from the meteorological department reveals that the frequency of cyclones hitting the Bangladesh coast has increased consistently since the 1990s, whilst the wind speeds vary between extremes of high and low intensity. The Intergovernmental Panel on Climate Change (IPCC) has said that this phenomenon could be due to the heating up of the sea's surface in the Bay of Bengal.



Map 6-8: Cyclone Storm Track area of Bangladesh

Drainage Congestion

202. Drainage congestion is a common phenomenon in some of the portions of the Polder area. Both the Gangrail and Taltola River have tidal influence that inundates the drainage khals. Over the years, siltation makes the existing drainage khals incapable for drainage excess rainwater in monsoon period. During field visit the bed level of Changamari khal (D/S-2), Telegati Khal (D/S-5) and Gate khal (D/S-1) are higher than the perennial rivers due to siltation and causing drainage congestion. However, the perennial Taltola River is not in full action; in fact, its flowing capacity has lessen due to siltation. The sluice gate of most of the drainage sluices are damaged and some of are not properly works which exacerbate the situation. Some villages are suffering severe water logging problem during monsoon period. According to local people and CEGIS study, around 25-30% area of the Polder are facing drainage problem during monsoon.

Navigation

203. Among two peripheral rivers, Gangrail River is moderately navigable however; its depth of flow has reduced due to siltation. Water flow of Taltola River has greatly reduced that hamper the navigation route. Due to the construction of Farakka barrage (India) and water logging in Bhobodaho khal in jessore water flow has reduced in a large scale in downstream. As a result, the perennial rivers of the Polder are losing their navigability due to reduced flow from upstream and over the year’s siltation.

Water Use

204. The actual status of drinking water in some of the coastal Polders is unpleasant/unsafe. During field survey in the Polder-17/2, it was found that the average daily domestic use of water was around 25-30 lpc. However, 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). Local people opined that they use deep tube wells as source of drinking water to meet up their daily requirements. For domestic purposes they use village ponds.

6.1.14 Environmental Quality and Pollution

a. Air Quality

205. The national standards for air quality are givenin **Table 6.8.**

Table 6-8: 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

206. The air particulates matter (APM) concentrations of the Polder area were measured by collecting PM samples on Teflon filters using Air Metrics portable sampler and subsequent gravimetric analysis using microbalance. The concentration of black carbon (BC) in the fine fraction ($PM_{2.5}$) of the samples was determined by reflectance measurement using an EEL-type

Smoke Stain Reflectometer. The NO_2 and SO_2 concentrations were determined using GENT sampler. The air sampling has been carried out for 1 day (24 hr) near the Polder at Kapilmuni bazar in Paikgacha upazila which is situated about 12 km to the southof the Polder.The results are presented in **Table 6.9**. The values suggest that the concentrations of the measured air quality parameters ($PM_{2.5}$, PM_{10}, and BC in $PM_{2.5}$, SO_2, and NO2) lie within the range of standard values of Bangladesh National Ambient Air Quality Standard (BNAAQS) as in Table 6.8. However, there are numerous vehicles driven by diesel engines and numbers of Motorcycles and other vehicles movement on the Khulna-Satkhira road and Paikgacha road in the Polder area which considered contributing to the ambient air especially Particulate Matter ($PM_{2.5}$).

Table 6-9: Values of ambient air quality parameters in the project area

Area	Air particulates matter concentration μg/m³ (24h average)				(mg/m³) (1h average)
	PM_{10}	$PM_{2.5}$	BC in $PM_{2.5}$	SO_2	NO_2
Kapilmuni, Paikgacha	50.5	36.5	8.1	63.2	0.047

Source: Air quality measured by Bangladesh Atomic Energy Commission, April, 2016

b. Water Quality

207. Importance water quality parameters (p^H, TDS, DO and salinity) have been measured during the major field investigation in February 2016, from different locations of the Polder **(Table 6.10).** The p^H values in the inspected surface water samples were slightly higher than neutral scale (p^H=7), which means the water in these locations was slightly alkaline type. During the monsoon period, it may take p^H values to drop below the acidic threshold. Values of TDS were found moderately high in several local khal (370-630 ppm) due to the increased siltation of the internal khals. The tidal water from the peripheral rivers with high silt concentrations intrudes the internal water courses as there is no water control structure at most of the locations, but sometimes during low tide a substantial amount of sediments get entrapped or silted within those khals. Measured values of DO were found close to the standards set by DoE for both irrigation (5 to 6 mg/l) and fishing (5 mg/l).

208. No salinity has found of the water bodies during field survey however; according to local people salinity will appear very soon and last four to five months (January to April). Concentration of salinity in drinking and irrigation water is found to be moderate due to the tidal influence of perennial rivers.

Table 6-10: Surface Water Quality in Dry season

Sl.	River /Khal	Location	GPS Location	TDS PPM	DO mg/L	Temp °C	pH	Salinity ppt
1	*Amtola Khal*	*Golapdia, Aitla union DS-1*	*22°47'14.3'' N 89° 18'2.5'' E*	*630*	*5.7*	*25*	*8.1*	*0*
2	*Mormuria khal*	*DS-3*	*22° 46'42.7'' N 89° 19'46.2'' E*	*380*	*6.3*	*26*	*7.8*	*0*

Sl.	River /Khal	Location	GPS Location	TDS PPM	DO mg/L	Temp °C	pH	Salinity ppt
3	Kulbari, banar beel/khal	DS-5	22° 48'48.8'' N 89° 20' 08.7'' E	370	6.5	28	7.7	0
DoE Standard Value (Bangladesh)				2100	4.5-8.0	20-30	6.0-9.0	-

Source: CEGIS field survey; 2016

C. Soil Qualitiy of Borrowpit and Khal

209. Soil samples were collected from two locations (borrow pit and internal khal) of Dumuria, Khulna (Polder 17/2) in the month of July, 2017. Collected soil samples were analyzed by Bangladesh Agricultural Research Institute (BARI). Result of the analyzed data reveals that all the parameters are within the average limit except Manganese (Mn) and Lead (Pb) (internal khal) which may be due to the tidal submergence of those areas. The sampling location of borrow pit was situated in riverside of the Polder which is submerged in regular high tide. Salt water frequently infiltrate at internal khal during high tide. In both of the cases salt water carry sediments. As no industries were found within or around the project area, this sediment may be the only source of excess Mn and Pb (in internal khal).

Table 6-11: Soil Quality of Borrow pit and Sediment quality of Internal Khal of Polder 17/2

Sl. No	Parameters	Sampling location (ppm)		Standard in soil (ppm)
		Borrow pit	Internal khal	
1	Fe	14,898	27,633	32,000
2	Mn	996	1,371	761
3	Pb	5.28	12.02	10
4	Cd	0.033	0.012	0.06
5	Cr	40.76	56.58	100
6	EC	1.5	3.2	

d. .Noise Quality

210. A number of suitable sites were selected within the Polder area for sound level measurements, considering some criterion in connection with sound generation (project interventions and other secondary activities) and places which are to be affected by the anomalies in sound level (settlements, schools). The Environmental Conservation Rules 1997, of Department of Environment (DoE), Bangladesh has defined standard noise levels as **50 dB** during day time for residential area. The Polder area has fallen under the category of residential area and the values of noise levels were found within the standard limit. The noise level has been measured during daytime. The values of noise level (location wise) are shown in **Table 6.12**.

Table 6-12: Daytime noise levels of the Polder area

Sl. No	Location	GPS Reading	Values (dB)	Area Category by ECR'97
1	Golapdia, Aitla union DS-1	22°47'14.3'' N 89°18'2.5'' E	38-45	Residential area
2	DS-3	22°46'42.7'' N 89°19'46.2'' E	36-43	Residential area
3	DS-5	22°48'48.8'' N	38-48	Residential area

Sl. No	Location	GPS Reading	Values (dB)	Area Category by ECR'97
		89°20' 08.7'' E		

Source: CEGIS field survey, February, 2015

6.2 Biological Environment

6.2.1 Bio-ecological Zone

211. The Polder area has fallen inside two of Bio-ecological zones in the study area, i.e. Ganges Floodplain (1689 ha.) and Saline Tidal Floodplain (1137 ha.). In which, major portion of the study area has been falls over the zone namely Ganges Floodplain (60%), and rest of the part falls over Saline Tidal Floodplain (40%).

6.2.2 Ecosystems

(a) Terrestrial ecosystem

212. Terrestrial ecosystem is classified according to their habitat. Each habitat supports a unique collection of plant species. The major terrestrial habitat patterns in the study area are: Homesteads, Crop field, Road and embankment side vegetation

Homestead vegetation

213. Homestead vegetation occupies most of the floral species in terms of diversity and population. Vegetation density (Photo 6.6) varies in different locations of this study area. Homestead vegetation is denser at north-west and north-east portion of Maltia, Chuknagar, Chakundia, Maguraghona etc villages. From south to east portion and south to west portion as well as Golabda, Chandipur, Chagamari, Boyarsinga, Kulbaria, Baratia etc villages follows low density of homestead vegetation due to expansion of shrimp farming. Species composition also varies according to different dense area. Narikel *(Cocos nucifera),* Rendi Koroi *(Albizia lebbeck),* Supari (*Areca catechu*)*,* Tal (*Borassus flabellifer*), Mahogony *(Swietenia mahagoni)* are commonly found all over the area. The most common cultivated plants that are now being selected for homestead plants are the exotic Mahogany *(Swietenia mahagoni),* Rendi Koroi *(Albizia lebbeck)* and Babla *(Acacia nilotica)* in this area the natural vegetation took place usually at rural settlement ridges, fallow water bodies and rural road slopes. Homestead vegetation provides roosting area for many resident birds and nesting sites for the waterfowl like egrets and herons. However, this type of vegetation provides major outputs of plant production.

214. North- South part of the Polder area possesses low dense of vegetation. Species richness and health of plant community is comparatively lower than other part of the study area. Homestead vegetation of this area has degraded in terms of density, diversity and health after initiation of unplanned shrimp farming.

Low density of Eastern part

High density of Western part

Photo 6-6: Present condition of homestead vegetation within the study area

Road and Embankment side vegetation

215. Roadside vegetations are generally planted and develop an ecosystem which is dominated by hard wood tree species. Major species are found along the road side of study area are Sirish (*Albizia lebbeck*), Sisso (*Dalbergia sissoo*), Babla (*Acacia nilotica*) Mahogoni (*Swietenia mahagoni*), Akashmoni (*Acacia moniliformis*), Sil koroi *(Albizia procera)* etc. The existing embankment side plantations are observed in Polder area which is planted by BWDB and local people, along the both side of embankment about 4 km. out of 11 km at the location of Boyarsing, kulbaria and Bartia villages. Major species are found along the embankment side of the study area are Cactus (*Cereus hildmannianus),* Babla (*Acacia nilotica*), Sirish (*Albizia lebbeck*), Desi neem (*Azadirachta indica*), Kaora (*Sonneratia apetala*), Gawa (*Exocearia agallocha*), etc. Local people have sensitized to take-care the plant for creating greenery and protect vulnerable embankment from tidal surge and tidal flood.

Photo 6-7: Plantation program inside the Polder area (Kulbaria village)

Threats on terrestrial ecosystem

216. North- South part of the Polder area possesses low dense of vegetation, terrestrial species diversity both flora and fauna are deteriorating due to deforestation, expansion of shrimp farming, water logging, salinity intrusion etc. As a result, water bird, small mammals and reptiles are relocating from this area. Local people informed that, increasing death of wild life due to food crisis and habitat loss. Total four number of brick fields is located in khornia village are also negative impact on terrestrial ecosystem. Brick fields are using fire wood (e.g. Bamboo,

Tal, Narikel, Khejur, Assath etc) and coal for burning bricks. Coconut trees, Tal trees, Mango trees and other fruit yielding trees are all affected by the emission from brickfields in this area. Crops and fruits productions are also affected by the tones of smoke coming out of the chimneys.

(c) Aquatic Ecosystem

217. Among the study area, Rivers, canals and homesteads ponds are the perennial wetlands which provides refuge and shelter for most of the aquatic flora and fauna. Homestead ponds are mainly used for domestic purposes. Most of the ponds in western part of the area are used for fresh water fish culture. Homesteads ponds are also rich with aquatic vegetation. Ponds (40 ha.) and ditches are rich in aquatic plant diversity which is mainly dominated by *Eichhornia, Salvinia*, *Nymphoides, Azolla*, *Pistia*, *Lemna, Ipomoea,* various types of algaeetc. On the other hand*,* saline water shrimp farm exists in more than 20% of total study area. Low density of aquatic biodiversity is observed in these shrimp farms. These farms are holding saline water for whole or part of the year. The partial water holding shrimp farms are also used for cultivation of boro paddy.

Photo 6-8: Major Aquatic ecosystem in the study area (Dated, 5 February, 2016)

Mangrove vegetation

218. Tidal flow in this area support succession of different mangroves plants. Ecotone of tidal River (Gangrail River) levees and khal banks was abounded by mangrove vegetation which is now decreased due to hinder tidal flow by creating dykes for fish culture. However, there are still now some mangrove forest patches with Gawa (Exocearia agallocha), Keora (Sonneratia apetalla), Hargoza (Acanthus illicifolius) etc. are observe at river side of Kulbaria, Bayarsing, Monoharpur villages.

219. Aquatic ecosystem and its biodiversity are deteriorating due to canal and river siltation and wetland degradation. The unplanned development of shrimp culture activities posed negative environment impacts in terms of deforestation, biodiversity and specially degradation of agricultural lands. At the western area, most of the local farmers are converting their agricultural land to shrimp farming. Local people informed that unplanned brackish water ghers expansion caused increasing the salinity in these areas. Due to unplanned bagda gher expansion smaller farmers have been compelled to use saline water into their ghers which

made both the water and soil saline. Most of the farms took tidal water from river, canal through channel of flooding system into their bagda ghers. These practices caused high land salinity andits effects are reflected on land fertility as well as crop production and they have adverse impact on local biodiversity. The fresh water pond encroached by shrimp farmers as well as saline water also affects aquatic biodiversity.

220. Formation of water management organizations (WMOs) after rehabilitation of the Polder will contribute solving the existing conflicts between the different water user groups. The WMOs with cooperation of Local Governement Institution and Local Administration can resolute the farmer-fisher conflict as has been discussed in Chapter 5.8.5.

6.2.3 Wildlife

221. Diversity of terrestrial fauna is one of the most important ecological indicators to evaluate the quality of habitats. At this time, habitats of birds, mammals, amphibians and reptiles inside the Polder area are gradually being reduced due to various reasons including depletion of forests, change in natural vegetation, use of pesticides and insecticides, plantation of exotic trees and human interference. Mammals are scarce and all the largemammals have already disappeared. This study site was natural habitat with many jungles and agricultural lands where many species of birds and other wild animals lived before shrimp farming. Among avifauna most common one in the study area are House Sparrow *(Passer domesticus)*, Common Myna *(Acridotheres tristis)*, Black kite *(Milvus migrans)*, Common Kingfisher (*Alcedo atthis*), Red Vented Bulbul (*Pycnonotus cafer*), Black Drongo (*Dicrurus macrocercus*) etc. These are found to be more commercial as they always try to live near human settlements. Random destruction of natural habitats by cutting nesting trees and foraging plants for commercial use of woods and lands are the main factor responsible for narrow down in avian foraging habitat and their nesting sites. Several species are listed in the IUCN Red Data Book occurs within the study area (Table 6.13) are listed in following table.

Table 6-13: List of Endangered and threatened wild life species inside the study area

Scientific name	Local name	Local status	IUCN status	Cause of threat
Lutra lutra	Dhari/Udbiral	Absent	Critically Endangered	Habitat loss
Canis aureus	Pati shail	Very rare	Vulnerable	Hunt and habitat loss
Varanus bengalensis	Gui shap	Rare	Vulnerable	Hunt
Varanus flavescens	Shona gui	Absent	Endangered	Hunt and habitat loss
Viverrricula indica	Khatash	Absent	Vulnerable	Habitat loss
Bungarus caeruleus	Kal keotey	Absent	Endangered	Hunt and habitat loss
Microhyla ornata	China bang	Very rare	Vulnerable	Habitat loss

Source: CEGIS Field survey, 2016 and RED DATA BOOK of IUCN

222. The hydrological cycle and the presence of perennial and seasonal wetland provide a diversified habitat for all biota. In the dry period, most of the wetlands in these areas remain completely or partially dry. Some species have not adapted to the altered environment whilst others have flourished. Among amphibians, Common Toad (*Bufo melanostictus*), Skipper frog (*Euphlyctis cyanophlyctis*), Cricket Frog (*Rana limnocharis*) are common and found in most

wetland habitat (e.g. ponds, ghers, canals and ditches) and has been the most successful in adapting to the habitat. Common Smooth Water Snake (Pyna sap), Checkered Keelback (Dhora shap), Common Skink (Anjan), aquatic and water-dependent birds (Pankoiri, Machranga, Coach bok etc.) and small mammals (bat, shrew, mongoose, monitor etc.) are severely affected by the alteration of the natural habitat. Natural wetland degradation has left very high or no sheltered place for waterfowl to roost or nest at the eastern part of the Polder area. Common wetlands bird species available in the study area are Indian Pond Heron, Little Egret, Common Kingfisher, Little Cormorant, Common moorhen etc.

Black Drongo (Dicrurus macrocercus)

Little Egret (Egretta garzetta)

Photo 6-9: Terrestrial fauna in the study area

6.2.4 Protected areas

223. The Department of Environment (DoE) in 1999 circulated that no development projects to be undertaken within 10 Km of any Ecological Critical Areas (ECAs). The Polder 17/2 is not within the ECA or near restricted area (Map 6.9).

Map 6-9: Ecologically Critical Area in Bangladesh

6.2.5 Fish Habitats

224. Fish habitats of the Polder area are broadly classified into capture fisheries and culture fisheries. Capture fisheries habitat includes internal khals (canals) and culture fisheries include ponds, ditches and ghers. Major Khals such as *Changmarikhal, Kulbaria gate khal,* Salta khal, Nikarimari/Muromunia Khal, Banabil khal are connected to the outsides river such as GangrailRiver and Taltola River. These rivers are flowing around the periphery of the Polder and they are tidal influenced and play as longitudinal migration route for fishes in the area. All most all khals are silted up and dried during dry season. Fishes of different species use these khals to accomplish their biological and physiological needs such as grazing, spawning and nursing etc during monsoon. Khals in this area are maintained by the inflow of tides in and from the surrounding land mass.

225. The culture fisheries of the Polder area are dominated by ghers farming. At present, local people mostly concentrate in bagda (shrimp) farming in this area, saline water is taken from the river through khals during January and February and exchange of water is continued throughout the shrimp culture period. *Golda* (Giant Prawn) along with white fish are also practiced in some *ghers* where saline water is not entered or low salinity exits. CEGIS fisheries expert find out that about 324 ha (21% of NCA) of agricultural land is used for shrimp culture (alternative fish culture) during May to November.

Capture Fisheries

226. Among the 350.50ha fish habitat 130 ha is open water fisheries habitat that is considered as capture fisheries habitat **(Table 6.14).** Maximum water depth of the internal *khals* is 0.5 meter in the dry season and not suitable for fish habitation during summer. Local people reported that siltation rate in the internal *khals* of the Polder area is gradually increasing.

Table 6-14: Fish Habitat Status of the Study Area

Sl	Fisheries Category	Habitat Types	Area (ha)	% of Habitat
1	Capture	*Khal* (Canal)	*122*	*17*
2		Inter Tidal Area	*8*	*1*
		Sub-total	***130***	***18***
3.	Culture	Gher	*554*	*76*
4.		Pond	*40*	*6*
		Sub-total	***594***	***8 2***
		Total	***724***	***100.00***

Source: CEGIS estimation based on GIS and Field Survey, 2016

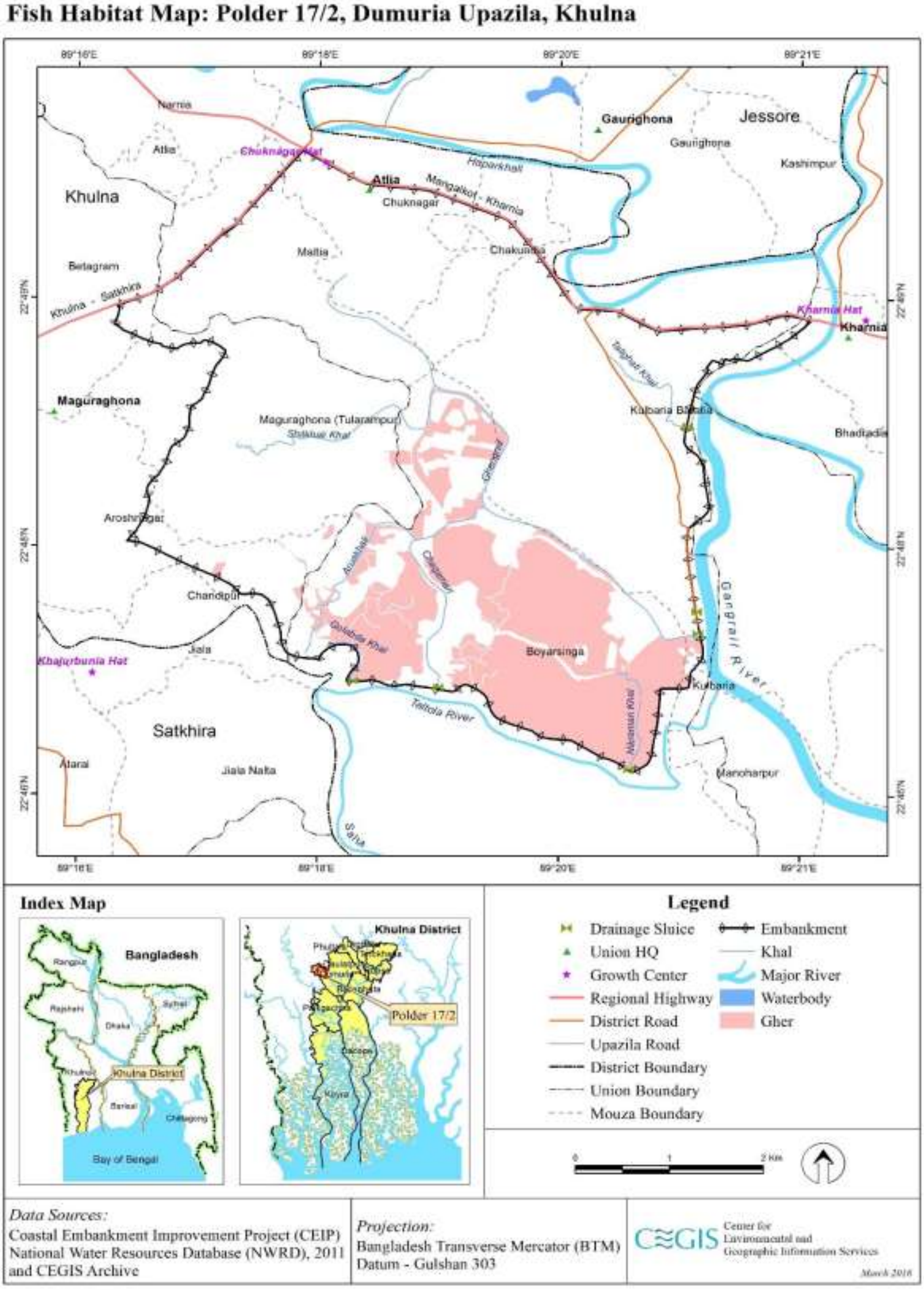
Culture Fisheries

227. The estimated culture fish habitat within the Polder is 594 ha **(Table6.14)** of which commercially culture *gher* is 554 ha and pond is 40 ha. Various kinds of aquaculture technology are practiced in the *gher* depending on water quality, especially salinity of water. *Bagda* (Shrimp) culture (improved intensive) in the gher along with other fish is started from January and mainly continues till November. In some areas, g*olda* (Giant Prawn) along with white fish are also practiced in some *ghers* where saline water is not entered or low salinity exits. In mixed culture *Catla, Rui, Mrigel*, *Grass carp, Silver carp, Big head carp*, *Tilapia*, Tengra*, Parse and Khorshola* is stocked as co-species in the gher. Pond culture practices is mainly semi-intensive method by adopting monoculture, poly-culture and mix culture method with major carp, exotic carp and other fast growing fish species.

Khal habital inside the Polder Area

Culture fish habitat (Ghers) inside the Polder at Dumuria, Khulna

Photo 6-10: Different Fish habitat in the study area



Map 6-10: Fish Habitats of the Study Area

Water Quality of Fish Habitat

228. Water quality is very important for the life of fish and effects all physiological function such as feeding, digestion, assimilation, growth, reproduction etc. The surface water quality parameters of a representative khal and gher have been measured and compared with the fish habitat suitability standards (**Table 6.15)**. It is observed that p^H, dissolve oxygen (DO), TDS and salinity are within the permissible limit for fisheries resources.

Table 6-15: Water quality parameters of different water bodies in the Polder area

Water Bodies	Temperature (ºC)	p^H	DO(mg/l)	TDS (ppm)	Salinity (ppt)
Khal (Canal)	25-28	7.7-8.1	5.7-6.5	370-630	nil
Gher	26	7.8	5.2	530	nil
Standard Values for Fish and shrimp	1.(28-34)** 2. (28-32) for tropical major carps; (25-30) for *P. monodon* culture. ***	(6.5-8.5)*	(4.0-6.0)*	1000*	1.(0-4) for prawn ; (5-35) for shrimp ** 2. (1.5-25)***** for shrimp ; 3. (10-20) for shrimp; (25-28) for *P. indicus;* (10-25) for euryhaline species ***
DoE Standards Values (Bangladesh)	20-30	6.0-9.0	4.5-8.0	2100	-

Source: **M A Mazid 2002; **Jack M et al. 2002;*** Bhatnagar et al. 2004; **** DoE 1997; ***** Chanratchakool 2003; Water quality measured in February 2016*

6.2.6 Fish Migration and Movement

229. Fish generally migrate from one habitat to another for breeding, feeding purposes and for favorable environment. The rivers and *khals* serve collective purpose of grazing, breeding, feeding and shelter of fishes. The peripheral rivers act as longitudinal migration route through the internal khals in the Polder area. The riverine fish species migrate through regulated *khals* in the Polder to some extent during the period of May to August. The internal *khals* are used as feeding and nursing ground of the fishes. Fish species such as *Tengra, Parshe, Chingires, Baila, Khorsola, Bhetki, Punti* etc. migrate to khals through the regulators to the water bodies as parts of their life cycle. Fish migration status in the Polder area is poor due to present condition of the rivers and *khals* as they are silted up-which reduce the length of successive migration routes, mal-functioning of water control structures and inactivity of the Water Management Organizations (WMO) for operating the sluices and regulators. Overall fish migration status is partially obstructed during early migration period (April-may) in the study area.

6.2.7 Fish Biodiversity

230. According to field investigation and consultation with fishers, PL collector, elderly people and local DoF officials, about 34-42 fishes species are known in the regular catch of fishers of the area. Fish biodiversity in the Polder area is moderate although the biodiversity of fishes has the declining trends over the years. The causes of gradual declining of fish abundance and biodiversity are due to the morphological changes of internal khals, siltation of fish habitats, squeezing of spawning and feeding grounds and illegal fishing etc. The studied Polder area comprises of both fresh water and brackish water fish species **(Photo 6.11).** The available fish

species are *Bagda* and *Golda chingri*, *Horina chingri, Tengra, Baila, Parshe, Bhetki, Punti, Shol, Taki, Shing, Tara baim, Gotum, Koi, Shing* etc **(Appendix-G).**

Shrimp (*P. monodon*) harvested from gher

Perse (*Liza parsia*), a widely culture co-species with shrimp in gher

Rui (*Labeo rohita*)

Big head carp and grass card dominated catch from gher

Tilapia *(Oreochromis niloticus) culture in gher*

Tengra

Photo 6-11: Major fishes occupying in the study area

6.2.8 Indicative Fish Species

231. Among the fish species found in the study area mentioned above, the major indicative and migratory fish species are Kaine Magur (Plotosus canius), near threatened in IUCN, Bangladesh; Bhetki (*Lates calcarifer*), not evaluated; Parshe (*Liza Parsia*), not evaluated and Guli Tengra (*Mystus gulio*), near threatened. These species are generally live in the brackish to saline water but during the spawning season they come to brackish to freshwater environment. The spawning season of *Lates calcarifer*, *Plotosus canius* and *Mystus gulio* range from March to August whereas *Liza parsia* breeds from November to February (Figure 6.9). Usually these fishes enter into the Polder with the tide in drifting mode of migration during the life stages of hatchling to fry. These fishes use the Ghers of the Polder as grow up habitat in a culture mode. In addition to this phenomenon, the larger sized fish those cannot withstand the tidal velocity enter into the Polder as most of the fishes generally perform anti-current movement. The sustainable and burst velocities of movement of following fish species are given below in Table 6.16. Speeds are generally referred to as 'burst' or 'sustained', which correspond to durations of seconds and hours beyond (>200 min), respectively. Fish generally use burst velocity or swimming speed for capturing prey while sustainable velocity or swimming speed for moving against the current. In calculating the velocities some criteria have been followed. These are: (i) total length of fish, (ii) habitat type (demersal/pelagic), (iii) water temperature, (iv) cruising swimming speed, (v) maximum swimming speed, etc.

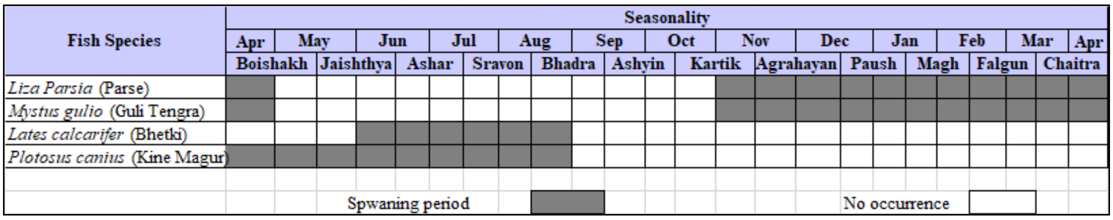


Figure 6.9: Seasonality of fish spawning

Table 6-16: Movement speed or velocity of indicative fish species

Fish Species	HabitatType	Min Size	Max Size	Water Temperature (^{0}C)	Min Size		Max Size	
		Total Length (cm)	Total Length (cm)		Max Sustainable Velocity (m/s)	Max Burst Velocity (m/s)	Maximum Sustainable Velocity (m/s)	Maximum Burst Velocity (m/s)
Plotosus canius (Kine Magur)	Demersal	36	69	27	0.74	2.84	1.10	4.20
Lates calcarifer (Bhetki)	Demersal	29	60	27	0.65	2.50	1.01	3.86
Liza Parsia (Parse)	Demersal	15	16	27	0.44	1.68	0.46	1.75
Mystus gulio (Guli Tengra)	Demersal	15	45	27	0.44	1.68	0.85	3.25

Source: http://www.fishbase.org; FAP- 6: Fish Pass Study, 1994

6.2.9 Threatened Fish Species

232. Threatened fish species are those, which are locally rare and unavailable for the long time (10-15 years) as reported by the local fishers and concerned elderly people are listed in **Table 6.17**.

Table 6-17: List of Threatened Fish Species

Scientific Name	Local Name	Local Status		IUCN status
		Rare	Unavailable	
Notopterus chitala	*Chital*	√		EN
Nandus nandus	*Bheda/Mini*	√		VU
Ompok pabda	*Pabda*	√		EN
Sperata aor	*Aire*	√		VU
Wallago attu	*Boal*	√		NO
Raiamas bola	Bhola	√		EN
Channa marulius	*Gojar*		√	EN
Plotosus canius	Gang Magur	√		VU

Source: *CEGIS Field Survey 2016 and Consultation with local fishers and elderly people in the study area.*

6.3 Human and Economic Development

6.3.1 Fish Production

233. *Gher* owners mostly concentrate in *Bagda* (shrimp) farming and start from January and continue until November depending on the suitable saline water. *Bagda* farming follows improve extensive to semi-intensive systems along with other brackish water fishes (*Tengra, Parshe, Khoshola*, *Bhetki* etc). If salinity drops in the *gher* during monsoon, fresh water fish species (*Catla, Rui, Mirgel*, Grass carp, Silver carp, Big head carp, *Tilapia* etc.) is stocked along with *golda* (prawn). On other hand, pond owners culture the fresh water fishes (*Catla, Rui, Mirgel*, Grass carp, Silver carp, Big head card, *Tilapia* etc.) in their pond over the year following poly-culture or mixed culture. As per discussion with the fish farmers, fishers and local officials of Department of Fisheries (DoF), the production of the fisheries resources are presented in the Table6.18. The fish productivity of *khal* (canal) is 120 kg/ha which is comparatively lower than the national productivity rate (196 kg/ha). The main reasons for low productivity are, reduction of water depth due to siltation, fishing by nets close to the sluice gates, obstruction of fish hatchling movement during pre-monsoon and monsoon due to improper management of sluice gate and low enforcement of Fish Conservation and Protection Acts. Fish productivity of cultured pond and *ghers* is also low. Low production of culture fisheries in the Polder area is due to tidal flooding risk for mal-functioning of sluices and regulator, lack of quality fish and shrimp seed and feed, and lack of training on modern fish culture. However, aquaculture practice in *gher* is increasing significantly in the Polder area.

Table 6-18: Fish Production of the Polder Area

Sl	Fisheries Category	Habitat Types	Production (MT)	Remarks
1	Capture	Khal (Canal)	15.00	-
		Inter tidal area	***0.50***	
		Sub-total	***15.50***	
2	Culture	Gher	194	Production includes *Bagda, Golda* and other fresh water and brackish water fish.
		Pond	141	
		Sub-total	***335***	
		Total	***350.50***	

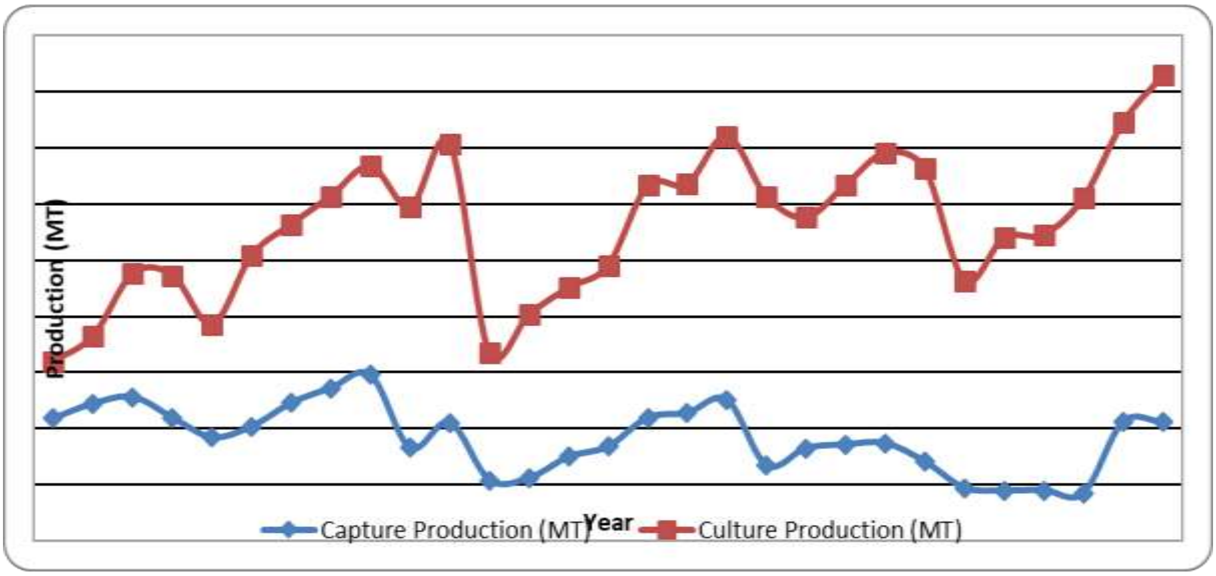
Source: CEGIS estimation based on field survey data 2016 and FRSS 2015

234. The estimated total fish production of the Polder area is about 350.50 MT (Table 6.18). Most of the fish production (about 95.58%) is from culture fisheries and very few (4.42%) is from the capture fisheries. Capture fisheries production is gradually declining over the year in the Polder area due to natural changes in river flow, disturbance in spontaneous fish migration, inadequate water in the rivers resulting from increased sedimentation in riverbeds due to reduced sediment deposition on floodplains protected by embankments and lack of proper operation and maintenance of sluice gates of the Polder.

Fish production trends of Khulna district

235. The Polder 17/2 is located in the coastal district Khulna. Once, the area was rich in capture fisheries. After the construction of Polders during 1960 to early 70s, a favorable environment was created for the quick spread of brackish water aquaculture inside the Polder areas disregarding the ban on entry of saline water through regulating arrangement. As a consequence, growth rate of capture fisheries started to decelerate. Statistical analysis of fish production of the last 30 years revealed that capture fish production (capture and culture fisheries) has declined trend. It is also found that from 1992-93 to 1997-98 decreasing trends was observed which may be due to the morphological changes of internal khals, reduction of water depth due to siltation, squeezing of spawning, breeding and feeding grounds, overfishing, fishing by illegal gears close to the sluice gates, obstruction of fish hatchling movement during pre-monsoon and monsoon due to improper management of sluice gate, lack in enforcement of fish conservation and protection Acts, lack of proper open water management, climate change etc. but then increases substantially till 2003-04 and afterwards declined gradually up to 2012-13 (figure 6.10). From the fiscal year 2013-14 upward increase (Figure 6.10) in production was observed which may be due to floodplain stocking with carp fingerlings, Beel nursery program and the strengthening of conservation measures.

236. On the other hand, comparatively higher growth rate (about 17.76%) was observed in culture fisheries which may be due to dissemination of improved technology packages, intensification, diversification and expansion of aquaculture, supportive/ need based extension services at farmer's level, introduction of high yielding species etc. Over the last three decades culture fish production increased almost three times (10056 MT in 1983-84 to 61595 MT in 2014-15).



Source: FRSS (1983-15)

Figure 6.10: Fish production trends of Khulna District (1983-2015)

6.3.2 Fishing Effort

Fishers

237. Mainly three types of Fishers' group as commercial, subsistence and part time fishers are found in the study area. Of them about 5-6% households are engaged in commercial fishing, 40-50% in subsistence fishing and 40-45% households are involved in part time fishing in and around the fish habitats of the Polder area. Commercial fishers are spending around 7-8 hours a day in fishing activities throughout the year. They usually catch fish in the nearby rivers, canals of Polders and also harvest fishes in private *ghers* and ponds as a rental or wages basis. They also catch the Post larvae (PL) of Bagda/Golda and crab seed from the rivers. The socio-economic condition of the commercial fishers is poor.

Fishing Season

238. Fishing in canals in the Polder area and in peripheral rivers starts in April and continues up to February. Rest of the time they are mainly engaged in other fishing. Most of the fish catch by using different gears is during late June to Mid November. Monofilament Gill net (Current Jal) fishing is the major fishing of the study area, followed by push net, cast net, lift net, seine net etc. Moreover, shrimp trap (Atol) is used in the gher to harvest shrimp and prawn while fish trap is used in the open water. It is important to note that *Ber jal* and *Bendi jal* are used in the periphery river round the year. The seasonality of major fishing gear is presented in the **Table 6.19.**

Table 6-19: Fishing seasonality of major fishing gear in the study area

Type of Gear	Apr	May	June	July	August	Sept	Oct	Nov	Dec	Jan	Feb	March	April
	Baishakh	Jaishthya	Ashar	Sraban	Bhadra	Ashyin	Kartik	Agrahayan	Poush	Magh	Falgun	Chaitray	
Seine net (Ber Jal)													
Gill net (Current Jal)													
Drag net (Net Jal)													
Push net (Dhela Jal)													
Cast net (Jhaki Jal)													
Sluice net (Dip net)													
Pull net (Tana Jal)													
Lift net (Vesal Jal)													
Fish Trap (Chau)													
Shrimp Trap (Atol)													
Lining (Borshi)													
	High		Moderate			Low			No Occurrence				

Source: CEGIS Field Survey, 2016

Fishing gear and craft

239. Different kinds of fishing gear and traps (Photo 6.13) are used to catch specific fish in the area according to fish species as well as season. Dingi boat is the widely used craft which is used to collect PL of shrimp, crab seed and fishes from the rivers or Khals by using Set bag net (Behundi jal), cast net (Khelpa jal), seine net (Current jal) etc. The following photo 6.12 indicates common fishing boat of the study area.

Photo 6-12: Traditional Fishing Boats


Cast net (Khepla Jal) operation in the study area


Shrimp Trap (Atol) is used in Ghers to Harvest Shrimp

Photo 6-13: Different type of fishing gear

6.3.3 Fish Marketing and Post Harvest Facilities

240. There are some fish and shrimp selling arats named Paikgacha, Dumuria, Kharnia, Mandartola, Chupnagarand Kapilmuni etc in the study area. In addition to, a number of daily or weekly bazaars (Hat) found in the study area. Kathaltola, Kulbaria bazar, Athara bazar etc some of the local fish selling bazaars located in the area. Generally, fishermen sell their harvested fish to the local bazaar. No permanent storage facility is available except a few ice factories to produce ice for temporal storage. Ice is generally used for transporting the fish and for temporary storage of fish/shrimp. Communication facility is poor in the study area. Van, Rickshaw, Nasimon, pick up, head load etc. are the commonly used means to transfer products from the producing areas to the consumption centers. Two private hatcheries (National Shrimp Hatchery & Nursery and Nazrul Shrimp hatchery) near Paikgacha Upazila area which can meet the demand of fish seed a little. The rest is supplied from the hatcheries and nurseries of different districts. In addition, fish feeds are also collected from the local market or to the mobile traders who comes from Khulna, Satkhira and Jessore districts. A large number of people find employment in the fisheries sector in the form of farmers, processors, traders, intermediaries, day laborers and transporters.

6.3.4 Fisheries Management

241. There is no community-based fishers association in the Polder area. The fishers have full fishing rights and access to existing fish habitats of the Polder area. There is no leased water body in the Polder. Department of Fisheries (DoF) has limited initiatives for fisheries resource conservation and management (enforcement of Fish Conservation and Protection Acts, training on aquaculture etc.) in this area. Some NGOs are also working, but their programs are very much limited to micro credit rather than extension services and aquaculture training.

6.3.5 Agriculture farmingpractices

242. Farming practices in the Polder area are largely controlled by physical, biological, climatic and socio-economic factors. There are two distinct cropping seasons in a year. The Kharif season isfrom March to October while the Rabi season isfrom November to February.

Based on crop adaptability and crop culture, the Kharif season is further sub-divided into the Kharif-1 (March-June) and the Kharif-II (July-October) seasons.

243. The Kharif-I season is characterized by high temperatures, low humidity, high evaporation, high solar radiation and uncertainty of rainfall with low alternating dry and wet spells. Local Transplanted Aus (Lt. Aus), High Yielding Variety of Transplanted Aus (HYV Aus) and Summer Vegetables aregrown in the Kharif-I season.

244. The Kharif-II starts from July and ends in October. The Kharif-II season comprises of wet and cloudy environment and heavy rainfall but uneven distribution, low solar radiation, high temperature and humidity. According to local farmers T aman rice both local and HYV and some vegetables are grown in this season under rainfed condition. Farmers also provide supplementary irrigation to HYV T aman crops under water stressed situation.

245. In the Rabi season starts from November and ends in February. During this season, crops are favored with high solar radiation, low humidity and temperature, but lack of adequate soil moisture depresses the crop yield. Wide ranges of crops are grown in this season. However, there are occasional overlaps such that the Kharif-II season crops Lt. Aman and HYV Aman rice are harvested in Rabi season.

6.3.6 Present Cropping Pattern by Land Type and Intensity

246. The present dominant cropping pattern of the Polder area is Fallow- T Aman (Local/HYV)-Fallow and Fallow- Fallow- Boro (HYV). Farmers are also growing cereal, oilseed, pulses and vegetables crops where HYV Boro, Oilseeds (Mustard), potato and Brinjal are shown in the (Picture-6.14 to Picture– 6.17). The cropping intensity of the Polder area is 162%. Detailed cropping intensityby land type is presented in Table 6.20.

Table 6-20: Present Cropping Pattern by Land Type

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Area (ha)	% of NCA
Highland	Fallow	HYV T. Aman	Fallow	125	8
	S. Vegetables	HYV T. Aman	Spices	31	2
	Fallow	Local T. Aman	W. Vegetables	204	13
	HYV T. Aus	HYV T. Aman	Potato	63	4
			Sub- total	423	27
Medium Highland	Fallow	HYV T. Aman	Oilseeds	139	9
	Local T. Aus	HYV T. Aman	Pulses	124	8
	Fallow	Local T. Aman	Fallow	355	23
	Fallow	HYV T. Aman	HYV Boro	185	12
	Fallow	Fallow	HYV Boro	324	21
			Sub-total	1128	73
			Total	1551	100
			Cropping Intensity (%)	162%	

Source: Field information, Local farmers and SAAO of DAE, 2016

Photo 6-14: View of HYV Boro field in the Polder AreainVillage Nikra

Photo 6-15: View of Oilseeds (Mustard) in the Polder Areain Village Atlia

Photo 6-16: View of Potato field in the Polder Area in Village *Kholshibunia*

Photo 6-17: View of Brinjal field in the Polder Area inVillage *Atlia*

6.3.7 Cropped Area and Production

247. Detailed cropped area, yield rate and crop production is presented in Table 6.20

a) Cropped Area

248. Total cropped area is 2,514ha of which rice is occupied by1,923 ha and the rest 592 ha are covered by non-rice crops. The rice and non-rice cropped area are 76% and 24% of the total cropped area respectively Table 6.20.

b) Crop Production

249. Total crop production is 9,929 metric tons of which rice production is 4,347 (44%) metric tons and non-rice production is 5,582 (56%) metric tons. Detailed informationare presented in Table 6.21.

Table 6-21: Present Cropped Area, Yield and Production of the Polder Area

Present crop grown	Present crop area, yield & production			% of contribution
	Cropped area (ha)	Yield/ha (mt)	Production (mt)	
Local T. Aus	124	1.6*	198	2
HYV T. Aus	63	1.9*	119	1
Local T. Aman	559	2.0*	1118	11
HYV T. Aman	667	2.3*	1535	15
HYV Boro	510	2.7*	1377	14
Total rice	**1,923**	**-**	**4,347**	**44**
Pulse	124	1.6	198	2
Oil Seeds	139	1.2	167	2
Spices	31	5.5	172	2
Potato	63	15	940	9
S. Vegetables	31	14	439	4
W. Vegetables	204	18	3,666	37
Total non-rice	**592**	**-**	**5,582**	**56**
Total Cropped Area	**2,514**	**-**	**9,929**	**100**

*Sources: Field information, Local farmers and SAAO of DAE, 2016. *Indicates cleaned rice*

6.3.8 Crop Damage

250. The scenarios of crop damage during 2009-2014 and 2015 are presented in Table 6.22 which shows that crops were damaged by Ailain 2009, Tidal affect in 2012 and Flooding due to heavy rainfall in 2013. According to farmers and our field observation, Local T aman 60%, HYV T aman 60%, Vegetables, 50% oilseeds 40% and spices 50%by flooding due to heavy rainfall (Field visit; February 2016).

Table 6-22: Crop Damaged by Different Means and % Losses during 2009-2014 and 2015

Crops	Damage (%)	Year	Reason of damage
Local T. Aman	60%	2009	AILA
HYV T. Aman	60%	2009	AILA
Vegetables	50%	2009	AILA
Oilseeds	40%	2009	AILA
Spices	50%	2009	AILA
HYV T. Aman	20%	2010	Heavy rainfall (water logging)
Vegetables	18%	2010	Pests
HYV T. Aman	20%	2011	Water logging
Vegetables	15%	2011	Pests
Local T. Aman	20%	2012	Tidal affect
Local T. Aman	28%	2013	Flooding due to heavy rainfall
HYV T. Aman	25%	2014	Water logging
Vegetables	15%	2014	Pests
HYV T. Aman	18%	2015	Tidal affect

Sources: Field information, Local farmers and SAAO, February, 2016

Crop Variety use

251. According to the local farmers and SAAO of DAE of Dumuria Upazila, Khulna, among rice and non-rice crops, farmers are using different variety of seeds. Detailed of the information is presented in Table 6.23.

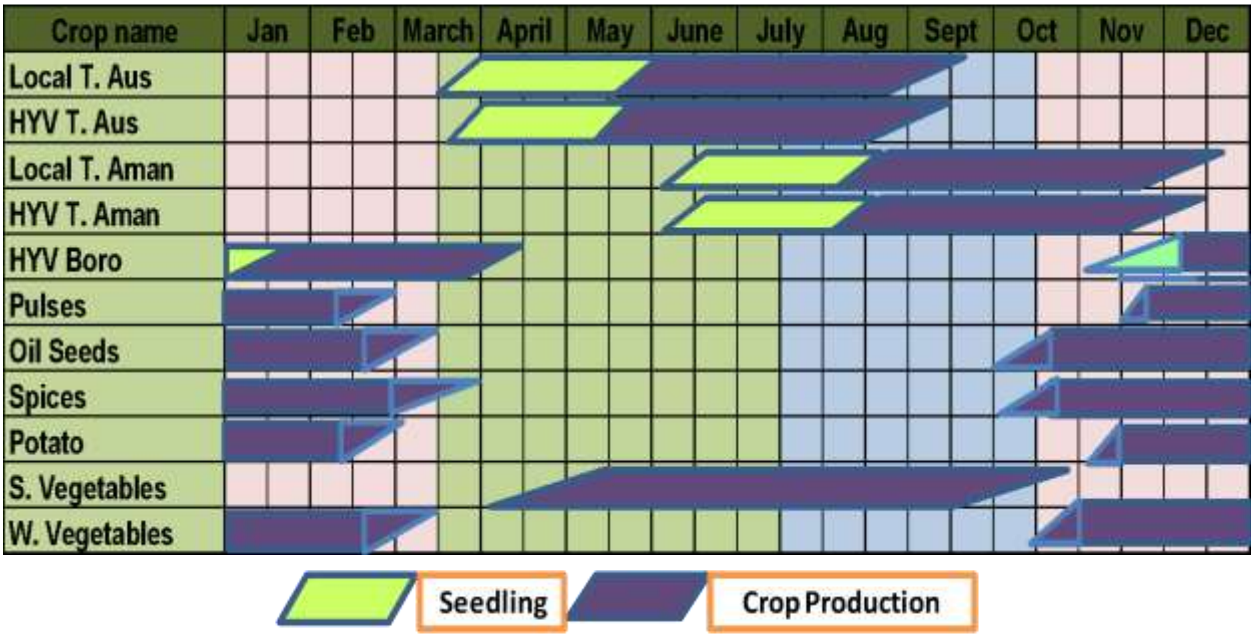
Table 6-23: Crop varieties used in the Polder area

Crop	Varieties
Local T. Aus	Sornobasori, Lal mota, Shada mota.
HYV T. Aus	BR-24, BR-26, BRRI dhan-48.
Local T. Aman	Benapole, Sada mota, Jatai balam
HYV T. Aman	BRRI dhan-52, BRRI dhan-43, BRRI dhan-57, BRRI dhan-49, BRRI dhan-48.
HYV Boro	BRRI dhan-10, BRRI dhan-28, BRRI dhan-29, BRRI dhan-47, Hira Dhan, Jagoron
Pulses	Utfala, BARI Masur -3, Khesari local Variety, Progoti, BARI Chola-7.
Oilseed	Rai 5, Kalyania, Sonali, BARI Mustard-14.
Spices	BARI Onion-2, BARI Onion-4: Bangla Lanka, Local variety of Chili and Local variety of coriander (Foridpuri)
Potato	Diamand, Cardinal, BARI Potato-44
Vegetables	Kajal, BARI Bt Brinjal-2; BARI Jhar seem-1, BARI Seem-5 (Short); country bean local; Manik, Ratan, BARI tomato-14.

Sources: Field information, Local farmers and SAAO, February, 2016

Crop Calendar

252. The detailed crop calendar of the Polder area is presented in Figure 6.11. It is observed that generally HYV Boro crops are transplanted during mid December to mid January. Some vegetables are very sensitive to temperature. Therefore, the time of sowing and harvesting of vegetables vary.



Sources: Field information, Local farmers and SAAO, February, 2016

Figure 6.11: Crop calendar of the entire Polder area

6.3.9 Agriculture Input Use

253. Seed, labor, fertilizer, pesticide and irrigation are the major inputs for crop production.

a) Seed

254. The seed rate used by the farmers in the Polder area is presented in Table 6.24. Most of the farmers in the Polder area use their own seeds in case of local variety, such as T. Aus and

T. Aman. Medium and small farmers meet their requirement from neighboring farmers or local markets. Various improved crop seeds is provided by BADC through seed dealers. The seed rate of vegetables generally depends on the size and viability of the seed. In the local market seeds are available in good condition.

Table 6-24: Seed rate, Irrigation and Power tiller cost in the Polder Area

Crop Name	Seed	Irrigation cost (Tk)	Equipments used for cultivation		Power tiller cost
	(Kg/ha)		Power tiller (%)	Bullock	
Local T. Aus	40	-	85-90	10-15	5,000
HYV T. Aus	32	-	100	-	5,000
Local T. Aman	40	-	90-95	10-5	5,000
HYV T. Aman	32	-	100	-	5,000
HYV Boro	35	6,500	100	-	6,000
Pulses	25-40	-	85	15	3,000
Oil Seeds	8	-	100	-	3,000
Spices	2-8	5,500	100	-	4,500
Potato	1.5 t/ha (cut tuber)	6,000	100	-	5,000
S. Vegetables	3-5	6,200	95	5	5,000
W. Vegetables	3-6	7,000	90	10	5,500

Sources: Field information, Local farmers and SAAO, February, 2016

b) Irrigation

255. Irrigation is provided mainly in HYV Boro and Robi crops in the Polder area. Surface water is the only source of irrigation as reported by local farmers. Khals and in few cases, ponds are the source of surface water for very limited time. Irrigation coverage of the Polder area is 49% (759ha) of the NCA during the dry season see Table 6.23. As of now, surface water is the only source of irrigation. Peripheral rivers (Taltola river, Gangrail river), and internal Khals (Golabdah khal, Changmari khal, Arua khali, Shitla khali khal and Talighati khal) are the sources of irrigation water. Surface water is extracted through Low Lift Pumps (LLPs). In some cases, Spices, Pulses, Potato, Orchard Summer and Winter Vegetables are grown with supplementary irrigation (Field visit; February, 2016 Supplementary irrigation cost is Tk.1,500-7,000/ha-depending on crops and number of applications.

c) Fertilizer and pesticides application

256. The rate of fertilizer use per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability (Table 6.25). The major fertilizers used in this area are Urea, TSP/SSP and MP. The quantities of fertilizer used are generally lower than the recommended doses and proportions of Urea, TSP/SSP and MP is not maintained. In many cases farmers used fertilizers in imbalanced way. Organic manures are not used by the farmers in the field crops. Annually about 826 metric tons of chemical fertilizers are being used in the Polder area of which 49.2% is urea, 21.1% is TSP, 20.2% is MP, 9.2% is Gypsum and 0.3% is Zinc. Generally, farmers did not use manure or compost in their fields. imbalanced use of chemical fertilizers affects the soil health which is ultimately reflected on crop yields.

Table 6-25: Fertilizer and Pesticides use in the Polder Area

Crop Name	***Fertilizer (Kg/ha)***					***Pesticides***
	Urea	***TSP***	***MP***	***Gypsum***	***Zinc***	***(Tk/ha)***
Local T. Aus	*125*	*45*	*45*	*20*	*0*	*450*
HYV T. Aus	*150*	*70*	*55*	*35*	*0*	*500*
Local T. Aman	*120*	*50*	*50*	*20*	*0*	*600*
HYV T. Aman	*160*	*80*	*65*	*25*	*0*	*1500*
HYV Boro	*190*	*80*	*80*	*50*	*0*	*1000*
Pulses	*50*	*45*	*40*	*30*	*5*	*500*
Oil Seeds	*140*	*70*	*50*	*30*	*2*	*420*
Spices	*180*	*90*	*130*	*50*	*8*	*800*
Potato	*250*	*70*	*150*	*25*	*6*	*1500*
S. Vegetables	*280*	*80*	*80*	*30*	*5*	*1200*
W. Vegetables	*270*	*85*	*85*	*30*	*5*	*1500*

Sources: Field information, Local farmers and SAAO of DAE, February, 2016

257. The use of pesticides depends on the degree of pest infestation. According to local farmers, the major insects are Yellow Stem borer, Ear cutting caterpillar, Brinjal fruit and shoot borer (Larva), Aphids, Leaf Hopper, Fruit weevils etc. Local farmer reported that they are using different types of pesticides such as Volian Flexi, Amestartop, Altima Plus, Virtako, Aktara, Fighter, and Fanfan etc. to prevent pest infestation in rice, vegetables and other croplands. Both liquid and granular pesticides are being used to prevent pest infestation in the rice cultivation. Farmers also reported that they applied pesticides once or twice in a crop season.

d) Labor forAgriculture

258. In the Polder area, mostly manual labor is used for cultivation. Thereby, agricultural labor is considered as one of the essential inputs for crop production. The labor requirement is not uniform throughout the year. The number of labor requirement varies from crop to crop. Annually a total of 0.807million man-days labour is used for crop cultivation. The average labor used in the Polder area is presented in Table 6.26.

Table 6-26: Agricultural Labor used by crop in the Polder Area

Crop name	**Labor (No/ha)**	**Crop name**	**Labor (No/ha)**
Local T. Aus	140	Oilseeds	105
HYV T. Aus	145	Spices	145
Local T. Aman	140	Potato	180
HYV T. Aman	145	S. Vegetables	180
HYV Boro	165	W. Vegetables	190
Pulses	90	-	-

Sources: Field information, Local farmers and SAAO, February, 2016

e) Integrated Crop Management

259. Recently, Integrated Crop Management (ICM) is practiced in many places. In this system, insects are controlled biologically. Farmers of the ICM areas use branches of trees, bamboo etc to make favorable perches for birds in fields with standing crops. The birds eat the insects which help control infestation. There are two ICM schools in the Polder area. DAE is providing training from 4.00 pm to 6.00 pm. ICM technique is mainly applied on rice and vegetables crops. Farmers and SAAO of DAE indicates that ICM is being practiced in the fields

covering about 10-15% of the cultivated areas and the impact has been found very encouraging. Day by day ICM practicing is increasing.

6.3.10 Livestock and Poultry

260. Livestock and poultry, being an essential element of an integrated farming system, play an important role in the economy of Polder-17/2. Livestock provide significant draft power for cultivation, threshing and crushing of oil seeds; cow dung as a source of manure and fuel; a ready source of funds and meat, milk and eggs for human consumption. Most of the households raise poultry and livestock, a practice that significantly reduce poverty through generating income and employment. The Cow, Horse, Goat and Sheep are the common livestock in this Polder area in which number of sheep is increase gradually due to help of government and NGO. The numbers of livestock and poultry in the Polder area are presented in Table 6.27.

Table 6-27: Number of Livestock and Poultry of the Polder Area

Name of Livestock and Poultry	% of HH having Livestock /Poultry in the Polder Area	Number of Livestock/poultry in the Polder Area
Cow/Bullock	30	3537
Buffalo	-	-
Goat	35	8253
Sheep	40	11790
Duck	65	22991
Chicken	70	20633

Sources: Field information, Local farmers and DLS, February, 2016

6.3.11 Feeds and Fodder

261. 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. Oil cake, bran, Grass, etc. are other common fodders in this Polder area. Shortage of grazing areas throughout the year aggravates the feed problem to the animal population. The poultry population at family level survives by scavenging and generally no feed supplements are provided. However, at times kitchen waste becomes feed to the poultry and duck are going heather and thither.

Photo 6-18: View of Chicken in the Polder area inVillage Baratia

Photo 6-19: View of Sheep in the Polder area inVillage Kulbaria

6.3.12 Livestock and Poultry Disease

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

6.4 Socio-Cultural environment

263. The Polder-17/2comprises of the part of DumuriaUpazilaunder Khulna district. The Polder area includes two unions namely Magurkhaliand Atlia.The percentages of union boundary are shown inTable 6.28.ThePolder is situated beside the Khulna-Satkhira Highway and other side of the Polder is located beside Taltola River and Gangrail River.

Table 6-28: Unions and upazilas in Polder-17/2

Name of district	Name of upazila	Name of unions/ Paurashava	Percentage of union within Polder
Khulna	Dumuria	Maguraghona	30
		Atlia	52

Source: Spatial GIS Analysis, CEGIS, 2016

6.4.1 Demography

264. The Polder area has 5,895 households and the population size is 25,078, of which 12,753 are male and 12,325 are female (Housing and Population Census, BBS, 2011, CEGIS estimation, 2015[4]). The percentage of male-female is almost same in the study area.

265. The average male-female sex ratio[5]is 103 of which there are 103 males per 100 females [BBS, 2011]. The average density of population is 1054 persons per sq. km, which is higher than the national density of 1,015 persons per sq. km. The inhabitants of this Polder belong to two main religious groups; i.e. the Muslim and the Hindu. About 75% of total populationis Muslim and 25% isHindu. The demographic data of this Polder is presented in Table 6.29.

Table 6-29: Demographic Data of Polder-17/2

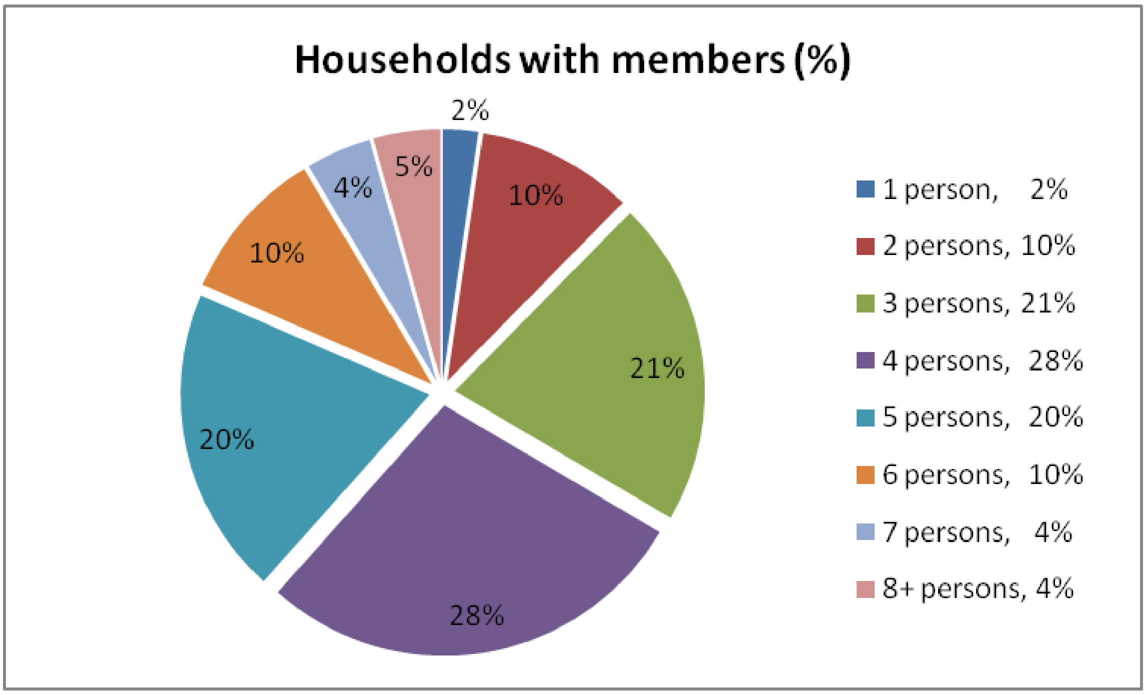
Unions	Households	Population			Sex ratio	Population density [sq. km]
		Both	Male	Female		
Maguraghona	1,691	7,273	3,657	3,616	101	1063
Atlia	4,204	17,805	9,096	8,709	104	1046
Total/Average	**5,895**	**25,078**	**12,753**	**12,325**	**103**	**1054**

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

[4]This estimation is based on BBS, 2011 Census data and 1.37 linear national growth rate;
Pop Future =Pop Present (1+r)n [Where: Pop Future = Future Population, Pop Present = Present Population, r = Growth Rate and n = Number of Years]

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

266. In the study area, household's distribution by number of personsshows that the highest percentage (28%) of household comprises of four persons (**Figure 6.12**). Although average household size is 4.3, a significant percentage (38%) of households comprises of five or more persons in each.



Source: Housing and Population Census, BBS, 2011

Figure 6.12: Distribution of Households comprisingof member

6.4.2 Age Structure

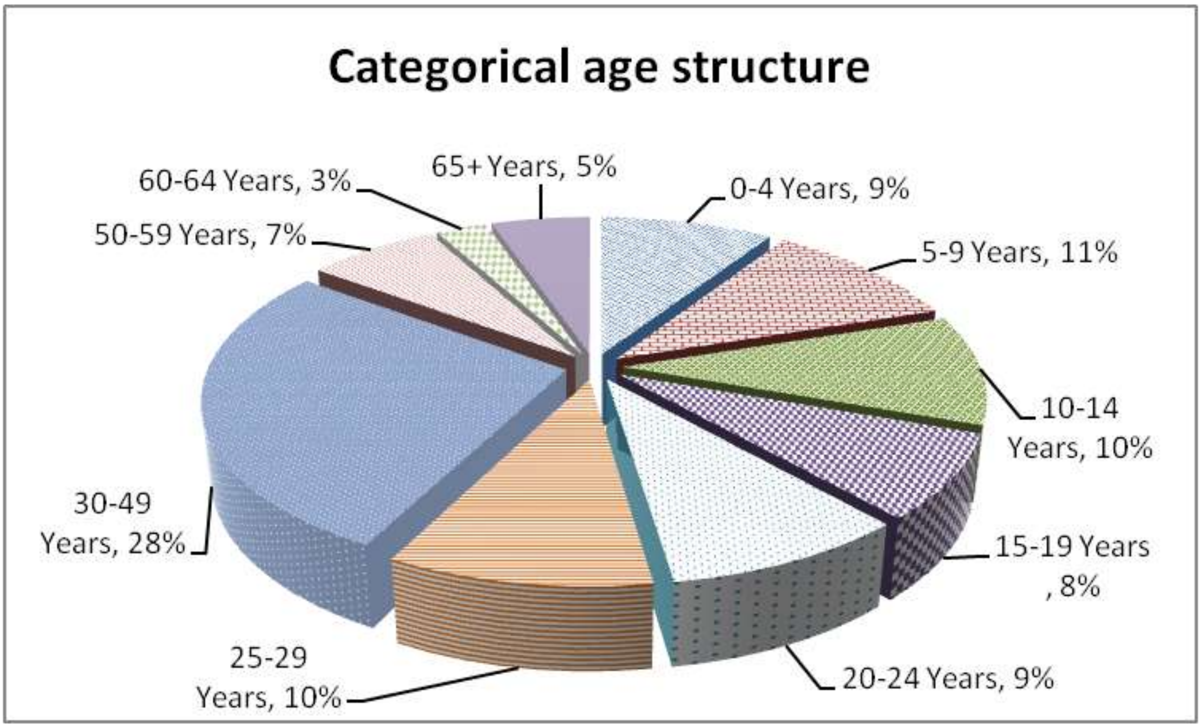
267. The highest number of population (28%) in the Polder area belongs to age category of 30 to 49 years old that indicates the trend of development. Only 3% people are in 60 to 64 years age category. Age groups of 0-14 years is defined as children, 15-24 years as early working age, 25-54 years as prime working age, 55-64 years as mature working age and 65 years and over as elderly people (source: World Fact Book, CIA6). 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 require more investment in health sector.

268. From analysis of age structure, it is found that about 31% of total population are children (age ranges up to 14 years), 64% of total population are youth (age ranges from 15 to 64 years) whose are considered as man-power and the rest 5% of total people belong to old category (age ranges above 65 years). Population of 15 to 64 years category is considered as labour force whereas, populations below 14 years and above 65 years are considered as dependent. Thus, the total dependency ratio[7] is 61 in which child dependency ratio is 46 and aged

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

[7]Dependency ratio=numberof people aged 0-14 & 65 and abovenumberof people aged 15-64x100

dependency ratio is 8. It is found that total 61 persons are dependent on 100 labour forces in which 47 are children and 8 are elderly people.



Source: Housing and Population Census, BBS, 2011

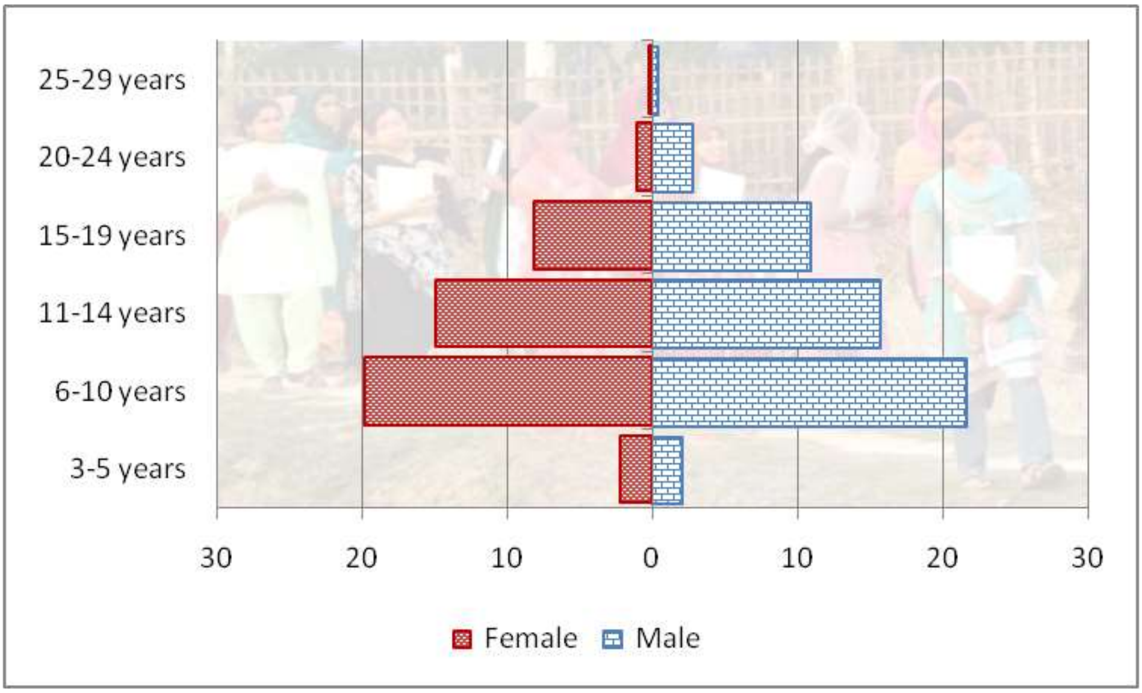
Figure 6.13: Age Structure of the Polder area

6.4.3 Education

School attendance

269. School attendance is a major indicator to measure the current and future status of a society. According to BBS, School attendance rate is measured from 3 years to 29 years by six clusters of age groups. 3 to 5 years is defined as pre-school attendance, 6 to 10 as primary, 11 to 19 years as secondary and higher secondary and finally 20 to 29 years as higher as well as advanced level attendance at educational institutions. Comparative scenario of attending and not attending rate shows that net attendance rate is the highest (17.3%) at Primary education (6-10 years) level than the rate starts reducing gradually.

270. However, it is found in the field visit that, almost every children of the family goes to school that means admitting in primary or pre-primary school is almost hundred percent. The rate of drop out in high school level has been reduced as well as increasing school attendance in primary and High school level because of Free-schooling and proving free educational Books.



Source: Housing and Population Census, BBS, 2011

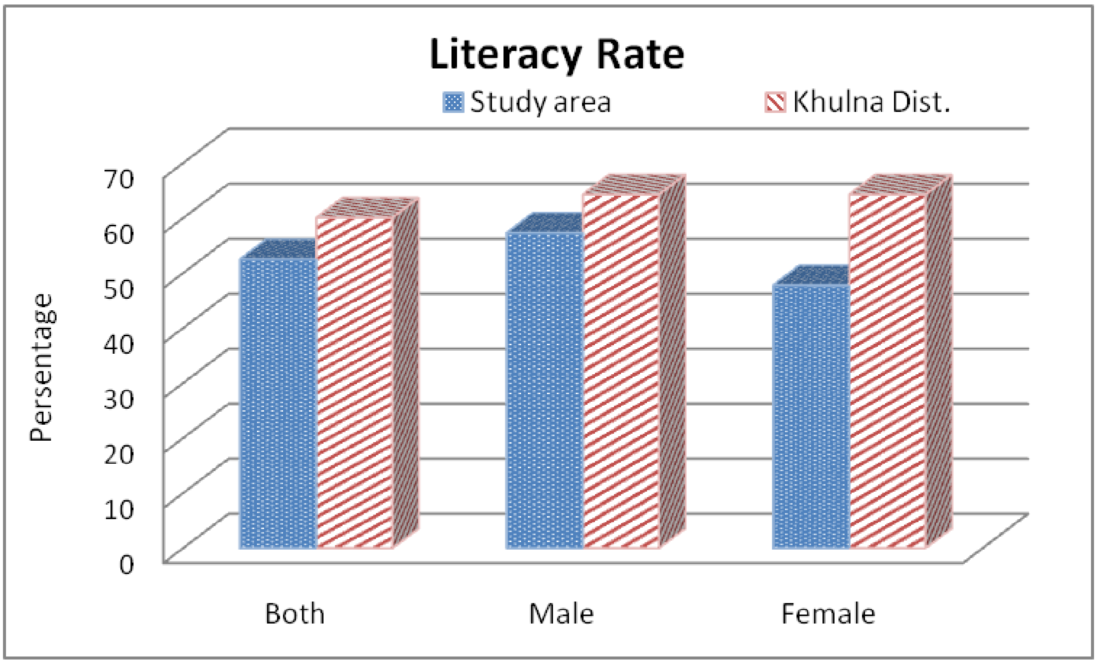
Figure 6.14: Comparative Pyramids of male-female school attendance

271. It is found that the rate of school attending both for male and female is equal in pre-school and primary level. However, attendance of female students started reducing from secondary level that comprises age structure 15 to 29 years. After completing or in the mid-time of High school education, most of the girls get married that decreases female attendance rate.

6.4.4 Literacy rate

272. According to BBS 2011, Literacy rate[8], based on a definition “ability to write a letter in any language” is 50.6%; where for male, it accounts to 54.7% and female 46.3% where the Khulna district literacy rate is both 60.1 in which male is 64.3 and female are 55.9. Literacy rate of the study area is lower than the district level. The rate of literacy reported above is for population of 7 years and over ages.

[8]Literacyrate is denotes ability to write a letter in any language. Literacy status assessment is made for population 7 years and over, 15 years and over, and also for population of all ages.



Source: Housing and Population Census, BBS, 2011

Figure 6.15: Literacy rate among the studied population

273. Academic institutions indicate the trends and scope of education in the studied area. Date shows **(Table 6.30)** that there are 19 primary schools where 11 High schools and three colleges in the study area. There are also fiveEbtedaye/ DakhilMadrashas in the locality that has wide influence on education. The scenario of education of the study area is moderate.

Table 6-30: Academic Institutions

Union	Number of Collage	Number of High school	Number of Primary school	Number of Madrasha
Magurkhali	1	3	8	2
Atlia	2	7	11	3
Total	3	11	19	5

Source: CEGIS fieldwork, February 2016

6.4.5 Ownership and Utilization of Land

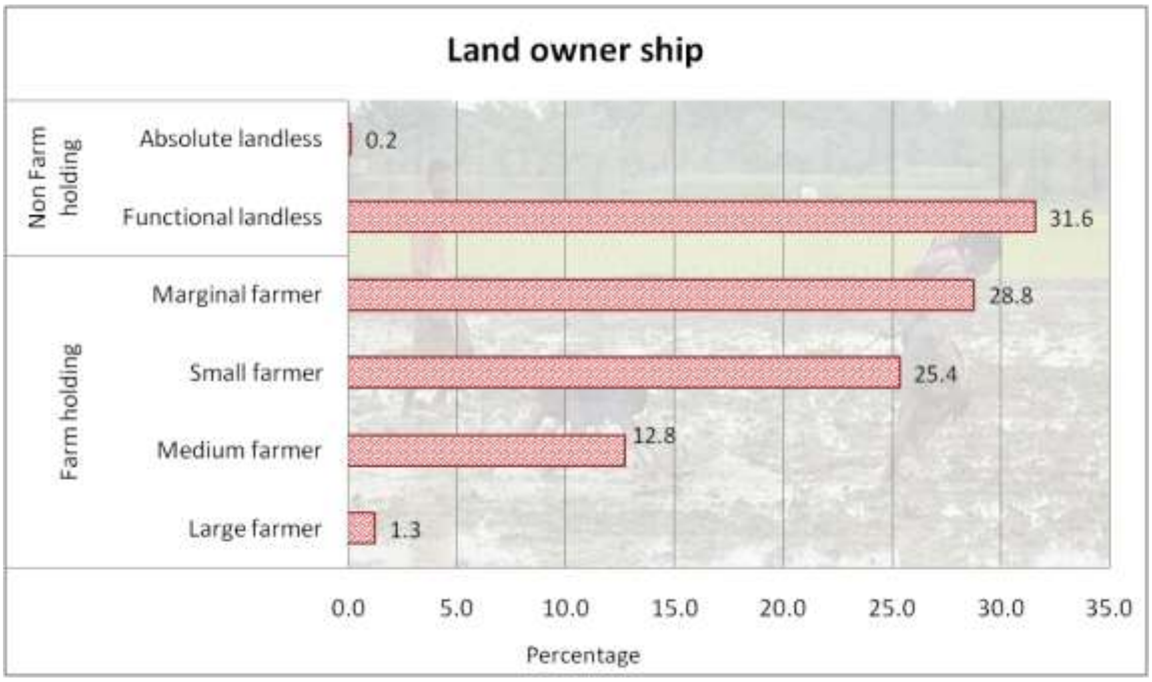
274. The Census of Agriculture, 2008 conducted by BBS classified land holdings into two broad categories- one is farm-holdings and another is non-farm holdings. A farm holding is defined as being an agricultural production unit having cultivated land equal to or more than 0.05 acre. Conversely, non-farm holding includes landless households and households having lands up to 0.04 acre. The study area shows that out of total holdings 68.2% is farm-holder and the rest 31.8% is non-farm holders.

275. According to BBS 2008 data on land holding distributions, in the study area, only 0.2% households are absolute landless i.e. they have either no lands forhomestead or cultivation. 31.6% households belong to functional landless category, which has land up to 0.04 acres.

276. On the other hand, farm holding distribution shows that 28.8% households belong to marginal farmer (0.05 to 0.99 acre), 25.4% belong to small farmer (1.00 to 2.49 acre),12.8%

belong to medium farmer (2.5 to 7.49 acre) and rest 1.3% belong to large farmer (7.5+ acre) categories. It is found that land fragmentation decreases the holding size therefore; large and medium farmers are gradually being turn into marginal farmers.

277. The entire land holdings can be categorized into three such as “owned land”, “land given to others” and “land taken from others”. It is found in the study area that about 43.9% 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 7.9% holdings are found to be given by the owners to others in terms of lease and/or rented for a limited time on payment either in cash of kind or in both. About 48.2% holdings are found to be taken by the farmers from others in terms of sharecropping and/or lease on other terms (BBS, 2008).



Source: The Census of Agriculture, 2008, BBS

Figure 6.16: Households by Land Holdings

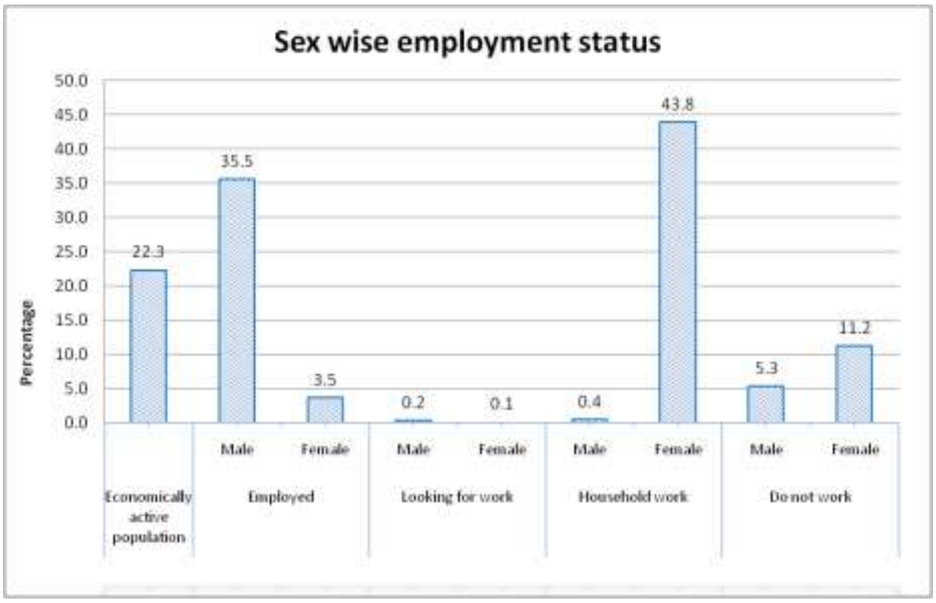
278. However, field observation shows that only 35% people clasp the maximum land(65%) as lease (locally called Hari) for shrimp practices. The lease owners have occupied the land year by year.

6.4.6 Occupation and Livelihood

279. Employment status is the key indicator to measure the socio-economic condition. It is found that almost 5,880 people (22.3%) of all work forces are economically active of which 9797 (39.1%) are employed, 73 (0.3%) are looking for work, Household work 11,087 (44.2%) and rest of the people (4,120) are in do not work category. Females are less engaged in financial activities (3.5%) in compare to males. Maximum females are engaged in household activities.

280. Women participation in direct income generating activities (employed category) is stale. Males who do not attend in education are engaged in employment; females are being married

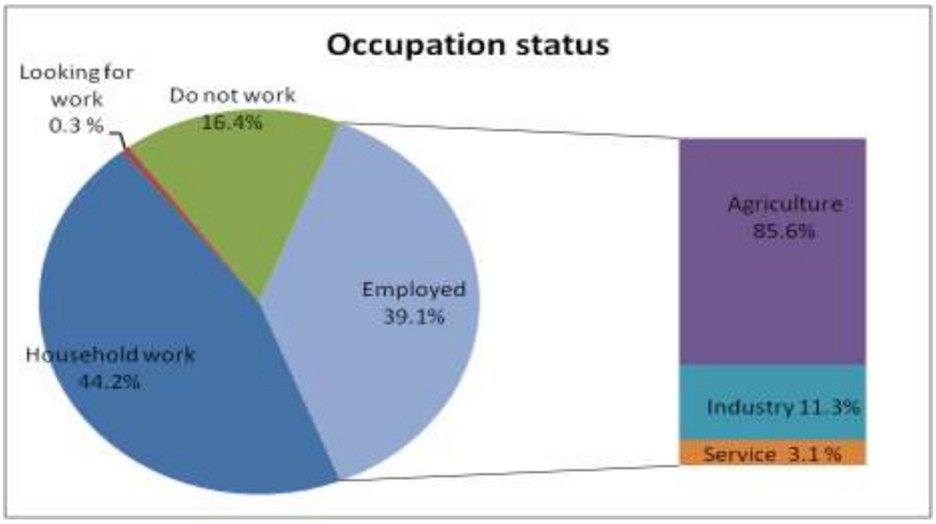
and in turn, contributed to the highest participation in household work (43.8%). The employed category also includes child labour as it was accounted from 7 years old population.



Source: Housing and Population Census, BBS, 2011

Figure 6.17:Employment status of the Polder

281. It is found in population censusthat 39.1% population areemployedof which85.6% are engaged in agricultural activities, 11.3% in industry and 3.1% in service. Agricultural activities include broadly crop-farming, fishery, livestock and poultry farming. Field findings suggest that rural women's participation is relatively higher in various post-harvest activities and livestock management activities than other agricultural activities. Scope of employment in agricultural sectors is gradually decreasing due to lack of fresh water tending to convert the lands into shrimp Gher. Few of them participate in some non-agricultural activities like handicrafts making, tailoring etc.



Source: Housing and Population Census, BBS, 2011

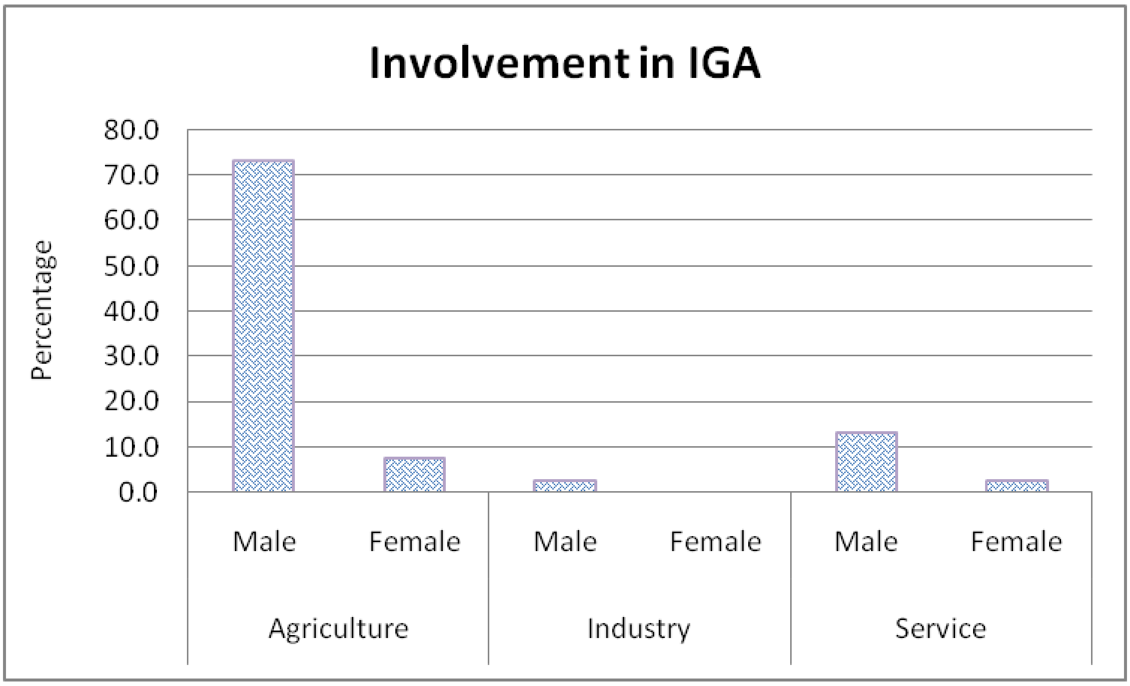
Figure 6.18:Occupationstatus among the studied population

282. However, according to BBS 2011, the main occupation is agriculture but the context is being changed for giving land as lease theshrimp culture thatdemands less labour than producing crops causing numerous people workless. Field observation also shows that this unemployment makes the local people vulnerable as well as poor. On the other hands, all the resources are going to be occupied in a few people's hand.

6.4.7 Labour Market

283. The employment rate[9] in the study area is 39 whereas the unemployment rate[10]is 61. It is evident that more than 61% of the total economically active population is still unemployed. Datashows that agriculture, industry and service are the sole sectors to generate employment for the local people. Field findings documented that people who are not permanently employed tend to engage themselves in other sectors such as agricultural labourers, fishers, brick field workers, earth workers, and cleaners. In agricultural sector, most of the labourersare supplied from the local villages.

284. In the study area, the maximum male farming labour wage rate is 350 BDT where lowest wage rate is 200 BDT and maximum female labour wage rate is 250, where lowest wage rate is 150 BDT. The involvement and trend of female in income Generating Activities (IGA) is very negligible.



Source: Housing and Population Census, BBS, 2011

Figure 6.19: Distribution of Population involvment in Income Generating Activity

285. Data confirms that agriculture is the main sector generating employment for the local people. In agricultural sector, almost all labourers come from the local villages. Out-migration

[9]Employment Rate =EmployedPopulationTotallabourforceX 100

[10] Unemployment Rate= 100-Employment Rate

from study area is very high (15%) during the months from January to April. These out-migrated people are generally engaged as rickshaw puller, mason, non-farm laborer and shoe factory worker etc. Seasonal out-migrants often go to Dhaka, Khulna, Barisal, and Chittagong districts for better employment. In the study area, the employment opportunity is very limited. Therefore, the seasonal in-migration is insignificant (Source: CEGIS fieldwork, 2016).

6.4.8 Quality of life

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

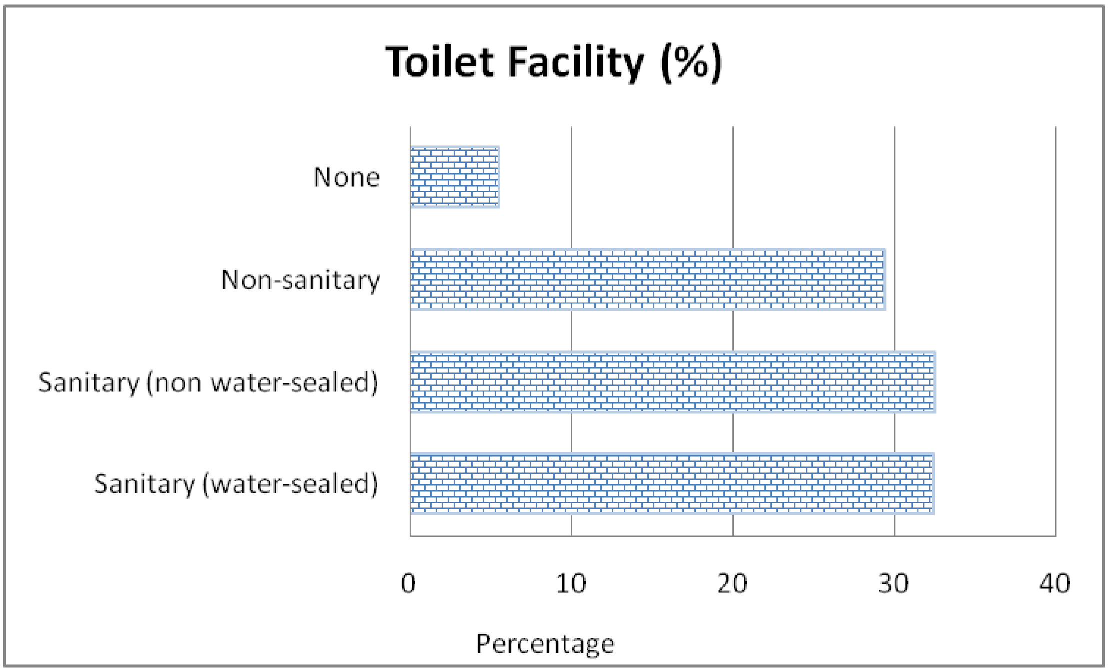
287. Electricity is the key to modernization and development. The facility of electricity coverage is poor (56.4%) across the Polder area. Data shows that Atlia union comprises the higher (60.5%) than Maguraghona (52.3%) union has the lowest coverage [Source: Housing and Population Census, BBS, 2011]. Moreover, about 10% households are now using solar electricity in the Polder area (CEGIS: fieldwork, 2016).

288. The overall housing condition11 is not satisfactory. The data shows, the majority of households haveKutcha houses (55.2%). Semi-pucca household is 28.6%, pucca houses constitute only 15.6% and 0.6% is still jhupri. Statistics show Atlia union comprises the highest puccahousehold (18.6%) andKutcha households (55.7%). It can be concluded that majoritypeople living in the study area belong to poor category in term of housing type.

289. Sanitation12 facilities in the study area shows that about 29.5% households use non-sanitary latrines and 32.9% use water-sealed sanitary latrines. Field findings confirm that non-sanitary latrines are predominant among*Kutcha* house owners. Overall, 32.4% people use sanitary toilet. Water-sealed sanitary latrines are available predominantly in *Pucca*houses. However, there are 5.5% houses with no sanitation facility thattend to use toilet facility on shared basis and in some cases, they use open spaces.

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

[12]BBS defined four types sanitation in Bangladesh such as (i) Sanitary (water-sealed): A water-sealed latrine is simply a pit latrine that has a water barrier to prevent odors. These latrines are simply pits dug in the ground in which human waste is deposited. (ii) Sanitary (not water-sealed/ring slab), latrine with a slab or other secure cover over the drop hole, or a polyethylene flap preventing in-sects from flying into or coming out of the pit; and (iii) Non-sanitary (Kucha): latrine is a frame or platform extending over earth or water; an "open pit latrine" does not have a squat platform or slab on the pit and (iv) No facilities: Defecation in bushes or fields or other outdoor locations



Source: Housing and Population Census, BBS, 2011

Figure 6.20:Distribution of Households by Sanitation Facilities

290. Collection of drinking water from Tube well is major (97.3%) throughout the study area, tap 0.5% and other sources (2.2%) including open water bodies as unconventional sources i.e. PSF, ponds, rainwater etc. These households are from poor classes and living in the rural areas having no access to tube-wells. Supply of “Tap Water” (0.5%) (Source from Tap) is mainly used in chuknagor areas. This supply system is dependent on abstraction from ground water.

291. 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. Poor people who cannot afford usually collect leaves from neighbours’ garden and also collect chips from paddy field. For fuel people are fully dependent on available natural resources in the area.

6.4.9 Poverty and Safety Net

292. Poverty of the study area has been measured following the Multidimensional Poverty Index (MPI) method. The process intended to indentify multiple deprivations at the household level in three broad dimensions such as education, health and standard of living. The index uses the same three dimensions as the Human Development Index: health, education, and standard of living. These are measured using ten indicators. Of them, eight indicators were selected to be analyzed for this study based on data availability and accordingly adapted to the prescribed methodology. The indicators and the threshold for defining poverty are presented in the following table 6.31.

Table 6-31: Indicators thresholds along with data sources for MPI calculation

Dimension	Indicator	Definitions/ threshold	Deprivation per indicator (%)	Contribution of deprivation in dimension to overall poverty	Data Source	Factor H[13]	Factor A[14]	MPI= H *x* A
Health	Child Mortality	A child has died in the household within the five years prior to the survey.	4	3.67	Upazila Health Bulletin 2015	0.57	0.59	0.34
Education	Years of schooling	No household member has completed five years of schooling.	57	41.70	Housing and Population Census, BBS 2011			
	School attendance	No child is attending school up to the age at which they should finish class 6.	34		Housing and Population Census, BBS 2011			
Living Standards	Cooking fuel	The household cooks with dung, wood or charcoal.	100	54.63	CEGIS fieldwork, 2016			
	Toilet	The household's sanitation facility is not improved or it is improved but shared with other households.	67		Housing and Population Census, BBS 2011			
	Water	The household does not have access to safe drinking water or safe drinking water is more than a 30-minute walk from home, roundtrip.	4		Housing and Population Census, BBS 2011			
	Electricity	The household has no electricity.	43		Housing and Population Census, BBS 2011			
	Floor	The household has a dirt, sand or dung floor.	84		Housing and Population Census, BBS 2011			

293. Analyzing poverty status, it is found that about 34% households are multidimensional poor (index value 0.34 out of 1= MPI). About 57% populations are living in these poor households [poverty head count =H] and on average 59% poor people are deprived of any indicator (intensity of deprivation=A).

294. The highest deprivation is found in the dimension of standard of living (54.63%). Among them 67% population have no access to improved sanitation facility (water-sealed sanitation), 84% people are living on dirt floored household (considering kutcha and jhupri), 100% of people are using dirt fuel (considering all types of traditional fuel), 43% households have no grid electricity coverage and 4% households are still collecting drinking water from unsafe sources (ponds, river etc.).

[13] H= Percentage of people who are MPI poor (incidence of poverty)
[14] A= Average intensity of MPI poverty across the poor (%)

295. The second highest deprivation (41.70%) found in the dimension of education. Considering two dimensions it is found that 57% household members have not completed at least Six years of schooling and 34% school-age children (up to grade 6) are not attending school.

296. In case of the dimension of health, it has an indicator (child mortality), as nutrition data is not available. It contributes 3.67% in overall poverty as 4% children found to be dead in the households within the five years prior to the survey (considering both IMR and U5MR).

6.5 Conflict

297. During field visit it is found that there is a conflict between gher owners and farmers in the Polder area. Especially, rural influential controls water control structures and allow saline water for shrimp culture illegally.

6.5.1 Gender and Women

298. Field observation suggests that Polder-17/2 is male dominated area. Roles of women in both decisions making at household level and economic contribution to household income are insignificant. Traditional belief is very strong here which infers generally males make all major household decision and at the same time, they contribute to household income more than females. A very few women work as day labour but in that case wage discrimination is very common where male labor get tk 300 to 350 and women labor get tk 200 to 250.

299. Government's Policy towards women education has been changed a lot over time in the Polder area. Women education rate has been increased; dropping out of school due to early marriage has been reduced. NGOs have changed the rural society to a significant extent in terms of awareness rising. Different NGOs and community health clinic work for women health and reduce women maternal mortality rate significantly.

300. Women mobility in the area is mostly localized except for the purpose of medical treatment, fetching water, farming activities, and visiting relatives. Mortality rate of the pregnant mother during delivery period has been reduced in the area (152.21/100,000). The growing consciousness among the local people as well as the health services provided by the public and other health centers including the programs of NGOs have contribution for decreasing the mother mortality rate. About 15 percent women are living with good health condition and the rest are suffering from various diseases such as low blood pressure and premature delivery (CEGIS fieldwork, 2016). Statistics shows the male literacy rate is higher than female. However, literacy rate of both male and female is ever increasing than the previous year.

6.5.2 Vulnerable Communities

301. It is reported by local people in the Polder area, the Polder is vulnerable to natural disaster notably with cyclonic storm, storm surges, tidal flooding, heavy rainfall etc. In some areas, embankments are vulnerable to be eroded within short time.

302. Tidal flood water enters into the Polder due to diversion channels have been silted up and loose apron of gate have been damaged. This water is coincided with heavy rain water and in turn, makes drainage congestion that eventually flooded 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.

6.5.3 Common Property Resources

Market

303. In the study area, there are sevenlocal markets called hat-bazaar. Major markets of the locality are Chuknagor and Atharomail. The people of the study area normally buy and sell their goods there. There are some minor merkets in the locality such as Kathaltola, Golapdoha, Boyarsing, Maguraghona (**Table 6.32**). etc. The people often have to go to khulnato buy goods, which are not available in the local market, which is 26km apart.

Table 6-32: Markets/Growth center in Project Area

Unions	Nos of markets/bazaar	Name of the Markets/bazaar
Maguraghona	3	Maguraghona, Aroshnagor, Atharomail
Atlia	4	Chuknagor, Kathaltola, Golapdoha and Boyarsing

Source: CEGIS field work, 2016

Transport network

304. Khulna-Satkhiraregionalroad is the main road network in the Polder area. Most of the people use this road as a way of communication and goods transportation. This is a coastal area and there is no road network surrounding the Polder except embankment. People use embankment as the way of communication. Now a day, due to erosion of the embankmentadjacent toGangrailRiver, sufferings of the people become beyonddescription. In the wet season, the sufferings increase many times. The people of the other area usually use upazila roads, union roads and village roads for communication and transportation Sidr (2007) and Aila (2009) haveeroded the embankment seriously. Overall, 65 km of road networks exist in the Polder area unions where 22 km roads are paved, 18 km roads are brick soling and 25km roads are earthen (**Table 6.33**).

Table 6-33: Road Utilities in Polder the Area

Type of Road	***Total Length (Km)***
Upazila Road (Pucca/ Paved)	***09***
Union Road (Pucca/ Paved)	***13***
Village Road-A (Herringbone/ Brick soling)	***18***
Village Road-B (Earthen road)	***25***

Source: CEGIS fieldwork, 2015

Waterways

305. Waterway is another mode of communication for this Polder. There are three navigation routes used by the local people as the main mode of communication. There are two main waterways: TaltolaRiver and GangrailRiver.

306. Local people cannot communicate through waterways due to siltation of existing waterway. The depth of rivers is varied in both dry and wet season based on seasonal variation. The water level of Taltolaand GangrailRiver go down and reduce the depth. However, people of the study area use these rivers as major way of communication and goodstransportation.

Photo 6-20: water way (GangrailRiver)in the Polder

Photo 6-21: Embankment cum Road in the Polder

6.5.4 Water Related Human Health Problems

Prevalence of diseases

307. Field finding shows that, waterborne diseases, coldness, fever, respiratory and skin diseases are the main diseases throughout the study area. The Polder is situated in adjacent to the coastal area. Therefore, saline humidity causes severe skin diseases. There are water congestion in South Aroshnagor, Chondipur, Boyershing, Golapdahga, Kulbaria, Chondipur, Monohorpur etc. village due to silted up of khals and River. Local people often use this stagnant water. It eventually leads them to skin disease as this water is already contaminated.

308. However, during wet season waterborne and coldness are very common. Water congestion takes acute form in this time as high tide pushes water inside the Polder area and heavy rainfall added extra water. This dampens the floor of houses that increases coldness.

Access to health services

309. Access to health services and facilities refer to availability and adequacy of supply, affordability, physical accessibility and socio-cultural acceptability. Field data shows that there are Union Sub-Centres, Community Clinics, Private Clinicsand NGOs Clinics etc in the study area. Therefore, they receive peripheral health services from Khulna Medical College (26km) away at Khulna District. Overall health condition appearsmoderatein the Polder area due to having few medical facilities with only 30 beds (Table 6.34).

Table 6-34: Existing health facilities in the Polder area

Facility Type	Number	No. of Beds
Union SubCentres	2	0
Union Health and Family Welfare Centres (belongs to DGHS)	4	0
Community Clinics	6	0
Private Clinics/Facilities	6	30
NGO Clinics/Facilities	2	0

Source: CEGIS fieldwork, February, 2016

310. According to Upazila Health Bulletin 2015, most of the people of DumuriaUpazilareceivehealth services from Upazila Health Complex. They also receive medical services from Union Health and Family Welfare Centre, Community Clinics and NGOs clinics.

The trend of receiving health services from private hospital or clinic is very negligible. Some people of the locality often receive the services from Community Clinics. As opposed to in the Talaupazila, all the people get medical services from only Upazila Health Complex.According to Health Bulletin 2015, all the people of the Polder area take emergency services from Upazila Health Complex (Table 6.35).

Table 6-35: Receive health facilities of OPD and Emergency at health complexes

Health Facility	DumuriaUpazila			
	OPD		Emergency	
	Above 5 Yr	Below 5 Yr	Above 5 Yr	Below 5 Yr
Upazila Health Complex	74.5	25.5	82	18
Union Sub-Centres	-	-	-	-
Union Health and Family Welfare Centre (belongs to DGFP)	95.38	4.62	-	-
Community Clinics	93	7	-	-
Private Clinics/Facilities	67.9	32.1	-	-
NGO Clinics/Facilities	83.9	16.1	-	-

Source: Upazila (Dumuria) Health

6.5.5 Cultural Sites

311. There are different cultural sites in the Bangladesh, which bears her tradition, culture and memory. Independent war of Bangladesh and related issues are the sentimental issue. There is some large mass grave in Bangladesh. ‘Chuknagar Baddhavumi’ is one of them. People often visit this Historical place located in the Polder area.

Photo 6-22: Chuknagar Baddhavumi

7 Analysis of project Alternatives

7.1 Overview

312. 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 considerations of these alternatives have been considered.

7.2 ‘No Project’ Alternative

313. The ‘No-Project’ option analysis provides a clear view of the existing situation of the Polder and helps understand the need of the proposed interventions under CEIP-I. At present the people in Polder is extremely vulnerable to cyclones, storm surges, wave action, and climate change effects, as described in Chapter 4. Furthermore, the Polder is not in a state to provide required services i.e. protection against tidal inundation, efficient drainage, and minimizing the impact of cyclonic surges. About 40 percent of the Polder area is vulnerable to salinity intrusion and water logging. The silted water channels are resulting into limited navigation in these waterways, declining fisheries, and increasing environmental pollution.

314. The interventions proposed in Polder17/2 under CEIP-1 are planned to eliminate the major problems described above. To highlight the present state of various aspects in the Polder and to help understand the importance of the proposed interventions under the Project, the ‘No Project’ and ‘with project’ scenarios are compared in Table 7.1 below.

315. Section 7.6 provides a detailed assessment of the high positive impacts of the Project that is considered to improve the security and socio-economic conditions for all strata in Polder-17/2.

Table 7-1: Comparison of ‘No Project’ and ‘With Project’ Scenarios

Proposed Works under CEIP-1	‘No Project’ Scenario	‘With Project’ Scenario
1.Re-sectioning of embankments (35.58 km) and design crest level (6.00 m, PWD and 5.00 m, PWD)	At certain number of points, the embankments will be further deteriorated and fall below the design level. Therefore, cyclones, rise in surge heights due to global warming, and tidal actions will inundate the Polder, causing severe damage to the lives and property of local people.	Re-sectioned embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, reduce 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 would enhance protection to Polder, facilitating transportation within the Polder even during monsoon.
	Reduction of agricultural area, crisis situation for farmers from January to April (salinity intrusion) and May to August (flooding).	Re-sectioned embankments providing support to Polder facilitate enhanced agriculture activities and increased area for cultivation, thus increasing agriculture output.
	Continued silt deposition inside the Polder due to cyclonic surges and	Decreased silt deposition in the Polder will result into improved

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
	floods would increase and cause water logging, drainage congestion and other associated problems.	drainage and navigation in internal lakes/khals, increased usage of surface water for irrigation, and reduce water logging problem.
	Local farmers and labor will remain financially stressed. Livelihood opportunities will remain limited, and local people will migrate outside the Polder for employment.	Enhanced agricultural activity will increase the demand for farm workers. Local people can engage themselves in the construction works inside the Polder. Improve earnings of local people during the construction phase of the project.
Bank revetment (300 m)	River bank erosion would further deteriorate the embankments and land resources would be damaged/ lost.	Bank revetment will provide enhanced protection against erosion by wave action, storm surges and currents, and will result into preservation of Polder and its land/agriculture resources.
	Further subsidence of the embankments and further damage to transportation routes.	The bank revetment will protect the embankments and facilitate transportation within the Polder.
Slope protection of Embankment (1.00 km)	Continued weakening of embankments; continuous subsidence of embankments due to traffic load and wave action; land resources would continue to be damaged.	Slope protection works will strengthen the embankments and protect them against subsidence, wave action, and wear and tear.
Replacement of drainage sluices with drainage-cum-flushing sluices.	Continued use of the existing drainage sluices for both flushing and drainage would cause further damage to these structures. As a result, water logging and drainage congestion would be increased due to malfunctioning of the sluices.	Drainage-cum-flushing sluices will be more efficient and drier season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
Replacement of the existing flushing sluices	No dry season agriculture practice will be possible. Shrimp culture during January to May, as sweet water cannot be used in the periods of low rainfall.	Replaced flushing sluices will facilitate better agriculture practices, increased dry season rice cropping, and reduced shrimp culture - thus benefiting the poor farmers.
Construction of new flushing sluices	Cultivable lands will be decreased in future.	New flushing sluices will facilitate increased surface water, better control on irrigation during periods of low rainfall and increased agricultural production.
Afforestation (30 ha)	Wind and wave action during cyclones would cause severe damage.	Effects of cyclone surge, wave action and gusty wind could be mitigated to a certain extent, reducing the loss of lives and assets.
Re excavation of Drainage Channels (36.7 km)	Depth of water would be further decreased, and drainage congestion and water logging would be further increased.	Depth of water bodies will increase; water logging and drainage congestion will decrease and fish habitats will increase.

7.3 'With project'Alternatives

316. 'With Project' Alternative explicates the interventions proposed under CEIP-1 to alter the Polder17/2 condition addressedthe problems summarized in 'No Project Alternative'.

7.4 Site selection alternative:

317. Since CEIP-I is a rehabilitation project, no site alternatives were available to be considered. However, a comprehensive multi-criteria analysis was carried out to prioritize the Polder rehabilitation under CEIP-1. The analysis results are presented in Table 7.2.

Table 7-2: Results of Multi-criteria Analysis to Prioritize Polder Rehabilitation

Criteria		***Mark Obtained***
Polder ***No***	***17/2***	
Type of Dyke	***ID***	
Location of the Polder	***Dumuria***	
Gross Area of the Polder ***(HA)***	***3400***	
Embankment Length (Km)	***11***	
Breach of Embankment (Km)	***-***	***0***
Erosion (Km)	***-***	***0***
Requirement of BPW (Km)	***-***	***0***
Location in the Risk Zone	***LRZ***	***5***
Drainage Congestion (HA)	***510***	0
Opinion of Stakeholder (marks, MV=15, MDV=10, LV=5)	***MV***	1***5***
Rehabilitation Cost (Crore BDT)	***29***	15
Special Criterion		***0***
Total Marks		***35***

Notes:

a) Rate of marks = Full marks allotted for the criterion against highest quantity of the criterion except "Rehabilitation Cost".
b) Negative marks has been allotted in case of "Rehabilitation Cost" exceeding $30 Million (210 Crore BDT).
c) HRZ = High Risk Zone, MRZ = Medium Risk Zone, LRZ = Low Risk Zone.
d) MV = Most Vulnerable, MDV = Medium Vulnerable, LV = Less Vulnerable.
e) SD = Sea Dyke; ID = Interior Dyke; MD = Marginal Dyke.
f) BPW = Bank Protective Work.
g) Rehabilitation Cost to consider embankment section with one meter extra height over the existing designed level.
h) Special Criterion indicates territory loss due to erosion of Polders located in border area.

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

318. Following Table 7.3 reviews the technical, financial, economic, environmental, and social considerations as probable consequences of the intervention.

Table 7-3: Technical, Economic, Environmental and Social Considerations

Intervention	**Considerations**			
	Technical	**Financial/Economic**	**Environmental**	**Social**
Re-sectioning, embankment with new design heights	Better protection against cyclone surges and water level rise	Financial savings from reduced damages caused by the floods	Improved surface water quality; improved natural vegetation	Reduced loss of lives and assets which would bring poverty reduction; increased employment

Intervention	Considerations			
	Technical	Financial/Economic	Environmental	Social
				opportunities for local people.
	Prevention of salinity intrusion in the Polder	Improved cropping pattern and boosting the local economy	Improved surface water quality	Improved cropping particularly for small farmers thus alleviating poverty.
Bank revetment, slope protection	Enhanced embankment protection against tidal wave action of rivers, provide erosion protection Protection to river bank erosion	Financial savings from reduced damages caused by the floods; increased life span for the infrastructure and associated water control structures; improved earnings of local people through employment during bank revetment works and slope protection works. Financial savings as the embankments will provide good road transportation routes.	Improved embankment stability; reduced soil erosion; and provide good means of transportation Reduced traffic congestion inside the Polder because of improved embankments, which will facilitate vehicular traffic	Reduced loss of lives and assets which would bring poverty reduction; increased employment opportunities for local people.
Replacement of existing drainage sluice with drainage-cum-flushing sluice and construction of new flushing sluices where needed	Better functional performance in both flushing and drainage; achieving the objectives of Polder and CEIP-I	Financial savings against damages due to water logging, drainage congestion, and salinity intrusion.	Removal of inactive sluices would improve the drainage characteristics	Better agriculture practice could be achieved which would improve cropping pattern, enhance local earnings, and reduce poverty.
		Agricultural production will be boosted as dry season rice cropping would increase	Water logging, drainage congestion would be reduced.	
Channel re-excavation	Reduce water logging and drainage congestion	Enhanced agriculture output; the dredged soil can later be used in construction works and will save construction cost	Increase navigability of water ways and fish habitats would improve, the ecosystem will be enhanced	Increase in cultivable area, increased availability of irrigation water thus increased farm income for local community; increased farm labor opportunities.

7.4.2 Alternatives during Construction

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

Material Storage

320. For project works in Polder 17/2, two options are available for material storage: within thePolder at suitable location(s); and outside the Polder at suitable locations. The first option would entail easy transportation of bulk materials from the sources outside the Polder; however, it would involve regular transportation of materials from the storage site to the work sites.

321. The required 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.

Material Sources

322. The study on sources of construction materials is very importantwhich is done in this section.

Soil for Embankments

323. A complete re-sectioning of entire embankment is required to be done for this Polder. It must necessitate huge volume of soil. Generally, following options are to explore to pursue the source of soil.

324. For re-sectioning of embankments, about 1,949 million cubic meters of soil will be required. The following options are available for sourcing this material:

325. Soil can be obtained from borrow pits along the river bank just outside the embankments, provided the soil quality is appropriate for this purpose. This is a feasible option with some benefits since it will minimize soil transportation needs, minimize related to material transportation and having minimum environmental and social impacts related to excavation and transportation. However, as BWDB does not own any land sites for borrow pits, these have to be obtained from the owners and compensation to be provided.

- *Part of the required material can be obtained from the re-excavation of the water channels within the Polder, provided the quality of this material is technically acceptable. About 0.295 million cubic meters of earth will be obtained from re-excavation of channels during implementation of rehabilitation works inside the Polder. This option minimize the cost of excavation for the borrow material, though the cost of transportation to work site will be slightly more than the first option, in addition to some environmental and social impacts such as traffic congestion and air pollution within the Polder.*
- *Some quantity of soil can be sourced from borrow pits inside the Polder. For this purpose consent of the land owners will have to be obtained and mutually agreed compensation will have to be paid them. This option will entail cost of excavation similar to the first option but more than the second option discussed above. Other considerations including cost of transportation and environmental and social impacts are likely to be similar the ones for the second option, though land degradation may take place in addition to the air quality and traffic congestion.*
- *If the river bed material is suitable having the required material quality, dredged material can be used for embankment construction. From an environmental point of view this is the preferred option, as there will be no terrestrial impact, while the aquatic impact will be very temporary and localised to the river bed. Any dredged material will rapidly be replaced due to the high sediment transport capacity in the rivers in the Polder region. Transport of the dredged material can take place directly at the embankment construction site, requiring minimal land transport. However, sites for de-watering the dredged material will be required. The use of dredged material is considered the preferred option from an environmental point of view.*

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

Sand

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

328. *Sand will* be procured directly from markets. This would entail consistent quality and assured supply; however, it would also entail increased transportation with associated environmental and social impacts including traffic congestion, noise and air pollution.

329. 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, the quality of the sand readily available may not be as required.

330. 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 DDCS&PMS Consultant before starting obtaining thematerial.

7.4.3 Alternatives for Workforce Procurement

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

- *Employing the bulk of the manpower from outside the Polder. This will entail requirement of larger labor camps, need for labor transportation causing traffic congestion and air pollution, and possible resistance and resentment from the local community.*
- *Employing manpower from within or in the vicinity of the Polder and only bringing more skilled and technical manpower from outside (if not available locally). This option will entail reduced labor camp sizes, decreased transportation needs and reduced environmental and social problems related to outside workers. This option will also offer employment opportunities for the local community thus i improving their economic condition and also increasing the local ownership and acceptance of the project. In view of these advantages, this is the preferred option for manpower sourcing*

7.4.4 Alternatives for Mode of Transportation

332. Trucks and trolleys are commonly used for carrying construction materials to main stock yard. The materials can be conveyed from the main stock yard to the worksite not only by road but also by river. The Polder is surrounded by river. Hari River is flowing to the East, Salta River to the South West, Taltola River to the West and Gangrail River to the North of the Polder. The condition of the road way is acceptable to carry larger vehicles. The peripheral river sometimes can also be used for conveying materials.

8 Environmental Impacts and Mitigation Measures

8.1 Preamble

333. This Chapter identifies the impacts of the project interventions on environment that may potentially be caused by various Project phases and also suggests the appropriate mitigation measures to avoid, offset, reduce, or compensate these impacts. Proposed Interventions which may cause potential environmental impacts during pre-construction, construction, and post-construction phases have been identified in Chapter 4. The following detailed investigations have been carried out to assess the magnitude of these impacts:

- Environmental quality baseline monitoring of air, noise, surface water, groundwater and soil;
- Ecological surveys comprising vegetation, wildlife and fisheries covering both mainland and offshore area;
- Offshore surveys comprising socio-economic status and environmental settings,
- Experts' consultations focus group discussions and public consultations.
- Census survey to assess the extent of resettlement (as required) loss of vegetation, occupation, income and poverty status of the affected households.

8.2 Impact Screening

334. As part of the environmental impact assessment process, a screening matrix was used specifically for the proposed Project, focusing on the potential environmental impacts during the design, construction and operation phases. Key potential impact sites are shown in Map 4.1. 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 impacts, and each of them were further divided into different aspects. The potential impacts thus predicted were characterized as follows:

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

335. The matrix of Polder 17/2 is provided in Table 8.1. The negative impacts predicted in this manner were the 'unmitigated' impacts. Appropriate mitigation measures have been recommended as part of this EIA study, for 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.

336. The assessment of the impacts follows the methodology and approach described in Chapter 2.

Table 8-1: Environmental Screening Matrix

Project Phases and Activities						**Physical**						**Biological**					**Human & Economic Development**								
	Air Quality	**Water Quality**	**Noise and vibration**	**Salinity intrusion**	**Drainage Congestion**	**Soil and water contamination**	**Irrigation**	**Land use**	**Soil salinity**	**Sedimentation**	**Hindrance for pedestrians and vehicles movement**	**Impact on vegetation**	**Impact on aquatic flora and fauna**	**Fish habitat condition**	**Fish movement and migration**	**Fish species richness**	**Impacts on crop production**	**Fish production**	**Employment Generation**	**Income Generation**	**Communication**	**Water use for domestic**	**Public Health**	**Out-Migration**	**Disaster Incidence**
Pre-Construction Phase																									
Planning and design of the proposed infrastructures	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	**0**	0	N	N	N	N	N	N	N
Preparation of construction site, labor shed, material stock yard etc.	MN	0	-	-	-	0	0	-		-	-	MN	-	-	-	-	HN	0	LP	N	N	N	N	N	N
Labor, materials and equipment mobilization	MN	0	-	-	-	-	-	-		-		MN	-	-	-		MN	0	N	N	LN	N	N	N	N
Display of billboard at construction site for public awareness			-	-		-	-	--			-	-	-	-	-	-	-		N	N	N	N	N	N	N
Construction Phase																									
Re-sectioning of embankment	MN	0	0	-	-	-	-	-		0	MN	MN	-	MN	0	0		0	HP	HP	LN	N	LN	HP	HP
Construction/repair of drainage sluices	MN	MN	MN	M N	MN	0	MN	-		-	-	0	-	HN	HN	MN	MN	MN	HP	HP	LN	N	LN	HP	HP
Re-excavation of Drainage khals	MN	MN	MN	-	MN	-	MN	-		0	-	-	MN	HN	HN	HN	MN	MN	HP	HP	LN	N	LN	HP	NHP
Implementation of afforestation	-	-	-	-	-	-	-	-		-	-	-	-	HN	HN	MN	MN	0	HP	HP	N	N	LP	LP	LP
Checking of the physical condition and function of embankment and water control structures	HP	HP	0	HP	HP	-	HP	N	HP	HP	HP	N	HP	HP	**0**	**HP**	HP	HP	N	N	N	N	N	N	HP
Checking of the depth of khals	HP	HP	-	HP	HP	MN	HP	-	HP	HP	HP	N	HP	HP	0	HP	HP	HP	N	N	N	N	N	N	HP
Checking the condition of R/S and C/S slopes	HP	HP	-	HP	HP	-	HP	-	HP	HP	HP	N	N	N	0	0	MP	MP	N	N	N	N	N	N	HP
Monitoring the functions of WMOs	HP	HP	-	HP	HP	-	HP	-	HP	HP	HP	N	HP	HP	HP	HP	MP	HP	N	N	N	N	N	N	MP

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

8.3 Impacts during Pre-construction Phase

8.3.1 Change of land use

Impact

337. Land would be needed to establish temporary facilities including construction camp (labor shed) and borrow areas. It is estimated that about 11 labor sheds would be constructed to established temporary facilities for the rehabilitation works. As per consultation with the main consultants all labor sheds (11) should be constructed in Khas land and requisite land.

338. For the re-excavation of canals materials and equipment mobilization requires land at side of the canals, which is commonly used for crop production.

339. Borrow pits for extraction of construction material are expected to be both from inside the Polder and in the foreshore land15. Borrow pits will generally be established on private land after agreement between the contractor and the private land owner, typically involving some compensation from the contractor to the land owner. The use of the borrow pit areas inside the Polder will typically be converted from agriculture to pond based aquaculture. In the foreshore areas, commonly fallow land will be used. Excavation will take place during the dry season. In wet season, these borrow pits areas are likely to fill up gradually due to sedimentation. The fallow land is used scattered for seedbed or grazing of livestock by the dwellers of the Polder.

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

Mitigation

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

- Established all the construction camps within the area owned by BWDB or acquired.
- Pay compensation/rent if private property is acquired on temporary basis, which instructions should be specified in the tender document.
- Construct labor shed/camp should be constructing at government khas land.
- Avoid impacts on local stakeholders.
- Any areas used for borrow pits in the foreshore should be away from sensitive areas such as mangrove vegetation.

Residual Impacts

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

8.3.2 Impacts on vegetations

Impact

343. North-Eastern portion (from chainage 00 km. to chainage 11 km.) as well as Boyarsing, Kulbaria, Monohorpur, Baratia etc etc villages of the Polder area possesses low dense of vegetation. So, there are number of six construction sites with labor sheds and stock yards

[15] Lessons learnt from implementation of CEIP Package-1. PDSC observations.

would be temporary established or formed in these locations whereas vegetation coverage and density is low inside the Polder area. Therefore, temporary impacts on existing vegetation especially herbs (*Cynodon, Cyperus Croton* etc.) and shrubs (*Calotrophis*, *Amaranthus, Phylasis* etc.) would be damaged. This vegetation will be regenerated due to naturally succession. No trees should be cut down in construction sites, so loss of vegetationmainly for herbs and shrubs is low.

Mitigation

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

- Labors should be made aware about local faunal species
- Labor sheds and stock yards should be established in low vegetative or barren land as much as possible
- Plantation of local species in the selected areas as early as possible after finishing the construction works.
- Labor should collect fuel wood for their own purpose from local market (Chuknager bazzar, Kharnia bazzar, Kathaltal Bazzar, Aroshnager natun bazzar etc.)

Residual impact

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

8.4 Impacts during Construction phase

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

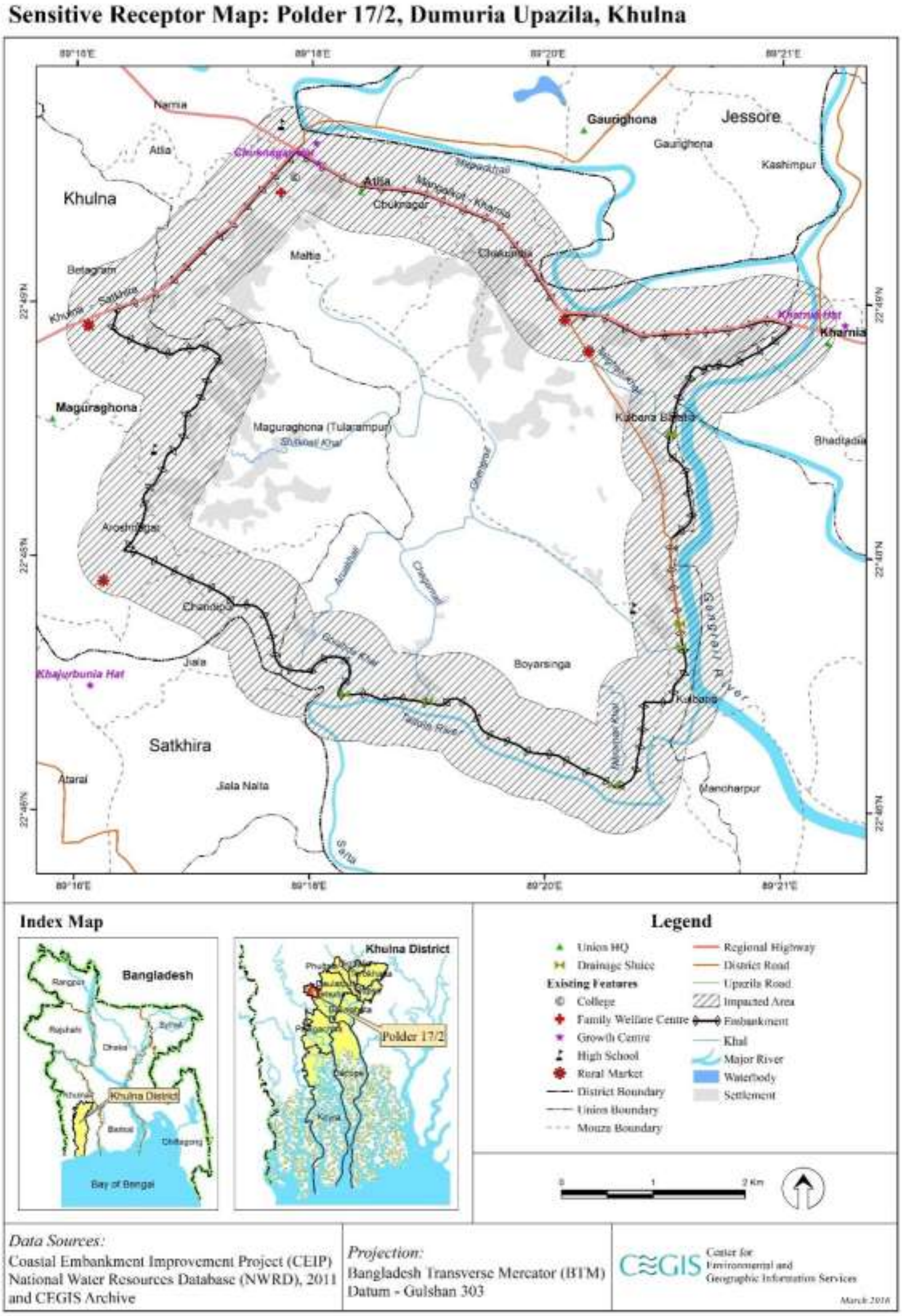
- Mobilization of equipment, construction materials and vehicles;
- Placement and compaction of earth for flood control embankment/sea dyke;
- Re-excavation of canals;
- Slope protection works;
- New construction/replacement of water control structures; and
- Disposal of canal excavated materials.

8.4.1 Generate Noise and Vibration

Impact

347. The construction activities particularly demolition of existing water control structures, excavation, compaction, operation of construction machinery and vehicular traffic will generate noise and vibration which are likely to affect the nearby communities. In addition, camp sites may also generate noise. Increased noise levels may cause disturbance, nuisance and even health hazards to the nearby communities as well as to the construction workers. In particular, the settlements near the working areas will be exposed to noise and vibration generated by the Project activities. However, there are few settlements at the eastern portion (major portion) of the Polder.The south-west portion of the embankment is situated totally in local area where settlements (households, schools etc.) are high. Moreover, sensitive receptors such as high

school, college, family welfare centre, community clinic/hospital etc. which are located close to the interventions (within 500 m from the embankment) are likely to be affected by noise during movement of vehicle as well as construction activities of water control structures (Figure 8.1). Table 8.2 shows the noise level to be expected from the equipment. According to ECR’97 60 dBA is permissible for mixed area in Bangladesh.According to ECR’97 and IFC- EHS guideline 2007, noise level 60 dBA is applicable for mixed area and 50 dBA for residential respectively (Table 8.3).



Map 8-1: Sensitive receptors near the embankment of Polder 17/2

Table 8-2: Noise level of different construction equipments and machineries

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, 2016

Table 8-3: Bangladesh and IFC Standards for Noise

Area Category	Standard Values (all values in dBA)			
	Bangladesh		IFC	
	Day	Night	Day	Night
Silent Zone	45	35		
Residential area; Institutional; Educational	50	40	55	45
Mixed area (basically residential and together used for commercial and industrial purposes)	60	50		
Commercial area	70	60	70	70
Industrial area	75	70	70	70

Source: Schedule 4, Rule-12, Environment Conservation Rules, 1997 (Page 3127, Bangladesh Gazette, 28 August 1997) (Translation from original Bengali) and Environmental, Health, and Safety (EHS) Guidelines GENERAL EHS GUIDELINES, World Bank Group, April, 2007

Note:

1. Day time is reckoned as the time between 6 a.m. to 9 p.m.
2. Night time is reckoned as the time between 9 pm to 6 am
3. 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 are prohibited in silent zones.

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

Mitigation

349. The following mitigation measures should be taken to address the above concerns:

- The regulators should not be demolished during school time (8 am to 1 pm) particularly near the schools;
- Restrict/limit construction activities during the day time;
- Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards;
- Vehicles and machinery should have proper mufflers and silencers;
- Provision of noise barriers at schools and other sensitive receptors should be assured, as needed;

- Provision of PPE (ear muffs and plugs) to labor should be made;
- Construction crew should be instructed to use the equipment properly, to minimize noise levels;
- Camps should be located at a safe distance from communities; and
- Liaison with the communities should be maintained and grievance redress mechanism will be established at the site.

Residual Impacts

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

8.4.2 Soil and Water Contamination

Impact

351. Construction materials, demolished debris, fuel both from transportation vessel and construction machineries (piling machine, pump etc.) may degrade the soil and water quality. The construction workers will generate domestic solid waste and waste water including sewage. The amount of domestic wastewater generated by the construction workers is assumed to be equal to the amount of water usage. Oily water, waste oils, oily rags and other similar wastes will be generated from workshop. The stores and warehouse will generate solid waste such as empty cement bags, cardboards and wooden crates. Improper disposal of these waste streams can potentially contaminate the soils and water resources of the area. Soil and water contamination can potentially have negative impacts on the local community, natural vegetation, agriculture and biological resources of the area including aquatic flora and fauna. Borrowing material from the river banks may potentially cause increased turbidity in the rivers. Furthermore, release of effluents, soil and/or sand in water bodies may increase water turbidity, which would prevent sunlight to enter into the water that is necessary for promoting photosynthesis of aquatic plants.

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

Mitigation

353. The following measures are to be implemented by contractor to address the above concerns:

- Prepare and implement pollution control plan;
- Workshops should have oil separators/sumps to avoid release of oily water;
- Avoid repairing of vehicles and machinery in the field;
- Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination;
- Dispose contaminated soil appropriately ensuring that it does not contaminate water bodies or affect drinking water sources;
- Contractor should 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 should regularly monitor the condition of its fleet;

- Material borrowed from the river banks should be carried out sufficiently away from the water edge, minimizing the possibility of loosing soil and wash out in the river;
- Contractor should locate camps far away from communities and drinking water sources;
- Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal);
- Release treated wastes on ground or in water;
- Recycle spoil and excavated material where possible;
- Dispose spoil at designated areas with community consent; and
- Construction material, demolished debris and excavated soil/silt should not be allowed to enter the water bodies.

Residual Impacts

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

8.4.3 Sedimentation

<u>Impact</u>

355. Borrowing material from the river banks may potentially cause increased sediments in the peripheral rivers. Similarly, excavation of water channels if carried out in water can potentially increase their sediment load. Excavated material from the channels if left along their banks may again enter the water thus increasing sediment load in canals. In addition, construction material, loose earth/soil, demolition debris, and other materials may enter the river or drainage khals causing increased sediments. Run off from construction sites, camps, and other temporary facilities may increase sediment load of water bodies.

356. The significance of this potential unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity (Table 8.1).

Mitigation

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

- Small scale Tidal River Management (TRM) may be implemented where appropriate;
- Contractor should protect untreated embankment slopes;
- Contractor should excavate channels after dewatering;
- Contractor shouldnot leave excavated earth and silt on channel banks;
- Contractor should implement measures to protect channels from run-off from working areas and camps; and

- Contractor should obtain borrowing material from river banks in such a manner so that there is no increase of siltation in rivers, and should not leave loose soil after excavation.
- Regular monitoring of drainage khals is necessary to maintain the capacity.

Residual Impacts

358. 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.**

8.4.4 Affects on agriculture crop production

Impact

359. Borrow pits for extraction of construction material are expected to be both from inside the Polder and in the foreshore land[16]. Borrow pits will generally be established on private land after agreement between the contractor and the private land owner, typically involving some compensation from the contractor to the land owner. The use of the borrow pit areas inside the Polder will typically be converted from agriculture to pond based aquaculture. In the foreshore areas, commonly fallow land will be used. Excavation will take place during the dry season. In wet season, these borrow pits areas are likely to fill up gradually due to sedimentation. The fallow land is used scattered for seedbed or grazing of livestock by the dwellers of the Polder.

360. In addition, construction activities, movement of construction machinery, project related vehicular traffic, material borrowing, material stockpiling, re-excavated soil of channels, waste disposal or camp establishment might damage crops or affect the cultivated land.

361. The significance of this potential unmitigated impact has been assessed as **Moderate**based on impact magnitude and receptor sensitivity.

Mitigation

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

- It should be considered a priority to establish borrow-pits in foreshore areas
- Compensation should be paid for any crop damage;
- Contractor should avoid cultivation fields during construction;
- Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps construction;
- Contractor would ensure that no vehicular movements take place inside cultivation fields;
- Contractor should ensure that no material is dumped inside cultivation fields;
- Re-excavation soil of canals should not be dumped in agricultural land and
- Contractor would maintain liaison with communities;

[16] Lessons learnt from implementation of CEIP Package-I. PDSC observations.

- Contactor will prepare site specific spoil management and disposal plans for each site to be followed upon approval by the DDCS&PMS Consultant and PMU.

Residual Impacts

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

8.4.5 Affects on irrigation

Impact

364. Construction activities particularly on construction of drainage sluices (1 no.), repairing of Drainage Sluice (3 nos.), Demolish of drainage sluices (1 no) and re-excavation of drainage channel (11.85 km) can potentially disrupt the crop irrigationtemporarily during both wet and dry season which would negatively affect cultivation. The works on sluices can cut off the flow of water from the river, while the excavation works in canals can affect water conveyance through them.

365. The significance of this potential unmitigated impact has been assessed as **Moderate** based on impact magnitude and receptor sensitivity.

Mitigation

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

- Contractor would construct by pass channels before construction of drainage sluices;
- Sequence of work at the drainage sluices, inlets and canals would be carefully planned to avoid irrigation disruption;
- Contractor would ensure that no negative impacts falls on crop irrigation;
- Contractor would maintain liaison with communities; and
- Contractor would work during the dry season.

Residual Impacts

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

8.4.6 Impacts on vegetation

Impact

368. All kinds of vegetation of right of the proposed construction sites would be damaged for placing of geo textile bags, soil and CC block. The locations where labor shed will be constructedand construction materials will be kept, would be also damaged. Moreover, vegetation from where soil would be collected will be also damaged. In the preparation of construction yards at the embankment site it issuspected that it will damage existing vegetation especially herbs and shrubs. But the bank revetment works will be completed that will cause temporary damage to mangrove plants mostly saplings: so loss of vegetation is low and temporary, after completion of works, new vegetation succession will be followed on

embankment sides due to tidal flow of Gangrail river. There will be no damage of homestead vegetation inside the construction area; sominor vegetation damage or loss is expected at the proposed intervention sites.

Mitigation

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

- Should be used low vegetative or barren land as much as possible for cc block manufacturing at construction yard
- Plantation with mangrove species (Kaora, Ora, Bain, Kakra etc.) along the embankment side after completing of construction activities
- All types of construction activities should be finished in schedule time
- Proper turfing should be implemented at embankment slopes with local grasses (i.e Durba (Cynodon dactylon), Mutha (Cyperus rotundus)) and ensure regular monitoring of turf grasses till they matured
- Collect soil from barren land and alternate source like riverbed or nearer barrow pits at countryside as much as possible

Residual impact:

370. With the help of above mitigation measures, the impacts associated with revetment, re-sectioning, slope protection of embankment will be low.

8.4.7 Impacts on timber trees/ fruit trees

Impact:

371. There are number of five water control structures would be replaced and repaired at proposed locations which are connecting to main rivers (Gangrail river) and numerous canals (e.g. Golapdha khal, Nikramari khal, Changmari khal etc.). About 20 numbers of trees with different size and heights need to cut at DS area (Table below). Gawa is the major cut off tree in this construction phase.

Table 8-4: Number of timber and fruit trees to be affected for construction of drainage sluice

Structure ID of DS	Location name	Species name	Number of trees to be cut
1	Golapdha	Gawa (Exocearia agallocha)	8
2	Chanmari Nikra	Khejur (Phoneix sylvestris)	2
3	Kulbaria	Babla (Acacia nilotica)	2
4 (A)	Kulbaria	Gawa (Exocearia agallocha)	5
4	Kulbaria	Babla (Acacia nilotica)	1
5	Taligati	Kaora (Sonneratia apetala)	2
		Total	20

372. For construction of new structure (DS3) and repair of water control structure (DS1, DS2, DS5) no trees have to be felled.

Mitigation

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

- Implement plantation at sluice ground and nearer foreshore mudflats after completion of construction works
- Local species plantation by the upper and lower portion of the embankment side at proposed DS area
- Give proper compensation to the tree owners against tree felling. It is mentioned here that a detail Ressetlement Action Plan (RAP) is being prepared for Package-3 under CEIP. According to plan, payment to owners against tree felling will be established and the vegetation damage will be compensated according ot RAPSocial aforestation along the countryside are planted by native species as well as salinity non tolerant variety (i.e Desi neem (Azadirachta indica),Sirish (Albizia lebbeck), Babla (Acacia nilotica), Narikel (Cocos nucifera), Tal (Boassus flabelifer), and river side plantation are mostly used for mangrove species (i.e. Kaora (Sonneratia apetala), Gawa (Exocearia agallocha), Golpata (Nypa fruticans) etc.) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works.

<u>Residual Impacts</u>

374. With the help of above mitigation measures, the impacts associated with construction of drainage sluice will be low.

8.4.8 Impacts on aquatic flora and fauna

<u>Impact</u>

375. There are two types of proposed construction activities which are direct impact on aquatic flora and fauna i.e. construction and repair of drainage sluice and re-excavation of drainage canals are suspected to damages and annihilate of existing aquatic biodiversity with flora and fauna specially submerge, floating plants, fishes, phytoplankton, zooplankton etc. inside the proposed re-excavated area. In this intervention are temporary impacts on a portion of surroundings mainly for aquatic ecosystem on. Aquatic ecosystem as well as primary producer of phytoplankton, zooplankton etc. would be regenerated when the water flows will be started after completion of construction works.

<u>Mitigation</u>

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

- Re-excavated spoil should be major concern to proper utilized. It may be used for re-sectioning of embankment (soil placing) and development of internal rural road
- Construction activities would be started at dry season from April to June for re-excavation of canals
- All types of activities should be finished of scheduled time
- Keep untouched the deepest points of the khal as much as possible.
- Implement tree plantation with local species at the khal bank side after re-excavation work

Residual impact

377. With the help of above mitigation measures, the impacts associated with re-sectioning of embankment will be low.

8.4.9 Impacts on vegetation for aforestation

Impact

378. Aforestation project has been observed about 4 km areainside Polderwhich is implemented by BWDB and local people. Major species are found in this project along the river side are Kawra, Gawa, Bain, Caila etc. The community people have sensitized to take-care the plant for creating greenery and protect vulnerable embankment from tidal surge and tidal flood. At the five villages of Boyarsing, Mohonpur, Baratia, Kulbaria, Changamari would be selected for plantation program about 11 km. (25 ha.) along the embankment side which are implemented by BWDB under this project. Saplings collection from local nursery is major concern to protect variable plant disease whereas, specific non tolerant species and mangrove plants should be collected. Inadequate distance between two saplings may hinder proper growth and cause outbreak of disease. This plantation will also protect the area from tidal flood and tidal wave.

Mitigation

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

- Local household should be involved in transit nursery program for proper seed germination and saplings collection
- FD, BWDB, local people, local nursery would be proper collaboration of plantation program
- Eco friendly fiber materials like jute bag, ropes etc. should be used for seed germination and to preserve saplings
- All kinds of polyethylene bags and plastic ropes should be avoided as much as possible,
- Knowing to local people to plant pathogen, penetration, cause of disease and distribution of local species
- Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation

Residual Impacts

380. With the help of above mitigation measures, the impacts associated with foreshore afforestation will be nil.

8.4.10 Degradation of the Fish Habitat Condition

Impact

381. Construction and repairmen of drainage sluices and re-excavation of khals would degrade the present habitats condition of khals. Removal of bottom soil of khals would destroy the habitat of bottom dwellers species such as baim, bele, kuchia (eel) fish, mud crab and benthic organisms (mainly mussels and snails) of those habitats. Therefore, the significance of this impact has been assessed as **major** on the basis of impact magnitude and sensitivity.

Mitigation

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

- Bypass canal should be made before the construction and repairmen of the sluice gates and by pass canal should be dismantled just after the completion of the repairing of the sluice gates and excavation work.
- Re-excavation work should be executed in dry season from November to May.
- Excavated soil should be dumped at safe distance from the bank of Khals on raised land.

Residual Impacts

383. Implementing the above mitigation measures, the impacts on fish habitat conditionare likely to be reduced to some extent. Therefore, the significance of residual impact will be **low**.

8.4.11 Obstruction in Fish Movement and Migration

Impact

384. The migratory route for fishes would be obstructed due to construction and repairmen of drainage sluice gates and re-excavation of 11.85 km connecting khals. As a result, lateral movement and migration of most of the brackish and freshwater fish species would be directly hampered. The significance of this impact has been assessed as **major** on the basis of impact magnitude and receptor sensitivity.

Mitigation

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

- Construct diversion channels before construction of regulator considering fish migration period e.g. May, June, July and August
- Most of the Small Indigenous Species (SIS) of fish spawn during the period of November to April and keep important role in the recruitment to next progeny. For this reason, limit the construction and re-excavation activities in the shallow area and/or maintain the alignment of bank side to keep space in other side for accomplishing migration to meet up the biological needs like spawning, feeding etc.
- Dismantle the bunds and other obstructions built for supporting the construction of structures as soon as the construction is over.
- In case of manual re-excavation of khals, compartment would be built and bailing out of water from one compartment to another for less damage to fish and excavate in cascading manner.
- Re-excavation of drainage khals will follow the construction of regulators by spanning a shortest possible time. Re-excavation of Khals should be implemented by maintaining the alignment of side so that fish can utilize the space on the other side for its migration. As a result, construction activities will have minimum hindrance to fish migration.
- Contractor will maintain liaison with fishers and farmers so that they could realize the issue for minimum impact to the shrimp farming and paddy cultivation.

Residual Impacts

386. Implementing the above mitigation measure, the impacts on the lateral fish migration are likely to be adequately addressed. Thus, the significance of residual impact will be **negligible**.

8.4.12 Reduce Fish Diversity

Impact

387. Consequences of obstruction to fish movement and migration due to the proposed activities during this period fish species diversity would be declined in the internal khals temporarily.

388. The significance of this potential of impact has been assessed as **moderate** on the basis of impact magnitude and receptor sensitivity.

Mitigation

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

- Deeper parts of the major khals should be conserved to conserve fish species

Residual Impacts

390. Implementing the above mitigation measure, the impacts associated with loss of fish biodiversity are likely to be addressed and reduced to some extent. Thus, the significance of residual impact will be **low**.

8.4.13 Decline of Fish Production

Impact

391. Due to construction and repairmen of drainage sluice gates and re-excavation of khals, it is expected that fish production from capture fisheries habitat (khals) would be reduced significantly for one season. Besides, fish and shrimp/prawn culture in the gher will also slow down due to lacking of water during dry season. Hence, the significance of this potential of impact has been assessed as highon the basis of impact magnitude and receptor sensitivity.

Residual Impacts

392. Implementing the above mitigation measure, the impacts associated with fish production decline are likely to be alleviated and the significance of residual impact will be **moderate**.

8.4.14 Safety and Health Hazards

Impact

393. The area is prone to cyclones and storm surges. On the other hand, all the work would be completed with the heavy machinery that contains safety hazards. Fuel storage and improper wastage disposal may contaminate the environment of the area and may pose safety hazards for the construction staff as well as for surrounding population. Unhygienicsanitation condition and unavailability of safe drinking water for the construction staff would expose them to health risks. Arrival of construction and other workers might potentially cause vulnerability of the nearby population to communicable diseases.17

[17]ttp://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

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

Mitigation

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

- The contractors should prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants. The Plan should also include awareness building and prevention measures, particularly for communicable diseases such as hepatitis B and C, and HIV/AIDS.
- The WBG's EHS Guidelines should be included in the contract documents and that should be followed during construction.
- Each contractor should prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan should be submitted to the Construction Supervision Consultants for review and approval;
- 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.
- Liaison should be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets should be kept in all the labor camps for obtaining weather information.
- The construction sites should have protective fencing to avoid any unauthorized entry, where appropriate and possible
- Health screening of employees would be a Contractors obligation prior to laborers 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 where required;
- The WBG's EHS Guidelines will be included in the contract documents. Each contractor will prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan will be submitted to Construction Supervision Consultants for review and approval;
- All employees need to provide induction training on health and safety prior to commencement of work. OHS issues would be part of the employee training plan. Training would include the provision of appropriate written or visual materials to reinforce learning. Illiteracy levels where high, the OHS issues should be covered more frequently than normal in toolbox talks;
- The labour shed/camps for accommodation of workers should be constructed according to the IFC/EBRD workers accommodation guidelines.
- Public awareness training and workshops on safety and health risks should 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) should 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 the rigorous standards for occupational health and safety are in place;
- Contractor should establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.
- The contractor should 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;
- Develop a recruitment process community employees that involves local authorities in clearly understood procedures;
- Employ a community liaison officer (which 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;
- Regularly report the labor force profile, including gender, and location source of workers;
- Report regularly the labor and working condition key performance indicators, for instance hours worked (regular and overtime) during period and cumulatively, hours lost, number and type of accidents, near misses, site audits and meetings; trainings, and use of labor grievance mechanism;
- Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase;
- Organize 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 work environment taking into account the inherent risks for this type of project.
- Availability of safe drinking water should have to be ensured for the construction staff.
- First aid boxes should have to be made available at each construction site. Emergency phone numbers (including hospitals, Fire services, and Police) should have to be displayed at key locations within the site. Each site should be occupied with an ambulance.

- Firefighting equipment should have to be made available at the camps and worksites.
- Waste management plan is to be prepared and implemented in accordance with international best practice.
- Liaison with the community should have to be maintained.

Residual Impacts

396. The impacts associated with safety and health hazards are likely to be mostly addressed with the help of above mitigation measures the significance of residual impact would be **low**.

8.4.15 Social and Gender Issues

Impact

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

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

Mitigation

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

- Proper awareness programs will be conducted through public consultation measures such as village scoping sessions, meetings and placement of billboards with assistance from the Union Parishad Chairman, Upazila Nirbahi Officer (UNO) and BWDB local officers.
- Liaison with the communities will be maintained.
- Cultural norms of the local community will be respected and honored.
- GRM will be established to address the grievances of local as well as outside laborers.
- Careful use of local natural resources and project resources, fuel, fuel-wood and electricity;
- Restrictions related to consumption of alcohol and drugs for foreign workers;
- Safe driving practices;
- Respect for the local community and its cultural norms in which laborers are working.
- Provision of prayer time to the workers during working period
- Avoiding construction activities during Prayer time.

Residual Impacts

400. With the help of above mitigation measures, the impacts associated with social unrest are likely

8.5 Positive impactduring Operation phase

8.5.1 Protected Tidal Flooding

401. Tidal flooding is a common phenomenon in the coastal region through the peripheral rivers. Tidal surge attacked the upper east portion of the Polder and the embankment was highly affected at that portion (Ch. 9+500 to Ch. 10+000). Tidal flooding may occur at some locations through drainage canals i.e. Gangrail Telighati etc. However, major portions of Polder 17/2 are not so adjacent to the Gangrail River and thus that portions may be less affected in future. Salinity intrusion is a long-term effect of tidal flooding specially through the drainage canals. The proposed interventions i.e. replacement and repairing of drainage sluices and re-sectioning of embankment would protect the area from tidal flooding.

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

Enhancement

403. The following enhancement measures are to be implemented to address the above concerns:

- Bank revetment with backing of embankment work along the Gangrail River should be constructed to protect the area from flooding during high tide and natural calamities.
- Regular monitoring of seepage of surface water from Peripheral River through the regulators will have to be checked during dry seasons and necessary steps will be taken to check seepage/salinity intrusion, if any.
- Proper re-excavation of drainage canals.
- Afforestation program should be taken at both side of the embankment, which would help to strengthen the embankment.

Residual Impacts

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

8.5.2 Reduced drainage congestion

Impacts

405. Over the year sedimentation as well as drainage congestion has become a crucial problem in this region and over 30% area is inundated during monsoon season. The reduced capacity of peripheral rivers as well as the drainage khals due to excess siltation causes this problem. The Changamari khal, Nikramari khal and some portions of Golabdah khal are found highly deteriorated condition due to siltation. Bed levels of these khals become higher than the adjacent peripheral rivers due to siltation. In most cases water is not properly drained out through this khals due to lack of proper connection with peripheral rivers. The highly affected villages of drainage congestion are Kathbunia, Khalilnagar, Hazrakathi, Ganganagar etc.

406. The proposed implementation work may improve the drainage congestion problem and rain water would be drained out properly during monsoon and regular tide. It is expected that above mentioned drainage congestion area removed.

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

Mitigation

407. The following enhancement measures are to be implemented to address the above concerns:

- Re-excavation of remaining drainage khals and dredging of periphery rivers to be implemented.
- The local government (Union parishad) should be authorized to monitor the development activities.
- Proper training for sluice gate operation and WMOs is needed;
- Reduce conflicts between farmers and fishermen by forming local community, and
- Implement small scale tidal river management (TRM).

Residual Impacts

408. The impacts associated with drainage congestion are likely to be mostly addressed with the help of above mitigation measures the significance of residual impact will be **Low**.

8.5.3 Change of cropping patterns

409. Presently, the cropping intensity of the Polder area is 162%. According to the proposed intervention, the Polder would be protectedfrom tidal & monsoon flooding and will arrest salinity intrusion. It would remove drainage congestion in the Polder area. Besides, drainage congestion will be significantly reduced due to re-excavation of internal channels of the Polder area as per proposed plan. Due to the improved situation, farmers of the respective areas would encourage to cultivate more crops in their lands. Thus, it is expected that the cropping intensity would be 174% in the Polder area in future (Table 8.5)with an expected increase of 12% from the base situation. Detailed change of cropping intensity is shown in the Table 8.5.

Table 8-5: Impact on cropping intensity in the Polder area

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Area (ha)	% of NCA
Highland	Fallow	HYV T. Aman	Fallow	96	6
	S. Vegetables	HYV T. Aman	Spices	64	4
	Fallow	Local T. Aman	W. Vegetables	155	10
	HYV T. Aus	HYV T. Aman	Potato	109	7
			Sub- total	423	27
Medium Highland	Fallow	HYV T. Aman	Oilseeds	186	12
	Local T. Aus	HYV T. Aman	Pulses	93	6
	Fallow	Local T. Aman	Fallow	310	20
	Fallow	HYV T. Aman	HYV Boro	279	18
	Fallow	Fallow	HYV Boro	259	17
			Sub-total	**1128**	**73**
			Total	**1551**	**100**
			Cropping Intensity (%)	**174**	

Sources: CEGIS Assessment from field information and DAE, February; 2016;

410. Presently, total cropped area is about 2,514 ha (NCA 2,496 ha) of which rice cropped area is 1,923 ha and non-rice cropped area is 592 ha as shown in Table 8.6. The total crop

production would be 9,929metrictons of which rice would be 4,347metric tons (44%) and non rice will be 5,582 metric tons (56%). Adverse impact might occur due to siltation of river and drainage channels.

Table 8-6: Impact on crop production in the Polder area

Crop Name	**Present /FWOP crop area, yield & production**			**Future crop area, yield & production**			**Impact (FWIP-FWOP)**		**% of production change**
	Cropped area (ha)	**Yield/ha (mt)**	**Production (t)**	**Cropped area (ha)**	**Yield/ha (mt)**	**Production (mt)**	**Area(ha)**	**production(ton)**	
Local T. Aus	124	1.6	198	93	1.8	168	(31)	(30)	(15)
HYV T. Aus	63	1.9	119	109	2.2	239	46	120	101
Local T. Aman	559	2	1,118	465	2.1	977	(94)	(141)	(13)
HYV T. Aman	667	2.3	1,535	827	2.4	1,984	160	449	29
HYV Boro	510	2.7	1,377	538	3.0	1,615	28	238	17
Total rice	**1,923**	**-**	**4,347**	**2,032**	**-**	**4,982**	**109**	**635**	**15**
Pulse	124	1.6	198	93	1.8	168	(31)	(30)	(15)
Oil Seeds	139	1.2	167	186	1.3	242	47	75	45
Spices	31	5.5	172	64	5.8	369	33	197	114
Potato	63	15	940	109	18	1,954	46	1,014	108
S. Vegetables	31	14	439	64	15	954	33	515	117
W. Vegetables	204	18	3,666	155	20	3,102	(49)	(564)	(15)
Total non-rice	**592**	-	**5,582**	**670**	**-**	**6,788**	**78**	**1,206**	**22**
Total Cropped Area	**2,514**	-	**9,929**	**2,702**	**-**	**11,771**	**188**	**1,842**	**11**

Sources: CEGIS Assessment from field information and DAE, February; 2016;

411. The cropped area would be increased if the project is implemented. The cropped area would be 2,702 ha of which rice cropped area would be 2,032 ha and non-rice cropped area would be 670 ha. The crop production might be boosted up significantly under the FWIP condition. The total crop production would be 11,771metric tons of which rice would be 4,982metric tons and non-rice would be 6,788metrictons. The rice and non-rice production would be about 15% and 22% higher in FWIP than that of FWOP respectively. Production would be increased mainly due to re-excavation of channels; constructions of drainage sluice and repair/replaced of flashing inlet with adoption of modern technology in crop production, change in cropping pattern etc. Crop production would be increased due to expansion of HYV T. Aus, HYV T. Aman, HYV Boro, Spices, Potato, Oil seeds and summer vegetables cultivation area. Additional 635metric tons of rice and 1,206metric tons of non-rice would be produced in FWIP over FWOP (Table 8.6).

Enhancement

412. The following enhancement measures are to be implemented to make project more beneficial to peoples:

- Irrigation should be provided in optimum level with minimum conveyance loss.
- Involvement of WMOs in project activities should enhance crop production.
- Introduction of HYV/Hybrid crop cultivars along with crop diversification need to be practiced.
- Introduction of HVCs (High Value Crop) Like Tomato, Green pea, Brinjal, Chili and some other Vegetables along with crop diversification need to be practised.
- Introduction of modern technology in agriculture like GAP, ICM etc

8.5.4 Reduce soil salinity

413. The proposed interventions re-sectioning of embankment construction of structure, repair of sluices would protect the Polder from tidal and monsoon flooding and will arrest salinity intrusion and would remove drainage congestion in the Polder area. Besides, drainage congestion will be significantly reduced due to re-excavation of internal channels of the Polder area as per proposed plan. These would increase the area of cultivation which intern would increase crop production as well as create opportunity for employment generation.

8.5.5 Impacts on foreshore area for afforestation

414. After aforestation, the community people (local beneficiaries) have sensitized to take-care the plant for creating greenery. Saplings collection from local nursery is major concern where as specific native species and mangrove plants should be collected. For the reason, nursery business and their number would be increased. Local people who are beneficiaries would be also benefited for this aforestation program. These plantations also protect the Polder from tidal flood and tidal wave inside the Polder area. Moreover, the vegetation provides habitat for wildlife (e.g. water dependent avifauna, insects, local birds etc.) and other biota.

8.5.6 Impacts on aquatic biodiversity

415. Re-excavation of existing canals is expected to remove water logging as well as drainage congestion at Aroshnager, Baratia, Monohorpur, Boyersing etc villages. It will have positive impact on canal surrounding vegetation, wildlife habitats and crop production. Existing anaerobic condition of the settlement soils will be reduced that will trigger all types of plants (tree, herbs and shrubs) succession. Decreasing of soil salinity will enhance vegetation succession as well as plant productivity and physical growth. Negative impact by increasing salinity will be minimized for regular drainage facilities. Fish production will also increase that will attract more water depended fauna. Moreover, the existing mangrove vegetation along the river and canal side will increase for getting regular tidal flow. So, aquatic ecosystem will be improved and divers after completion of construction works.

8.5.7 Fish Habitat and Habitat Condition

416. Re-excavation of the khals will convert shallow khals to deeper one which would act as fish shelter for certain fish species and crustaceans like *Guchi, Baro Baim, Bele, Mud crab* etc during lean period. Besides, some of the brood fish of small indigenous fish species can stay in the deeper area which will spawn in the following year. Moreover, mending of sluice gates and re-excavation of khals would increase the fresh water holding area thereby will increase freshwater availability that will prevent the gradual saltwater intrusion by accelerating the ground water recharge rate in that area. It would also ease the discharge of excess water during rainy season and reduce the risk of over flowing the ghers and ponds.

Enhancement Measures

417. The following enhancement measures are to be implemented to make project more beneficial to peoples:

- Fisheries Conservation and Protection Acts & rules and fishing ban period should be strictly imposed for protecting indiscriminate fishing, collection of fish hatchlings, catching of PL of shrimp and other fishes in the khals as well as outsides the river adjacent to the Polder area.

- Establishment of fish sanctuary in the deeper part of the khals and managed through fishers' organization.
- Awareness development among the local people through meeting, leaflet/flyer distribution, demonstration, observation of different day like fish week etc.

8.5.8 Fish Movement and Migration

418. As result of construction and mending of drainage sluices and re-excavation of khals fish movement and migration would be facilitated significantly. In addition, increased water depth of khals would also facilitate the internal fish movement and migration to a large extent.

Enhancement Measures

419. The following enhancement measures are to be implemented to make project more beneficial to peoples:

- Use of harmful fishing gear like Behundi jal, Gill net (current jal) and indiscriminate fishing should be stopped during migration period in the project area.
- Illegal fishing nearby sluice gate mustbe stopped strictly and follow-up by WMOs and fishers.

8.5.9 Fish Diversity and Species Richness

<u>Impact</u>

420. Sufficient fresh water will be available throughout the year in the khals that will facilitate the regular migration of fishes. As consequences, all fishes including locally threatened indigenous fish species would appear again resulting increased availability. Therefore, numbers of fish species would be increased and abundance of fishes might take place.

Enhancement measures

421. The following enhancement measures are to be implemented to make project more beneficial to peoples

- Fish species which are known as threatened locally should be conserved.
- Local fishers should be encouraged not to harvest the threatened fish species.
- Local community should protect the deep areas of the khals to protect the brood fish for the propagation in the following year.
- Release the brood of threatened fish species in the khals for the spawning and conserved them.
- Training may be provided to WMG and WMA on "Integrated Water Management and Operation & Management of Sluice Gates" which enable them to understand the opening time of sluice gate in accordance to fish and shrimp migration and culture period.

8.5.10 Fish Production

422. Culture of fish in gher and ponds within the Polder area would be more secured and protected from saline water and tidal surge due to protection work, repairmen of sluice gates and re-sectioning of embankment that will encourage local fish farmers to cultivate fish and shrimp. Re-excavation of 11.85 km internal khals would facilitate restoration of large area of

water body that will increase capture fisheries and facilitate the culture fisheries to promote aquaculture.

Enhancement Measures

423. The following enhancement measures are to be implemented to make project more beneficial to peoples.

- Threatened and indigenous small fish species should be stocked in the khals to increase fish biodiversity and production.
- Fish sanctuary should be established in the deeper part of the each khals to conserve the brood fish for the next year spawning as well as protect the juvenile fishes.
- Harmful fishing gear like gill net (current jal) uses should be stopped in the capture fisheries.
- Training on environment friendly modern fish, prawn and shrimp culture should be provided to the fishers/farmers to intensify the aquaculture.
- The WMAs should be involved in the integrated water management through proper maintenance of sluice gates and khals for the expansion of both capture and culture fisheries.

8.5.11 Employment Generation

424. Earthwork demands a lot of labor that would create employment of local day labourers.Construction of sluice, regulator, slope etc would ensure the employment of both technical and non-technical labors. In the long run, working opportunities in agriculture may be extended that might create enhanced employment scope in agriculture sector.

Enhancement Measures

425. The following enhancement measures are to be implemented to make project more beneficial to peoples

- Local technical and non-technical labour should be recruited in project activities.
- The entire earthwork should be done manually as early as possible to employ more labor.

8.5.12 Water uses for domestic purpose

426. There is acute scarcity of fresh water in the Polder area. Restriction of entrance of saline water might increase fresh water for domestic purpose. The reserve of fresh water in the khals and canals might ensure the availability of fresh water for using people and cattle as well.

Enhancement Measures

427. The following enhancement measures are to be implemented to make project more beneficial to peoples

- Creating reservoir to reserve rainwater that can be used in dry season.
- Awareness builds up to conserve rain water for domestic purpose.
- Ensuring proper maintenance to keep the depth of the khals.

- Protecting saline water entrance in the local khals and canals by installing water control structure.

8.5.13 Disaster incidence and vulnerability

428. The incident and damage of natural disaster may reduce to desired level by the implementation of proposed interventions. With implementation of the project, the incident of natural calamities such as drainage congestion, flood etc would reduce as well as the damage of natural disaster would reduce. Thus, the lives, properties, shelter as well as crops would remain safe from the disaster. The people would live with calm and quiet with safety and security from natural calamities.

Enhancement Measures

429. The following enhancement measures are to be implemented to make project more beneficial to peoples

- Raise the height of the embankment as per design level.
- Water control structure should be constructed and maintain properly.
- Constructing shelter house to be used during emergency
- Providing warning massage on time among the people.

8.5.14 Standard of living

430. Extending agricultural practices, employment and income of the people of the Polder area would increase that would directly influence the standard of living of the local people. Better communication would also impact on standard of living. With the increase of income, overall condition of housing, health, education, drinking water quality would increase proportionally.

Enhancement Measures

431. The following enhancement measures are to be implemented to make project more beneficial to peoples

- Creating awareness using rain water and to use of sanitary latrine.
- Providing rain water purifier for domestic purpose.
- Creating employment opportunities in different sectors.

8.5.15 Impact of major periodic maintenance works

Impact

432. The major periodic maintenance works during project operation phase include (i) re-sectioning of embankments including turfing; (ii) repair or replacement of metal works/hinges, lifting mechanisms, gates, block works, head / wing walls etc.; and re-excavation of khals by LCSs / PICs. It is expected that these periodic maintenance works would have minor negative and positive environmental and social impacts. However, re-sectioning of embankment along with turfing may hamper movement of local people temporarily. Besides, temporary damages of herbs, shrubs, various species of grass and bushes would take place due to soil dumping for re-sectioning work. The repairing works of structure would obstruct movement and migration of fish species like Chingri, Baila, Pairsa and fresh water fish like puti, tengra, bele, etc. Fish hatchling movement will also be hampered due to repairing works during hatchling period (May-July). On

the other hand, a significant number of local labour will be recruited for earth work, repairing of embankment and afforestation, soil dumping and compaction of earth. Most of the maintenance works will be done by the LCS/WMO involving 60% male and 40% female from the local area. Thus, employment access to both male and females of locality during operation /maintenance phase will be promoted significantly and they can also take part in different decision-making processes.

Mitigation/Enhancement Measures

- Re-sectioning of embankment along with turfing would be conducted segment by segment so that the movement of local people would not be hampered
- Re-excavation activity should be done segment wise
- Construction activities should be avoided during fish migration period, e.g. month of May to July
- Excavated earth should be dumped at a safe distance from the khal banks to avoid return back in the khals
- Implement plantation along the slopes of embankment after completing the earth works;
- Construction activities should not be carried out at early morning and night to avoid disturbance to wild fauna.

8.6 Positive impact during Post-Construction phase

8.6.1 Risk of Embankment Failure

Imapct

433. Embankment failure or breaching of embankment is a common threat in the coastal regionthat is caused due to runoff, wave action, tidal surge and unauthorized activities like entering saline/brackish water through pipies across the embankment by local people making the embankment weak. Lack of regular maintenance has created weak point at the sensitive locations of the embankment where the set back is less than 15m to 25m. Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously have accelerated the risk of embankment failure. The southern portion of the embankment (Ch. 0+000 to Ch.4+500) is more vulnerable against frequent surge of this region. Moreover, embankment from Ch. 9 + 000 to Ch. 10+000 (along Gangrail river) may suffer in future due to lack of afforestation.

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

Mitigation

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

- Regular monitoring and rigorous maintenance of the embankment and existing water control structures especially along the southern and western side of the Polder should be ensured. This monitoring will particularly be carried out before and after monsoon season.

- Proper dumping and compaction of soil should be ensured during re-sectioning of the embankment.
- Side slope protection works should be maintained with proper design.
- Available cyclone and flood shelter should be prepared as a contingency measure during emergency situation.
- WMG should develop fund for such emergency situation.
- Structural measures like geo bag and sand bag should be kept in the Upazila office for emergency need.

Residual Impacts

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

8.6.2 Reduction of Fish Migration Time and Extent

Impact

437. The mal-functioning of the drainage sluices in the Polder area are still facilitating the migration of Pairsa, Vetki and Gulsha, Tengra, Chingri fishes from river to internal khal and vice-versa. However, 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. The improved drainage sluices would thus hamper the migration behavior of above-mentioned fish species as well as other aquatic fauna. Moreover, the migration of Pairsa, Vetki, Gulsha, Tengra, Chingri, etc., would be very much restricted with the replacement of the proposed drainage sluices.

438. The significance of the combined impacts has been assessed as Major on the basis of impact magnitude and sensitivity to receptors.

Mitigation

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

Follow sluice gate operation manual (Appendix-E) for allowing fish migration;

Provide training to WMOs for fish friendly operation of sluices;

440. Collection and stocking of juvenile fish from rivers to the Polder will be done once in a year during the period of April to May by the fish farmers.

Residual Impacts

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

(b) Summary of Assessed Impacts

442. A summary of these impacts and their significance is presented in a Table (Appendix G).

8.6.3 Increase use of agro-chemicals

Impact

443. At present, about 510 ha and 667 ha of lands are under Boro (HYV) and T. Aman (HYV) rice cultivation respectively. Presently, 424 tons of chemical fertilizers and 9 tons (Both granular and liquid) of pesticides are being used for cultivation of Boro (HYV) and T. Aman (HYV) rice. After implementation of the project interventions especially re-excavation of channels would cause expansion of area under irrigated cultivation of Boro (HYV) and T. Aman (HYV) rice. It is expected that about 200 ha of which Boro (HYV) and T. Aman (HYV) area are 61 ha and 139 ha would be increased in future with the project. The expansion of irrigated area in association of cultivation area would increase use of chemical inputs including fertilizers and pesticides. It is estimated that additional 87metric tons of chemical fertilizers and 1.35 metrictons of pesticides would be required for future. Runoff from such cultivation fields might potentially pollute the water bodies and even drinking water sources thus causing health hazards to the communities.

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

Mitigation

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

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

Residual Impact

446. 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 the residual impact will be Negligible.The present and future cropped area, use of fertilizers and pesticides are furnished in Table 8.7 below:

Table 8-7: Impact on Area (ha), Fertilizers (kg) and Pesticides (kg/ml) required in Present and Future Situation

Crop name	Present cultivated area(ha)	Fertilizer (kg/ha)	Granular pesticides kg/ha	Liquid pesticides (ml/ha)	Total Fertilizer (kg)	Total granular pesticides (kg)	Total liquid pesticides (ml)	Future cultivated area(ha)	Increased area (Ha)	Total future fertilizer (kg)	Future granular Pesticides (kg)	Future liquid pesticides (ml)	Impact		
													Fertilizers (kg)	Pesticides (kg)	Pesticides (ml)
Local T. Aus	124	235	4	600	29,050	494	74,170	93	(31)	21,787	371	55,627	-7,262	(124)	-18,542
HYV T. Aus	63	310	5	700	19,427	313	43,867	78	16	24,283	392	54,833	4,857	78	10,967
Local T. Aman	559	240	6	800	134,175	3,354	447,251	451	(108)	108,164	2,704	360,548	-26,011	(650)	-86,703
HYV T. Aman	667	330	7	900	220,256	4,672	600,699	807	139	266,220	5,647	726,053	45,963	975	125,355
HYV Boro	510	400	8	1000	203,967	4,079	509,918	571	61	228,455	4,569	571,137	24,488	490	61,219
Pulses	124	170	0	0	21,015	-	-	93	(31)	15,761	-	0	-5,254	-	-
Oil Seeds	139	292	2	400	40,608	278	55,627	201	62	58,656	402	80,351	18,048	124	24,723
Spices	31	458	8	1000	14,351	251	31,333	63	32	28,701	501	62,667	14,351	251	31,333
Potato	63	501	8	1200	31,396	501	75,200	78	16	39,245	627	94,000	7,849	125	18,800
S. Vegetables	31	710	7	1100	22,247	219	34,467	62	31	44,020	434	68,200	21,773	215	33,733
W. Vegetables	204	750	8	900	152,750	1,629	183,300	188	(16)	141,000	1,504	169,200	-11,750	(125)	-14,100
Total	**2,514**	**-**	**-**	**-**	**889,241**	**15,792**	**2,055,832**	**2,684**	**170**	**976,293**	**17,151**	**2,242,616**	**87,052**	**1,358**	**186,785**

Sources: CEGIS Assessment from field information and DAE, February; 2016;

9 Cumulative Impacts

9.1 Cumulative Impacts

447. Definition: Cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions.

448. Cumulative impacts on the environment of individual effect can be minor but it can be significant when in combination with others taking over a period of time. The multiple impacts of different activities may have an additive, synergistic or antagonistic effect on one another and with the natural processes.

449. Methodology: Cumulative impacts entail the total of all impacts to a particular resource that have occurred, or occurring, or may occur as a result of any action or influence in the surrounding area. To Assess Cumulative Impact (CIA) of the proposed polder under CEIP, a number of other projects exist apart from the CEIP Polders (at the vicinity of the polder) as well as future plan has been considered. Before assessing the impacts, Valued Environmental Component (VEC) has been selected. VECs for which an impact was deemed insignificant in the EIA are not included in the CIA. The combined impacts of the project, other projects and activities, and natural environmental drivers surrounding the polder that will influence the VEC's condition e.g. life and livelihood of people, water resources/hydrology, environmental quality, natural ecosystem and flora-fauna etc.in a specific Polder have been assessed as cumulative impact. The cumulative impact has been estimated qualitatively based on the consensus estimate of a panel of experts. Furthermore, necessary additional mitigation measures have been suggested for reducing an estimated unacceptable cumulative impact on a VEC to an acceptable level.

450. Several existing, on-going and planned projects also exist in this region. Such projects may have impact on the hydrological network, life and livelihood of people, environmental quality, natural ecosystem, flora-fauna, etc. of Polder 17/2. This Chapter attempts to analyze several indirect effects regarding several existing and ongoing project, as well as the implementation of different interventions proposed in Polder 17/2 under Coastal Embankment Improvement Project-1 (CEIP-1). Besides, necessary mitigation measures based on analysis of cumulative impacts are proposed.

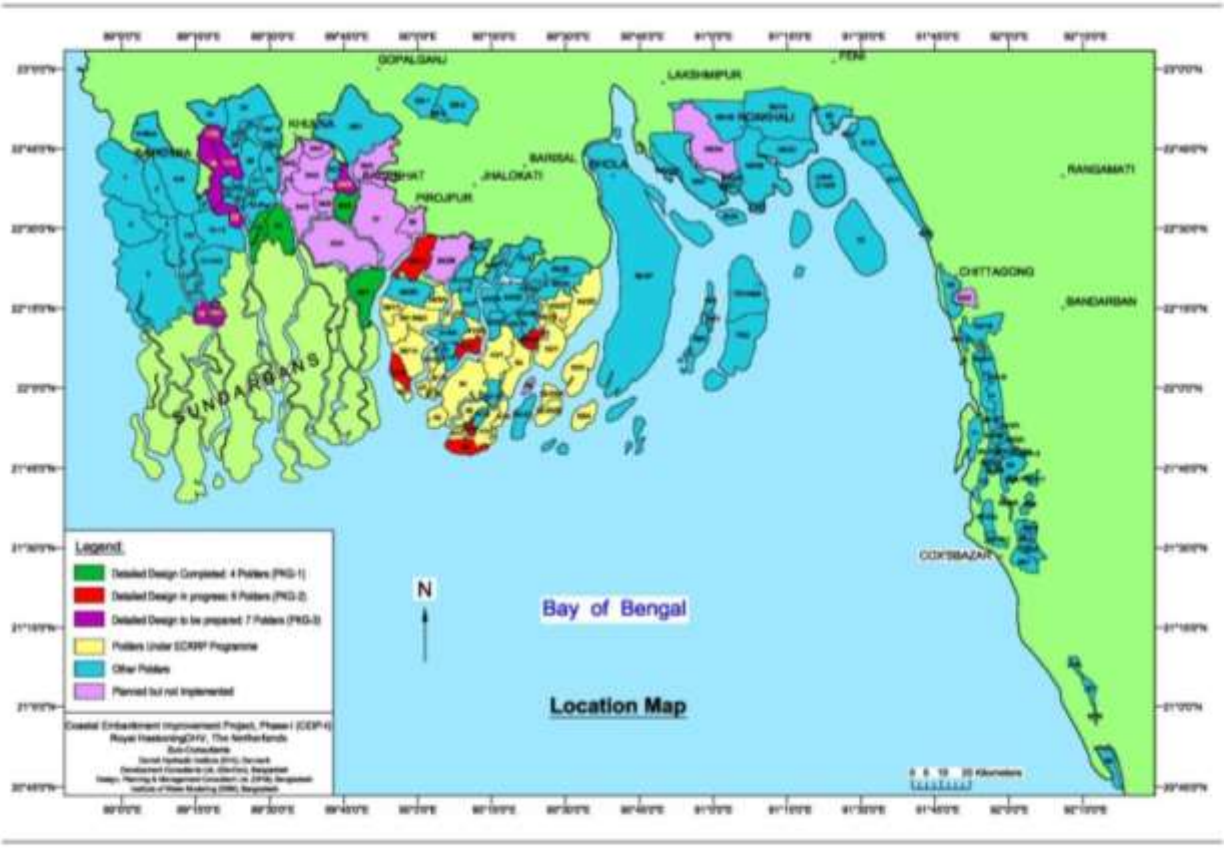
9.2 Proposed CEIP interventions on Polder-17/2

451. CEIP-1 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 long-term objective of the project is to increase the resilience of the entire coastal population to tidal flooding as well as natural disasters by upgrading the whole embankment system. The embankment improvement and rehabilitation approach will be adopted over a period of 15 to 20 years and in this regard a total number of 17 Polders have been selected through a participatory screening process.

9.2.1 Synopsis of existing and on-going projects around Polder 17/2

452. Apart from CEIP interventions, there are some other development projects nearby Polder-17/2, implemented locally or regionally. Activities of these projects may generate cumulative impacts on the Polder in future. Table 9.1 shows a list of various projects in

relevance with Polder-17/2, undertaken by different line agencies in Khulna, Bagerhat and Satkhira districts.



Map 9-1: Locations of Polders under CEIP-1

Table 9-1: List of water management projects

Agency	Project Name	Duration	Location	Sensitivity
National				
MoDMR	Comprehensive Disaster Management Program (CDMP), Phase II	2010-ongoing	Entire country	Negligible
BWDB	Projects under Climate Change Trust Fund	2013-ongoing	Entire country	Low
	Water Management Improvement Project (WMIP)	2010-ongoing	Entire country	Low
Regional				
BWDB	Blue Gold Program	2013-ongoing	Coastal zone	Moderate
	Coastal Embankment Rehabilitation Project (CERP)	1995-2004	Coastal zone	Negligible
BFD	Marine Shrimp culture technology	1998-2004	Coastal zone	Moderate

453. The projects (listed in **Table 9.1**) which have or may have **moderate sensitivities** on some of the environmental or social components of Polder-17/2 are briefly discussed in the following sections.

9.3 Cummulative Impacts of proposed and existing projects

9.3.1 Impact on hydrology and flooding situation

454. Several other on-going and planned projects also exist in this region. Such projects may have impact on the hydrological network, life and livelihood of people, environmental quality, natural ecosystem, flora-fauna, etc. of Polder 17/2.Polder 16 and Polder 17/1 are located very adjacent to the Polder-17/2 at South directions which are also considered for improvement planning. Both Polders are situated at the downstream of Polder-17/2. The Gangrail river is flowing at downstream of Polder-17/2 to Polder 17/1. The tendency of storm surge effect is higher to Polder 17/1 than others. However, the protective works i.e. higher crest level, slope protection work of Polder 17/1 may divert flow direction to Polder-17/2 through Gangrail River. This tendency may slightly affect the Polder because very small portion of this Polder is adjacent to the river. In future, salinity intrusion may affect the water bodies and agricultural fields of Polder-17/2 through peripheral canals due to increased water level due to climate change of Gangrail River and Taltola River.

455. The Salta River is flowing between Polder 16 and Polder-17/2 which is in moribund situation now. Polder 16 has situated in downstream of Polder-17/2 and the flow of peripheral rivers i.e. Salta, Haria has reduced due to siltation. So, there is a less possibility of storm surge diversion and salinity intrusion due to improvement of Polder 16.

9.3.2 Impact of construction materials on local markets

456. The construction materials to be required for re-sectioning of the embankment, water regulatory sluices, flushing sluices, and bank protection work will include soil, cement, and steel, stone and sand. The constructions materials especially sand and stone for construction of sluice gate to be procured mainly from Sylhet directly. Coarse sand available from Sylhet and stone chips (good quality) may be imported from neighbor countries. Cement and Steel will be procured from company sale market of Khulna or will be procured from cement factory and steel factory directly which would not cause any impact on market price. A small amount of sand and cement can be procured from the local market at adjacent to the polder or from Khulna during executions of construction works. No significant impact will be caused due to sand procurement of sand and cement from local market.

9.3.3 Impact on Livelihood

457. The socio-economic condition of Polder 17/2 will be ameliorated due to the overall development of this region, i.e., construction works of Polder 17/1 and Polder 16 will attract labors from outside as well as local people will also get working opportunity.

9.3.4 Impacts on rivers/water courses hydrology

458. Because of polderization, the sediments which earlier (before polderization) could spread out over the Polder area is being deposited in the river course. As a consequence, river bed has been rising and aggravating erosion situation of the Polder area as well as affecting navigation. This situation will also continue after rehabilitation of Polder. Tidal influx would also remain within the river course and exert hydraulic pressure on the Polder and deteriorate erosion.

9.3.5 Impacts on fish migration and biodiversity

459. The successive siltation in peripheral rivers and canals of Polder 16 may hamper fish migration. In course of time, fish migration may be fully or partially obstructed in the Polder area due to siltation. As a result, the fisheries biodiversity for both fresh and brackish water may marginally decrease. Due to protection of Polder from flood water, water will move towards the upstream of Salta and downstream of Gangrail River during high tide. This increased volume of water will enhance fish migration in that water body. Consequently, fish migration of surrounding canals will be improved. In future, the salinity tolerant fish species will dominate while fresh water fish species may decrease.

9.3.6 Impacts of Blue Gold interventions on Polder-17/2

460. A total number of 12 Polders in Satkhira, Khulna and Patuakhali districts have been selected for implementation of the program in the first phase. Among these, Polder 26 is very adjacent to Polder-17/2 in the South-East direction and therefore may generate some impacts in future. The protective works i.e. higher crest level, slope protection of Polder 26 may create induced hydraulic pressure to Polder-17/2. The Gangrail River interact these two Polders closely. The tidal effect of Gangrail River may affect the embankment of Polder-17/2 through several perennial canals i.e. Gangrail and Telegati canal. Consequently, saline intrusion may be increased in peripheral canals. Moreover, siltation rate may be increased due to tidal influence of Gangrail River. There is also a risk of storm surge attack due to climate change effect in near future on both of the Polders through perennial rivers.

9.3.7 Impacts of Marine Shrimp Culture Technology

461. In 1998, Bangladesh Fishery Department (BFD) extended the culture technology of marine shrimp on macro scale in Khulna, Bagerhat, Sathkhira and Cox’s bazaar. The project continued upto 2004. However, the popularity of shrimp culture spread in local level. Shrimp culture in Polder-17/2 during dry season is a very common practice like other surrounding Polders. The shrimp culture is not labor intensive, thus creates more unemployment problem. In the dry season, a number of places in the embankment were cut down to allow the entry of saline water through Telegati, Gangrail khal etc. which may be reduced the strength of the embankment by creating weak points. One notable positive impact of shrimp culture in Polder-17/2 is that it initiated a financial revolution of the Polder area, however; it has become a monopoly business. By now, the local people have fallen in an ambivalent situation that they are suffering by loosing agricultural land and increased shrimp culture in their land. Moreover, there are some negative environmental impacts i.e. infertility of aquatic animals, flora and fauna due to overtopping of saline water from shrimp culture ponds.

9.4 Reciprocal Impact (Polder 17/2)

462. Reciprocal impacts of Polder 17/2 have been assessed based on the model results conducted by Institute of Water Modelling (IWM). IWM used Rainfall runoff model, hydrodynamic models and Storm surge model to analyze the existing meteorological situation of the Polder area. They have evaluated the physical changes in the relative Polders, which may occur due to climate change. All data used in the model setup and calibration (including topography, soil maps, land use maps, and weather data, river network and cross-section, water level, discharge and salinity) were obtained from different sources. The climate change scenario RCP 8.5 is used in the models to simulate the climate change effects.

463. The runoff inside costal Polder is simulated using NAM (Nodbor Afstroming Model) of DHI mike package. In the NAM model a lump watershed was defined, which considered the area of Polder 17/2. The contribution area of internal drainage system of Polder 17/2 was defined in the mike 11 network module. Taking 2012 as base year, the peak runoff occurred in the mid of September with a magnitude of 7.185 cumec. The year 1987 was selected as design year corresponding to 10-year return period. The peak runoff without considering climate change is 28.17 cumec where as 33.53 cumec pick runoff is obtained at the end of August considering climate change. The pick runoffs without considering climate change and considering climate change are 292% and 367% higher than the base year respectively.

464. The assessment of effectiveness of existing drainage system is performed under climate change scenario RCP 8.5. Climate change condition is added to the model by considering sea level rise of 50 cm at downstream boundary, increase of flow of Ganges with 16% to 28%, Brahmaputra with 8.5 % to 18.5% and Upper Meghna with 8% to 11%. Five days rainfall event is considered with 10-year return period for the simulation for the existing drainage system.

465. From the simulation, flood free (FF) area and F0 (0~0.3m) area cover about 8.85% and 4.99% respectively without considering climate change. The fulfillment of drainage criteria requires about 85% to 90% FF and F0 land, whereas 13.84% of FF and F0 land was found from the simulation without climate change.

466. Considering the climate change scenario FF and F0 land cover are reduced to 5.95% and 2.16% respectively. The F1 land class (water depth .03m to 0.9m) and F2 land (water depth 0.9m to 1.8m) also reduced from 20.38% to 14.15% and from 59.65% to 49.08%. But the F3 (water depth 1.80m to 3.60m) increased from 6.74% to 28.67%. It implies that about 91.89% land area remains submerged under climate change condition due to inadequate drainage system and needs further attention to obtain a climate resilient Polder management.

467. The newly developed, calibrated and validated Bay of Bengal Model has been applied for the study of storm surge modeling. It is a combination of Cyclone and Hydrodynamic (MIKE21FM) models. Three open boundaries are defined in the model, two in the North in the Upper Meghna River at Bhairab and in the Padma River at Baruria. Another one is in the South in the Southern Bay of Bengal up to 16° latitude. The coastal Polders are included in this model as dike.

468. Wind speed for 25 years return period is used for determining the wave height considering climate change. The wave height simulated for Polder 17/2 is 0.19 m.

469. The South West Regional Model (SWRM) has been calibrated and validated using annual maximum monsoon water level of 27 years (1982-2011) for monsoon water level analysis. Water level corresponding to log-normal return period of 10, 25, 50 and 100 are 3.38, 3.64, 3.85 and 4.09 m + PWD without considering climate change. Water levels considering climate change are 3.81, 3.95, 4.06and 4.16 m +PWD respectively.

470. The overall summary of climate change for storm surge is insignificant whereas the monsoon water level governs the overall impact of the Polder. Considering 25 years return period of monsoon water level and maximum wind wave height, the crest level of the Polder should be above 4.14 m + PWD. The present crest level of the Polder is 3.98 to 4.30m. So the crest level is sufficient to address the future climate change.

10 Environmental Management Plan

471. This Chapter presents the Environmental Management Plan (EMP) for the CEIP-1 activities in the Polder-17/2. The EMP essentially provides the implementation mechanism for the environmental and social mitigation measures discussed in Chapter 8.

10.1 Objectives of EMP

472. The basic objective of the EMP is to manage, prevent, and mitigate potential adverse impacts of Project interventions in thePolder-17/2. The specific objectives of the EMP are to:

- Facilitate the implementation of the environmental and social mitigation measures identified in the present EIA and discussed in **Chapter 8**.
- Assign responsibilities of project proponent, contractors, consultants, and other members of the Project team for the environmental and social management of the Project;
- Define a monitoring mechanism and identify monitoring parameters to ensure effective implementation of the mitigation measures.
- Assess environmental training requirements for different stakeholders at various levels.
- Describe communication and documentation requirements.

10.2 EMP Components

473. The EMP components are listed below:

- Institutional Arrangement
- Mitigation Measures and Plan
- Monitoring Plan
- Documentation and reporting
- Contractual arrangements for EMP implementation
- EMP implementation cost
- Capacity building
- Grievance redress mechanism

474. These components are discussed in the following Sections.

10.3 Institutional Arrangement

475. Clearly defined that functional institutional arrangements are essential for ensuring effective and sustainable implementation of the EMP, particularly the mitigation measures identified in the EIA. An Organogram showing the institutional set up of CEIP-1including organization for implementation and monitoring of the EMP is shown in Figure 10.1.

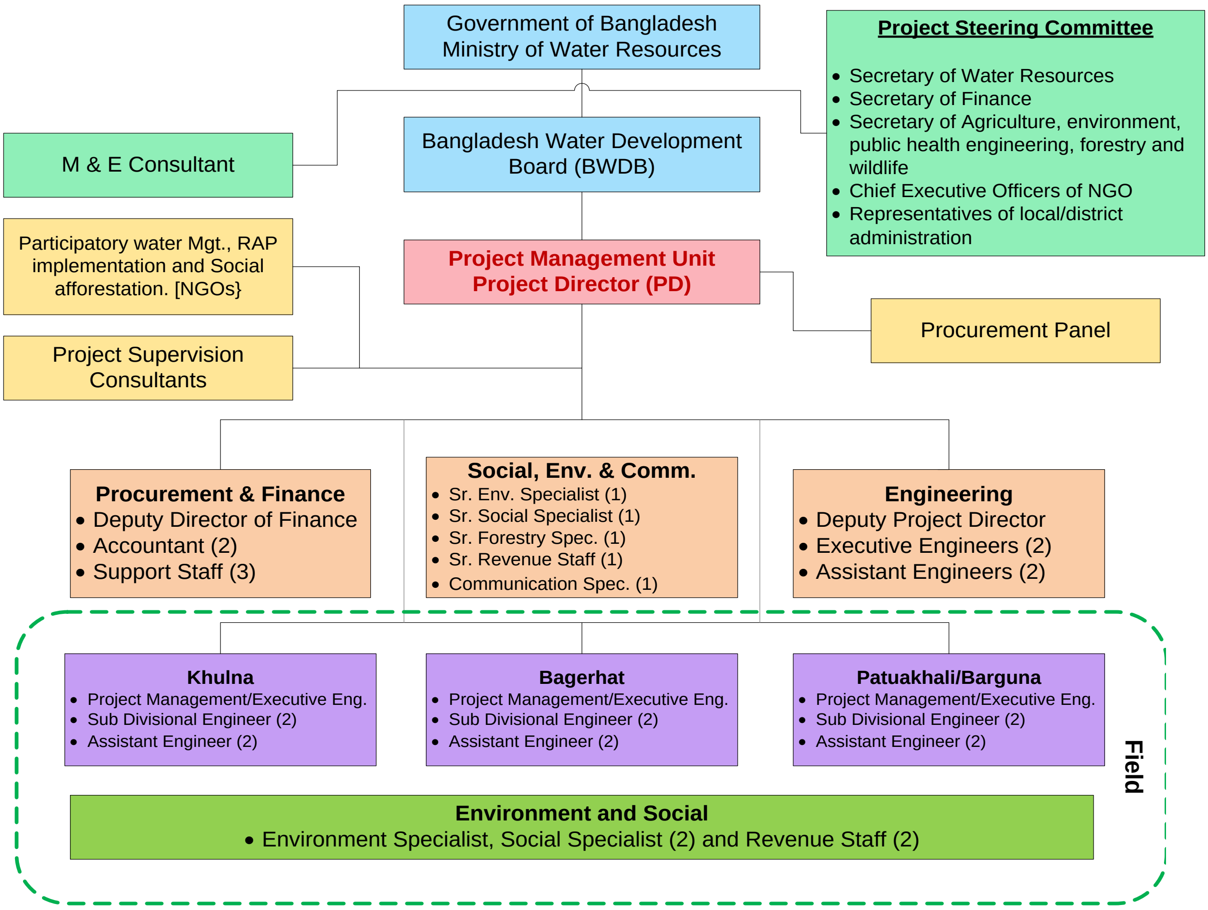


Figure 10.1: Organogram showing the institutional setup for CEIP-1

476. The institutional arrangements proposed to implement the EMP of Polder-17/2 are described below:

10.3.1 Overall Responsibility

477. The overall responsibility of EMP implementation and fulfiling other environmental obligations during the Project implementation lies with the Project Director (PD). For which, the PD will be supported by the environmental and social staffs of the PMU, Detailed Design, Construction Supervision and Project Management Support Consultants (DDCS & PMSCs) and Contractors.

10.3.2 Construction phase

Environment and Social Staff in PMU

478. As described in Section 4.8, the BWDB will set up the PMU to manage the implementation of the Project and will be led by the Project Director (PD).To manage and oversee the environmental and social aspects of the Project, the PMU will have an Environment, Social, and Communication Unit (ESCU) .The Unit will supervise compliance with and implementation of the EMP. The Unit will include a Senior Environmental Specialist. One environmental specialist will be posted at the field level to support all the three Divisions.The ESCU will maintain liaison with WB safeguard team, regulatory agencies, and other stakeholders during implementation. The ESCU will also coordinate with the environmental staff

of the Detailed Design Construction Supervision and Project Management Consultants (DDCS&PMSC). In order to effectively manage the EA process and EMP implementation, the ESCU will be established and made operational before awarding the contract to the contractor. The ESCU will be responsible for updating the EIA after receiving the pending information.

479. IPoE will review the updated report and will guide to ESCU for further improvement of the monitoring report.

Environment and Social Staff with Detailed Design Construction Supervision and Project Management Consultants (DDCS&PMSC)

480. The DDCS&PMSC will be responsible for overall supervision of Polder rehabilitation related activities. The DDCS&PMSCs will ensure quality control and report to the PD. The DDCS&PMSCs will also assist the ESCU for ensuring environmental compliance and monitoring of progress including EMP and/or ECP implementation. The DDCS&PMSC will supervise the contractors, ensuring design compliance and quality of works.For supervising the EMP implementation, DDCS&PMSC will have dedicated and adequately qualified and experienced environmental staff including field-based environmental monitors (Ems).The DDCS&PMSC will supervise and monitor contractors to ensure compliance with the EMP.The DDCS&PMSC 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 (ESs)

481. The construction Contractors will have adequate number of dedicated, properly qualified and experienced, site-based Environmental 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 work remain within acceptable limits. The ESs will maintain coordination with the DDCS &PMSC at the site. The ESs will also be responsible to conduct environmental trainings for the construction crew.

10.3.3 Post-construction Phase

482. BWDB core unit has post of 4 Assistant Chief and 2 Deputy Chief to oversee the overall environmental compliance of BWDB implemented projects. Under CEIP, the ESCUwill provide training to the BWDB people responsible for monitoring of environmental compliance. Thus, smooth transition to BWDB will take place to ensure environmental compliance during O&M after completion of the project. These staff will be responsible to manage the environmental aspects of the operation and maintenance of one Polder, its water control structures, and other relevant issues such as protection of key environmental resources of the Polder and fish migration. Water Management organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (Nov 2000) and involve the beneficiary communities. WMOs will be trained by BWDB to ensure environmental management during project operation. Environmental Management Unit of BWDB will ensure and oversee the environmental management during project implementation and operation. The Water Management Organization will also be trained and involved in EMP implementation during the operation phase.

10.4 Mitigation Measures and Plan

483. Mitigation is an integral part of impact evaluation. The mitigation where is deemed appropriate; the proponent should strive to act upon effects, in the following order of priority:

- To eliminate or avoid adverse impacts, where reasonably achievable.
- To reduce adverse impacts to the lowest reasonably achievable level.
- To regulate adverse impacts to an acceptable level, or to an acceptable time period.
- To create other beneficial impacts to partially or fully substitute for, or counter-balance, adverse effects.

484. Mitigation measures will be considered starting from the Environmental Assessment process. It is thus important, that there should be a good integration between the EIA team and project design engineers. Project specific environmental construction guidelines should be developed. These guidelines will specify precautions and mitigation measures for construction activities, and to be included in the EMP.

485. Impacts identified severe in consequence category and or likelihood category will be further analyzed to identify additional mitigation measures which are potentially available to eliminate or reduce the predicted level of impact. Potential mitigation measures will include:

- habitat compensation program;
- species specific management program;
- engineering design solutions;
- alternative approaches and methods to achieving an activity 's objective;
- stakeholder's participation in finalizing mitigation measures;
- construction practice, including labor welfare measures;
- operational control procedures and
- management systems

486. Mitigation measures during pre-construction, construction and post-construction operation phases have been presented in a tabular form in Table 10.1 Moreover, cost related EMP has been presented in further section.

Table 10-1: Mitigation plan during pre-construction, construction and post construction phases

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
Pre-construction Phase			
Deterioration of Environmental Quality (Air and Noise)	• Construction material (sand etc.) should be covered while transporting and stock piled. • The contractors need to be cautious to avoid unnecessary honking of material carrying trawler. • The contractors should be encouraged to move all	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	construction equipment, machinery and materials during day time instead of night. • Stockyard should be covered during non-working period. • Exhaust emissions from vehicles and equipment should comply with standards. • Vehicles, generators and equipment should be properly tuned. • Water will be sprinkled as and where needed to suppress dust emissions. • Speed limits should be enforced for vehicles on earthen tracks. • Vehicles and machinery should have proper mufflers and silencers.		
Changes in land use	• Establish the construction camps within the area owned by BWDB, wherever available. • Compensation/rent are to be paid if private property is acquired on temporary basis, the instructions should be specified in the tender document. • Construct labor shed/camp at government khas land. • Avoid impacts on local stakeholders.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Impacts on undergrowth herbs and shrubs	• Use barren land or possible low vegetated land for placing of materials stock yards • Fuel wood should be collected from local market. • The work should be completed within the contracted scheduled time (4 month) • Labor should be made aware about local faunal species.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Increased Vehicular Traffic during	• The contractor should prepare a traffic management plan (TMP) and obtain	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
mobilization	approval from the Detailed Design Construction Supervision and Project Management Support Consultant (DDCS&PMSC) ● Contractor should also implement mobilization plan considering water vessels and launch movement in the external rivers and, avoid the time of launch movement. ● The TMP should be shared with the communities and should be finalized after obtaining their consent. ● The TMP should address the existing traffic congestion particularly at Mandartala Bazar and Katalia Bazar. ● Ensure minimal hindrance to local communities and commuters. ● The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes. ● The embankment works should be carried out in segments and soil should be placed linearly on one half of the embankment, leaving the other half for use as track. ● The works of the second half should be undertaken after completion of the first half ● Work schedule should be finalized in coordination and consultation with local representatives and communities, specifically union parishad members of the polder. ● Local routes should not be blocked as far as possible. If unavoidable, alternative routes should be identified in consultation with local community. ● Vehicular traffic should be limited in the Polder area and the embankment during off peak time. To avoid accident, signal man should be		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	appointed during School time (10:00am to 13:00pm) and weekly marketdays (Hatbar) • Keep provision of training Keep provision of training on vehicular traffic moving pattern and management system for the local stakeholders using multimedia presentation and showing Video at different common population gathering places in the Polder area.		
• **Construction Phase**			
Generate Noise and Vibration	• Demolition of the regulators should not be carried out during school time (8 am to 1 pm) particularly near the schools; • Restricting/limiting construction activities during day time; • Noise levels from vehicles, equipment and machinery to comply with the national and WB noise standards; • Vehicles and machinery should have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors, as needed; • Provision of PPE (ear muffs and plugs) to labor; • The construction crew should be instructed to use proper equipment, to minimize noise levels; • Camps should have to be located at safe distances from communities	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Deterioration of Air Quality	• Exhaust emissions from vehicles and equipment should comply with standards. • Proper tuning of vehicles, generators and equipment should be carried out, to minimize exhaust emissions. • Construction materials (sand/soil) should be kept covered while transporting		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	and stock piled. ● Regular water sprinkling should be carried out as and where needed, particularly on the earthen tracks near communities. ● Vehicle speed should be low (15 km per hour) on earthen tracks particularly near communities and school. ● Vehicles and other machinery should be turned off when idle ● Good quality fuel should be used for minimizing exhaust emissions. ● Camps should be located at safe distance from communities and schools.		
Soil and Water Contamination	● Prepare and implement pollution control plan; ● Workshops should have oil separators/sumpsto avoid release of oily water; ● Avoid repairing of vehicles and machinery in the field; ● Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination; ● Dispose contaminated soil appropriately ensuring that it does not contaminate water bodies or affect drinking water sources; ● Contractor should 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 should regularly monitor the condition of its fleet; ● Material borrowed from the river banks should be carried out sufficiently away from the water edge, minimizing the possibility of loosing soil and wash out in the river; ● Contractor should locate	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	camps far away from communities and drinking water sources; ● Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal); ● Release treated wastes on ground or in water; ● Recycle spoil and excavated material where possible; ● Dispose spoil at designated areas with community consent; and ● Construction material, demolished debris and excavated soil/silt should not be allowed to enter the water bodies.		
Increase of Drainage Congestion	● Construct diversion channels before replacement of drainage sluices. ● Sequence of work on the drainage sluices and on the water channels should be carefully planned to avoid drainage congestion. ● Contractor should ensure that drainage channels are not obstructed or clogged by the construction activities which do not causes any drainage congestion situation in the crop fields.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Increasing of Sedimentation	● Contractor should excavate channels after dewatering them properly; ● Contractor should not dump the excavated earth and silt on channel banks; ● Contractor should take necessary measures to protect channels from run-off from working areas and camps; and ● Contractor should obtain borrow material from foreshore areasin such a manner so that there is no increase in siltation on the rivers, and should not leave loose soil after excavation.	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency

Effects on agriculture crop production	• It should be considered a priority to establish borrow-pits in foreshore areas
	• Resettlement Action Plan should be prepared and should also be implemented accordingly
	• Compensation would be made for any crop damage;
	• Contractor would avoid cultivable fields during construction;
	  • Contractor would avoid agricultural land for material borrowing, material stockpiling and labor camps;
	  • Contractor would ensure that no vehicular movements take place through the cultivable fields;
	  • Contractor would ensure that no material is dumped on the cultivation fields;
	  • Re-excavated soil of canals should not be dumped in agricultural land and
	  • Contractor would maintain liaison with the local communities;
	  • Contactor will prepare site specific spoil management and disposal plans for each site to be followed upon approval by the DDCS&PMS Consultant and PMU.
		Contractor	DDCS&PMSC, M&E Consultant, BWDB

Effects on irrigation	• Contractor should construct diversion channels before construction/replacement of each regulator; • Sequence of work of the regulators and the water channels would be carefully planned to avoid irrigation disruption; • Contractor would ensure having no negative impacts on crop irrigation; • Contractor would maintain	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	**Mitigation Measures**	**Responsible Agency for implementation of mitigation**	**Monitoring/Supervision Agency**
	liaison with the local communities; and • Contractor would work during dry season. (between November to May)		
Impacts on Feeding and Spawning Ground of Fish Habitat	• Earth work should be conducted during the dry season (November-May • Sequence of work at the bank sides of Salta and Gangrail rivers will be planned considering local fisheries condtion to minimize impacts on spawning and subsequently nursery ground of fish. • Earth work should be conducted during the dry season (November-February) • Sequence of work at the bank side of Salta and Gangrail rivers will be carefully planned to minimize impacts on spawning and subsequently nursery ground of fish. • Contractor will maintain liason with experienced fishermen.	Contractor	DDSCS&PMSC, M&E Consultant and, BWDB
Impact on fish habitat and migration	• Duration of construction of structures and other interventions should be shortened as much as possible at least should maintained as per the contract period.Most of the Small Indigenous Species (SIS) of fish spawn during the period of November to April and keep important role in the recruitment to next progeny. For this reason, limit the construction and re-excavation activities in the shallow area and/or maintain the alignment of bank side to keep space in other side for accomplishing migration to meet up the biological needs like spawning, feeding etc. • Dismantle bundhs and other obstructions built for supporting	Contractor	DDSCS&PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	the construction of structures as soon as work is over. • In case of manual re-excavation of Khals, compartment could be built and bailing out of water from one compartment to another for less damage to fish and excavate in cascading manner. • Re-excavation of drainage khals will follow the construction of regulators by spanning a shortest possible time. Re-excavation of Khals should be implemented by maintaining the alignment of side so that fish can utilize the space on the other side for its migration. As a result, construction activities will have minimum hindrnace to fish migration. • Sequence of construction of regulators and re-excavation of drainage Khals should be set scientifically in such way so that, implementation of project could be done with minimum hindrnace to fish migration. • Contractor will maintain liaison with communities so that they could realize the issue. It is more important in case of timing of entering water into the Polder for shrimp culture along with paddy cultivation and exiting water from the same. Liaison of contractor with community would create scope for setting proper time for the construction work so that no or less impact to the shrimp farming and paddy cultivation is caused.		
Obstruction of Fish Movement and Migration	• Construct diversion channels before construction of regulator considering fish migration period e.g. May, June, July and August • Most of the Small Indigenous Species (SIS) of fish spawn during the period of		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	November to April and keep important role in the recruitment to next progeny. For this reason, limit the construction and re-excavation activities in the shallow area and/or maintain the alignment of bank side to keep space in other side for accomplishing migration to meet up the biological needs like spawning, feeding etc. ● Dismantle the bunds and other obstructions built for supporting the construction of structures as soon as the construction is over. ● In case of manual re-excavation of khals, compartment would be built and bailing out of water from one compartment to another for less damage to fish and excavate in cascading manner. ● Re-excavation of drainage khals will follow the construction of regulators by spanning a shortest possible time. Re-excavation of Khals should be implemented by maintaining the alignment of side so that fish can utilize the space on the other side for its migration. As a result, construction activities will have minimum hindrance to fish migration. ● Contractor will maintain liaison with fishers and farmers, so that they could realize the issue for minimum impact to the shrimp farming and paddy cultivation. ●		
Impact on timber/ fruit tree	● Give proper compensation to the tree owners against tree felling. It is mentioned here that a detail Ressetlement Action Paln (RAP) is being prepared for Package-3 under CEIP. According to plan, payment to owners against tree felling will be	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	established. ● Implement plantation with native species (i.e Sirish (Albizialebbeck), Narikel (Cocos nucifera), Tal (Boassusflabelifer), Khejur (Phoneixsylvestirs), etc) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works. ● Avoid construction activities during favorable time of wild life movement (early morning and night)		
Impact on aquatic flora and fauna	● Keep untouched the deepest points of the khal as much as possible. ● Use excavated soil spoils for khal dyke re-sectioning ● Implement tree plantation with local species at the khal bank side after re- excavation work where excavated soil dumped khal bank side. ● Use minimum land as much as possible for excavator/ labor movement	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Impacts on river/ foreshore side vegetation	● Aware labors about plant conservation who are engaged for afforestation activities ● Collect saplings from near by natural sources as much as possible. ● All kinds of polyethylene bags and plastic ropes should be piled up in a pit for dumping or burning in proper way ● Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation (i.e. using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers) ● Pre-consultation with Forest Department and other related non-government organizations for selecting suitable species for plantation	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	and spacing of the saplings ● Develop a pest management plan for the holistic afforestation		
Impact on Fish Production	● Provide fisheries training in collaboration with Department of Fisheries (DoF) on environment friendly improved fish/prawn culture technology as well as the rice-cum-golda/fish farming. ● Golda farming will be encouraged through campaign/awareness development. ● Provide skill development training to the fish farmers for more fish/prawn production in gher and ponds. ● Stocking the fresh water fish fry (Carps and other small indigenous fish species) in the khals inside the polder area after completion of construction works.		BWDB, WMA with collaboration of DoF
Safety and Health Hazards	● The contractors should prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants. The Plan should also include awareness building and prevention measures, particularly for communicable diseases such as hepatitis B and C, and HIV/AIDS. ● The WBG's EHS Guidelines should be included in the contract documents and that should be followed during construction. ● Each contractor should prepare an Emergency Response Plan defining procedure to be followed during any emergency. This plan should be submitted to the Construction Supervision Consultants for review and approval;	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• 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. • Liaison should be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets should be kept in all the labor camps for obtaining weather information. • The construction sites should have protective fencing to avoid any unauthorized entry, where appropriate and possible • Health screening of employees would be a Contractors obligation prior to laborers 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 where required; • The WBG's EHS Guidelines will be included in the contract documents. Each contractor will prepare an Emergency Response Plan defining procedure to be followed during any emergency. This plan will be submitted to Construction Supervision Consultants for review and approval; • All employees need to provide induction training on health and safety prior to commencement of work. OHS issues would be part of the employee training plan. Training would include the provision of appropriate written or visual materials to		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	reinforce learning. Illiteracy levels where high, the OHS issues should be covered more frequently than normal in toolbox talks; ● The labour shed/camps for accommodation of workers should be constructed according to the IFC/EBRD workers accommodation guidelines. ● Public awareness training and workshops on safety and health risks should 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) should 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 the rigorous standards for occupational health and safety are in place; ● Contractor should establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	reprisal. ● The contractor should 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; ● Develop a recruitment process of community employees that involves local authorities in clearly understood procedures; ● Employ a community liaison officer (which 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; ● Regularly report the labor force profile, including gender, and location source of workers; ● Report regularly the labor and working condition key performance indicators, for instance hours worked (regular and overtime) during period and cumulatively, hours lost, number and type of accidents, near misses, site audits and meetings; trainings, and use of labor		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	grievance mechanism; ● Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase; ● Organize 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 work environment taking into account the inherent risks for this type of project. ● Availability of safe drinking water should have to be ensured for the construction staff. ● First aid boxes should have to be made available at each construction site. Emergency phone numbers (including hospitals, Fire services, and Police) should have to be displayed at key locations within the site. Each site should be occupied with an ambulance. ● Firefighting equipment should have to be made available at the camps and worksites. ● Waste management plan is to be prepared and implemented in accordance with international best practice. ● Liaison with the community should have to be maintained.		
Increased Inland and Waterway Traffic	● Contractor is to prepare and implement traffic management plan ● Contractor is to establish new, temporary jetties as and where needed. ● River crossing for material transportation should be during night time as and	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	where possible and appropriate • Liaison to be maintained with community and BIWTA.		
Damage to Local Infrastructure	• The condition of the instruments, vehicles and equipment being used for the construction and transportation activities will be regularly monitored. • All damaged equipment should be restored to original or better condition. •		
Social unrest between Local worker and outside worker	• Proper awareness programs should be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, UpazilaNirbahi Officer (UNO) and BWDB local officers. • Liaison with the communities shouldhave to be maintained. • Cultural norms of the local community shouldhave to be respected and honored. • GRM shouldhave to be established to address the grievances of local as well as outside laborers. • To be careful is use of local natural resources and project resources, fuel, fuel-wood and electricity. • Restrictions are to be imposed consumption of alcohol and drugs. • To be careful about safe driving • To respect the local community and the cultural norms in which laborers are working. • Avoid construction activities during Prayer time.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Social unrest between Local worker and outside	• Proper awareness programs should be conducted through public consultation measures	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
worker	such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, UpazilaNirbahi Officer (UNO) and BWDB local officers. ● Liaison with the communities should have to be maintained. ● Cultural norms of the local community should have to be respected and honored. ● GRM should have to be established to address the grievances of local as well as outside laborers. ● To be careful is use of local natural resources and project resources, fuel, fuel-wood and electricity. ● Restrictions to be imposed on consumption of alcohol and drugs. ● To be careful about safe driving ● To respect the local community and the cultural norms in which laborers are working. ● Avoid construction activities during Prayer time.		
Natural hazard	● Weather signals should have to be considered by the contractor during construction works. ● Radio and television should have to be kept in all labor sheds for getting weather information through these media. ● Ensure rigorous standards for occupational health and safety are in place. ● Having the Contractor establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Social and	● Proper awareness programs	Contractor	DDCS&PMSC, M&E

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
Gender Issues	will be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, UpazilaNirbahi Officer (UNO) and BWDB local officers. ● Liaison with the communities will be maintained. ● Cultural norms of the local community will be respected and honored. ● GRM will be established to address the grievances of local as well as outside laborers. ● Careful use of local natural resources and project resources, fuel, fuel-wood and electricity; ● Restrictions related to consumption of alcohol and drugs for foreign workers; ● Safe driving practices; ● Respect for the local community and its cultural norms in which laborers are working. ● Avoiding construction activities during Prayer time.		Consultant, BWDB
Post Construction Phase			
Risk of embankment failure	● Regular monitoring and rigorous maintenance of the embankment and existing water control structures especially along the southern and western side of the Polder should be ensured. This monitoring will particularly be carried out before and after monsoon season. ● Proper dumping and compaction of soil should be ensured during re-sectioning of the embankment. ● Side slope protection works should be maintained with proper design. ● Available cyclone and flood shelter should be prepared as a contingency measure	BWDB	BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	during emergency situation. ● WMG should develop fund for such emergency situation. ● Structural measures like geo bag and sand bag should be kept in the Upazila office for emergency need.		
Increase use of agro chemicals	● 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 would have close contact with DAE for adoption of various measures of ICM. ● Farmers would be encouraged to use organic manure to increase soil fertility while avoiding water contamination. and ● Farmers would be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.	BWDB	BWDB

10.5 Environmental Code of Practice

487. A generic Mitigation Measures for EMP has been presented in Table 10.2 below:

Table 10-2: Generic Mitigation/Compensation Measures/Guideline

(ECoP: Environmental Code of Practice)

Parameter/Activities	Mitigation/Compensation Measure/Guideline
ECoP 1: Soil/ Land Management	
Sources of Material for Earthwork	● During design the segment wise soil requirement and location of the sources of soil for earthwork for each Polder construction/rehabilitation will be identified. ● Selection of Borrow 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 from pollutants ● Disposal of excess soil will be done at site with no objection from DoE and local authority.
Borrowing of Earth	**Borrow Area Selection** ● Borrowing 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 on the following areas.

	● Lands close to toe line and within 500m from toe line. ● Irrigated agricultural lands (In case of necessity for borrowing from such lands, the topsoil shall be preserved in stockpiles. ● Grazing land. ● Lands within 1km of settlements. ● Environmentally sensitive areas such as reserve forests, protected forests, sanctuary, wetlands. Also, a distance of 500 m will be maintained from such areas. ● Unstable side ● 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 borrow areas before commencing the borrowing activity that provide the basis of the redevelopment plan; ● Chainage along with offset distance; ● Area (Sq.m); ● Photograph and plan of the borrow area from all sides; ● Type of access/width/kutcha/pucca etc. from the roadway; ● Soil type, Slope/drainage characteristics; ● Water table of the area or identify 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 photographs of the rehabilitated site from different angles.
Excavation operation and Management of Excavated Material	● To minimize the adverse impact during excavation of material following measures are need to be undertaken: ● Adequate drainage system shall be provided to the excavated area ● At the stockpiling locations, the Contractor shall construct sediment barriers to prevent the erosion 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 their sliding. ● In case of blasting, the procedure and safety measures shall be taken as per DoE guidelines. ● The Contractor shall ensure that all workers related safety measures shall be taken. ● The Contractor shall ensure maintenance of crushers regularly as per manufacturer ‘s recommendation. ● During transportation of the material, measures shall be taken to minimize the generation of dust and to prevent accidents.
Handling Dredged/excavated Material from River/khal	● Deposition of dredged material will be away from the channel edge to limit damage to streamside habitats. This also allows a degree of flooding to occur on the floodplain, thereby creating opportunities for wet grassland, scrub/wet woodland, wetlands and seasonally grazed rough grass. ● Where possible biotechnical engineering, for example geo textiles, may be used to help stabilize the material and aid re-colonization. ● Other possibilities include: drying and spreading the spoil over adjacent land, which can improve soil fertility in some cases, but may also smother important flora and habitats; excavating a trench and infilling it with spoil, thus minimizing disturbance to agriculture and the local

	environment; dumping off-site is possible but expensive, using spoil to create artificial wetlands.
ECoP 2: Water Resource and Hydrology Management	
Hazardous Waste Management	● The contractor will minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes).
Ponding of water/water logging	● Do not allow ponding of water especially near the waste storage areas and construction camps ● Discard all the storage containers that are capable of storing of water, after use or store them in inverted position ● Reinstate relief and landscape ● Monitor drainage pattern after high down pouring and recession flood ● Connect water pockets to the nearest drainage structures/canals
Top Soil management	The Contractor shall ● Water the material stockpiles, access roads and bare soils on an as required to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds) ● All the work sites (except permanently occupied by the road and supporting facilities) will be reinstated to its initial conditions (relief, topsoil, vegetation cover). ● Ensure that roads used by construction vehicles are swept regularly to remove sediment
Construction activitiesin water bodies	● Protect water bodies from sediment loads by silt screen or bubble curtains or other barrier. ● Do not discharge cement and water curing used for cement concrete directly into water courses and drainage inlets ● Monitor the water quality in the runoff from the site or areas affected by dredge plumes, and improve work practices as necessary
ECoP 3: Air Management	
Construction vehicular traffic	● The Contractor will ● Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. ● Operate the vehicles in a fuel-efficient manner ● Cover haul vehicles carrying dusty materials (cement, borrow and quarry) moving outside the construction site ● Impose speed limits on all vehicle movement at the worksite to reduce dust emissions ● Control the movement of construction traffic ● Water construction materials prior to loading and transport ● Service all vehicles regularly to minimize emissions ● Materials will be transported to site in off peak hours.
Construction activities	● Water the material stockpiles, access roads and bare soils when needed 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 worker 's camp shall be located at least 500 m away from

Construction labor Camps	the nearest habitation. ● The waste disposal and sewerage system for the camp shall be properly designed, built and operated so that no odor is generated.
ECoP 4: Noise Management	
Construction vehicular traffic	● Maintain all vehicles in order to keep it in good working order in accordance with manufactures maintenance procedures ● Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise at the work site.
Construction machinery	● Appropriately site all noise generating activities to avoid noise pollution to local residents. ● Maintain all equipment in order to keep it in good working order in accordance with manufactures maintenance procedures.
Construction activity	● Notify adjacent landholders/Schools prior to any typical noise events outside of daylight hours ● Employ best available work practices on-site to minimize occupational noise levels ● Install temporary noise control barriers where appropriate ● Plan activities on site and deliveries to and from site to minimize impact ● Monitor and analyze noise and vibration results and adjust construction practices as required ● Avoid working during 09:00pm to 06:00 am within 500m from residences.
ECoP 5: Ecology Management	
Clearances of vegetation	● Use barren land or possible low vegetated land for placing of materials stock yards ● Fuel wood should be collected from local market. ● The work should be completed within contacted scheduled time (4 month) ● Labor should be made aware about local faunal species ● Collect soil from barren land as much as possible ● Proper turfing should be implemented at embankment slopes with local grasses and ensure regular monitoring of turf grasses till they matured ● Give proper compensation to the tree owners against tree felling. ● Implement plantation with native species (i.e Sirish (Albizia lebbeck), Narikel (Cocos nucifera), Tal (Boassus flabelifer), Khejur (Phoneix sylvestirs), etc) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works. ● Avoid construction activities during favorable time of wild life movement (early morning and night) ● Keep untouched the deepest points of the khal as much as possible. ● Use excavated soil spoils for khal dyke re-sectioning ● Implement tree plantation with local species at the khal bank side after re- excavation work where excavated soil dumped khal bank side. ● Use minimum land as much as possible for excavator/ labor movement
Outbreak plant diseases	● Aware labors about plant conservation who are engaged for afforestation activities. ● Collect saplings from nearer natural source as much as possible. ● All kinds of polyethylene bags and plastic ropes should be piled up in a pit for dumped or burned in a proper way ● Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation (i.e.: using of disease-free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers) ● Pre-consultation with Forest Department and other related non-government organizations for selecting of suitable species for plantation and spacing of the saplings. ● Develop a pest management plan for the holistic afforestation.
ECoP 6: Agriculture Management	
Loss of Top Soil	● Soil from fallow lands/ non-agricultural lands will 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 stockpiles will be done in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil ● Locate topsoil stockpiles in areas outside drainage lines and protect from erosion ● Spread the topsoil to maintain the physico-chemical and biological activity of the soil. ● The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites. ● Topsoil stockpiles will be monitored and if any will adverse conditions be identified. The corrective actionsfor this 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 cultivated. ● Environmentally and socially responsive shrimp farming e.g. shrimp-rice farming system is encouraged. ● Increasing upland discharge of fresh water will push back ingress of saline water from the sea. ● Green manure application is promoted. ● Ground water abstraction for shrimp farming will be avoided.
ECoP 7: Fisheries Management	
Earth work for constructing by pass canal	● Earth work for by pass should be done in dry season. ● By-pass canal should be dismantled just after completing the construction and repairing of sluice gates and re-excavation of khals.
Bailing out of water by manual labor or pump	● Bailing out of water should be done by constructing the compartments in the khals. ● Entire khals should not be closed during construction work.
Construction works for sluice gates and re-excavation of khals	● Construction and re-excavation should be avoided during spawning of the fishes and peak time of fish and shrimp culture in gher. ● Construction work should be done in winter and early dry season (November to February). ● Critical breeding area of small indigenous fish species (SIS) will be identified and declared as sanctuaries. ● Creation of some deeper part in the khals and declared as sanctuaries where brood fish and juveniles may stay during dry season and can breed in the following year. ● Soil removed from the bottom of khals should be placed in safe distance from the bank of khals and compact to avoid the wash out during rainy season. ● Open the sluice gates just after completion of construction and repair work to flow the water.
ECoP 8: Ecology Management	
Clearancesof vegetation	● Use barren land or possible low vegetated land for placing of materials stock yards ● Fuel wood should be collected from local market. ● The work should be completed within contacted scheduled time (4 months) ● Labor should be made aware about local faunal species ● Collect soil from barren land as much as possible ● Proper turfing should be implement at embankment slopes with local grasses (i.e. Durba (Cynodon dactylon), Mutha (Cyperus sp) and ensure

	regular monitoring of turf grasses till they matured ● Avoid construction activities during favorable time of wild life movement (early morning and night). ● Give proper compensation to the tree owners against tree felling. ● Implement plantation with native species (i.e Sirish (Albizia lebbeck), Narikel (Cocos nucifera), Tal (Boassus flabelifer), Khejur (Phoneix sylvestirs), etc) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works. ● Avoid construction activities during favorable time of wild life movement (early morning and night) ● Keep untouched the deepest points of the khal as much as possible. ● Use excavated soil spoils for khal dyke re-sectioning ● Implement tree plantation with local species at the khal bank side after re- excavation work where excavated soil dumped khal bank side. ● Use minimum land as much as possible for excavator/ labor movement
Outbreak plant diseases	● Aware labors about plant conservation who are engaged for afforestation activities ● Collect saplings from nearer natural source as much as possible. ● All kinds of polyethylene bags and plastic ropes should be piled up in apit for dumped or burned in a proper way ● Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation (i.e.: using of disease-free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers) ● Pre-consultation with Forest Department and other related non-government organizations for selecting of suitable species for plantation and spacing of the saplings ● Develop a pest management plan for the holistic afforestation.
ECoP 9: Ecology Management	
Selection of location and construction of labour shades with allied facilities	● Locate the construction camps at areas which are acceptable from environmental, cultural or social point of view. ● Consider the location of construction camps far away from the communities in order to avoid social conflicts in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. ● 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. ● The labour shade should be located at area, 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. ● Ensure adequate housing for all workers. ● Safe and reliable water supply. ● Treatment facilities for sewerage of toilet and domestic wastes. ● Storm water drainage facilities. ● Hygienic sanitary facilities and sewerage system. ● Conduct consultation with communities including local government institutes bodies (Village Head and Group Village Head, Local member of Union Parishad) prior to set-up the camp.
SolidWaste Management	● Ensure proper collection and disposal of solid wastes within the construction camps. ● Establish waste collection, transportation and disposal systems with the manpower and equipment/vehicles needed. ● All solid wastes should have to be collected and removed from the working camps and disposed in approved disposal sites. ● Store inorganic wastes in a safe place within the household and clear

	organic wastes on daily basis to waste collector.
Fuel supplies for cooking and heating purposes	● 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. ● Made available alternative fuels like natural gas or kerosene on ration to the workforce to prevent them using biomass for cooking.
Health and Hygiene	● Provide adequate health care facilities within the construction sites. ● Provide first aid facility round the clock. Maintain necessary stock of medicines in the facility. ● Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. ● Providing training of all workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work. ● Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers; ● Awareness should be built up about communicable diseases and remedies among the labour and the local people. ● Personal Protective Equipment (PPE) should be ensured during work. ● The first aid must be provided among the labour and it should be placed where anyone can easily access. ● Place display boards at strategic locations within the camps containing messages on best hygienic practices. ● Occupational Health and Safety (OHS) should be followed strongly including safe drinking water, displaying poster proper instruction of first aid boxes, emergency phone number, safety equipment etc.
Payment of Wages	● The payment of wages should be as per the Minimum Wages Act. ● To display boards in local languages showing the minimum wages at labour camps ● Contractor is required to maintain a register for payment of labor wages with entry of every labour working for him.
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 etc., graveyards, monuments and any other important structures as identified during design and all properties/ sites / remains notified. ● All conservation and protection measures should be taken up as per design. Access to such properties from the road shall be maintained cleared and cleaned. ● Not block access to cultural and religious sites, wherever possible. ● Stop construction works that produce noise (particularly during prayer time). ● Take special care and use appropriate equipment when working next to a cultural/religious center. ● Stop work immediately and notify the site manager/Team leader, if during construction, an archaeological or burial site is discovered. It is an offence to recommence work in the vicinity of the site until 'approval to continue' is obtained by the archaeological authority. ● Resolve cultural issues in consultation with local leaders and supervision consultants. ● Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works so as to maintain effective surveillance over public health, social, and security matters.
Risk from Hazardous Activity	● All workers employed on mixing material, cement, lime mortars, concrete etc., should be provided with protective footwear and protective goggles. Workers, engaged in welding works, should be provided with welder's protective eye-shields. Stone-breakers should be provided with protective goggles and clothing and should be seated at sufficiently safe intervals.

10.6 Chance-Find Procedures for Physical Cultural Property

488. 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, including:

- Stop work immediately following the discovery of any materials with possible archeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;
- Protect artifacts as far as possible using plastic covers, and implement measures to stabilize the area, if necessary, to protect artifacts properly;
- Prevent and penalize any unauthorized access to the artifacts; and
- Restart construction works only upon the authorization of the relevant authorities (e.g. Upazila Nirbahi Officer, Deputy Commissioner and Department of Archeology).

10.7 Monitoring Plan

489. Extensive monitoring of the environmental concerns of the CEIP project will be required as per World Bank guideline. The monitoring program will help to evaluate: (i) the extent and severity of the environmental impacts against the predicted impacts and baseline; (ii) the performance of the environmental protection measures or compliance with pertinent rules and regulations; (iii) trends in impacts; and (iv) overall effectiveness of the project environmental protection measures. The monitoring plans will 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 will be created, which will help to evaluate the impacts easily.

490. The Monitoring activities during design/preconstruction period are:

- Checking the contractor's bidding documents, particularly to ensure that all necessary environmental requirements have been included; and
- Checking that the contract documents' (Environmental Social Management Action Plan) references to environmental mitigation measures requirements have been incorporated as part of contractor's assignment and making sure that any advance works are carried out in good time.

491. Environmental monitoring during construction phase is a function of supervision, and the essential purpose is to ensure adherence to the EMP. The monitoring is a 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 DDCS & PMSC on regular basis. Additional monitoring will be carried out by the Environmental, Social and Communication Unit (ESCU).

492. 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 the environmental management point of view. In addition to this activity, information on the locations, type and consequences of flooding, erosion, flora and fauna mortality, availability of fish, occupational shift, migration is required. Recommended air, noise

and water quality monitoring, greening and landscaping and community feedback are also included in the Monitoring Plan. The monitoring plan and details of monitoring locations for environmental condition indicators of the project during the construction and operation stage are presented in Table 10.2 and Table 10.3

Table 10-3: Environmental Monitoring Plan during Construction and Operation phase

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	**Supervised by**
Pre-Construction phase					
Labor health and sanitation facilities	Work sites	Visual observations, digital camera and checking record book	Twice in project implementation period	BWDB, Contractor	BWDB, Consultant
Construction phase					
Sources of Material	Work Site	Possession of official approval or valid operating license of materials suppliers (Cement, soil).	Before an agreement for the supply of material is finalized.	Contractor	DDCS & PMSC and M&E Consultants, BWDB
Operation of borrow site	Borrow pit/site	Visual inspection of borrow site and ensuring operational health and safety	monthly	Contractor	DDCS & PMSC and M&E Consultants, 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	DDCS & PMSC and M&E Consultants, BWDB
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	DDCS & PMSC, BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DDCS & PMSC, BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Daily	Contractor	DDCS & PMSC, BWDB
	Material storage sites	Visual inspection to ensure dust suppression work	Monthly	Contractor	DDCS & PMSC

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
		plan is being implemented			
Noise	Construction sites	Visual inspection to ensure good standard equipment are in use	Weekly	Contractor	DDCS & PMSC and M&E Consultant, BWDB
	Construction sites	Ensure work restriction between 09:00 pm-6:00 am close to School/ Madrasha, Hospital & Villages	Weekly	Contractor	DDCS & PMSC, M&E Consultant andBWDB
	Construction sites and nearby communities	Recording noise level of work sites and nearby communities, if applicable	At the beginning and monthly	Contractor	DDCS&PMSC, M&E Consultants and BWDB
	Manually CC block preparing sites	Ensuring proper quality of equipment/vehicle to reduce noise level	Throughout	Contractor	DDCS&PMSC, M&E Consultants and 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	DDCS & PMSC, M&E Consultant andBWDB
Drinking Water Quality(TDS, Turbidity, pH, FC, as if groundwater etc)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality	yearly	Contractor through a nationally recognized laboratory	DDCS & PMSC, M&E Consultants and BWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid wastes and wastes is deposited at designated site	Weekly	Contractor	DDCS & PMSC, M&E Consultant and BWDB
	Manually CC block preparing sites	Proper management of waste and waste water	Weekly	Contractor	DDCS&PMSC, M&E Consultants and BWDB
Water Quality	Water bodies near nursery	Odor and chemical testing	Dry season	Contractor through nationally recognized laboratory	DDCS & PMSC, M&E Consultant and BWDB
Waste	Work site and	Visual inspection	Weekly	Contractor	DDCS &

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Management	Nursery	of collection, transportation and disposal of grasses, debris and is deposited at designated site			PMSC M&E Consultant andBWDB
	Work site and Nursery	Visual inspection of Water bars & cut-offs. sediment traps to prevent water pollution caused by run-off from harvesting areas	Beginning of work	Contractor	DDCS & PMSC. M&E Consultants and BWDB
Top Soil	Storage area	Top soil of 0.15 m depth should be excavated and stored properly	Beginning of earthwork	Contractor	DDCS & PMSC, BWDB
	Storage area	The stored top soils should be used as cladding material over the filled lands	Immediately after filling and compaction of dredge materials	Contractor	DDCS & PMSC, 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	DDCS & PMSC and BWDB
Clearance of vegetation	Each of construction sites at embankment (11 km.) and proposed khal bank (21 km.) of both side	Survey and comparison with baseline environment	Quarterly	Contractor through nationally recognized institute	DDCS & PMSC, M&E Consultant and BWDB
Plant species selection	Nursery	Visual quality checking of selected plant species and to be planted of selected areas	Before plantation	Contractor	DDCS & PMSC, M&E Consultant and BWDB
Waste Management for afforestation	1.Afforestation sites are: a) Boyarsing, b) Monohorpur, c) Baratia, d)Kulbaria villages,	Poly bags, debris etc waste materials are disposed at selected sites	Weekly	Contractor	DDCS & PMSC and BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
	2. Nursery				
Construction and repair of drainage sluices	Construction site	Physical Observation	Weekly	Contractor	DDCS & PMSC and BWDB
Bailing out of water from khals	Construction site	Physical Observation	Weekly	Contractor	DDCS & PMSC and BWDB
Re-excavation of khals	Construction site	Physical Observation	Weekly	Contractor	BWDB
Engaged local labour in the Polder area	Polder area	Checking address to record book and National Identity Card or Chairman certificate	During routine monitoring	Contractor	DDCS & PMSC andBWDB
Sanitation	Construction camp/site	Visual Inspection	Weekly	Contractor	DDCS & PMSCM&E Consultant andBWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid waste and other depositions at designated site	Weekly	Contractor	DDCS & PMSC,M&E Consultant andBWDB
Operation phase					
Surface Water Quality (TDS, Turbidity, pH, 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
Crop production	In the Polder area	Compare the production with the baseline	3 (Three) cropping season	BWDB through a nationally recognized institution	M&E Consultant
Soil quality	In the Polder area	Compare the soil quality with the baseline	Two (2) times of year (dry & wet season)	SRDI, BARI, DU	M&E Consultant
Soil salinity	In the Polder area	Compare the soil salinity with the baseline	Onc (1) times of year (dry season)	SRDI, BARI, DU	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	In the project area	Visual inspection and public	Yearly	BWDB	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
structure		feedback			
Erosion	Along Alignment	Visual Inspection presence of gullies or erosion	Yearly	BWDB	M&E Consultant
Growth and death ratio of planted saplings and turfed grasses	Proposed afforestation areas are a) Boyarsing, b)Monohorpur, c) Baratia, d)Kulbaria villages	Survey and comparison with baseline environment	Yearly	Contractor	DDCS & PMSC, M&E Consultant and BWDB
Fencing preparation		Visual inspection of fencing condition	Monthly		
Faunal diversity	Proposed afforestation area	Survey and comparison with baseline environment	Yearly		DDCS & PMSC, M&E Consultant and BWDB
Fish Species Diversity	Khals and Sluice Gates adjacent River	Catch Assessment and Physical Observation	Two times per year (dry & wet season)	BWDB/ WMA	BWDB with collaboration of DoF
Habitat Condition	Khals and Sluice Gates adjacent River	Physical Observation and Testing of Water Quality Parameter (i.e. DO, pH, Salinity and Turbidity etc.)	Quarterly four times per year (dry & wet season)	BWDB/ WMA	BWDB with Collaboration of DoF
WMOs formation and activities	Polder area	Activities of WMOs	Every three month per year	BWDB with the help of GO/NGO	BWDB and Consultant
Fish swimming speed or velocity	In the project area	Measurement of water velocity	Once in a Week	WMO with help of UFO	M&E Consultant
Operation of fish pass	In the project area	Visual inspection and fishermen feedback	Reound the year	BWDB	M&E Consultant

Qualitative Spot-Checking Indicators

493. Moreover, a rapid environmental monitoring will be carried out according the following checklist 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
Provision and use of PPE			
Camp Site			

Parameter	Visual Judgment		
	Poor	Moderate	Satisfactory
Management			
Plant Site Management			
Borrow Area Management			
Top Soil Prevention			
Waste Management			
Provision of safe drinking water , sanitation and first aid facility			
Occupational Health and Safety			
Stockpiling of construction materials			
Reporting and Documentation			

Third Party Validation

494. 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 remediation.

10.8 Documentation, Record keeping and Reporting

10.8.1 Record Keeping

495. 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 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. ESC unit will assist BWDB for keeping these records initially. The trained BWDB staff will take the responsibility of record keeping and monitoring during operation phase.

10.8.2 Monitoring Records

Quantitative Physical Monitoring

496. 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. DDCS & PMSC will regularly monitor and provide information to ESCU for updating the database. DDCS &PMSCwill 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" (approximately 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.

497. 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

498. A Site Inspection Checklist for recording the findings of the general site condition surveys would be developed by the respective contractors, on the basis of the Environmental Mitigation Plan described in Chapter 6, during the construction phase. The Site Inspection Checklist would be supported by sketches, as necessary.

Information Sources

499. A complete and up-to-date file of all relevant sources of information will be maintained by the ESC unit of PMU. This file would be readily accessible and include, as a minimum, copies of the following documents:

- Current environmental permits and consents;
- Action to fulfill the requirement of annual site clearance for Polder area
- All relevant national regulations, international guidelines and codes of practice;
- Manufacturers' MSDSs for all hazardous substances used on the plant;
- Manufacturers' operating manuals for all environmental monitoring equipment;
- Current calibration certificates for all equipment which requires calibration by an external organization; and
- The latest version of this Environmental Management and Monitoring Plan.

Non-Compliance Report

500. Any breaches of the acceptable standards specified, would be reported to the PMU using a standard form, i.e. a Non-Compliance Report (NCR).

501. A copy of each completed NCR would be kept on file by DDCS & PMSC, to be replaced by the replied copy when it is received. A record of corrective actions would also be made and tracked to their completion.

Monthly Internal Reports by DDCS&PMSC

502. The DDCS&PMSC will prepare a monthly report for issuance 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.

Bi-annual Environmental Monitoring Report

503. ESC unit of BWDB will prepare the Bi-annaul monitoring report on which will include the environmental monitoring and the plan for next 6 months during construction phase and will submit to the World Bank for review. The progress report will summarize the information presented in Table 10.2 and Table 10.3 respectively.

Environmental Audit Report & Third-Party Monitoring Report

504. It is expected that BWDB will conduct annual environmental audit. In addition, the environmental audit will be carried out before the mid-term evaluation and before project closing. All Environmental Audit Report will be shared with the Bank. Environmental monitoring will be conducted by the Third-Party Monitoring Team during project implementation. The Third-Party Monitoring report will also be shared with the Bank.The Bank would also supervise the environmental compliance as part of regular implementation support missions.

10.9 Contractual arrangements for EMP implementation

505. Since many contractors do not have clear understanding on the need of environmental management, some quotes very low price for implementation of EMP and eventually cannot implement EMP as per design. To avoid this problem, fixed Budget will be assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting. The contractor needs to submit a Construction Environmental Social Action Plan (C/ESMP) based on the EIA in line with the construction schedule and guideline. The C/ESMP needs to be reviewed by the DDCS&PMS Consultant and cleared by BWDB and World Bank.

10.9.1 Guideline to Incorporate Environmental Management in Bid Document & Preparation of C/ESMAP

- Prepare cost estimates, to be incorporated in the Bid Documents.
- Environmental Management Plan along with the good environmental construction guidelines to be incorporated in the bid document ‘s work requirements.
- Preparation of work requirement (addendum/corrigendum to Polder& hydraulic structure construction/afforestation) and
- Corrigendum / Addendum to Polder/embankment specification, if any, as special provisions to be incorporated in bid document.
- Penalty clauses for not complying with EMP requirements to be incorporated. Indicative penalty clauses proposed in the CEIP are presented below (Addendum to Clause 17.2 Contractor ‘s Care of the Works of FIDIC).

- The contractor has to follow all traffic safety measures as defined in the technical specification. Damage shall be levied at the rate Tk. 3000/- per day per location for non – conformity of traffic safety measures as per the decision of the engineer.
- The contractor has to follow all environmental mitigation measures as defined in the technical specification read along with the Environmental Management Plan for the specific CEIP activities. Damage shall be levied at the rate Tk. 3000/- per day per location for nonconformity of Environmental Management Plan measures as per the decision of the BWDB Engineer.
- The contractor has to ensure that prior to every monsoon season, during the construction period; all 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), will be provided to staff and labor all times 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.

10.10 Guideline for Compensation and Contingency Plan during Project Period

506. Compensation becomes necessary when project impacts cannot be satisfactorily mitigated. This can be paid in cash or kind and the emphasis will be on ensuring fairness and causing minimum inconvenience to the affected party. The most common cause of compensation payment is displacement of people and loss of productive land due to land acquisition, tree cutting, or property damage. Such impacts can rarely be fully compensated. The compensation will be given as per provision of the Resettlement Action Framework. Any disputes over the compensation will be handled by the Grievance Redress Committee.

507. In addition to the compensation, water management projects should also have a contingency plan to deal with emergencies and accidents. Such incidences encompass a whole range of situations from personal injury during operation of a machine to breaching of an embankment. Therefore, BWDB would be prepared for the following emergency situations:

- Embankment failure during a flood – keep sufficient 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 first aid boxes at the work site and project office. Have a plan for quickly transporting a seriously injured person to the nearest hospital.

10.11 EMP Implementation Cost

508. The estimated costs for the environmental management and monitoring activities are set out in Table 10.4 and Table 10.5 respectively.

Table 10-5: Tentative Cost Estimates for Environmental Management

Item No.	Description	Cost Million BDT	Cost Million $	Responsible Agency	Timeframe
1	Construction of alternative or bypass channels at each construction sites.	5.6	0.07	Contrctor	During pre-construction and construction
2	Installation of fugitive particulate matter system and Spraying water on embankment/road	0.5	0.00625	Contrctor	During pre-construction and construction
3	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils	Budget included in RAP		Contractor	During pre-construction
4	Awareness program on plant and wild life conservation.	0.02	0.00025	BWDB	During post-construction
5	Consultancy services cost for supervision and monitoring of EMP	1	0.01	BWDB	During post-construction
6	Training to the farmers with field demonstration regarding IPM and ICM.	0.4	0.005	BWDB with help of DAE	During post-construction
7	Training to the fisherman/pond owner with field demonstration regarding pond culture.	0.04	0.0005	BWDB & WMO with help of UFO	During post-construction
8	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1	0.0125	BWDB	During post-construction
9	Updating EMP as per	1	0.0125	BWDB	During post-

Item No.	Description	Cost Million BDT	Cost Million $	Responsible Agency	Timeframe
	requirement.				construction
10	Establishment of Fish Sanctuaries in khals for the Conservation of indigenous Fishes and stocking of Threatened Fish species and Brood Stock of Indigenous Small Fish Species (2 Nos. Sanctuaries-One sanctuary in each khals @ 0.1 million BDT)	0.04	0.0005	BWDB with cooperation of DoF	During operation
11	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	1	0.0125	Contractor, BWDB	During construction and post-construction
12	Training to WMA on “Integrated water Management and Operation and Management of Sluice Gates”	1.5		BWDB	During operation
13	Compensation for trees	Budet Included in Afforestation Plan		BWDBwith a consultation of Forest Department	During construction
14	WMOs monitoring cost	1	0.00625		
15	Construction of fish pass friendly structure (one fish pass)	61	0.690112652	Contractor, BWDB	During construction
	Optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes				
Total Cost		**74**	**0.826**		

Table 10-6: Tentative Cost Estimates for Environmental Monitoring

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
1	Soil quality monitoring including N,P,K, S, Zn, salinity, organic Matter, pH etc. samples in Polder 17/2 = 6 samples x 3 times @ Tk.5,000	300,000	3.75	Contractor	During pre-construction, construction and post construction period phases
2	Monitoring of Fish	800,000	10	Contractor	During

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	Biodiversity, Fish Migration, Fish Production			with help of UFO	construction and post-construction
4	Fish swimming speed or velocity and depth preference	150,000	1.8	Contractor with help of UFO	During post-construction
5	Crop Production/Farm Survey for four (4) times of year (dry & wet season).	60,000	0.75	Contractor with help of UFO	During post-construction
6	Air and noise quality monitoring and analysis.	500,000	6.25	Contractor	During construction
7	Surface and ground Water quality monitoring cost (testing for Turbidity, pH, DO, BOD, Salinity etc. + test of As, e etc. for HTWs at workers' camp site) 6 samples in Polder-17/2 during pre-construction, construction and post-construction periods + water quality analysis of HTWs of 10 workers' camp	500,000	6.25	Contractor	During construction and post-construction phases
8	Benthic fauna analysis	200,000	0.0025	Contractor & DOF	Before, during and regularly after construction
9	Diversity of Flora and fauna	200,000	2.5	Contractor	During construction and post-construction phases
	Total Cost	**2,710,000**	**31.3025**		

10.12 EMP Updating

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

10.13 Afforestation Plan

510. Embankment slope area will be planted with different fruit yielding, medicinal and timber plants. 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 and middle row along the slope can be planted with *Tamarindus indica* (Tamarind/Tentul), *Acacia nilotica* (Gum Arabic/Babla), *Borassus flabellifer* (Palmyra Palm/Tal), *Cocos nucifera* (Coconut/Narikel) and *Phoenix sylvestris* (Date Palm/Khajur) at a spacing of 2M (6.5 ft) apart. The upper row can 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 shallow rooted bushy plants which are available in local area. The *Tamarindus indica* (Tentul) and *Acacia nilotica* (Babla) seedlings have to 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 *Borassus flabellifer* (Tal), *Cocos nucifera* (Coconut/Narikel) and *Phoenix sylvestris* (Date Palm/Khajur) seedlings may be purchased from local nurseries. Planting of 2,500 seedlings will make one ha slope plantation. As per that estimation, a total of 15,750 nos of saplings can be planted along the slope of 7.0 Km embankment length.

511. About 2.15 ha foreshore area will be planted with mangrove species to protect against tidal surges, wave attack and strong winds in order to reduce toe erosion and to stabilize the embankment. The areas selected for afforestation in this are shown in detail in Map 5.2. The available foreshore area of the Polder can be planted with suitable mangrove species. *Sonneratia apetala* (Mangrove Apple/Keora), *Avicennia officinalis* (Indian Mangrove/Baen) and *Nypa fruticans* (Nipa Palm/Golpata) can be selected as the suitable species for this Polder. Golpata will be planted only along the strips of river and canal banks with an available area of about 0.93 ha. Average distance between two saplings will be 1.5 m for Baen/Kewra sapling and 2.0m for Golpata plantation to makeup the forest cover. In addition, the denuded area of existing forest patches will be planted under enrichment and mound plantation technic. By this way, about 4,000 mangrove saplings can be planted in 0.93 ha of available foreshore area of this Polder. Figure 10.2 shows the typical cross-section of afforestation.

512. Type of plantation and tentative area are given in following table:

Table 10-7: Details of Plantation types and available area for afforestation of the Polder

Sl. No.	Plantation Type	Sub-type	Approximate Area (ha.) for Plantation	Required Saplings (Nos)/Ha	Total Required Saplings (Nos) for the Polder
1	Embankment Slope Plantation		6.30	2,500	15,750
2	Foreshore Plantation	Golpata Plantation	0.94	2,500	2,347
		Mound Plantation	0.39	1,600	618
		Enrichment Plantation	0.54	300	163
		Kewra-Baen Plantation	0.29	4,444	1,268
Total			8.45		20,145

(Ref: Final Interim Report on Additional Tasks Assigned, Volume-III, September, 2013, Page: III-21).

513. 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.

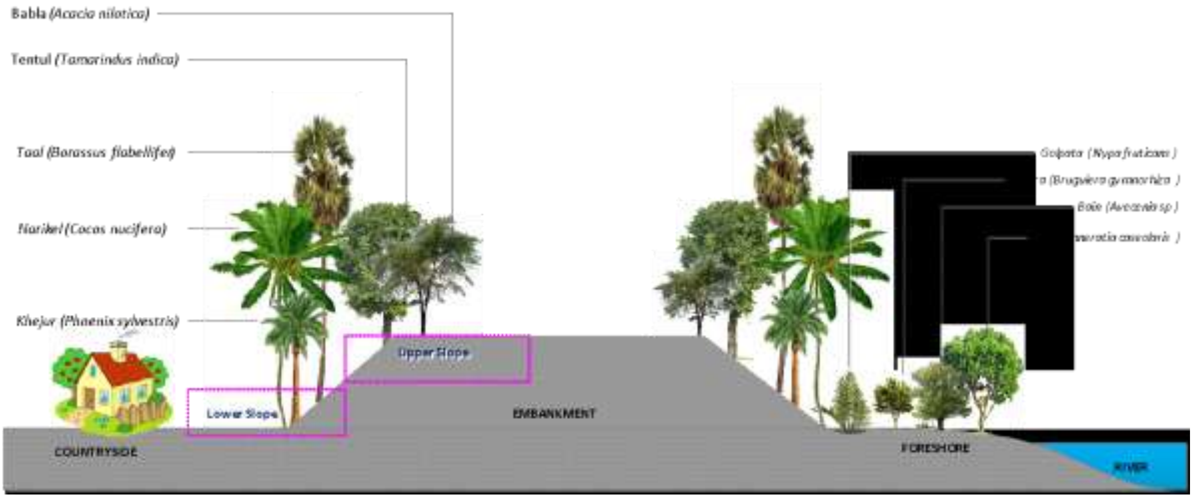


Figure 10.2: Typical cross section of Embankment slope and Foreshore Afforestation

514. Detail Plantation establishment Matrix is presented in following Table 10.8.

Table 10-8: Detail Plantation establishment Matrix

Item of works	Time schedule for the given type				
	Nypa Plantation	**Enrichment Plantation**	**Keora Baen**	**Mound Plantation**	**Polder Slope Plantation**
Selection of site, survey the site and prepare plantation site map.	March	January	February and March	February	February
Preparation of mounds	n.a.	n.a.	n.a.	March	n. a.
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.	March	April 1st week.
Pit making	n.a.	March 2nd week.	n. a.	March 3rd week.	April 1st week.
Application of Compost	n.a.	March 4th week.	n. a.	April 2nd week.	April 3rd week.
Stacking	May 3rd week.	April 1st week.	n. a.	April 4th week	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 (after the first shower)	April 4th week.
Planting of	June 1st	April 4th	May be 1st or	Immediately	Immediately

Item of works	Time schedule for the given type				
	Nypa Plantation	**Enrichment Plantation**	**Keora Baen**	**Mound Plantation**	**Polder Slope Plantation**
seedlings.	week. Immediately after bringing seedlings from the nursery.	week.	2nd week of May.	after bringing the seedlings.	after bringing the seedlings.
Fixing of red flags indicating planting sites to avoid fishing.	May 4th week.	n. a.	n. a.	n. a.	n. a.
Application of fertilizers.	n. a.	After of week of planting the seedling.	n. a.	After a week of planting seedlings.	After of week of planting.
First weeding	August 1st week	May 4th week	May 4th week, 1st year.	June 1st week.1st year.	May 2nd week, 1st year, to be done by the watcher free of charges.
Second weeding	November 1st week	June 3rd week	June 1st week.1st year.	June 4th 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.	July 4th week 1st year.	May 1st week, 2nd year, to be done by the watcher free of charges.
Fourth weeding		August 4th week.	May 1st week. 2nd year.	July 1st week. 2nd year.	August 1st week, 2nd year, to be done by the watcher free of charges.
Fifth weeding with light pruning if necessary.	n. a.	April 1st week next year.	October 1st week. 2nd year.	August 4th week. 2nd year.	n. a.
Sixth weeding (Climber cutting)	n. a.	June 1st week next year.	n. a.	n. a.	n. a.
Seventh weeding (Climber cutting)	n. a.	August 1st week. Next year.	n. a.	n. a.	n. a.
Pruning.	n. a.	n. a.	n. a.	October 4th week	n. a.

Item of works	Time schedule for the given type				
	Nypa Plantation	**Enrichment Plantation**	**Keora Baen**	**Mound Plantation**	**Polder Slope Plantation**
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.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.
Since these activities are related to biological science the time frame may not be kept very rigid. Some adjustments may be required depending on rainfall, temperature, wind speed, tide, etc.					

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

10.14 Grievance Redress Mechanism

515. BWDB will establish a grievance redress mechanism (GRM) as a means to ensure social accountability and to answer to queries and address complaints and grievances about any irregularities in application of the guidelines adopted in this EMF for assessment and mitigation of social and environmental impacts. Based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly, saving the aggrieved persons from having to resort to expensive, time-consuming legal action. The procedure will however not pre-empt a person's right to go to the courts of law.

10.14.1 Grievance Redress Focal Points

516. 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 PMO, Dhaka. 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

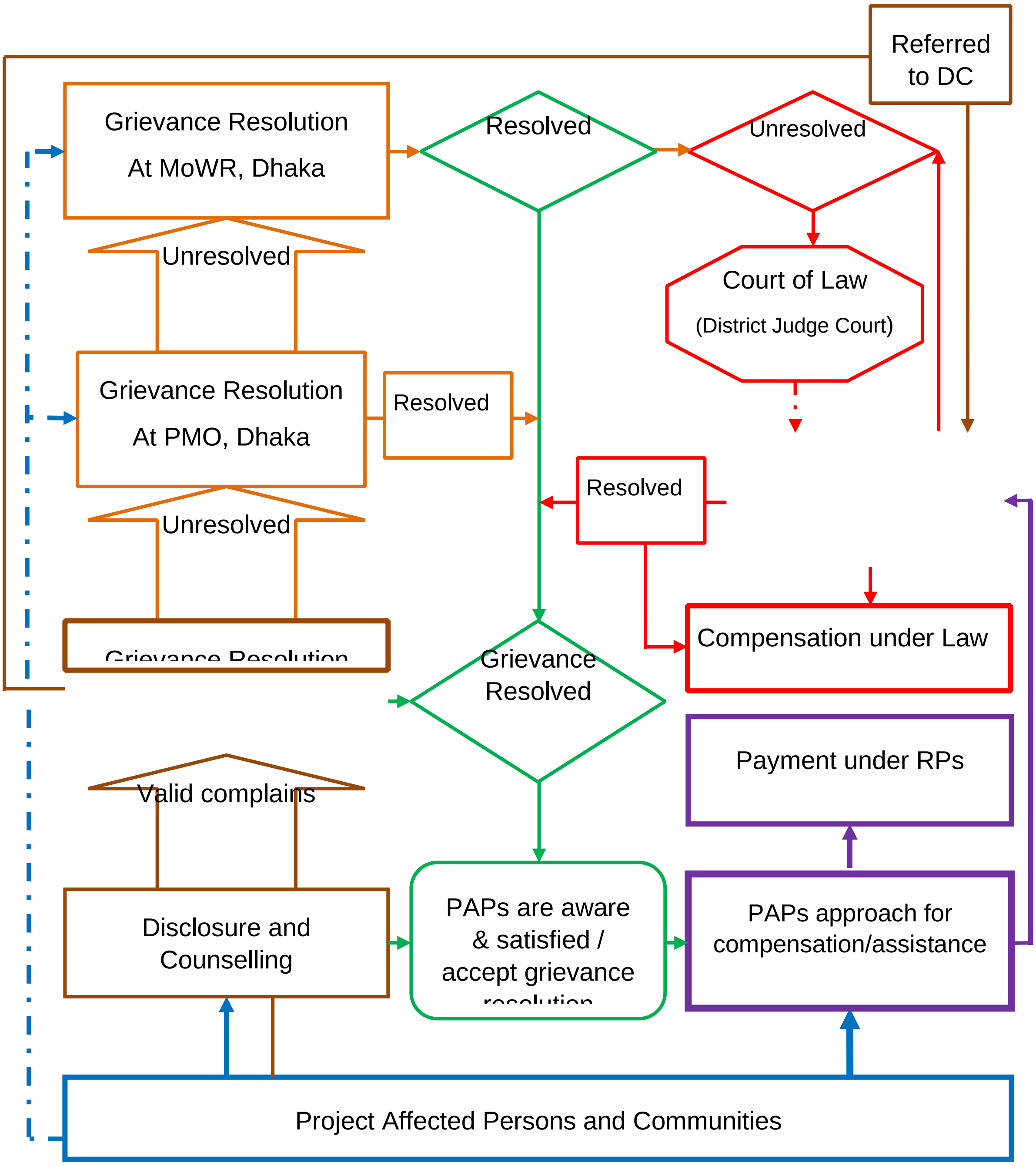
1. Executive Engineer (BWDB Division Office)	:	Convener
2. Representative of the RP Implementing NGO	:	Member-Secretary
3. Local UP Chairman /Ward Councillor	:	Member
4. Teacher from Local Educational Institution (nominated by Upazila Administration)	:	Member
5. Representative from Local Women's Group	:	Member
6. Representative from the PAP Group	:	Member

517. Members of the GRCs will be nominated by the Executive Engineer at Division level and approved by the Project Director, PMO, BWDB, Dhaka.

10.14.2 Grievance Resolution Process

518. 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.

519. 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 PMO for further review. The Project Director will assign the ESCU at PMO 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.



DC/District LA Office

Figure 10.3: GRM Process Flow Chart

520. 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 without 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:

- Where a GRC member is removed, appoint another person in consultation with the Project Director.

521. 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.

10.14.3 GRM Disclosure, Documentation and Monitoring

522. 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 EIAand the GRM in the form of information brochures will be distributed among the project affected persons. The PAPs will also be briefed on the scope of the GRC, the procedure for lodging grievances cases and the procedure of grievance resolution at the project level.

523. 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:

524. **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.

525. **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.

526. **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.

527. 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 PMO will also prepare periodic reports on the grievance resolution process and publish these on the BWDB website.

10.15 Capacity Building

528. 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 10.9 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.

529. 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 10-9: Environmental Trainings

Contents	Participants	Responsibility	Schedule
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area.	Selected BWDB officials; PMU; DDCS & PMSC staff	DDCS & PMSC & 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; DDCS & PMSC; selected contractors' crew	DDCS & PMSC & 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

530. Capacity building training programs will be undertaken in the following area:

- Training of the management level officials of BWDB, BWDB environmental compliance personnel on the overall environmental concerns and responsibilities for implementing EMP
- Recruitment of new professionals with background on environment, if required and provide necessary training
- Organizing workshop, seminar, with stakeholders on the environmental concerns of CEIP

- Special training program for the contractors and workers on the EMP and their responsibilities, who will actually be involved in the construction of the project interventions. The Contractors will be provided guideline for preparation of Environmental Action Plan in line with the construction workplan.
- Training of the WMOs on successful operation of hydraulic structures
- Training on structured format in reporting for all stages of implementation and those of relevant agencies who are involved in EMP implementation.

531. The training programs will be arranged before implementation of the interventions in the Polder area. Detailed plan can be made by the proposed ESC Unit of BWDB.

10.16 Risk Assessment and Mitigation Measures

532. Risk assessment in a development project involves the identification or recognition of weaknesses and gaps in the project and evaluation of their potential threats to the sustainability of the project. The rehabilitation works in Polder17/2 have the dual purpose of prevention of saline water intrusion into the Polder area and agricultural improvement within that area. The expected positive impacts from the project interventions have been summarized below, while the potential adverse impacts have been identified and quantified above as well as their mitigation measures have also been suggested in this report. Yet, challenges or threats do remain in two sectors, which are addressed in this section. These relate to (a) navigation (b) function of water management association and (c) fish migration and movement.

10.16.1 Navigation

533. Navigation in the inland waterways is an important aspect of the coastal economy - facilitating the movement of people and commodities. Hence, emPoldering areas are likely to obstruct normal navigational operations in the rivers and connecting khals, and this issue could be a matter of concern in Polder 17/2. However, since the early construction of Polders in the 1960s, the problem was recognized and analyzed to reach the conclusion that, in most cases, the benefits obtained from the construction of Polders far outweigh the navigational losses. Field visits to Polder 17/2 also revealed that water bodies and internal khals in the project area are used for transportation of goods and persons, but there is not much marked demand for water traffic to and from the Poldered area and the neighboring sites outside the Polder. Drainage sluices and sluice gates are provided in the Polder, which are being rehabilitated under this project. The gates in those structures are also operated in regular intervals to restrict salinity intrusion. However, such gates or boat passes in the embankment for allowing navigation through the embankment to and from the Polder would allow large volumes of saline water inside the Polder and may damage the soil, water and land – destroying crops.

534. However, in order to maintain navigation scenario, an arrangement may be made for lifting or pulling on rail of small size country boat from one side to other side i.e. river side to country side and vise-versa for navigation purposes. This arrangement will not allow entry of saline water inside the Polder thus would not damage soil, water, land and crops.

10.16.2 Function of Water Management Association

535. This project has aimed at rejuvenating the Water Management Organizations (WMO) in the Polder, which consists of a three-tier organizational structure with Water Management Groups (WMG) at the bottom of the hierarchy, Water Management Association (WMA) at the

mid-level and Water Management Federation (WMF) at the top. The main functions of the WMOs are supposed to be assisting and participating in the operation and maintenance of the Polder. However, at the moment, there are no active WMOs on site, and their activities are almost non-existent. The disrepair and lack of maintenance of the Polder in the past due to financial inadequacies of the WMOs as well as insufficient support from the BWDB had contributed to the general decay of the Polder's structure and utility. In the past, there was usually no fund allocated for the WMOs' functions and needs. In Table 5.15 above, a long list of duties and responsibilities of different tiers of WMOs has been provided, which – if successfully performed and implemented – would greatly contribute to the sustainability of the project. It is, therefore, recommended that the project should (i) ensure the organization/formation of the WMOs before operation of the gates, training them in the operation of structures etc., as well as in records/accounts keeping, and collaboration with NGOs, and CBOs, and most importantly. This would help in developing ownership of the WMA for realization of benefits from the Polder without hampering the hydrological and environmental settings of the Polder (ii) In addition to activation of WMOs, BWDB may recruit sluice khalashi for each of the Drainage Sluices for smooth operation of the gates as per initial practice (iii) provide budgetary allocation in the post-operation phase for the O & M related tasks of the WMOs (iv) In addition, borrow pit, embankment slope, water bodies in the khas land may be provided to the WMOs as an income generating sources for their sustainability.

10.16.3 Fish Migration and Movement

536. The peak velocity considered in designing of drainage sluices ranges from 3-4 m/s. The sustainable velocities of the indicative fish species are estimated in the range of 0.46 m/s to 1.1 m/s and burst velocities are in the range of 1.75 m/s to 4.2 m/s (Section 6.2.10). It is noted that burst velocities of fish are applicable for capturing prey as the duration is only for seconds. Considering designed peak velocities of drainage sluices and the estimated sustainable velocities of the indicative fishes, it is observed that no fish will be able to pass through the gates. Gradual decrement of the discharge and corresponding velocity at some stages the fish can move against the current and eventually can pass through the gates if attain the velocities congenial for such species.

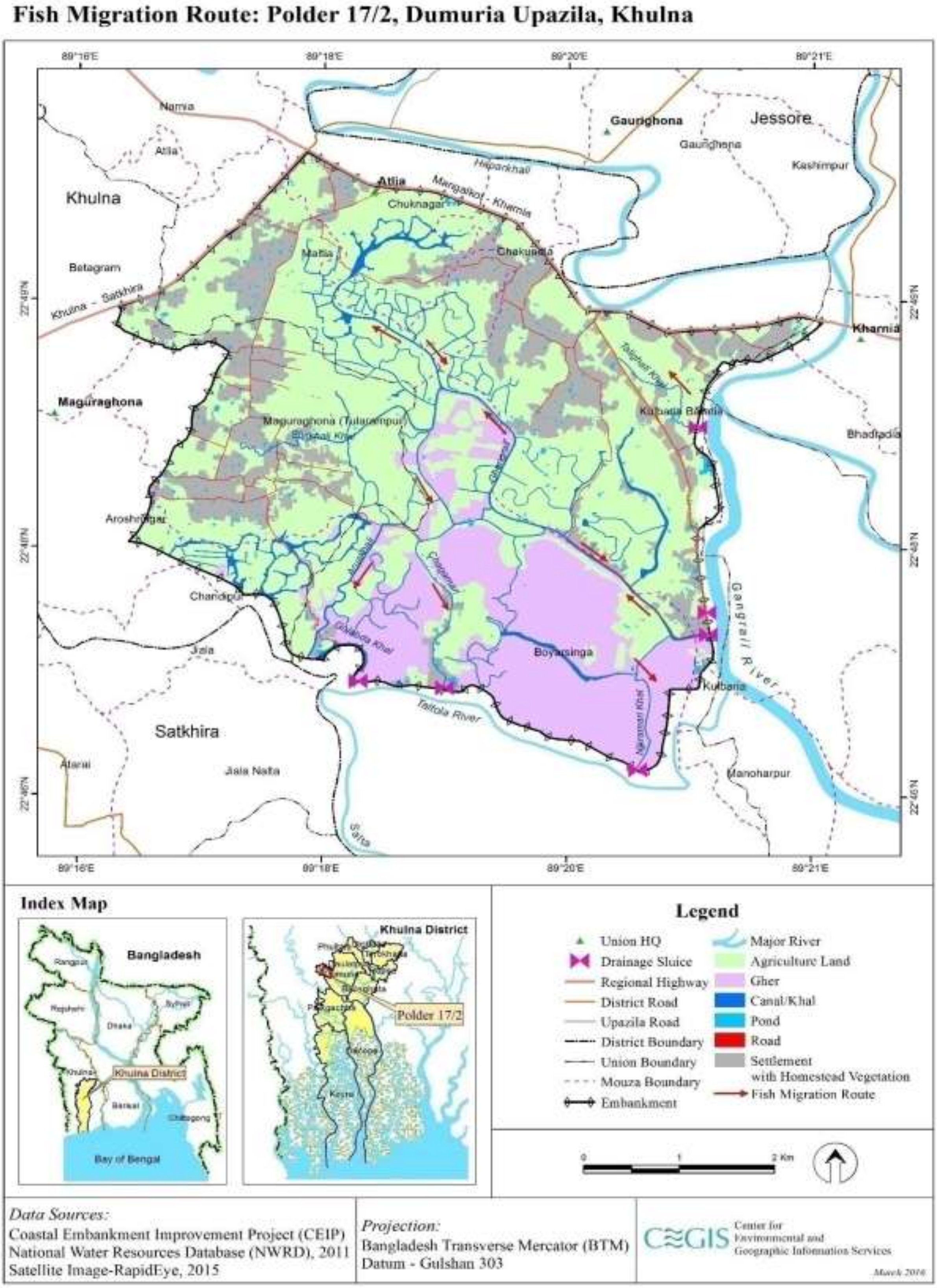
537. On the other hand, during spawning season fish hatchlings and fries will be able to pass through the gates with relatively high mortality. Moreover, there is a conflict of interest between the Gher owners and agriculture farmers regarding the issue of water usage.

538. For mitigating the fish passing issues through the gates, it is recommended to consider the fish pass friendly aspects in the structures to be constructed in the Polder for the proper management of water. These may be done either by constructing drainage sluices by maintaining the velocities passable for the mentioned indicative fish species or by constructing fish pass structure. In case of sluice gates, based on catchment flow optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes. In constructing fish pass, fish swimming speed or velocity and depth preference should be considered. In case of the indicative fishes velocities are mentioned in Table 6.14 and the depth preferences are as follows: *Plotosus canius:* 2-10 m; *Liza Parsia*: 1.5-10 m; *Mystus gulio*: 1.5-10 m and *Lates calcarifer*: 2-20 m.

539. The Ghers in the study area are mostly concentrated in Boyarsigna mouza (Map 10.1). These mouza is relatively less crop intensive. The major drainage canals pass through the mentioned mouza and Ghers as well include Golabdha khal, Changmari khal and Nikmari khal.

So, entry of saline water through these drainage canals in this cluster area of the above mouza may not harm significantly to the crops if water can be managed in the canals in such a way that water does not spill over the crop fields. In that case, the proper operation of the sluice gates and their distributary canals should be ensured.

540. In other areas where Ghers are less intensive and crops are dominant, there should be a mechanism of water distribution in equitable manner. Generally, surface water irrigation for the Boro crops is done during January to March when drifting migration of hatchling and fry with the tide of *Liza parsia* and *Mystus gulio* may be obstructed as the farmers will use the deposited water of the canal and inhibit the entry of saline water. The fishes at all their life stages from hatchling to adult of *Plotosus canius, Lates calcarifer*, *Liza parsia* and Mystus gulio will be entered with the tide into the Polder area when water will be allowed during the T. Aman cultivation season.



Map 10-1: Fish habitat in the Polder area

11 Stakeholder Consultation and Disclosure

541. 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.

11.1 Overview

542. The GoB as well as international donors (e.g. the World Bank) attaches 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.

543. 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.

544. 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

- The following objectives have served as the moving force for the design, implementation and fact findings during the participation process:
- To provide key Project information and create awareness among various stakeholders about project intervention;
- To have interaction for primary and secondary data collection with project beneficiaries, affectees, and other stakeholders;
- To identify environmental and social issues such as displacement, safety hazards, employment, and vulnerable persons;
- To begin establishing communication and an evolving mechanism for the resolution of social and environmental problems at local and Project level;
- To involve Project stakeholders in an inclusive manner; and
- To receive feedback from primary stakeholders on mitigation and enhancement measures to address the environmental and social impacts of the Project.

11.3 Approach and Methodology

545. Participatory approach was followed in conducting the public consultation meetings in the Polder-17/2. 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.

546. Focus group discussions (FGD) were carried out during the public consultation process. In order to conduct the FGD and consultation meetings, two checklists were prepared covering the aspects including an overview of the proposed CEIP-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, biological resources, socio-economic resources, and disaster aspects were discussed in detail.

547. 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-17/2 were asked to share their needs, problems, possible sustainable solutions, and their views on the Project interventions. The stakeholders' perceived views on important environmental and social components (IESCs) and 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

548. Stakeholders include all those who affect and are being affected by policies, decisions or actions within a particular system. Stakeholders can be groups of people, organizations, institutions and sometimes even individuals. Stakeholders can be divided into primary and secondary stakeholder categories.

549. ***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-17/2, the primary stakeholders include the people living within the Project area particularly those who reside within and in the immediate vicinity of the Polder. The primary stakeholders of the Project include the farmers, fishermen, local business community as well as the households to 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.

550. ***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.

551. 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

552. 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 were also finalized in this way considering availability of the participants, ensuring the maximum participation, weather and compliance with the other arrangement.

Enlisting and Invitation

553. 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.

554. A formal invitation was sent to them and also communicated over telephone for ensuring their presence in the meeting.

Consultation Instrument

555. **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 Annex-XX).

556. **Attendance list:** An inventory of the participants was maintained in attendance sheet containing contact number. Scanned list of participants is attached in Annex-XX.

557. **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.

558. **Sound Recorder:** For ensuring peoples voice are taken using recorder of each consultation. The study team encouraged all to participate willingly through explaining the ethics of the study and recorded it.

Consultation Process

559. The study team conducted the meeting. During consultation meeting, the following process was followed with sequences.

560. **Greetings:** At the outset, the team expressed greetings to all participants. Welcomed them for attending and stated the entire design of the meeting.

561. **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.

562. **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.

563. **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.

564. **Note taking:** discussed issues and opinions were written in notebook carefully. All issues were given equal importance.

565. **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.

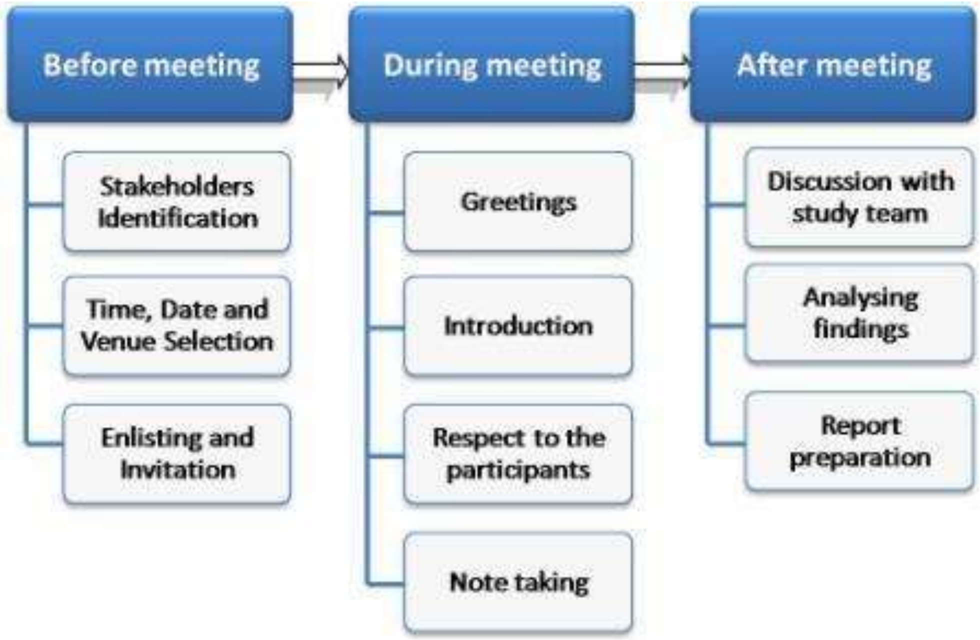


Figure 11.1: Overall consultation process

11.5 Public Consultation Meetings and FDGs

11.5.1 Consultation Process

566. A number of public consultation meetings and FGDs were conducted at different locations of the Polder-17/2. The details of these meetings and FDGs are presented in **Table 11.1** and some photographs of these meetings are given in **Pictures 11.1** to .**11.3**.

Table 11-1: Meeting venue including time and date

Sl	District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
1	Khulna	Dumuria	Maguraghuna	Dakhin Arosh Nagar Govt. Primary School	PCM	06/02/2016	10:00 AM
2	Khulna	Dumuria	Maguraghuna	Nikra bazar	FGD	5/02/2016	11:00 AM
3	Khulna	Dumuria	Maguraghuna	Dakhin Arosh Nagar Natun Bazar	FGD	5/02/2016	4:00 P.M

11.5.2 Consultation Participants

567. The main participants of the consultation meetings included public representative, farmer, trader and daily-wage laborers of the Polder-17/2 and nearby areas. A total of 55 participants attended these consultations. The participant details are provided in Annex **Table 11.2**.

Table 11-2: Participant Details

Sl	Meeting venue	Type of consultation	Type of Participants	No. of participants
1	Dakhin Arosh Nagar Gov't Primary School	PCM	Primary stakeholders	36
2	Nikra bazar	FGD	Primary stakeholders	10
3	Dakhin Arosh Nagar Natun Bazar	FGD	Primary stakeholders	9




Photo 11-1: PCM at Dakhin Arosh Nagar Govt. Primary School

11.6 Issues discussed in FGDs and Meetings

568. 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 socio-economic aspects listed below were discussed.

- *Water resources:*

    - Surface water (tidal flooding, drainage, salinity, siltation)
    - Water management (flood control, drainage, irrigation)
- *Land resources:*
    - cropping practice,
    - production and yield,
    - water logging and drainage congestion
    - Crop damage.
- *Socio-economic aspects:*
    - Occupation and Employment (unemployment/joblessness)
    - Migration (temporary/permanent out-migration)
    - Poverty (food and income poverty)
    - Education (poor literacy rate, non-schooling, less female education, drop out etc)
    - Health and nutrition (illness, diseases, poor nutrition)
    - Quality of life (poor housing and sanitation facilities, scarcity of drinking water, fuel and fodder)
- *Disasters:*
    - Cyclones
    - Tidal surge
    - River erosion
    - Associated damages
- *The sustainable and integrated solutions of the main problems being faced in the Polder:*
    - Water resource management
    - Agriculture and fisheries management
    - Land resource management
    - Disaster management.

11.7 Community Concerns and Suggested Solutions

569. At the outset, the study team gave a brief description about the project. The participants also stated that the project authority informed them frequently about this project. However, the stated description by the study team makes them clearer about the objectives and process of the project.

11.7.1 Attitude to the project

570. The communities including the persons to be affected by the Project expressed their views in favor of the Project and wanted early implementation to protect them from the tidal surges and disasters such as Aila and Sidr. They demanded adequate compensation and other benefits for the loss of their assets and livelihood, as well as alternative place for relocation of their houses and business.

Photo 11-2: FGD at Nikra bazar

Photo 11-3: FGD at Dakhin Arosh Nagar Natan Bazar

571. 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**

Table 11-3: Community Concerns and Suggested Solutions

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
Overall	- Salinity intrusion, Tidal flood, Tidal surge, Drainage congestion, Low height and vulnerable of Embankment, Encroachment of internal canals, Expansion of unplanned shrimp farming, Salta river siltation, water logging due to drainage congestion at certain parts of the Polder area.	- Comprehensive rehabilitation of the Polder should be taken up at the earliest with the active involvement of the local community. - Proper compensation should be given to affected people - Illegally captured canal should be liberated and that canal should be excavated - Immediate construction of drainage sluice (01no.) and Repairing of drainage sluice (03 nos.) - Proposed drainage sluice and flushing sluice linking canals should be excavated.
Water resources	- Height of the embankment is being eroding gradually - Water logging is the major concern in this affected areas (e.g. Dakhin Magurghuna, Uttar Magurghuna, Dakhin Aroshnagar, Uttar Aroshnagar, Chondipur, Kuraghat, etc. villages) - Major canals have been silted up due to unplanned shrimp farming, Illegal DCR cut off, encroachment of canals etc. - Tidal Flooding, Storm surge, salinityintrusion, Encroachment of internal khal, erosion, inactive sluice gates and khal has been silted up.	- Strengthening the banks with blocks, spreading stones/Geo-bags along vulnerable spots e.g. (change protection work from Km 9.38 to Km 9.52). - Re-sectioning of the embankment to protect erosion and embankment breach - Damage sluice gate, inlet, outlet and all water control infrastructures should be made sure in the important water pass area - Internal drainage canal (e.g. Golabdah, Changmari, Arua khali, Shitla khali, Talighati canal etc. should be re-excavated. - Shatter has to be water proofed.
Agriculture resources	- Crop damage due to drainage congestion and water logging	- Repair the embankment as per design level.

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
	- Lack of irrigation water during dry season due to siltation of rivers and internal khals - Amon variety would not cultivate during time because of water logging Dakhin Magurghuna, Uttar Magurghuna, Dakhin Aroshnagar, Uttar Aroshnagar, Chondipur, Kuraghat, etc. villages.	- 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 the regulators. - As soon as possible blockd linkage cannel and large canal should be excavated, such as- Golabdah, Changmari, Arua khali, Shitla khali, Talighati canal etc.
Fishery resources	- Major canals havealready lost their connectivity and reduced depth due to encroachment, damages of drainage sluice, unplanned shrimp farming and saline water intrusion. - 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 canal (e.g. Golabdah, Changmari, Arua khali, Shitla khali, Talighati canal etc.) 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 - Using angler in an illegal way should be stopped - Illegally captured canal should be liberated and that cannel should be excavated - Integrated cultivation should be used
Ecological resources	- Any extreme wave action would be not protected to surrounding area due to insufficient of foreshore afforestation - Countryside vegetation would be deteriorated and change of vegetation coverage due to river bank erosion and extreme salinity intrusion. - A number of trees would be felled and existing undergrowth vegetation would be damaged at construction sites for implementation of project intervention.	- Keep compensation to the proper owners/authorities against tree felling - Implement social aforestation along the embankment slopes - Social aforestation along the countryside and River side completion by BWDB, FD, LGI and local people. - Proposed afforestation plan would arrest the vulnerabilities of embankment and protect bank erosion from tidal surge - Local people should be engaged on seed germination, sapling management for transit nursery. - Plantation for local suitable tree species like Babla, Sirish, Chumbul, Rain tree etc. and proper monitoring for saplings and fencing - Implement social aforestation along the embankment slopes - Taligati village (Atra Union) would be protected from wave action as well as river erosion from Gangrail River.
Socio-economic resources	- 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	- Rehabilitation of affected people should be done in proper way. - Ensure proper resettlement of those households which may be affected by the project intervention for re construction of retired embankment

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
	respect to the actual requirement. - Rural power elite captured open water bodies illegally i.e. canals, ditches for their own purposes - Tends of dependency on the Sundarbans area has been increased for last five years due to lack of employment opportunities. - Seasonal migration has been increased for Garments, Brick fields and Agricultural sector.	- The embankment cum road should repair immediately in places. - After enlarging embankment, a maintenance and monitoring team should be formed for proper maintenance of it. - To Create and strengthenWMGs so that mass people can have access to open water bodies easily. - Should be proper maintenance for re functioning of water control infrastructures - Gate operator (locally called gate khalashi) should be recruited - Illegal DCR cut off should be stopped - In mud work Participation of local people should be given the first priority - Construction materials, instruments should be carried through the roadway.

11.8 Framework for Consultations during Project Implementation

572. 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 needs 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	*The affected communities.*	*BWDB; Supervision*

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
	Complaint Register (discussed later in the document).		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 (seeSection 4.9)	Institutional stakeholders; Grass root stakeholders, including the beneficiary communities.	BWDB

11.9 EIA Disclosure

573. The draft final EIA report was disclosed to the public on 26th July (from 11:00am to 13:00pm), 2017 in Dumuria Upazila, Khulna. The main objective of the meeting was to present the findings of the draft final EIA report and to receive feedback from the local stakeholders. The report was also finalized through incorporation of comments and suggestions received from the meetings.

574. The participants of the PDM includes, Upazila Nirbahi Officer (UNO), Upazila Chairman, Vice Chairman and other concerned government officials, Journalists, NGO representatives, environmentalists and activists, local stakeholders and other representatives of CEGIS. A total of 45 participants attended the public disclosure meetings. The findings of the Public Disclosure Meeting (PDM) alongwith some photographs of the meeting are given below:

Photo 11-4: View of PDM at Upazila Auditorium, Dumuria, Khulna

11.10 Findings of the PDM:

575. The communities including the persons to be affected 2 by the Project expressed their views in favour of the Project and wanted an early implementation to protect them from natural disasters. They demanded following actions for immediate implementation:

- This plan will be done with the participation of local people and representatives
- Peripheral rivers e,g, Hari river should be re-excavated under this project , otherwise, internal khal re-excavation would not remove the drainage congestion in the Polder area
- The suggested sluice gates should be prepared in a planned way so that the saltwater cannot enter into the Polder and sluice gates maintenance should be done in a proper way
- Fish movement system in each sluice gate should be considered
- TheHari river should be connected with Fultola river for reducing drainage congestion in the Polder area
- Proper compensation should be made to the project affected people before starting the construction activities
- Issues like climate change, sustainable development etc should be taken into consideration while implementing the project.
- Effective monitoring should be maintained during the construction of the project activities
- Good coordination should be ensured between BWDB and local administration for better functioning of the Polder
- Engagement of local government for canal excavation should be ensured
- Tree plantation need to be increased
- Awareness building program among the communities should be conducted for better water management
- Proper O & M for embankments and sluice gates in the Polder area should be ensured
- Water Management Organizations (WMOs) should be formedfor proper operation and management of water control structures.

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Appendix A: Checklist

EIA of Coastal Polders under CEIP

Checklist for Water Resources Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

A. Administrative Information

Name of Polder:	**BWDB Zone:**	**Hydrological Zone:**
BWDB Circle name:	BWDB O & M Division:	
District (s):	Upazila (s):	
Union (s):	Mouza (s):	

B. Project Description

	General Information	
	a. Type of project:	b. Area of Polder (Ha):
	c. Objectives of the scheme:	
	d. New problems (if any) created by the project activities:	
	e. Year of Starting:	f. Year of completion:
	g. Name of surrounding Polder	
	h. Name of the projects hydro-morphologically dependent on the Polder	
	i. Cumulative hydraulic and morphological impacts as anticipated by local people	
Data Collected by:		Date:
	Present Status/condition of Embankment	

Embankment length (……………….Km)	**Embankment Type: Submergible / Full flood protection**

Breaching: 1. Yes 2. No Breaching spot (If yes): (Please specify the spot names, length, GPS reading)

Location of Breaching Points (Name of Place)	**Reasons of breach**	**Good**		**Moderately affected**		**Badly affected/ Vulnerable**		**Completely damaged**	
		GPS ID	**Length**	**GPS ID**	**Length**	**GPS ID**	**Length**	**GPS ID**	**Length**

Public Cuts: 1. Yes 2. No Public Cuts (If yes): (Please specify the spot names, length, GPS reading)

Location of Public Cuts	**Reasons**	**Moderately affected**		**Badly affected/ Vulnerable**		**Completely damaged**	
		GPS ID	**Length**	**GPS ID**	**Length**	**GPS ID**	**Length**

Re-sectioning: 1. Yes 2. No Re-sectioning (If yes): (Please specify the spot names, length)

From	**To**	**Length**	**Height**	**Actual reasons**

Regulators

Location of Structure	**GPS ID**	**Type**	**Vent Size**	**No of Vent**	**Service Condition (VG/G/M/B/VB)**[18]	**Present Condition (Partial/full damage/good)**	**Present Problems**	**Reasons for problem**	**Year of problem**	**Rehabilitable (Y/N)**	**Replaceable (Y/N)**
Fish pass Structures											
Cross Drainage Structures (Syphon/Aqueduct)											
Barrage											

Pipe Sluices										
Irrigation Inlets										
Bridge/Culverts										
Others										

[18] VG – Very Good, G – Good, M – Moderate, B – Bad, VB – Very Bad

Drainage Channels									
Name	**Length**	**Flow Direction**	**Flow (%)**	**Present Service Condition \Problems**	**Reasons of Problem**	**Re-excavation Need (Y/N)**	**Proposed Re-excavation Mode (Manual/ Mechanical)**	**From – To (Approx. length)**	**GPS ID (Structure)**

Irrigation Canals					
Name	Length	Problems	Reasons	Re-sectioning (Y/N)	From – To (Approx. length)
Protective Works					

Location Name	Type (Temporary/ Permanent)	Length	Present Condition (G/ MD/ CD)[19]	Problems	Reasons	From – To (Approx. length)	GPS ID (Protection Work)

Do you think that local people/Stakeholders were involved or could be involved in future for the maintenance work of the above mentioned works? If 'Yes' mention the source of generating funds?	
Persons engaged in operating gates of the structures:	BWDB/Local people or Stakeholders/Beneficiaries
Problems facing in operating the gates of the structures:	
Your suggestions regarding the people to be engaged in operating these gates:	BWDB/Local people or Stakeholders/Beneficiaries

D. Water Resources

1.River system (inside and outside the Polder)

Inside	Outside	Main river	Flow direction

2. Name of beels:			
Union	Beels	Union	Beels
3. Topography:		4. Drainage pattern:	
5. Drainage congestion extent (ha):		Causes: Natural / Man made/Through project activities	
Problems:		Reasons:	
6. Water logging (% of extent) in the month of February			

[19] G – Good, MD – Moderately Damaged, CD – Completely Damaged

Union	Area (%)	Causes

7. Flooding (depth, % of extent, onset, peak and recession)

Flood/Inundation Condition	Area (%)	Reasons of Flooding	
F0 (< 30 cm)			Onset:
F1 (30-90 cm)			Peak:
F2 (90 – 180 cm)			
F3 (180 – 360 cm)			Recession:
F4 (> 360 cm)			

E. River Erosion

River/Khal name	Area (ha)	Length (m)	Reasons

F. Accretion

River/Khal name	Area (ha)	Reasons

G. Water Quality (Peoples perception)

1. Ground water (Presence of pollutant)

Arsenic (Yes/No)	Location:
Iron (Yes/No)	Location:

2. Surface water

River/Khal name	Quality of water (Good/Bad/Avg.)	Type of Pollutant	Sources of pollutant

H. Historical severe flood:

Recent flood	**Extent (Days)**	**Flood level (cm)**	**Damage of resources**	
1988				
1994				
1998				
2004				
2007				
Last five years	Flood year			Flooding areas:
	Non flood year			

I. Participatory Social Mapping by stakeholders (Name of regulators, name of public cuts points, Name of breaching points, location of water-logged area, identification of encroached canal with name and their location on map)

J. Peoples opinion of the project

Pre-project condition:
Period of project benefits:
Present condition and Present problems:
Causes of problems:
Probable Solution/Improvement:

EIA of Coastal Polders under CEIP

Checklist for Land Resources, Agriculture and Livesock Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

Land Resources:

Land degradation

Factors	Year from starting LD	Result of LD
Soil erosion		
Sand carpeting		
Salinisation		
Acidification		
Nutrient deficiency		
Farming practices		
Water logging		
Others		

Agriculture Resources: (For small project information collection from filed. For large project both primary and secondary information collection from field and DAE office)

Cropping Pattern by land type

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	% of area

Crop calendar

Crop name	Seedling		Transplanting/Sowing		Harvesting	
	Start	End	Start	End	Start	End

Crop yield

Crop Name	Damage free Yield (ton/ha)	Damage area (%)	Damage Yield(ton/ha)

*Damage area and yield loss calculation: Last 3 year's average value

Crop damage

Name of hazard	Ranked	Timing	Causes
Flood			
Drought			
Pest infestation*			
Others:			
*List name of pest and pesticide by crop			

Fertilizer and pesticide application

Crop Name	Seed (Kg/ha)	Fertilizer (Kg/ha)				Pesticide		
		Urea	TSP	MP	Other	No of Appli.	Liq. (ml/ha)	Gran. (Kg/ha)

Irrigation, Land preparation and Labour

Crop Name	Irrigation			Land preparation			Labour	
	Mode	% of Area	Charge (Tk/ha)	Power (%of Area)	Animal (% of Area)	Tk/ha	Nos./ha	Tk/ labour

Note: Support Services of the project areas

Livestock Resources: Primary and Secondary Information collection from field and DLS offices

Livestock and poultry production

Name of Livestock/poultry	% of HH having Livestock/Poultry	No. of Livestock/poultry per HH
Cow/Bullock		
Buffalo		
Goat		
Sheep		
Duck		
Chicken		

Feed and Fodder

Name of Livestock/poultry	Feed/Fodder Scarcity (Timing)	Causes	Remarks
Cow/Bullock			
Buffalo			
Goat			
Sheep			
Duck			

Chicken			

Diseases

Name of Livestock/poultry	Name of Disease	Disease (Timing)	Causes	Remarks
Cow/Bullock				
Buffalo				
Goat				
Sheep				
Duck				
Chicken				
Note: Support Services-				

Where, when, how much and causes of Crop Damage.

Fisheries Baseline Checklist

EIA of Coastal Polders under CEIP

Village: Mouza: Union: Upazila: District:

BWDB Circle: BWDB Division:

Background Water bodies: Name: Alphabetic, Area: in Ha/% of area/Ana, Length: in km, Depth/Inundation depth: in Meter, Flood Duration: in Months, Production: metric ton

Problem/Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
Capture Fisheries: Culture Fisheries: Indiscriminate Fishing Activities:	a. Total No. of fisher HHs: b. %/No. of CFHHs: c. %/No. of SFHHS: d. No. of Days spend annually in fishing by CFHHs: SFHHs: e. Hrs/Day spend in fishing by	River																
		Beel (Leased/non leased)																
		Khal																
		Floodplain																

	CFHHs:	Swamp Forest																
		Fish pond																
	SFHHs:	Baor																
		Other																

Fish Migration				**Fish Biodiversity**		**Species List**					**Species Composition**				
						River	**Khal**	**Beel**	**Pond**	**Other**	**Group**	**River**	**Khal**	**Beel**	**Pond**
Previous Migration Status				Fish diversity status (Poor/Moderate/Rich)/ %							Major carp				
											Exotic carp				
											Other carp				
											Catfish				
											Snakehead				
Present Obstacle to fish migration:	1.			Reasons of increase or decrease	1.						Live fish				
					2.						Other fish				
	2.				3.						Prawn				
					4.						Hilsa				
	3.				5.										
Important breeding, feeding and over wintering ground															
											Rui				
											Catla				
Horizontal Migration	Species:	Season (Months)	Routes:	Significant areas	1.						Mrigel				
	1.				2.						Koi				

Fish Migration				Fish Biodiversity		Species List					Species Composition				
						River	Khal	Beel	Pond	Other	Group	River	Khal	Beel	Pond
pattern	2. 3. 4. 5.	:			3.						Sarpunti				
											Large prawn				
											Small Pprawn				
Vertical Migration Pattern	Species: 1. 2. 3. 4. 5.	Season (Months) :	Habitats:	Species of Conservation Significance	Rare:						Silver carp				
											Carpu				
											Grass carp				
											Tengra				
					Unavailable:						Chapila				
											Others				

Post Harvest Activities		**Fishermen Lifestyle**	
Fish edible quality:		Socio-economic Status of subsistence level fishermen:	
Source of pollution in each habitat:		Socio-economic Status of Commercial fishermen:	
Seasonal vulnerability:		Other conflict (with muscle men/ agriculture/ other sector/laws):	
Ice factory (Number, location and name):		Fishermen community structure (Traditional/Caste/Religion)	
Landing center, whole sale market, other district markets, etc.:		Traditional fishermen vulnerability (Occupation change/others):	
Storage facility (number, location and name):		Existing Fisheries Management	
Fish market (Number, location and name):		Fishermen Community Based Organizations (FCBOs):	
Marketing problems:		WMOs activity:	
Fish diseases (Name, Host species, Season, Syndrome, Reason, etc.):		Fishing right on existing fish habitats (Deprived/Ltd. access/Full access):	
Other backward and forward linkages (Number, location and name):		Leasing system:	

Fish Migration	Fish Biodiversity	Species List					Species Composition				
		River	Khal	Beel	Pond	Other	Group	River	Khal	Beel	Pond

Transport facility (Mode of fish transportation, cost, other involvements)		Enforcement of fisheries regulation (Weak/strong):	
Dry fish industries (Number, location and name):		Department of Fisheries (DoF) activity:	
Others information:		NGOs activities:	

Note: 1. Major Carp - Rui, Catla, Mrigal, 2. Exotic Carp - Silver Carp, Common Carp, Mirror Carp, Grass Carp, 3. Other Carp - Ghania, Kalbasu, Kalia, 4. Cat Fish - Rita, Boal, Pangas, Silon, Aor, Bacha, 5. Snake Head - Shol, Gazar, Taki, 6. Live Fish - Koi, Singhi, Magur, 7. Other Fish - Includes all other fishes except those mentioned above.

Beels: Rui (Labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus mrigala), Kalbasu (Labeo calbasu), Gonia (Labeo gonius), Boal (Wallago attu), Air (Mystus aor / Mystus seenghala), Shol/Gazar (Channa spp.), Chital/Phali (Notopterus chitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustes fossilis /Clarias batrachus), Sarpunti (Puntius sarana), Large Shrimp (Macrobrachium rosenbergii /M. malcomsonii), Small Shrimp, Silver Carp (Hypophthalmichthys molitrix), Carpio (Cyprinus carpio), Grass Crap (Ctenopharyngodon idellus), Pabda (Ompok pabda), Punti (Puntius spp.), Tengra (Mystus spp.), Baim (Mastacembelus spp.), Chapila (Gudusia chapra), Others.

Pond: Rui (Labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus mrigala), Kalbasu (Labeo calbasu), Mixed Carp, Silver Carp (Hypophthalmichthys molotrix), Grass Carp(Ctenopharyngodon idellus), Mirror Carp (Cyprinus carpio var. specularis), Tilapia (Oreochromis mossambicus / O. niloticus), Shrimp, Aor (Mystus aor / Mystus seenghala), Boal (Wallago attu), Shol/Gazar & Taki (Channa spp.), Chital/Phali (Notopterus chitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustes fossilis / Clarias batrachus), Sarpunti (Puntius sarana), Thai Sarpunti (Puntius gonionotus), Punti (Puntius spp.), Others.

EIA of Coastal Polders under CEIP

Checklist for Ecological Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

Basic Information

Date		Prepared by		
Name of the Polder				
BWDB Circle Name				
District/s			Upazila/s	
Location of the FGD				

Habitat Information/Ecosystem Types (Please put tick where is applicable)

Agriculture land		Forest patches including social forestry	
Settlement/Homesteads		Canal and ponds	
Orchard		Grasslands	
Fallow		Reserve forest	
Ridges		Others	

Terrestrial Vegetation Checklist (List of Major Plant Species)

Species Name	**Status**	**Utilization**
Homestead Vegetation		
Mangrove Vegetation		
Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others		

Terrestrial Wildlife Check List

Species Name	**Habitat**	**Status**	**Migration Status**
Mammals			
Amphibians			
Reptiles			
Birds			
Habitat: 1= Homestead forest, 2= Floodplains, 3= Wetlands, 4= River, 5= Pond, 6=Forest Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Migration Status: 1= Local, 2= Local Migratory, 3= Migratory			

Aquatic Wildlife Checklist

Species Name	**Habitat**	**Status**	**Migration Status**
Mammals			
Amphibians			

Species Name	**Habitat**	**Status**	**Migration Status**
Reptiles			
Birds			
Habitat: 1= Homestead forest, 2= Floodplains, 3= Wetlands, 4= River, 5= Pond, 6=Forest Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Migration Status: 1= Local, 2= Local Migratory, 3= Migratory			

Foreshore vegetation/Mangrove vegetation

Name of the forest patches location (s)	**Species Name**	**Abundance**	**Utilization**
Abundance1= High,2=Moderate,3=Low Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others			

Major Wetland information

Name of wetland	Type of Wetland	Area inAcre	Connectivity		Impor tance
			Khal	River	

Type 1= Beels, 2= Rivers, 3= Open water wetlands, 4= Floodplains, 5= Closed water wetlands, 6= Ponds, 7= Baors (oxbow lake).
1=Fish; 2= migratory bird; 3= other wildlife; 4=aquatic flora

Wetland vegetation Checklist

Species Name	Habit	Status	Utilization

Habit 1=Submerged, 2=Free floating, 3=Rooted floating, 4=Sedges, 5=Marginal
Status 1= High, 2= Moderate, 3= Low
Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others

Forest Information (Surrounding/nearer the Polder)

Forest Name with Range/Beet office	Type	Location	Area in Acre	Major Plant Species

Type 1=Swamp Forest, 2=Reserve Forest, 3=Vested Forest, 4=Reed forest, 5=Other (specify)

(9) Anticipated Impacts due to proposed interventions on particular Ecosystems

(Impact from changed land use, noise, human presence etc.)

Name of Intervention	Impacts
Embankment Re-sectioning	
Breach Closing	
Construction of Water control Structures	

(10) Comments (If any):

EIA of Coastal Polders under CEIP

RRA/FGD Data Collection Format for Socio-economic Survey

Date of Survey:................................. Name of Polder:

1. Place of Interview:

Name of Mouza(s)..

Union(s)/Ward(s)...

Municipality(s).ifany ....

Upazila(s)/Thana(s)...

District(s)/.....................................

2. Characteristics of Population:

2.1 Total Households, Population (male, female, rural and urban) in Project area

Total Households	Population		
	Male	Female	Total

Source: BBS

2.2 Age distribution

Age range													
0-4 Years		5-9 Years		10-14 Years		15-17Years		18-34 Years		35-59 Years		60+Years	
M	F	M	F	M	F	M	F	M	F	M	F	M	F

Source: BBS

2.3 Literacy rate

% of Literacy (Over 7 years)		
Total	Male	Female

Source: BBS

2.4 Occupation and employment

Main occupation by population	% of population
Not working	
Looking for work	
Household work	
Agriculture	
Industry	
Water, Electricity & Gas	
Construction	

Main occupation by population	% of population
Transport	
Hotel & Restaurant	
Business	
Service	
Others…..	

Source: BBS

Main occupation by households:

Main occupation by households	% of households
Agriculture/Forestry/Livestock	
Fishery	
Agriculture Laborer	
Non-agriculture Laborer	
Handloom	
Industry	
Business	
Hawker	
Construction	
Transport	
Religious	
Service	
Rent	
Remittance	
Others…..	

Source: BBS

2.5 Labor availability and wage

a. Labor (Male) for farming (High/Medium/Low), Av.Wage/Day (Tk.) Max:........Min: ....

b. Labor (M) for non-farming (High/ Medium/Low), Av. Wage/Day (Tk.) Max:..........Min: ....

c. Labor (Female) for farming (High/Medium/Low), Av. Wage/Day (Tk.) Max:..........Min: ....

d. Labor (F) for non-farming (High/ Medium/ Low), Av. Wage/Day (Tk.) Max:.........Min: ....

2.6 Migration (seasonal/permanent)

a. Seasonal out migration from study area (% per year with location):

b. Seasonal in migration to study area (% per year with location):

c. Permanent out migration from study area (Number per 1/2 years with location):

d. Permanent in migration to study area (Number per 1/2 years with location):

2.7 Annual Expenditure and Income by range

a. Expenditure

Expenditure group (in taka)	Percentage of households
<=12,000	
12,000-24,000	
24,000-60,000	
60,000-1,08,000	
1,08,000-2,40,000	
>=2,40,000	

Sources: RRA

b. Income

Expenditure group (in taka)	Percentage of households
<=12,000	
12,000-24,000	
24,000-60,000	
60,000-1,08,000	
1,08,000-2,40,000	
>=2,40,000	

Sources: RRA

Self assessed poverty for year round

Sl. No.	Poverty status	Percentage of households
1	Deficit	
2	Balance/Breakeven	
3	Surplus	

Sources: RRA

Housing (photographs)

Sl. No.	Housing status	% of hhs having
1	Jhupri	
2	Kutcha	
3	Semi Pucka	
4	Pucca	

Source: RRA

Drinking water (photographs)

Sl. No.	Drinking water sources	Percentage of households use
1	Tap	
2	Tube well	
3	Well	
4	Pond	
5	Other........................	

Source: BBS

Sanitation (photographs)

Sl. No.	Toilet types	Percentage of households under each type
1	Water Sealed	
2	Ring Slub	
3	Kancha	
4	No facilities	

Source: RRA

2.12 Diseases in Polder area

a. Diseases in area

Sl. No.	Disease	Ranking by incidence	Sl. No.	Disease	Ranking by incidence
1	Influenza/ Common fever		9	Chicken pox	
2	Cough/cold		10	Skin disease	
3	Diarrhoea		11	Diabetes	
4	Dysentery		12	Hypertension	
5	Hepatitis		13	Asthma	
6	Malaria		14	T B	
7	Dengue fever		15	Gastric	
8	Typhoid		16	Arsenicosis	

Sources: RRA

b. Health facilities in study area (photographs)

Sl. No.	Type of facility	Number of facilities with name
1	Number of District level Hospitals	
2	Number of Upazila Health Complex	
3	Union Health Center	
4	Private Health Clinic/ Hospitals	

Sources: RRA

b.1 Status of peripheral health facilities used by the study area people:

____
____
____
____

Source of treatment facilities in study area

Sl.	Source of treatment facilities	% of hhs received
1	Trained Physician	
2	Paramedic/ Diploma Physician	
3	Quack Doctor and Informal Treatments	
4	No treatment facilities at all	

Sources: RRA

2.13 Electricity

Percentage of household having electricity facility: ....BBS
Percentage of household having electricity facility: ....(During Survey)

3. Social overhead capital (photographs)

3.1 Existing road networks in study area and it's level of benefit

a. National Road (km.) ....(GIS) Beneficial: Highly /Moderately / Poorly
b. Regional Road (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly
c. Local Road Pucca (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly
d. Local Road Kancha (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

3.1.1 Status of peripheral road networks (with name) used by the study area people:

____
____
____
___

3.2 Existing railway network in study area and it's level of benefit

a. Railway (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

3.2.1 Status of peripheral railway service used by the study area people:

____
____
____
____
____
____

3.3 Existing waterways in study area and it's level of benefit

a. National Route (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

b. Local Route (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

3.3.1 Status of peripheral water ways (with name) used by the study area people:

____
____
____

3.4 Status of the navigation route by season

a. National Route: Served Seasonally/Through out the year

b. Local Route: Served Seasonally/ Through out the year

3.5 Major waterways handicapped

a. by structures.................................... location

b. by siltation................................. location

3.6 Nos. of major ghats/ports and name:

3.7 Academic Institution (school, colleges) (photographs)

Sl. No.	Type of facility	Nos. of Institution	Type of facility	Nos. of Institution
1	Primary School		Ebtedayee Madrasha	
2	High School		Dakhil Madrasha	
3	College		Alim/ Fazil Madrasha	

Sources: RRA

3.6.1 Status of peripheral academic institutions (with name) used by people of the study area:

____
____
____
____
____

3.8 Markets and GC (photographs)

Sl. No.	Type of facility	Nos. of markets	Comments with name
1	Major markets		
2	Minor markets		
3	Growth Centers		

Sources: RRA

3.8.1 Status of peripheral markets used by people of the study area:

____
____
____
____

4. Land holding categories

4.1 Percentage of HH who have owned agricultural land: ....(BBS)

Percentage of households with different land ownership category in the area:

Land ownership classes	Percentage of household
Land less/ No land (0 decimal)	
Land less (up to 49 decimal)	
Marginal (50-100 decimal)	
Small (101-249 decimal)	
Medium (250-749 decimal)	
Large (750 + decimal)	

Sources: RRA

5. Conflict between different land owner group and professional group

Reasons of Conflicts	**Present status of problem**	**Solution they want with location**
Water control infrastructures		
Land elevation		
Cross-interest		

6. Disaster related information: (photographs)

6.1 Type of major disaster and damage occurred in the area after completion of the Project

Sl.	**Major Disaster**	**Severely affected year**	**% of area affected**	**% of hhs affected**	**% of crop damage**	**Major crop damaged**
1	Flood					
2	Drought					
3	Tidal flood					
4	Storm					
5	Cyclone					

Sl.	Major Disaster	Severely affected year	% of area affected	% of hhs affected	% of crop damage	Major crop damaged
6	Hail storm					
7	Salinity intrusion					
8	Water logging					
9	Erosion					

Sources: RRA

7. Safety Nets and Poverty Reduction Measures in the area:

7.1 Name and activity of GO/ NGOs working in this area

Name	Activity (Credit, Education, Health, Forestry, Fishery, Livestock Rearing, Women Empowerment, Human Rights, VGF, Boyosko bhata, etc.)	% of HHs coverage

8. Information on Water Management Organizations (WMOs) (photographs of office building, committee members, resolution etc)

8.1 Do you know about the CEIP project? Y/N

8.2 Existence of WMOs: Yes/No

8.2.1 If WMO exists:

Sl	Issue/Question	Response/Suggestion		
a)	Year of formation (date if possible)			
b)	Registered by whom?			
c)	Number of members (male-female)	Male	Female	Comments
	Farmer			
	Trader			
	Labor			
	Landless			
	Fisher			
	Service holder			
	Others			

Sl	Issue/Question	Response/Suggestion
d)	No. of villages covered	
e)	Existence of fund	
f)	AGM	
g)	Election	
h)	EC meetings	
i)	Present water resources management activities	

8.2.2 Name of EC members with address/phone number:

Sl. No.	Name	Address	Phone Number
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

If WMO does not exist, please state the reasons for

____
____
____
____

8.3 Are people willing to form WMO? Y/N

(If yes, give demonstrative proof of their capacity if any)

8.4 Is WMO willing to take up management responsibilities? Y/N

8.4.1 If yes, please give some idea about what to do on management

9. Some other Issues

9.1 Any land acquisition to be needed for the rehabilitation of the Polder ? Yes/No

9.1.1 If yes, size of the area? __________________________________(acre)

9.1.2 If yes, are they willing to provide land for acquisition? Yes/No

9.2 Any replacement of people to be needed for the rehabilitation of the scheme? Yes/No

9.2.1 If yes, how many? _____________________________ (number of household)

9.3 Have any cultural heritage /archeological sites in the Polder? Yes/No

Give some description

9.4 Have any vulnerable communities (e.g. landless, fishermen, boatmen, destitute women without food and/or shelter) in the scheme area? Yes/No

a. Give some description

9.5 Have any common property resources (e.g. irrigation systems, fishing grounds (wetlands), pastures, forests, graveyard, cremation ground, mosque, temple, etc.) in the scheme area? Yes/No

a. Give some description

10. Comments of Facilitator:

Name of the RRA/FGD Participants:

Name	Age	Occupation	Address/Phone No.

Appendix B: DoE Approved 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/ 12 5 Date: 05/06/2013

Subject: Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I).

Ref: Your Application dated 31/03/2013.

With reference to the above mentioned subject, the Department of Environment (DOE) hereby accords Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I) at Satkhira, Khulna, Bagerhat, Pirojpur, Patuakhali and Barguna Districts subject to fulfilling the following terms and conditions.

I. This clearance shall only be applicable for the development of the infrastructure of the said project.

II. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) report considering the overall activity of the said Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE).

III. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)

4a. Project activities:
- A list of the main project activities to be undertaken during site clearing, construction as well as operation
- Project Plan, Design, Standard, Specification, Quantification, etc.

4b. Project schedule: The phase and timing for development of the Project

4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.

4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.

5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
   - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
   - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
   - Environment Quality : Air, Water, Soil and Sediment Quality
   - Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions
6. Socio-economic environment should include, inter alia, following:
   - Population: Demographic profile and ethnic composition
   - Settlement and housing
   - Traffic and transport
   - Public utilities: water supply, sanitation and solid waste
   - Economy and employment: employment structure and cultural issues in employment
   - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.
7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).
   In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the

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scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man maid or natural, wildlife, socio-economic aspect shall be incorporated in detail.

8. Management Plan/Procedures:
   For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.
   An outline of the Environmental Management Plan shall be developed for the project.
   In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)
   Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
10. Conclusion and Recommendations

IV. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.

V. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project.

VI. Violation of any of the above conditions shall render this clearance void.

VII. The project authority shall submit the EIA along with an application for Environmental Clearance, the applicable fee in a treasury chalan and the no objection certificates (NOCs) from the local authority to the head office in Dhaka with a copy to the Khulna and Barisal Divisional Office of DOE.

VIII. This clearance is valid for one year from the date of issuance and the project authority shall apply for renewal to Head Office with a copy to the Khulna and Barisal Divisional Office of DOE at least 30 days ahead of expiry.

IX. This Site Clearance Certificate has been issued with the approval of the appropriate authority.

05.06.2013

(Syed Nazmul Ahsan)
Deputy Director (Environmental Clearance)
&
Member Secretary
Environmental Clearance Committee
Phone # 02-8181778

Mr. Md. Sarafat Hossain Khan
Superintending Engineer & Project Coordinator
Coastal Embankment Improvement Project (Phase-I)
Bangladesh Water Development Board (BWDB)
72, Gre- -4 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 C: Details of Relevant Policies and Laws

(A) National Legislation

(i) Environment Conservation Act, 1995

The national environmental legislation is known as Environmental Conservation Act (ECA), 1995 (subsequent amendments) is currently the main legislative document relevant to environmental protection in Bangladesh. It was promulgated in 1995 and has repealed the earlier environment pollution control ordinance of 1977. The main objectives of ECA 1995 are:

- Conservation and improvement of environment, and
- Control and mitigation of pollution of environment.

The main strategies of the Act can be summarized as:

- Declaration of ecologically critical areas, and restriction on the operation and process, which can be carried, out or cannot be initiated in the ecologically critical areas.
- Regulation in respect of vehicles emitting smoke harmful for the environment.
- Environmental clearance.
- Regulation of the industries and other development activities – discharge permit.
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes.
- Promulgation of standard limit for discharging and emitting waste.
- Formulation and declaration of environmental guidelines.

Bangladesh Environmental Conservation Act (Amendment 2000) focuses on: (1) ascertaining responsibility for Compensation in cases of damage to ecosystems, (2) increased provision of punitive measures both for fines and imprisonment and (3) fixing authority on cognizance of offences.

Bangladesh Environmental Conservation Act (Amendment 2002) elaborates on: (1) restriction on polluting automobiles, (2) restriction on the sale and production of environmentally harmful items like polythene bags, (3) assistance from law enforcement agencies for environmental actions, (4) break up of punitive measures and (5) authority to try environmental cases.

Bangladesh Environmental Conservation Act (Amendment 2010) elaborates on (1) demarcation of wetlands and water bodies, (2) Hazardous waste import, transportation, storage etc., (3) Cutting of hills, mountains (4) Ecologically Critical Areas.

Failure to comply with any part of the Environment Conservation Act 1995 may result in punishment to a maximum of 5 years imprisonment or a maximum fine of Tk. 100,000, or both.

(ii) Environment Conservation Rules, 1997 (amendments in 2002 and 2003)

A set of the relevant rules promulgated to implement the ECA 1995. There have been three amendments to the Rules until now in February and August 2002 and April 2003 respectively. The Rules mainly consist of:

- The national Environmental Quality Standards (EQS) for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhaust;
- Categorization of industries, development projects and other activities on the basis of pollution activities of the existing or proposed industries/development projects/activities.

- Procedure for obtaining environmental clearance;
- Requirement for undertaking IEE and EIA as well as formulating EMP according to categories of industries/development projects/activities;
- Procedure for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.

The proposed projectbelongs to the Red Category according to the classification of industrial units or projects described in the Schedule-1 in the Rules. The procedure for issuing Environmental Clearance Certificate is elaborated in the Rules that must have to follow by the BWDB.

Another rule of the ECR is to determine environmental standards. The standards for air, water, sound, odor and other components of the environment shall be determined in accordance with the standards specified in Schedules - 2, 3, 4, 5, 6, 7 and 8. The proposed project must comply these standards during carrying out the activities.

(iii) The Environment Court Act, 2000

The Environment Court Act, 2000 has been enacted in order to establish environmental courts in each administrative Division of Bangladesh. Under this Act, the court has concurrent jurisdiction i.e. to try both civil and criminal cases. The basis for instituting a case is a violation of the “environmental law”, meaning the Bangladesh Environment Conservation Act, 1995 and Rules made there under. In particular the environment court is empowered to:

- Impose penalties for violating court orders;
- Confiscate any article, equipment and transport used for the commission of the offence2;
- Pass any order or decree for compensation;
- Issue directions to the offender or any person (a) not to repeat or continue the offence; (b) to take preventive or remedial measures with relation to any injury, specifying the time limit and reporting to the DOE regarding the implementation of the directions.

(iv) Bangladesh Water Act, 2013

The Water Act 2013 exists for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh.

As per this Act, all forms of water (e.g., surface water, ground water, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people. 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. Issuance of clearance certificate must be obtained by all organizations or appropriate authorities that are involved in undertaking, making or implementing a Water Resource Development Project before initiating the project, according to section 16.

(v) Guidelines for Participatory Water Management (GPWM), 2014

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

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

• Participation is an important voluntary process in which local stakeholders influence policy formulation, alternative plans/designs, investment choices and management decisions affecting their communities and establish the sense of ownership.

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

(vi) The Embankment and Drainage Act, 1952

This is an Act to consolidate the laws relating to embankment and drainage and make better provisions for the construction, maintenance, management, removal and control of embankments and watercourses or the better drainage of lands and for their protection from floods, erosion or other damage by water. The major provisions are:

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.

Section 25 describes the restoration of land etc. that any person who shall have sustained damage by the execution of such works shall receive compensation from the Government or the Authority. Any alteration if appear unnecessary shall be restored as nearly as possible to the state in which they were before the activity at the expense of the Government or the Authority.

Section 28 outlines the provisions of compensation of damages of any land or any right of fishery, right of drainage, right to the use of water or other right of property shall be compensated.

Section 55 to 59 outline penalties for following cases: unauthorized interference and abetment, injuring embankments, diverting rivers or grazing cattle on embankments, removal of obstruction and repair of damage, and obstructing persons in exercise of powers under this Act.

(vii) Wildlife (Conservation and Security) Act, 2012

The Bangladesh Wildlife (Conservation and Security) Act of 2012 has been formulated by repealing previous laws i.e. Wildlife (Preservation) Act of 1973 and it aims at conservation and safety of biodiversity, forest and wildlife of the country. The Department of Forest (DoF) has the primary responsibility for implementing this Act. The key issues in the Act are:

- Prohibition made related to wild animals and plants that no person can hunt any wild animal without a license or willfully pick, uproot, destroy or collect any plant
- Determination of vulnerable, endangered and critically endangered species of wild animals and plants
- Declaration of sanctuary for the conservation of forest and habitat of wildlife and prohibitions made on such sanctuary.
- Requirement of license to cultivate, extract, manufacture, rear, export or import any wild animal or part of its body, meat, trophy, uncured trophy or any plant.
- Restriction on import, export and re-export of wild animals and plants.

The regulation of the Wildlife Act prohibits establishing or operating any industrial factory within 2 (two) kilometers from the boundary of a sanctuary. This applies to the Polders improvement activity near the Sundarbans Reserve Forest area. Capturing, killing, shooting or trapping of wildlife is prohibited in sanctuary and conservation of all natural resources such as vegetation, soil and water are managed mainly for undisturbed breeding of wildlife. Clause 14 articulates the activities prohibited in a sanctuary listed below:

- cultivate any land;
- establish or undertake any industrial operation;
- harvest, destroy or collect any plant;
- set any kind of fire;
- enter into a sanctuary with any weapon without the permission of the Chief Warden or the officer authorised by him in this behalf;
- disturb or threat any wildlife, or use chemicals, explosives or any other weapon or substances which may destroy wildlife habitat;
- introduce any exotic animal or plant;
- introduce any domestic animal or allow any domestic animal to stray;
- dump any materials detrimental to wildlife;
- explore or dig for extraction of minerals;
- fell any plant or part thereof except silvicultural operations required for natural regeneration of plants;
- divert, stop or pollute watercourse; or
- Introduce any alien and invasive plant species.

This Act is particularly relevant to this study because “biodiversity “is dealt under the Act and according to the Act, “biodiversity” means genetic and species diversity of all species or sub-species of flora and fauna living in aquatic, terrestrial and marine ecosystems or diversity of their ecosystems. It is to be ensured that sufficient mitigation measures are taken for ensuring the safety of biodiversity and protection of flora and fauna. The EIA provides mitigation measures for biodiversity conservation including ecology and fisheries in chapter-8.

(viii) The Protection and Conservation of Fish Act, 1950 and Rules, 1985

The Act aims for the protection and conservation of fish in Bangladesh which has amendment in 1995. This Act provides power to the government to:

- Make and apply rules in any water or waters for the purposes of protection of fisheries.
- Prohibit or regulate the erection and use of fixed engines; and the construction, temporary or permanent, of weirs, dams, bunds, embankments and other structures.
- Prohibit the destruction of fish by explosives, guns, and bows in inland or coastal areas.
- Prohibit the destruction of fish by means of poisoning, pollution and effluents.
- Prescribe the seasons during which fishing is allowed.
- Prohibit fishing in all waters during spawning periods.
- Specify the officials with authority to detect breaches.

The Government made Rules in 1985 which contains 11 sections about various measures of protection and conservation and 2 Schedules specifying waters in which the catching of certain fish species is prohibited without a valid license, specifying fish species of which the catching or sale in certain periods is prohibited, and containing a form of a license for catching of carps in Prohibited Waters. Regulation 3 prohibits the erection of fixed engines in rivers and canals. No fish shall be destroyed by making use of poison or explosives (regulations 4 and 5). Licenses issued under regulation 8 only for purposes of pisciculture. Regulations prohibit the catching, carrying, transporting, offering for sale or possessing of frogs.

(ix) The Forest Act, 1927

The Forest Act was passed in 1927 in order to consolidatethe lawrelating to forests,The forest Act was enacted to preserve and safeguardforest in general, both public and private.The Forest Act of 1927 was amended in 1989 to provide deterrent penalties for certain forest offences and latest amendment came 2000 to add provision for social forestry. To elaborate the social forestry procedure Social Forestry Rules were framed in 2004 under the Forest Act, 1927 and Forest Transit Rules were framed in 2011.

This Act bears some important provisions suchas constitution of reserved forest, formation of any forestlandor wasteland or any land suitable for afforestation willbe the property of Government. This Act covers all procedural matters in implementationin all aspects related to forest conservation and developmentin Bangladesh. The key issues in the Act are:

- Section 3: The Government may declare any forest land which is property of the Government to be reserved forest land.
- Section 4: The Government shall issue a notice to that effect in the Official Gazette.
- Section 5: No rights shall be acquired in reserved forest land other than those acquired by succession or by government grant or contract and no clearing of cultivation shall be carried out other than in accordance with rules made by the Government for the reserved area.
- Section 28 provides for settlement of claims in the reserved area, prohibited activities, and powers of the Forest Officer in respect of such area. The Government may assign to any village community reserved forests and such forest land shall be called Village Forest.
- Section 32: Other public forest or waste land may be declared protected forests and the Government may make rules in respect of all matters listed in the section for such areas.
- Section 76 defines additional regulation making powers of the Government.

(x) Acquisition and Requisition of Immovable Property Ordinance 1982

The principal legal instrument governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable Property Ordinance, 1982 and subsequent amendments during 1993 - 1994. The 1982 Ordinance requires that compensation be paid for (i) land and assets permanently acquired (including standing crops, trees, and houses) and (ii) any other damages caused by such acquisition. The Ordinance provides certain safeguards for the owners and has provision for payment of "fair value" for the property acquired.

Deputy Commissioners (DC) will pay compensation for the land to be acquired based on Land Acquisition Proposals to be submitted by the requiring body. DCs, in all the cases, determine market value of acquired assets on the date of notice of acquisition (notice under section 3 of the Ordinance). The DCs then adds 50% premium on the assessed value for cash compensation under law (CCL) of all acquired assets except standing crops due to compulsory acquisition. The CCL paid for land is generally less than the "current market price" as owners customarily report undervalued land transaction prices in order to pay lower stamp duty and registration fees. If the land acquired has standing crops cultivated by tenant (bargadar) under a legally constituted agreement, the law requires that part of the compensation money be paid in cash to the tenants as per the agreement. Places of worship, graveyard and cremation grounds are not to be acquired for any purpose. The law requires that the salvaged materials upon payment of compensation will be auctioned out by the government. Under the 1982 Ordinance, the Government is obliged to pay compensation only for the assets acquired.
However, the provisions under this law are not adequate to cope with the adverse effects related to land acquisition and involuntary resettlement, nor do they do fully match the requirements of the WB's Operational Polices (OP 4.12) or international standards. Some of such gaps in existing land acquisition law of the country are:

- Existing GOB laws recognize title owners only; informal settlers are not covered
- Consultation with affected community not legally required
- No support or program for income and livelihood restoration.

In light of addressing these shortcomings, the Government of Bangladesh is working on preparation of a **national policy on involuntary resettlement**, which is consistent with the general policy of the Government that the rights of those displaced by development projects shall be fully respected, and persons being displaced shall be treated with dignity and assisted in such a way that safeguards their welfare and livelihoods irrespective of title, gender, and ethnicity. The Government will undertake further work towards legislative changes to safeguard resettlement rights by law once the draft policy is approved in the Cabinet.
This proposed project requires land acquisition in each Polder area, which should be done following the procedure mentioned in this Act.

(xi) Noise Pollution (Control) Rules, 2006

According to Environment Protection Act 1995, the government formulated the noise pollution Rules & Regulation in 2006. This regulation recommends to keep the sound level 50 dB at the quieter area from 6am until 9pm and at night 40 dB, similarly, at residential area on the day of 55 dB and at night 45 dB, a mixed area, 60 dB at day time and at night 50 dB, a commercial area on the day of 70 dB and at night 60 dB and the industrial areas of the day 75 dB and at night 70 dB.

(xii) Disaster Management Act, 2012

The Disaster Management Act 2012 aims at coordinating the activities of disaster management and making these object oriented and strengthened to build up infrastructure of effective disaster management to fight all types of disaster. Disastermeans any such incidents created by nature or human.

This Act is particularly relevant to avoiding accidental hazard both in construction and post-construction phase. The relevance of this act for this proposed project arises as following:

- To make a disaster management plan for rehabilitation to bring back any infrastructure, life, livelihood and working environment damaged by disaster to previous condition or better condition.
- To create effective disaster management infrastructure to fight disaster and to make the public concerned and strengthened to face the disasters.
- To ensure that obstacle is created in plying fire brigade and rescue vehicles during fire, earthquake, building slide or other disaster.

Disaster (to certain degree) may occur in present project if any harmful situation occurs during the normal work or construction activity. Therefore, appropriate management plan should have to be taken by the project proponent to prevent any unwanted disaster in the location.

(xiii) Antiquities Act, 1968

The Antiquities Act 1968 (amended in 1976) establishes the legal framework for the preservation and protection of antiquities. According to the Act, any ancient monument (minimum 100 years old) illustrative of architecture, warfare, politics or culture can be regarded as an article of antiquity. The law terms the archeological sites and monuments as antiquities. The Act has defined the procedure in dealing with antiquities in following matters, i.e. custody, preservation of ownerless antiquity, prohibition of movement of antiquity, right of access to protected immovable antiquities etc.

If the proposed project finds any archaeological sites or national antics during carrying out the activity, then it will be dealt under this Act. Discovery or existence of an antiquity will immediately be notified to the Advisory committee formed under this law for the protection of national antiquities. Mitigation measures are outlined for the potential damage and loss of cultural propertiesin chapter 10.

(xiv) Bangladesh Labour Act, 2006 and Rules, 2015

Bangladesh Labour Act was promulgated in 2006. The legislation pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions. The amendment in 2013 has introduced a good number of important items like workers' welfare, rights and safety and industrial safety and expansion of the industry are particularly relevant for this proposed study.

In 2015, Bangladesh government has introduced the Bangladesh Labour Rules. Some of the relevant points of this Rules are health and fire safety, prescribe from for filling case in Labour Court, and approval of factory plan and any extension among others.

The Bangladesh Labour Act 2006 consolidated and repealed 25 previous labour related laws including the Dock Labourers Act, 1934, the Factories Act, 1965 among others.

The proposed project is required to obey occupation health and safety of the workers covered under this Act while carrying out the activities.

(B) Relevant National Policies, Plans and Strategies

(i) National Environment Policy, 1992

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

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

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

- ensure environmentally-sound utilization of all water resources;
- ensure that water development activities and irrigation networks do not create adverse environmental 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.

The Policy is applicable to the Package 3 under CEIP-1and the proposed interventions are required to comply with all the policy directives emphasizing particularly on reducing adverse environmental impacts. The EIA studies of the coastal Polders are required to clearly address the potential impacts and propose mitigation measures.

(ii) National Water Policy, 1999

The National Water Policy (NWP) was adopted in 1999 with the objectives of improved water resources management and protection of the environment.

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.

Most of the above clauses will be applicable to the Package 3 under CEIP-1. The Project design and present EIA study will be required to comply with these requirements.

(iii) National Water Management Plan, 2004

The National Water Management Plan (NWMP) has been prepared with three central objectives consistent with Water Policy aims and national goals. These objectives are:

- Rational management and wise-use of Bangladesh's water resources
- People's quality of life improved by the equitable, safe and reliable access to water for production, health and hygiene

- Clean water in sufficient and timely quantities for multi-purpose use and preservation of the aquatic and water dependent eco-systems.

The Plan is structured in a manner that the objectives of 84 different programmes planned for the next 25 years contribute individually and collectively to attainment of both the overall objectives as well as to intermediate sub-sectoral goals. 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.

The CEIP-1 is itself a project designed under this Plan and addresses its key objectives for the water resource management in the coastal areas.

(iv) Coastal Zone Policy, 2005

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.

The Policy has relevance in proposed project in following matters:

- Reduction of *vulnerabilities:* Safety measures will be enhanced by combining cyclone shelters, multi-purpose embankments, killas, road system and disaster warning system. It should include special measures for children, women, the disabled and the old;
- Sustainable management of natural resources: Small water reservoirs shall be built to capture tidal water in order to enhance minor irrigation in coastal areas. Appropriate water management system within the Polder utilizing existinginfrastructures will be established for freshwater storage and other water utilization.

(v) National Land-use Policy 2001

The Government of Bangladesh has adopted national Land use Policy, 2001. The salient features of the policy objectives are:

- To prevent the current tendency of gradual and consistent decrease of cultivable land for the production of food to meet the demand of expanding population;
- To promote sustainable and planned utilization ofland through 'zoning system' of land for commercial and other purposes;
- To ensure the best utilization of char lands by land accretion for rehabilitation of landless people,
- To protect state-owned land which can be used to meet the needs of development projects;
- To ensure that land use is in harmony with natural environment;
- To use land resources in the best possible way and to play supplementary role in controlling the consistent increase in the number of land less people towards the elimination of poverty and the increase of employment;
- To protect natural forest areas, prevent river erosion and destruction of hills;
- To prevent land pollution; and
- To ensure the minimal use of land for construction of both government and nongovernment buildings.

The land-use policy has specific section for the coastal region, where strengthening the protection against cyclone through implementing various activities has been guided. The extent of activities that will affect the land will ensure that the existing national land use policy is adhered.

(vi) National Agriculture Policy, 1999

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. The policy has some specific guidelines related to coastal areas ensuring to the development of coastal zone agriculture.

- To increase production of potential crops suitable for the coastal areas.
- To build water reservoir to capture tidal water and thereby expanding mechanized irrigation facilities in the coastal areas.
- To research the development of improved crop varieties and technologies suitable for cultivation in coastal, hilly, water logged and salinity affected areas.

The above policies are not directly relevant to the responsibility of the project proponent; however, the proposed CEIP-1is expected to contribute to achieving the objectives of the agriculture policy.

(vii) Guidelines for Environmental Assessment of Water Management (Flood Control, Drainage and Irrigation- FCD/I) Projects

The Guidelines for Environmental Assessmentof Water Management (Flood Control, Drainage and Irrigation- FCD/I) Projects is prepared by the Water Resources Planning Organization (WARPO) on 2001 and approved on 2003 by the Ministry ofEnvironment and Forestwith assistancefrom National Water Management Plan Project (NWMPP).

The Guidelines are intended to be a mandatory part of planning FCD/I projects of all sizes.The aim of this document is to provide the framework for EA of FCD/I projects in Bangladesh. The steps for EA include project appreciation, data collection and environmental baseline description, fieldinvestigations, people's participation, scoping and bounding, impact assessment, analysis ofalternatives and the environmental management plan, which are within the national framework of environmental and social planning.

However, these EA Guidelines for FCD/I projects do not contain details of all the necessary environmentalissues and procedures. EA practitioners must follow the relevant instructions in other nationalregulations and guidelines, as well as those of bilateral or international funding agencies whenapplicable. Therefore, ECR 1997 has been followed primarily along with this for the procedures for obtaining ECC from DoE along with these Guidelines. There is no major deviation in the process.

(C) Implication of legal aspects on this project

(i) Administrative Procedures for Obtaining Location/Environmental Clearance

The legislative bases for environmental assessment for the proposed project intervention are the Environmental Conservation Act 1995 and the Environmental Conservation Rules 1997. According to the ECA 1995, the proponent must need to obtain an Environmental Clearance Certificate from the Department of Environment (DoE) in the manner prescribed by the Rules.

Environmental clearance has to be obtained in two steps: first location clearance and thereafter environmental clearance. Environmental Clearance Certificate is issued to all existing and proposed industrial units and projects falling in the Green category, but it is required to obtain a Location Clearance Certificate for industrial units and projects falling in the Orange – A, Orange – B and Red categories, and then the Environmental Clearance Certificate will be issued. According to the categorization, construction/reconstruction/expansion of flood control embankments, Polders, and dykes related activities fall into the Red category. Therefore, the proposed water supply project falls under the 'Red' category and hence necessitates a full-scale EIA.

Like all other projects, this project also needs to meet the requirement of the DOE. An environmental assessment (EA) study needs to be undertaken for obtaining the environmental clearance. The procedure to obtain an Environmental Clearance Certificate for this "Red" category project requires submission of following documents along with the application:

- Feasibility Report for the Project (where applicable)
- Environmental Impact Assessment (EIA) Report
- Environmental Management Plan (EMP)
- No Objection Certificate from relevant Local Authority (where applicable)
- Other necessary information, (where applicable)

Public participation or consultation is not a condition in the ECR 1997 and/or EIA Guidelines, however, DoE prefers the proponent to do public consultation during the assessment and puts condition for it while providing site clearance or during the approval of the EIA TOR.

Steps to be followed for obtaining Environmental Clearance Certificate (ECC) in connection with the Red Category from DOE are outlined in **Figure 1.1**.

Figure 1.1: Process of obtaining Clearance certificate from DoE

(ii) Organization related to Enforcement of Environmental Standards

The Department of Environment (DoE**),** the technical arm of the Ministry of Environment and Forest (MoEF) is the regulatory body and the enforcement agency of all environmental related activities. It is the responsible body for reviewing and approving the EIA reports in Bangladesh.

The DOE is headed by a Director General (DG). The DG has complete control over the DoE. The power of the DG, as given in the Act, may be outlined as follows:

- The DG has the power to close down the activities considered harmful to human life or the environment. The operator has the right to appeal and procedures are in place for this. However, if the incident is considered an emergency, there is no opportunity for appeal.
- The DG has the power to declare an area affected by pollution as an ecologically critical area. The DoE governs the type of work or process, which can take place in such an area.
- Before undertaking any new development project, the project proponent must take an Environmental Clearance from the DoE. The procedures to take such clearance are in place.

Failure to comply with any part of ECA 1995 may result in punishment by a maximum of 10 years imprisonment or a maximum fine of Tk. 1000,000 or both.

(D) World Bank's Environmental Safeguard Policies

(i) **Environmental Assessment (OP 4.01)**

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 the project implementation period. 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.

The present EIA has been carried out in compliance with this Operational Policy(OP).

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

Category A: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.

Category B: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas--including wetlands, forests, grasslands, and other natural habitats--are less adverse than those of Category A projects.

Category C: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.

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

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

(ii) **Natural Habitats (OP 4.04)**

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.

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 (provided later in the document) to prevent any potential impacts of the Project on the nearby foreshore area.

(iii) **Water Resources Management (OP 4.07)**

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.

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

(iv) **Physical Cultural Resources (OP 4.11)**

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. [20]

- 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

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

to be unavoidable, minor, or otherwise acceptable. Specific details of the justification should be discussed in project documents.

- This policy pertains to any project in which the Bank is involved, irrespective of whether the Bank is itself financing the part of the project that may affect cultural property.

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

(v) **Forestry (OP 4.36)**

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.

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.

(vi) **Projects on International Waterways (OP 7.50)**

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.

(vii) **Pest Management (OP 4.09)**

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.

(viii) **Indigenous Peoples (OP 4.10)**

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:[21]

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

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

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

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.

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.

(ix) **Involuntary Resettlement (OP 4.12)**

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.[22]

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.

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.

(x) **Projects in Disputed Areas (OP 7.60)**

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

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

The Bank may proceed with a project in a disputed area if the governments concerned agree that, pending the settlement of the dispute, the project proposed for country A should go forward without prejudice to the claims of country B. [23]

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

(xi) **Safety of Dams (OP 4.37)**

The Policy seeks to ensure that appropriate measures are taken and sufficient resources provided for the safety of dams that the WB finances. However, this OP is not relevant since the proposed Project does not involve construction of dams.

(xii) **Public Disclosure of Information (BP 17.50)**

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.

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.

(xiii) **Environment, Health and Safety (EHS) Guidelines**

The Environment, Health, and Safety (EHS)[24] 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.

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

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

Appendix D: No Objection Certificates

মাগুরাঘোনা ইউনিয়ন পরিষদ

স্মারক নং- তারিখ-

অবস্থানগত/পরিবেশগত ছাড়পত্রের স্থানীয় কর্তপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্রের ছক

১। আবেদনকারীর নাম ঃ প্রকল্প পরিচালক, উপকূলীয় বাঁধ উন্নয়ন প্রকল্প (CEIP) বাংলাদেশ পানি উন্নয়ন বোর্ড ।

২। পিতা/স্বামীর নাম ঃ প্রযোজ্য নয়

৩। আবেদনকারীর ঠিকানা ঃ প্রকল্প পরিচালকের কার্যালয় , উপকূলীয় বাঁধ উন্নয়ন প্রকল্প (CEIP) বাড়ী নং: ১৫ (৫ম তলা), সড়ক নং: ২৪, গুলশান-২, ঢাকা-১২১২

৪। প্রকল্পের অবস্থানগত ঠিকানা ঃ পোল্ডার ১৭/২, খুলনা জেলার ডুমুরিয়া উপজেলায় মাগুরাঘোনা ইউনিয়নে, অবস্থিত।

৫। প্রকল্পের তফছিল ঃ

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
খুলনা	ডুমুরিয়া				মাঝারি উচু ভূমি	হেক্টর

৬। প্রকল্পের কার্যক্রম ঃ বাঁধ উঁচুকরন, স্লুইজ গেট ও রেগুলেটর নির্মাণ ও মেরামত, খাল পুনঃখনন ইত্যাদি।

উপরোক্ত তথ্যাদির আলোকে পোল্ডার পোল্ডার ১৭/২ পূর্নবাসন প্রকল্প বাস্তবায়নের জন্য নিম্নেবর্ণিত অনাপত্তি প্রদান করা হলো।

শর্তাবলী ঃ

১। প্রকল্প স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষণ আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে।
২। পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত ছাড়পত্র গ্রহণ করতে হবে।
৩। কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তার নিশ্চিত করতে হবে।
৪। উপযুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে। এবং অগ্নিকান্ড কিংবা অন্য কোন দূর্ঘটনার সময় জরুরী নির্গমন ব্যবস্থা থাকতে হবে।
৫। বায়ু ও শব্দ দূষন করা যাবে না।
৬। প্রকল্প সৃষ্ট তরল বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না।

উপরে উল্লিখিত যে কোন শর্তলঙ্ঘন করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক প্রকল্পের বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

তারিখ ঃ

স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও সীলঃ
(আবুল কালাম সামসুদ্দীন)

Appendix E: Gate Operation Plan in Bangla

পোল্ডারের স্লুইস গেট পরিচালনার ক্ষেত্রে নিয়মাবলী

অতীতে পানি উন্নয়ন বোর্ডের কর্মচারীর মাধ্যমে স্লুইস গেটগুলো পরিচালিত হতো। বাজেট স্বল্পতার কারণে সে পদগুলো এখন স্থগিত করা হয়েছে। বর্তমানে গেটগুলো পরিচালনার দায়িত্ব সুবিধাভোগীদের উপর অর্পন করা হয়েছে। প্রতিটি পোল্ডাওে এ জন্য পানি ব্যবস্থাপনা সংস্থা (WMG, WMO, WMA) গঠন করা হয়। কৃষি উন্নয়ন ও মৎস্য সম্পদের কথা বিবেচনা করে পোল্ডার ১৭/২ 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 F: Wildlife Species Composition

Table 1: Checklist of terrestrial plant species found within the Polderarea

Scientific Name	Family	Local Name	Habit
Acacia moniliformis	*Mimosaceae*	*Akashmoni*	*Tree*
Acalypha indica	*Euphorbiaceae*	*Muktajhuri*	*Herb*
Aegle marmelos	*Rutaceae*	*Bel*	*Tree*
Albizia lebbeck	*Leguminosae*	*Sirish*	*Tree*
Albizia procera	*Leguminosae*	*Silkaroi*	*Tree*
Albizia richrdiana	*Leguminosae*	*Gogon Sirish*	*Tree*
Alstonia scholaris	*Apocynaceae*	*Chatim*	*Tree*
Anthocephalus chinensis	*Rubiaceae*	*Kadom*	*Tree*
Areca catechu	*Palmae*	*Supari*	*Tree*
Artocarpus heterophyllus	*Moraceae*	*Kathal*	*Tree*
Averrhoa carambola	*Averrhoaceae*	*Kamranga*	*Tree*
Azadirachta indica	*Meliaceae*	*Nim*	*Tree*
Bambusa sp.	*Gramineae*	*Bans*	*Tree*
Barringtonia acutangula	*Barringtoniaceae*	*Hijal*	*Shrub*
Borassus flabelifer	*Palmae*	*Tal*	*Tree*
Calamus tenuis	*Palmae*	*Bet*	*Shrub*
Calotropis gigantea	*Asclepiadaceae*	*Akand*	*Shrub*
Carica papaya	*Caricaceae*	*Papay*	*Shrub*
Carissa carandas	*Apocynaceae*	*Karamcha*	*Shrub*
Cassia alata	*Leguminosae*	*Dadmordon*	*Shrub*
Cassia fistula	*Leguminosae*	*Sonalu*	*Tree*
Casuarina equisetifolia	*Casurianaceae*	*Jahu*	*Shrub*
Centella asitica	*Umbelliferae*	*Thankuni*	*Herb*
Cestrum nocturnum	*Compositae*	*Hasnahena*	*Shrub*
Citrus grandis	*Rutaceae*	*Jambura*	*Tree*
Cleorodendrum viscosum	*Verbenaceae*	*Bhat*	*Shrub*
Clerodendrum inerme	*Verbenaceae*	*Bhant*	*Herb*
Cocos nucifera	*Palmae*	*Narikel*	*Tree*
Cotula hemispherica	*Compositae*	*Kancha ghash*	*Herb*
Crotolaria retusa	*Gramineae*	*Ban-san*	*Herb*
Croton bonplandianum	*Euphorbiaceae*	*Banjhal*	*Herb*
Cuscuta australis	*Convolvulaceae*	*Swarnalata*	*Herb*
Cynodon dactylon	*Gramineae*	*Durba*	*Herb*
Cyperus diformis	*Cyperaceae*	-	*Herb*
Dalbergia sissoo	*Fabaceae*	*Sisso*	*Tree*
Datura suaveolens	*Solanaceae*	*Dutura*	*Herb*
Dentella repens	*Rubiaceae*	*Hachuti*	*Herb*
Dillenia indica	*Dilleniaceae*	*Chalta*	*Tree*
Diospyros discolor	*Ebanaceae*	*Bilatigab*	*Tree*
Diospyros perigrina	*Ebanaceae*	*Deshigab*	*Tree*
Erythrina ovalifolia	*Leguminosae*	*Talimandar*	*Tree*
Euphorbia hirta	*Euphorbiaceae*	*Dudhia*	*Herb*
Ficus benghalensis	*Moraceae*	*Bot*	*Tree*
Ficus heterophylla	*Moraceae*	*Bhui Dumur*	*Herb*
Ficus hispida	*Moraceae*	*Dumur*	*Shrub*
Ficus religiosa	*Moraceae*	*Assawath*	*Tree*
Glycosmis pentaphylla	*Rutaceae*	*Daton*	*Shrub*
Lagerstromia speciosa	*Lythraceae*	*Jarul*	*Tree*
Leucauna laucocephalata	*Mimisaceae*	*Ipil ipil*	*Tree*

Scientific Name	Family	Local Name	Habit
Litchi chinensis	*Sapindaceae*	*Lichu*	*Tree*
Mangifera indica	*Anacardiaceae*	*Aum*	*Tree*
Marsilea quadrifolia	*Marciliaceae*	*Susnishak*	*Herb*
Mikania scandens	*Compositae*	*Assamlata*	*Herb*
Moringa oleifera	*Moringaceae*	*Sajna*	*Tree*
Nicotiana plumbaginifolia	*Solanaceae*	*Bantamak*	*Herb*
Nyctanthes arbortristris	*Solanaceae*	*Sefali*	*Herb*
Ocimum americanum	*Labiatae*	*Tulshi*	*Herb*
Pandanus sp.	*Pandanaceae*	*Keya*	*Herb*
Phoneix sylvestris	*Palmae*	*Khejur*	*Tree*
Pongamia pinnata	*Fabaceae*	*Karoch*	*Tree*
Psidium guajava	*Myrtaceae*	*Peyara*	*Shrub*
Rhynchospora rufescens	*Cyperaceae*	*Shimbhatraji*	*Herb*
Ricinus communis	*Euphorbiaceae*	*Reri*	*Shrub*
Rorippa indica	*Cruciferae*	*Bansarisha*	*Herb*
Sacciolepis interrupta	*Gramineae*	*Nardulla*	*Herb*
Sesbania rostrata	*Leguminosae*	*Dhaincha*	*Herb*
Spondias dulcis	*Anacardiaceae*	*Amra*	*Tree*
Streblus asper	*Urticaceae*	*Sheora*	*Shrub*
Swietenia mahagoni	*Meliaceae*	*Mahogoni*	*Tree*
Syzygium cumini	*Myrtaceae*	*Kalojam*	*Tree*
Tamarindus indica	*Leguminosae*	*Tetul*	*Tree*
Tectona grandis	*Verbenaceae*	*Segun*	*Tree*
Terminalia arjuna	*Combretaceae*	*Arjun*	*Tree*
Terminalia catappa	*Combretaceae*	*Katbadam*	*Tree*
Trewia nudiflora	*Euphorbiaceae*	*Pitali/Latim*	*Tree*
Zizyphus mauritiana	*Rhamnaceae*	*Baroi*	*Tree*

Source: Field survey, 2012

Table 2: Checklist of aquatic flora species found within the Polder area

Scientific Name	Family	Local Name	Habit
Alternanthera philoxiroides	*Amaranthaceae*	*Helencha*	*Herb*
Ceratophyllum desmersum	*Cearatophyllaceae*	*Jhangi*	*Herb*
Colocasia esculenta	*Araceae*	*Kachu*	*Herb*
Eclipta alba	*Compositae*	*Kalokeshi*	*Herb*
Eichhornia crassipes	*Pontaderiaceae*	*Kochuripana*	*Herb*
Enhydra fluctuans	*Cyperaceae*	*Helencha*	*Herb*
Hygroryza aristata	*Gramineae*	*Putki*	*Herb*
Ipomoea aquatica	*Convolvulaceae*	*Kalmi sak*	*Herb*
Lemna perpusilla	*Lemnaceae*	*Khudipana*	*Herb*
Ludwigia abscendens	*Onagraceae*	*Keshordam*	*Herb*
Ludwigia hyssopifolia	*Onagraceae*	*Keshordam*	*Herb*
Mersilea quadrifoliata	*Mersileaceae*	*Susnisak*	*Herb*
Monochoria hatata	*Pontaderiaceae*	*Kechur*	*Herb*
Nachamendra alternifolia	*Hydrocharitaceae*	*Kaisa*	*Herb*
Najas. sp	*Najadaceae*	*Goisa*	*Herb*
Nymphaea nouchali	*Nymphaeaceae*	*Shapla*	*Herb*
Nymphaea stellata	*Nymphaeaceae*	*Nilshapla*	*Herb*
Phragmites karka	*Gramineae*	*Nol*	*Herb*
Pistia stratiotes	*Araceae*	*Topapana*	*Herb*
Polygonum barbatum	*Polygonaceae*	*Bishkatali*	*Herb*
Polygonum glabrum	*Polygonaceae*	*Bishkatali*	*Herb*
Sagittaria sagittifolia	*Alismataceae*	*Chhotokul*	*Herb*

Scientific Name	Family	Local Name	Habit
Scirpus juncoides	*Cyperaceae*	*Chisra*	*Herb*
Spirodela polyrhiza	*Lemnaceae*	*Khudipana*	*Herb*
Trapa natans	*Trapaceae*	*Singra*	*Herb*
Vallisnaria spiralis	*Hydrocharitaceae*	*Bicha*	*Herb*
Vetiveria zizanioides	*Gramineae*	*Binna*	*Herb*
Wolffia microscopica	*Lemnaceae*	*Guripana*	*Herb*

Source: Field survey, 2012

Table 3: Checklist of bird species found within the study area

Status
IUCN Status
VU- Vulnerable
EN-Endangered
CR- Critically Endangered
LC-Least Concern
Birdlife Global Status
Same as IUCN Status
Local Status
CR-Common Resident
UR-Uncommon Resident
CWV- Common Winter Visitor
UWV- Uncommon Winter Visitor
RR-Rare Residant
DD-Data Deficient
WV-Winter Vagrant
RWV-Rare winter visitor
Birdlife Status: LC= Leased Concerned; NT = Near Threatened; NRF = No Record Found

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Acridotheres fuscus	*Jungle Myna*	*Jhuti Shalik*		CR	LC
Actitis hypoleucos	*Common Sandpiper*	*Pati Batan*		CWV	LC
Aegithina tiphia	*Common Iora*	*Pati Fatikjal*		CR	LC
Alcedo atthis	*Common Kingfisher*	*Pati Machranga*		CR	LC
Amaurornis phoenicurus	*White-breasted Water hen*	*Dholabook Dahuk*		UR	LC
Anastomus oscitans	*Asian Open bill*	*Eshio Shamkhol*		CR	LC
Anthus hodgsoni	*Olive-backed Pipit*	*Jolpaipith Tulika*		CWV	LC
Anthus richardi	*Richard's Pipit*	*Richarder Tulika*		CWV	LC
Anthus roseatus	*Rosy Pipit*	*Golapi Tulika*		CWV	LC
Anthus rufulus	*Paddy field Pipit*	*Dhani Tulika*		CR	LC
Ardeola grayii	*Indian Pond Heron*	*Deshi Kanibok*		CR	LC
Artamus fuscus	*Ashy Wood swallow*	*Metey Bonababil*		CR	LC
Athene brama	*Spotted Owlet*	*Khuruley Kutipecha*		CR	LC
Bubulcus ibis	*Cattle Egret*	*Go Boga*		CR	LC
Caprimulgus macrurus	*Large-tailed Nightjar*	*Lenja Ratchora*		CR	LC
Casmerodius albus	*Great Egret*	*Boro Boga*		CR	LC
Celeus brachyurus	*Rufous Woodpecker*	*Khoira Khathkurali*		CR	LC
Centropus sinensis	*Greater Coucal*	*Boro Kubo*		CR	LC
Charadrius dubius	*Little Ringed Plover*	*Soto Nothjiria*		CR/CWV	LC
Cisticola juncidis	*Zitting Cisticola*	*Bhomra Soton*		CR	LC
Columba livia	*Common Pigeon*	*Gola Paira*		CR	LC
Copsychus saularis	*Oriental Magpie-Robin*	*Udoi Doel*		CR	LC

Coracias benghalensis	*Indian Roller*	*Bangla Nilkanto*		CR	LC
Coracina macei	*Large Cuckoo shrike*	*Boro Kabashi*		CR	LC
Corvus macrorhynchos	*Large-billed Crow*	*Dar Kak*		CR	LC
Corvus splendens	*House Crow*	*Pati Kak*		CR	LC
Cuculus micropterus	*Indian Cuckoo*	*Bokotakou Kokil*		CR	LC
Cypsiurus balasiensis	*Asian Palm Swift*	*Ashio Talbatashi*		CR	LC
Dendrocitta vagabunda	*Rufous Treepie*	*Khoira Harichacha*		CR	LC
Dendrocopos macei	*Fulvous-breasted Woodpecker*	*Batabi Kathkurali*		CR	LC
Dendrocygna bicolor	*Fulvous Whistling Duck*	*Raj Shorali*		CWV	LC
Dendrocygna javanica	*Lesser Whistling Duck*	*Pati Shorali*		CR	LC
Dicrurus macrocercus	*Black Drongo*	*Kala Fingey*		CR	LC
Dinopium benghalense	*Lesser Golden back*	*Bangla Kaththokra*		CR	LC
Dinopium javanense	*Common Golden back*	*Pati Kaththokra*		CR	LC
Egretta garzetta	*Little Egret*	*Choto Boga*		CR	LC
Egretta intermedia	*Yellow-billed Egret*	*Majhla Boga*		CR	NR
Elanus caeruleus	*Black-winged Kite*	*Katua Chil*		UR	LC
Eudynamys scolopaceus	*Asian Koel*	*Eshio Kalakokil*		CR	LC
Falco tinnunculus	*Common Kestrel*	*Pati Kestrel*		CWV	LC
Gallicrex cinerea	*Water cock*	*Deshi Kora*		UR	LC
Gallinago gallinago	*Common Snipe*	*Pati Chega*		CWV	LC
Gallinago stenura	*Pin-tailed Snipe*	*Lenja Chega*		CWV	LC
Gallinula chloropus	*Common Moorhen*	*Pati Panmurgi*		CR	LC
Glareola lactea	*Small Indian Pratincole*	*Soto Babubatan*		CR	LC
Halcyon smyrnensis	*White-throated Kingfisher*	*Dholagola Machranga*		CR	LC
Haliastur Indus	*Brahminy Kite*	*Shonkho Chil*		CR	LC
Hierococcyx varius	*Common Hawk-Cuckoo*	*Pati Chokhgelo*		CR	LC
Hypothymis azurea	*Black-naped Monarch*	*Kalaghar Rajon*		CR	LC
Ixobrychus cinnamomeus	*Cinnamon Bittern*	*Khoira Bogla*		UR	LC
Ketupa zeylonensis	*Brown Fish Owl*	*Khoira Mechopecha*	VU	UR	LC
Lanius cristatus	*Brown Shrike*	*Khoira Latora*		CWV	LC
Lanius schach	*Long-tailed Shrike*	*Lenja Latora*		CR	LC
Larus ridibundus	*Common Black-headed Gull*	*Kalamatha Gangchil*		CWV	LC
LC Acridotheres tristis	*Common Myna*	*Bhat Shalik*		CR	LC
Leptocoma zeylonica	*Purple-rumped Sunbird*	*Begunikomor Moutushi*		CR	LC
Lonchura malabarica	*Indian Silver bill*	*Deshi Chandithot*		UR	LC
Lonchura malacca	*Black-headed Munia*	*Kalamatha Munia*		UR	LC
Lonchura punctulata	*Scaly-breasted Munia*	*Butibook Munia*		CR	LC
Malacocincla abbotti	*Abbott's Babbler*	*Aboter Satarey*		CR	LC
Megalaima asiatica	*Blue-throated Barbet*	*Neelgola Boshonto*		CR	LC
Megalaima haemacephala	*Coppersmith Barbet*	*Shekra Boshonto*		CR	LC
Megalaima lineata	*Lineated Barbet*	*Dagi Boshonto*		CR	LC
Megalurus palustris	*Striated Grassbird*	*Dagi Ghashpakhi*		CR	LC
Merops orientalis	*Green Bee-eater*	*Shobuj Shuichora*		CR	LC
Metopidius indicus	*Bronze-winged Jacana*	*Dol Pipi*		UR	LC
Milvus migrans	*Black Kite*	*Bhubon Chil*		CR	LC
Mirafra assamica	*Bengal Bush Lark*	*Bangla Jharbhorot*		CR	LC
Motacilla alba	*White Wagtail*	*Dhola Khonjon*		CWV	LC

Motacilla cinerea	*Grey Wagtail*	*Metey Khonjon*		UWV	LC
Motacilla citreola	*Citrine Wagtail*	*Sitrin Khonjon*		CWV	LC
Motacilla madaraspatensis	*White-browed Wagtail*	*Dholavru Khonjon*		UR	LC
Nettapas coromandelianus	*Cotton Pygmy Goose*	*Dhola Balihash*		UR	LC
Numenius arquata	*Eurasian Curlew*	*Eureshio Gulinda*		V	LC
Numenius glareola	*Wood Sandpiper*	*Bon Batan*		CWV	LC
Nycticorax nycticorax	*Black-crowned Night Heron*	*Kalamatha Nishibok*		CR	LC
Oriolus xanthornus	*Black-hooded Oriole*	*Kalamatha Benebou*		CR	LC
Orthotomus sutorius	*Common Tailorbird*	*Pati Tuntuni*		CR	LC
Parus inornata	*Plain Prinia*	*Nirol Prina*		CR	LC
Parus major	*Great Tit*	*Boro Tit*		CR	LC
Passer domesticus	*House Sparrow*	*Pati Chorui*		CR	LC
Pericrocotus cinnamomeus	*Small Minivet*	*Choto Saheli*		CR	LC
Phalacrocorax niger	*Little Cormorant*	*Choto Pankouri*		CR	LC
Picus xanthopygaeus	*Streak-throated Woodpecker*	*Dagigola Kathkurali*		UR	LC
Ploceus philippinus	*Baya Weaver*	*Deshi babui*		CR	LC
Pluvialis fulva	*Pacific Golden Plover*	*Proshanto Shonajiria*		CWV	LC
Psittacula krameri	*Rose-ringed Parakeet*	*Modna Tia*		CR	LC
Pycnonotus cafer	*Red-vented Bulbul*	*Bangla Bulbul*		CR	LC
Rhipidura albicollis	*White-throated Fantail*	*Dholagola Chatighurani*		CR	LC
Spilornis cheela	*Crested Serpent Eagle*	*Tila Nag-eegol*		CR	LC
Sterna acuticauda	*Black-bellied Tern*	*Kalapet Panchil*			LC
Sterna aurantia	*River Tern*	*Nodia Panchil*		UWV	LC
Sterna hirundo	*Common Tern*	*Pati Panchil*		UWV	LC
Streptopelia chinensis	*Spotted Dove*	*Tila Ghughu*		CR	LC
Streptopelia decaocta	*Eurasian Collared Dove*	*Eurashio Konthighughu*		CR	LC
Streptopelia tranquebarica	*Red Turtle Dove*	*Lal Konthighughu*		CR	LC
Sturnus contra	*Pied Myna*	*Eshio Pakrashalik*		CR	LC
Sturnus ginginianus	*Bank Myna*	*Gaang Shalik*		UR	LC
Sturnus malabaricus	*Chestnut-tailed Starling*	*Khoiralej Telshalik*		CR	LC
Tadorna ferruginea	*Ruddy Shelduck*	*Khoira Chokachoki*		CWV	LC
Terpsiphone paradisi	*Asian Paradise-flycatcher*	*Eshio Shabulbuli*		UR	LC
Treron phoenicopterus	*Yellow-footed Green Pigeon*	*Holdepa Horial*		CR	LC
Turdoides striatus	*Jungle Babbler*	*Bon Satarey*		CR	LC
Turdoides earlei	*Striated Babbler*	*Dagi Satarey*		UR	LC
Tyto alba	*Barn Owl*	*Lokkhi Pecha (SA)*		UR	LC
Upupa epops	*Eurasian Hoopoe*	*Pati Hoodhood*		UR	LC
Vanellus duvaucelii	*River Lapwing*	*Nodi Titi*	EN	UR	LC
Vanellus indicus	*Red-wattled Lapwing*	*Hot Titi*		UR	LC
Zoothera torquatus	*Eurasian Stone Chat*	*Pati Shilafidda*		CWV	LC
Zosterops palpebrosus	*Oriental White-eye*	*Udoi Dholachokh*		CR	LC

Source: Field survey, 2012

Table 4: Checklist of Mammals, Amphibians, and Reptiles with status found along the Polder alignment

Local Status code: CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV – Winter Visitor; UWV – Uncommon Winter Visitor

IUCN Status code: CR – Critically Endangered, EN - Endangered, VU – VuMNerabal

Scientific Name	English Name	Local Name	IUCN Status (BD)	Local Status
Mammals				
Bandicota bengalensis	Lesser Bandicoot Rat	Indur	-	CR
Bandicota indica	Greater Bandicoot Rat	Dhari Indur	-	CR
Canis aureus	Asiatic Jackal	Pati Shial	VU	RR
Felis chaus	Jungle Cat	Ban Biral/Woab	EN	RR
Herpestes javanicus	Small Indian Mongoose	Beji	-	UR
Hipposideros galeritus	Cantor's Leaf-nosed Bat	Kantor Pata-nak Chamchika	NT	UR
Megaderma lyra	Indian False Vampire	Daini Chamchika	-	CR
Mus musculus	House Mouse	Nengti Indur	-	UR
Pipistrellus coromandra	Indian Pipistrelle	Chamchika	-	CR
Platanista gangetica	Ganges River Dolphin	Shishu/Shushuk/Hou m	EN	UR
Prionailurus viverrinus	Fishing Cat	Mechho Bagh	EN	UR
Pteropus giganteus	Flying Fox	Badur		CR
Rattus rattus	Common House Rat	Ghorer Indur	-	CR
Rousettus leschenaulti	Fulvous Fruit Bat	Kola badur	LC	UR
Suncus murinus	Asian House Shrew	Chika	CR	CR
Viverricula indica	Small Indian Civet	Khatash	VU	RR
Amphibians				
Hoplobactrachus tigerinus	Indian Bull Frog	Sona bang	-	C
Microhyla ornata	Ornate Microhylid	Cheena Bang	VU	C
Hylarana tytleri	Leaping Frog	Pana Bang	-	U
Polypedates leucomystax	Asian Brown Tree Frog	Gecho Bang	-	CR
Polypedates maculatus	Indian Tree Frog	Gecho Bang	-	UR
Reptiles				
Pangshura tectum	Indian Roofed Turtle	Kori/Hali Kasim	-	C
Pangshura tentoria	Median Roofed Turtle	Kaitta	-	U
Aspideteres gangeticus	Ganges softshell Turtle	Khalua Kasim	EN	UR
Lissemys punctata	Spotted Flapshell Turtle	Patapori/ Shundi Kasim	VU	UR
Calotes versicolor	Common Garden Lizard	Roktochosha	-	CR
Gekko gecko	Tokay Gecko	Tokkhak/Kokkay	VU	CR
Hemidactylus brookii	Brooks House Gecko	Tiktiki	-	CR
Hemidactylus flaviviridis	Yellow-bellied House Gecko	Goda Tiktiki	-	CR
Hemidactylus frenatus	Common House Gecko	Tiktiki	-	CR
Mabuya carinata	Keeled Grass skink	Anzoni	-	C
Sphenomorphus maculatus	Spotted Litter skink	Anzoni	-	C
Varanus bengalensis	Bengal Monitor	Gui Shap	VU	CR
Varanus salvator	Water Monitor	Sona Gui	EN	RR
Typhlops jerdoni	Jerdon's Blind Snake	Sutanoli Shap	-	CR
Atretium schistosum	Olive Keelback	Matia Shap	-	CR
Amphiesma stolatum	Striped Keelback	Chilu Shap	-	CR
Enhydris enhydris	Common Smooth Water	Painna Shap	-	CR

Scientific Name	English Name	Local Name	IUCN Status (BD)	Local Status
	Snake			
Lycodon aulicus	Common Wolf Snake	Gharginni Shap	-	CR
Ptyas mucosus	Indian Rat Snake	Daraj Shap	-	CR
Xenochropis piscator	Checkered Keelback	Dhora Shap	-	C
Bungarus caeruleus	Common Krait	Kal-keute Shap	EN	UR
Naja naja	Spectacled Cobra	Khoiya Gokhra Shap	EN	C
Naja kaouthia	Monocled Cobra	Gokhra Shap	VU	RR

Source: Field survey, 2012

Appendix G: Available fish species of different habitats in the study area

Scientific Name	Local name	English Name	Fish Habitat			
			River	Khal	Gher	Pond
Brackish Water Fish Species						
Lates calcarifer	Bhetki	Barramundi	M	L	NA	NA
Liza parsia	Persa	Gold spot Mullet	H	L	NA	NA
Polynemus paradiseus	Tapse	Paradise Threadfin	M	L	NA	NA
Rhinomugil corsula	Khorsula	Corsula	M	L	L	L
Raiamas bola	Bhola	Indian Trout	L	NA	NA	NA
Acentrogobius cyanomos	Nuna Baila	Salin Goby	H	M	NA	NA
Glosssogobius giuris	Baila	Tank Goby	M	M	NA	NA
Gadusia chapra	Chapila	Chapila	H	L	NA	NA
Plotosus canius	Gang Magur	Canine Catfish	L	NA	NA	NA
Setipinna phasa	Phasa	Gangetic hairfin anchovy	M	NA	NA	NA
Macrobrachium rosenbergii	Golda chingri	Giant River Prawn	L	L	L	NA
Acanthus latus	Datina	Yellow Seabream	M	L	NA	NA
Scatophagus argus	Bishtara	Spotted Butter fish	L	L	NA	NA
Penaeus monodon	Bagda chingri	Giant Tiger Shrimp	M	L	L	NA
Metapenaeus monoceros	Harina chingri	Greasy back Shrimp	M	M	NA	NA
Macrobrachium rude	Kathali chingri	Hairy River Prawn	M	L	NA	NA
Puntius spp	Puti	Spot fin Swamp Barb	M	M	L	LA
Mastacembelus armatus	Baim	Long fin Snake Eel	M	L	NA	NA
M. pancalus	Guchi	Stiped Spiny Eel	M	M	NA	NA
Macrognathus aculeatus	Tara Baim	Lesser Spiny Eel	M	H	NA	NA
Mystus vitatus	Tengra	Mystus	H	H	L	NA
M. cavasius	Gulsha Tengra	Gangetic mystus	M	M	NA	NA
Heteropneustes fossilis	Jiol	Stinging Catfish	NA	L	L	L
Channa striatus	Shol	Snakehead Murrel	NA	L	NA	NA
C. punctatus	Taki	Spotted Snakehead	NA	L	NA	NA
Anabas testudineus	Koi	Climbing perch	NA	L	NA	NA
Ompok pabda	Pabda	-	L	L	NA	NA
Sperata aor	Aor	Cat fishes	L	L	NA	NA
Wallago attu	Boal	Cat fishes	L	L	NA	NA
Pungasius pungasius	Pungus	Riverine giant cat fish	L	NA	M	M
Otolithies argentatus	Sada poa	Puma fish	L	NA	NA	NA
Colisa fasciata	Khoilsa	Banded gourami	NA	L	NA	NA

Scientific Name	Local name	English Name	Fish Habitat			
			River	Khal	Gher	Pond
Lepidocephalus guntea	Gutum	Gutum	L	L	NA	NA
Scylla serrata	Kankra	Crab	H	H	NA	NA
Culture Fish Species						
Labeo rohita	Rui	Rohu	L	NA	H	H
Catla catla	Catla	Catla	NA	NA	H	H
Cirrhinus cirrhosus	Mrigal	Mrigal Carp	NA	NA	H	H
Rhinomugil corsula	Khorsula	Corsula mullet	M	M	H	L
Barbodes gonionotus	Thai/Raj puti	Thai puti /Silver barb	NA	NA	M	H
Hypophthalmichthys molitrix	Silver carp	Silver carp	NA	NA	M	M
Aristichthys nobilis	Brigade, Big head carp	Big head carp	NA	NA	M	M
Ctenopharyngodon idella	Grass carp	Grass carp	NA	NA	M	M
Oreochromis mossambicus	Tilapia	Mozambique tilapia	NA	NA	M	L
O. niloticuss	Tilapia	Nile tilapia	NA	NA	M	M
Pungasius sutchi	Thai Pangus	Yellow tail catfish	NA	NA	L	M
Cyprinus carpio var. communis	Carpio	Common carp	NA	NA	L	M
Cyprinus carpio var. specularis	Mirror carp	Mirror carp	NA	NA	L	L

Source: CEGIS Field Survey 2016 and Consultation with local fishers and elderly people in the study area

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

Appendix H: Summary of Assessed Negative Impacts

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
A. Pre-construction Phase									
Changes in land use (preparation of construction facilities, borrow areas, others)	Short term	Local	Reversible (after construction phase)	Certain	Minor	Low	• All the construction camps should be established within the area owned by BWDB. • Pay compensation/rent if private property is acquired on temporary basis, which instructions should be specified in the tender document. • Labor shed/camp should be constructing at government khas land. • Avoid impacts on local stakeholders.	Very low	
Clearance of vegetation	Short term	Local	Reversible (after construction phase)	Certain	Low to Medium	Medium	• Labor sheds and stock yards should be formed low vegetative area or barren land as much as possible. • Labors should be made aware about local faunal species • Labor should be collected fuel wood for their own purpose from local market (Chuknager bazzar, Kharnia bazzar, Kathaltal Bazzar, Aroshnager natun bazzar etc.	low	
B. Construction Phase									

Generate noise and vibration	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Moderate	• The regulators will not be demolished during school time (8 am to 1 pm) particularly near the schools; • Restrict/limit construction activities during the day time; • Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards; • Vehicles and machinery will have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors should be assured, as needed; • Provision of PPE (ear muffs and plugs) to labor; • Construction crew will be instructed to use the equipment properly, to minimize noise levels; • Camps will be located at a safe distance from communities;	Low	
Soil and water contamination due to wastes	Short term	Local	Reversible (after construction phase)	Certain	High	Major	• Prepare and implement pollution control plan; • Workshops will have oil separators avoid release of oily water; • Avoid repairing of vehicles and machinery in the field; • Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination; • Dispose contaminated soil appropriately ensuring that it does not contaminate water bodies or affect drinking water sources; • Contractor will ensure that there is	Low	

							no leakage, spillage or release of fuel, oil or any other affluent/waste on the ground or in the water from its construction machinery, vehicles, boats, launches, and barges. Contractor will regularly monitor the condition of its fleet; ● Material borrowing from the river banks will be carried out sufficiently away from the water line, minimizing the possibility of loose soil to wash away in the river; ● Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal); ● Release untreated wastes on ground or in water; ● Construction material, demolished debris and excavated soil/silt will not be allowed to enter the water bodies.		
Sedimentation	Short term	May extend beyond Polder	Mostly Irreversible	Likely	High	Moderate	● Small scale Tidal River Management (TRM) may be implemented where appropriate; ● Contractor will protect untreated embankment slopes; ● Contractor will excavate channels after dewatering them; ● Contractor will not leave excavated earth and silt on channel banks; ● Contractor will implement measures to protect channels from run-off from working areas and camps; and ● Contractor will obtain borrowing material from river banks in such a manner so that there is no increase of siltation in rivers, and will not	Low	

							leave loose soil after excavation. ● Regular monitoring of drainage khals is necessary to maintain the capacity.		
Affects on agriculture crop production	Short term	Local	Reversible	Likely	Minor	Low	● Compensation should be paid for any crop damage. ● Contractor should avoid cultivation fields during construction. ● Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps construction. ● Contractor should ensure that no vehicular movements take place inside cultivation fields. ● Contractor should ensure that no material is dumped inside cultivation fields. ● Re-excavated soil of canals should not be damp in agricultural land. ● Contractor should maintain liaison with communities.	Negligible	
Affects on irrigation	Short term	Local	Reversible	Likely	Low to Medium	Major	● Contractor should construct bypass channel before construction/repair of each sluices and Inlets. ● Sequence of work at the sluices and in the water channels should be carefully planned to avoid irrigation disruption. ● Contractor should ensure no negative impacts on crop irrigation. ● Contractor should maintain liaison with communities. ● Contractor should work during dry season.	Low	
Clearance of vegetation	Short term	Local	Reversible (after construction	Occasional	Low to Medium	Medium	● Should be used low vegetative or barren land as much as possible for cc block manufacturing in	Low	

			phase)				construction yard ● Plantation with mangrove species (Kaora, Ora, Bain, Kakra etc.) along the embankment side after completing of construction activities ● All types of construction works should be finished in schedule time ● Proper turfing should be implement at embankment slopes with local grasses (i.e Durba (Cynodon dactylon), Mutha (Cyperus rotundus)) and ensure regular monitoring of turf grasses till they matured ● Collect soil from barren land and alternate source like riverbed or nearer barrow pits at countryside as much as possible ● Implement plantation at sluice ground and nearer foreshore mudflats after completion of construction works ● Social aforestation along the countryside are planted by native species as well as salinity non tolerant variety (i.e Desi neem (Azadirachta indica),Sirish (Albizia lebbeck), Babla (Acacia nilotica), Narikel (Cocos nucifera), Tal (Boassus flabelifer), and river side plantation are mostly used for mangrove species (i.e. Kaora (Sonneratia apetala), Gawa (Exocearia agallocha), Golpata (Nypa fruticans) etc.) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works.		

							• Re-excavated spoil should be major concern to proper utilized. It may be used for re-sectioning of embankment (soil placing) and development of internal rural road • Construction activities would be started at dry season from April to June for re-excavation of canals • All types of activities would be finished of schedule time • Keep untouched the deepest points of the khal as much as possible. • Implement tree plantation with local species at the khal bank side after re- excavation work		
Outbreak of plant diseases	Short term	Local	Reversible	Occasional	Nil to Medium	Medium	• Local people will be involved and awareness in transit nursery program for proper seed germination, saplings collection and preserve • Care should be taken for pest management, excessive use of fertilizer, biological control of plant disease while raising nursery and sapling plantation • FD, BWDB, local people, local nursery owner would be proper collaboration of plantation program with control of plant disease • Eco friendly fiber materials like jute bag, ropes etc. should be used for seed germination and to preserve saplings • Knowing to local people to plant pathogen, indication, cause and distribution of plant disease of affected species • All kinds of polyethylene bags and	Nil	

							plastic ropes should be piled up in a pit for dumped in a proper way ● Aware labors about plant conservation who are engaged for afforestation activities		
Impacts on Fish Habitat and Habitat Quality	Short term	Local	Reversible	Certain	Medium	Major	● Bypass canal should be constructed before the construction and repairmen of the sluice gates and by pass canal should be dismantled just after the completion of the repairing of the sluice gates and excavation work. ● Re-excavation work should be executed in dry season November to April ● Excavated soil should be dumped at safe distance from the bank of Khals on raised land.	Low	BWDB and Contractor
Impacts on Fish Movement and Migration	Short term	Local	Reversible	Certain	Medium	Major	● Alternative by pass channel should be excavated to facilitate the regular movement and migration of fish, shrimp/prawn and other aquatic organisms	Negligible	BWDB and Contractor
Impact on Fish Biodiversity	Short term	Local	Reversible	Certain	Medium	Moderate	● Deeper parts of the major khals should be conserved to conserve fish species	Low	BWDB, WMA with collaboration of DoF
Impact on Fish Production	Short term	Local	Reversible	Certain	Medium	High		Moderate	BWDB, WMA with collaboration of DoF
Safety and Public Health Hazards	Short term	Local	Reversible	Likely	High	Major	● Each contractor should prepare an Emergency Response Plan defining procedures to be followed during any emergency. ● Proper waste management plan should be introduced.	Low	BWDB, Contractor

							● Sanitary toilet should be installed. ● Awareness should be built up about communicable diseases and remedies among the labor. ● The first aid must be provided among the labor. And first aid box should be placed where anyone have easy access. ● Occupational Health and Safety (OHS) should be followed straightly including safe drinking water, Poster displaying proper instruction of first aid boxes, emergency phone number, safety equipment etc. ● Report should be noted daily about labor health and safety; ● All workers must be provided with appropriate Personal Protective Equipment (PPE) and should use them. ● Public awareness training and workshops on safety and health risks should be conducted for local communities prior to and during construction operations. ● Contractor should establish a labor grievance mechanism.		
C. Post Construction Phase									
Risk of embankment failure	Long term	Local	Reversible	Unlikely	High	Major	● Regular monitoring and rigorous maintenance of the embankment and existing water control structures especially along the southern and western side of the Polder will be ensured. This monitoring will particularly be carried out before and after	Low	

							monsoon season. ● Proper dumping and compaction of soil should be ensured during re-sectioning of the embankment. ● Side slope protection works should be maintained with proper design. ● Available cyclone and flood shelter will be prepared as a contingency measure during emergency situation. ● WMG should develop fund for such emergency situation. ● Structural measures like geo bag and sand bag will be kept in the Upazila office for emergency need.		
Tidal flooding	Long term	Local	Reversible	Likely	High	Major	● Bank revetment with backing of embankment work along the Gangrail River should be constructed to protect tidal flooding during high tide and natural calamities. ● Regular monitoring of seepage of surface water from peripheral river through the regulators will have to be checked during dry seasons and necessary steps will be taken to check seepage, if any. ● Proper re-excavation of drainage canals. ● Afforestation program will be taken at both side of the embankment, which will help to strengthen the embankment.	Low	
Sedimentation and drainage congestion	Long term	Local	Reversible	Likely	High	Major	● Re-excavation of drainage khals to be implemented. ● Re-excavation of drainage channels will be implemented with full community involvement and	Moderate	

							participation of WMGs. ● The local government (Union parishad) will be authorized to monitor the development activities. ● Proper training for sluice gate operation and WMOs is needed; ● Reduce conflicts between farmers and fishermen by forming local community. and ● Implement small scale tidal river management (TRM).		
Salinity intrusion	Long term	Local	Reversible	Likely	High	Major	● Regular monitoring and careful maintenance of the water control structures will have to be ensured. ● Proper monitoring against unauthorized inlets. ● Standard operating procedures will have to be prepared and implemented for the water control structures. These procedures will be translated in Bangla as well. ● Capacity building of WMOs will have to be carried out.	Low	
Soil and water contamination (increased use of chemical inputs) and reduced soil fertility	Long term	Local	Reversible	Likely	High	Major	● Capacity building and awareness rising of the farmers should be carried out to practice Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) in order to minimize usage of chemical inputs. ● Farmers group should have close contact with DAE for adoption of various measures of IPM, ICM and GAP. ● Farmers should be encouraged to use organic and green manure to increase soil fertility while avoiding water contamination.	Moderate	

							• Farmers should be encouraged to cultivate leguminous crops (N2 fixing) to enhance the soil quality as well as soil productivity.		
Increase salinity intrusion	Long term	Local	Reversible	Likely	High	Major	• Regular monitoring and careful maintenance of the water control structures will have to be ensured. • Standard operating procedures will have to be prepared and implemented for the water control structures. These procedures will be translated in bangla as well. • Capacity building of WMOs will be carried out.	Low	
Impact on Fish Habitat Condition	Short term	Local	Reversible	Likely	Medium	Moderate	• Maintenance activities (rivers dredging and khals re-excavation) should be executed after certain interval for removing the silt from the rivers and Khals bed	Negligible	BWDB

Appendix I: List of participants of PCM

Participant List 1: Participants list of PCM at Magurghuna Union Parishad Conference room

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থান: [illegible] মাগুরঘোনা উপজেলা: ডুমুরিয়া

জেলা: খুলনা সময়: তারিখ: ০৬/০২/২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
১.	মো: [illegible] রহমান [illegible]	কৃষক	[illegible]	[illegible]	[illegible]
২.	[illegible]	চেয়ারম্যান	[illegible]	01722590324	[illegible]
৩.	মোঃ শফিকুল ইসলাম	ছাত্র	আরশনগর	[illegible]	[illegible]
৪.	মো: নূরুজ্জামান	কৃষক	আরশনগর	[illegible]	[illegible]
৫.	এস.এম আলমগীর	সা. সাংবাদিক	[illegible]	01718818116	[illegible]
৬.	মোঃ [illegible]	কৃষক	আরশনগর	[illegible]	[illegible]
৭.	মোঃ [illegible]	কৃষক	আরশনগর	[illegible]	[illegible]
৮.	বি.এম. [illegible]	শিক্ষক	আরশনগর	[illegible]	[illegible]
৯.	মো: [illegible]	ইউপি সদস্য	[illegible]	[illegible]	[illegible]
১০.	মোবারেক আলী	সাবেক ইউপি সদস্য	[illegible]	[illegible]	[illegible]
১১.	মো: [illegible]	ব্যবসা	[illegible]	[illegible]	[illegible]
১২.	[illegible] রহমান	ব্যবসা	[illegible]		
১৩.	মো: [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
১৪.	মো: [illegible]	সা: [illegible]	[illegible]	[illegible]	[illegible]
১৫.	মো: মাসুদুর রহমান	ব্যবসা	আরশনগর	[illegible]	মাসুদ
১৬.	মো: [illegible]	কৃষি	আরশনগর	[illegible]	[illegible]
১৭.	মো: আবুল [illegible]	কৃষক	[illegible]	[illegible]	[illegible]
১৮.	মো: বিপন ইসলাম	ছাত্র	আরশনগর	[illegible]	মো: বিপন
১৯	মো: রবিউল বিশ্বাস	কৃষি	আরশনগর	[illegible]	রবিউল

আয়োজনে:

CEGIS Center for Environmental and Geographic Information Services
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থানঃ দ: শ্রীরামনগর মঃ প্রা: বিদ্যালয় ইউনিয়নঃ সুরখালী উপজেলাঃ ডুমুরিয়া
জেলাঃ খুলনা সময়ঃ তারিখঃ ০৬/০২/২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
২০.	মো: সোহেল	ছাত্র	আরজ্জানপুর	[illegible]	মো: সোহেল
২১.	মো: শফিকুল ইসলাম	কৃষক	✓	০১৯২৫-৬৫৬৫৪৮	শফিকুল
২২.	বি, এম, আশিকুল ইসলাম	ছাত্র	✓	০১৯২৫৫২৫২৫৮৫	[illegible]
২৩.	মো: বাহারুল ইসলাম	ছাত্র	✓	01923989689	[illegible]
২৪.	মো: আবায়েদ হোসেন	ছাত্র	✓	01943 701182	আবায়েদ
২৫.	বি, এম, মিজানুর রহমান	প্রাক্তন শিক্ষক	✓	০১৭৯১-৮৫৮৬৫৪	[illegible]
২৬.	মো: ফারুক হোসেন	ব্যবসা	✓	01916-409102	Hossain
২৭.	মো: অলিউর রহমান	চাকুরী	✓	01711-152631	[illegible]
২৮.	মো: আনিছুল	ছাত্র	✓	০১৯২৫-৭২৯৮১৬	[illegible]
২৯.	মো: আবু হুসাইন	চাকুরী	✓	01918-467117	[illegible]
৩০.	সিরাজউদ্দীন বিশ্বাস	ব্যবসা	✓	01728-374020	সিরাজ
৩১.	মো: মনিরুজ্জামান শেখ	ব্যবসা	✓	01942-206415	মনি
৩২.	মো: শাহজাহান শেখ	ব্যবসা	✓	01916-409102	শাহজাহান
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উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

স্থান: ডুমুরিয়া উপজেলা পরিষদ মিলনায়তন

সময়: সকাল ১০:০০

তারিখ: ২৬/০৭/২০১৭

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
০১	মো: খান আলী মুনসুর	চেয়ারম্যান উপজেলা পরিষদ	০১৭১১৪৬৭৫৪৬	[illegible]
০২	মোহাম্মদ আশেক হাসান	ইউ.এন.ও ডুমুরিয়া		[illegible]
০৩	মো: [illegible] মামুন	AC (land), ডুমুরিয়া, খুলনা		[illegible]
০৪	এম এম কামরুজ্জামান	উপজেলা যুব উন্নয়ন কর্মকর্তা	01711-161224	[illegible]
০৫	খান আনিছুর রহমান	USSO	01924430025	[illegible]
০৬	মো: আশরাফুজ্জামান	PIO	01711448961	[illegible]
০৭	মো: [illegible]	সময় সংবাদ	01710-752444	[illegible]
০৮	মো: [illegible]	[illegible]	01718135605	[illegible]
০৯	[illegible]	[illegible]	01711351980	[illegible]
১০	শেখ আবুল হোসেন	চেয়ারম্যান [illegible]	01712651869	[illegible]
১১	[illegible]	সময় সংবাদ	01711972986	[illegible]
১২	[illegible] রায়	U.P সদস্য ডুমুরিয়া	01721923446	[illegible]
১৩	[illegible] মল্লিক	ডুমুরিয়া [illegible]	01711953023	[illegible]
১৪	শেখ [illegible] আলী	[illegible]	০১৭১২৪০৫৫৭৮	[illegible]
১৫	মো: সাইফুল ইসলাম	[illegible] ডুমুরিয়া	01918.604066	[illegible]

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স্থান: ডুমুরিয়া উপজেলা পরিষদ মিলনায়তন তারিখ: ২৬/০৭/২০১৭
সময়: সকাল ১০:০০

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৬	মো: মাহবুবুর রহমান মিঠুন	ডুমুরিয়া	০১৯১৪-৪৫৬৮৫১	
১৭	কামরুজ্জামান টিটো	সমাজ সেবক	01727026871	
১৮	সরদার দৌলত হোসেন	সমাজ সেবক	01711056522	
১৯	শেখ মোঃ হাফিজ	সমাজ সেবক ডুমুরিয়া	০১৭১২২৬৫০৪৬	
২০	শেখ মোঃ শাহজাহান	UP সদস্য ডুমুরিয়া	01716478614	
২১	জয় কুমার মন্ডল	UP সদস্য ডুমুরিয়া	01711-928314	
২২	অনাদি কুমার বিশ্বাস	UP সদস্য ডুমুরিয়া	01943-030870	
২৩	কবিতা রানী বিশ্বাস	UP সদস্য ডুমুরিয়া	01918904733	
২৪	তরুন তালুকদার	ইউ.পি সদস্য ডুমুরিয়া	01969240869	
২৫	মোঃ জামাল হোসেন খান	সমাজ সেবক ডুমুরিয়া	01916808068	25/07/17
২৬	এস.এম. জাহাঙ্গীর আলম	সহ: উপজেলা শিক্ষা অফিসার	01911839483	23/7/17
২৭	দেবেন্দ্র কুমার সরকার	উপ: পরিসংখ্যান কর্মকর্তা	01714-931831	23/7/17
২৮	অতুল কুমার ভট্টাচার্য	সিনিয়র উপজেলা মৎস্য কর্মকর্তা	01712-515407	23/07/17
২৯	সুরেশ কুমার সিংহ	[illegible]	01714444266	23/7/17
৩০	শিখা রানী [illegible]	ইউ.পি সদস্য	01723421009	24/7/17

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স্থান: ডুমুরিয়া উপজেলা পরিষদ মিলনায়তন

সময়: সকাল ১০:০০

তারিখ: ২৬/০৭/২০১৭

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৩১	মোঃ সিরাজুল ইসলাম	ভাইস চেয়ারম্যান উপজেলা পরিষদ	01717-337305	[illegible]
৩২	মিনতি [illegible]	ভাইস চেয়ারম্যান মহিলা উপজেলা পরিষদ ডুমুরিয়া	01920717517	[illegible]
৩৩	[illegible]	[illegible]	01948124508	
৩৪	[illegible]	[illegible] LGED	01711930776	[illegible]
৩৫	[illegible]	[illegible]	01730945875	[illegible]
৩৬	[illegible]	[illegible], ডুমুরিয়া	01917-955383	[illegible]
৩৭	[illegible]	ডুমুরিয়া	—	[illegible]
৩৮	মো. [illegible]	[illegible]	01718-124856	[illegible]
৩৯	[illegible]	[illegible] উপজেলা [illegible]	01922986497	[illegible]
৪০	[illegible]	[illegible], CEGIS	01911686751	[illegible]
৪১	নারায়ন চন্দ্র দাস	ডুমুরিয়া	01915819109	নারায়ন
৪২	[illegible]	[illegible]	01914920680	[illegible]
৪৩	মোঃ রবিউল ইসলাম	[illegible]	01711-735091	[illegible]
৪৪	মো: নজরুল ইসলাম	[illegible]	01718-843 846	[illegible]
৪৫				

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Appendix J: Checklist of Public Consultation Meeting

ENVIRONMENTAL IMPACT ASSESSMENT OF

Coastal Embankment Improvement Project (CEIP)

<u>Checklist for Public Consultation Meeting (PCM)</u>

- Self and organization's introduction
- Orientation of the participants
- Purpose of the meeting (Generic and specific)
- Brief introduction about the project (by facilitator)
- Outlining the general problems of the studied area
- Knowledge about the project
- Attitude towards the project
- Project related problems (especially drainage, tidal water, agricultural practice, land source, ground water, intake and discharge of water, quality of water, Fisheries resources; Plantation, Marine ecosystem, Terrestrial wildlife employment, income, etc.)
- Project induced opportunities
- Suggestions for mitigation of problems
- Suggestions for enhancement of opportunities
- Suggestions to project implementers and planners

Appendix K: Comments and Responses

Comments and Responses on EIA report of Polder 17/2 under Package-3

Sl	*Comments by IPOE (Professor Dr. Ainun Nishat)*	*Responses by CEGIS*
1	*Scoping and bounding need to be mentioned in approach and methodology chapter*	*It has already been incorporated in the report (sections 2.2.3 & 2.2.4). This chapter has also been re-organized according to the EIA steps*
2	*Characteristics of brackish fish species and indicative fish species in the Polder area*	*Characteristics of brackish fish species and indicative fish species have been addressed in section 6.2.8*
3	*exist velocity to the gate*	*Exist velocity has been mentioned in section 10.16.3*
4	*Timing of the fish fry movement*	*It has been mentioned in the report (section 6.2.8 and figure 6.9)*
6	*Restore the connectivity /Boat pass or some other way to be provided as per as for boat movement*	*Navigation through boat lifting arrangement has been suggested and addressed in the report (section 10.16.1 in Chapter 10)*
7	*Operation of gate through WMA which should be formed before operation of the gate*	*It has been mentioned in section 6.8 and section 10.16.2*
8	*Do they belief that the project can be managed and operated by the existing staff?*	*Insufficient and mentioned in the report (section 10.16.2)*
9	*Operation of the gates to be voiced/point out by the EIA team*	*A detailed gate operation plan has been pointed out by the EIA team in the report (section 5.9 in chapter 5). In addition, gate operation plan in Bengali has been prepared and provided in Appendix -E*
10	*Flap gates to be replaced by manual gate for allowing fish migration*	*In order to facilitate fish migration and prevent saline water intrusion both flap gate and vertical lifting gate have been provided*
11	*Polder to be used for paddy cultivation not shrimp cultivation, but shrimp cultivation is economically viable and mostly occupied by local influential people. How to solve this problem?*	*A doable plan has been suggested in section 10.16.3 (chapter 10) considering conflict between gher owners and farmers*
12	*Actual requirement of staff for Polder management to be addressed*	*It has been addressed in section 5.9.1. BWDB may recruit sluice khalashi for each of the Drainage Sluices for smooth operation of the gates as per initial practice. It may also be suggested to form Polder management committee consisting BWDB field officials, representatives of WMO,LGI and land owner for properly management of water issues in the Polder area.*
13	*Stakeholder list may be collected from BWDB before conducting the EIA disclosure meeting*	*It must be considered all the times in future*

Appendix L: Comments and Responses (World Bank)

Responses according to the World Bank Comments made on the EIA Report of Polder17/2 of Package-3

Sl	Comments by WB	Responses by EIA Consultant	Action taken
1	Strategic/Sectoral Assessment: Given that multiple Polders are being considered and they are part of a larger government intervention, it is recommended to clarify in the EIAs if any Strategic or Sectoral Environmental Assessment has been conducted in relation to the Coastal Zone Policy (2005), the Coastal Development Strategy (2006) or similar government plans informing the rehabilitation of Polders, and if so, how those Assessments inform the site-specific EIAs	A strategic Environmental Assessment (SEA) has been carried for CEIP-1 before conducting the EIA study.	It has been mentioned in executive summary and Chapter-1 (Introduction)
2	Selection Criteria: Similarly, the EIA states that "This Polder is one of the 17 Polders selected for rehabilitation through feasibility study under CEIP-1.". The EIA, in the Executive Summary and other relevant sections (e.g. Alternative Analysis) should explain any environmental criteria that was used to select the Polders.	Preliminary 17 Polders were selected for rehabilitation in feasibility study considering physical conditions as well as damages of the Polder. Afterwards, these Polders were selected through screening matrix. In environmental point of view, a multi-criteria analysis were conducted which has been mentioned in SEA report.	It has been mentioned in executive summary and Chapter-1 (Introduction)
3	Past Experiences: Since a number of Polders under Works Package 1 have started the construction phase, it is recommended to include a brief explanation of any past experiences or evidence on terms of	Agreed. This issue will be considered	

Sl	Comments by WB	Responses by EIA Consultant	Action taken
	potential significant adverse environmental impacts (e.g. loss of fauna, impacts on sensitive ecosystems, fisheries, etc.) associated to such projects as well as the track record of the Project in managing such impacts and the effectiveness and efficiency of the set of proposed mitigation measures, especially those related to water management and biological/ecological aspects (shrimp culture, fish sanctuaries, etc.). We think the project is already in a situation to learn from the experience and to introduce adjustments (if necessary) and to avoid copying exactly the same measures from other Polders without reflecting on them.		
4	DoE Clearance. Has the EIA been awarded by the DoE clearance? What is the status of the process? Has the IEE been processed and issued?	EIA report of Polder17/2 has not been awarded by DoE yet because this report is in the process of finalization. After finalization, it will be submitted at DoE for Clearance. IEE report was submitted to DoE and obtained site clearance.	It has been mentioned in Chapter 1 (Introduction).
5	Legal framework. How does the EIA and the project apply the policy, legislative and regulatory framework? The chapter presents a compilation of laws and regulation, but how the project understands and ensures its compliance? It is also important to understand how such laws will be	This chapter has already been addressed. Details of the policy, legislatve and regulatory framework have been appended.	Chapter 3 and Appendix-C

Sl	Comments by WB	Responses by EIA Consultant	Action taken
	implemented and enforced, in the specific circumstances of the project. It is important therefore to conduct a gap analysis to confirm whether the national framework enables or requires risk and impacts to be addressed in accordance with Bank requirements. Where this is not the case, options need to be identified to address such gaps.		
6	Climate change. The exercise to bring climate change data to the EIA and to make the CC case is interesting. However, the EIA does not conclude how project design responds to those projections and how project design mitigates the effect of climate change. What is the connection between data and the model utilized for project design?	It may be mentioned here that drainage modelling of the coastal Polder has been carried out by IWM to find out the design parameters for drainage channel systems, drainage regulator, river bank, slope protection works. Climate resilient coastal embankment crest level has been design considering the combined effects of cyclone storm surge effects and cyclone induced wind wave. The model has been developed and simulated considering climate change condition considering with and without interventions by IWM, 2016	It has been mentioned in Chapters 5.4 & 5.6
7	Enhancement of conflicting uses. In various sections the EIA mentions an existing conflict between Gher owners and farmers in the Polder. We believe that this is an important aspect that the EIA does not analyze beyond this general mention. The EIA should explain how the		This issue has been addressed in the Section 6.2.6.

Sl	Comments by WB	Responses by EIA Consultant	Action taken
	interventions of the Project would impact this existing conflict and the EMP should include specific measures to address it.		
8	Para. 127. Afforestation. How does the EMP follow the BWDB afforestation regulations? How is the EMP including the detail information on plantation program (Table 5.8). It would be good to articulate this chapter with EMP.		Yes, the afforestation plan will be implemented as per regulations of BWDB. As per comments, afforestation plan has been articulated in EMP Chapter (Section 10.13)
9	Re-excavation of drainage khals. Local people may be encouraged to take earth from the spoils. How will the aptitude of use of the earth be determined?	As per consultation, local people expressed their interest to take re-excavated materials for different uses.	
10	Construction schedule. How does the construction schedule impact social and community events? The EIA reports on some cultural property presence in the area of influence that might be important to consider.		It has been considered in Section 5.6.7
11	Manpower requirement. We recommend to revisit the numbers of Table 5.10. Otherwise, it suggests a huge labor influx (36,000).		The figure mentioned in Table **5.10 has been revised based on the experience from the works implementation in Package-1.**
12	Project implementation arrangements. We mentioned this in previous reviews before. This section should be adjusted to describe the realism and level of implementation of the proposed arrangements. What we want to say is that part of these arrangements are already		**This issue has been considered and updated the report accordingly** in Chapter 10.3.

Sl	Comments by WB	Responses by EIA Consultant	Action taken
	existing, such as the IPoE and at this stage of project development and evolution it would be good to reflect about these existing arrangements and how they have performed in other Polders. It is very important to describe in the EMP how the mandate and role of the different stakeholders discussed in section 5.8 articulates with the EMP. Many operational activities described in this section have clear implications at the EMP level. Capacity issues should be discussed.		
13	Sensitive receptors. How is the baseline defined for education and health affected by the project? Lease also discusses how the market/growth centers and the cultural heritages and common property resources in the Polder would be affected by the project. They have been included in the baseline, as part of the area of influence.	Selection sensitive receptors as well as growth Centre and common resources properties within 500 m distance from the embankment have been considered	It has been considered in Section 8.4.1 and Figure 8.1
14	Pest management. Para 480 includes the development of a pest management plan for the holistic afforestation. It would be good to capture the experience from the afforestation actions delivered for the Polders under construction.	The afforestation plan has not taken in Package-1 because the construction works under this project in progress	The issue been mentioned in Section 8.4.7
15	Compensation mechanisms. Where in the report is the compensation criteria to establish the payments to the owners against tree	A detail Resettlement Action Plan (RAP) is being prepared by the Consultant. According to the plan, payment to the owners against tree	

Sl	Comments by WB	Responses by EIA Consultant	Action taken
	felling? How is this implemented?	felling will be established. It would be included after getting the RAP report.	
16	EMP and mitigation measures. EMP follow the same footprint as previous reports. In the case of the mitigation measures it is not clear who is responsible for implementation, where and when. This is not fixed by the EMP. While each impacts included a reasonable set of mitigation measures, the EMP chapter of the report includes a generic mitigation guideline. While this is useful it is not enough to guide the preparation of the detailed EMP and the contractor EMP. For example, in terms of obstruction of fish movement and migration, who is going to implement the six proposed mitigation measures, when and where. Is the est6imated implementation cost enough to ensure all the proposed mitigation measures. Our impression is that not all the proposed mitigation measures have been included in the Table 10.4?. Our recommendation is to cut and paste to bring to the table the mitigation measures included in the environmental assessment chapter. The more accurate and defined the EMP is, the better can support the future bidding document directly.	This chapter is being updated according to the comment	

Sl	Comments by WB	Responses by EIA Consultant	Action taken
17	Construction Camps: In various sections of the EIA it is stated that labor sheds and camps will be constructed, but the EIAs should clarify if such labor sheds/camps will house workers or not. If those structures are to house workers it is recommended to include in the EMP section a reference to internationally recognized guidelines for construction and operation of such camps, such as the IFC/EBRD workers accommodation guidelines http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/learning+and+adapting/knowledge+products/publications/publications_gpn_workersaccommodation. Please state if the project will involve labor influx or not following the bank definition.		It has been considered in Section 8.4.14
18	Traffic Management: The EIAs identify risks and impacts related to the project-related traffic and there are different mitigation measures mentioned in different sections of the EIAs. It is recommended to consolidate traffic-related mitigation measures and ensure that they are consistent throughout the document, and also to clarify the scope of key elements of the Traffic Management Plan that should be prepared. Increase of Vehicular	National and WB noise standards have been included in the report to comply Noise levels from vehicles, equipment and machinery etc. Moreover, the Contractors have prepared traffic managementplan as part of EAP (Package-1) and C_ESMP (Package-2), which will be followed by the Contractor of Package-3.	This issue has been discussed in Section 8.4.1 and Table 8.2

Sl	Comments by WB	Responses by EIA Consultant	Action taken
	Traffic during mobilization – it is recommended to 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. This also applies to Hindrance of Pedestrian and Vehicular Movement. Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards. Include reference parameters and link.		
19	*Mangrove Afforestation: On the foreshore area mangrove species will be replanted and that "Mangrove vegetation has immense contribution to protect the embankments and charland from tidal surge, provides fuel and thatch materials to the local inhabitants as well as creates ideal habitats for the local avifauna and other wild animals." Given the importance of mangroves, and the fact that survival rates of replanted mangroves tends to be very low it is recommended that the EIAs include a specific description of the ration of seedlings to be planted for each lost mangrove tree as well as a survival and growth rate targets and corresponding monitoring indicators.*	*Survival rate of each mangrove species are illustrated in FinalInterimReport on AdditionalTasksAssigned September,2013 (Feasibility report on Afforestation)*	*This issue has already been included in EMP (Section 10.13)*
20	*EHS Guidelines: The section on Environment, Health and Safety*		*The health and safety issue has been considered and the*

Sl	Comments by WB	Responses by EIA Consultant	Action taken
	Guidelines should specify that the most relevant EHS Guideline is the General one and provide a link in the document: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines		guideline has been linked in the report (Sections 8.4.14)
21	Pesticides: The interventions under the proposed Project may result in an increased availability of irrigation water through cleaning and excavation of watercourses in the Polder. This increased water availability can in turn potentially increase the usage of chemical fertilizers and pesticides. During regular environment monitoring during operational phase if the water and soil pollution is observed, the proponent will be responsible for preparing a Pest Management Plan with prior approval from Bank." On the above, please clarify: a) parameters to be used to determine if there are exceedances in water and soil pollution linked to use of pesticides; and b) what agency will be responsible for preparing and implementing Pest Management Plan, conduct capacity building in Integrated Pest Management (IPM) and Integrated Crop Management (ICM), as stated in the EIA, in a way that it would	Level of chemicals including heavy metals will be measured during monitoring to check if the environmental quality standards (EQS) are exceeded in which case IPM and ICM will be prepared by the Department of Agricultural Extension (DAE). Objective of the infrastructure project is agricultural crop production which has been addressed. DAE will be the agency responsible for agricultural crop production through reduced dependence on agro-chemicals/ adoption og pest management plan.	

Sl	Comments by WB	Responses by EIA Consultant	Action taken
	effectively mitigate the impact; this allocation of responsibilities if important given that this is basically an infrastructure project and not an agricultural project and purchase and handling of pesticides is not part of project activities.		
22	Periodic Maintenance Works: The EIAs should describe the environmental management procedures that will be in place during the operational phase of the project for conducting "Major Periodic Maintenance Works", which could have considerable impacts.		It has been mentioned in the report (Section 8.5.15)
23	IPoE Assessment: What was the result of the IPoE review of the EIA?	IPoE has reviewed the draft EIA report of Polder 34/3 and has made some comments. Accordingly, the EIA report of Polder 17/2 has been updated.	The comments and responses have been appended in the report (Appendix-K)
24	Disclosure and consultation: Please include final details on disclosure and consultation of the EIA	Initially, consultation meetings have been conducted. Disclosure meeting at regional and national level have also been conducted	