FINAL REPORT

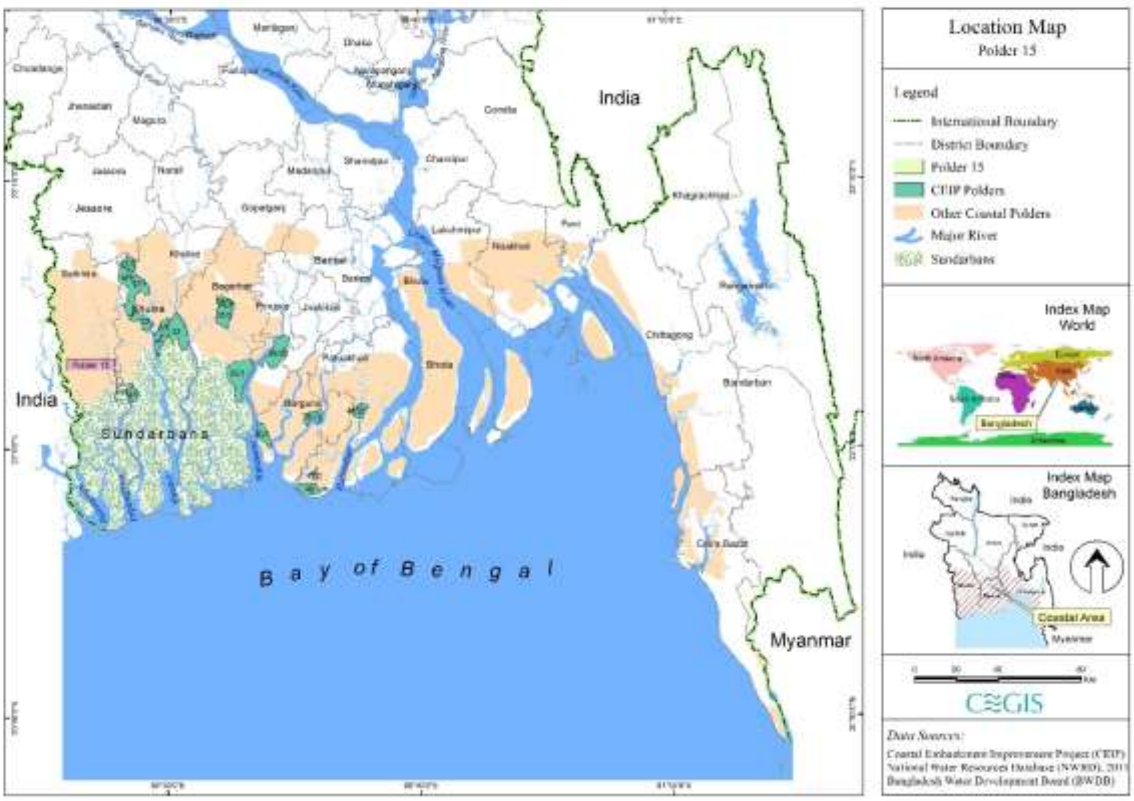
Government of the People's Republic of Bangladesh

Ministry of Water Resources

Bangladesh Water Development Board

COASTAL EMBANKMENT IMPROVEMENT PROJECT

PHASE-1



Package-3

ENVIRONMENTAL IMPACT ASSESSMENT OF POLDER- 15

May, 2021

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STUDY TEAM

A multidisciplinary team from Center for Environmental and Geographic Information Services (CEGIS) conducted the EIA studyfor Rehabilitation of Polder 15.The study team comprised of the following professionals:

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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	Institute 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.
Arat:	Generally, an office, a store or a warehouse in a market place from which Aratdar conducts his business.
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, usually perennial and important for fishery production familiar in the southwestern part of Bangladesh.
Bazar:	Market
Beel:	A saucer-shaped natural depression, which generally retains water throughout the year and in some cases seasonally connected to the river system.
Bepari:	Middleman in the marketing chain who transports the products to the other places, use of term depends on the location, sometimes also used synonymously with retailer.
Boro:	A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January and harvested before the onset of monsoon in April- May.
Charland:	The chars, otherwise known also Charlands, are riverine lands located in the active river basins of the main rivers of Bangladesh. They are formed on the banks of the river and islands in the mid-stream of the main channel that are created by the continual shifting of these rivers and emerge from the deposition of sand and silt from upstream.
Faria:	Local trader/agent/intermediary.
Golda:	Prawn *(Macrobrachium rosenbergii*), non-saline/fresh water species
Gher:	Farm lands converted into ponds with low dykes and used for cultivation of shrimp/prawn/fish.
Haor:	A back swamp or bowl-shaped depression located between the natural levees of rivers and comprises of a number of *Beel*s.
Haat:	Market place where market exchanges are carried out either once, twice or thrice a week, however not every day.
Jaal:	Different types of fishing net to catch fish from the water bodies.
Jolmohol:	Section of river, individual or group of *Beel*s (depression), or individual pond owned by the government but leased out for fishing. They are also called Jalkar, or Fishery.

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

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

Khal: A drainage channel usually small, sometimes man-made. The channel through which the water flows. 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-1 (March-June) and kharif-2 (July-October).

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

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

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

Perennial Khal: Khal, having flow all year round.

Pucca: Well-constructed building using modern masonry materials.

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

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

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

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

T. *Aman*: Transplanted Aman.

Upazila: Upazila is an administrative subdivision of a District.

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

UNITS CONVERSION

1 m^2	= 10.77 ft^2
1 Decimal **(শতাংশ)**	= 435.60 ft^2
1 Decimal **(শতাংশ)**	= 40.47 m^2
1 Katha **(কাঠা)**	= 1.653 Decimal **(শতাংশ)**

1 Bigha **(বিঘা)**	= 33 Decimal **(শতাংশ)**, The area of Bigha changes in some locations
1 Bigha **(বিঘা)**	= 20 Katha **(কাঠা)**
1 Acre **(একর)**	= 3 Bigha **(বিঘা) (**Area of Bigha changes in some locations)
1 Acre **(একর)**	= 60 Katha **(কাঠা)**
1 Acre **(একর)**	= 100 Decimal **(শতাংশ)**
1 Hectare **(হেক্টর)**	= 247 Decimal **(শতাংশ)**
	= 7.5 Bigha **(বিঘা)**
	= 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 17Polders 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. 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 15, which is one of these seven Polders of Package 3.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 15 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 15 is located in Shyamnagar Upazila under Satkhira District of Bangladesh. The administrative and management control lies with BWDB's Satkhira O&M Division-1 under the southwestern zone. Water related problems like saline intrusion, drainage congestion, sedimentation, lack of irrigation water and tidal flooding have increased severely in this area. Consequently, the lives and livelihoods of the communities here have been disrupted. The side slopes of the embankment are being damaged and eroded in different places mainly due to river erosion and wave action. The overtopping that had occurred during the *Aila* (2009) had also damaged and eroded the embankment in many locations of the Polder. There are many unauthorized mini-structures constructed by the gher owners for lifting saline water from the river for the purpose of shrimp culture.

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 the key improvement works to be carried out in Polder 15 under CEIP- are: re-sectioning of embankment (23.92 km); construction of retired embankment (6.86 km); CEIP design crest level of embankment 4.50 mPWD (entire embankment); re-excavation of drainage channels (30 km); slope protection work of embankment (4.44 km); construction (Replacement) of 04 drainage sluices; construction of 08 flushing inlets; repairing of 08 flushing sluices; bank revetment work 0.40 km and afforestation 20 ha (about 11 km along the periphery rivers). Other components of the CEIP- will include implementation of social action plan and environmental management plan; supervision, monitoring and evaluation of project impacts; project management, technical assistance, trainings, technical studies, and contingent emergency response.

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. Three tier organizational structure comprising Water Management Groups (WMG) at the lowest level, Water Management Associations (WMA) at the mid-tier and Water Management Federation (WMF) at the apex 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. CBO 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 Environmental Management Plan (EMP) and Resettlement Action Plan (RAP) have been prepared as per GoB regulations and World Bank Policies.

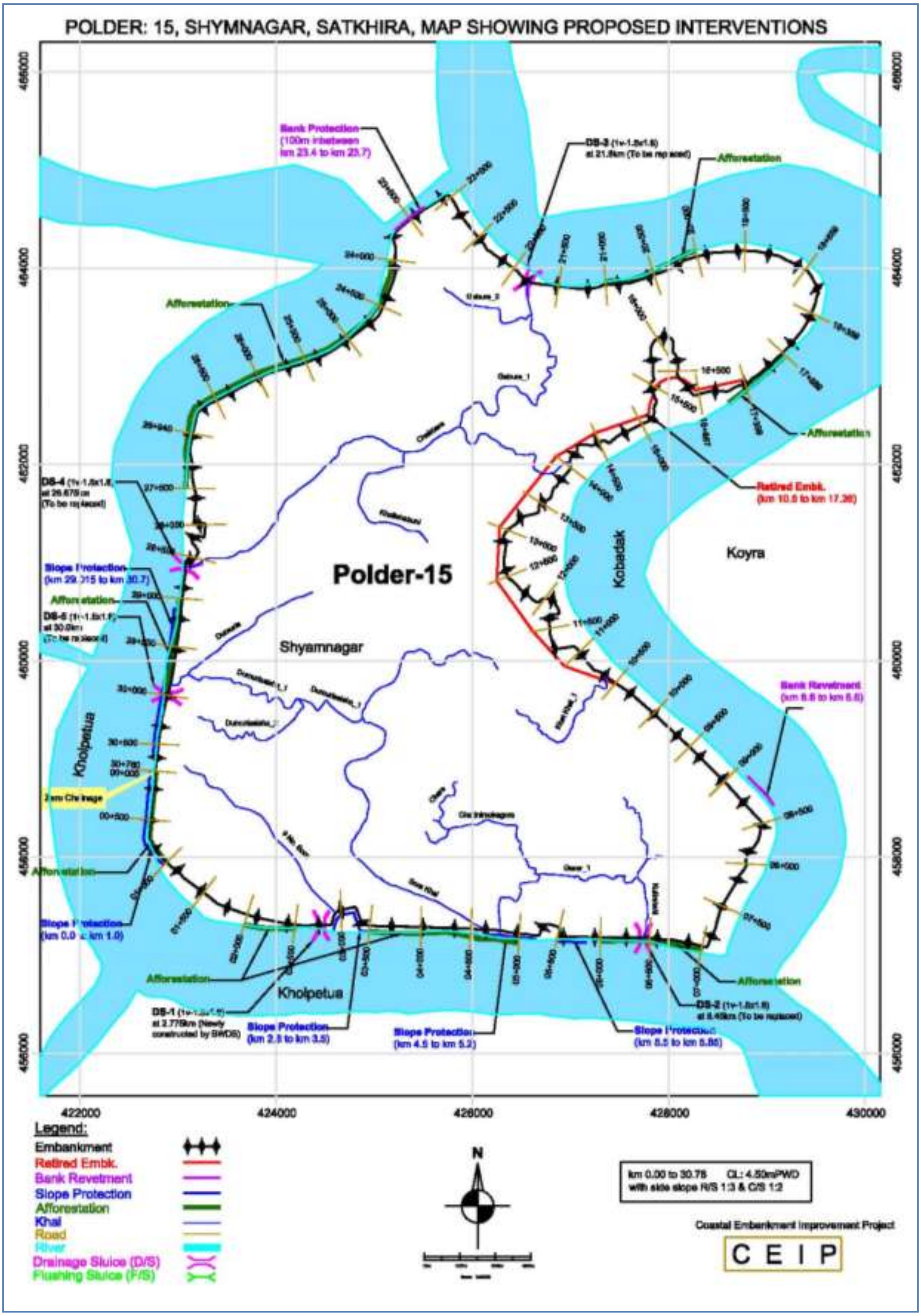
Proposed Rehabilitation Plan

The proposed interventions in Polder 15 under CEIP-1 are listed in the following table.

Type of Work	Length	Description of activities/works
Re-sectioning of embankment	23.92 km	Strengthening, widening and raising of existing embankment. The work will be executed from 0+000 to 10+500 and17+359 to 38+780
Construction of retired embankment	6.86 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 10+500 to 17+359
Construction (Replacement) of drainage sluices	04 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
Construction of Flushing Inlets	08 nos.	Flushing Inlets will be constructed at different locations to drain out excess rain water under the proposed rehabilitation plan.

Type of Work	Length	Description of activities/works
Re-excavation of drainage channels	30 km	Whole drainage channels with a total length of 30 km will be re-excavated to ease water flow and reduce drainage congestion
Slope protection of embankment	4.44 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
Bank revetment	0.50 km (map) 0.40 km (Polder brief)	Bank protection works along the Kobadak river will be carried out respectively
Afforestation	6.02 ha	Afforestation will be implemented within the Polder to ensure the environmental sustainability as well as protection of embankment from erosion and tidal action

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



Technical and nontechnical manpower will be required for the construction works. Tentively, 254 manpower will be required during construction period of which 54 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-15 is located in the southwestern region of Bangladesh. Topographically, this area is flat and developed by sedimentation process by the two mighty rivers of the country. Administratively, the Polder covers one Union Parishad namely Gabura of Shymnagar Upazila under Satkhira District.

The Polder is surrounded by the Kobadak River to the East and North, Kholpetua River to the South and West. A number of khals have criss-crossed the Polder area. There are 5 numbers of drainage sluices but no flushing inlets exist in the Polder. Most of the structures are damaged. The flood control embankment (30.78 km) of the Polder exists with under sectioned condition. Most of the segments of the embankment are in vulnerable condition.

The Polder lies in agro-ecological zone of Tidal Floodplain. The gross area of the Polder is about 3,116 ha of which 9% is available for cultivation. Other 81 % of areas are covered by gher, settlement including homestead and water bodies. Among the cultivable land, cropped area occupies 272 ha. The annual total rice production is about 779 metric ton consisting of Aman and Boro.

The climate of the Polder area is monsoon tropical. The monthly maximum average temperature (1980-2013) 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 1998.

Bagda gher dominates culture fishery in the Polder area. Total fish production of the Polder area is around 2,008 MT. Most of the fish production (97%) comes from Bagda gher. Fish migration status is very poor in the Polder area. Barriers at the inlets of khals by gher owners, encroachment of khals, use of illegal nets, mal-functioning of water control structures etc., are the main causes to obstruction of fish migration.

Polder 15 consist brackish nature of vegetation and saline prone wetlands. 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. Settlement platforms of this area are usually placed along the internal khal banks or along the embankment. Vegetation of this ecosystem exists in low density and few floral undergrowth. Wildlife population is also low due to lack of sufficient and diverse vegetation.

The total households 6,762 support a total population of 31,115 of which 15,398 male and 15,717 female with a population density of 1,137 persons per sq km. The average literacy rate is 52%, of which male 56% and female 48%. Out of total population, 43% are employed, 36% engaged in household work, 0.6% looking for work and 20% 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 include deterioration of environmental quality from , clearance of vegetation and increased vehicular traffic as follows:

IECs	Impact	Mitigation
Environmental	Exhaust emission from trawler/vehicle and containing particulate matter and other	• Construction material (sand) should be covered while transporting and stock piled.

IECs	Impact	Mitigation
quality (Air and Noise)	ingredients would deteriorate the ambient air quality around the construction site and nearby areas due to movement of equipment carrying trawlers/vehicles. 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.	• 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 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.	• The contractor will prepare a traffic management plan (TMP) and obtain approval from the DDCS&PMSC. • The TMP will be shared with the communities, stakeholders and will be finalized after obtaining their consent. • The TMP will address the existing traffic congestion particularly at the Ghorilal and Jhorshing Bazaars. • Ensure minimal hindrance to local communities and commuters. • 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

IECs	Impact	Mitigation
		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	• 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

IECs	Impact	Mitigation
	project activity sites. During construction, the natural drainage system of the area will be hampered and may create temporary drainage congestion.	and demolish the same after completion of the construction. • Facilitate drainage and erosion control measures at work sites near agricultural fields.
Crop production	About 20.9 ha of land is likely to be acquired for construction of retired embankment along Kobadak River. This land includes single crop area (Ch 10.500km-Ch 17.359 km) that is likely to be affected. This land includes cultivated areas (here, only single cropped land 2.32 ha) others covered by shrimp culture in addition to houses and other structures	• 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	The bank side as well as tidal floodplain of periphery river of Polder 15 (Kholpetua River) has 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) the feeding, nursery and even	• 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 condition to minimize impacts on spawning and subsequently nursery ground of fish. • Contractor will maintain liaison with experienced local fishermen

IECs	Impact	Mitigation
	spawning ground of these fish species.	
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 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	Contractor will carry out khal excavation in segment thus minimizing impacts on benthic fauna.

IECs	Impact	Mitigation
	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 Khalishabunia, Parshemary and Dumuria 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 burrow pits 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 construction sites, and air quality deterioration caused by the Project's vehicular traffic and	• The contractors will prepare site specific Health, Safety and Environment, Health and Safety (EHS). • 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.

IECs	Impact	Mitigation
	construction activities will potentially pose health hazards for the construction staff and nearby population.	• 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. • 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

IECs	Impact	Mitigation
		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

IECs	Impact	Mitigation
		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 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.	• 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.

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 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	Air emissions will be generated from storage and handling of raw materials (mainly sand and cement)	• Emission inventory on a regular basis and comparison with air quality standards and between

IECs	Impact	Mitigation
Manufacturing of CC block		
ambient air quality	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.	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 isnot 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	• The Contractor will prepare and implement a pollution control and waste management plan based

IECs	Impact	Mitigation
Manufacturing of CC block		
	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	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 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..	• 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. • Workshops should be equipped with impermeable floors and oil-containing equipment should only be repaired in workshops.

IECs	Impact	Mitigation
Manufacturing of CC block		
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, 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	• 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

IECs	Impact	Mitigation
Manufacturing of CC block		
	impact on both the terrestrial and aquatic environment as well as human health and safety	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.
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
Occupational and community	Occupational and community health and safety will not substantially differ from the above described. An	Accidents involving project vehicles and boats/cargo vessels during decommissioning should be

IECs	Impact	Mitigation
Manufacturing of CC block		
health and safety	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.	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.	• 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.

IECs	Impact	Mitigation
	Mishandling and poor maintenance of these control structures will undermine the very objective of the Project.	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.
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.
Shrimp farming and Livelihood	Shrimp farming is a common practice in this Polder area. According to field visit and consultation with local people that shrimp gher (bagda gher) occupy 85% of total NCA of the Polder. A significant number of farmers are involved in shrimp farming in this are because it is more profitable than paddy. Shrimp export contributes significantly to the local and national economic development, employment and income generation as well as	• Prospective of Golda farming should be encouraged through campaigning and by providing training on improved culture practices as well as rice-cum-golda farming within available sweet water; • Alternative income generation, i.e., livestock rearing, poultry and integrated fish culture may create scope of alternative

IECs	Impact	Mitigation
	livelihood improvement. However, after implementation of the proposed intervention, saline water intrusion by embankment and water control structures will also be reduced significantly within the project area; the drainage system will be improved. As a result, rice area will be increased compared to its base condition. It is expected that shrimp farm area may be impacted due to reduction in saltwater intrusion. Thus, fish production from shrimp gher may be declined. The livelihood of the shrimp farmers will be impacted.	income for shrimp farm labour; • Shrimp farming is suitable and profitable for only rich farmer but not for landless people, marginal and small farmer. Considering poverty reduction the proposed CEIP project.

Risk Assessment

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

Issue	Risk	Mitigation Measures
Fish Migration and movement	The peak velocity considered in designing of drainage sluices ranges from 3-4 m/s. The sustainable velocities of the indicative fish species are estimated in the range of 0.46 m/s to 1.1 m/s and burst velocities are in the range of 1.75 m/s to 4.2 m/s (Section 6.2.10). The peak velocity of the sluice gate would hamper to fish migration and movement inside the polder. It is noted that burst velocities of fish are applicable for capturing prey as the duration is only for seconds	• The fish pass friendly aspects in the structures to be constructed in the Polder for the proper management of water. • The structure may be done either by constructing drainage sluices by maintaining the velocities passable for the mentioned indicative fish species or by constructing fish pass structure. • In case of sluice gates, based on catchment flow optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes. • In constructing fish pass, fish swimming speed or velocity and depth preference should be considered. In case of the indicative fishes velocities are mentioned in Table 6.14 and the depth preferences are as follows: Plotosus canius: 2-10 m; Liza Parsia: 1.5-10 m; Mystus gulio: 1.5-10
Function of Water Management Association	At the moment, there are no active WMOs on site, and their activities are almost non-existent. The disrepair and lack of maintenance of the Polder in the past due to financial inadequacies	• 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

	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.	NGOs, and CBOs, and most importantly. This would help in developing ownership of the WMA for realization of benefits from the Polder without hampering the hydrological and environmental settings of the Polder • In addition to activation of WMOs, BWDB may recruit sluice khalashi for each of the Drainage Sluices for smooth operation of the gates as per initial practice • provide budgetary allocation in the post-operation phase for the O & M related tasks of the WMOs • Borrow pit, embankment slope, water bodies in the khas land may be provided to the WMOs as an income generating sources for their sustainability.
Navigation	Drainage sluices and sluice gates are provided in the Polder, which are being rehabilitated under this project. The gates in those structures are also operated in regular intervals to restrict salinity intrusion. However, such gates or boat passes in the embankment for allowing navigation through the embankment to and from the Polder would allow large volumes of saline water inside the Polder and may damage the soil, water and land – destroying crops.	• In order to maintain navigation scenario, an arrangement may be made for lifting of small size country boat from one side to other side i.e. river side to country side and vise-versa for navigation purposes. • This arrangement will not allow entry of saline water inside the Polder, and thus would not damage soil, water, land and crops.

Environmental Management Plan (EMP)

The 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 to the indirect loser/ land owner/ share croppers of construction sites	600,000	7.5	Contractor	During pre-construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	/damage to dredge spoils				
2	Awareness program on plant and wild life conservation.	200,000	2.5	BWDB	During post-construction
3	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
4	Consultancy services cost for supervision and monitoring of EMP	800,000	10	BWDB	During post-construction
5	Training to the farmers with field demonstration regarding IPM and ICM.	200,000	2.5	BWDB with help of DAE	During post-construction
6	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
7	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
8	Solid and liquid waste disposal arrangement.	100,000	1.25	BWDB	
9	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1,000,000	12.5	BWDB	During post-construction
10	Consultancy services cost for river bank erosion monitoring	1,200,000	15	BWDB	During construction
11	Training to the Contractors regarding environmental management	100,000	1.25	BWDB	During pre-construction
12	Training of Environmental awareness of local population	80,000	1	Contractor	During pre-construction and construction phases
13	Updating EMP as per requirement.	1,000,000	12.5	BWDB	During post-construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
14	Construction of alternative or bypass channels at each construction sites.	1,061,053	13.26	Contrctor	During pre-construction and construction
15	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
16	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
17	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
18	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
19	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
20	WMOs monitoring cost	150,000	1.88		
21	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	**70,804,279**	**885.055**		

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 area	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
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

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
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 groundwater etc)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality.	yearly	Contractor through a nationally recognized laboratory	DDCS&PMSC, ,M&E Consultantand BWDB
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	Yearly	Contractor through nationally	DDCS&PMSC, M&E

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
		baseline environment		recognized institute	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 all works	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.
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
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

Cumulative Impacts

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 15 were considered in this study. Apart from CEIP interventions, there are some other development projects in the region of Polder 15, implemented locally or regionally. Impact on hydrology and flooding situation due to construction and implantation of proposed and existing projects were assessed.

Impact on hydrology and flooding situation

The Polder is surrounded by the Kobadak River to the East and North, Kholpetua River to the South and West. A number of khals have criss-crossed the Polder 15 area. 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 strong flow direction of Kobadak River may have a chance of salinity intrusion through Chakbaria and Sora khals inside the Polder area. Other CEIP Polders are far away from Polder 15 so they have no impact thereof.

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 Polder15 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 15), 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 15 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.

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 outat 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 15 was held on 5thDecember, 2017 at Shyamnagar Upazila of Satkhira 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. Embankment Improvement Project, Phase- 1 (CEIP-1), (here in after referred as 'Project'),under which 14/1Polder 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 15 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 of the country to convert this area into permanent agricultural lands (refer Map 1.1 for coastal polders) to increase the agriculture production. The Polders in this area are enclosed on all sides by dykes or embankments, separating the land from the main river system and offering protection against tidal floods, salinity intrusion and sedimentation. Without embankments the coastal communities would be exposed to diurnal tidal flooding. The Poldered lands are slightly higher than sea level. These 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 attention to storm surges. Recent cyclones have substantially damaged the embankments and threatened the integrity of the coastal polders. In addition to breaching due to cyclones, siltation of peripheral rivers surrounding the embankments has caused failures of the drainage systems, creating water logging inside the Polders. This has led to large scale environmental, social and economic degradation. Poor maintenance and inadequate management of the Polders have also contributed to internal drainage congestion and heavy internal siltation which comes from connected river and for top soil erosion. Soil fertility and agriculture production are declining in of water logged areas. Other areas suffer from salinity increase due to incursion of sea water into the Polders.

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

5,700 km long embankments in 139 Polders, the magnitude of such a project is daunting and requires prudent planning. Hence a multi-phased approach of embankment improvement and rehabilitation will be adopted over a period of 15 to 20 years. The proposed CEIP-1 is the first phase of this long-term program.

Map 1.1: Location of Coastal Polders

1.3 Project Overview

7. Polder- 15 is located in Shymnagar Upazila under Satkhira District of southwestern Bangladesh (Map 1.2). The Polder covers a gross area of 3,116 ha of which net area is 2442 ha. The Project aims to enhance protection against natural disasters, increase resilience during and after such disasters, and improve agricultural production by reducing drainage congestion and check saline water intrusion. To achieve these objectives, the following key improvement and rehabilitation works will be carried out in Polder-15 under Package -3, CEIP-1:

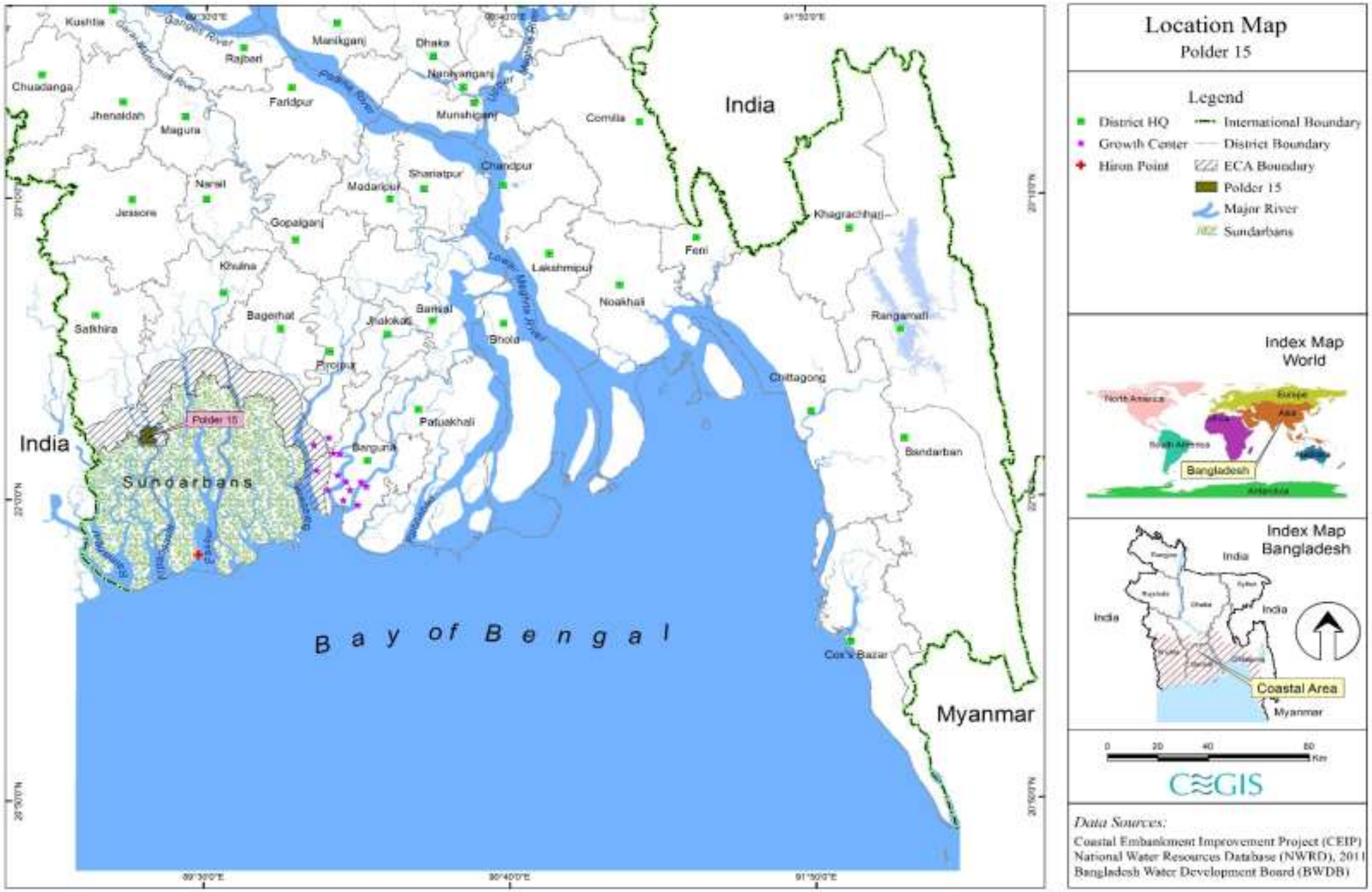
Type of Work	Specification
Re sectioning of Embankment	23.92 km
Design crest level of Embankment	4.50 m PWD
Construction of retired Embankment	6.86 km
Construction of Drainage Sluice	4 nos.
Construction of Flushing Sluice	8 nos.
Re excavation of Drainage Channel	30 km
Bank protection works	0.40 km
Slope protection of Embankment	4.44 km
Afforestation	6.02 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 and old developed projects shall obtain environmental clearance from the Department of Environment (DoE), Ministry of Environment and Forest (MoEF). Similarly, the World Bank's environmental safeguard policies require an environmental assessment to be carried out for projects being considered for its financing. The present EIA fulfills both of these requirements.



Map 1.2: Location of Polder- 15

1.5 Objectives of the Study

10. The objective of the EIA study for Polder -15 is to to identify and assess the potential environmental impacts of the proposed project interventions, evaluate alternatives, and design appropriate mitigation and management measures as well as monitoring guidelines to be addressed in the Environmental Management Plan (EMP)[1] in compliance with the national regulatory and WB environmental policies and guidelines (for further details refer to Chapter 3).

The specific objectives of the EIA study are to:

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

1.6 Scope of Works

The scope of works of for conducting the EIA for Polder- 15 includes the following:

(i) Carry out detailed field investigation on 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 Component (IESCs).

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

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

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

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

(vii) Consult with modeling consultants to establish conformity of the impact assessment with existing and ongoing mathematical model due to climate change developed by a number of

[1]WB Operation Policy 4.01. 2011 Revision

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 describe in qualitative terms.

(ix) Describe alternatives which were examined in course of developing the proposed project and identify other alternatives which could achieve the same objectives. The concept of alternatives extends to the sighting and design, technology selection, rehabilitation/construction techniques and phasing, and operating and maintenance procedures. Compare alternatives in terms of potential environmental impacts, vulnerability, reliability, suitability under local conditions, and institutional, training, and monitoring requirements. While describing the impacts, the irreversible or unavoidable are immitigable and impacts for which mitigation may be possible. 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 it during construction and operation. Include in the plan an estimate of capital and operating costs and a description of other inputs (such as training and institutional strengthening) needed to implement the plan.

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

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

(xiv) Prepare the EIA report.

1.7 Structure of the Report

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) provides various alternatives considered during the feasibility and design stage of the project, and their environmental and social considerations.

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

Chapter 9 (Cumulative 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

11. 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

12. 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.

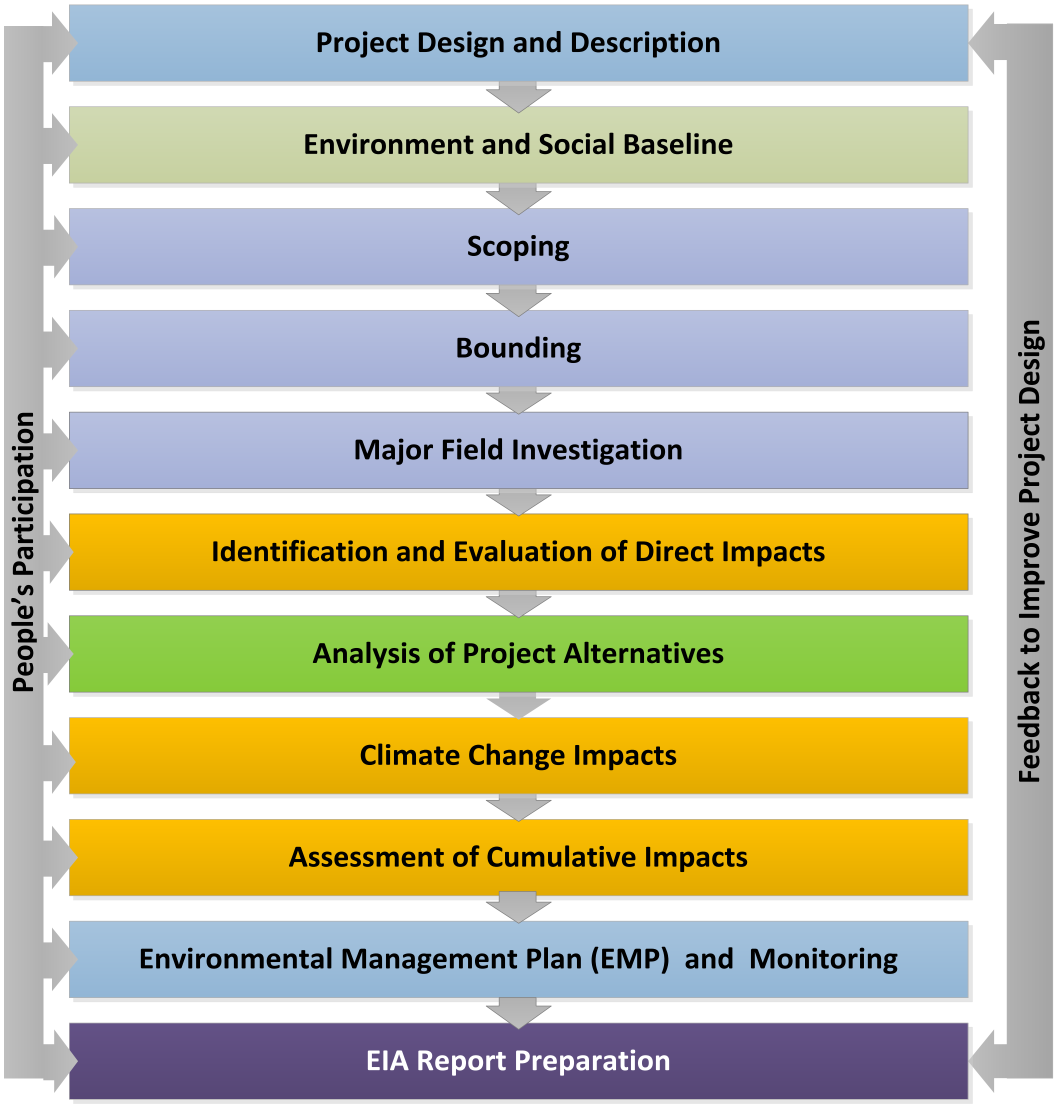


Figure 2.1: Overall approach of the EIA study

2.2 Methodology

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

2.2.1 Analysis of the Project Design and Description

14. 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.

15. 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.

16. 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.

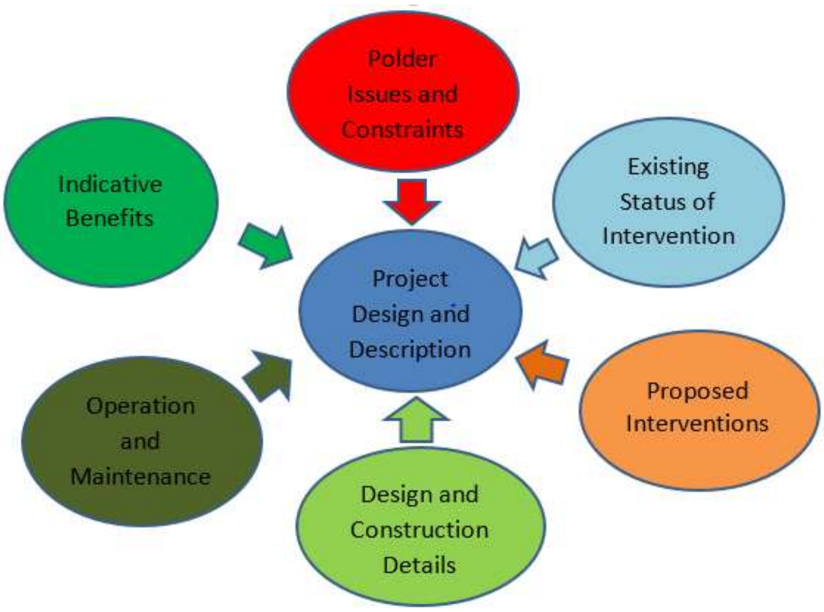


Figure 2.2: Aspects to be addressed in the Project Design and Description

2.2.2 Baseline Data Collection and Analysis

17. 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.

18. 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

19. 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

20. 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.

21. 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).

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

Land Resources

23. 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

24. 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:

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

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

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

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

Ecological Resources

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

30. Field investigation methods included physical observation; transect walk, habitat survey and consultations with local people. Public consultation meetings were carried out through FGD and Key Informants Interview (KII) methods. Inventory of common flora and fauna 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

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

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

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

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

Livestock Resources

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

Socio-cultural Environment

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

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

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

2.2.3 Scoping

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

2.2.4 Bounding

39. The influence area of the project 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.

40. 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. Theindirect influencearea is located immediately outside the Polder embankments (this area could be used for staging of construction works, material stockpiling, and/or earth borrowing), access routes for the Polder, borrow as well as spoil disposal areas, and labor camps/contractor facilities if located outside the Polder. The Polder is surrounded by river Hari to the East, Upper Salta River to the South West, Taltola River to the West and Geangrail River to the North. It is noted that the indirect area of influence includes peripheral rivers, land surrounding Polders and Sundarban (up to 1 km).

2.2.5 Major Field Investigation

41. The EIA study team members collected intensive data on the possible impact of the project after obtaining the detailed rehabilitation plan from the project authority. The study team carried out a number of comprehensive field investigations in order to collect primary data and solicit feedback from local people. Intensive data on Baseline and IESCs were collected from the field during this stage. Information on the IESCs were collected through a mixed method including RRA, PRA and KII using checklists for water resources, land resources, agriculture, livestock, fisheries, ecosystem and socio-economic components.

Intensive consultations with the local people were carried out for their feedback on the key parameters. This process helped the multidisciplinary EIA study team to qualify their professional observations. In 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

42. *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.*

43. 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

44. 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.

45. 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

46. 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.

47. 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

48. 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

49. 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

50. 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.

51. 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

52. 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

53. 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

54. 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.

55. 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

56. 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.

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

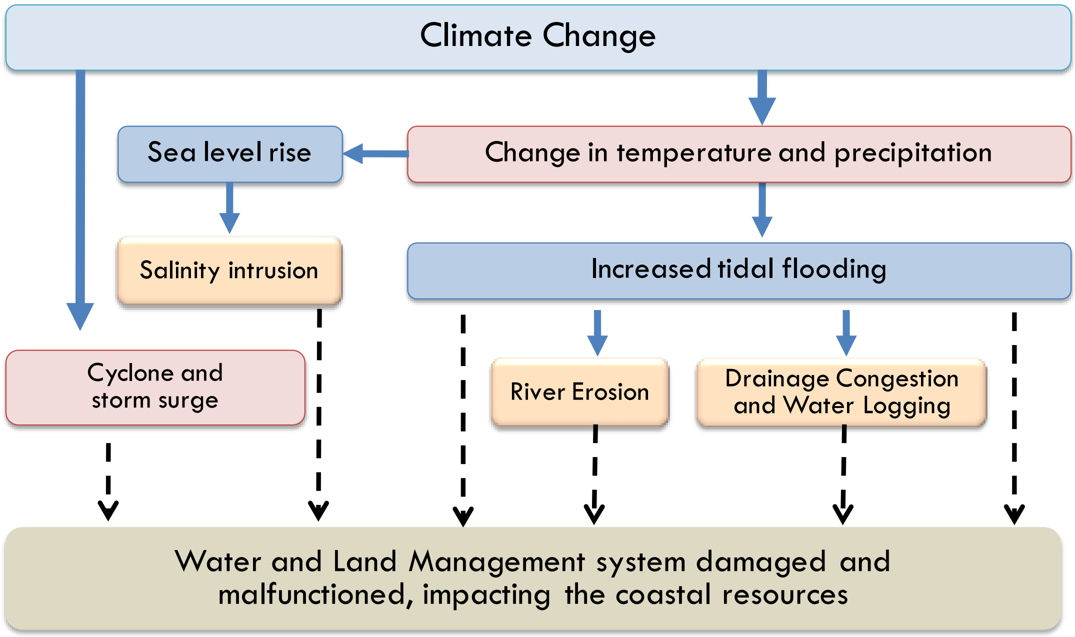


Figure 2.4: Typical process diagram of climate change impacts in coastal areas

58. 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

59. 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.

60. 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

61. 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

62. At the end of the study, the present report has beenprepared incorporating all the findings of the EIA.

3. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

63. 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

64. 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
(xiv) National Biodiversity Strategy & Action Plan 2007, 2016
(xv) Bangladesh Climate Change Strategy & Action Plan 2009
(xvi) Bangladesh: National Programme of Action for Protection of the Coastal and Marine Environment from Land-Based Activities 2005

3.2 National Environmental Laws

List of relevant national laws and regulation are given below:

(i) Bangladesh Environment Conservation Act (ECA), (Amendments) 2010
(ii) Bangladesh Environment Conservation Rules (ECR), 1997, Amendment 2010
(iii) Bangladesh Environment Court Act, 2010
(iv) The Forest Act, 1927 & Amendment Act 2000
(v) Private Forest Ordinance (PFO), 1959
(vi) Social Forestry Rules, 2004 and Amendments
(vii) Antiquities Act, 1968
(viii) Bangladesh National Building Code, 2006
(ix) Standing Orders on Disaster, 2010
(x) The Acquisition and Requisition of Immovable Property Ordinance, 1982
(xi) The East Bengal State Acquisition and Tenancy Act, 1950 (Revised 1994)
(xii) Constitutional Right of the Tribal Peoples Rights
(xiii) Ethnic Minority Rights in PRSP 2005
(xiv) Bangladesh Wildlife Act 2012
(xv) The Marine Fisheries Ordinance,1983

The details of the above polices, strategies, and laws are given in Appendix-C

3.3 Other Relevant Acts

65. There are a number of other laws and regulations relevant to the project which is 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 of fishes 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

66. Government of 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 shown in Table 3.2

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

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

67. The environmental legislative basis for approval of the CEIP-1 is the Bangladesh Environmental Conservation Act 1995 (BECA'95) and the Environmental Conservation Rules 1997 (ECR'97, 2010). DoE, under MoEF is the regulatory body responsible for enforcing the ECA'95 and ECR'97 (Amended 2010). 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 15 falls under the 'Red' category[3].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)

68. 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:

69. 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

70. Legislative basis for EIA in Bangladesh are the Bangladesh Environmental Conservation Act 1995 (BECA'95) and the Environmental Conservation Rules 1997 (ECR'97, 2010). Department of Environment (DoE), under the Ministry of Environment and Forest (MoEF), is the regulatory body responsible for enforcing the BECA'95 and ECR'97, 2010. According to the Bangladesh 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. Moreover the Polder 15 is located within 10 km of the northern periphery of the Sundarban, declared as Ecologically Critical Area (ECA) in 1999 under the BECA 1995. The application procedure for obtaining site clearance and environmental clearance for the sub-projects of Red category is shown in Figure 3.1.

[3] Projects having significant negative impacts on environment fall under red category. Both IEE and EIA studies are required for these kinds of projects.

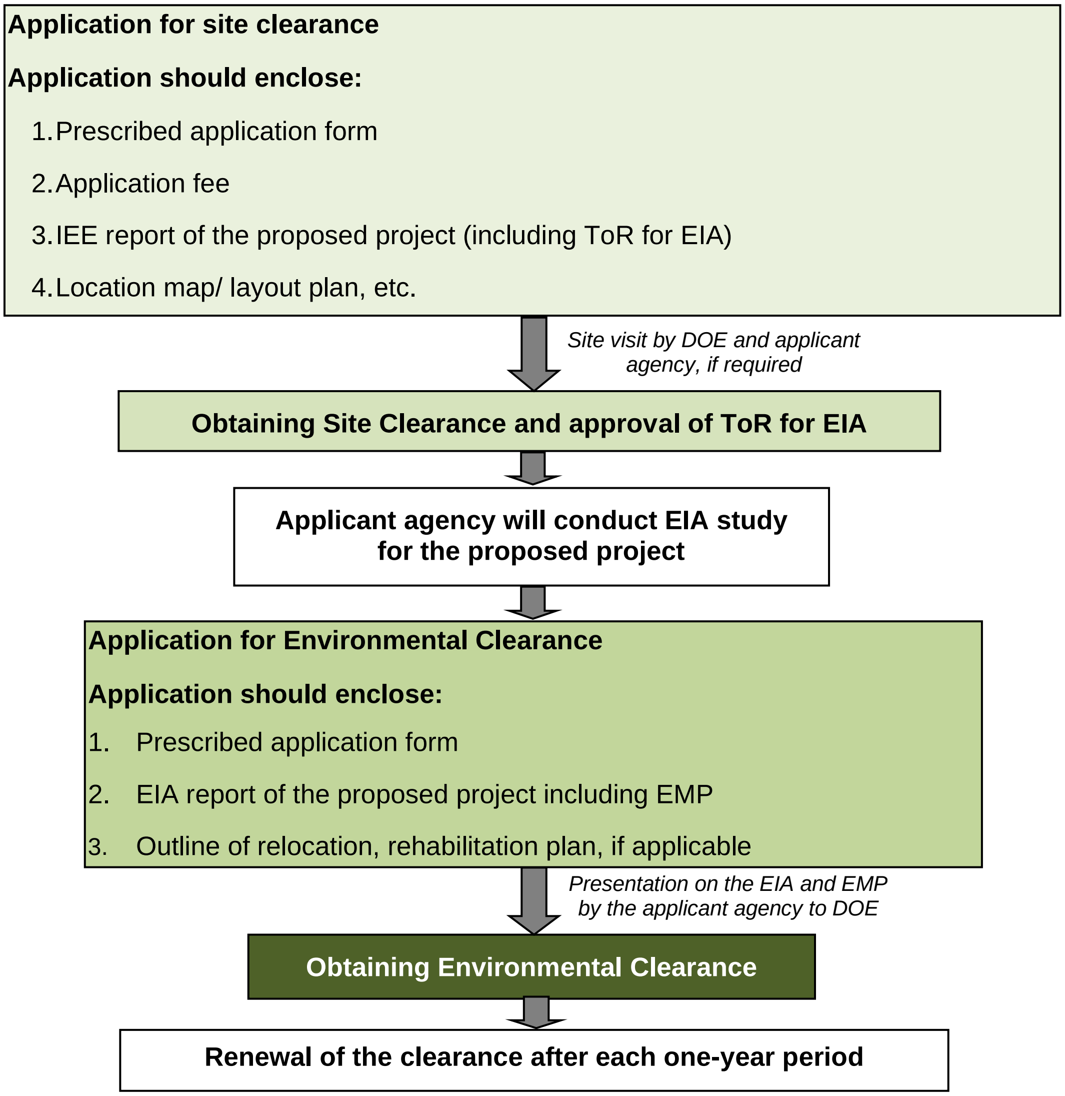


Figure 3.1: Process of obtaining Clearance certificate from DoE

3.7 World Bank's Environmental Safeguard Policies

71. 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

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

3.8 Implications of WB Policies on CEIP

73. The project interventions for Polder 15 fall under Category A[4], due to the complexity of environmental issues associated with project activities involving major civil works by reconstruction and rehabilitation of the coastal embankment to protect against tidal flooding and storm surges. Since the coastal area is of high ecological sensitivity and vulnerability certain negative environmental impacts may occur during the implementation and operational phase on overall Polder system. There may be localized impact on the natural habitats especially on the fish spawning site and protected areas, during the implementation of the civil works.

74. The environment assessment (OP/BP 4.01), natural habitats (OP/BP 4.04) and forests (OP/BP 4.36) policy have been triggered for the proposed operation. Although no direct impacts on physical cultural resources are expected, screening mechanism incorporated into the EA process will identify subprojects with archeological, paleontological, historical, religious, or unique natural values, chance and find procedure will 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 in operational phase if the water and soil pollution is observed, the proponent will be responsible for preparing Pest Management Plan with prior approval from the Bank. No Project activities are to be carried out in the rivers except some transportation. However, this will not have any affect whatsoever on the upper riparian water usage or availability. Hence International Waterways (OP 7.5) is not expected to be triggered.

[4] ***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

4. CLIMATE CHANGE IMPACT

4.1 Climate Change

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 (GHG) 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 to 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. In this connection, monthly and annual mean data of maximum and minimum surface air temperature and monthly and annual rainfall over Polder 15 has been used for the period of 1976-2005 for this study. It is mentioned here that Polder 15 is located near the Satkhira and so, meteorological parameters of Satkhira station is considered as a Polder 15 in the study. Satkhira station data (Polder 15) has been collected from Bangladesh Meteorological Department (BMD). Seasonal mean values have been computed from the monthly data of rainfall and temperature for the four meteorological seasons e.g. pre-monsoon (March-May), monsoon (June-September), post-monsoon (October-November) and winter (December-February). There are some months with missing data of Satkhira station (Polder 15) 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.

4.1.1 Annual Climate Change Trends

4.1.2 Annual mean maximum temperature trend

80. Long-term changes in surface temperature and precipitation over Polder 15 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 15 shows that the temperature has the dominant decreasing trend as shown in Figure 4.1.

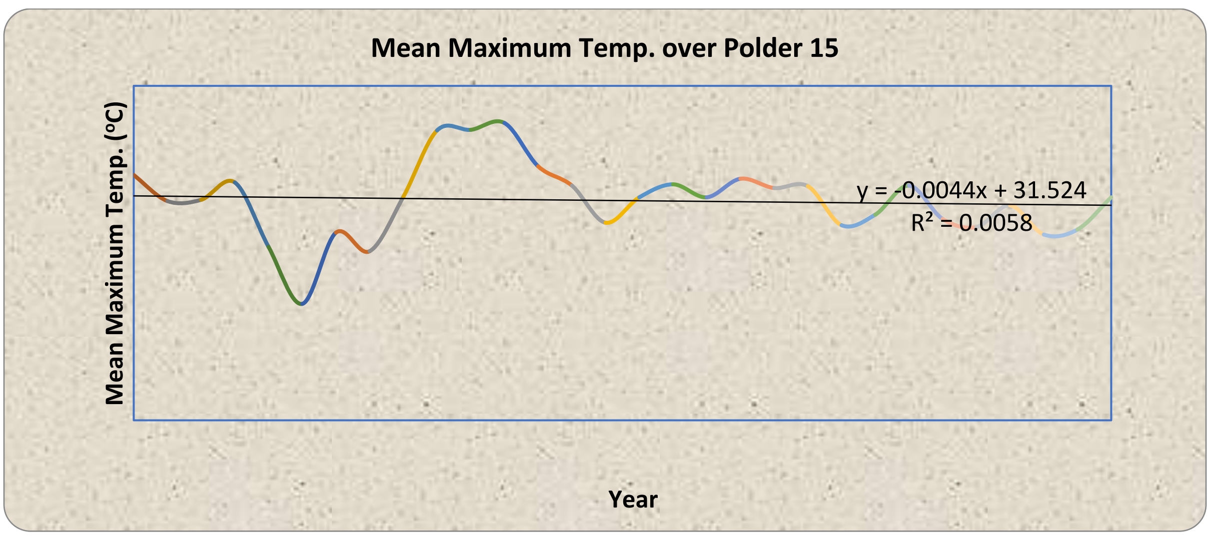


Figure 4.1: Temporal variations of mean maximum temperature over Polder 15 during the period 1976-2005

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 15 at the rate of -0.0044ºC/year, which is not statistically significant.

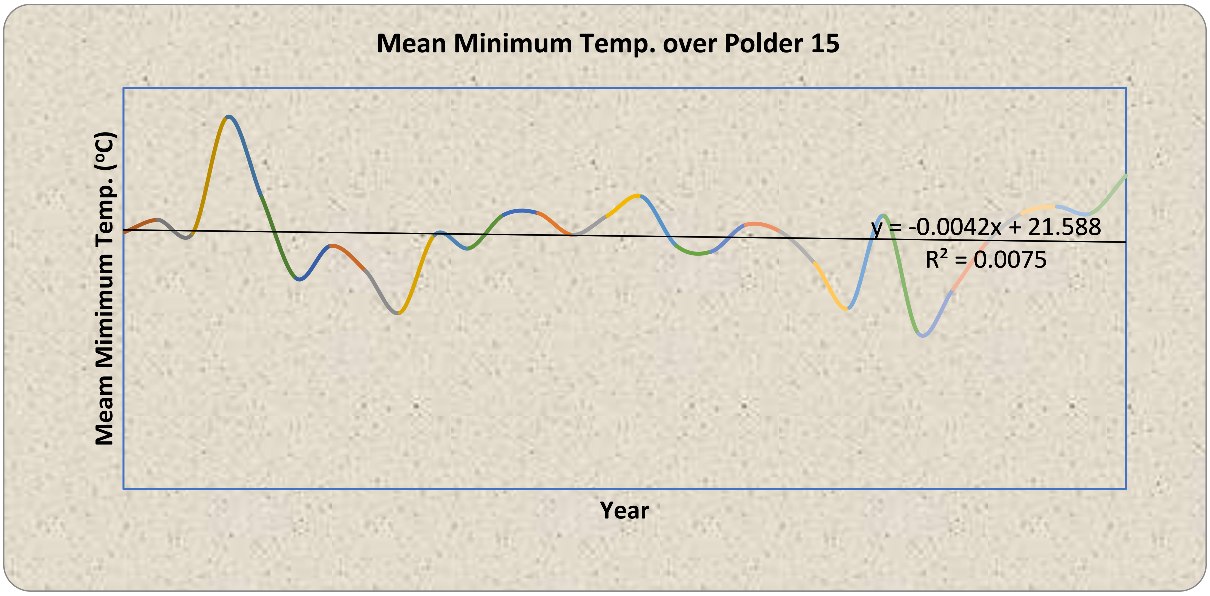


Figure 4.2: Temporal variations of annual mean minimum temperature over Polder 15 during the period 1976-2005.

4.1.3 Annual mean minimum temperature trend

82. The temporal plots of the time series of annual mean minimum surface air for Polder 15. The yearly variation of annual mean minimum surface air temperature for Polder 15 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 15 at the rate of -0.0042ºC/year which is not statistically significant during the same period.

4.1.4 Annual total rainfall

83. The temporal plots of the annual total rainfall of Polder 15 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.

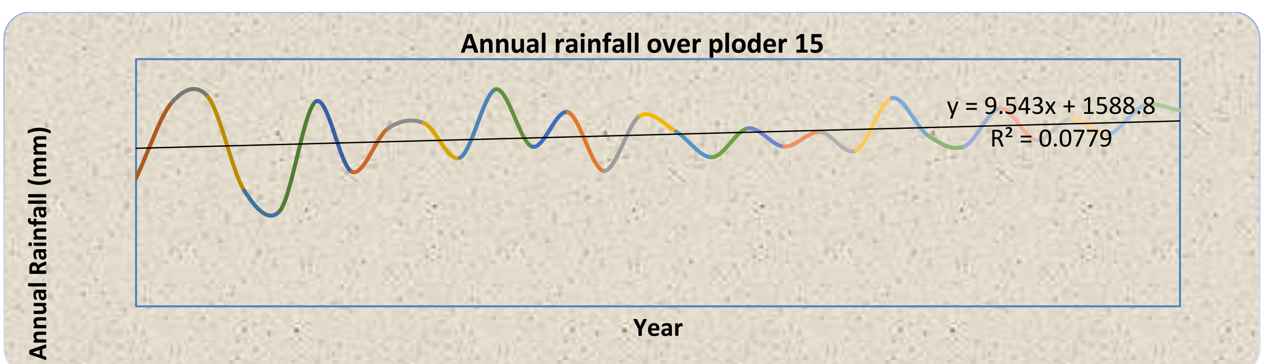


Figure 4.3: Temporal variations of annual rainfall over Polder 15 during the period 1976-2005

4.2 Seasonal climate change trends

4.2.1 Winter climate change trends

Winter mean maximum temperature trend

84. The winter mean maximum surface air temperature shows a slightly increasing trend from 1976-2005. The decreasing trend is observed over Polder 15 at the rate of -0.0216ºC/year which is statistically significant at 5% level.

Winter mean minimum temperature trend

85. According to the trend analysis, it is found that the winter mean minimum surface air temperature has a decreasing trend over Polder 15 during the period of 1976-2005 The decreasing trend over the Polder is -0.015ºC/year which is not statistically significant.

Winter season rainfall trend

86. The temporal variations of winter rainfall obtained for 1976-2005 show a slightlydecreasing 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

Pre-monsoon mean maximum temperature trends

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

Pre-monsoon mean minimum temperature trends

88. Pre-monsoon mean minimum temperature shows an increasing trend over Polder 15 during the period 1976-2005. It is observed that warming trend over Polder 15 at the rate of 0.002ºC/year is not statistically significant.

Pre-monsoon total rainfall trend

89. The pre-monsoon total rainfall during the period 1976-2005,shows anincreasing trend at a rate of1.499 mm/year for Polder 15which is not statistically significant.

4.2.3 Monsoon Climate Change Trends

Monsoon mean maximum temperature trends

90. The Polder-15 has shown warming trend of mean maximum temperature in the monsoon season during the period 1976-2005 (Figure not shown here). Polder-15 exhibits warming trend during the monsoon season at the rate of 0.0203ºC/year which is statistically significant at 5% level.

Monsoon season mean minimum temperature trends

91. It is observed that Polder-15 has shown warming trend of mean minimum temperature in the monsoon season during the period 1976-2005 (Figure not shown). Polder-15 has slightly warming trend with the value of 0.0039ºC/year which is not statistically significant.

Monsoon season rainfall trends

92. 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 (Figure not shown). It is seen that increasing trend in the monsoon season rainfall are observed over Polder-15 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 means maximum temperature trends

93. The Polder-15 has shown decreasing trend for post-monsoon season of mean maximum temperature during the period 1976-2005 (Figure not shown). Decreasing trend is observed over the Polder-15 at the rate of -0.0288^{o}C/year, which is statistically significant at 5% level at the same period.

Post-monsoon means minimum temperature trends

94. Post monsoon mean minimum temperature has shown slightly decreasing trend over Polder-15 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

95. 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 15 at the rate of 6.241mm/year (Figure not shown) 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-15

96. 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).

97. 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.

98. 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.

99. 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 RCP4.5 scenario

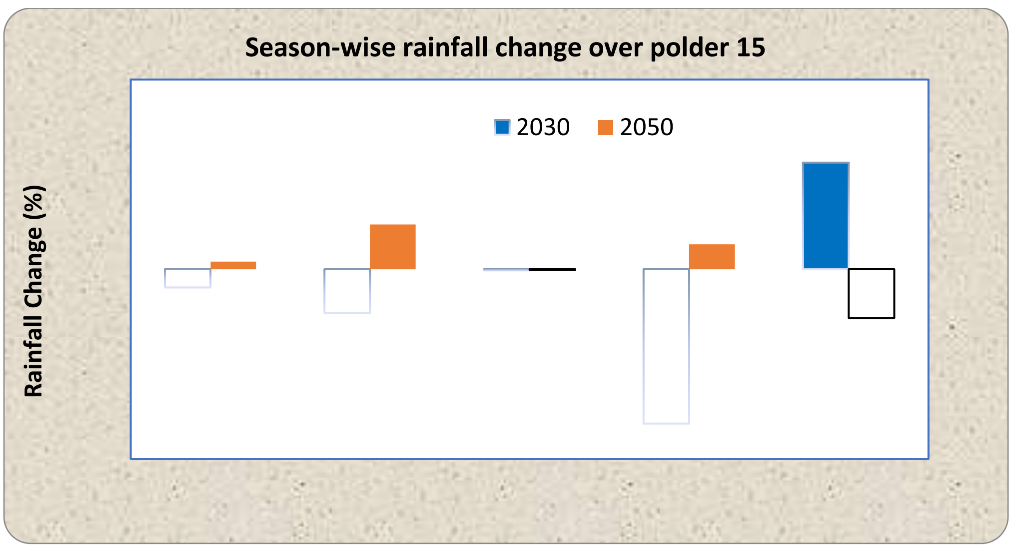


Figure 4.4: Change of seasonal rainfall (%) over Polder-15 for the year 2030 and 2050

100. 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 15 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-15 may be decreased by -2.6% for the year 2050.

Projection of Maximum and Minimum Temperature over Polder 15

101. 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

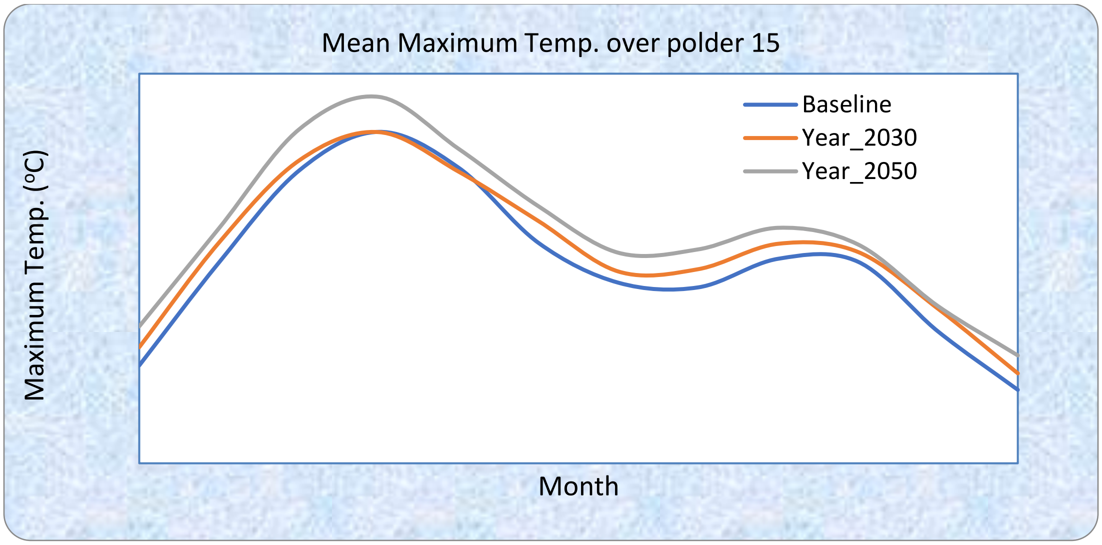


Figure 4.5: Annual cycle of projected maximum temperature with baseline over Polder-15 in 2030 and 2050

102. 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 0.8ºC 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-15 may vary by -0.2-1.0ºC. On an average the maximum surface air temperature is estimated to increase by 0.6ºC over Polder-15 for the year 2030. Similarly, maximum surface air temperature may change 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 1.6º 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-15 may vary by 0.9 - 1.9º C. On an average the maximum surface air temperature is estimated to increase by 1.5ºC over Polder-15 for the year 2050.

Minimum temperature projections

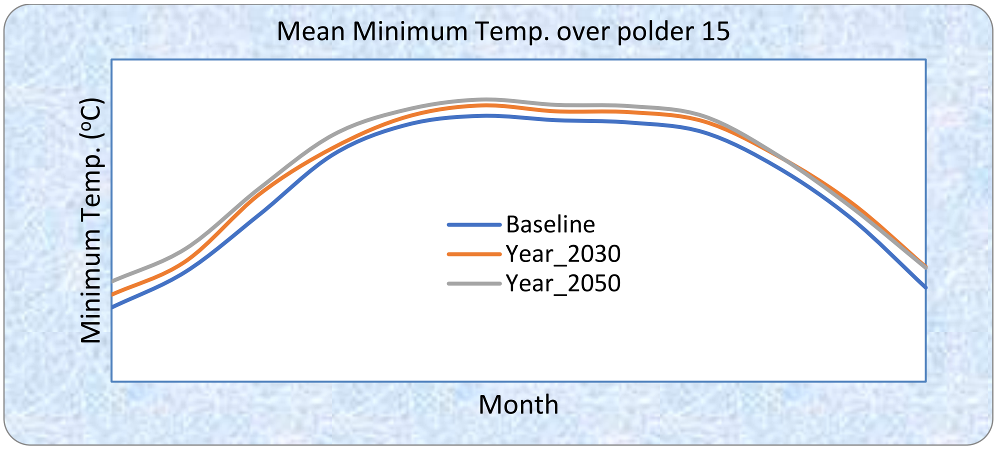


Figure 4.6: Annual cycle of projected minimum temperature with baseline over Polder-15 in 2030 and 2050

103. 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 by 1.1°C over Polder-15 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 by 1.7°C over Polder-15 in future for the same period.

4.3 Climate Change Induced Natural Hazard

104. 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

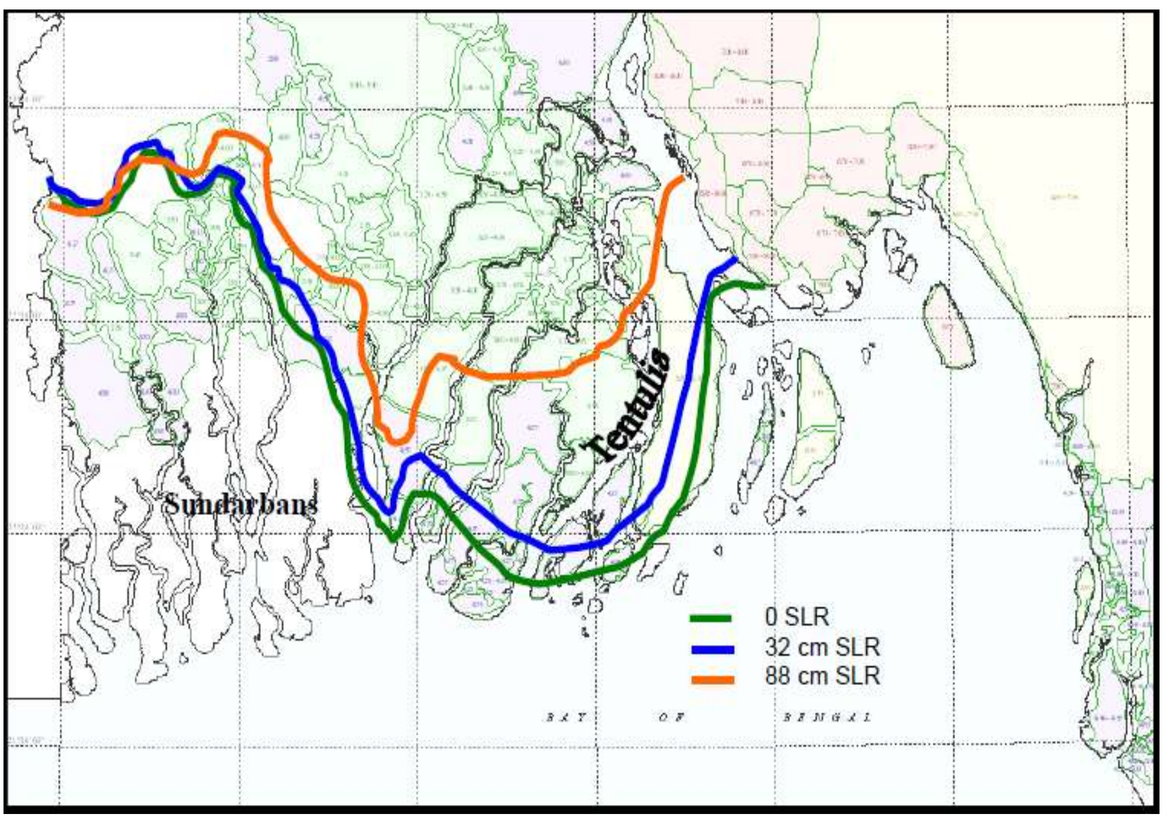
105. Bangladesh is vulnerable to current coastal hazards and anticipated Sea Level Rise (SLR) because of its lower elevation. WARPO (2006) predicted that the Sea Level Rise (SLR) may be increased by 14, 32 and 88 cm in 2030, 2050 and 2100 respectively which may inundate about 8, 10 and 16% respectively 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

106. 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.

107. The average elevation of coastal lands in Bangladesh is below 1.5 mPWD. It is predicted in several studies that the sea-level in the Bay of Bengal may rise in the range of 0.3 to 1.5 m by the year 2050 (DOE, 1993). In the coastal front there will be stronger-than-usual backwater effect due to sea level rise induced high oceanic stage, resulting into retardation of discharge flow, particularly around the confluence points of the major rivers. Consequently, the risk of floods of high intensity and duration, similar to that occurred in 1998, will be exacerbated. Under climate change scenario about 18 per cent of current lowly flooded areas will be susceptible to higher levels of flooding while about 12 to 16%of new areas will be at risk of varied degrees of inundation. As per recommendations of NAPA, the SLRs in the coast of Bangladesh are 14 cm, 32 cm and 88 cm for the year 2030, 2050 and 2100 respectively. In a recent study, IWM (2006) predicted that flooding of coastal lands may increase by 21% by the year 2100 and 10.3% by the year 2050 with respect to the ordinary flooding condition when approximately 50% lands go under flood.



Map 4.1: Different sea level rise in dry season (IWM and CEGIS, 2007)

4.3.3 Salinity Intrusion

108. 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			

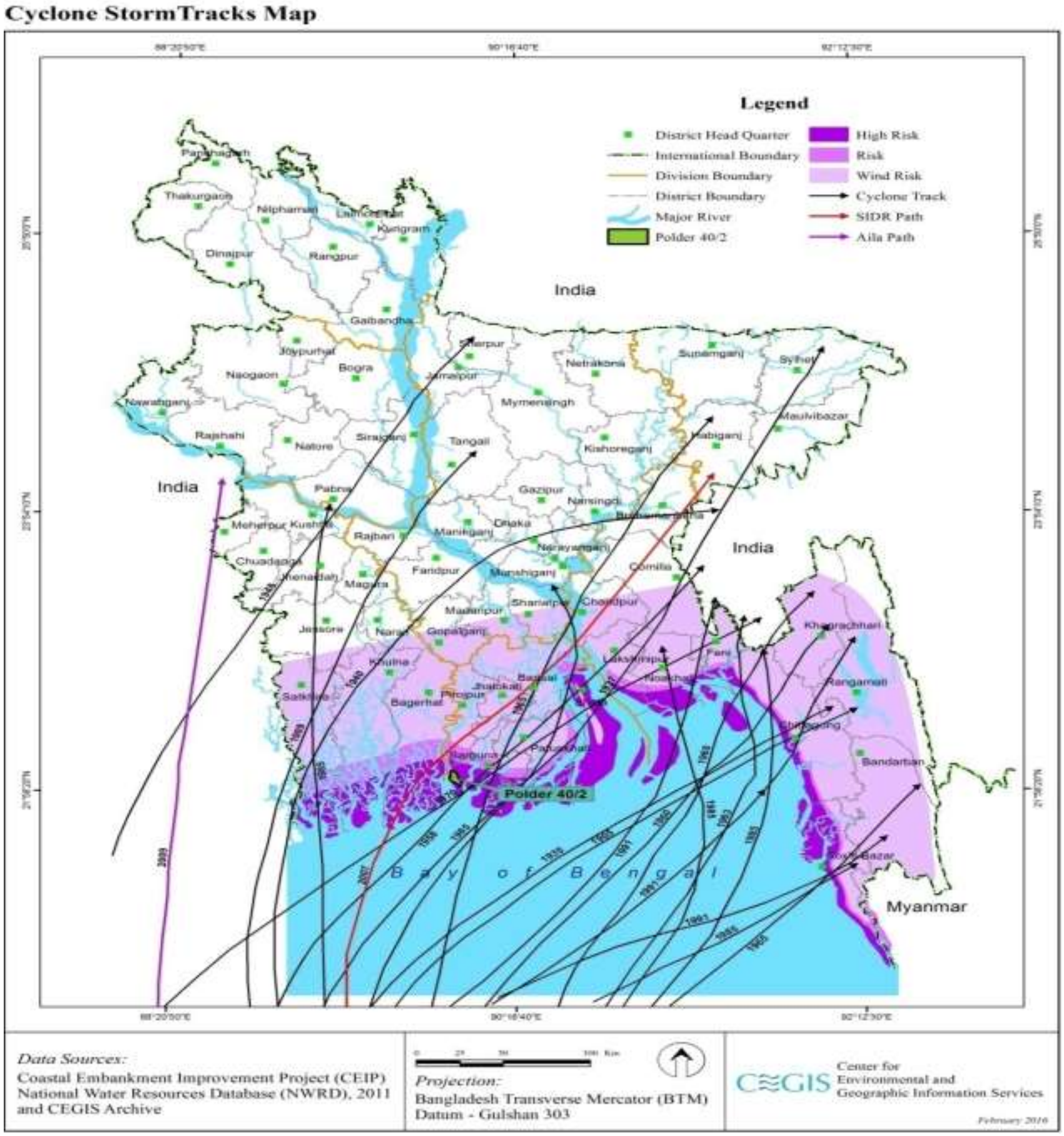
4.3.4 Cyclones and Storm Surges

109. 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).

110. 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.

111. 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) and 16 cyclones (Table 4.2) have occurred in the last 25 years. Table 4.2 represents that the occurrence of cyclone is more frequent due to climate change. The strength and number of major cyclones may be increased due to higher sea surface temperatures associated with global warming. Tropical cyclones and storm surges are particularly severe in the Bay of Bengal region. Last devastating cyclone (Aila) hit the study area and project site on 25th May 2009. The project area is located in the wind risk zone of Bangladesh.

112. 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

113. 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).

114. 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 Project Background

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

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

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 Pussur which have sandy bottoms and clay/silt banks and the smaller rivers which have an excess of silt and clay. The consequent choking of smaller rivers resulted in drainage congestion within some internal polders, and navigation problems in some.

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 on account 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 will 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.

Polder-15 is one of the polders to be rehabilitated under the CEIP-1.

5.4 Overview of Polder- 15

124. The Polder is located in Shymnagar Upazila under Satkhira District. The Polder covers one Union Parishad (U/P) namely Gabura. The Polder is surrounded by two large rivers Kobadak River to the East and North, Kholpetua River to the South and West. The Kobadak and Kholpetua Rivers are to the north of the Sundarban. Sundarban is the largest mangrove forest and a World Heritage Site of the world, located at the southern and south-western boundary of the Polder.The Polder-15 lies within the Ecologically Critical Area (ECA) declared by the DOE under the BECA 1995 which entails especial clearences from the DOE to implement any RED category project.

125. The Polder was conceived in the early 1960s. Construction of the Polder started in 1968 and was completed in 1971. Cyclone is the main threat to cause damage to life and property in the Polder area. Later on, the Polder was included in CERP for rehabilitation after the disaster of the tropical cyclone Aila (2009). The original concept of construction of this Polder was to protect low lying coastal areas against tidal flooding and salinity intrusion, considering only the tidal effects but ignoring the effects of wind, wave and cyclonic storm surges. In the present context, the Polder is under increased threat from cyclone surges, wave action that result from climate change.

5.5 Objective of the Project

126. The primary objective of the project is to restore the polder that may protect the coastal population from natural disasters and climate change. This may be fulfilled through a set of specific objectives, viz., (a) to protect embankment from river erosion and wave action; (b) to prevent salinity intrusion; (c) to provide improved drainage facilities; (d) to prevent sedimentation both in agricultural land and in water resources system; (e) to enhance scope of agricultural production; (f) to reduce vulnerability to sea level rise due to climate change; and finally (g) to protect life and properties of the polder community from storm surges.

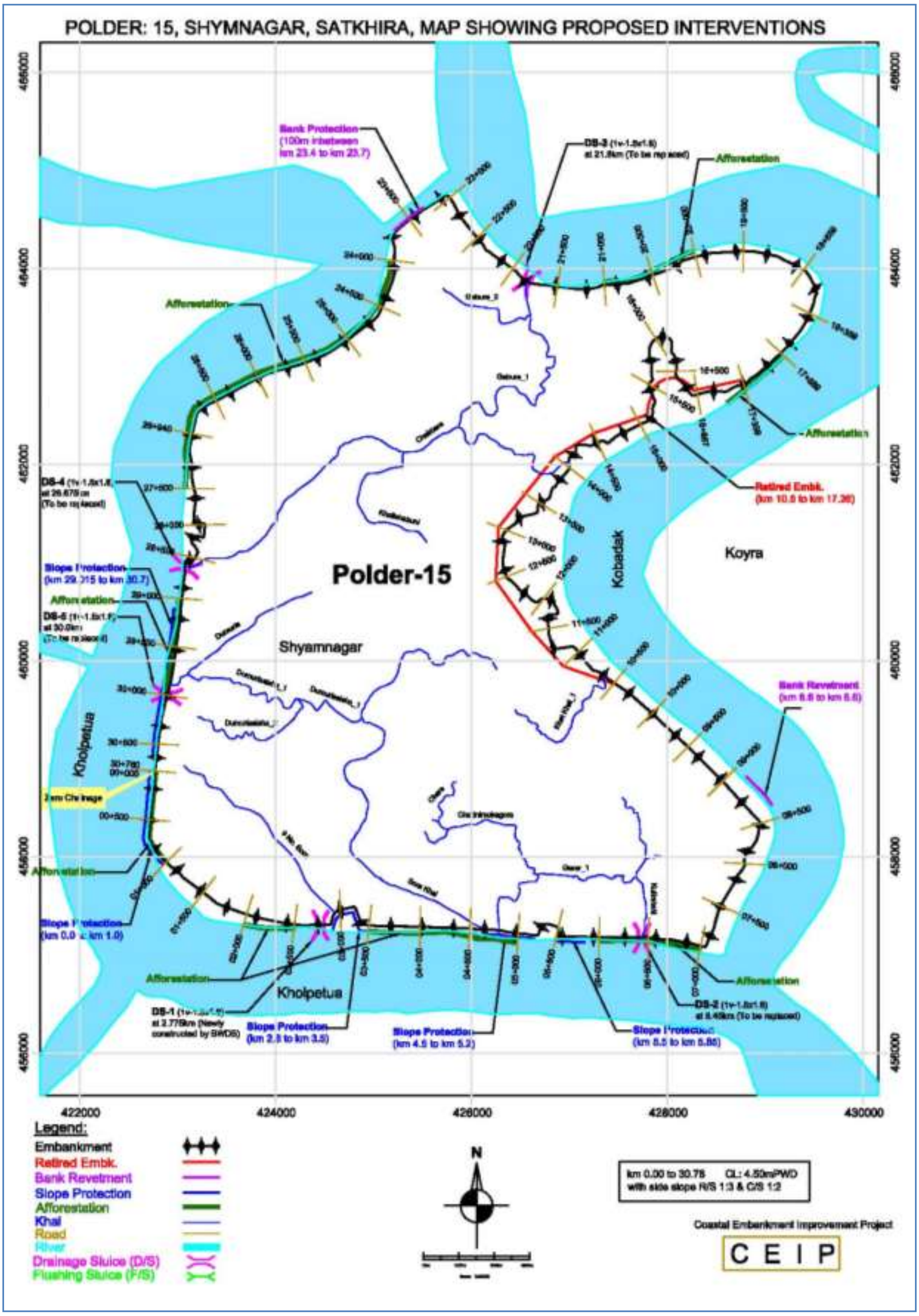
5.6 Water Management Problems and Issues in Polder 15

127. Polder-15, like other Polders in the coastal area of Bangladesh, was designed originally to protect the inner area against highest tides, without much attention to storm surges. Most segments of the embankment have been damaged mainly by overtopping of cyclones and storm surges especially Aila (2009). Moreover, many sections of the embankment have been damaged by wave action and eroded due to river flow.. It is reported that during Aila, the entire Polder area was submerged by 1 m to 1.5 m of surge water and about 75 people died, damage occurred and breaches formed at several places, parts of the embankment were washed away. At present the Polder area remains inundated with saline water causing an abrupt ecological change inside the Polder area and no living environment has yet been re-established. More than 80% of the Polder area is now under shrimp culture ghers and few agriculture lands remains inside the polder. The total length of the embankment needs to be re-sectioned as per recommended crest level based on sea level rise as determined by CEIP.

128. It is also observed that numbers of hand tube-wells are been installed on the crest of embankment by the gher owners for lifting water from the river to fulfill water demand inside the Polder. There is no flushing inlet in the Polder area but there is demand for flushing within the Polder for fishing. An adequate number of flushing inlets are required otherwise, un-authorized installation of pipes would pose a threat to the integrity of the embankment.

129. There are 5 (five) numbers of Drainage Sluices in the Polder. The condition of the existing structures is also very deplorable. The concrete surfaces of the structures have deteriorated due to long-term use and contact with saline water. In some places, the reinforcement is exposed and corroded. Most of the structures are not in repairable condition. Loose aprons of the structures have been damaged. Out of the 5 (five) existing structures, 4 (four) are required to be replaced and 1 (one) structure (DS-1) has recently been constructed (2010-2011) by BWDB but would need adjustment to fit with the proposed new crest level. Recently, some closures have been constructed without providing any sluices adjacent to this which may create drainage congestion in the Polder area. Hence, two numbers of additional drainage sluices are required to be constructed for efficient drainage subject to design by CEIP. Besides, most of the internal drainage channels have silted up which need to be re-excavated for efficient drainage within the Polder area.

130. An Index Map showing the alignment of the embankment, drainage sluice, drainage channels are shown in Map 5.1:



Map 5.1: Existing Interventions of Polder- 15

131. Based on local opinions clustered during the major field investigation carried out in November 2015, the study team identified the following key water management problems and issues in Polder-15.

- ✓ Recent cyclones and storm surges, particularly the recent cyclone of 2009 (Aila);
- ✓ Lack of timely repair and maintenance of water control structures and embankments

- ✓ Inadequate budget allocation for O & M and its inefficient use
- ✓ Abuse of existing infrastructure for fishing, shrimp/ prawn farming through unauthorized and inappropriate inlet, pipes which result in weakening of the embankments and malfunctioning of regulators
- ✓ Inadequate plantation in the foreshore and lack of coastal green belt;
- ✓ Absence of functional community organizations for operation and co-management of the polder system.

5.7 Present Status of Water Management Infrastructures

132. To ensure sustainable management, optimal use and equitable utilization of water resources Water Management Infrastructures are seemed as physical interventions that are the key features of intervention work. There are some typical water management infrastructures such as peripheral embankments, drainage sluices, drainage khals and others in Polder 15. Based on field investigation carried out in November 2015, coupling with the information received from CEIP Consultant, the study team gathered the following information regarding the status of existing infrastructures.

Table 5.1: Summary **of existing water management infrastructures**

Type of Infrastructures	Specification
Total length of Embankment	30.78 km (Design crest: 4.27 mPWD)
Total number of Drainage Sluices	05 nos
Total length of Drainage Khals (Water Channel)	40 Km
Gross protected area	3,116 ha
Net Cultivable area (agriculture and gher)	2442 ha

Source: CEGIS estimation, 2015

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

134. The total length of the embankment is 30.78 km. Embankment of the Polder is aligned along the Kobadak and Kholpetua Rivers as mentioned above. At present, most of the segments of the embankment are in vulnerable condition at reason to the recent cyclone Aila (2009). During the cyclone Aila, the entire embankment was damaged, some segments were breached and some segments were washed away. After that, the Polder was taken up for rehabilitation on emergency basis under CERP but it is not sustainable solution to the Polder area. The entire embankment needs rehabilitation as per new design section determined by CEIP.

135. During field visit in November 2015, it is observed that the entire length of embankment of the Polder is below the design section. Some repairing work of the embankment was going at some segments by BWDB for their regular maintenance work. There are some brick soling on the crest of the embankment at some segments as the main communication system of the Polder.

Photograph 5.1: Present condition of the embankment of the polder

5.7.1 Slope protection

136. The existing slope condition of embankment is under the threat of wave action of the periphery rivers. Damages to the embankment occur when depression is formed in the sea especially during cyclone and high tide period. Some segments of the protective works are in vulnerable condition due to the crest width of the embankment and C/S slope is under design section. To protect the embankment from wave thrust, slope protection work of embankment at several segments were taken under CERP and BWDB after Aila. The length of embankment at various segments requires to be protected by providing slope protection works as determined by CEIP.

Photograph 5.2: Existing slope protection work

5.7.2 Water Control Structures

137. There are 5 (five) numbers of Drainage Sluices in Polder-15. During field visit, most of the drainage sluices were found damaged and in deplorable condition except DS-1 which was constructed in the year of 2010-2011 and found in functioning condition. At present, the concrete surface of the structures has been deteriorated due to prolonged exposure to saltwater. A number of gates have been corroded and the loose aprons have been damaged as well. 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. Sweet water retention needs to be ensured within internal canal system for cultivating crops. There is public demand for flushing of the river water within the Polder area. As there is no flushing inlet in the Polder, an adequate number of flushing inlets are required to be constructed. Otherwise,

more un-authorized pipe-lines will be installed than the existing by Gher owners through the embankment for taking saline water inside the Polder threatening the stability of the embankment. Formation of strong "Sluice Committees" and WMA is needed for gate operation and for improving water management system inside the polder. **Table 5.2** below provides a detailed understanding of the existing drainage sluices in Polder-15 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. 2+775 (9 no. Sora)	RCB (1vent-1.5mx1.8m)	The structure has been constructed in the year of 2010-2011 and the condition is good.	Needs adjustment to fit with the proposed new crest level
2	DS – 2	Ch. 6+450 (Chandnimuka)	RCB (1vent-1.5mx1.8m)	Concrete surface of the wing-wall has been deteriorated and reinforcement is exposed There is a leakage underneath the sluice bed U/S and D/S loose apron have been damaged. Moreover, the sluice is in deplorable condition and is not repairable.	Needs to be replaced with provision for drainage and flushing.
3	DS – 3	Ch. 21+800 (Gabura)	RCB (1vent-1.5mx1.8m)	Concrete surface has deteriorated and cracks have developed on the surface of the wing-wall. Reinforcement is found to be exposed and has rusted. Moreover, the sluice is in deplorable condition and is not repairable.	Needs to be replaced
4	DS – 4	Ch. 28+675 (Chokbara)	RCB (1 vent-1.5mx 1.8m)	Concrete surface has deteriorated and reinforcement exposed Some cracks has developed on the surface of the head wall and loose apron damaged Moreover, the sluice is in deplorable condition and is not repairable.	Needs to be replaced
5	DS-5	Ch. 30+00 (Dunuria bazar)	RCB (1 vent-1.5mx 1.8m)	Concrete surface has become undermined Some cracks have developed on the surface of the wing-wall and floor of the structure Moreover, the sluice is in deplorable condition and is not repairable.	Needs to be replaced with provision for drainage and flushing.

Note: DS = Drainage Sluice, RCP = Reinforced Concrete Pipe, RCB = Reinforced Concrete Box
Source: CEIP 2015, and CEGIS Field Investigation, 2015.

Photo 5.3: Deteriorated condition of DS-2

Photo 5.4: Moderately functioning condition of DS-3

Photo 5.5: Deteriorated condition of DS-4

Photo 5.6: Moderately functioning condition of DS-5

Photo 5.7: Functioning condition of DS-1

5.7.3 Drainage Channel

138. Numbers of drainage khals exist in the Polder area and are perennial in nature. Total length of the drainage channels is around 40 km inside the polder. Most of the khals are silted up and need 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 overtopped embankment at tremendous pressure resulting enlargement of width of some of the khals and extensive breaching of many segments of the embankment mainly at

Chakbara, Dumuria, 9 no. Sora, Sora khals and at Jaliakhali which looks like a river inside the Polder.

Figure 5.1: Enlarged width of the khals of the Polder after Aila (satellite image)

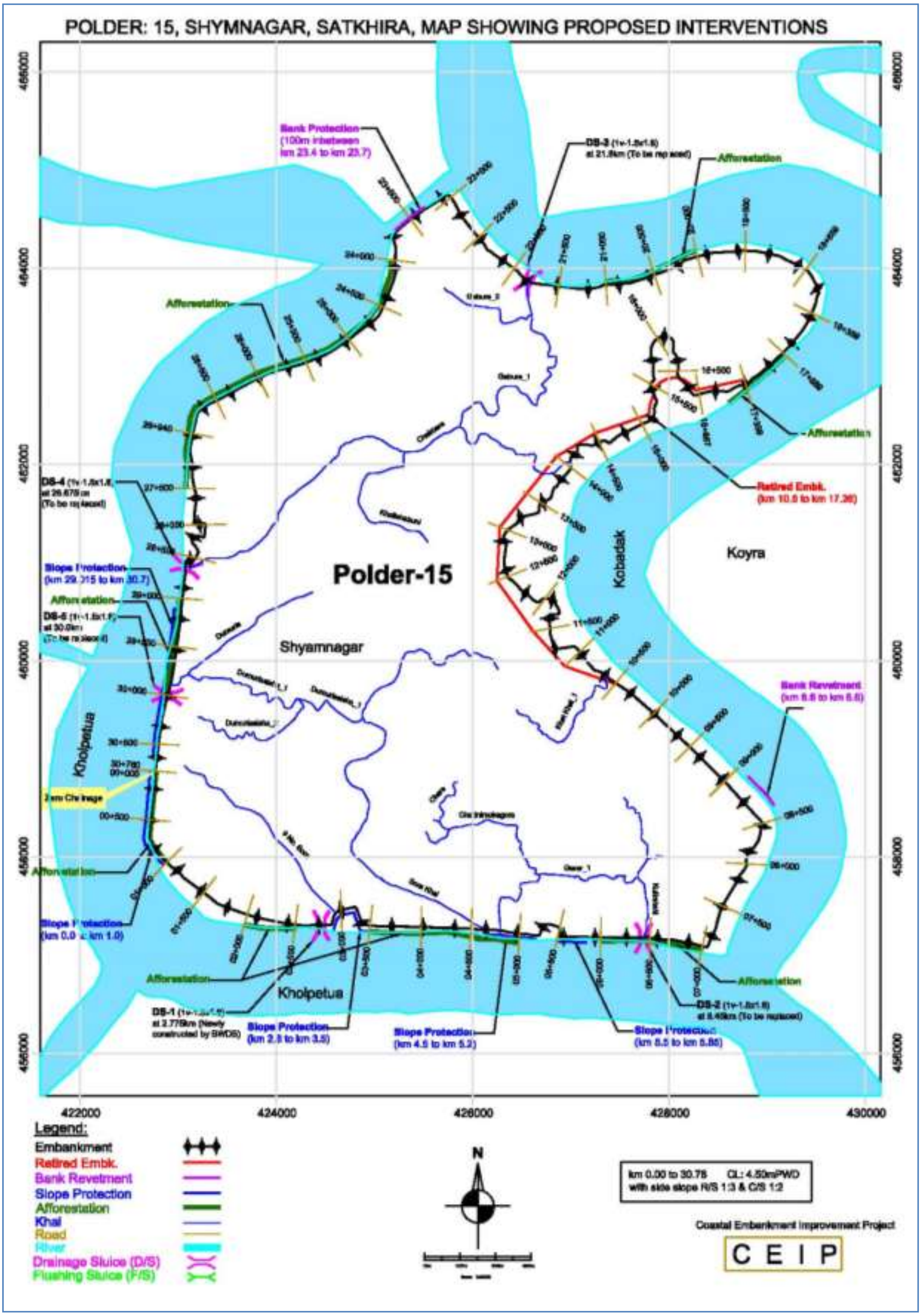
5.8 Proposed Rehabilitation Plan

139. The proposed interventions in Polder-15 (Map 4.2) under CEIP-1 are listed in **Table 5.3**. The interventions have further been detailed in the following sections.

Table 5.3: Summary of Proposed Interventions in Polder- 15

Type of Work	Specification
Re-sectioning of Embankment	23.92 km
Construction of Retired Embankment	6.86 km
CEIP design crest level of Embankment	4.50 mPWD (entire embankment)
Construction (Replacement) of Drainage Sluices	04 nos.
Construction of Flushing Inlets	08 nos.
Re-excavation of Drainage Channels	30 km
Slope protection work of Embankment	4.44 km
Bank Revetment work	0.50 km (map) 0.40 km (Polder brief)
Afforestation	6.02 ha

Source: Design Team of DDCS & PMSC, 2015



Map 5.2: Proposed Interventions of Polder- 15

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

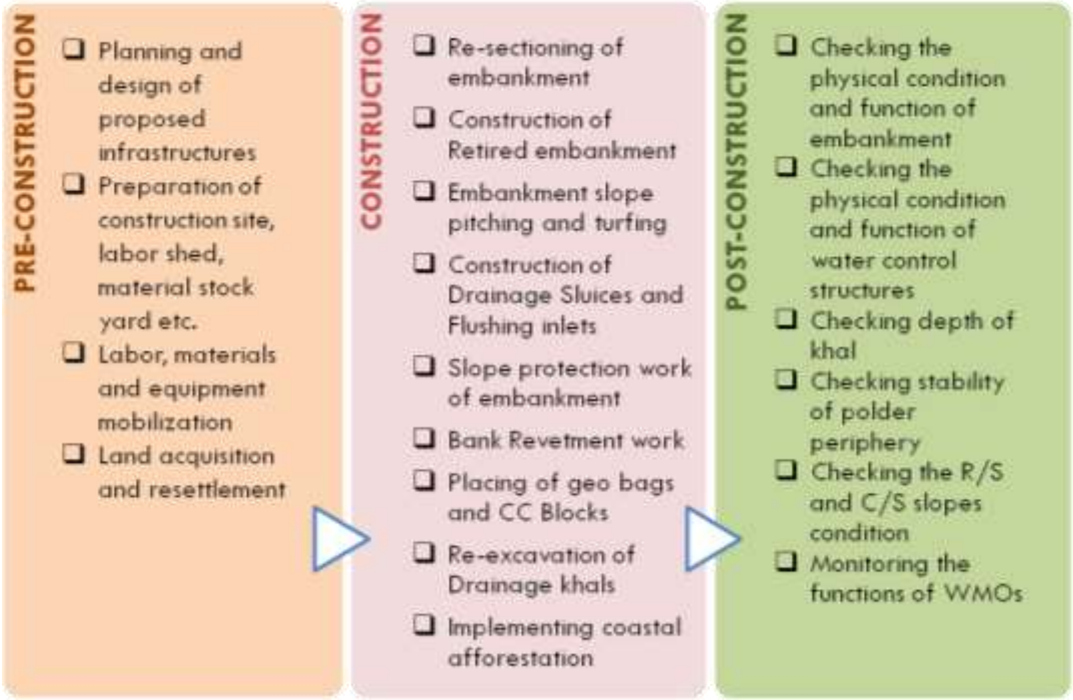


Figure 5.2: List of activities in Polder- 15 at different project phases

5.8.1 Works on Embankment

141. Under the proposed interventions in the Polder, a total of 23.92 km of embankment will be re-sectioned.

142. The process will be done with mechanical compaction as per designed crest level varies from 4.92 to 5.04mPWDwhich has been assessed through mathematical modeling considering 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 one location 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 5.4a: Detail of Works on Embankments

Sl. No	Chainage	Length (Km)	Proposed Crest Level	Side slopes
Re-sectioning of Embankment				
1	0+000 to 10+500	10.50	4.5 mPWD	R/S 1:3 and C/S 1:2
2	17+359 to 38+780	13.42	4.5 mPWD	R/S 1:3 and C/S 1:2
Construction of Retired embankment				
3	10+500 to 17+359	6.86	4.5 mPWD	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	Modelled Storm Surge level (corrected mPWD)	Standard Deviation (m)	Sidr Simulated surge level (corrected mPWD)	Aila Simulated surge level (corrected mPWD)	Recommended Slope	Free board for Grass or Smooth paved (Roughness coefficient 1.0)	Free board for rough Slope (Roughness coefficient 0.8)	Allowance for Subsidence	Rqd crest Levelw/o roughness + Subsidence & no std	Rqd crest Levelw/o roughness + std + Subsidence	Rqd crest Levelwith roughness + subsidence & no std	Rqd crest Levelwith roughness + Subsidence + std	25 year maximum WL in June-Sept period	Max wind wave height in June Sept period	Free board for Grass or smooth paved(Roughness coefficient 1.0)	Rqd crest Levelw/o roughness with subsidence and freeboard	Crest Level Considering 0.90m freeboard according to Standard Design Manual, Volume 1, standard design
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

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

144. Labor sheds construction with proper sanitation and other required allied facilities should 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 the instruction of the Engineer-in-charge. The tools required for the construction of embankments will be procured during this period. After validating the final design, excavation of soil/carried earth will be dumped in layers in a 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 developed after proper compaction in layers. The required turfing with grass will then be provided on the slope of the embankment. Watering and fertilizers will also be provided.

5.8.2 Construction (Replacing) of Drainage Sluices and Flushing Inlets

145. There are four numbers of existing Drainage Sluices of Polder-15 that will be constructed or replaced by new design specifications. Besides, eight numbers of new Flushing Inlets will be constructed at different locations under the proposed interventions for rehabilitation of Polder- 15 under CEIP . The summary of the proposed works related to the drainage sluices is given in Table 5.5

146. It is 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. As per design of Drainage Sluices (DS), The invert level of DS are fixed inconsideration of the lowest water 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.

Table 5.5: Details of Works Related Drainage Sluices

Sl. No.	Name of drainage sluices	Chainage (at km)	Khal Name	Name of outfall river	Length of Khal (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-2 (1v-1.5m x 1.8m)	6.45	Kulirshishi khal	Kholpetua River						Replacement of structure as proposed
02	DS-3 (1v-1.5m x 1.8m)	21.80	Gabura Khal	Kobadak River						Replacement of structure as proposed
03	DS-4 (1v-1.5m x 1.8m)	28.675	Chakbara Khal	Kholpetua River						New construction of Structure as proposed
04	DS-5 (1v-1.5m x 1.8m)	21.20	Dumuria Khal	Kholpetua River						New construction of Structure as proposed

Source: Design Team of DDCS & PMSC, 2015

Description of construction activities

147. During pre-construction phase for construction of drainage sluices, flushing inlets, construction of labor shed with sanitation and other facilities should be completed. During this period, required construction materials (sand, cement, wood, shuttering materials, etc.) will be procured by the contractor as per tender schedule. Before starting the construction of 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. After that, the foundation treatment required for the structure will be carried out. CC and RCC works along with cutting, bending and binding of rods will then be performed as per specification. CC blocks will be prepared and placed as and where required as per design. After construction of approach roads/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.

5.8.3 Re-excavation of Drainage Khals

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148. The internal drainage channels with a total length of 30 km will be re-excavated to ease water flow and reduce drainage congestion. An estimated volume of 150,000 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.

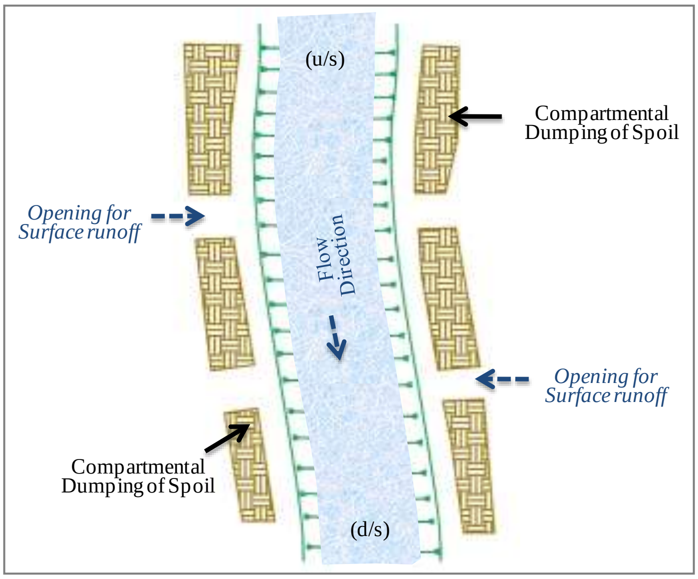


Figure 5.3: Plan form of a typical khal to be re-excavated

Table 5.6: Khals to be Re-excavated

Sl.	Name of Khal	Length (km)
1	Sora khal	Total length of all the 5 drainage khals has been estimated to be 13.44 km,
2	Kulir Shishi khal	
3	Gabura khal	
4	Chakbora khal	
5	Dumuria khal	

Source: CEIP-1 Design Study Team, 2017

Description of Construction Activities

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

5.8.4 Slope Protection/Bank Revetment

150. A total of 4.44 km of slope protection works will be carried out along the Kholpetua and 0.5 km of bank protection works along the Kobadak river will be carried out respectively (Refer **Map 5.2**).

Description of Construction Activities

151. The construction of labor sheds, creation of sanitation facilities and procurement of construction materials (sand, cement, wood, shuttering materials, etc.) will be carried out before the start of construction activities. At first the slope of the river bank will be developed by earth as per design. At the same time, the required CC blocks will be casted or manufactured and flood walls will be constructed. After completion of the preparation of CC blocks, geo-textile bags will be placed along the slope and CC blocks will be placed on it. A launching apron will be prepared with CC blocks along with dumping of CC blocks in assorted form and will be completed up to toe of the river banks. Finally, turfing will be made on the slope or crest of the embankments. Proper drainage provision will be included to avoid formation of rain cuts for surface run off.

152. 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 6.02 ha area will be underplantation in this Polder.

5.8.5 Construction Details

5.8.6 Construction Schedule

153. The construction works in Polder- 15 under the CEIP-1 is expected to be completed in four years. The construction schedule is presented in **Table 5.6.**

Table 5.6: Construction Schedule

Part A

Sl No	Description	Year One								Year Two			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)												
2	Construction of retired embankment (km)												

3	Construction of Drainage Sluices and flushing inlets (nos)												
4	Bank revetment and Slope Protection Works (km)		Manufacture of cc blocks and procurement of hard rock										
5	Re-excavation of Drainage Channels (km)												
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 (km)					Turfing							
2	Construction of retired embankment (km)												
3	Construction of Drainage Sluices and flushing inlets (nos)												
4	Bank revetment and Slope Protection Works (km)												
5	Re-excavation of Drainage Channels (km)												
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 (km)												
2	Construction of retired embankment (km)												

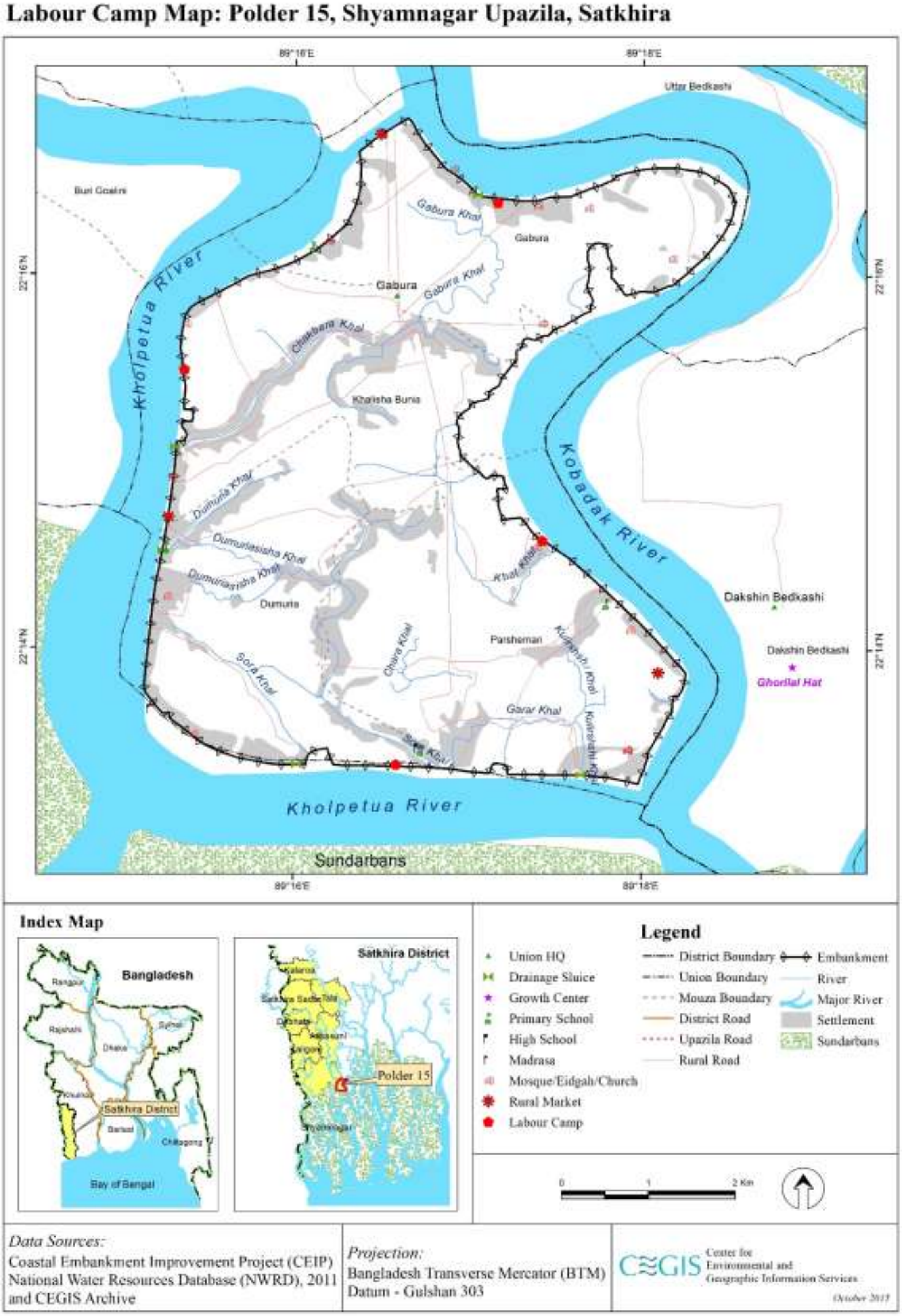
Sl No	Description	Year Three								Year Four			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
3	Construction of Drainage Sluices and flushing inlets (nos)												
4	Bank revetment and Slope Protection Works (km)												
5	Re-excavation of Drainage Channels (km)												
6	Other works, including surveys, quality checks, testing, inspections and the like												
7	Site clearance and clean up												

Source: CEIP-1 Design Study Finding2015

5.8.7 Construction Manpower Requirement

154. Technical and non-technical manpower will be required for the construction works. The manpower will include senior professionals, Engineers, Technicians, Supervisors, Surveyors, Mechanics, Foremen, Machinery operators, Drivers, and un-skilled laborers[5]. The estimated manpower requirement is presented in **Table 5.7**. 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.

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



Map 5.5: Location of labour camp

Table 5.7: Required manpower for construction

	Required Manpower	Number
1	Engineer	4
2	Machinery operator	5
3	Mechanics	12
4	Surveyor	8
5	Skilled labour	25
6	Un-skilled labour	200

Source: CEIP-1Design Study Finding, 2015

5.8.8 Construction Materials

155. The construction materials 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 of these materials are presented in **Table 5.8** below

Table 5.8: Details of Construction materials

	Description	Quantity	Sources
Re-sectioning and retired embankment			
1	Earth work	15,578,639.65m^3	Borrow pits, dredging 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)
Bank protection (CC block: 60,00,000nos)			
6	Cement		To be procured from, cement factory (directly)
8	Sand		To be procured from Khulna, Sylhet
9	Stone		To be procured from Khulna, Sylhet or imported from neaighbour countries

Source: CEIP-1 Design Study Finding 2015

156. For rehabilitation of Polder 15 under CEIP, only 1.3 km slope protection work will be undertaken. Automated CC Block manufacturing plant will not be required. The block will be made manually.

157. The earth for embankment rehabilitation will be collected from the offshore area of Polder-15.

5.8.9 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 presented below.s

Table 5.9: List of construction equipment and machinery

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

Source: CEIP-1 Design Study Finding, 2015

5.8.10 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. The 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 the Ministries of Finance, Agriculture, Environment & Forest, Public Health Engineering, and the Chief Executive Officers 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).**The BWDB will set up a PMU to oversee the development and management of the Project. It will be led by a Project Director appointed by the BWDB who will have the rank of Chief Engineer, and will directly report to the Director General (DG). The PMU will have a central project office located at the headquarters of the BWDB in Dhaka. The PMU will have 3 subordinate units: (i) Engineering Unit; (ii) Procurement and Finance Unit; and (iii) 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 Procurement and Finance Unit will be responsible for the entire procurement and financial management process of the Project. It will also be responsible for monitoring project progress, to liaise with the Bank, and to prepare annual programs, implementation reporting,

updating all procurement reporting documents, and financial management reporting. The procurement staff would consist of a Senior Procurement Specialist and one Procurement Specialist. The finance staff would consist of one Deputy Director, Finance, two Accountants and three support staffs.

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

164. An Environment, Social and Communication Unit (ESCU) will supervise compliance with the Environmental Management Plan and Social Action Program. This unit, together with the engineering unit will implement the communication strategy. This unit will include a Senior Environmental Specialist, a Senior Social Specialist, a Senior Forestry Specialist, a Revenue Staff and a Communication Specialist. ESCU will supervise programs in 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. For civil works contracts, the Project Director will serve as the Employer, and the Project Supervision Consultant will serve as the Engineer for construction supervision. At site, a Resident Engineer, appointed by the consultant, with a team of specialists and inspectors will supervise the Contractor.
- DDCS&PMSC will supervise/assist in the implementation of safeguard instruments.
- A Monitoring and Evaluation Consultant will provide support in monitoring project impacts and supervise the implementation of the EMP/RAP and report to the PMU.
- A Procurement Panel will be appointed by the BWDB to oversee the procurement process of large value contracts subject to prior review under the Project. The panel will consist of two international/expatriate specialists and one national specialist.

167. *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.

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

5.9 Operation and Maintenance Plan

5.9.1 Introduction

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

170. The Polders have been playing a vital role in safeguarding the coastal area; ensuring and increasing agricultural production; improving livelihoods of the people; and mitigating environmental damages. But these are vulnerable to storm surges; high tides; annual floods; land erosion and drainage congestion. In many cases the structures as built have not been found adequate to cope with the diverse needs of the local people. Changes in the land use pattern have created water management conflicts and newer dimension needs asking the structures to allow water to flow in both directions. So, maintenance of the polder system with embankments and structural elements has become of permanent importance. The GoB either with assistances from international donors and lending agencies or out of its own resources has been spending money almost on a regular basis to keep the Polders in good working condition eventually to save the coastal people. The Coastal Embankment Improvement Program (CEIP) is one of the latest such interventions to address a systematic restoration and upgrading of the polder systems in the coastal region. Under this long term phased program of polders improvement, Operation and Maintenance issues with special reference to Local Government Institutions (LGIs) as well as local stakeholder’s participation and need based budgeting will continue to remain at the apex.

5.9.2 Operational Plan

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

(i) Operational Activities

172. 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 olders 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)

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

(a) Regulation of gates

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

175. The picture in other polders where only FCD activities exist is different; institutional set up for the users' organizations is yet to be built and introduced. This particular issue will be discussed in details in the following section to address Beneficiaries Participation in coastal Polders.

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

177. Flap Gates of regulators should remain in place at all times except during maintenance and flushing. During pre-monsoon period, the vertical lift gates of each regulator should remain closed for retention of water for irrigating Aus crops by LLPs. During monsoon (July to September), the vertical lift gates should normally remain closed; but may be opened to regulate the water levels inside the polder and should not be allowed to exceed the stated maximum permissible level for safety reasons. In order to achieve this, discharges into the river should commence depending on the river levels and should be stopped soon after the permissible 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, etc. However, the frequency and type of this decision-making process will vary with the seasonal conditions.

178. During the post monsoon season (October to November), the vertical lift gates will be operated to retain water in the drainage canals without overtopping the canal banks and increasing the soil moisture level for cultivation. In all these cases there should have enough consultation with the beneficiaries' organizations because agricultural practices, crop varieties; cropping pattern changes with time as well as fish culture which is commonly practiced in the Polder area. Gate operation plan in Bangla is provided in Appendix-D.

179. Operation of Flushing Sluices and Pipe Inlets should also have similar practices with maximum involvement of beneficiaries' organizations. The O&M section and DWM staffs of BWDB will assist them in the water management of command areas inside the polders.

(b) Frequent Watching of Embankments

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

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

(c) Regular Checking of Structures

182. This is also a typical monitoring activity to be carried out by BWDB's O&M field staffs to detect slips at abutments, damage of protective works and wing walls, and periodic damage

to flap gates and fall boards, etc. The functional groups under WMGs in the polders will assist the O&M Section Office of BWDB to identify and report the damages for rectification.

(d) Survey of embankment & structures and Engineering survey

183. The survey data obtained by the O&M field staffs of BWDB are used for estimating the required maintenance works. Physical condition of embankments and structures are investigated through field surveys once in a year. This is specially required to prepare the details for carrying out periodic maintenance works.

(e) *Supervision of preventive maintenance works*

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

(ii) Planning of Operation

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

186. The decision making process involved in structure operation is shown in Figure 5.5. This illustrates schematically the procedural steps necessary to translate water management needs into actual operation. The water management plan drawn over a season provide the framework upon which water levels in the drainage channels i.e. operation targets and day-to-day structure operation needs will be based. However, actual field water levels may diverge from the water management targets due to some unpredictable factors like rainfall or other causes. During the cropping season, monthly, weekly or daily operational adjustments will be required. Routine monitoring of water management and hydrological conditions will help supply data that together with the water management plan, will dictate the need of adjusting the operational measures.

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

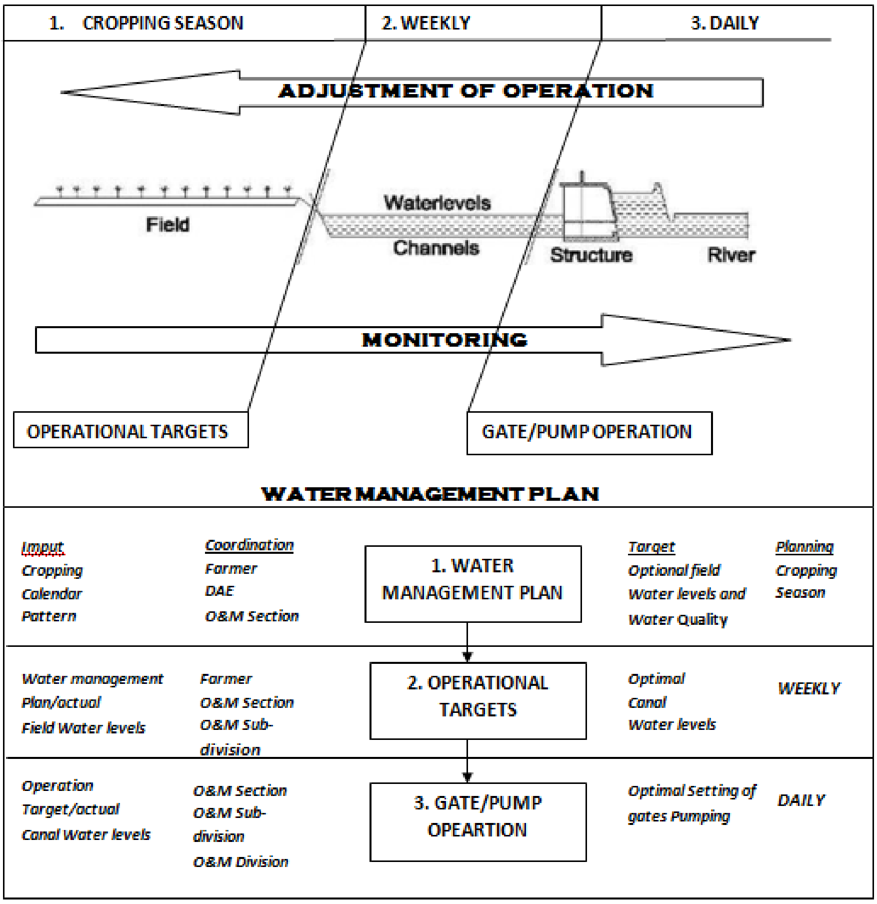


Figure 5.4: Decision making in operation

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

188. In the coastal Polders both the drainage and water conservation requirements are equally important; in the wet season drainage will get priority while in the dry season, conservation of sweet water inside the polder becomes the predominant factor. The seasonal water management plan must therefore emerge covering the polder as a whole and on the basis of the requirements of all water users. The plan will have to be prepared jointly by the BWDB's O&M offices, the leaders of WMGs / WMAs, and DWM of BWDB. Draft water management plans will be drawn up at the user level, i.e., at WMGs (Figure 5.5, Planning Procedure); these will be combined into water management plans at WMA (Sub-Division level). In large polders the plans will be compiled by the Executive Engineer (in support and cooperation of the WMF- if it exists) and DWM to produce the final WM plan. This needs to be prepared well ahead of the cropping season so that critical farm operation (e.g., seed bed preparation, fish and shrimp or salt production requirements) can be carried out in line with the plan.

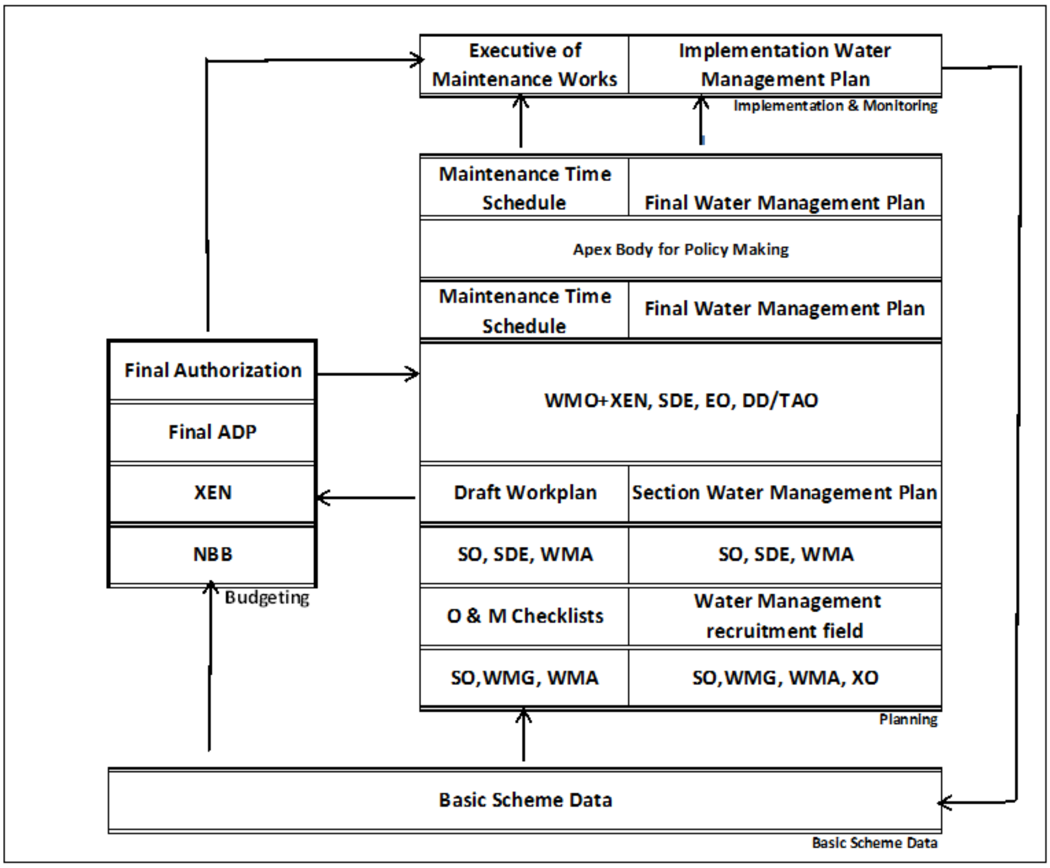


Figure 5.5: Standard Planning Procedure

Note:

DD	Deputy Director
TAO/UAO	Thana/Upazila Agriculture Officer
BS	Block Supervisor

189. For other Abbreviations see FIG: Relationship between WMGs and LGIs

190. Inputs required for the WM plan includes information on cropp calendars and cropping pattern to be formulated by the farmers in consultation with agricultural and fisheries extension services, DWM and BWDB's O&M staffs. Together with information on the system (Basic Polder data, O&M guidelines, Design details, etc.) and status of the system (Monitoring data, O&M checklists, Maintenance work plans, and Maintenance time schedules) a detailed water management plan will be drawn up. In large polders, there will be water management model for use as an important tool in the planning process. The models can be used to compute several water management scenarios and the effects of certain measures (e.g., extra regulators, early drainage or flushing.) can be simulated. The model can also be used to develop weekly operation targets and may become a very useful tool in the day-to-day management of large polders. Specially trained staff will be required for such advanced calculation. In fact the WM Plan is a formal agreement between the BWDB's O&M offices and the water users' platforms (WMG or WMA) ensuring the operational services to be provided. Once the WM Plan is finalized, information can be passed on to other agencies through the apex body of the beneficiaries so that necessary adjustments can be made to accommodate other national programs, work plans, etc.

(b) Weekly Operation Targets:

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

(c) Day-to-Day operation:

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

5.9.3 Maintenance Works

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

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

(i) Preventive or Routine Maintenance;

(ii) Periodic Maintenance;

- Minor Periodic Maintenance
- Major Periodic Maintenance

(iii) Emergency Maintenance;

(i) Preventive or Routine Maintenance

194. 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.

The preventive maintenance works have been spelled out precisely in Table 5.10

(ii) Periodic Maintenance

195. 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.

196. 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 (CBs). However, in case of earth works at least 25% of the works should be allotted to LCSs. Both these types of periodic maintenance are summarized as under:

(a) Minor Periodic Maintenance Works:

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

(b) Major Periodic Maintenance Works:

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

197. The periodic maintenance works have been spelled out precisely in Table 5.11.

(iii) Emergency Maintenance

198. 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 advance planning of these kinds of works is not possible. **Table 5.10** indicates each type of emergency maintenance works.

Table 5.10: Types and Classification of Maintenance Works

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

Sl. No	Description of Maintenance Works	Implementation Mode									
		Classification by Type of Maintenance			Community Based Functional Groups under WMOs						LCB
		I	II	III	EMG	ES	CMG	SMG	LCS	PIC	
11	Brushing cheeped or loose paint rust on metal parts; and painting	√						√	√		
12	Patching minor damages or minor brick		√								√
13	Replacing rubber seal of gate, positioning		√					√			√
14	Repairing or replacing damaged metal works /hinges, lifting devices for flap or Vertical sliding gates		√					√			√
15	Repair defective block works(aprons)		√								√
16	Replacing stop logs, flap gate or vertical		√	√							√
17	Repair headwalls, wing walls, aprons of		√								√
18	Protective Works Re-positioning/replacing of incidentally displaced blocks/ boulders /concrete frames, small repair to sand/gravel filter		√								√
19	Channels Cleaning khal and out fall drains and de- silting out fall drains	√					√				
20	Re-excavation of khal		√						√		
21	Removing cross dams (used as access roads, flashing bunds or water retention)		√			√					

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

(iv) Planning of Maintenance

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

200. 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 elementsoftheinfrastructurewhilethe O & M checklistshelpidentifythewater 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.

5.10 Project Cost

201. The implementation cost of the rehabilitation of Polder 15 is BDT 11,236 lac (112 crore 36 lac).

202. Need of Resettlement Action Plan (RAP)

203. The interventions proposed in Polder 15 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 such intervention of construction of retired embankments. It can therefore be concluded that no major resettlement may occur during project implementation. However, some minor resettlements may be needed as some households still exist over or adjacent to the polder periphery, which may be displaced during construction works. In this connection, a detail RAP investigation is required, which is being conducted by the consultants.

5.11 No Objection Certificate

204. Polder 15 is located in the Shymnagar Upazila under Satkhira District, covering Gabura Union Parishad (UP). No archeological sites or cultural heritages are known to exist in the union, 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 Parishad Chairman, which are attached in **Appendix D**. It is also noted that Polder-15 is located within the Ecologically Critical Area for which special clearance needs to be taken from National ECA Committee headed by the Secretary, MOEF (ECA Rules 2016).

6. ENVIRONMENTAL BASELINE AND EXISTING CONDITION

205. 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

206. Physical environment refers to the physical and chemical features of an area. It includes the climate, water, rainfall, wind, land, obtainable nutrients and all other natural resources within the area. The following sections provide analyses on different physical environmental features of the Polder-15.

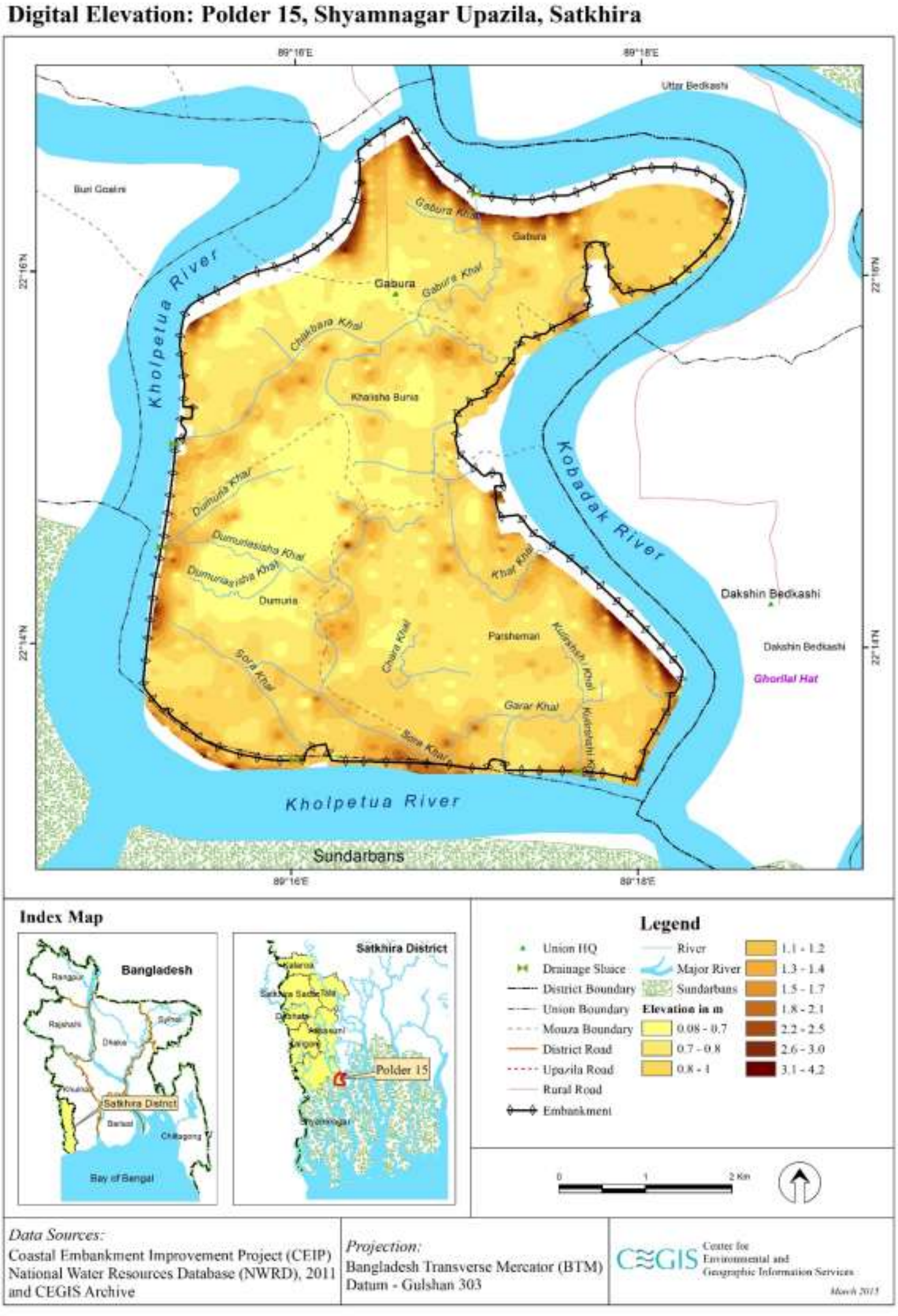
6.1.1 Geology

207. The Polder-15 is situated in a low-lying coastal region. From Spatial analysis, it has been observed that the polder is composed of Tidal Deltaic Deposit. The major portion of this deltaic sediment is deposited subaqueously in the permanent body of water where tidal waves and currents aid in the transportation and deposition. Typically low-lying deltaic environment comprises of soft sediments and are densely populated, and these regions are quite dynamic and changes in coastal geomorphology are quite rapid from impact of each cyclone.

6.1.2 Topography

208. The Polder area is located in the south-western 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 300x300m resolution, generated by the National Water Resources Database (NWRD). Analysis using Digital Elevation Model (DEM) infers that the Reduced Levels[6] (RLs) inside the polder vary from 0.96 to 1.90 m+PWD, with average RL of around 1.24 m+PWD. Map 6.1 shows the topography of the Polder area, identifying the rivers and categorizing land elevations.

[6] 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.



Map 6.1: Digital Elevation Model of the Polder area

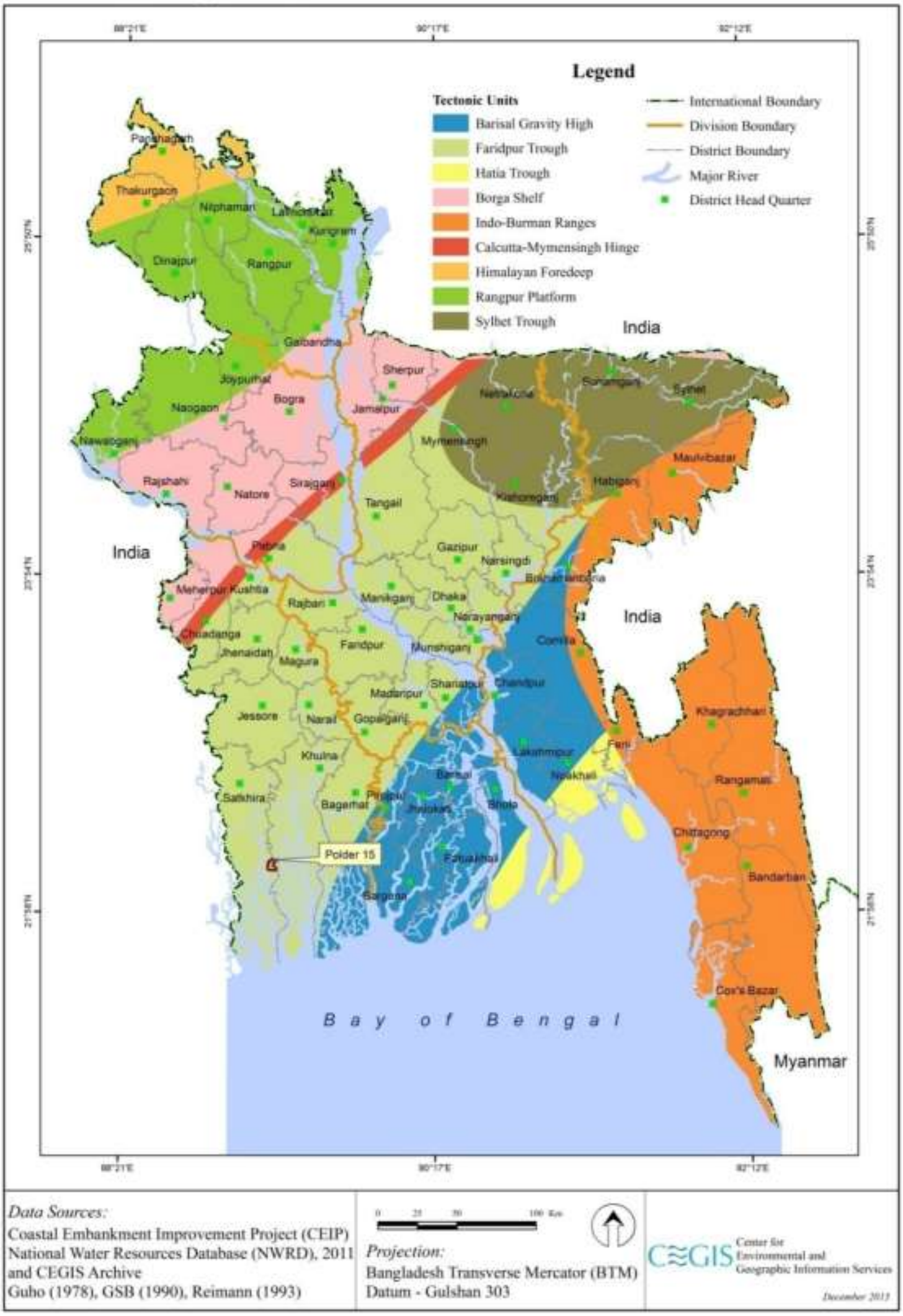
6.1.3 Seismicity

209. Geographical location of Bangladesh has made it ideally suited for natural disasters like earthquake. Tectonic framework of Bangladesh and adjoining areas indicate that Bangladesh is suited adjacent to the plate margins of India and Eurasia where devastating earthquakes have occurred in the past. Depending on the geological structure, Geological Survey of Bangladesh (GSB) has prepared a seismic zoning map of Bangladesh in 1979 dividing the country into three generalized seismic zones: Zone-I, Zone-II, and Zone-III (Map 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).

Moreover, the Polder- 15 is located inside the Faridpur Trough, which is situated adjacent to the Hinge Zone, and is characterized by a general gravity-low with the development of Neogene sequence. Map **6.3** below represents the tectonic units available in Bangladesh and the location of the Polder area. It can therefore be inferred observed that both in consideration of seismicity and stratigraphy, the Polder area falls on a relatively safer (seismically quiet and tectonically stable) side.

Map 6.2: Earthquake Zones of Bangladesh and location of Polder- 15

Tectonic Units Map: Polder 15



Map 6.3: Tectonic Units Bangladesh and location of Polder- 15

6.1.4 Land Resources

210. 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

211. Thirty agro-ecological zones (AEZs), 88 sub-regionsand 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 withGanges Tidal Floodplain AEZ-13.

AEZ 13: Ganges Tidal Floodplain

212. 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.

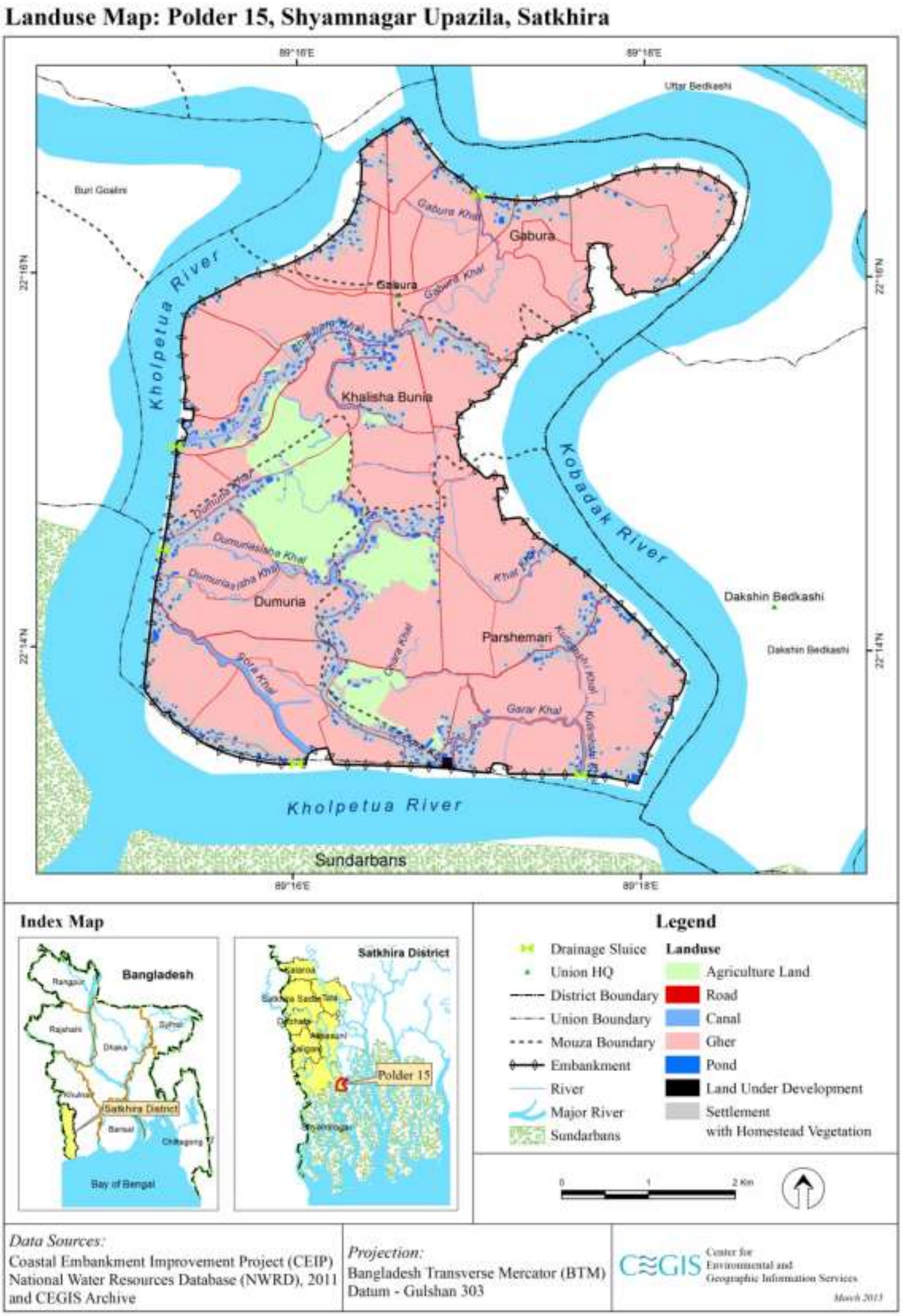
(b) Land use

213. 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 3,116 ha where Net Cultivable Area (NCA) is 2,442 ha (where 272 ha is being used for agriculture and remaining 2,170 ha is being used for shrimp culture) which is 79% of total gross area. The non-cultivable land is covered by the settlements, canals, embankment, roadsand ponds. The land use detailsof 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	272	9
Gher (Shrimp culture + crops area)	2,170	70
Canal	60	2
Embankment and Road	95	3
Pond	59	2
Settlement with Homestead Vegetation	460	15
Total	**3,116**	**100**

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006



Map 6.4: Land Use of the PolderArea

(c) Land Type

214. 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(CEGIS Assessment based on SOLARIS –SRDI; 2006).

(d) Drainage Characteristics

215. 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). In most cases, the land remains wet/ waterlogged for a considerable period of time after the rainy season.

(e) Available Soil Moisture

216. 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. The entire Polder area covered with low available soil moisture (CEGIS Assessment based on SOLARIS –SRDI; 2006).

(f) Soil Quality

217. Soil were collected from inside the Polder area at Kazipara (22°14'35.66"N, 89°15'30.07"E), Chandnimukha 9 no. Sora (22°13’19.36’’N, 89°16'24.72"E) and Kazibari 10 No.Sora (22°13’’59.29"N, 89°16'11.42"E) on 13th November, 2015 for analyzing chemical properties of soil. The existing cropping pattern is Fallow- HYV Aman-Fallow, Fallow-HYV Aman-Fallow and Fallow-Lt. Aman-Hybrid Boro at the soil sampling locations.

218. The samples were collected from top soil (depth: 0-15cm from surface) and analyzed for Electrical Conductivity (EC), Soil Reaction (pH), 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 EntomologyDivision, BARI, Gazipur. The result shows that organic matter content is very low to low. Soils are deficient in N and P status is very low to low. the status of S and K are very high and Zn is high to very high level.

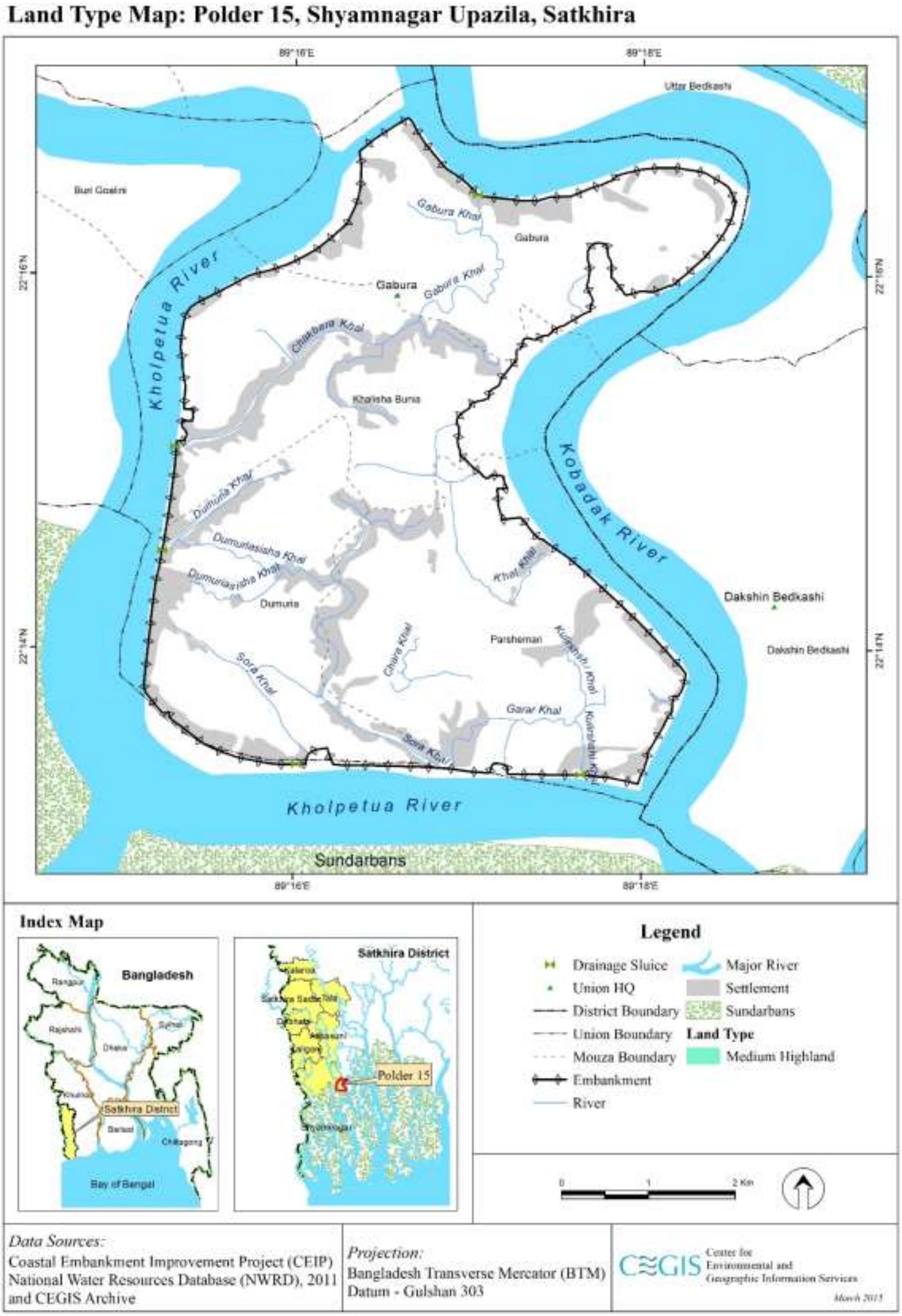
219. The soil salinity is found slightly moderately saline during the sampling period (November, 2015). The pH range varies from 7.7-7.8 among the soil sampling sites. The soil quality test result with methods by location is presented in Table 6.2.

Table 6.2: Chemical properties of soil on agriculture land

Parameters	Unit	Kazipara	Chandnimukha 9 no. Sora	Kazibari 10 No.Sora	Method
EC	ds/m	5.53	5.07	9.76	Glass Electrode
pH	-	7.8	7.8	7.7	Glass Electrode

Parameters	Unit	Kazipara	Chandnimukha 9 no. Sora	Kazibari 10 No.Sora	Method
OM	%	1.64	1.41	1.26	Wet Oxidation
N	%	0.09	0.08	0.07	Kjeldahl distillation
K	meq/100gm	0.58	0.50	0.69	Olsen/ Bray and Kurtz
P	µg/g	2.79	6.68	6.55	NH4OAc
S	µg/g	366.20	181.81	638.52	CaH2PO4 Extracting
Zn	µg/g	1.89	1.93	2.40	DTPA Extraction
Carbofuran	ppm	Nil	Nil	Nil	Thermo Electron &Pekin Elmer

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



Map 6.5: Land type of the Polder area

6.1.5 Climate

220. Climatic 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 climatic 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 climatic parameters are given in the following sections:

(a) Rainfall

221. Rainy season is very nominal in the Polder area in comparison to the other region of the country. Values of monthly maximum and average cumulative rainfalls are collected from the BMD station of Satkhira (1983-2013). The collected data are shown in Figure 6.1 below. 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 30 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 occurs 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 maximum rainfall as observed during the months of June (688 mm) and January (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 January (3.74 mm) respectively.

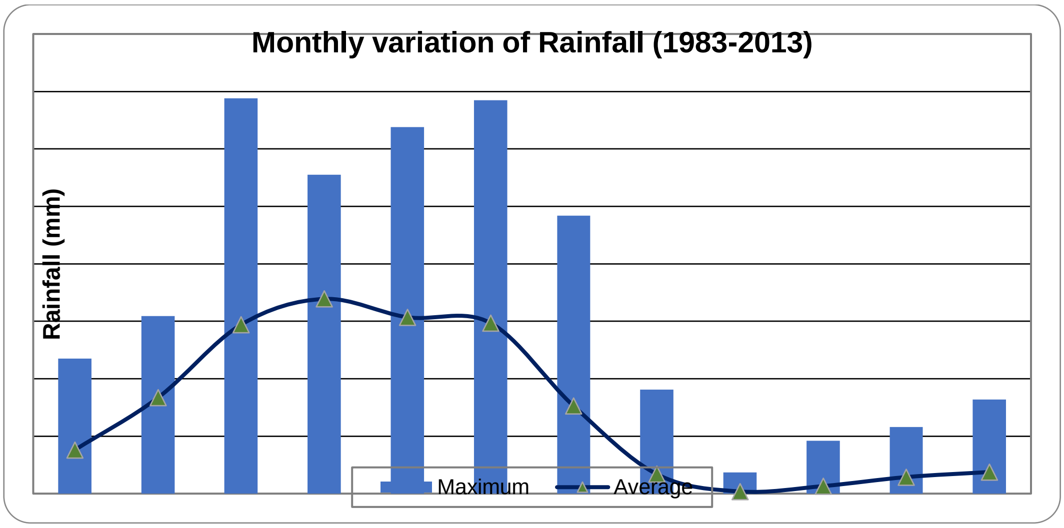


Figure 6.1: Monthly maximum and average rainfall at Satkhira BMD station

222. The historical trend analysis of annual rainfall of last 30 years (1983-2013) shows a decreased trend, which indicates that the amount of yearly rainfall is decreasing with respect to time. **Figure 6.2** reflects the rainfall trend of the Polder area and it is observed that decreasing of annual rainfall by 3.537 mm per year.

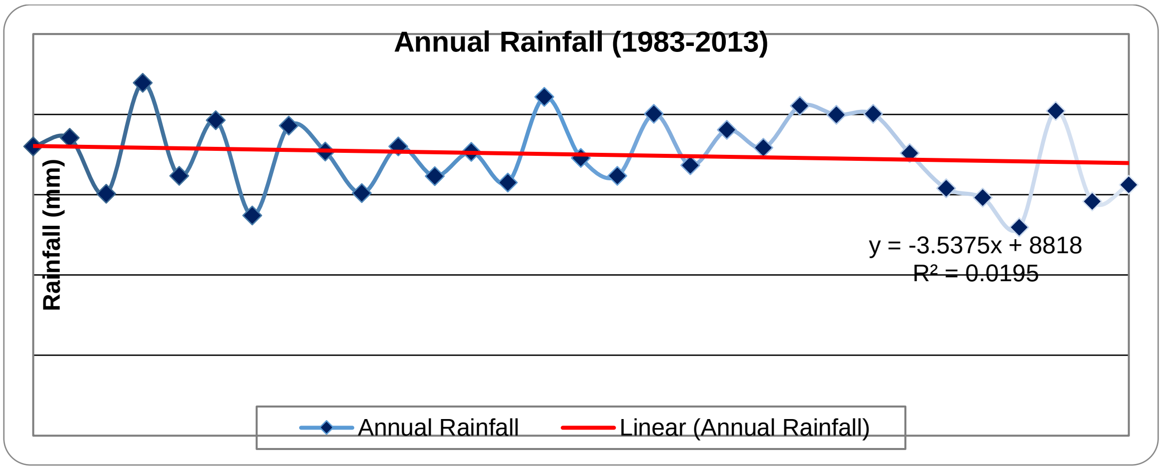


Figure 6.2: Annual rainfall (mm) trend in the Polder area

(b) Temperature

223. . Temperature data of last 30 years (1983-2013) from the BMD station shows that the monthly maximum average temperature varies from 27.55°C (January) to 37.29 °C (April), and April is the warmest month where as the 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. The highest maximum temperature ever recorded in the last 30 years was 37.29°C, which is occured in the month of April, 1992 while the lowest ever recorded minimum temperature is 10.38°C, recorded in the month of January, 1989. Values of monthly maximum and minimum of average temperature are collected from the BMD station of Satkhira (1980-2013). The monthly maximum and minimum temperature of last 30 years (1980-2013) are shown in **Figure 6.3**

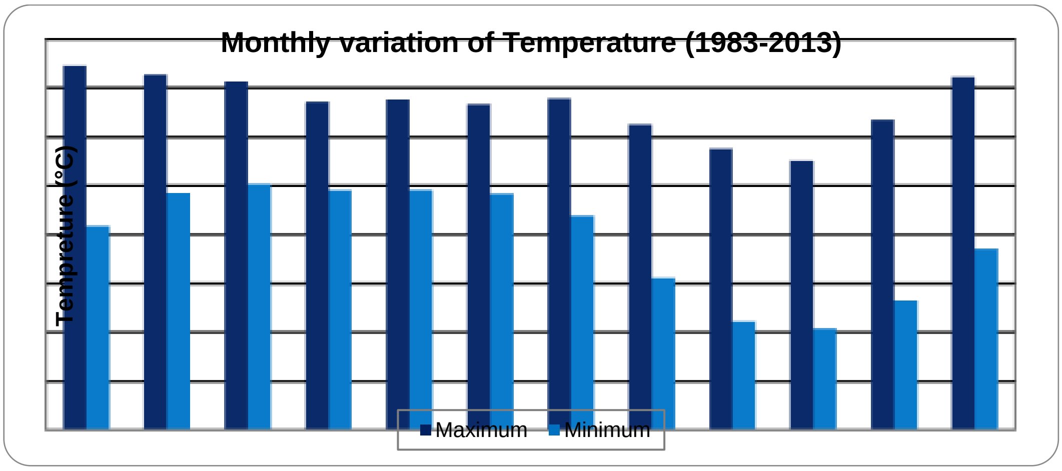


Figure 6.3: Average monthly maximum and minimum temperature at Satkhira BMD station

(c) Relative Humidity

224. 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.

225. **Figure 6.4** shows that monthly average relative humidity in the Polder area varies seasonally from 68.69% (March) to 85.83% (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 from 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 data are collected from BMD station of Satkhira for the last 30 years (1983-2013) and is shown in **Figure 6.4**.

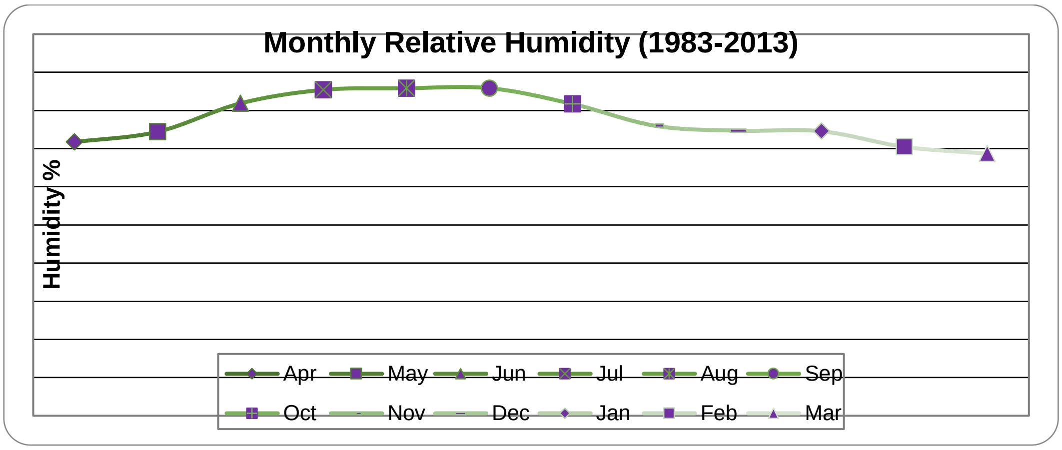


Figure 6.4: Monthly average relative Humidity at Satkhira BMD station

(d) Wind Speed

226. Historical data on wind speed for the last 30 years (1980-2013) has been collected from the BMD station at Satkhira. The monthly average wind speed in Satkhira region varies from 3.13 to 7.61 km/hr. The variation of monthly average wind speed is shown in **Figure 6.5** below. The figure shows that the average speed of wind is highest in April (7.61 km/hr) and lowest in October (3.13 km/hr).

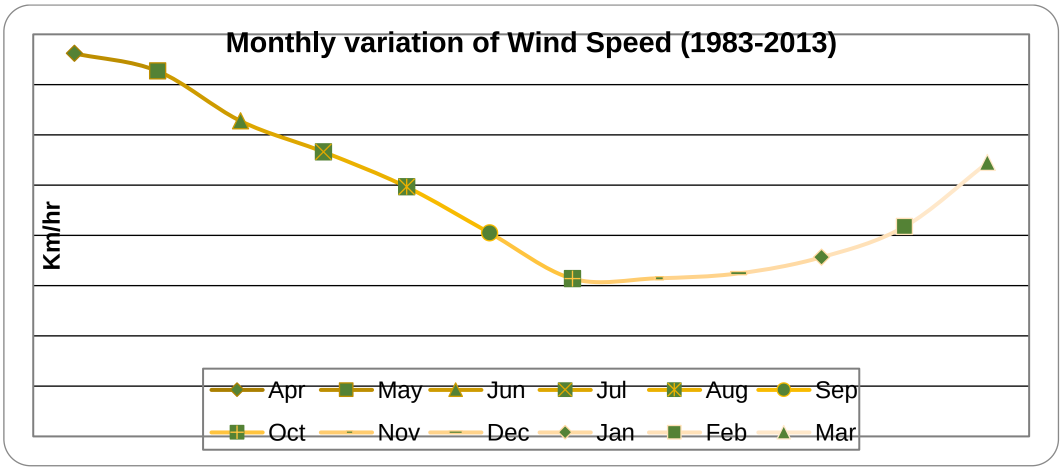


Figure 6.5: Monthly variation of average wind speed at Khulna BMD station

(e) Sunshine Hours

227. The data for sunshine hours for the last 30 years (1983-2013) has been collected from the BMD station at Satkhira. The monthly average values of sunshine hours in Satkhira vary from 4.51 to 8.66 hour/day. The average value of sunshine hours is highest in April (8.66 hr/day) and lowest in July (3.88 hr/day). Figure 6.6 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.

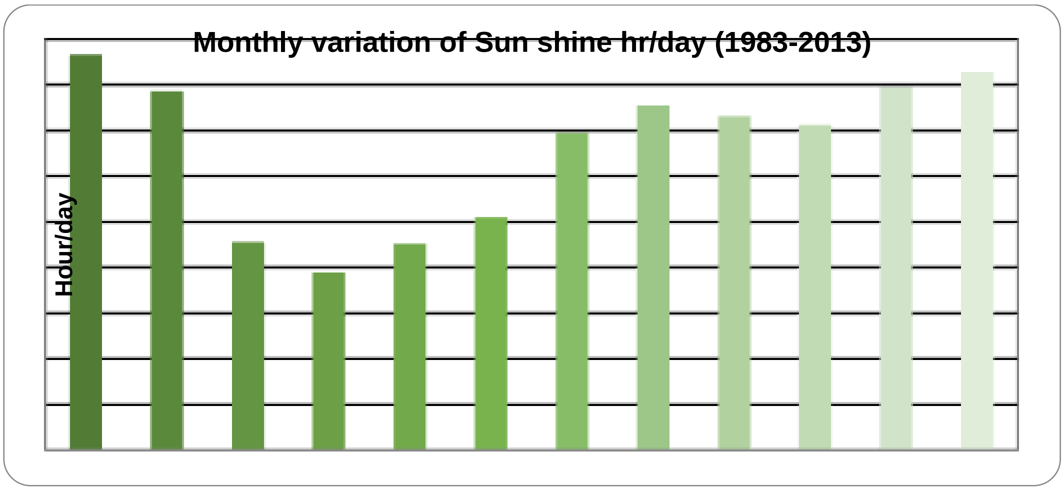


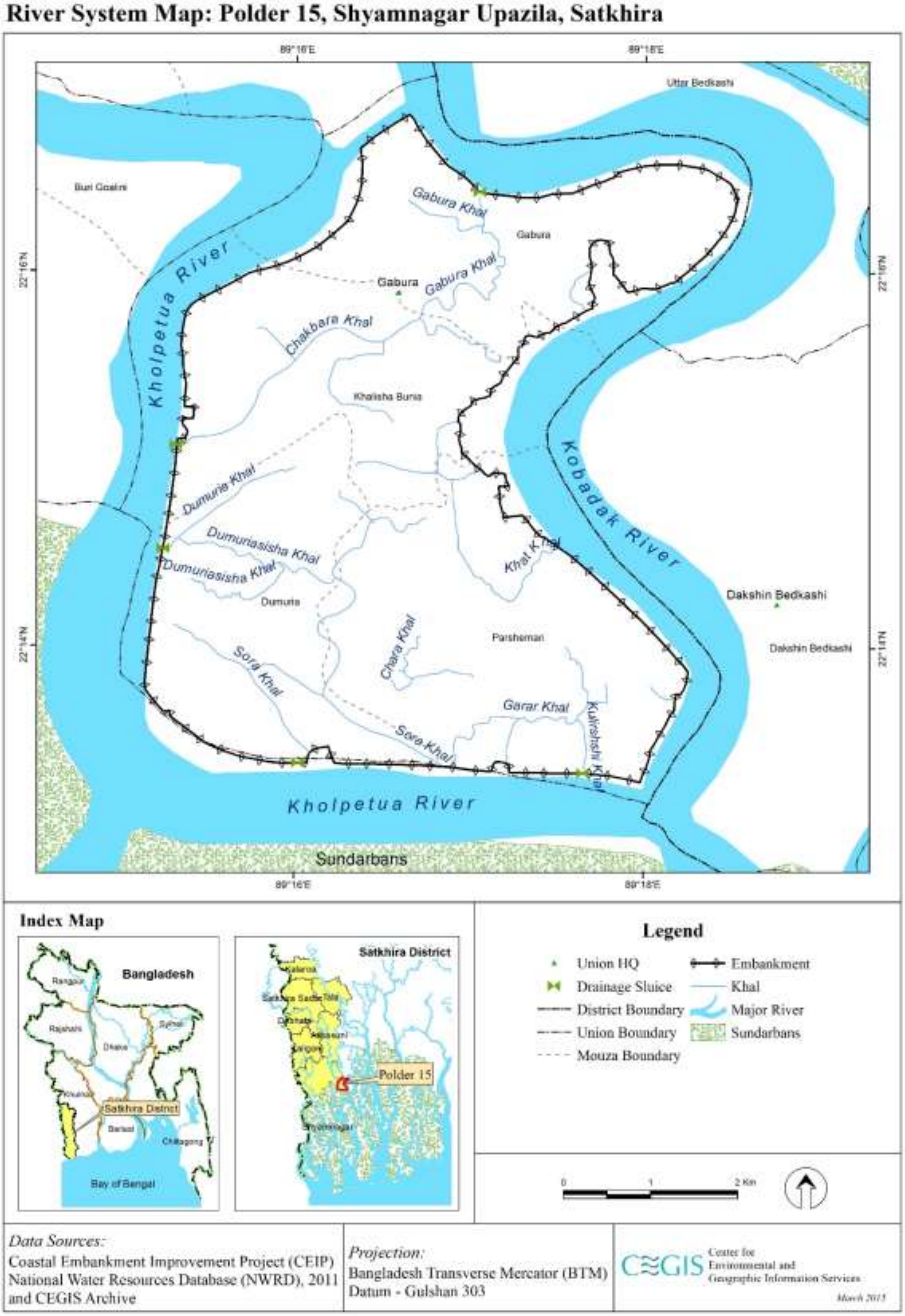
Figure 6.6: Monthly average sunshine hours per day at Satkhira BMD station

6.1.6 Water Resources System

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

(a) Major Rivers and Khals

229. Polder- 15 is surrounded by Kholpetua River to the west and south and Kobadak River to the east and north. The Kobadak and Kholpetua Rivers are to the north of the Sundarban Reserve Forest. Sundarban - the biggest mangrove forest and a world heritage of the World - is located at the southern and south-western boundary of the Polder. Kobadak and Kholpetua are the major rivers of the Polder. Besides numerous khals exist in the polder area namely Chakbara khal, Dumuria khal, 9 no Sora khal, Sora khal, Chadnimukha khal, Khulirshishi khal, Gabura khal, Khat khal, and Jaliakhali khal. All the khals are connected with the peripheral rivers of the Polder. The River system of the area is shown in **Map 6.6.**



Map 6.6: Water Resources System of the Polder

(b) Hydrological Connectivity

230. The main rivers of the Polder are Kobadak flows from north to south direction with having high tidal influence. The Kobadak River originates from Bhairab River at Chowgacha union in Chowgacha Upazila of Jessore District and flows to the northern and eastern portion of the polder and its outfall is at Kholpetua River by the side of south-eastern corner of the polder. Another major river of the Polder Kholpetua originates from the Betna River at Budhhata Union in Assasuni Upazila of Satkhira District which flows to the western and southern portion of the polder and its outfall is at Arpangasia River in Koyra Upazila of Khulna District. The internal khals as mentioned above are connected with peripheral the rivers of the Polder. Both the rivers and khals are perennial in nature having high tidal influences throughout the year.

6.1.7 Hydrological Settings

(a) Surface Water Levels

231. To assess the surface water characteristics of the Polder area, data on surface water levels for the Kobadak River 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 at south-east of the polder opposite river bank. But, there is no station of BWDB around the Polder of the Kholpetua Rivers to assess the surface water characteristics for the rivers.

232. Secondary information on water levels have been collected from the above mentioned BWDB station from the year 1980 to 2009 for the Kobadak River. Figure 6.7 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).

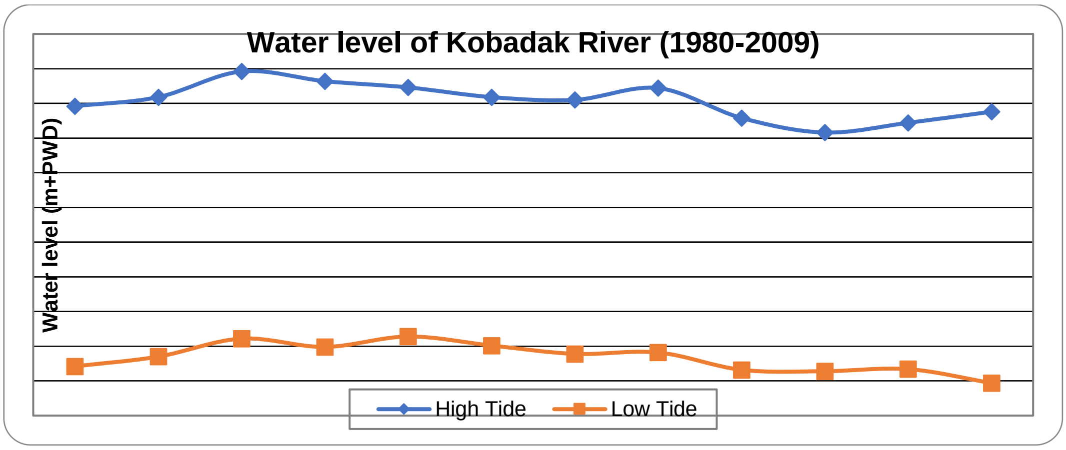


Figure 6.7: Surface Water Level of Kobadak near Polder area

Photograph 6.1: Kobadak river at Parshemari

Photograph 6.2: Kholpetua River at Dumuria

(b) Groundwater Table

233. There are no observation wells of BWDB inside or outside of the Polder to assess the ground water table (GWT). During field visit, it was observed that few deep tube-wells exist in the Polder, which are about 600-800 ft in depth, installed by NGOs. But the numbers of the deep tube-wells are insufficient for drinking water facilities of the Polder area.

6.1.8 Water Resources Issues and functions

(a) Tropical cyclones and Tidal Storm Surge Flooding

234. Tropical cyclones are major threat to the coastal polder areas. The most devastating cyclone that struck the Polder was Aila. 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 Satkhira and Khulna districts suffered the heaviest damage.

235. Aila made landfall with sustained winds between 65 and 75 mph (105 and 120 km/hr), it brought with a deadly storm surge 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 entered the Polder also by overtopping and breaches of the embankment along Kobadak River and Sakbaria River at several locations.

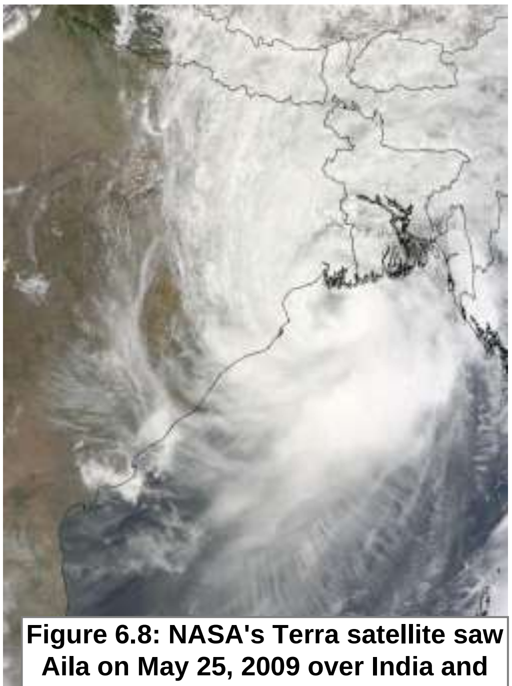


Figure 6.8: NASA's Terra satellite saw Aila on May 25, 2009 over India and Bangladesh (Image Credit: NASA/MODIS Rapid Response)

236. At present, the flood control embankment of the Polder is 30.78 km. Most of the segments of the embankment are in vulnerable condition especially at Jalakhali, Parshemari, Chandnimukha, 10 no. Sora, Chakbara, Dumuria, and Gabura of the polder. Local people stated that during Aila the segments of the embankment at the mentioned locations were damaged severely and surge water entered into the Polder by overtopping and breaches at several locations. They opined that during high tide, surge water reaches the edge of the present crest of the embankment and sometimes it is overtopped. Moreover, about 70% 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 surgethat may occur in the future.Besides, there are numbers of unauthorized hand tube-wells installed through horizontal boring pipe on 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 possibly gives rise to breaches during hide tide surge and cyclone.

Photograph 6.3: Worst condition of embankment near Chakbara

Photograph 6.4: Vulnerable condition of embankment near Jalakhali

(b) Drainage Congestion and Water Logging

237. Drainage congestion is another problem of the Polder area. According to the local people, drainage congestion and water logging problem exists in the Polder area because of gher practices or shrimp culture over the year. There are only 5 numbers of drainage sluices in the Polder for drainage. During field visit it was observed that four of the structures were in damaged condition, one of them was found in functioning condition which was constructed by BWDB in the year of 210-2011. During high tide, water enters into the polder through the malfunctioning structures connected to the khals. It is observed that about 70% 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 places here and it takes 3 to 5 days to drain out the excessive water. The four numbers of damaged drainage sluices need to be replaced with provision for drainage and flushing as per CEIP design for smooth drainage of the Polder. Besides, the connecting khals of the drainage sluices are silted up and needs to be excavated as per CEIP design for efficient drainage within the Polder.

(c) Erosion

238. River bank erosion is one of the major problems of the Polder. Erosion takes places along the Kholpetua and Kobadak River. There already exists slope protection works at several segments of the embankment to protect from bank erosion. Local people stated that during high tide erosion occurred at the river bank, as a result the set back distance from the embankment is decreasing day by day and eroded embankment in some segments needs to retire. To protect the Polder, slope protection work at several segments of the embankment and bank revetment works are needed.

(d) Navigation

239. The peripheral rivers around the Polder are predominantly used for water-way navigation. Small boats and trawlers navigate through the rivers mainly for fishing purposes and carrying goods. Many fishing boats navigate in the Kobadak River and Kholpetua River and also go inside Sundarban for fishing and others purposes. There are two ghats for crossing the river namely Nildumur kheya ghat on Kholpetua River and Pareshemari kheya ghat on Kobadak River. A nominal navigation takes place inside the Polder area where only fishing boats ply through the khals.

Photograph 6.5: Fishing boat rowing on the Kobadak River

Photograph 6.6: Pareshemari kheya ghat on Kobadak River

Photograph 6.7: Fishing boat rowing on the Kholpetua River

Photograph 6.8: Nildumur kheya ghat on Kholpetua River

6.1.9 Environmental Quality and Pollution

240. This section provides a baseline scenario on the environmental indicators, i.e., water quality and noise level of the Polder area. The values of these environmental parameters are collected during field visit in the Polder area.

(a) Air Quality

The national standards for air quality are given in **Table 6.3.**

Table 6.3: Standards of ambient air quality

Organization	Unit	Concentration of micrograms per meter cube				
		PM_{10}	$PM_{2.5}$	BC in $PM_{2.5}$	SO_2	NO_2
BNAAQS	24h average (μg/m³)	150	65	-	365	-
	Annual (μg/m³)	50	15	-	-	100
WHO	24h average (μg/m³)	50	25	-	-	200

Organization	Unit	Concentration of micrograms per meter cube				
		PM_{10}	$PM_{2.5}$	BC in $PM_{2.5}$	SO_2	NO_2
						(1h average)
	Annual (µg/m^3)	20	10	-	-	40

Source: Bangladesh National Ambient Air Quality Standard

241. The air particulates matter (APM) concentrations of the Polder area were measured by collecting PM samples on Teflon filters using Air Metrics portable sampler and subsequent gravimetric analysis using microbalance. The concentration of black carbon (BC) in the fine fraction ($PM_{2.5}$) of the samples was determined by reflectance measurement using an EEL-type Smoke Stain Reflectometer. The NO_2 and SO_2 concentrations were determined using GENT sampler. The air sampling has been carried out for 1 day (24 hr) near the Polder at Betbunia near *kheya ghat* in Paikgacha upazila which is situated about 28 km to the north of the Polder, representing the air quality for Polder 15. The results are presented in **Table 6.4**.The values suggest that the concentrations of the measured air quality parameters ($PM_{2.5}$, PM_{10}, BC in $PM_{2.5}$, SO_2, NO_2) lie within the range of standard values of Bangladesh National Ambient Air Quality Standard (BNAAQS) as in **Table 6.2**. However, numerous boats driven by diesel engines ply on the surrounding rivers and numbers of motorcycles and light vehicles movement in the Polder area which is considered contributing to the ambient air especially to the relatively high measured value of Particulate Matter ($PM_{2.5}$).

Table 6.4: Values of ambient air quality parameters in the project area

Area	Air particulates matter concentration µg/m^3 (24h average)				(mg/m^3) (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

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 (Photograph6.9). Surface water quality of the Polder area is found satisfactory related to DoE standardexcept for EC, indicating slight saline conditions. Table 6.4 presents the values of the surface water quality with reference to the DoE standard of the Polder area.

Table 6.5: 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)	pH
Kholpetua River	Dumuria bazar	22°14'39.6"N 89°14'57.5"E	247	17	7.8	21.9	8.1
Chakbara Khal	Chakbara, DS-4	22°15'17.70"N 89°15'3.49"E	267	14	5.9	22.3	8.0
Kobadak River	Pareshemari kheya ghat	22°16'53.60"N 89°17'32.74"E	322	15	6.6	22.7	8.2
Gabura Khal	Gabura, DS-3	22°16'52.89"N 89°17'3.93"E	225	14	6.2	20.8	8.0
DoE Standard Value			***2100***	***-***	***4.5-8.0***	***20-30***	***6.0-9.0***

Source of surface water	Location	GPS point	Water quality parameter				
			TDS (ppm)	Salinity (ppt)	DO (mg/L)	Temperature (°C)	pH
	(Bangladesh)						

Source: CEGIS field survey, January, 2016

Photograph 6.9: CEGIS professional measuring water quality at field

242. **Salinity.** During monsoon the salinity levels are found to be very low because of the increased amount of fresh water in the water bodies which dilutes the salinity. 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 dry season in the month of January, the overall salinity levels in surface water was found moderate to high as 14 to 17 ppt (**Table 6.4**) and about 15-20 percent of the Polder area is affected. This happens because of the following reasons: (i) major portion of the polder area is under *gher* culture, (ii) saline water enters through gher owners' inlets and (iii) malfunctioning of sluices.

244. **Dissolved Oxygen (DO)** is an essential parameter for the metabolic process that produces energy for growth and reproduction of fishes and other aerobic aquatic biota. Decrease in DO values below the critical level of 3 mg/l causes death of most fishes and other aerobic aquatic organisms. During field visit in the month of January, values of DO inside the Polder was found to vary from 5.9 to 7.8 mg/L at four locations (Table 6.7) which complies with the DoE standards for both irrigation and fisheries as well as aquatic vegetation.

245. **Dissolved Oxygen (DO)** is an essential parameter for sustainingaquatic flora and fauna. Decrease in DO values below the critical level of 3 mg/L causes death of most fishespecies and other aerobic aquatic organisms.Thevalues of DO measuredinside the Polder varies from 5.9 to 7.6 mg/Lwhich complies with the DoE standards for irrigationand fisheries as well as aquatic vegetation.

246. pH. The hydrogen ion concentration of water is expressed by its pH value. A pH value of 7 indicates the neutral condition, neither alkaline nor acidic. The pH values found during field investigation are higher than the neutral zone (pH=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 were satisfactory compared with the DoE standard (pH=6 to 9).

247. **Temperature.** Temperature of water bodies affects the fish habitats and their oxygen holding capacity. During field investigation in the month of January, the temperature of the

water bodies inside the Polder area was found to vary from 20.8°C to 22.7°C, which complies with the DoE standard (20°C-30°C) for both irrigation and fish habitats.

248. Total Dissolved Solids (TDS). The values of TDS were found relatively low inside the Polder area, varied from 225 to 322 mg/l (**Table 6.4**) which may relate to low tidal effect. TDS values during field visit which were found to be within the limit and comply with DoE standards.

(c) Noise Quality

249. A number of suitable sites were selected within the Polder area for sound level measurements, considering some criterion in connection with sound generation (project interventions and other secondary activities) and places which are to be affected by any anomalies in sound level. The Environmental Conservation Rules 1997, of Department of Environment (DoE), Bangladesh has defined standard noise levels as **50 dB** during day time for residential area. The Polder area has fallen under residential area category and the noise level value was found within the standard limit. The noise level has been measured during daytime. The values of noise level (location wise) are shown in **Table 6.6.**

Table 6.6: Daytime noise levels of the Polder area

Sl. No	Location	GPS Reading	Values (dB)	Area Category by ECR'97
1	Kalibari	22°16'12.00"N 89°15'10.00"E	38.4	Residential area
2	Gabua bazar near bridge	22°17'14.22"N 89°16'22.85"E	38.6	Residential area
3	Gabura	22°16'52.89"N 89°17'3.93"E	41.5	Residential area
4	Chakbara	22°15'21.2"N 89°15'6.20"E	42.5	Residential area
5	Dumuria	22°14'39.6"N 89°14'57.6"E	46.3	Residential area
6	Jalakhali	22°16'19.47"N 89°18'21.54"E	36.4	Residential area
7	Chandnimukha	22°13'16.11"N 89°17'46.14"E	44.8	Residential area

Source: CEGIS field survey, November, 2015

(d) Soil Quality

250. Soil samples were collected from inside the Polder area at Kazipara (22°14'35.66"N, 89°15'30.07"E), Chandnimukha 9 no. Sora (22°13'19.36''N, 89°16'24.72"E) and Kazibari 10 No. Sora (22°13''59.29"N, 89°16'11.42"E) on 13th November, 2015 for analyzing chemical properties of soil. The existing cropping pattern is Fallow- HYV Aman-Fallow, Fallow-HYV Aman-Fallow and Fallow-Lt. Aman-Hybrid Boro at the soil sampling locations. The samples were collected from top soil (depth: 0-15 cm from surface) and analyzed Electrical Conductivity (EC), Soil Reaction (pH), Organic Matter (OM), Nitrogen (N), Potassium (K), Phosphorus (P), Sulphur (S) and Zinc (Zn) from laboratory of SRDI, Dhaka and pesticide residues (Carbofurane) from Entomology Division, BARI, Gazipur. The result shows that organic matter content is very low to low. Soils are deficient in N, P status is very low to low, the status of S and K are very high and the status of Zn is high to very high level. The soil salinity is found slightly moderately saline during the sampling period (November, 2015). The pH range varies from 7.7-7.8 among the soil sampling sites. The soil quality test result with methods by location is presented in **Table 6.7.**

Table 6.7: Chemical properties of soil on agriculture land

Parameters	Unit	Kazipara	Chandnimukha 9 no. Sora	Kazibari 10 No.Sora	Method
EC	ds/m	5.53	5.07	9.76	Glass Electrode
pH	-	7.8	7.8	7.7	Glass Electrode
OM	%	1.64	1.41	1.26	Wet Oxidation
N	%	0.09	0.08	0.07	Kjeldahl distillation
K	meq/100gm	0.58	0.50	0.69	Olsen/ Bray and Kurtz
P	µg/g	2.79	6.68	6.55	NH4OAc
S	µg/g	366.20	181.81	638.52	CaH2PO4 Extracting
Zn	µg/g	1.89	1.93	2.40	DTPA Extraction
Carbofuran	ppm	ND	ND	ND	Thermo Electron & Pekin Elmer

Source: CEGIS (Test from SRDI and BARI laboratory), December 2015; ND = Not Detected

6.2 Biological Environment

251. Polder 15 is located at south-west zone of the country experiencing diurnal tidal fluctuations and consisting brackish nature of vegetation and saline prone wetlands.

6.2.1 Bio-ecological Zone (BEZ)

252. The Polder occupies Bio-ecological zone 10 (Saline Tidal Floodplain). This BEZ 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 inside the Polder is prevented by embankments.

6.2.2 Ecosystem

253. Different land types, elevation from sea level, tidal influences and interventions by human activities created diverse ecosystem in the polder. Terrestrial as well as aquatic ecosystems of this Polder is described below.

a. Terrestrial Ecosystems

254. Terrestrial ecosystem of this Polder is categorized as:

- Homesteads,
- Crop fields and
- Embankments

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

256. There exists a small amount of rainfed aman paddy field at central area of this Polder. Moreover, homestead vegetable gardening also found to some extent in all the villages to meet vegetable demand of the home owners. This ecosystem performs food supply for human as well as fodder for other livestock. Details of cultivated crops are described in agricultural section of this report. Crop field contains lowest diversity of vegetation.

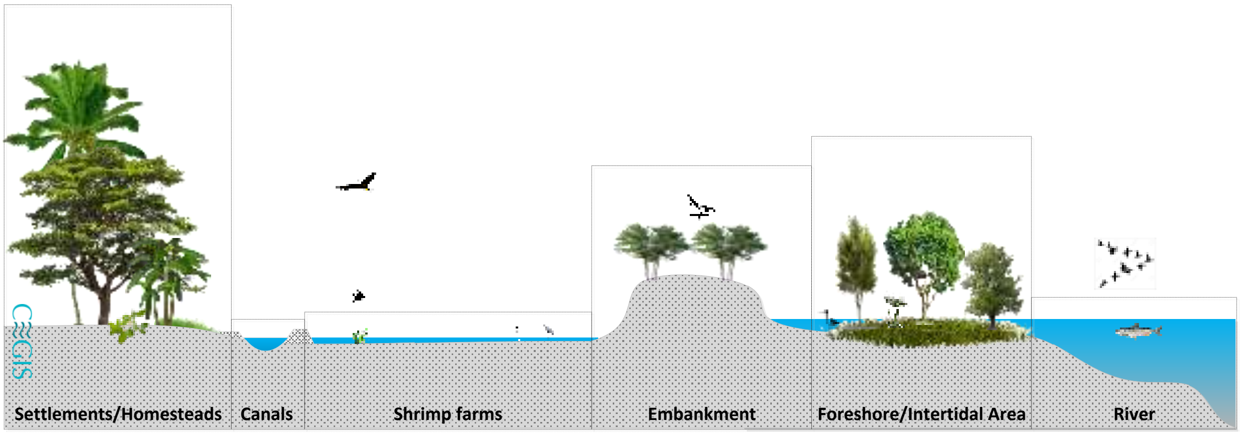


Figure 6.9: Typical ecosystems of the polder

257. Embankment is the isolator of foreshore and countryside habitats. In some sections of the peripheral embankment there is little vegetation due to low moisture holding capacity of soil and destruction of substantial parts by cyclone Aila in 2009. However, embankment of the Polder performs major communication facilities to the local people and support grazing ground for local avifauna.

b. Aquatic Ecosystems

258. The major type of aquatic ecosystem is shrimp farms that occupy most of the agriculturalland inside the Polder. This is actually a saline water wetland andis fragmented with numerous earthen dykes (Photograph6.13). Water control structures provideflushing facilities toshrimp 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.

259. 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 thehabitats are without any free floating or rooted floating vegetations. Canals act as migratoryroutes of river fishes, other aquatic animals and canals levees support media for mangrove plant succession.

Photograph 6.10: Vegetation pattern of a settlement at Jaliakhali Village surrounded by shrimp farms

260. The clayey land between peripheral embankment and river is inundated twice in a day is the intertidal/foreshore area of the Polder that supports scattered mangrove vegetation. This mudflat usually faces erosion and accretion by tidal actions of peripheral rivers (Kobadak and Kholpetua). This area is rich in benthos and creates ideal habitats for fishes, crabs, mudskippers, sandpipers and herons. Most of the foreshore area is now under plantation programme by Climate Resilient Ecosystems and Livelihood (CREL) Project. Foreshore vegetation acts as protector of embankment from tidal surge.

Photograph 6.11: Forseshore afforestation under CREL Project at Gabura 2 No. Ward

6.2.3 Floral Composition

261. Floral composition of this Polder depends on land elevation and tidal influence. The upland ecosystem as well as homestead vegetation is dominated by Coconut *(Cocos nucifera),* Date Palm *(Phoenix sylvestris),* Neem *(Azadichta indica),* and Jiga (*Lennea coromandelica*), Palm *(Borassus flabeliffer) and* Rendi Koroi *(Albizia saman).* Most of the homestead are barren or bare of undergrowth vegetation. There are some mangove species like Kewra *(Sonneratia apetala) and* Gewa *(Excoecaria agallocha)* are also sighted along homestead margines near the embankment. Extreme dryness of surface soil in dry season and saline saturation of sub soil disfavour plant succession in homesteads. For this reason, species richness and health of plant community is comparatively poor than other parts of the country. Vegetation density of this area have dropped down after innitiation of saline water shrimp farming 25 years ago. In addition, all types of planted and naturally generated undergrowth vegetation were severely damaged due to failure of peripheral embankment as well as being affected by tidal flooding and prolonged inundation by Cyclone Aila in the year 2009.

262. Embankment of this Polder is usually barren because most of the parts have been damaged by tidal surge and unsuitability of soil for growing plants.

263. Foreshore area of this Polder is dominated by Kewra (Sonneratia apetala) and Bain (Avecenia alba) trees. The undergrowth is dominated with Dhanshi (Proteresia sp). Marginal ridges/ ecotones of foreshore is exclusively dominated by Gewa (Excoecaria agallocha).

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

6.2.4 Wildlife Diversity

265. 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)*, Stripped Keelback *(Amphiesma stolatum)* are occasionally found on homestead platforms and also near water area. Garden Lizard *(Calotes versicolor)* and House Lizard *(Hemidactylus brooki)* are common among lizard. According to field discussion, no evidence of turtle inside the Polder is recorded in the last 15 years.

Photograph 6.12: Common avifauna of the Polder that depend on aquatic ecosystems

266. Avifaunal groups representhighest 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 occurred at homestead forest. Among the waterbirds, Great Egret, Indian Grey Heron preferred large shrimp farms at the southern portions of the Polder. Evidence of Wagtails are quite common at foreshore mudflats and shrimp ghers near the peripheral rivers. Common Sandpiper and Black Winged Stilt are also roaming along newly accreted mudflats, riversides or shrimp farms.

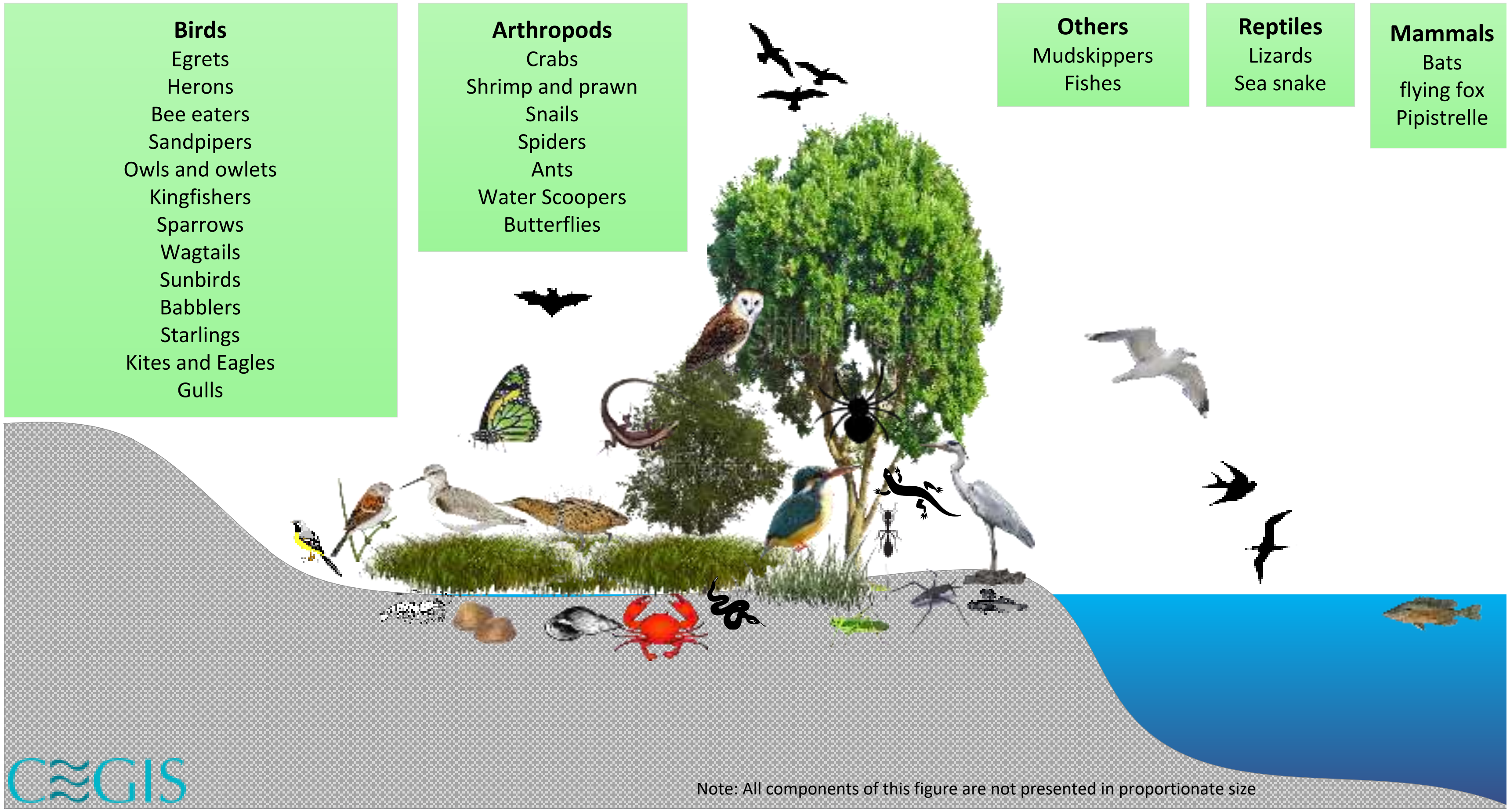


Figure 6.10: Major Faunal communities of foreshore ecosystem

267. Major groups of mammals include mongoose, mouse and bats. No large mammals exist in the study area due to lack of proper habitats. Common species are House rat (Rattus *rattus)*, Common mongoose *(Herpestes edwardsi)*, Indian flying fox *(Pteropus giganteus)* and Indian Pipistrelli *(Pipistrellus coromandra)*. Ganges River Dolphin, *(Platanista gangetica),* an endangered species, migrates round the year through Kholpetua and Kobadak Rivers.

6.2.5 Existence of important Habitat surrounding the Polder

268. Polder 15 is isolated from Sundarban Reserve Forest by Kholpetua River to its southern and south-western parts (Figure below). Moreover, foreshore area of this Polder has some small patches of mangrove plantations at different reaches. But these mangrove patches has very low density of Kewra and Bain trees, scattered tall grasses. The Polder falls within the Ecologically Critiical Area (ECA) of Bangladesh. Except this, no nationally or internationally designated habitat exists inside the Polder.

Figure 6.11: Satellite image showing Location of important habitats surround the Polder
(Source: Google Earth, Image Date: Jan, 2015)

6.2.6 Indicative flora and fauna

269. Embankment of the Polder acts as protector of tidal flooding/saline water intrusion and sluices act as drainage controller. Ecosystem patterns of this Polder have created accordingly. Homesteads and cropfields are dominated with freshwater loving plant species whereas khal banks and river foreshore are dominated with saline water loving /mangrove plant species. Kewra *(Sonneratia appetala)* and Gewa *(Excoecaria agallocha)* are the indicator species of this Polder those indicate saline water intrusion through khals/canals inside the Polder. Once upon a time, mangrove succession inside the Polder took place only along the major khal banks which are now sporadically found at homestead margins or even beside the shrimp farm dykes. This indicates the changes of vegetation composition of this area. Internal khals, ditches and homestead ponds were abounding with water hyacinth, water lettuce, etc.

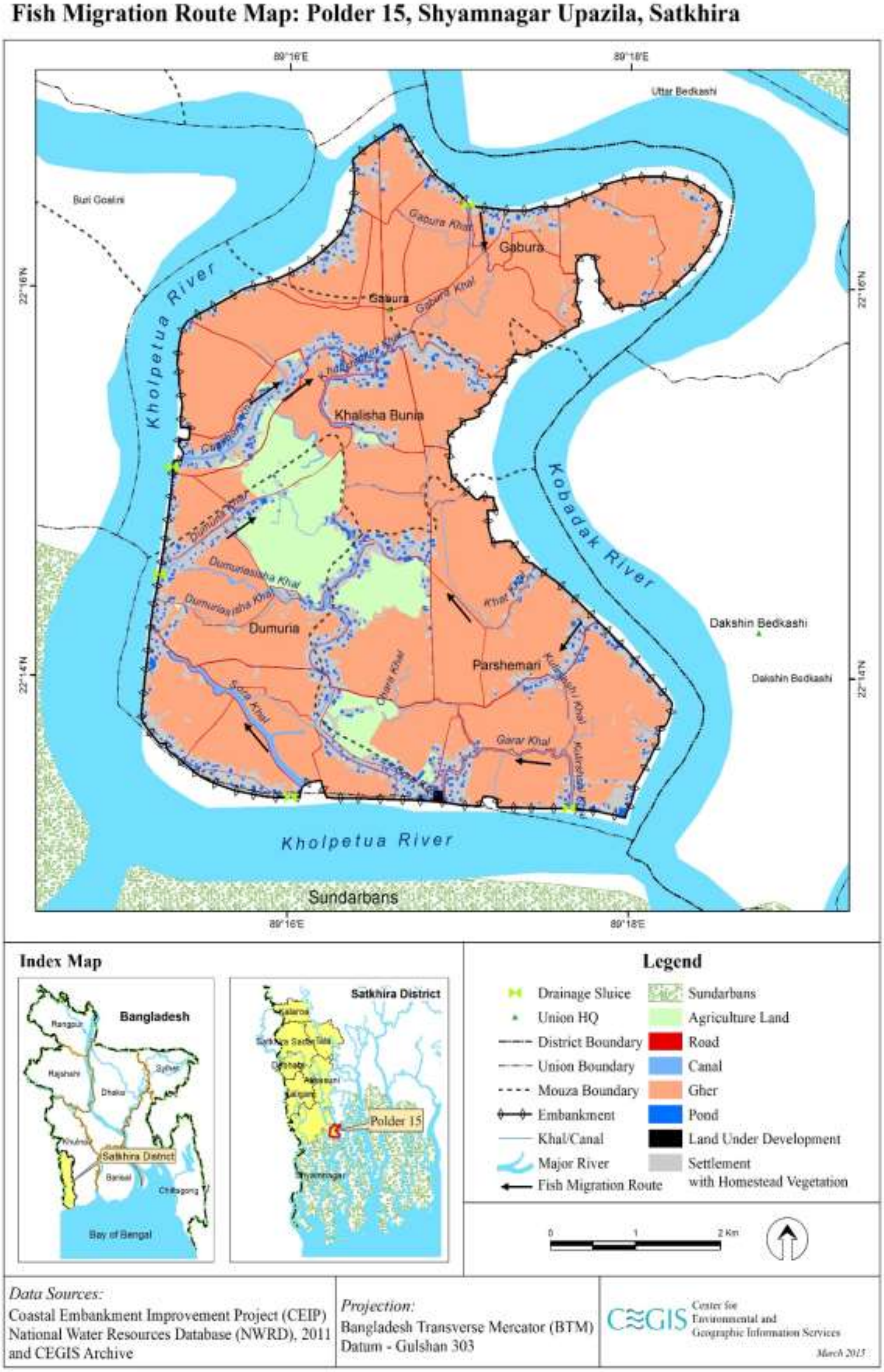
Accordingly fresh water snails and mussel were also found in most of the stagnant waterbodies. These species have become rare in the wetlands due to salinity intrusion in the Polder for shrimp culture and by being swept away by floods during the Cyclone Aila. Non-functionality of water control structures has triggered saline water intrusion that has negative impact on homestead vegetation as well. 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.

Photograph 6.13: Perkinsonia aculeata, locally known as 'Bilati Babla' fruit is edible and neddleshaped, used to be indicator plant of southwest Polders of Bangladesh now rarely found

(Photo taken from Parshemari Village)

6.2.7 Fish Habitat

270. Polder 15 is located at Shymnagar Upazila of Satkhira District. The Polder is bounded by Kobadak River to the east and north, Kholpetua River to the south and west. Sunderbans, the one of the largest mangrove forests of the world is located at southern boundary and part of western boundary of the polder Fish habitats of the Polder area are classified into capture fisheries habitats and culture fisheries habitats.. Capture fisheries habitat include mainly internal khals (**Map 6.7**). Among these Sora *khal, Khulirshahi khal, Khat khal, Dumuriasisha khal, Gabura khal, etc.,* are important with respect to fisheries habitat. There are some water bodies which were created during Aila and linked with internal khals. The culture fishery of the Polder area is dominated by Bagda gher and occupy most of the cultivable area of Polder. The number of culture ponds is reported as negligible.



Map 6.7: Fish habitat in the study area

Capture fisheries

271. Fish habitat in the Polder area is 2,289 ha of which 60 ha is capture fish habitat (**Table 6.8**). Capture fish habitat mainly consists of a number of seasonal and perennial canals/khals. Although peripheral rivers and tidal floodplain influence fish migration as well as fish production inside the Polder, the peripheral rivers and tidal floodplain has not been considered for fish production estimation of the Polder area.

Table 6.8: Fish habitat status of the study area

Fishery Category	Habitat Type	Area (Ha)
Capture	khal	60
	Sub-Total=	**60**
Culture	Bagda (shrimp) Gher	2,170
	Homestead pond	59
	Sub-Total=	***2,229***
	Grand Total=	**2,289**

Source: Image analysis and Field Survey, 2015

272. Average depth of internal khals is 1.5-2.5 m which is sufficient for fish habitation. Depth of seasonal canals of the study area is insufficient for sheltering fish juveniles due to over siltation in the canals. During field visit, it was observed and local people informed that embankment breaching due to Aila caused siltation in many sections of the khals.

(a) Perennial khal

(b) Khal linked with gher

Photo 6.14: Open water fish habitat

Culture fisheries

273. The estimated culture fish habitat is 2,229 ha (**Table 6.7**) of which *Bagda gher* is 2,170 ha. The *gher* occupy 97% of total fish habitat and the remaining 3% is homestead pond and khals. Although, every household has a pond but their size (upto 5-8 dec) is small. The ponds are mostly used for domestic purposes. During field visit, local people informed that the water quality of pond is still saline after Aila. Due to this reason, aquaculture practice is not expanding in the Polder area.

(a) Bagda gher (b) Homestead pond

Photograph 6.15: Fish pond in the Polder area

6.2.8 Habitat Quality

Water Quality

274. Some parameters of the surface water quality of periphery rivers and khals related to fish habitat suitability have been measured and presented in **Table 6.9**. From the measured data, it was observed that all water quality parameters are within the permissible limit for fisheries resources. The salinity in water bodies (both internal and river) was negligible during measurement taken in June. However, salinity will increase in the dry season.

Table 6.9: Water quality parameters of different water bodies in the polder area

Water bodies	Parameters				
	Temp (ºC)	pH	DO (mg/l)	TDS (ppm)	Salinity (ppt)
Periphery River	29	7.7	5.7	230	negligiblr
Internal Khal	30	7.8	5.2	70	negligible
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 - *M A. Mazid 2002 ** Jack M. et al, 2002(Water quality measured in last June, 2015) (to be incorporated)*

Role of Aquatic Vegetation for Fisheries

275. 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 arehabitats and spawning ground of fish and forinsects 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 areais 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.

6.2.9 Fish Migration and Movement

276. The fishes are migrating 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 sheltering ground of open water fishes. Fish species like *Chingri, Vetki, Pairsa, Khorsula,* etc., migrate horizontally to these water bodies

as part of their life cycle. Peripheral rivers along with internal 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.

6.2.10 Fish diversity

277. The study area is poor to moderate in fish biodiversity though the biodiversity of open water fishes has the declining trend over the years. Local people reported that more than 30 numbers of fish species are available in the area. Most of the fishes are from brackish water habitat. Brackish water fish species like *Chingri, Koral/Vetki, Pairsa,* etc., are commonly found in the internal *khal* and periphery river. There is no fresh water fishes in the Polder area due to salt water intrusion in the Polder area round the year for mal-function and damged water control structures as well as expansion of shrimp ghers. List showing the status of fishes of different habitat available in the study area is presented in **Table 6.10**.

Photograph 6.16: Composition of Fish Catch of the Polder Area

Table 6.10: 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	Kain 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
Scylla serrata	Kankra	H	H	NA
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
Ctenopharyngodon idellus	Grass Carp	NA	NA	L
Catla catla	Catla	NA	NA	L
Labeo rohita	Rui	NA	NA	L
Cirrhina mrigala	Mrigel	NA	NA	L

Source: Field Survey, 2015;

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

278. *Bagda* is the dominantly cultured shellfish/crustacean in the Polder area. During field visit, it is observed that about 85% of net cultivable area has been converted into gher where *Bagda Chingri* is cultured commercially round the year. It is mentioned that *Vetki, Pairsa* and *Khorsola* are also being cultured in the gher. Pond culture fish species mainly include *Rui, Catla, Mrigel, Tilapia, Silver carp* and *Grass carp,* etc. The local people reported that the productivity of carp's fishes in the pond is very low due to salinity in pond water.

6.2.11 Indicative Fish Species

279. Among the fish species found in the study area mentioned above, the major indicative and migratory fish species are Kaine Magur (Plotosus canius), near threatened in IUCN, Bangladesh; Bhetki (*Lates calcarifer*), not evaluated; Parshe (*Liza parsia*), not evaluated and Guli Tengra (*Mystus gulio*), near threatened. These species generally live in the brackish to saline water but during the spawning season they come to brackish to freshwater environment. The spawning season of *Lates calcarifer, Plotosus canius* and *Mystus gulio* range from March to August whereas *Liza parsia* breeds from November to February **(Figure 6.12)**. Usually these fishes enter into the Polder with the tide in drifting mode of migration during the life stages of hatchling to fry.

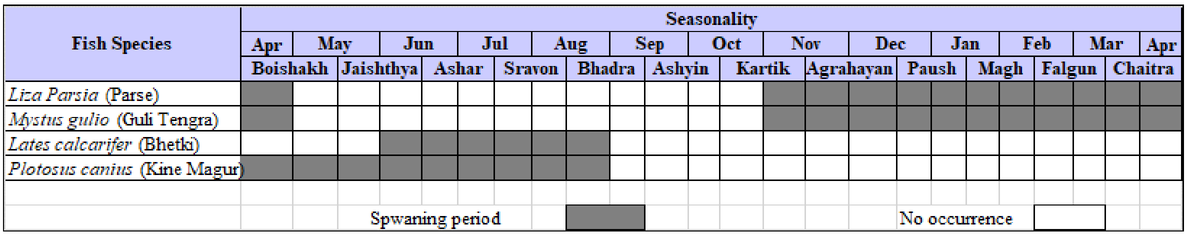


Figure 6.12: Seasonality of fish spawning

Table 6.11: Movement speed or velocity of indicative fish species

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

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

6.2.12 Threatened fish species

280. As per field investigation and consultation with elderly local people, threatened fish species in the Polder area are reported as locally rare and unavailable for last 10-15 years. Local people reported that there are no fresh water fish species in the natural water bodies

(khals) inside the polder. About 8-10 years back (*before* Aila), plenty of fresh water fishes like *Koi, Shing, Magur, Puti, Taki, Shol, Boal,* etc, were found in natural water bodies. Recently, these species are extinct/ disappeared locally. Regular saltwater intrusion in the Polder area due to Aila has caused the disappearance of fresh water fisheries from this area. Other causes are lack of water availability, loss of flow and water depth because of siltation, changing and modification of habitat pattern due to increasing of *gher* practices, etc.

6.3 Human and Economic development

6.3.1 Fish Production

281. The estimated total fish production of the Polder area is 2,008 metric tons (**Table 6.12**). Most of the fish production (about 99%) is from culture fisheries and very less (1%)from the capture fisheries. The *contribution* of capture fisheries is very low in the Polder area. After Aila, fish production trend of the capture fishery in the Polder area is decreasing extensively due to salt water intrusion in the Polder area round the year. Other reasons are indiscriminate fishing by illegal nets, siltation and low water flow in the internal khals, obstruction of fish migration route, etc.

Table 6.12: Fish Production from Different Habitats of the Polder Area

Fishery Category	Habitat type	Habitat Area (Ha)	Production (MT)
Capture	khal	60	5
	Sub-Total=	***60***	**5**
Culture			
	Bagda Gher	2,170	1,953
	Homestead pond	59	50
	Sub-Total=	***2,229***	**2,003**
	Grand Total=	**2,289**	**2,008**

FRSS and Catch Assessment Survey, CEGIS (2015)

6.3.2 Fishing Effort

Fishers numbers

282. The fisher's households in the Polder area include commercial and subsistence fishers. Local people reported that about 80% of households of the Polder are engaged in fishing. Among the fishers household, 60% households of the total fishers are professional/commercial fishers. They spend almost 20 hours of a day and 8-10 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 40% are subsistence level fishers. Local fishers informed that about 10% of commercial fishers have changed their occupation due to threat of being caught by robbers during fishing. Of the fisher's community, 95% fishers are Muslim and 5% are Hindu religion. There is no specific "Fishers village" in the Polder area. Most of the Hindu caste fishers live in *Jaliakhali* and *Khalishabunia* villages within the Polder. The socio-economic *condition* of the commercial fishers is poor to moderate. Most of them have fishing nets and trawlers/boats. The seasonal vulnerability of the fishers in the Polder area starts from late November and continue upto April of the next year. During this period, fish catch is hardly recorded due to the presence of more salinity in the surrounding water bodies (e.g. rivers and khals). Under these circumstances, 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 to other districts looking for short term jobs (e.g. day labor in brick field).

Fishing Season

Fishing season in the Polder area starts from April / May and continues up to December. Most of the fish is caught by different gears during late June to mid-November. The seasonality of major fishery and gear type is furnished in the **Table 6.13**.

Table 6.13: 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 | Medium | Low | No occurrence

Source: Field Survey, 2015

6.3.3 Fishing Crafts and Location

283. 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, Kusha*, *Dingi* fishing boats, etc. Some of the fishing boats in the Polder area are shown in the photo below 6.17.

Photograph 6.17: Fishing boat (*Kusha Nouka*) in the study area

6.3.4 Fishing Gear and Target Fish Species

284. Different types of nets/gears are used for fishing as mentioned in **Table 6.11.** Of the fishing gear, (a) Mono filament 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% of 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 6.18: Common fishing gear (*Jaki jal*) in the polder area

6.3.5 Fish Marketing and Post-Harvest Facilities

285. The local fishers sell bulk of their catch either directly to the local fish market or to fish depot. There are about 40 fish depot in the Polder area. There is no specific fish market (*arat*) present in this area. No structured fish landing centers are found near the Polder. Local fishers use Launch/ kheya ghat as temporary fish landing center. There is no ice factory in the polder area. Ice for fish preservation is collected from the *Shyamnagar* (*Satkhira*) and *Koyra Bazar* (*Khulna*). There are 3 numbers of dry fish (Chingri shutki) sheds locally called Khoti in the polder area. These *Khoti* are located at *Napitkhali* within the older. Mainly *Chingri* is dried in the *Khoti* through smoke process (traditional) in the sheds. Disease is the main restraining factor for the development of shrimp farming in the polder area. Most of the *gher* farming faces disease problems in every year. Local *gher* farmers reported that such type of disease is seen from mid March and continue upto May. There is no fish drying industry in the Polder area.

6.3.6 Fisheries Management

286. There is no government registered fisherman association (*Matshyajibi Somitte*) in the Polder area. The fishermen have full access to fishing on existing fish habitats. 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 in micro credit rather than extension services and aquaculture training. It may be mentioned that **Muslim Relief Bangladesh** a non-government organization helped the Aila affected fishermen through cash or providing net/boat for their rehabilitation. Enforcement of fisheries regulation is weak in and outside the Polder area.

6.3.7 Agricultural Practices

287. 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.

288. 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.

289. 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.

290. In Rabi season, only Hybrid/Boro rice is grown in the polder area. However, there are occasional overlaps such that the Kharif-II season crops Hybrid/Boro rice is harvested in Rabi season.

6.3.8 Present Cropping Patterns

291. 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 rainfail situation in the rained areas. The dominant cropping pattern in the medium high land is Fallow-HYV Aman-Fallow which occupies about 73% of the NCA. Detailed cropping patterns by land type are presented in **Table 6.14.**

Table 6.14: 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	5	2
	Fallow	HYV Aman	Fallow	199	73
	Fallow	Lt.Aman	Fallow	68	25
Total				**272**	**100**
Cropping intensity = **102%**					

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

Photograph 6.19: Aman rice field in the polder area

Photograph 6.20: Aman rice harvesting in the polder area

292. In the Polder area, following crops varieties used by the farmers which are presented in the **Table 6.15**.

Table 6.15: Varieties cultivated in the Polder area

Crop	Varieties
Lt. Aman	Patnai, Shadaghati, Boyer boat and Moriceshail
HYV Aman	BR 11, BR 23, BRRI dhan 30, BRRI dhan 49, BRRI dhan51, BRRI dhan52

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

6.3.9 Cropping Intensity

293. Cropping intensity is the number of times in percent a crop is planted per year in a given agricultural area. It is the ratio of effective crop area harvested to the physical area. The cropping intensity of the Polder area is 102%.

6.3.10 Cropped Area and Production

294. Total cropped area is 277 ha which occupied only rice. Aman rice are commonly grown in the Chakbara, Dumuria, Chadnimukha and Lakshikhali and Boro rice is grown in Dumuria and Lakshikhali in the Polder area.

295. Total crop production is 779 metric tons which comes from only the rice crop (Table 6.9). Among the rice crops the contributions of HYV Aman are dominated which is about 89% and only 3.5% production is covered by the Boro rice. Detailed cropped area presented in the **Table 6.16**.

Table 6.16: Present cropped area, yield and production of the Polder area

Crop name	Crop area (ha)	Yield (m. tons/ha)	Production (m. tons)
Lt. Aman	68	2.01*	137*
HYV Aman	204	3.02*	615*
Hybrid Boro	5	5.03*	27*
Total	**277**		**779***

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

6.3.11 Crop Damage

296. The scenarios of crop damage during 2010-2015 is presented in Table 6.16. . About 20% field crops (Lt. Aman) were damaged in the year 2010 by natural calamities (heavy rainfall). From the 2012 to 2015 HYV Aman rice damage increased gradually due to salinity. Salinity problem in Chadnimukha and Chakbara villages is increasing day by day due to fish farming specially shrimp culture (shrimp culture need saline water). The amount of damage caused by pest attack is now controlled because farmers use pesticide and ICM. Detailed crop damage is presented in **Table 6.17**.

Table 6.17*: Crop area damaged by different means and losses during 2010-2015*

Sl No.	Crops	Damage (%)	Year	Reason of damage
1	Lt. Aman	10	2015	Pests
	HYV Aman	20	2015	Salinity
	Hybrid Boro	5	2015	Pests
2	Lt. Aman	10	2014	Pests
	HYV Aman	12	2014	Salinity
	Hybrid Boro	7	2014	Pests
3	Lt. Aman	15	2013	Pests
	HYV Aman	10	2013	Salinity
	Hybrid Boro	5	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 field survey, November; 2015 and secondary data from local SAAO of DAE.

6.3.12 Agricultural Inputs

Seeds

297. Seeds have been an important role in the reproduction and spread of all plants. Plants are the foundation of human diets across the world. Selection of seeds is very important for growing crops and germination percentages, disease infestation and yield quality is the main considering criteria of selection. Most of the farmers used their own seeds for high germination rate as well as good production. in case of local variety such as Lt. Aman and HYV Aman but hybrid Boro Rice and some HYV Aman seeds are provided by different seed companies. There are five private seed dealers in the Polder area. Farmers usually do not follow the recommended dose of seeds.

Fertilizers

298. Fertilizer is the vital inputs for crop production and maintaining 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 in local dealer shop but price is very high. The Polder farmers used chemical fertilizers such as Urea, TSP, MP and Gypsum (for neutralize the salinity) in different crops. They don't consider the recommended dose and other factors of fertilizer application. Urea used in higher than other chemical fertilizers. Farmers did not use organic manure or compost **(Table 6.18).**

Table 6.18: Fertilizer, pesticide and seed used within Polder 15

Crops	Seeds used / ha (kg)	Fertilizer/ha (kg)					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	100	60	50	0	8	0	0	600-700	90	4500
HYV Aman	45	180	115	80	0	15	0	0	1000-1100	90	4500
Hybrid Boro	15	210	140	120	0	15	0	18750	1300-1500	90	4500

Sources: Field information; November, 2015

Pesticides

299. Pesticide use in the crop production has harmful effects for both human and environment, after that farmer can use pesticides to control pests. The use of pesticides depends on the degree of pest infestation. All farmers (100%) applied pesticides in all crops such as T. Aman (Local), T. Aman (HYV) and hybrid Boro Rice. The polder farmers applied pesticides two or three or more times. They used under or overdose pesticides and did not maintain proper timing of 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 were using 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)

300. In the project area farmers are newly practicing ICM about 10% of the crop cultivated area in the field. ICM activities areimplemented 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

301. Labor is one of the most important inputs in agricultural production. How it is measured and valued is critical for establishing the cost of producing agricultural commodities and accurately portraying labor's relative share of the total cost of production. In the Polder area, without tillage most of the cultural practices for crop production are being done 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 number of labors used in the Polder area is presented in **Table 6.19**.

Table 6.19: Average number labors used in the Polder area

Sl. No.	Crop name	Labor(No/ha)
1	Lt. Aman	150
2	HYV Aman	165
3	Hybrid Boro	180

Source: CEGIS Assessment from field information, November 2015

Irrigation

302. Irrigation is provided mainly in HYV Boro crops in the Polder area. Irrigation coverage of the Polder area is only about 2% (5 ha) of the total NCA during the dry season. Surface water is being used for irrigation. Sora Khal, Khat Khal, Dumuriasisha khal, and Chakbara Khal are the main sources of surface water irrigation. Low Lift Pump (LLP) is used for lifting water for irrigation. Farmers also use some manually operated irrigation implement like DTW, Seuti, Don. etc., which cover only 10% of the irrigation land. But the availability of irrigation water has been declining due to siltation of the river and khals. Moreover, silted up khals are being used as gher in some area of the polder which cause less water availabel for irrigation facilities. Aman (Local) and HYV Aman are cultivated under rain-fed condition. Details of coverage area by irrigation is given in **Table 6.120**.

Table 6.20: Irrigational implement used in the Polder area

Sl. No.	Crop name	Irrigational Implement	Area (ha)
1	Hybrid Boro	Low Lift Pump (LLP)	4.5
2	Hybrid Boro	DTW	0.3
3	Hybrid Boro	Seuti, Dom	0.2

Source: CEGIS Assessment from field information, November 2015

6.3.13 Livestock and Poultry

303. Livestock and poultry, being essential elements of an integrated farming system, play an important role in the economy of the Polderarea. They providefood, income, employment and many other contributions to rural development. This region is vast in land, water and vast amount of livestock and poultry population. Livestock and poultry, being an essential element of integrated farming system, play an important role in the economy of Polder 15. 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 reduces poverty through generating income and employment. The numbers of livestock and poultry in the Polder area are presented in **Table 6.21.**

Table 6.21: Number of Livestock and Poultry of the Polder Area

Name of Livestock and Poultry	% of HH having Livestock/ Poultry in the Polder Area	Number of Livestock/ poultry in the Polder Area
Cow/Bullock	5	
Goat	45	
Sheep	7	

Name of Livestock and Poultry	% of HH having Livestock/ Poultry in the Polder Area	Number of Livestock/ poultry in the Polder Area
Duck	65	
Chicken	80	

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

6.3.14 Feeds and Fodder

304. The owners of the livestock population are facing problems with respect to non-availability of fodder and feeds during the months of 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 is buying by farmer as per need. The poultypopulation at family level survives by scavenging and generally no feed supplements are provided. However, at times kitchen waste becomes feed to the chicken and duck take their feed from the outside of the homestead area like ghers, ponds, canals, etc.

Photograph 6.21: Duck rearing in the Polder area

Photograph 6.22: Cow rearing in the Polder area

6.3.15 Livestock and Poultry Diseases

305. Productions of livestock and poultry are mainly constrained due to diseases and death of the population. Outbreak of disease is causing a considerable economic loss in livestock farming. Every year livestock population is affected by different diseases. Major livestock diseases are Foot and Mouth Disease (FMD), Swollen Throat (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

306. The socio-economic condition of the people living in ‘Polder 15’ (i.e. the EIA study area) has been described in this Chapter. In doing so, primary data were collected using a range of RRA techniques, including Key Informant Interview (KII), Focus Group Discussion (FGD), observation and 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

307. The Polder 15 is situated in Shyamnagar upazila of Satkhira district. The Polder area encloses only one union namely Gabura, which is shown in **Table 6.22.**

Table 6.22: Upazila and unions in Polder 15

Name of district	Name of upazila	Name of unions	Percentage of union within polder
Satkhira	Shyamnagar	Gabura	100

Source: Spatial GIS Analysis, CEGIS, 2015

6.4.2 Demography

308. The 6,762 households living in the Polder area have a total population of 31,115 of which 15,398 are male and 15,717 are female. The female population is higher than the male population. The demographic data of this Polder is presented in **Table 6.23**.

Table 6.23: The Demographic Data of the Polder area

Households	Population			Sex ratio	Population density
	Total	**Male**	**Female**		
6,762	31,115	15,398	15,717	98	1,137
	100 (%)	49.48(%)	50.51(%)		

Source: Population Census 2011, BBS

309. The average density of the population in the Polder 15 is 1,137 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 96% of total populations are Muslim, 4% Hindus and the rest of them (0.01%) belong to other religious groups. The national sex ratio is 100 while in the study area it is 98 which is slightly lower than of the national level.

Demography for the year 2015

310. According to the BBS 2015, the population growth rate of Bangladesh is 1.37%. Considering linear growth rate it is distributed into 4 year (2011-2014). This calculator attempts to show the power of human numbers to grow exponentially. 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[7] assumes consistent growth. Study area population has been calculated with the number of baseline population. Applying this method, in the year 2015 the household number is 7,140; total population is 32,855 in which 16,259 are male and 16,596 are female. The demographic data of this Polder for the year 2015 is presented in **Table 6.24**.

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

Where:

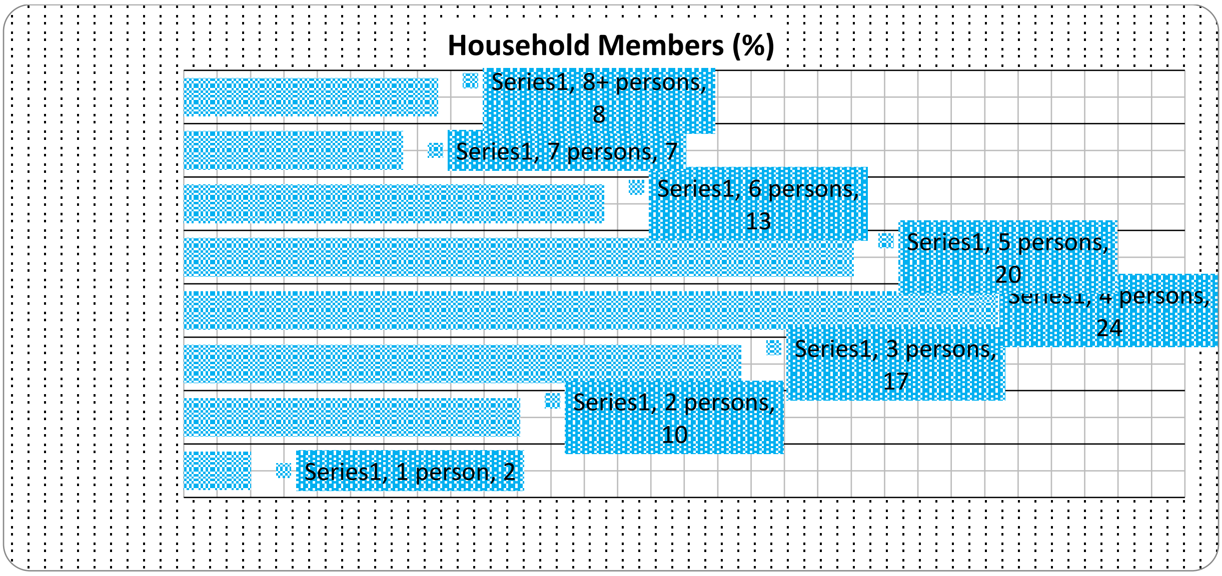
Pop_{Future} = Future Population, $Pop_{Present}$ = Present Population, r = Growth Rate and n = Number of Years

Table 6.24: The Demographic Data of the Polder-15

Households	Population			Sex ratio	Population density
	Total	**Male**	**Female**		
7,140	32,855	16,259	16,596	103	1,201
	100 (%)	49.48(%)	50.51(%)		

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

311. 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, households distribution by number of persons it is found a little higher (4.6) than the national scenario of 4.4 where the highest percentage (24%) of household comprises 4 persons. F**igure 6.13** presents the distribution of household members.

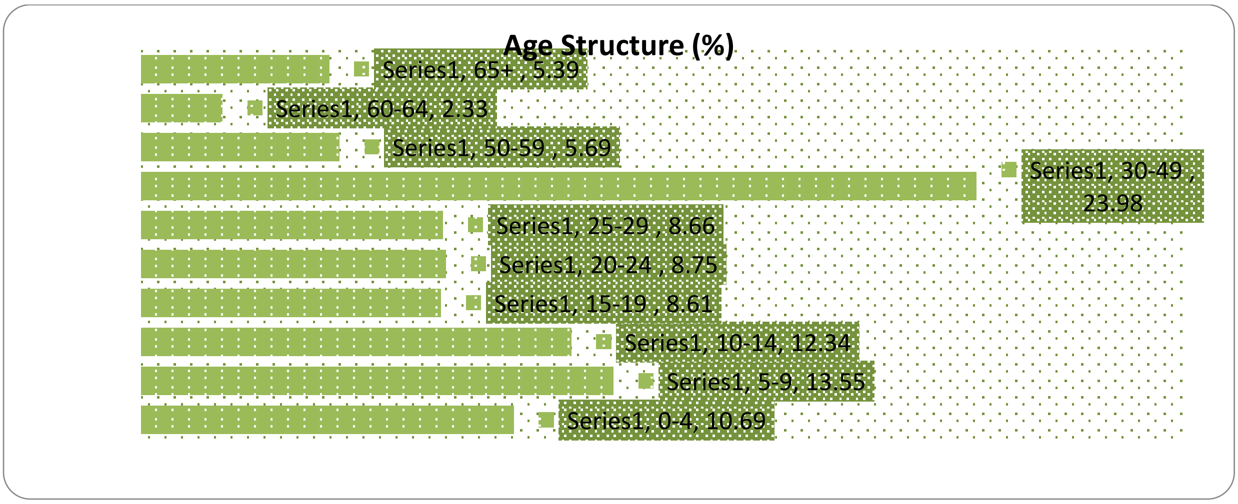


Sources: Housing and Population Census, BBS, 2011

Figure 6.13: Distribution of Households comprising member in each

6.4.3 Age Structure

312. With respect to age structure in Polder14/1about 23.98% belong to age category of 30 to 49 years old.. About 2.33% and 5.69% people are in 60-64 and 65+ year's category respectively which is presented in **Figure 6.14.**

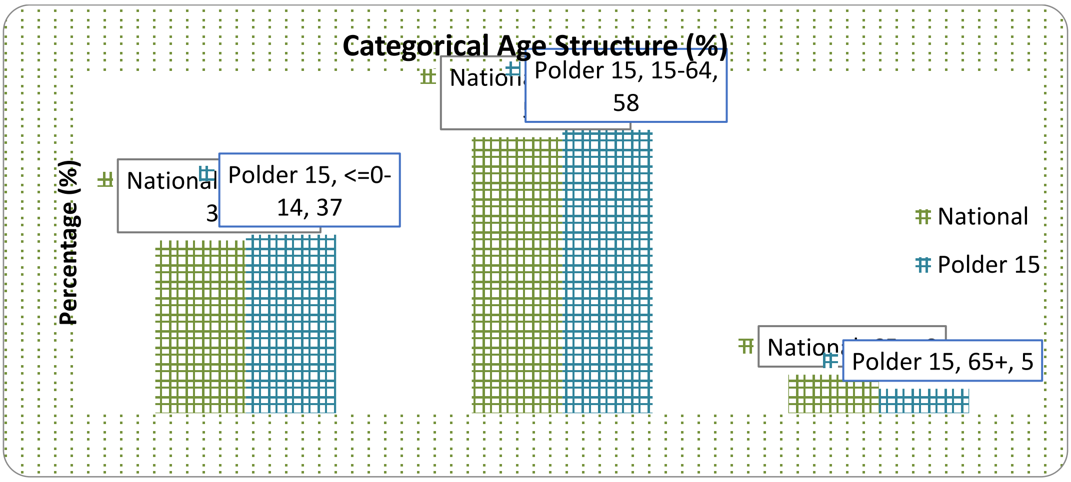


Sources: Housing and Population Census, BBS, 2011

Figure 6.14: Age Structure of the studied people

313. Age groups of 0-14 years is defined as children, 15-24 years as early working age, 25-54 years as prime working age, 55-64 years as mature working age and 65 years and over as elderly people (source: World Fact Book, CIA[8]). This classification is important as the size of young population (under age 15) would need more investment in schools, while size of older populations (ages 65 and over) would call for more investment in health sector.

314. The percentage of the (potentially) active working populationin the age group of 15-64 is 58%. Unfortunately, the huge active working population suffersunder asevere unemployment problem, which made almost one-third of them under poverty line. The categorical distribution of age structureaccording to *Housing and Population Census, BBS 2011* is presented in Figure 6.15.



Sources: Housing and Population Census, BBS, 2011

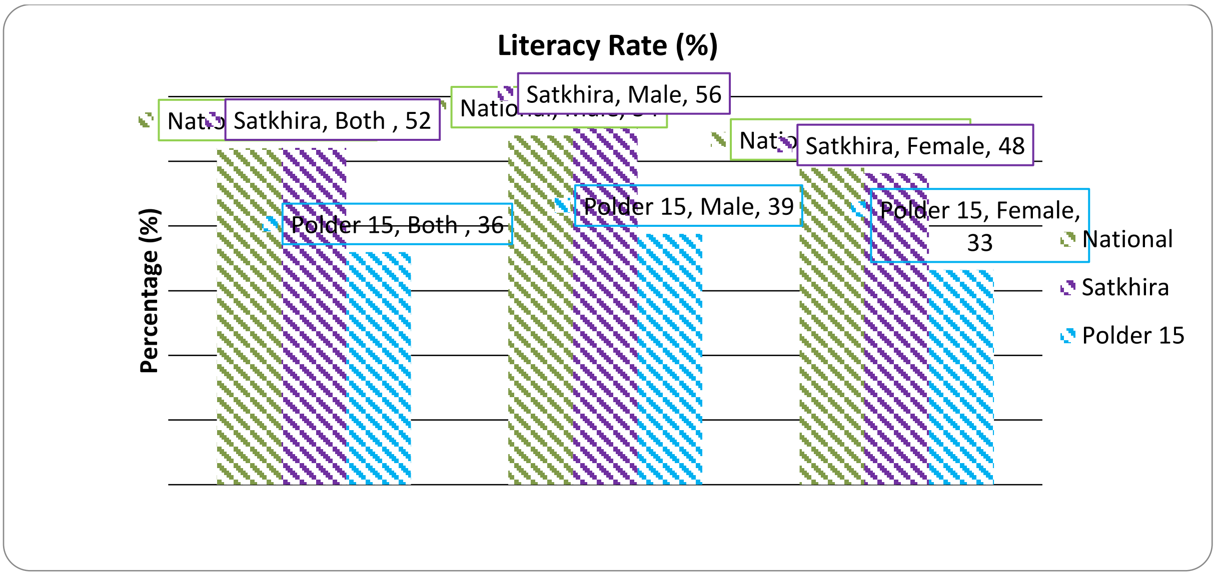
Figure 5.15: Categorical distribution of studied population

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

315. There is a small percentage (5%) of 65 years 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[9] is about 72 in which child dependency ratio[10] is 64 and aged dependency ratio[11] is 8. It illustrates that total 72 persons are dependent on 100 labor forces in which 64 are children and 8 are elderly people.

6.4.4 Education

316. Literacy rate, based on a definition “ability to write a letter in any language” is 52%, where for male it accounts to 56% and female 48%. The rate of literacy reported above is for population of 7 years and over ages (**Figure 6.16)**. Literacy rate of the Polder area is comparatively lower than the national and the district rate.



Source: Population Census, BBS 2011

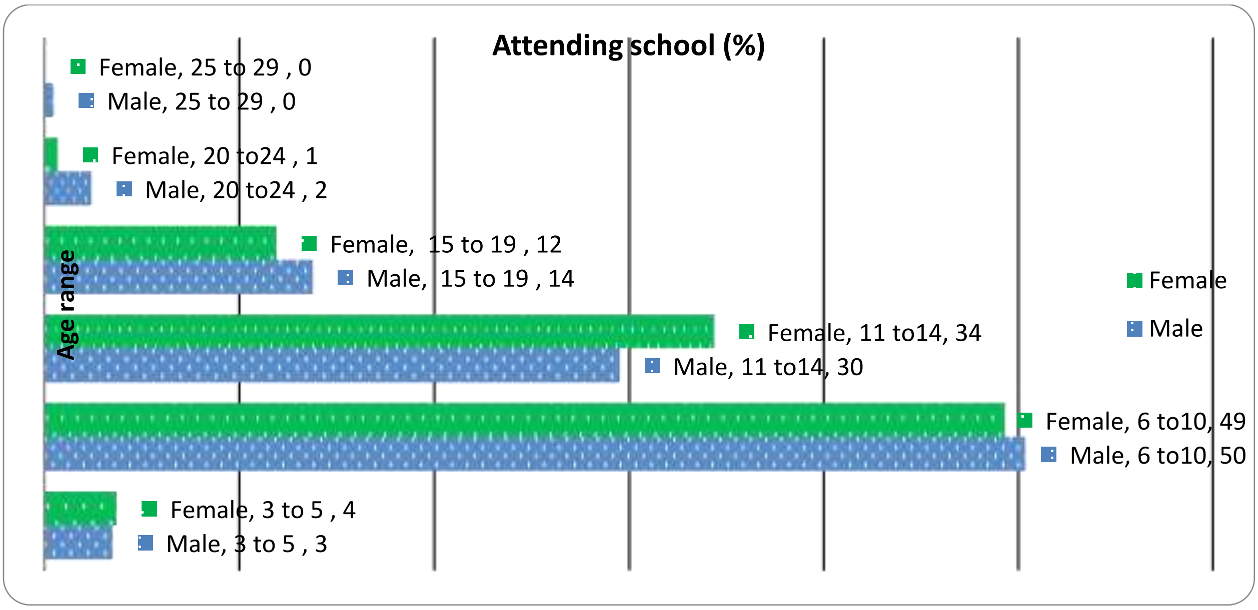
Figure 6.16: Literacy rate among the studied population

317. Like the female education rate of Bangladesh and Khulna, it is also comparatively lower than male rate in the study area. But, nowadays, this trend is gradually changing in the area. People also emphasizes on female education.

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

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

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



Source: Population and Housing Census, BBS 2011

Figure 6.17: Percentage of Male or Female students attending school

318. Data shows that attendance of male and female in school in different age range is almost same even in the age range of 11-14 and 3-5, female's percentage is more than male. This indicates that female attending school has gradually increased in the area.

319. Field findings shows there are 12 primary schools, 2 high schools and 4 Ebtedaye/ Dakhil Madrashas in the study area. *(Source: CEGIS field work, 2015).*

Source: CEGIS fieldwork, 2015

Photograph 6.23: Local educational institutions at the Polder area

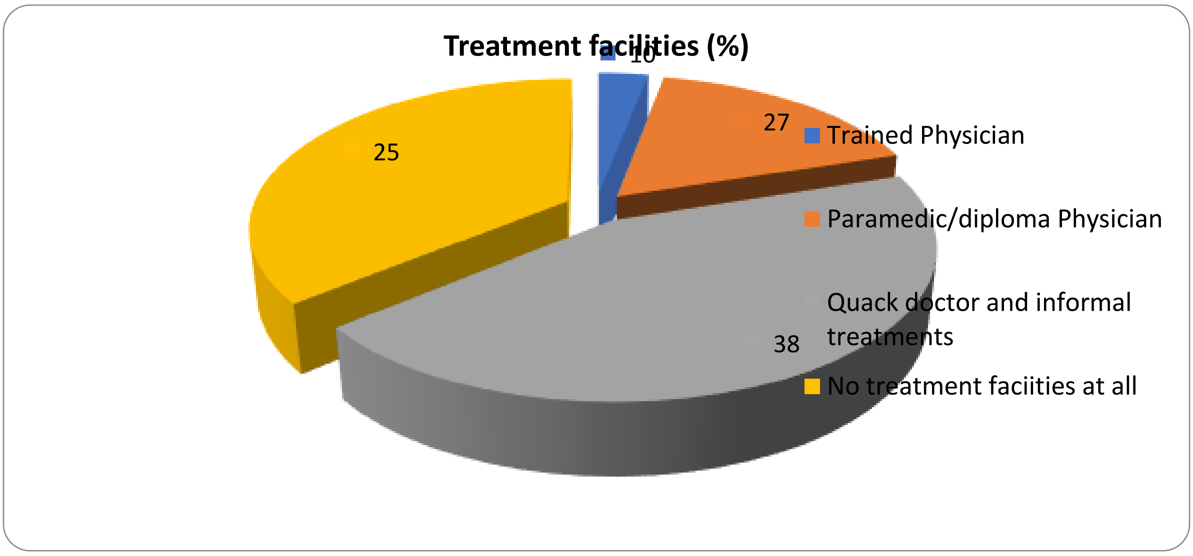
6.4.5 Access to health service

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 are 4 community clinics, 1 union family welfare center and 23 local pharmacies. But there is no private clinic/ hospital and upazila health complex. Therefore, a substantial portion of population tend to receive services from local chemists and village trained physicians. Most of the people of the area also receive treatment from nearby Sadar Upazila (Shyamnagar

Upazila) Health Complex at the time of serious health problems. However, the economically well-to-do people receive treatment from nearby private clinics like Janani Nursing Home, Modern Clinic, Sheba Hospital, Rida Private Hospital, or go to Dhaka for better treatment facilities.

Photo 6.24: Local people are receiving treatment from a village doctor.

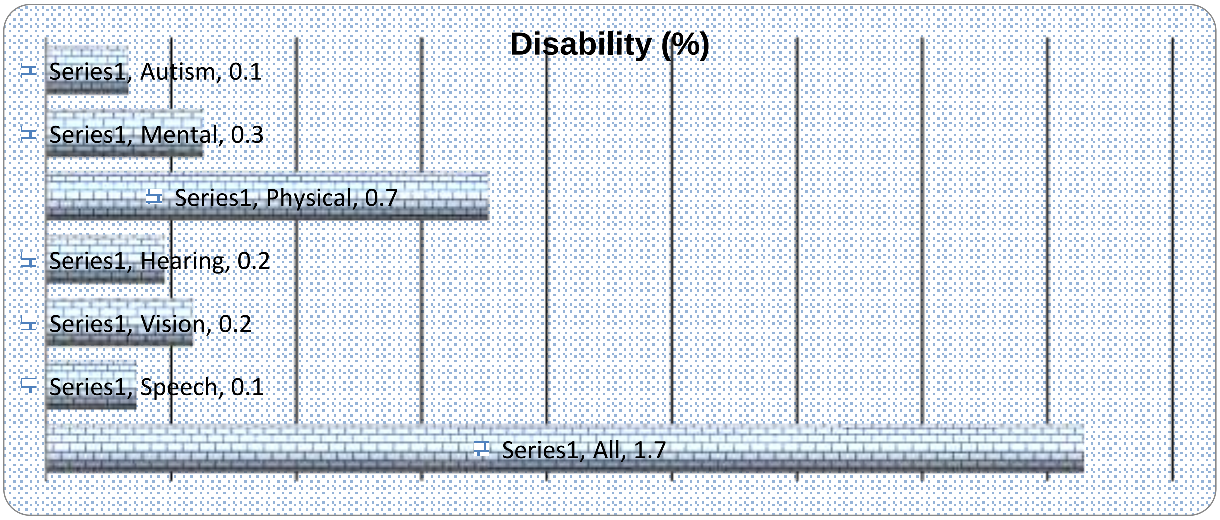
321. It is found that that nearly 38% people receive health services from quack doctors and informal treatment systems, 27% from paramedic/ diploma physicians and only 10% from trained doctors. About one-forth population does not receive treatment facility due to their impoverishment.



Source: CEGIS fieldwork 2015

Figure 6.18: Sources of treatment facilities of the Polder area

322. The Population Census, 2011 identified almost six types of disabilities and their proportionate distribution in the respective area. It is found that the study area comprises of 1.7% of all types of disabilities and 0.7% people reported that they are physically challenged **(Figure 6.19).**



Source: Population and Housing Census, BBS 2011

Figure 6.19: Common disabilities in the Polder area.

323. Local people opined that the incidence of diarrhea is the most prevalent ailment in the area. Dysentery, skin diseases, cough, hypertension and common fevers are also frequent in the Polder area.

Table 6.24a: Disease Profile in the Polder area

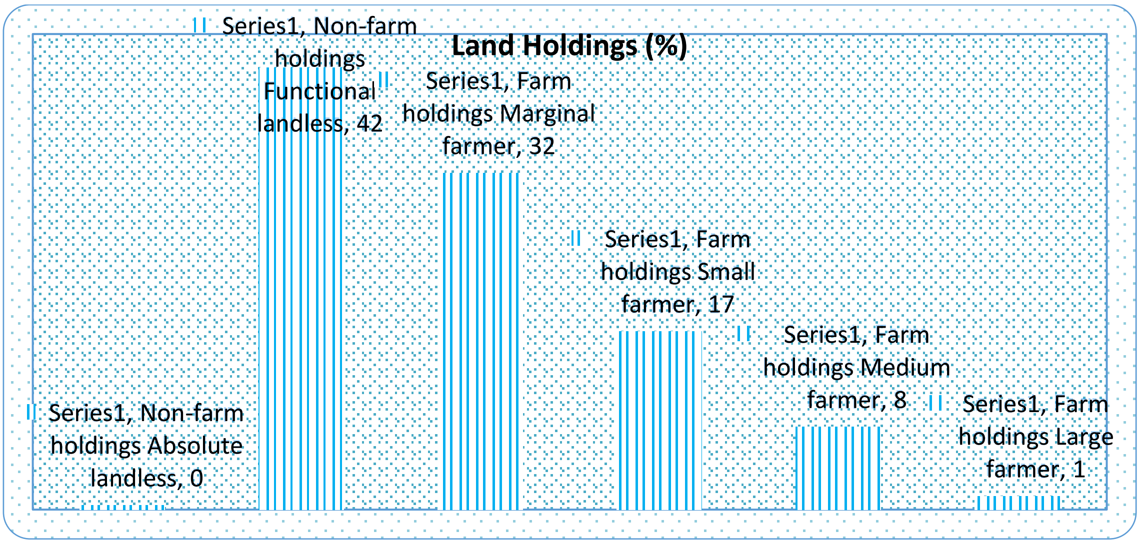
Disease	Ranking by Incidence
Diarrhea	1
Dysentery	2
Skin diseases	3
Influenza/Common fever	4
Cough/cold	5
Chicken pox	6
Typhoid	7
Gastric	8
Asthma	9
Hypertension	10
Diabetes	11
Hepatitis	12

Source: CEGIS fieldwork, 2015

6.4.6 Ownership and utilization of land

324. The Census of Agriculture, 2008 by BBS classified land holdings into two broad categories- one is farm-holdings and another is non-farm holdings. A farm holding is defined as being an agricultural production unit having cultivated land equal to or more than 0.05 acre. Conversely, non-farm holding includes landless households and households having lands up to 0.04 acre. The study area shows that out of total holdings, 42% is farm and the rest 58% is non-farm holdings.

325. The land holdings in the study area show that 0.41% households are absolute landless, i.e. they have no land either homesteads or cultivated. 42% households belong to functional landless category that comprises households those have only homestead lands and those have homestead with 0.01 to 0.04 acre cultivated lands. Here, cultivated lands include mainly kitchen gardening produced predominantly by housewives mainly for household consumption.



Source: The Census of Agriculture, 2008, BBS

Figure 6.20: Households by land holdings

326. On the other hand, farm holding distribution shows that 32% households belong to marginal farmer (0.05 to 0.99 acre), 17% belong to small farmer (1.00 to 2.49 acre), 8% belong to medium farmer (2.5 to 7.49 acre) and 1% belong to large farmer (7.5+ acre) categories. It is evident that land fragmentation decreases the holding size; large and medium farmers are gradually being converted to small and marginal farmers.

327. The small land owners are unable to prevent the land 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 this large numbers of landless populations as a result of land acquiring, compelling them to adopt alternative livelihood options, for instances; farm and non-farm laboring, driving, earth work, working for shrimp farm and other manual works. Some local people stated that few years ago, they had reasonable lands, but now they belong to absolute landless category because of river erosion. On the other hand, people also lose their land as a result of land grabing by gher owners/shrimp cultivators.

6.4.7 Occupations and Livelihood

328. Out of the total 31,115 population, 11,444 (36.78%) are economically active of which 4,879 (43%) employed, 68 (0.6%) looking for work and 4,138 (36.16%) engaged in household work while 2,359 (20.61%) 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 6.21: Employment status of the Polder

329. It is true that when agriculture was the main occupation in the area, people involved themselves in different types of agricultural activities. But as a result of shrimp cultivation, people lost agricultural activities and they became wage laborer. On the other hand, labor intensive field is too limited in the area. Therefore, most of the unemployed people migrate to other regions like Chittagong, Dhaka, Barisal, Khulna, Narail, Gopalgonj, Kushtia districts and nearby upazilas as a day laborer.

330. 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 (36%). The employed category also includes child labor as it was accounted from 7 years old population. Main occupation in the area is shrimp cultivation, and many women also collect shrimp fry from the nearer river but this shrimp fry is now, relatively, unavailable in the rivers. As a result, the shrimp fry collection employed women have become unemployed. The other main occupations in the area are agricultural farming, earthworks and brickfield works.

Photo 6.25 : Different modes of livelihood activites in the polder 15

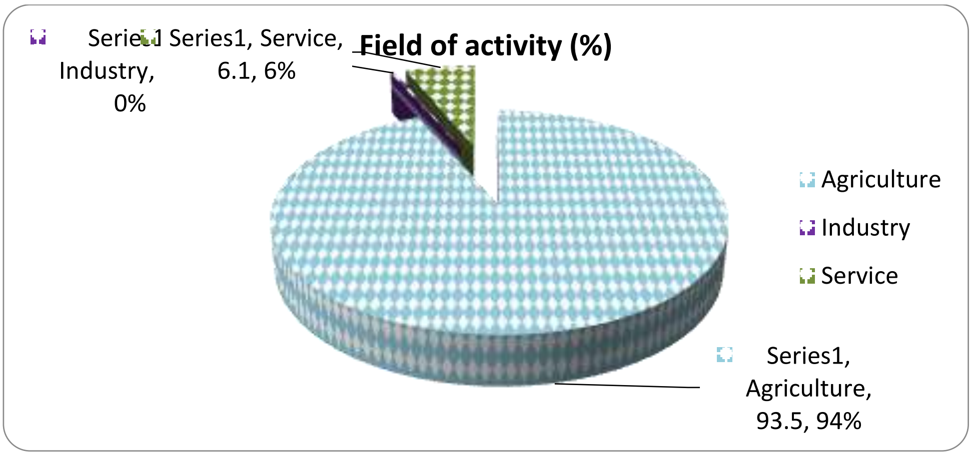
331. Agricultural activities include broadly fishery and crop farming. Scope of employment in agricultural sector is gradually decreasing due to lack of sweet water and inducing saline water in the area for shrimp cultivation. The gher cultural practice in the area is shown in the **Photograph 6.25.**

Photo 6.26: Practice of shrimp cultivation in agricultural land in the area

332. People stated that once people from nearby regions came for employment in their area, but as a result of decreasing agricultural farming, shrimp culture reduces employment. Therefore, they have to migrate for employment.

6.4.8 Labour market

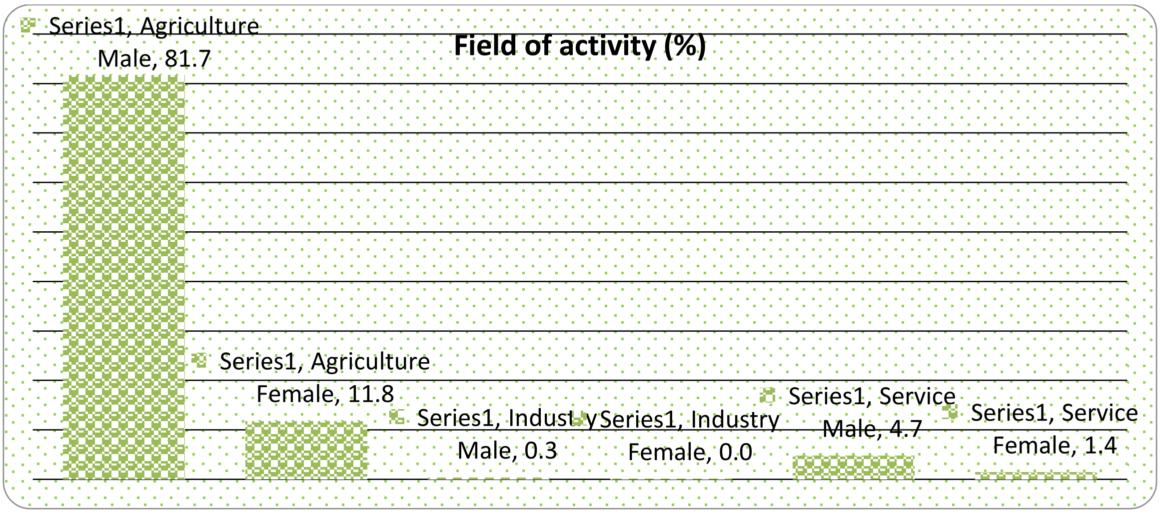
333. Data confirms that agriculture, industry and service are the sole sectors to generate employment for the local people. Field findings documented that people who are not permanently employed tend to engage themselves in those sectors in the forms of agricultural laborers, fishers, brick field workers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



Source: Housing and Population Census, BBS, 2011

Figure 6.22: Distribution of population by field of activity

334. Most people of the area are directly or indirectly involved in agriculture. Only a very few people are involved in industry and services. Female participation in labor market is comparatively low (Figure 6.23).



Source: Housing and Population Census, BBS, 2011

Figure 6.23: Distribution of male and female distribution by field of activity

Labor conditions and relations

335. Labor condition in the area is poor. Most of the people work as day laborers who are engaged in a poor working environment, e.g. the people who are involved in brick field as day labor, frequently suffer from different types of diseases which are oriented from the poor working condition of the brickfield. On the other hand, the people who are involved in shrimp cultivation as day labor, frequently suffer from different types of water borne diseases which are oriented from the water condition. But the owner don't give them proper facilities even don't give them money for their treatment. They give them low wage, which is too much low for their livelihood, around Tk. 300-400 per day. Often the labor class face humiliation and their human rights are violated by the owner class.

336. The male laborers who are involved in farming activities get wage Tk. 200-300 per day, female laborers get Tk. 200-250 per day. But non-farming male laborer gets wage of Tk. 300-400 per day while female gets Tk. 200-300 per day. There is wage discrimination between male-female labors.

337. The above figure implies that male participation in agriculture sectors is higher than that of industry and service. But the industry and service employed people are out migrated people of the area. Field findings documented that during harvesting period, they take part in action with men in same agricultural field. Some of them also collect fish and shrimp fry from river; and and are engaged in earthwork.

Labor Migration

338. Labor migration is a common feature in the area. During field visit, people stated that out migration of laborers is found higher in the study area whereas in-migration is relatively low. About 80% labor powers are frequently out-migrated in different seasons. These out-migrants are mainly agricultural laborer who usually go to neighboring districts (e.g. Chittagong, Dhaka, Barisal, Khulna, Narail, Gopalgong, Kushtia district and nearby upazilas) for better livelihood because of employment opportunity. Additionally, there are a few international out migrants (1%) who tend to go to Middle East for searching better livelihood opportunities.

6.4.9 Standard of living

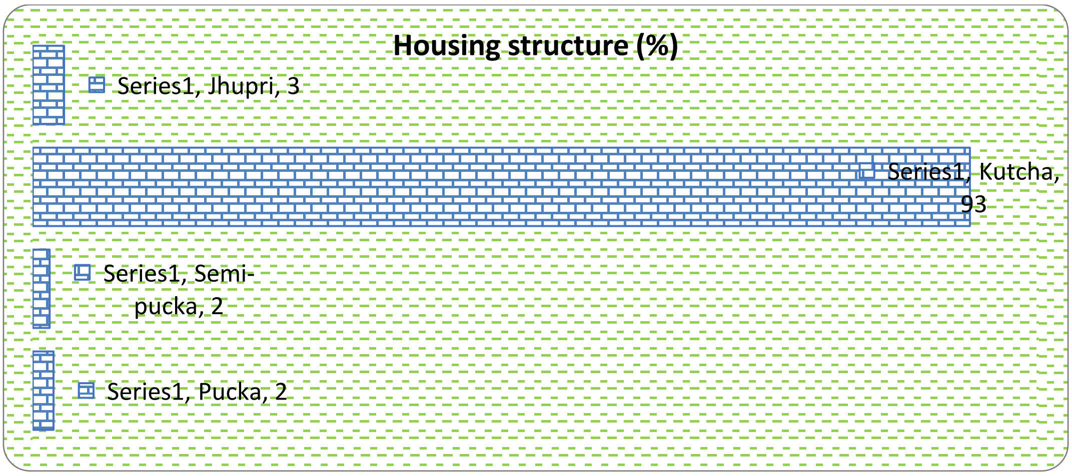
339. Standard of living indicates the level of wealth, comfort, material goods and necessities availability to the studied population which includes peoples' access to electricity, sanitation facilities, safe drinking water availability, fuel consumption and housing condition.

340. According to BBS Report, 2011, 18.9% people of the Polder 15 are under electricity connection. But field data shows a better scenario, it states that 78% people are now getting electricity facilities by solar system. A large portion of the people (about 22%) are still out of electricity facilities. *(Source: CEGIS fieldwork, 2015).* Different NGOs provide this solar system.

Photo 6.27: Electricity connections of the area

341. According to Housing and Population Census, BBS, 2011; the overall housing condition[12] is not satisfactory. It shows the predominance of kutcha houses (93.2%) over other three types. Semi-pucka household is 1.7%, pucka is 2.1% and 3.1% is still jhupri houses. But in field situation, it is found that about 60% houses are Semi-Pucka. Most of these Semi-pucka houses are sponsored by different NGOs.

[12] 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-pucka**: 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) **Pucka**: House which is made by fully concrete, cement, and iron.



Source: Housing and Population Census, BBS, 2011

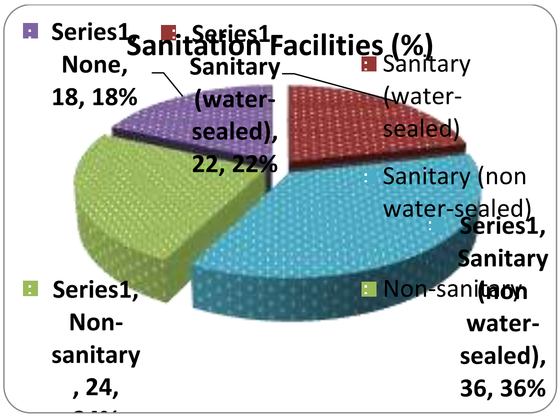
Figure 6.24: Housing condition in the study area

Photo 6.28: Different types housing structure at the Polder area

342. Sanitation[13] facilities in the study area show that 21.6% households use sanitary (water sealed) latrines, 35.9% use non-water-sealed sanitary latrines and 24.3% use

[13] 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

non-sanitary latrines. Field findings confirm that non-sanitary latrines are predominant among kutcha houses where water-sealed sanitary latrines are used in kutcha, semi-pucka and pucka households. However, there are 18.2% houses, which have no sanitation facilities but tend to use on shared basis and in some cases uses open spaces (**Figure 6.25 and 6.26**).



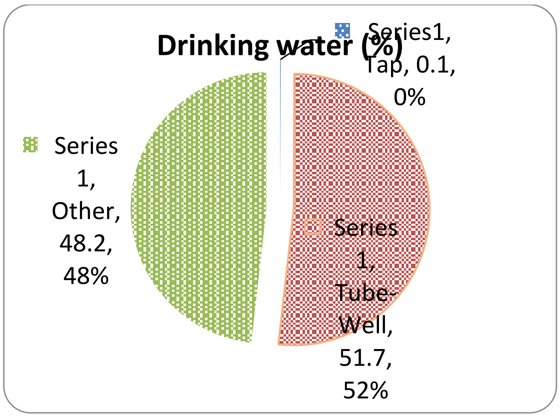


Figure 6.25: Distribution of households by sanitation facilities

Figure 6.26: Distribution of households by sources of drinking water facilities

Source: Housing and Population Census, BBS, 2011

343. Crisis of drinking water is also present in the area. Most of the people collect drinking water from tube-well, harvesting rain water, purified water supply by different NGOs. The poorer people of the area collect the drinking water from their neighbor's tube-well.

Photo 6.29: People collect safe drinking water from different sources

6.4.10 Poverty Situation

344. 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 the food consumption of the inhabitants within three different categories (**Figure 6.27).** It is observed that 13% 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

over the drop hole, or a polyethylene flap preventing in-sects from flying into or coming out of the pit; and (iii) Non-sanitary (Kucha): latrine is a frame or platform extending over earth or water; an "open pit latrine" does not have a squat platform or slab on the pit and (iv) No facilities: Defecation in bushes or fields or other outdoor locations.

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. But only 5% of the households are in surplus category and the rest of them (82%) are in balance category.

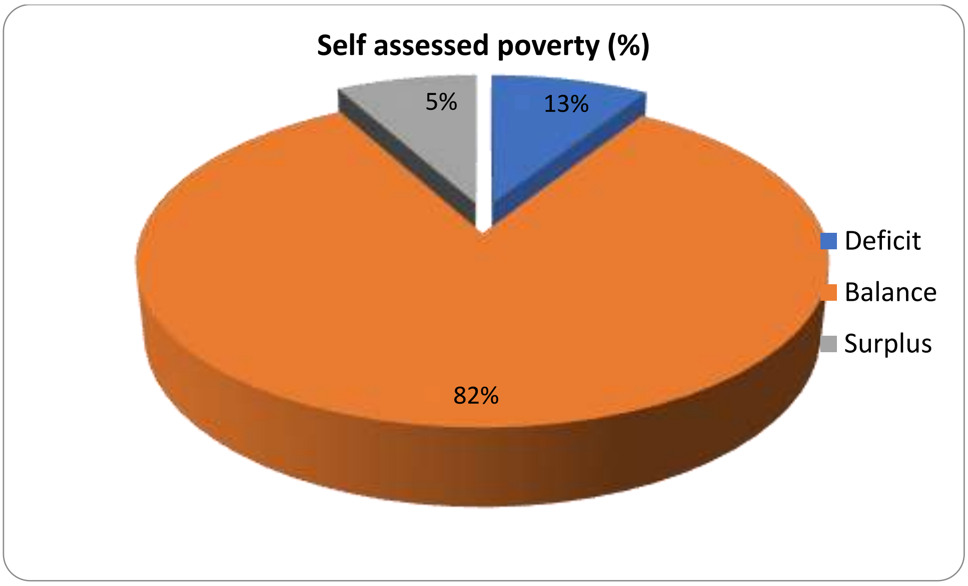


Figure 6.27: Self assessment of poverty status

6.4.11 Social Capital

345. Different types of safety net programs are initiated by government and NGOs in the Polder 15. The major social safety nets and poverty reduction programs are initiated by 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 among the targeted poor households and vulnerable communities to some extent. But some poor people stated that, in reality, they get only a minimum advantage from the government programs, which is basically given on basis of political consideration rather they have, even, sustained for the NGOs activities.

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

347. With micro credit programs, many NGOs also serving many social development activities without charge. 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 and goat rearing, different types of medicine and vaccine, etc., UNDP helps to repair naturally destructed houses, Shushilan 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 keep important contribution for safe drinking water. About 80 percent of households are found to benefit from the NGOs interventions.

Table 6.25: NGOs and their Programs in the Polder 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	✓	-	-	-	-	-	-	-
Shushilan	✓	-	-	-	-	-	-	✓

Source: CEGIS fieldwork, 2015


Photo 6.30: NGOs activities in the Polder area

6.4.12 Roads

348. There are various types of roads which provide means of communication mostly within the Polder. People of the polder can easily enter into the upazila sadar by upazila pucca road. According to NWRD database 2015, about 40.70 km of notable road network exist in the studied area where 15.97 km roads is paved/ brick soling and 24.73 km road is earthen. But after the devastating disaster of Aila, the whole paved/brick soling roads are demolished. Therefore, most of the roads in the area are now earthen and few roads are brick soling. New road construction activities also have continued in the area.

349. Main vehicles using the Polder roads include motorbikes, bicycles, vans, and auto rickshaws. Due to poor road conditions, most of the traffic constitutes motorcycles and bicycles in the Polder area. As a result of poor communication system, people suffer from different types of difficulty and they are dissatisfied with the weak communication system.

Photo 6.31: Roads of the study area

6.4.13 Market/growth centre

350. There are five markets in the Polder 15. The easiest cost efficient communication system in the area is waterway. The Chandnimukha Hat gets more preference than the other markets. Moreover, other small village shops of the area play important roles for the inhabitants. People of the area face difficulty for the lack of growth centre in the study area. Name of the existing market and growth centres of the Polder area are mentioned in Table 6.26:

Table 6.26: Markets and growth centre in project area

Unions	Number of markets/ bazaar	Name of the Markets/bazaar
Gabura	5	➢ Gabura Hat ➢ Gainbari Hat ➢ Dumuria Hat ➢ Parshemari Hat ➢ Chandnimukha Hat

Source: CEGIS Fieldwork 2015

Photo 6.32: Markets in the Polder area

6.4.14 Gender and Women

351. Field observation suggests that Polder 15 is highly male dominated area. Roles of women in both decisions making at household level and economic contribution to household income are insignificant. Traditional believe is very strong here that generally males make all major household decisions and at the same time they contribute to household income more than females. Few women work as day labor, but in that case wage discrimination is very common where male labor get Tk. 300 to 400 per day, the women labor get Tk. 200 to 250 per day.

Photo 6.33: Women activities in the Polder area

352. Over time, government strong policy towards women education has changed a lot in Polder area where women education rate has increased and dropping school due to early marriage has reduced. NGOs have changed the rural society to a significant extent in terms of rising awareness. Different NGOs along with community health clinics work for women health and reduce women's maternal mortality rate. The studied people stated that there are some union health workers who play important roles for women health improvement.

353. 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 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

354. The studied Polder 15 is situated beside the Sundarban which is the largest mangrove forest in the world and a world heritage site. Along with the unlimited natural resources and beauties, Sundarban provide services and resources on which many people from the area depend for their livelihood.. People state that almost 60% people survive on the Sundarban's resources. But frequent disturbance of pirates in the Sundarban region make the people's life insecure. So, now, most of the people don't collect resources from the Sundarbans rather they go to nearer region for working as a day laborer. On the other hand, Sundarban can be made a great tourism spot in the country by the government's initiatives.


Photo 6.34: Natural scenario of the Sundarban

6.4.16 Social Structure

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 landownership in earlier times, 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 dominatingthe rural power structure. In social relation, males are considered as the main livelihood earner and females are usually confined to household chores. But some women are also involved in shrimp cultivation who basically collect shrimp fries. Some women work as a day laborer in earthwork and brickfield work. Furthermore, kitchen maintenance is the main task of women. In decision making both in society and family, males are the main contributors. People reported that as female literacy rate is gradually increasing, they are now contributing, although trivial, in household income particularly in service sector such as teaching, factory worker, etc.

6.4.17 Rituals and festivities

355. Anniversaries, fairs and festivals form a vital part in the social life of ordinary people of the Polder 15. The biggest religious festivals are Eid-ul-Fitr and Eid-ul- Azha for the Muslim community, Durga Puja for the Hindus, and 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

religious groups perform their religious festivals with cheerfulness. Even members of other religious communities participate in the festivals with eagerness. Like Muslims participate in different types of Pujas whereas Hindus and Christians also participate in Eids and other Muslim festivals. All religious communities also participate in the ethnic community's festivals.

356. Among the non-religious festivals Bangla New Year (Pahela Baishakh, on 14 April), Language Martyrs' Day (on 21 February, now also called 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

357. 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. Besides these, the BWDB embankment is also commonly used for different livelihood purposes, i.e. living or taking shelter by the local inhabitants. There is no known historical or archeological sites declared by government in the Polder area except the Sundarban, a world heritage, besides the Polder. There are 29 mosques, 5 graveyards, 4 temples, 5 cyclone centers, 5 bazaars and a cultural center.

Photograph 6.35: Common Properties of the area

7. ANALYSIS OF PROJECT ALTERNATIVES

7.1 Overview

358. The chapter presents 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

359. The ‘No-Project’ option analysis provides a clear view of the existing situation of the Polder and helps understand the need of the proposed interventions under CEIP-1. At present the people in Polder are extremely vulnerable to cyclones, storm surges, wave action, and climate change effects, as described in Chapter 4. Furthermore, the Polder is not in a state to provide required services i.e., protection against tidal inundation, efficient drainage, and minimizing the impact of cyclonic surges. About 60 percent of the Polder area is vulnerable to salinity intrusion and water logging. The silted water channels allow limited navigation in these waterways, declining fisheries, and increasing environmental pollution.

360. The interventions proposed in Polder 15 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.

361. Section 8.6 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 15. 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

Activity	‘No Project’ Scenario	‘With Project’ Scenario
Re-sectioning of embankments (23.92 km) and design crest level (4.50 m, PWD)	At certain number of points, the embankments will further deteriorate and drop below the design level. Therefore, cyclones, rise in surge heights due to global warming, and tidal actions will inundate the Polder, causing severe damage to the lives and property of local people.	Re-sectioned embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, reduction in loss of lives and assets caused by the natural disasters.
	Because of submergence of the embankments during monsoon, transportation system would further deteriorate inside the Polder, and sufferings of local people would further increase.	Re-sectioned embankments will provide enhanced protection to Polder, facilitating transportation within the Polder even during monsoon.
	Reduction of agricultural area, crisis situation for farmers from January to April (salinity intrusion) and May to August (flooding).	Re-sectioned embankments providing support to Polder facilitate enhanced agriculture activities and increased area for cultivation, thus increasing agriculture output.
	Continued silt deposition inside the Polder due to cyclonic surges and floods would increase and cause water logging, drainage congestion and other associated problems.	Decreased silt deposition in the Polder will result into improved drainage and navigation in internal lakes/khals, increased usage of surface water for irrigation, and reduced water logging problem.

Activity	'No Project' Scenario	'With Project' Scenario
	Local farmers and labor will remain financially stressed. Livelihood opportunities will remain limited, and local people will migrate outside the Polder for employment.	Enhanced agricultural activity will increase the demand for farm workers. Local people can engage themselves in the construction works inside the Polder. Improve earnings of local people during the construction phase of the project.
Bank revetment (400 m)	River bank erosion would further deteriorate the embankments and land resources would be damaged/ lost.	Bank revetment will provide enhanced protection against erosion by wave action, storm surges and currents, and will result into preservation of Polder and its land/agriculture resources.
	Further subsidence of the embankments and further damage to transportation routes.	The bank revetment will protect the embankments and facilitate transportation within the Polder.
Slope protection of Embankment (4.44 km)	Continued weakening of embankments; continuous subsidence of embankments due to traffic load and wave action; land resources would continue to be damaged.	Slope protection works will strengthen the embankments and protect them against subsidence, wave action, and wear and tear.
Construction of drainage sluices with drainage-cum-flushing sluices.	Continued use of the existing drainage sluices for both flushing and drainage would cause further damage to these structures. As a result, water logging and drainage congestion would be increased due to malfunctioning of the sluices.	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
Construction of the existing flushing sluices	No dry season agriculture practice will be possible. Shrimp culture during January to May, as sweet water cannot be used in the periods of low rainfall.	Replaced flushing sluices will facilitate better agriculture practices, increased dry season rice cropping, and reduced shrimp culture - thus benefiting the poor farmers.
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 (20 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

362. 'With Project' Alternative explicates the interventions proposed under CEIP-1 to alter the Polder 16 condition and address the problems summarized in 'No Project Alternative'

7.3.1 Site selection alternative

363. 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	15	
Type of Dyke	ID	
Location of the Polder	Shyamnagar, Satkhira	

Gross Area of the Polder (HA)	3441	
Embankment Length (Km)	27	
Breach of Embankment (Km)	3	5
Erosion (Km)	22	8
Requirement of BPW (Km)	-	0
Location in the Risk Zone	LRZ	5
Drainage Congestion (HA)	516	1
Opinion of Stakeholder (marks, MV=15, MDV=10, LV=5)	MV	15
Rehabilitation Cost (Crore BDT)	68	15
Special Criterion	0	0
Total Marks		39

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

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

Table 7.3: Technical, Economic, Environmental and Social Considerations

Intervention	Considerations			
	Technical	Financial/Economic	Environmental	Social
Re-sectioning, embankment with new design heights	Better protection against cyclone surges and water level rise	Financial savings from reduced damages caused by the floods	Improved surface water quality; improved natural vegetation	Reduced loss of lives and assets which would bring poverty reduction; increased employment opportunities for local people.
	Protection to river bank erosion	Financial savings as the embankments will provide good road transportation / communication routes.	Reduced traffic congestion inside the Polder because of improved embankments, which will facilitate vehicular traffic	Reduction of loss of assets which would bring poverty reduction
	Prevention of salinity intrusion in the Polder	Improved earning of local people during construction		Improved cropping particularly for

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

7.3.3 Alternatives during Construction

365. Material stockpiling, material sourcing, manpower supply, required transportation, etc., are the key factors of construction site. Alternative options are proposed upon the factors mentioned above.

7.3.4 Material Storage

366. Two conventional alternatives 1) Inside the Polder; and 2) Outside the Polder are suggested for material storage. The first option gives easy transportation of bulk materials from the sources; the required materials are transported from the sources to the Polder and are stored in the stock yard for utilizing at construction phase.

7.3.5 Material Sources

367. The exploration on construction materials will be studied at this point. The effective options are described below.

Soil for Embankments

368. For renovation process of embankments, plenty of soil will be required. The following options are available for sourcing this material:

369. Borrow pits must be considered as one of the main sources of soil. Plenty of soil can be obtained from borrow pits of the river. Minimizing transportation requirement so as by minimizing the costs, this source has become a worthy alternative option. It has minimal negative impacts at borrow pit areas. These pits will be filled up through accumulation of silt within a couple of seasons. It ensures minimum social and environmental impacts from excavation and transportation.

370. Re-excavation of channel is another option. In this option if material meets the acceptable quality, it would minimize the excavation cost. Although 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.

371. 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.

372. 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.

Sand

373. 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.

374. Sand will be purchased directly from the markets. This would ensure quality and supply; however it would increase transportation cost and associated environmental and social impacts including traffic congestion and air pollution.

375. 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.

7.3.6 Alternatives for Workforce Procurement

376. Two separate options are considered for sourcing the manpower for the construction sites. The options are described here.

377. Besides skilled and technical manpower, the rest of the employee is sourced from the Polder area. It will reduce labor camp sizes, decrease transportation need and associated environmental and social problems. This option will also offer employment opportunities for the local community. This option not only gives the financial stability to the local people but also develop local ownership of the project.

378. Employing major part of the manpower from outside of the Polder can create traffic congestion and air pollution requiring larger camps and labor transport. It may lead to create unwanted situation in the Polder area imposing dissatisfaction and resentment among the local people.

7.3.7 Alternatives for Mode of Transportation

379. In carrying the construction materials only trucks are common within the Polder area. Besides roadway the materials from the main stockyard are possible to be carried by waterways to the site. The roads within the Polder area are not that suitable for heavier vehicles such as dump truck, trolley, excavator, etc., within the Polder. That's why carrying of earth and other construction materials are done by small carts, non motorized vehicles, manual labor, etc. Small boats, trawlers are common to transport the construction materials.

380. The depth as well as the width of Kobadak River is high. The Polder is bounded by this river Kobadak to the East and North, Kholpetua River covers from South to West. Sunderbans which is one of the largest mangrove forests of the world is located at southern boundary and part of western boundary of the Polder. Both Kobadak and Kholpetua rivers remain navigable throughout the year and can be used for transportation purposes during construction. For construction in northern parts of the Polder, Kholpetua River is the most suitable waterway for transportation of construction materials.

381. The Polder is located in Shyamnagar Upazila under Satkhira District. There are 11 Km of Union roads and 447 Km of village roads that serve the Polder area. The kutcha road serves the people sporadically in dry and wet season. The condition of the road does not permit heavier vehicles under any circumstances. In this case, peripheral rivers can be the alternative way of carrying construction materials.

8. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACTS

8.1 Preamble

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

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

8.2 Impact Screening

383. As part of the environmental impact assessment process, a screening matrix was used specifically for the proposed Project, focusing on the potential environmental impacts during the design, construction and operation phases. 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.

384. The matrix of Polder 15 is provided in **Table 8.1.** The negative impacts predicted in this manner were the 'unmitigated' impacts. Appropriate mitigation measures have been recommended as part of this EIA study, for reducing the occurrence possibility and severity of the potentially adverse impacts. The potentially negative impacts identified through this process are discussed in the subsequent sections.

Table 8.1: Environmental Screening Matrix

Project Phases and Activities	Physical				Biological			Social and Socioeconomic											
	Air and Noise Quality	Erosion	Flooding	Drainage System	Fish Habitat Quality and Migration	Feeding and Spawning Ground	Vegetation damage	Vehicular Traffic	Land Use and cropping intensity	Agricultural Crop Production	Irrigation facilities	Social unrest	Employment generation	Communication	Social Use of Water	Public Health	Out-Migration	Disaster Incidence
Pre-Construction Phase																		
Planning and design of the proposed infrastructures	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Preparation of construction site, labor shed, material stock yard etc.	0	-	-	-	-	-	0	-	0	-	**-**	-	0	-	-	-	-	-
Labor, materials and equipment mobilization	-	-	-	-	0	-	-	0	-	-	**-**	-	0	MN	-	-	-	-
Land acquisition and resettlement	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-
Construction Phase																		
Re-sectioning of embankment	0	-	-	-	-	-	0	-	-	-	**-**	MN	MP	MN	-	MN	MP	-
Construction of Retired embankment	MN	-	-	-	-	-	-	-	-	0	**-**	MN	MP	MN	-	MN	MP	-
Embankment slope pitching and turfing	MN	-	-	-	-	-	-	-	-	-	**-**	MN	MP	MN	-	0	MP	-
Construction of Drainage Sluices and Flushing inlets	MN	-	-	MN	MN	-	0	MN	-	-	**MN**	MN	MP	MN	-	MN	MP	-
Slope protection work of embankment	0	-	-	-	-	MN	-	-	-	-	**-**	MN	MP	0	-	MN	MP	-
Bank Revetment work	MN	-	-	MN	-	MN	0	-	-	-	**-**	MN	MP	0	-	0	MP	-

Project Phases and Activities	**Physical**				**Biological**			**Social and Socioeconomic**										
	Air and Noise Quality	Erosion	Flooding	Drainage System	Fish Habitat Quality and Migration	Feeding and Spawning Ground	Vegetation damage	Vehicular Traffic	Land Use and cropping intensity	Agricultural Crop Production	Irrigation facilities	Social unrest	Employment generation	Communication	Social Use of Water	Public Health	Out-Migration	Disaster Incidence
Placing of geo bags and CC Blocks	-	MN	0	MN	-	MN	0	-	-	-	**-**	MN	MP	0	-	0	MP	-
Re-excavation of Drainage khals	MN	-	-	-	MN	MN	MN	-	-	-	**MN**	MN	MP	-	-		MP	-
Implementing coastal afforestation	-	-	-	-	-	-	0	-	-	-	**-**	MN	MP	-	-		MP	-
Operation Phase																		
Monitoring and Maintenance of protective and earth works by BWDB.	MP	HP	HP	HP	-	-	-	-	MP	MP			-	-	MP	-	-	MP
Formation of local committees for monitoring the works properly.	HP	HP	HP	HP	-	-	-	-	-	-			-	-	MP	-	-	-

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

8.3 Impacts during Pre-construction phase

385. Site development involves the following activity:

- 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

386. 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 increase in the watercourses, i.e. Kholpetua and Kobadak River. The increased navigation is expected to amplify intensify the noise level in the local vicinity. Therefore, settlements, bazaar areas and surroundings of the construction site will be affected by the increased noise levels.

387. Besides, exhaust emission from materials and equipment mobilization trawlers 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 trawler. 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 to their baseline condition.

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

Mitigation

389. 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.
- Prohibition of vehicle movement during night time
- Monitoring noise level of nearby community, where appropriate and preparation of noise in the nearby community where appropriate
- 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 the standards of DoE.
- Sprinkling of water and ramming the materials of stockyard and approach roads regularly.
- Stockyard should be covered during non-working period.

Residual Impacts

390. 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 very **Low**.

8.3.2 Change of land use

Impact

391. 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.

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

393. Borrow pits for extraction of construction material are expected to be both from inside the Polder and in the foreshore land14. 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.

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

Mitigation

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

- All the construction camps should be established within the area owned by BWDB.
- Pay compensation/rent if private property is acquired on temporary basis, which instructions should be specified in the tender document.
- Labor shed/camp should be constructed on government Khas land.
- Avoid direct confrontation with 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

396. With the help of above mitigation, the impacts associated with changes in land use are likely to be adequately addressed and the significance of residual impact will be **very low.**

8.3.3 Impacts on vegetation for preparation of construction sites, labour shed and material stock yards

Impacts

397. Existing vegetation at proposed construction sites, labour shed and material stock yards is expected to be damaged (Details locations of sites will be illustrated after getting RAP Report). In the context of this Polder, negligible amount of vegetation is suspected to be damaged as most of the countryside lands near embankment is occupied by shrimp gher (lower land) or fallow (the upper dry land). Those lands have no vegetation except low density of seasonally grown local grasses like *Cyperus rotundus* and *Cynodon dactylon*. In addition , the settlements near embankment also have low density of vegetation. So, there are no severe damages of vegetation in pre-construction stage for project works.

Mitigation

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

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

399. Avoid vegetation damage as much as possible to select sites for labour shed and material stock by using nearer fallow land or barren homestead yards

400. Give proper compensation to the tree owners against tree felling specially for fruit yielding trees (List of affected tree will be finalize after getting RAP Report)

401. Implement tree plantation at the damaged sites after completion of construction works.

Residual Impacts

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

8.3.4 Increase vehicular traffic during mobilization

Impact

403. During contractor mobilization, equipment, machinery, material, and manpower will be transported to the Polder resulting in additional traffic on roads and in waterways. This traffic may potentially cause traffic congestion particularly at 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 which are not suitable for movement of vehicle. However, during weekly markets ('haat') all the stakeholders use this embankment as road for carrying their goods for buying and selling and other purposes. Moreover, most of the schools are located near the embankment and five important bazaars are also located besides the embankment these will face traffic congestion during weekly '*Haat'*. Earth work for re-sectioning of embankment and vehicles movement may also create short term disturbances to the Polder inhabitants.

Mitigation

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

- 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 Stakeholders will be finalized after obtaining their consent.
- The TMP will address the existing traffic congestion particularly at the Gabura Hat, Gainbari Hat, Dumuria Hat, Parshemari Hat and Chandnimukha Hat.
- 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 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 marketdays (Hatbar)

- Keep provision of training on vehicular traffic movement pattern and management system for the local stakeholders by using multimedia presentation and showing video at different common population gathering places of the Polder area.

Residual Impacts

405. 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

406. 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 and Flushing inlets
- Slope protection work of embankment
- Bank Revetment work
- Placing of geo bags and CC Blocks
- Re-excavation of Drainage Khals
- Implementing coastal afforestation

8.4.1 Deterioration Environmental (Air and Noise) Quality

Impact

407. The construction activities particularly manufacturing of C.C blocks through mixture machines, earth work and its compaction, 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 are likely to be severely affected by noise pollution which may create disturbance in performing the commercial activities.

408. The Table shows the probable noise levels from the equipment. According to ECR'97, 50 dBA is applicable during day time for residential area in Bangladesh while Polder area may be considered the same.

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

409. 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 to their baseline condition.

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

Mitigation

411. 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 sprinklingand 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.
- 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

412. 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

413. The construction activity particularly for construction and 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 in the khals.

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

Mitigation

415. 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

416. The impacts associated with drainage system is 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

417. About 20.9 ha of land is likely to be acquired for construction of retired embankment along Kobadak River. This land includes single crop area (Ch 10.500km-Ch 17.359 km) that is likely to be affected. This land includes cultivated areas (here, only single cropped land 2.32 ha) others covered by shrimp culture in addition to houses and other structures. The losses of production under the acquired land are given in Table 7.2.

418. 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 excavation of river bed of Kobadak and Kholpetua rivers as well as Sora Khal, Gabura Khal, Khat Khal, Dumuriasisha khal and Chakbara 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)
T. Aman (HYV)	2.32	3.02	7.0
Total			**7.0**

Source: Field information; 2015

419. 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.

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

Mitigation

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

- Resettlement Action Plan should be prepared and should also be implemented accordingly
- Compensation should be paid for any crop damage.
- Contractor should avoid cultivation fields during construction.
- Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps construction.
- Contractor should ensure that no vehicular movements take place inside cultivation fields.
- Contractor should ensure that no material is dumped inside cultivation fields.
- Re-excavated soil of canals should not be damp in agricultural land.
- Contractor should maintain liaison with communities.
- 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

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

8.4.4 Effects on irrigation

Impact

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

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

Mitigation

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

- Contractor should construct bypass channel before construction/ replacement/ demolished of each regulator.
- Sequence of work at the regulators and in the water channels should be carefully planned to avoid irrigation disruption.
- Contractor should ensure no negative impacts on crop irrigation.
- Contractor should maintain liaison with communities.
- Contractor should work during the dry season.

Residual Impacts

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

8.4.5 Impacts on Feeding and Spawning Ground of Fish Habitat

Impact

427. The bank side as well as tidal floodplain of periphery river of Polder 15 (Kholpetua River) has been reported as the feeding, nursery and spawning ground of brackish water fish species like Chewa, Pairsa, Gulsha Tengra, Bagda, Chingri, etc. It is expected that activities of bank revetment (earth work from km 8.6 to km 8.8 and km 23.4 to km 23.7) and slope protection (earth work from km 0.0 to km 1.0, km 2.3 to km 3.5, km 4.5 to km 5.2, km 5.5 to km 5.85, km 29.015 to km 30.7) would partially destroy (if in the dry season) or fully destroy (if in the rainy season) the feeding, nursery and even spawning ground of these fish species.

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

Mitigation

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

- Earth work should be conducted during the dry season (November-May)
- Sequence of work at the bank side of Kholppetua rivers will be planned considering local fisheries condition to minimize impacts on spawning and subsequently nursery ground of fish.
- Contractor will maintain liaison with experienced local fishermen.

Residual Impacts

430. 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

431. There are 4 drainage sluices and 8 flushing inlets will be constructed in the Polder area. These sluices are connected with internal khals and periphery rivers. Under this project, damaged sluices will be replaced by new one which will be constructed near the existing sluices. During replacement of drainage sluices, the drainage channels will not be clogged. But flushing inlets will be constructed 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, e.g. Pairsa, Vetki (juvenile), Chingri, Gulsa, etc., are expected to take part in drifting migration with tides through bypass channels.

432. The significance of the combined impacts have been assessed as Moderate on the basis of impact magnitude and sensitivity to receptors.

Mitigation

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

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

Residual Impacts

434. 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 **Moderate**.

8.4.7 Impacts on Benthic Fauna

Impact

435. 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 eggsand benthic organisms will be destroyed due to this intervention.

436. The significance of the combined impacts have been assessed as **Major** on the basis of impact magnitude and sensitivity to receptors.

Mitigation

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

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

Residual Impacts

439. 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

440. Embankment re-sectioning of will damage cause undergrowth vegetation both at embankment slopes and the sites from where 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 as slope protection. There are some strips of Gewa saplings beside the embankment slopes at Khalishabunia, Parshemary and Dumuria villages. These strips have been created by germination of floating seeds from nearer mangrove forest and sapling size are not more than 3m in height. However, usually all saplings of these strips are not matured lastly and villagers used this plant as their fuel source. These saplings will be cut/damaged during the re-sectioning of the embankment.

441. In addition, foreshore areas of this Polder have taken mangrove plantation programme by Climate Resilient Ecosystems and Livelihood (CREL) Project. Existing vegetation of this foreshore is suspected to damage if soil will be collected from there.

Mitigation:

442. The following measures should be implemented 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

443. With the help of above mitigation measures, the impacts associated with earth works are likely to be adequately addressed and have no residual impact.

8.4.9 Impacts on mangrove vegetation at foreshore for bank revetment works

Impacts:

444. Both of the proposed revetment reaches of the existing embankment supports mainly undergrowth, grassy vegetation. Revetment reaches near Chouddarashi Bridge followed by some strips of Bain and Kewra trees; and near Parshemari Tekerhat '*Dhanshi*' grass and seedling of *'Bain'* trees have been planted. All of these vegetation will be damaged for slope raising, placing of geo-textiles and concrete blocks. These two places experience severe erosion and the foreshore vegetation gets washed away frequently. So, considering the present situation, minor vegetation damage is expected at the proposed bank revetment sites. There is no referable vegetation at both locations of the proposed revetment sites.

Mitigation:

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

- Care should be taken to enhance plantation at nearer foreshore area (a. mudflats between Chouddarashi Bridge and starting points of bank Revetment at Ch. 23.4 km and b. mudflats at north from the Parshemari Tekerhat Kheyaghat to compensate for vegetation loss due to bank revetment.
- Implement plantation with native species along countryside slope of the embankment after finishing of construction works
- Guarding and caring for the saplings to grow, periodic weeding, monitoring regularly, replacing dead/weak saplings with new ones.

Residual Impacts

446. With the help of above mitigation measures, the impacts associated with revetment of embankment will be low residual impact.

8.4.10 Impact on vegetation at construction sites of water control structures

447. A total of 10 medium sized Rendi Koroi trees may need to be cut for site preparation of the proposed drainage sluices. Except this, no referable vegetation is suspected to be damaged for this intervention (Illustrated in following Table). 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

Structure Name		Location Name	Tree Name	Number of trees to be cut
DS2		Napitkhali	Rendi Koroi *(Albizia saman)*	2
DS4		Chalkbara	Rendi Koroi *(Albizia saman)*	1
DS5		Nildumur Haat	Rendi Koroi *(Albizia saman)*	7

Mitigation:

- 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

448. With the help of above mitigation measures, the impacts associated with construction of drainage sluice will low residual impact.

8.4.11 Impacts on foreshore ecosystem for coastal afforestation

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

Mitigation:

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

- Aware labours about plant conservation who are engaged for afforestation activities
- Keep close liaison with CREL Project Authority and Forest Department while implementation of plantation programme
- Collect saplings from near-natural sources (i.e from mangrove forest at south bank of Kholpetua River) and from nurseries of Burigoalini Forest Range 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 nursery raising and sapling plantation (i.e.: using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers)
- Pre-consultation with Forest Department and other related non-government organizations for selecting of suitable species for plantation and spacing of the saplings
- Develop a pest management plan for the holistic afforestation
- 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

451. With the help of above mitigation measures, the impacts associated with foreshore afforestation there will be no residual impact.

8.4.12 Impacts on Sundarban and Mangrove Forest

Impacts

452. Polder 15 is adjacent to the Sundarbans Reserve Forest area. But it is totally isolated by Kholpetua River to its south and western sides and by Kobadak River to its eastern and northern sides . The average width of these rivers are about 500m. So, there will be no impacts on Sundarban Reserve Forest area by the construction activities.

Mitigation Measures

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.

8.4.13 Safety and Public Health Hazards

Impact

453. The area is prone to cyclones and storm surges. Although the works will be carried out during the dry season, a certain level of safety hazards still exists for the construction staff. The construction activities will involve operation of heavy construction machinery, vehicular traffic, excavation and filling operations. These activities may pose some safety hazards to the local population as well as for the construction workers. The fuel storage at the camp sites may also pose safety hazard for the construction staff as well as for surrounding population. Inappropriate waste disposal at the camps and construction sites, and air quality deterioration caused by the Project's vehicular traffic and construction activities potentially pose health hazards 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

454. The following measures should be implemented 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 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 procedure 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, Occupational Health Safety (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;
- Provide health insurance for employees for the duration of their contracts;
- Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts;
- Develop a recruitment process community employee that involves local authorities in clearly understood procedures;
- Employ a community liaison officer (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.
    - Availability of safe drinking water will be ensured for the construction staff.
    - First aid boxes will be made available at each construction site. Emergency phone numbers (including hospitals, Fire Department, and Police) will be displayed at key locations within the site. Each site will have an ambulance available.
    - Firefighting equipment will be made available at the camps and worksites.
- Waste management plan to be prepared and implemented in accordance with international best practice.
- Liaison with the community will be maintained.

Residual Impacts

455. 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.

8.4.14 Increased Inland and Waterway Traffic

Impact

456. Transportation of construction materials is a key concern during the Project since the Polder 15 is located in a remote area of Shyamnagar Upazila under Satkhira 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 other option is waterway transportation, which is comparatively easier, cost effective and fast way. Material transportation along the major roads and waterways may not create a significant problem; however, additional traffic at smaller jetties may cause traffic congestion and hindrance to other commuters, travelers, and transporters. 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

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

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

Residual Impacts

458. 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.

8.4.15 Hindrance for Pedestrian and Vehicle Movement

Impact

459. Five main markets are located in the Polder near the embankment; these include Gabura Hat, Gainbari Hat, Dumuria Hat, Parshemari Hat and Chandnimukha Hat. These markets play an important role by providing sources of livelihood of the Polder inhabitants as well as meeting the daily needs of the people. Construction activities along the embankments are likely to disrupt 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 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

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

- 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.
- GRM will be put in place.
- 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.

Residual Impacts

461. 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.

8.4.16 Damage to Local Infrastructure

Impact

462. 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

463. The following measures should be implemented 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 impact

464. 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.

8.4.17 Social unrest between Local worker and outside worker

Impact

465. A large numbers of skilled and unskilled labors will be required for construction activities. Most of the labor will be needed for re-sectioning of embankment and retired embankment. It is envisaged that about 60 percent construction workers will be recruited from within the Polder while the remaining will come from other areas. The presence of outside laborers in the area may create 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.

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

Mitigation

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

- Proper awareness programs should be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, Upazila Nirbahi Officer (UNO) and BWDB local officers.
- Liaison with the communities should 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.
- The Contractor will provide proper housing for his staff at site with adequate facility securing neighbours' safety.
- The Contractor will prepare a code of Contact for his staff showing respect to comply with and custom or cultural norms.

Residual Impacts

468. 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.

8.4.18 Seasonal Impacts due to natural hazards

469. 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 while most of the cyclone and storm surges are occurred in this area. According to previous record of occurred cyclone and storm surges, October to November and April to May is peak month of occurrence of cyclone and storm surges. It is suspected that the construction activities during this period may hamper as well as workers may get injured.

Mitigation

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

- 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, and emergency are in place.

Residual Impacts

471. 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.

8.4.19 Impact of manufacturing of CC block

472. For rehabilitation of Polder 15 under CEIP-1, only 1.3 km slope protection work will be undertaken. The automated CC Block manufacturing plant will not be required. The CC blocks will be made manually.

473. However, there will some of the impact of the activities like generating dusts, risks of accidents, possibility water and soil pollution, generation of noise etc.

Mitigations

- Sprinkling of water will be ensured to control dusts when required
- Ensuring use of Personal Protective Equipment (PPE) by the workers
- Ensuring proper management of wastes and waste water.
- Ensuring proper quality of equipment/ vehicles to reduce noise level

8.4.20 Impacts during Post-construction Phase

474. Both negative and positive impacts during post-construction-phase are described in the following sections:

(a) **Positive Impact of the Project**

8.5 Protection from tidal flooding and storm surges

Impact

475. The proposed re-sectioning and retirement of embankment with new design section by CEIP considering 5th IPCC (2013) predicted global sea level rise will protect the Polder area significantly from tidal flooding and further storm surges. At present about 70% of the embankment is under designed section and extremely vulnerable condition at Jalakhali, Parshemari, Chandnimukha, 10 no. Sora, Chakbara, Dumuria, Gabura areas of the Polder which will be protected noticeably after implementation of the proposed interventions under CEIP.

476. The significance of this potential positive impact has been assessed as **Major** on the basis of impact magnitude.

8.5.1 Erosion protection

Impact

477. 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 river bank erosion. Besides, proposed afforestation along the rivers at proposed locations will also protect the Polder from the river erosion of 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.

478. The significance of this potential positive impact has been assessed as **Major** on the basis of impact magnitude.

8.5.2 Improve drainage system

Impact

479. 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 improve significantly. The conveyance capacity of the khals will be increased and that will also increase water retention capacity of the Polder area. Consequently, the cropping pattern will be increased while presently about 70% of the Polder net area is covered by shrimp culture ghers. Drainage congestion in Chakbara, Dumuria, Sora and Chandnimukha khal during monsoon will be removed and drainage pattern will be smoother than present condition.

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

8.5.3 Protection from salinity intrusion

481. According to the proposed intervention, re-sectioning and retired embankment 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 70% of the net area of the Polder is occupied by shrimp culture ghers. It is very important to operate the sluices properly so that WMOs would be formed in the Polder and took over the maintenance and operation of the sluices adequately to protect saline water intrusion.

8.5.4 Change of cropping pattern and intensity

482. Presently, cropping intensity of the Polder area is 102%. According to the proposed intervention, the polder would protect from tidal and monsoon flooding and will arrest salinity intrusion and would remove drainage congestion in the polder area. Besides, drainage congestion will be significantly reduced due to re-excavation of internal khals of the polder area as per proposed plan. Due to improved situation, farmers of the respective areas would encourage to cultivate more crops in their lands. Thus, it is expected that cropping intensity would 104% in the polder area in future **(Table 8.5).** So, cropping intensity of the polder area would change 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	11	4
	Fallow	HYV Aman	Fallow	207	76

	Fallow	Lt.Aman	Fallow	54	20
			Total	**272**	**100**

Source: Filed information; 2015

8.5.5 Increase crop production

483. Presently, total cropped area is about 277 ha (NCA 272 ha) which is totally occupied by rice crops. If the project is not implemented and the area remains same as baseline or may be due to reduction of salinity problem. 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 779 tons crop would be produced which is rice. Adverse impact might 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

Baseline/FWOP				FWIP					
Crop name	**Crop area(ha)**	**Yield (m.tons /ha)**	**Production (m.tons)**	**Crop area(ha)**	**Yield (m.tons/ha)**	**Production (m.tons)**	**Impacted area(ha)**	**Imapcted production (m.tons)**	**% Change of production**
Lt.Aman	68	2.01	137	54	2.30	125	-14	-12	-8
HYV Aman	204	3.02	615	218	3.20	696	14	81	13
Hybrid Boro	5	5.03	27	11	5.30	58	5	30	111
Total	277		779	283		879	5	100	13

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

484. The cropped area would change if the project is implemented. The cropped area would be about 283 ha which is totally occupied by rice crops. The crop production might be boosted up significantly under the FWIP condition. The total crop production would be about 879 tons. Rice production would increase mainly due to protection of agricultural land from river bank erosion, construction of structure and repair/replaced of structure which adoption of modern technology in crop production, change in cropping pattern, etc. Production would increase due to expansion of HYV Aman HYV, HYV Boro HYV, Orchard, and vegetables cultivation area. Additional 100 tons (13% positive change) of rice would be produced in FWIP over FWOP (Table 6.5).

Impact

485. Increase in agriculture production, reduction of drainage congestion, income generation is expected to improve the livelihood of the people. Maximum people of the Polder area would be benefited (income increase) with the increase of crop production where very few people are taking benefits from shrimp farming.

Enhancement

486. The following measures should be implemented to make project more beneficial to peoples:

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

8.5.6 Enhance Fish Habitat condition

487. Bank protection works especially dumped geobags completely to cover the benthic zone of the river bank slope that might have an impact on benthic habitats. The impacts on benthic zone are local, short term, and reversible. It is reported that the siltation over the geobags covers the dumped geobag within a year and restores the benthic habitat. However, the proposed bank protection works at different locations (chainage km 8.6 to km 8.8 and 23.4 to km 23.7) of periphery rivers of the Polder will 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.

488. The significance of this localized impact has been assessed as **Moderate** on the basis of impact magnitude and sensitivity.

Enhancement measures

- Harmful fishing gears like gill net (Current Jal) and Net jal (used in the inlet of sluice) should be stopped in the Polder area.
- Drainage within the Polder and exchange of water to & from the peripheral rivers to be maintained.

8.5.7 Impacts on foreshore area for afforestation

489. Implementation of foreshore afforestation programme of this project will mitigate negative impacts associated with tree felling. Consequently, it will enhance mangrove vegetation regeneration and coverage surrounding the Polder that is expected to protect embankment from tidal surge, reduce erosion of foreshore land and provide habitats especially for various avifauna and substrate for the algae that is eaten by fishes.

8.5.8 Employment Generation

490. The construction work will generate a significant amount of employment over its construction period for local people and other associated professionals. People will also be involved in carrying operation and maintenance related jobs to operate the hydraulic structures. It is expected that agriculture production will increase; water logging will decrease due to the project which will create jobs indirectly from 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.

8.5.9 Gender Promotion

491. Construction work requires various types of skilled and unskilled labors. It is found that in Bangladesh, a portion of construction labors are female. In the Polder, females are vulnerable to natural disaster and mostly distressed and widows who are dependent on others and do not have any definite source of income. But the construction activities give them a new window for employment. Therefore, employment access to them during the construction works and operation/maintenance phase is significantly positive for gender promotion.

8.5.10 Livelihood Development

492. Polder 15 was one of the worst affected Polders during cyclone Aila. The project is expected to increase resilience of people within Polder 15. On the other hand, intrusion of saline

water for shrimp cultivation decreases employment opportunities in the area. But it is expected that the intervention may increase agriculture production and income generation which will improve the livelihood of the people.

8.5.11 Social Use of Water

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

8.5.12 Disaster incidence

494. The study area being nearest to the Bay-of-Bengal, natural disaster often hits this area as well as without having any protection measure, the people of this locality are very much vulnerable. There is no protection of lives and properties from different natural disaster. After implementation of the project the Polder will protect them directly from different natural disasters, e.g., tidal surge, river erosion, flooding, etc.

8.5.13 Seasonal out-migration

495. Lack of employment opportunities induce out-migration, which is most frequent in the area. It is expected that with the current project intervention seasonal out migration of day laborers from this Polder may reduce due to creation of employment opportunities in agriculture and other sectors respectively. However, the scale of this out migration will be low as well as in migration in crop harvesting may increase.

(b)Negative Impact of the Project

8.5.14 Increase Salinity Intrusion due to Leakage of Regulators

Impact

496. The proposed project has also been designed to protect salinity intrusion through the embankment construction of drainage sluices from the rivers Kholpetua and Kobadak Rivers. These interventions will help expand the cultivation of crops during dry season. According to coastal polders experiences, disoperation and leakage of sluices result in salinity intrusion during dry season causing contamination to the soil, water resources, and crops in the Polder. If the regulators will not be monitored and operated by the BWDB after project completion then salinity intrusion due to disoperation and leakage of sluices will be initiated in future.

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

Mitigation

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

- 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 should be prepared and implemented for the water control structures. These procedures should be translated in bangle as well.
- Capacity building of WMOs should be carried out.

Residual Impacts

499. 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**.

8.5.15 Increase use of agro-chemicals

Impact

500. At present, about 5 ha and 204 ha of land are under Boro and Aman rice cultivation respectively. Shrimp culture practices are dominating here due to saline water. After the fulfillment of intervention at Polder area agricultural practices covered land would increase instead of shrimp farming. Regular agriculture practices cause reduction of the soil fertility and increased use of agro-chemicals.

501. Presently, 81,985 kg of chemical fertilizers is required for cultivation of Boro and Aman rice. The pesticide requires for total rice production is 1,055 kg (Granular) and 136,350 ml (Liquid). According to the initial estimates, non saline water would be available from the internal canal system, after the completion of the proposed Project and also reduction in the salinity problem of entire Polder area. This would allow expansion of area under irrigated cultivation of Boro and also increase Aman rice production. This expansion of irrigated cultivation is likely to result in decreased soil fertility and increased use of chemical inputs including fertilizers and pesticides. Due to expansion of Boro and Aman cultivation, additional about 8,370 kg of chemical fertilizers and pesticide is 112 kg (Granular) 13,600 ml (Liquid) would be required for crop production in future (**Table 8.7**). Runoff from such cultivation 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

Crop name	Present cultivate area(ha)	Fertilizer required (kg/ha)	Granular pesticides required kg/ha	Liquid pesticide required ml/ha	Total Fertilizer required(kg)	Total granular pesticides 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)	Impact		
													Fertilizers(kg)	Pesticides(kg)	Pesticides(ml)
HYV Aman	204	390	5	650	79,560	1,020	132,600	218	14	85,020	1,090	141,700	5,460	70	9,100
Hybrid Boro	5	485	7	750	2,425	35	3,750	11	6	5,335	77	8,250	2,910	42	4,500
Total	**209**				**81,985**	**1,055**	**136,350**	**229**	**20**	**90,355**	**1,167**	**149,950**	**8,370**	**112**	**13,600**

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

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

Mitigation

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

- Capacity building and awareness rising of the farmers should be carried out to practice Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) in order to minimize usage of chemical inputs.
- Farmers group should have close contact with DAE for adoption of various measures of ICM and GAP.
- Farmers should be encouraged to use organic and green manure to increase soil fertility while avoiding water contamination.
- Farmers should be encouraged to cultivate leguminous crops (N_2 fixing) to enhance the soil quality as well as soil productivity.

Residual Impacts

503. 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**.

8.5.16 Reduced Fish Migration Time and Extent

Impact

504. The mal-function drainage sluices in the Polder area are still facilitating the migration of *Pairsa, Vetki, Gulsha,* and *Tengra* fishes and *Chingri* 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. Thus, the improved drainage sluices would hamper the migration behavior of above mentioned fish species. Moreover, the migration of *Pairsa, Vetki, Gulsha, Tengra, and Chingri* would be very restricted with the replacement of the proposed drainage sluices.

505. The significance of the combined impacts have been assessed as **Moderate** on the basis of impact magnitude and sensitivity to receptors.

Mitigation

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

- Knowing the exact migration period
- Proper sluice gate operation allowing fish migration;
- Provide training to WMOs regarding fish-friendly gate operations; and
- Transferring juvenile fish from rivers to Polder.
- Restrict the use of mono-filament net and other destructive gears during the breeding and migration period.

Residual Impacts

507. 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 to some extent.

8.5.17 Impact on Shrimp farming and Livelihood

Impact

508. Shrimp farming is a common practice in this Polder area. According to field visit and consultation with local people that shrimp gher (bagda gher) occupy 85% of total NCA of the Polder. A significant number of farmers are involved in shrimp farming in this are because it is more profitable than paddy. Shrimp export contributes significantly to the local and national economic development, employment and income generation as well as livelihood improvement. However, after implementation of the proposed intervention, saline water intrusion by embankment and water control structures will also be reduced significantly within the project area; the drainage system will be improved. As a result, rice area will be increased compared to its base condition. It is expected that shrimp farm area may be impacted due to reduction in saltwater intrusion. Thus, fish production from shrimp gher may be declined. The livelihood of the shrimp farmers will be impacted.

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

Mitigation

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

- Prospective of Golda farming should be encouraged through campaigning and by providing training on improved culture practices as well as rice-cum-golda farming within available sweet water;
- Alternative income generation, i.e., livestock rearing, poultry and integrated fish culture may create scope of alternative income for shrimp farm labour;
- Shrimp farming is suitable and profitable for only rich farmer but not for landless people, marginal and small farmer. Considering poverty reduction the proposed CEIP project will be very helpful for landless people, marginal and small farmer as a whole.

Residual Impacts

511. 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 **Moderate**.

8.5.18 Risk of Embankment Failure

Impact

512. Rain cuts, wave action, tidal surge and public cuts are the major causes of embankment breaching of the coastal region. Lack of regular maintenance has created weak points at the sensitive locations of the embankment. Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously have accelerated the risk of embankment failure. Counter clockwise circulation of the cyclone of the Bay of Bengal will make the embankment too more susceptible to breaches. On the other hand, hand tube-wells, which is locally known as ninety tube-well, have been installed at the crest of the embankment by gher owners for lifting saline water to satisfy the water demand for shrimp cultivation which has seriously weakened the embankment increasing the risk of embankment failure.

Mitigation

513. The following measures should be implemented 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 should be ensured. This monitoring should particularly be carried out before and after monsoon season.
- Prevent installation of hand tube-wells at the crest of the embankment.
- Maintain regular liaison with the local community members including gher owners/managers advocating for the protection/maintenance of the embankment
- Available cyclone and flood shelter should be prepared as a contingency measure during emergency situation.
- WMG should develop a fund for this kind of emergency situation.
- Structural measures like geo bag and sand bag should be kept in stock yard of local BWBD colony.

Residual Impacts

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

8.5.19 Increase Salinity Intrusion Due to Leakage of Regulators

515. 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

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

- Regular monitoring and careful maintenance of the water control structures will be ensured.
- Standard operating procedures should be prepared and implemented for the water control structures. These procedures should be translated and printed in Bangla and distributed to all and also discussed during meetings with the local community members/gher owners/managers.
- Capacity building of WMOs should be carried out.

Residual Impacts

517. 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.

8.5.20 Summary of Assessed Impacts

518. A summary of these impacts and their significance discussed in the above sections is presented in **Appendix-I**.

8.6 Impacts from CC block Manufacturing Plant

519. 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.

8.6.1 Operation phase

520. 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

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

- Beneficial Impacts
- High negative (adverse) impact

- Moderate negative impact
- Low impact

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

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

8.6.2 Beneficial impacts

524. 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.

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

8.6.3 Negative impacts

8.6.4 Emissions to air and ambient air quality

Potential Impacts

526. 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

527. 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.

Pollution prevention and control techniques for the reduction of SO2 and NOx 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)

528. 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.

529. Greenhouse Gas (GHG) Emissions and Energy Use. Greenhouse gas emissions, especially CO2, are mainly associated with the use of energy in the plants. Reference is made to the above measures to reduce SO2 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.

Residual impact

530. 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.

8.6.5 **Noise**

Potential Impacts[15]

531. 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 isnot close to residential areas these impacts on nearby communities are considered low to moderate.

Mitigation

532. 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.

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

- 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

533. 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.

Monitoring

534. 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	Daytime07.00 – 22.00	Night-time22.00 – 07.00
Residential, institutional, education	55	45
Industrial, commercial	70	70

8.6.6 Waste Management

Potential Impacts

535. 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

536. 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.

537. 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

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

8.6.7 Contaminated Land and Hazardous Materials Management

Potential Impacts

539. 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.

540. 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

541. 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.

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

Residual impact

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

8.6.8 Occupational Health and Safety(OHS)

Potential Impacts

544. 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

545. 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.

546. 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:

547. 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).

548. 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).

549. 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.

550. 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

551. Implementing the mentioned mitigation measures will mitigate the impacts to low.

8.6.9 Community Health and Safety

Potential Impacts

552. Potential impacts related to community health and safety for the CC block plant entails mainly traffic related hazards.

Mitigation Measures

553. 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.

8.6.10 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.

8.7 Decommissioning phase

554. 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.

8.7.1 Environmental

555. Air Quality, Noise and Vibration

Potential Impacts

556. 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.

Due to the limited size of the plant area the potential impacts on the environment during decommissioning is considered to be low.

8.7.2 Solid waste and contaminated land

Potential Impacts

557. 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.

558. 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.

559. 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

560. Implementing proper waste management as described above will lead to low residual impacts

8.7.3 Surface water

Potential Impact

561. 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

562. 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

563. Implementing the mentioned mitigation measures will mitigate the potential impacts to low.

8.7.4 Occupational and community health and safety

Potential Impacts

564. 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

565. 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

566. Implementing the mentioned mitigation measures will mitigate the potential impacts to low.

9. CUMULATIVE IMPACTS

9.1 Cumulative Impact

567. 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.

568. 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.

569. 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.

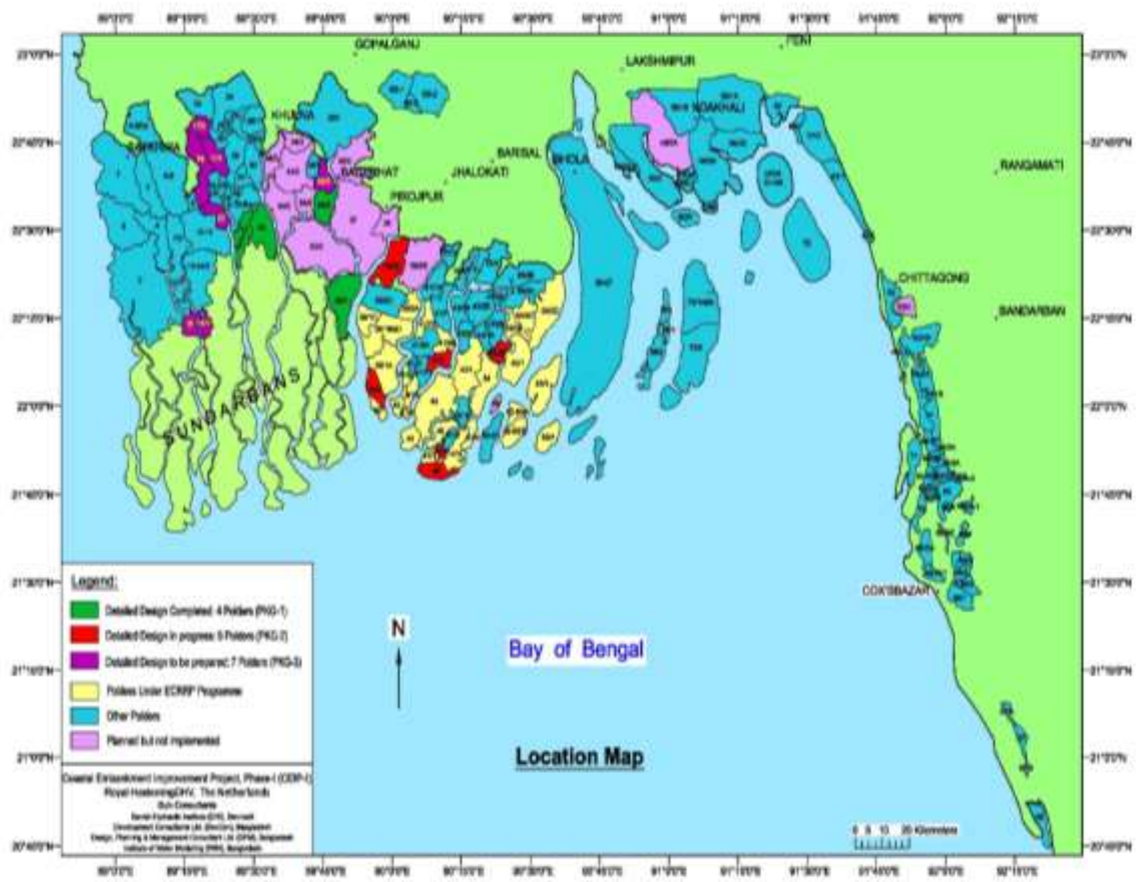
570. Several existing, on-going and planned projects also exist in this region. Such projects may have impact on the hydrological network, life and livelihood of people, environmental quality, natural ecosystem, flora-fauna, etc. of Polder 15 This Chapter attempts to analyze several indirect effects regarding several existing and ongoing project, as well as the implementation of different interventions proposed in Polder 15 under Coastal Embankment Improvement Project-1 (CEIP-1).Besides, necessary mitigation measures based on analysis of cumulative impacts are proposed.

9.2 Proposed CEIP-1 intervention on Polder- 15

571. 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- 15

572. Apart from CEIP interventions, there are some other development projects in the region of Polder 15, implemented locally or regionally. Activities of these projects may have moderate to low impacts on the Polder in future. **Table 9.1** below shows a list of various projects in relevance with Polder 15, undertaken by different line agencies in Khulna, Bagerhat and Satkhira districts.



Map 10.1: Locations of polders under CEIP-1

Table 9.1: List of water management projects

Agency	Project Name	Duration	Location	Sensitivity
National				
MoDMR	Comprehensive Disaster Management Program (CDMP), Phase II	2010-ongoing	Entire country	Negligible
BWDB	Projects under Climate Change Trust Fund	2013-ongoing	Entire country	Low
	Water Management Improvement Project (WMIP)	2010-ongoing	Entire country	Low
Regional				
BWDB	Blue Gold Program	2013-ongoing	Coastal zone	Low
	Coastal Embankment Rehabilitation Project (CERP)	1995-2004	Coastal zone	Negligible
BFD	Marine Shrimp Culture Technology	1998-2004	Coastal zone	Moderate
Local				

Agency	Project Name	Duration	Location	Sensitivity
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

573. The Kholpetua River is flowing along the total south-western part of the Polder even slightly in the north direction. In addition, the Kobadak River passes along the North and East direction of the Polder (Map 4.1). The average existing crest level of the Polder is 4.27 mPWD. The design crest level of the Polder due to proposed interventions (i.e., re-sectioning) is 4.50 mPWD. Slope protection and bank protection works are also proposed for this Polder. These interventions would reduce the effect of storm surge and overtopping of peripheral rivers into the Polder. However, under CEIP-1, Polder- 14/1 is situated very adjacent (North-east direction) to the Polder-15 which has also some proposed interventions. The proposed design crest level of the Polder-14/1 is same (4.50 mPWD) as 15. As the proposed interventions of Polder- 14/1 will reduce the storm surge effect of itself, there may be slight chances to divert the storm surges to the western portion of Polder- 15. Overtopping may occur into Polder 15 at the western portion by Kobadak River due to induced pressure of Polder- 14/1. Existing salinity intrusion problem may be increased by strong flow of Kobadak River through Chakbara and Sora khal inside the Polder. However, in the embankment chainage 15+500 to 16+500 is more vulnerable that may cause severe overtopping and salinity intrusion problem in future. Other CEIP Polders are far away from Polder- 15 so they have no impact on it.

9.4.2 Impact on Flora and Fauna of Sundarban

574. The total South and partially South-East portions of Polder 15 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 15, 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

575. 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 Satkhira and 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

576. The socio-economic condition of Polder -15 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 15

577. 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 Impacts on fish migration and biodiversity

578. The successive siltation in peripheral rivers and canals of Polder 15 may hamper fish migration. In course of time, fish migration may be fully or partially obstructed in the polder area due to siltation. As a result, the fisheries biodiversity for both fresh and brackish water may marginally decrease. Due to protection of polder from flood water, water will move towards the upstream of outside rivers during high tide. This increased volume of water will enhance fish migration in that water body. Consequently, fish migration of surrounding canals will be improved. In future, the salinity tolerant fish species will dominate while fresh water fish species may decrease.

Mitigation Measures:

- Capital dredging as well as maintenance dredging and river bank protection should be under taken to mitigate the diverse impact.
- Gate operation plan should be maintained considering fish migration period.
- Internal khals linked with Outside River should be re-excavated.
- Prawn culture instead of shrimp culture should be introduced in the polder area
- Crest level 4.5m PWD nee 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 rehabilitee 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 Impacts of Marine Shrimp Culture Technology

579. In 1998, the Department of Fisheries (DOF) extended the culture technology of marine shrimp on macro scale in Khulna, Bagerhat, Sathkhira and Cox's Bazaar. However by that time the popularity of shrimp culture had already spread at local level. Shrimp culture in Polder 16 during dry season is a very common practice like in other surrounding polders. The shrimp culture is not labor intensive, thus creates more unemployment problem. In the dry season, a number of places in the embankment were cut down to allow the entry of saline water through existing different khals., which reduced the strength of the embankment by creating weak points. One notable positive impact of shrimp culture in Polder 15 is that it initiated a financial revolution of the Polder area however, it has become a monopoly business. By now, the local people have fallen in an ambivalent situation that they are suffering by loosing agricultural land and increased shrimp culture in their land. Moreover, there are some negative environmental impacts, i.e., flora and fauna due to overtopping of saline water from shrimp culture ponds.

9.4.8 Reciprocal Impact

580. Reciprocal impacts of Polder 15 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.

581. 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 with an increase in rainfall of 178% considering climate change for the simulation for the existing drainage system.

582. From the simulation, flood free (FF) areas and F0 (0~0.3m) areas cover about 33% and 40% of the polder area, respectively, without considering climate change. The fulfilment of the overall drainage criteria requires about 85% to 90% are FF and F0 land, whereas only 73% of FF and F0 land was found from the simulation without climate change.

583. Considering the climate change scenario FF and F0 land cover are reduced to 17.58% and 19.92% respectively. However, F1 land class (water depth .03m to 0.9m) increases from 27.41% to 62.13%. It indicates that the drainage channels have not proper storing capacity to resist the future climate condition and needs further attention to obtain a climate resilient polder management.

584. The newly developed, calibrated and validated Bay of Bengal Model has been applied for the study of storm surge modelling. 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 0.17 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	2.19	2.36	0.17
25	2.59	2.67	0.08
50	2.89	2.89	0.00
100	3.18	3.12	-0.06
Sidr	3.67	-	-
Aila	3.28	-	-

585. 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 15 are 24.33, 34.36, 41.40

and 48.26 m/s whereas during Sidr and Aila the wind speeds were 34.27 and 18.79 m/s respectively.

586. Wind speed for 25 years return period is used for determining the wave height considering climate change. The wave height simulated for polder 34/3 is 0.32 m.

587. The South West Regional Model (SWRM) has been calibrated and validated using annual maximum monsoon water levels 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 2.71, 2.78, 2.84 and 2.88 m + PWD without considering climate change. Water levels considering climate change are 3.19, 3.29, 3.36 and 3.43 m+PWD, respectively.

588. 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 Poldervary from 3.47 to 4.33 m+PWD. So the present crest level is not sufficient to address the future climate changeand 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 15.

10. ENVIRONMENTAL MANAGEMENT PLAN

589. This Chapter presents the Environmental Management Plan (EMP) for the CEIP-1 activities in the Polder-15. The EMP essentially provides the implementation mechanism for the environmental and social mitigation measures discussed in Chapter 7.

10.1 Objectives of EMP

590. The basic objective of the EMP is to manage, prevent, and mitigate potential adverse impacts of Project interventions in the Polder- 15. The specific objectives of the EMP are to:

- Facilitate the implementation of the environmental and social mitigation measures identified during the present EIA and discussed in **Chapter 7**.
- Assign responsibilities of project proponent, contractors, consultants, and other members of the Project team for the environmental and social management of the Project;
- Define a monitoring mechanism and identify monitoring parameters to ensure effective implementation of the mitigation measures.
- Assess environmental training requirements for different stakeholders at various levels.
- Describe communication and documentation requirements.

10.2 EMP Components

- 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

591. These components are discussed in the following Sections:

10.3 Institutional Arrangement

592. Clearly defined and functional institutional arrangements are essential for ensuring effective and sustainable implementation of the EMP, particularly the mitigation measures identified in the EIA. An Organogram showing the institutional setup of CEIP-1 including organisation for implementation and monitoring of the EMP is shown in **Figure 10.1.**

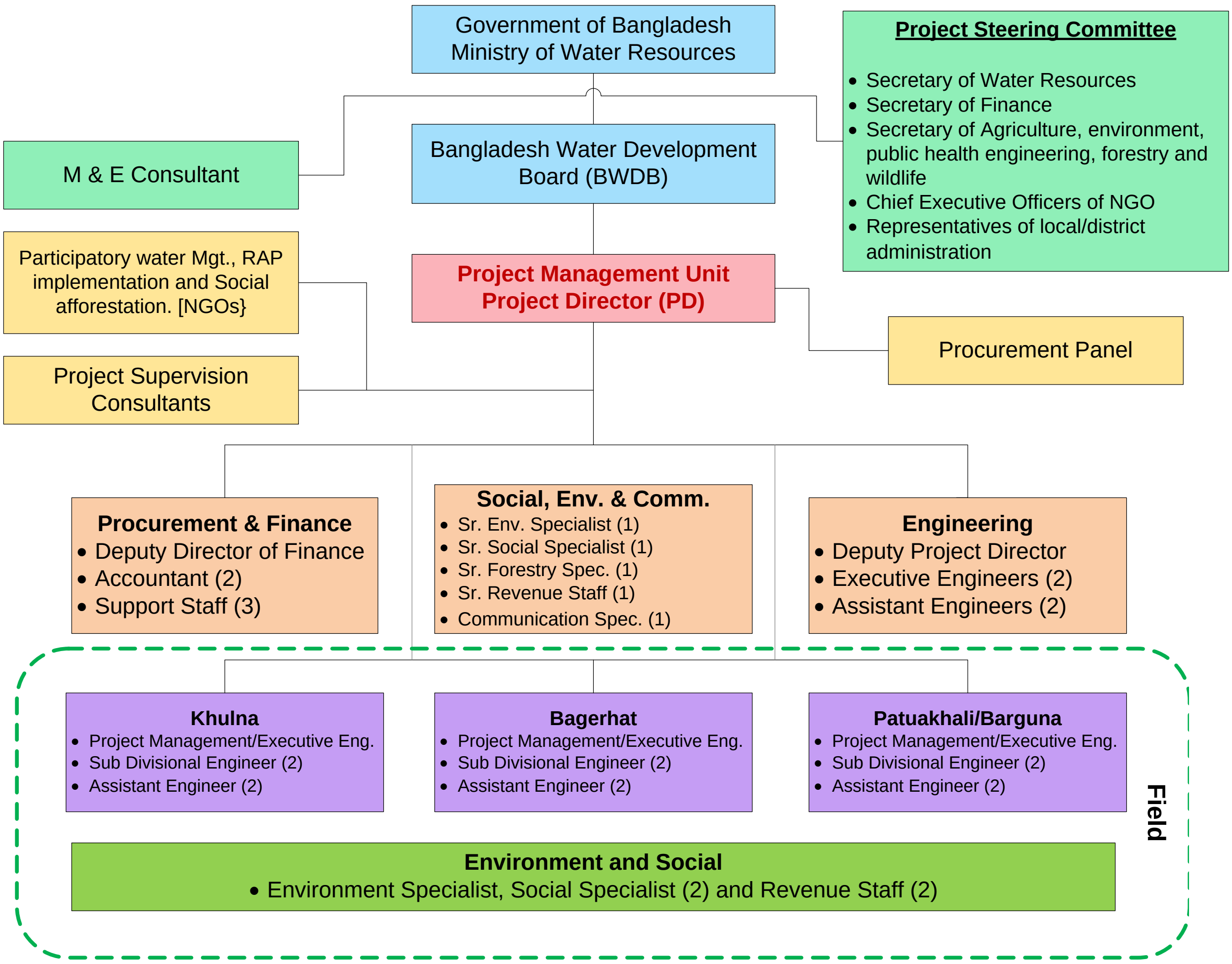


Figure 10.1: Organogram showing the institutional setup for CEIP-1

593. The institutional arrangements proposed to implement the EMP of Polder 15 are described below.

594. IPoE will review the updated report and will also guide to ESCU for further improvement of the monitoring report.

10.3.1 Overall Responsibility

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

595. 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 CommunicationUnit (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.

596. 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)

597. 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.

10.3.3 Contractor's Environment Supervisors

598. The construction contractors will have adequate number of dedicated, properly qualified and experienced, site-based DDCS&PMSC (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. The ESs will also be responsible to conduct environmental trainings for the construction crew.

10.3.4 Post-construction Phase

599. The BWDB monitoring unit has post of 4 Assistant Chief and 2 Deputy Chief 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 happen to ensure environmental compliance during the O&M after the project completion. These staff will be responsible to manage the environmental aspects of the operation and maintenance of Polder, its water control structures, and other relevant issues such as protection of key environmental resources of the 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

600. Mitigation is an integral part of impact evaluation. Where mitigation is deemed appropriate; a proponent should strive to act upon effects, in the following order of priority, to:

- Eliminate or avoid adverse impacts, where reasonably achievable.
- Reduce adverse impacts to the lowest reasonably achievable level.
- Regulate adverse impacts to an acceptable level, or to an acceptable time period.
- Create other beneficial impacts to partially or fully substitute for, or counter-balance, adverse effects.

601. Mitigation measures should be considered starting with Environmental Assessment process. It is important therefore, that there is good integration between the EIA team and project design engineers. Project specific environmental construction guidelines should be developed. These guidelines will specify precautions and mitigation measures for construction activities, and to be included with the EMP.

602. Impacts identified severe in consequence category and or likelihood category will be further analyzed to identify additional mitigation measures that are potentially available to eliminate or reduce the predicted level of impact. Potential mitigation measures will include:

- habitat compensation program
- species specific management program
- engineering design solutions
- alternative approaches and methods to achieving an activity‘s objective
- stakeholder’s participation in finalizing mitigation measures
- construction practice, including labor safety and welfare measures.
- operational control procedures
- management systems

603. 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.

Table 10.1: Mitigation plan during pre-construction, construction and operation phases

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
A. Pre-construction Phase			
Deteriorated environmental (air and noise) quality	• 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	Contractor	DDCS&PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	materials during day time instead of night. • Exhaust emissions from trawler and equipment should comply with the standards of DoE. • Sprinkling of water and ramming the materials of stockyard and approach roads regularly. • Stockyard should be covered during non-working period.		
Changes in land use	• All the construction camps should be established within the area owned by BWDB. • Pay compensation/rent if private property is acquired on temporary basis, which instructions should be specified in the tender document. • Labor shed/camp should be constructed on government Khas land. • Avoid direct confrontation with local stakeholders.	Contractor	DDCS&PMSC, M&E Consultant and BWDB
Clearances of vegetation	• Avoid vegetation damage as much as possible to select sites for labour shed and material stock by using nearer fallow land or barren homestead yards • Give proper compensation to the tree owners against tree felling specially for fruit yielding trees (List of affected tree will be finalize after getting RAP Report) • Implement tree plantation at the	Contractor	DDCS&PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	damaged sites after completion of construction works.		
Increased Vehicular Traffic during mobilization	• The contractor will prepare a traffic management plan (TMP) and obtain approval from the Detailed Design Construction 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 Gabura Hat, Gainbari Hat, Dumuria Hat, Parshemari Hat and Chandnimukha Hat. • 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	Contractor	DDCS&PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	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 movement pattern and management system for the local stakeholders by using multimedia presentation and showing video at different common population gathering places of the Polder area.		
B. Construction Phase			
Deteriorated environmental	• Construction machineries should	Contractor	DDCS&PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
(air and noise) quality	have proper mufflers and silencers. • 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. • 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. • Sprinkling of water and ramming of the material 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. • 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		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	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. • Bailing out of water behind the earthen dams during construction work. • Both contractor and BWDB should supervise the construction work and built temporary and demolish the same after completion of the construction.	Contractor	DDCS&PMSC, M&E Consultant and BWDB
Effects on crop production	• Resettlement Action Plan should be prepared and should also be implemented accordingly • Compensation should be paid for any crop damage. • Contractor should avoid cultivation fields during construction. • Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps construction. • Contractor should ensure that no vehicular movements take place inside cultivation fields. • Contractor should ensure that no material is dumped inside cultivation fields. • Re-excavated soil of canals should not be damp in agricultural land.	Contractor	DDCS&PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Contractor should maintain liaison with communities.		
Effects on irrigation	• Contractor should construct bypass channel before construction/ replacement/ demolished of each regulator. • Sequence of work at the regulators and in the water channels should be carefully planned to avoid irrigation disruption. • Contractor should ensure no negative impacts on crop irrigation. • Contractor should maintain liaison with communities. • Contractor should work during dry season.	Contractor	DDDCS&PMSC, M&E Consultant and BWDB
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 condition to minimize impacts on spawning and subsequently nursery ground of fish. • Contractor will maintain liaison with experienced local fishermen. •	Contractor	DDCS&PMSC, M&E Consultant and, BWDB
Impact on fish habitat and migration	• Construct diversion channels before construction of regulator considering fish migration period e.g. May, June , July and August	Contractor	DDCS&PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• 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		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	could realize the issue for minimum impact to the shrimp farming and paddy cultivation.		
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 from barren land and alternate source like riverbed or nearer barrow pits at countryside as much as possible • Keep close liaison with CREL Project Authority and Forest Department while implementation of earth works • Create plant strips with same damaged species at the toe of the embankment after completion of earthwork • Proper turfing on embankment slopes with local grasses (i.e Durba (Cynodon dactylon) , Mutha (Cyperus rotundus)) and ensure regular monitoring of turf grasses till they matured	Contractor	DDCS&PMSC, M&E Consultant and 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	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	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		
Impacts on mangrove vegetation at foreshore for bank revetment	• Care should be taken to enhance plantation at nearer foreshore area (a. mudflats between Chouddarashi Bridge and starting points of bank Revetment at Ch. 23.4 km and b. mudflats at north from the Parshemari Tekerhat Kheyaghat to compensate for vegetation loss due to bank revetment. • Implement plantation with native species along countryside slope of the embankment after finishing of construction works • Guarding and caring for the saplings to grow, periodic weeding, monitoring regularly, replacing dead/weak saplings with new ones.	Contractor	DDCS&PMSC, M&E Consultant and BWDB
Impact on vegetation at construction sites of water control structures	• Implement plantation at sluice ground and nearer foreshore mudflats after completion of construction works	Contractor	DDCS&PMSC, M&E Consultant and BWDB
Impacts on foreshore ecosystem for	• Aware labours about plant conservation who	Contractor	DDCS&PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
coastal afforestation	are engaged for afforestation activities • Keep close liaison with CREL Project Authority and Forest Department while implementation of plantation programme • Collect saplings from near-natural sources (i.e from mangrove forest at south bank of Kholpetua River) and from nurseries of Burigoalini Forest Range as much as possible • All kinds of polyethylene bags and plastic ropes should be piled up in a pit for dumping or burned in a proper way • Care should be taken for physical and biological control of plant disease while nursery raising and sapling plantation (i.e.: using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers) • Pre consultation with Forest Department and other related non-government organizations for selecting of suitable species for plantation and spacing of the saplings • Develop a pest management plan for the holistic afforestation		
Safety and Public Health Hazards	• The contractors will prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the	Contractor	DDCS&PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	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,		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	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 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		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	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		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	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		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	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. • Availability of safe drinking water will be ensured for the construction staff. • First aid boxes will be made available at each construction site. Emergency phone numbers (including hospitals, Fire Department, and Police) will be displayed at key locations within the site. Each site will have an ambulance available. • Firefighting equipment will be made available at the camps and worksites. • 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.		
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 night time 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, BWDB
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	Contractor	DDCS&PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	consultation with local community. • GRM will be put in place.		
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
Social unrest between Local worker and outside worker	• Proper awareness programs should be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, Upazila Nirbahi Officer (UNO) and BWDB local officers. • Liaison with the communities should 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.	Contractor	DDCS&PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Respect for the local community and its cultural norms in which laborers are working. • 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, 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, and emergency are in place.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Impact of manually manufacturing of CC block	• Sprinkling of water will be ensured to control dusts when required • Ensuring use of Personal Protective Equipment (PPE) by the workers • Ensuring proper management of wastes and waste water.	Contractor	DDCS &PMSC, M&E Consultant and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Ensuring proper quality of equipment/vehicles to reduce noise level		
C. Post Construction/Operation Phase			
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 should be prepared and implemented for the water control structures. These procedures should be translated in bangle as well. • Capacity building of WMOs should be carried out.	BWDB	BWDB
Increase use of agro-chemicals	• Capacity building and awareness rising of the farmers should be carried out to practice Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) in order to minimize usage of chemical inputs. • Farmers group should have close contact with DAE for adoption of various measures of ICM and GAP.	BWDB	BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Farmers should be encouraged to use organic and green manure to increase soil fertility while avoiding water contamination. • Farmers should be encouraged to cultivate leguminous crops (N2 fixing) to enhance the soil quality as well as soil productivity.		
Reduced Fish Migration Time and Extent	• Knowing the exact migration period • Proper sluice gate operation allowing fish migration; • Provide training to WMOs regarding fish-friendly gate operations; and • Transferring juvenile fish from rivers to Polder. • Restrict the use of mono-filament net and other destructive gears during the breeding and migration period.	BWDB	BWDB
Impact on shrimp farming and livelihood	• Prospective of Golda farming should be encouraged through campaigning and by providing training on improved culture practices as well as rice-cum-golda farming within available sweet water; • Alternative income generation, i.e., livestock rearing, poultry and integrated fish culture may create scope of alternative income for shrimp farm labour;	BWDB	BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Shrimp farming is suitable and profitable for only rich farmer but not for landless people, marginal and small farmer. Considering poverty reduction the proposed CEIP project will be very helpful for landless people, marginal and small farmer as a whole.		
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

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 50m 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** • 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	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

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Management of Excavated Material	• 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. • 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.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• 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

604. The Contractor will be responsible for familiarizing themselves with the following "Chance Finds Procedures" in case culturally valuable materials are uncovered during excavation or any project activities as per Antiquities Act, 1968, including:

- Stop work immediately following the discovery of any materials with possible archaeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;
- Protect artefacts as well as possible using plastic covers, and 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

605. 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.

606. 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.

607. **Environmental monitoring** during construction phase is a function of supervision, and the essential purpose is to ensure adherence to the EMP. The monitoring is a daily process, which ensures that departures from the EMP are avoided or quickly rectified, or that any unforeseen impacts are quickly discovered and remedied. This monitoring will be carried out by the DDCS &PMSCon a 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.

608. **Post project monitoring** evaluation will be carried out to evaluate the impacts of the Project during first three (3) years of operation of the Project. Regular monitoring of the condition of the embankment, drainage structures and slope protection structures and afforestation are important from an environmental management point of view. In addition to this 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**, along with the responsible agencies for implementation and supervision

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 & PMSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
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 area	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 andBWDB
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 and BWDB
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	DDCS& PMSC, BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DDCS & PMSC, BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Daily	Contractor	DDCS & PMSC , BWDB
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DDCS & PMSC

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
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 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 & PMSC, M&E Consultant, BWDB
		Noise monitoring of nearby community, where applicable	Weekly	Contractor	DDCS&PMSC, M&E Consultant and BWDB
		Ensure work restriction between 09:00 pm-6:00 am close to School/ Madrasha, Hospital & Villages	Weekly	Contractor	DDCS & PMSC, 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 & PMSC, M&E Consultant and BWDB
Drinking Water Quality(TDS, Turbidity, pH, EC, as if groundwater etc)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality	yearly	Contractor through a nationally recognized laboratory	DDCS & PMSC, M&E Consultant and BWDB
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 Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Reinstatement of Work Sites	All Work Sites	Visual Inspection	After completion of all works	Contractor	DDCS & PMSC, M&E Consultant, BWDB
Fish migration and movement	Project area Near sluice gate in major Khals)	Catch Assessment Survey	Once per week	Contractor through nationally recognized institute	DDCS & PMSC, M&E Consultant, BWDB
Vegetation clearance	Each of construction sites at embankment	Survey and comparison with baseline environment	Quarterly	Contractor through nationally recognized institute	DDCS & PMSC, M&E Consultant, BWDB
Safety of workers Monitoring and reporting accidents	At work sites	Usage of Personal Protective equipment	Monthly	Contractor	DDCS&PMSC, M&E Consultant, BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each polder	Sampling and analysis of surface water quality	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
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	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
Fisheries biodiversity	In the Polder area (re-excavated Khals and adjacent floodplains)	Catch Assessment and market survey	Two (2) times of year (dry & wet season)	BWDB through a nationally recognized institution	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Fish migration and movement	Polder area (Near sluice gate in major Khals)	Catch Assessment Survey	Two (2) times of year (dry & wet season)	Contractor through nationally recognized institute	DDCS & PMSC, M&E Consultant, BWDB
Wildlife monitoring (Mammals, birds, reptiles, amphibians)	Within Polder and adjacent rivers	Field visit and Direct observation	January, April, October,	BWDB through a nationally recognized wildlife NGO	Outsourced Consulting NGO

Source: MRDI, 2011, LGED, 2011

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

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
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 and compare with baseline	Yearly	BWDB through a nationally recognized Institution	M&E Consultant
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 assessment 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	Round the year	BWDB	M&E Consultant

Qualitative Spot Checking Indicators

609. 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 Indicator

Parameter	Visual Judgment			Comments
	Poor	Moderate	Satisfactory	
Workers Safety				

Parameter	Visual Judgment			Comments
	Poor	Moderate	Satisfactory	
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

610. BWDB will engage independent consultants to conduct a Third Party Validation (TPV) of the EMP implementation on a yearly basis during the construction phase. During the TPV, the consultants will review the implementation and effectiveness of various EMP activities including mitigation measures, environmental monitoring, trainings, and documentation. The consultants will also identify gaps and non-compliances in EMP implementation and propose actions for their remediation.

10.7 Documentation, Record keeping and Reporting

10.7.1 Record Keeping

611. Proper arrangements are necessary for recording, disseminating and responding to information which emerges from the various environmental monitoring and management programs. They are also necessary for rendering the environmental management system "auditable". However, the primary focus must remain on the pragmatic control of pollution, not the creation of complex bureaucratic procedures. BWDB will maintain **database of the polder specific Environmental Impact and Monitoring information** for keeping all type of monitoring record. **ESC**U will assist BWDB for keeping those records initially. The trained BWDB staff will take the responsibility of record keeping and monitoring during operation phase.

10.7.2 Quantitative Physical Monitoring

612. The objective of quantitative physical monitoring is to ensure that the mitigation measures designed to prevent, reduce and where possible offset any significant adverse impacts on the environment are being implemented throughout the Project lifecycle. DDCS & PMSC will regularly monitor and provide information to ESCU for updating the database. DDCS & PMSC will provide the following information bi-weekly to ESCU, if not urgent.

- Sampling points;
- Dates and times of sample collection;
- Test results;
- Control limits;
- "Action limits" (circa 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.

613. The monitoring data would be continually processed as it is received, so as to avoid a buildup of unprocessed data.

10.8 General Site Inspections and Monitoring

614. A Site Inspection Checklist for recording the findings of the general site condition surveys would be developed by the respective contractors, on the basis of the Environmental Mitigation Plan described in **Chapter 6 and Section 11.4**, during the construction phase. The Site Inspection Checklist would be supported by sketches, as necessary.

Information Sources

615. 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 the environmental monitoring equipment;
- Current calibration certificates for all the equipment that requires calibration by an external organization; and
- The latest version of this Environmental Management and Monitoring Plan.

Non-Compliance Report

616. Any breaches of the acceptable standards specified, would be reported to the PMU using a standard form, i.e. a Non-Compliance Report (NCR).

617. A copy of each completed NCR would be held on file by CS, to be replaced by the reply copy when it is received. A record of corrective actions would also be made and tracked to their completion.

Monthly Internal Reports by DDCS & PMSC

618. The DDCS & PMSC will prepare a monthly report for issue to the ESCU of PMU. These reports will summarize the following:

- Progress in implementing this EMP/ESMP;
- 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.

Half Early Progress Report by BWDB

619. ESCU will prepare the **half yearly progress report** on environmental *management and will submit to the World Bank for review during construction phase.* The progress report will summarize the information presented in Article 11.6.5.

Environmental Audit Report & Third-Party Monitoring Report

620. It is expected 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 Bank. Environmental monitoring will be conducted during the project Third Party Monitoring. The Third Party Monitoring report will also be shared with Bank.The Bank would also supervise the environmental compliance as part of regular implementation support missions.

10.9 Contractual arrangements for EMP implementation

621. Since many contractors do not have clear understanding the need of environmental management, some quoted very low price for implementation of EMP and eventually cannot implement EMP as per design. To avoid this problem, fixed Budget will be assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting. The contractor needs to submit an **Environmental,Social ManagementPlan (C/ESMP)** based on the EIA in line with the constractor's schedule and guideline. The C/ESMP needs to be reviewed by the supervision consultant and cleared by BWDB and World Bank.

10.10 Guideline to Incorporate Environmental Management in Bid Document & Preparation of C/ESMP

- Prepare cost estimates, to be incorporate in 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.

10.11 Guideline for Compensation and Contingency Plan during Project Period

622. 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.

623. In addition to the compensation, water management projects should also have a contingency plan to deal with emergencies and accidents. Such incidences encompass a whole range of situations from personal injury during operation of a machine to breaching of an embankment. Therefore, BWDB would prepare for the following emergency situations:

- Embankment failure during a flood – keep sufficient number of sand bags in reserve.
- Bank caving/erosion – keep sufficient number of concrete blocks and sand bags in reserve.
- Have an emergency evacuation plan for the people in the line of danger.
- Have a place designated as emergency shelter and ensure proper water supply, power supply and sanitation at this site.
- Accidental spill of harmful chemicals – train some members on how to confine such a spill and minimize potential danger to humans and other animals.
- Fire – keep fire extinguisher or emergency water pump ready at local project office.
- Personal injury – keep a first aid box at the project office. Have a plan for quickly transporting a seriously injured person to the nearest hospital.

10.12 EMP Implementation Cost

624. The estimated costs for the environmental management and monitoring activities are set out in **Table 10.6** below.

Table 10.6: Estimated costs for the environmental management and monitoring activities

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
1	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils	600,000	7.5	Contractor	During pre-construction
2	Awareness program on plant and wild life conservation.	200,000	2.5	BWDB	During post-construction
3	Awareness building up campaign(mock drill) may be organized to	200,000	2.5		During pre-construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	local community to avoid accidents from vehicular traffic				
4	Consultancy services cost for supervision and monitoring of EMP	800,000	10	BWDB	During post-construction
5	Training to the farmers with field demonstration regarding IPM and ICM.	200,000	2.5	BWDB with help of DAE	During post-construction
6	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
7	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
8	Solid and liquid waste disposal arrangement.	100,000	1.25	BWDB	
9	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1,000,000	12.5	BWDB	During post-construction
10	Consultancy services cost for river bank erosion monitoring	1,200,000	15	BWDB	During construction
11	Training to the Contractors regarding environmental management	100,000	1.25	BWDB	During pre-construction
12	Training of Environmental awareness of local population	80,000	1	Contractor	During pre-construction and construction phases
13	Updating EMP as per requirement.	1,000,000	12.5	BWDB	During post-construction
14	Construction of alternative or bypass channels at each construction sites.	1,061,053	13.26	Contractor	During pre-construction and construction
15	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
16	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
17	Emergency budget allocation for closing breach points of embankments and	1,200,000	15	Contractor, BWDB	During construction and post-construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	repairing the damage of structure				
18	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
19	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
20	WMOs monitoring cost	150,000	1.88		
21	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	**70,804,279**	**885.055**		

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 15 = 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

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-15 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

10.13 Afforestation Plan in Polder 15

625. A total of 6.02 ha foreshore area of this Polder is available for Afforestation as another important intervention aiming for expand vegetation coverage, enhance environmental sustainability, protect embankment from wave action and reduce foreshore erosion. Afforestation will be carried out by Department of Forest to be supported by the selected NGO. Type of plantation and tentative available area are given in following table:

Table 10.8: 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 to be planted in the Polder
1	Foreshore Plantation	Golpata Plantation	2.63	2,500	6,567
		Mound Plantation	1.08	1,600	1,729
		Enrichment Plantation	1.52	300	455
		Kewra-Baen Plantation	0.80	4,444	3,548
Total			**6.02**		**12,299**

(Ref: Final Interim Report on Additional Tasks Assigned, Volume-III, September, 2013, Page: III-21).

626. Available foreshore area will be planted with mangrove species which are naturally grown in his area. *Sonneratia apetala* (Mangrove Apple/Keora), *Avicennia officinalis* (Indian Mangrove/Baen) and *Nypa fruticans* (Nipa Palm/Golpata) can be selected as the suitable

mangrove species for this polder. Golpata will be planted only along the strips of river and canal banks with an available area of about 2.63 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 denude area of existing forest patches will be planted under enrichment and mound plantation technic. By this way, about 13,000 mangrove saplings can be planted in total available foreshore area of this polder. The areas selected for afforestation in this are shown in detail in **Map 4.1.**

627. The afforestation regulations (policy) enunciated by the BWDB on June 01, 1998 will be followed. Afforestation plan have been finalize after reviewing previous studies on foreshore afforestation, consultation with Forest Department and field verification for suitable species selection. Typical Plantation Design of the Polder Area is representing in **Figure 10.2.**

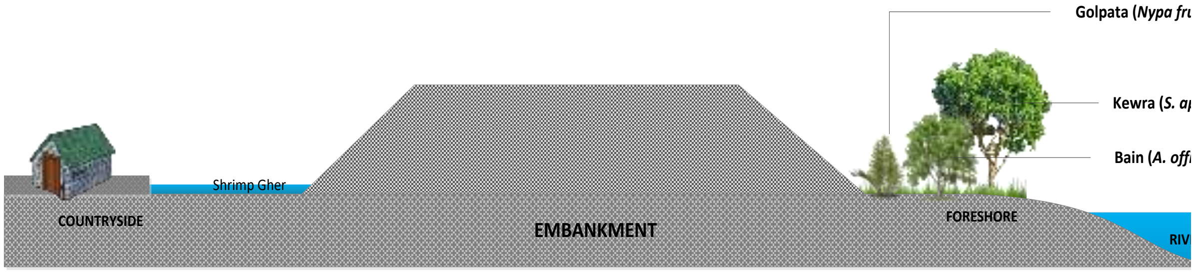


Figure 10.2: Typical Plantation Design for the Polder

Detail Plantation establishment Matrix is presented in following Table.

Table 10.9: Detail Plantation establishment Matrix.

Item of works	Time schedule for the given type			
	Nypa Plantation	**Enrichment Plantation**	**Keora-Baen**	**Mound Plantation**
Selection of site, survey the site and prepare plantation site map.	March	January	February and March	February
Preparation of mounds	n.a.	n.a.	n.a.	March
Cleaning of unwanted growths by cutting them off.	May 3rd week.	April 4th week immediately before planting.	One week before the planting day. May be in the 1st week of May.	March
Pit making	n.a.	March 2nd week.	n. a.	March 3rd week.
Application of Compost	n.a.	March 4th week.	n. a.	April 2nd week.
Stacking	May 3rd week.	April 1st week.	n. a.	April 4th 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)
Planting of seedlings.	June 1st week. Immediately after bringing seedlings from the nursery.	April 4th week.	May be 1st or 2nd week of May.	Immediately after bringing the seedlings.
Fixing of red flags indicating planting sites to avoid fishing.	May 4th week.	n. a.	n. a.	n. a.

Item of works	Time schedule for the given type			
	Nypa Plantation	**Enrichment Plantation**	**Keora-Baen**	**Mound Plantation**
Application of fertilizers.	n. a.	After of week of planting the seedling.	n. a.	After a week of planting seedlings.
First weeding	August 1st week	May 4th week	May 4th week, 1st year.	June 1st week.1st year.
Second weeding	November 1st week	June 3rd week	June 1st week.1st year.	June 4th week.1st year.
Third weeding	May 1st week next year	July 2nd week	June 4th week.	July 4th week 1st year.
Fourth weeding		August 4th week.	May 1st week. 2nd year.	July 1st week. 2nd year.
Fifth weeding with light pruning if necessary.	n. a.	April 1st week next year.	October 1st week. 2nd year.	August 4th week. 2nd year.
Sixth weeding (Climber cutting)	n. a.	June 1st week next year.	n. a.	n. a.
Seventh weeding (Climber cutting)	n. a.	August 1st week. Next year.	n. a.	n. a.
Pruning.	n. a.	n. a.	n. a.	October 4th week
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.
Since these activities are related to biological science the time frame may not be kept very rigid. Some adjustments may be required depending on rainfall, temperature, wind speed, tide, etc.				

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

10.14 EMP Updating

628. The study infers that EMP has been developed assessing the impacts of interventions on the basis of baseline and prediction information. But monitoring has to be carried out to collect information on the impacts at actuality resulted due to construction of interventions. Furthermore, actual information due to implementation of EMP measures need to be collected for updating the EMP to make the development more environmental friendly as because EMP is not an one time plan rather it is a plan which needs updating continuously.

10.15 Grievance Redress Mechanism

629. BWDB will establish a Grievance Redress Mechanism (GRM) as a means to ensure social accountability and to answer to queries and address complaints and grievances about any irregularities in application of the guidelines adopted in this EMF for assessment and mitigation of social and environmental impacts. Based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly, saving the aggrieved persons from having to resort to expensive, time-consuming legal action. The procedure will however not pre-empt a person’s right to go to the courts of law.

10.15.1 Grievance Redress Focal Points

630. A Grievance Redress Committee (GRC) at local level will be formed for each Union with union level representation to ensure easy accessibility by the project affected persons

and communities. This local GRC will be the local focal points of the project GRM. The GRM sets out the information and communications strategy to ensure that PAPs and communities are fully informed about their rights to offer suggestions and make complaints. All grievances received through the GRM process will primarily be forwarded to the GRCs. The Secretariat for each GRC will be at the office of the Executive Engineer. If any grievance is not resolved at GRC, the aggrieved person may request the convener of GRC to forward the case to the Project Director at PMO, Dhaka. The GRC will officially forward the cases with their comments to the Project Director. Hearing of petitions with GRCs will be held at the Convener's office or at Union Parishad/Ward Councillor's office as agreed by the committee members. The membership of the GRCs will ensure proper presentation of complaints and grievances as well as impartial hearings and investigations, and transparent resolutions.

Membership of GRC

1. Executive Engineer (BWDB Division Office)	:	Convener
2. Representative of the RP Implementing NGO	:	Member-Secretary
3. Local UP Chairman /Ward Councilor	:	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

Members of the GRCs will be nominated by the Executive Engineer at division level and approved by the Project Director, PMO, BWDB, Dhaka.

10.15.2 Grievance Resolution Process

631. 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.

632. 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 ESC at PMO for review the grievance cases and assist Project Director in making decision. The ESC 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

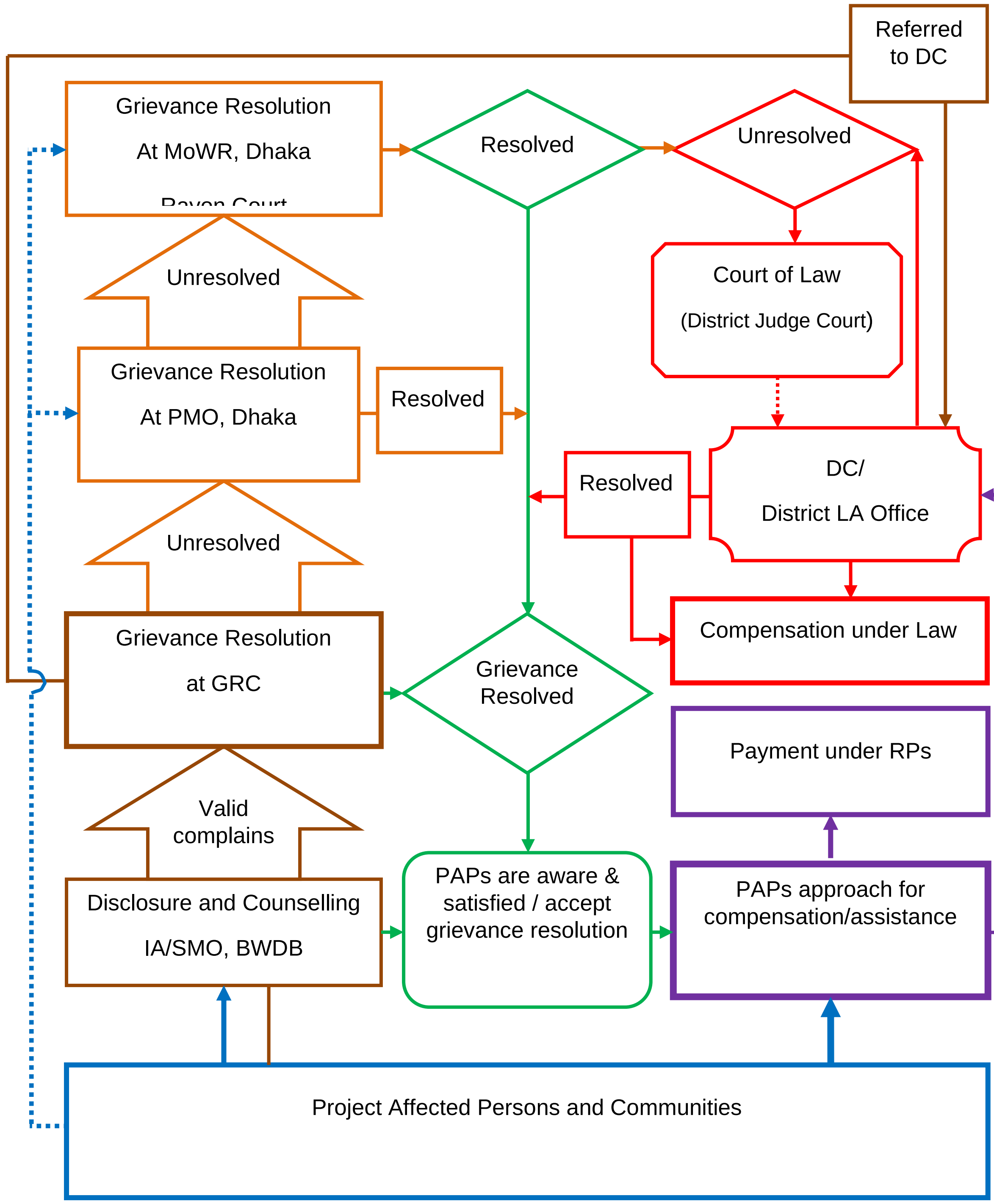


Figure 10.3: GRM Process Flow Chart

633. 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.
- 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.

10.15.3 GRM Disclosure, Documentation and Monitoring

634. The affected persons and their communities will be informed of the project's grievance redress mechanism in open meetings at important locations and in PAP group meetings. Bangla translations of the EMF and the GRM in the form of information brochures will be distributed among the project affected persons. The PAPs will also be briefed on the scope of the GRC, the procedure for lodging grievances cases and the procedure of grievance resolution at the project level.

635. 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.

636. 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.

10.16 Capacity Building

637. 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's 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 10.10** 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.

638. 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 10.10: 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; staff DDCS & PMSC	DC & DDCS&PMSC & ESCU	Prior to the start of the Project activities. (To be repeated as needed.)
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Mitigation measures; Community issues; Awareness of transmissible diseases Social and cultural values.	DDCS & PMSC PMU; selected contractors' crew	DDCS & PMSC and 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

639. 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.

640. The training programs will be arranged before implementation of the interventions in the polder area. Detail plan can be made by the proposed ESCU of BWDB.

10.17 Risk Assessment and Mitigation Measures

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 15 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.

10.17.1 Navigation

641. 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 15. 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 15 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.

642. However, in order to maintain navigation scenario, an arrangement may be made for lifting or of small size country boat from one side to other side, i.e. river side to country side and vise-versa for navigation purposes. This arrangement will not allow entry of saline water inside the Polder thus would not damage soil, water, land and crops.

10.17.2 Function of Water Management Association

643. This project has aimed at rejuvenating the Water Management Organizations (WMO) in the Polder, which consists of a three-tier organizational structure with Water Management Groups (WMG) at the bottom of the hierarchy, Water Management Association (WMA) at the mid-level and Water Management Federation (WMF) at the top. The main functions of the WMOs are supposed to be assisting and participating in the operation and maintenance of the Polder. However, at the moment, there are no active WMOs on site, and their activities are almost non-existent. The disrepair and lack of maintenance of the polder in the past due to financial inadequacies of the WMOs as well as insufficient support from the BWDB had contributed to the general decay of the polder's structure and utility. In the past, there was usually no fund allocated for the WMOs' functions and needs. In Table 5.15 above, a long list of duties and responsibilities of different tiers of WMOs has been provided, which – if successfully performed and implemented – would greatly contribute to the sustainability of the project. It is, therefore, recommended that the project should (i) ensure the organization/formation of the WMOs before operation of the gates, training them in the operation of structures etc., as well as in records/accounts keeping, and collaboration with NGOs, and CBOs, and most importantly. This would help in developing ownership of the WMA for realization of benefits from the polder without hampering the hydrological and environmental settings of the Polder (ii) In addition to activation of WMOs, BWDB may recruit sluice khalashi for each of the Drainage Sluices for smooth operation of the gates as per initial practice (iii) provide budgetary allocation in the post-operation phase for the O & M related tasks of the WMOs (iv) In addition, borrow pit, embankment slope, water bodies in the khas land may be provided to the WMOs as an income generating sources for their sustainability.

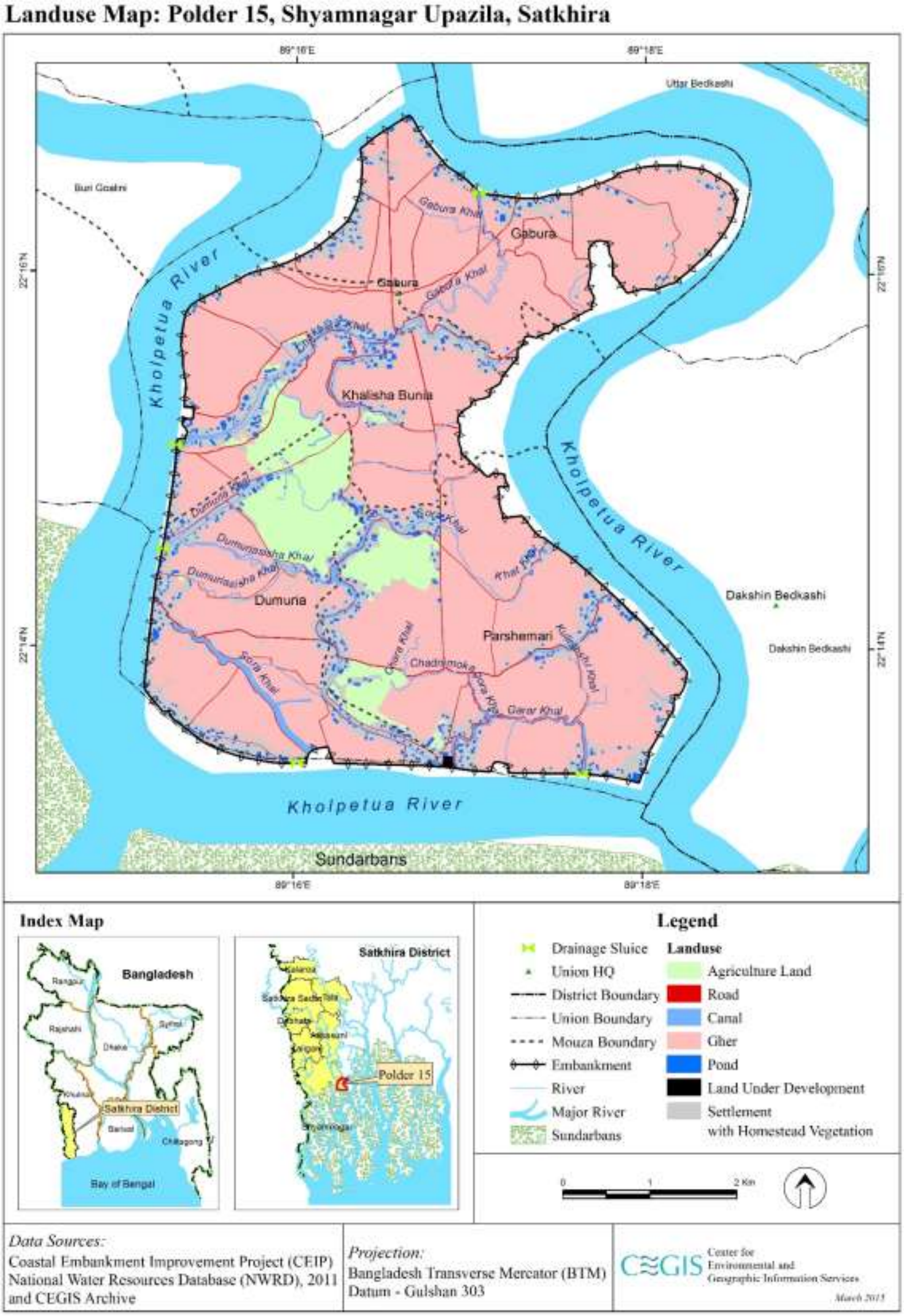
10.17.3 Fish Migration and Movement

644. 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. On the other hand, during spawning season fish hatchlings and fries will be able to pass through the gates with relatively high mortality.

645. 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.

646. The ghers are concentrated in all over the Polder area including Gabura, Khalisha Bunia, Parshemaria and Dumuria (partial) mauzas. These mauzas are relatively less crop intensive. It is mentioned here that a part of Dumuria, Khalisha Bunia mauzas where Ghers are less intensive and crops are dominant, there should be a mechanism of water distribution in equitable manner (Map 10.1). Generally, T. Aman crop is grown in these area where supplementary irrigation by rain fed is used. So, entry of saline water during January to March when drifting migration of hatchling and fry with the tide of *Liza parsia* and *Mystus gulio* may be facelifted. 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. It is mentioned here that farmers are trying to BYV boro cultivation at near to their settlement but the area of boro is very low. In this case, Low Lift Pump (LLP) is used for lifting water for irrigation. No surface water is used for irrigation of HYB boro.



Map 11.1: Fish migration route in the Polder area

11. STAKEHOLDER CONSULTATION AND DISCLOSURE

647. 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

648. 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. Participation of stakeholders is an integral part of the EIA process to gather local knowledge for baseline conditions, understand perceptions of the community regarding impact significance and propose meaningful mitigation measures. During the present EIA study, an attempt was made to consult with a full range of stakeholders to obtain their views on Project interventions.

649. Public participation is obligatory for the EIAs of the Red Category projects according to the EIA Guidelines of the DoE. Public participation through consultations in the water sector project is also mandated according to the Guidelines for the Participatory Water Management (GPWM) of the BWDB. Similarly, the World Bank's OP 4.01 requires that stakeholder consultations are carried out at least twice for the Category A projects, once shortly after environmental screening and before the terms of reference for the EA are finalized, and then once a draft EIA report is prepared.

650. 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

651. Following were the objectives of the stakeholder consultations:

- ✓ To provide key Project information and create awareness among various stakeholders about project intervention;
- ✓ To have interaction for primary and secondary data collection with project beneficiaries, affected, 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

652. Participatory approach was followed in conducting the public consultation meetings in the Polder-15. The EIA study team members 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 support of the UNOs and/or PIOs, the union level public representatives as well as the key persons were

informed about the specific consultation meetings and were requested to participate in the meeting.

653. Focus group discussions (FGD) were carried out during in the public consultation process. In order to conduct the FGD and consultation meetings, two checklists were prepared covering the aspects including an overview of the proposed CEIP-1, information on the ongoing EIA process, and seeking information on the problems of the area with their potential solutions. The local needs and demands were discussed by giving equal opportunity to all participants attending the meeting. During consultation meeting all relevant issues pertaining to water resources, land resources, biological resources, socio-economic resources, and disaster aspects were discussed in detail.

654. During the FGDs and consultation meetings, the EIA team displayed maps of the Project area, shared the initial concepts on proposed interventions and facilitated the response of the participants. The stakeholders of the Polder-15 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

655. 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.

656. ***Primary Stakeholders:*** Primary stakeholders are people who would be directly benefited or impacted by a certain project intervention. In case of the Polder-15, the primary stakeholders include the people living within the Project area particularly those who reside within and in the immediate vicinity of the Polder. The primary stakeholders of the Project include the farmers, 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.

657. ***Secondary Stakeholders:*** This category of stakeholders pertains to those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project aspects. NGOs, concerned government departments, and line agencies fall under this category in this Project.

658. 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.

11.5 Time, Date and Venue Selection

659. Venue, date and time of meeting was selected through consultation with local people and the project proponent. An agreed venue was selected 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.

11.6 Enlisting and Invitation

660. A comprehensive list of potential stakeholders was prepared through the consultation. This list was intended to cover all sorts of interest groups, occupational groups, socially acceptable and knowledgeable peoples.

661. A formal invitation was sent to them and also communicated over telephone for ensuring their presence in the meeting.

11.7 Consultation Instrument

662. **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-G).

663. **Attendance list:** An inventory of the participants was maintained in attendance sheet containing contact number. Scanned list of participants is attached in Annex-F.

664. **Camera:** For visualizing the participants, photographs were taken using camera. Photos of the meeting participants are presented at the end of this chapter.

665. **Sound Recorder:** Deliberations of the participants were recorded using recorder of each consultation. The study team encouraged all to participate willingly by explaining the ethics of the study and recorded it.

11.8 Consultation Process

666. The study team conducted the meeting. During consultation meeting, the following sequence was followed.

667. **Greetings:** At the outset, the team exchanged greetings with all the participants, welcomed them for attending and stated the entire design of the meeting.

668. **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.

669. **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.

670. **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 all to participate willingly by explaining the ethics of the study.

671. **Note taking:** Issues were discussed and opinions were written in notebook carefully. All issues were given equal importance.

672. **Recapitulation and closing the session:** At the end, the study team recapitulated the session and responded to the quarries. Finally, the facilitator closed the session thanking the participants.

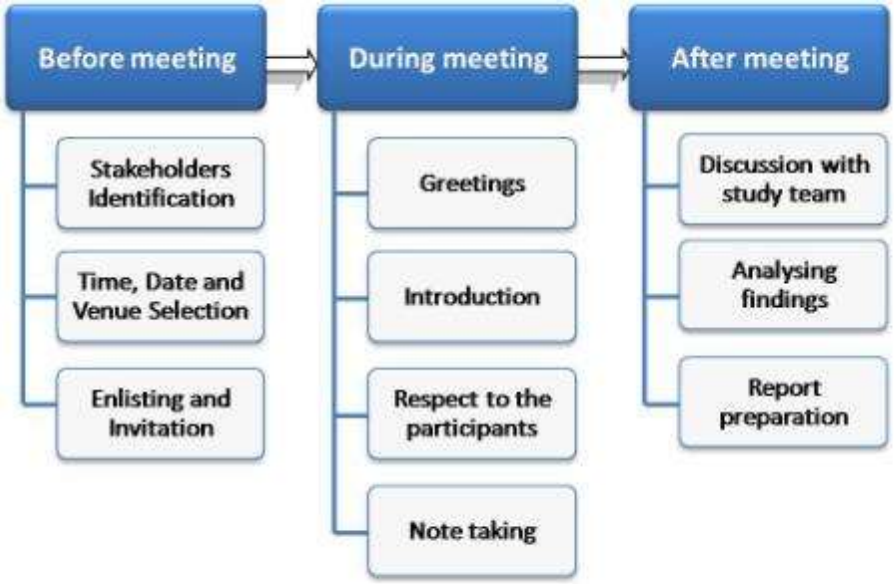


Figure 11.1: Overall consultation process

11.9 Public Consultation Meetings and FGDs

11.9.1 Consultation Process

673. A number of public consultation meetings and FGDs were conducted at different locations of the Polder-15. The details of these meetings and FGDs are presented in **Table 11.1** and some photographs of these meetings are given in **Photo 11.1 to 11.4.**

Table 11.1: Meeting venue including time and date

Sl	District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
1	Khulna	Koyra	Dakshin Bedkashi	Dakshin Bedkashi Porishad Conference	PCM	19/01/2016	10:00
2	Khulna	Koyra	Dakshin Bedkashi	Khosabunia village	FGD	18/12/2015	12:00
3	Khulna	Koyra	Dakshin Bedkashi	Gabura Bazzar	FGD	20/12/2015	11:00
4	Khulna	Koyra	Dakshin Bedkashi	Gabura Union Parisad	FGD	21/12/2015	12:30

11.9.2 Consultation Participants

674. The main participants of the consultation meetings included public representatives, farmers, traders and daily-wage laborers of the Polder-15 and nearby areas. A total of 64 participants attended these consultations. Details of the participants are provided in **Table 11.2**.

Table 11.2: Participant Details

Sl	Meeting venue	Type of consultation	Type of Participants	No. of participants
1	Gabura Union Porishod Conference room	PCM	Secondary and Primary stakeholders	36
2	Khosabunia village	FGD	Primary stakeholders	10
3	Gabura Bazzar	FGD	Primary stakeholders	8
4	Gabura Union Parisad	FGD	Primary stakeholders	10

Photo 11.1: PCM at Gabura Union Auditorium

11.10 Issues discussed in FGDs and Meetings

675. At the outset of the meetings and FGDs, an overview of the proposed Project including the ongoing activities of the implementing agencies and the EIA process was shared with the participants. Subsequently, the key environmental, social, and socioeconomic aspects listed below were discussed.

- Water resources:
  - ✓ Surface water (tidal flooding, drainage, salinity, siltation)
  - ✓ Water management (flood control, drainage, irrigation)
- Land resources:
  - ✓ Cropping practice,
  - ✓ Production and yield,
  - ✓ Water logging and drainage congestion
  - ✓ Crop damage.
- Socio-economic aspects:
  - ✓ Occupation and Employment (unemployment/joblessness)
  - ✓ Migration (temporary/permanent out-migration)
  - ✓ Poverty (food and income poverty)
  - ✓ Education (poor literacy rate, non-schooling, less female education, drop out etc.)
  - ✓ Health and nutrition (illness, diseases, poor nutrition)
  - ✓ Quality of life (poor housing and sanitation facilities, scarcity of drinking water, fuel and fodder)
- Disasters:
  - ✓ Cyclones
  - ✓ 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.

11.11 Community Concerns and Suggested Solutions

676. At the outset, the study team gave a brief description about the project. The participants also stated that the project authority informed them frequently about this project. However, the stated description by the study team made them clearer about the objectives and process of the project.

11.11.1 Attitude to the project

677. The communities including the persons to be affected by the Project expressed their views in favor of the Project and wanted early implementation to protect them from the tidal surges and disasters such as Aila and Sidr. They demanded adequate compensation and other benefits for the loss of their assets and livelihood, as well as alternative place for relocation of their houses and business.

Photo 11.2: FGD at Khosabunia village

Photo 11.3: FGD at Gabura bazaar

Photo 11.4: FGD at Gabura Union Parisad

678. The outcomes of the consultation meetings in terms of concerns and the suggested solutions were noted and organized by themes in the **Table 11.3** below.

Table 11.3: Community Concerns and Suggested Solutions

Themes/ Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
Overall	- Drainage congestion, Tidal flood, Tidal surge, Salinity intrusion, Low height and vulnerable Embankment, Encroachment of internal canals, Kholepetua and Arpangasia 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.	- Proper compensation should be given to affected people - Comprehensive rehabilitation of the polder should be taken up at the earliest with the active involvement of the local community. - Illegally captured canals should be liberated and excavated - Embankment height to be raised from 5.30 to 6.00 meters. - Extreme wave of Kholepetua and Arpangasia River creates erosion which must be controlled. - Immediate construction of drainage sluice (Shora, Chadnimukha, Gabura, Chalkbara and Dumuria Bazar) - Proposed drainage sluice and flushing sluice linking canal should be excavated.
Water resources	- Kobadak and Kholepetua rivers are threats to local people due to continuous erosion - Kholpatua, Dhanmari, Kalibari village have no drainage facilities - 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 damages the embankment - Tidal flooding, storm surge, salinity intrusion, encroachment of internal khal, erosion, inactive sluice gate and khal has silted up	- -Strengthening the banks with blocks, spreading stones/Geo-bags along vulnerable spots e.g. Gabura, Ghagramari, Labubunia, Kholpatua villages - -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 e.g. Gabura khal, Chalkbara khal, Dumuria khal, Sora khal, Chandimukha khal etc. - Shutter should be water proofed

Themes/ Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
	- Height of the embankment is reducing gradually	
Agriculture resources	- Loss of crop production due to drainage congestion and water logging at Labunia, Chalkbara and Gabura villages which are mostly damaged area - Lack of irrigation water during dry season due to siltation of rivers and internal canals	- Repair of the embankment as per design level - Re-excavation of rivers and connecting internal canals - Repairing of the sluices and construction of new sluice - Regular operation and maintenance the regulators. - As soon as possible silted connecting canals. like - Gabura khal, Chalkbara khal, Dumuria khal, Sora khal, Chandimukha Khal etc. should be re-excavated
Fishery resources	- Major canals have already lost their connectivity and depth due to encroachment of canal, damages of drainage sluice, unplanned shrimp farming and saline water intrusion - Reducing depth of internal Khals and habitat quality degradation due to siltation - Fish and hatchling movement disrupted due to properly operation of water control structures. - Illegally control Khals and water control infrastructure to catch fish - Indiscriminate fishing by Sluice net - Entrance of saline water	- Re-excavation of canals (e.g. Gabura khal, Chalkbara khal, Dumuria khal, Sora Khal, Chandimukha 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 illegally control Khals & water control infrastructure to catch fish - Using angler in an illegal way should be stopped - Illegally captured cannel should be - liberated and excavated - Integrated cultivation should be practiced.
Ecological resources	- It would not be possible to protect surrounding area from any extreme wave action due to insufficient foreshore afforestation - Countryside vegetation would be deteriorated and change of vegetation coverage due to river bank erosion and extreme salinity intrusion. - A number of trees would be fell 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 are to be implemented by the concerned 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, saplings conservation for transit nursery. - Plantation of local suitable Mangrove tree species like Golpata, Kakra, Baim, Kaora, Sundari etc. and proper monitoring for saplings and fencing

Themes/ Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
		- Implement social aforestation along the embankment slopes at Kholpatua, Kalibari, Napitkhali, Labunia, Dumuria villages would be protected from wave action as well as river erosion from Kobadak and Kholpatua rivers.
Socio-economic resources	- Above 350 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 captured open water bodies illegally i.e. canals, ditches for their own purposes - Dependency on the Sundarbans area has been 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 poor from Gabura to Dumuria - About 80 no of Munda (Ethnic community) HHs are living under hardcore situation due to lack of unemployment, river erosion and different natural disasters. They are dwelling mainly in Gabura, Parsemari, Dumuria villages along the Kholepatua and Kabadak Rivers side of Gabura Union. - There is no appropriate road communication for the transportation of construction materials, heavy and medium machineries.	- Rehabilitation of affected people along with ethnic community should be done according to Resettlement Action Plan . - Ensure proper resettlement of those households which may be affected by the project intervention for re construction of retired embankment (e.g. Labunia, Ghagramari villages). - The embankment cum road (e.g. from Chandimukha to Chalkbara, Kalibari to Jalakhali, Labunia to Pharsemari village and Napitkhali to Dumuria Bazar) should be repaired immediately in different places. - After rehabilitating embankment, a maintenance and monitoring team should be formed for its' proper maintenance. - To organize and strengthen WMGs so that mass people can access to open water bodies easily. - Proper maintenance for functioning of water control infrastructures at Shola, Chandimukha, Gaburai, Chalkbara, and Dumuria villages - Gate operator (locally called gate khalashi) should be recruited - Illegal DCR cut off should be stopped - To create opportunity for tourism industry at the Gabura union, it should be done not only for the improvement of employment status of this area but also for the reduction of dependency on Sundarbans. - In earth work participation of local people should be given the first priority - Construction materials, instruments should be carried through the water way (e.g. Kobadak and Kholepatua River) and Chakbara Keya Ghat, Dumuria Bazzar keya ghat, Chandimukha Kheya Ghat and Napitkhali Kheya Ghat can be used to unload the construction materials

11.12 EIA Disclosure

679. A Public Disclosure Meeting (PDM) on the EIA report of Polder 15 under the Coastal Embankment Improvement Project, Phase-1 (CEIP-1) was held on 5th December, 2017 at Shyamnagar Upazila of Satkhira District. The Meeting was held in the Upazila conference room from 10:30 am to 1:10 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.

680. The participants of the PDM included Upazila Nirbahi Officer (UNO), Upazila Chairman (acting), Upazila Agriculture officer, CEIP-BWDB representative and other concerned government officials, Journalists, NGO representatives, environmentalists, activists, local stakeholders and other representatives (a list of participants is presented in Appendix-H). The meeting was chaired by the Upazila Nirbahi Officer Md. Kamruzzaman. Upazila Chairman (acting) Mr. Mohsen-Ul-Mulk was the Chief Guest. A total of 57 participants attended the PDM. Dr. Ashraful Alam, CEGIS presented the study results in the meeting. Project summary was displayed in front of participants. The main points of the presentation are given bellow:

- Background of the Project
- Objective of the Costal Improvement Project (CEIP)
- Present condition and Major problems of the Polder 15
- Project location Images
- Proposed Resettlement plan
- Environmental impact and mitigation measures
- Procedure of monitoring plan
- Type of compensation committee &
- Recommendation

Findings of the PDM:

681. The participants, including the persons likely to be affected by rehabilitation of Polder 15, 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;

682. Views on Structural Issues around embankment reconstruction

- The participants said that Polder-15 is under the Gabura Union. This Polder surrounded by Kholpetua River, look as an Island. The proposed embankment will greatly benefit the area. There are some farm lands outside the proposed alignment of the embankment. People have requested the World Bank to include those areas inside the embankment.
- In order to maintain the embankment and keep it in stable condition, river training and dredging is needed. Formation of scouring created in the river should be managed. Otherwise, the embankment will be in threat. The embankment height should be increased.
- To maintain the embankment, guards can be appointed for every 2km distance. This can be done by an embankment management committee in cooperation with the local people and Union Parishad. A guideline for the operation of this committee should be made and funds should be allocated.
- Some people illegally insert pipes through the embankment structure to get saltwater inside the polder. This activity damages the embankment and creates erosion of the structure. This type of undue activities should be stopped.
- Effective monitoring should be conducted during the construction of the project activities.

Views on Drainage Improvement Issues

- Peripheral river e.g. Kholpetua 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

- There are some illegal settlements on top of embankment and people want to know whether these will be demolished and will the owners get any compensation.
- Proper compensation should be paid to the project affected people before starting the construction activities.

Views on private use of BWDB land and on enhancement of BWDB capacity

- Some influential people have established fish farms in BWDB land. This illegal land use should be stopped.
- There is very little communication among the Satkhira BWDB office and local administration. The manpower of BWDB should be increased and capability to work at site locations should be enhanced.

General Views

- The farmers will be benefitted by the new embankment. But some steps should be taken so that the farmers can get saline tolerant rice seeds easily. Afforestation programme should be established in the outer sides of the embankments. Ecotourism initiatives can be added with afforestation also.
- There are indigenous communities living in this Upazila. But they do not have representatives in the project implementation committee. They should be included.
- A land survey should be done to identify and designate suitable land for agriculture and shrimp.
- Awareness building program among the communities should be conducted for better water management

Some photographs of the meeting are display in below.

	
Public Discloser Meeting (PDM) has been chaired by Mr. Kamruzzaman, UNO, Shyamnagr Upazila, Satkhira	***Upazila Nirbahi Officer, Acting Upazila Chairman, UP Chairman attended the PDM seasons***

	
View of participants	***A presentation given by Dr. Ashraful Alam***
	
PDM perticipants	***Participants expressed their opinion in the discloser meeting***

Photo 11.5: View of PDM at Upazila Auditorium, Shyamnagar, Satkhira

11.13 Framework for Consultations during Project Implementation

683. The stakeholder consultation is a continued process, and should be maintained throughout the project. The consultations carried out during the present EIA study and reported in this Chapter are essentially a first step in this process. During the subsequent project phases, participation of the project stakeholders need to be ensured. **Table 11.4** presents the proposed participation framework during different project phases.

Table 11.4: Participation Framework

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
Project Design Phase	• Meetings with institutional stakeholders (carried out during the present EIA and RAP preparation); • Meetings with grass root stakeholders (carried out during the present EIA and RAP preparation)	Institutional stakeholders; Grass root stakeholders, including the communities to be affected by the Project.	EIA consultant.

Project 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.	Affected communities.	BWDB; Supervision Consultants; Contractors
	Consultations with the project affected / communities during the external monitoring.	Affected communities.	External monitoring consultants.
	Consultations with the project affected / 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

REFERENCES

Ali, A. (1999), "Climate change impacts and adaptation assessment in Bangladesh", Climate Research, Vol. 12, pp. 109-16.

BARC (2012). (Bangladesh Agricultural Research Council), Fertilizer Recommendation Guide, Farm gate, Dhaka-1215.

Bhatnagar, A., Jana, S.N., Garg, S.K. Patra, B.C., Singh, G. and Barman, U.K.2004. Water quality management in aquaculture, In: Course Manual of summer school on development of sustainable aquaculture technology in fresh and saline waters, CCS Haryana Agricultural, Hisar (India), pp 203- 210.

Brammer, H., 2000, Agro-ecological aspects of agricultural research in Bangladesh, University Press Limited: Dhaka.

CEIP, 2012, Feasibility Report (Agriculture and livestock part), Coastal Embankment and Improvement Project (CEIP), Bangladesh Water Development Board (BWDB), Dhaka, Bangladesh.

CEIP, 2012, Feasibility Report (Volume -V, Land use Reports, Part-B: Fisheries), Coastal Embankment and Improvement Project, Phase-I (CEIP-I), Bangladesh Water Development Board (BWDB)

CEIP, 2015, Terms of Reference (ToR) for Environmental Impact Assessment (EIA) & Environmental Management Plan (EMP) for 13 Polders, Coastal Embankment Improvement Project, Phase-I (CEIP-I), 2015 under Bangladesh Water Development Board (BWDB)

Chanratchakool, P. 2003. "Problems in the Paeneus monodon culture in low salinity areas" Aquaculture Asia, vol VIII (1). pp. 54-56.

Dash, S.K., Kulkarni, M.A., Mohanty, U.C. and Prasad, K., 2009. "Changes in the characteristics of rain events in India". J. Geophys. Res., 114

DoE, 2001. Bangladesh: State of the Environment 2001. Department of Environment, Ministry of Environment and Forest, Dhaka, Bangladesh.

FAO/UNDP (1988). Land Resources Appraisal of Bangladesh for Agricultural Development. Report 2: Agro-ecological Regions of Bangladesh.

FRSS, 2015. Fisheries Statistical Report of Bangladesh. Fisheries Resources Survey System (FRSS), Department of Fisheries, Bangladesh. Volume 31: 57 p.

GoB, 2009. Bangladesh Climate Change Strategy and Action Plan 2009, Government of Bangladesh, Dhaka.

GOB. DoE, 1997, EIA Guidelines for Industries. Department of Environment (DoE), Dhaka, Bangladesh.

Goswami, B.N., Venugopal, V., Sengupta, D., Madhusoodanan, M.S. and Xavier, P. K., 2006 "Increasing trend of Extreme Rain Events over India in a Warming Environment". Science, 314, 5804, 1442-1445.

Goswami, B.N., Venugopal, V., Sengupta, D., Madhusoodanan, M.S., Xavier, P.K., 2006. "Increasing trend of extreme Rain Events over India in a Warming Environment". Science, 314, 5804, 1442-1445.

Hassan, A., Hossain B.M.T.A., and Ahsan, M. R. 2010a. Mean Area Distribution Method for Downscaling GCM Results. In: Choudhury, G. A., Hassan, A., and Ahmed, A. U.(Eds.), Climate Change Risk and Adaptation for Bangladesh, CEGIS, Dhaka, Bangladesh.

Houghton, J.T., Ding, Y., Griggs, D.J., Noguer, M., van der Linden, P.J., Dai, X., Maskell, K. and Johnson, C.A. (Eds) (2001), "Climate Change 2001": The Scientific Basis, Cambridge University Press, Cambridge, p. 881.

Huq, S., Karim, Z., Asaduzzaman, M. and Mahtab, F. (Eds) (1999), Vulnerability and Adaptation to Climate Change in Bangladesh, Kluwer, Dordrecht, p. 147.

IMD, 2006, "Trends in precipitation extremes over India". NCC Research Report No. 3/2006

IMD, 2012. "Annual Climate Summary 2012". National Climate Centre, Pune.

Intergovernmental Panel on Climate Change (2001), Climate Change 2001: The scientific Basis, Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Houghton, J.T., Ding. Y., Griggs, D.J., Noguer, M., van der Linden, P.J., Dai, X., Maskell, K., Johnson, C.A. (Eds), IPCC, Cambridge University Press, Cambridge, p. 881.

Intergovernmental Panel on Climate Change (2007), Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller, H.L. (Eds), IPCC, Cambridge University Press, Cambridge, p. 996.

IPCC, 2001, Climate Change 2001: The scientific Basis, Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Houghton, J.T., Ding. Y., Griggs, D.J., Noguer, M., van der Linden, P.J., Dai, X., Maskell, K., Johnson, C.A. (Eds), IPCC, Cambridge University Press, Cambridge, p. 881.

IPCC, 2007, Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller, H.L. (Eds), IPCC, Cambridge University Press, Cambridge, p. 996.

IPCC, 2013. "Climate Change 2013 - The Physical Science Basis". Cambridge University Press, U.K.

IUCN, 2000. Red list of threatened animals of Bangladesh. The World Conservation Union (IUCN), Dhaka, Bangladesh. 54 pp.

Jack M. Whetstone, Gravil D. Treece, Craig L. Browdy, and Alvin D. Stokes, 2002. Opportunities and Constraints in Marine Shrimp Farming, SRAC Publication No. 2600, July 2002

Khondker, M. 2004 (edited). Limnology. University Book Publishers. Dhaka, Bangladesh.

LGED, 2011. Environmental Management Framework for Rural Transport Improvement Project (RTIP-2), Final Report, Local Government Engineering Department (LEGD), Dhaka, Bangladesh.

Mazid. M. A 2002, Development of Fisheries in Bangladesh, Plans for Strategies for Income Generation and Poverty Alleviation, Momin Offset Press, Dhaka1205.

MoA, 2013. National Agriculture Policy, Ministry of Agriculture, Government of the People's Republic of Bangladesh.

MoEF,1995. National Environment Management Action Plan (NEMAP), Voll-II, Main Report. Ministry of Environment and Forest (MoEF), Government of the Peoples Republic of Bangladesh.

MoWR, 1999. National Water Policy, Ministry of Water Resources, Government of the People's Republic of Bangladesh.

MoWR, 2005. Coastal Zone Policy, Ministry of Water Resources, Government of the People's Republic of Bangladesh.

Murty TS. 1984: Storm surges meteorological ocean tides. *Can J Fish Aquat Sci*; 212: 897p.

Nishat, A., Huq, S.M. Imamul, Barua, Shuvashish P., Reza, Ali A.H.M., Khan, Moniruzzaman A.s. (eds.), 2002. Bio-ecological zones of Bangladesh. IUCN Bangladesh Country Office, Dhaka, Bangladesh, xii+ 141 pp.

Singh, O.P., 2002. Spatial Variation of Sea Level Trend Along the Bangladesh Coast, Marine Geodesy 25, 44 pp.205–212

SMRC (2000). The vulnerability Assessment of the SAARC Coastal Region due to Sea Level Rise: Bangladesh case. SMRC-No.3, SMRC Publication, 108 pp.

SOLARIS-SRDI (Soil and Land Resources Information System-Soil Resource and Development Institute), 2006. SOLARIS Model developed by Center for Environmental and Geographic Information Services (CEGIS) for Soil Resource and Development Institute (SRDI), Farm gate, Dhaka-1215.

WARPO, 2005. Guidelines for Environmental Assessment of Water Management (flood control, Drainage and Irrigation) projects. National Water Management Project. Water Resources Planning Organization (WARPO), Dhaka

WARPO, 2006. Coastal Development Strategy. Water Resources Planning Organization (WARPO), Dhaka, February, 2006.

APPENDIX A: CHECKLIST

EIA of Coastal Polders under CEIP

Checklist for Water Resources Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

A. Administrative Information

Name of Polder:	BWDB Zone:	Hydrological Zone:
BWDB Circle name:	BWDB O & M Division:	
District (s):	Upazila (s):	
Union (s):	Mouza (s):	

B. Project Description

General Information	
a. Type of project:	b. Area of polder (Ha):
c. Objectives of the scheme:	
d. New problems (if any) created by the project activities:	
e. Year of Starting:	f. Year of completion:
g. Name of surrounding polder	
h. Name of the projects hydro-morphologically dependent on the polder	
i. Cumulative hydraulic and morphological impacts as anticipated by local people	

Data Collected by:	Date:
Present Status/condition of Embankment	
Embankment length (………………Km)	Embankment Type: Submergible / Full flood protection

Breaching: 1. Yes 2. No Breaching spot (If yes): (Please specify the spot names, length, GPS reading)

Location of Breaching Points (Name of Place)	Reasons of breach	Good		Moderately affected		Badly affected/ Vulnerable		Completely damaged	
		GPS ID	Length	GPS ID	Length	GPS ID	Length	GPS ID	Length

Public Cuts: 1. Yes 2. No Public Cuts (If yes): (Please specify the spot names, length, GPS reading)

Location of Public Cuts	Reasons	Moderately affected		Badly affected/ Vulnerable		Completely damaged	
		GPS ID	Length	GPS ID	Length	GPS ID	Length

Re-sectioning: 1. Yes 2. No Re-sectioning (If yes): (Please specify the spot names, length)

From	To	Length	Height	Actual reasons

Regulators											
Location of Structure	GPS ID	Type	Vent Size	No of Vent	Service Condition (VG/G/M/B/VB)16	Present Condition (Partial/full damage/good)	Present Problems	Reasons for problem	Year of problem	Rehabilitable (Y/N)	Replaceable (Y/N)
Fish pass Structures											
Cross Drainage Structures (Syphon/Aqueduct)											
Barrage											

Pipe Sluices										
Irrigation Inlets										
Bridge/Culverts										

[16] 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/Permanent)	Length	Present Condition (G/ MD/ CD)[17]	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			
Union	Area (%)	Causes	

[17] G – Good, MD – Moderately Damaged, CD – Completely Damaged

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 (People's 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 Livestock 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:	River																

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
Culture Fisheries:	c. %/No. of SFHHS: d. No. of Days spend annually in fishing by CFHHs: SFHHs:	Beel (Leased /non leased)																
Indiscriminate Fishing Activities:	e. Hrs/Day spend in fishing by CFHHs:	Khal																
	SFHHs:	Floodplain																
		Swamp Forest																

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
		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				
Present Obstacle to fish migration:	1.	Reasons of increase or decrease	1.						Live fish				
									Other fish				
	2.		2.						Prawn				
									Hilsa				
	3.		3.										

Fish Migration				**Fish Biodiversity**		**Species List**					**Species Composition**				
						River	**Khal**	**Beel**	**Pond**	**Other**	**Group**	**River**	**Khal**	**Beel**	**Pond**
Important breeding, feeding and over wintering ground															
					4.										
					5.						Rui				
											Catla				
Horizontal Migration pattern	Species: 1. 2. 3. 4. 5.	Season (Months):	Routes:	Significant areas	1.						Mrigel				
											Koi				
					2.						Sarpunti				
					3.						Large prawn				
											Small Pprawn				
Vertical Migration Pattern	Species: 1. 2. 3. 4. 5.	Season (Months):	Habitats:	Species of Conservation Significance	Rare:						Silver carp				
											Carpu				
											Grass carp				
											Tengra				
					Unavailable:						Chapila				
											Others				

Fish Migration				Fish Biodiversity		Species List					Species Composition				
						River	Khal	Beel	Pond	Other	Group	River	Khal	Beel	Pond

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):	

Post-Harvest Activities		**Fishermen Lifestyle**	
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			

Species Name	Habitat	Status	Migration Status
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/nearer the polder)

Forest Name with Range/Beet office	**Type**	**Location**	**Area in Acre**	**Major Plant Species**

Type 1=Swamp Forest, 2=Reserve Forest, 3=Vested Forest, 4=Reed forest, 5=Other (specify)

(9) Anticipated Impacts due to proposed interventions on particular Ecosystems

(Impact from changed land use, noise, human presence etc.)

Name of Intervention	Impacts
Embankment Re-sectioning	
Breach Closing	
Construction of Water control Structures	

(10) Comments (If any):

EIA of Coastal polders under CEIP

RRA/FGD Data Collection Format for Socio-economic Survey

Date of Survey:.................................. Name of Polder:

1. Place of Interview:

Name of Mouza(s)...

Union(s)/Ward(s)..

Municipality(s).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	
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	

Expenditure group (in taka)	Percentage of households
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. No.	**Type of facility**	**Nos. of Institution**	**Type of facility**	**Nos. of Institution**
1	Primary School		Ebtedayee Madrasha	
2	High School		Dakhil Madrasha	
3	College		Alim/ Fazil Madrasha	

Sources: RRA

3.6.1 Status of peripheral academic institutions (with name) used by people of the study area:

3.8 Markets and GC (photographs)

Sl. No.	Type of facility	Nos. of markets	Comments with name
1	Major markets		
2	Minor markets		
3	Growth Centers		

Sources: RRA

3.8.1 Status of peripheral markets used by people of the study area:

____
____
____
____

____

4. Land holding categories

4.1 Percentage of HH who have owned agricultural land: ....(BBS)

Percentage of households with different land ownership category in the area:

Land ownership classes	Percentage of household
Land less/ No land (0 decimal)	
Land less (up to 49 decimal)	
Marginal (50-100 decimal)	
Small (101-249 decimal)	
Medium (250-749 decimal)	
Large (750 + decimal)	

Sources: RRA

5. Conflict between different land owner group and professional group

Reasons of Conflicts	Present status of problem	Solution they want with location
Water control infrastructures		
Land elevation		
Cross-interest		

6. Disaster related information: (photographs)

6.1 Type of major disaster and damage occurred in the area after completion of the Project

Sl. 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					
7	Salinity intrusion					
8	Water logging					
9	Erosion					

Sources: RRA

7. Safety Nets and Poverty Reduction Measures in the area:

7.1 Name and activity of GO/ NGOs working in this area

Name	Activity (Credit, Education, Health, Forestry, Fishery, Livestock Rearing, Women Empowerment, Human Rights, VGF, Boyosko bhata, etc.)	% of HHs coverage

8. Information on Water Management Organizations (WMOs) (photographs of office building, committee members, resolution etc)

8.1 Do you know about the CEIP project? Y/N

8.2 Existence of WMOs: Yes/No

8.2.1 If WMO exists:

Sl	Issue/Question	Response/Suggestion		
a)	Year of formation (date if possible)			
b)	Registered by whom?			
c)	Number of members (male-female)	Male	Female	Comments
	Farmer			

Sl	Issue/Question	Response/Suggestion		
	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			

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/ 12.5 Date: 05/06/2013

Subject: Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I).

Ref: Your Application dated 31/03/2013.

With reference to the above mentioned subject, the Department of Environment (DOE) hereby accords Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I) at Satkhira, Khulna, Bagerhat, Pirojpur, Patuakhali and Barguna Districts subject to fulfilling the following terms and conditions.

I. This clearance shall only be applicable for the development of the infrastructure of the said project.
II. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) report considering the overall activity of the said Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE).
III. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)

4a. Project activities:
- A list of the main project activities to be undertaken during site clearing, construction as well as operation
- Project Plan, Design, Standard, Specification, Quantification, etc.

4b. Project schedule: The phase and timing for development of the Project

4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.

4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.

5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
   - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
   - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
   - Environment Quality : Air, Water, Soil and Sediment Quality
   - Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions
6. Socio-economic environment should include, inter alia, following:
   - Population: Demographic profile and ethnic composition
   - Settlement and housing
   - Traffic and transport
   - Public utilities: water supply, sanitation and solid waste
   - Economy and employment: employment structure and cultural issues in employment
   - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.
7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).
   In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the

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scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man maid or natural, wildlife, socio-economic aspect shall be incorporated in detail.

8. Management Plan/Procedures:
   For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.
   An outline of the Environmental Management Plan shall be developed for the project.
   In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)
   Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
10. Conclusion and Recommendations

IV. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.

V. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project.

VI. Violation of any of the above conditions shall render this clearance void.

VII. The project authority shall submit the EIA along with an application for Environmental Clearance, the applicable fee in a treasury chalan and the no objection certificates (NOCs) from the local authority to the head office in Dhaka with a copy to the Khulna and Barisal Divisional Office of DOE.

VIII. This clearance is valid for one year from the date of issuance and the project authority shall apply for renewal to Head Office with a copy to the Khulna and Barisal Divisional Office of DOE at least 30 days ahead of expiry.

IX. This Site Clearance Certificate has been issued with the approval of the appropriate authority.

05.06.2013

(Syed Nazmul Ahsan)
Deputy Director (Environmental Clearance)
&
Member Secretary
Environmental Clearance Committee
Phone # 02-8181778

Mr. Md. Sarafat Hossain Khan
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Coastal Embankment Improvement Project (Phase-I)
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Copy Forwarded to :

1) PS to Secretary, Ministry of Environment and Forest, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Khulna/Barisal Divisional Office, Khulna/Barisal.
3) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

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APPENDIX C: DETAILS OF RELEVANT POLICIES AND LAWS

(A) 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-1 and the proposed interventions are required to comply with all the policy directives emphasizing particularly on reducing adverse environmental impacts. The EIA studies of the coastal polders are required to clearly address the potential impacts and propose mitigation measures.

(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-1 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-1 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-1 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 integrates the 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 subsector by creating an enabling policy framework. Among 60 or more policy statements, the following two policy statements address the coastal zone:

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

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, Amendment 2016

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

19. 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.

2. No person shall transport an antiquity from one place in Pakistan to another with the object of exporting it in contravention of section 22.
3. 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.
4. 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 ladder the 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.18

(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 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.

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18 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.

(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 prices19. 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.

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

- Relocation of households and other establishments: 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 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 awards20.
- 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 this Operational Policy (OP).

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

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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20 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. [21]

[21] Excerpts from the OPN 11.03. WB Operational Manual. September 1986.

- 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)

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:[22]

- 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.[23]

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.

[22] Excerpts from the OP 4.10. WB Operational Manual. July 2005.

[23] Excerpts from WB OP 4.12. WB Operational Manual. December 2001.

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. [24]

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)25 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.

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

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

APPENDIX D: NO OBJECTION CERTIFICATES

গনপ্রজাতন্ত্রী বাংলাদেশ সরকার

১২ নং গাবুরা ইউনিয়ন পরিষদ

চেয়ারম্যান কার্যালয়

ডাকঘর-চাঁদনীমুখা,উপজেলা:-শ্যামনগর,জেলা:- সাতক্ষীরা ।

স্মারক নং:- তারিখ:-

অবস্থানগত/পরিবেশগত ছাড়পত্রের স্থানীয় কর্তৃপক্ষ 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 ১৫, সাতক্ষীরা জেলার শ্যামনগর উপজেলার গাবুরা ইউনিয়নে অবস্থিত ।

৫। প্রকল্পের তফছিল :

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
সাতক্ষীরা	শ্যামনগর				মাঝারি উঁচু ভূমি	হেক্টর

৬। প্রকল্পের কার্যক্রম : বাঁধ উঁচুকরন, সুইজ গেট ও রেগুলেটর নির্মাণ ও মেরামত, খাল পুনঃখনন ইত্যাদি ।

উপরোক্ত তথ্যাদির আলোকে পোল্ডার পোল্ডার ১৫ পুর্নবাসন প্রকল্প বাস্তবায়নের জন্য নিম্নেবর্ণিত অনাপত্তি প্রদান করা হলো ।

শর্তাবলী :

১। প্রকল্প স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষণ আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে ।
২। পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত ছাড়পত্র গ্রহণ করতে হবে ।
৩। কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তার নিশ্চিত করতে হবে ।
৪। উপযুক্ত অগ্নি নির্বাপিক ব্যবস্থা রাখতে হবে । এবং অগ্নিকান্ড কিংবা অন্য কোন দূর্ঘটনার সময় জরুরী নির্গমন ব্যবস্থা থাকতে হবে ।
৫। বায়ু ও শব্দ দূষন করা যাবে না ।
৬। প্রকল্প সৃষ্ট তরল বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না ।

উপরে উল্লিখিত যে কোন শর্তলঙ্ঘন করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক প্রকল্পের বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে ।

২০/০১/১৬

তারিখ : ২০/০১/১৬

স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও সীল

জি,এম মাছুদুল আলম
চেয়ারম্যান
১২নং গাবুরা ইউনিয়ন পরিষদ
শ্যামনগর,সাতক্ষীরা ।

APPENDIX E: MULTI-CRITERIA ANALYSIS TO PRIORITIZE POLDER REHABILITATION

Results of Multi-criteria Analysis to Prioritize Polder Rehabilitation

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
1	63/1A	SD, ID, MD	Anowara	7500	48	7	11	17	6	10	6	HRZ	15	0	0	MV	15	117	5		0	59	Breach caused by the cyclonic surge (AILA) and wave action. The embankment section is partly damaged due to erosion
2	35/3	ID	Bagerhat	6790	40	9	14	8	3	8	5	MRZ	10	0	0	MV	15	89	10		0	57	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
3	32	MD	Dacope	8097	50	3	4	5	2	25	15	HRZ	15	1215	1	MV	15	108	5		0	57	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
4	59/3C	SD, MD	Companigonj	16200	42	8	13	-	0	5	3	MRZ	10	0	0	MV	15	115	5		0	46	Breach caused by the cyclonic surge and wave action.
5	48	SD, ID	Kalapara	5400	38	-	0	3	1.125	7	4	HRZ	15	0	0	MV	15	112.19	5		0	40	Severe damage of embankment due to wave action
6	14/1	ID	Koyara	2933	25	5	9	14	5	-	0	LRZ	5	450	0	MV	15	88	10		0	44	Breach caused by the cyclonic surge and wave

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
																							action. The embankment section is partly damaged due to erosion
7	47/5	SD, ID, MD	Kalapara	7500	33	2	3	7	3	5	3	HRZ	15	0	0	MV	15	103.61	10		0	49	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
8	46	SD, ID	Kalapara	4697	40	5	7	3	1	-	0	HRZ	15	0	0	MDV	10	124.24	5		0	38	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
9	15	ID	Shymna gar	3441	27	3	5	22	8	-	0	LRZ	5	516	0	MV	15	68	15		0	48	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
10	64/2B	SD, ID, MD	Chakoria	7736	96	5	7.167	15.50 0	6	-	0	HRZ	15	0	0	MV	15	163	5		0	48	The embankment section is partly damaged due to erosion & wave action.
11	71	SD	Kutubdia	5116	40	0	0	20	8	-	0	HRZ	15	0	0	MV	15	72	10		0	48	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
12	47/1	SD, ID	Kalapara	2478	22	4	6.371	-	0	2	1	HRZ	15	0	0	MV	15	71	10		0	48	Breach caused by the cyclonic surge and wave action during SIDR & AILA

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
13	42	SD, ID, MD	Barguna Sadar	2794	28	-	0	3	1.125	2	1	LRZ	5	0	0	MV	15	80	10		0	32	Embankment damaged and erosion cost due to wave action.
14	41/6B	ID, MD	Barguna Sadar	7280	44	2	2.389	6	2.250	5	3	LRZ	5	0	0	MV	15	74	10		0	37	Embankment damaged and erosion cost due to wave action.
15	41/5	SD, ID, MD	Barguna Sadar	3880	50	4	6	3	1	1	1	HRZ	15	0	0	MV	15	104	10		0	47	Breach caused by the cyclonic surge(SIDR & AILA) and wave action. The embankment section is partly damaged due to erosion
16	65	ID	Chakaria	6649	48	-	0	16	6	2	1	HRZ	15	0	0	MV	15	119	5		0	42	The embankment section is partly damaged due to erosion
17	58/1	SD, ID	Manpura	4200	32	1	1	2	1	-	0	HRZ	15	630	1	MV	15	58	15		0	47	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
18	69/NE	ID	Moheshkhali	2226	16	2	4	8	3	-	0	HRZ	15	0	0	MDV	10	36	15		0	47	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
19	66/2	ID	Cox's Bazar & Ramu	2621	20	-	0	5	2	-	0	HRZ	15	0	0	MV	15	43	15		0	47	The embankment section is partly damaged due to erosion

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
20	66/4	ID	Chakaria	3324	24	9	15	5	2		0	HRZ	15	0	0	MDV	10	53	15		0	57	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
21	65/A	ID	Chakoria	806	9	-	0	5	2	-	0	HRZ	15	0	0	MV	15	18	15		0	47	The embankment section is partly damaged due to erosion
22	66/1	SD, ID, MD	Cox's Bazar	4930	20	1	1	1	0	1	1	HRZ	15	0	0	MV	15	61	15		0	47	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
23	62	SD	Bandar, Patenga & Pahartali	5600	22	-	0	5	2	-	0	HRZ	15	0	0	MV	15	59	15		0	47	The embankment section is partly damaged due to erosion
24	41/7	ID, MD	Mirzaganj	6984	51	6	10	1.50	0	3	2	LRZ	5	0	0	MV	15	84	10		0	41	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
25	56/57	ID	Bhola Sadar, Borhanuddin, Charfassion, Daulatkhan	123800	250	5	7	15	6	15	9	HRZ	15	5571	5	MV	15	534	-10		0	46	Breach caused by the cyclonic surge (AILA) and wave action. The embankment section is partly damaged due to erosion

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
26	33	ID	Dacope	8100	52	3	4	10	4	12	7	HRZ	15	1215	1	MV	15	128	5		0	51	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
27	65/A1	ID	Chakaria	2800	20	-	0	2	1	0	0	HRZ	15	0	0	MV	15	40	15		0	46	The embankment section is partly damaged due to erosion
28	58/3	SD	Manpura , Sudaram	1308	17	-	0	7	3	5	3	HRZ	15	0	0	MDV	10	31	15		0	46	The embankment section is partly damaged due to erosion
29	58/2	SD	Manpura	4312	28	-	0	7	2	4	2	HRZ	15	647	1	MV	15	50	15		0	50	The embankment section is partly damaged due to erosion
30	64/1C	SD, ID	Bashkha li	2151	23	1	1.115	11	4.031	-	0	HRZ	15	0	0	MDV	10	53	15		0	45	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
31	63/1B	ID, MD	Anowara	7300	21	-	0	-	0	-	0	MRZ	10	0	0	MV	15	36	15		0	40	-
32	72	SD, MD	Swandip	2270 0	58	9	15	-	0	-	0	HRZ	15	0	0	MDV	10	192	5		0	45	Breach caused by the cyclonic surge(SIDR) and wave action
33	17/1	ID	Dumuria	5020	45	-	0	37	14	-	0	LRZ	5	753	1	MV	15	88	10		0	44	The embankment section is partly damaged due to erosion
34	7/1	ID	Assasuni ,	3110	34	1	1	18	7	-	0	LRZ	5	467	0	MV	15	81	10		0	38	Breach caused by the cyclonic surge(AILA) and

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
			Shamnagar																				wave action. The embankment section is partly damaged due to erosion
35	55/3	SD, ID	Galachipa, Charfassion	9845	56	-	0	-	0	5	3	HRZ	15	0	0	MV	15	236	-10		0	23	-
36	55/2D	SD, MD	Patuakhali, Dashmia	8540												MV		99					
37	55/2E	MD, ID	Patuakhali, Dashmina, Bouphol	10535												MV		123					
38	67/B	ID	Teknaf	900	8	-	0	7	3	-	0	MRZ	10	0	0	MDV	10	26	15	Naf River	5	43	The embankment section is partly damaged due to erosion
39	69/P1	SD	Moheshkhali	1800	13	1	1	5	2	-	0	HRZ	15	0	0	MDV	10	96	10		0	38	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
40	64/1B	ID, MD	Bashkhali	8000	53	5	7.167	-	0	-	0	HRZ	15	0	0	MDV	10	144	5		0	37	Breach caused by the cyclonic surge(SIDR & AILA) and wave action.

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
41	61/1	SD	Sitakunda	8769	27	1	2.150	-	0	-	0	HRZ	15	0	0	MDV	10	107	5		0	32	Breach caused by the cyclonic surge(SIDR & AILA) and wave action
42	67/A	MD	Teknaf & Ukhiya	1500	13	0	0	5	2	-	0	MRZ	10	0	0	MDV	10	48	15	Naf River	5	42	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
43	70	SD, ID, MD	Moheshkhali	3025	32	-	0	5	2	-	0	HRZ	15	0	0	MDV	10	122	5		0	32	The embankment section is partly damaged due to erosion
44	67	ID	Teknaf	2000	13	-	0	5	2	-	0	MRZ	10	0	0	MDV	10	46	15	Naf River	5	42	The embankment section is partly damaged due to erosion
45	65/A3	ID	Chakaria	604	10	0	0	-	0	1	1	HRZ	15	0	0	MDV	10	26	15		0	41	Breach caused by the cyclonic surge and wave action
46	59/2	ID	Ramgati	21255	82	6	9	4	1	1	1	MRZ	10	0	0	MV	15	190	5		0	41	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
47	3	ID	Debhata, Kaliganj	22267	64	1	1	1	0	2	1	LRZ	5	3340	3	MV	15	155	5	Issamoti River	10	40	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion

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48	41/1	SD, MD	Barguna Sadar	4048	34	-	0	-	0	1	0	MRZ	10	0	0	MV	15	83	10		0	35	-
49	36/1	ID	Bagerhat, Chitalmari, Fakirhat, Morelgonj, Rupsa	40343	95	0	0	40	15	-	0	LRZ	5	6051	5	MDV	10	190	5		0	40	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
50	47/2	ID, MD	Kalapara	2065	17	-	0	-	0	1	0	HRZ	15	0	0	MDV	10	39	15		0	40	-
51	47/4	SD, ID, MD	Kalapara	6600	57	0	0	-	0	-	0	HRZ	15	0	0	MV	15	150	5		0	35	Breach caused by the cyclonic surge(SIDR) and wave action
52	40/1	SD, ID, MD	Patharghatha	2105	23	-	0	-	0	-	0	MRZ	10	0	0	MV	15	91	10		0	35	-
53	40/2	SD, ID, MD	Patharghatha	4453	36	-	0	-	0	-	0	MRZ	10	0	0	MV	15	85	10		0	35	-
54	45	SD, ID	Amtali	4089	27	-	0	-	0	-	0	MRZ	10	0	0	MV	15	96	10		0	35	-
55	23	ID	Paikgacha	5910	37	1	2	19	7	-	0	LRZ	5	887	1	MDV	10	123	5		0	30	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
56	66/3	SD, ID, MD	Cox's Bazar	4832	52	-	0	11	4	-	0	HRZ	15	0	0	MDV	10	133	5		0	34	The embankment section is partly damaged due to erosion

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57	55/1	SD, ID	Galachipa	10325	46	1	1	0	0	5	3	LRZ	5	0	0	MV	15	145	5		0	29	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
58	55/2B	ID, MD	Galachipa	2600	30	2	2	1	0	2	1	LRZ	5	0	0	MV	15	81	10		0	34	Breach caused by the cyclonic surge (AILA) and wave action. The embankment section is partly damaged due to erosion
59	29	ID	Batiaghata, Dumuria	8218	49	2	3	13	5	-	0	LRZ	5	1233	1	MV	15	102	10		0	39	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
60	16	ID	Paikgacha, Tala	10445	45	1	2	25	9	-	0	LRZ	5	1567	1	MDV	10	108	5		0	33	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
61	68	SD, ID	Teknaf	3500	27	0	0	5	2	-	0	MRZ	10	0	0	MDV	10	95	10		0	32	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
62	64/1A	SD, ID	Bashkhali	5750	58	1	0.796	2	0.750	-	0	HRZ	15	0	0	MV	15	137	5		0	37	Breach caused by the cyclonic surge and wave action. The embankment

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																							section is partly damaged due to erosion
63	43/1A	ID, MD	Amtali	2675	27	0	1	-	0	2	1	MRZ	10	0	0	MDV	10	51	15		0	37	Breach caused by the cyclonic surge (SIDR) and wave action. Breach closed by constructing ring bundh
64	43/2C	SD, ID, MD	Galachipa	2753	26	1	1	-	0	1	1	LRZ	5	0	0	MV	15	54	15		0	36	Breach caused by the cyclonic surge (SIDR) and wave action
65	34/3	ID	Bagerhat	3656	17	-	0	17	6	-	0	LRZ	5	0	0	MDV	10	55	15		0	36	The embankment section is partly damaged due to erosion
66	43/2A	ID, MD	Patuakhali	5182	39	2.00	0	-	0	2	1	LRZ	5	0	0	MV	15	73	10		0	31	Breach caused by the cyclonic surge(SIDR & AILA) and wave action
67	73/1 (A & B)	SD, ID, MD	Hatiya	21377	80	4	6	28	11	-	0	HRZ	15	0	0	MV	15	219	-10		0	36	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
68	17/2	ID	Dumuria	3400	11	-	0	-	0	-	0	LRZ	5	510	0	MV	15	28	15		0	35	-
69	43/1	SD, ID, MD	Amtali	10600	65	1.50	0	1	0	-	0	MRZ	10	0	0	MV	15	128	5		0	30	Breach caused by the cyclonic surge(SIDR & AILA) and wave action The embankment section is partly damaged due to erosion

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70	28/2	ID	Batiaghata	2590	20	-	0	-	0	-	0	LRZ	5	389	0	MV	15	48	15		0	35	-
71	32	SD, ID	Sharankhola	13058	63	2	2	21	8	-	0	HRZ	15	0	0	MV	15	126	5		0	45	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
72	61/2	SD	Mirsharai	19855	10	0	0	-	0	-	0	MRZ	10	0	0	MDV	10	54	15		0	35	Breach caused by the cyclonic surge and wave action
73	73/2	SD, MD	Hatiya	11134	48	-	0	0	0	-	0	HRZ	15	0	0	MDV	10	214	-10		0	15	The embankment section is partly damaged due to erosion
74	39/1A	SD, MD	Patharghatha	11740	58	-	0	-	0	-	0	MRZ	10	0	0	MV	15	123	5		0	30	-
75	39/2C	SD, MD	Matbaria	10748	55	-	0	-	0	-	0	LRZ	5	0	0	MV	15	122	15		0	35	-
76	41/4	SD, ID, MD	Barguna Sadar	1741	19	-	0	-	0	-	0	LRZ	5	0	0	MV	15	46	15		0	35	-
77	44	SD, ID	Amta!i, Kalapara	17530	82	-	0	-	0	-	0	HRZ	15	0	0	MV	15	174	5		0	35	-
78	47/3	ID, MD	Kalapara	2025	20	-	0	-	0	-	0	HRZ	15	0	0	LV	5	42	15		0	35	-
79	52/53A	SD, ID, MD	Galachipa	3663	25	-	0	-	0	-	0	LRZ	5	0	0	MV	15	76	10		0	30	-

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
80	60	ID	Sonagazi	9150	38	-	0	-	0	-	0	MRZ	10	0	0	MDV	10	63	15		0	35	-
81	64/2A	ID, MD	Chakoria	3750	34	-	0	-	0	-	0	HRZ	15	0	0	LV	5	34	15		0	35	-
82	31	MD	Dacope	7288	47	-	0	4	2	4	2	LRZ	5	1093	1	MV	15	126	5		0	29	The embankment section is partly damaged due to erosion
83	13-14/2	ID	Koyara	17854	93	0	0	17	6	-	0	LRZ	5	2678	2	MV	15	156	5		0	34	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
84	31/Part	MD	Batiaghata	4848	29	-	0	9	3	-	0	LRZ	5	727	1	MDV	10	86	10		0	29	The embankment section is partly damaged due to erosion
85	22	MD	Paikgacha	1630	20	-	0	10	4	-	0	LRZ	5	245	0	MDV	10	50	15		0	34	The embankment section is partly damaged due to erosion
86	06-08 (Ext)	ID	Satkhira, Kalarua	8330	9	-	0	8	3	-	0	LRZ	5	1250	1	MDV	10	26	15		0	34	The embankment section is partly damaged due to erosion
87	18-19	ID	Paikgacha	3380	32	-	0	9	3	-	0	LRZ	5	507	0	MDV	10	76	10		0	29	The embankment section is partly damaged due to erosion
88	43/2E	ID, MD	Patuakhali	1650	20	-	0	-	0	6	4	LRZ	5	0	0	MDV	10	89	10		0	29	-

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
89	34/1	ID	Bagerhat	2212	10	-	0	8	3	-	0	LRZ	5	332	0	MDV	10	28	15		0	33	The embankment section is partly damaged due to erosion
90	9	ID	Paikgac ha.	1255	8	-	0	6	2	-	0	LRZ	5	188	0	MDV	10	28	15		0	32	The embankment section is partly damaged due to erosion
91	39/2A	ID, MD	Bamna	5080	32	-	0	-	0	4	2	LRZ	5	0	0	MDV	10	88	10		0	27	-
92	55/4	SD	Galachip a	5142	33	-	0	-	0	4	2	LRZ	5	0	0	MDV	10	136	5		0	22	-
93	21	MD	Paikgac ha	1417	17	-	0	5	2	-	0	LRZ	5	213	0	MDV	10	37	15		0	32	The embankment section is partly damaged due to erosion
94	20, 20/1	MD	Paikgac ha	1600	23	-	0	5	2	-	0	LRZ	10	240	0	MDV	20	59	30		0	93	The embankment section is partly damaged due to erosion
95	4	ID	Assasuni	1050 0	80	2	2	21	8	-	0	LRZ	5	1575	1	MDV	10	153	5		0	32	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
96	1	ID	Assasuni , Debhata & Satkhira	2838 1	96	1	1	1	0	3	2	LRZ	5	4257	3	MV	15	171	5		0	31	Lowest Pocket Silted Up. Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
97	Kumiriya to Sonaichari Flood Control Project	SD	Sitakunda	1610	5	0	0.557	-	0	-	0	HRZ	15	0	0	MV	15	8	15		0	46	Breach caused by the cyclonic surge(SIDR & AILA) and wave action
98	41/2	SD, ID, MD	Barguna Sadar	3644	39	-	0	-	0	1	0	LRZ	5	0	0	MDV	10	118	5		0	20	-
99	43/2F	ID, MD	Amtali	4453	32	-	0	-	0	-	0	MRZ	10	0	0	LV	5	53	15		0	30	-
100	7/2	ID	Assasuni.	10486	60	1	2	18	7	-	0	LRZ	5	1573	1	MDV	10	116	5		0	30	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
101	24	ID	Abhaynagar, Dumuria, Keshobpur, Manarampur	28340	26	-	0	-	0	-	0	LRZ	5	4251	3	LV	5	61	15		0	28	-
102	06-08	ID	Assasuni, Satkhira, Tala	18450	53	1	2	10	4	-	0	LRZ	5	2768	2	MDV	10	128	5		0	28	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
103	55/2C	ID, MD	Galachipa	6275	48	-	0	-	0	3	2	LRZ	5	0	0	MDV	10	73	10		0	27	-
104	26	ID	Dumuria	2696	29	-	0	2	1	-	0	LRZ	5	404	0	LV	5	66	15		0	26	The embankment section is partly damaged due to erosion
105	28/1	ID	Dumuria	5600	23	-	0	-	0	-	0	LRZ	5	840	1	LV	5	65	15		0	26	-
106	2	ID	Assasuni, Satkhira	11296	64	0	1	10	4	-	0	LRZ	5	1694	1	MDV	10	129	5		0	26	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
107	10-12	ID	Koyara, Paikgacha	16315	67	2	2	3	1	-	0	LRZ	5	2447	2	MDV	10	119	5		0	25	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
108	27/1, 27/2	ID	Dumuria	4260	45	-	0	-	0	-	0	LRZ	5	713	1	LV	10	109	30		0	86	-
109	41/3	ID, MD	Barguna Sadar	1053	20	-	0	-	0	-	0	LRZ	5	0	0	LV	5	43	15		0	25	-
110	41/6A	SD, MD	Barguna Sadar	3850	33	-	0	-	0	-	0	LRZ	5	0	0	LV	5	49	15		0	25	-
111	41/7A	ID, MD	Betagi	6220	39	-	0	-	0	-	0	LRZ	5	0	0	LV	5	51	15		0	25	-
112	43/2B	ID, MD	Galachipa, Amtai,	5460	42	-	0	-	0	-	0	MRZ	10	0	0	LV		49	15		0	25	-

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
			Patuakhali																				
113	43/2D	ID, MD	Patuakhali	6500	43	-	0	-	0	-	0	LRZ	5	0	0	LV	5	50	15		0	25	-
114	52/53B	SD, ID, MD	Galachipa	4064	34	-	0	-	0	-	0	LRZ	5	0	0	LV	5	96	10		0	20	-
115	55/2A	ID, MD	Patuakhali, Galachipa, Amtoli	7166	43	-	0	-	0	-	0	LRZ	5	0	0	LV	5	80	10		0	20	-
116	59/1A	ID	Companiganj,	15506	36	-	0	-	0	-	0	LRZ	5	0	0	LV	5	98	10		0	20	-
117	5	ID, MD	Kaliganj, Shymnagar	55061	192	2	3	12	5	-	0	LRZ	5	8259	7	MV	15	272	-10		0	24	Lowest Pocket Silted Up Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
118	25	ID	Dumuria Fultala	17400	46	-	0	-	0	-	0	LRZ	5	2610	2	LV	5	83	10		0	22	-
119	30	MD	Batiaghata	6396	40	-	0	-	0	-	0	LRZ	5	959	1	LV	5	110	5		0	16	-
120	59/1B	ID	Sudharam, Laxipur	18218	40	-	0	-	0	-	0	LRZ	5	0	0	LV	5	156	5		0	15	-

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
121	59/3B	SD, ID, MD	Shudharam	31376	63	-	0	-	0	-	0	MRZ	10	0	0	LV	5	182	5		0	20	-
122	39/1B		Matbaria	13100	63	-	1	-				LRZ	5		0			138	5		0	11	-
123	41/7B		Betagi	6150		-		-				LRZ	5		0			58	15		2	22	-
124	Bibichini		Betagi	4600		-		-				LRZ	5		0			33	15		3	23	-
125	43/1B		Kalapara	3000		-		-				HRZ	15		0			63	15		4	34	-
126	CDSP-II		Sonagazi	1981		-		-				HRZ	15		0			35	15		5	35	-
127	Dumki Laukathi		Patukhali	18550		-		-				LRZ	5		0			61	15		6	26	-
128	Itbaria Labukhali		Patukhali	9650		-		-				LRZ	5		0			53	15		7	27	-
129	Mirzagonj Rampura		Mirzagonj, Patuakhali	16500		-		-				LRZ	5		0			69	15		8	28	-
130	50/51		Galachipa	6935		-		-				HRZ	15		0			138	5		9	29	-
131	54		Kalapara, Amtoli,	13954		-		-				HRZ	15		0			174	5		10	30	-

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
			Galachipa																				
132	Satla Bagda -1		Agailjhara, Wazirpur			-		-				LRZ	5		0			59	15		11	31	-
133	Satla Bagda -2		Uzirpur, Agailjhara			-		-				LRZ	5		0			196	5		12	22	-
134	Satla Bagda -3		Uzirpur, Agailjhara			-		-				LRZ	5		0			25	15		13	33	-
135	59/2 Ext.		Ramgati	4000		-		-				HRZ	15		0			52	15		14	44	-
136	Boychar		Hatiya			-		-				HRZ	15		0			159	5		15	35	-
137	Char Bagardona-1		Suborna char	1350		-		-				HRZ	15		0			24	15		16	46	-
138	Char Bagardona-2		Suborna char	1200		-		-				HRZ	15		0			21	15		16	46	-
139	Char Mojid		Suborna char	850		-		-				HRZ	15		0			15	15		16	46	-

Notes:

	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks

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 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.

APPENDIX F: LIST OF PARTICIPANTS OF PCM

Participant List 1: Participants list of PCM at

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থান: গাবুরা ইউনিয়ন পরিষদ ইউনিয়ন: গাবুরা উপজেলা: শ্যামনগর
জেলা: সাতক্ষীরা সময়: তারিখ: ২১-০১-২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
	জি. এম. মাছুদুল আলম	চেয়ারম্যান	গাবুরা	০১৭১১-৬১০৬১৬	[illegible]
	মো: গোলাম মোস্তফা	UP সদস্য ২নং ওয়ার্ড	গাবুরা	০১১৯৬১০২৬৬৮৪	[illegible]
	মো: আব্দুল মতিন	UP সদস্য ৪নং ওয়ার্ড	[illegible]	[illegible]	[illegible]
	[illegible]	UP সদস্য ৬নং ওয়ার্ড	[illegible]	[illegible]	[illegible]
	[illegible]	UP সদস্য ৩নং ওয়ার্ড	[illegible]	[illegible]	[illegible]
	[illegible]	UP সদস্য ৮নং ওয়ার্ড	"	[illegible]	[illegible]
	শ্রী [illegible]	UP সদস্য ৯নং ওয়ার্ড	"	[illegible]	[illegible]
	[illegible]	UP সদস্য ৩নং ওয়ার্ড	"	[illegible]	[illegible]
	[illegible]	UP সদস্য ৭,৮,৯ ওয়ার্ড	"	[illegible]	[illegible]
	[illegible]	UP সদস্য ৪,৫,৬ ওয়ার্ড	"	[illegible]	[illegible]
	[illegible]	UP সদস্য ১,২,৩ ওয়ার্ড	"		
	[illegible]	সাংবাদিক		[illegible]	[illegible]
	[illegible]			[illegible]	[illegible]
	শামিমা		[illegible]		[illegible]
	মো: আশিক [illegible]	[illegible]	গাবুরা/[illegible]	০১৯৪৪৭৮২৭৭৪	Ashi
	[illegible] সুলতানা	[illegible]	[illegible]		[illegible]
	কামাল হোসেন	[illegible]	[illegible]		[illegible]
	শ্রী [illegible]	"	"	—	[illegible]

আয়োজনে:

CEGIS Center for Environmental and Geographic Information Services
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

Participant List 2: Participants list of PCM at

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থান: গাবুরা ইউনিয়ন পরিষদ ইউনিয়ন: গাবুরা উপজেলা: শ্যামনগর

জেলা: সাতক্ষীরা সময়: তারিখ: [illegible]-০২-২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
	নিরঞ্জন	ব্যবসায়ী	[illegible]	[illegible]	[illegible]
	[illegible]	সমাজসেবক	১০ নং [illegible]	[illegible]	[illegible]
	মো: [illegible]	"	"	[illegible]	[illegible]
	মো: [illegible]	শিক্ষক	১০ নং ওয়ার্ড	01717-488514	[illegible]
	মো: [illegible] রহমান	সমাজসেবক	৪ নং ওয়ার্ড	01920-292206	[illegible]
	এম. এম. নজরুল ইসলাম	"	১০ নং ওয়ার্ড	[illegible]	[illegible]
	গাজী [illegible]	উপদেষ্টা	৮ নং ওয়ার্ড	[illegible]	[illegible]
	এম. কে. এ. মিলন	শিক্ষক	৯ নং ওয়ার্ড	[illegible]	[illegible]
	আবুল হোসেন	সমাজসেবক	৬ নং ওয়ার্ড	[illegible]	[illegible]
	এম. কে. আ: রশিদ	শিক্ষক	৬ নং ওয়ার্ড	[illegible]	[illegible]
	মো: আমিনুর রহমান	সমাজসেবক	৯ নং ওয়ার্ড	[illegible]	[illegible]
	মো: শাহ আলম	জেলে	৩ নং ওয়ার্ড	[illegible]	[illegible]
	মো: আহসান হাবীব	গ্রাম পুলিশ	৩ নং ওয়ার্ড	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]		[illegible]
	মো: [illegible]	[illegible]	[illegible]		
	ইমদাদুল হক	[illegible]	[illegible]	01985 529170	[illegible]
	সাহিন হোসেন	[illegible]	"	-	[illegible]
	আবুল কাশেম গাজী	কৃষক	[illegible]	-	

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Table: ……………………………………………(FGD-5)

Sl No	Name of Participants	Age	Occupation	Address/Mobile
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

APPENDIX G: 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 H: LIST OF PARTICIPANTS IN PDM HELD AT SHYAMNAGAR UPAZILA, SATKHIRA

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

স্থান : শ্যামনগর উপজেলা পরিষদ মিলনায়তন

সময় : ১০:০০

তারিখ: ০৫/১২/১৭

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১	মো: [illegible]	UNO	01785759095	[illegible]
2	[illegible]	চেয়ারম্যান (উ:)	01718-082838	[illegible]
৩	[illegible]	UAO	01913-442777	[illegible]
৪	ড. মো: [illegible]	[illegible]	01911493918	[illegible]
৫	[illegible]	[illegible]	[illegible]	[illegible]
৬	[illegible]	[illegible]	[illegible]	[illegible]
৭	মো: [illegible]	[illegible]	[illegible]	[illegible]
৮	মো: [illegible]	শ্যামনগর থানা [illegible]	01721-195982	[illegible]
৯	মো: [illegible]	[illegible]	[illegible]	[illegible]
১০	[illegible]	[illegible]	[illegible]	[illegible]
১১	মো: [illegible]	[illegible]	[illegible]	[illegible]
১২	মো: [illegible]	[illegible]	01934722815	Rahmat
১৩	[illegible]	[illegible]	01715-387402	[illegible]
১৪	Kamal Hossain Shaikh.	Technical officer Shushilan	01752-599597	[illegible]
১৫	Masud Rana	SAE/ SO BWDB	01721-919548	[illegible]
১৬	মো: [illegible]	প্রধান শিক্ষক [illegible]	01914287157	[illegible]
১৭	[illegible]	[illegible]	[illegible]	[illegible]
১৮	[illegible]	USEO	[illegible]	[illegible]

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সভায় অংশগ্রহণকারীদের তালিকা

স্থান : শ্যামনগর উপজেলা পরিষদ মিলনায়তন

সময় : ১০ : ০০

তারিখ: ০৫/১২/১৭

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৯	প্রনব বিশ্বাস	প্রোগ্রাম অফিসার (OCC)	01730781056	[illegible]
20	মো: সাইদুল ইসলাম	উপজেলা মহিলা বিষয়ক অফিস	01720002865	[illegible]
২১	[illegible]	[illegible]	01718-249424	[illegible]
22	কৃষ্ণপদ মন্ডল	[illegible]	01914 271279	Krishnapada
২৩	[illegible]	[illegible]	০১৭১১৬৬১৫৫৭২	[illegible]
2৪	দিলীপ চক্রবর্তী	[illegible]	০১৭২৮-৬৮৬২৪০	Dilip
2৫	[illegible] চক্রবর্তী	[illegible]	০১৭১৫ ১১৯৪৪	[illegible]
2৬	[illegible]	[illegible]	০১৭৯৪ ৭১৭৯৬	[illegible]
2৭	[illegible]	[illegible]	০১৭২২১৭৭৫৩৩	[illegible]
2৮	[illegible] কুমার চক্রবর্তী	[illegible]	০১৭২৪৬২০৪৭৪	[illegible]
2৯	মো: নূরুল ইসলাম	[illegible]	01742-431952	[illegible]
৩০	মো: নুরুল ইসলাম	ইমাম [illegible]	০১৭১৮৬০৪৪১৮	নুরুল ইসলাম
৩১	[illegible]	[illegible]	01736-329825	[illegible]
৩2	[illegible] চক্রবর্তী	[illegible]	01986673980	[illegible]
৩৩	হর চ্যাটার্জী	[illegible]	01721-037818	[illegible]
৩৪	মো: মহসীন আলম	[illegible]	০১৮৬৯-৯৫৭২৭২	[illegible]
৩৫	[illegible]	[illegible]	01948-906221	[illegible]
৩৬	দিলীপ [illegible]	[illegible]	০১৭২৪৪৮৮২৭৪	[illegible]

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স্থান : শ্যামনগর উপজেলা পরিষদ মিলনায়তন

সময় : ১০:৩০

তারিখঃ ০৫/১২/২০১৭

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৩৭	[illegible]	[illegible]	[illegible]	[illegible]
৩৮	[illegible]	[illegible]	01717-003394	[illegible]
৩৯	মো: ইসমাইল হোসেন	[illegible]	01716 808992	[illegible]
৪০	[illegible]	[illegible]	01918614532	[illegible]
৪১	[illegible]	[illegible]	01716-716848	[illegible]
৪২	[illegible]	[illegible]	01718-931364	[illegible]
৪৩	মো: [illegible]	[illegible]	[illegible]	[illegible]
৪৪	মো: [illegible]	LGED office	[illegible]	[illegible]
৪৫	[illegible]	O.S. office U.N.O office	01718-868595	[illegible]
৪৬	মো: [illegible] ইসলাম	UPAZILA Tech UNO office, Shyam	01777-986200	[illegible]
৪৭	তুহিন মিস্ত্রী	Upazila Consultant UNO office, Shym	01921-316079	[illegible]
৪৮	[illegible]	UPZ / SU	01924216074	[illegible]
৪৯	[illegible]	[illegible]	01715-389402	[illegible]
৫০	মো: জাহিদ হোসেন	[illegible]	[illegible]	জাহিদ
৫১	মো: [illegible]	[illegible]	[illegible]	[illegible]
৫২	মো: মনিরুল ইসলাম	[illegible]	[illegible]	[illegible]
৫৩	মো: [illegible]	[illegible]	[illegible]	[illegible]
৫৪	[illegible]	[illegible]	[illegible]	[illegible]

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স্থান ঃ শ্যামনগর উপজেলা পরিষদ মিলনায়তন

সময় ঃ ১০ : ৩

তারিখঃ ০৫/১২/২০১৭

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
৫৫.	Sazzad Sajib	PM / Shushilan	01761730933	[signature]
৫৬.	Md-Abdul Karim	Upazila Coordinator WAVE foundation	01717-669446	Karim
৫৭.	MD IMAM Hossin	VOS Bangladesh	01717222912	[signature]

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APPENDIX I: SUMMARY OF ASSESSED IMPACTS

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
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 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 trawler and equipment should comply with the standards of DoE. • Sprinkling of water and ramming the materials of stockyard and approach roads regularly. • Stockyard should be covered during non-working period.	Low
Changes in land use	Short term	Local	Reversible (after construction phase)	Certain	Low to Medium	Low	• All the construction camps should be established within the area owned by BWDB. • Pay compensation/rent if private property is acquired on temporary basis, which instructions should be specified in the tender document. • Labor shed/camp should be constructed on government Khas land. • Avoid direct confrontation with local stakeholders.	Very low
Clearances of vegetation	Sort term	Local	Reversible (after constructi	Certain	Low to Medium	Low	• Avoid vegetation damage as much as possible to select sites for labour shed and material stock by using nearer	low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
			on phase)				fallow land or barren homestead yards • Give proper compensation to the tree owners against tree felling specially for fruit yielding trees (List of affected tree will be finalize after getting RAP Report) • Implement tree plantation at the damaged sites after completion of construction works.	
Involuntary resettlement	Will be added	Will be added	Will be added	Will be added	Will be added	Will be added	Will be added	Will be added
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 particularly at the Gabura Hat, Gainbari Hat, Dumuria Hat, Parshemari Hat and Chandnimukha Hat. • 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.	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• 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 weekly market day (Haatbar) should be considered during vehicular traffic movement. • Keep provision of training on vehicular traffic movement pattern and management system for the local stakeholders by using multimedia presentation and showing video at different common population gathering places of the Polder area.	
B. Construction Phase								
Deteriorated environme	Short term	Local	Reversible (after	Occasional	Medium	**Minor**	• Construction machineries should have proper mufflers and silencers.	**Low**

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
ntal (air and noise) quality			construction phase)				• 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. • Sprinkling of water and ramming of the material 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. • 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.	
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. • Bailing out of water behind the earthen dams during construction work. • Both contractor and BWDB should supervise the construction work and built temporary and demolish the	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							same after completion of the construction.	
Effects on agriculture crop production	Short term	Local	Reversible	Likely	Minor	Low	• Compensation should be paid for any crop damage. • Contractor should avoid cultivation fields during construction. • Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps construction. • Contractor should ensure that no vehicular movements take place inside cultivation fields. • Contractor should ensure that no material is dumped inside cultivation fields. • Re-excavated soil of canals should not be damp in agricultural land. • Contractor should maintain liaison with communities.	Negligible
Effects on irrigation	Short term	Local	Reversible	Likely	Low to Medium	Moderate	• Contractor should construct bypass channel before construction/ replacement/ demolished of each regulator. • Sequence of work at the regulators and in the water channels should be carefully planned to avoid irrigation disruption. • Contractor should ensure no negative impacts on crop irrigation. • Contractor should maintain liaison with communities. • Contractor should work during dry season.	Low
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 Kholpetua River will be carefully planned to minimize impacts on spawning and subsequently nursery ground of fish.	Moderate

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Contractor should maintain liaison with experienced fishermen.	
Impact on fish habitat and migration	Short term	Local	Reversible	Likely	Medium	Moderate	• 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 hindrance to fish migration. • Contractor will maintain liaison with communities so that they could realize the issue. It is more important in case of timing for letting 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
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	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							minimizing impacts on benthic fauna.	
Clearance of vegetation	Short term	Local	Reversible (after construction phase)	Occasional	Low to Medium	Low	• Collect soil from barren land and alternate source like riverbed or nearer barrow pits at countryside as much as possible • Keep close liaison with CREL Project Authority and Forest Department while implementation of earth works • Create plant strips with same damaged species at the toe of the embankment after completion of earthwork • Proper turfing on embankment slopes with local grasses (i.e Durba (Cynodon dactylon) , Mutha (Cyperus rotundus)) and ensure regular monitoring of turf grasses till they matured	Low to nil
Impacts on mangrove vegetation at foreshore for bank revetment							• Care should be taken to enhance plantation at nearer foreshore area (a. mudflats between Chouddarashi Bridge and starting points of bank Revetment at Ch. 23.4 km and b. mudflats at north from the Parshemari Tekerhat Kheyaghat to compensate for vegetation loss due to bank revetment. • Implement plantation with native species along countryside slope of the embankment after finishing of construction works • Guarding and caring for the saplings to grow, periodic weeding, monitoring regularly, replacing dead/weak saplings with new ones.	
Impact on vegetation at construction sites of water							• Implement plantation at sluice ground and nearer foreshore mudflats after completion of construction works	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
control structures								
Impacts on foreshore ecosystem for coastal afforestation							• Aware labours about plant conservation who are engaged for afforestation activities • Keep close liaison with CREL Project Authority and Forest Department while implementation of plantation programme • Collect saplings from near-natural sources (i.e from mangrove forest at south bank of Kholpetua River) and from nurseries of Burigoalini Forest Range as much as possible • All kinds of polyethylene bags and plastic ropes should be piled up in a pit for dumping or burned in a proper way • Care should be taken for physical and biological control of plant disease while nursery raising and sapling plantation (i.e.: using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers) • Pre consultation with Forest Department and other related non-government organizations for selecting of suitable species for plantation and spacing of the saplings • Develop a pest management plan for the holistic afforestation	
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	Moderate

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							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 procedure 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	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							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 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;	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							▪ 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; ▪ Provide health insurance for employees for the duration of their contracts; ▪ Provide insurance for accidents resulting in disabilities or death of	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							employees for the duration of their contracts; ▪ Develop a recruitment process community employee that involves local authorities in clearly understood procedures; ▪ Employ a community liaison officer (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;	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							▪ 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. o Availability of safe drinking water will be ensured for the construction staff. o First aid boxes will be made available at each construction site. Emergency phone numbers (including hospitals, Fire Department, and Police) will be displayed at key locations within the site. Each site will have an ambulance available. o Firefighting equipment will be made available at the camps and worksites. ▪ Waste management plan to be prepared and implemented in accordance with international best practice. ▪ Liaison with the community will be maintained.	
Increased Inland and Waterway Traffic							▪ Contractor to prepare and implement traffic management plan. ▪ Contractor to establish new, temporary jetties where needed.	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							▪ River crossing for material transportation during night time where possible and appropriate ▪ Material transportation through rivers during high tide where needed. ▪ Liaison to be maintained with community and BIWTA.	
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. • GRM will be put in place.	Low
Damage to Local							• The condition of the infrastructure being used for the construction and	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
Infrastructure							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.	
Social unrest between Local worker and outside worker	Short term	Local	Reversible	Likely	Medium	Moderate	• Proper awareness programs should be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, Upazila Nirbahi Officer (UNO) and BWDB local officers. • Liaison with the communities should 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.	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Avoiding construction activities during Prayer time.	
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
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, and emergency are in place.	Low
C. Post Construction Phase								
Increase Salinity Intrusion due to Leakage of Regulators	Short term	Local	Reversible (after construction phase)	Likely	Medium	Moderate	• 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 should be	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							prepared and implemented for the water control structures. These procedures should be translated in bangle as well. • Capacity building of WMOs should be carried out.	
Increase use of agro-chemicals	Long term	Local	Reversible	Likely	High	Major	• Capacity building and awareness rising of the farmers should be carried out to practice Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) in order to minimize usage of chemical inputs. • Farmers group should have close contact with DAE for adoption of various measures of ICM and GAP. • Farmers should be encouraged to use organic and green manure to increase soil fertility while avoiding water contamination. • Farmers should be encouraged to cultivate leguminous crops (N2 fixing) to enhance the soil quality as well as soil productivity.	Moderate
Reduced Fish Migration Time and Extent	Long term	Local	Reversible	Likely	Medium	Moderate	• Knowing the exact migration period • Proper sluice gate operation allowing fish migration; • Provide training to WMOs regarding fish-friendly gate operations; and • Transferring juvenile fish from rivers to Polder. • Restrict the use of mono-filament net and other destructive gears during the breeding and migration period.	Low/Negligible

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
Impact on shrimp farming and livelihood	Long term	Local	Reversible	Likely	High	Major	• Prospective of Golda farming should be encouraged through campaigning and by providing training on improved culture practices as well as rice-cum-golda farming within available sweet water; • Alternative income generation, i.e., livestock rearing, poultry and integrated fish culture may create scope of alternative income for shrimp farm labour; • Shrimp farming is suitable and profitable for only rich farmer but not for landless people, marginal and small farmer. Considering poverty reduction the proposed CEIP project will be very helpful for landless people, marginal and small farmer as a whole.	Moderate

APPENDIX J: COMMENTS AND RESPONSES (IPOE)

Comments and Responses on EIA report of Polder 15 under Package-3

Sl	Comments by IPOE (Professor Dr. Ainun Nishat)	Responses by CEGIS
1	Scoping and bounding need to be mentioned in approach and methodology chapter	It has already been incorporated in the report (sections 2.2.3 & 2.2.4). This chapter has also been re-organized according to theEIA steps
2	Characteristics of brackish fish species and indicative fish speciesin the Polder area	Characteristics of brackish fish species and indicative fish specieshave been addressedin section 6.2.10
3	Mention exist velocity to the gate	Exist velocity has been mentioned in section 10.15.3
4	Timing of the fish fry movement	It hasbeen mentioned in the report (section 6.2.10 and figure 6.11)
6	Restore the connectivity /Boat pass or someother way tobe provided as per as for boat movement	Boat pass arrangementhas been suggested in thereport(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 5.9 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 EIAteam	A detailed gate operation plan has been provided in the report (section 5.9 in chapter 5). In addition, gate operation plan in Bengali has been prepared and providedin 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 5.9.1. BWDB may recruit sluice khalashi for each of the Drainage Sluices for smooth operation of the gates as per initial practice. It has also ben suggested to form Polder management committee comprising BWDB field officials and LGI and land owner for proper management of water issues in the Polder area.
13	Stakeholder list may be collected from BWDB before conducting the EIA disclosure meeting	Will be collected as per suggestion

APPENDIX K: 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 15 during field survey and public consultations in order to carry out the study.

The key improvement works to be carried out in Polder 15 under CEIP-1 are: re-sectioning of embankment (23.92 km); bank protection works (0.50 km); slope protection of embankment (4.44km); construction (replacing) of 4 number of drainage sluices; construction (replacing) of 8 flushing sluices;, re-excavation of drainage channels (30 km) and afforestation of (6.02 ha). Other components of the CEIP-1 will include implementation of social action plan and environmental management plan; supervision, monitoring and evaluation of project impacts; project management, technical assistance, trainings, and technical studies; and contingent emergency response.

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.

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 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.

WB Comments	Responses
Para 138 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 labour camp is shown in a Map in the report (Figure 5.4). Detailed of labour camps information has been discussed in section 5.5.5 (chapter 5).
This EIA does not include the environmental and social impact assessment of CC block manufacturing plants. Please prepare the separate assessment	Only 0.5 km bank protection works (Table 5.3) will be carried out for rehabilitation of Polder 16. The CC block will be prepared manually. Hence, CC block manufacturing plants will not be used.
Table 5.12 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 5.6.2 and Table 5.8 in chapter 5
Para 146 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 148 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 has 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. Please explain the reasons that this assumption is made.	As per design of Drainage Sluices (DS), The invert level of DS is fixed inconsideration of the lowest water level. Hence, the canals bed level which are below the invert level have the capacity of retain some water within it. The water is 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 6.1.4
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 370: 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
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 5.5.3, 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 5.7.7and a conceptual soil dumping location is shown in figure 5.3

WB Comments	Responses
Table 8.1- Please include the potential impacts on involuntary resettlement.	Data is not available as the RAP consultant was 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 will be prepared by the contractor and included in the Contractor's Environmental & Social Management Plan (C-ESMP) of Package-3 as has been practiced in Package1 & 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 8.4.12
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 8.4.16
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 385 that an approval needs to be obtained from DCSC for clearance of vegetation	It has been added in the report
Please add in para 385 that the contractor needs to prepare flora and fauna protection plan	It has been added in the report
Para 394 (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
~~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	This issue has been addressed in the report

WB Comments	Responses
from government, use of only approved quarry and borrow sites, anti-erosion measures including use of retaining walls and gabions where required.	
~~Para 406~~ (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
~~Para 430~~ (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
~~Para 433~~ (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
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 9.3.2)
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 10.3.1)
EMP (ESMP): Section 9 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 Table 10.1 (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
~~Para 503-~~ Reference is made on Appendix 10 Environmental Management Framework yet there is neither Appendix 10 nor EMF.	It was written by mistake. This write up has already been removed from the para.
Please revisit Table 10.1 ECoP. There are a number of incomplete or too generic guidance. Please clarify who does what.	???
Monitoring Plan- Please add noise monitoring at nearby communities (where necessary) and visual inspection of spill	It has been added
~~Para 519-~~ Please clarify DDCS will prepare a monthly report on the status of EMP/ESMP implementation.	The issue has been clarified in section 11.7.1
Afforestation ~~(Para 530)~~ - 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 section 10.10
~~Para 534-~~ Please replace the term EMF with EMP.	Corrected as per comment
Please include Environmental Committee for the mechanism of project monitoring and supervision.	An ESCU (Environmental and Social Communication Unit) for supervision and monitoring for activities related to implementation works has been mentioned in

WB Comments	Responses
	the report. The ESCU is monitoring the implementation 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.