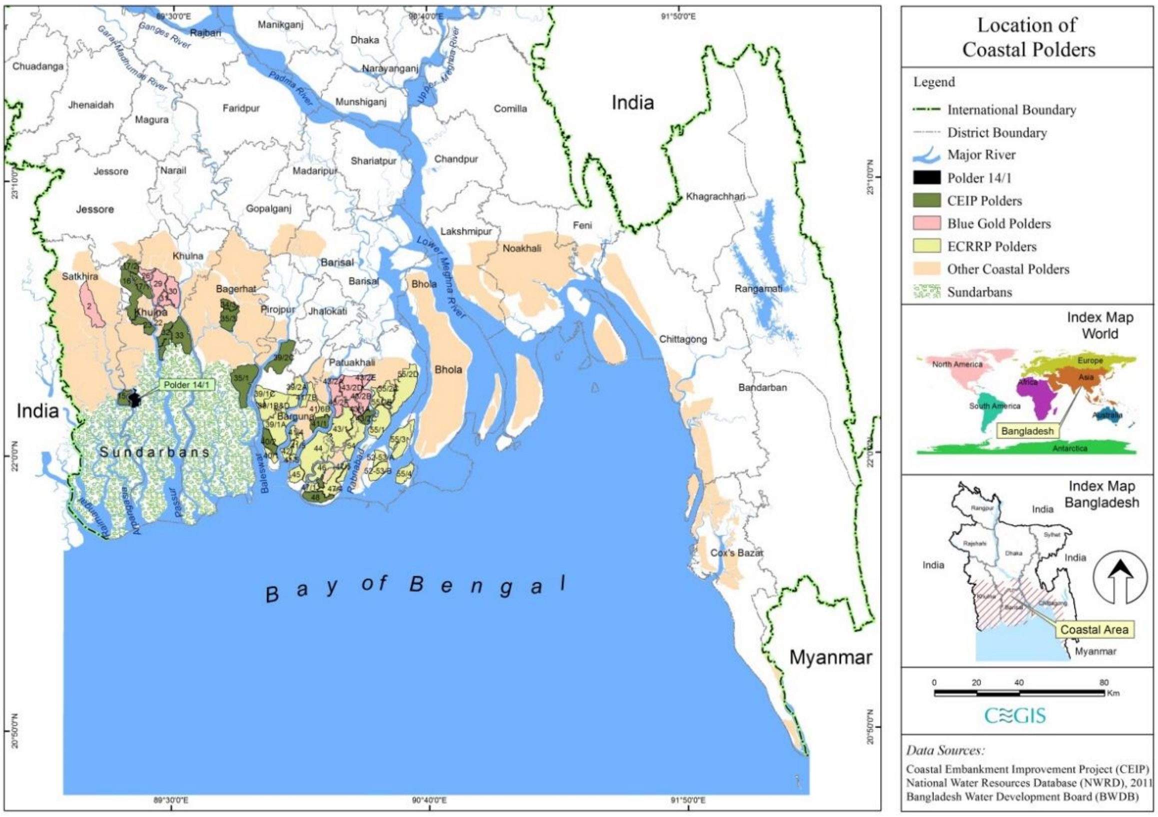
FINAL REPORT

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 OF
POLDER 14/1

May, 2021

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Study Team

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Table of Content

List of Tables

List of Figures

List of Maps

List of Photographs

Abbreviations and Acronyms

ASA	Association for Social Advancement
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorology Department
BP	Bank Procedure
BRAC	Bangladesh Rural Advancement Centre
BWDB	Bangladesh Water Development Board
CDS	Coastal Development Strategy
CDP	Coastal Development Partner
CEGIS	Center for Environmental and Geographic Information Services
CEIP	Coastal Embankment Improvement Program
CEIP-I	Coastal Embankment Improvement Project, Phase-1
CERP	Coastal Embankment Rehabilitation Project
CES	Consulting Engineering Services
CZPo	Coastal Zone Policy
DAE	Department of Agricultural Extension
DDCS&PMSC	Detailed Design Construction Supervision and Project Management Support Consultant
DevCon	Dev Consultants Ltd
DOE	Department of Environment
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
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ES	Environmental Screening
ESCU	Environment, Social and Communication Unit
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
ha	hectare
HYV	High Yielding Variety
IDA	International Development Association (World Bank)
IEE	Initial Environmental Examination
IESCs	Important Environmental and Social Components
ILO	International Labour Organization
IS	Institutional Survey
IUCN	International Union for Conservation of Nature

IWM	Institue of Water Modelling
KII	Key Informant Interview
LLP	Low Lift Pump
MC	Main Consultant (for CEIP-I Feasibility study)
MOEF	Ministry of Environment and Forest
MOWR	Ministry of Water Resources
MSDSs	Material Safety Data Sheets
MSL	Mean Sea Level
NCA	Net Cultivated Area
NGO	Non-Governmental Organization
NOC	No Objection Certificate
N.P.K	Nitrogen Phosphorous Potassium
NWRD	National Water Resources Database
O&M	Operation and Maintenance
PAP	Project Affected Person
PCM	Public Consultation Meeting
PCD	Project Concept Document
PID	Project Information Document
PIO	Project Implementation Office
PRA	Participatory Rural Appraisal
PWD	Power Works Department
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
SRDI	Soils Resources Development Institute
SSO	Social Service Office
STW	Shallow Tubewell
TDS	Total Dissolved Solids
TOR	Terms of Reference
UAO	Upazila Agricultural Officer
UFO	Upazila Fisheries Office(r)
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

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.
Aratdar:	Main actor acting 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:	Broadcast Aus
Bagda:	Shrimp (*Penaeus monodon),* brackish/slightly saline water species.
Baor:	Baor dead arm of a river in the Moribund Delta as in the case of the Ganges; also called oxbow lake. It appears as a saucer shaped depression. The term baor is synonymous to beel, familiar in the southwestern part of Bangladesh.
Bazar:	Market
Beel:	A saucer-shaped natural depression, which generally retains water throughout the year and in some cases seasonally connected to the river system.
Boro:	A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January and harvested before the onset of monsoon in April- May.
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 ofnumbers of *beel*s/low-lying areas
Haat:	Market place where market exchanges are carried out either once, twice or thrice a week, however not every day.
Jal:	Different types of fishing net to catch fish from the water bodies.
Jhupri:	Very small shed for living, made of locally available materials. A type of house used by very poor community members.
Kutcha:	A house made of locally available materials with earthen floor, commonly used in the rural areas.
Khal:	A drainage channel usually small, sometimes man-made. This 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-I (March-June) and Kharif-II (July-October).

Khas land: Land holding by the Government.

Kutcha Toilet: The earthen simple pit latrine consisting of a hole without cover.

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.

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

T. Aman: Transplanted T. Aman generally grown between July and December.

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 of 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)**	= 3 Bigha **(বিঘা)**
1 Acre**(একর)**	= 60 Katha **(কাঠা)**
1 Acre**(একর)**	= 100 Decimal**(শতাংশ)**
1 Hectare**(হেক্টর)**	= 247 Decimal**(শতাংশ)**
1 Hectare**(হেক্টর)**	= 7.5 Bigha **(বিঘা)**
1 Hectare**(হেক্টর)**	= 2.47 Acre**(একর)**

Executive Summary

The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase I (CEIP-I), under which 17 Polders will be rehabilitated and improved in the coastal area of the country. The GoB has obtained financial assistance from the World Bank (WB) for this Project. In accordance with the national regulatory requirements and WB safeguard policies, the rehabilitation and improvement activities of 17 Polders will be implemented with three packages. EIA and EMP 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 Phase-1 of CEIP, Package-3 could not be implemented which are decided to implement in the next phase.Hoowever, it was decided to complete these 7 EIAs under this phase. In accordance with the national regulatory requirements and WB safeguard policies, EIA and EMP studies of seven Polders under Package-3 have been carried out. This document presents the EIA report of Polder 14/1, which is one of these seven Polders of Package 3 under phase-2 of CEIP. It may be mentioned that preliminarily 17 Polders were selected for rehabilitation in the feasibility study considering physical conditions as well as damages to the Polders. Afterwards, these Polders were selected through screening matrix. Considering environmental point of view, 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 14/1 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

The coastal zone, in the past, in its natural state, used to face inundation by high tides, salinity intrusion, cyclonic storms and associated tidal surges. In 1960s, polderization started in the coastal areas to convert this area into permanent agricultural lands. The Polders in this area are enclosed on all sides by dykes or embankments, separating the land from the main river system and offering protection against tidal floods, salinity intrusion and sedimentation. These Polders are equipped with in- and outlet sluice gates to control the water inside the embanked area.

The Polders were originally designed without proper attention to storm surges. Recent cyclones caused 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. Poor maintenance and inadequate management of the Polders have also contributed to internal drainage congestion and heavy external siltation. As a result, soil fertility and agriculture production 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 from high tides, storm surges. 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

The proposed Polder 14/1 is located in Koyra Upazila under Khulna district of Bangladesh. The administrative and management control lies with BWDB's Khulna O&M Division under the Southwestern zone. The Project aims to enhance protection against natural disasters, increase resilience during and after such disasters, and improve agricultural production by reducing saline water intrusion. To meet the objectives of the CEIP-1, the key improvement works to be carried out in Polder 14/1 under CEIP-1 are: re-sectioning of embankment (27.25 km); retirement of embankment (3.25 km); re-excavation of drainage channels (30 km); slope protection of embankment (6.86 km); bank revetment work (1 km); construction and replacement of 4 drainage sluices; and afforestation on the foreshore areas (30 ha). Bangladesh Water Development Board is the implementing agency of this Project.

The Bangladesh Water Development Board (BWDB) is the implementing agency of this Project. After implementation of the proposed interventions, local stakeholders' participation in the development and maintenance of this Polder will be ensured. A 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 Organizations often termed as CBOs can also play a vital role in maintenance activities. CBOs include ES (Embankment Settler); EMG (Embankment Maintenance Group); LCS (Landless Contracting Society); and CMG (Canal Maintenance Group).

Regulatory and Policy Framework

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

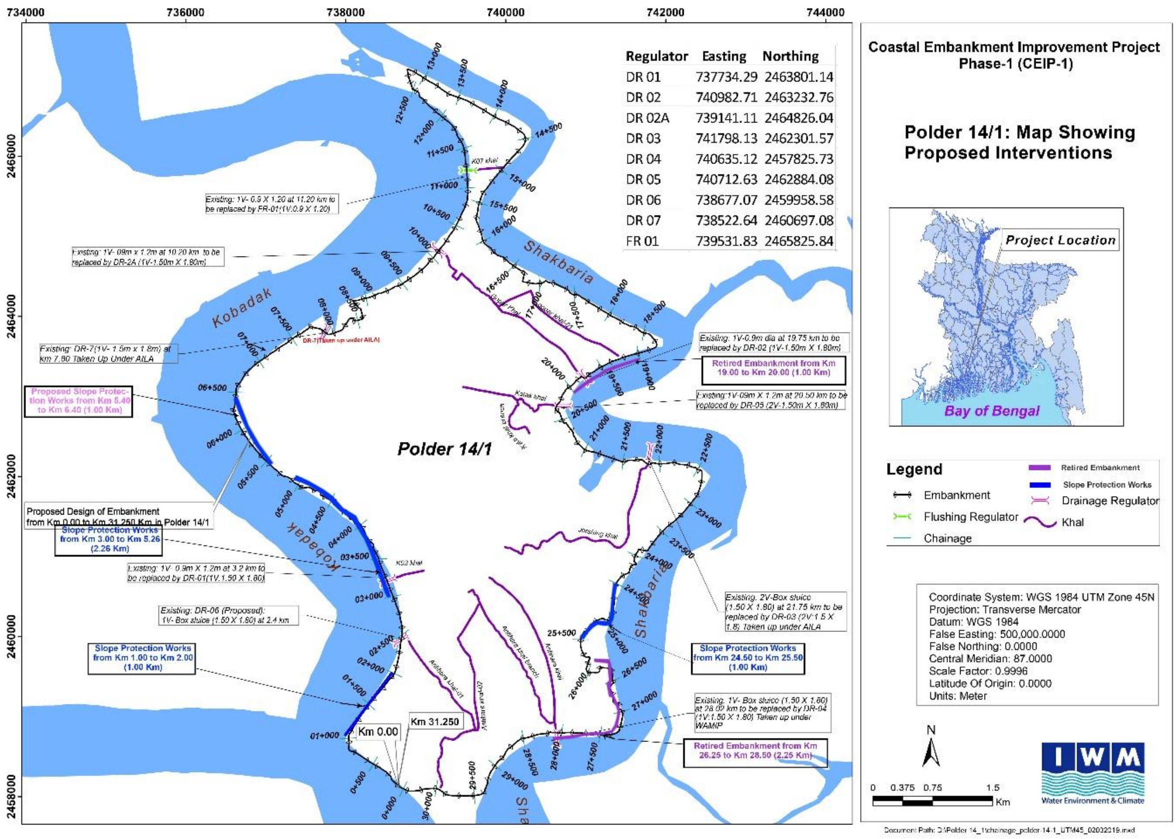
Proposed Rehabilitation Plan

The proposed interventions in Polder 14/1 under CEIP-1 are listed in the following table.

Type of Work	Length	Description of activies/works
Re-sectioning of embankment	27.25 km	Strengthening,widening and raising of existing embankment.The work will be executed from 0+000 to 19+000, 20+000 to 26+250 and 28+500 to 30+500.
Construction of retired embankment	3.25 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 19+000 to 20+000 and Ch 26+250 to 28+500.

Type of Work	Length	Description of activies/works
Construction of drainage sluices	02 nos.	Two new drainage sluice will be constructed at different locations to drain out excess rain water under the proposed rehabilitation plan.
Construction (Replacement) of drainage sluices	02 nos.	The structure has been fully damaged and approach embankment washed away during AILA. However, Among four existing drainage sluices of the Polder; two will be constructed or replaced with new design specifications
Re-excavation of drainage channels	13 km	Six (6) drainage channels with a total length of 13 km will be re-excavated to ease water flow and reduce drainage congestion
Slope protection of embankment	6.80 km	slope protection of the embankment against wave action will be carried out from Ch 12.00 to Ch 12.500 and Ch 24.50 to Ch 25.50 respectively
Afforestation	17.37 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 m PWD which has been assessed 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.



Technical and non-technical manpower will be required for the construction works. Tentaively, 263 manpower will be required during construction period of which 63 is skilled and 200 (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 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.

Environmental Baseline Conditions

The Polder is located in *Koyra* Upazila under *Khulna* District of Bangladesh. The gross area of the Polder is 2,229 hectares (ha) of which net agricultural area is 362 ha. It is observed that about 80% of the Polder net area has been converted to shrimp culture *Ghers*.

Most of the segments of the embankment have been damaged mainly for overtopping of water for cyclones and storm surges especially during *Aila* (2009). There is an abrupt ecological degradation inside the Polder area and no dwelling environment has yet been re-established.

The climate of the Polder area is monsoon tropical. The monthly maximum average temperature (1983-2013) varies from 27.55°C (January) to 37.29°C (April), and April is the hottest month and monthly minimum temperature varies within the range of 10.38°C (January) to 25.18°C (June), and January is the coldest month of the Polder area. November to March is the driest months with negligible rainfall and June to October is the wettest months with highest rainfall. The maximum rainfall 688 mm is recorded in June 1988.

There are 4 (four) numbers of Drainage Sluices (DS) in the Polder of which DS-1 and DS-2 are fully damaged while DS-3 is partially functioning and DS-4 is newly constructed under WMIP but not operable yet. Local people are demanding to have a new sluice near the Patuakhali closure which is linked up with *Jorshing Khal*, *Hajerali Khal* and *Sadderfer Khal* for efficient drainage within the Polder area. Most of the *Khals* are silted up. During *Aila*, storm surge water entered into the Polder through the *Khals* and overtopped the embankment at tremendous pressure resulting in extensively enlarged width of the *Khals* and breaching of the embankment at several portions as well. The average maximum water level at Koyra is 2.46 m + PWD (in June) and average minimum is 1.58 m + PWD (in January) during high tide. During low tide, the average maximum water level is -1.36 m + PWD (in August) and average minimum is - 2.03 m + PWD (in March). Salinity intrusion is another problem of the Polder. In the month of November during field visit, the salinity of the surface water both inside and outside of the Polder were found between 4 to 7 ppt that will increase in April.

The noise level at different places within the Polder area was found within the standard limits.

Sixteen percentage area of the Polder is under agriculture practice. The rest is covered by the settlements, canals, embankment, *Ghers*, ponds, and roads. Total Polder area is within Medium High Land according to SRDI. The dominant cropping pattern in the medium high land is Fallow-HYV *Aman*-Fallow which occupies about 51% of the Net Cultivated Area (NCA). The cropping intensity of the area is 130%. Annual crop production is 1,573 tons. Irrigation provided mainly in hybrid *Boro* which is about 135 ha (30%) of the total NCA. Mainly surface water is used for irrigation. The crop damage of the Polder area was about 25% due to soil salinity and pests during 2010-2015. About 15% of household in the Polder area are rearing cow/bullock, 40% of household are rearing goat, 4% of household are rearing sheep, 70% of household are rearing duck and 80% of household are rearing chicken.

Bagda Gher is dominating in culture fishery in the Polder area. Total fish production of the Polder area is around 1,260 tons. Large amount of fish production (96%) comes from *Bagda Gher*. Fish migration status is poor to moderate in the Polder area. Silted up *Khal*, water regulatory structure on *Khals*, etc., are main causes to obstruction for fish migration.

The Polder occupies Bio-ecological Zone 10 (Saline Tidal Floodplain). Major ecosystems of this Polder are homesteads, crop fields, embankments, shrimp farm, foreshore/intertidal river and canal. Homestead bears higher population of flora and fauna. The encircled embankment of this Polder is barren or lightly vegetated. Adaptation of xerophytic species is remarkable in the entire Polder area. Some portions (*Taltala* and *Boyarjhanpa*) of the embankment are planted with *Babla* and Tamarind tree. Intertidal area of this Polder supports various avifaunas, crabs, mudskipper and scattered mangrove vegetation.

The total households 3,834 having a total population 16,467 of which 8,214 male and 8,254 female with a population density of 1,046 persons per sq km. The literacy rate is 46%, while male 51% and female 42%. Out of total population, 44% are engaged in household work, 37% are employed, and 0.7% looking for work and 19% do not work.

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:

IECs	Impact	Mitigation
Environmental quality (Air and Noise)	• Exhaust emission from trawler and containing particulate matter and other ingredients would deteriorate the ambient air quality around the construction site and nearby areas due to movement of equipment carrying trawlers. • Noise level around the construction sites and in settlement areas will be deteriorated for mobilization of construction materials, trawler equipment and man-power.Therefore, settlements, bazaar areas and surroundings of the construction site will be affected by the increased noise level.	• Construction material (sand) 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. • Exhaust emissions from trawlers and equipment should comply with the standards of DoE. • Regulars sprinkling of water and ramming the materials of stockyard regularly. • Stockyard should be covered during non-working period.
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	• 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.

IECs	Impact	Mitigation
	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 also located beside the embankment which will face traffic congestion during *Haat* time.	• Ensure minimal hindrance to local communities and commuters. • 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)

Impacts during Construction phase

The potential impacts during construction phase include air pollution, noise pollution, disruption of drainage system, loss of crop production, disruption of 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:

IECs	Impact	Mitigation
Environmental (Air and noise) quality	• The construction activities particularly manufacturing of C.C blocks through mixture machines, earth work and its compaction along with operation of construction machinery will generate noise and vibration cause disturbance, nuisance to the nearby communities as well as to the construction workers. • Besides, exhaust emission from the concrete mixture machine and fugitive particulates during construction activities especially for manufacturing CC blocks which are likely to affect the ambient air quality and the nearby communities.	• Construction machineries should have proper mufflers and silencers. • Noise levels from the construction machineries should comply with national noise standards (residential zone) • Provision should be made for noise barriers at construction sites and schools, madrashas and other sensitive receptors as needed. • Water sprinkling and compacting of the materials should be done during construction • Exhaust emissions from the mixture machine should comply with standards • Provision of PPE (ear muffs and plugs) for labors to be ensured. • Installation of fugitive particulate matter system and spraying water on construction materials. • Construction team will be instructed to use the equipment properly, to minimize noise levels. • Installation of acoustic enclosures around generators. • Prohibition of vehicle movement at night • Monitoring noise in the nearby community.

		• Preparation of noise and vibration management plan as a part of pollution control plan.
Drainage congestion	• Drainage system would be impacted and create of drainage congestion • The construction activity particularly for construction/replacement of drainage sluices and re-excavation of the khals may create obstacle to the natural drainage system of the study area especially around the project activity sites. During construction, the natural drainage system of the area will be hampered and may create temporary drainage congestion.	• Some temporal earthen dams should be built in the khal behind the construction of drainage sluices and at both ends of the re-excavation segment. • Bailing out of water within the earthen dams during construction work. • Both contractor and BWDB should supervise the construction work and build temporary dams and demolish the same after completion of the construction. • Facilitate drainage and erosion control measures at work sites near agricultural fields.
Crop production	About 9.9 ha of land (Ch 19.00km-Ch 20.00 km and Ch 26.250 km-Ch 28.500 km) are likely to be acquired for construction of retired embankment along Sakbaria River. This land includes single and double cropped areas which are likely to be affected. This land includes cultivated areas (here, single cropped land 0.57 ha and double cropped area 1.2 ha) shrimp culture in addition to houses and other structures. The losses of rice production under the acquired land is 9.6 metric ton of which Boro (HYV) is 6.04 metric tons and Aman (HYV) 3.56 metric tons respectively	• Resettlement Action Plan should be prepared and should also be implemented accordingly • Compensation should be made for any crop damage. • Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps construction. • Contractor should ensure that no vehicular movements take place through cultivation fields and no material is dumped inside cultivation fields. • Re-excavated soil of canals should not be dumped in the agricultural lands. • Contactor will prepare site specific dredged material management and disposal plans for each site to be followed upon approval by the DDCS&PMS Consultant and PMU.
Irrigation	Construction activities particularly on regulators, water channels and re-excavation (30km) activity of canals can potentially disrupt the irrigation during both wet and dry season thus negatively affecting the cultivation.	• Contractor should construct diversion channel before construction/ replacement/ demolishment of the regulators. • Sequence of work for the regulators and the water channels should be carefully planned to avoid any disruption in irrigation. • Contractor should ensure of having no negative impacts on crop irrigation. • Contractor should maintain liaison with communities. • Contractor should work during the dry season.
Fish Feeding and spawning ground	• Polder 14/1 is bounded by Kobodak and Arpangasia rivers on the western and Sakbaria River on the eastern part of the Polder. As per consultation with	• Earth work should be conducted during the dry season (November-May) • Sequence of work at the bank sides of Kobodak and Sakbaria rivers will be planned considering local fisheries

	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 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.	condition to minimize impacts on spawning and subsequently nursery ground of fish. • 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. •
Benthic fauna	• During construction activities including re-excavation of khals and bank protection work especially bailing out of water from the khals, clearing the bushes of the embankment	• Contractor will carry out khal excavation in segment thus minimizing impacts on benthic fauna.

	slope, sloping and shaping of the embankment and placing of C.C blocks for bank protection would hamper the river habitat condition locally. The habitat of Mud eel fish species (*chewa, cuchia, baim,* etc) and some SIS (Small Indigenous Species), shrubs and others aquatic plants preferred species for laying eggs and benthic organisms will be destroyed due to this intervention**.**	
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.
Safety and public health hazards	• **The area is prone to cyclones and storm surges. The works will be carried out during dry season; a certain level of safety hazards will still exist 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 to the construction workers. Inappropriate waste disposal at the camps and**	• The contractors will prepare site specific Environment, Health and Safety (EHS) Plans. • The WBG's EHS Guidelines are to be referenced in the contract documents and that should be followed during construction period. • Liaison will have to be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets will have to be given to all the labor camps for obtaining weather information. • Each contractor will have to prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan will be submitted to

	construction sites, and air quality deterioration caused by the Project's vehicular traffic and construction activities will potentially pose health hazards for the construction staff and nearby population.	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. • All employees need to carry out induction health and safety training prior to the commencement of work. Occupational Health Safety (OHS) issues would be part of the employee training plan. Training would include provision of appropriate written or visual materials to reinforce learning. Where illiteracy levels are high, OHS issues need to be covered more frequently than normal in toolbox talks. • Observe the statutory requirements related 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 activity. The construction contractor(s) would not hire people under the age of 18 on permanent contracts and would include short training activities for youth to the extent possible. • Contractor will establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. • 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 insurance for accidents resulting in disabilities or death of employees for the duration of their contracts. • Report regularly on 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. • Organize training programs and keep training registers for construction workers. • Availability of safe drinking water will have to be ensured for the construction staff. • First aid boxes will have to be made available at each construction site. Emergency phone numbers (including

		hospitals, Fire Department, and Police) will have to be displayed at key locations within the site. Each site will have an ambulance available. • Firefighting equipment will be made available at the camps and worksites.
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.
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. • Presence of number of labors from outside can potentially cause encroachment in the privacy of local population particularly women and hence their mobility can be negatively affected.	• 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 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.
Natural hazards	• As per construction schedule, the rehabilitation activities of the Polder will be conducted from October to May when	• Weather signals will have to be considered by the contractor during construction works.

	most of the cyclone and storm surges are occurred in this area. According to previous records of occurrence of cyclone and storm surges are within the month from October to November and April to May. It is suspected that the construction activities during this period may be hampered as well as workers may be injured.	• Radio and television will have to be provided in all the labor sheds for receiving weather information through these media. • Ensuring rigorous standards for occupational health and safety are in place.

Impacts from CC block manufacturing plant

The impact assessment is also focused on the environmental and social issues of automated CC-block manufacturing plant during operation of plants as well as decommissioning of CC-block plants based on potential impacts gathered through several visits to the CC-block manufacturing plants leads to the following potential impacts. Appropriate mitigation measures have been recommended to mitigate the adverse impacts during plant operation and decommissioning phases as follows:

IECs	Impact	Mitigation
Manufacturing of CC block		
Emissions to air and ambient air quality	Air emissions will be generated from storage and handling of raw materials (mainly sand and cement) and emissions from equipment for transport, power supply and the plant itself. These emissions can deteriorate the ambient air quality in the immediate vicinity of the CC-block manufacturing plants. These emissions pose health hazards for the nearby communities as well as for the workers. In particular, any settlements near the plant areas may be exposed to air emissions caused by the CC-block manufacturing activities. However, effects of air pollution on biological and material receptors like flora, fauna, and construction materials need to be analysed.	• Emission inventory on a regular basis and comparison with air quality standards and between CC-Block plant operational and non-operational days • Use of wind protection, barriers for wind protection for raw material stored in open piles • Water sprinkling to be carried out where needed, particularly in dry season and on plant tracks and access roads near residential areas • Dust extraction equipment and bag house filters, particularly for dry materials loading and unloading points • Vehicle speed to be low at site and access roads (maximum 15 km per hour) • Air quality monitoring to ensure mitigation measures are working, and further action to be taken if tolerance limits are exceeded • Exhaust emissions from vehicles and equipment will comply with standards • Vehicles and other machinery to be turned off/tuning when idle to minimize exhaust emissions • Use of fuels with a low sulphur content (natural gas or LPG) • Greenhouse Gas (GHG) Emissions and Energy Use. Greenhouse gas emissions, especially CO_2, are mainly associated with the use of energy in the plants. Reference is made to the above

		measures to reduce SO_2 and NOx emissions to reduce greenhouse gas emissions. However, the plant is not considered as a major energy consumer and therefore the impacts are considered low.
Noise level	The CC block manufacturing activities will generate noise and vibration, which are likely to affect any nearby communities and workers. Increased noise levels may cause disturbance, nuisance and even health hazards for nearby communities as well as for the workers. If the CC block plant is not close to residential areas these impacts on nearby communities are considered low to moderate	• **Refers to construction phase**
Waste management	The CC block manufacturing activities will generate solid and liquid waste. Solid waste will include domestic garbage; refuse from CC block construction, empty cement bags, etc. Liquid waste will include sewerage. The impact is considered moderate to low as the process does not generate much waste and the numbers of workers is limited	• The Contractor will prepare and implement a pollution control and waste management plan based on a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes. • Hazardous wastes should always be segregated from non-hazardous wastes. If generation of hazardous waste cannot be prevented through the implementation of the above general waste management practices, its management should focus on the prevention of harm to health, safety, and the environment. The following additional principles should be adhered to: • Ensuring that contractors handling, treating, and disposing of hazardous waste are reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the waste being handled • Ensuring compliance with applicable local and international regulations
Hazardous materials	• Contamination of land should be avoided by preventing or controlling the release of hazardous materials, hazardous wastes, or oil/chemical to the environment. When contamination of land is suspected or confirmed, the cause of the uncontrolled release should be identified and corrected to avoid further releases and associated	• Control measures to be implemented are: construction of secondary containment for storage tanks, avoidance of underground storage tanks and controlled transfer of oil from vehicle tanks to storage and vice versa. Proper secondary containment structures should be capable of containing at least 110 per cent of the largest tank or 25% per cent of the combined tank volumes in areas with above-ground tanks with a total storage

	adverse impacts. Contaminated lands should be managed to avoid the risk to human health and ecological receptors. • The main risks for contaminated land at the plants is the storage and transfer/unloading of oil and lubricants for the vehicles and equipment..	volume equal or greater than 1,000 litres. • Workshops should be equipped with impermeable floors and oil-containing equipment should only be repaired in workshops.
Occupational health and safety(OHS)	• **Potential impacts related to occupational health and safety at the plant entails mainly physical hazards, as there are:** • Rotating and Moving Equipment • Noise and vibration • Industrial Vehicle Driving and Site Traffic	• **Refers to construction phase**
Community health and safety	• **Potential impacts related to community health and safety for the CC block plant entails mainly traffic related hazards.**	• Transport safety practices as training on safety aspects and driving skills among drivers and use of speed control devices on trucks • Regular maintenance of vehicles • Minimizing pedestrian interaction with construction vehicles • Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads
Decommissioning		
• Environment quality(Air quality, noise and vibration)	• Potential impacts on air quality and noise and vibration impacts during decommissioning of the plants will be related to the use of cranes, vehicles and other demolishing equipment, and transport of materials. Air quality may be impacted due to soil erosion after decommissioning as well; soil erosion could be caused by the exposure of barren soil surfaces to wind.	• Refers to construction phase
Solid waste	• Solid waste will mainly be limited to refuse from CC block construction (concrete leftovers), rejected CC blocks, empty cement bags, scrap metal, etc. The impact is considered moderate to low. • Small amounts of hazardous wastes will include: small amount of contaminated soils,	• The Contractor will prepare and implement a pollution control and waste management plan based on a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes. • In the absence of qualified commercial or government-owned waste disposal operators in Bangladesh, these wastes

	unspent solvents, oily rags, used filters, empty paint cans, empty chemical containers, used lubricating oil and used batteries and lighting equipment. • Not properly managed these wastes might lead to a moderate to high impact on both the terrestrial and aquatic environment as well as human health and safety	might be managed through installing on-site waste treatment or recycling processes (waste could be assembled at one site). However, considering the amount of these wastes, the final option might be an environmental sound long-term storage of wastes at an appropriate location up until external commercial options become available.
Surface water	Soil erosion caused by the exposure of barren soil surfaces to wind and rain during and after site clearing may result in impacts to the quality of the natural water systems and ultimately the biological systems that use these waters. The potential impact is considered to be moderate.	• Scheduling to avoid heavy rainfall periods (i.e., decommissioning during the dry season) to the extent practical • Mulching or re-vegetating to stabilize exposed areas • Designing channels and ditches for post-construction flows • Reducing or preventing off-site sediment transport through use of proper site drainage, settlement ponds, silt fences, etc.
Occupational and community health and safety	Occupational and community health and safety will not substantially differ from the above described. An exception might be traffic safety. Decommissioning traffic will include movement of heavy vehicles and local cargo vessels for the transport of materials and equipment increasing the risk of traffic-related accidents and injuries to workers and local communities. •	• Accidents involving project vehicles and boats/cargo vessels during decommissioning should be minimized through a combination of education and awareness-raising, proper planning (avoiding severe weather conditions), • Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents. • Specific attention should be paid to decommissioning works in the Health and Safety Plan and Emergency Response Plan.

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:

IECs	Impact	Mitigation
Embankment failure	Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously accelerates the risk of embankment failure. Counter clockwise circulation of the cyclone of the Bay of Bengal make the embankment more susceptible to breaches too. On the other hands, lifting of saline water through tubewell over the crest of the embankment by the Gher owners for saline shrimp cultivation.this practice will cause seriously weakens the embankment and increases the risk of embankment failure.	Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the eastern side of the Polder will have to be ensured. Monitoring will particularly be carried out before and after monsoon season. Prevent the establishment of hand tube-wells at the crest of the embankment. Available cyclone and flood shelters will have to be prepared as a contingency measure during emergency situation. WMG will have to develop funds for facing any emergency situation. Materials like geo bag and sand bag will have to be kept in stock yard of local BWBD colony.
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.
Use of agro-chemicals	At present 109 ha and 295 ha of land are under HYV Aman and HYV Boro rice cultivation. Shrimp culture practices are dominating here due to saline water. Presently, 168,460 kg of chemical 2,347 kg of granular pesticide and 293,700ml of liquid pesticides are used in the polder area. It is assumed that the, non-saline water would be available from the internal canal system, after the completion of the project and will reduce the salinity of the Polder area. This would allow expansion of irrigated cultivation of HYV Aman and HYV Boro rice. Due to expansion of HYV Aman and HYV Boro cultivation, additional 8,500 kg of chemical fertilizers and granular pesticide 121 kg and liquid pesticides 14,700 ml would be required for future crop production.	Capacity building and awareness raising of the farmers should be carried out regarding use of 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 ICM and GAP. Farmer should be encouraged to use organic and green manure to increase the soil fertility as well as avoid to water contamination of water sources. Farmers should be encouraged to cultivate leguminous crops (N2 fixing) to enhance the soil quality as well as the soil productivity.

IECs	Impact	Mitigation
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.

Risk Assessement

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	• 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

	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.	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.

Cumulative Impact

The cumulative impact of several existing and ongoing project, 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 14/1 were considered in this study. Apart from CEIP interventions, there are some other development projects in the region of Polder 14/1, implemented locally or regionally. Impact on hydrology and flooding situation due to construction and implantation of proposed and existing projects were assessed.

The major part of Polder 14/1 is surrounded by the Sakbaria River in Eastern portion and Kobadak River to the Western portion. The Sakbaria River and Kobadak River flow to the North-East and North-West directions of the Polder 14/1 respectively. Another river called Arpangasia flows to the southern direction of the Polder. The existing crest level of the Polder is 4.27 mPWD. Re-sectioning works are proposed in the Polder with a design crest level of 4.50 mPWD. This increase would reduce the intrusion of storm surge and saline water in the

Polder. However, under CEIP-1, Polder 15 is situated very adjacently (North-west direction) to the Polder 14/1 which has also some proposed interventions. The proposed design crest level of the Polder 15 is same (4.50 mPWD) as 14/1. As both of the polders 14/1 and 15 will have the same crest level, water may overtop the embankment that will cause flooding during monsoon or due to rise of surge height. Infrastructural damage may be caused due to tidal flooding of Polder 14/1. The flow direction of Kobadak and Arpangasia Rivers may tend to Polder 14/1 that may have a chance of salinity intrusion through Gharilal khal inside the Polder. Other CEIP Polders are far away from Polder 14/1 so they have no impact on it.

The total North-East and South-East portions of Polder 14/1 is fully covered by the Sundarban. Sundarban acts as a safeguard in this region against severe storm surges and maintains ecological balance. The proposed interventions of Polder 14/1, i.e., higher crest level may divert wind direction towards Sundarban that may be a threat in a small scale to trees and wild animals of that part of Sundarban.

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 14/1 will be ameliorated due to the overall development of this region, i.e., construction works of Polder 15 will attract labors from outside as well as local people will also get a working opportunity.

There would be no impact on Sundarbans by the construction activities of the ongoing and proposed projects. During construction of activities of the polder (Polder 14/1), noise, dust and wastewater and other wastage would be generated from labor camp, movement of vehicle and construction of bank protection works which would have a negligible impact on the Sundarban biodiversity because the Sundarban is isolated by the river.

Polderization have a positive impact on shrimp culture in Polder 14/1 that initiated a financial revolution of the Polder area. On the other hand, there are some negative environmental impacts, i.e., infertility of aquatic animals, flora and fauna due to overtopping in saline water from shrimp culture ponds.

Environmental Management Plan (EMP)

The contractor is responsible for implementing the EMP during the construction phase whereas the design and supervision consultant is primarily responsible for monitoring the implementation of the EMP. The environment specialist to be employed by BWDB will conduct field inspections and surveys on a regular basis. The environment specialist will report to the Senior Environment Specialist at Head Quarter. The M&E consultant will be responsible for independent monitoring and implementation of the EMP, and evaluation of the environmental compliance of the project. DoE will have to be consulted if any complicated issue arises during construction and operation stages. BWDB will apply for site clearance/environmental clearance and annual renewal of environmental clearance certificate from DoE. WMOs will be trained to ensure adequate water and environmental management practices during project operation. The Environmental Management Unit of BWDB, strengthened through CEIP-1, will ensure and oversee the environmental management during project operation. The tentative cost for Environmental Management is mentioned as follows:

Tentative Cost Estimates for Environmental Management

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
1	Crop compensation	300,000	3.75	Contractor	During pre-construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils				
2	Awareness program on plant and wild life conservation.	96,000	1.2	BWDB	During post-construction
3	Construct a new sluice near the Patakhali closure which is linked with Jorshing Khal, Hajerali Khal and Sadderfer Khal for efficient drainage within the Polder area.				During construction
4	Awarense building up campaign(mock drill) may be organized to local community to avoid accidents from vehicular traffic	200,000	2.5		During pre-construction
5	Consultancy services cost for supervision and monitoring of EMP	280,000	3.5	BWDB	During post-construction
6	Training to the farmers with field demonstration regarding IPM and ICM.	200,000	2.5	BWDB with help of DAE	During post-construction
7	Awareness building up to local community for conservation	50,000	0.625	BWDB & WMO with help of UFO	During post-construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	of threatened fish species.				
8	Training to the fisherman/pond owner with field demonstration regarding pond culture.	40,000	0.5	BWDB & WMO with help of UFO	During post-construction
9	Solid and liquid waste disposal arrangement.	100,000	1.25	BWDB	
10	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1,000,000	12.5	BWDB	During post-construction
11	Consultancy services cost for river bank erosion monitoring	1,200,000	15	BWDB	During construction
12	Training to the Contractors regarding environmental management	100,000	1.25	BWDB	During pre-construction
13	Training of Environmental awareness of local population	80,000	1	Contractor	During pre-construction and construction phases
14	Updating EMP as per requirement.	1,000,000	12.5	BWDB	During post-construction
15	Construction of alternative or bypass channels at each construction sites.	1,061,053	13.26	Contrctor	During pre-construction and construction
16	Conservation and stocking of threatened fish species (at least 3 spots).	120,000	1.5	BWDB with help of UFO	During pre-construction and construction phase

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
17	Campaigning and providing training on improved culture practices as well as the rice cum golda farming.	200,000	2.5	BWDB with help of UFO	During post-construction
18	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	1,200,000	15	Contractor, BWDB	During construction and post-construction
19	Additional Tree Plantation at HH and other grounds to compensate the tree cutting (planting 3 trees for cutting 1tree) @ Tk.50 each tree including the cost of sapling, gabion and nursing etc. (19,834 nos. of trees)	991,700	12.4	BWDB in association of Department of Forest	During post-construction
20	Water sprinkling at re-sectioned/newly constructed embankments (@ Tk.3,000 per km (of embankment 30.50 km)	91,500	1.14	Contractor	During pre-construction and construction phases
21	WMOs monitoring cost	150,000	1.88		
22	Construction of fish pass friendly	61420026	767.75	Contractor, BWDB	During construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	structure (one fish pass)				
	Optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes				
Total Cost		**69,880,279**	**873.50**		

Extensive monitoring of the environmental concerns of the Polder 14/1 will be required as per World Bank guideline. The monitoring program will help to evaluate: (i) the extent and severity of the environmental impacts against the predicted impacts and baseline; (ii) the performance of the environmental protection measures or compliance with pertinent rules and regulations; (iii) trends in impacts; and (iv) overall effectiveness of the project environmental protection measures. The monitoring plans will be included in the EMP for specific sub-projects. Moreover, for all type of monitoring, a comprehensive database of the polder specific Environmental Impact and Monitoring information will be created, which will help evaluate the impacts easily.

The monitoring plan during pre-construction, 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
During Construction					
Sources of Material	Work Site	Possession of official approval or valid operating license of suppliers materials (Cement, soil).	Before an agreement for the supply of material is finalized.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Operation of borrow site	Borrow pit/site	Visual inspection of borrowing site and ensuring operational health and safety	monthly	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Top Soil	Storage are	Top soil of 0.15 m depth will be excavated and stored properly	Beginning of earthwork	Contractor	DDCS&PMSC,BWDB
		The stored top soils will 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

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
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, M&E Consultant, BWDB
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	DSCS&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	DSCS&PMSC and 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 and BWDB
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DDDCS&PMS Consultants
Air Quality (PM_{10}, $PM_{2.5}$)	Close to School/ Madrasha, Hospital & Villages	Air quality monitoring	Half Yearly	Contractor through a nationally recognized laboratory	DDCS&PMSC, M&E Consultant, BWDB
Noise	Construction sites	Visual inspection to ensure good standard equipment are in use	Weekly	Contractor	DDCS&PMSC, M&E Consultants and 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 Consultants and BWDB
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each Polder	Sampling and analysis of surface water Quality.	Dry season	Contractor through a nationally recognized laboratory	DDCS&PMSC, M&E Consultant and BWDB
Drinking Water Quality(TDS, Turbidity, pH, FC, as if	Sources of drinking water at constructi	Sampling and analysis of water quality.	yearly	Contractor through a nationally recognized laboratory	DDCS&PMSC, ,M&E Consultanta nd BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
groundwater etc)	on camp/site				
Sanitation	Construction camp /site	Visual Inspection	Weekly	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid waste and solid waste is deposited at designated site	Weekly	Contractor	DDCS&PMSC,M &E Consultants and BWDB
Flora and Fauna	Project area	Survey and comparison with baseline environment	Yearly	Contractor through nationally recognized institute	DDCS&PMSC, M&E Consultant and BWDB
Cultural and archeological Sites	At all work sties	Visual observation for chance finding	Daily	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Reinstatement of Work Sites	All Work Sites	Visual Inspection	After completion of allworks	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Safety of workers Monitoring and reporting accidents	At work sites	Usage of Personal Protective equipment	Monthly	Contractor	DDCS&PMS Consultant, BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each Polder	Sampling and analysis of surface water quality	Yearly	BWDB through a nationally recognized laboratory	M&E Consultant
Air Quality (Dust PM_{10}, $PM_{2.5}$)	At the baseline monitoring site	24 hours Air quality monitoring	Yearly	BWDB through a nationally recognized laboratory	M&E Consultant
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
Crop production	In the Polder area.	Compare the production with the baseline.	2 (Two) 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.	M&E Consultant.

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant

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 safeguards 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 14/1 = 6 samples x 3 times @ Tk.5,000	200,000	2.5	Contractor	During pre-construction, construction and post construction period phases
2	Fish Habitat Observation for four (4) times of year (dry & wet season).	100,000	1.25	Contractor with help of UFO	During construction and post-construction
3	Fish Catch Assessment Survey for two (2) times of a year (dry & wet season).	200,000	2.5	Contractor with help of UFO	During 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.	200,000	2.5	Contractor	During construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
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-14/1 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	Diversity of Flora and fauna	200,000	2.5	Contractor	During construction and post-construction phases
Total Cost		1,460,000	18.25		

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 14/1 was held on 4th December, 2017 at Koyra Upazila of Khulna District. 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.

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.

1. Introduction

1.1 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 14/1 Polder will be rehabilitated and improved. Preliminarily, 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, 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 submmitted to Department of Environment (DoE) and obtained site clearance.

2. The GoB has obtained financial assistance from the World Bank (WB) for this project. It is to be mentioned here that the Site Clearance of all the 17 (seventeen) Polders had been obtained from the Department of Environment (DoE), Bangladesh on the basis of the Initial Environmental Examination (IEE) reports been completed earlier. The Polder 14/1 is one of the 7 Polders under Package 3.

1.2 Background

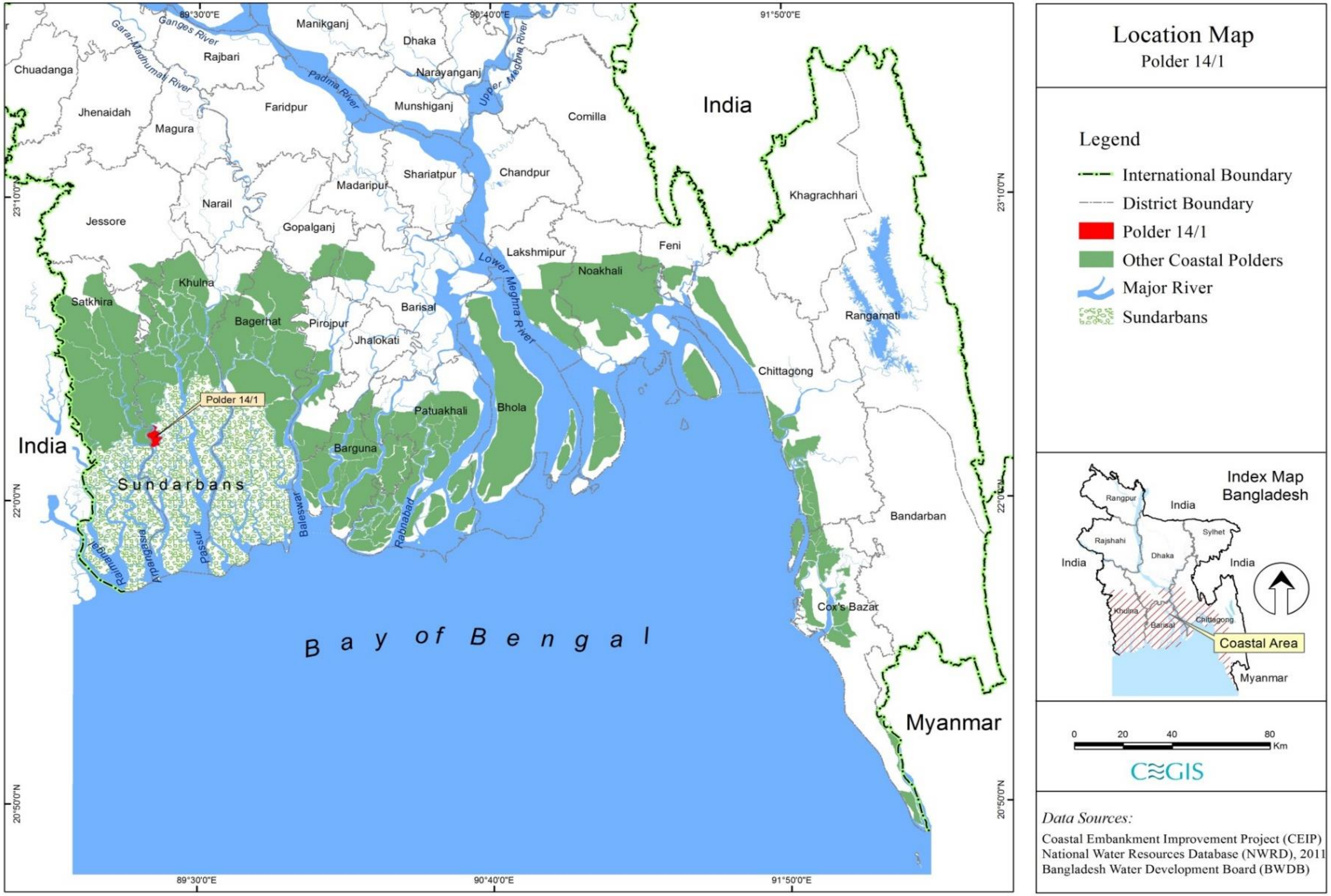
3. The coastal region of Bangladesh covering 19 districts adjoining the Bay of Bengal is characterized by a delicately modified ecosystem of an evolving flat delta subject to very high tides, salinity intrusion and frequent cyclones coming from the Bay of Bengal encountering very large sediment inflows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

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

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

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

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


Location Map
Polder 14/1
Legend
International Boundary
District Boundary
Polder 14/1
Other Coastal Polders
Major River
Sundarbans
Index Map
Bangladesh
Coastal Area
0 20 40 80 Km
C≋GIS
Data Sources:
Coastal Embankment Improvement Project (CEIP)
National Water Resources Database (NWRD), 2011
Bangladesh Water Development Board (BWDB)
India
Myanmar
Bay of Bengal
Sundarbans
Polder 14/1
Khulna
Satkhira
Bagerhat
Barisal
Patuakhali
Barguna
Bhola
Noakhali
Chittagong
Cox's Bazar
Bandarban
Rangamati
Khagrachhari
Comilla
Dhaka
Jessore

Map 1.1: Location of Coastal Polders (in green), including Polder 14/1 (in red).

1.3 Project Overview

7. Polder 14/1 is located in Koyra Upazila under Khulna District of Southwestern Bangladesh (Map 1.2). The Polder covers a gross area of 2,229 ha of which net cultivable area is 1,700 ha (in where 362 ha is being used for agriculture and the remaining area is being used for shrimp culture). 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 achive these objectives, the following rehabilitation and improvement works will be carried out in the Polder:

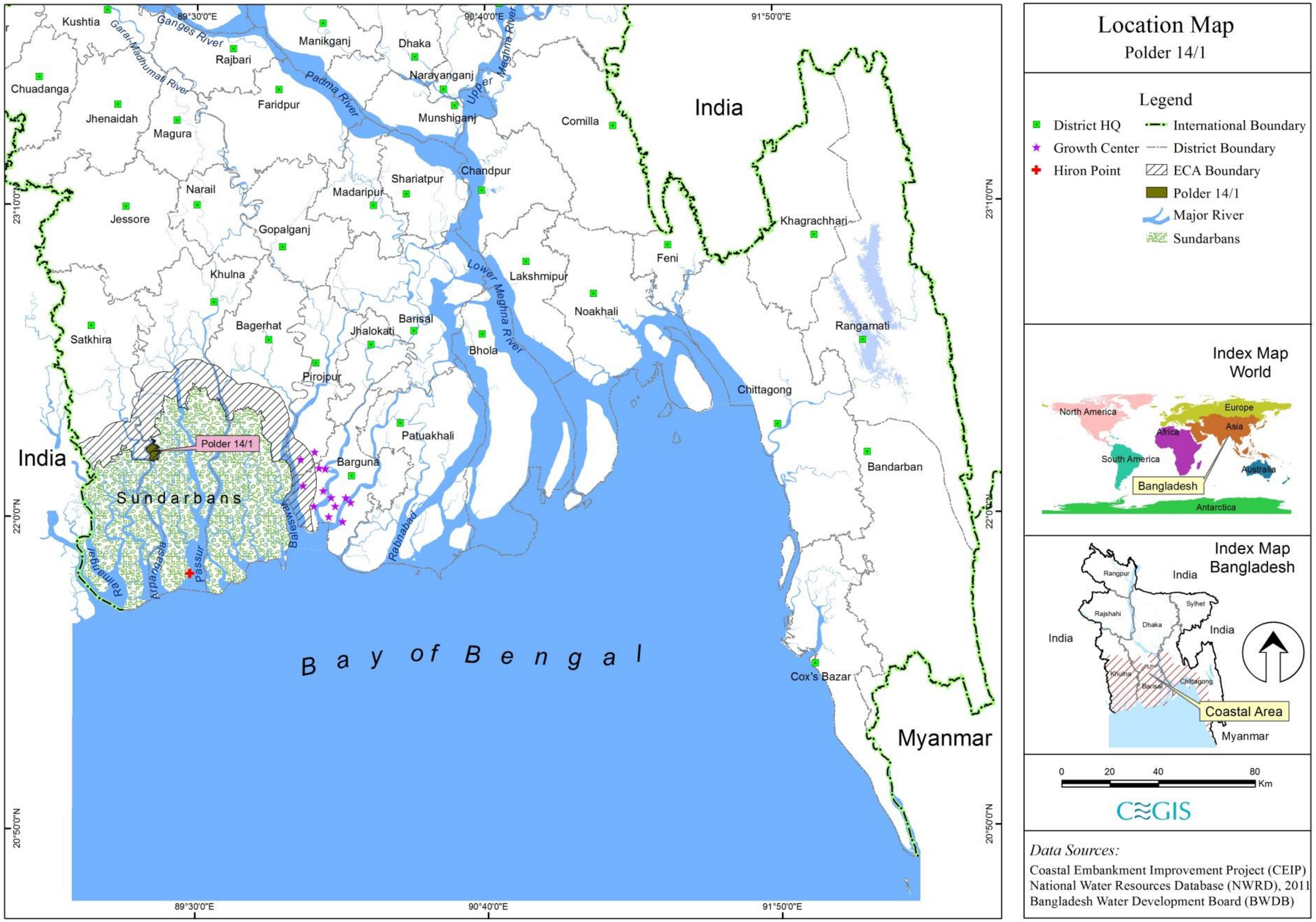
Type of Work	Specification
Re-sectioning of embankment	27.25 km
Design crest level of embankment	4.50 mPWD
Retired embankment	3.25 km
Construction of drainage sluice	2 nos.
Demolishing of existing drainage sluices	1 no.
Construction of flushing Sluices	4 nos.
Re excavation of drainage channel	30 km
Slope protection of embankment	7.86 km
Bank Revetment	1.0 km
Afforestation	17.37 ha

Source: CEIP, 2015

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

1.4 Regulatory and Policy Framework

9. The Bangladesh Environment Conservation Act, 1995 (amended in 2002, 2010), requires that all development projects shall obtain environmental clearance from the DoE, Ministry of Environment and Forest (MoEF). Similarly, the World Bank's environmental safeguard policies require an environmental assessment for those projects under their financing. The present EIA fulfills both of these requirements.



Map 1.2: Location of Polder 14/1 and ecologically critical area (hatched)

1.5 Objective of the Study

10. The objective of the EIA study for Polder-14/1 is to identify and assess the potential environmental impacts of the proposed project interventions, evaluate alternatives, and design appropriate mitigation, management, and monitoring measures to be addressed in the Environmental Management Plan (EMP)1. In compliance with the national regulatory and WB environmental policies and guidelines (for further details refer to 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 dredged material 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 environmental monitoring plan.

1.6 Scope of Works

12. The scope of works of for conducting the EIA for Polder 14/1 includes the following:

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

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

(iii) Determine the cumulative environmental impacts of the project, which may occur inside and outside the project area.

(iv) Distinguish between significant positive and negative impacts, direct and indirect impacts, immediate and long-term impacts, and unavoidable or irreversible impacts.

(v) Identify feasible and cost effective mitigation measures for each impact predicted as above to reduce potentially significant adverse environmental impacts to acceptable levels.

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

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[1]WB Operation Policy 4.01. 2011 Revision

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

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

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

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

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

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

(xiii) Develop environmental monitoring format for regular monitoring of the project during pre-construction, construction and operational stage; and

(xiv) Prepare the EIA report.

1.7 Structure of the Report

13. The report comprises the following chapters:

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

Chapter 2 (Approach and Methodology) presents the detailed approach and procedure followed to conduct the EIA study. The Chapter also describes data sources and methodology of data collection, processing and impact assessment.

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

Chapter 4 (Climate Change Impact): describes 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 Project Alternatives) providesvarious 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 and Reciprocal Impacts) presents analysis of cumulative impacts of the proposed Project and other projects in the area. In addition, induced impacts are also covered in the Chapter.

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

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 disclosure requirement for the EIA is also included in this Chapter.

2. Approach and Methodology

14. This Chapter presents the detailed approach and methodology followed to conduct the EIA study for rehabilitation of Polder-14/1.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-14/1 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.

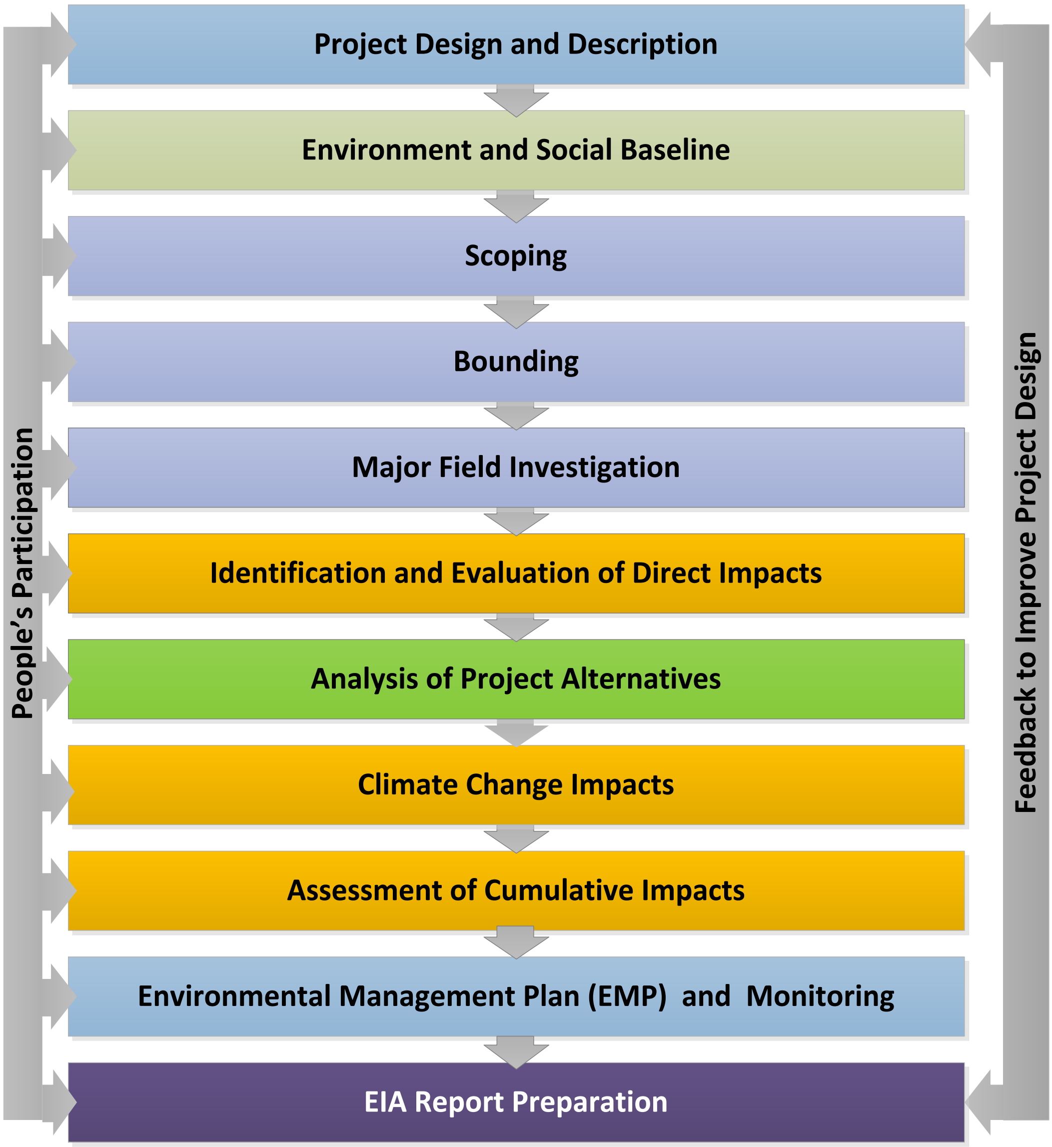

Figure 2.1: Overall approach of the EIA study

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-14/1 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.

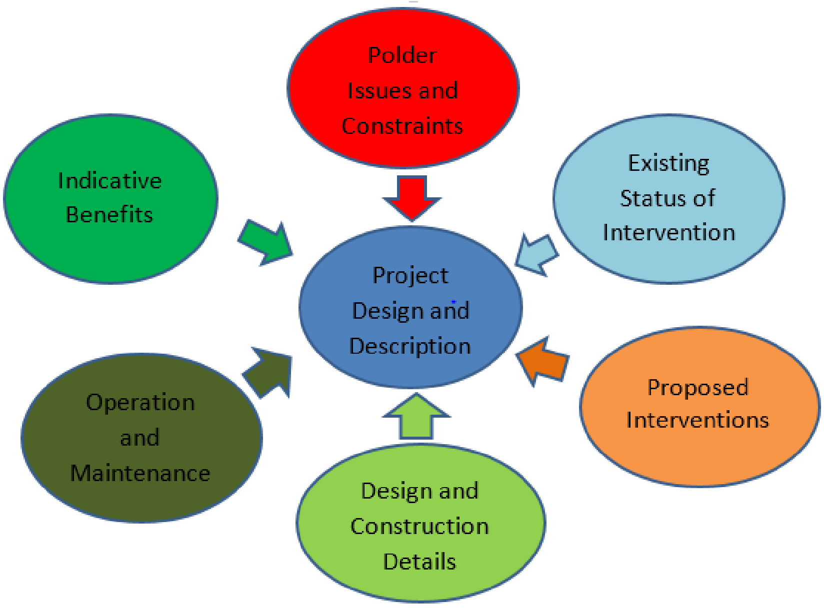

Figure 2.2: Aspects to be addressed in the Project Design and Description

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 DDCS&PMS Consultants and used to register the information obtained from different stakeholders.

Physical Environment

22. Field visits at different stages of the study were arranged to the Polder area and primary data on water resources components were collected. Local knowledgeable persons and community representatives were also interviewed through a developed checklist. 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 was collected from Upazila[2] Land and Soil Resources Utilization Guide of Soils Resources Development Institute (SRDI). The secondary data of these parameters was verified at field level through physical observations as well as consultations with the local people and officials of the Department of Agriculture Extension (DAE) during field visit.

(a) Biological Environment

Agricultural Resources

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

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

secondary sources from the DAE. Crop production was determined using the following formula:

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

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

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

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

Ecological Resources

28. 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.

29. 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 along with their status was developed based on field surveys and from the data base of the International Union for Conservation of Nature (IUCN).

Fish and Fisheries

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

31. 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.

32. 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.

33. Secondary information from Upazila Fisheries Office(r) (UFOs) and literature were blended with primary data from individual habitats to estimate fish production.

Livestock Resources

34. 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.

Socio-cultural Environment

35. 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.

36. 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

37. 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

38. The influence area of the project were defined two broadly categories e.g. direct influence area and indirect influence area. direct influence area is the area where all physical works will take place whereas the indirect influence areas are those ouside direct physical works but within 1 km radius from the direct influence area.

39. The influence area of the project were defined in two broad 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. The indirect influence area 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 within 1km of the radius. 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).

2.2.5 Major Field Investigation

40. 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 this exercise attention was given to understand the historical status of the IESCs and the possible condition of the same against the proposed interventions.

2.2.6 Identification and Evaluation of Direct Impacts

41. At this stage, attempts were made to assess the impacts of the proposed interventions of the Polder quantitatively. 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. Expectedchanges due to proposed interventions were assessed to generate the FWIP conditions. Comparison and projection methods were used for impact prediction.

42. A screening matrix was used specifically for the proposed Project before impact analysis in detail. This matrix was focused on the potential environmental impacts during the design, construction and operation phases. The matrix examined the interaction of project activities with various important components of the environment. The impacts were broadly classified as physical, biological and social impacts, and each of them were further divided into different aspects.

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.

Magnitude

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 baselineconditions	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/obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Sensitivity

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

Table 2.2: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very High	Vulnerable receptor with little or no capacity to absorb 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 Table 2.3 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 has been based on experience from implementation of similar projects, applying expert judgment and from consultation with stakeholders.

2.2.7 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.

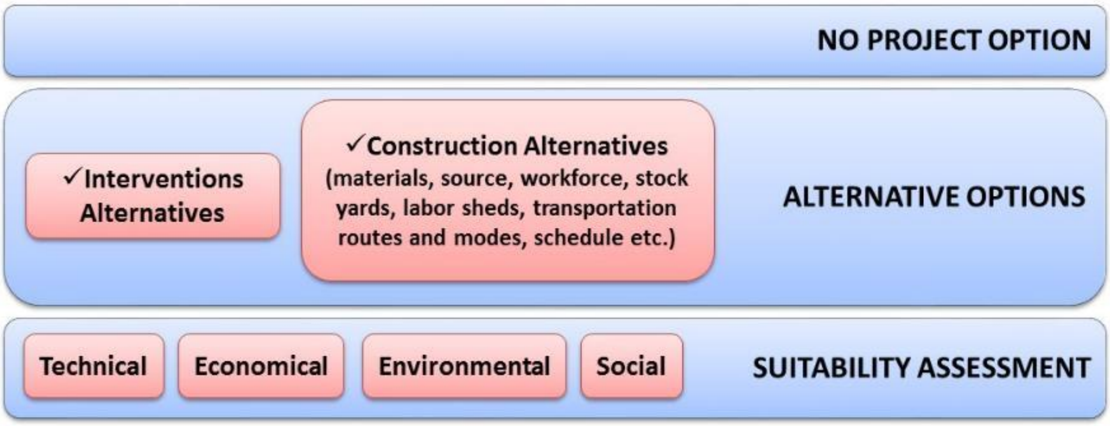

Figure 2.3: Concept of Alternative analysis to be used in the EIA study

2.2.8 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 the Germanwatch 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.

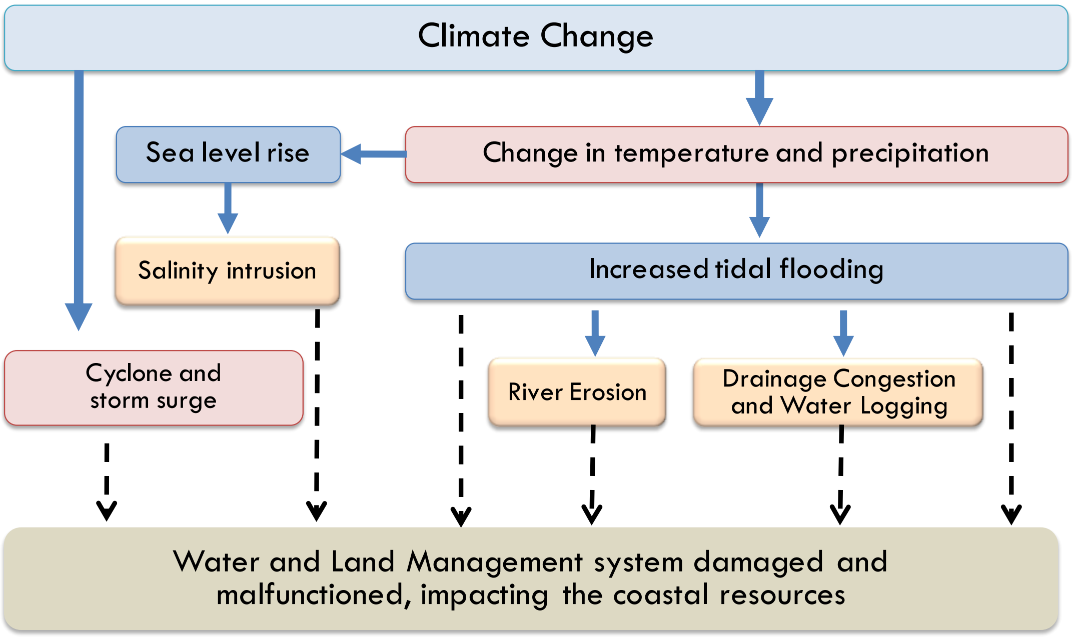

Figure 2.4: Typical process diagram of climate change impacts in coastal areas

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.

2.2.9 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 the cumulative impacts, environmental and social issues like rivers/watercourses hydrology, flooding situation, flora and fauna, shrimp farming and livelihood in and around the polder have 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 levels have been identified based on modelling of the combined effects of cyclone storm surge effects and cyclone wind induced waves, taking into consideration expected Climate Change induced increases in cyclone intensities the impact of proposed interventions on drainage, flooding, river dynamics have been analyzed as well through modeling. The model results have been utilized in the EIA study.

2.2.10 Preparation of Environmental Management and Monitoring Plan

60. An EMP for the proposed Project has beenprepared 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).

2.2.11 EIA Report Preparation

61. At the end of the study, the present report has beenprepared 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 inthis chapter.

3.1 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, 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

65. The detail of the above polices, strategies, and laws are given in Appendix-C.

3.3 Other Relevant Acts

66. There is a number of other laws and regulations relevant to the project which are presented in Table 3.1.

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
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 as the Ramsar Convention, the Convention on the Conservation of Migratory Species of Wild Animals (CMS), the Rio de Janeiro Convention on Biological Diversity (CBD) conservation and the Kyoto protocol on climate change etc. An overview of the relevant international treaties and conventions signed by GoB is provided in Table 3.2 below:

Table 3.2: Treaty or Convention and Responsible Agency

Treaty	Year	Brief Description of Treaty and Convention	Relevant Departments
Protection of birds (Paris)	1950	Protection of birds in wild state	DoE/DoF
Ramsar Convention	1971	Protection of wetlands	DoE/DoF
Protocol Waterfowl Habitat	1982	Amendment of Ramsar Convention to protect specific habitats for waterfowl	DoE/DoF
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural monuments	DoA
CITES convention	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	DoE/DoF

Treaty	Year	Brief Description of Treaty and Convention	Relevant Departments
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
MoU on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia	2003	Intergovernmental agreement that aims to protect, conserve, replenish and recover sea turtles and their habitats in the Indian Ocean and South-East Asian region	MOEF/FD

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

68. The environmental legislative basis for approval of the CEIP-1 project is the Environmental Conservation Act 1995 (ECA'95) and the Environmental Conservation Rules 1997 (ECR'97). DoE), 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 14/1 is grouped under 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:

- **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

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

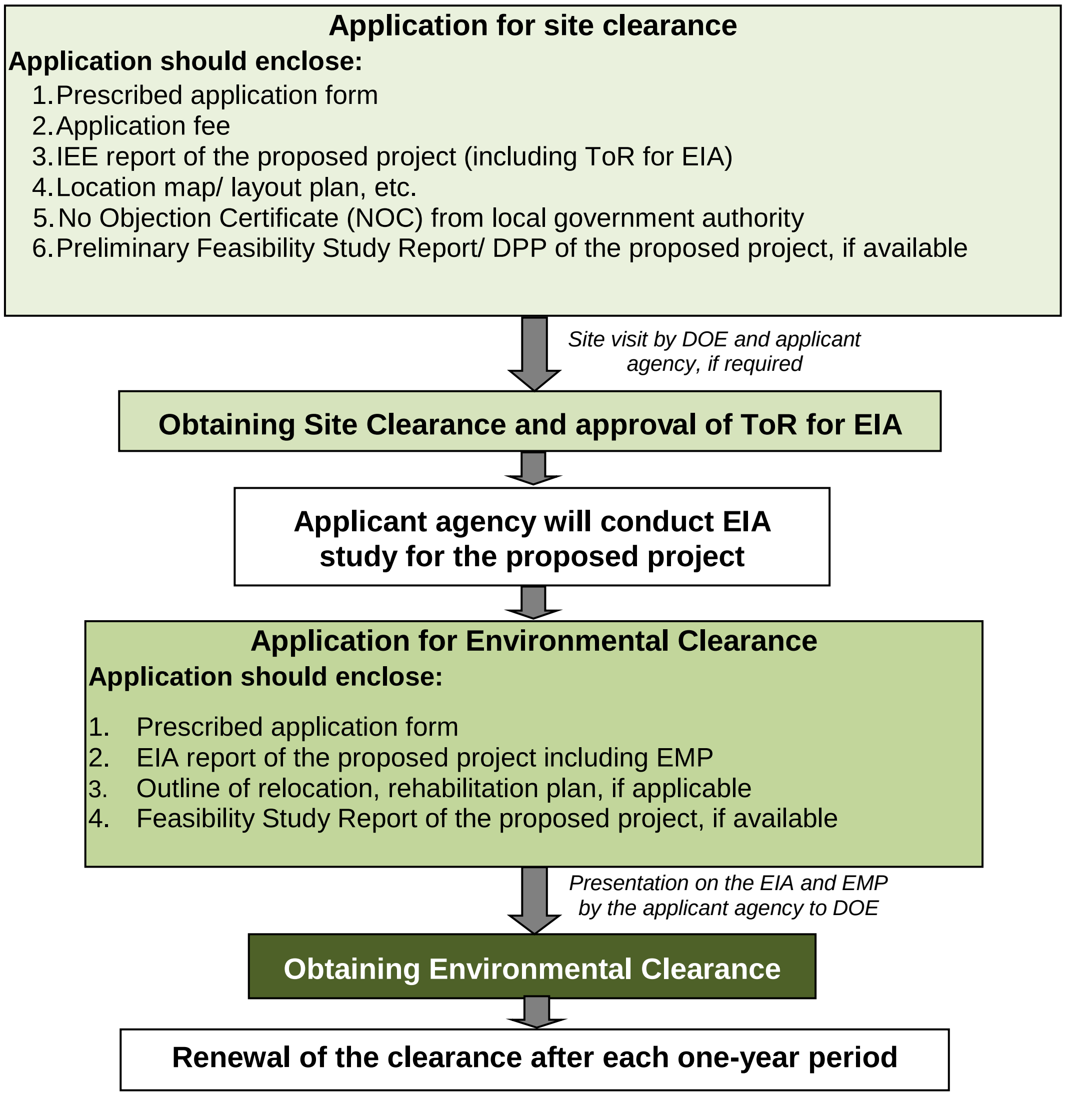

Figure 3.1: Process of obtaining Clearance certificate from DoE

3.7 World Bank's Environmental Safeguard Policies

72. 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

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

3.8 Implications of WB Policies on CEIP

74. The project interventions for Polder 14/1 occupy 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. 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 for improved agriculture production. During regular environment monitoring inoperational phase if water and soil pollution is observed, the proponent will be responsible for preparing a Pest Management Plan with prior approval from Bank. No Project activities are to be carried out in the rivers except some transportation. However, this will not have any affect whatsoever on the upper riparian water usage or availability.

4. Climate Change Impact

75. Climate change is one of the most complex issues facing us today. It involves many dimensions – science, economics, society, politics and moral and ethical questions – and is a global problem, felt on local scales, that will be around for decades and centuries to come. Carbon dioxide, the heat-trapping greenhouse gas that has driven recent global warming, lingers in the atmosphere for hundreds of years, and the planet (especially the oceans) takes a while to respond to warming. So even if we stopped emitting all greenhouse gases today, global warming and climate change will continue to affect future generations. In this way, humanity is "committed" to some level of climate change.

76. Climate is a critical factor in the lives and livelihoods of the people and socioeconomic development 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, respectively by 2046-2065 (IPCC, 2013). The newer findings indicate that warming is more pronounced than expected. The impact would be particularly severe in the tropical areas, which mainly consist 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 medium rainfall events (Goswami *et al*. 2006) over India have been observed. Changes in rainfall and temperatures have also been reported by Dash *et al.* (2009), and others.

77. Bangladesh has to face the challenge of sustaining its economic growth in the era of rapidly changing global climate. The problem has emanated from accumulated greenhouse gas emissions in the atmosphere, anthropogenically generated through long-term and intensive industrial growth and high consumption lifestyles in developed countries. Though, there is need to continuously engage international community collectively and cooperatively deal with this threat, Bangladesh needs a strong national strategy to firstly, adapt to climate change and secondly, to further enhance the ecological sustainability of its development path. This path is based on its unique resource endowments, the overriding priority of economic and social development and poverty eradication, and its adherence to its civilization legacy that places a high value on the environment and the maintenance of ecological balance. In its journey to developmental pathway, the country has a wider spectrum of choices precisely because it is at an early stage of development. The national vision is to create a prosperous, but not wasteful society, an economy that is self-sustaining in terms of its ability to unleash the creative energies of our people and is mindful of our responsibilities to both present and future generations.

78. Climate change, rapidly increasing population, depletion of natural habitats and resources are important global challenges having direct impacts on livelihoods and raising concerns for food security, water supply, health and energy. To address these issues, there is need to mobilize the capabilities to facilitate the mounting societal demand for in changing climate, fully knowing that climate has both physical aspects which can shape the availability of natural resources, such as in particular renewable energies, as well as informational aspects that may be used, at least potentially, to support socio-economic decision-making.

79. One of the best ways of understanding how climate may change in future is to examine how it has changed in the past based upon long-term observational records. Polder 14/1 is located in Koyra Upazila of Khulna District But its location is nearest to the Satkhira district and thus meteorological parameters have been collected from the Satkhira station for the

period from 1976-2005, which is more realistic. .Polder Seasonal mean values have been computed from the monthly data of rainfall and temperature for the four meteorological seasons e.g. pre-monsoon (March-May), monsoon (June-September), post-monsoon (October-November) and winter (December-February). There are some months with missing data of Satkhira station (Polder 14/1) of BMD. To maintain the continuity, the gaps have been filled up by the time mean values of the existing years for maximum and minimum temperatures. In rainfall data the variation is very large and so time-interpolation is not possible and the spatial interpolation is also not reliable for rainfall. It will be fair to mention that for a climate change studies it would have been better if longer period of data is available.

4.1 Annual Climate Change Trends

4.1.1 Annual mean maximum temperature trend

80. Long-term changes in surface temperature and precipitation over Polder 14/1 were analyzed using observational data of BMD from 1976 to 2005. The temporal plots of the time series of annual mean maximum temperature of Polder 14/1 shows that the temperature has the dominant decreasing trend as shown in Figure 4.1.

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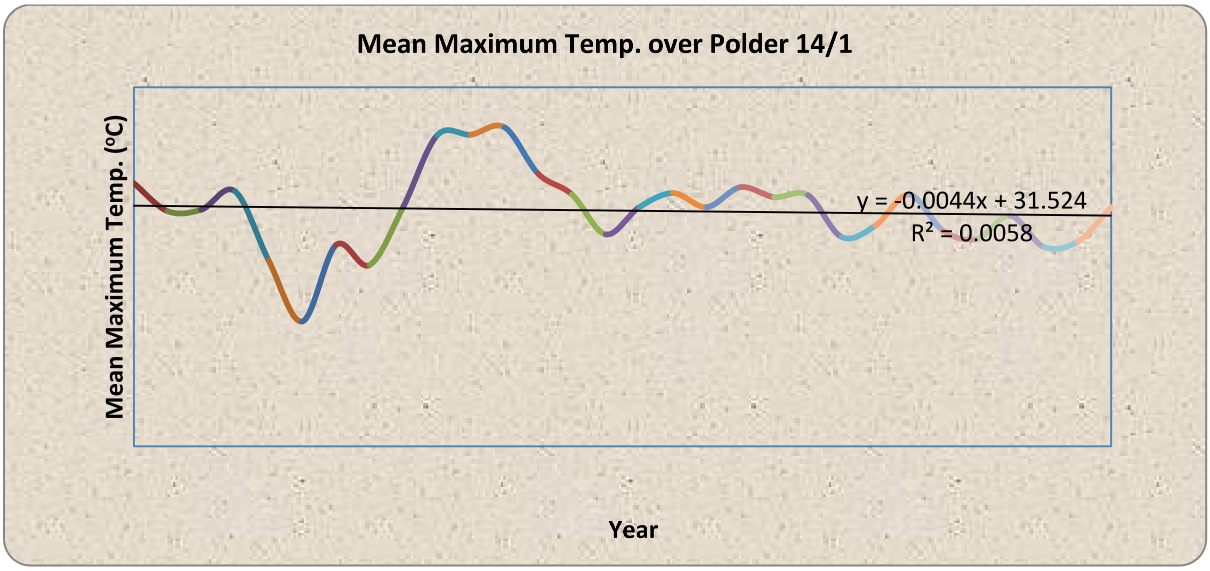


Figure 4.1: Temporal variations of mean maximum temperature over Ploder 14/1 during the period 1976-2005

81. 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 slightly decreasing trends over Polder 14/1 at the rate of -0.0044ºC/year, which is not statistically significant.

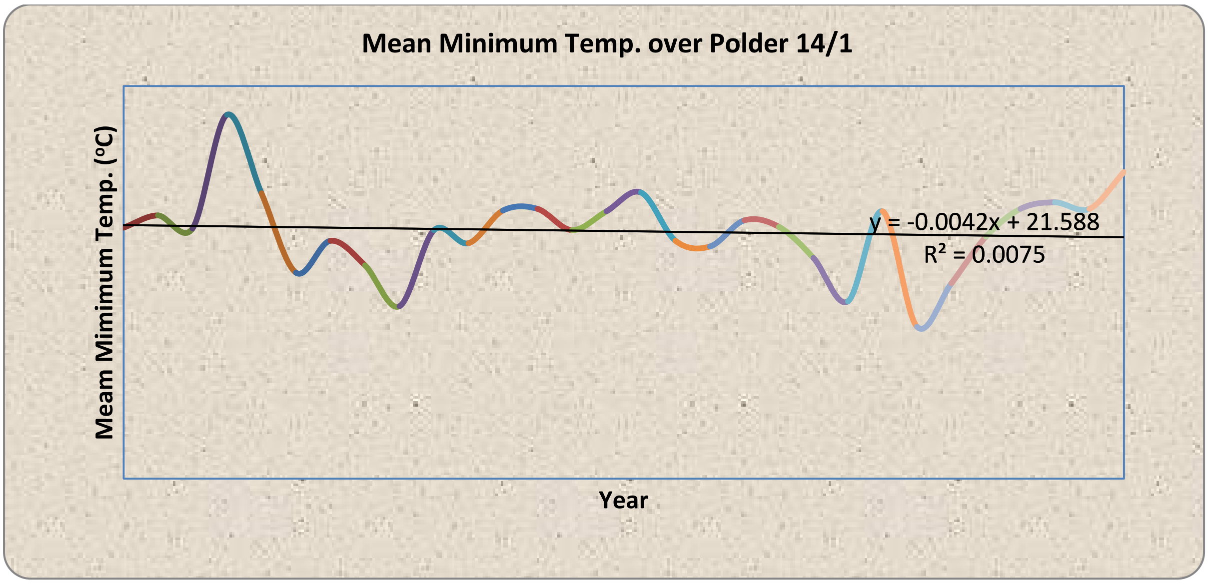


Figure 4.2: Temporal variations of annual mean minimum temperature over Polder 14/1 during the period 1976-2005

4.1.2 Annual mean minimum temperature trend

82. The temporal plots of the time series of annual mean minimum surface air of Polder 14/1. The yearly variation of annual mean minimum surface air temperature for Polder 14/1 is shown in Figure 4.2 for the period 1976-2005. The results of the trend analysis of annual mean minimum temperatures have shown slightly decreasing trends over Polder 14/1 at the rate of -0.0042ºC/year which is not statistically significant during the same period.

4.1.3 Annual total rainfall

83. The temporal plots of the annual total rainfall of Polder 14/1 have drawn to investigate the nature of inter-annual fluctuations. The temporal variations of the annual total rainfall (Figure 4.3) are observed during the period 1976-2005. It is noticed that increasing trends in the annual rainfall at the rate of 9.54 mm/year, during the same period, which is not statistically significant.

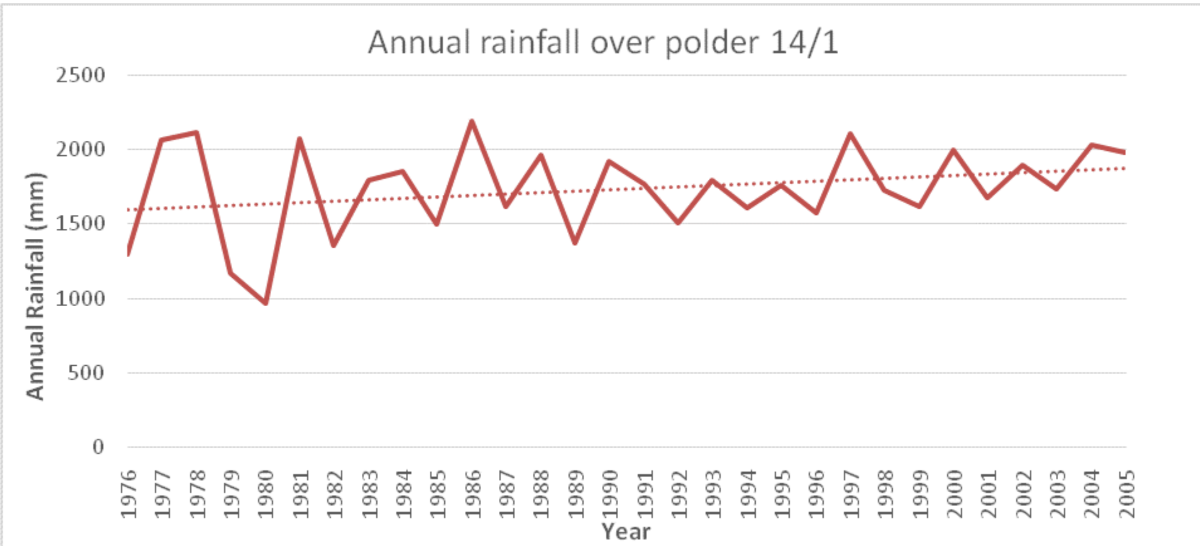


Figure 4.3: Temporal variations of annual rainfall over Polder 14/1 during the period 1976-2005

4.2 Seasonal climate change trends

84. The following section is described for seasonal trend analysis.

4.2.1 Winter climate change trends

a. Winter mean maximum temperature trend

85. The winter mean maximum surface air temperature shows a slightly increasing trend from 1976-2005. The decreasing trend is observed over Polder 14/1 at the rate of -0.0216ºC/year which is statistically significant at 5% level.

b. Winter mean minimum temperature trend

86. According to the trend analysis, it is found that the winter mean minimum surface air temperature has a decreasing trend over Polder 14/1 during the period of 1976-2005 The decreasing trend over the Polder is - 0.015ºC/year which is not statistically significant.

c. Winter season rainfall trend

87. The temporal variations of winter rainfall obtained for 1976-2005 show a slightly decreasing trend in the winter rainfall for Polder at the rate of -1.85 mm/year, which is not statistically significant.

4.2.2 Pre-monsoon Climate Change Trends

a. Pre-monsoon mean maximum temperature trend

88. Pre-monsoon mean maximum temperature shows a decreasing trend during the period 1976-2005for Polder 14/1 at a rate of -0.0038ºC/year, which is not statistically significant.

b. Pre-monsoon mean minimum temperature trend

89. Pre-monsoon mean minimum temperature shows an increasing trend over Polder 14/1 during the period 1976-2005. It is observed that warming trend over Polder 14/1 at the rate of 0.002ºC/year is not statistically significant.

c. Pre-monsoon total rainfall trend

90. The pre-monsoon total rainfall during the period 1976-2005, shows an increasing trend at a rate of 1.499 mm/year for Polder 14/1 which is not statistically significant.

4.2.3 Monsoon Climate Change Trends

a. Monsoon mean maximum temperature trends

91. The Polder 14/1 has shown warming trend of mean maximum temperature in the monsoon season during the period 1976-2005. Polder 14/1 exhibits warming trend during the monsoon season at the rate of 0.0203ºC/year which is statistically significant at 5% level.

b. Monsoon season mean minimum temperature trends

92. It is observed that Polder 14/1 has shown warming trend of mean minimum temperature in the monsoon season during the period 1976-2005. Polder 14/1 has slightly warming trend with the value of 0.0039ºC/year which is not statistically significant.

c. Monsoon season rainfall trends

93. 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 noticed during the period 1976-2005. It is seen that increasing trend in the monsoon season rainfall are observed over Polder 14/1 at the rate of 3.6534mm/year during the same period, which is not statistically significant.

4.2.4 Post-monsoon Climate Change Trends

- **Post-monsoon mean maximum temperature trends**

94. The Polder 14/1 has shown decreasing trend for post-monsoon season of mean maximum temperature during the period 1976-2005. Decreasing trend is observed over the Polder 14/1 at the rate of -0.0288^{o}C/year, which is statistically significant at 5% level at the same period.

- **Post-monsoon mean minimum temperature trends**

95. Post monsoon mean minimum temperature has shown slightly decreasing trend over Polder 14/1 and decreasing trend also shows at the rate of -0.0135^{o}C/year for the period 1976-2005, which is not statistically significant.

- **Post-monsoon season rainfall trends**

96. The temporal variations and the trend of post-monsoon rainfall are obtained during the period 1976-2005. It is seen that increasing trend in the post-monsoon season is noticed over Polder 14/1 at the rate of 6.241mm/year during the above period, which is statistically significant at 5% level.

4.2.5 Climate change projection

4.2.6 Projection of rainfall over Polder 14/1

97. 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).

98. A Global Climate Model (GCM) can provide reliable prediction information on scales of around 300 km by 300 km covering what could be a vastly differing landscape (from very

mountainous to flat coastal plains for example) with greatly varying potential for floods, droughts or other extreme events.

99. Regional Climate Models (RCM) and Empirical Statistical Downscaling (ESD), applied over a limited area and driven by GCMs can provide information on much smaller scales supporting more detailed impact and adaptation assessment and planning, which is vital in many vulnerable regions of the world.

100. In this context, regional climate model data (50 km by 50 km) 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.

Rainfall projections for RCP 4.5 scenario

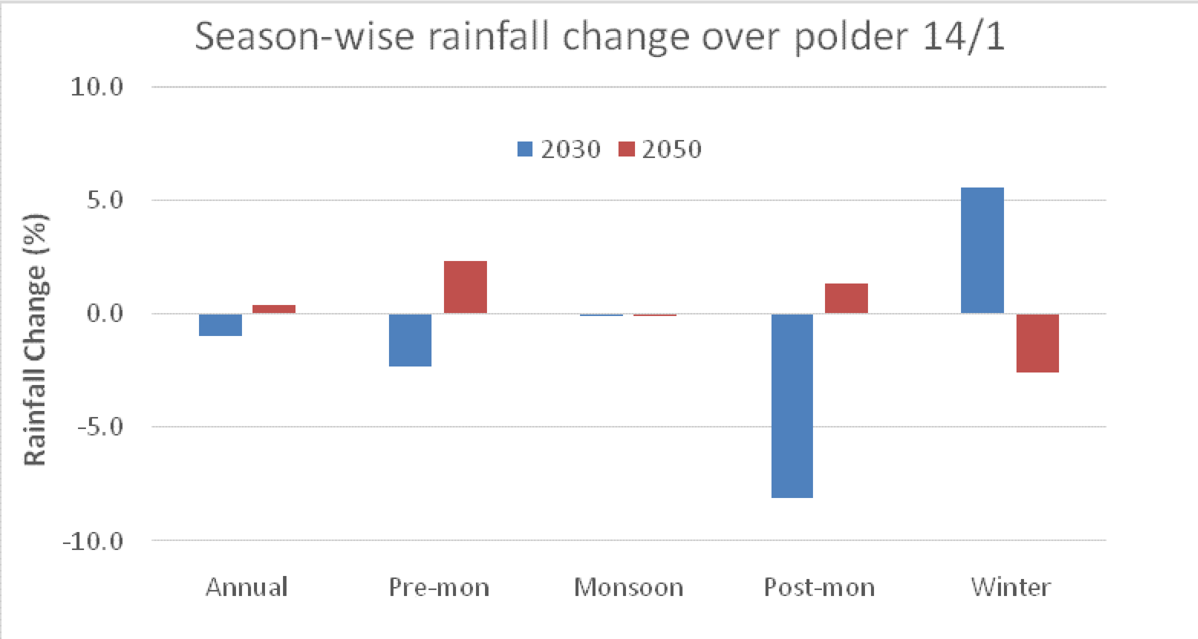


Figure 4.4: Change of seasonal rainfall (%) over Polder 14/1 for the year 2030 and 2050

101. The rainfall change is found to be -2.3, -0.1, -8.1 and 5.6 for pre-monsoon, monsoon, post-monsoon and winter, respectively for 2030 (Figure 4.4). On an average annual rainfall change over Polder 14/1 may be changed -1.0% for the year 2030. Similarly, the change of rainfall is observed to be 2.4, 0.1, 1.3 and - 2.6% for pre-monsoon, monsoon, post-monsoon and winter, respectively for 2050 (Figure 4.4). On an average annual rainfall change over Polder 14/1 may be decreased -2.6% for the year 2050.

Projection of Maximum and Minimum Temperature over Polder 14/1

102. 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). The year of 2030 and 2050 of maximum and minimum surface air temperature projections for RCP4.5 is given below.

Maximum temperature projections:

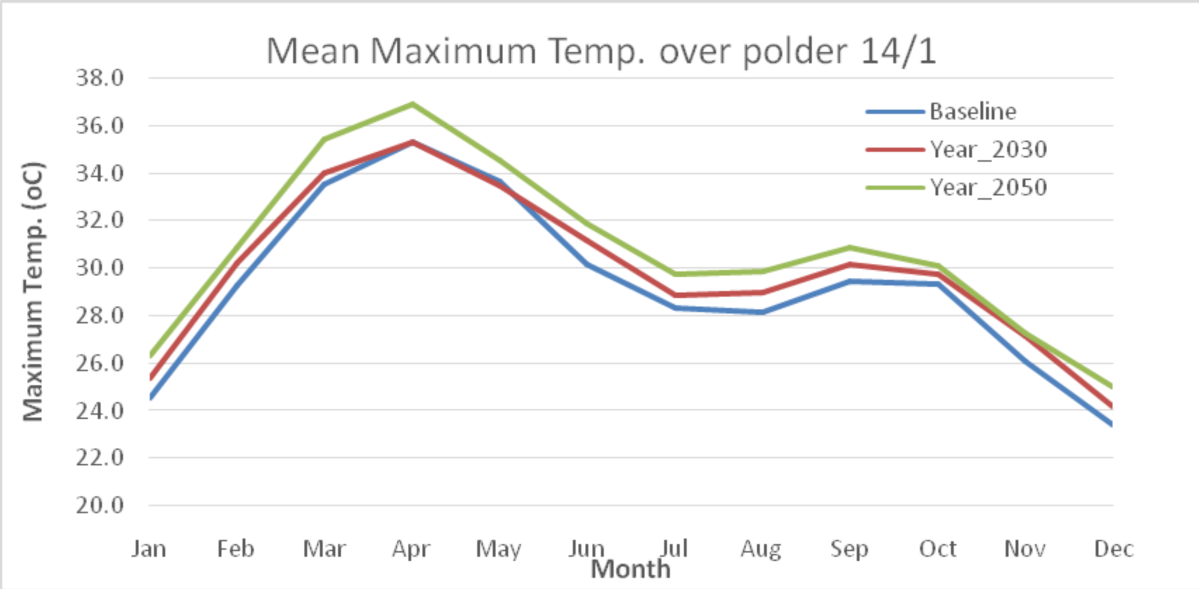


Figure 4.5: Annual cycle of projected maximum temperature with baseline over Polder 14/1 in 2030 and 2050

103. Mean maximum temperature shows bimodal characteristics. Maximum surface air temperature may change in 2030 by 0.8, 0.9, 0.5, 0.0, -0.2, 1.0, 0.5, 0.8, 0.7, 0.5, 1.0 and 0.8°C for January, February, March, April, May, June, July, August, September, October, November and December, respectively as shown in Figure 4.5. Maximum surface air temperature in various months over Polder 14/1 may vary by -0.2-1.0°C. On an average the maximum surface air temperature is estimated to be increased by 0.6°C over Polder 14/1 for the 2030. Similarly, maximum surface air temperature may be changed in 2050 by 1.8, 1.6, 1.9, 1.6, 0.9, 1.7, 1.4, 1.8, 1.4, 0.8, 1.2 and 1.6° C for January, February, March, April, May, June, July, August, September, October, November and December, respectively as shown in Figure 5. Maximum surface air temperature in various months over Polder 14/1 may be varied by 0.9 - 1.9° C. On an average the maximum surface air temperature is estimated to be increased by 1.5°C over Polder 14/1 for the 2050.

Minimum temperature projections:

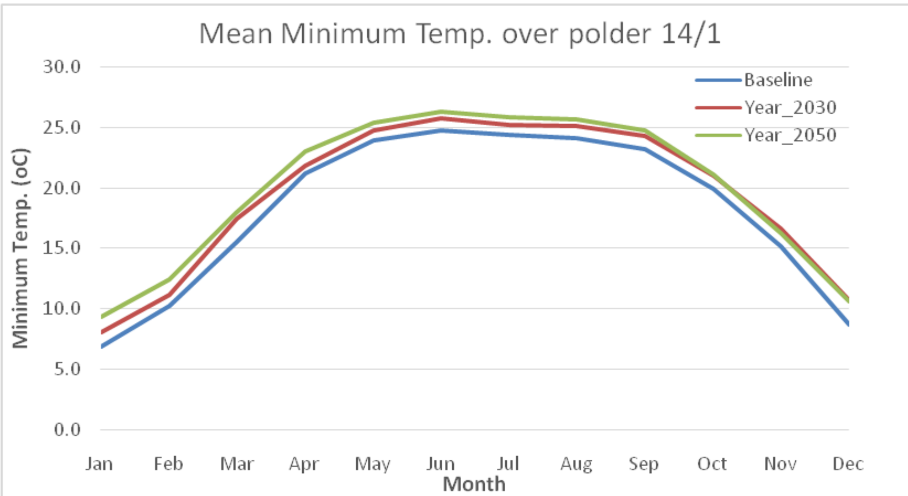


Figure 4.6: Annual cycle of projected minimum temperature with baseline over Polder 14/1 in 2030 and 2050

104. The change of minimum surface air temperature is found to be 1.2, 1.0, 1.9, 0.6, 0.7, 1.0, 0.8, 1.0, 1.0, 1.1, 1.5 and 1.9° C for January, February, March, April, May, June, July, August, September, October, November and December, respectively as shown in Figure 4.6. It is observed that the change lies between 0.6-1.9°C for the period 2030 and on an average, minimum surface air temperature may increase 1.1°C over Polder 14/1 in future for the period 2030. Similarly,the change of minimum surface air temperature is found to be 2.4, 2.1, 2.4, 1.8, 1.4, 1.5, 1.4, 1.5, 1.5, 1.1, 1.1 and 1.8° C for January, February, March, April, May, June, July, August, September, October, November and December, respectively as shown in Figure 4.6. It is observed that the change lies between 1.1-2.4°C for the period 2050 and on an average, minimum surface air temperature may increase 1.7°C over Polder 14/1 in future for the same period.

4.3 Climate Change Induced Natural Hazard

105. Bangladesh is vulnerable to sea level rise, as it is characterized by a densely populated coastal area with smooth relief comprising broad and narrow ridges and depressions (Brammer, et al., 1993). Sea level rise has various impacts on Bangladesh. The Bay of Bengal is one of the hotspots for the generation of tropical cyclones. In this region, cyclones occur in the pre- and post-monsoon seasons. The coast is also vulnerable to cyclone-induced storm surges. Following are the possible implications of climate change considered in this study for the coastal areas of Bangladesh:

4.3.1 Sea Level Rise and Coastal Inundation

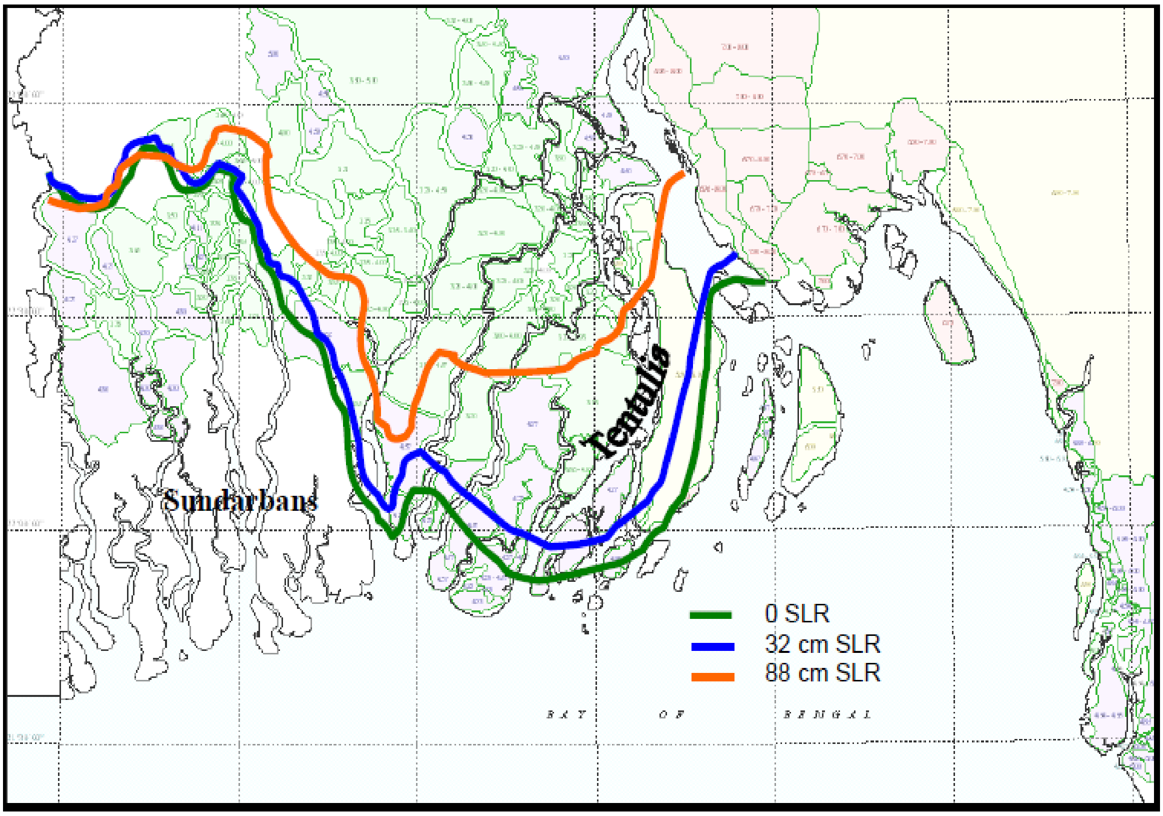
106. Bangladesh is vulnerable to current coastal hazards and anticipated Sea Level Rise (SLR) because of its lower elevation. WARPO (2006) predicted that the Sea Level Rise (SLR) may be increased by 14, 32 and 88 cm in 2030, 2050 and 2100 respectively which may inundate about 8, 10 and 16% respectively of total land mass of Bangladesh. The 5th IPCC (2013) predicted that the global sea level may be raised by 26 and 47 cm during the period 2046-2064 and 2081-2100 respectively using RCP4.5 scenario. The rate of sea level rise of Bangladesh is higher than that of global sea level rise. SMRC (2000) observing three tidal gauge records for the period 1977-1998 (22 years) and found that tidal level at Hiron Point, Char Changa and Cox's Bazar has been raised by 4.0 mm/year, 6.0 mm/year and 7.8 mm/year respectively;. These three tidal gauge stations are located in western coast (Hiron Point), Central Coast (Char Changa) and Eastern Coast (Cox's Bazar) respectively. The rate of the tidal trend is almost double in the eastern coast than that of the western coast. This difference would be due to subsidence and uplifting of land. However, Sing (2002) mentioned that the difference is mainly due to land subsidence.

4.3.2 Tidal Flooding

107. Tidal flood is a common phenomenon in the coastal belt of Bangladesh. Two tide events (high tide and low tide) occur in a day. During high tide, low lying and un-protected areas are inundated causing damage to agriculture and this extent even gradually increased due to sea level rise.

108. The average elevation of coastal lands in Bangladesh is below 1.5 mPWD. It is predicted in several studies that the sea-level in the Bay of Bengal may rise in the range of 0.3 to 1.5 m by the year 2050 (DOE, 1993). In the coastal front there will be stronger-than-usual backwater effect due to sea level rise induced high oceanic stage, resulting into retardation of discharge flow, particularly around the confluence points of the major rivers. Consequently, the risk of floods of high intensity and duration, similar to that occurred in 1998, will be exacerbated. Under climate change scenario about 18 per cent of current lowly flooded

areas will be susceptible to higher levels of flooding while about 12 to 16%of new areas will be at risk of varied degrees of inundation. As per recommendations of NAPA, the SLRs in the coast of Bangladesh are 14 cm, 32 cm and 88 cm for the year 2030, 2050 and 2100 respectively (Map 4.1). In a recent study, IWM (2006) predicted that flooding of coastal lands may increase by 21% by the year 2100 and 10.3% by the year 2050 with respect to the ordinary flooding condition when approximately 50% lands go under flood.



Map. 4.1: The projected Sea Level Rise in the coast of Bangladesh for the year 2050 (blue line) and 2100 (orange line) respectively.

4.3.3 Salinity Intrusion

109. Saline water intrusion is highly seasonal in the coastal area of Bangladesh. Salinity and its seasonal variation are dominant factors for the coastal ecosystem, fisheries and agriculture. Therefore, any change in the present spatial and temporal variation of salinity will affect the biophysical system of the coastal area. IWM and CEGIS (2007) found that the base condition, about 10 percent of the coastal area is under 1 part per thousand (ppt) salinity and 16 percent area is under 5 ppt salinity and this area will be increased to 17.5 percent (1 ppt) from 10 percent and 24 percent (5 ppt) from 16 percent by 2050 considering 88 cm sea level rise. So, there will be an increase of about 8 percent in the area under 5 ppt salinity levels due to sea level rise. The areas of influence of 5 ppt salinity line under different sea level rise are shown in Map 4.1. The intrusion of salinity will increase soil salinity and surface water salinity and might affect agriculture crop production.

Table 4.1: Major Cyclones Hit the Bangladesh Coast

Major Cyclone year and Dates		Maximum Wind Speed (km/hr)	Storm Surge Height (meter)
30 Oct	1960	211	4.6-6.1
30 May	1961	160	6.1-8.8
28 May	1963	203	4.2-5.2
11 May	1965	160	6.1-7.6
15 Dec	1965	211	4.6-6.1
1 Nov	1966	146	4.6-9.1
23 Oct	1970	163	3.0-4.9
12 Nov	1970	224	6.1-9.1
25 May	1985	154	3.0-4.9
29 Nov	1988	160	3.0-4.0
29 Apr	1991	225	6.0-7.5
2 May	1994	210	2.0-3.0
25 Nov	1995	140	2.0-3.0
19 May	1997	220	3.1-4.2
15 Nov (Sidr)	2007	240	up to 10
25 May (Aila)	2009	120	3.0
Source: MCSP, 1993; Bangladesh Meteorological Department and field survey, 2010			

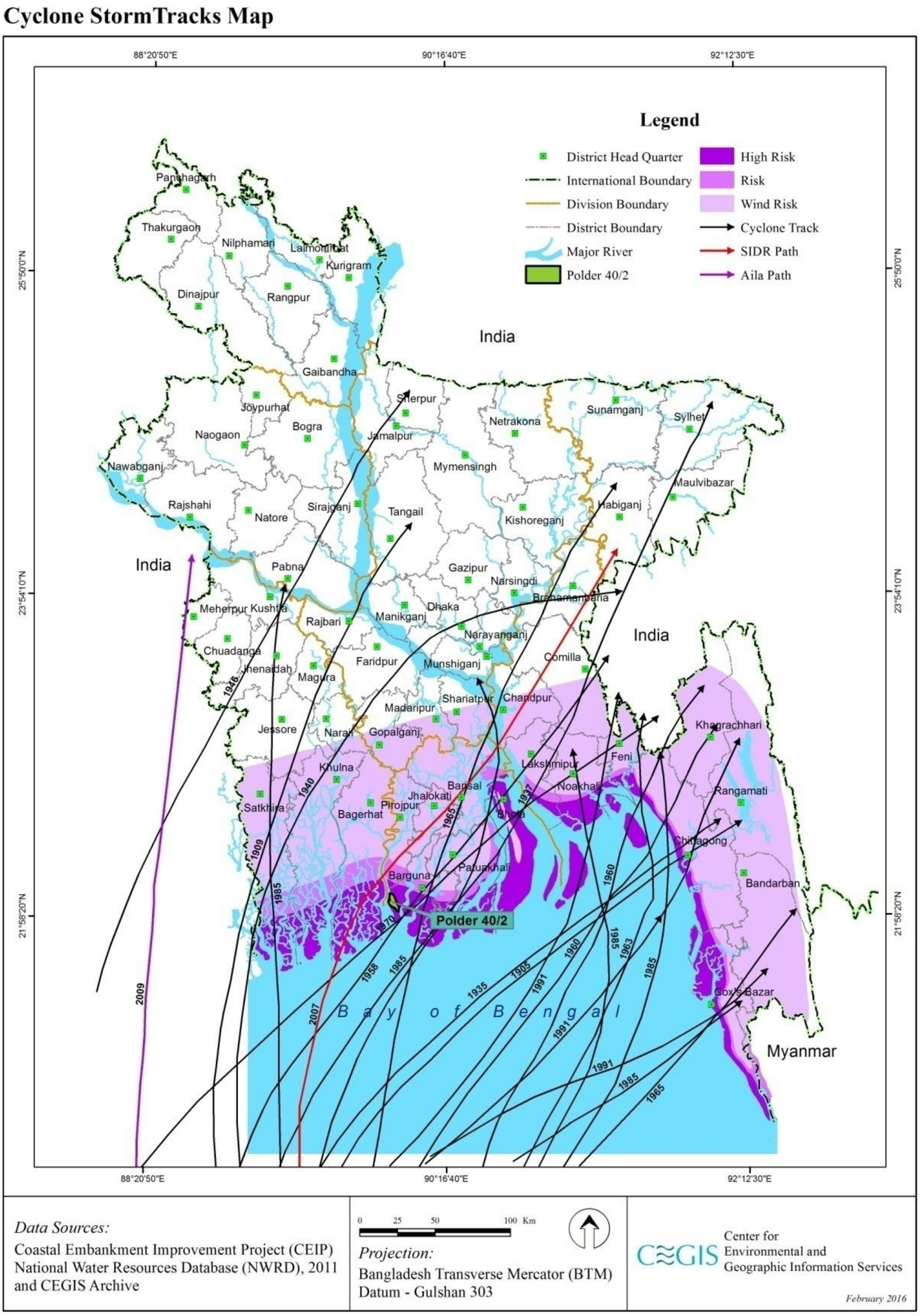
4.3.4 Cyclones and Storm Surges

110. Bangladesh is especially vulnerable to cyclones because of its location at the triangular shaped head of the Bay of Bengal, the sea-level geography of its coastal area, its high population density and the lack of coastal protection systems. During pre-monsoon (April–May) or post-monsoon (October–November) seasons, cyclones frequently hit the coastal regions of Bangladesh. About 40% of the total global storm surges are recorded in Bangladesh (Murty, 1984).

111. Tropical cyclones accompanied by storm surges are among the major disasters that occur in Bangladesh and severely damage lives and standing crops in the study area. Roughly, three to seven severe cyclones hit the coastal area in each decade. There is some evidence that peak intensity may increase by 5 percent to 10 percent, which would contribute to enhance storm surges and coastal flooding. Increase in wind velocity and storm surge height will result in further inland intrusion.

112. Tropical cyclones and surges are the major threats to the coastal areas, causing loss of human lives and livestock and severe damage to crops and properties. During last 125 years, more than 42 cyclones had hit the coastal areas (Map 4.2). The occurrence of cyclone is more frequent due to climate change. The strength and number of major cyclones may be increased due to higher sea surface temperatures associated with global warming. Tropical cyclones and storm surges are particularly severe in the Bay of Bengal region. Last devastating cyclone (Aila) hit the study area and project site on 25th May 2009. The project area is located in the wind risk zone of Bangladesh.

113. The area is vulnerable to cyclone and storm surge. During Aila, storm surge water entered the polder area by overtopping the left bank of the Passur River. As per local community perception, the site has experienced the maximum surge height during cyclone Aila. The local people opined that the area was inundated by the surge height of 4.47m during Aila.



Map 4.2: Previous Cyclonic Storm Tracks *(Source: MCSP, 1993)*

4.3.5 Rainfall and Temperature, Drainage, and Water logging

114. 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 the society more than changes in the mean climate (IPCC, 2001). Human induced changes in the global climate and associated sea-level rise are widely accepted by the policy makers and scientists. The IPCC concluded that the balance of evidence suggests a discernible human influence on global climate (IPCC-AR4, 2007). The exact magnitude of the changes in the

global climate is still uncertain and subject to worldwide scientific studies. It is broadly recognized that Bangladesh is more vulnerable to these changes. Indeed, it has internationally been argued that Bangladesh, as a country, may suffer the most severe impacts of climate change. Bangladesh is highly vulnerable because it is a low-lying country located in the deltaic plain of the Ganges, the Brahmaputra and the Meghna and densely populated. Its national economy strongly depends on agriculture and natural resources that are sensitive to climate change and sea-level rise. The impact of higher temperature and more extreme weather events such as floods, cyclone, severe drought and sea-level rise are already being felt in South Asia and will continue to intensify (Huq et al., 1999; Ali, 1999). In this connection proper planning and sensible management of water resources are essential for this region. Long-term planning is not possible without any idea of the change of climate that may take place in future. Climate models are the main tools available for developing projections of climate change in the future (Houghton et al., 2001).

115. Regional Climate Downscaling (RCD) has an important role to play by providing projections with much greater detail and more accurate representation of localized extreme events than the GCM. South Asia Coordinated Regional climate Downscaling Experiment (CORDEX) domain data (resolution 50 km) are available at Centre for Climate Change Research (CCCR), IITM, India. The CCCR is recognized by World Climate Research Programme (WCRP) and is responsible to generate downscaling model data over South Asia CORDEX domain. These data have been used to generate the future scenarios for rainfall and temperature at Patuakhali (because Patuakhali is the nearest place of the Polder) in Bangladesh using RCP4.5 data set. The RCM model outputs were analyzed to find out seasonal and annual rainfall and temperature over Bangladesh. It is assumed that the year 2030 means averaged precipitation/temperature during the period 2021-2040 and year 2050 means averaged precipitation/temperature for the period of 2041-2060 and base period 1990 means averaged during the period 1981-2000.

5. Description of the Project

5.1 General

116. The coastal region of Bangladesh frequently face natural calamities i.e. storm surges. In coastal region, numerous Polders were constructed to protect the southern region of the country. For the time being the Polders are damaged that hampers its objectives. The Coastal Embankment Improvement Project (CEIP) triggers to safeguard the Polder from tidal flooding, salinity intrusion and climate change induced storm surges. The ultimate aim of the project is agricultural improvement. The project activities, construction methodology, construction schedule and the institutional arrangements for implementation of the Project are briefly discussed in this chapter.

5.2 Coastal Embankment Project

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

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

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

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

5.3 The CEIP Initiative

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

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

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

124. Polder 14/1 is one of the Polders to be rehabilitated under the CEIP-1.

5.4 Overview of Polder 14/1

125. Polder is located in Koyra Upazila under Khulna District. The Polder covers two Union *Parishads* (U/P) namely *Uttar Bedkashi* and *Dakhin Bedkashi*. The Polder is bounded by *Sakbaria* River in the East, *Arpangasia* River in the South, *Kobadak* River in the West and *Kobadak* and *Sakbaria* Rivers are in the North. Also, Sundarbans is the biggest mangrove forest of the World which is located at the eastern boundary of the Polder.

126. The Polder was conceived in the early 1960s. Construction of the Polder started in 1967 and completed in 1970. **Later on, the** Polder **was included in CERP for rehabilitation after the disaster of the tropical cyclone Aila (2009).** In the present context, the Polder is under increased threat from cyclone surges and wave action which result from climate change. **This is the reason for selection of** Polder **14/1 for** rehabilitation under CEIP-1.

Objective of the Project

127. 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 set of specific objectives, viz.; (a) protection of embankment from river erosion and wave action; (b) preventing saline intrusion; (c) providing improved drainage facilities; (d) preventing sedimentation in both the agricultural land and in 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) protection of lives and properties of the Polder community from storm surges.

5.5 Water Management Problems and Issues in Polder 14/1

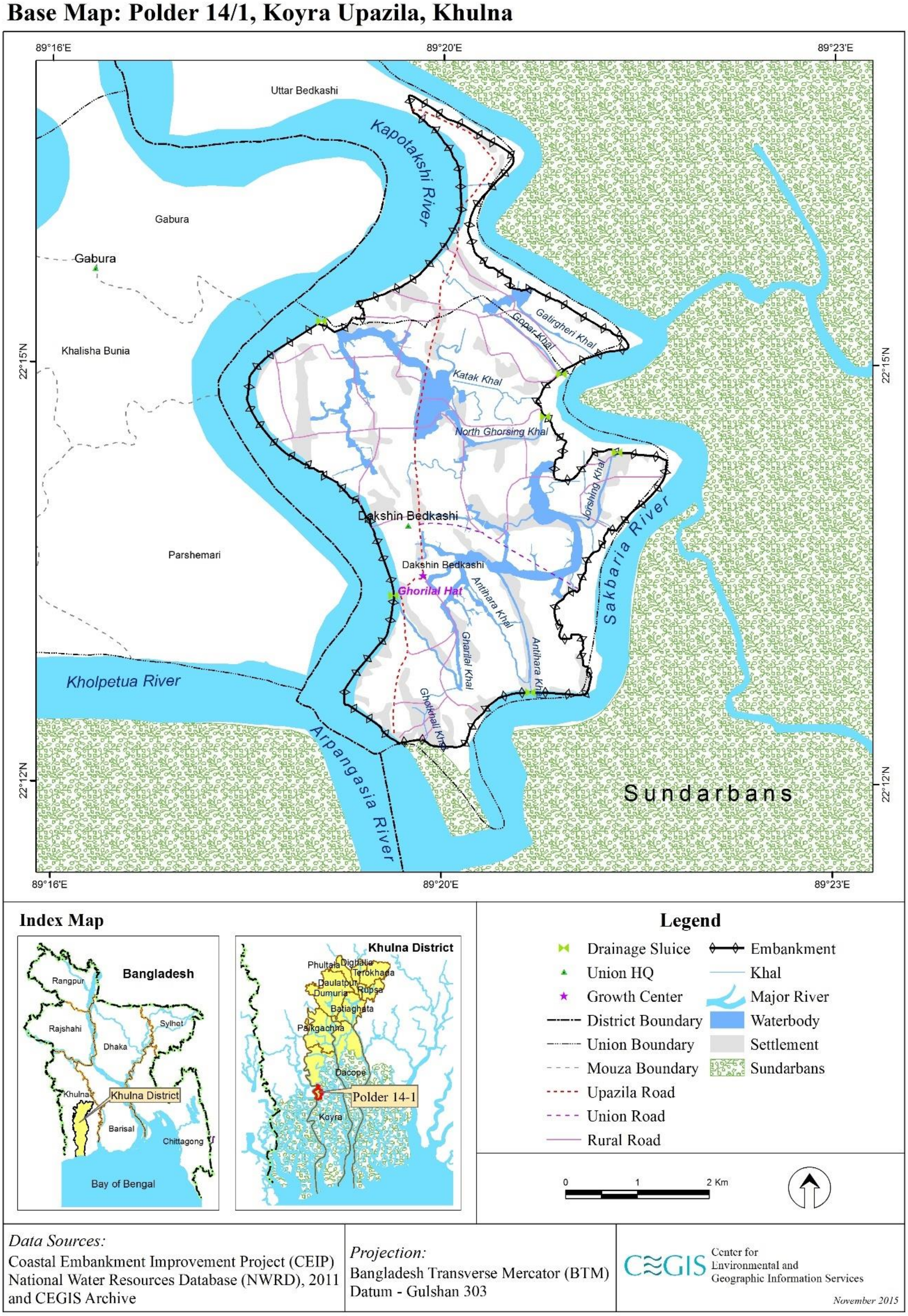
128. Most segments of the embankment of the Polder 14/1 have been damaged mainly by overtopping of river water due to cyclones and storm surges especially the *Aila* (2009). Many segments of the embankment have already been damaged by wave action and eroded due to river erosion. At many places, the embankment was overtopped during *Aila*. It is reported that during *Aila*, the entire Polder area was submerged by 1m to 1.5m of surge water and about 200 people died, breaches were formed at many places, and parts of the embankment were damaged and washed away.

129. More than 60% of the Polder area is now under shrimp Ghers and more that 15% is under agriculture lands remains inside the Polder. It is observed that hand tube-wells have been installed on the crest of the embankment by *Gher* owners for lifting water from the river to shrimp cultivation inside the Polder. Due to this reason, the entire embankment is under-

sectioned than that of the design condition and is being aggravated day by day due to the effect of climate change.

130. There are 4 (four) numbers of drainage sluices in the Polder. Two of them namely DS-1 and DS-2 are fully damaged while DS-3 is in partially functioning and DS-4 has been constructed newly under WMIP but not yet operated due to retirement embankment at this place is necessary. It also appears that the existing sluices are not sufficient for smooth drainage of the Polder area. It is to be noted that a closure has already been constructed at *Patakhali* of the Polder without providing any drainage sluice. This may create drainage *congestion* within the Polder. Local people are demanding to have a new sluice near the Patakhali closure which is linked with *Jorshing Khal*, *Hajerali Khal* and *Sadderfer Khal* for efficient drainage within the Polder area. Hence, additional sluices are required for smooth drainage of the Polder. Besides, most of the internal drainage channels have been silted up and need re-excavation for efficient drainage within the Polder area.

131. An Index Map 5.1 showing the alignment of the embankment, drainage sluice, drainage channels of the Polder 14/1.



Map 5.1 Base map of Polder 14/1

132. Based on local opinions clustered during the major field investigation, the study team identified the following key water management problems and issues in the Polder.

Lack of regular operation and maintenance of water control structures and embankments;

Inadequate allocation of budget and its inefficient use;

Community abuse of existing infrastructure for fishing, shrimp/ prawn farming through unauthorized and inappropriate sluices which ultimately resulted in weakening the embankment and malfunctioning the regulators;

High rate of siltation in internal drainage *Khals* and peripheral rivers which hinders natural overland drainage;

Inadequate plantation in the foreshore and lack of coastal green belt;

Decreased in carrying capacity of *Khals* due to illegal encroachment;

Recent cyclones and storm surges, particularly the recent cyclones *Aila* (2009); and

Absence of functional community organizations for operation and management of the Polder system.

5.6 Present Status of Water Management Infrastructures

133. There are some water management infrastructures such as peripheral embankments, drainage sluices, drainage *Khals* and others in Polder 14/1. Based on field investigation, coupled with the information received from CEIP Consultant, the study team gathered the following information regarding the status of existing infrastructure.

Table 5.1: Summary of Existing Water Management Infrastructures

Type of Infrastructures	Specification
Total length of Embankment with design crest level	30.50 km (4.50 mPWD)
Total number of Drainage Sluices	04 nos.
Total length of Drainage Khals (Water Channel)	30 Km
Gross Area	2,229 ha
Net Cultivable Area	1,700 ha

Source: CEGIS estimation, 2015

134. To ensure sustainable management, optimal use and equitable sharing of water resources through proper management of the infrastructures; adequate physical interventions are required.

135. The entire length of the Embankment of the Polder (30.50 km) is aligned along the *Kobadak*, *Sakbaria* and *Arpangasia* Rivers. At present, most of the segments of the embankment are in vulnerable condition after the cyclone *Aila*. The entire embankment was damaged, some segments were breached, and some segments have been washed away. After that, the Polder was taken up for rehabilitation under CERP but it was not sustainable.

136. It was observed that the entire length of embankment of the Polder is below the design level. Some repairing works of the embankment was in progress at some segments by BWDB.

Photograph 5.1: Present Condition of the Embankment

5.6.1 Slope protection

137. The existing slope of embankments has fallen under the threat of wave action of the peripheral rivers. Damages to the slope of embankment occur when depression is formed in the sea especially during cyclone and high tide period. To protect the embankment from wave thrust, slope protection work of embankment at several segments was taken under CERP and BWDB.

Photograph 5.2: Deteriorated Condition of Existing Slope Protection Work

5.6.2 Water Control Structures

138. The existing drainage sluices DS-1 and DS-2 were found in fully damaged condition, DS-3 was found in partial functioning condition. DS-4 is newly constructed under WMIP but was not in operation as the retired embankment at this segment needs to be retired. After rehabilitation of the Polder, the DS-4 will be operated and functioning. At present, the concrete surface of the structures has deteriorated due to prolonged exposure to saltwater. A number of gates have been corroded and the loose aprons have been damaged as well. Some of the sluices were found with no gates. Furthermore, the structures also undergo issues in connection with mismanagement from local communities especially *Gher* owners. Local people opined that many gates are operated based on the local interest rather than water management interest. As there is no flushing inlet in the Polder, adequate numbers of flushing inlets are required to be constructed. Otherwise, more un-authorized pipe-lines will be installed by *Gher* owners through the embankment for taking water inside the Polder endangering the stability of the embankment. Formation of strong “Sluice Committees” and WMA is needed for

gate operation and for improvement of water management system inside the Polder.Table 5.2 below provides a detail understanding of the existing drainage sluices in Polder and addresses the need for future works.

Table 5.2 Status of existing water control structures

Sl.	Structure	Chainage (km)	Type and Size	Present condition	Recommendation for remedy
Drainage Sluice					
1	DS – 1	Ch. 7+800 (Padmapukur, Uttar Bedkahi	RCP (2 vent-0.9 m dia)	○ The structure has been fully damaged and approach embankment washed away during AILA.	The structure is required to be replaced by RCB sluice (1v-1.5 x 1.8) in place of pipe sluice with provision for flushing and drainage.
2	DS – 2	Ch. 19+750 (Binapani)	RCP (1 vent-0.9m dia)	○ The structure has been fully damaged and approach embankment washed away during AILA.	The structure is required to be replaced by RCB sluice (1v-1.5 x 1.8) in place of pipe sluice with provision for flushing and drainage.
3	DS – 3	Ch. 21+880 (Jorshingh)	RCB (2vent-1.5mx1.8m)	○ Loose apron, railing and lift gates have been damaged.	Needs to be repaired
4	DS – 4	Ch. 28+020 (Boro Antihara)	RCB (1 vent-1.5mx1.8m)	○ Constructed in 2013-15 under WMIP. ○ Not in operation yet due to retired of embankment at approach of the structure	Needs to be retired of embankment at this segment

Note: DS = Drainage Sluice, RCP = Reinforced Concrete Pipe, RCB = Reinforced Concrete Box

Source: DDCS & PMSC 2015, and CEGIS Field Investigation, 2015

Photograph 5.3: Fully damaged condition of Rw DS-1 (Padmapukur)

Photograph 5.4: Partial functioning condition of DS-3 (Jorshing)

Photograph 5.5: Newly constructed DS-4 under WMIP (Boro Antihara)

5.6.3 Drainage Channel

139. Most of the diversion channels and internal drainage channels have silted up. About 30 km of khals are needed to be re-excavated for efficient drainage within the Polder. Most of the *Khals* have been silted up and needs to be re-excavated for smooth drainage through the existing drainage sluice and retention as well. During Aila, storm surge water entered into Polder through the Khals and overtopping embankment at tremendous pressure resulting in enlargement on the width of the Khals extensively. This enlarged width of the khals, inside of the Polder, looks like river (Figure 5.1).

Figure 5.1: Enlarged Width of the Khals after Aila on Google Image

5.6.4 Water Control Structures

140. The existing drainage sluices DS-1 and DS-2 were found in fully damaged condition, DS-3 was found in partial functioning condition. DS-4 is newly constructed under WMIP but was not in operation as the embankment at this segment needs to be retired. After rehabilitation of the Polder, the DS-4 will be operated and functioning. At present, the concrete surface of the structures has deteriorated due to prolonged exposure to saltwater. A number of gates have been corroded and the loose aprons have been damaged as well. Some of the sluices were found with no gates. Furthermore, the structures also undergo issues in connection with mismanagement from local communities especially *Gher* owners. Local people opined that many gates are operated based on the local interest rather than water management interest. As there is no flushing inlet in the Polder, adequate number of flushing inlets is required to be constructed. Otherwise, more un-authorized pipe-lines will be installed by *Gher* owners through the embankment for taking water inside the Polder endangering the stability of the embankment. Formation of strong “Sluice Committees” and WMA is needed for gate operation and for improvement of water management system inside the Polder.Table 5.2 below provides a detail understanding of the existing drainage sluices in Polder and addresses the need for future works.

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2	DS – 2	Ch. 19+750 (Binapani)	RCP (1 vent-0.9m dia)	○ The structure has been fully damaged and approach embankment washed away during AILA.	The structure is required to be replaced by RCB sluice (1v-1.5 x 1.8) in place of pipe sluice with provision for flushing and drainage.
3	DS – 3	Ch. 21+880 (Jorshingh)	RCB (2vent-1.5mx1.8m)	○ Loose apron, railing and lift gates have been damaged.	Needs to be repaired
4	DS – 4	Ch. 28+020 (Boro Antihara)	RCB (1 vent-1.5mx1.8m)	○ Constructed in 2013-15 under WMIP. ○ Not in operation yet due to retired of embankment at approach of the structure	Needs to be retired of embankment at this segment

Note: DS = Drainage Sluice, RCP = Reinforced Concrete Pipe, RCB = Reinforced Concrete Box

Source: DSC 2015, and CEGIS Field Investigation, 2015

Photograph 5.3: Fully damaged condition of Rw DS-1 (Padmapukur)

Photograph 5.4: Partial functioning condition

of DS-3 (Jorshing)

Photograph 5.5: Newly constructed DS-4 under WMIP (Boro Antihara)

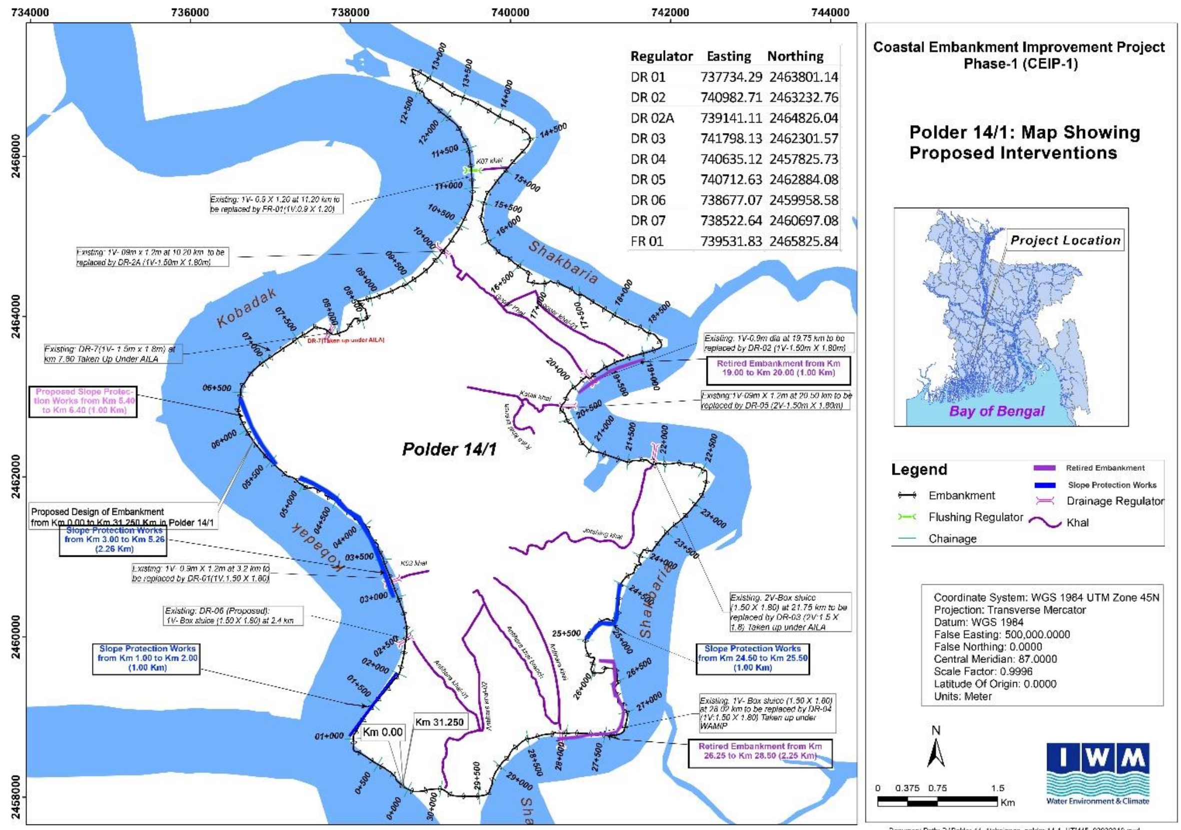
5.7 Proposed Rehabilatation Plan

141. The proposed interventions in Polder 14/1 (Map 5.2) under CEIP-1 are listed in Table 5.3. The interventions have further been detailed in the following sections.

Table 5.3: List of Proposed Interventions in Polder 14/1

Type of Work	Specification
Re-sectioning of embankment	27.25 km
Construction of retired embankment	➢ 3.25 km
CEIP design crest level of embankment	➢ 4.50 mPWD (entire embankment)
Construction of drainage sluices	➢ 02 nos.
Construction (Replacement) of drainage sluices	➢ 02 nos.
Re-excavation of drainage channels	➢ 30 km
Slope protection of embankment	6.80 km
Bank revetment work	➢ 1.0 km
Afforestation	➢ 17.37 ha

Source: Design Team of DDCS&PMSC, 2015



Map 5.2: Proposed Interventions of Polder 14/1

142. To implement the interventions of the project, 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.

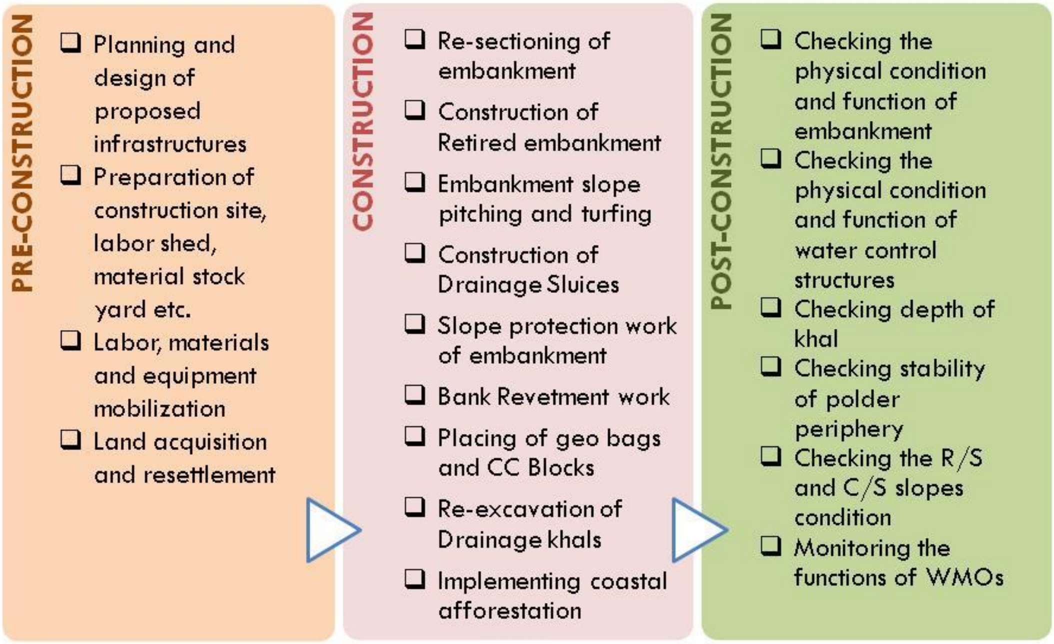


Figure 5.2: List of Activities in Polder 14/1 at Different Project Phases

5.7.1 Works on Embankment

143. Under the proposed interventions of the Polder, a total of 27.25 km of embankment will be re-sectioned. The process will be done with mechanical compaction as per designed crest level 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 which is shown in Table 5.4b. Another work is construction of retired embankment in two locations of the Polder which will also be implemented as per recommended crest level mentioned in Table 5.4 b. The side slopes of the embankment will also be rehabilitated as per design made under CEIP-1.Table 5.4a shows detail information on the works on the embankment to be carried out and Table 5.4b shows the design parameters determining the embankment crest level counting the climate change scenario.

Table 5.4 a: Detail of Works on Embankments

Sl.	Chainage	Length (Km)	Side slopes
Re-sectioning of Embankment			
1	➢ 0+000 to 19+000	➢ 19.00	➢ R/S 1:3 and C/S 1:2
2	➢ 20+000 to 26+250	➢ 6.25	➢ R/S 1:3 and C/S 1:2
3	➢ 28+500 to 30+500	➢ 2.00	➢ R/S 1:3 and C/S 1:2
Construction *of Retired embankment*			
1	➢ 19+000 to 20+000	➢ 1.00	➢ R/S 1:3 and C/S 1:2
2	➢ 26+250 to 28+500	➢ 2.25	➢ R/S 1:3 and C/S 1:2

Source: Design Team of DDCS&PMSC, 2015

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 Level w/o roughness + Subsidence & no std	Rqd crest Level w/o roughness + std + Subsidence	Rqd crest Level with roughness + subsidence & no std	Rqd crest Level with 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 Level w/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)*
118	KOBADAK 244000	4.27	4.01	3.21	0.19	2.41	3.25	1:3	0.48	0.38	0.30	3.99	4.18	3.89	4.08	3.77	0.57	0.42	4.49	4.97
119	SAKBARIA 32830	4.27	3.55	3.52	0.23	2.84	3.06	1:3	0.25	0.20	0.30	4.07	4.30	4.02	4.25	3.72	0.40	0.25	4.27	4.92
120	SAKBARIA 25781	4.27	3.47	3.49	0.23	2.82	3.05	1:3	0.15	0.12	0.30	3.94	4.17	3.91	4.14	3.83	0.33	0.18	4.31	5.03
3	KOBADAK 231000	4.27	4.33	3.21	0.17	2.44	3.35	1:3	0.45	0.35	0.30	3.96	4.13	3.86	4.03	3.84	0.58	0.42	4.56	5.04

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. 14/1, 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

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

145. Labor sheds construction with proper sanitation and other required allied facilities will be planned before the commencement of construction activities for embankment works. 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 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, excavated soil/carried earth will be dumped in layers in the selected area. At the same time, each layer (of 1.5 feet) of dumped soil will have to be compacted by a compactor machine. The sloping and shaping of embankment will be made after proper compaction in layers. The required turfing with grass will then be provided on the slope of the embankment. Watering and fertilizing will also be provided.

5.7.2 Construction (Replacing and New) of Drainage Sluices

146. Among four existing drainage sluices of the Polder; two will be constructed or replaced with new design specifications. Besides, another two new drainage sluice will be constructed at different locations under the proposed rehabilitation plan. The summary of design information of the proposed works for these drainage sluices are given in Table 5.5.

147. The EIA study presume that the invert level of the drainage sluice gate have been fixed in manner that about 50-60% of water will be retained in the khal to facilitate in irrigation, fisheries, environment and other purposes.

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 (1v-1.5m x 1.8m)	7.80	**Padmapukur/North Jorshing Khal	Kobadak River	2.50	-1.08	0.60	-0.23	-1.00	Replacement of structure as proposed
02	DS-2 (1v-1.5m x 1.8m)	19.75	Gopar Khal	Sakbaria River	2.50	-1.03	0.50	-1.90	-1.00	Replacement of structure as proposed
03	DS-6 (1v-1.5m x 1.8m)	2.40	Antihara Khal -01	Kobadak River	2.00	-1.08	0.80	*	-1.00	New construction of Structure as proposed
04	DS-5 (1v-1.5m x 1.8m)	21.20	North Ghorsing khal	Sakbaria River	2.50	➢ -1.01	➢ -0.50	➢ -0.70	➢ -1.00	➢ New construction of Structure as proposed

Source: Design Team of DDCS&PMSC, 2015

Description of Construction Activities

148. Construction of labor shed with sanitation and other facilities will be completed during pre-construction phase for construction of drainage sluices at near the construction site. During this period, required construction materials (sand, cement, wood, shuttering materials etc.) will have to be procured by the contractor as per tender schedule. Before starting the construction work of drainage sluices, ring bundhs and diversion channels will have to be constructed on the selected and prepared site as per instruction of the Engineer-in-charge. Later, the foundation treatment required for the structure will be carried out. CC and RCC works along with cutting, bending and binding of rods will then be performed as per specification. CC blocks will be prepared and placed as and where required as per design. After construction of approach roads/embankment, fitting and fixing of gates and hoisting device will be carried out. Gates will be properly painted. The intake and outfall of the gates will be constructed as per design. The CC blocks will be made for river training works and pitching works will then be conducted.

5.7.3 Bank/Slope Protection Work

149. Bank protection work will be carried out from Ch 5.30 to Ch 5.70 while slope protection will be carried out from Ch 12.00 to Ch 12.500 and Ch 24.50 to Ch 25.50 respectively (Refer Map 5.2).

Description of construction activities

150. The construction activities involved for the bank protection and slope protection works are: construction of labor shed, creation of sanitation facility and procurement of construction materials (sand, cement, wood, shuttering materials etc.). The slope of the river bank 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. For River Bank Protection and Embankment Protection Works CC Blocks of various sizes will be used to control river erosion activities.

5.7.4 Re-excavation of Drainage Khals

151. Six (6) drainage channels with a total length of 13 km will be re-excavated to ease water flow and reduce drainage congestion. An estimated volume of 92995 cubic meters of soil/silt will be excavated. 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.

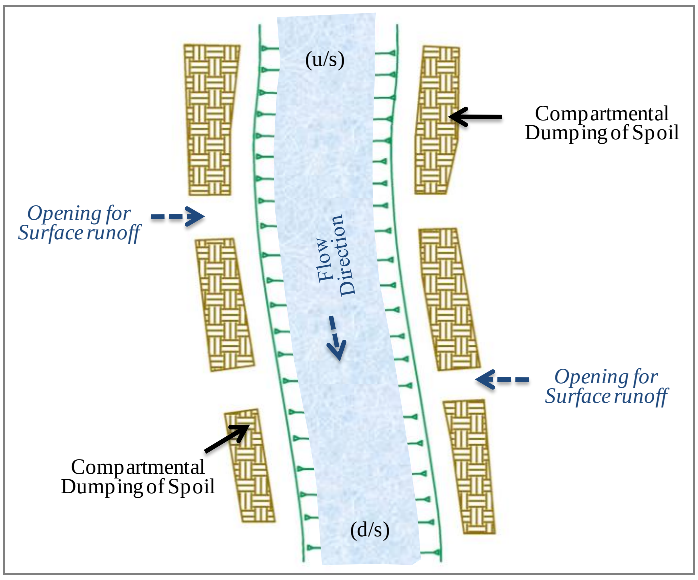


Figure 5.3: Plan form of a typical khal to be re-excavated

Table 5.6: Khals to be Re-excavated

Sl.	Name of Khal	Length (km)
1	Antihara Khal-1	2.00
2	Antihara Khal-2	2.00
3	Gharilal Khal	3.00
4	Gopar Khal	2.50
5	Hajerali Khal	1.00
6	Jorshing Khal	2.50

Source: CEIP-1 Design Study Team, 2017

Description of construction activities

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

153. 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 8.45 ha area will be planted of this Polder. Construction Details

5.7.5 Construction Schedule

154. The construction works in Polder 14/1 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 SI No	**Description**	**Year One**								**Year Two**			
		May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**
1	Re-sectioning of Embankment	■						■	■	■	■	■	■
2	Construction of retired embankment	■						■	■	■	■	■	■
3	Construction of Drainage Sluices							■	■	■	■	■	■
4	Bank revetment and Slope Protection Works	■	Manufacture of cc blocks and procurement of hard rock					■	■	■	■	■	■
5	Re-excavation of Drainage Channels	■						■	■	■	■	■	■
6	Other works, including surveys, quality checks, testing, inspections and the like	■	■	■	■	■	■	■	■	■	■	■	■

Part B

SI No	**Description**	**Year Two**								**Year Three**			
		May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**
1	Re-sectioning of Embankment	■			■	Turfing							
2	Construction of retired embankment	■											
3	Construction of Drainage Sluices	■	■	■				■	■	■	■	■	■
4	Bank revetment and Slope Protection Works	■											
5	Re-excavation of Drainage Channels	■						■	■	■	■	■	■
6	Other works, including surveys, quality checks, testing, inspections and the like	■	■	■	■	■	■	■	■	■	■	■	■

Part C

SI No	**Description**	**Year Three**								**Year Four**			
		May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**
1	Re-sectioning of Embankment												
2	Construction of retired embankment												
3	Construction of Drainage Sluices	■											
4	Bank revetment and Slope Protection Works												
5	Re-excavation of Drainage Channels	■											

6	Other works, including surveys, quality checks, testing, inspections and the like												
7	Site clearance and clean up												

Source: CEIP-1 Design Study Finding, 2015

5.7.6 Construction Manpower Requirement

155. Technical and nontechnical 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). 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.

Table 5.8: Required Manpower for Construction

SL	Required Manpower	Number
1	Senior professionals	5
2	Site Engineer	6
3	Technicians	12
4	Admin/support Staff	10
6	Skilled labour	30
7	Un-skilled labour	200

Source: CEIP-1 Design Study Finding

5.7.7 Construction Material

156. 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, steel, and sand. Estimated quantities and availability of these materials are presented in Table 5.9.

Table 5.9: Details of Construction materials

Sl No	Construction Material	Quantity	Sources
Re-sectioning and retired embankment			
1	Earth work	671915 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 sluices and flushing sluices			
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)

Sl No	Construction Material	Quantity	Sources
Bank protection			
6	CC Blocks	60,00,000 nos	To be made at construction site during construction

157. Source: CEIP-1 Design Study Finding The carried earth for embankment rehabilitation will be collected from the offshore area of Polder 14/1.

5.7.8 Construction Machinery

158. 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 shown in Table 5.10.

Table 5.10: List of construction equipment and machinery

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

Source: CEIP-1 Design Study Finding

5.8 Project Implementation Arrangements

159. 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. BWDB will act as the *Project Implementing Agency* and implement the project through a Project Management Unit (PMU).

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

161. Project Management Unit (PMU). BWDB will set up a PMU to oversee the development and management of the Project. It will be led by a Project Director appointed by the BWDB who will be in the rank of Chief Engineer, and will directly report to the Director General (DG). The PMU will have a central project office located at the headquarters of the BWDB in Dhaka. The PMU will have 3 subordinate units: (i) Engineering Unit; (ii) Procurement and Finance Unit; and (iii) Environment, Social 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*.

162. 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 utilize 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.

163. The Procurement and Finance Unit will be responsible for the entire procurement and financial management process of the Project. It will also be responsible for monitoring project progress, to liaise with the Bank to prepare annual programs, implementation reporting and updating of all procurement reporting documents as well as 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.

164. An Environment, Social and Communication Unit (ESCU) will supervise the activities in 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. ESCU will supervise programs for all the Packages, including Package 3.

165. 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.

166. 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 EMP, the Social Action Plan including mobilization of Water Management Organization, the RAP and the EMP.

A Design and Construction Supervision Consultancy Firm will assist the PMU in preparing the detailed design of the remaining Polders and supervise all construction works. For civil works related 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 Contractors. DDCS&PMSC will supervise/assist in the implementation of safeguard instruments.

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

168. A Procurement Panel will be appointed by BWDB to oversee the procurement process of large value contracts subject to prior review under the Project. The panel will consist of two international/expatriate specialists and one national specialist.

169. 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.

170. These institutional arrangements are effective and are being followed in Package -1 and Package-2 of CEIP-1.

5.8 Water Management and Gate Operational Plan

171. 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.

172. 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 coup with the diversified needs of the local people. Changes in the land use pattern of the area have also created water management conflicts and new dimensional needs asking the structures to allow water to flow in both directions. So maintenance of the Polder system with embankments and structural elements built over there has permanently become important. The Government of Bangladesh either with 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.

5.8.1 Operation Plan

173. Operational plan involves setting out the schedule of activities related to operation of gates of water control structures by the users' organization to control water levels best suited to water management and agricultural needs. The following issues have been considered in the preparation of Operation Plan;

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

- Operation of structures should therefore be an organizational, low cost activity requiring quick communication with the beneficiaries and with project staffs at the lowest level.

(a) Operational Activities

174. 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)

175. 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:

Regulation of gates

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

177. The photograph 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.

178. The gates of each drainage sluice / regulator must be operated following certain fixed rules regarding timings. BWDB O&M section in consultation with the beneficiaries' organizations, DWM staffs and DAE field staffs will ensure operation of the gates in conformity with operational timing based on actual water management and agricultural needs.

179. Flap Gates of regulators should remain in place at all times except during maintenance and flushing. During pre-monsoon period, the vertical lift gates of each regulator should remain closed for retention of water for irrigating Aus crops by LLPs. During monsoon (July to September), the vertical lift gates should normally remain closed; but may be opened to regulate the water levels inside the Polder and should not be allowed to exceed the stated maximum permissible level for safety reasons. In order to achieve this, discharges into the river should commence (river levels permitting soon after this level is attained). This type of water management decisions should be taken after due consideration of daily rainfall, river stages, water levels inside the Polder, gate opening schedules. However, the frequency and type of this decision making process will vary with the seasonal conditions.

180. 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 over time as well as fish culture which is commonly practiced in the Polder area.

181. 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.

i. Frequent Watching of Embankments

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

ii. Regular Checking of Structures

183. 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.

iii. Condition Survey (of embankment & structures) and Engineering Survey

184. 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.

iv. Supervision of Preventive Maintenance Works

185. 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.

(b) Planning of Operation

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

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

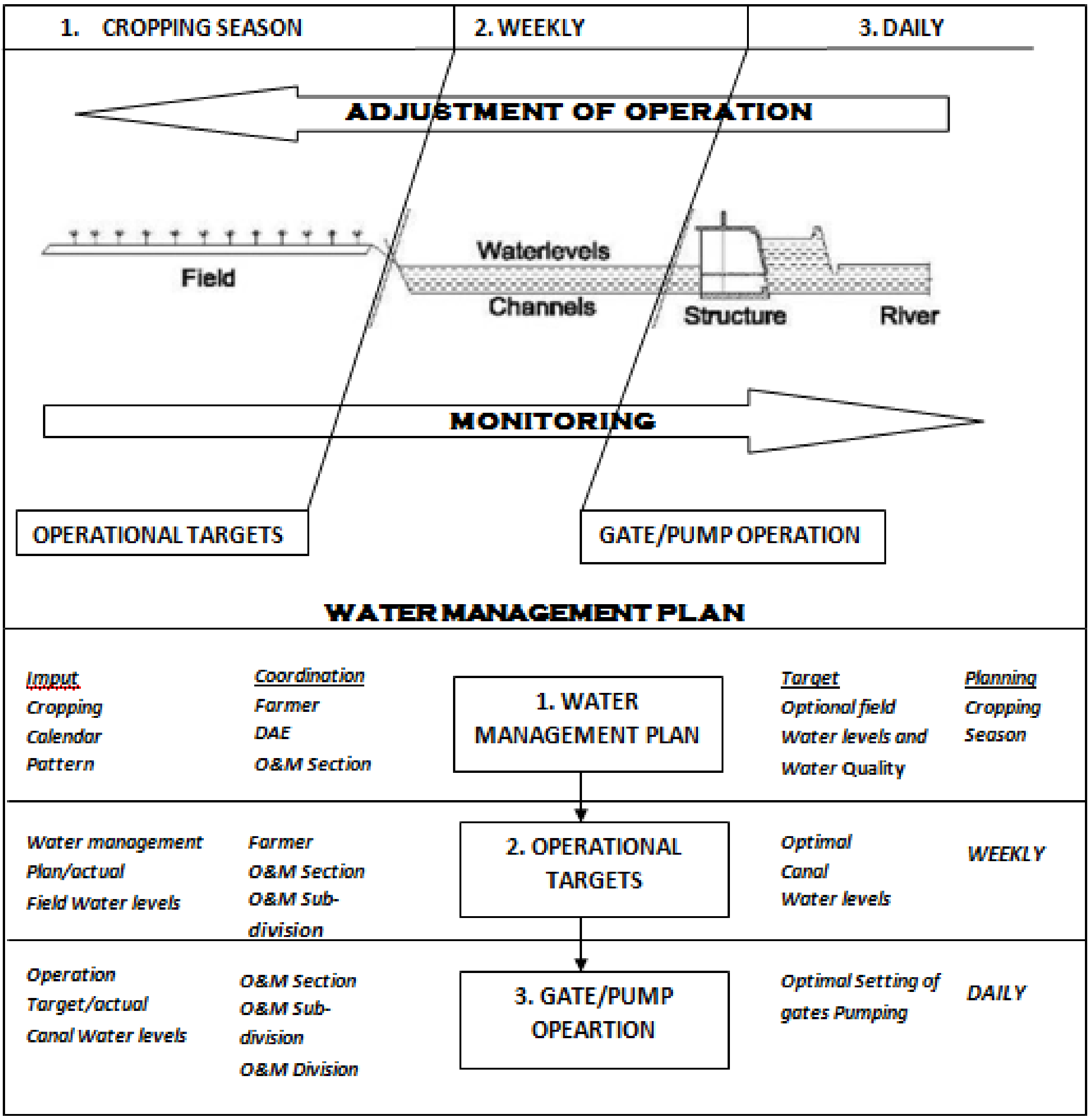


Figure 5.4: Decision Making in Operation

5.8.2 Maintenance Works

187. Maintenance of embankments and structures is the most important item of activities in the coastal Polders. It is necessary and cannot be avoided because it helps in preserving the infrastructure in good and functional condition; protects investments; and prevents high rehabilitation costs. Since this is included in the day-today tasks schedule and needs continuous efforts, maintenance of coastal Polders put emphasis on simple and cost effective community-based interventions.

188. In the coastal Polders, water management work should be maintained regularly. These activities are divided into:

(a) Preventive or Routine Maintenance;

(b) Periodic Maintenance;

- Minor Periodic Maintenance
- Major Periodic Maintenance

(c) Emergency Maintenance;

(a) Preventive or Routine Maintenance

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

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

(b) Periodic Maintenance

190. 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.

191. 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:

i. 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;

ii. 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.

192. The periodic maintenance interventions have been spelled out precisely in Table 5.13 below.

(c) Emergency Maintenance

193. 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.

(d) Planning of Maintenance

194. As already stated maintenance activities in BWDB Polders are conceived in three distinct categories, i.e., Preventive Maintenance; Periodic Maintenance; and Emergency Maintenance.

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

5.9 Project Cost

196. The total estimated cost as calculated is Tk.11,126 Lac (111 crore and 26 lac) only.

5.10 Need of Resettlement Action Plan (RAP)

197. The interventions proposed in Polder 14/1 do not include any major type of works to be carried out in new alignments. All Drainage or Flushing Sluices, proposed to be replaced, will be re-constructed on existing alignment. Also, for the embankment re-sectioning works, the existing alignment is to be used for the additional set back distance is to be used. Moreover, there is no construction of retired embankments. It can therefore, be concluded that no major resettlement may occur during project implementation. However, some minor resettlements may be needed as some households still exist over or adjacent to the Polder periphery, which may be displaced during construction works. In this connection, a detail RAP investigation is required, which is being conducted by the consultants.

5.11 No Objection Certificate

198. Polder 14/1 is located in the Koyra Upazila under Satkhira District, covering Uttar Bedkashi and Dakhin Bedkashi Unions. No archeological sites or cultural heritages are known to exist in these unions, which might be affected for interventions proposed for the rehabilitation of the Polder. Furthermore, there will be no problems of land acquisition or displacement of people since rehabilitation will be made on the existing infrastructures. This has been addressed in the No Objection Certificates (NOCs) collected from the Union Chairmen, which are attached in Appendix E.

6. Environmental Baseline and Existing Conditions

199. 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 Physical Environment

200. Physical environment refers to the physical and chemical features of an area. It includes the climate, rainfall, wind, soil, obtainable nutrients and all other natural resources within the area. The following sections provide analyses on different physical environmental features of the Polder 14/1:

6.1.1 Geology

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

6.1.2 Topography

202. The Polder area is located in the southern hydrological zone of the country, with very low average elevations. In order to assess the topography of the Polder area, RLs (Reduced Levels) were collected from the Digital Elevation Model (DEM) of 300 $\times$ 300m resolution, generated by the National Water Resources Database (NWRD). Analysis using Digital Elevation Model (DEM) infers that the Reduced Levels[3] (RLs) inside the Polder vary from 0.92 to 1.61 m+PWD, with average RL of around 1.20 m+PWD. Map 6.1 shows the topography of the Polder area, identifying the rivers and categorizing land elevations.

6.1.3 Seismicity

203. 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 situated 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 6.2). Accordingly, the project area falls under Zone-III, which is characterized by Low earthquake prone site and has a basic seismic coefficient of 0.04g (Map 6.2).

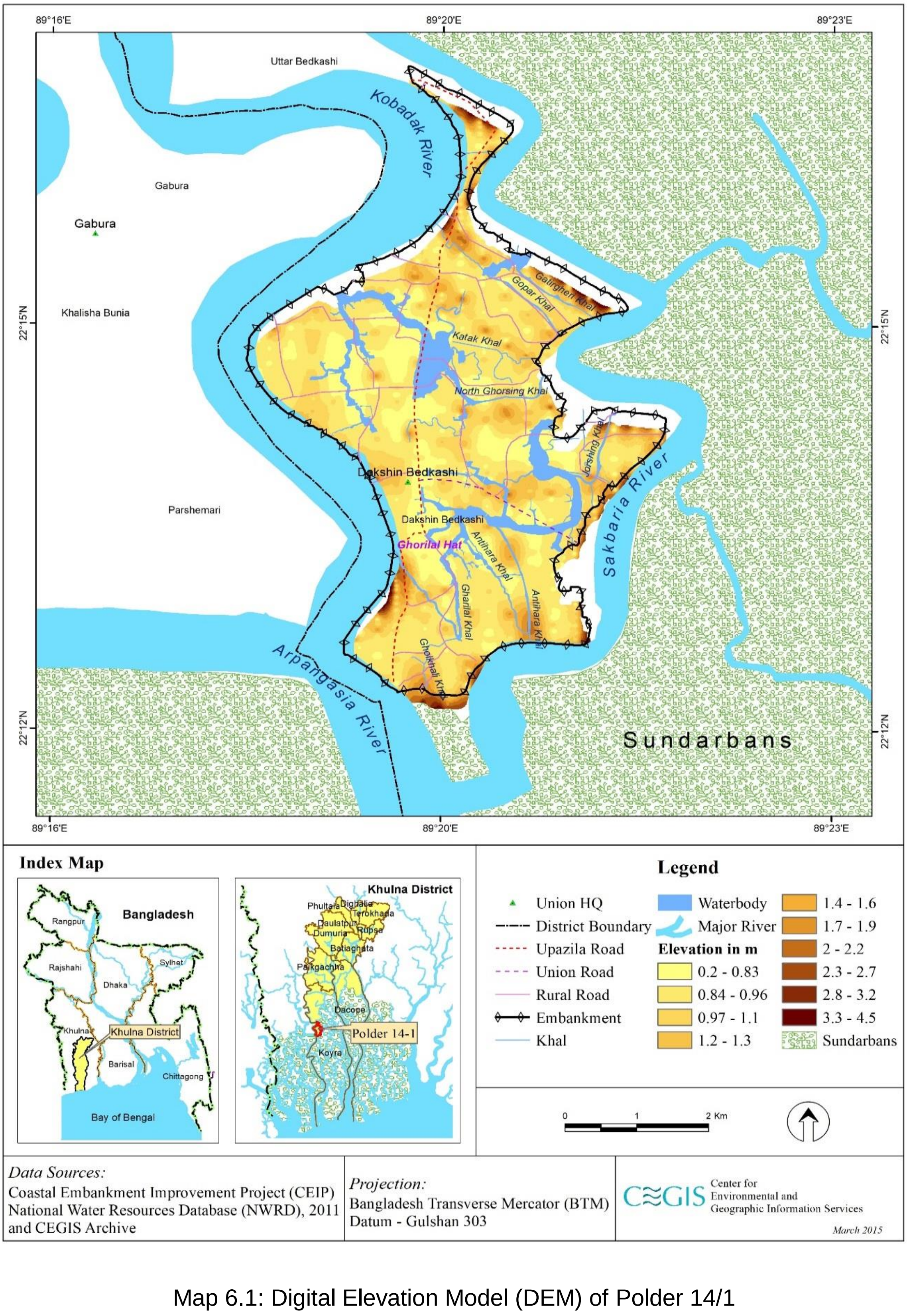
204. Moreover, the Polder 14/1 is located inside the Faridpur Trough, which is situated adjacent to the Hinge Zone, and is characterized by a general gravity-low with the

[3] Reduced Level in surveying refers to equating elevations of survey points with reference to a common assumed datum. It is a vertical distance between survey point and adopted datum plane.

development of Neogene sequence. Map 6.3 represents the tectonic units available in Bangladesh with the location of the Polder.

205. It can therefore be inferred that both in consideration of seismicity and stratigraphy, Polder falls on a relatively safer (seismically quiet and tectonically stable) side.

Digital Elevation: Polder 14/1, Koyra Upazila, Khulna



Map 6.1: Digital Elevation Model (DEM) of Polder 14/1

Earthquake Zone Map: Polder 14-1

Data Sources:
National Water Resources Database (NWRD), 2011 and CEGIS Archive
Geological Survey of Bangladesh (GSB),1979

0 25 50 100 Km

Projection:
Bangladesh Transverse Mercator (BTM)
Datum - Gulshan 303

CEGIS Center for Environmental and Geographic Information Services

February 2016

Map 6.2: Earthquake Zones of Bangladesh and Location of Polder 14/1

Map 6.3: Tectonic Units Bangladesh and location of Polder 14/1

6.1.1 Land Resources

206. Land is the surface of the earth that is not covered by water or area of ground, especially when used for a particular purpose such as farming , building and economic activity. Land comprises natural resources such as soils, minerals, water and biota. These components are organized in ecosystems which provide a variety of services essential to the maintenance of the integrity of life-support systems and the productive capacity.

(a) Agro-ecological Zones

207. Thirty agro-ecological zones (AEZs), 88 sub-regions and 536 units have been identified by adding successive layers of information on the physical environment which are relevant for land use and assessing agricultural potential in Bangladesh (BARC, 2012). The Polder area is lying with Ganges Tidal Floodplain AEZ-13.

AEZ 13: Ganges Tidal Floodplain

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

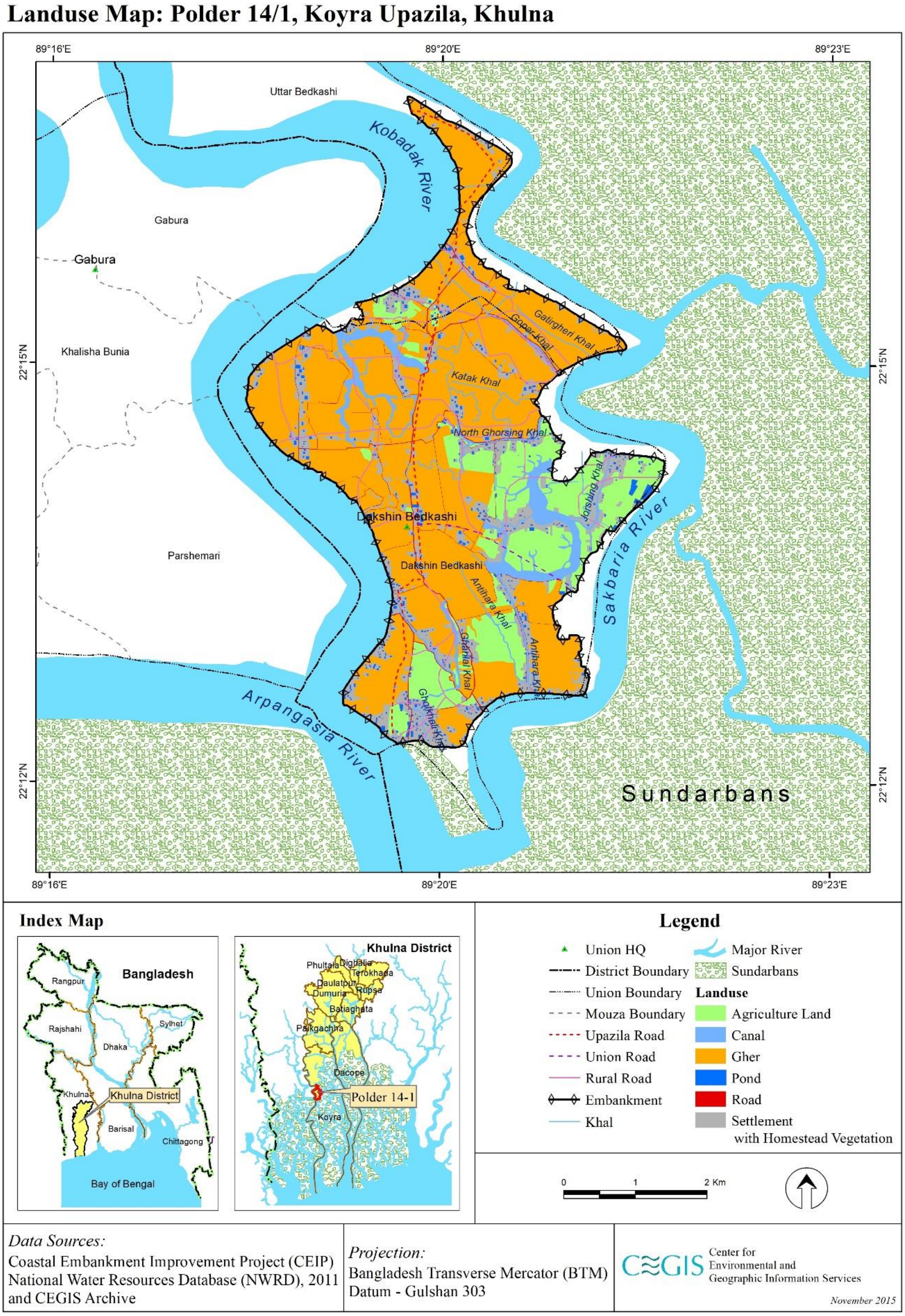
(b) Land use

209. Land use involves the management and modification of natural environment of land into built environment such as settlements, canals, embankment, ghers, ponds, and roads. In this Polder the gross area is 2,229 ha where Net Cultivable Area (NCA) is 1700 ha (where 362 ha is being used for agriculture and remaining 1,338 ha is being used for shrimp culture) which is 76% of total gross area. The non-cultivable land is covered by the settlements, canals, embankment, ghers, ponds, and roads. The land use details of the Polder area is given in the Table 6.1 and Map 6.4.

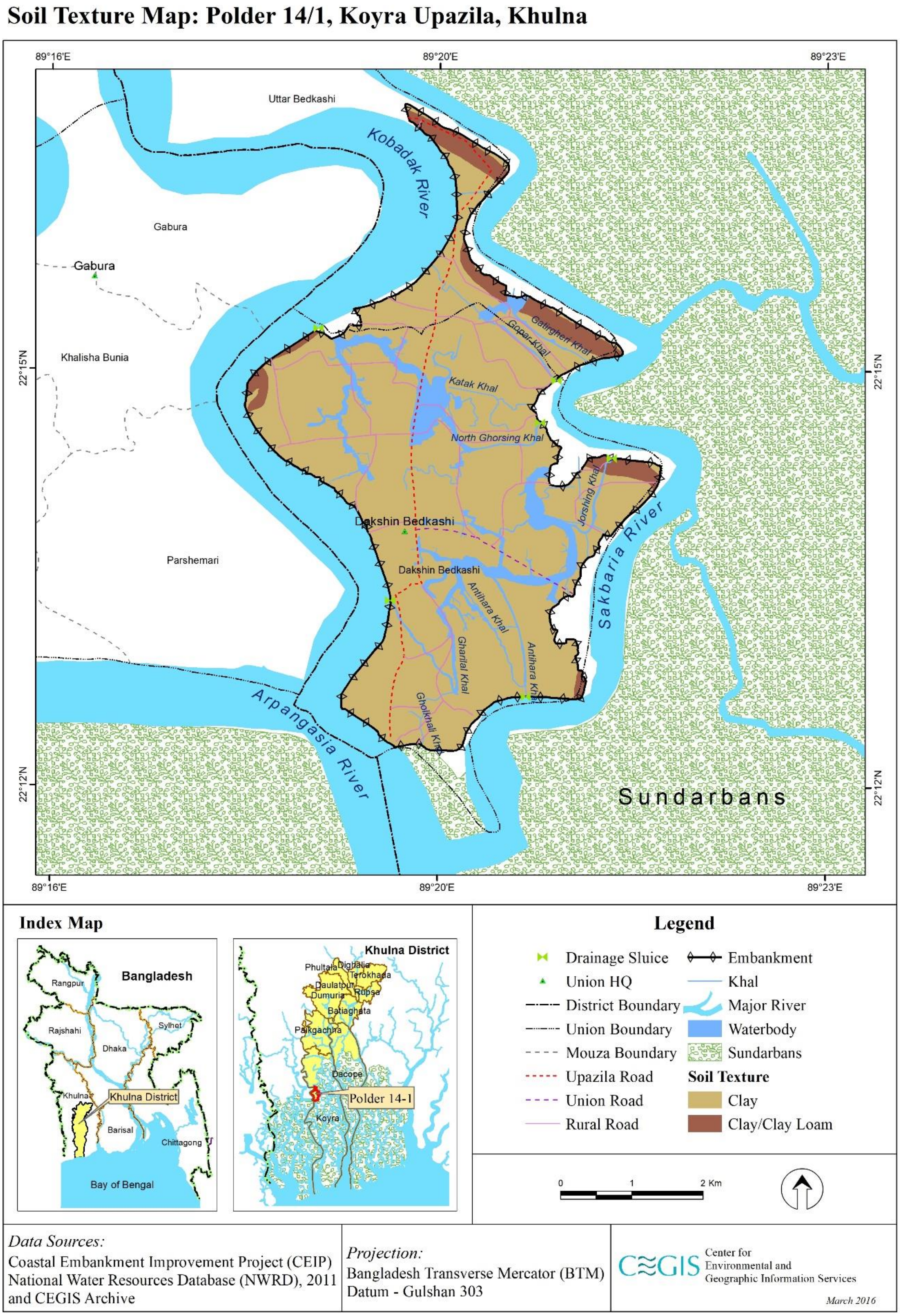
Table 6.1: Present land use of the Polder area

Land use	Area (ha)	% of gross Area
Agriculture Land	362	16
Gher (Shrimp culture + crops area)	1,338	60
Canal	130	6
Embankment	21	1
Pond	43	2
Road	31	1
Settlement with Homestead Vegetation	305	14
Total	**2,229**	**100**

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006



Map 6.4: Land Use of the Polder Area



Map 6.5: Soil Texture of the Polder Area

(c) Land Type

210. 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. Cultivated

land based on the seasonal inundation depth of normal flooding. According to Soil Resource Development Institute (SRDI, 1988), five land types (High land, Medium Highland, Medium Lowland, Lowland and Very Lowland) have been classified in terms of depth of flooding on agriculture land. The entire study area is under medium highland (F_1) which is normally flooded between 0 and 90 cm depth of water continuously for more than two weeks to few months during the monsoon season.

(d) Drainage Characteristics

211. 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). The entire Polder area is covered by poorly drained class (CEGIS Assessment based on SOLARIS –SRDI; 2006).

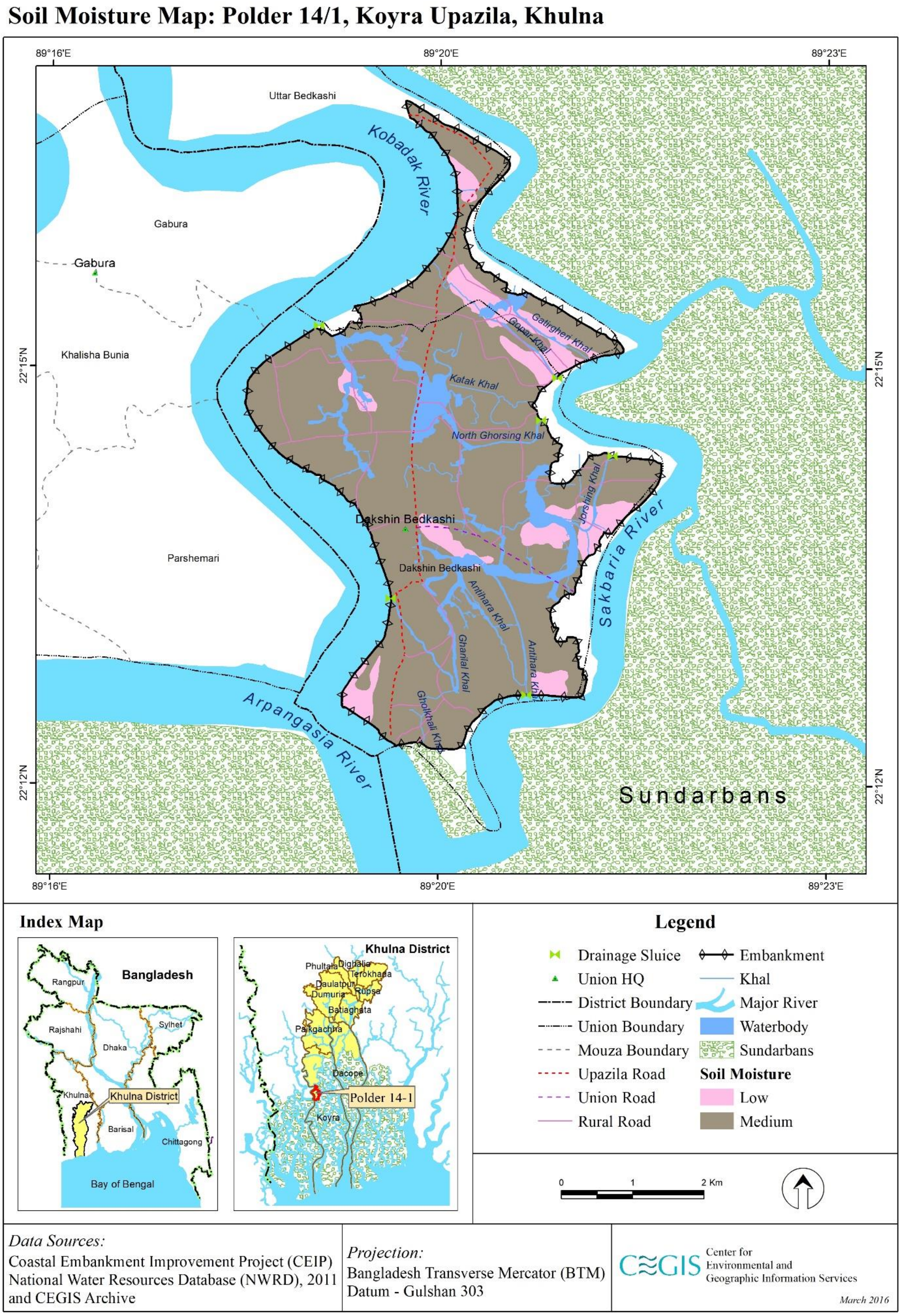
(e) Available Soil Moisture

212. Soil moisture varies depending on the soil characteristics. Growth of plant and crop production depends on the soil moisture from which plants uptake the essential nutrient and water. Medium available soil moisture is dominant (96% of the NCA). Details of the soil moisture in the Polderis presented in Table 6.2 and Map 6.6.

Table 6.2: Detailed distribution of available soil moisture in the Polder area

Sources: CEGIS Assessment based on SOLARIS-SRDI; 2006

Classification of soil based on available soil moisture	Characteristics	Area (ha)	% of NCA
Low	Plant extractable soil moisture remained in the field level less than one month.	68	4
Medium	Plant extractable soil moisture remained in the field level for one to two month.	1,632	96
	Total	**1,700**	**100**



Map 6.6: Available Soil Moisture of the Polder area

(f) Land Form

213. The land of Polder area is dominated by Basin form (97%). Detailed distribution of landform of the Polder area is presented in Table 6.3

Table 6.3: Detailed distribution of land form in the Polder

Land Form	Area (ha)	% of NCA
Basin	1657	97
Ridge	43	3
Total	**1700**	**100**

Sources: CEGIS Assessment based on SOLARIS-SRDI; 2006

(a) (g) Soil Quality

214. Soil were collected from inside the Polder area at Padhopukur (22°16'04.29"N, 89°18'53.99"E), *Boro Angtihara* (22°13’46.42’’N, 89°19'55.72"E) and *Jorshing* (22°15’'03.77"N, 89°20'13.55"E) on 14th November, 2015 for analyzing chemical properties of soil. The existing cropping pattern is Fallow- HYVAman-Fallow, Fallow-HYV Aman-HYV Boro and Fallow-Lt. Aman-Hybrid Boro of the soil sampling locations.

215. The samples were collected from top soil (depth: 0-15cm from surface) and analyzed for Electrical Conductivity (EC), Soil Reaction (p^H), Organic Matter (OM), Nitrogen (N), Potassium (K), Phosphorus (P), Sulphur (S) and Zinc (Zn) from laboratory of the SRDI, Dhaka and pesticides residues (Carbofurane) from Entomology Division, BARI, Gazipur. The result shows that organic matter content is very low to low. Soils are deficient in N, but the status of P, S is high to very high and the status of K is very low and Zn is reasonable.

216. The soil salinity is found very slight saline to slightlysaline during the sampling period (November, 2015). However, according to the SRDI information (SRDI, 2010), about 58% of NCA is non saline to very slightly saline and 42% NCA is strongly with some moderately saline. The pH range varies from 8.6-9.0 among the soil sampling sites. The soil quality test result with methods by location is presented in Table 6.4.

Table 6.4: Chemical properties of soil on agriculture land

Parameters	Unit	Padhopukur	Boro Angtihara	Jorshing	Method
EC	ds/m	2.56	6.70	2.13	Glass Electrode
p^H	-	8.6	9.0	9.0	Glass Electrode
OM	%	1.33	1.17	0.93	Wet Oxidation
N	%	0.07	0.08	0.05	Kjeldahl distillation
K	meq/100gm	0.58	0.76	0.45	Olsen/ Bray and Kurtz
P	µg/g	32.11	7.71	5.77	NH_4OAc
S	µg/g	223.70	268.58	185.50	CaH2PO4 Extracting
Zn	µg/g	4.56	1.76	2.30	DTPA Extraction
Carbofuran	ppm	nill	nill	nill	Thermo Electron & Pekin Elmer

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

6.1.2 Climate

217. Climatological information of the study area has been collected from the Satkhira station of BMD which is the nearest station of the Polder area. Data on climatological parameters such as Rainfall, Temperature, Relative Humidity, Wind Speed and Sun shine

hour are accumulated from the NWRD-CEGIS archive and synchronized at district level for the Polder area. Summary of the analysis of climatological parameters are given in the following sections:

(a) Rainfall

218. Rainy season is very nominal in the Polder area in comparison to the other region of the country. Values of monthly maximum and average rainfalls are collected from the BMD station of Satkhira (1983-2013). The collected data are shown in Figure 6.1. The figure shows that November to March are the driest months of the year with negligible rainfall and June to October are the wettest months with highest rainfall. The record of last 31 years (1983-2013) shows that, the Polder area received monthly maximum rainfall of 688 mm which was recorded in June 1988. The figure shows that significant rainfall occured during the months of May to October while very insignificant during the months of December to February. The hyetograph shows the highest and lowest values of rainfall are observed during the months of June (688 mm) and December (37 mm) respectively while the line graph illustrates that the highest and lowest values of average rainfall are observed during the months of July (339 mm) and December (3.74 mm) respectively.

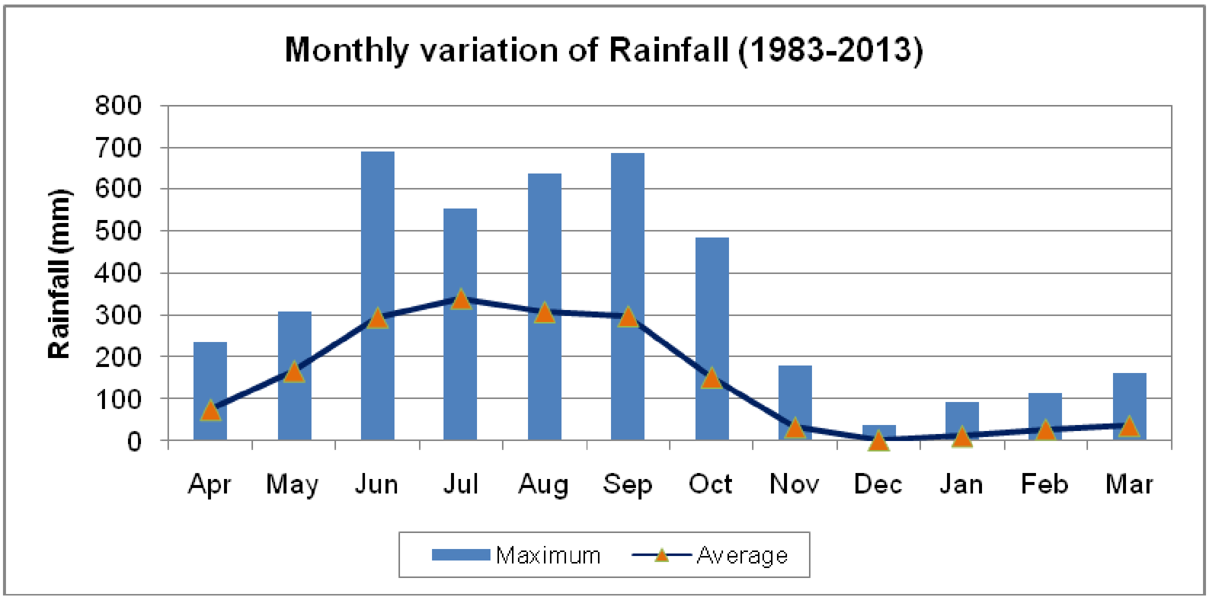


Figure 6.1: Monthly Maximum and Average Rainfall

(b) Temperature

219. Temperature data of last 31 years (1983-2013) from the BMD station shows that the monthly maximum average temperature varies from 28°C (January) to 37°C (April), and April is the warmest month where as the monthly minimum temperature varies within the range of 10°C (January) to 25°C (June), and January is the coldest month of the Polder area. The highest maximum of average temperature ever recorded in the last 31 years is 37°C which is found to occur in the month of April, 1992 while the lowest ever recorded minimum temperature is 10°C, recorded in the month of January, 1989. The monthly maximum and minimum temperature of last 31 years (1983-2013) are shown in Figure 6.2. below;

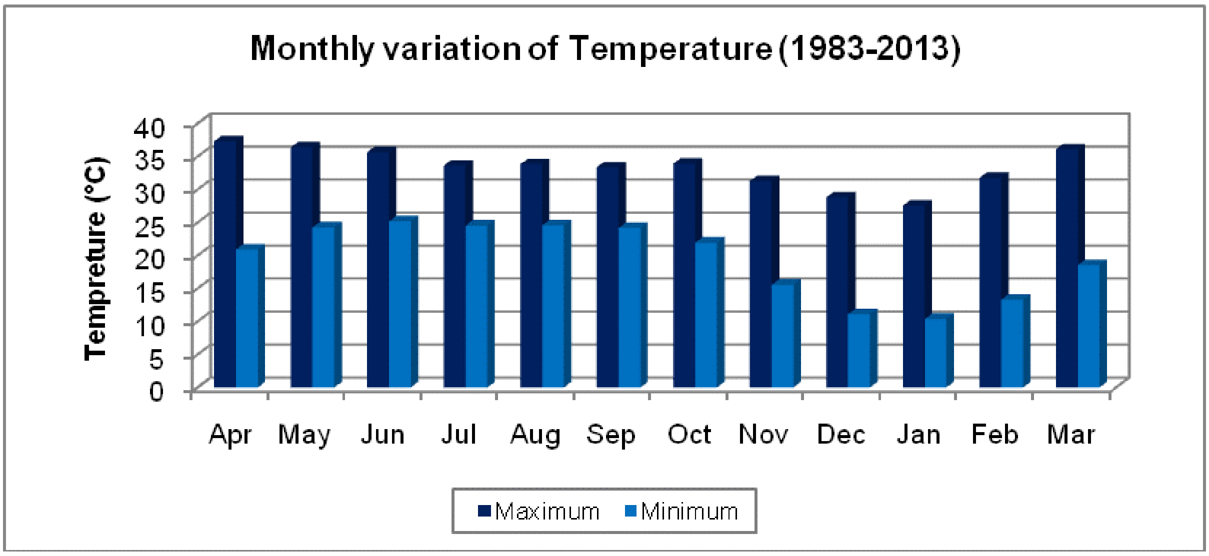


Figure 6.2: Monthly variation of Temperature in the study area

(c) Humidity

220. Relative humidity is the ratio of the partial pressure of water vapor in an air-water mixture to the saturated vapor pressure of water at a prescribed temperature. The value depends on temperature and the pressure of the system of interest. As the temperature of the atmosphere increases, vapor carrying capacity in water increases, and thus the atmospheric vapor pressure also increases.

221. Figure 6.3 shows that monthly average relative humidity in the Polder area varies seasonally from 69% (March) to 86% (September).The most humid months are June to October (relative humidity greater than 80%) and vary from 81 to 86 % while during December to March, it remains within a range of 68 to 74%. The line graph of average relative humidity demonstrates a significant fluctuation as relative humidity values start to increase from April due to the increase in atmospheric water vapors coupled with temperature rise. Relative humidity rises above 85 % in monsoon (July to September) and starts decreasing from post monsoon season following the monsoon rainfall. The monthly average relative humidity for the last 31 years (1983-2013) is shown in Figure 6.3.

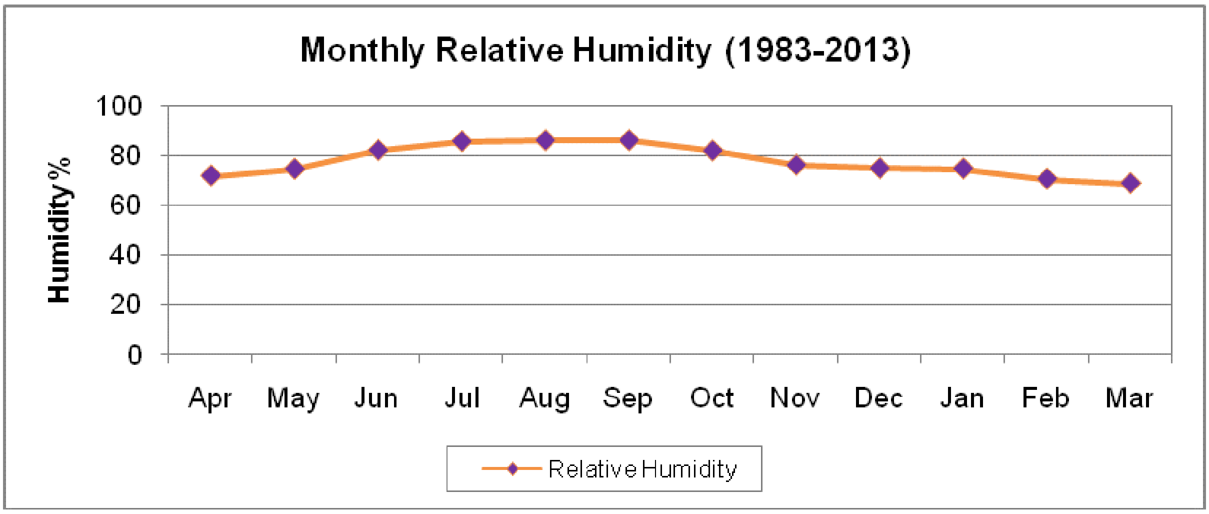


Figure 6.3: Monthly Average Relative Humidity

(d) Wind Speed

222. Historical data on wind speed for the last 31 years (1983-2013) has been considered to state the wind speed of the Polder area. The monthly average wind speed in Polder area varies from 3 to 8 km/hr. The variation of monthly average wind speed is shown in Figure 6.4 below. The figure shows that the average speed of wind is highest in April (8 km/hr) and lowest in October (3km/hr).

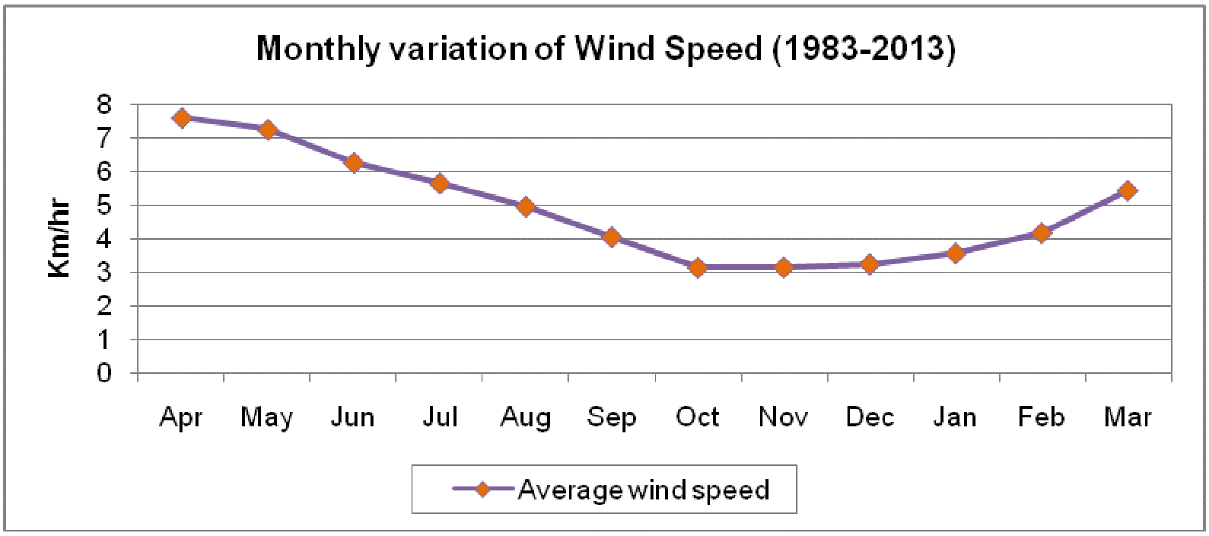


Figure 6.4: Monthly Variation of Average Wind Speed

(e) Sunshine Hours

223. The monthly average values of sunshine hours in the Polder area vary from 5 to 9 hour/day. The average value of sunshine hour is highest in April (9 hr/day) and lowest in July (4 hr/day). Figure 6.5 shows that from November to May, the daily average sunshine hours are higher than 7 hours, but due to increased extent of cloud cover in monsoon (June to September) the values dropped below 5 hr/day.

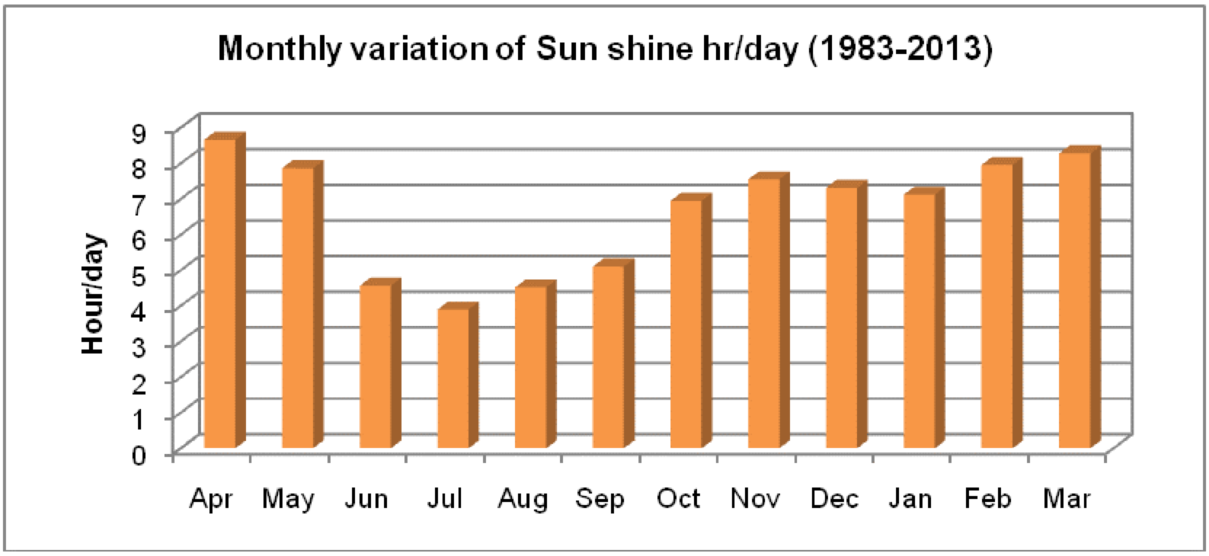


Figure 6.5: Monthly Average Sunshine Hours per Day

6.1.3 Water Resources System

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

(a) Major Rivers and Khals

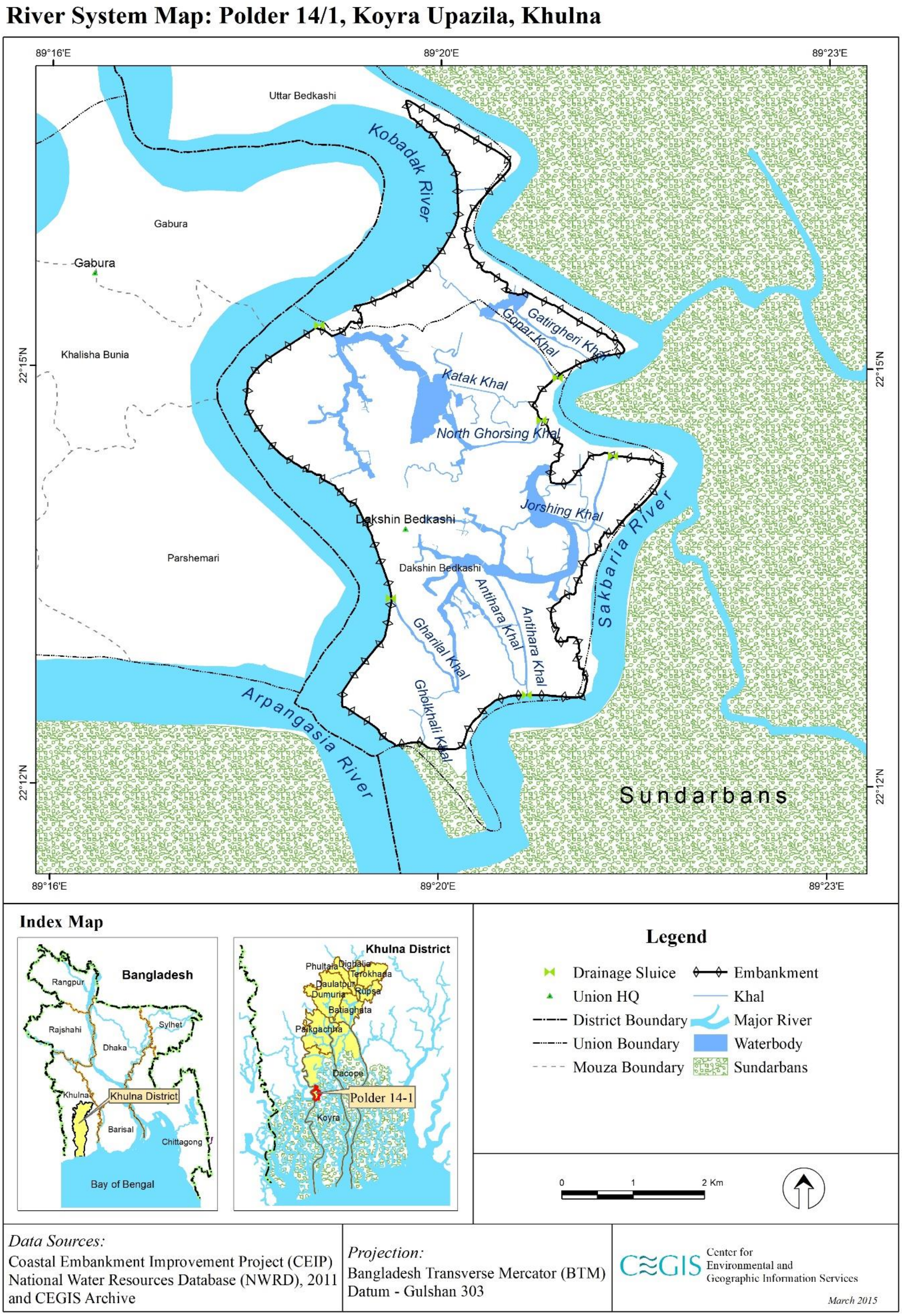
225. Polder 14/1 is surrounded by *Sakbaria* River on the East, *Arpangasia* River on the South, *Kobadak* River on the West. The *Kobadak* and *Sakbaria* Rivers are on the North of the Polder. Sundarban, the biggest mangrove forest is located at the eastern boundary of the Polder. Besides, number of khals exist in the Polder area namely, *Gholkhali khal, Antihara khal, Kashitana khal, Jorshing khal, Hajer Ali khal, Sadderer khal, North Ghoringh khal, Hatalbunia khal, Katak khal, Goper khal, Gatirgheri khal* which all are inter connected with the peripheral rivers of the Polder. The River system of the area is shown in Map 6.7

(b) Hydrological Connectivity

226. The main rivers of the Polder are Kobadak (Photograph 6.1) and Sakbaria (Photograph 6.2) which flow from north to south having high tidal influence. The Kobadak River originates from Bhairab River at Chowgacha Union in Chowgacha Upazila of Jessore District and flows to the western portion of the Polder and its outfall is at Kholpetua River in Koyra Upazila of the Khulna District. The other major river of the Polder, i.e., Sakbaria originates from the Koyra River at Nalian range Union in Koyra Upazila of Khulna District which flows to the eastern portion of the Polder and its outfall is at Arpangasia River in the same Upazila. Besides, the Arpangasia River originates from Kobadak River and where outfall is at the Bay of Bengal after flowing along the Sundarban. The internal khals as mentioned above are connected with these rivers. Both rivers and khals are perennial in nature having high tidal influences throughout the year.

Photograph 6.1: Kobadak river at Golkhali

Photograph 6.2: Sakbaria river at Angtihara



Map 6.7: River System of the Polder

6.1.4 Hydrological Settings

(a) Surface Water Levels

227. Data on surface water levels for the Kobadak River to assess the surface water characteristics of the Polder area have been collected from a station of BWDB at Kobadak Forest station in Koyra Upazila namely SW-165-Kobadak forest station (TDWL), which is located in south-west of the Polder. But, there is no station of BWDB on both Arpangasia and Sakbaria Rivers to assess the surface water characteristics for the rivers.

228. Secondary information on water levels have been collected from the above mentioned BWDB station from the year 1980 to 2009 for the River. Figure 6.6 denotes a hydrograph showing monthly variation of water levels of the river having tidal influence. The crest portion of the hydrograph indicates the rising in monsoon period. During high tide, the average maximum water level at Koyra is 2.46 m +PWD (in June) and average minimum is 1.58 m +PWD (in January). During low tide, the average maximum water level is -1.36 m +PWD (in August) and average minimum is - 2.03 m +PWD (in March).

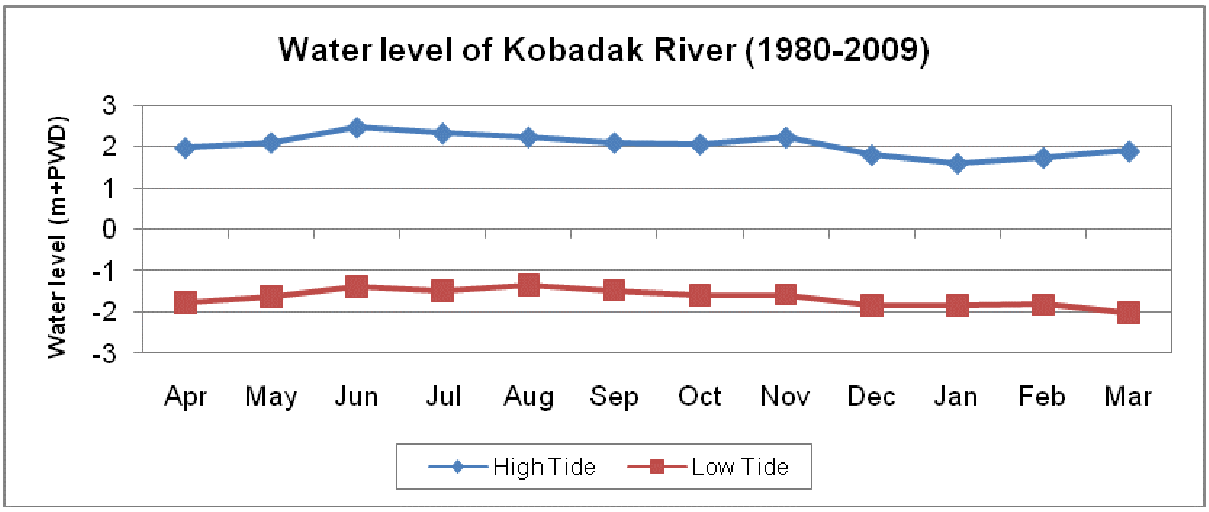


Figure 6.6: Surface Water Level of Kobadak

(b) Groundwater Table

229. There are no observation wells of BWDB inside or outside of the Polder to assess the ground water table (GWT). During field visit, deep tube-wells were observed to exist in the Polder having depth of about 600-800 ft and are being installed by the NGOs. The numbers of the deep tube-wells are insufficient for supplying drinking water facilities to all people of the Polder area.

6.1.5 Water Resources Issues and functions

(a) Tropical cyclones

230. Tropical cyclones are major threat to the coastal Polder areas (Figure 6.7). The most devastating cyclone that struck the Polder is *Aila* which was a furious cyclone of ever. Aila was a *Cat-1*(hurricane) cyclonic storm that hit on the mid-day of 25 May 2009 at the south-western coastline of Bangladesh especially Atchara and Khulna districts suffered the heaviest.

231. Aila made landfall with sustained winds between 65 and 75 mph (105 and 120 km/hr), it brought with it a deadly storm surge in between 10-13 feet high. This strong storm surge forced the embankment to breakdown at the vulnerable points and flooded the Polder areas. The surge water also entered the Polder by overtopping and breaching the embankment along Kobadak River and Sakbaria River at several locations.

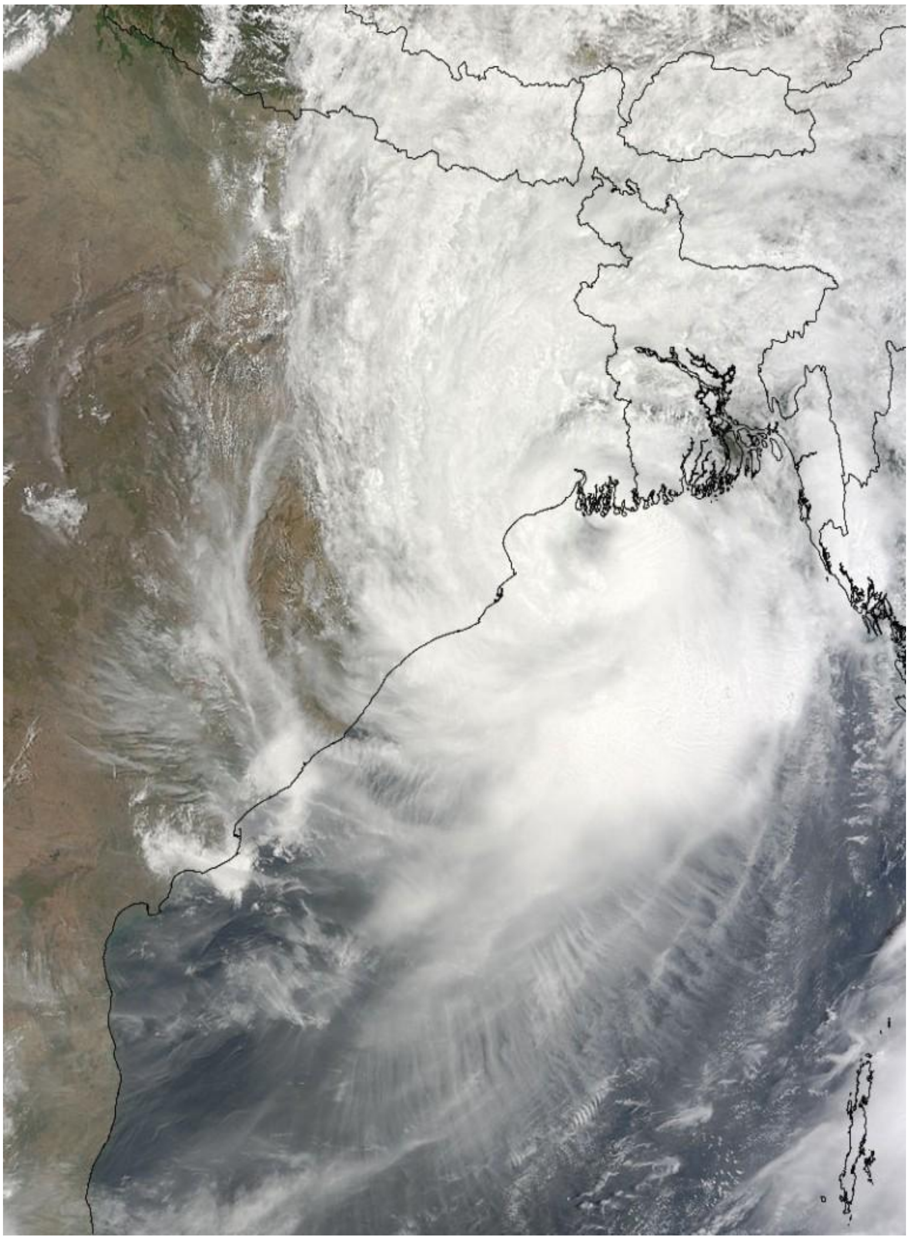


Figure 6.7: NASA's Terra satellite saw Aila on May 25, 2009 over India and Bangladesh (Image Credit: NASA/MODIS Rapid Response)

(b) Tidal Storm Surge Flooding

232. The flood control embankment of the Polder is 30.50 km.. Most of the segments of the embankment are in extremely vulnerable condition especially at *Uttar Bedkashi, Gazipara, Padmapukur, Horiharpur, Sakbaria, Dakshin Bedkashi, Choramukha, Maider char (Photograph 6.3) Matiabhanga, Golkhali (Photograph 6.4), Gharilal, Chhota Angtihara, Bara Angtihara, Angtihara, Jorshing,* and *Binapani* of the Polder. Local people opined that during high tide, surge water reaches at the edge of the present crest of the embankment and sometimes are overtopped. A number of segments in the embankment are now in the worst condition and it may be washed out if any strong storm occurs and the entire Polder area will be flooded. Moreover, about 85% of the flood control embankments is in vulnerable condition and are below the design section and the Polder area is under threat of any tropical cyclone and storm surge that may occur in the future.

Photograph 6.3: Worst condition of embankment near Maider char

Photograph 6.4: Vulnerable condition of embankment near Golkhali

233. Besides, there are numbers of unauthorized hand tube-wells (Photograph 6.5), installed at the crest of the embankment by the gher owners for lifting saline water from the rivers to satisfy water demand for shrimp culture. These unauthorized structures make the embankment weaker and increase the possibility of breaching through various points of the embankment during cyclone and high tidal surge.

Photograph 6.5: Vulnerable condition of embankment along Sakbaria river

Photograph 6.6: Hand tube-wells on the embankment caused damages

(c) Drainage Congestion and Water Logging

234. The local people opined that the existing drainage congestion and water logging problem is very nominal in the Polder area. There are only 4 numbers of drainage sluices in the Polder for the purpose of drainage. During field visit two numbers of the structures are found in fully damaged condition, one is in moderately functioning condition and another is newly constructed and still is not in operation.

235. During high tide, water enters into the Polder area through the above mentioned structures on the connecting khals. It is observed that about 85% of the Polder area has been converted to shrimp culture ghers. This shrimp culture practice started over three decades and stands throughout the year. Local people opined that, during monsoon drainage congestion takes place in the Polder area and takes 3 to 5 days to drain out the excess water.

236. There is a closure constructed on *Hajer Ali Khal* at *Patakhali* (Figure 6.8) whose width has been extended for the effect of Aila. *Hajer Ali Khal* has number of branches as it has to convey huge volume of water especially during monsoon and plays vital role in the drainage system of the Polder. At present, drainage congestion with minimum water logging takes places in the catchment area of the *Hajer Ali Khal*. The *North Ghorsing Khal* has also similar phenomena like the ***Hajer Ali khal***. Its width was also extended during Aila and conveys excess water during monsoon. Drainage sluice (DS-1) is connected with the *Khal*, which is completely damaged and needs to be replaced as per design and specifications of CEIP for smooth drainage. Consequently, additional new drainage sluices are required to be constructed adjacent the Patakhali closure connecting the catchment area of *Hajer Ali Khal*.

Figure 6.8: Extended Width of the Khals after Aila of the Polder 14/1

(d) Navigation

237. The peripheral rivers around the Polder are predominantly used for water-way navigation. Small boats and trawlers navigate through these rivers mainly for fishing and carrying goods. Many fishing boats navigate in the Sakbaria River and also enter the Sundarban for fishing and other various purposes (Photograph 6.7). Besides, there is a cargo vessel terminal in Sakbaria River near *Angtihara* Shipping police outpost (*Photograph 6.8*). The cargo vessels carry Fly-ash from India and halts here for Customs formalities. There is a navigation ghat of BIWTA (Photograph 6.9) in the Sakbaria River at Jorshing bazaar of the Polder. A very little navigation takes place inside the Polder area, only the fishing boats move through the khals inside the Polder.

Photograph 6.7: Fishing boat returning from Sundarban after fishing & collecting firewood

Photograph 6.8: Cargo terminal in Sakbaria River near Angtihara

Photograph 6.9: BIWTA navigation ghat at Jorshing bazar

6.1.6 Environmental Quality

238. This section provides a baseline scenario of air quality, water quality and noise level in the Polder area. The values of these environmental parameters were collected during field visit.

(a) Air Quality

239. The national standards for air quality are given in Table 6.6.

Table 6.6: Standards of ambient air quality

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

Source: Bangladesh National Ambient Air Quality Standard

240. The air particulates matter (APM) concentrations of the Polder area were measured by collecting PM samples on Teflon filters using an 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 Betbunia near *kheya ghat* in Paikgacha upazila which is situated about 27 km to the north of the Polder, representing the air quality for Polder 14/1 The results are presented in Table 6.7.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 6.7. However, there are numerous boats driven by diesel engines that ply on the surrounding rivers and numbers of motorcycles and light vehicles movement in the Polder area which is considered to be contributing to the ambient air especially to the relatively high measured value of Particulate Matter ($PM_{2.5}$).

Table 6.7: 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
Betbunia, Paikgacha	63.4	42.5	8.1	65.1	0.053

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

(b) Surface Water Quality

241. Five major water quality parameters (p^H, TDS, DO, temperature and salinity) were measured from different locations of the Polder area during major field investigation in January, 2016 (Photograph 6.10). Surface water quality of the Polder area is found satisfactory related to DoE standard except for EC, indicating slight saline conditions. Table 6.8 presents the values of the surface water quality with reference to the DoE standard of the Polder area.

Table 6.8: Surface water quality of the Polder area

Source of surface water	Location	GPS point	Water quality parameter				
			TDS (ppm)	Salinity (ppt)	DO (mg/L)	Temperature (°C)	p^H
Kobadak River	Kobadak forest station	22°13'6.49"N 89°18'32.04"E	322	15	6.6	21.9	8.0
Sakbaria River	Angtihara	22°13'3.41"N 89°20'30.88"E	338	15	7.6	20.4	8.1
Hajer Ali khal	Patakhali	22°14'44.65"N 89°20'13.75"E	223	14	6.2	21.5	8.0
North Ghorsing	Padmapukur	22°15'46.71"N 89°18'28.38"E	285	14	6.4	20.2	8.1
DoE Standard Value (Bangladesh)			***2100***	***-***	***4.5-8.0***	***20-30***	***6.0-9.0***

Source: CEGIS field survey, January, 2015

Photograph 6.10: CEGIS professional measuring water quality at field

242. Salinity. During monsoon the salinity levels are very low because of the increased amount of fresh water in the water bodies. The level of salinity starts increasing from January due to the reduction of upland discharge and reaches the peak in April and then starts decreasing again. Saline water intrudes the areas due to malfunctioning of water control structures causing interruption to agricultural practices.

243. In the dry season, the overall salinity levels both in soil and surface water are high and roughly about 60-70 percent of the Polder area is affected. This happens because of the following reasons: (i) about 60 percent of the Polder area is under *gher* culture, (ii) saline water enters through gher owners' inlets and (iii) malfunctioning of sluices. However in the month of January during field visit, the salinity value was found ranging from 14 to 15 ppt as shown in Table 6.8.

244. Dissolved Oxygen (DO) is an essential parameter for sustaining aquatic flora and fauna. Decrease in DO values below the critical level of 3 mg/L causes death of most fishe species and other aerobic aquatic organisms. The values of DO measured inside the Polder varies from 6.2 to 7.6 mg/L which complies with the DoE standards for irrigation and fisheries as well as aquatic vegetation.

245. $p^{H,}$ The hydrogen ion concentration of water is expressed by its p^{H} value. A pH value of 7 indicates the neutral condition, neither alkaline nor acidic. The p^{H} values found during field investigation are quite higher than the neutral zone (p^{H}=7) which indicates that water in these locations are alkaline in nature. All the pH values found in the surface water sources during field investigation is satisfactory compared with the DoE standard (p^{H} = 6 to 9).

246. The temperature of water bodies affects the fish habitats and their oxygen holding capacity. The temperature of the water bodies inside the Polder area was found to vary from 20.2°C to 22.7°C, which complies with DoE standard (20°C-30°C) for both irrigation and fish habitats.

247. Total Dissolved Solids (TDS), the values of TDS were found quite high inside the Polder area ranged between 223-338 mg/l (Table 6.9) because of low tidal water intrusion. TDS values during field visit were found to be within the limit and complies with DoE standard.

(c) Noise Quality

248. Seven suitable sites were selected within the Polder area for measurements of sound level, considering some land use criterion which areas would be affected by the activities generated during implementation of the project. The Environmental Conservation Rules 1997, of Department of Environment (DoE), Bangladesh has defined standard noise level as 50 dB

during day time for residential area. The Polder area has fallen under residential area category and the noise level values were found within the standard limit. The noise levels were measured during daytime. The values of noise level (location wise) are shown in Table 6.9.

Table 6.9: Daytime noise levels of the Polder area

Sl. No	Location	GPS Reading	Values (dB)	Area Category by ECR'97
1	Kobadak forest station	22°13'6.49"N 89°18'32.04"E	34.4	Residential area
2	Padmapukur	22°15'50.44"N 89°18'18.83"E	38.6	Residential area
3	Choramukha	22°14.00'52"N 89°18.00'4"E	42.5	Residential area
4	Uttar Bedkashi	22°16'50.33"N 89°19'28.41"E	40.6	Residential area
5	Gharilal	22°13'47.71"N 89°18'56.89"E	48.3	Residential area
6	Angtihara	22°13'3.41"N 89°20'30.88"E	36.4	Residential area
7	Jorshing	22°14'52.93"N 89°20'45.27"E	48.6	Residential area

Source: CEGIS field survey, November, 2015

6.2 Biological Environment

6.2.1 The Bio-ecological Zones

249. The Polder occupies the Bio-ecological zone 10 (Saline Tidal Floodplain) under the southwest zone of the country consisting brackish nature of vegetation and saline prone wetlands. This BEZ 10 extends over the coastal area of Khulna, Satkhira, Bagerhat, Jhalokathi and Barguna Districts that ecosystems are derived with tidal action. This zone has numerous tidal river and creeks and tidal flooding is prevented by embankments.

6.2.2 Ecosystem Diversity

250. Ecosystems of the coastal Polders vary with elevation from sea level, extent of tidal influences and interventions by human activities.

a. The Terrestrial Ecosystems

251. The terrestrial ecosystem of this Polder (14/1) is mainly categorized as: i) Homesteads, ii) Cropfields, and iii) Embankments.

252. Homestead is the major type of upland ecosystem that consists of maximum number of floral and faunal species. Settlement platforms of this area are usually placed along the banks of the internal khal or along the embankment. Vegetation of this ecosystem exists with low density and less of undergrowth flora. Wildlife population is also low due to lack of sufficient density and diversity of vegetation.

253. Crop field include rain-fed Aman paddy field (Photograph 6.13). Tiny homestead vegetable gardening is also found to some extent in all villages to meet the requirement of the household members. This ecosystem performs food supply for human as well as fodder for other animals. Details of cultivated crops are described in agricultural section of this report. Cropfield contains lowest diversity of vegetation.

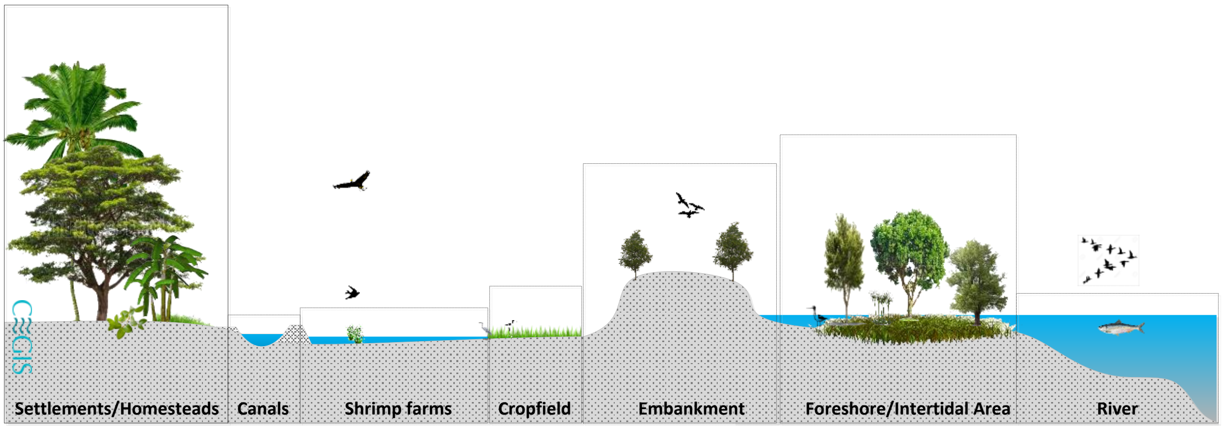


Figure 6.9: Typical Ecosystems of the Polder

254. Embankment is the isolator of foreshore and countryside habitats. Peripheral embankment of this Polder is mostly vegetation less (Photograph 6.11) due to low moisture holding capacity of soil and destruction of substantial part by cyclone Aila in 2009. Embankment of the Polder support grazing ground for local avifauna.

Photograph 6.11: Embankment vegetation

Photograph 6.12: Crop field vegetation

b. Aquatic Ecosystems

255. The major type of aquatic ecosystem is shrimp farms that occupy most of the agricultural land inside the Polder. This is actually a saline water wetland and is fragmented with numerous earthen dykes (Photograph 6.13). Water control structures provide flushing facilities to shrimp farms and allow saline water from the peripheral external rivers. There is no vegetation except one or two species of brackish grasses in shrimp farms. Few water-dependent avifauna like heron egrets, wagtails, sandpipers, etc., graze in shrimp farms. The embankment and fore-shore areas provide roosting habitat to the resident and migratory birds. Aquatic mammal like dolphins occur in the peripheral rivers.

256. The riverine ecosystem inside the Polder include canals, flows of which are controlled by sluice gates. Except large canals, most of the canals have been merged with shrimp farms and the habitats are without any free floating or rooted floating vegetations. Canals act as migratory routes of river fishes, other aquatic animals and canals levees support media for mangrove plant succession.

Photograph 6.13: Vegetation pattern of shrimp farms and settlement platform at Charamukha Village near Kobadak River that have been affected by tidal flood in 2009

257. Intertidal/foreshore area between peripheral embankment and river is inundated twice in a day and is occupied by scattered mangrove vegetation (Photograph 6.14). This mudflat usually face erosion and accretion mainly at the meandered reaches of Sakbaria and Kobadak River. This area creates ideal habitats for crabs, mudskippers, sandpipers and herons. Most of the foreshore area is now under plantation programme of Climate Resilient Ecosystems and Livelihood (CREL) Project. Foreshore vegetation act as protector of embankment from tidal surges, provides sanctuary to numerous invertebrate species and also acts as a nursery and spawning ground for many fishes.

Photograph 6.14: Embankment as a isolator of settlement and foreshore habitat showing vulnerablity by tidal surge at Golkhali village.

Table 6.10: Importance of Foreshore area for different wildlife groups

Wildlife Groups	Cause of dwelling
Birds	
Egrets	Nesting
Herons	Nesting
Bee eaters	Resting
Common Sandpiper	Nesting
Owls and owlets	Nesting
Kingfishers	Nesting and feeding

Wildlife Groups	Cause of dwelling
Sparrows	Resting
Wagtails	Resting
Sunbirds	Nesting and Feeding
Babblers	Resting
Starlings	Nesting
Reptiles	
Garden Lizard	Sheltering
Mammals	
Bats, flying fox and pipistrelle	Resting
Others	
Crabs, mudskippers, snails	Grazing, resting and feeding

Source: Field observation and reported by the elders peoples

6.2.3 Floral Composition

258. Land elevation and tidal influence regulate vegetation pattern of this Polder. The upland ecosystem as well as homestead vegetation is dominated by Coconut *(Cocos nucifera),* Date Palm *(Phoenix sylvestris),* Indian Lilac *(Azadichta indica),* and Sweet Igna *(Pithocelobium dulci)* **and** Rain Tree *(Albizia saman).* Except for tree species, homesteads are barren or lack undergrowth vegetation. Gewa *(Exoecharia agallocha)* tree is very common in homestead backyards near the embankment. Extreme drougtiness of surface soil in dry season and saline saturation of sub soil disfavour plant succession in homesteads. Hence, species richness and health of plant community are comparatively poor than other parts of the country. Vegetation density of this area have dropped down after initiation of saline water shrimp farming about 25 years back. In addition, all types of planted and natural undergrowth vegetation have been severely damaged due to failure of peripheral embankment as well as affect of tidal flooding by Cyclone Aila.

259. Major portion of embankment of the Polder is barren because of unsuitability of soil for growing plants. However, a strip of plantation along both side of the embankment at Padmapukur (Chainage within 7.00 - 9.00 km.) exists. This strip has been planted with invasive *Acacia sp* (locally called “Current Babla”). At south-western part of the embankment (Gharilal and Golkhali) the toes are vegetated with numerous Gewa *(Excoecaria agallocha)* saplings with not more than 3m height.

Table 6.11: Tree density on embankment slopes at different places of the Polder

Location Name	Species Name		Average Density per running 50m. single slope		Average DBH (cm.)
	Local	Scientific	Countryside	Riverside	
Sakbaria	Guiye Babla	*Acacia nilotica*	15	5	9
	Gewa	*Excoecaria agallocha*	50	120	3
Padmapukur	Guiye Babla	*Acacia nilotica*	2	0	8
	Current Babla	*Acacia sp*	320	250	4
	Gewa	*Excoecaria agallocha*	20	25	3
Matiabhanga Gharilal	Guiye Babla	*Acacia nilotica*	2	0	5
	Gewa	*Excoecaria agallocha*	530	300	4
	Sirish	*Albizia saman*	8	0	10
Golkhali	Gewa	*Excoecaria agallocha*	20	2	6
	Sirish	*Albizia saman*	5	0	15
Boro Angtihara	Gewa	*Excoecaria agallocha*	-	50	4
	Guiye Babla	*Acacia nilotica*	4	0	7
Jorshing	Gewa	*Excoecaria agallocha*	200	30	4

Note: DBH= Diameter at Breast Height, Source: CEGIS Field observation, Nov, 2015

260. Upper storey of foreshore area of this Polder is dominated by Kewra (***Sonneratia apetala***) and Bain (***Avicenia alba***) tree and lower storey by Dhanshi (***Proteresia*** sp.). Marginal ridges/ ecotones of foreshore is exclusively dominated by Gewa (***Excoecaria agallocha***).

261. Floral diversity in aquatic ecosystems is poor for alteration by saline water due to tidal surge. Homestead ponds and settlement burrow pits hold brackish water with low abundance of hyacinth *(Eichhornia crassipes)* and water cabbage *(Pistia stratiotes)* with scattered brackish grass *(Digitaria sanguinalis)*. Shrimp farms are also dominated by the same brackish grass species.

6.2.4 Wildlife Diversity

262. Wildlife occurrences of this Polder are concentrated mainly at homestead forest and foreshore vegetation. Common toad *(Bufo melanostictus)* is frequently found at moist and cool places of homesteads platforms. Snake population have drastically dropped down with reduction of vegetation coverage after introducing shrimp farming and saline water flooding by Cyclone Aila. Common Wolf snake *(Lycodon aulicus)* and Stripped Keelback *(Amphiesma stolatum)* are occasionally found in homestead platforms and also near water area. Garden Lizard *(Calotes versicolor)* and House Lizard *(Hemidactylus brooki)* are common among lizards. <u>According to field discussion, no evidence of turtles inside the Polder was recorded in the last 10 years</u>.

Photograph 6.15: Some Foreshore Ecosystem Dependent Avifauna of the Polder

263. Avifaunal groups represent highest numbers of faunal species among vertebrates of this Polder. Asian Pied Starling *(Sturnus contra)*, Common myna *(Acridotheres tristis)*, House Crow *(Corvus splendens),* House Sparrow *(Passer domesticus)*, etc., are common local birds usually occurring at homestead forest. Among the water birds, Great Egrets and Indian Grey Heron prefer large shrimp farms at the southern portions of the Polder. Three species of wagtails (i.e: White Wagtail, Grey Wagtail and Citrine Wagtail) have been sighted at foreshore mudflats and shrimp ghers near the peripheral rivers. Common Sandpiper and Black Winged

Stilt have also found roaming along newly accreted mudflats, riversides or even in shrimp farms.

264. Mammals in the Polder include mongoose, mouse and bats. No large mammals exist in the study area for lack of habitats. Common species are House rat *(Rattus rattus)*, Common mongoose *(Herpestes edwardsi)*, Indian flying fox *(Pteropus giganteus)* and Indian Pipistrelli *(Pipistrellus coromandra)* etc. Ganges River Dolphin *(Platanista gangetica)* migrates round the year through Kholpetua and Sakbaria River.

6.2.5 Existence of Important Habitat Surrounding the Polder

265. Polder 14/1 is isolated from Sundarban Reserve Forest by Sakbaria River to its eastern and south-eastern parts and by Arpangasia River to its south-western parts. Beside this, some small patches of mangrove plantations exist at different reaches of foreshore area of the Polder. <u>A foreshore wildlife sanctuary, declared by 9 No. Binapani Ward Disaster Management Committee exists close to the embankment chainage 20.00-21.00 km. at Daskhin Bedkashi village. This is a community conserved sanctuary (Photographs 6.17, and 6.18) but has no national or international designation, despite which it is locally important for the conservation of biodiversity.</u>

Photograph 6.17: Wildlife Sanctuary at Binapani

Photograph 6.18 Mangrove afforestation by CREL Project at Harirampur

Figure 6.10: Satellite Image Showing Location of Sundarbans Reserve Forest and Mangrove Plantation Areas

(Source: Google Earth, Image Date: Jan, 2015)

6.2.6 Indicative flora and fauna

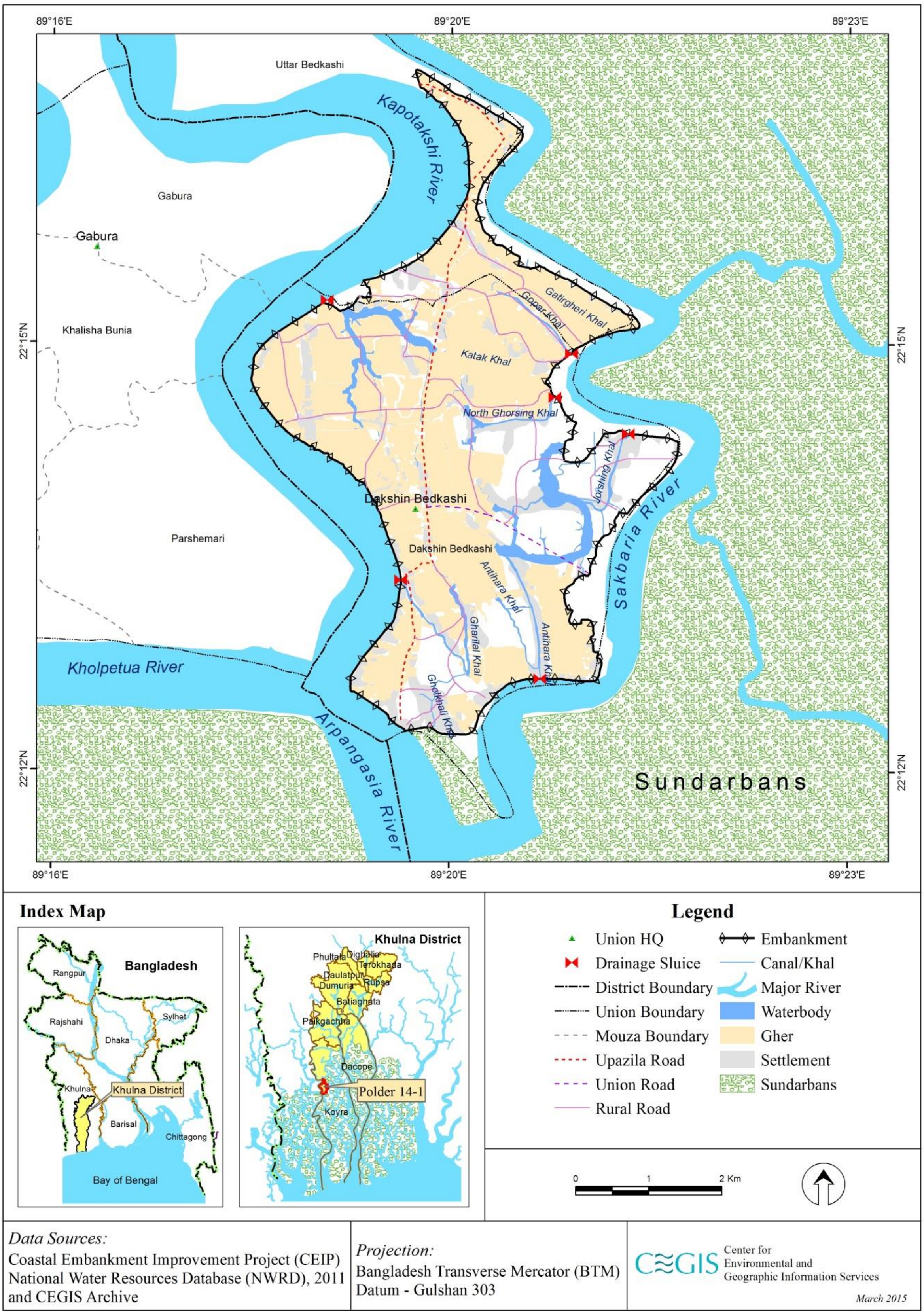
266. Encircled embankment of the Polder act as protector of saline water intrusion and sluices act as drainage controller. Accordingly, the land inside the Polder supports different ecosystems. Homesteads and cropfields are dominated with fresh water loving plant species whereas khal banks and river foreshore are dominated with saline water loving /mangrove plant species. Kewra *(Sonneratia apetala)* and Gewa *(Excoecaria agallocha)* are the indicator species of this Polder those indicating saline water intrusion through khals/canals inside the Polder. Though maximum open land of the Polder is occupied by saline water shrimp farms (*ghers*) and tidal water is allowed to enter inside the Polder in all seasons for flushing of *ghers,* as such succession of saline tolerant species are usually found in all the canal banks and at even some of the gher dykes in Golkhali, Gharilal and Angtihara. Freshwater molluscs (bivalve) is another indicator species of this area found in most of the homestead ponds of this Polder. The molluscs (bivalve) species have disappeared from this area due to washing by tidal flood during Cyclone Aila. Non-functionality of water control structures is also a cause for saline water intrusion that negatively impacts on homestead vegetation.

6.2.7 Fish Habitat

267. Fish habitats of the Polder area are classified into capture fisheries habitats and culture fisheries habitats. Capture fisheries habitat include mainly internal khals (Map 6.8). Among which *Gopar khal, North Ghorshing khal, Antihara khal, Katak khal, etc* are important in respect of fisheries habitat. There are some water bodies in the Polder area. These water bodies were created during Aila and linked with internal khals. The culture fishery of the Polder area is dominated by *Bagda Gher*. This type of *Gher* has occupied most of the cultivable area of the Polder. Very few numbers of cultured pond is reported in this area.

268. Although peripheral rivers and tidal floodplain influence fish migration as well as fish production inside the Polder, the peripheral rivers and tidal floodplain have not been considered in estimating fish production of the Polder area.

Fish Habitat Map: Polder 14/1, Koyra Upazila, Khulna



Map 6.8: Fish habitat in the study area

Capture fisheries

269. Fish habitat in the Polder area is 1,511 ha of which 130 ha is capture fish habitat (Table 6.12).

Table 6.12: Fish habitat status

Fishery Category	Habitat Type	Area (Ha)
Capture	Canal (*Khal*)	*130*
	Sub-Total	***130***
Culture	Bagda Gher	*1,338*
	Cultured pond	*8*
	Homestead pond	*35*
	Sub-Total	***1,381***
	Grand Total	**1,511**

Source: Image analysis and Field Survey, 2015

270. Average depth of internal canals is 1.5 to 2.5 m which is sufficient for fish habitation. Depth of seasonal canals of the Polder area is insufficient for sheltering fish juveniles due to excessive siltation on them. It is observed and learnt from the local people during field visit that *Aila* caused siltation in many canals due to breaching of embankment. On the other hand, heavy current water during Aila has formed large number of water bodies in many segment of canal inside the Polder.

(a) Perennial Canal (b) Seasonal Canal

Photograph 6.18: Open water fish habitat

Culture fisheries

271. The estimated culture fish habitat is 1,381 ha (Table 6.12) of which Bagda *Gher* is 1,338 ha. The *Gher* occupies 97% of total culture fish habitat followed by homestead pond and commercial pond. Although, every household have a pond but the size (5-10 dec) of which are small. The homestead ponds are mainly used as freshwater reservoir for domestic purposes. During field visit, local people informed that the water quality of pond is still saline after the *Aila*. Due to which, aquaculture practice is not expanding in the Polder area. Under such circumstance, many people have adopted various types of fish culture like mono, poly, and mix-culture in large ponds. Fish culture in homestead pond is traditional. Moreover, semi-intensive fish culture (Mono sex Tilapia) is being practiced in some of the ponds in west Haripur village of the Polder.

(a) Homestead pond (b) cultured pond

Photograph 6.19: Fish pond in the Polder area

Habitat Quality

Water Quality

272. Some parameters of the surface water quality of Periphery Rivers and khals related to fish habitat suitability have been measured and presented in Table 6.13. From the measured data, it is observed that all water quality parameters are within the permissible limit for fisheries resources. The salinity in water bodies (both internal and river) is nil.

Table 6.13: Water quality parameters of different water bodies in the Polder area

Water bodies	Parameters				
	Temp (ºC)	p^H	DO (mg/l)	TDS (ppm)	Salinity (ppt)
Kobadak River	21.9	8.0	6.6	322	15
Sakbaria River	20.4	8.1	7.6	-	15
Internal Khal	21.5	8.0	6.2	223	14
Standard values for fish	(28-34)**	(6.5-8.5)*	4.0-6.0*	1000*	(0-4) for prawn* and (5 -35) for shrimp**

Source: Field Survey (Date: 18/01/2016)

Role of Aquatic Vegetation for Fisheries

273. Aquatic vegetation play important role in the aquatic ecosystem. It provide important habitat for small animals like aquatic insects, snails and freshwater shrimp, which in turn supply food for fish and waterfowl. Different types of hydrophytes like emergent, submerged and floating with leafs are habitats and spawning ground of fish and for insects and crustaceans. In the wetland, some fishes lay eggs in the body of plants. Beside these, some fishes live on the rotten part of the aquatic plants (Khondker, 2004). During field visit, it is observed that natural water bodies in the Polder area is void of aquatic flora, such as free floating, submerged, sedges and meadows. The presence of salinity due to Aila has created such environment. Especially after devastating Aila, such situation has aggravated.

6.2.8 Fish Migration and Movement

274. The fishes migrate from river to Polder area through open and regulated khals during late June to August. Different khals like *Gopar khal, North Ghorshing khal, Antihara khal, Katak khal, etc.,* are used for migration and movement, and serve as sheltering ground for open

water fishes. Many fish species migrate horizontally to these water bodies as part of their life cycle. Peripheral rivers along with internal rivers and khals of the Polder area are silted up naturally and structures on the khals cause the reduction of the length of successive migration routes. Overall fish migration status is poor to moderate in the Polder area.

6.2.9 Fish Biodiversity

275. The study area is moderate in fish biodiversity and the biodiversity of open water fishes has a declining trend over the years. Local people reported that more than 70 numbers of fish species are available in the area. Most of the fishes are included in brackish water habitat. Brackish water fish species like *Koral/Vetki, and Parsha* are commonly found in the internal khals and Periphery Rivers. Local people reported that there is no fresh water fish species in the natural water bodies (khals) inside the Polder. Regular saltwater intrusion in the Polder area is a common phenomenon after saltwater intrusion has caused disappearance of fresh water fisheries from this area. Local people also reported that before Aila, plenty of fresh water fishes like *Koi, Shing, Magur, Puti, Taki, Shol,* etc., were found in natural water bodies. Recently, these species have become extinct locally. List showing the status of fishes of different habitat in the study area is presented in Table 6.14.

Photograph 6.20: Composition of Fish Catch of the Polder Area

Table 6.14: Status of Fish Species along with crustacean Diversity of Different Fish Habitats in the Study Area

Scientific Name	Local Name	Habitat type		
		Periphery River	Khal	Fish pond/Gher
Brackish Fish Species				
Plotosus lineatus	Kani Magur	L	L	NA
Lates calcarifer	Koral/Bhetki	H	M	M
Otolithes argentatus	Sada Poa	L	NA	NA
Liza parsia	Pairsa	H	M	M
Liza tade	Bata mach	M	L	L
Rhinomugil corsula	Khorsola	M	L	L
Mystus gulio	Tengra	M	M	L
Polynemous paradiseus	Tapasi / Muni	L	L	NA
Sillaginopsis panijus	Tolar dandi	H	L	NA
Arthropods/Crustaceans				
Scylla serrata	Kankra	H	H	NA

Scientific Name	Local Name	Habitat type		
		Periphery River	Khal	Fish pond/Gher
Macrobrachium rosenbergii	Golda chingri	NA	NA	L (gher)
Metapenaeus monoceros	Horina chingri	H	L	NA
Penaeus monodon	Bagda chingri	M	L	H
Culture Fish Species				
Telapia mossambica	Telapia	NA	NA	H
Hypophthalmichthys molitrix	Silver Carp	NA	NA	H
Puntius suchi	Sharputi	NA	NA	H
Ctenopharyngodon idellus	Grass Carp	NA	NA	M
Catla catla	Catla	NA	NA	M
Labeo rohita	Rui	NA	NA	M
Cirrhina mrigala	Mrigel	NA	NA	M

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

276. *Bagda* is dominant culture shellfish/crustacean in the Polder area. About 85% of net cultivable area has been converted into ghers where only *bagda chingri* is cultured commercially round the year. It may be mentioned here that *Vetki, Pairsa* and *Khorsola* are also cultured commercially in the ghers. Pond culture fish species mainly include *Tilapia, Sarputi, Silver carp* and *Grass carp,* etc. Besides, carp fish species like *Rui, Catla, Mrigel* are also cultured in both homestead and commercial ponds. The productivity of carp fishes in the ponds is very low due to presence of salinity in pond water.

6.2.10 Indicative Fish Species

277. Among the fish species found in the study area mentioned above, the major indicative and migratory fish species are Kaine Magur (*Plotosus canius*), considered near threatened by IUCN, Bangladesh; Bhetki (*Lates calcarifer*), not evaluated; Parshe (*Liza Parsia*), not evaluated and Guli Tengra (*Mystus gulio*), near threatened. These species generally live in the brackish to saline water but for spawning they enter 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 6.7**). Usually these fishes enter into the Polder with the tide in drifting mode of migration during the life stages of hatchling to fry.

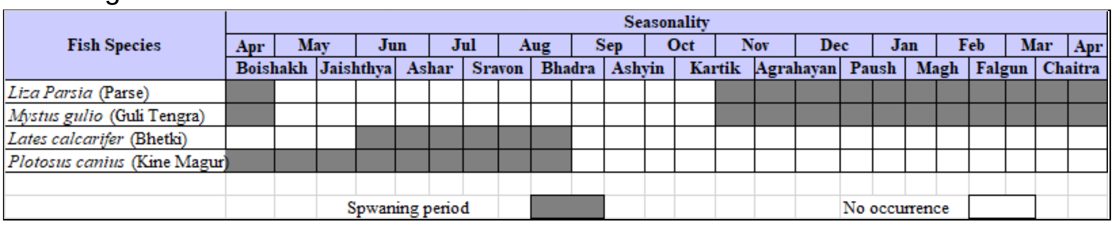


Figure 6.11: Seasonality of fish spawning

Table 6.15: Movement speed or velocity of indicative fish species

Fish Species	Habitat Type	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*

6.3 Human and Economic Development

6.3.1 Fish Production

278. The estimated total fish production of the Polder area is 1,260 metric tons (Table 6.16). Most of the fish production (about 99%) is from culture fisheries and and very less (1%)from the capture fisheries. *Bagda Gher* comprises 95% of total production followed by homestead pond, commercial pond and khal. Fish production trend of the capture fishery in the Polder area is decreasing due to indiscriminate fishing by illegal nets, siltation and low water flow in the internal khals, obstruction of fish migration, salt water intrusion throughout the year for mal-function of water control structures, etc.

Table 6.16: Fish Production from Different Habitats of the Polder Area

Fishery Category	Habitat type	Habitat Area (Ha)	Production (Ton)
Capture	Khal	130	14
	Sub-Total	***130***	**14**
Culture	Bagda Gher	*1,338*	1,204
	Commercial pond	*8*	19
	Homestead pond	*35*	23
	Sub-Total	***1,381***	**1,246**
	Grand Total	**1,511**	**1,260**

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

Fishers Number

279. The fisher's households in the Polder area include commercial and subsistence fishers. Local people reported that about 80% of the households of the Polder are fishers. Among which, 70% households of the total fishers are engaged as professional / commercial fishers and they spend almost 12 hours of a day and 8 to 10 months of a year in fishing activities. The commercial fishers catch fish in the Periphery Rivers, Sundarbans and deep sea for a long time. Remaining 30% are subsistence level fishers. Local fishers informed that about 20% fishers have changed their occupation due to regular attack of robbers. According to field visit, it is learnt that 60% fishers are Muslim and 40% practice Hindu religion. There is no specific "Fisher's village" in the Polder area.

280. The socio-economic condition of the commercial fisher is poor to moderate and most of them have fishing nets and trawlers/boats. The seasonal vulnerability of the fishers in the Polder area starts from late November and continues upto April of the following year. During this period, fish catch is hardly recorded due to the presence of excess salinity in the surrounding water bodies (e.g., rivers and khals). Many fishers are involved in collecting shrimp fry (*Bagda Pona*) from the peripheral rivers. Some of the fishers maintain their livelihood through day labor (working in gher) or migrate outside the Polder looking for short-term jobs.

Fishing Season

281. Fishing season in the Polder area starts from April / May and continues up to December. Most of the fish catch by different gears occur during late June to Mid November. The seasonality of major fishery and gear type is furnished in the Table 6.17.

Table 6.17: Fishing Seasonality of the Polder Area

Type of Gear	Seasonality																							
	Apr	May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr
	Boishakh		Jaishthya		Ashar		Sravon		Bhadra		Ashyin		Kartik		Agrahayan		Paush		Magh		Falgun		Chaitra	
Current jal (Gill net)	Low	Low	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Low	Low
Net jal	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Bhadai/Bendi jal	Low	Low	High	High	High	High	High	High	High	High	High	High	Low	Low	Low	Low	Low	Low	High	High	High	High	Low	Low
Jhaki jal	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium	High	High	High	High	High	High	High	High	Medium	Medium	Medium	Medium	Low	Low	Low	Low

High: dark shading; Medium: medium shading; Low: light shading; No occurrence: no shading

Source: Field Survey, 2015

Fishing Crafts and Location

282. The commercial fishers of the Polder area catch fish in the peripheral rivers and internal *khals* by using both mechanized and traditional boats including *Jala Nouka* and *Kusha, Dingi* fishing boats, etc. Fishing *Boats* in the Polder area is shown in the following Photograph 6.19.

Photograph 6.21: Fishing boat in the study area

Fishing Gear and Target Fish Species

283. Different types of nets/gear are used for fishing as mentioned in Table 6.17. Of the fishing gear,(a) Mono-filament gill net, locally known as *Current Jal* is used to catch hilsa; (b) Seine net (Ber jal/bendi jal) is used to catch all types of small and big fishes; (c) Cast net, locally known as *Jhaki jal* is used to catch *puti, chingri, tengra,* etc. (d) Cast net, locally known as *Net jal* is used at the mouth of regulators to catch *tengra, chingri, pairsa, vetki* and other small fishes. Around 80% fishers have fishing gears/nets. Jhaki jal (cast net) is a common traditional fishing gear and is used in all water bodies in the Polder area.

Photograph 6.22: Common Cast Net (J*aki Jhal*) in the Polder area

6.3.2 Fish Marketing and Post Harvest Facilities

284. The local fishers sell bulk of their catch either directly to the local fish market or to fish depot. There are about 8 (eight) depot in the Polder area. There is no specific fish market (*arat*) in this area. No structured fish landing centers are found in the area. Local fishers use Jhorong Launch ghat as temporary fish landing center. There is no ice factory in the Polder area. Ice for fish preservation is collected from the *Koyra* Bazar. Disease is the main restraining factor for the development of shrimp farming in the Polder area. Most of the gher farms face disease problems every year. Local *Gher* farmers reported that such type of disease is seen from mid March and continues up to May. There is no such improved fish drying industries in the Polder area. But local fishers dry fish especially *Chring* through smoking process (traditional way) which is locally called *Khoti*. There are seven *Khoti* in the Polder areas which are located at the *Golkhali* and *Jhorshin*g villages near the periphery of embankment.

6.3.3 Fisheries Management

285. There are two government registered fisherman association (*Matshyajibi Somitte*) in the Polder area. The activities of the associations are to organize the fishermen and to remove their internal collision and to protect them from the robbers. The fishermen have full access to fishing on existing fish habitats. There are two leased water bodies in the Polder. These water bodies have been formed during Aila. Upazila Nirbahi Officer (UNO) has leased these water bodies to the Community Based Fisheries Organization (CBFO). Real fishermen could not bid for leasing the water bodies in favor of them due to lack of money, local elites in the name of fishermen association get bid and control the water bodies. Under such circumstances, local fishers have no access to catch fish in the leased area. Department of Fisheries (DoF) has limited activities for fisheries resource conservation and management in this area. Some NGOs are working, but they are very much limited to micro credit rather than extension

services and aquaculture training. It is to be mentioned here that, Muslim Relief Bangladesh - a non-government organization helped the Aila affected fishermen through cash or by providing net/boat for their rehabilitation. Enforcement of fisheries regulation is weak in and outside the Polder area.

6.3.4 Agriculture farming Practices

286. Farming practices in the Polder area are largely controlled by physical, biological, climatological and socio-economic factors. There are two distinct cropping seasons in a year. They are *Kharif* and *Rabi* seasons. The *Kharif* season is from March to October while the *Rabi* season starts from November to February. Based on crop adaptability and crop culture, the *Kharif* season is further sub-divided into the *Kharif-I* (March-June) and the *Kharif-II* (July-October) seasons.

287. 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. In this season, none of the crops are grown in the Polder area.

288. The *Kharif-II* season is characterized by high rainfalls, lower temperatures, high humidity, low solar radiation and high floods that recede towards the end of the season. Rice is the predominant crop grown during this season due to the submergence of soil. Excessive soil moisture also restricts other crops suitable for a high temperature regime. High Yielding Varieties of Transplanted Aman (HYV Aman) and local T. Aman rice are grown in the *Kharif-II* season.

289. In the *Rabi* season, only Hybrid Boro rice is grown in the Polder area. However, there are occasional overlaps such that the *Kharif-II* season crop of Aman rice is harvested in Rabi season.

6.3.5 Present Cropping Patterns and Intensity

290. The presnnt cropping pattern is the proportion of area under various crops at a point of as it changes over space and time. The selection of crops and their varieties is to be made depending on the soil and rain fall situation in the rainfed areas. The dominant cropping pattern in the medium high land is Fallow-HYV Aman-Fallow which occupies about 51% of the NCA. Detailed cropping patterns by land type are presented in Table 6.18.

291. Cropping intensity is the number of times a crop is planted per year in a given agricultural area. It is the ratio of effective crop area harvested to the physical area.

Table 6.18: Detailed cropping patterns by land type in the Polder area

Land type	Kharif-I(March-June)	Kharif-II(July-October)	Rabi(November-February)	Area(ha)	% of NCA
Medium High land	Fallow	HYV Aman	Hybrid/Boro	109	30
	Fallow	HYV Aman	Fallow	186	51
	Fallow	Lt.Aman	Fallow	67	19
Total				**362**	**100**
Cropping intensity = **130%**					

Sources: CEGIS Assessment from field information and DAE, November; 2015;

Photograph 6.23: Aman rice field in the Polder area

Photograph 6.24: Aman rice harvesting in the Polder area

Cropping intensity

292. Total cropped area is 470 ha of which the coverage of rice is 100%. Cropping intensity of the Polder is about 130%. Varieties of crops, grown in the Polder area, are presented in the Table 6.19.

Table 6.19: Varieties cultivated in the study area

Crop	Varieties
Lt. Aman	➢ *Patnai, Takshal* and *Moriceshail*
HYV Aman	BR 11, BR 23, BRRI dhan 49, BRRI dhan51, BRRI dhan52
Hybrid Boro	Not Known

Sources: Field survey, November; 2015 and secondary data from local SAAO, DAE.

6.3.6 Cropped area, Yield and Production

293. Detailed cropped area, crop production and yield rate are presented in Table 6.20.

Cropped Area

294. Total cropped area is 470 ha which is occupied by only rice. Aman rice are commonly grown in the *Gholkhali, Boro Antihara, Choto Antihara, Jorshing* and Boro rice is grown in *Boro Antihara, Choto Antihara, Jorshingin* the Polder area. Detailed cropped area presented in the Table 6.20.

Crop Production

295. Total crop production in the Polder area is 1,572 metric tons which is produced only from the rice crop (Table 6.7). Among the rice crops the contributions of HYV Aman is dominant. Details are presented in Table 6.20.

Table 6.20: Present Cropped area, Yield and Production

Crop name	Crop area (ha)	Yield (m. tons/ha)	Production (m. tons)
Lt. Aman	67	2.01*	135
HYV Aman	295	3.02*	888
Hybrid Boro	109	5.03*	549
Total	**471**	**0**	**1,572**

*Sources: CEGIS estimation based on field information and DAE, October; 2015 * Indicates cleaned rice*

Crop Calendar

296. The detailed crop calendar of different crops of the study area is presented in Figure 6.12. It is observed that the raising of seedlings generally starts in mid June to mid August and transplanting starts in mid August and continues up to September depending on rainfall in the transplanted Aman field. Transplanted Aus generally starts from late March and continues till mid May. HYV Boro crops are transplanted during end December to end January.

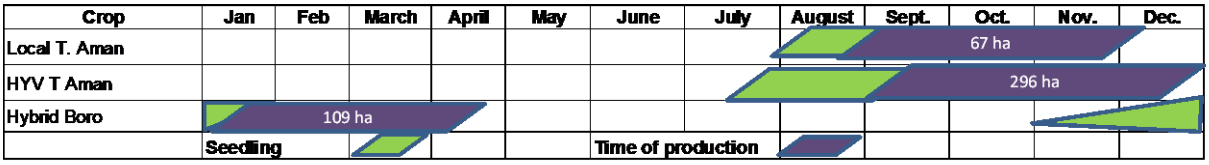


Figure 6.12 : Existing Cropping season of the study area

Crop Damage

297. The scenarios of crop damage during 2010-2015 is presented in Table 6.20. About 20% field crops (Lt. Aman) were damaged in the year 2010 by natural calamities (heavy rainfall). The damage of HYV Aman rice gradually increased from 2012 to 2015 due to salinity. Salinity problem in Gholkhali, Boro Antihara and *Choto Antihara* villages is increasing with time due to increasing of fish farming specially shrimp culture (shrimp culture need saline water). The damage caused by pest has now been controlled by the farmers using pesticide and ICM. Detailed data on crop damage is presented in Table 6.21.

Table 6.21*:* Crop area damaged by different means and losses during 2010-2015

Sl No.	Crops	Damage (%)	Year	Reason of damage
1	Lt. Aman	15	2015	Pests
	HYV Aman	15	2015	Salinity
	Hybrid Boro	5	2015	Pests
2	Lt. Aman	12	2014	Pests
	HYV Aman	12	2014	Salinity
	Hybrid Boro	5	2014	Pests
3	Lt. Aman	15	2013	Pests
	HYV Aman	10	2013	Salinity
	Hybrid Boro	7	2013	Pests
4	Lt. Aman	15	2012	Pests
	HYV Aman	15	2012	Pests
5	Lt. Aman	15	2011	Pests
	HYV Aman	10	2011	Pests
6	Lt. Aman	20	2010	Heavy rainfall (Water logging)
	HYV Aman	25	2010	Heavy rainfall (Water logging)

Sources: CEGIS estimation based on field information and DAE, November; 2015

6.3.7 Agricultural Inputs

Seeds

298. Good quality *seeds* are essential to grow a strong and healthy crop. Healthy *seeds* can be bought from trusted sources or farmers can produce their own *seeds for high germination rate as well as good production*. In that case, *seed selection* can be used to improve the quality of *seeds*. In the Polder area most of the farmers used their own seeds in case of Lt. Aman and HYV Aman but hybrid Boro Rice and some HYV Aman seeds are provided by different seed companies. There are six private seed dealers in the Polder area. In most cases, the farmers do not follow the recommended dose of seed.

Fertilizers

299. Fertilizer is a vital input for crop production and use of optimum dose is very important for gaining expected yield. The fertilizer dose per hectare varies from land to land depending on soil fertility, crop cultivars, cropping pattern. All kinds of chemical fertilizers are not available with local dealers and prices are very high. The farmers of the Polder used chemical fertilizers such as Urea, TSP, MP and Gypsum (for neutralizing the salinity) in different crops. They don't consider the recommended dose and other factors of fertilizer application. Urea is highly used than other chemical fertilizers. Farmers do not use organic manure or compost (Table 6.22).

Table 6.22: Fertilizer, Pesticide and Seed used in Polder 14/1

Crops	Seeds used / ha (kg)	Fertilizer dose (Kg/ha)					Manure (cow dung compost)	Irrigation cost /ha (Tk) Diesel operated	Pesticide (ha/Tk)	Used cultivation equipments (%)	Cost power tiller
		Urea	TSP	MP	Gypsum	Zinc					
Lt. Aman	60	113	75	40	0	8	0	0	700 - 800	90	4,500
HYV Aman	45	188	113	75	0	15	0	0	1,000 - 1,200	90	4,500
Hybrid Boro	15	225	135	115	0	15	0	18,750	1,200 - 1,500	90	4,500

Sources: Field information; November 2015

Pesticides

300. The use of pesticides depends on the degree of pest infestation. All farmers (100%) apply pesticides in all crops such as T. Aman (HYV) and Hybrid Boro Rice. The farmers of the Polder apply pesticides in all crops for two or three and more times. They use pesticides in underdose or overdose and do not maintain any timing in application. The major insects as reported by the farmers were Yellow stem borer, Brown plant hopper, Rice bug and Ear-cutting cater pillar, etc. Local farmers reported that they use different types of pesticides such as Kartap, Fortunate, Amithrin, Korazan and Ultima plus, etc., to prevent pest infestation in crop field.

Integrated Crop Management (ICM)

301. In the project area farmers are newly practicing ICM about 10% of the crop cultivated area in the field. ICM activities are implemented by the Department of Agricultural Extension (DAE).. DAE is an agency responsible for agricultural crop production through reduced dependence on agro-chemicals.

Labor for Agriculture

302. Labor is one of the most important inputs in agricultural production. In the Polder area, without tillage most of the cultural practices for crop production are being made manually by the labor. The labor requirement and their wages are not equal throughout the year. The number of labor requirement varies from crop to crop. The average numbers of labors used in the Polder area is presented in Table 6.23.

Table 6.23: Average numbers of Labors used in the Polder Area

Sl. No.	Crop name	Labor (No/ha)
1	Lt. Aman	150
2	HYV Aman	160
3	Hybrid Boro	170

Source: CEGIS Assessment from field information, November 2015

Irrigation

303. Irrigation is mainly provided in HYV Boro crops in the Polder area. Irrigation coverage is about 37% of the NCA during dry season. Surface water is being used for irrigation. *Antihara Khal, Sadderter Khal, Jorshing Khal,* and *Hajer Ali Khal* are the main sources of surface water irrigation. Low Lift Pumps (LLP) is used for lifting water for irrigation. Farmers also use STW, Seuti, Dom, etc., which cover only 10% of the irrigation land. The availability of irrigation water has been declining due to siltation of the river and *Khals*. *Khals* are also added to the *Gher* which reduced the irrigation facilities. Aman (Local) and HYV Aman are cultivated under rainfed condition. Detailed of coverage area by irrigation is given in Table 6.24.

Table 6.24: Irrigational implement used in the Polder area

Sl. No.	Crop name	Irrigational Implement	Area (ha)
1	Hybrid Boro	Low Lift Pump (LLP)	120
2	Hybrid Boro	STW	10
3	Hybrid Boro	Seuti, Dom	5

Source: CEGIS Assessment from field information, November 2015

6.3.8 Livestock and Poultry

304. Livestock and poultry, being essential elements of an integrated farming system, play an important role in the economy of the Polder area. They providefood, income, employment and many other contributions to rural development. Livestock provide significant draft power for cultivation, threshing and crushing of oil seeds; cow dung is a source of manure and fuel; a ready source of funds and meat, milk and eggs for human consumption. Most of the households raise poultry and livestock, a practice that significantly reduce poverty through generating income and employment. The numbers of livestock and poultry in the Polder area are presented in Table 6.25.

Table 6.25: Number of Livestock and Poultry

Name of Livestock and Poultry	% of HH having Livestock/Poultry	Number of Livestock/poultry
Cow/Bullock	15	1,150
Goat	40	6,134
Sheep	4	920
Duck	70	18,787
Chicken	80	15,336

Sources: CEGIS Assessment based on field information and DLS, November; 2015

Fodder

305. The owners of the livestock population are facing problems with respect to non-availability of fodder and feeds during the months starting from July to November due to unavailability of grazing land and salinity problem. Rice straw is the main fodder, oil cake, bran, grass, etc., are other common fodders in this Polder area which are brought by the farmers as per their need. The poultry population at family level survives by scavenging and generally no feed supplements are provided. However, at times kitchen wastes become feed to the chicken and duck take their feed from outside of the homestead area like ghers, ponds, canals, etc.

Photograph 6.25: Duck Rearing in the Polder Area

Photograph 6.26: Goat Rearing in the Polder Area

Diseases

306. Productions of livestock and poultry are mainly constrained due to diseases and death of the population. Outbreak of disease causes a considerable economic loss in livestock farming. Every year 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 cows, goats and sheep.

6.4 Socio-cultural Environment

307. The socio-economic condition of the people living in 'Polder 14/1 has been narrated in this section. In doing so, primary data were collected using a range of RRA techniques including Key Informant Interview (KII), Focus Group Discussion (FGD), observation and unstructured interview. Moreover, relevant secondary information was compiled from the community series of the Population Census 2011 published by Bangladesh Bureau of Statistics (BBS) and from different reliable sources.

6.4.1 Area and Location

308. The Polder 14/1 is situated in Koyra Upazila under Khulna District. The Polder area encloses two Unions namely Dakshin Bedkashi and Uttar Bedkashi. Percentages of Union boundary are shown in Table 6.26.

Table 6.26: Upazila and unions in Polder 14/1

Name of District	Name of Upazila	Name of Unions	Percentage of Union within Polder
Khulna	Koyra	Dakshin Bedkashi	86
		Uttar Bedkashi	14

Source: Spatial GIS Analysis, CEGIS, 2015

6.4.2 Demography

309. The 3,834 households living in the Polder area have a total population of 16,468 of which 8,214 are male and 8,254 are female (BBS 2011). The female population is little higher than the male population. The demographic data of this Polder is presented in Table 6.27.

Table 6.27: Demographic Information

Households	Population			Sex ratio	Population density (per sq.km)
	Total	Male	Female		
3,834	16,468	8,214	8,254	99	1,046
	100 (%)	50(%)	50(%)		

Source: Population Census 2011, BBS

310. The average density of the population in the Polder 14/1 is 1,046 persons per sq. km while the national population density is 1,015 persons per sq. km. The inhabitants of this Polder belong to two main religious groups; i.e. the Muslim and Hindu. About 80.66% of total populations are Muslims and 19.32% are Hindus and the rest (0.02%) are Christian. The national sex ratio is 100 whereas the studied area is 99, which is slightly lower than that of the national level.

311. The population growth rate of Bangladesh is 1.37 (BBS, 2015). Considering a linear growth rate, it is distributed in 4 year (2011-2014). This calculation attempts to show the power of human numbers to grow exponentially, like the proverbial penny in a savings account that yields millions in interest after a thousand years. Culture, infant mortality, quality of health care, life expectancy, availability of birth control, illiteracy, education, war and pestilence all effect growth, but for the sake of simplicity this calculation[4] assumes consistent growth. Study area population has been calculated with the number of baseline population. Applying this method, in the year 2015 the total population is 17,389 in which 8,674 are male and 8,715 are females and 4,048 total households. The demographic data of this Polder for the year 2015 is presented in Table 6.28.

Table 6.28: The Demographic Data of the Polder-14/1

Households	Population			Sex ratio	Population density
	Total	Male	Female		
4,048	17,389	8,674	8,715	104	1104
	100%	49.87%	50.12%		

Source: Population Census 2011, BBS and Population estimation for the year 2015, CEGIS

312. *Munda*, the only ethnic community, is living within the study area for 12/15 years. There are 14 *Munda* households in the village of *Zorshing*, 6 households in *Binapani* and a few households in *Angthihara* and *Horiyarpur* village. Photograph 6.27 shows *Munda* people and housing structure of the Polder area.

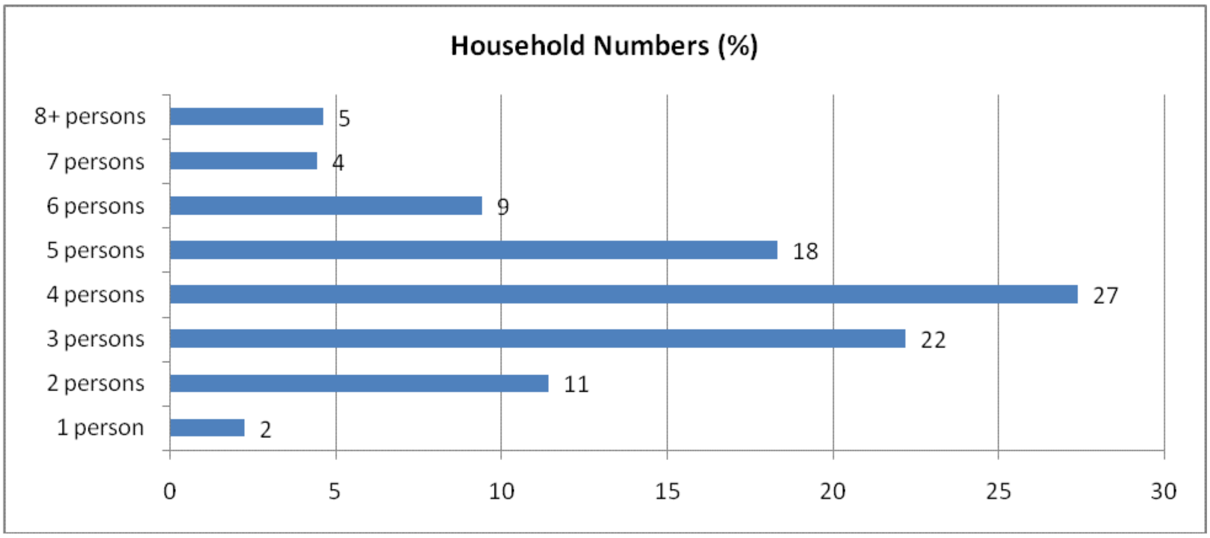
[4]The formula to calculate a growth rate given a beginning and ending (Estimated Population) population is: $Pop_{Future} = Pop_{Present}(1+r)^n$

Where:

Pop_{Future} = Future Population, $Pop_{Present}$ = Present Population, r = Growth Rate and n = Number of Years

Photograph 6.27: Munda People of the Area

313. The size of households in Bangladesh continues its long term decline, with an average of 4.4 persons per household in 2011, compared to 4.8 in 2001 and 5.5 in 1991. In the overall study area, it is found that households' distribution by number of persons is almost same as the national scenario of 4.2 where the highest percentage (27.4%) of household comprises of 4 persons in each. The distribution of household members is presented in Figure 6.11.

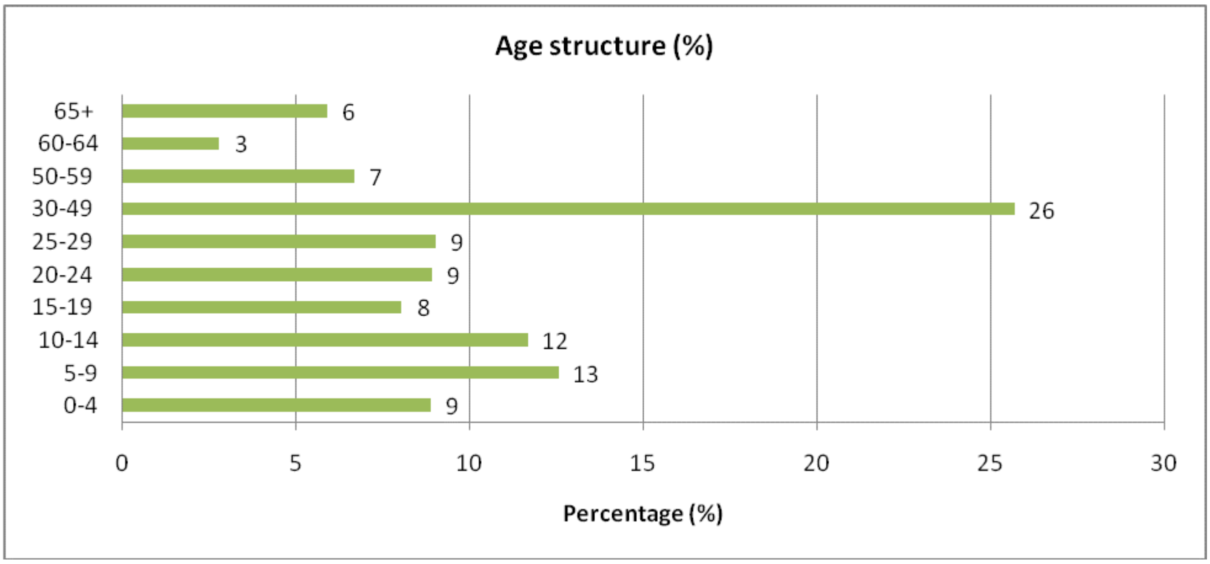


Sources: Housing and Population Census, BBS, 2011

Figure 6.12: Distribution of Households Comprising Member in Each

6.4.3 Age Structure

314. With respect to age structure in Polder 14/1about 25.66% belong to age category of 30 to 49 years old. About 3% and 6% people are in 60-64 and 65+ year's category respectively which is presented, according to Housing and Population Census, BBS 2011, in Figure 6.13.



Sources: Housing and Population Census, BBS, 2011

Figure 6.13: Age Structure of the Studied People

315. Age groups of 0 to 14 years is defined as children, 15 to 24 years as early working age, 25 to 54 years as prime working age, 55 to 64 years as mature working age and 65 years and over as elderly people (source: World Fact Book, CIA[5]). This classification is important as the size of young population (under age 15) would need more investment in schools, while size of older populations (ages 65 and over) would call for more investment in the health sector.

316. The percentage of the (potentially) active working population in the age group of 15-64 is 65%. Unfortunately, the huge active working population suffers under a severe unemployment problem, which made almost one-third of them under poverty line. The categorical distribution of age structure according to *Housing and Population Census, BBS 2011* is presented in Figure 6.14.

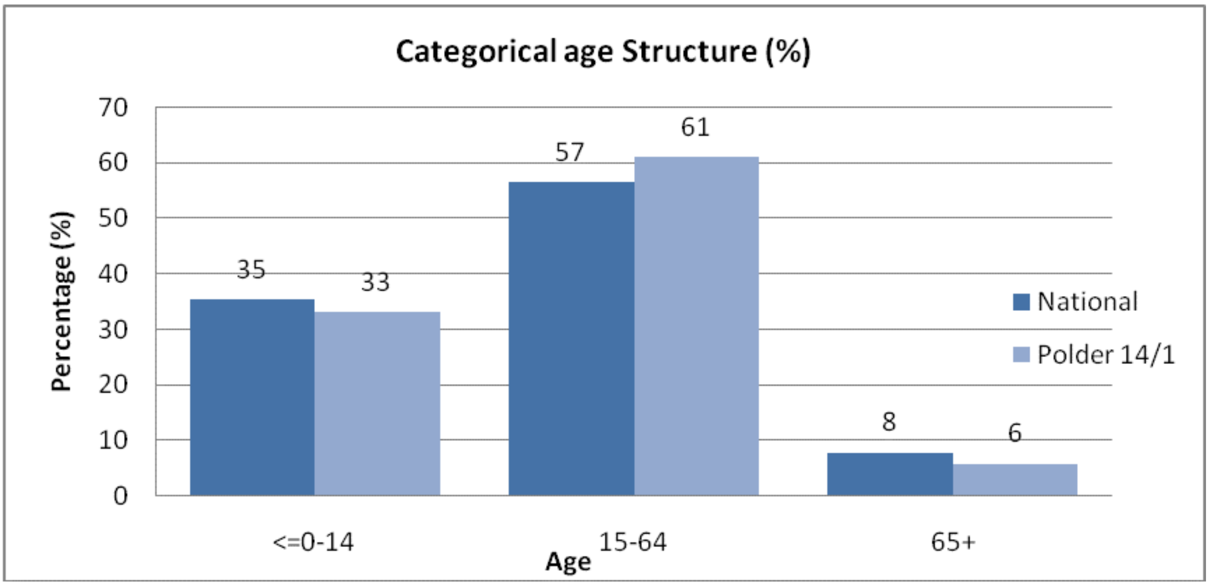


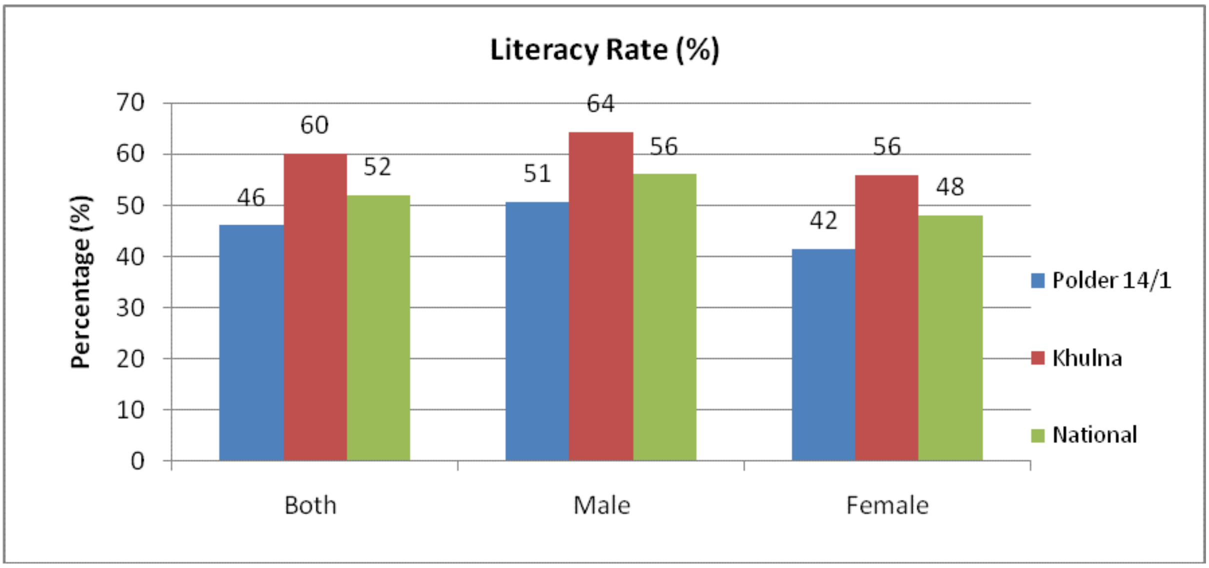
Figure 6.14: Categorical distribution of studied population

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

317. There is a small percentage (7%) of people 65 years and above. The categorization is made on the basis of ILO reference for opting out potential labor force and dependent population. Population of 15 to 64 years category is considered as labor force whereas, populations below 14 years and above 65 years are considered as dependent. Thus, the total dependency ratio[6] is about 64 in which child dependency ratio[7] is 54 and aged dependency ratio[8] is 10. It illustrates that total 64 persons are dependent on 100 labor forces in which 54 are children and 10 are elderly people.

6.4.4 Education

318. The literacy rate, based on the definition "ability to write a letter in any language" is 46%, where for male it accounts to 51% and female 42%. The rate of literacy reported above is for population of 7 years and over ages (Figure 6.15). Data confirms that like the national population of Bangladesh (Male 54.1% and Female 49.4%), the male populations are more educated than the female counterpart in the study area.



Source: Population Census, BBS 2011

Figure 6.15: Literacy rate Amang the studied population

319. Field investigation show that there are 13 primary schools, 3 high schools and 4 Ebtedaye/ Dakhil Madrashas in the study area. There are girls' high schools among the three high school, but there is no college in the Polder area. *(Source: CEGIS field work, 2015).*

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

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

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

Photograph 6.28: Local educational institution at Polder area

Source: CEGIS fieldwork, 2015

6.4.5 Access to Health Service

320. Access to health services and facilities refer to availability and adequacy of supply, affordability, physical accessibility and socio-cultural acceptability. Field data shows that there is a community clinic, a union family welfare center and 13 pharmacies in the study area. But there is no private clinic/hospital or Upazila Health Complex (UHC). Therefore, a substantial pattern tends to receive services from local chemist and/or village trained physicians. Most of the people of the area also receive treatment from nearby Sadar Upazila (Koyra Upazila) Health complex and Jaygir Mohol Hospital at the time of serious health problems. However, the economically well-to-do people receive treatment from nearby private clinics.

321. It is found that nearly 44% people receive health services from quack doctors and informal treatment systems, 17% from paramedic/ diploma physicians and only 3% from trained doctor. Vast proportion of population (36%) receives no treatment facility due to their impoverishment.

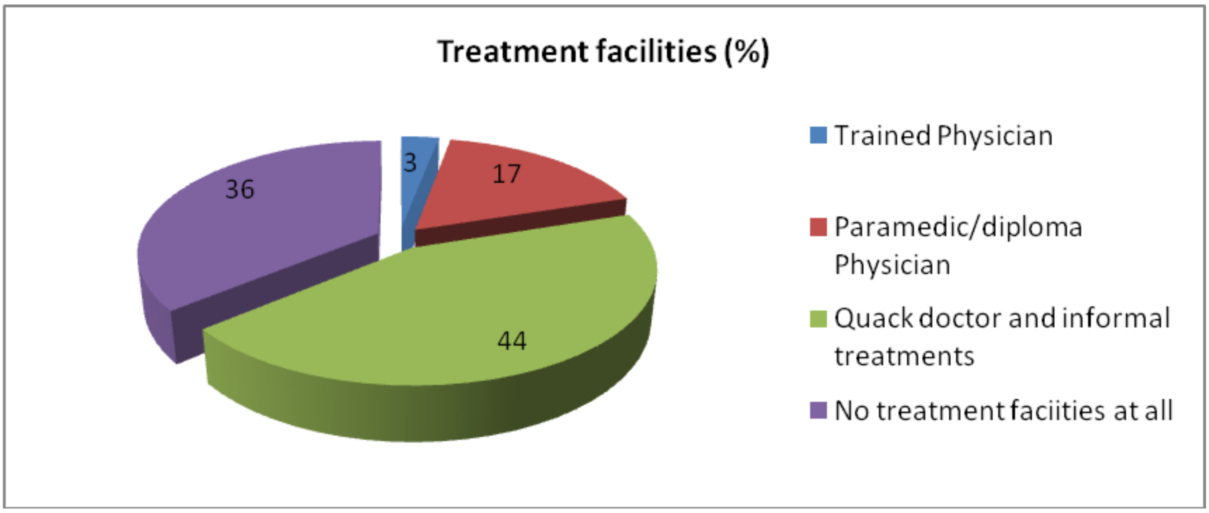


Figure 6.16: Sources treatment facilities of the Polder

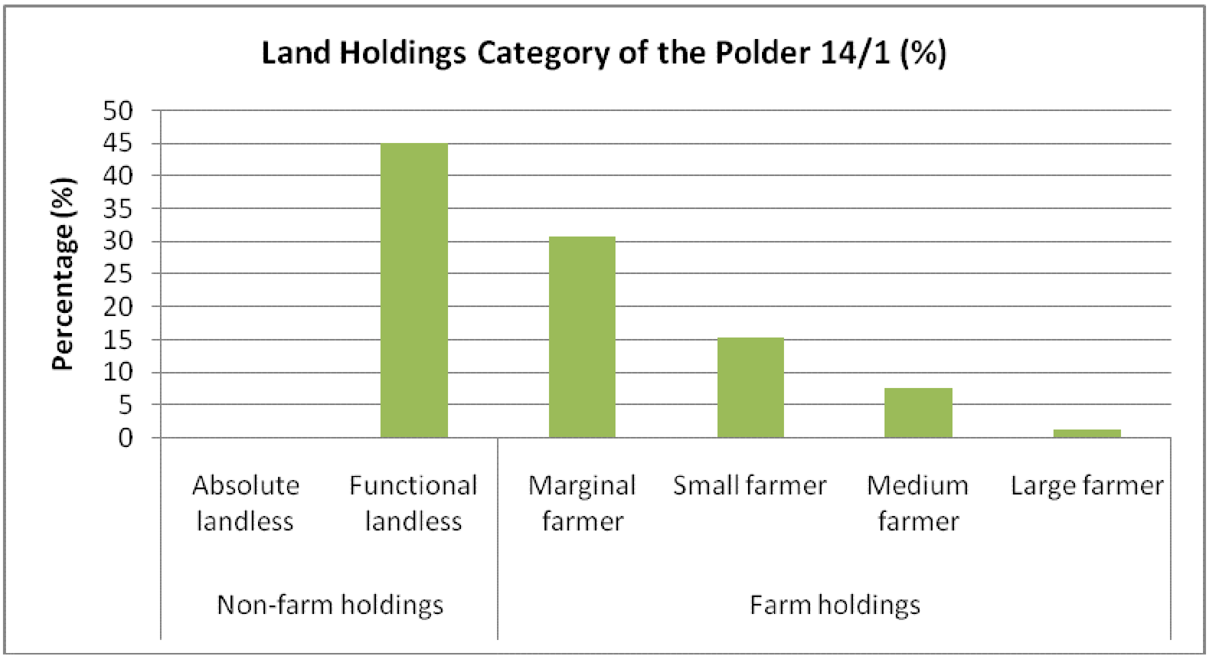
322. The Population Census, 2011 identified six types of disabilities and their proportionate distribution in the respective area. It is found that there are 3% of all types of disabilities and 2% people reported that they are physically challenged in the study area. Local people opined that the incidence of diarrhea is the most prevalent ailment in the area. Dysentery, skin

diseases, cough, flux, worms, tumor, hypertension and common fevers are also common in the Polder.

6.4.6 Ownership and Utilization of Land

323. The Census of Agriculture, 2008 by BBS classified land holdings into two broad categories- one is farm-holdings and one 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 45% is farm and the rest 55% is non-farm holdings.

324. Therefore, the land holdings in the study area show that 0.03% households are absolute landless, i.e., they have no lands either homesteads or cultivated. 44.89% households belong to functional landless category that comprises households those have only homestead lands (46.10%) and those having homestead with 0.01 to 0.04 acre cultivated lands (11.48%). Here, cultivated lands include mainly kitchen gardening produced predominantly by housewives mainly for household consumption



Source: The Census of Agriculture, 2008, BBS

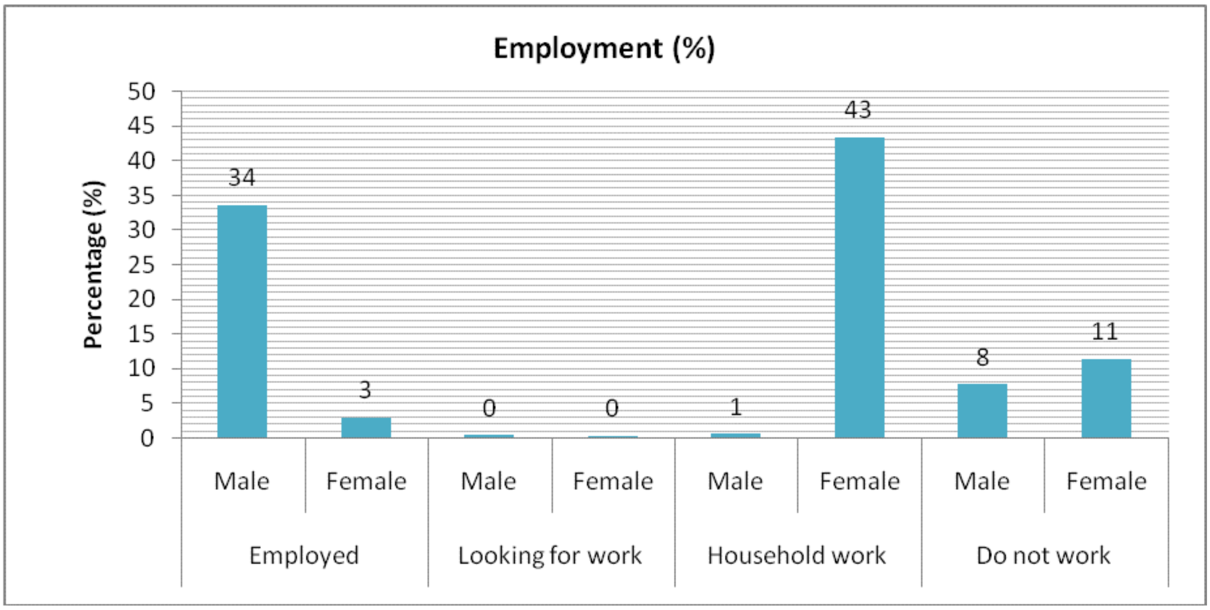
Figure 6.17: Households by land holdings

325. Farm holding distribution shows that 30.69% households belong to marginal farmer (0.05 to 0.99 acre), 15.41% belong to small farmer (1.00 to 2.49 acre), 7.69% belong to medium farmer (2.5 to 7.49 acre) and 1.29% belong to large farmer (7.5+ acre) categories. It is evident that land fragmentation decreases the holding size therefore; large and medium farmers are gradually being converted to marginal farmers.

326. The small land owners are not able to prevent their land from acquiring by the shrimp cultivators/Gher owners in spite of minimum year-round payment which pressurize them to out migration for income generation. Field data proved that large numbers of landless populations, as a result of land acquisition, usually adopt alternative livelihood options, for instances; farm and non-farm laboring, driving, earth work, working for shrimp farm and other manual works.

6.4.7 Occupations and Livelihood

327. Out of the total 16,467 population, 4,864 (30%) are economically active of which 1645 (37%) employed, 29 (0.7%) looking for work and 2,133 (44%) engaged in household work and 997 (19%) people do not work. The economically active population includes those who are aged 7 and over and not attending school at reference period of Housing and Population Census, 2011. Therefore, the definition include employed, looking for work and household work categories and exclude children below 7 years, physically impaired and elderly people who are not engaged in income generation works at reference period. Here household work particularly for women participation is accounted in terms of household activities as well as alternative income generation.



Source: Housing and Population Census, BBS, 2011

Figure 6.18: Employment status of the Polder

328. From field data, it is also found that most of the people are unemployed who have to migrate to other regions like Chittagong, Dhaka, Barisal, Khulna, Narail, Gopalganj, Kushtia districts and nearby upazilas as a day laborer due to lack of employment opportunities.

329. Women participation in direct income generating activities (employed category) is trivial as education status confirms that whereas not attending males are engaged in employment, females are getting married and in turn, contributed to the highest participation in household work (46%). The employed category also includes child labor as it was accounted from 7 years old population. Shrimp cultivation is one of the main occupations in the area.So; many women also participated to collect shrimp fry from the nearby river but are now relatively, unavailable in the rivers. As a result, the women who were engaged in this activity are becoming unemployed. The other major occupations in the area are agricultural farming, earthworks and brickfield works.

Photograph 6.29: Different modes of livelihood activites at Polder 14/1

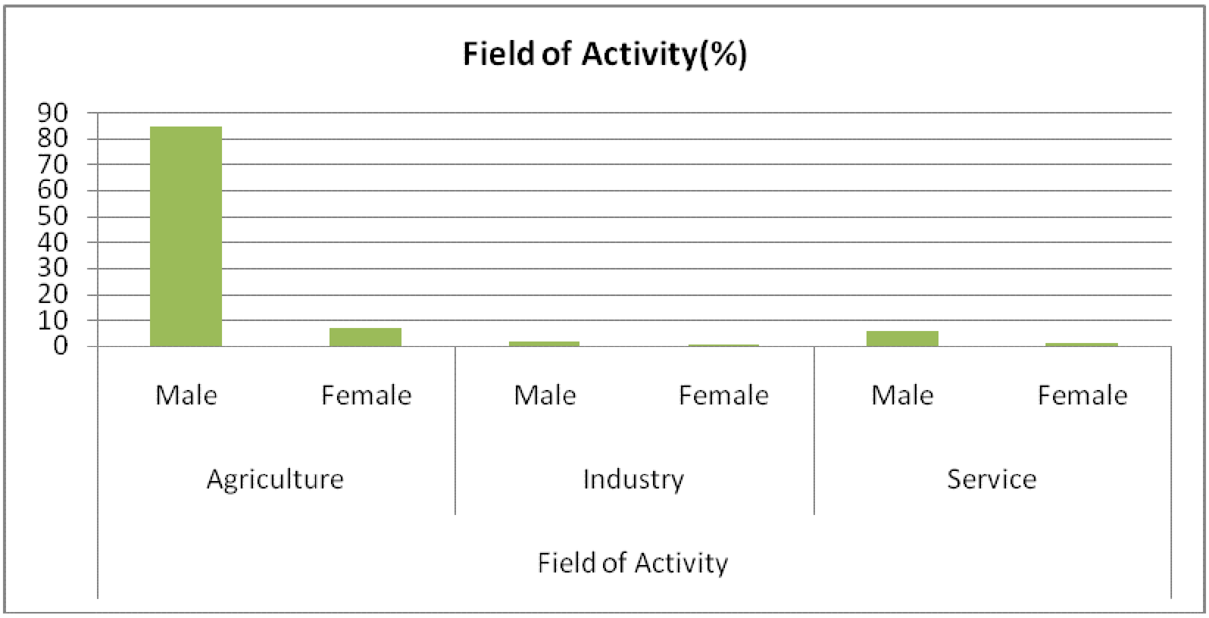
330. Scope of employment in the agricultural sector is gradually decreasing due to the lack of sweet water and inducing saline water in the area for shrimp cultivation, where there is only 16% agricultural land and 60% for shrimp cultivation *(Source: CEGIS fieldwork, 2015).* The Gher cultural practice in the area is shown in the Photograph 6.30.

Photograph 6.30: Practice of shrimp cultivation (gher) in agricultural land in the area

331. People stated that once people from the surrounding regions used to come for employment in their area, but for the gradual decrease of agricultural land and agricultural farming and increasing of shrimp culture has reduced the employment opportunity in the agriculture field as such, therefore, they have to out migrate for employment.

6.4.8 Labor Market

332. Data confirms that agriculture, industry and service are the sole sectors to generate employment in Polder 14/1. Field findings suggested that people who are not permanently employed tend to engage themselves in those sectors in the forms of agricultural laborers, fishers, brick field workers and earth workers. In agricultural sectors, most of the laborers come from the local villages.



Source: Housing and Population Census, BBS, 2011

Figure 6.19: Distribution of population by field of activity

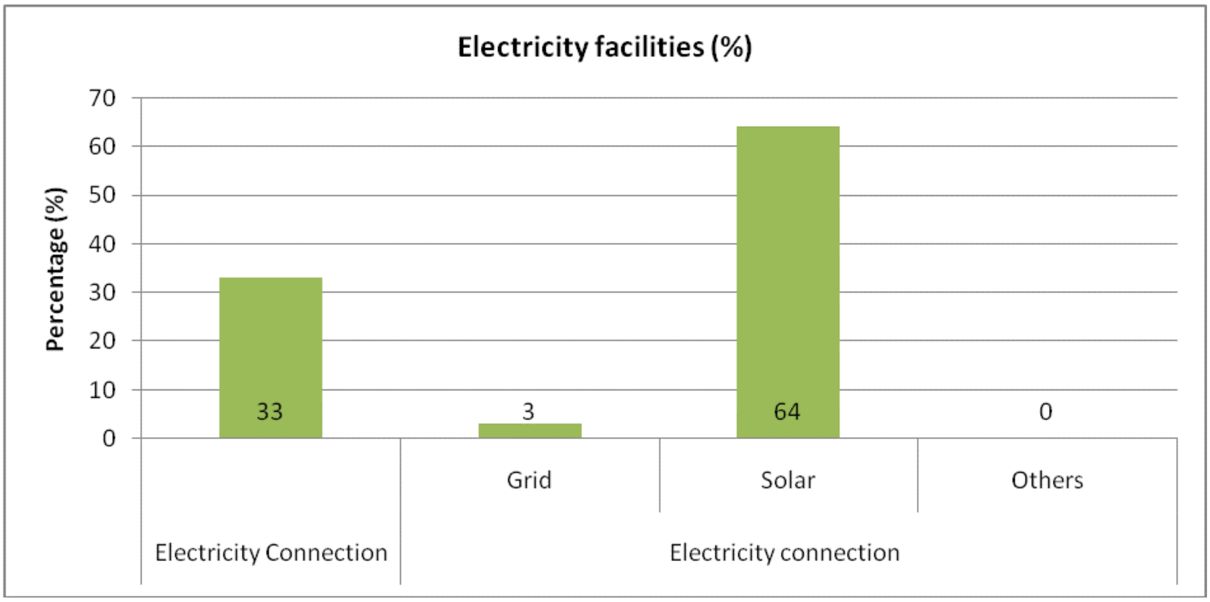
333. The above figure implies that male participation in agriculture sectors is higher than those in industry and service sectors and the people employed in these two sectors are out migrated people. Field findings suggested that during harvesting period, they take part with men in the agricultural field. Some of them also collect fish from river and within earthwork, etc. The wage rate varies between Tk. 200 to Tk. 250 per day for female whereas men wage rate is Tk. 300 to Tk. 350 per day.

334. During field visit, people stated that out migration of laborers is higher (about 80%) in the study area whereas in-migration is relatively low. These out-migrants are mainly agricultural laborers who usually go to neighboring Districts (e.g, Chittagong, Dhaka, Barisal, Khulna, Narail, Gopalganj, Kushtia Districts and nearby Upazilas) for better livelihood and due to lack of employment opportunities. Additionally, there are few international out migrants (1%) who tend to go to Middle East for searching better livelihood options. It is found that in the last 5 five years almost 8 households have migrated permanently to Dhaka and most of them are working in garment sector.

6.4.9 Standard of Living

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

336. According to BBS Report, 2011, 23% people of the Polder have electricity connection. But field data shows a better scenario, it states that 67% people are now getting electricity facilities of which 64% from solar and only 3% from grid connection. But almost 33%, a large portion of the people, are out of electricity facilities. New grid connection has been provided through Banipani to Jhorshing villages. *(Source: CEGIS fieldwork, 2015).*



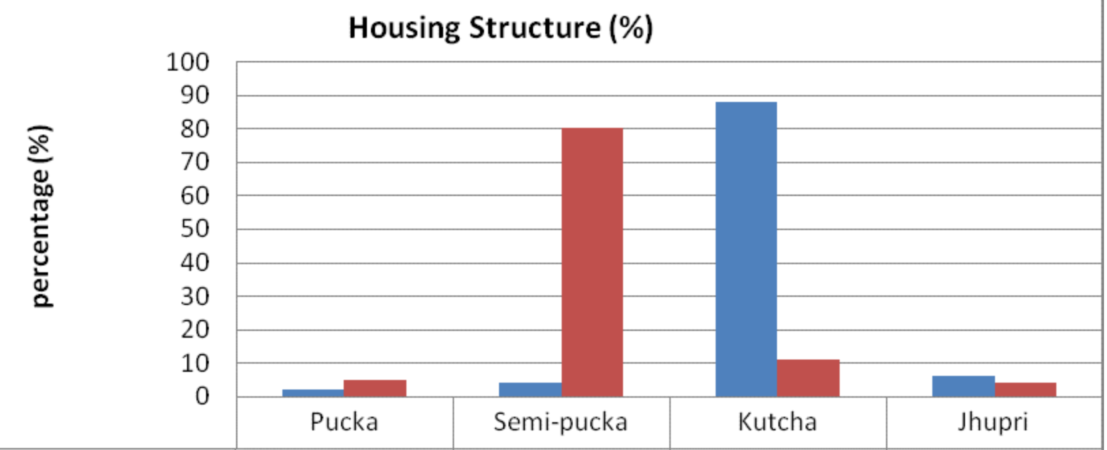
Source: CEG IS fieldwork, 2015

Figure 6.20: Electricity facilities of the area

Photograph 6.31 Electricity connections of the area

337. According to Housing and Population Census, BBS, 2011; the overall housing condition[9] is not satisfactory. It shows the predominance of kutcha houses (88%) over other three types. Semi-pucca household is 4%, pucca is 2% and 6% is still jhupri houses. But from field data, it is found that about 80% houses are Semi-Pucca, 5% Pucca, 11% Kutcha and 4% jhupri. Most of these Semi-pucca houses are sponsored by Islamic Relief.

[9] 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.



	Pucka	Semi-pucka	Kutcha	Jhupri
BBS, 2011	2	4	88	6
CEGIS Field Data, 2015	5	80	11	4

Source: Housing and Population Census, BBS, 2011

Figure 6.21: Housing condition in the study area

Photograph 6.32: Different types of housing structures in the Polder area

338. Sanitation[10] facilities in the study area show that about 42% households use sanitary (water sealed) latrines, 19% use non water-sealed sanitary latrines and 24% use non-sanitary

[10]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

latrines. Field findings confirm that non-sanitary latrines are predominant among kutcha houses while water-sealed sanitary latrines are used in kutcha, semi-pucka and pucka households. However, there are 154 houses, which have no sanitation facilities but tend to use on shared basis and in some cases use open spaces (Figure 6.21).

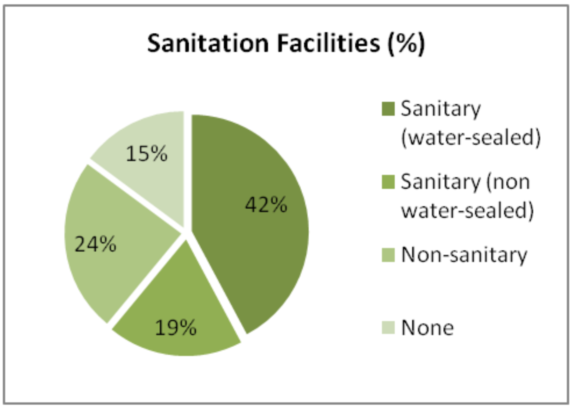


Figure 6.22: Distribution of households by sanitation facilities

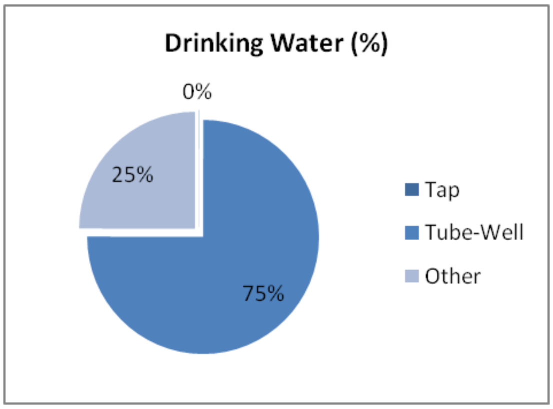


Figure 6.23: Distribution of households by sources of drinking water facilities

Source: Housing and Population Census, BBS, 2011

339. There is crisis of drinking water in the area. Most of the people collect drinking water from tube-well, harvesting rain water, purified water supply by different NGOs. But the poor people of the area collect drinking water from the tube-wells of their neighbor's.

Photograph 6.33: People collect safe drinking water from different sources

6.4.10 Poverty Situation

340. Poverty profile has been prepared by the participants of the RRA themselves through a self-assessment exercise. The assessment is based on the year-round income along with food consumption of the inhabitants within three different categories (Figure 6.24). It is observed that about 9% of the households are in the 'deficit' category. These households have been identified in the RRA as the poor households of the Polder area. Considering the standard consumption of food (three meals in a day), the deficit group was usually taking two meals in a day in the lean period since they could not afford three full meals. Only 8% of the

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.

households in average are in the surplus category and rest of them (83%) is in balance category.

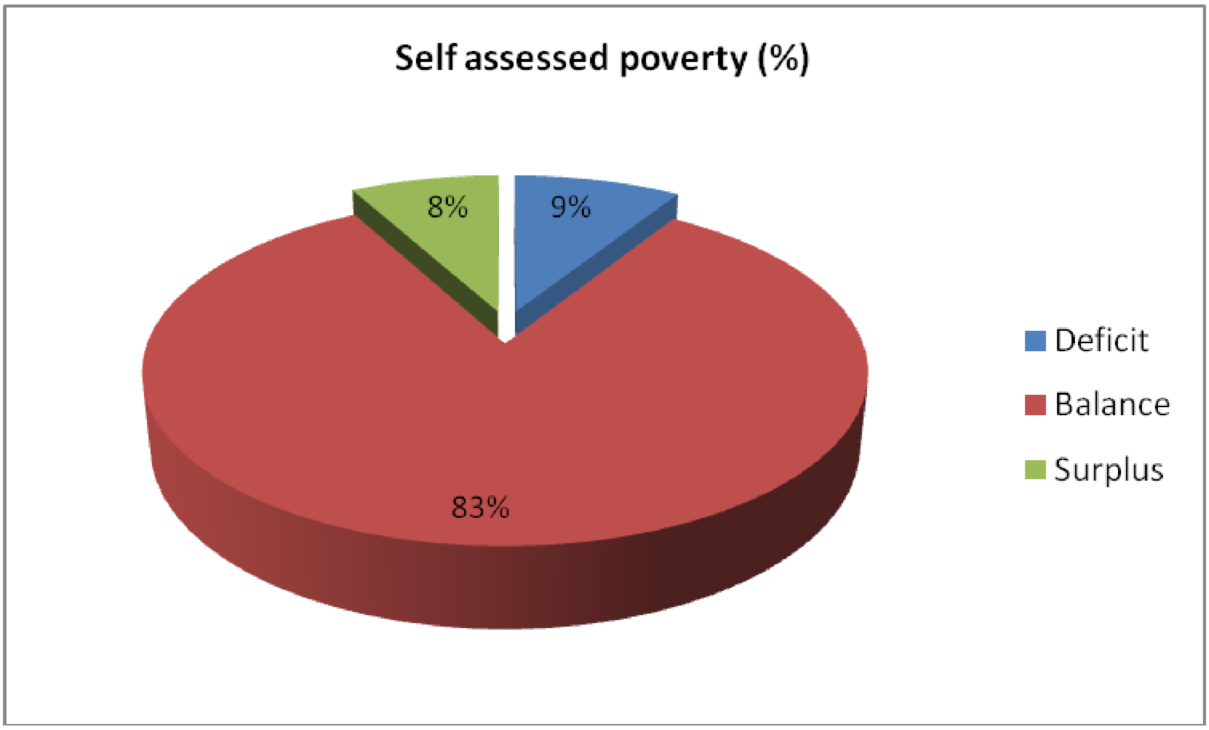


Figure 6.24: Self assessment of poverty status

6.4.11 Social Capital

341. The provision of different types of safety net programs have been initiated by the government and NGOs in the Polder 14/1. The major social safety nets and poverty reduction programs initiated by the government in the area include the Vulnerable Group Development (VGD), Food/Taka for Work (F/TFW), Food for Education/Cash for Education, Rural Maintenance Program (RMP), Old Age Allowance, Freedom Fighter Allowance and Integrated Poverty Reduction Program. According to local people, these programs have created food security as well as social safety nets Amang the targeted poor households and vulnerable communities to some extent. But some of the poor people stated that, in reality, they get only a minimum advantage from the government programs, which is basically given on the basis of political consideration.

342. A number of local, national and international NGOs are working in the Project area. The main activities of these NGOs are in operating micro credit programs Amang the rural poor and landless women/men. The major NGOs working in the area include Islamic Relief, UNDP, SMKK, Muslim Aid, BRAC (Bangladesh Rural Advancement Centre), ASA (Association for Social Advancement), and Grameen Bank, Bureau Bangladesh, Diganto, Polli Unnayan, Uttaran, Rupantor, Sushilon and different local associations.

343. Along micro credit programs, numbers of NGOs also serve in many social development activities without any charges. After Aila, Islamic Relief has appeared as the most important NGO for the local people. It has rehabilitated through constructing new houses with CI Sheet for them which were destroyed. As a result, 80% houses of the area are presently semi-pucka. Along with all these activities, Islamic Relief also gives them free capital for business. Many NGOs are serving with micro credit programs while BRAC is working for non-formal education, health, human rights, water and sanitation, gender and children development programs. Uttaran gives them free capital for business, cow, goat different types of medicine and vaccine, etc. UNDP helps them in repairing naturally destructed houses, Sushilon works for the

maintenance of embankment. Along with micro credit, SMKK gives them adequate information about agricultural cultivation, money for domestic animal rearing, training on fish cultivation and free treatment facilities. Muslim Aid and Islamic Relief also made important contribution for safe drinking water. About 80 percent of households are found to be benefited from the NGOs interventions.

Table 6.29: NGOs and their Programs in the Project Area

Name of the NGOs	Type of Programs							
	Credit	Education	Water and Sanitation	Health	Disaster	Gender	Food security	Others
Islamic Relief	-	✓	✓	✓	✓	-	✓	✓
SMKK	-	✓	✓	✓	-	-	✓	✓
BRAC	✓	✓	✓	✓	-	✓	✓	✓
USAID	-	✓	✓	✓	-	✓	✓	✓
Uttaran	✓	-	-	✓	-	-	✓	✓
ASA	✓	-	-	-	-	-	-	-
Muslim Aid	-	✓	-	-	-	-	✓	✓
Grameen Bank	-	-	-	-	✓	-	✓	-
Bureau Bangladesh	✓	✓	-	-	-	-	-	✓
Diganto	✓	✓	-	-	-	-	-	-
Polli Unnayan	✓	-	-	-	-	-	-	-
Rupantor	✓	-	-	-	-	-	-	-
Sushilon	✓	-	-	-	-	-	-	✓

Source: CEGIS fieldwork, 2015

Photograph 6.34: NGOs activities in the area

6.4.12 Roads

344. There are various types of roads which provide means of communication mostly within the Polder. The Polder is surrounded by three major rivers namely, Kobadak, Sakbaria and Arpangasia River. People of the Polder can easily enter into the upazila sadar by upazila pucka road. According to NWRD database 2015, about 63 km of notable road network exist

in the studied unions of which 10.7 km roads are paved/brick soling while 52.3 km are earthen. Table 6.30 presents data on road network in the Polder area; Photograph 6.35 presents some photographs of these roads.

Table 6.30: different roads of the study area

Name of the Unions	Types of the Roads	Description	Length (KM)	Total
Dakshin Bedkashi Uttar Bedkashi	➢ Paved/ Brick Soling	➢ Charamukha Tin Rasta to Copotakhi High School road to Golilal Bazar	➢ 7.7	➢ .7
		➢ Bedkashi High School-Charamukha WDB.	➢ 1.5	
		➢ Horilal UZR (Chowrasta)-Charamukha Kheyaghat road.	➢ 1.5	
	Earthen Road	➢ Ghorilal FRB-Golkhali Pry. School road	➢ 3.71	52.3
		➢ Horihorpur P/School-Benapani CARE Road	➢ 3.3	
		➢ Holdibunia UZR .-Charamukha Road	➢ 3	
		➢ Chairman's Bazar- Angtihara Primary School	➢ 2.5	
		➢ Hodubunia-Channir Chalk	➢ 4	
		➢ Bedkashi High School - Charamukha WDB	➢ 5.5	
		➢ Ghorilal UZR (Chowrasta) - Jorshing Bazar road	➢ 6	
		➢ Ghorilal UZR-Angtihara Ghat	➢ 3	
		➢ Charamukha WDB Embt.-Bedkashi GPS Road	➢ 25	
		➢ Binapani Sluice Gate-Ghoper Khal CARE Culvert	➢ 3.6	
		➢ Binapani WDB-H/O Dr. Nihar Ranjan	➢ 6.68	
		➢ Charamukha UZR-Shak Baria Embt	➢ 2.48	
		➢ Patakhali WAPD-Patakhali Pry School Road	➢ 1.87	
		➢ Goalkhali P/School-Goalkhali Mosque	➢ 4	

Source: CEGIS fieldwork and LGED website, 2015

Photograph 6.35: Roads of the studied area

6.4.13 Market/Growth Centre

345. There is only one (1) growth center and three (3) local markets in the Polder. The growth center in the area is Ghorilal Bazar. It is situated on the bank of Kobadak River. The Jorshing Bazar/ market is another big bazaar in the Polder area which is located on the bank of Sakbaria River .The easiest cost efficient communication system in the area is waterway. Therefore, Ghorilal Bazar gets more preference than the other markets and has become the only growth center in the Polder. Moreover, other small markets of the area play important roles for the inhabitants.

Table 6.31: Markets and growth centre in project area

Unions	Number of markets/ bazaar	Name of the Markets/bazaar
Dakshin Bedkashi Uttar Bedkashi	04	➢ Ghorilal Bazaar ➢ Angtihara Bazaar ➢ Chairman Bazaar ➢ Jorsing Bazaar

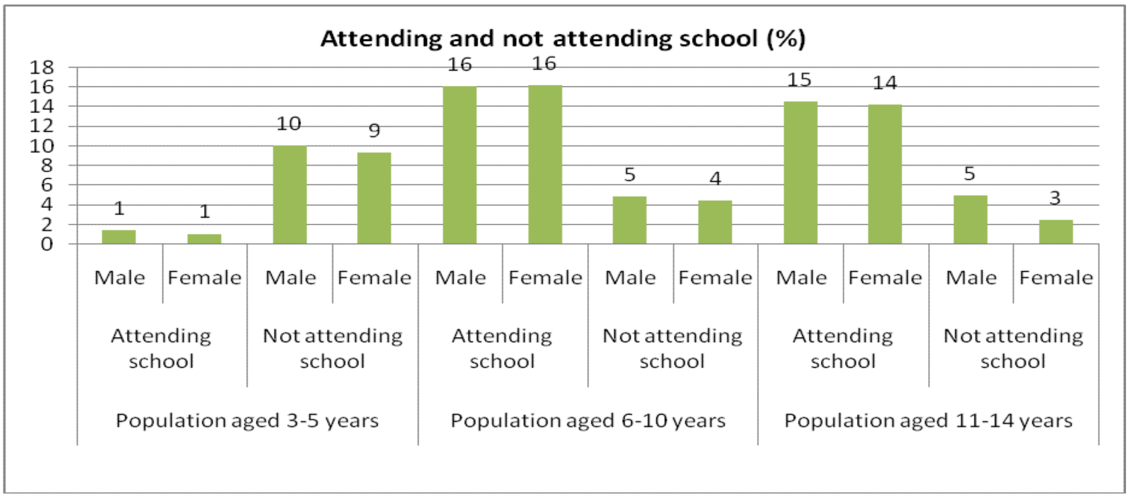
Source: CEGIS Fieldwork 2015


Photograph 6.36: Markets in the study area

6.4.14 Gender and Women

346. Field observation mentioned that the Polder is a highly male dominated area. Role of women in both decision making at household level and economic contribution to household income are inconsequential. Traditional believes are very strong here. Generally males make all major household decisions and at the same time they contribute to household income more than the females . few women work as day labor, but in such case wage discrimination is very common where male labor gets Tk. 300 to 350 and women labor gets Tk.200 to 250.

347. Over time, government’s strong policy towards women education has changed the situation in Polder area where women education rate has increased and dropping out from school due to early marriage has reduced. Figure 6.25 shows the comparative positive school going scenario of the area. NGOs have changed the rural society to a significant extent in terms of awareness rising. Different NGOs along with community health clinics are working for women health which has reduced the women maternal mortality rate. The studied people stated that in some union health workers have played important roles for women health improvement.



Source: Population Census, BBS 2011

Figure 6.25: Male and female school attendance in the area

348. Women mobility in the area is mostly localized except when going for medical treatment, fetching water, farming activities, and visiting relatives. Mortality rate of the pregnant mother during delivery period has been reduced in the area. The growing consciousness among the local people as well as the health services provided by the public and other health centers including the programs of NGOs have contributed to the decrease of the mortality rate. About 10 percent women are living with good health condition and the rest are suffering from various diseases especially with premature delivery. About 10% women are getting proper nutrition and about 10% have access to the health centers, which are around 12 km away on average from their residence. *(CEGIS field work, 2015).*

6.4.15 Cultural Heritage and Tourism

349. Polder 14/1 is situated beside the Sundarban, the biggest mangrove forest in the world. It has been inscribed as a UNESCO world heritage site in 1997. The Sundarban Reserve Forest is surrounded by a very densely populated area, for which human pressure is important. Around 1.2 million local users reside seasonally in the area for fishing and other resource use activities. Commercial hunting was a problem mainly before the 1970s and this result particularly a serious depletion of the crocodile populations and to a lesser extent to the deer population. Though the protection has improved significantly in the last decades, yet illegal hunting is still taking place on an incidental basis and fishery causing adverse impact on the populations of the remaining turtle and crocodile populations as these animals drown frequently in the fishing nets.

350. However, the main threat may be presently from outside in the form of pollution. On the northern edge of the area, Mongla port, the second largest port of the country is situated. This port and its associated marine traffic is a frequent source of oil spillage and there is a permanent risk of accidents with chemicals. Moreover, toxic products (pesticides, etc.) may enter the system due to pollution in the huge Ganges catchment at the upstream. Pollution may be a direct source of mortality, but it may also reduce the health, and increase the mortality rate in the long run. Many products such as pesticides have also been proved to reduce the reproductivity (birth rate) in animal populations. A future threat is the exploitation of mineral gas, abundant beneath the ground of the Sundarban. Therefore, it should be a great concern for the government of Bangladesh.

Photograph 6.37: Natural scenario of the Sundarban

6.4.16 Social Structure

351. Social stratification is also **present in the study area where people's different types of capital e.g.**, social capital, cultural capital, physical capital, financial capital, etc., determine their positions. Gher owners belong to the highest strata **and landless to the lowest. Although the power structure was** centered around the land ownership in earlier time**s**, this has now changed. The people who are the Gher owners **are now dominant in the rural power structure. Even land owners** obey the Gher owner because they are linked with external power sources and **the politically powerful.**Here, marginal land owners are in worse condition. Gher owners are now dominating the rural power structure.

6.4.17 Rituals and Festivities

352. Anniversaries, Fairs and Festivals form a vital part in the social life of ordinary people of the Polder 14/1. The biggest religious festivals are Eid-ul-Fitr and Eid-ul-Azha for the Muslim community, Durga Puja for the Hindus, Christmas for the Christians. Other Muslim Festivals include Eid-e-Mialdunnabi, Muharram and Shab-e-Barat. Although there are many types of discriminations in the Polder area, but there is no religious discrimination. Different types of religious groups are performing their religious festivals with cheerfulness. Even other religious communities participate in the festivals with eagerness. For example Muslims participate in different types of Puja where Hindus and Christians also participate in Eids and many Muslim festivals. All religious communities also participate in the ethnic community's festivals.

353. Amang the non-religious festivals Bengali New Year (Pahela Baishakh, on 14 April), Language Martyrs' Day (on 21 February, presently the International Mother Language Day), Independence and National Day (26 March), and Victory Day (16 December) are celebrated. Mostly these festivals are performed by the students of schools and colleges of the area.

6.4.18 Common Property Resources

354. The common property resources and community facilities in the area are different social amenities, e.g. mosques, graveyards, temples, cremation grounds, playgrounds, open water bodies and Eidgahs (place for offering Eid prayers). These are used by the local people for the purposes of religious, social and cultural gatherings. Beside these, the BWDB embankment is also very commonly used for different livelihood purposes, i.e., living or taking shelter by the local inhabitants. However, there is no known historical or archeological site declared by the government in the Polder area. There are 13 mosques, 7 graveyards, 6 temples, 5 cyclone centers, 5 bazaars and a cultural center.

7. Analysis of Project Alternatives

7.1 Overview

355. 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

356. According to last investigation report, Polder 14/1 has been found under threatened condition due to feeble embankments. And these alarmingly deteriorating embankments of the Polder are being degenerated on account of continuous action of wave. Already, few symptoms have been encountered at many points; it has become unfit to provide its valuable services. The 'No Project Alternative' elaborates the detail of consequences in the Polder towards various contexts since degradation continues. Furthermore, the proposed interventions under CEIP-1 along with its probable consequences are summarized correspondingly. Natural disaster such as cyclones; storm surge as well as mean sea level rise for global warming will aggravate the condition of the Polder.

357. The interventions proposed in Polder 14/1 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.

358. 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 14/1.

359. Table 7.1 shows these proposed interventions under the heading of 'no project' and 'with project' alternative.

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

Proposed Interventions	'No Project' Scenario	'With Project' Scenario
1.Re-sectioning of embankments (27.25 km) and design crest level (4.50 m, PWD).	The embankments at certain number of points will be further deteriorated and dropped below the design level. Therefore, cyclones, rise in surge heights due to global warming, and tidal actions will inundate the Polder, causing severe damage to the lives and properties of local people.	Re-sectioned embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and high tides due to global warming. Hence, of lives and assets caused by the natural disasters will be reduced.
	Due to submergence of the embankments during monsoon, transportation system inside the Polder would be further deteriorated, and the sufferings of local people would increase more.	Re-sectioned embankments will provide enhanced protection to Polder, facilitating transportation within the Polder even during monsoon.

Proposed Interventions	'No Project' Scenario	'With Project' Scenario
	Reduction of agricultural area, crisis situation for farmers from January to April (salinity intrusion) and May to August (flooding).	Re-sectioned embankments will provide support to Polder and facilitate the agricultural activities and increase the area for cultivation, thus increase of the agriculture output.
	Continued silt deposition inside the Polder due to cyclonic surges and floods would be increased and will cause water logging, drainage congestion and other associated problems.	Decrease of silt deposition in the Polder will result an improved drainage and navigation in the internal lakes/khals, increase usage of surface water for irrigation, and reduce water logging problem.
	Local farmers and labor will remain financially stressed. Livelihood opportunities will remain limited, and local people will migrate outside from the Polder for employment.	Enhanced agricultural activity will increase the demand of farm workers. Local people can engage themselves in the construction works inside the Polder. Improve the earnings of local people during the construction phase of the project.
Bank revetment (1.0 m)	River bank erosion would further deteriorate the embankment and land resources would be damaged/ lost.	Bank revetment will provide enhanced protection against erosion from wave action, storm surges and currents, and will result into preservation of Polder and its land/agriculture resources.
	Further subsidence of the embankments and further damage to transportation routes will take place.	The bank revetment will protect the embankments and facilitate transportation within the Polder.
Slope protection of Embankment (6.80 km)	Weakening of embankments will continue; subsidence of embankments due to traffic load and wave action will continue; 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.
Construction of drainage sluices with drainage-cum-flushing sluices.	Continuous use of the existing drainage sluices for both flushing and drainage would cause further damage to these structures. As a result, water logging and drainage congestion would increase due to malfunctioning of the sluices gates.	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
Construction of the existing flushing sluices	No dry season agriculture practice will be possible. Shrimp culture during January to May will continue as sweet water cannot be used in the periods of low rainfall.	Replaced flushing sluices will facilitate better agriculture practices, increase dry season rice cropping, and reduce shrimp culture - thus benefiting the poor farmers.
Re excavation of Drainage Channels (30.00 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.
Afforestation (17.37 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.

7.3 With project' Alternatives

360. 'With Project' Alternative explicates the interventions proposed under CEIP-1 to alter the Polder 14/1 condition addressed the problems summarized in 'No Project Alternative'.

7.3.1 Site selection alternative:

361. Since CEIP-1 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	14/1	
Type of Dyke	ID	
Location of the Polder	Koyra	
Gross Area of the Polder (HA)	2933	
Embankment Length (Km)	25	
Breach of Embankment (Km)	5	9
Erosion (Km)	10	5
Requirement of BPW (Km)	-	0
Location in the Risk Zone	LRZ	5
Drainage Congestion (HA)	450	0
Opinion of Stakeholder (marks, MV=15, MDV=10, LV=5)	MV	15
Rehabilitation Cost (Crore BDT)	126	10
Special Criterion	-	0
Total Marks		44

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.

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

362. Steps are taken to assess the technical, financial, economic, environmental, and social considerations which are presented in Table 7.3 below.

Table 7.3: Technical, Economic, Environmental and Social Considerations

Intervention	Considerations			
	Technical	**Financial/Economic**	**Environmental**	**Social**
Re - sectioning, embankment with new design heights	Better protection against cyclone, storm surges and water level rise	Financial savings from reduced damages caused by the floods.	Improved surface water quality; Improved natural vegetation.	Reduction in loss of lives and assets would bring poverty reduction; increase employment opportunities for local people.
	Protection to river bank erosion	Financial savings as the embankments will provide good road transportation routes.	Reduce traffic congestion inside the Polder because of improved embankments, which will facilitate vehicular traffic	Reduction in loss of assets which would bring poverty reduction
	Prevention of salinity intrusion in the Polder.	Improve earning of local people during construction. Increase the cropping pattern and boost up the local economy.		Improve crop production particularly for small farmers thus alleviating poverty.
Bank revetment, slope protection	Enhance embankment protection against tidal wave action of rivers, provide erosion protection	Financial savings from reduced damages caused by the floods; increase life span of the infrastructure and associated water control structures; improve earnings of local people through employment during bank revetment works and slope protection works.	Improve embankment stability; reducesoil erosion; and provide good means of transportation	Reduce loss of lives and assets which would bring poverty reduction; increase employment opportunities for local people.
Replacement of existing drainage sluice with drainage-cum-flushing sluice and construction of new flushing sluices as and where needed.	Better functional performance in both flushing and drainage; achieve the objectives of Polder and CEIP-1.	Financial savings against damages due to water logging, drainage congestion, and salinity intrusion.	Removal of inactive sluices will improve the drainage characteristics.Water logging, drainage congestion would be reduced.	Better agriculture practice could be achieved which would improve the cropping pattern, enhance local earnings of local people and reduce poverty.
		Agricultural production will be boosted as dry season rice cropping would increase.		

Intervention	Considerations			
	Technical	Financial/Economic	Environmental	Social
Channel re-excavation	Reduce water logging and drainage congestion	Enhance agriculture output; the dredged soil can later be used in construction works and will save construction cost.	Increase navigability of water ways and fish habitats would be improved, the ecosystem will be enhanced.	Increase cultivable areas, increase availability of irrigation water thus increase farm income for local community; increase farm labor opportunities.

7.3.3 Technical Alternatives

363. Once the problems being faced by the Polder and the inhabitants of the Polder are identified, several technical alternatives on the basis of the problems they faced earlier are considered accordingly. These alternatives include strengthening of the embankment, protection of river banks, protection of embankment slope, improvement of the sluices and their performance, and reduction of drainage congestion and water logging. These technical alternatives are discussed in Table 7.4 below.

Table 7.4: Technical Alternatives for Polder 14/1

Proposed Interventions	Alternative Options	Consequence
Strengthening of the embankment	No change in alignment and no re-sectioning/repairing of the existing embankment	The present vulnerable situation of the embankment and thus the entire Polder would continue (similar to the 'no project' scenario discussed earlier).
	Retirement/relocation of the existing embankment, as and where required	The Project objectives will be partially achieved of. NO protection against storm surges and sea water rise.
	Backing/minor inward shifting of embankment with slope protection	Same as above.
	Constructing new embankments (selected option)	New embankments will safeguard the Polder against storm surges, floods, and high tides due to global warming. Hence, there would be reduction in loss of lives and assets caused by the natural disasters.
	Re-sectioning of existing embankment with new design heights (selected option).	Higher and wide embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and high tides due to global warming. Hence, there will be reduction in loss of lives and assets caused by the natural disasters.
River bank protection works	No change in the existing embankment	River bank erosion would further deteriorate the embankment and land resources would be damaged/lost (similar to the 'no project' scenario discussed earlier).
	Retirement of embankment	The Project objectives will be partially achieved for decrease in Polder area; and continued erosion of the river bank.
	Bank Revetment (selected option)	Bank revetment will provide enhanced protection against erosion for wave action, storm surges and currents, and will protect the Polder and its land/agriculture resources.

Proposed Interventions	Alternative Options	Consequence
Protection of embankment slope (against wave action)	No change in the existing embankment	Continuously weaken the embankment; continue the subsidence of embankment due to traffic load and wave action; land resources would continue to be damaged/ lost (similar to the 'no project' scenario discussed in earlier).
	Slope protection (selected option)	Slope protection works will strengthen the embankment and protect them against subsidence, wave action, and wear and tear.
	Foreshore plantation (selected option)	Effects from cyclone surge, wave action and wind could be mitigated to some extent, reducing loss of lives and assets.
Replacement of drainage sluices	No change in the existing structures.	Continuous use of the existing drainage sluices for both flushing and drainage would cause further damage to these structures. As a result, water logging and drainage congestion would be increased due to malfunctioning of the sluices (similar to the 'no project' scenario discussed earlier).
	Repairing of structures (possible where there is no need of re-sizing) (selected option for some structures).	For sluices which are beyond any repair works would be similar to the 'no project' scenario as described above.
	Replacement of existing drainage Sluice with Drainage-cum-flushing sluice (selected option for some of the sluices depending upon need).	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
	Regulators with provision for appropriate arrangement of passages for fish and small boats.	In addition to the above advantages, the structures will facilitate fish migration and navigation through them. The cost of such structure is likely to be very high.
Rehabilitation of flushing sluices	No change in the existing structure	No dry season agriculture practice will be possible. Shrimp culture during January to May will continue, as sweet water cannot be used in the periods of low rainfall (similar to the 'no project' scenario discussed earlier).
	Repair of the existing structures	For sluices which are beyond any repair, works would be similar to the 'no project' scenario described above.
	Replacement of the existing Flushing Sluices (selected option)	Replaced flushing sluices will facilitate better agriculture practices, increase dry season rice cropping, and reduce shrimp culture - thus benefiting the poor farmers.
Reducing drainage congestion	No action is taken.	Depth of water bodies would further decrease, drainage congestion and water logging will further increase (similar to the 'no project' scenario discussed earlier).
	Channel re-excavation (selected option)	Depth of water bodies will increase, water logging and drainage congestion will be decreased and fish habitats will increase.

7.3.4 Alternatives during Construction

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

7.3.5 Material Storage

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

7.3.6 Material Sources

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

Soil for Embankments

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

- Borrow pits must taken into account as one of the main source of soil. A good volume of soil can be obtained from the burrow pits of the river. Minimizing transportation requirment so as by minimizing the cost the source has bocome a worthy alternative option. It has minimal negative impacts in burrow pit's areas as those unoccupied pits will be occupied through silting within a couple of seasons. It ensures minimum social and environmental impacts from excavation and transportation.
- Another alternative option for obtaining soil is re-excavatioin of channel. In this option if material meets the quality it would minimize the excavation cost of burrowed material. Althrough transportation cost will be slightly more than the first option in addition to few environmental and social impacts, i.e., traffic congestion and air pollution, etc.
- If riverside soil quality is not compatible for the embankments of the Polder, then desired quality might be achieved from the river beds. This option would entail higher cost of material transportation and other social and environment related problems such as traffic congestion, air and water pollution.
- The soils from either the burrow pits or the river bed have to be tested for any pollutants or toxic material prior to any use. If safe, only then the soil may be used.

368. The final decision for source of the material is to be decided during construction phase of the project.

Sand

369. Sand is used to a large extent for repairing and renovating the embankment, concreting works, and manufacturing of concrete blocks for slope protection. Two alternative options are available for sourcing sand. Based on the situation, DDCS&PMSC engineers will decide the source of the sand.

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

371. River bed can be an alternative source of sand. This would reduce the transportation needs along with the associated costs and environmental as well as social impacts. However, quality of this sand may not be consistent and this sand may need to be washed before use.

372. At this stage, the final decision regarding the source this material has also not been finalized. This decision is likely to be taken during construction phase.

7.3.7 Alternatives for Workforce Procurement

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

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

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

7.3.8 Alternatives for Mode of Transportation

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

377. The Polder is surrounded by Sakbaria River to the East, Arpangasia River to the South, Kobadak River to the West and Kobadak and Sakbaria River to the North. Kobadak River is a big river considering its depth and width. The river remains navigable throughout the year and can be used for transportation purposes during construction. Sakbaria River can also be used for the same during construction works in the east portion of the Polder. However, these water bodies are small in both width and depth and therefore small boats are recommended for these water bodies. For construction in other parts of the Polder, Kobadak River is the most feasible route for waterway transportation considering the overall effectiveness in transportation through this river.

378. The Polder is located in Koyra Upazila under Khulna District. There are 10 km of Upazila, 2.5 km of Union and 34 km of village roads serving the Polder area. The length of kutcha roads is serving the people moderately in dry season, but they become very poor in wet season. The road condition in the Polder area is not suitable to move heavy vehicle during construction. Kobadak and Sakbaria Rivers can only be used as waterways for transportation purposes.

8. Assessment of Environmental and Social Impacts

8.1 Preamble

379. This Chapter identifies the impacts of the project interventions on environment which may potentially be caused in various Project phases, and also suggests the probable 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 5. 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 of 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

380. As part of the environmental impact assessment process, a screening matrix was used specifically to the proposed Project, focusing on the potential environmental impacts during the design, construction and operation phases. The matrix examined the interaction of project activities with various important components of the environment. The impacts were broadly classified as physical, biological and social 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.

381. The matrix of the Polder 14/1 is shown in Table 8.1. The negative impacts predicted in this manner are 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. 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					Social and Socioeconomic									
	Air and Noise Quality	Salinity Intrusion	Flooding	Drainage system	Traffic Congestion (water way)	Land use	Fish habitat and Migration	Fish Production	Crop Production	Irrigation	Vegetation	Employment opportunities	Income Generation	Communication	Social Urnest	Local Infrastucture	Safty and Health hazard	Out-Migration	Disaster Incidence	Public Health	Vehiculaer Traffic
Pre-Construction Phase																					
Planning and design of the proposed infrastructures	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Preparation of construction site, labor shed, material stock yard etc.	o	-	-	-	-	0	-	-	-	-	0			-	MN	0	MN	-	-	-	MN
Labor, materials and equipment mobilization	o	-	-	-	0	-	0	-	-	-	-			0	-	0	MN	-	-	MN	HN
Land acquisition and resettlement	-				-	0	-	-	-	-	-			-	MN	MN	MN	MN	-	MN	MN
Construction Phase																					
Re-sectioning of embankment	0	-	-	-		-	-	-	-	-	MN			MN	MN	-	MN	MP	-	MN	MN
Construction of Retired embankment	0	-	-	MN		MN	-	-	0	MN	0			0	MN	MN	MN	MP	-	MN	MN
Embankment Slope Pitching and Turfing	0	-	-	-		-	-	-	-	-	MN			MN	MN	-	MN	MP	-	0	MN
Construction of Drainage Sluices	0	-	-	0		MN	MN	o	-	MN				MN	MN	MN	HN	MP	-	Mn	MN
Slope Protection work of embankment	0	-	-	-		-	-	-	-	-	MN			MN	MN	-	MN	MP	-	0	0
Bank Revetment work	0	-	-	-		MN	-	-		-	0			0	MN	-	MN	MP	-	0	0
Placing of geo bags and CC Blocks	-	MN	0	MN		0	MN	MN		-	0			0	MN	-	MN	MP	-	0	0
Re- excavation of Drainage khals	0	-	-	MN		MN	HN	MN		MN	MN			-	MN	-	MN	MP	-	MP	MP
Implementing coastal afforestation	-	-	-	-		-	-	-		-	-			-	MN	-	0	MP	-	MP	0
Post Construction Phase																					
Monitoring and Maintenance of protective and earth works by BWDB.	-	MN	HP	HP	-	MP	MP	MP	HP	HP	HP	HP	HP	MP	-	MP	-	MP	MP	MP	MP

Key:-HN: High negative impact; MN: moderate negative impact; 0: insignificant/negligible impact; HP: high positive impact; MP: moderate positive impact; -: No impact

8.3 Impacts during Pre-construction phase

382. Site development involves the following activities:

- Planning and design of the proposed infrastructures
- Preparation of construction site, labor shed, material stock yard etc.
- Labor, materials and equipment mobilization
- Land acquisition and resettlement

8.3.1 Deterioration of Environmental Quality (Air and Noise)

Impact

383. Noise level around the construction sites and in settlement areas will be deteriorated for mobilization of construction materials, trawler equipment and man-power. Navigation will be increased in the watercourses, i.e., Kobadak, Arpangasia and Sakbaria rivers. The increased navigation is expected to amplify the noise level of the local vicinity. Therefore, settlements, bazaar areas and surroundings of the construction site will be affected by the increased noise level.

384. Besides, exhaust emission from trawler and containing particulate matter and other ingredients would deteriorate the ambient air quality around the construction site and nearby areas due to movement of equipment carrying trawlers. Fugitive dust emissions from the material stockyards would also deteriorate the ambient air quality of the locality. Moreover, the air and noise pollution are temporal and are reversible and will naturally return back to their baseline condition.

385. The significance of this 'unmitigated' impact has been assessed as Minor on the basis of impact magnitude and receptor sensitivity.

Mitigation

386. The mitigation measures suggested to address the above concerns are:

- Construction material (sand) 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, machineries and materials during day time instead of night.
- Exhaust emissions from trawlers and equipment should comply with the standards of DoE.
- Regulars sprinkling of water and ramming the materials of stockyard regularly.
- Stockyard should be covered during non working period.

Residual Impacts

387. 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 impacts will be Low.

8.3.2 Change of Land Use

Impact

388. Land would be needed to establish temporary facilities including construction camp (labor shed) and borrowpit areas. Labor sheds would be constructed to establish temporary

facilities for workers during preparation of CC blocks for bank and slope protection works. As per consultation with the main consultant all labor sheds would be constructed in khas lands and requisite lands.

389. For the re-excavation of canals, materials and equipment mobilization requires land along the bank of the canals, which is used for crops production.

390. Borrow pits for extraction of construction material are expected to be both from inside the Polder and in the foreshore land11. 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 be filled up gradually due to sedimentation. The fallow land is used for scattered seedbed or grazing of livestock by the dwellers of the Polder.

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

Mitigation

- **The following mitigation measures are been suggested to address the above concerns:**

392. The construction camps should be established within the area owned by BWDB.

- Pay compensation/rent if private property is acquired on temporary basis, whose instructions should be specified in the tender document.
- Labor shed/camp should be constructed in 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, known fish spawning ground, habitat for any endangered flora /fauna species.

Residual Impacts

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

8.3.3 Fish Habitat Quality Deteriorate

Impact

394. There will be no significant impact on the fisheries resources during pre-construction phase. However, accidental spillage of diesel/fuel may occur during mobilization of construction materials and equipment by boats and can cause temporary or long-term impact to the habitat quality depending on the nature of the spillage.

8.3.4 Impacts on Vegetation for Preparation of Construction Sites, Labor Shed and Material Stock Yards

Impact

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

395. 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). In context to this Polder, it is suspected that the damage would be negligible to vegetation as most of the lands near the embankment inside the Polder is occupied by shrimp gher (lower land) or fallow (the upper dry land). These lands have no vegetation except low density of local grasses like *Cyperus rotundus* and *Cynodon dactylon*. These natural grasses grow seasonally and will be able to regenerate within one year after completion of the construction activities. However, the Contractor needs an approval of the DDCS&PMSC for final selection of site for construction, labour shed and material stock yards.

Mitigation

396. Habitat will be restored byplanting trees, grasses at the damaged sites after completion of construction works.

Residual Impacts

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

8.3.5 Increased vehicular traffic during mobilization

Impact

398. 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. The embankment is the main road for communication for a large portion of the local people. Most of the internal roads in the Polder area have been damaged by Aila and are not suitable for movement of vehicle. However, during weekly market days and marketing time, all the stakeholders use the embankment as road for carrying their goods for buying and selling and other purposes. 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 also located beside the embankment which will face traffic congestion during *Haat* time. Earth work for re-sectioning of embankment and vehicles movement also may create short term disturbances to the Polder inhabitants.

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

Mitigation

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

The contractor will prepare a traffic management plan (TMP) and obtain approval from the DDCS&PMSC.

- Contractor will implement the mobilization plan considering water vessels and launch movement in the external rivers and to avoid the launch movement times.
- 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.

- The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes.
- The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track.
- The works of the second half will be started after completion of first half.
- Work schedule will be finalized in coordination and consultation with local representatives and communities. Specifically Union Parishad members of the Polder.
- Local routes will not be blocked as much as possible. If unavoidable, alternative routes will 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 appointed during School time (10:00am to 13:00pm) and weekly market days (Hatbar)
- 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.

Residual Impacts

401. The temporary impacts on Hindrance for Pedestrian and Vehicle Movement are likely to be addressed with the help of above mitigation measures, and the significance of residual impact is considered be Low.

8.4 Impacts during construction phase

402. Implementation of the interventions involves the following activities:

- Re-sectioning of embankment
- Construction of Retired embankment
- Embankment slope pitching and turfing
- Construction of Drainage Sluices
- Slope protection work of the embankment
- Bank Revetment work
- Placing of geo bags and CC Blocks
- Re-excavation of Drainage khals
- Implementation of coastal afforestation

8.4.1 Deterioration of Environmental (Air and Noise) Quality

Impact

403. The construction activities particularly manufacturing of C.C blocks through mixture machines, earth work and its compaction along with operation of construction machinery will generate noise and vibration which are likely to affect the nearby communities. Increased noise levels may cause disturbance, nuisance to the nearby communities as well as to the construction workers. In particular, the settlements near the construction site will be exposed to noise and vibration generated by the Project activities. Therefore, sensitive receptors and pedestrians through the embankment cum road will likely to be severely affected by noise pollution which may create disturbance in performing the commercial activities.

404. The Table 8.2 below shows the noise level from the equipment. According to ECR'97, 50 dBA is applicable during day time for residential area in Bangladesh while Polder is situated in similar area.

Table 8.2: Noise level of equipment

SL	Equipments	Noise Level (dBA)
1	Bull-dozer	85
2	Excavator	80
3	Compactor	85
4	Concrete Mixer	85
5	Generator	81
6	Scraper	86

405. Besides, exhaust emission from the concrete mixture machine and fugitive particulates during construction activities especially for manufacturing CC blocks which are likely to affect the ambient air quality and the nearby communities. Fugitive dust emissions from the earthwork of embankment and khals and construction of drainage sluices would also deteriorate the ambient air quality of the locality. Moreover, the air and noise pollution are temporal and are reversible and will naturally return back to their baseline condition.

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

Mitigation

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

- Construction machineries should have proper mufflers and silencers.
- Noise levels from the construction machineries should comply with national noise standards (residential zone)
- Provision should be made for noise barriers at construction sites and schools, madrashas and other sensitive receptors as needed.
- Water sprinkling and compacting of the materials should be done during construction
- Exhaust emissions from the mixture machine should comply with standards
- Restricting/limiting construction activities during the day time.
- Provision of PPE (ear muffs and plugs) for labors to be ensured.
- Installation of fugitive particulate matter system and spraying water on construction materials.
- Construction team will be instructed to use the equipment properly, to minimize noise levels.
- Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.
- Installation of acoustic enclosures around generators.
- Notification of major noise generating activities to affected people.
- Prohibition of vehicle movement at night
- Monitoring noise in the nearby community.
- Preparation of noise and vibration management plan as a part of pollution control plan.

Residual Impacts

408. The impacts associated with noise and vibration is likely to be adequately addressed with the help of the above mitigation measures. The significance of residual impact will be Low.

8.4.2 Hindrance to the natural drainage system and create of drainage congestion

Impact

409. The construction activity particularly for construction/replacement of drainage sluices and re-excavation of the khals may create obstacle to the natural drainage system of the study area especially around the project activity sites. During construction, the natural drainage system of the area will be hampered and may create temporary drainage congestion.

410. The significance of this unmitigated temporal impact has been assessed as Moderate on the basis of impact magnitude and spatial extent.

Mitigation

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

- Some temporal earthen dams should be built in the khal behind the construction of drainage sluices and at both ends of the re-excavation segment.
- Bailing out of water within the earthen dams during construction work.
- Both contractor and BWDB should supervise the construction work and build temporary dams and demolish the same after completion of the construction.
- Facilitate drainage and erosion control measures at work sites near agricultural fields.

Residual Impacts

412. The impacts associated with drainage system are likely to be adequately addressed with the help of the above mitigation measures. The significance of residual impact will be Low.

8.4.3 Effects on Crop Production

Impact

413. About 9.9 ha of land (Ch 19.00km-Ch 20.00 km and Ch 26.250 km-Ch 28.500 km) are likely to be acquired for construction of retired embankment along Sakbaria River. This land includes single and double cropped areas which are likely to be affected. This land includes cultivated areas (here, single cropped land 0.57 ha and double cropped area 1.2 ha) shrimp culture in addition to houses and other structures. The losses of production under the acquired land are given in Table 8.3.

414. During collection of earth from the borrow pit areas no agriculture land would be impacted in the Polder area as all spoil earth would be collected from offshore area through manual excavation and river bed of Kobadak, Arpangasia and Sakbaria rivers as well as Jorshing Khal, Hajerali khal, Katak khal, Antihara Khal, Gharilal Khal, Sadderfer khal and Gholkhali Khal.

Table 8.3: Loss of Production under the acquired land (Retired Embankment)

Name of Crops	Area(ha)	Yield(T/ha)	Production loss (m.ton)
Boro (HYV)	1.2	5.03	6.04
T. Aman(HYV)	1.77	2.01	3.56
		Total	**9.60**

Source: Field information; 2015

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

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

Mitigation

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

Resettlement Action Plan should be prepared and should also be implemented accordingly

Compensation should be made for any crop damage.

Contractor should avoid cultivable 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 through cultivation fields.

Contractor should ensure that no material is dumped inside cultivation fields.

Re-excavated soil of canals should not be dumped in the agricultural lands.

Contractor should maintain liaison with the communities.

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

Residual Impacts

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

8.4.4 Effects on irrigation

Impact

419. Construction activities particularly on regulators, water channels and re-excavation (30km) activity of canals can potentially disrupt the irrigation during both wet and dry season thus negatively affecting the cultivation. The works on sluices can cut off the incoming water from the river; while the re-excavation works in water channels can affect water conveyance through them and also saline water would be enter the Polder area which can disrupt the crop production.

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

Mitigation

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

Contractor should construct diversion channel before construction/ replacement/ demolishment of the regulators.

Sequence of work for the regulators and the water channels should be carefully planned to avoid any disruption in irrigation.

Contractor should ensure of having no negative impacts on crop irrigation.

Contractor should maintain liaison with communities.

Contractor should work during the dry season.

Residual Impacts

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

8.4.5 Impacts on Feeding and Spawning Ground of Fish Habitat

Impact

423. Polder 14/1 is bounded by Kobodak and Arpangasia rivers on the west and Sakbaria 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 species like *Chewa, Pairsha, Gulsha Tengra, Bagda, chingri*, etc. It is expected that activities of bank revetment (earth work from km 5.3 to km 5.7 and km 28.7 to km 29.3) and slope protection (earth work from km 1.0 to km 2.0, km 3.0 to km 5.26, km 5.5 to km , km 7.0 to km 7.3, km 7.8 to km 8.8 and km 12.0 to km 12.5) would cause the partial destruction (if in the dry season) and full destruction (if in the rainy season) the feeding, nursery and even spawning ground of these fish species.

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

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

Earth work should be conducted during the dry season (November-May)

Sequence of work at the bank sides of Kobodak and Sakbaria rivers will be planned considering local fisheries condtion to minimize impacts on spawning and subsequently nursery ground of fish.

Contractor will maintain liason with experienced local fishermen.

Residual Impacts)

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

8.4.6 Impacts on Fish Habitat and Migration

Impact

426. There are 4 drainage sluices in the Polder of which two are fully damaged by Aila. In addition to these 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. These sluices are connected with the *khals* of the Polder. Under this project, replacement of damaged sluices as well as construction of new sluices will be conducted near the existing sluices. 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 Moderate. 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.

Mitigation

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

428. 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 hindrnace 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.

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

Residual Impacts

8.4.7 Impacts on Benthic Fauna

Impact

430. During construction activities including re-excavation of khals and bank protection work especially bailing out of water from the khals, clearing the bushes of the embankment slope, sloping and shaping of the embankment and placing of C.C blocks for bank protection would hamper the river habitat condition locally. The habitat of Mud eel fish species (*chewa, cuchia, baim,* etc) and some SIS (Small Indigenous Species), shrubs and others aquatic plants preferred species for laying eggs and benthic organisms will be destroyed due to this intervention.

Mitigation

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

Contractor will carry out khal excavation in segment thus minimizing impacts on benthic fauna.

Residual Impact

432. The Project's impacts on benthic fauna will be somewhat reduced with the help of the above mitigation measures. After the construction phase, these resources are likely to fully

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

8.4.8 Impacts on vegetation at embankment slopes for re-sectioning

Impacts

433. Re-sectioning of embankment will damage all undergrowth vegetation both at embankment slopes and the sites from which the soil would be collected. Most of the parts of the embankment of this Polder are barren and substantial parts of riverside slope have 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. However, usually all saplings of these strips are not matured and villagers use these plants as their fuel source. These saplings will be cut down/damaged during embankment re-sectioning.

434. On the other hand, 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..

Mitigation

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

- 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 DDDCS&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.

Residual Impacts

436. The impacts associated with re-sectioning of embankment will be adequately addressed with the help of above mitigation measures and the significance of residual impact will be negligible. Impacts on vegetation at embankment site and construction yards for bank revetment works.

Impact

437. Minor vegetation damage is expected at the proposed bank revetment sites. There is no referable vegetation at both locations of the proposed revetment sites. Most of the vegetation at foreshore mudflats has been washed out due to erosion of the river. Very few numbers of homestead trees need to be felled for slope raising and placing of geo textile. Besides, preparation of construction yard CC Block manufacturing/ casting will be placed near the existing shrimp gher after dewatering. So there is no question of vegetation loss.

Mitigation:

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

439. Choose barren land for CC Block manufacturing and material storing.

440. Implement plantation with native species along countryside slope of the embankment after finishing of construction works.

Residual Impacts

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

8.4.9 Impact on vegetation at construction sites of water control structures

442. About 40 numbers of trees of different size and heights need to be felled down near Matiabhanga Gharilal for construction of new structure "DS 6" (Table 8.4 below). No other trees are suspected to be felled down for construction of other water control structures. The vegetation damage will be compensated according to Resettlement Action Plan (RAP).

Table 8.4: Number of Trees to be affected for construction of drainage sluice

Location Name	Tree Name	Number of trees to be cut
Matiabhanga Gharilal	Kewra (*Sonneratia apetalla*)	20
	Bain (*Avecenia officinalis*)	10
	Babla (*Acacia nilotica*)	40

Mitigation:

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

- Plantation to be made near the sluice and near by foreshore mudflats after completion of the construction works.
- Saplings planted should be protected so that they are not washed out by the tide. Local community members may be employed for this.
- Prepare a flora, fauna protection plan.

Residual Impacts

444. The impacts associated with Construction of drainage sluice are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Low.

8.4.10 Impacts on foreshore ecosystem for coastal afforestation

445. In context of this Polder, most of the foreshore areas have already been planted under coastal afforestation by Climate Resilient Ecosystems and Livelihood (CREL) Project. However, further afforestation program may damage the existing undergrowth vegetation due to labor movement. Incautious disposal of sapling's poly bags may cause deterioration of soil quality during plantation at foreshore area. There may be a risk of outbreak of plant diseases to the other existing plants from the planted disease affected saplings. Water flow in creeks and strips of planted area may interrupt for aggregation of plant or plant shoots. Inadequate distance between the two saplings may hinder proper growth and cause outbreak of disease.

Mitigation:

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

- Aware labors, engaged for afforestation activities on plant conservation
- Keep close liaison with CREL Project Authority and Forest Department while implementation of plantation program
- Collect saplings from nearby natural sources (i.e., from mangrove forest at eastern bank of Sakbaria River and western bank of Arpangasia River) as much as possible
- All kinds of polyethylene bags and plastic ropes should be piled up in a pit for disposing (dumping or burning) them properly.
- Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation (i.e., use of disease free seeds, proper treatment of nursery soils, use of appropriate doses of pesticides and fertilizers)
- Pre-consultation with Forest Department and other concerned non-government organizations for selecting suitable species for plantation and spacing of the saplings
- Develop a pest management plan for the holistic afforestation
- Monitor the survival and growth of planted saplings for at least three years after completion of the project under the Social Forestry Program of the Forest Department.

Residual Impacts

447. The impacts associated with foreshore afforestation are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be nil.

8.4.11 Impacts on Sundarban and Mangrove Forest

Impacts

448. Polder 14/1 is adjacent to the Sundarbans Reserve Forest area. But it is totally isolated by Sakbaria River to its eastern and south-eastern parts and by Arpangasia River to its south-western parts. The average width of these rivers are about 400m. So, there will be no impacts on Sundarban Reserve Forest area by the construction activities.

449. But there is a small mangrove forest close to the embankment of polder 14/1 at chainage from 20.00 km to 21.00 km adjacent to Daskhin Bedkashi village. The local community declared this area as a wildlife sanctuary and locally formed a committee as 9 no Binapani Ward Disaster Management Committee to protect the areas. Basically this Sanctuary is not related by the Sundarban Reserve forest area. But, there will be some impacts like cleaning of some area that decreases the wildlife habitat, restricts their movement and noise/sound produced by construction activities during construction period that will disturb the wildlife inside the locally declared wildlife sanctuary.

Mitigation Measures

450. The following mitigation measures are suggested to minimize the above concern issues:

- Alignment of embankment near the sanctuary areas to be avoided if possible. If not then use as less as possible.

- Fencing should be made near the wildlife sanctuary area to protect the wildlife’s movement in the construction areas.
- Noise barriers to be established along the wildlife sanctuary areas to protect the sound
- Mangrove plantation should be made to the affected areas after completion of construction works.
- Construction work should be avoided during night.
- Awareness should be build up to the construction labors not to create disturbance to the animals in the mangrove forest area during the construction period.

8.4.12 Safety and Public Health Hazards

Impact

451. The area is prone to cyclones and storm surges. The works will be carried out during dry season; a certain level of safety hazards will still exist 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 to the construction workers. The fuel storage at the camp sites (eight camp) may also pose safety hazards for both the construction staff and the 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 will potentially pose health hazards for 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.

Mitigation

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

- The contractors will prepare site specific Health, Safety and Environment, Health and Safety (EHS) (Plan and obtain approval from the Detailed Design,Construction Supervision & Project Management Support 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 are to be included in the contract documents.
- Liaison will have to be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets will have to be given to all the labor camps for obtaining weather information.
- Each contractor will have to 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 workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.
- The construction sites will have protective fencing to avoid any unauthorized entry, where appropriate and possible.
- Health screening of employees would be a 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 when required.

- All employees need to carry out induction health and safety training prior to the commencement of work. Occupational Health Safety (OHS) issues would be part of the employee training plan. Training would include provision of appropriate written or visual materials to reinforce learning. Where illiteracy levels are high, OHS issues need to be covered more frequently than normal in toolbox talks.
- Public awareness training and workshops on safety and health risks will be conducted for local communities prior to and during construction operations.
- Observe the statutory requirements related 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 activity. The construction contractor(s) would not hire people under the age of 18 on permanent contracts and 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 will establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.
- The contractor will adopt a Human Resource Policy appropriate to the size and workforce which indicates the approach for management of 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 (this could be full time or part of another post's responsibilities).
- Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training.
- Report regularly on the labor force profile, including gender, and location source of workers.
- Report regularly on 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 programs and keep training registers for construction workers.
- Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy working considering the inherent risks for this type of project.
- Availability of safe drinking water will have to be ensured for the construction staff.
- First aid boxes will have to be made available at each construction site. Emergency phone numbers (including hospitals, Fire Department, and Police) will have to be displayed at key locations within the site. Each site will have an ambulance available.
- Firefighting equipment will 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 will have to be maintained.

Residual Impacts

453. The impacts associated with safety and health hazards are likely to be mostly addressed with the help of above mitigation measures and the significance of residual impact will be Moderate.

8.4.13 Increased Inland and Waterway Traffic

Impact

454. Transportation of construction materials is a key concern during the Project since the Polder 14/1 is located in a remote area of Koyra Upazila under Khulna district. Two broad options are available for carrying construction materials to the Project stockyards in the Polder. The first option is road transportation and the second option is waterway transportation which is comparatively easier, cost effective and faster. Material transportation along the major roads and waterways may not create any significant problem; however, additional traffic may cause traffic congestion and hindrance to other commuters, travelers, and transporters in the existing jetties. For the material transportation from the stock yard to the construction sites, Polder's internal roads can be used; alternatively, the outer rivers can also be used for this purpose.

Mitigation

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

- Contractor to prepare and implement traffic management plan.
- Contractor to establish new or temporary jetties where needed.
- River crossing for material transportation should be made during night time where possible and appropriate.
- Material transportation to be made through rivers during high tide as and where needed.
- Liaison to be maintained with community and BIWTA; and also with the law enforcement agencies for security reasons.

Residual Impacts

456. The impacts associated with additional traffic on roads and along water ways are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Low.

8.4.14 Hindrance for Pedestrian and Vehicle Movement

Impact

457. Four main markets are located in the Polder near the embankment; these include Ghorilal Bazaar, Chairman Bazaar, Angtihara Bazaar and Jorshing Bazaar. These markets play important roles by providing sources of livelihood for the Polder inhabitants as well as meeting the daily needs of the people. Construction activities along the embankments are likely to disrupt the activities of these markets. 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.

Mitigation

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

- 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.

Residual Impacts

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

8.4.15 Damage to Local Infrastructure

Impact

460. There could be some inadvertent damage to the roads, electricity lines, water channels, jetties, and other structures during the construction activities, transportation of equipment and material, and associated vehicular traffic.

Mitigation

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

The condition of the infrastructure being used for the construction and transportation activities will be regularly monitored.

All damaged infrastructure will be restored to original or better condition.

To take preventive measures for protection of local infrastructure.

Residual impacts

462. The impacts associated with damage to infrastructure are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Low.

8.4.16 Social unrest between Local worker and outside worker

Impact

463. A large 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.

- Demand of the local people related to the labor recruitment processes.
- Conflicting issues between the labors and the contractors related to wage, working hour, working facilities, women workers involvement and payment schedule.
- May create labor leadership problem.

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

Mitigation

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

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.

Liaison with the communities will have to be maintained.

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 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.

Residual Impacts

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

8.4.17 Seasonal Impacts due to natural hazards

467. Historically, this area is vulnerable to cyclone, storm and tidal surges. As per construction schedule, the rehabilitation activities of the Polder will be conducted from October to May when most of the cyclone and storm surges are occurred in this area. According to previous records of occurance of cyclone and storm surges are within the month from October to November and April to May. It is suspected that the construction activities during this period may be hampered as well as workers may be injured.

Mitigation

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

- Weather signals will have to be considered by the contractor during construction works.
- Radio and television will have to be provided in all the labor sheds for receiving weather information through these media.
- Ensuring rigorous standards for occupational health and safety are in place.

Residual Impacts

469. The impacts associated with seasonal impacts (natural hazards) are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Low.

8.5 Impacts during Post-construction Phase

(a) Positive Impact of the Project

8.5.1 Protect tidal flooding and storm surges

Impact

470. The proposed re-sectioning and retirement of embankment with new design section by CEIP, considering 5thIPCC (2013) predicted global sea level rise, will protect the Polder area significantly from tidal flooding and further storm surges. At present about 85% of the embankment is under designed and are in extremely vulnerable condition at Uttar Bedkashi, Gazipara, Padmapukur, Horiharpur, Sakbaria, Dakshin Bedkashi, Choramukha, Maider char, Matiabhanga, Golkhali, Gharilal, Chhota Angtihara, Bara Angtihara, Angtihara, Jorshing, Binapani areas of the Polder could be protected noticeably after implementation of the proposed interventions under CEIP.

471. The significance of this potential positive impact has been assessed as Major on the basis of impact magnitude and sensitivity to receptors.

8.5.2 Erosion Protection

Impact

472. The proposed slope protection work and bank revetment works along the embankment would protect the Polder area from river erosion. If the proposed protective works are implemented adequately at the mentioned locations or chainage, the Polder will be protected significantly from erosion. Besides, the proposed afforestation along the rivers will also protect

the river erosion by minimizing the wave action during high tide. Moreover, it will safeguard social livelihood and ensure socio-economic security, assets along with the ecosystem of the study area.

473. The significance of this potential positive impact has been assessed as Major on the basis of impact magnitude and sensitivity to receptors.

8.5.3 Improve drainage system

Impact

474. After implementation of the proposed re-excavation of internal drainage khals and construction of drainage sluices as per design and specification by CEIP, the drainage system and situation of the Polder area would be improved significantly. The conveyance capacity of the khals will be increased which will increase the water retention of the Polder area. Consequently, the cropping pattern will be increased while presently about 80% of the Polder net area is covered by shrimp culture ghers. Drainage congestion in Hajer Ali khal and North Jorshing khal during monsoon will be removed and drainage pattern will be smoother than the present condition.

475. The significance of this potential positive impact has been assessed as Moderate on the basis of impact magnitude.

8.5.4 Protect salinity intrusion

476. According to the proposed intervention, re-sectioning and retirement of the embankment and construction of drainage sluices as per design would protect saline water intrusion in the Polder area. Proper construction of sluices and adequate operation of the sluices will protect saline water intrusion in the Polder during dry season while about 80% of the net area of the Polder is occupied by shrimp culture ghers. It is very important to operate the sluices; WMOs would be formed and take over the maintenance and operation of the sluices adequately to protect saline water intrusion.

477. Increased Crop Production Presently, the cropping intensity of the Polder area is 130%. According to the proposed intervention, the Polder would be protected from tidal and monsoon flooding and will arrest salinity intrusion and would remove drainage congestion from the Polder area. Besides, drainage congestion will be significantly reduced due to re-excavation of internal khals of the Polder area as per proposed plan. Due to the improved situation, farmers of the respective areas would be encouraged to cultivate more crops in their lands. Thus, it is expected that the cropping intensity would be 132% in the Polder area in future (Table 8.5). So, cropping intensity of the Polder area would be increased by around 2% from the base situation.

Table 8.5: Future cropping pattern of the Polder area

Land type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (November-February)	FWIP	
				Area (ha)	% of NCA
MHL	Fallow	HYV Aman	Hybrid Boro	116	32
	Fallow	HYV Aman	Fallow	192	53
	Fallow	Lt.Aman	Fallow	54	15
Total				**362**	**100**

Source: Filed information; 2015

478. Presently, total cropped area is about 471 ha (NCA 362 ha), which is totally occupied by rice crops. If the project is not implemented the area will remain same as baseline or may

reduce due to salinity problem and the production would decrease from the baseline situation. The farmers would be desperate to produce more crops for their increased demand under FWOP condition. A total of 1,573 metric tons crop would be produced which is rice. Adverse impact may occur due to siltation of river and drainage channels. The production would remain same as base situation or may decrease (Table 8.6).

Table 8.6: Impact on crop production and land use in the Polder area

Crop name	Baseline/FWOP			FWIP			Impacted area (ha)	Impact (FWIP-FWOP)	% of Change
	Crop area (ha)	Yield (m.tons/ha)	Production (m.tons)	Crop area (ha)	Yield (m.tons/ha)	Production (m.tons)			
Lt.Aman	67	2.01	135	54	2.10	114	-13	-21	-16
HYV Aman	295	3.02	888	308	3.20	985	13	96	11
Hybrid Boro	109	5.03	549	116	5.20	602	7	53	10
Total	**471**		**1,573**	**478**		**1,701**	**7**	**128**	**8**

Sources: CEGIS Assessment from field information and DAE, November; 2015;

479. The cropped area would be increased if the project is implemented. The estimated cropped area would be about 478 ha which will be totally occupied by rice crops. The total crop production would be about 1,701 metric tons. Rice production would be increased mainly due to protection of agricultural land from river bank erosion, construction of structure and repairing/replacing of the structure with adoption of modern technology in crop production, change in cropping pattern etc. Production would be increased due to expansion of Aman (HYV), Boro (HYV), Orchard, and vegetables cultivation area. Additional 128 tons (8% positive change) of rice would be produced in FWIP over FWOP (Table 8.6).

8.5.5 Polders Enhance Fish Habitat condition

480. Bank protection work will create new fish habitats. The works will also promote the production of periphyton and serve as grazing ground for sucker and algae feeding aquatic species like shrimps, snails and certain fishes like *Kine Magur, Tengra*, *Aire, Bele, Baro Baim*, etc. The significance of this localized impact has been assessed as medium on the basis of impact magnitude and receptor sensitivity.

Enhancement measures

- Harmful fishing gear like gill net (Current Jal) and Net jal (used in the inlet of sluice) should be banned in the Polder area.

8.5.6 Impacts on foreshore area for afforestation

481. Implementation of foreshore afforestation program of this project will mitigate the negative impacts associated with tree felling. Consequently, it will enhance mangrove vegetation coverage surrounding the Polder which is expected to protect the embankment from tidal surge, reduce erosion of foreshore land and provide habitats especially for various avifauna.

8.5.7 Employment Generation

482. The construction work will generate a significant amount of employment throughout its construction period for local people and other associated professionals. People will also be involved in carrying the operation and maintenance related jobs to operate the hydraulic structures. It is expected that the agriculture production will increase and water logging will

decrease for the project which indirectly will create jobs in agriculture, business and commercial services. On the other hand, during construction period, earthwork of embankment and construction of structures will create temporary employment opportunities for laborer of the Polder. The employment generation represents the different way of livelihood by which people can generate their income and improve their living standard.

8.5.8 Gender Promotion

483. Construction work requires various types of skilled and unskilled labors. A portion of construction labors in Bangladesh. Females in the Polder area are vulnerable to natural disaster and mostly the distressed and widow who are dependent on others and do not have any definite source of income. The construction activities in the Polder will open a new window for them regarding employment. Therefore, the employment access for these women during construction period and operation/maintenance period is significantly positive for gender promotion.

8.5.9 Livelihood Development

484. Polder 14/1 is one of the worst affected Polders during cyclone Aila. The project is expected to increase resilience of people within Polder 14/1. On the other hand, intrution of saline water for shrimp cultivation decreases employment opportunities in the area. But it is expected that the intervention may increase the agriculture production and income generation which will improve the livelihood of the people.

8.5.10 Social Use of Water

485. One of the main utilities of water is its social uses i.e. taking shower, washing chores and other social uses. During summer, most of the open water bodies i.e. Khals and ponds dry up and causes scarcity of water where the proposed channels are re-excavated for drainage. As a result, people cannot use water for their social needs at that time. Hence, if the proposed channels are re-excavated for drainage, it will ensure the various social use of water.

8.5.11 Disaster Incidence

486. The study area being nearest to the Bay-of-Bengal, natural disaster often hit this area due to lack of any functional protectivemeasure and thus the people of this locality are very much vulnerable affecting the lives and properties from different natural disaster. After implementation of the proposed interventions, the Polder area will be protected from different natural disasters, e.g., tidal surge, river erosion, flooding, etc.

8.5.12 Seasonal Out-migration

487. For the lack of employment opportunities, out-migration is most frequent in the area. But it is expected that the interventions will reduce the seasonal out migration of day laborers from this Polder due to creation of employment opportunities in agriculture and other sectors respectively. Out-migration will also be reduced during construction activities of the Polder. Moreover, in migration in the Polder area during crop havesting may increase.

8.6 Negative impact of the Project

8.6.1 Risk of Embankment Failure

Impact

488. Rain cuts, wave action, tidal surge and public cuts are the major causes of embankment breaching of the coastal region. Lack of regular maintenance creates weak point at the sensitive locations of the embankment. Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously accelerates the risk of embankment failure. Counter clockwise circulation of the cyclone of the Bay of Bengal make the embankment more susceptible to breaches too. On the other hands, hand tube-wells, which are locally known as ninety tube-well, are installed at the crest of the embankment by the Gher owners for lifting saline water to satisfy the water demand for shrimp cultivation which seriously weakens the embankment and increases the risk of embankment failure.

Mitigation

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

- Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the eastern side of the Polder will have to be ensured. Monitoring will particularly be carried out before and after monsoon season.
- Prevent the establishment of hand tube-wells at the crest of the embankment.
- Available cyclone and flood shelters will have to be prepared as a contingency measure during emergency situation.
- WMG will have to develop funds for facing any emergency situation.
- Materials like geo bag and sand bag will have to be kept in stock yard of local BWBD colony.

Residual Impacts

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

8.6.2 Increase of Salinity Intrusion Due to Leakage of Regulators

491. 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.

Mitigation

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

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

Residual Impacts

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

8.6.3 Increase use of agro-chemicals

Impact

494. At present, about 109 ha and 295 ha of land are under HYV Aman and HYV Boro rice cultivation respectively. Shrimp culture practices are dominating here due to saline water. After the fulfillment of intervention at Polder area the land protected for agriculture practices would be increased instead of shrimp farming. Continuous agriculture practices causes reducing the soil fertility and consequently increases the use of agro-chemicals.

495. Presently, 168,460 kg of chemical fertilizers is required for cultivation of HYV Aman and HYV Boro rice. The pesticides required for total rice production is 2,347 kg of granular pesticide and 293,700ml of liquid pesticides. According to the initial estimate it is assumed that the, non saline water would be available from the internal canal system, after the completion of the project and will reduce the salinity problem of the entire Polder area. This would allow expansion of irrigated cultivation of HYV Aman and HYV Boro rice. Such expansion of irrigation is likely to result in the decrease of soil fertility and increased use of chemical inputs including fertilizers and pesticides. Due to expansion of HYV Aman and HYV Boro cultivation, additional 8,500 kg of chemical fertilizers and granular pesticide 121 kg and liquid pesticides 14,700 ml would be required for future crop production (Table 8.7). Runoff from these cultivated fields might potentially pollute the water bodies and even drinking water sources thus causing health hazards to the communities.

Table 8.7: Impact on area (ha) fertilizers (kg) and pesticides (Tk) required in present and future situation

Crops Name	Baseline/FWOP							FWIP					Impact		
	Present cultivate area (ha)	Chemical Fertilizer required (kg/ha)	Granular pesticides required kg/ha	Liquid pesticide required ml/ha	Total Fertilizer required (kg)	Total granular pesticides required (kg)	Total liquid pesticides required (ml)	Future cultivated area (ha)	Increased area (ha)	Total future fertilizer required (kg)	Total future granular Pesticides (kg)	Total future liquid pesticides required (ml)	Chemical Fertilizer (kg)	Granular pesticides (kg)	Liquid pesticide (ml)
HYV Aman	295	390	5	700	115,050	1,475	206,500	308	13	120,120	1,540	215,600	5,070	65	9,100
Hybrid Boro	109	490	8	800	53,410	872	87,200	116	7	56,840	928	92,800	3,430	56	5,600
Total	**404**				**168,460**	**2,347**	**293,700**	**424**	**20**	**176,960**	**2,468**	**308,400**	**8,500**	**121**	**14,700**

Sources: CEGIS Assessment from field information and DAE, November; 2015;

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

Mitigation

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

498. Capacity building and awareness raising of the farmers should be carried out regarding use of 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 ICM and GAP.

Farmer should be encouraged to use organic and green manure to increase the soil fertility as well as avoid to water contamination of water sources.

Farmers should be encouraged to cultivate leguminous crops (N_2 fixing) to enhance the soil quality as well as the soil productivity.

Residual Impacts

499. The impacts associated with usage of increased level of chemical inputs are likely to be somewhat addressed with the help of above mitigation measures and the significance of residual impact will be moderate.

8.6.4 Reduction of Fish Migration Time and Extent

Impact

500. 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.

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

Mitigation

502. 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;

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

503. 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

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

8.7 Impacts from CC block Manufacturing Plant

505. For the automated CC-block manufacturing plant, the impact assessment is focused on the environmental and social impacts of the operation phase and future decommissioning phase. The residual impacts of the construction phase are described when relevant.

8.7.1 Operation phase

506. A scoping / screening process of the potential impacts gathered through several visits to the CC-block manufacturing plants leads to the following potential impacts during the operation phase of the plants:

- Environmental
  - Involvement of Labour/Workers in the Plant
  - Air Emissions and Ambient Air Quality

  - Greenhouse Gas Emissions and Energy Use
  - Noise
  - Waste Management
  - Contaminated Land and Hazardous Materials Management
- Occupational Health and Safety
- Community Health and Safety
- Land Requirement

507. The potential impacts thus predicted are characterized as follows:

- Beneficial Impacts
- High negative (adverse) impact
- Moderate negative impact
- Low impact

508. Appropriate mitigation measures are then recommended for the Moderate and High Impacts, thus reducing the occurrence possibility and severity of the potentially adverse impacts.

509. Beneficial Impacts are described and enhancement measures are recommended.

8.7.2 Beneficial impacts

510. The primary beneficial impact is employment generation. For the operation of the plant as well as in the supply chain, multiple workers are needed as operators, Fork lift/ truck drivers, boat operators etc.

511. In order to enhance this positive impact the contractor is required to engage local workers in various positions as much as possible.

8.7.3 Negative impacts

8.7.3.1 Emissions to air and ambient air quality

Potential Impacts

512. Air emissions will be generated from storage and handling of raw materials (mainly sand and cement) and emissions from equipment for transport, power supply and the plant itself. These emissions can deteriorate the ambient air quality in the immediate vicinity of the CC-block manufacturing plants. These emissions pose health hazards for the nearby communities as well as for the workers. In particular, any settlements near the plant areas may be exposed to air emissions caused by the CC-block manufacturing activities. However, effects of air pollution on biological and material receptors like flora, fauna, and construction materials need to be analysed.

Mitigation

513. Dust (particular matter) can be prevented with the following mitigation measures:

- Emission inventory on a regular basis and comparison with air quality standards and between CC-Block plant operational and non-operational days

- Segregation of storage areas from other operational areas
- Use of wind protection, barriers for wind protection for raw material stored in open piles
- Construction material (sand/soil) to be kept covered while transporting and stock piled
- Water sprinkling to be carried out where needed, particularly in dry season and on plant tracks and access roads near residential areas
- Enclosed dry raw material transportation systems (e.g. conveyors belts)
- Dust extraction equipment and bag house filters, particularly for dry materials loading and unloading points
- Vehicle speed to be low at site and access roads (maximum 15 km per hour)
- Air quality monitoring to ensure mitigation measures are working, and further action to be taken if tolerance limits are exceeded

Monitor flora, fauna within the vicinity of the CC-plant for any impact.

514. Pollution prevention and control techniques for the reduction of SO_2 and NO_x emissions include:

- Exhaust emissions from vehicles and equipment will comply with standards
- Proper tuning of vehicles, generators, and equipment, to minimize exhaust emissions
- Vehicles and other machinery to be turned off when idle
- Good quality fuel
- Use of fuels with a low sulphur content (natural gas or LPG)

515. In addition to the above, liaison with the nearby communities will be maintained and a grievance redress mechanism will be established at the plant for workers and nearby residents.

516. Greenhouse Gas (GHG) Emissions and Energy Use. Greenhouse gas emissions, especially CO_2, are mainly associated with the use of energy in the plants. Reference is made to the above measures to reduce SO_2 and NO_x emissions to reduce greenhouse gas emissions. However, the plant is not considered as a major energy consumer and therefore the impacts are considered low.

Residual impact

517. By implementing a proper selection of above mitigation measures, the impacts associated with air emissions and ambient air quality are likely to be adequately addressed and the significance of residual impacts will be low. Post-project epidemiological studies may also show residual impacts (if any) related to prevalence of bronchitis or other air pollution related diseases either among the workers or people living in the vicinity.

8.7.3.2 Noise

Potential Impacts[12]

- [12] **Noise exposure to workers is further covered under the section on Occupational Health and Safety.**

518. The CC block manufacturing activities will generate noise and vibration, which are likely to affect any nearby communities and workers. Increased noise levels may cause disturbance, nuisance and even health hazards for nearby communities as well as for the workers. If the CC block plant is not close to residential areas these impacts on nearby communities are considered low to moderate.

Mitigation

519. In order to mitigate noise impacts the following mitigation measures should be implemented:

- Restricting/limiting operation activities during 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 residential areas and other sensitive receptors
- Installing vibration isolation for mechanical equipment
- The plant operators will be instructed to properly use the equipment, to minimize noise levels
- Liaison with the communities will be maintained and grievance redress mechanism will be established.
- Provision and use of effective earmuffs and where necessary additional earplugs and other PPEs by workers to be ensured.
- Introduction of rotational works of workers at high noise area to limit the time spent at work site and conduct of regular hearing test of workers

Residual impact

520. Implementing a proper selection of above mitigation measures, the impacts associated with noise are likely to be adequately mitigated and the significance of residual impacts will be moderate to low. Monitoring should be applied in order to substantiate this assessment.

521. **Monitoring**

522. Noise impacts should not exceed the levels presented in Table 9 below or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Table 8.8: Noise Level Guidelines (Source: WB Guidelines)

•	• **One Hour L_{Aeq}(dBA)**	
• **Receptor**	• **Daytime 07.00 – 22.00**	• **Night-time 22.00 – 07.00**
• **Residential, institutional, education**	• **55**	• **45**
• **Industrial, commercial**	• **70**	• **70**

8.7.3.3 ***Waste Management***

Potential Impacts

523. The CC block manufacturing activities will generate solid and liquid waste. Solid waste will include domestic garbage; refuse from CC block construction, empty cement bags, etc. Liquid waste will include sewerage. The impact is considered moderate to low as the process does not generate much waste and the numbers of workers is limited.

Mitigation

524. The Contractor will prepare and implement a pollution control and waste management plan based on a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes.

525. Hazardous wastes should always be segregated from non-hazardous wastes. If generation of hazardous waste cannot be prevented through the implementation of the above general waste management practices, its management should focus on the prevention of harm to health, safety, and the environment. The following additional principles should be adhered to:

- Understanding potential impacts and risks associated with the management of any generated hazardous waste during its complete life cycle.
- Ensuring that contractors handling, treating, and disposing of hazardous waste are reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the waste being handled
- Ensuring compliance with applicable local and international regulations

Residual impact

526. Implementing a proper Waste Management Plan will mitigate potential impacts to low.

8.7.3.4 Contaminated Land and Hazardous Materials Management

Potential Impacts

527. Contamination of land should be avoided by preventing or controlling the release of hazardous materials, hazardous wastes, or oil/chemical to the environment. When contamination of land is suspected or confirmed, the cause of the uncontrolled release should be identified and corrected to avoid further releases and associated adverse impacts. Contaminated lands should be managed to avoid the risk to human health and ecological receptors.

528. The main risks for contaminated land at the plants is the storage and transfer/unloading of oil and lubricants for the vehicles and equipment. However, the limited use and the fact that oil and lubricants are not a feed stock material to be used in the process or product of the plant leads to a moderate to low potential impact.

Mitigation measures

529. Control measures to be implemented are: construction of secondary containment for storage tanks , avoidance of underground storage tanks and controlled transfer of oil from vehicle tanks to storage and vice versa. Proper secondary containment structures should be capable of containing at least 110 per cent of the largest tank or 25% per cent of the combined tank volumes in areas with above-ground tanks with a total storage volume equal or greater than 1,000 litres.

530. Workshops should be equipped with impermeable floors and oil-containing equipment should only be repaired in workshops.

Residual impact

531. Implementing the mentioned preventive measures will mitigate potential moderate impacts to low.

8.7.3.5 Occupational Health and Safety(OHS)

Potential Impacts

532. Potential impacts related to occupational health and safety at the plant entails mainly physical hazards, as there are:

- Rotating and Moving Equipment
- Noise and vibration
- Industrial Vehicle Driving and Site Traffic

533. The impacts from the rotating and moving equipment and of noise and vibration are considered high. The impacts from the vehicle driving and site traffic are considered moderate.

Mitigation Measures

Preventive and protective measures should be based on a comprehensive job safety analyses and be introduced according to the following order of priority:

- Controlling the hazard at its source through use of engineering controls, e.g. machine guarding, acoustic insulating, etc.
- Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.
- Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.
- A Health and Safety Plan and an Emergency Response Plan should be developed and included in the Contractor's ESMP
- A health screening of employees from outside the region should be carried out prior to labourers start working on site.

HR related measures are:

- Ensuring acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work
- Ensuring no workers are charged fees to gain employment on the Project;
- A labour grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal will be installed. Existing GRM may be utilized to address this with the present GRC members on-board.
- 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
- International and national laws and regulations should be followed related to minimum age for employment of children (no employment of any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activities)
- Proper and regular wage payment to workers and maintain gender equity.

534. To protect the occupational health and safety at the plants further, the following is required as a minimum:

- Noise-absorbing materials should, to the extent feasible, be applied
- Rotating and alternating parts of the equipment should be physically isolated
- Passageways for pedestrians and vehicles within and outside buildings should be segregated and clearly indicated
- Drivers on the forklifts require specific training and should be fit for the job
- Occupational health and safety training should be organized and specified for the hazards identified
- Exposed moving parts or exposed pinch point of the equipment should be guarded
- Noise levels should be within the following limits:

535. No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).

536. The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A).

537. Although hearing protection is preferred for any period of noise exposure in excess of 85 dB(A), an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB(A) increase in sound levels, the ‘allowed’ exposure period or duration should be reduced by 50 per cent.

538. Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, periodic medical hearing checks should be performed on workers exposed to high noise levels.

- Exposure to whole-body vibrations from surfaces on which the worker stands or sits, should be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure.

Residual impact

Implementing the mentioned mitigation measures will mitigate the impacts to low.

8.7.3.6 <u>Community Health and Safety</u>

Potential Impacts

539. Potential impacts related to community health and safety for the CC block plant entails mainly traffic related hazards.

Mitigation Measures

Mitigation measures include:

- Transport safety practices as training on safety aspects and driving skills among drivers and use of speed control devices on trucks
- Regular maintenance of vehicles
- Minimizing pedestrian interaction with construction vehicles
- Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads

Residual impact

Implementing the mentioned mitigation measures will mitigate the impacts to low.

8.7.3.7 Cumulative and Induced Impacts

Neither cumulative nor induced impacts are expected from the CC block manufacturing plants, as they are relatively small stand-alone plants with a minimum impact except for noise and air pollution.

With the construction of the automated CC plant land use has changed for the time being but may remain so in the long run.

8.8 Decommissioning phase

540. This section provides additional, specific guidance on prevention and control of potential impacts that may occur during decommissioning of the CC block plant. In order to avoid repetition, cross-referencing is made to above sections.

8.8.1 Environmental

Air Quality, Noise and Vibration

Potential Impacts

541. Potential impacts on air quality and noise and vibration impacts during decommissioning of the plants will be related to the use of cranes, vehicles and other demolishing equipment, and transport of materials. Air quality may be impacted due to soil erosion after decommissioning as well; soil erosion could be caused by the exposure of barren soil surfaces to wind.

542. Due to the limited size of the plant area the potential impacts on the environment during decommissioning is considered to be low.

8.8.2 Solid waste and contaminated land

Potential Impacts

543. Solid waste will mainly be limited to refuse from CC block construction (concrete leftovers), rejected CC blocks, empty cement bags, scrap metal, etc. The impact is considered moderate to low.

544. Small amounts of hazardous wastes will include: small amount of contaminated soils, unspent solvents, oily rags, used filters, empty paint cans, empty chemical containers, used lubricating oil and used batteries and lighting equipment.

545. Not properly managed these wastes might lead to a moderate to high impact on both the terrestrial and aquatic environment as well as human health and safety.

Mitigation Measures

- The Contractor will prepare and implement a pollution control and waste management plan based on a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes.
- In the absence of qualified commercial or government-owned waste disposal operators in Bangladesh, these wastes might be managed through installing on-site waste treatment or recycling processes (waste could be assembled at one site). However, considering the amount of these wastes, the final option might be an environmental sound long-term storage of wastes at an appropriate location up until external commercial options become available.

Residual Impacts

546. Implementing proper waste management as described above will lead to low residual impacts

8.8.3 Surface water

Potential Impact

Soil erosion caused by the exposure of barren soil surfaces to wind and rain during and after site clearing may result in impacts to the quality of the natural water systems and ultimately the biological systems that use these waters. The potential impact is considered to be moderate.

Mitigation Measures

Soil erosion and water system management could include:

- Scheduling to avoid heavy rainfall periods (i.e., decommissioning during the dry season) to the extent practical
- Mulching or re-vegetating to stabilize exposed areas
- Designing channels and ditches for post-construction flows
- Reducing or preventing off-site sediment transport through use of proper site drainage, settlement ponds, silt fences, etc.

Residual impact

547. Implementing the mentioned mitigation measures will mitigate the potential impacts to low.

8.8.4 Occupational and community health and safety

Potential Impacts

548. Occupational and community health and safety will not substantially differ from the above described. An exception might be traffic safety. Decommissioning traffic will include movement of heavy vehicles and local cargo vessels for the transport of materials and

equipment increasing the risk of traffic-related accidents and injuries to workers and local communities. Potential impacts are considered moderate to low.

Mitigation measures

549. Accidents involving project vehicles and boats/cargo vessels during decommissioning should be minimized through a combination of education and awareness-raising, proper planning (avoiding severe weather conditions), and coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents. Specific attention should be paid to decommissioning works in the Health and Safety Plan and Emergency Response Plan.

Residual Impacts

550. Implementing the mentioned mitigation measures will mitigate the potential impacts to low.

9. Cumulative Impacts

9.1 Cumulative Impacts

551. **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.

552. 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.

553. **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.

554. 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 14/1. 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 14/1 under Coastal Embankment Improvement Project-1 (CEIP-1). These effects include cumulative impact of Polder 14/1 and the reciprocal impacts of climate change and other Polders in the vicinity. Necessary mitigation measures need to be proposed based on analysis of cumulative impacts on rivers/watercourses hydrology and fish migration. Currently, no mitigation measures are proposed.

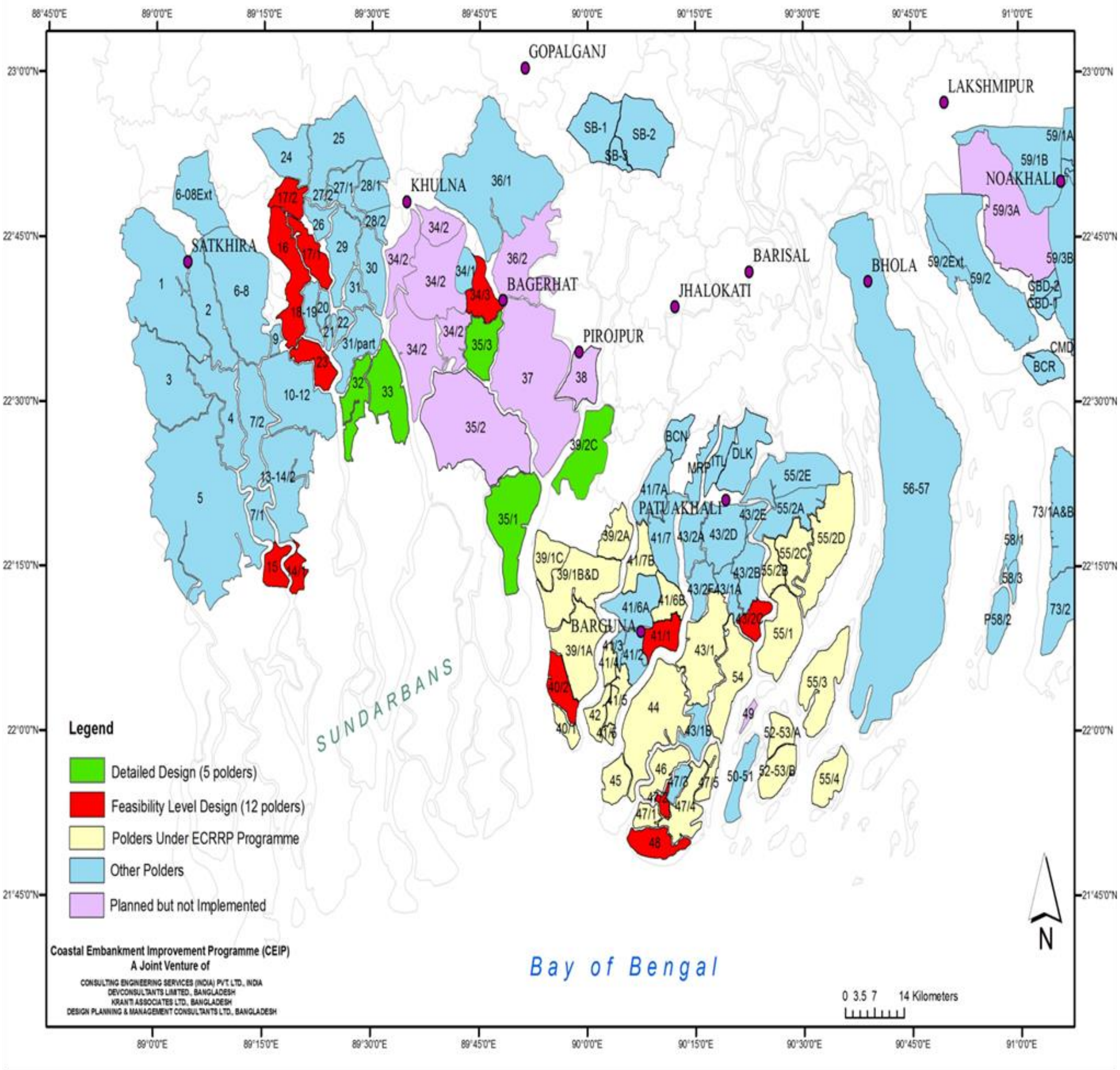
9.2 Proposed CEIP intervention on Polder 14/1

555. CEIP is a multi-phased effort laid down by the GoB to refocus its strategy on the coastal area by providing extra emphasis on frequent storm surges. The long term objective of the project is to increase the resilience of the entire coastal population against tidal flooding, salinity intrusion 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. Among these 17 Polders (shown in Map 9.1), four Polders (Polders 32, 33, 35/1, 35/3) were selected for rehabilitation works under the first phase of CEIP (CEIP-1), which are being implemented. The other 13 Polders have undergone feasibility studies and would be implemented gradually in later phases. It is assumed that

Implementation of CEIP interventions may cause the following impacts of Polder 14/1 and its surrounding.

9.3 Synopsis of existing and on-going projects around Polder 14/1

556. Apart from CEIP interventions, there are some other development projects in the region of Polder 14/1, implemented locally or regionally. Table 9.1 below shows a list of various projects in relevance with Polder 14/1, 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

Agency	Project Name	Duration	Location	Sensitivity
	Water Management Improvement Project (WMIP)	2010-ongoing	Entire country	Low
Regional (Khulna, Barguna, Bagerhat, Patuakhali Districts)				
BWDB	Blue Gold Program	2013- ongoing	Coastal zone	Low
	Coastal Embankment Rehabilitation Project (CERP)	1995-2004	Coastal zone	Negligible
BFD	Marine Shrimp culture technology	1998-2004	Coastal zone	Moderate
Local				
LGED	Rural Development Project-16: Infrastructure (Phase-II)	1999-2004	Patuakhali and Barguna	Negligible

9.4 Cummulative Impacts of proposed and existing projects

9.4.1 Impact on hydrology and flooding situation

557. Several rivers (Map 5.1) have covered the surroundings of Polder 14/1. The Sakbaria River passes along the Eastern portion and the Kobadak River passes to the Western portion of the Polder. Moreover, Sakbaria River and Kobadak River also flow the North-East and North-West directions of the Polder 14/1 respectively. Another river called Arpangasia flows to the southern direction of the Polder. Existing average crest level of the Polder is 4.27 mPWD. There is a proposed re-sectioning work of the Polder with a design crest level of 4.50 mPWD. Slope protection and bank protection works are also proposed for this Polder. These interventions would reduce the effect of storm surge to the Polder. However, Polder 15 is situated in the North-west direction of Polder 14/1, which also has some proposed interventions. The proposed design crest level of the Polder 15 is same (4.50 mPWD) as of Polder 14/1. As both of the polders 14/1 and 15 will have the same crest level, water may overtop the embankment that will cause flooding during monsoon or due to rise of surge height. Infrastructural damage may be caused due to tidal flooding of Polder 14/1. Therefore, during cyclonic events storm water would not be able to enter Polder 15 because of its proposed bank protection and high crest level of embankments. As a result water may overtop the embankment of both the Polders due to their same proposed crest level and cause flooding during monsoon or due to rise in surge height. Infrastructural damage may be caused due to flooding of Polder 14/1.The flow direction of Kobadak and Arpangasia River may tend to Polder 14/1 that may have a chance of salinity intrusion through Gharilal khal inside the Polder. Other CEIP Polders are far away from Polder 14/1 so they have no impact on it.

9.4.2 Impact on Flora and Fauna of Sundarban

558. The total North-East and South-East portions of Polder 14/1 are fully covered by the Sundarban, world’s largest mangrove forest. Sundarban acts as a safeguard in this region against severe storm surges and maintain ecological balance. The proposed interventions of Polder 14/1, i.e., higher crest level may divert wave direction towards Sundarban that may be a threat in a small scale to the trees and wild animals of that part of Sundarban.

9.4.3 Impact of construction materials on local markets

559. 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 and preparation of CC-block 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.

9.4.4 Impact on Livelihood

560. The socio-economic condition of Polder 14/1 will be ameliorated due to the overall development of this region, i.e., construction works of Polder 15 will attract labors from outside as well as local people will also get working opportunity.

9.4.5 Impact of Noise and Vibration of Construction Activities on Sundarban Synopsis of projects around Polder 14/1

561. Activities of these projects may have very low impacts on the polder in future. There would be no impact on Sundarbans by the construction activities of the above mentioned projects. During construction of activities of the polder, noise, dust and wastewater and other wastage would be generated from labour camp, movement of vehicle and construction of bank protection works which whould have negligible impact on sundarban biodiversity because the Sundarban is isolated by the river. The river’s width varies from 280m to 645m from the Polder. To minimize the impact, noise barrier can be built around the construction areas; water sprinkling should be used on the embankment regularly for dust management.

9.4.6 Mitigation Measures

- Crest level 4.5m PWD need to be justified through discussing local people;
- Protection work can be initiated where scouring occurs;
- Existing regulators need to check. If problems found then need to rehabilitate or rebuild based on need;
- Wave breaker should be constructed along the embankment for reducing of wave action;
- Social awareness have to develop on a larger scale through discussing with local people.

9.4.7 Marine Shrimp Culture Technology

562. In 1998, Bangladesh Forest 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, seeing viral attacks (of white spot syndrome virus, taura syndrome virus, and infectious hypodermal and haematopoietic necrosis virus) on shrimps in the later stages of the project implementation. However, the popularity of shrimp culture spread in local level. At present, shrimp culture in Polder 14/1 during dry season is a very common practice. 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; this reduced the strength of the embankment by creating weak points. One notable

positive impact of shrimp culture in Polder 14/1 is that it initiated a financial revolution of the Polder area however; it has become a monopoly business. The local people have fallen in an ambivalent situation that they are suffering to use their land for both agriculture and fisheries. Moreover, there are some negative environmental impacts, i.e., infertility of aquatic animals, flora and fauna due to overtopping in saline water from shrimp culture ponds.

9.4.2 Reciprocal Impact

563. Reciprocal impacts of Polder 14/1 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 hydrological situation of the Polder area. IWM evaluated the physical changes in the Polder 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 national/international sources including published reports and surveys by IWM.

564. 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.

565. From the simulation, flood free (FF) area and F0 (0~0.3m) areas cover about 60.6% and 17.5% of the Polder area respectively without considering climate change. The fulfillment of the overall drainage criteria requires about 85% to 90% FF and F0 land, whereas only 78.1% of FF and F0 land was found from the simulation without climate change.

566. Considering the climate change scenario FF land cover reduced to 14% but F0 class increased to 26% respectively. The F1 land class (water depth .03m to 0.9m) also increased from 15% to 32%. It implies that about 60% land area remains submerged under climate change condition due to inadequate drainage system and needs further attention to obtain a climate resilient Polder management.

567. 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. The surge water levels in different return period are presented in Table 9.2. It is observed that due to climate change, surge level increases up to 0.39 m.

Table 9.2: Storm Surge level for different return periods with and without climate change condition

Events and Return period	**Surge level (m+PWD) without climate change**	**Surge level (m+PWD) with climate change**	**Change in surge level**
10	2.35	2.74	0.39
25	2.84	3.21	0.37

Events and Return period	Surge level (m+PWD) without climate change	Surge level (m+PWD) with climate change	Change in surge level
50	3.20	3.55	0.35
100	3.56	3.89	0.33
Sidr	3.23	-	-
Aila	3.05	-	-

568. Statistical analysis of significant wave height is carried out using extreme value analysis in MIKE Zero. Cyclonic wind field for 19 severe cyclones have been generated using MIKE21 Cyclone model for the entire costal region of Bangladesh. The cyclonic wind speed corresponding to 10, 25, 50, 100 years return periods at Polder 14/1 are 22.14, 30.71, 36.72 and 42.57 m/s whereas during Sidr and Aila the wind speeds were 39.38 and 23.78 m/s respectively.

569. Wind speed for 25 years return period is used for determining the wave height considering climate change. The wave height simulated for Polder 14/1 is 0.60 m.

570. 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 levels corresponding to log-normal return period of 10, 25, 50 and 100 are 3.33, 3.44, 3.51 and 3.58 m + PWD without considering climate change. Water levels considering climate change are 3.76, 3.84, 3.93 and 4.02 m +PWD respectively. 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 4.42 m + PWD. The present crest levels of the Polder vary from 3.47 to 4.33 m+PWD. So the present crest level is not sufficient to address the future climate change and will be increased to 4.60 m providing additional safety for higher return periods land subsidence as part of the re-sectioning of all embankments in Polder 14/1.

10. Environmental Management Plan (EMP)

571. This Chapter presents the Environmental Management Plan (EMP) for the CEIP-1 activities in the Polder. The EMP essentially provides the implementation mechanism for the environmental and social mitigation measures discussed in Chapter 8.

10.1 Objectives of EMP

572. The basic objective of the EMP is to manage, prevent, and mitigate potentially adverse impacts of Project interventions in the Polder. 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 for project proponent, contractors, consultants, and other members of the Project team for the environmental and social management of the Project;

Define a monitoring mechanism and identify monitoring parameters to ensure effective implementation of the mitigation measures.

Assess environmental training requirements for different stakeholders at various levels.

Describe communication and documentation requirements.

10.2 EMP Components

573. 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

574. These components are discussed in the following Sections.

10.3 Institutional Arrangement

575. Clearly defined and functional institutional arrangements are essential for ensuring effective and sustainable implementation of the EMP, particularly the mitigation measures identified in the EIA. An Organogram showing the institutional set up of CEIP-1 including organisation for implementation and monitoring of the EMP is shown in Figure 10.1.

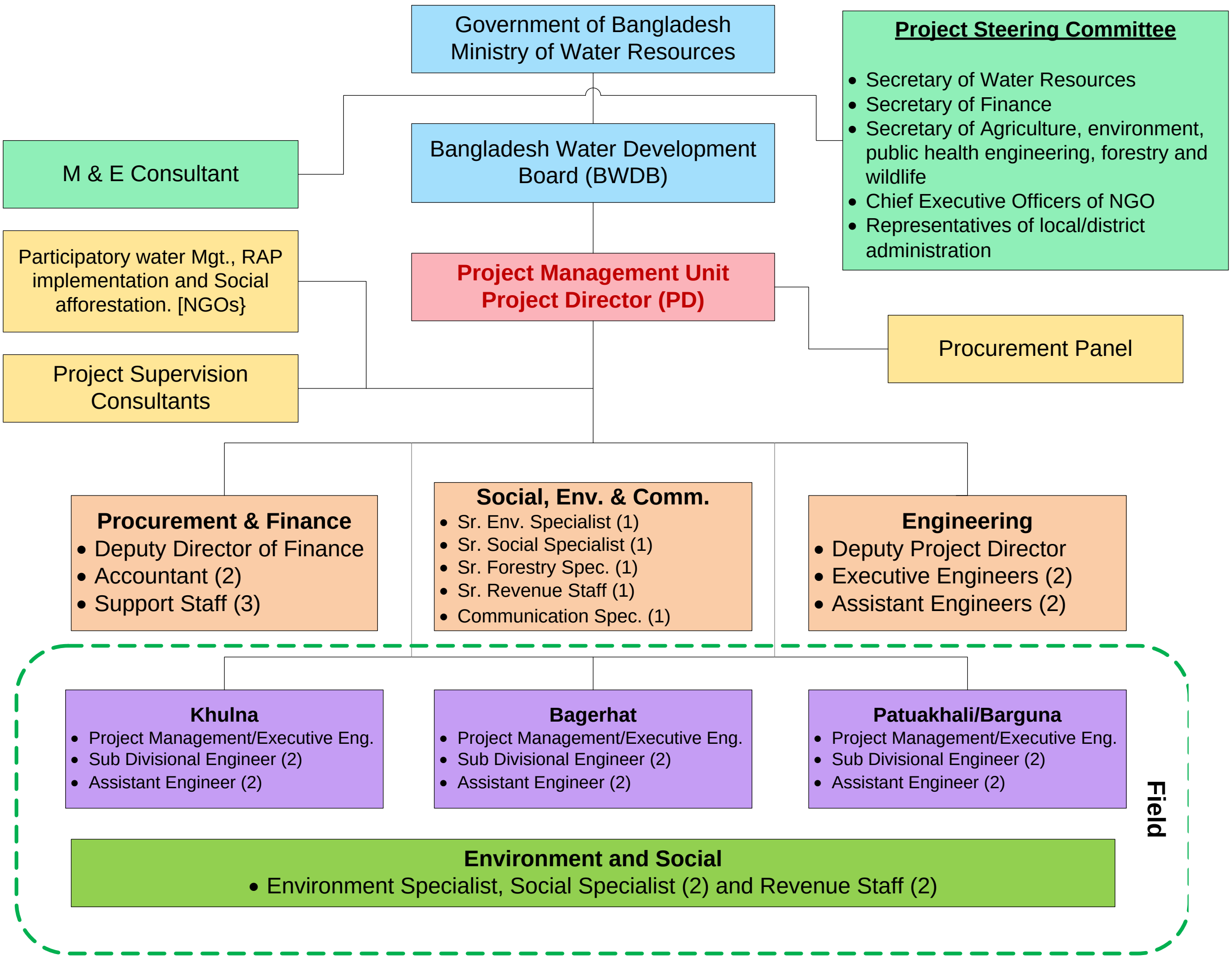


Figure 10.1: Organogram showing the institutional setup for CEIP-1

10.3.1 Overall Responsibility

576. The overall responsibility of EMP implementation and fulfiling other environmental obligations during the Project lies with the Project Director (PD). For which, the PD will be supported by the environmental and social staff of the PMU,DDCS&PMS Consultants, Third Party M&E Consultants and Contractors.

10.3.2 Construction phase

Environment and Social Staff in PMU

577. As described in Section 4.8, the BWDB will set up the PMU to manage the Project implementation. 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 environment-related field activities mainly.. The ESCU will maintain liaison with the WB safeguard team, regulatory agencies, and other stakeholders during implementation. The ESCU will also coordinate with the environmental staff of the DDCS&PMSCs. 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.

578. 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 & Project Management Support Consultants (DDCS&PMSCs)

579. The DDCS&PMSCSCswill be responsible for the overall supervision of Polder rehabilitation related activities. The DDCS&PMSCwill ensure quality control and report to PD. Theywill also assist the ESCU for ensuring environmental compliance and monitoring of progress including EMP and/or ECP implementation. The DDSC&PMSCwill supervise the Contractors, ensuring design compliance and quality of works. For supervising the EMP implementation, DDCS&PMSCwill have dedicated and adequately qualified and experienced environmental staff including field-based environmental monitors (EMs). The EMs will supervise and monitor contractors to ensure compliance of the EMP. The DDCS&PMSenvironmental 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

580. The construction contractors will have adequate number of dedicated, properly qualified and experienced, site-based Environment Supervisors (ESs) at the construction sites. The ESs will be responsible to implement various aspects of the EMP particularly the mitigation measures to ensure that the environmental impacts of the construction works remain within acceptable limits. The ESs will maintain coordination with the DDCS&PMSC(EMs) at the site level. The ESs will also be responsible to conduct environmental trainings for the construction crew.

10.3.3 Post-construction Phase

581. BWDB core unit has positions of 4 Assistant Chiefs and 2 Deputy Chiefs to oversee the overall environmental compliance of BWDB implemented projects. Under CEIP-1, the ESC unit will 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

582. 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.

583. Mitigation measures should be considered starting with 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.

584. 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;

stakeholders participation in finalizing mitigation measures;

construction practice, including labor safety and welfare measures;

operational control procedures and

management systems

585. Mitigation measures during pre-construction, construction and post-construction operation phases have been presented in a tabular form in Table 10.1 which will be used in Polder specific mitigation measure stated in Chapter 8. The table also spells out the responsibility of implementation and monitoring/supervision agencies in different phases. Moreover, cost related to EMP has been presented in a different Table 10.6

Tabel 10.1: Mitigation plan during pre-construction, construction and operation phases

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
Pre-Construction			
Deteriorated environmental (air and noise) quality	• Construction material (sand) should be kept covered while transporting and stock piled and contractor should supervise. • The contractors need to be conscious avoid unnecessary honking of material carrying trawlers. • The contractors should be encouraged to move all construction equipment, machineries and materials during day time instead of night. • Exhaust emissions from trawler and equipment should comply with standards of DoE.	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Mobilization trawler should have proper mufflers and silencers. • Water sprinkling and ramming the material stockyard should be done regularly. • Stockyard should be covered during non-working periods which should monitor by the contractor.		
Changes in land use (preparation of construction facilities, borrow areas, others)	• All the construction camps would be established within the area owned by BWDB. • Pay compensation/rent if private property is acquired on temporary basis, which instructions would be specified in the tender document. • Labor shed/camp would be construct at government khas land. • Avoid impacts on local stakeholders.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Clearances of vegetation	• Avoid vegetation damage as much as possible to select sites for labor shed and material stock by using nearer fallow land or barren homestead yards. • Give proper compensation to the tree owners against tree felling specially for fruit yielding trees • Implement tree plantation at the damaged sites after completion of construction works	Contractor	DDCS&PMSC , M&E Consultant, BWDB
Increased Vehicular Traffic during mobilization	• The contractor will prepare a traffic management plan (TMP) and obtain approval from the Detailed Design Costruction Supervision and Project Management Support Consultant (DDCS&PMSC) • Contractor also implement mobilization plan considering water vessels and launch movement in the external rivers and, avoid the launch movement time. • The TMP will be shared with the communities and will be finalized after obtaining their consent. • The TMP will address the existing traffic congestion particularly at the Ghorilal and Zorsing Bazars. • Ensure minimal hindrance to local communities and commuters. • The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes.	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. • The works of the first half when completed, and then of the other half will be undertaken. • Work schedule will be finalized in coordination and consultation with local representatives and communities. Specifically union parishad members of the Polder. • Local routes will not be blocked as much as possible. If unavoidable, alternative routes will be identified in consultation with local community. • Vehicular traffic should be limited in the Polder area and the embankment during peak time. Appoint signalman during peak time/ School time (10:00am to 13:00pm) and weekly market days (Hatbar). 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			
Deteriorated environmental (air and noise) quality	• Construction machinery should have proper mufflers and silencers. • Noise levels from the construction machinery should comply with national noise standards (residential zone) • Regular recording of noise level at workers' site and adoption of required measure accordingly including monitoring of noise level of the nearby community, where applicable. • Provision should be made for noise barriers at construction sites, schools/madrashas and other sensitive receptors as needed. • Sprinkling of water and ramming on the material during construction. • Exhaust emissions from trawler and equipment should comply with standards • Restricting/limiting construction activities during the day time;	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Provision of PPE (ear muffs and plugs) for labor; • Construction team will be instructed to properly use the equipment, to minimize noise levels; • Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.		
Hindered to the natural drainage system	• Some temporal earthen dams should be built in the khal behind the construction of drainage sluices and behind the re-excavation segment at each reach. • Bail out of water behind the temporal earthen dams during construction work of the bridge. • Both contractor and BWDB should supervise the construction work of the bridge and built temporal dams as well as demolish the same after completion of the construction work.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Affects on agriculture crop production	• Compensation would be paid for any crop damage. • Resettlement Action Plan should be prepared and should also be implemented accordingly • • Contractor would avoid cultivation fields during construction. • Contractor would 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 would ensure that no material is dumped inside cultivation fields. • Re-excavated soil of canals would not be damp in agricultural land. • Contractor would maintain liaison with communities.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Affects on irrigation	• Contractor would construct bypass channel before construction/replacement/demolished of each regulator. • Sequence of work at the regulators and in the water channels would be	Contractor	DDCS&PMSC, M&E Consultants and BWDB

Potential Impacts	**Mitigation Measures**	**Responsible Agency for implementation of mitigation**	**Monitoring/Supervision Agency**
	carefully planned to avoid irrigation disruption. • Contractor would ensure no negative impacts on crop irrigation. • Contractor would maintain liaison with communities. • Contractor would work during dry season.		
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 Kobodak and Sakbaria rivers will be planned considering local fisheries condtion to minimize impacts on spawning and subsequently nursery ground of fish. • Contractor will maintain liason with experienced fishermen.	Contractor	DDCS&PMSC, M&E Consultant and BWDB
Impact on fish habitat and migration	• 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 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.	Contractor	DDCS&PMSC, M&E Consultant, and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• 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.		
Impacts on benthic fauna	• Khal re-excavation should be carried out segment wise. • Contractor will carry out khal excavation in segment thus minimizing impacts on benthic fauna.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Clearance of vegetation	• Collect soil for re-sectioning from barren land as much as possible • Proper turfing should be implement at embankment slopes with local grasses and ensure regular monitoring of turf grasses till they matured • Choose barren land for CC Block manufacturing and material storing • Keep close liaison with CREL Project Authority and Forest Department while implementation of earth works • Implement plantation with native species at countryside slope of the embankment to arrest vegetation loss	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Outbreak of plant diseases	• Keep close liaison with CREL Project Authority and Forest Department while implementation of afforestation and for selecting suitable species for plantation and spacing of the saplings • Care should be taken for physical and biological control of plant disease while nursery raising and sapling plantation • Develop a pest management plan for the holistic afforestation • Collect saplings from nearer natural source (i.e.: from mangrove forest at eastern bank of Sakbaria River and western bank of Arpangasia River) as much as possible	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Safety and Public Health Hazards	• The contractors will prepare site specific Health, Safety and Environment (HSE) Plan and obtain	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	approval from the Construction Supervision Consultants. The Plan should also include awareness rising and prevention measures for particularly for communicable diseases such as hepatitis B and C, and HIV/AIDS. • The WBG's EHS Guidelines will be included in the contract documents. • Liaison will be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets will be kept in all the labor camps for obtaining weather information. • 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 workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities; • The construction sites will have protective fencing to avoid any unauthorized entry, where appropriate and possible • Health screening of employees would be a Contractor obligation prior to 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 where required; • All employees need to carry out induction health and safety training prior to commencement of work. OHS issues would be part of the employee training plan. Training would include the provision of appropriate written or		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	visual materials to reinforce learning. Where illiteracy levels are high, OHS issues need to be covered more frequently than normal in toolbox talks; • Public awareness training and workshops on safety and health risks will be conducted for local communities prior to and during construction operations. • Observing statutory requirements relating to minimum age for employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activity. The construction contractor(s) would not hire people under the age of 18 on permanent contracts but would include short training activities for youth to the extent possible; • Ensuring acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work; • Ensuring no workers are charged fees to gain employment on the Project; • Ensuring rigorous standards for occupational health and safety are in place; • Contractor will establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. • The contractor will adopt a Human Resource Policy appropriate to the size and workforce which indicates the approach for management employees (this could be part requested in the tender process); • Produce job descriptions and provide written contracts and other information that outline the working conditions and terms of employment, including the full range of benefits;		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• 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 (this could be full time or part of another post's responsibilities); • Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training; • Report regularly on the labor force profile, including gender, and location source of workers; • Report regularly on 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 a training program and keep training registers for construction workers; • Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project. • Waste management plan to be prepared and implemented in accordance with international best practice.		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Liaison with the community will be maintained.		
Hindrance for Pedestrian and Vehicle Movement	• The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. When the works are completed on the first half, it will be opened for local traffic while works will be undertaken on the other half of the embankment. • Work schedule will be finalized in coordination and consultation with local representatives and communities. • Local routes will not be blocked as much as possible. If unavoidable, alternative routes will be identified in consultation with local community.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Social unrest between Local worker and outside worker	• Proper awareness programs will be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, Upazila Nirbahi Officer (UNO) and BWDB local officers. • Liaison with the communities will be maintained. • Cultural norms of the local community will be respected and honored. • GRM will be established to address the grievances of local as well as outside laborers. • Careful use of local natural resources and project resources, fuel, fuel-wood and electricity. • Restrictions related to consumption of alcohol and drugs. • Safe driving practices. • Respect for the local community and its cultural norms in which laborers are working.	Contractor	DDCSPMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Avoiding construction activities during Prayer time.		
Increased inland and waterway traffic	• Contractor to prepare and implement traffic management plan. • Contractor to establish new, temporary jetties where needed. • River crossing for material transportation during nighttime where possible and appropriate • Material transportation through rivers during high tide where needed. • Liaison to be maintained with community and BIWTA.	Contractor	DDCS&PMSC, M&E Consultant, and BWDB
Seasonal Impacts (Natural Hazards)	• Weather signals will be considered by the contractor during construction works. • Radio and television will be provided in all the labor sheds for receiving weather information through these media. • Ensuring rigorous standards for occupational health and safety are in place.	Contractor	DDCS&PMSC, M&E Consultant and BWDB
Damage to Local Infrastructure	• The condition of the infrastructure being used for the construction and transportation activities will be regularly monitored. • All damaged infrastructure will be restored to original or better condition. • To take preventive measures for protection of local infrastructure.	Contractor	DDCS&PMSC, M&E Consultant and BWDB
Post-Construction			
Increase Salinity Intrusion due to Leakage of Regulators	• Formation of WMOs in concern with the structures and embankment • Regular monitoring and careful maintenance of the water control structures will be ensured. • Concern WMOs and BWDB should monitor for further installation of unauthorized hand tube-well on embankment by gher owner. • Standard operating procedures will be prepared and implemented for the water control structures. These procedures will be translated in bangle as well.	BWDB with the help of DAE	BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Capacity building of WMOs will be carried out.		
Soil and water contamination (increased use of chemical inputs) and reduced soil fertility	• Capacity building and awareness rising of the farmers would be carried out to practice Integrated Pest Management (IPM), Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) in order to minimize usage of chemical inputs. • Farmers group would have close contact with DAE for adoption of various measures of IPM, ICM and GAP. • Farmers would be encouraged to use organic and green manure to increase soil fertility while avoiding water contamination. • Farmers would be encouraged to cultivate leguminous crops (N_2 fixing) to enhance the soil quality as well as soil productivity.	BWDB with the help of DAE	BWDB
Hampered fish migration	For Sluice gate operation a manual will be prepared for facilitation of fish migration • WMO will be provided training to follow the manual to facilitate fish migration • Transferring juvenile fish from rivers to Polder.	BWDB with the help of DoF	BWDB
Risk of embankment failure	• Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the eastern side of the Polder will be ensured. This monitoring will particularly be carried out before and after monsoon season. • Prevention of establishing hand tube-wells at the crest of the embankment. • Available cyclone and flood shelter will be prepared as a contingency measure during emergency situation. • WMG will develop a fund for this kind of emergency situation. • Structural measures like geo bag and sand bag will be kept in stock yard of local BWBD colony.	BWDB	BWDB
Increase salinity intrusion due	• Regular monitoring and careful maintenance of the water control structures will be ensured.	BWDB	BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
to leakage of regulators	• 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.		

586. Based on the past experience, a generic Mitigation Measures for EMP has been presented in Table 10.2 below for reference. This can be used as a reference material for comprehending the scope of the EMP.

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 good quality of borrow materials that used for embankment filling • 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 50 m from toe line. • Irrigated agricultural lands (In case of necessity for borrowing from such lands, the topsoil shall be preserved in stockpiles although borrowing from agricultural land need to be avoided. • 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**

Parameter / Activities	Mitigation/Compensation Measure/Guideline
	• 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 photograph of the rehabilitated site from different angles.
Re-excavation operation and Management of Excavated Material	To minimize the adverse impact during re-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. • Overburdened labors shall be removed. • During excavation slopes shall be flatter than 20 degrees to prevent 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 Material from khals re-excavation	• 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 3: 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.

Parameter / Activities	Mitigation/Compensation Measure/Guideline
	• 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 will any adverse conditions be identified corrective actions will include. • Anaerobic conditions-turning the stockpile or creating ventilation holes through the stockpile. • Erosion – temporary protective silt fencing will be erected.
Soil salinity	• Use of aquatic plants like 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.
• Automated CC Block Plant	
Construction Materials	• Materials to be stacked separately like sand, shingles, etc. • Shingles to be washed while stacking • Sand to be covered preventing them to be blown by wind • Sand to be seived to discard mudlumps and other debris
Signages at the Plant	• Bangla and English signs to be displayed at clearly visible locations • Warning signs, including "DOs & DON'T's" to avoid any accidents • Signs strictly mentioning use of PPEs (ear plugs, ear muffs, masks, helmets, gloves, shoes, etc.) while working at the plant • Visible signs for fuel storage, stack yards, electrical appliances, live electrical wires, office/residential area, etc. • Signs with speed limits and movement directions for vehicles, fork lifters • Display board showing numbers of laborers working in a shift, CC blocks produced and storage site • Marking electrical appliances, live wires; keeping wires out of reach to avoid any accident • Sign showing designated sites of fire estinguishers
Automated Plant	• Operated during day time only and in shifts • Noise produced to be monitored and documented, if necessary noise barriers to be installed • Machine to be checked for any leakage, if any leakage spill trays to be introduced • PPEs for workers at all times when working at the plant; workers not be exposed beyond noise levels of 85 decibels • Workers to work in shifts of eight hours • Training/briefing of the workers related to operation and maintenance
CC Blocks	• CC Blocks stacked properly with production date/batch number/size • Ample space in-between the stacks for movement and inspection • CC blocks to be watered regularly for stability • Maintain register documenting the production

10.5 Chance-Find Procedures for Physical Cultural Property

587. 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 archaeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;

Protect artefacts as far as possible using plastic covers, and implement measures to stabilize the area, if necessary,;

Prevent and penalize any unauthorized access to the artefacts; and

Restart construction works only upon the authorization of the relevant authorities (e.g. Upazila Nirbahi Officer, Deputy Commissioner and Department of Archaeology).

10.6 Monitoring Plan

588. Extensive monitoring of the environmental concerns of the CEIP project will be required as per World Bank guidelines. The monitoring program will help to evaluate: (i) the extent and severity of the environmental impacts against the predicted impacts and baseline; (ii) the performance of the environmental protection measures or compliance with pertinent rules and regulations; (iii) trends in impacts; and (iv) overall effectiveness of the project environmental protection measures. The monitoring plans will be included in the EMP for specific sub-projects. Moreover, for all 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.

589. The Monitoring activities during design/preconstruction period are:

- checking the contractor's bidding documents, particularly to ensure that all necessary environmental requirements have been included and
- checking that the contract documents' (Environmental Action Plan) references to environmental mitigation measures requirements have been incorporated as part of contractor's assignment and making sure that any advance works are carried out in good time.

590. 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 regular basis. Additional monitoring will be carried out by the Environmental and Social Unit.DDCS&PMSC will prepare the monthly report on the status of EMP/ESMP implementation.

591. 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 10.3 and Table 10.4

Table 10.3: Environmental Monitoring Plan during Construction and Operation of Rehabilitation and Improvement of Polders System

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
During Construction					
Sources of Material	Work Site	Possession of official approval or valid operating license of suppliers materials (Cement, soil).	Before an agreement for the supply of material is finalized.	Contractor	DDCS&PM SC M&E Consultant andBWDB
Operation of borrow site	Borrow pit/site	Visual inspection of borrowing site and ensuring operational health and safety	monthly	Contractor	DDCS&PM SC, M&E Consultant andBWDB
Top Soil	Storage area	Top soil of 0.15 m depth will be excavated and stored properly	Beginning of earthwork	Contractor	DDCS&PM SC andBWDB
		The stored top soils will be used as cladding material over the filled lands	Immediately after filling and compaction of dredge materials	Contractor	DDCS&PM SC, and 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&PM SC, 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&PM SC, M&E Consultant and BWDB
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	DDCS&PM SCBWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DDCS&PM SC,BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying	Daily	Contractor	DDCS&PM SC andBWDB

Parameter	**Location**	**Means of Monitoring**	**Frequency**	**Responsible Agency**	
				Implemented by	**Supervised by**
		of waters) are in place.			
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DDCS&PM SC
Air Quality (PM_{10}, $PM_{2.5}$)	Close to School/ Madrasha, Hospital & Villages	Air quality monitoring	Half Yearly	Contractor through a nationally recognized laboratory	DDCS&PM SC,M&E Consultant and BWDB
Noise	Construction sites	Visual inspection to ensure good standard equipment are in use Noise monitoring of work sites and nearby community , where applicable	Weekly	Contractor	DDCS&PM SC, M&E Consultant andBWDB
	Construction sites	Ensure work restriction between 09:00 pm - 6:00 am close to School / Madrasha, Hospital & Villages	Weekly	Contractor	DDCS&PM SC,M&E Consultant and BWDB
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each Polder	Sampling and analysis of surface water Quality.	Dry season	Contractor through a nationally recognized laboratory	DDCS&PM SCM&E Consultant and BWDB
Drinking Water Quality(TDS, Turbidity, pH, FC, as if groundwater etc)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality.	yearly	Contractor through a nationally recognized laboratory	DDCS&PM SCM&E Consultant, BWDB
Sanitation	Construction camp /site	Visual Inspection	Weekly	Contractor	DDCS&PM SCM&E Consultant and BWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid waste and solid waste is deposited at designated site	Weekly	Contractor	DDCS&PM SCM&E Consultant and BWDB
Flora and Fauna	Project area	Survey and comparison with baseline environment	Yearly	Contractor through nationally	DDCS&PM SCM&E Consultant and BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
				recognized institute	
Cultural and archeological Sites	At all work sties	Visual observation for chance finding	Daily	Contractor	DDCS&PM SCM&E Consultant and BWDB
Reinstatement of Work Sites	All Work Sites	Visual Inspection	After completion of allworks	Contractor	DDCS&PM SC, M&E Consultant and BWDB
Safety of workers Monitoring and reporting accidents	At work sites	Usage of Personal Protective equipment	Monthly	Contractor	DDDCS&P MSCM&E Consultant and BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each Polder	Sampling and analysis of surface water quality	Yearly	BWDB through a nationally recognized laboratory	M&E Consultant
Air Quality (Dust PM_{10}, $PM_{2.5}$)	At the baseline monitoring site	24 hours Air quality monitoring	Yearly	BWDB through a nationally recognized laboratory	M&E Consultant
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
Crop production	In the Polder area.	Compare the production with the baseline.	2 (Two) cropping season.	BWDB through a nationally recognized institution.	M&E Consultant.
Soil quality	In the Polder area.	Compare the soil quality with the baseline.	Two (2) times of year (dry & wet season).	SRDI.	Consultant.
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant

CS=Contractor Supervisor

Table 10.4: Environmental Monitoring Plan during Construction and Operation of Afforestation

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
During Implementation					
Plant Selection	Nursery	Visual inspection. Type and variety of plant species to be planted for turfing on the top of embankment and foreshore	Before plantation	Contractor	DDCS&PMSC, BWDB and M&E Consultant
Water Quality	Water bodies near nursery	Odor and chemical testing	Dry season	Contractor through nationally recognized laboratory	DDCS&PMSC, BWDB and M&E Consultant
Waste Management	Work site and Nursery	Visual inspection of collection, transportation and disposal of grasses, debris and is deposited at designated site	Weekly	Contractor	DDCS&PMSC, BWDB and M&E Consultant
	Work site and Nursery	Visual inspection of Water bars & cut-offs .sediment traps to prevent water pollution caused by run-off from harvesting areas	Beginning of work	Contractor	DDCS&PMSC, BWDB and M&E Consultant
Nursery Embankment Management	Nursery	Visual inspection of height of embankment, possibility of water logging and connection to the waterbodies	Beginning of each nursery	Contractor	DDCS&PMSC, BWDB and M&E Consultant
During Operation and Management					
Multilevel belt of trees	Polder top and along the Polder	Visual inspection	Yearly	BWDB through nationally recognized institution	M&E Consultant
Flora and Fauna	In the project area	Detail species assessment	Yearly	BWDB through a	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
		and compare with baseline		nationally recognized institution	
Fish Habitat Observation	In the project area	Physical observation	Four (4) times of year (dry & wet season)	Contractor with help of UFO	M&E Consultant
Fish Catch assessmen survey	In the project area	Catch survey	two (2) times of a year (dry & wet season)	Contractor with help of UFO	M&E 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
Erosion	Along Alignment	Visual Inspection presence of gullies or erosion	Yearly	BWDB	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

592. 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 10.5 can be followed during project construction and operation process.

Table 10.5: Spot Checking Indicators

Parameter	Visual Judgment			Comments
	Poor	Moderate	Satisfactory	
Workers Safety				
Camp Site Management				
Plant Site Management				
Borrow Area Management				
Top Soil Prevention				
Waste Management				
Occupational Health and Safety				
Stockpiling of construction materials				
Reporting and Documentation				

Third Party Validation

593. BWDB will engage independent consultants to conduct a Third Party Validation (TPV) of the EMP implementation on quaterly basis during the construction phase. During the TPV,

the consultants will review the implementation and effectiveness of various EMP activities including mitigation measures, environmental monitoring, trainings, and documentation. The consultants will also identify gaps and non-compliances in EMP implementation and propose actions for their remediation.

10.7 Documentation, Record keeping and Reporting

10.7.1 Record Keeping

594. 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.

10.7.2 Monitoring Records

Quantitative Physical Monitoring

595. 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&PMSCwill 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.

596. The monitoring data would be continually processed as it is received, so as to avoid a build-up of unprocessed data.

General Site Inspections and Monitoring

597. 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 8 during the construction phase. The Site Inspection Checklist would be supported by sketches, as necessary.

Information Sources

598. A complete and up-to-date file of all relevant sources of information will be maintained by the ESCU of PMU. This file would be readily accessible and include, as a minimum, copies of the following documents:

Current environmental permits and consents;

Action to 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

599. Any breaches of the acceptable standards specified, would be reported to the PMU using a standard form, i.e. a Non-Compliance Report (NCR).

600. A copy of each completed NCR would be held 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

601. The DDCS&PMSCwill 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

602. ESCU 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, Table 10.3 and 10.4 respectively.

Environmental Audit Report & Third Party Monitoring Report

603. 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.

10.8 Contractual arrangements for EMP implementation

604. 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 Contractor's Environmental Social Management Action Plan (C-ESMAP) based on the EIA in line with the construction schedule and guideline. The EAP needs to be reviewed by DDCS&PMSC and cleared by BWDB and World Bank.

605. Guideline to Incorporate Environmental Management in Bid Document & Preparation of C-ESMP

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 provide to staff and labor all time as defined in the labor codes read along with the EMP. Damage shall be levied at the rate of Tk. 1000/- per day for non-conformity as per the decision of the Engineer.

10.9 Guideline for Compensation and Contingency Plan during Project Period

606. 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.

607. 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 a first aid box at the project office. Have a plan for quickly transporting a seriously injured person to the nearest hospital.

10.10 EMP Implementation Cost

608. The estimated costs for the environmental management activities are set out in Table 10.6 below.

Table 10.6: Tentative Cost Estimates for Environmental Management

Item No.	Description	BDT	In Thous and $	Responsib le Agency	Timeframe
1	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils	300,000	3.75	Contractor	During pre-construction
2	Awareness program on plant and wild life conservation.	96,000	1.2	BWDB	During post-construction
3	Construct a new sluice near the Patakhali closure which is linked with Jorshing Khal, Hajerali Khal and Sadderfer Khal for efficient drainage				During construction

Item No.	Description	BDT	In Thous and $	Responsib le Agency	Timeframe
	within the Polder area.				
4	Awareness building up campaign(mock drill) may be organized to local community to avoid accidents from vehicular traffic	200,000	2.5		During pre-construction
5	Consultancy services cost for supervision and monitoring of EMP	280,000	3.5	BWDB	During post-construction
6	Training to the farmers with field demonstration regarding IPM and ICM.	200,000	2.5	BWDB with help of DAE	During post-construction
7	Awareness building up to local community for conservation of threatened fish species.	50,000	0.625	BWDB & WMO with help of UFO	During post-construction
8	Training to the fisherman/pond owner with field demonstration regarding pond culture.	40,000	0.5	BWDB & WMO with help of UFO	During post-construction
9	Solid and liquid waste disposal arrangement.	100,000	1.25	BWDB	
10	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1,000,000	12.5	BWDB	During post-construction
11	Consultancy services cost for river bank erosion monitoring	1,200,000	15	BWDB	During construction
12	Training to the Contractors regarding environmental management	100,000	1.25	BWDB	During pre-construction

Item No.	Description	BDT	In Thous and $	Responsib le Agency	Timeframe
13	Training of Environmental awareness of local population	80,000	1	Contractor	During pre-construction and construction phases
14	Updating EMP as per requirement.	1,000,000	12.5	BWDB	During post-construction
15	Construction of alternative or bypass channels at each construction sites.	1,061,053	13.26	Contrctor	During pre-construction and construction
16	Conservation and stocking of threatened fish species (at least 3 spots).	120,000	1.5	BWDB with help of UFO	During pre-construction and construction phase
17	Campaigning and providing training on improved culture practices as well as the rice cum golda farming.	200,000	2.5	BWDB with help of UFO	During post-construction
18	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	1,200,000	15	Contractor, BWDB	During construction and post-construction
19	Additional Tree Plantation at HH and other grounds to compensate the tree cutting (planting 3 trees for cutting 1tree) @ Tk.50 each tree including the cost of sapling, gabion and nursing etc. (19,834 nos. of trees)	991,700	12.4	BWDB in association of Department of Forest	During post-construction
20	Water sprinkling at re-sectioned/newly constructed embankments (@ Tk.3,000 per km (of embankment 30.50 km)	91,500	1.14	Contractor	During pre-construction and construction phases

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
21	WMOs monitoring cost	150,000	1.88		
22	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	61,420,026	767.75	Contractor, BWDB	During construction
	Total Cost	**69,880,279**	**873.50**		

Here, 1 USS $ = 80 Taka

Table 10.7: 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 14/1 = 6 samples x 3 times @ Tk.5,000	200,000	2.5	Contractor	During pre-construction, construction and post construction period phases
2	Fish Habitat Observation for four (4) times of year (dry & wet season).	100,000	1.25	Contractor with help of UFO	During construction and post-construction
3	Fish Catch Assessment Survey for two (2) times of a year (dry & wet season).	200,000	2.5	Contractor with help of UFO	During post-construction

Table 10.7: Tentative Cost Estimates for Environmental Monitoring

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
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.	200,000	2.5	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-14/1 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	Diversity of Flora and fauna	200,000	2.5	Contractor	During construction and post-construction phases
	Total Cost	**1,460,000**	**18.25**		

Here, 1 USS $ = 80 Taka

10.11 Afforestation Plan

609. 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. Also check Hossain[13] (2015) for suitable plants for protection of embankment ecosystem. Top soil at the construction/rehabilitation sites will be stored and used for plantation and regeneration of vegetation. Afforestation will be carried out by the Department of Forest, which will be supported by the selected NGO.

610. Type of plantation and tentative areas 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).

611. 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 4.2. 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

[13] Hossain, M. 2015. Handbook of selected plant species for the Sundarbans and the embankment ecosystem. GIZ.

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.

612. 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.

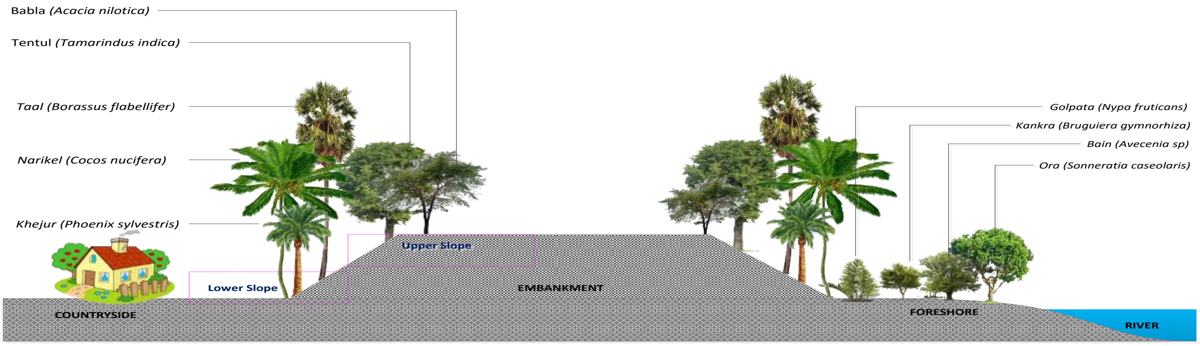


Figure 10.2: Typical cross section of Embankment slope and Foreshore Afforestation

Detail Plantation establishment Matrix is presented in following Table.

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 seedlings.	June 1st week. Immediately after bringing seedlings from the nursery.	April 4th week.	May be 1st or 2nd week of May.	Immediately after bringing the seedlings.	Immediately 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.
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

10.12 EMP Updating

613. 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 to be actuality resulted due to construction of interventions. Furthermore, actual information due to implementation of EMP measures need to be collected for updating the EMP to make the development more environmental friendly as because EMP is not one time plan rather it is a plan which needs continuous updating.

10.13 Grievance Redress Mechanism

614. 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 EIA 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.

10.13.1 Grievance Redress Focal Points

615. 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.

<u>Membership of GRC</u>

1.Executive Engineer (BWDB Division Office)	:	Convener
2. Representative of the RP Implementing NGO	:	Member-Secretary
3. Local UP Chairman /Ward Councillor	:	Member
4. Teacher from Local Educational Institution (nominated by Upazila Administration)	:	Member
5. Representative from Local Women's Group	:	Member
6. Representative from the PAP Group	:	Member

616. Members of the GRCs will be nominated by the Executive Engineer at division level and approved by the Project Director, PMO, BWDB, Dhaka.

10.13.2 Grievance Resolution Process

617. 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.

618. 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. The GRM process flow chart is shown in Figure 10.3.

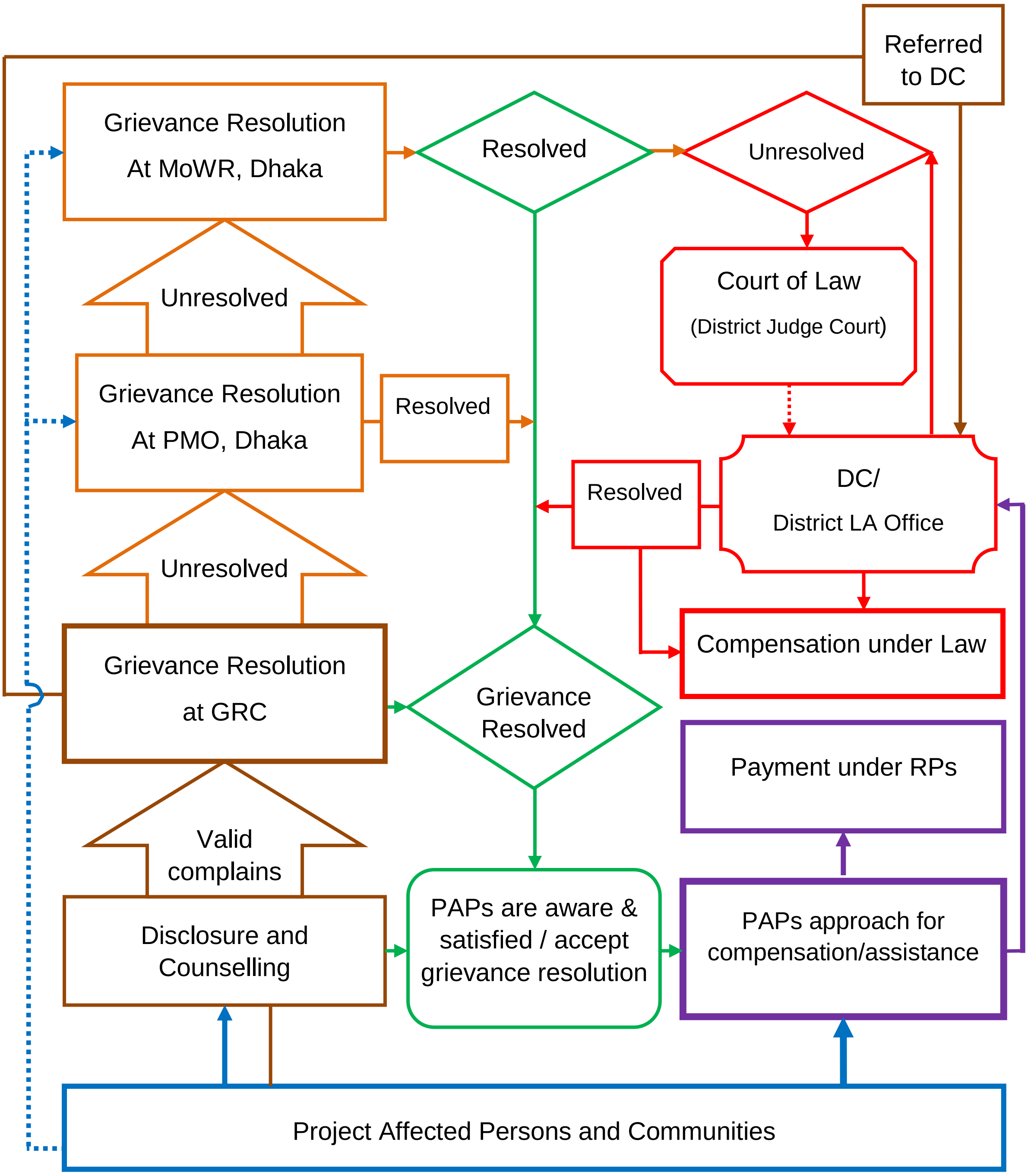


Figure 10.3: GRM Process Flow Chart

619. To ensure that grievance redress decisions are made in formal hearings and in a transparent manner, the Convener will apply the following guidelines:

Reject a grievance redress application with any recommendations written on it by a GRC member or others such as politicians and other influential persons.

Remove a recommendation by any person that may separately accompany the grievance redress application.

Disqualify a GRC member who has made a recommendation on the application separately before the formal hearing:

- Where a GRC member is removed, appoint another person in consultation with the Project Director.

620. 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.

10.13.3 GRM Disclosure, Documentation and Monitoring

621. 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 EIA and the GRM in the form of information brochures will be distributed Amang 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.

622. To ensure impartiality and transparency, hearings on complaints will remain open to the public. The GRCs will record the details of the complaints and their resolution in a register, including intake details, resolution process and the closing procedures. BWDB will maintain the following three Grievance Registers:

Intake Register: (1) Case number, (2) Date of receipt, (3) Name of complainant, (4) Gender, (5) Father or husband, (6) Complete address, (7) Main grievance regarding social (loss of land/property or entitlements) or environmental, (8) Complainants' story and expectation with evidence, and (8) Previous records of similar grievances.

Resolution Register: (1) Serial no., (2) Case no.,(3) Name of complainant, (4) Complainant's story and expectation, (5) Date of hearing, (6) Date of field investigation (if any), (7) Results of hearing and field investigation, (8) Decision of GRC, (9) Progress (pending, solved), and (10) Agreements or commitments.

Closing Register: (1) Serial no., (2) Case no., (3) Name of complainant, (4) Decisions and response to complainants, (5) Mode and medium of communication, (6) Date of closing, (7) Confirmation of complainants' satisfaction, and (8) Management actions to avoid recurrence.

623. 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.

10.14 Capacity Building

624. 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.

625. 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; PMU; DDCS&PMSC staff	DDCS & PMSC and ESCU	Prior to the start of the Project activities. (To be repeated as needed.)
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Mitigation measures; Community issues; Awareness of transmissible diseases Social and cultural values.	PMU;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

626. 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.

627. The training programs will be arranged before implementation of the interventions in the Polder area. Detail plan can be made by the proposed ESC Unit of BWDB.

10.15 Risk Assessment and Mitigation Measures

628. 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 Polder 14/1 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 three sectors, which are addressed in this section. These relate to (a) navigation and (b) water management organizations (WMO) and (c)Fish migration and movement

10.15.1 Navigation

629. 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 14/1. 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 14/1 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.

630. However, 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.

10.15.2 Function of Water Management Association

631. This project has aimed at rejuvenating the Water Management Organizations (WMOs) 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.

10.15.3 Fish Migration and Movement

632. 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.

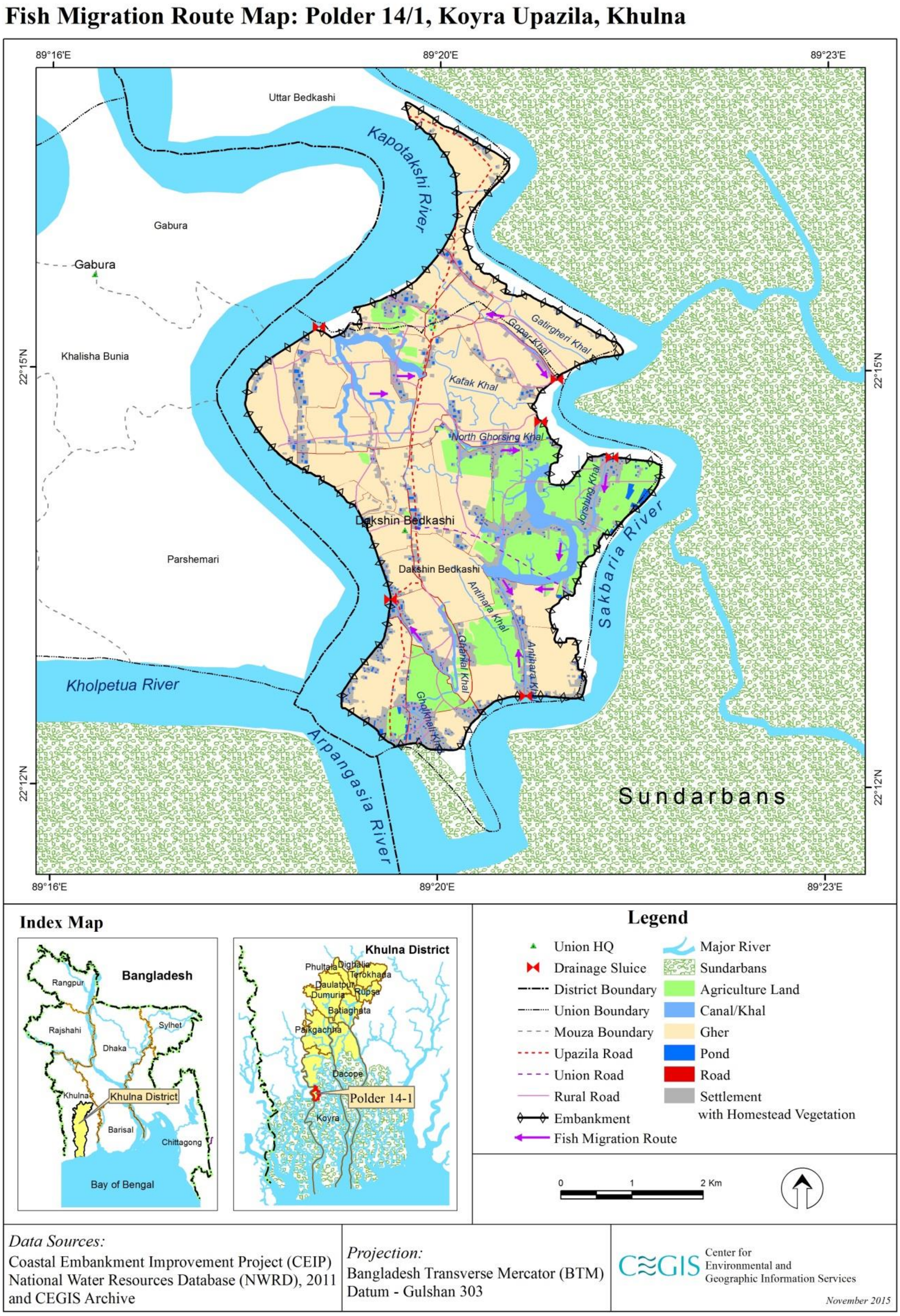
633. On the other hand, during spawning season fish hatchlings and fries will be able to pass through the gates with relatively high mortality. Moreover, there is a conflict of interest between the Gher owners and agriculture farmers regarding the issue of water usage.

634. 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.

635. The Ghers are concentrated all most all over the Polder area. Total cropped area is 470 ha which is occupied by only rice. Aman rice are commonly grown in the Gholkhali, Boro Antihara, Choto Antihara, Jorsging and Boro rice is grown in Boro Antihara, Choto Antihara, Jorshing in the Polder area. According to field visit, it is reported that HYV boro is being practiced near the Jorshing and Antihara khals (Map 10.1). 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.

636. The other areas where gher is dominant and relatively less crop intensive. The major drainage canals pass through these areas. So, entry of saline water through these drainage canals in this cluster area made of above mouzas 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.



Map 10.1: Fish migration route in the Polder area

11. Stakeholder Consultation and Disclosure

637. 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

638. The GoB as well as international donors (e.g. the World Bank) place great importance on involving primary and secondary stakeholders for determining the environmental and social impacts associated with project implementation. In order to gather local knowledge for baseline conditions, understand perceptions of the community regarding impact significance, and propose meaningful mitigation measures, participation of stakeholders is an integral part of the EIA process. During the present EIA, an attempt has been made to consult with a full range of stakeholders to obtain their views on Project interventions.

639. According to the EIA Guidelines of the DoE, public participation is obligatory for the EIA studies of the Red Category projects. Public participation through consultations in the water sector project is also mandatory 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.

640. 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

641. 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 Amang 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

642. Participatory approach was followed in conducting the public consultation meetings in the Polder 14/1. The EIA study team 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.

643. Focus group discussions (FGD) were carried out in the public consultation process. In order to conduct the FGD and consultation meetings, two checklists were prepared covering the aspects including an overview of the proposed CEIP-1, information on the ongoing EIA process, and seeking information on the problems of the area with their potential solutions.The local needs and demands were discussed by giving equal opportunity to all participants attending 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.

644. During the FGDs and consultation meetings, the EIA team displayed maps of the Project area, shared the initial concepts of proposed interventions and recorded the response of the participants. The stakeholders of the Polder 14/1 were asked to share their needs, problems, possible sustainable solutions, and their views on the Project interventions. The stakeholders' perceived views on important environmental and social components (IESCs) and Project's impacts on them, along with perceived benefits, risks, threats and demand from the Project were identified during discussions.

11.4 Identification of Stakeholders

645. 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.

646. *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 14/1, the primary stakeholders included 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, fishers, 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.

647. *Secondary Stakeholders:*This category of stakeholders pertain 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.

648. 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

649. Venue, date and time of meeting was selected through consultation with local people, the project proponent and the consultant. These three groups selected an agreed venue considering the closeness to the proposed project, easy accessibility to the venue and which is likely to be neutral. Date and time was also finalized in this way considering availability of

the participants, ensuring the maximum participation, weather and compliance with the other arrangement.

Enlisting and Invitation

650. A comprehensive list of potential stakeholders was prepared through consultation. This list was intended to cover all sorts of interest groups, occupational groups, socially acceptable and knowledgeable people.

651. A formal invitation was sent to them and also communicated over telephone for ensuring their presence in the meeting.

Consultation Instrument

652. 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- I).

653. Attendance list: An inventory of the participants was maintained in the attendance sheet containing contact number.

654. Camera: For visualizing the participants, photographs were taken using camera. Photos of the meeting participants have been presented at the end of this chapter.

655. Sound Recorder: Deliberations of the participantswere recorded 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

656. The study team conducted the meeting. During consultation meeting, the following process was followed with sequences.

657. Greetings: At the outset, the team spelled greetings to all participants, welcomed them for attending and stated the entire design of the meeting.

658. 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.

659. Respect to the participants: The study team showed respect to all participants. They respected not only the individuals but also their values, cultural practices and social structures.

660. Ensuring peoples' voice: Generally, all participants cannot participate equally. In fact, a substantial number of participants tend to remain silent in any meeting. However, the study team encouraged to all the participante willingly by explaining the ethics of the study.

661. Note taking: discussed issues and opinions were written in notebook carefully. All issues were given equal importance.

662. Recapitulation and closing the session: At the end, the study team recapitulated the issues discussed and responded to the quarries. Finally, the facilitator closed the session by thanking the participants.

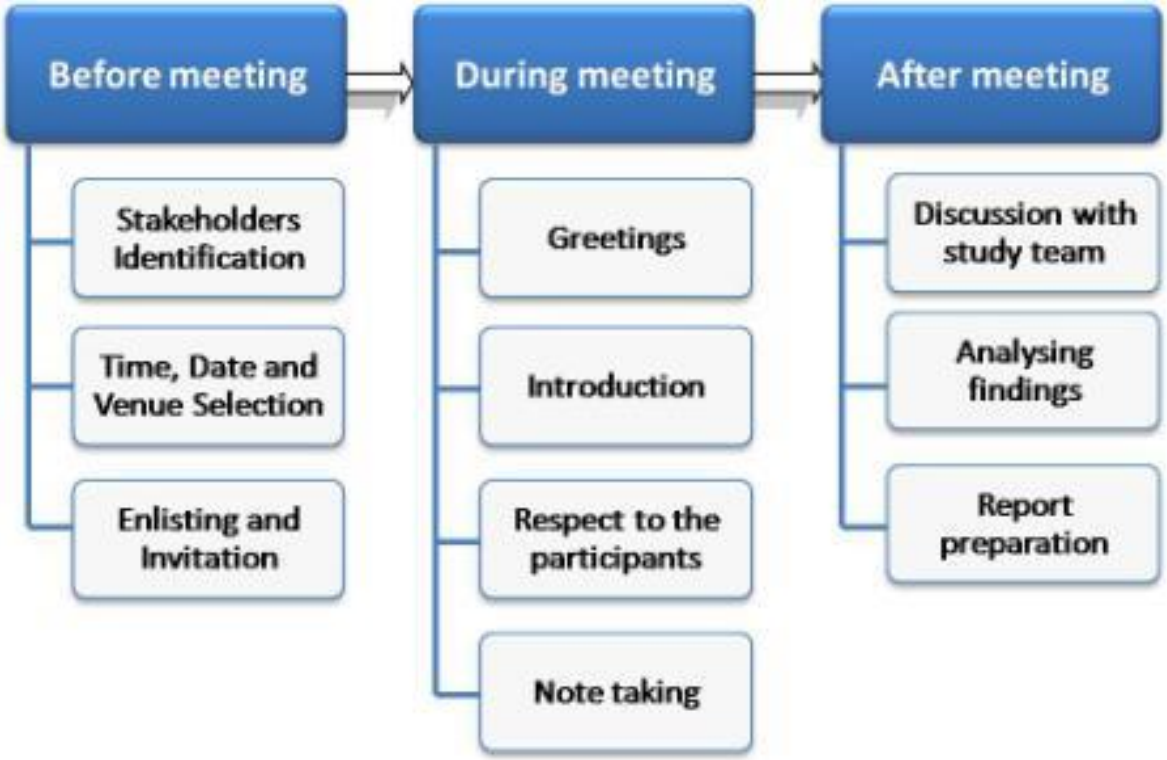


Figure 11.1: Overall consultation process

11.5 Public Consultation Meetings and FDGs

11.5.1 Consultation Process

663. A number of public consultation meetings and FGDs were conducted at different locations of the Polder 14/1. The details of these meetings and FDGs are presented in Table 11.1 and some photographs of these meetings are given in Photo 11.1 and 11.2.

Table 11.1: Meeting venue including time and date

Sl	District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
1	Khulna	Koyra	Dakshin Bedkashi	Dakshin Bedkashi Porishod	PCM	20/01/2016	10:00
2	Khulna	Koyra	Dakshin Bedkashi	Gorilal Bazzar	FGD	15/12/2015	

11.5.2 Consultation Participants

664. The main participants of the consultation meetings included public representative, farmer, trader and daily-wage laborers of the Polder 14/1 and nearby areas. A total of 46 participants attended these consultations. Details of the participant are provided in Annex Table 11.2 below.

Table 11.2: Participant Details

Sl	Meeting venue	Type of consultation	Type of Participants	No. of participants
1	Dakshin Bedkashi Union Porishod Conference room	PCM	Secondary and Primary stakeholders	32
2.	Gorilal Bazzar at Dakshin Bedkashi Union	FGD	Primary stakeholders	14

Photograph 11.1: PCM at Dakshin Bedkashi Union Auditorium

11.6 Issues discussed in FGDs and Meetings

665. At the outset of the meetings and FGDs, an overview of the proposed Project including the ongoing activities of the implementing agencies and the EIA process was shared with the

participants. subsequently, the key environmental, social, and socioeconomic aspects listed below were discussed.

Water resources:

- Surface water (tidal flooding, drainage, salinity, siltation)
- Water management (flood control, drainage, irrigation)

Agriculture:

- 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

666. 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 helped them in clearly understanding about the objectives and process of the project.

11.7.1 Attitude to the project

667. 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.

Photograph 11.2: FGD at Gorilal bazar

668. The outcomes of the FGDs and consultation meetings in terms of concerns and the suggested solutions were noted and organized by themes are presented in the Table 11.3 below.

Table 11.3: Community Concerns and Suggested Solutions

Themes/ Topics	11.8 Concerns/Issues/ Problems	11.9 Suggested Solution/Remedies
Overall	➢ Drainage congestion, Tidal flood, Tidal surge, Salinity intrusion, Low height and vulnerable of Embankment, Encroachment of internal canals, Kabadak, Arpangasia and Sakbaria rivers erosion, water logging due to siltation at certain parts of the Polder and poor communication system are the main community concerns in the Polder area.	➢ Comprehensive rehabilitation of the Polder should be taken up at the earliest with the active involvement of the local community. ➢ Proper compensation should be given to affected people ➢ Illegally captured canals should be liberated and the canal should be re-excavated ➢ Embankment height should be increased from 5.30 to 6.00 meter. ➢ To expand tourism industry at Goalkhali village (1 no. ward) of Dakshin bedkashi union and environment friendly policy should be followed. ➢ Extreme wave of Arpangasia and Kobadak River along with west side wave of Manic River creates erosion which must be controlled. ➢ Immediate construction of drainage sluice (Patakhali and Gorilal Bazar) and Repairing of drainage sluice (Padmapukur and Binapani) ➢ Proposed drainage sluice and flushing sluice linking canal should be excavated.
Water resources	➢ Kobadak and Sakbaria rivers are threats to local people due to continuous river erosion ➢ Kobadak and Sakbaria river flows should be concurrent at the point of padmapukur village of Bedkashi union. ➢ Drainage congestion at Chara Mukha village (8 no. ward, Goalkhali village (1 no. ward).	➢ Strengthening the banks with blocks, spreading stones/Geo-bags along vulnerable spots e.g. Padmapukur, Hariarpur (Uttar Bedkashi Union) Goalkhali, Binapani, Choto Angtihara (Dakshin Bedkashi Union). ➢ Embankment side of Binapani and Antihara should be protected without delay.

Themes/ Topics	11.8 Concerns/Issues/ Problems	11.9 Suggested Solution/Remedies
	➢ Major canals have silted up due to unplanned shrimp farming, Illegal DCR cut off, encroachment of canals etc. ➢ Siphon (locally called Nineting Boring) system are randomly used for shrimp cultivation, which generally cause damage of Embankment ➢ Tidal flooding, storm surge, salinity intrusion, encroachment of internal khal, erosion, inactive sluice gate and khal has silted up ➢ Height of the embankment is eroding gradually	➢ Re-sectioning of the embankment to protect erosion and embankment breach ➢ Damaged sluice gate, inlet, outlet and all water control infrastructures should be repaired ➢ Internal drainage canal should be re-excavated ➢ To expand tourism industry, environment friendly policy should be followed. ➢ Shelters has to be made water-proof
Agriculture resources	➢ Crop damage due to drainage congestion and water logging ➢ Lack of irrigation water during dry season due to siltation of rivers and internal khals.	➢ Repair the embankment as per design level ➢ Re-excavation of rivers and khals as per design level. ➢ Connecting the khals with rivers. ➢ Repairing the sluices and construction of new sluice. ➢ Regular operation and maintenance of the regulators. ➢ As soon as possible, blockd linkage canal and large canal like Joresing khal, Gharilal khal, Angtihara khal, Goalkhali khal and Patakhali khal etc should be re-excavated.

Themes/ Topics	**11.8 Concerns/Issues/ Problems**	**11.9 Suggested Solution/Remedies**
Fishery resources	➢ Major canals already lost their connectivity and depth due to encroachment of canals, damages of drainage sluice, unplanned shrimp farming and saline water intrusion ➢ Reduced 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 and water control infrastructure to catch fish ➢ Indiscriminate fishing by sluice net ➢ Entrance of saline water	➢ Re-excavation of canals (e.g. Joresing khal, Gharilal khal, Angtihara khal, Goalkhali khal, Patakhali khal 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 illegal control of khal and water control infrastructure to catch fish ➢ Using angler in an illegal way should be stopped ➢ Illegally occupied canals should be liberated and re-excavated ➢ Integrated cultivation should be used
Ecological resources	➢ Any extreme wave action would damage surrounding area due to insufficient foreshore afforestation ➢ Countryside vegetation has deteriorated and vegetation coverage has due to river bank erosion and extreme salinity intrusion. ➢ A number of trees would be cut and existing undergrowth vegetation would be damaged at construction sites for implementation of project intervention.	➢ Keep provision of compensation to the proper owners/authorities against tree felling ➢ Implement social aforestation along the embankment slopes ➢ Social aforestation along the countryside by local people and river side plantation to be implemented by forest authority ➢ 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 Mangrove tree species like Golpata, Kakra, Baim, Kaora, Sundari etc. and proper

Themes/ Topics	11.8 Concerns/Issues/ Problems	11.9 Suggested Solution/Remedies
		monitoring for saplings and fencing ➢ Implement social aforestation along the embankment slopes at Gorilal Bazar, Charamukha, Maderchar, Padpukur villages to protect from wave action as well as river erosion from Kobadak River. Conversely,afforestation at Mativanga, Goalkahli, Choto Antihara, Kashiadhali and Kathkatha Bazar villages would protect against wave action as well as river erosion from Sakbaria and Arpangashia River
Socio-economic resources	➢ More than 450 HHs will be displaced and their life and livelihood may be hampered. ➢ Lack of adequate expertise and experienced manpower to carry out the O&M of the Polder and the numbers of field staffs are also insufficient and inadequate in some places of the Polder with respect to the actual requirement. ➢ Rural power elite have captured open water bodies illegally i.e. canals, ditches for their own purposes ➢ Dependency on the Sundarbans area has increased for last five years due to lack of employment opportunities. ➢ Seasonal migration has increased for Garments and Agricultural sector ➢ Main communication and transportation system are extremely very poor from Kathkatha Bazar to Garilal Bazar ➢ About 70 Munda individuals (Ethnic community) HHs are living under hardcore situation due to lack of unemployment, river	➢ Rehabilitation of affected people along with ethnic community should be done according to the Resettlement Action Plan (RAP) ➢ Ensure proper resettlement of those households which may be affected by the project intervention for re construction of retired embankment (e.g. Binapani, Choto Antihara villages) in accordance with the RAP. ➢ The embankment cum road (e.g. from Padmapukur to Goalkhali village and Kathkatha Bazar to Choto Antihara village) should repaired immediately in places. ➢ After enlarging embankment, a maintenance and monitoring team should be formed for proper maintenance of it. ➢ Formation and strengthening of WMGs so that mass people can access to open water bodies easily. ➢ Proper maintenance of water control infrastructures at Patakhali, Gorilal, Binapani, Padmapukur, Choto Antihara and Gashidhali villages

Themes/ Topics	11.8 Concerns/Issues/ Problems	11.9 Suggested Solution/Remedies
	erosion and different natural disasters. They are dwelling mainly in Binapani, Joreshing, Khashiadhali villages along the Sakbaria River side of Daksshin Bedkashi Union. ➢ There is no road communication for the transportation of construction materials, heavy and medium machineries.	➢ Gate operator (locally called gate khalashi) should be recruited ➢ Illegal DCR cut off should be stopped ➢ To create opportunity for tourism industry at the Goalkhali village (About 400 acres) of Dakshin Bedkashi union and it should be done not only for the improvement of employment status of this area but also for the reduction of dependency on Sundarbans. ➢ Participation of local people should be given the first priority in earth work ➢ Construction materials, instruments should be carried through the water way (e.g. Kobadak and Sakbaria River) and Garilal Bazar, Keya Ghat, Kathkatha Bazar, Kheya Ghat and Uttar Bedkashi Kheya Ghat can be used to unload the construction materials

11.10 Framework for Consultations during Project Implementation

669. The stakeholder consultation is a continued process, and should be maintained throughout the project. The consultations carried out during the present EIA and reported in this Chapter are essentially a first step in this process. During the subsequent project phases as well, participation of the project stakeholders need to be ensured. The proposed participation framework during different project Phases is presented in Table 11.4.

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 Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
Project Construction Phase	➢ Information disclosure (sharing of the project objectives, project components, major benefits, potential impacts, mitigation measures and Resettlement Plan with the affected communities and other stakeholders).	➢ Institutional stakeholders; ➢ Grass root stakeholders, including the communities to be affected during the project implementation.	BWDB; Supervision Consultants; Contractors
	➢ Consultations and liaison	➢ The communities around the work sites, borrow areas, and access routes	BWDB; Supervision Consultants; Contractors
	➢ Grievance Redressal Mechanism and Social Complaint Register (discussed later in the document).	➢ The affected communities.	BWDB; Supervision Consultants; Contractors
	➢ Consultations with the communities during Compliance Monitoring and Effects Monitoring (discussed later in the document).	➢ Affected communities.	BWDB; Supervision Consultants; Contractors
	➢ Consultations with the project affectees / communities during the external monitoring.	➢ Affected communities.	External monitoring consultants.
	➢ Consultations with the project affectees / communities during the site visits by the WB monitoring mission.	➢ Project site staff; ➢ Contractors; ➢ Affected communities.	WB monitoring mission.
Project Operation Phase	➢ Community participation in O&M activities (see Section 4.9).	➢ Institutional stakeholders; ➢ Grass root stakeholders, including the beneficiary communities.	BWDB

11.11 EIA Disclosure

670. A Public Disclosure Meeting (PDM) on the EIA report of Polder 14/1 under the Coastal Embankment Improvement Project (CEIP) was held on 4th December, 2017 at Koyra Upazila of Khulna District. The Meeting was held in the Upazila conference room from 10:00 am to 1:15 pm. 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 has been finalized through incorporation of comments and suggestions received from the PDM.

671. 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 (a list of participants is presented in Appendix-J. The meeting was chaired by the Upazila Nirbahi Officer Mr. Shimul Kumar Shaha, Koyara Upazila and Chief Guest was Upazila Chairman Mr. A.K.H.M Tomiz Uddin. A total of 42 participants attended the PDM (Appendix-J). Dr. Ashraful Alam, CEGIS presented the study results in the meeting. Project summary was displayed in front of participants. Main points of the presentation are given below.

- Background of the Project
- Objective of the Costal Embankment Improvement Project (CEIP)
- Present condition and Major problems of the Polder 14/1
- Project location Images display
- Proposed Resettlement plan
- Environmental impact and mitigation measures
- Procedure of monitoring plan
- Type of compensation committee and
- Recommendation

Some photographs of the meeting are also given below.

Upazila Nirbahi Officer, Upazila Chairman, Vice-chairman attended the PDM

UP member of Bedkashi Union has expressed her idea in the discloser meeting

Photograph 11.3: View of PDM at Upazila Auditorium, Koyra, Khulna

Findings of the PDM:

672. The participants, including the persons likely to be affected by rehabilitation of Polder 14/1, expressed their views in favour of the Project and wanted its early implementation to protect them from natural disasters. Their views are listed below according to the nature of suggestions;

673. Views on Structural Issues around embankment reconstruction

- The participants said that Polder 14/1 has various problems. The Polder was damaged by Cyclone Sidr and Aila. The rehabilitation works have not been properly completed. The local people requested to finish the Polder re-construction work properly and include rest of areas which were not protected by the Polder. The project plan should be finalized based on discussion with local people and Union Parishad representatives.
- Main reason for embankment breach is the scouring created in the river. River training work should be done for protecting the embankment. The Sakbaria and Kapatakshi River need to be dredged along the specific location.
- Representative of local MP Mr. Mostafizur Rahman said that to ensure proper construction of embankment, soil testing and compaction should be done. The embankment should be constructed properly both in the upper part and in lower part. Sometimes, lower part is not constructed with the same importance and quality that the upper part gets. The sensitive locations of the embankment should be identified and repaired properly. RCC blocks should be placed in the toe area of embankment.
- The embankment height should be increased and additional unprotected areas should be included in the Polder area.
- The starting and ending time for project reconstruction is to be informed
- Effective monitoring should be conducted during the construction of the project activities.

Views on Drainage Improvement Issues

- Peripheral rivers e.g. Sakbaria River and Kapatakshi River should be re-excavated under this project. Otherwise, internal khal re-excavation would not be able to remove the drainage congestion in the Polder area and ensure plantation in the edge of embankment for protecting it from cyclonic surges.

Views on Compensation for Loss

- Proper compensation should be paid to the project affected people before starting the construction activities.
- Many houses, farm lands, and shops were not included in the acquisition list. He wanted to know whether those will be included in the list and if so, when it will be done.

General Views

- The Upazila Chairman should be included in the project implementation committee during construction period.
- Awareness building program among the communities should be conducted for better water management

- As there will be foreign engineers and labors working in the project, it was suggested to employ interpreters to facilitate communication with the local people. This will create trust among the local people regarding the project work.

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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	Present Condition (Partial/full	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										

14 VG – Very Good, G – Good, M – Moderate, B – Bad, VB – Very Bad

Others										

Drainage Channels									
Name	Length	Flow Direction	Flow (%)	Present Service Condition \Problems	Reasons of Problem	Re-excavation Need (Y/N)	Proposed Re-excavation Mode	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/Permanen	Length	Present Condition (G/ MD/ CD)15	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			

15 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	Onset:
F0 (< 30 cm)			
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			

<table>
<tr><td>1998</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>2004</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>2007</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td rowspan="2">Last five years</td><td colspan="2">Flood year</td><td></td><td rowspan="2">Flooding areas:</td></tr>
<tr><td colspan="2">Non flood year</td><td></td></tr>
</table>

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 years 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	Dura	Area	Length	Width	Depth	Dura
Capture Fisheries:	a. Total No. of fisher HHs: b. %/No. of CFHHs: c. %/No. of SFHHS:	River																
Culture Fisheries:	d. No. of Days spend annually in fishing by CFHHs: SFHHs:	Beel (Leased/non leased)																

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	Dura	Area	Length	Width	Depth	Dura
Indiscriminate Fishing Activities:	e. Hrs/Day spend in fishing by CFHHs:	Khal																
	SFHHs:	Floodplain																
		Swamp Forest																
		Fish pond																
		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				
	1.		1.						Live fish				

Fish Migration				Fish Biodiversity	
Present Obstacle to fish migration:	2. 3.			Reasons of increase or decrease	2. 3. 4. 5.
Important breeding, feeding and over wintering ground					
Horizontal Migration pattern	Species: 1. 2. 3. 4. 5.	Season (Months):	Routes:	Significant areas	1. 2. 3.
Vertical Migration Pattern	Species: 1. 2. 3. 4. 5.	Season (Months):	Habitats:	Species of Conservation Significance	Rare: Unavailable:

Species List					Species Composition				
River	Khal	Beel	Pond	Other	Group	River	Khal	Beel	Pond
					Other fish				
					Prawn				
					Hilsa				
					Rui				
					Catla				
					Mrigel				
					Koi				
					Sarpunti				
					Large prawn				
					Small Pprawn				
					Silver carp				
					Carpu				
					Grass carp				
					Tengra				
					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:	
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		

Species Name	**Status**	**Utilization**
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			

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			

Aquatic Wildlife Checklist

Species Name	Habitat	Status	Migration Status
Mammals			
Amphibians			
Reptiles			
Birds			

Species Name	**Habitat**	**Status**	**Migration Status**
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 in Acre**	**Connectivity**		**Importance**
			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/near 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).if any
....
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	
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	

Main occupation by households	% of households
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. No.	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.	**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		

Reasons of Conflicts	Present status of problem	Solution they want with location
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. No.	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					
6	Hail storm					

Sl. No.	Major Disaster	Severely affected year	% of area affected	% of hhs affected	% of crop damage	Major crop damaged
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

Sl	Issue/Question	Response/Suggestion		
	Farmer			
	Trader			
	Labor			
	Landless			
	Fisher			
	Service holder			
	Others			
d)	No. of villages covered			
e)	Existence of fund			
f)	AGM			
g)	Election			
h)	EC meetings			
i)	Present water resources management activities			

Sl	Issue/Question	Response/Suggestion

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.

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/ 125

Date: 05/06/2013

Subject: Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I).

Ref: Your Application dated 31/03/2013.

With reference to the above mentioned subject, the Department of Environment (DOE) hereby accords Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I) at Satkhira, Khulna, Bagerhat, Pirojpur, Patuakhali and Barguna Districts subject to fulfilling the following terms and conditions.

I. This clearance shall only be applicable for the development of the infrastructure of the said project.

II. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) report considering the overall activity of the said Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE).

III. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)

4a. Project activities:
- A list of the main project activities to be undertaken during site clearing, construction as well as operation
- Project Plan, Design, Standard, Specification, Quantification, etc.

4b. Project schedule: The phase and timing for development of the Project

4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.

4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.

5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
   - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
   - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
   - Environment Quality : Air, Water, Soil and Sediment Quality
   - Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions
6. Socio-economic environment should include, inter alia, following:
   - Population: Demographic profile and ethnic composition
   - Settlement and housing
   - Traffic and transport
   - Public utilities: water supply, sanitation and solid waste
   - Economy and employment: employment structure and cultural issues in employment
   - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.
7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).
   In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the

1/2

scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man maid or natural, wildlife, socio-economic aspect shall be incorporated in detail.

8. Management Plan/Procedures:
For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.
An outline of the Environmental Management Plan shall be developed for the project.
In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)
Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
10. Conclusion and Recommendations

IV. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.

V. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project..

VI. Violation of any of the above conditions shall render this clearance void.

VII. The project authority shall submit the EIA along with an application for Environmental Clearance, the applicable fee in a treasury chalan and the no objection certificates (NOCs) from the local authority to the head office in Dhaka with a copy to the Khulna and Barisal Divisional Office of DOE.

VIII. This clearance is valid for one year from the date of issuance and the project authority shall apply for renewal to Head Office with a copy to the Khulna and Barisal Divisional Office of DOE at least 30 days ahead of expiry.

IX. This Site Clearance Certificate has been issued with the approval of the appropriate authority.

05.06.2013

(Syed Nazmul Ahsan)
Deputy Director (Environmental Clearance)
&
Member Secretary
Environmental Clearance Committee
Phone # 02-8181778

Mr. Md. Sarafat Hossain Khan
Superintending Engineer & Project Coordinator
Coastal Embankment Improvement Project (Phase-I)
Bangladesh Water Development Board (BWDB)
72, Gre[illegible]d, Dhaka-1205.

Copy Forwarded to :

1) PS to Secretary, Ministry of Environment and Forest, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Khulna/Barisal Divisional Office, Khulna/Barisal.
3) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

2/2

Appendix C: Details of Environment Relevant Policies and Laws

(A) Relevant National Policies, Strategies and Plans

(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 2 under CEIP-I and the proposed interventions are required to comply with all the policy directives emphasizing particularly on reducing adverse environmental impacts. The EIA studies of the coastal Polders are required to clearly address the potential impacts and propose mitigation measures.

(ii) National Environment Management Action Plan, 1995

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

(iii) National Water Policy, 1999

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

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 2 under CEIP-I. The Project design and present EIA study will be required to comply with these requirements.

(iv) Guidelines for Participatory Water Management 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.

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

The National Water Management Plan (NWMP) 2001, approved by the National Water Resources Council in 2004, envisions establishing an integrated development, management and use of water resources in Bangladesh over a period of 25 years. WARPO has been assigned to monitor the national water management plan. The major programs in the Plan have been organized under eight sub-sectoral clusters: (i) Institutional Development, ii) Enabling Environment, (iii) Main River, (iv) Towns and Rural Areas, v) Major Cities; (vi) Disaster Management; (vii) Agriculture and Water Management, and (viii) Environment and Aquatic Resources. Each cluster comprises of a number of individual programs, and a total of 84 sub-sectoral programs have been identified and presented in the investment portfolio. Most of the programs are likely to be implemented in coastal areas.

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

(vi) 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 coast of Bangladesh is known as a zone of vulnerabilities as well as opportunities. It is prone to natural disasters like cyclone, storm surge and flood. In this regard, for reducing risk, the policy emphasizes the improvement of coastal Polders and seeks to enhance safety measures by combining cyclone shelters, multi-purpose embankments, road system and disaster warning system.

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

(vii) Coastal Development Strategy, 2006

The Coastal Development Strategy (CDS) focuses on the implementation of the coastal zone policy. The CDS was approved at the second meeting of the Inter-Ministerial Steering

Committee on ICZMP held on 13 February 2006. Nine strategic priorities, evolved through a consultation process, guide interventions and investments in the coastal zone:

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

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

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

The National Land Use Policy (NLUP), enacted in 2001, aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities. The NLUP urges that increasing the land area of the country may not be possible through artificial land reclamation processes, which are cost-effective only in the long run. Therefore, land use planning should be based on the existing and available land resources. The policy suggests establishing land data banks where, among others, information on accreted riverine and coastal chars will be maintained. Among the 28 policy statements of NLUP, the following are relevant to coastal area:

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

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

(ix) 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. Although the policy does not emphasize the coastal zone separately, all specific objectives are applicable to the development of coastal zone agriculture. The policy particularly stressed on minor irrigation capturing tidal water in reservoirs in coastal areas and research on the development of improved varieties and technologies for cultivation in coastal, hilly, water-logged and salinity affected areas. The policy also recognizes that adequate measures should be taken to reduce water-logging, salinity and provide irrigation facilities for crop production.

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

(x) National Fisheries Policy, 1996

The National Fisheries Policy (NFP), 1996 recognizes that fish production has declined due to environmental imbalances, adverse environmental impact and improper implementation of fish culture and management programs. The policy particularly focuses on coastal shrimp, aquaculture and marine fisheries development.

The policy suggests following actions:

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

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

(xi) National Forest Policy, 1994

The Forest Policy 1994 recognizes the importance of biodiversity for environmental sustenance. The policy is explicitly mentioned that habitats for the wildlife and vegetation will be conserved through afforestation and by bringing forest lands under Protected Areas. The policy targets to bring 20% of the total land area of the country under forest cover, and at least 10% of which under protected areas by 2015. It also declared that measures will be taken to improve degraded forests. The Policy, at the same time, advocated social forestry, which includes agro forestry, woodlot plantations, strip plantations in vacant public and private lands of the country. Afforestation could directly contribute to climate change mitigation efforts and efforts to improve forest quality add to forest resilience.

(xii) Private Forest Policy 1994

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

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

(xiii) National Livestock Development Policy, 2007

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

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

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

(B) National Environmental Laws

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

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

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

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

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

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

The ECA 1995 was amended in 2010, which provided clarification of defining wetlands as well as Ecologically Critical Areas and included many important environmental concerns such as conservation of wetlands, hill cutting, ship breaking, and hazardous waste disposal. This amendment empowered the government to enforce more penalties than before. Moreover, affected persons were given provision for putting objections or taking legal actions against the polluters or any entity creating nuisance to affected person.

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

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

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

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

Rule 7 classifies projects into four categories depending on environmental impact and location for the purpose of issuance of ECC. These categories are: Green, Orange A, Orange B, and Red.

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

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

(iii) Bangladesh Environment Court Act, 2010

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

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

According to the Act the Government (Forest Department) can prohibit certain activities in the declared Reserved Forest area such as any intervention kindles, keeps or carries any fire; trespasses or pastures cattle, or permits cattle to trespass; causes any damage by negligence in felling any tree or cutting or dragging any timber; etc.

“26. Acts prohibited in such forests. -

(1) Any person who, in a reserved forest-

(a) Kindles, keeps or carries any fire except at such seasons as the Forest-Officer may notify in this behalf;

(b) Trespasses or pastures cattle, or permits cattle to trespass;

(c) causes any damage by negligence in felling any tree or cutting or dragging any timber;

(d) quarries stone, burns lime or charcoal, or collects, subjects to any manufacturing process, or removes any forest produce other than timber; or who enters a reserved forest with firearms without prior permission from the Divisional Forest Officer concerned, shall be punishable with imprisonment for a term which may extend to six months and shall also be liable to fine which may extend to two thousand taka, in addition to such compensation for damage done to the forest as the convicting Court may direct to be paid.”

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

(v) Private Forest Ordinance (PFO), 1959

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

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

(vi) Social Forestry Rules, 2004 and Amendments

Social forestry was included in the Forest (Amendment) Act 2000 and the Social Forestry Rules were approved in 2004 (amended in 2010 and 2011). The Rules defined the process of beneficiaries’ selection, roles and responsibilities of different stakeholders, management, capacity building and distribution of earnings from social afforestation. According to the rules, the beneficiaries shall be selected from amongst the local communities and shall preferably be from the amongst the followings persons, namely: (a) landless persons; (b) owners or occupants of less than 50 decimals of land; (c) destitute women; (d) unprivileged community; (e) poor ethnic minority; (f) poor forest villages; and (g) insolvent freedom fighters or insolvent successor of freedom fighters. The rules provided the rotation period for different plantation and benefit sharing. In general, the communities responsible for maintenance of plantation will receive around 45% of timber value of the forest.

(vii) Antiquities Act, 1968

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

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

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

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

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

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

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

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

- Subject to the provisions of this Act or of any agreement under section 12, no person shall, except for carrying out the purposes of this Act, destroy, break, damage, alter, injure, deface or mutilate, or scribble, write or engrave any inscription or sign on, any antiquity in respect of which the Director has accepted guardianship or the Central Government has acquired any right.

- The court trying an offence under sub-section (2) may direct that the whole or any part of the fine recovered shall be applied in defraying the expenses of restoring the antiquity to the condition in which it was before the commission of the offence.

21. Dealing in antiquities.

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

23. Prohibition of movement of antiquity.

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

(viii) Bangladesh National Building Code, 2006

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

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

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

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

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

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

(ix) Standing Orders on Disaster, 2010

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

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

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

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

The Ministry of Land (MoL) is authorized to deal with land acquisition. The MoL delegates some of its authority to the Commissioner at Divisional level and to the Deputy Commissioner at the District level. The Deputy Commissioners (DCs) are empowered by the MOL to process land acquisition under the Ordinance and pay compensation to the legal owners of the acquired property. *Khas* (government owned land) lands should be acquired first when a project requires both *khas* and private land. If a project requires only *khas* land, the land will be transferred through an inter-ministerial meeting following the acquisition proposal submitted to DC or MoL as the case may be. The DC is empowered to acquire a maximum of 50 standard *bigha* (6.75 ha) of land without any litigation where the Divisional Commissioner is involved for approval. Acquisition of land more than 50 standard *bigha* is approved from the central land allocation committee (CLAC) headed by the chief executive of the Government of Bangladesh proposed by the MoL.

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

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

The State Acquisition and Tenancy Act (Sections 86 and 87) also define the ownership and use right of alluvium (payosti or reformation in situ or original site) and diluvion land (nadi sikosti) in the country. In legal terms, eroded lands (sikosti) inside the alluvion-diluvion (AD) line (i.e. including submerged land or underwater land) are considered khas land once declared by concerned Deputy Commissioner (DC) demarcating the AD Line.[1]

(xii) Constitutional Right of the Tribal Peoples Rights

The Constitution of Bangladesh does not mention the existence of cultural and ethnic minorities in Bangladesh. The only protective provision for the ethnic minorities that the policy makers often refer to in the context is Article 28 (4) which states that: Nothing shall prevent

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

the state from making special provision in favor of women and children or for the advancement of any backward section of the citizens. The above provision is an ambiguous one and it does not define who or what constitutes "backward". However, the Government recognizes existence of “tribal peoples” and the need for special attention and in general tribal people are essentially viewed as backward, poor and socio-economically & culturally inferior. Towards this end a special program was initiated in 1996-97 by the Prime Minister’s Secretariat aimed at improving the socio-economic situation of the indigenous people of Bangladesh, resident outside the Chittagong Hill Tracts.

(xiii) Ethnic Minority Rights in PRSP 2005

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

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

(xiv) 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(Ordinance II of 1982 with amendments up to 1994) and other land laws and administrative manuals relevant to land administration in Bangladesh. According to the Ordinance, whenever it appears to the GoB that any property in any locality is needed or is likely to be needed for any public purpose or in the public interest, the Government can acquire the land provided that the property is not used by the public for the purpose of religious worship, graveyard and cremation ground. The 1982 Ordinance requires that compensation be paid for (i) land and assets permanently acquired (including standing crops, trees, houses); and (ii) any other damages caused by such acquisition. The Deputy Commissioner (DC) determines (a) market value of acquired assets on the date of notice of acquisition (based on the registered value of similar property bought and/or sold in the area over the preceding 12 months), and (b) 50% premium on the assessed value (other than crops) due to compulsory acquisition. The 1994 amendment made provisions for payment of crop compensation to tenant cultivators. Given that people devalue land during title transfer to minimize tax payment, compensation for land paid by DC including premium largely remains less than the actual market price.

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

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

- Avoid or minimize resettlement: The law only implicitly discourages unnecessary acquisition, as lands acquired for one purpose cannot be used for a different purpose. However, there are no mechanisms to monitor if this condition is actually adhered to.
- Eligibility for compensation: The law stipulates compensation only for the persons who appear in the land administration records as the owners. It does not recognize the rights of those, such as squatters, who do not possess legal title to the lands they live in or make a living from.
- Compensation: The law provides compensation for lands and other objects built and grown on them (structures, trees and orchards, crops and any other developments like ponds, built amenities, etc.). No provisions are there to assess and restore lost income stream or income sources that acquisition causes to the affected persons, be they legal titleholders or others like squatters, tenants and employees of affected businesses.
- Compensation standards: Although the law stipulates 'market prices' of the acquired lands as the just compensation, the legal assessment method almost always results in prices that are far below the actual market prices1. Certain pricing standards, which are regarded as unrealistic, are used to assess other losses like structures and various built amenities, trees, crops and the like.
- Relocation of households and other establishments: No legal obligation is there to relocate, or assist with relocation of, those whose homesteads have been acquired or whose place of residence or livelihoods has been affected. Such persons/households, be they titleholders or squatters, are left on their own.
- Ensuring payment of compensation: Lands are legally acquired and handed over to the project execution agency as soon as the acquisition authority identifies the owners (or 'awardees'), by examining the records, and sends a legal notice advising them to claim the compensation (or 'awards'). It is the obligation of the affected landowners to

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

prove, by producing an array of documents that the acquired lands legally belong to them. As gathering these documents is a long, expensive and cumbersome process, many landowners may remain unable to claim their awards1.

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

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

(C) **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 thisOperational 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.

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

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-I has 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. [1]

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

This OP is not triggered since no cultural or archaeological resources are known to exist in the vicinity of the Project nor have any such resources been identified during 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)

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

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:[1]

- 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.[2]

1 Excerpts from the OP 4.10. WB Operational Manual. July 2005.
2 Excerpts from WB OP 4.12. WB Operational Manual. December 2001.

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)

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. [1]

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 Guidelines

The Environment, Health, and Safety (EHS)2 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.

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

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

Appendix D: No Objection Certificates

বিসমিল্লাহির রহমানির রহিম

৭নং দক্ষিণ বেদকাশী ইউনিয়ন পরিষদ কার্য্যালয়

গ্রাম-আংটিহারা, ডাকঘর ঃ জোড়শিং, উপজেলা ঃ কয়রা,
জেলা ঃ খুলনা ।
মোবাঃ ০১৭১১-৫৭১৪২৬, ০১৯৭১-৫৭১৪২৬, ০১৯১৬-৫৩০২৫২

পূর্ব সূত্র ঃ....................

তারিখ ঃ ২০/১/১৬

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 ১৪/১, খুলনা জেলার কয়রা উপজেলার দক্ষিণ বেতকাশী ইউনিয়নে অবস্থিত।

৫। প্রকল্পের তফছিল ঃ

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
খুলনা	কয়রা	দক্ষিণ বেদকাশী			মাঝারি উঁচু ভূমি	হেক্টর

৬। প্রকল্পের কার্যক্রম ঃ বাঁধ উঁচুকরন, স্লুইজ গেট ও রেগুলেটর নির্মাণ ও মেরামত, খাল পূনঃখনন ইত্যাদি।

উপরোক্ত তথ্যাদির আলোকে পোল্ডার ১৪/১ 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।

২০/১/১৬

তারিখ ঃ ২০/১/১৬

স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও সীলমোহর

আলহাজ্ব মো. এ মান্নান
চেয়ারম্যান
৭নং দক্ষিণ বেদকাশী ইউনিয়ন পরিষদ
কয়রা, খুলনা

Appendix E: Gate Operation Plan in Bengali

পোল্ডারের স্লুইস গেট পরিচালনার ক্ষেত্রে নিয়মাবলী

অতীতে পানি উন্নয়ন বোর্ডের কর্মচারীর মাধ্যমে স্লুইস গেটগুলো পরিচালিত হতো। বাজেট স্বল্পতার কারণে সে পদগুলো এখন স্থগিত করা হয়েছে। বর্তমানে গেটগুলো পরিচালনার দায়িত্ব সুবিধাভোগীদের উপর অর্পন করা হয়েছে। প্রতিটি পোল্ডারে এ জন্য পানি ব্যবস্থাপনা সংস্থা (WMG, , WMA, WMF) গঠন করা হয়। কৃষি উন্নয়ন ও মৎস্য সম্পদের কথা বিবেচনা করে পোল্ডার ১৪/১ এর গেট পরিচালনায় পানি ব্যবস্থাপনা সংস্থাগুলোকে নিম্নোক্ত বিষয়গুলো বিবেচনা করতে হবে:

- কৃষি ও মৎস্য সম্পদ ব্যবস্থাপনার সাথে সামঞ্জস্য রেখে একটি নির্দিষ্ট নিয়মের মধ্য দিয়ে প্রতিটি রেগুলেটরের গেট অবশ্যই 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;
- বর্ষা পরবর্তী সময় (অক্টোবর-নভেম্বর) গেট এমনভাবে পরিচালনা করতে হবে যাতে খালে শুষ্ক মৌসুমেও পর্যাপ্ত পানি থাকে। এক্ষেত্রে লক্ষ্য রাখতে হবে যেন খালের পানি তীর উপচে না যায় এবং কৃষি কার্যক্রম ব্যাহত না হয়;
- ফ্ল্যাশিং স্লুইস ও পাইপ ইনলেট পরিচালনার ক্ষেত্রেওএকই নিয়ম অনুসরণ করতে হবে;
- কৃষি কার্যক্রম, শস্যের 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, , WMA & WMF) সমন্বিত পানি ব্যবস্থাপনার উপর প্রশিক্ষণ প্রদান করতে হবে।

Appendix F: Wildlife Species Composition

Table 1: Checklist of terrestrial plant species found within the Polder area

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

Scientific Name	Family	Local Name	Habit
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
Litchi chinensis	➢ Sapindaceae	➢ Lichu	➢ Tree

Scientific Name	Family	Local Name	Habit
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
Scirpus juncoides	➢ Cyperaceae	➢ Chisra	➢ Herb

Scientific Name	Family	Local Name	Habit
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 Resident

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	➢
Actitis hypoleucos	➢ Common Sandpiper	➢ Pati Batan		➢ CWV	➢
Aegithina tiphia	➢ Common Iora	➢ Pati Fatikjal		➢ CR	➢
Alcedo atthis	➢ Common Kingfisher	➢ Pati Machranga		➢ CR	➢
Amaurornis phoenicurus	➢ White-breasted Water hen	➢ Dholabook Dahuk		➢ UR	➢
Anastomus oscitans	➢ Asian Open bill	➢ Eshio Shamkhol		➢ CR	➢
Anthus hodgsoni	➢ Olive-backed Pipit	➢ Jolpaipith Tulika		➢ CWV	➢
Anthus richardi	➢ Richard's Pipit	➢ Richarder Tulika		➢ CWV	➢
Anthus roseatus	➢ Rosy Pipit	➢ Golapi Tulika		➢ CWV	➢
Anthus rufulus	➢ Paddy field Pipit	➢ Dhani Tulika		➢ CR	➢
Ardeola grayii	➢ Indian Pond Heron	➢ Deshi Kanibok		➢ CR	➢
Artamus fuscus	➢ Ashy Wood swallow	➢ Metey Bonababil		➢ CR	➢
Athene brama	➢ Spotted Owlet	➢ Khuruley Kutipecha		➢ CR	➢
Bubulcus ibis	➢ Cattle Egret	➢ Go Boga		➢ CR	➢

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Caprimulgus macrurus	Large-tailed Nightjar	Lenja Ratchora		CR	
Casmerodius albus	Great Egret	Boro Boga		CR	
Celeus brachyurus	Rufous Woodpecker	Khoira Khathkurali		CR	
Centropus sinensis	Greater Coucal	Boro Kubo		CR	
Charadrius dubius	Little Ringed Plover	Soto Nothjiria		CR/CWV	
Cisticola juncidis	Zitting Cisticola	Bhomra Soton		CR	
Columba livia	Common Pigeon	Gola Paira		CR	
Copsychus saularis	Oriental Magpie-Robin	Udoi Doel		CR	
Coracias benghalensis	Indian Roller	Bangla Nilkanto		CR	
Coracina macei	Large Cuckoo shrike	Boro Kabashi		CR	
Corvus macrorhynchos	Large-billed Crow	Dar Kak		CR	
Corvus splendens	House Crow	Pati Kak		CR	
Cuculus micropterus	Indian Cuckoo	Bokotakou Kokil		CR	
Cypsiurus balasiensis	Asian Palm Swift	Ashio Talbatashi		CR	

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Dendrocitta vagabunda	➢ Rufous Treepie	➢ Khoira Harichacha		➢ C R	➢
Dendrocopos macei	➢ Fulvous-breasted Woodpecker	➢ Batabi Kathkurali		➢ C R	➢
Dendrocygna bicolor	➢ Fulvous Whistling Duck	➢ Raj Shorali		➢ C W V	➢
Dendrocygna javanica	➢ Lesser Whistling Duck	➢ Pati Shorali		➢ C R	➢
Dicrurus macrocercus	➢ Black Drongo	➢ Kala Fingey		➢ C R	➢
Dinopium benghalense	➢ Lesser Golden back	➢ Bangla Kaththokra		➢ C R	➢
Dinopium javanense	➢ Common Golden back	➢ Pati Kaththokra		➢ C R	➢
Egretta garzetta	➢ Little Egret	➢ Choto Boga		➢ C R	➢
Egretta intermedia	➢ Yellow-billed Egret	➢ Majhla Boga		➢ C R	➢
Elanus caeruleus	➢ Black-winged Kite	➢ Katua Chil		➢ U R	➢
Eudynamys scolopaceus	➢ Asian Koel	➢ Eshio Kalakokil		➢ C R	➢
Falco tinnunculus	➢ Common Kestrel	➢ Pati Kestrel		➢ C W V	➢
Gallicrex cinerea	➢ Water cock	➢ Deshi Kora		➢ U R	➢
Gallinago gallinago	➢ Common Snipe	➢ Pati Chega		➢ C W V	➢

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Gallinago stenura	➢ Pin-tailed Snipe	➢ Lenja Chega		➢ CWV	➢
Gallinula chloropus	➢ Common Moorhen	➢ Pati Panmurgi		➢ CR	➢
Glareola lactea	➢ Small Indian Pratincole	➢ Soto Babubatan		➢ CR	➢
Halcyon smyrnensis	➢ White-throated Kingfisher	➢ Dholagola Machranga		➢ CR	➢
Haliastur Indus	➢ Brahminy Kite	➢ Shonkho Chil		➢ CR	➢
Hierococcyx varius	➢ Common Hawk-Cuckoo	➢ Pati Chokhgelo		➢ CR	➢
Hypothymis azurea	➢ Black-naped Monarch	➢ Kalaghar Rajon		➢ CR	➢
Ixobrychus cinnamomeus	➢ Cinnamon Bittern	➢ Khoira Bogla		➢ UR	➢
Ketupa zeylonensis	➢ Brown Fish Owl	➢ Khoira Mechopecha	➢	➢ UR	➢
Lanius cristatus	➢ Brown Shrike	➢ Khoira Latora		➢ CWV	➢
Lanius schach	➢ Long-tailed Shrike	➢ Lenja Latora		➢ CR	➢
Larus ridibundus	➢ Common Black-headed Gull	➢ Kalamatha Gangchil		➢ CWV	➢
LC Acridotheres tristis	➢ Common Myna	➢ Bhat Shalik		➢ CR	➢
Leptocoma zeylonica	➢ Purple-rumped Sunbird	➢ Begunikomor Moutushi		➢ CR	➢
Lonchura malabarica	➢ Indian Silver bill	➢ Deshi Chandithot		➢ UR	➢

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Lonchura malacca	➢ Black-headed Munia	➢ Kalamatha Munia		➢ UR	➢
Lonchura punctulata	➢ Scaly-breasted Munia	➢ Butibook Munia		➢ CR	➢
Malacocincla abbotti	➢ Abbott's Babbler	➢ Aboter Satarey		➢ CR	➢
Megalaima asiatica	➢ Blue-throated Barbet	➢ Neelgola Boshonto		➢ CR	➢
Megalaima haemacephala	➢ Coppersmith Barbet	➢ Shekra Boshonto		➢ CR	➢
Megalaima lineata	➢ Lineated Barbet	➢ Dagi Boshonto		➢ CR	➢
Megalurus palustris	➢ Striated Grassbird	➢ Dagi Ghashpakhi		➢ CR	➢
Merops orientalis	➢ Green Bee-eater	➢ Shobuj Shuichora		➢ CR	➢
Metopidius indicus	➢ Bronze-winged Jacana	➢ Dol Pipi		➢ UR	➢
Milvus migrans	➢ Black Kite	➢ Bhubon Chil		➢ CR	➢
Mirafra assamica	➢ Bengal Bush Lark	➢ Bangla Jharbhorot		➢ CR	➢
Motacilla alba	➢ White Wagtail	➢ Dhola Khonjon		➢ CWV	➢
Motacilla cinerea	➢ Grey Wagtail	➢ Metey Khonjon		➢ UWV	➢
Motacilla citreola	➢ Citrine Wagtail	➢ Sitrin Khonjon		➢ CWV	➢
Motacilla madaraspatensis	➢ White-browed Wagtail	➢ Dholavru Khonjon		➢ UR	➢

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Nettapas coromandelianus	➢ Cotton Pygmy Goose	➢ Dhola Balihash		➢ UR	➢
Numenius arquata	➢ Eurasian Curlew	➢ Eureshio Gulinda		➢ V	➢
Numenius glareola	➢ Wood Sandpiper	➢ Bon Batan		➢ CWV	➢
Nycticorax nycticorax	➢ Black-crowned Night Heron	➢ Kalamatha Nishibok		➢ CR	➢
Oriolus xanthornus	➢ Black-hooded Oriole	➢ Kalamatha Benebou		➢ CR	➢
Orthotomus sutorius	➢ Common Tailorbird	➢ Pati Tuntuni		➢ CR	➢
Parus inornata	➢ Plain Prinia	➢ Nirol Prina		➢ CR	➢
Parus major	➢ Great Tit	➢ Boro Tit		➢ CR	➢
Passer domesticus	➢ House Sparrow	➢ Pati Chorui		➢ CR	➢
Pericrocotus cinnamomeus	➢ Small Minivet	➢ Choto Saheli		➢ CR	➢
Phalacrocorax niger	➢ Little Cormorant	➢ Choto Pankouri		➢ CR	➢
Picus xanthopygaeus	➢ Streak-throated Woodpecker	➢ Dagigola Kathkurali		➢ UR	➢
Ploceus philippinus	➢ Baya Weaver	➢ Deshi babui		➢ CR	➢
Pluvialis fulva	➢ Pacific Golden Plover	➢ Proshanto Shonajiria		➢ CWV	➢
Psittacula krameri	➢ Rose-ringed Parakeet	➢ Modna Tia		➢ CR	➢

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Pycnonotus cafer	➢ Red-vented Bulbul	➢ Bangla Bulbul		➢ CR	➢
Rhipidura albicollis	➢ White-throated Fantail	➢ Dholagola Chatighurani		➢ CR	➢
Spilornis cheela	➢ Crested Serpent Eagle	➢ Tila Nag-eegol		➢ CR	➢
Sterna acuticauda	➢ Black-bellied Tern	➢ Kalapet Panchil			➢
Sterna aurantia	➢ River Tern	➢ Nodia Panchil		➢ UWV	➢
Sterna hirundo	➢ Common Tern	➢ Pati Panchil		➢ UWV	➢
Streptopelia chinensis	➢ Spotted Dove	➢ Tila Ghughu		➢ CR	➢
Streptopelia decaocta	➢ Eurasian Collared Dove	➢ Eurashio Konthighughu		➢ CR	➢
Streptopelia tranquebarica	➢ Red Turtle Dove	➢ Lal Konthighughu		➢ CR	➢
Sturnus contra	➢ Pied Myna	➢ Eshio Pakrashalik		➢ CR	➢
Sturnus ginginianus	➢ Bank Myna	➢ Gaang Shalik		➢ UR	➢
Sturnus malabaricus	➢ Chestnut-tailed Starling	➢ Khoiralej Telshalik		➢ CR	➢
Tadorna ferruginea	➢ Ruddy Shelduck	➢ Khoira Chokachoki		➢ CWV	➢
Terpsiphone paradisi	➢ Asian Paradise-flycatcher	➢ Eshio Shabulbuli		➢ UR	➢

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Treron phoenicopterus	➢ Yellow-footed Green Pigeon	➢ Holdepa Horial		➢ CR	➢
Turdoides striatus	➢ Jungle Babbler	➢ Bon Satarey		➢ CR	➢
Turdoides earlei	➢ Striated Babbler	➢ Dagi Satarey		➢ UR	➢
Tyto alba	➢ Barn Owl	➢ Lokkhi Pecha (SA)		➢ UR	➢
Upupa epops	➢ Eurasian Hoopoe	➢ Pati Hoodhood		➢ UR	➢
Vanellus duvaucelii	➢ River Lapwing	➢ Nodi Titi	➢	➢ UR	➢
Vanellus indicus	➢ Red-wattled Lapwing	➢ Hot Titi		➢ UR	➢
Zoothera torquatus	➢ Eurasian Stone Chat	➢ Pati Shilafidda		➢ CWV	➢
Zosterops palpebrosus	➢ Oriental White-eye	➢ Udoi Dholachokh		➢ CR	➢

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/Houm	➢ EN	➢ UR

Scientific Name	English Name	Local Name	IUCN Status (BD)	Local Status
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				
	➢	➢	➢	➢
	➢	➢	➢	➢
	➢	➢	➢	➢
	➢		➢	➢

Scientific Name	English Name	Local Name	IUCN Status (BD)	Local Status
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
	➢	➢	➢	➢
	➢	➢	➢	➢
Varanus salvator	➢ Water Monitor	➢ Sona Gui	➢ EN	➢ RR
	➢	➢	➢	➢
Atretium schistosum	➢ Olive Keelback	➢ Matia Shap	➢ -	➢ CR
Amphiesma stolatum	➢ Striped Keelback	➢ Chilu Shap	➢ -	➢ CR
Enhydris enhydris	➢ Common Smooth Water Snake	➢ Painna Shap	➢ -	➢ CR
Lycodon aulicus	➢ Common Wolf Snake	➢ Gharginni Shap	➢ -	➢ CR

Scientific Name	English Name	Local Name	IUCN Status (BD)	Local Status
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 kaouthia	Monocled Cobra	Gokhra Shap	VU	RR

Source: Field survey, 2012

Appendix G: Summary of Assessed Impacts

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
A. Pre-construction Phase									
Deteriorated environmental (air and noise) quality	Short term	Local	Reversible (after construction phase)	Occasional	Medium	**Minor**	• Construction material (sand) should be kept covered while transporting and stock piled and contractor should supervise. • The contractors need to be conscious avoid unnecessary honking of material carrying trawlers. • The contractors should be encouraged to move all construction equipment, machineries and materials during day time instead of night. • Exhaust emissions from trawler and equipment should comply with standards of DoE. • Mobilization trawler should have proper mufflers and silencers.	**Low**	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Water sprinkling and ramming the material stockyard should be done regularly. • Stockyard should be covered during non working periods which should monitor by the contractor.		
Changes in land use (preparation of construction facilities, borrow areas, others)	Short term	Local	Reversible (after construction phase)	Certain	Low to Medium	Low	• All the construction camps would be established within the area owned by BWDB. • Pay compensation/rent if private property is acquired on temporary basis, which instructions would be specified in the tender document. • Labor shed/camp would be construct at government khas land. • Avoid impacts on local stakeholders.	Very low	Changes in land use (preparation of construction facilities, borrow areas, others)
Clearances of vegetation	Sort term	Local	Reversible (after construction phase)	Certain	Low to Medium	Low	• Avoid vegetation damage as much as possible to select sites for labor shed and material stock by using nearer fallow land or barren homestead yards. • Give proper compensation to the tree owners against tree felling specially for fruit yielding trees • Implement tree plantation at the damaged sites after completion of construction works	low	Clearances of vegetation
Increased Vehicular Traffic during mobilization	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Moderate	• The contractor will prepare a traffic management plan (TMP) and obtain approval from the Design Consultant (DC) and Construction Supervision (CS) consultant. • Contractor also implement mobilization plan considering water vessels and launch movement in the external rivers and, avoid the launch movement time. • The TMP will be shared with the communities and will be finalized after obtaining their consent. • The TMP will address the existing traffic congestion	Low	Increased Vehicular Traffic during mobilization

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							particularly at the Ghorilal and Zorsing Bazars. • Ensure minimal hindrance to local communities and commuters. • The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. • The works of the first half when completed, and then of the other half will be undertaken. • Work schedule will be finalized in coordination and consultation with local representatives and communities. Specifically union parishad members of the Polder. • Local routes will not be blocked as much as possible. If unavoidable, alternative routes will be identified in consultation with local community. • Vehicular traffic should be moved in the Polder area and also on embankment during off peak time. No school time (10:00 Am to 13:00Pm) and day of marketing time (Hatbar) should be considered during vehicular traffic movement. • 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.		
B. Construction Phase									
Deteriorated environmental	Short term	Local	Reversible (after constr	Occasional	Medium	**Minor**	• Construction machinery should have proper mufflers and silencers. • Noise levels from the construction machinery should	**Low**	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
(air and noise) quality			uction phase)				comply with national noise standards (residential zone) • Provision should be made for noise barriers at construction sites, schools/madrashas and other sensitive receptors as needed. • Sprinkling of water and ramming on the material during construction. • Exhaust emissions from trawler and equipment should comply with standards • Restricting/limiting construction activities during the day time; • Provision of PPE (ear muffs and plugs) for labor; • Construction team will be instructed to properly use the equipment, to minimize noise levels; • Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.		
Hindered to the natural drainage system	Short term	Local	Reversible (after construction phase)	Likely	Medium	**Minor**	• Some temporal earthen dams should be built in the khal behind the construction of drainage sluices and behind the re-excavation segment at each reach. • Bail out of water behind the temporal earthen dams during construction work of the bridge. • Both contractor and BWDB should supervise the construction work of the bridge and built temporal dams as well as demolish the same after completion of the construction work.	**Low**	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Affects on agriculture crop production	Short term	Local	Reversible	Likely	Minor	Low	• Compensation would be paid for any crop damage. • Contractor would avoid cultivation fields during construction. • Contractor would 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 would ensure that no material is dumped inside cultivation fields. • Re-excavated soil of canals would not be damp in agricultural land. • Contractor would maintain liaison with communities.	Negligible	Affects on agriculture crop production
Affects on irrigation	Short term	Local	Reversible	Likely	Low to Medium	Moderate	• Contractor would construct bypass channel before construction/replacement/demolished of each regulator. • Sequence of work at the regulators and in the water channels would be carefully planned to avoid irrigation disruption. • Contractor would ensure no negative impacts on crop irrigation. • Contractor would maintain liaison with communities. • Contractor would work during dry season.	Low	Affects on irrigation
Impacts on Feeding and Spawning Ground of Fish Habitat	Short term	Local	Reversible	Likely	High	Major	• Earth work should be conducted during the dry season (November-February) • Sequence of work at the bank side of Kobodak and Sakbaria rivers will be carefully planned to minimize impacts on spawning and subsequently nursery ground of fish. • Contractor will maintain liason with experienced fishermen.	Moderate	Impacts on Feeding and Spawning Ground of Fish Habitat

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Impact on fish habitat and migration	Short term	Local	Reversible	Likely	High	Major	• Duration of construction of structures and other interventions should be shortened as much as possible at least should maintain the contract period. • Dismantle bundhs and other obstructions built for supporting 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. • Sequence of construction of regulators and re-excavation of drainage Khals should be set scientifically 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.	Low	Impact on fish habitat and migration
Impacts on benthic fauna	Short term	Local	Reversible	Likely	High	Major	• Khal re-excavation should be carried out segment wise. • Contractor will carry out khal excavation in segment thus minimizing impacts on benthic	Low	Impacts on benthic fauna
Clearance of vegetation	Short term	Local	Reversible (after construction phase)	Occasional	Medium to high	Low to Moderate	• Collect soil for re-sectioning from barren land as much as possible • Proper turfing should be implement at embankment slopes with local grasses and ensure regular monitoring of turf grasses till they matured	Low	Clearance of vegetation

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Choose barren land for CC Block manufacturing and material storing • Keep close liaison with CREL Project Authority and Forest Department while implementation of earth works • Implement plantation with native species at countryside slope of the embankment to arrest vegetation loss		
Outbreak of plant diseases	Short term	Local	Reversible	Occasional	Medium to high	Moderate	• Keep close liaison with CREL Project Authority and Forest Department while implementation of afforestation and for selecting suitable species for plantation and spacing of the saplings • Care should be taken for physical and biological control of plant disease while nursery raising and sapling plantation • Develop a pest management plan for the holistic afforestation • Collect saplings from nearer natural source (i.e.: from mangrove forest at eastern bank of Sakbaria River and western bank of Arpangasia River) as much as possible	Nil	Outbreak of plant diseases
Safety and Public Health Hazards	Short term	Local	Reversible	Likely	High	Major	• The contractors will prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants. The Plan should also include awareness rising and prevention measures for particularly for communicable diseases such as hepatitis B and C, and HIV/AIDS. • The WBG's EHS Guidelines will be included in the contract documents. • Liaison will be established with the Bangladesh Meteorological Department for early warning	Moderate	Safety and Public Health Hazards

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							of storms and cyclones. Radio and television sets will be kept in all the labor camps for obtaining weather information. • 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 workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities; • The construction sites will have protective fencing to avoid any unauthorized entry, where appropriate and possible • Health screening of employees would be a Contractor obligation prior to 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 where required; • All employees need to carry out induction health and safety training 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. Where illiteracy levels are high, OHS issues need to		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							be covered more frequently than normal in toolbox talks; • Public awareness training and workshops on safety and health risks will be conducted for local communities prior to and during construction operations. • Observing statutory requirements relating to minimum age for employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activity. The construction contractor(s) would not hire people under the age of 18 on permanent contracts but would include short training activities for youth to the extent possible; • Ensuring acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work; • Ensuring no workers are charged fees to gain employment on the Project; • Ensuring rigorous standards for occupational health and safety are in place; • Contractor will establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. • The contractor will adopt a Human Resource Policy appropriate to the size and workforce which indicates the approach for management		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							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 (this could be full time or part of another post's responsibilities); • Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training; • Report regularly on the labor force profile, including gender, and location source of workers; • Report regularly on 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		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							mechanisms during the construction phase; • Organize a training program and keep training registers for construction workers; • Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project. • Waste management plan to be prepared and implemented in accordance with international best practice. • Liaison with the community will be maintained.		
Hindrance for Pedestrian and Vehicle Movement	Short term	Local	Reversible	Likely	Medium	Moderate	• The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. When the works are completed on the first half, it will be opened for local traffic while works will be undertaken on the other half of the embankment. • Work schedule will be finalized in coordination and consultation with local representatives and communities. • Local routes will not be blocked as much as possible. If unavoidable, alternative routes will be identified in consultation with local community.	Low	Hindrance for Pedestrian and Vehicle Movement

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Social unrest between Local worker and outside worker	Short term	Local	Reversible	Likely	Medium	Moderate	• Proper awareness programs will be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, Upazila Nirbahi Officer (UNO) and BWDB local officers. • Liaison with the communities will be maintained. • Cultural norms of the local community will be respected and honored. • GRM will be established to address the grievances of local as well as outside laborers. • Careful use of local natural resources and project resources, fuel, fuel-wood and electricity. • Restrictions related to consumption of alcohol and drugs. • Safe driving practices. • Respect for the local community and its cultural norms in which laborers are working. • Avoiding construction activities during Prayer time.		Social unrest between Local worker and outside worker
Increased inland and waterway traffic	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Moderate	• Contractor to prepare and implement traffic management plan. • Contractor to establish new, temporary jetties where needed. • River crossing for material transportation during nighttime where possible and appropriate • Material transportation through rivers during high tide where needed. • Liaison to be maintained with community and BIWTA.	Low	Increased inland and waterway traffic

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Seasonal Impacts (Natural Hazards)	Short term	Local	Reversible	Likely	Medium	Moderate	• Weather signals will be considered by the contractor during construction works. • Radio and television will be provided in all the labor sheds for receiving weather information through these media. • Ensuring rigorous standards for occupational health and safety are in place.	Low	Seasonal Impacts (Natural Hazards)
Damage to Local Infrastructure	Short term	Local	Reversible	Likely	Medium	Moderate	• The condition of the infrastructure being used for the construction and transportation activities will be regularly monitored. • All damaged infrastructure will be restored to original or better condition. • To take preventive measures for protection of local infrastructure.	Low	Damage to Local Infrastructure
C. Post Construction Phase									
Increase Salinity Intrusion due to Leakage of Regulators	Short term	Local	Reversible (after construction phase)	Likely	Medium	**Minor**	• Formation of WMOs in concern with the structures and embankment • Regular monitoring and careful maintenance of the water control structures will be ensured. • Concern WMOs and BWDB should monitor for further installation of unauthorized hand tube-well on embankment by gher owner. • 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.	**Low**	BWDB and WMOs
Soil and water contami	Long term	Local	Reversible	Likely	High	Major	• Capacity building and awareness rising of the farmers would be carried out to practice Integrated Pest Management	Moderate	Soil and water contami

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
nation (increased use of chemical inputs) and reduced soil fertility							(IPM), Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) in order to minimize usage of chemical inputs. • Farmers group would have close contact with DAE for adoption of various measures of IPM, ICM and GAP. • Farmers would be encouraged to use organic and green manure to increase soil fertility while avoiding water contamination. • Farmers would be encouraged to cultivate leguminous crops (N_2 fixing) to enhance the soil quality as well as soil productivity.		nation (increased use of chemical inputs) and reduced soil fertility
Hampered fish migration	Long term	Local	Reversible	Likely	Medium	Moderate	• Proper sluice gate operation allowing fish migration. • provide training to WMOs; • Transferring juvenile fish from rivers to Polder.	Low/ Negligible	Hampered fish migration
Risk of embankment failure	Long term	Local	Reversible	unlikely	High	Major	• Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the eastern side of the Polder will be ensured. This monitoring will particularly be carried out before and after monsoon season. • Prevention of establishing hand tube-wells at the crest of the embankment. • Available cyclone and flood shelter will be prepared as a contingency measure during emergency situation. • WMG will develop a fund for this kind of emergency situation. • Structural measures like geo bag and sand bag will be kept in stock yard of local BWBD colony.	Low	Risk of embankment failure

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Increase salinity intrusion due to leakage of regulators	Long term	Local	Reversible	Likely	High	Major	• Regular monitoring and careful maintenance of the water control structures will be ensured. • Standard operating procedures will be prepared and implemented for the water control structures. These procedures will be translated in bangle as well. • Capacity building of WMOs will be carried out.	Low	Increase salinity intrusion due to leakage of regulators

Appendix H: List of participants of PCM

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থানঃ দক্ষিণ বেদকাশী ইউ: পরিষদ ইউনিয়নঃ দক্ষিণ বেদকাশী উপজেলাঃ কয়রা

জেলাঃ খুলনা সময়ঃ তারিখঃ ২০/০১/২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
১.	আলহাজ্ব জি.এম. ডি. [illegible]	চেয়ারম্যান	দঃ বেদকাশী U.P	০১৭১১-৫৭১৪২৬	[signature] ২০/১/১৬
২.	আবদুল মজিদ	অব: প্রধান শিক্ষক	দঃ বেদকাশী	০১৭১৫-১১৪৮০ ৪২	[signature]
৩.	আশুতোষ রায়	সহঃ অধিনায়ক	দঃ বেদকাশী	০১৭২০-৫৩৭০২৪	[signature]
৪.	সমরেশ চন্দ্র সরকার	সহঃ সভাপতি দ: বেদকাশী ইউ: আওয়ামী লীগ	৯ নং বীনাপানি	০১৯৬৭-৭১৮৫৬৮	[signature]
৫.	মোঃ মোশারফ হোসেন		৬নং [illegible]	০১৯৩৪৮৮১১০০	মোঃ মোশারফ হোসেন
৬.	মোঃ আব্দুর রহিম	জেলা কৃষক লীগ [illegible]	৬নং ওয়ার্ড	০১৯৫১৩৮১৭৭৭২	আব্দুর রহিম
৭.	বেল্লাল	ব্যবসা	২নং ওয়ার্ড	০১৭৭৩৪৯৯৭৮	বেল্লাল
৮.	মোঃ আঃ হামিদ	ব্যবসা	১নং ওয়ার্ড	০১৯৪০০১৪০২৬	হামিদ
৯.	পরিমল সরকার	ব্যবসা	৯ নং বীনাপানি	০১৯২৭০২০০৪৬	[signature]
১০.	সাইফুল ইসলাম	গ্রাম-পুলিশ	দক্ষিণ বেদকাশী	০১৭৮৪৬৩৭১১৭	সাইফুল
১১.	মোঃ আতিকুর রহমান	অফিস সহকারী	দক্ষিণ বেদকাশী	01962691211	Rahman
১২.	মো: ছিদ্দিক শেখ	ব্যবসা	গোলখালী	০১৯১৪১৪০৮৮১	ছিদ্দিক
১৩.	লিটন ~~সরদার~~ মন্ডল	ব্যবসা	আংটিহারা	০১৯২৩১২৪০৭৪	লিটন
১৪.	মো: মহাসিন গাজী	গ্রাম-পুলিশ	খড়িলাল	০১৭১০৭৭১০৫৭	মহাসিন
১৫.	উসমান গনি খোকন	ইউ: পি সদস্য	দঃ বেদকাশী	০১৭১৮৫৬২১৮২	[signature]
১৬.	যশোমতি মন্ডল	ইউ পি সদস্য	চরামুখা	০১৯৫৬৮৬২৫২৬	যশোমতি
১৭.	গৌরী রানী	গৃহিণী	চরামুখা	01921975957	গৌরী রানী
১৮.	মোছা: ছালমা	গৃহিণী	আংটিহারা	01930527465	ছালমা
১৯.	নারায়ণ	~~গৃহিণী~~ বাঘ বন্ধু	গোলখালী	01980248794	[signature]

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উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থানঃ দ: বেদকাশী ইউ: পরিষদ ইউনিয়নঃ দক্ষিন বেদকাশী উপজেলাঃ কয়রা

জেলাঃ খুলনা সময়ঃ তারিখঃ ২০/০১/২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
২০.	মোছা: ছালমা	গৃহিনী	আংটিহারা	~~০১৭২০৪১৫২০৩~~ ০১৭৫২৪১০৯২৪	[illegible]
২১.	গাজী [illegible] ইসলাম	ইউপি সদস্য	[illegible] ওয়ার্ড	০১৭১১-৪৫০১৮০১	[illegible]
২২.	রেহানা আফরোজ	U.P. সদস্যা	৪-৫-৬	০১৯২২৩৯৬৩৬০	[illegible]
২৩.	নুর মোহাম্মদ গাজী	ব্যবসা	দ: বেদকাশী	০১৯২৮-০০৭০৭০৬	নূর মোহাম্মদ
২৪.	মাকছুদুল গাজী	ব্যবসা	চরামুখা	০১৯১১২২৮০১২	মোকছুদুল
২৫.	নরেশ বাইন	ব্যবসা	[illegible]	০১৯১৬০৯৩৬৫৫২	নরেশ বাইন
২৬.	মো: নাজমুল ইসলাম	ইউ. পি. [illegible]	দ: বেদকাশী	01912-128240	[illegible]
২৭.	মো: [illegible]	ব্যবসা	দ: বেদকাশী	০১৯১৮২৫২৩৯৮	[illegible]
২৮.	মাহমুদ গাজী	ব্যবসা	দ: বেদকাশী	০১৯৬২২৬৪১৯৮	মাহমুদ
২৯.	মোছা: ছালমা	গৃহিনী	দ: বেদকাশী	০১৯৮৯৫৮৬৩৫৭	ছালমা
৩০.	[illegible] সেখ	ব্যবসা	দ: বেদকাশী	০১৮৬৭৯৮০১২০	[illegible]
৩১.	ওয়াজেদ আলী	ব্যবসা	দ: বেদকাশী	০১৭৬৪৩১৫৫৪৪	ওয়াজেদ
৩২.	কামরুল ইসলাম	ব্যবসা	দ: বেদকাশী	01723244531	কামরুল
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৩৪.					
৩৫.					
৩৬.					
৩৭.					
৩৮.					

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Appendix I: Checklist of Public Consultation Meeting

ENVIRONMENTAL IMPACT ASSESSMENT OF

Coastal Embankment Improvement Project (CEIP)

Checklist for Public Consultation Meeting (PCM)

- 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 J: List of participants of PDM

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

স্থান ঃ কয়রা উপজেলা পরিষদ মিলনায়তন

সময় ঃ সকাল ১০:০৬ | তারিখঃ ০৪/১২/২০১৭ইং

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
০১	অধ্য: মো: তফিজ উদ্দীন	উপজেলা চেয়ারম্যান, কয়রা	01722-627144	[illegible]
০২	শিমুল কুমার সাহা	UNO, কয়রা		[illegible]
০৩	মোছা: জাহিদা আক্তার	মহিলা ভাইস চে:	01917343925	[illegible]
04.	জি.এম. শফিকুল ইসলাম	চেয়ারম্যান দক্ষিণ বেদকাশী UP	01716629920	[illegible] 04/12/17
৫	আলহাজ্ব মো: নুরুল ইসলাম সরদার, চেয়ারম্যান	উত্তর বেদকাশী ইউনিয়ন পরিষদ	০১৭২৫-৬৮৬৮৭৫	[illegible] ০৪/১২/১৭
৬	মাহমুদুল হাসান, ভাইস চেয়ারম্যান কয়রা	কয়রা ইউ: পরিষদ	০১৭১৬-০১৭৬৬৬	[illegible] 04-12-17
৭	বিকাশ চন্দ্র সরদার	চেয়ারম্যান ৩নং মহেশ্বরীপুর ইউ:পি	মো: 01987444000	[illegible] ০৪/১২/১৭
৮	মোস্তাফিজুর রহমান	প্রতিনিধি, মাননীয় সংসদ সদস্য	01715442168	[illegible] ৪/১২/১৭
৯	সমরেশ চন্দ্র সরকার	প্রতিনিধি:- মাননীয় সংসদ সদস্য দ: বেদকাশী ইউনিয়ন	০১৭৬৭-৭১৮৮৬৮	[illegible] ৪/১২/১৭
১০	শেখ মো: আব্দুল মতিন	ARDO/BRDB	০১৭১৮-৫৫৩৯১২	[illegible] ৪/১২/১৭
১১.	মিসেস: মরিয়ম মাহমুদা	দক্ষিণ বেদকাশী 1.2.3 U.P. সদস্য	০১৭২৯৬১৬৩০৪	[illegible] ৪/১২/১৭
১২.	মিসেস নায়লানুর লাকি	দ: বেদকাশি 7,8,9 সংরক্ষিত	০১৭৭০০১২৮৪৯	[illegible] 4.12.17
১৩.	জি.এম. আব্দুল গনি	দঃ বেদকাশী ৪ নং ওয়ার্ড	০১৭৭১৫০১৩২৫	[illegible] 4/12/17
১৪.	মো: মোজাম্মেল	দঃ বেদকাশী ৮ নং ওয়ার্ড	০১৭১১২২৯৭০৯	[illegible]
১৫	মিসেস, সবুজা খাতুন	দ: বেদকাশী ৪.৫.৬ নং সদস্য	01917-949186	[illegible]
১৬	মো: দাউদ হোসেন মোল্লা	সভাপতি, উ: দু: ব্য: ক: কয়রা	০১৭৩৮-১৬১৫২৯	[illegible] ০৪/১২/১৭
১৭.	সুলতানা মিলি	উ: বেদকাশী ৪.৫.৬ সংরক্ষিত আসন	০১৯২৪৩৯৩০০০	[illegible] 04/12/17
১৮.	গোলাম মোস্তফা	উঃ (কোষাধ্যক্ষ)	০১৯২১৫৮৬৭৬২	[illegible]

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স্থান ঃ কয়রা উপজেলা পরিষদ মিলনায়তন

সময় ঃ ১০:৩০

তারিখঃ ০৪/১২/১৭

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯.	সাইম সরকার	ইন্টার্ন [illegible]	01986-619366	[illegible]
২০.	মেহেদী হাসান	গোবরাপুর [illegible]	01916-808759	[illegible]
২১.	এম, মহেদি হাসান	UAE	01725-224472	[illegible]
২২.	মো: আসাদুজ্জামান শেখ	UEO	01712-729135	[illegible]
২৩.	আ নেশা মন্ডল	প্যানেল চেয়ারম্যান উত্তর বেদকাশী ইউপি	01913598511	[illegible]
২৪.	ডা: মো: আ: কুদ্দুস	ULO.	01749.827110	[illegible]
২৫.	ডাঃ মোশাররফ [illegible]	[illegible]	01718846173	[illegible]
২৬.	ডাঃ মো: [illegible]	[illegible] কমপ্লেক্স	01913264914	[illegible]
২৭.	মোঃ আমিরুজ্জামান	UWAO	01718848697	[illegible]
২৮.	তাসমিম আলাউদ্দিন আহমদ	UFO	01913 326964	[illegible]
২৯.	এম, এম, মিজানুর রহমান	UAO	01717344845	[illegible]
৩০.	মোঃ আব্দুল হান্নান	কৃষক, মহারাজপুর	—	[illegible]
৩১.	মোকাদ্দেস আলী	কৃষক, মহারাজপুর	—	[illegible]
৩২.	আব্দুর সাত্তার পরামানিক	মধ্যবিত্ত	—	[illegible]
৩৩.	মো: কেরামত আলী	মুক্তিযোদ্ধা কমান্ডার	01914568798	[illegible]
৩৪.	মো: আমিনুল ইসলাম [illegible]	[illegible]	01913908689	[illegible]
৩৫.	আহমদ হোসেন	প্রভাষক	01913-536819	[illegible]
৩৬.	Amol Kumar Das	Proshika Enro		Amol das

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স্থান ঃ কয়রা উপজেলা পরিষদ মিলনায়তন

সময় ঃ ১০ : ৩০

তারিখঃ ০৪/১২/১৭

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৩৭.	সাইফুল ইসলাম মিলন	[illegible] ইঞ্জিনিয়ার (সওজ)	01915-885859	মিলন
৩৮.	আব্দুল্লাহ-আল-মামুন	"	01723-244531	[illegible]
৩৯.	[illegible] আলম খন্দকার	[illegible] / বেতকাশী	[illegible]	[illegible]
৪০.	আবু হাসান চৌধুরী	[illegible] / বেতকাশী	01721-932489	[illegible]
৪১.	কামাল হোসেন	বেতকাশী	–	কামাল
৪২.	মো: তরিকুল ইসলাম	সচিব বেতকাশী	01718-595838	[illegible]
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Appendix K: Comments and Responses (IPOE)

Comments and Responses on EIA report of Polder 14/1 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 2.23 & 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 6.2.10
3	exist velocity to the gate	Exist velocity has been mentioned in section 10.15.3
4	Timing of the fish fry movement	It has been mentioned in the report (section 6.2.10 and figure 6.11)
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 10.15.1 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 10.15.2
8	Do they belief that the project can be managed and operated by the existing staff?	Insufficient and mentioned in the report (section 10.15.2)
9	Operation of the gates to be voiced/point out by the EIA team	A detailed gate operation has been pointed out by the EIA team in the report (section 5.8 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 10.15.3 (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 5.8.1. BWDB may recruit sluice khalashi for each of the Drainage Sluices for smooth operation of the gates as per initial practice. Here may also be suggested to form Polder management committee consisting BWDB field officials and 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 needs to be considered at all the times in future

Appendix L: WB Comments on CEIP EIA Draft Report – Package 3

The EIA has been conducted by the Center for Environmental and Geographic Information Services (CEGIS). The team has conducted numerous field visits and ensured participation of the community of Polder 14/1 during field survey and public consultations in order to carry out the study.

The key improvement works to be carried out in Polder 14/1 under CEIP-1 are:

Type of Work	Specification
Re-sectioning of embankment	27.25 km
Design crest level of embankment	4.50 mPWD
Retired embankment	3.25 km
Construction of drainage sluice	2 nos.
Demolishing of existing drainage sluices	1 no.
Construction of flushing Sluices	4 nos.
Re excavation of drainage channel	30 km
Slope protection of embankment	7.86 km
Bank Revetment	1.0 km
Afforestation	17.37 ha

Overall, the EIA is comprehensive and can be streamlined to avoid repetition especially regarding project description and mitigation measures proposed in EIA. The EIA will be also benefitted from including the additional mitigations measures, clarifying project description and implementation arrangement. Please revise the EIA for Polder 16 for another review.

WB Comments	Responses
General: The document title is "EIA" however it includes social aspects as well. Why it is called as EIA rather than ESIA?	Only the baseline information related to the various social aspects has been included in this document, which is appropriate and essential to understand the ground situation of the project area in relation to the ensuing environmental conditions and ecological/natural resources. This report, in fact, is not a social impact assessment; hence the document title only mentions EIA as per the contract.
Executive Summary: Please include EMP/ESMP table, EMP/ESMP implementation cost and monitoring table in Executive Summary.	➢ EMP/ESMP, monitoring plan with cost has been included in the executive summary
Introduction: Please enlarge Map 1.1 so that locations of all polders in Package 3 can be identified	➢ As per comment, location map has been corrected and replaced
Policy and Regulatory Framework: Section 3.7 is overlapped with the figure. Please resolve it	➢ It has been resolved
OP7.50 is triggered for the project. Please revise the text.	The rivers around the Polder are local rivers and not international rivers. The OP 7.50 was mentioned in the report by mistake

WB Comments	Responses
	which has already been deleted from the report.
Methodology: Please explain how impact assessment methodology from para. 40-45 relates to impact screening explained in Section 7.	➢ Method for impacts screening has been explained in this chapter
Climate Change impacts: The climate change impact doesn't mention the flood and storm surges effects which is relevant to the polder. It only covers the rainfall and the temperature projections.	➢ This issue has been considered and addressed in the report
Project Description: Please clarify the details of afforestation activities including who will be responsible for implementation of afforestation, location of afforestation, afforestation period, types of tree species used.	The contractor will work with the Senior Forestry Specialist at PMU for afforestation; indigenous tree species will be selected for plantation; afforestation period is pre-monsoon (Apr-May); local NGOs/CBOs/WMOs will be hired and will be responsible for maintenance of the saplings under social forestry guidelines.
Para 146 states temporary labour camp for local labour during preparing CC block will be established. Please include the basic information of camp sites such as land requirement, number of camp sites, what kinds of facilities would be constructed. Please also assess the potential labor influx. Labor influx plan should be prepared as a part of EMP/ESMP where appropriate.	➢ Location of work sites for tentative labour camps is shown in a Map in the report (Figure 5.2). Details of labour camps have been discussed in para 146,149 and 151 (chapter 5).
This EIA does not include the environmental and social impact assessment of CC block manufacturing plants. Please prepare the separate assessment	➢ Only 0.3 km bank protection works (Table 5.4) will be carried out for rehabilitation of Polder 14/1 . The CC block will be prepared manually. Hence, CC block manufacturing plants will not be established in the Polder
Table 5.11 shows construction materials for pre-sectioning of embankment and drainage sluices/flushing inlets. Please also explain how to procure the other construction materials used for other project activities such as river bank protection and slope protection. Please also clarify how many CC block manufacturing plants will be established.	➢ This issue has been mentioned in section 5.7.10 and Table 5.9 in chapter 5
Para 164 A Social, Environment and Communication Unit: Is this unit established only for Package 3? Is this the same Environmental and social unit for Package 1? Please explain.	➢ It is the same SECU at PMU for all the packages
Para 166 Would DCSC supervise/assist implementation of safeguard instruments such as EMP or RAP? Please clarify	➢ Clarified and the relevant paragraph has been rephrased
The EIA study presumes that the invert level of the drainage sluice gate have been fixed in manner that about 50-60% of water will be	➢ As per design of Drainage Sluices (DS), The invert level of DS are fixed inconsideration of the lowest water

WB Comments	Responses
retained in the khal to facilitate in irrigation, fisheries, environment and other purposes. Please explain the reasons that this assumption is made.	level. Hence, the canals bed level which are below the invert level have the capacity of retain some water within it. The water are being used for irrigation, fisheries and domestic purposes.
Baseline Condition: Land use: No natural vegetation such as forest and wetland? It is not clear in Table 6.1.	➢ There is no natural/mangrove forest or vegetation or beel (wetland) within the Polder area which has been mentioned in section 6.1.3. The canals represent the wetlands.
Mangrove: Please show the distribution of Mangrove on a map. Is it also possible to show the size of mangrove forest areas?	➢ It has already been mentioned in the above response
Has endangered river dolphins been recorded in the rivers along the polder? Please clarify.	➢ Yes, freshwater river dolphin (*Platanista gangetica*) occurs in the peripheral rivers.
Analysis of Alternative: Para 359: Please clarify which, either procuring sand from market or sand collected from riverbed, is the proposed option.	➢ This section has been revised as per comment. Two options arepresented here
Technological alternative analysis is not really conducted. Please include the technological alternative for each proposed work. For example, as a technological alternative for construction of replacement of the existing flushing sluices, would the repair of existing flushing sluices be considered?	➢ Status of the drainage structures has been provided in Table 5.2, which explain the reasons for replacement/construction of the drainage structures/flushing sluices as well as repair of flushing sluices.
Mitigation measures: Please clarify how to manage the excavated soil/silt from drainage channels.	➢ Management of excavated soil/silt from drainage channels have been discussed in section 5.8.4, para 152 and a conceptual soil dumping location is shown in figure 5.3
Table 8.1- Please include the potential impacts on involuntary resettlement.	➢ Data is not available as the RAP consultant has not provided it.
Please clarify the contractor will prepare Traffic Management Plan to address potential E&S impacts including traffic safety, noise, vibration and air pollution.	➢ Traffic Management Plan has been prepared by the contractor and included in the Contractor's Environmental & Social Management Plan (C-ESMP) in Packages-1&2, and the same would be followed for the Polders of Package-2.
All the mitigation measures proposed in Section 7 should be reflected in EMP table which needs to be developed in Section 9.	➢ All mitigation measures proposed in chapter 8 have been reflected in EMP Table (Table 10.1 in Chapter 10)
Please analyze the impacts related to labor and propose the comprehensive mitigation measures including OHS, management plans for workers camp and labor conditions.	➢ Addressed in section 8.4.11

WB Comments	Responses
Please analyze the impacts related to community security, health and safety and propose comprehensive mitigation measures.	➢ impacts related to community security, health and safety as well as mitigation measures have been addressed in section 8.4.11
Please include the impact analysis and mitigation measures for sand excavation from riverbed.	➢ There will be no sand extraction from the river bed for any kind of activities related to the rehabilitation of the polder. Mentionable that repair of embankment will be done by borrow pit earth and sand will be carried from the outside area rather than river bed for concreting and other construction works.
Please clarify the prohibition of clearance trees as a mitigation measure in para.385 as indicated in para .384.	➢ Not clear
Please add in para 420 that an approval needs to be obtained from DCSC for clearance of vegetation	➢ It has been added in the EIA report; Section 8.4.8, para 421
Please add in para 385 that the contractor needs to prepare flora and fauna protection plan	➢ It has been added in the EIA report
Para 393 (Noise) - Please propose the following measures to be implemented by contractor: installation of acoustic enclosures around generators, notification of major noise generating activities to affected people, prohibition of vehicle movement during night time, monitoring noise in the nearby community where appropriate, preparation of noise and vibration management plan as a part of pollution control plan proposed in para 398.	➢ This issue has been addressed in the report, Section 8.4.1, para 393.
Para 398 (Soil and water contamination) - Please propose the following measures to be implemented by contractor: Installation of temporary drainage works (channels and bunds) and/or temporary sediment basins where sediment and erosion control are required, preparation of spill control procedure, workshops fully bunded with impervious floors and walls, all containers, drums and drums in good condition, storing all liquid fuels in fully bunded storage containers, refueling only within bunded areas, provision of spill kit and other oil spill response tools, preparation of Emergency Response Plan , refueling only within bunded area.	➢ This issue has been addressed in the report
Para 402(Aggravated Sedimentation) - Please propose the following measures to be implemented by contractor: preparation of borrow area management plan and obtaining necessary permits from government, use of only approved quarry and borrow sites, anti-	➢ This issue has been addressed in the report

WB Comments	Responses
erosion measures including use of retaining walls and gabions where required.	
Para 397 (Impacts on agricultural lands) – Please implement drainage and erosion control measures at the work sites near agricultural fields.	➢ This issue has been addressed in the report; Section 8.4.2, para 397
Para 421 (Vegetation/Afforestation) - Please propose the top soil at the construction/ rehabilitation sites should be stored and used for plantation and redevelopment of vegetation.	➢ This issue has been addressed in the report . Section 8.4.8,para 421.
Para 439 (Road communication) - Please propose the following measures to be implemented by contractor: provision of clear demarcation of the work sites, application of no authorized entry, appropriate warning signs at strategic locations.	➢ This issue has been addressed in the report , Section 8.4.13, para 439
Cumulative Impacts: Necessary mitigation measures need to be proposed based on the analysis of cumulative impacts. Currently, no mitigation measures are proposed.	➢ It has been mentioned in the report (Section 9.1)
Please also include the assessment of impacts on rivers/watercourses hydrology and fish migration.	Assessment of impacts on rivers/watercourses hydrology and fish migration have been incorporated in the report (Sections 9.2 & 9.3.1)
EMP (ESMP): Section 10 should present EMP table consolidating all the mitigation measures proposed in Section 7, ECoP and mitigation measures proposed in Appendix E.	➢ Considered and all mitigation measures have been presented in Chapter 10.
Environmental and social staff in PMU – It is not clear if the separate Environmental and Social and Communication Unit (ESCU) will be developed for Package 3, or the same institutional arrangement will be maintained. If the same institutional structure is maintained, the expansion of ESCU should be made since the significant increase of supervision/monitoring works regarding EMP/ESMP implementation is expected.	➢ The same institutional structure will be maintained for all packages including Package 3
Monitoring Plan- Please add noise monitoring at nearby communities (where necessary) and visual inspection of spill	➢ It has been added
Para 539- Please clarify DDCS will prepare a monthly report on the status of EMP/ESMP implementation.	➢ The issue has been clarified in section 10.7.2
Afforestation - Please confirm that there are four locations for foreshore plantation (according to Map 5.2), and its selection criteria. Please also explain who will be responsible to develop afforestation plan and its implementation.	➢ A detailed afforestation plan has been mentioned in Table 10.8
Para 561- Please replace the term EMF with EMP.	➢ Corrected as per comment; para 561

WB Comments	Responses
Please include Environmental Committee for the mechanism of project monitoring and supervision.	➢ An ESCU (Environmental and Social Communication Unit) for supervision and monitoring for environment activities related to implementation works has been mentioned in the report. The ESCU is monitoring the environment related works under Package -1 and Package-2 of CEIP-1. Therefore, further environmental committee is not required.
Stakeholder Consultation: Please include the responses to the comments received at Public Disclosure Meeting (para 592).	➢ This paragraph has been revised according to comment.