FINAL REPORT

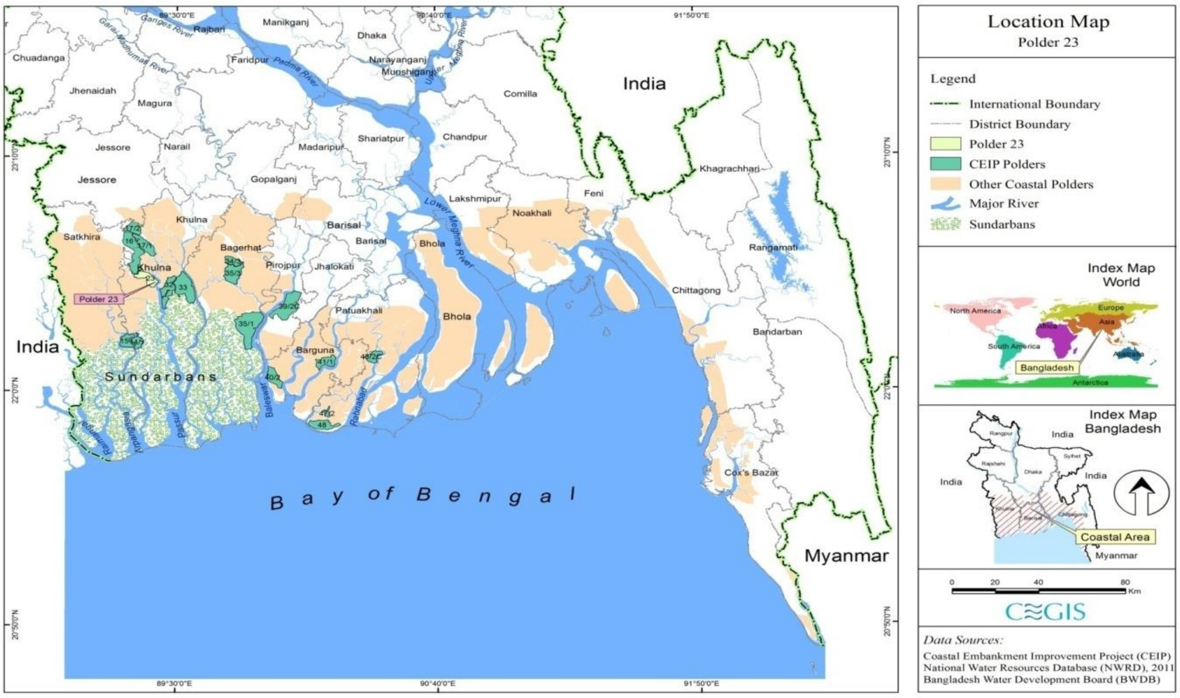
Government of the People's Republic of Bangladesh

Ministry of Water Resources

Bangladesh Water Development Board

COASTAL EMBANKMENT IMPROVEMENT PROJECT

PHASE-1



Package 3

ENVIRONMENTAL IMPACT ASSESSMENT OF POLDER 23

May, 2021

Study Team

A multidisciplinary team from Center for Environmental and Geographic Information Services (CEGIS) conducted the EIA study for Rehabilitation of Polder 23. The study team comprised of the following professionals:

Sl. No.	Position	Incumbent
1	Water Resources Engineer/Team Leader	Mr. Md. Sarfaraz Wahed
2	River Morphologist	Mr. Pintu Kanungoe
3	Environmental Specialist	Mr. Kazi Kamrull Hassan
4	Socio-economist	Dr. Dilruba Ahmed
5	Soil & Agriculture Specialist	Dr. Anil Chandra Aich
6	Fishery Specialist	Dr. Ashraful Alam
7	Ecologist	Mr. Ashoke Kumar Das
8	GIS/RS Specialist	Ms. Pia Afreena Huq
9	Junior Professional (Water Resources Engineering)	Mr. Fahad Khan Khadim
10	Junior Professional (Morphology)	Mr. Sudipta Kumar Hore
11	Junior Professional (Fishery)	Mr. Md. Ashraful Alom
12	Junior Professional (Ecology)	Mr. Md. Sharif Hossain Sourav
13	Junior Professional (Forestry)	Mr. Md. Mizanur Rahman
14	Junior Professional (Sociology)	Mr. Mobasher Bin Ansari
15	GIS/RS Analyst	Mr. Md. Saidur Rahman
16	GIS/RS Analyst	Mr. Hasan Tawfique Imam
17	Enumerator	Mr. Md. Azizur Rahman
18	Enumerator	Mr. Muhammad Shahidur Rahman

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Last but not the least, successful completion of the EIA study of Polder 23 under CEIP-1 has been made possible with active participation of the community of Polder 23 during field survey and public consultation meetings.

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Abbreviations and Acronyms

ASA	Association for Social Advancement
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorology Department
BRAC	Bangladesh Rural Advancement Centre
BWDB	Bangladesh Water Development Board
CDS	Coastal Development Strategy
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
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
DPHE	Department of Public Health Engineering
EA	Environmental Assessment
ECA	Environment Conservation Act
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules
ECRRP	Emergency 2007 Cyclone Recovery and Restoration Project
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ES	Environmental Screening
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
FRSS	Fisheries Resources Survey System
FWIP	Future-with-Project
FWOP	Future-without-Project
GIS	Geographical Information System
GO	Government Organization
GOB	Government of Bangladesh
GPP	Guidelines for People's Participation
GWT	Ground Water Table
ha	Hectare
HYV	High Yielding Variety
IEE	Initial Environmental Examination
IESCs	Important Environmental and Social Components
ICZM	Integrated Coastal Zone Management
IUCN	International Union for Conservation of Nature
IWM	Instititute of Water Modelling
KII	Key Informant Interview
LGIs	Local Government Institutions

LLP	Low Lift Pump
MC	Main Consultant (for CEIP-I Feasibility study)
MoEF	Ministry of Environment and Forest
MoL	Ministry of Land
MoWR	Ministry of Water Resources
MSDSs	Material Safety Data sheets
MT	Metric ton
NAPA	National Adaptation Programme of Action
NEMAP	National Environment Management Action Plan
NCA	Net Cultivable Area
NFP	National Fisheries Policy
NGO	Non-Governmental Organization
NLUP	National Land Use Policy
NOC	No Objection Certificate
NWRD	National Water Resources Database
NWMP	National Water Management Plan
NWP	National Water Policy
O&M	Operation and Maintenance
PAP	Project Affected Person
PCM	Public Consultation Meeting
PIO	Project Implementation Office
PMU	Mrpject Management Unit
PRA	Participatory Rural Appraisal
PRSP	Poverty Reduction Strategy Paper
PSC	Project Steering Committee
RAP	Resettlement Action Plan
RRA	Rapid Rural Appraisal
SLR	Sea Level Rise
SRDI	Soil Resource Development Institute
TDS	Total Dissolved Solids
ToR	Terms of Reference
UFO	Upazila Fisheries Office
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding
WARPO	Water Resources Planning Organization
WB	World Bank
WMA	Water Management Association
WMF	Water Management Federation
WMG	Water Management Groups
WMIP	Water Management Improvement Project
WMO	Water Management Organization

Glossary

Aila:	Major Cyclone, which hit Bangladesh coast on May 25, 2009
Aman:	Group of rice varieties grown in the monsoon season and harvested in the post-monsoon season. This is generally transplanted at the beginning of monsoon from July-August and harvested in November-Dec. Mostly rain-fed, supplemental irrigation needed in places during dry spell.
Aratdar:	Main actor acting as a wholesaler or commission agent or covers both functions at the same time; carries out public auctions and is the main provider of credit in the marketing chain.
Aus:	Group of rice varieties sown in the pre-monsoon season and harvested in the monsoon season. These are broadcasted/transplanted during March-April and harvested during June-July. Generally, rain-fed, irrigation needed for HYV T. Aus.
B Aus:	Broadcast Aus
Bagda:	Shrimp (*Penaeus monodon),* brackish/slightly saline water species.
Baor:	Baor dead arm of a river in the Moribund Delta as in the case of the Ganges; also called oxbow lake. It appears as a saucer shaped depression. The term baor is synonymous to beel, familiar in the southwestern part of Bangladesh.
Bazar:	Market
Beel:	A saucer-shaped natural depression, which generally retains water throughout the year and in some cases seasonally connected to the river system.
Boro:	A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January and harvested before the onset of monsoon in April- May.
Golda	Prawn *(Macrobrachium rosenbergii*), non-saline/fresh water species
Gher	Farm lands converted into ponds with low dykes and used for cultivation of shrimp/prawn/fish.
Haor:	A back swamp or bowl-shaped depression located between the natural levees of rivers and comprises 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.
Jal:	Different types of fishing net to catch fish from the water bodies.
Jhupri:	Very small shed for living, made of locally available materials. One 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. Thismay 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).
Khas land:	Land holding by the Government.
Kutcha Toilet:	The earthen simple pit latrine consisting of a hole without cover.
Rabi:	Dry agricultural crop growing season; mainly used for the cool winter season between November and February.

Ring slab:	The simple pit latrine consists of a hole in the ground (which may be wholly or partially lined) covered by a squatting slab or seat where the user defecates. The defecation hole may be provided with a cover or plug to prevent the entrance of flies or egress of odor while the pit is not being used.
Sidr:	Major Cyclone, which hit Bangladesh coast on November 15, 2007.
T. Aman:	Transplanted Aman, grown between July to December
Upazila:	Upazila is an administrative subdivision of a district.
Water sealed:	A water sealed latrine is simply a pit latrine that has a water barrier to prevent odors. These latrines are simply pits dug in the ground in which human waste is deposited. A water sealed latrine has a bowl fixture that has a set amount of water retained in it. It is operated on the pour to flush system. These types of latrines can be connected to a septic tank system.

Units Conversion

1 m^2	= 10.77 ft^2
1 Decimal **(শতাংশ)**	= 435.60 ft^2
1 Decimal **(শতাংশ)**	= 40.47 m^2
1 Katha **(কাঠা)**	= 1.653 Decimal **(শতাংশ)**
1 Bigha **(বিঘা)**	= 33 Decimal **(শতাংশ)**, **the area of Bigha changes in some locations.**
1 Bigha **(বিঘা)**	= 20 Katha **(কাঠা)**
1 Acre **(একর)**	= 3 Bigha **(বিঘা)**
1 Acre **(একর)**	= 60 Katha **(কাঠা)**
1 Acre **(একর)**	= 100 Decimal **(শতাংশ)**
1 Hectare **(হেক্টর)**	= 247 Decimal **(শতাংশ)**
1 Hectare **(হেক্টর)**	= 2.47 Acre **(একর)**

Executive Summary

The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase 1 (CEIP-1), under which 17 Polders will be rehabilitated and improved in the coastal area of the country. The GoB 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 23, 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 23 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 southern Bangladesh adjoining the Bay of Bengal is characterized by a delicately balanced natural morphology of an evolving flat delta subject to very high tides and frequent cyclones coming in from the Bay of Bengal encountering very large sediment inflows from upstream. The coastal zone, in the past, in its natural state, used to face inundation by high tides, salinity intrusion, cyclonic storms and associated tidal surges. In 1960s, polderization started in the coastal areas to convert this area into permanent agricultural lands. The polders in this area are enclosed on all sides by dykes or embankments, separating the land from the main river system and offering protection against tidal floods, salinity intrusion and sedimentation. These Polders are equipped with in- and outlet sluice gates to control the water inside the embanked area.

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

The above reasons led the Government to re-focus its strategy on the coastal area 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 23 is located in Paikgachha Upazila under Khulna District of Bangladesh. The administrative and management control lies with BWDB's Khulna O&M Division under the southwestern zone. Water related problems like salinity intrusion, drainage congestion, sedimentation, lack of suitable 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 so many unauthorised mini structures constructed by the Gher owners for lifting 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-I, the key improvement works to be carried out in Polder 23 under CEIP-1 are: re-sectioning of embankment (36.5 km); construction of retired embankment (0.5 km); CEIP design crest level of embankment 5.00 (Ch. 7.50 to 16.50 km) and 4.50 mPWD (remaining chainage); slope protection work of embankment (3.00 km); construction (Replacement) of drainage sluices (17 nos); repairing of flushing sluices (08 nos); demolishing of flushing sluices ((14 nos); Re-excavation of drainage channels (20.15 km) and afforestation of 26 ha (about 13 km along the periphery rivers). Other components of the CEIP-1 will include implementation of 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.

The Bangladesh Water Development Board (BWDB) is the implementing agency of this Project.

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

Regulatory and Policy Framework

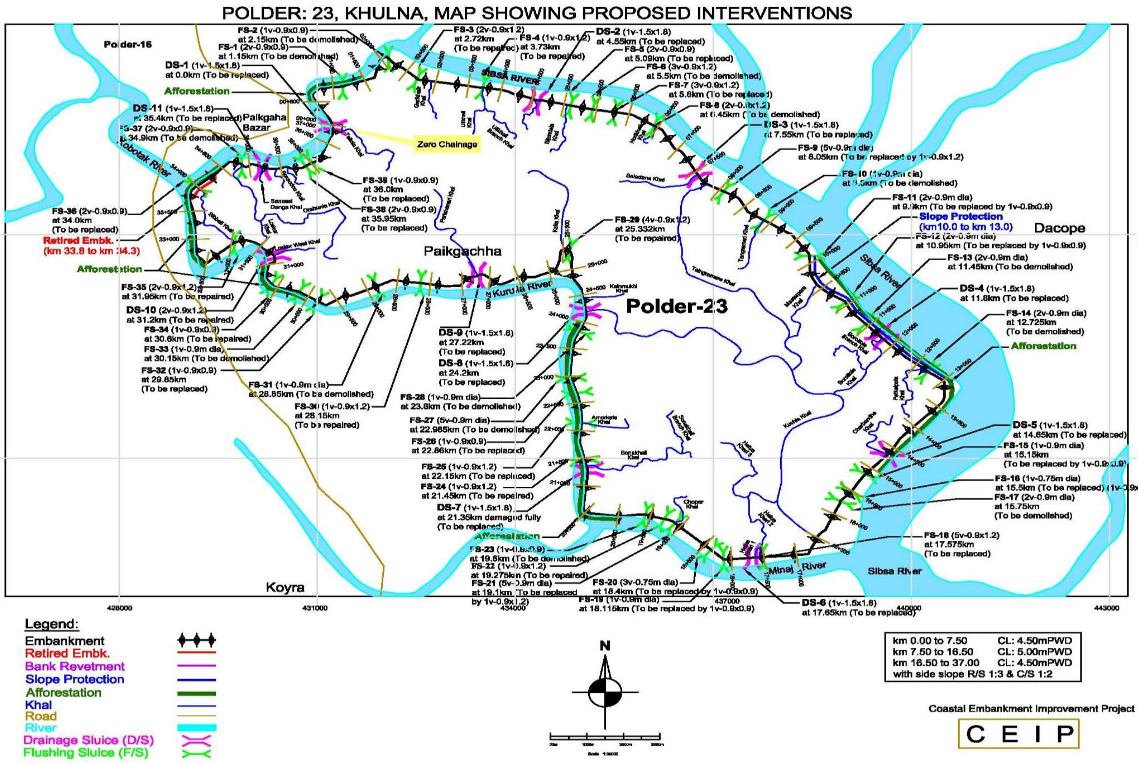
The construction, reconstruction, expansion of Polders and flood control embankment is categorized as Red in accordance with the DoE's classification and according to the World Bank safeguard policies, the project has been classified as Category A. The Environmental Impact Assessment (EIA) study has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

Proposed Rehabilitation Plan

The proposed interventions in Polder- 23 under CEIP-1 are listed in the following table.

Type of Work	Length	Description of activities/works
Re-sectioning of embankment	36.50 km	Strengthening, widening and raising of existing embankment. The work will be executed from Ch 0.00 to 7.50, 7.50 to 16.50, 16.50 to 33.80 and 34.30 to 37.00.
Construction of retired embankment	0.50 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 33.80 to 34.30.
Construction of drainage sluices	02 nos.	Two new drainage sluices will be constructed at different locations to drain out excess rain water under the proposed rehabilitation plan.
Construction (Replacement) of drainage sluices	09 nos.	The structure has been fully damaged and approach embankment washed away during AILA. Nine number of drainage sluices will be constructed However, Among the drainage sluices of the Polder, eight numbers of existing sluices will be replaced and one new drainage sluice will be constructed with new design specifications.
Construction (Replacement) of flushing sluices	17 nos.	The structure has been fully damaged and approach embankment washed away during AILA. Seventeen numbers of existing flushing sluices will be replaced with new design specifications.
Re-excavation of drainage channels	20.15 km	Ten (10) drainage channels with a total length of 20.15 km will be re-excavated to ease water flow and reduce drainage congestion
Slope protection of embankment	3.00 km	Slope protection of the embankment against wave action will be carried out from Ch 10.00 km to 13.00.
Afforestation	7.23 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 4.5 to 5.00 mPWD which has been assesd through mathmetical modeling concedering storm surge level and monsoon water level for 25-year return period under climate change scenarios. Sideslope of mbankment will be R/S 1:3 and C/S 1:2 respectively.



Environmental Baseline Conditions

The Polder 23 is located in the southwestern region of Bangladesh. Topographically, this area is flat and developed by sedimentation process by the three mighty rivers of the country. Administratively, the Polder covers parts of Paikgachha Upazila under Khulna district.

The Polder is surrounded by the Shibsa River, Kurulia River and Minaj River. A number of Khals have criss-crossed into the Polder area. There are 11 numbers of drainage sluices and 39 numbers of flushing sluices exists in the Polder. Most of the structures are damaged. The flood control embankment (37 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 the Saline Tidal Floodplain. The gross area of the Polder is about 4,489 ha of which 9% is available for paddy cultivation. A large portion (79%) of the polder area is occupied by shrimp farms. Other 12 % of areas are covered by settlements including homestead and water bodies. Among the cultivable land, cropped area occupies 422 ha. The annual total rice production is about 1,206 metric tons consisting of Aus, Aman and Boro.

The climate of the Polder area is monsoon tropical. The monthly maximum average temperature (1980-2013) varies from 26.68°C (January) to 36.71°C (May), and May is the warmest month andmonthly minimum temperature varies within the range of 9.96°C (January) to 25.50°C (August), and January is the coldest month of the Polder area. November to February arethe driest months with negligible rainfall and June to September arethe wettest months with highest rainfall. The maximum rainfall 846 mm was recorded in June 2002.

Bagda gher is dominated in culture fishery in the Polder area. Total fish production of the polder area is around 3,990 MT. Large amount of fish production (91%) comes from Bagda gher. Fish migration status is very poor in the Polder area. Barriers at the inlet of khal bygher owners, encroachment of khals, using of net jal, mal-functioning of water control structures, etc., are the main causes of obstruction to fish migration.

Polder 23 is located at south-west zone of the country consisting brackish nature of vegetation and saline prone wetlands. The Polder falls under Bio-ecological zone 10 (Saline Tidal Floodplain). Major ecosystems of this Polder are homesteads, crop fields, embankments, shrimp farm, foreshore/intertidal river and canal.

Homestead bears higher population of flora and fauna. The encircled embankment of this polder is barren or lightly vegetated. Adaptation of xerophytic species is remarkable in entire the polder area. Some portions (Taltala and Boyarjhanpa), the embankments are planted with Babla and Tamarind tree. Inter-tidal area of this Polder supports various avifauna as crabs, mudskippers and scattered mangrove vegetation.

The total household 5,025 having a total population 22,128 of which 11,086 are males and 11,042females with a population density of 1,094 persons per sq km. The average literacy rate is 57%, while male 65% and female 49%. Out of total population, 46%are engaged in household work, 33% are employed, 01% 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 increased noise level and dereriated air quality, land use change and increased vehicular traffic as follows:

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
	Pre-construction Phase	
Air and Noise quality	Noise level around the construction sites and in settlement areas will be deteriorated for mobilization of construction, materials, trawler equipment and man-power. Navigation will be increased in the watercourses i.e. *Sibsa*, *Kurulia* and *Minaj* River. The increased navigation is expected to intense the noise level of the local vicinity. Besides, exhaust emission from materials and equipment mobilization trawlers and containing particulate matter and other ingredients would deteriorate the ambient air quality around the construction site and nearby areas due to movement of equipment carrying trawler. Fugitive dust emissions from the material stockyards would also deteriorate the ambient air quality of the locality.	• Construction material (sand etc.) should be covered while transporting and stock piled. • The contractors need to be cautious to avoid unnecessary honking of material carrying trawler. • The contractors should be encouraged to move all construction equipment, machinery and materials during day time instead of night. • Stockyard should be covered during non-working period. • Exhaust emissions from vehicles and equipment should comply with standards. • Vehicles, generators and equipment should be properly tuned. • Water will be sprinkled as and where needed to suppress dust emissions. • Speed limits should be enforced for vehicles on earthen tracks. • Vehicles and machinery should have proper mufflers and silencers.
Vegetation	Preparation of construction sites, labor sheds and material stock yards is expected to damage vegetation where the land will be used for these purposes (Details will be illustrated after getting RAP Report).	• Habitat will be restored by planting trees, grasses at the damaged sites after completion of construction works.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Land use	Land would be needed to establish temporary facilities including construction camp i.e labor shed and borrow pit areas. It is estimated that about 13 labor sheds would be constructed to established temporary facilities for the rehabilitation works. Therefore, land use will be changed temporary.	• Establish the construction camps within the area owned by BWDB, wherever available. • Compensation/rent are to be paid if private property is acquired on temporary basis, the instructions should be specified in the tender document. • Construct labor shed/camp at government khas land. • Avoid impacts on local stakeholders. • Any areas used for borrow pits in the foreshore should be away from sensitive areas such as mangrove vegetation, known fish spawning ground, habitatfor any endangered flora /fauna species.
vehicular traffic during mobilization	1. During contractor mobilization, equipment, machinery, material, and manpower will be transported to the Polder resulting in additional traffic on roads and waterways. This traffic may potentially cause traffic congestion particularly at roads and jetties. Moreover, most of the schools are located near the embankment and three important *Bazars* are also located besides the embankment. These will face traffic congestion during *Haat* time. Earth work for re-sectioning of embankment and vehicles movement also may create short term disturbances to the polder inhabitants.	• The contractor should prepare a traffic management plan (TMP) and obtain approval from the DDCS&PMSConsultant. • Contractor should also implement mobilization plan considering water vessels and launch movement in the external rivers and avoid the launch movement time. • The TMP should be shared with the communities and should be finalized after obtaining their consent. • The TMP should address the existing traffic congestion particularly at the Paikgaccha Bazar, Sholadana Bazar and Amurkata Bazar. • Ensure minimal hindrance to local communities and commuters. • The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works should be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. • The works of the first half should be completed, and then of the other half should be undertaken. • Work schedule to be finalized in coordination and consultation with local representatives and communities, specifically the Union Parishad members of the Polder. • Local routes will not be blocked as much as possible. If unavoidable,

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
		alternative routes will be identified in consultation with local community. • Vehicular traffic should be limitedin 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 moving pattern and management system for the local stakeholders using multimedia presentation and showing video at different common population gathering places in the Polder area.

Impacts during Construction Phase

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

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Noise Vibration and air quality	The construction activities particularly demolition of existing water control structures, excavation, compaction, operation of construction machinery and vehicular traffic will generate noise and vibration which are likely to affect the nearby communities. The sensitive receptors including seven schools which are located close to the embankment (within 500 m) are likely to be more severely affected by noise. Construction machinery and Project vehicles will release exhaust emissions, containing carbon monoxide (CO), sulphur dioxide (SO_2), oxides of nitrogen (NO_X), and particulate matter (PM). These emissions can deteriorate the ambient air quality in the immediate vicinity of the Project sites	• 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 near 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 should be instructed to use the equipment properly, to minimize noise levels.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
		• Liaison with the communities should be maintained and grievance redress mechanism will be established at the site.
Natural drainage system	The construction activity particularly for construction of drainage sluices, flushing 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 temporarily drainage congestion in the *Khals*	• Some temporaryearthen 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 temporary earthen dams during construction work. • Both contractor and BWDB should supervise the construction work • Contractor should ensure that drainage channels are not obstructed or clogged by the construction activities. • Contractor should ensure that construction activities do not inundate cultivation fields.
Soil and Water Contamination	Construction materials, demolished debris, fuel both from transportation vessel and construction machineries (piling machine, pump etc.) may degrade the soil and water quality. The construction workers will generate domestic solid waste and waste water including sewage. The amount of domestic wastewater generated by the construction workers is assumed to be equal to the amount of water usage. Oily water, waste oils, oily rags and other similar wastes will be generated from workshop. The stores and warehouse will generate solid waste such as empty cement bags, cardboards and wooden crates. Improper disposal of these waste streams can potentially contaminate the soils and water resources of the area. Soil and water contamination can potentially have negative impacts on the local community, natural vegetation, agriculture and biological resources of the area including aquatic flora and fauna.	• Prepare and implement pollution control plan; • Workshops should have oil separators/sumpsto avoid release of oily water; • Avoid repairing of vehicles and machinery in the field; • Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination; • Dispose contaminated soil appropriately ensuring that it does not contaminate water bodies or affect drinking water sources; • Contractor should ensure that there is no leakage, spillage or release of fuel, oil or any other affluent/waste on the ground or in the water from its construction machinery, vehicles, boats, launches, and barges. Contractor should regularly monitor the condition of its fleet; • Material borrowed from the river banks should be carried out sufficiently away from the water edge, minimizing the possibility of loosing soil and wash out in the river; • Contractor should locate camps far away from communities and drinking water sources; • Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal);

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
		• Release treated wastes on ground or in water; • Recycle spoil and excavated material where possible; • Dispose spoil at designated areas with community consent; and • Construction material, demolished debris and excavated soil/silt should not be allowed to enter the water bodies.
Irrigation	Construction activities particularly on regulators, water channels and re-excavation (20.15 km) activity of canals can potentially disrupt irrigation during both wet and dry season, thus negatively impacting cultivation.	• Contractor should construct diversion channels before construction/replacement of each regulator; • Sequence of work of the regulators and the water channels would be carefully planned to avoid irrigation disruption; • Contractor would ensure having no negative impacts on crop irrigation; • Contractor would maintain liaison with the local communities; and • Contractor would work during dry season.
Fish Feeding and spawning ground	Polder 14/1 is bounded by Kobodak and Arpangasia rivers on the western and Sakbaria River on the eastern part of the Polder. As per consultation with local fishers during field visit it is learnt that, the bank sides of these rivers have been reported as the feeding, nursery and spawning ground of brackish water fish species like *Chewa, Pairsha, Gulsha Tengra, Bagda, chingri*, etc. It is expected that activities of bank revetment would cause the partial destruction (if in the dry season) and full destruction (if in the rainy season) of the feeding, nursery and even spawning ground of these fish species.	• 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. The contractor will maintain proper sequence of work so that the earth work part of the revetment work could be done within minimum period as far as possible.
Fish Movement and Migration	A total of 20.15 km of internal *Khals* will be re-excavated under CEIP. It is expected that *khal* re-excavation activities especially bailing out of water would damage fish habitat in Khals and hamper fish migration temporarily during this phase.	• Construct diversion channels before construction of regulator considering fish migration period e.g. May, June, July and August • Dismantle the bundhs 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

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
		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 implemented one after another so that the construction activities could be made with minimum hindrnace to fish migration. • Contractor will maintain liaison with fishers and farmers so that they could realize the issue for minimum impact to the shrimp farming and paddy cultivation.
Benthic Founa	2. During activities of re-excavation of *Khals* especially bailing out of water from the *Khals* would hamper the khal habitat condition. The habitat of Mud eel fish species (*chew, baim* etc) and benthic organisms will be affected by this activity.	• Khal re-excavation should be carried out segment wise. • Contractor will carry out khal excavation in segment thus minimizing impacts on benthic fauna. • Monitor pre- and post-analysis of benthic fauna.
Vegetation	• Re-sectioning of embankment will damage all undergrowth vegetation both at embankment slopes and the sites from which the soil would be collected. been covered with concrete blocks for slope protection. Embankment toes at Sakbaria, Matiabhanga, Gharilal and Jorshing villages follow strips of dense but small size (not more than 3m height and DBH 4cm) Gewa (Excoecaria agallocha) plants. These strips have been created naturally by germination of floating seeds from nearer mangrove forest. These saplings will be cut down/damaged during embankment re-sectioning. • Collection of soils from foreshore area will also cause vegetation damage of these locations. Most of the foreshore area of this Polder is under plantation program by Climate Resilient Ecosystems and Livelihood (CREL) Project.	• Collect soil from barren land and alternate source like riverbed or nearby burrowpits at countryside as much as possible. • Keep close liaison with CREL Project Authority and Forest Department during implementation of earth works. • Needs approval from the DDCS&PMSC for vegetation clearance, if needed • Create plant strips with same species at the toe of the embankment after completion of earthwork. The community members may be involved for protection of the saplings. • Proper turfing should be made on the embankment slopes with local grasses (i.e., Durba (Cynodon dactylon), Mutha (Cyperus rotundus)) and ensure regular monitoring of turfed grasses till they matured. • The top-soil at the construction and rehabilitation sites should be stored and used for plantation activities.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
		• 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.
Inland and Waterway Traffic	3. 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 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.	• 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 should be maintained with community and BIWTA.
Safety and Public Health Hazards	The area is prone to cyclones and storm surges. Although the works will be carried out during the dry season, a certain level of safety hazards still exists for the construction staff. The construction activities will involve operation of heavy construction machinery, vehicular traffic, excavation and filling operations. These activities may pose some safety hazards to the local population as well as for the construction workers. The fuel storage at the camp sites may also pose safety hazards for the construction staff as well as to surrounding population. Inappropriate waste disposal at the camps and construction sites, and air quality deterioration caused by the Project's vehicular traffic and construction activities potentially pose health hazards to the construction staff and nearby population. Unhygienic condition and unavailability of safe drinking water for the construction staff will expose them to health risks. In addition, influx of construction staff can potentially expose the nearby population to communicable diseases.	• The contractors should prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants. The Plan should also include awareness building and prevention measures, particularly for communicable diseases such as hepatitis B and C, and HIV/AIDS. • The WBG's EHS Guidelines should be included in the contract documents and that should be followed during construction. • Each contractor should prepare an Emergency Response Plan defining procedure to be followed during any emergency. This plan should be submitted to the Construction Supervision Consultants for review and approval; • All workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities. • Liaison should be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets should be kept in all

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
		the labor camps for obtaining weather information. • The construction sites should have protective fencing to avoid any unauthorized entry, where appropriate and possible • Health screening of employees would be a Contractors obligation prior to laborers working on site and living in the temporary accommodation facilities. The health screening would entail normal review of physical fitness and also include a review of appropriate vaccinations. Workers would be given vaccinations as and where required; • The WBG's EHS Guidelines will be included in the contract documents. Each contractor will prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan will be submitted to Construction Supervision Consultants for review and approval; • All employees need to provide induction training on health and safety prior to commencement of work. OHS issues would be part of the employee training plan. Training would include the provision of appropriate written or visual materials to reinforce learning. Illiteracy levels where high, the OHS issues should be covered more frequently than normal in toolbox talks; • The labour shed/camps for accommodation of workers should be constructed according to the IFC/EBRD workers accommodation guidelines. • Public awareness training and workshops on safety and health risks should be conducted for local communities prior to and during construction operations. • Observing statutory requirements relating to minimum age for employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activities. The

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
		construction contractor(s) should not hire people under the age of 18 on permanent contracts but would include short training activities for youth to the extent possible; • Ensure the acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work; • Ensure that no workers are charged fees to gain employment on the Project; • Ensure the rigorous standards for occupational health and safety are in place; • Contractor should establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. • The contractor should adopt a Human Resource Policy appropriate to the size and workforce which indicates the approach for management employees (this could be part requested in the tender process); • Produce job descriptions and provide written contracts and other information that outline the working conditions and terms of employment, including the full range of benefits; • Provide health insurance for employees for the duration of their contracts; • Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts; • Develop a recruitment process community employees that involves local authorities in clearly understood procedures; • Employ a community liaison officer (which could be full time or part of another post’s responsibilities); • Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training;

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
		• Regularly report the labor force profile, including gender, and location source of workers; • Report regularly the labor and working condition key performance indicators, for instance hours worked (regular and overtime) during period and cumulatively, hours lost, number and type of accidents, near misses, site audits and meetings; trainings, and use of labor grievance mechanism; • Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase; • Organize training program and keep training registers for construction workers; • Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project. • Availability of safe drinking water should have to be ensured for the construction staff. • First aid boxes should have to be made available at each construction site. Emergency phone numbers (including hospitals, Fire services, and Police) should have to be displayed at key locations within the site. Each site should be occupied with an ambulance. • Firefighting equipment should have to be made available at the camps and worksites. • Waste management plan is to be prepared and implemented in accordance with international best practice. • Liaison with the community should have to be maintained.
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	• 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

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
	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.	be opened for local traffic and the works of the other half will be undertaken. • Work schedule will be finalized in coordination and consultation with local representatives and communities. • Local routes will not be blocked as far as possible. If unavoidable, alternative routes will be identified in consultation with local community. • No unauthorized entry of the local people/unwanted personnel at the camp site/work site will be allowed. • Work sites and movement routes to be clearly demarcated, with appropriate warning signs (in Bangla and Chinese) at strategic locations. • GRM will be put in place.
Social unrest	A number of skilled and unskilled labors will be required for the construction activities. Most of the labor will be needed for re-sectioning of embankment and constructing retired embankment. It is envisaged that about 60 percent construction workers will be recruited from within the Polder area while the remaining from other areas. The presence of outside laborers in the area may create friction and conflict between the local labor and outside labor., and between local community and outside labor. Presence of number of labors from 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 hazard	Historically, this area is vulnerable to cyclone, storm and tidal surges. As per construction schedule, the development activities of the proposed new polder will be conducted from October to May while most of the cyclone and storm surges are occurred in this area. According to previous record of occurrence of cyclone and storm surges, October to November	• Weather signals should have to be considered by the contractor during construction works. • Radio and television should have to be kept in all labor sheds for getting weather information through these media.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
	and April to May are the pick months of occurrence of cyclone and storm surges. It is suspected that the construction activities during this period may hamper as well as the workers may be injured	• Ensure rigorous standards for occupational health and safety are in place. • Having the Contractor establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.

Impacts from CC block manufacturing plant

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

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

Important Environmental Components (IECs)	Impact	Mitigation
		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 domestic garbage; refuse from CC block construction, empty cement bags, etc. Liquid waste will include sewerage. The impact is considered moderate to low as the process does not generate much waste and the numbers of workers is limited	• The Contractor will prepare and implement a pollution control and waste management plan based on a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes. • Hazardous wastes should always be segregated from non-hazardous wastes. If generation of hazardous waste cannot be prevented through the implementation of the above general waste management practices, its management should focus on the prevention of harm to health, safety, and the environment. The following additional principles should be adhered to: • Ensuring that contractors handling, treating, and disposing of hazardous waste are reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the waste being handled • Ensuring compliance with applicable local and international regulations
Hazardous materials	• Contamination of land should be avoided by preventing or controlling the release of hazardous materials, hazardous wastes, or oil/chemical to the environment. When contamination of land is	• 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

Important Environmental Components (IECs)	Impact	Mitigation
	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.	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.
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

Impacts during Project Operation Phase

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

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Embankment Failure	Embankment failure or breaching of embankment is a common threat in the coastal region that is caused due to runoff, wave action, tidal surge and unauthorized activities like entering	• Regular monitoring and rigorous maintenance of the embankment and existing water control structures especially along the southern and western side of the Polder should be

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
	saline/brackish water through pipies across the embankment by local people making the embankment weak. Lack of regular maintenance has created weak point at the sensitive locations of the embankment where the set back is less than 15m to 25m. Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously have accelerated the risk of embankment failure.	ensured. This monitoring will particularly be carried out before and after monsoon season. • Proper dumping and compaction of soil should be ensured during re-sectioning of the embankment. • Side slope protection works should be maintained with proper design. • Available cyclone and flood shelter should be prepared as a contingency measure during emergency situation. • WMG should develop fund for such emergency situation. • Structural measures like geo bag and sand bag should be kept in the Upazila office for emergency need.
Agro chemicals	Implementation of the project interventions especially re-excavation of channels would cause expansion of area under irrigated cultivation of Boro (HYV) and T.Aus (Local) varieties of rice. The expansion of irrigated area would increase use of chemical inputs including fertilizers and pesticides. Runoff from such cultivation fields might potentially pollute the water bodies and even drinking water sources thus causing health hazards to the communities.	• Capacity building and awareness raising of the farmers will be carried out to practice Integrated Pest Management (IPM) and Integrated Crop Management (ICM) – in order to minimize usage of chemical inputs. • Farmers group/WMO would have close contact with DAE for adoption of various measures of ICM. • Farmers would be encouraged to use organic manure to increase soil fertility while avoiding water contamination. and • Farmers would be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.
Shrimp Farming and Livelihood	Shrimp farming is a common practice in this polder area. From the field visit, it wasfound that about 80% of the total area of land inside the polder has been converted to shrimp culture Ghers. After implementation of the proposed intervention, paddy land area will be increased compared to its base condition. On the other hand, shrimp farming area may be impacted due to reduction in saltwater intrusion. Thus, fish production from shrimp Gher may decline. The livelihood of the shrimp farmers will be impacted.	• 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 as these are eco-friendly in nature • Alternative income generation i.e. livestock rearing, poultry and integrated fish culture may create scope of alternative income for shrimp farm labour; and • Implementation of land zoning for shrimp Gher in the polder area.

Cumulative Impacts The cumulative impacts of several existing and ongoing projects, as well as the proposed projects of CEIP-1 around the proposed rehabilitation Polder, were 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 23 and ***they were*** considered in this study. Apart from CEIP interventions, there are some other development projects in the region of Polder 23, implemented locally or regionally. Impacts on hydrology and flooding situation due to construction and implementntation of proposed and existing projects were assessed as follows:Polder 18 and Polder 19 is located at the upstream (North-West direction) of Polder 23. The existing crest level of Polder 18-19 is 3.85 mPwd which will be increased up to 5.8 mPWD due to proposed interventions. The proposed protective interventions of Polder 18-19 may divert the seasonal storm surges to the Polder 23. As a result of this diversion, salinity intrusion into the Polder 23 may be increased that will reducethe agricultural production and exacerbate the social life. There is a tendency of accumulating silt along the perennial rivers that will increase in volume by wastes of proposed construction works and may induce hydraulic pressure on Polder 23. Therefore, the rehabilitation of activities of this polder may impact on hydrology and flooding situation of its surrounding area.

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 procurement of sand and cement from the local market.

The socio-economic condition of Polder 23 will be ameliorated due to the overall development of this region, i.e., construction works of Polders 16, 17/1 and 17/2 will attract labors from outside as well as local people will also get working opportunity.

Polderization has a positive impact on shrimp culture in Polder 23 that initiated a financial revolution of the Polder area. On the other hand, there are some negative environmental impacts, i.e., infertility of aquatic animals, flora and fauna due to overtopping in saline water from shrimp culture ponds.

Environmental Management Plan (EMP)

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

Tentative Cost Estimates for Environmental Management

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

Item No.	Description	Cost Million BDT	Cost Million $	Responsible Agency	Timeframe
	of construction sites /damage to dredge spoils				
4.	Awareness program on plant and wild life conservation.	0.02	0.00025	BWDB	During post-construction
5.	Consultancy services cost for supervision and monitoring of EMP	1	0.01	BWDB	During post-construction
6.	Training to the farmers with field demonstration regarding IPM and ICM.	0.4	0.005	BWDB with help of DAE	During post-construction
7.	Training to the fisherman/pond owner with field demonstration regarding pond culture.	0.04	0.0005	BWDB & WMO with help of UFO	During post-construction
8.	Solid and liquid waste disposal arrangement.	100,000	1.25	BWDB	
9.	Training on improved fish culture	1.5	0.019		
10.	Training to the Contractors regarding environmental management	100,000	1.25	BWDB	During pre-construction
11.	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1	0.0125	BWDB	During post-construction
12.	Updating EMP as per requirement.	1	0.0125	BWDB	During post-construction
13.	Establishment of Fish Sanctuaries in khals for the Conservation of indigenous Fishes and stocking of Threatened Fish species and Brood Stock of Indigenous Small Fish Species (2 Nos. Sanctuaries-One sanctuary in each khals @ 0.1 million BDT)	0.04	0.0005	BWDB with cooperation of DoF	During operation
14.	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	1	0.0125	Contractor, BWDB	During construction and post-construction
15.	Training to WMA on “Integrated water Management and Operation and Management of Sluice Gates”	1.5	0	BWDB	During operation
16.	Social forestry program along both sides of the embankment and other khas areas	Included in afforestation budget	0	BWDB	During operation
17.	Compensation for trees	Budet Included in Afforestation Plan	0	BWDBwith a consultation of Forest Department	During construction
18.	Construction of fish pass friendly structure (one fish pass) Optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes	61	0.690112652	Contractor, BWDB	During construction
Total Cost		**75**	**0.839**		

Extensive monitoring of the environmental concerns of the Polder 16 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 construction and during operation phases is presented in a tabular form below:

Environmental Monitoring Plan during Construction and Operation 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 materials suppliers (Cement, soil).	Before the agreement for the supply of material is finalized.	Contractor	DDCS & PMSC, M&E Consultant, BWDB
Operation of borrow pit site	Borrow pit/site	Visual inspection of borrow pit site and ensuring operational health and safety	monthly	Contractor	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 earth 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, 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

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	DDCS & PMSC, BWDB
Traffic safety	Construction area	Visual inspection to observe 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 storagesites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DDCS & PMSC
Air Quality (PM_{10}, $PM_{2.5}$)	Close to School/ Madrasha, Hospital &Villages	Air quality monitoring	Half Yearly	Contractor through a nationally reputed 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 Consultant, BWDB
		Ensure restriction of work between 09:00 p.m.-6:00 a.m. close to School/ Madrasha, Hospital & Villages	Weekly	Contractor	DDCS & PMSC, M&E Consultant, BWDB
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample from the river of each Polder	Sampling and analysis of surface water quality	Dry season	Contractor through a nationally reputed laboratory	DDCS & PMSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Drinking Water Quality (TDS, Turbidity, pH, FC, as of if groundwater etc)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality	yearly	Contractor through a nationally reputed laboratory	DDCS & PMSC, M&E Consultant, 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 wastes and also inspection of wastes is depositionof at designated site	Weekly	Contractor	DDCS & PMSC, M&E Consultant, BWDB
Flora and Fauna	Project area	Survey and comparison with baseline environment	Yearly	Contractor through nationally reputed institute	DDCS & PMSC, M&E Consultant, 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	Aftercompletion of allworks	Contractor	DDCS & PMSC, M&E Consultant, BWDB
Safety of workers Monitoring and reporting accidents	At work sites	Usage of Personal Protective equipment	Monthly	Contractor	DDCS & PMSC, M&E Consultant, BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample on each river of each polder	Sampling and analysis of surface water quality	Dry season	BWDB through a nationally reputed laboratory	M&E Consultant
Air Quality (Dust PM_{10}, $PM_{2.5}$)	At the baseline monitoring site	24 hours Air quality monitoring	Yearly	BWDB through a nationally reputed laboratory	M&E Consultant
Flora and Fauna	In the project area	Detail species assessment and	Yearly	BWDB through a nationally	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
specially fisheries		compare with baseline		reputed institution	
Agriculture	In the project area	Compare the production with the baseline	Yearly	BWDB through a nationally reputed institution	M&E Consultant
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant

Source: MRDI, 2011, LGED, 2011

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, M&E Consultant
Water Quality	Water bodies near nursery	Odor and chemical testing	Dry season	Contractor through nationally reputed laboratory	DDCS & PMSC, BWDB, M&E Consultant
Waste Management	Work site and Nursery	Visual inspection of collection, transportation and disposal of grasses, debris and is deposited at designated site	Weekly	Contractor	DDCS & PMSC, BWDB, M&E Consultant
	Work site and Nursery	Visual inspection of Water bars & cut-offs. sediment traps to prevent water pollution caused by run-off from harvesting areas	Beginning of works	Contractor	DDCS & PMSC, BWDB, M&E Consultant
Nursery Embankment Management	Nursery	Visual inspection of height of embankment, possibility of water logging and connection to the waterbodies	Beginning of each nursery	Contractor	DDCS & PMSC, BWDB, M&E Consultant
During Operation and Management					
Multilevel belt of trees	Polder top and along the polder	Visual inspection	yearly	BWDB through nationally recognized institution	M&E Consultant
Flora and Fauna	In the project area	Detail species assessment and compare with baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Erosion	Along Alignment	Visual Inspection presence of gullies or erosion	Yearly	BWDB	M&E Consultant

BWDB will prepare a Bi-annual Monitoring Report on environmental management and will share this with the World Bank for review during construction phase. The effectiveness of screening, monitoring and implementation of the EMP along with the project component activity monitoring will be carried out by a third-party monitoring firm annually. The Annual Environmental Audit Report prepared by the third-party monitoring firm will be shared with the safeguard's secretariat. The Third-Party M&E Consultants will be responsible for independent monitoring of the implementation of EMP. The tentative cost estimates for Environmental monitoring are 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 23 = 6 samples x 3 times @ Tk.5,000	300,000	3.75	Contractor	During pre-construction, construction and post construction period phases
2	Monitoring of Fish Biodiversity, Fish Migration, Fish Production	800,000	10	Contractor with help of UFO	During construction and post-construction
4	Fish swimming speed or velocity and depth preference	150,000	1.8	Contractor with help of UFO	During post-construction
5	Crop Production/Farm Survey for four (4) times of year (dry & wet season).	100,000	1.25	Contractor with help of UFO	During post-construction
6	Air and noise quality monitoring and analysis.	500,000	6.25	Contractor	During construction
7	Surface and ground Water quality monitoring cost (testing for Turbidity, pH, DO, BOD, Salinity etc. + test of As, e etc. for HTWs at workers' camp site) 6 samples in Polder-23 during pre-construction, construction and post-construction periods + water quality analysis of HTWs of 10 workers' camp	500,000	6.25	Contractor	During construction and post-construction phases
8	Benthic fauna analysis	200,000	0.0025	Contractor & DOF	Before, during and regularly after construction
9	Diversity of Flora and fauna	200,000	2.5	Contractor	During construction and post-construction phases

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	Total Cost	**2,750,000**	**31.8025**		

The project activity will be implemented through systematic and effective organizational structure of BWDB headquarters to field level. The Project Management Unit (PMU) will implement the project and the Project Steering Committee (PSC) under the Ministry of Water Resources will oversee and monitor overall activities. The Environmental, Social and Communication Unit (ESCU) to be established for implementation and management of the EMP will be structured to provide co-ordination, technical support and services during the environmental screening and preparation of EA, and implementation of the environmental mitigating measures. At least one of the two environmental specialists must be on board. The specialists will prepare sub-project specific environment screening report with EMP, supervise the implementation of EMP and support capacity building of the field level staff of BWDB and contractor. The ESCU will review the EMP and ensure quality of the environmental screening.

Stakeholder Consultation and Disclosure

Three tiers of consultation process e,g FGD/Informal discussion, PCM (Public Consultation Meeting) and PDM (Public Disclosure Meeting) were conducted under this study. Two Focus Group Discussion (FGD) and five (05) informal discussion were carried outat different locations of polder. Two PCMs at Union level were conducted with the participation of local people, representatives of local government (Union Parishad) and representatives of the BWDB with the objective of disclosing the impacts of the project and the EMP.Local people showed interest in the project and were positive minded for its implementation which is vital for their survival. They also expressed that if the monitoring plan is implemented properly during the pre-construction, construction 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 16 was held on 25th July, 2017 in Paikgaccha Upazila, Khulna. The participants of the PDM included Upazila Nirbahi Officer (UNO), Upazila Chairman, Upazila Vice Chairman and other concerned government officials, Journalists, NGO representatives, environmentalists, activists, local stakeholders and other representatives. No national level disclosure meeting yet to be done.

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. Background

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

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

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

7. The coastal embankment system of Bangladesh was originally designed without paying much attention to storm surges. Recent cyclones brought substantial damage to the embankments and further threatened the integrity of the coastal Polders. In addition to breaching due to cyclones, siltation of peripheral rivers has caused the coastal Polders to suffer from water logging, which has led to large scale environmental, social and economical degradation. Poor maintenance and inadequate management of the Polders have also caused internal drainage congestion and heavy external siltation. Soil fertility and agriculture production in some areas are declining because of water logging and salinity increase inside the Polders. In addition, sea level rises due to global warming also need to be addressedsince the coastal areas are highly vulnerable to flooding/water logging. The above-mentioned reasons have led the government to readjust its strategy on the coastal area from ensuring protections against high tides by providing protection against frequent storm surges as well. The long-term objective of the government is to increase the resilience of the entire coastal population from tidal flooding, other natural disasters by upgrading the whole embankment system. With an existing network of nearly 5,700 km long embankments in 139 Polders, the magnitude of such a project is daunting and requires prudent planning. Hence, a multi-phased

approach of embankment improvement and rehabilitation will be adopted over a period of 15 to 20 years. The proposed CEIP-1 is the first phase of this long-term program.

Map 1-1: Location of Coastal Polders

Project Overview

8. Polder 23 is located in Paikgachha Upazila under Khulna District of southwestern Bangladesh (Map 1.2). The Polder covers a Gross area of 4,489 ha. The overall cropping intensity is around 100% (which is much below the national average of 191%) giving a total agricultural cropped area of 422 ha. The project aims to enhance protection against natural disasters, increase resilience during and after such disasters, and improve agricultural production by reducing drainage congestion. To achive these objectives, the following key improvement and rehabilitation works will be carried out in Polder 23 under Package 3, CEIP-1:

Type of Work	Specification
Re sectioning of embankment	36.50 km
Design crest level of embankment	5.00 and 4.50 mPWD
Retirement of Embankment	0.50 km
Construction of drainage sluice	10 nos.
Construction of flushing inlets	17 nos.
Repairing of drainage sluice	8 nos.
Demolishing of drainage sluice	14 nos
Slope protection works	3.0 km
Re excavation of drainage channel	20.15 km
Afforestation	19.04 ha

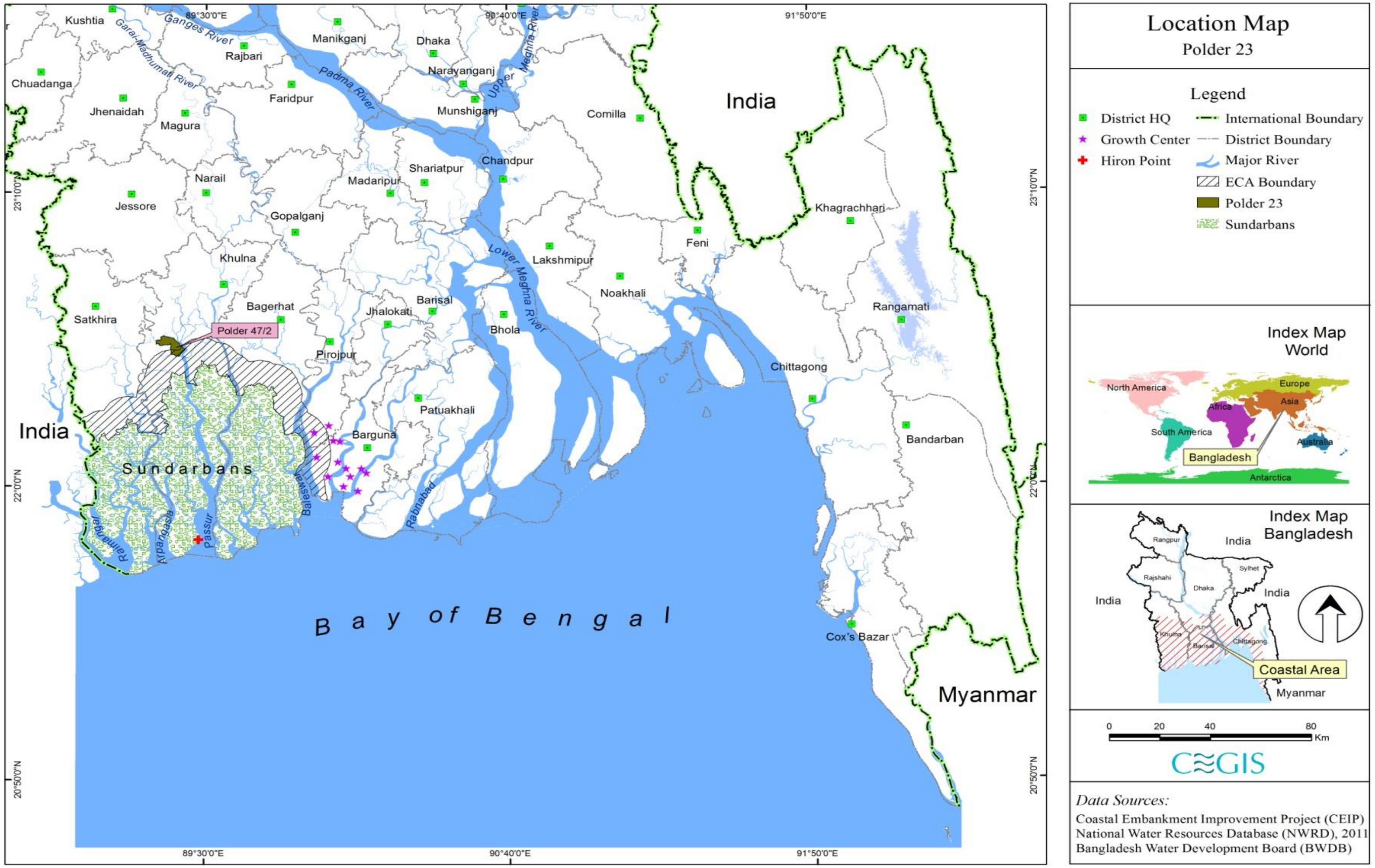
Source: CEIP, 2015

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

10. The BWDB is the implementing agency of the Project. Detail information of the Project is presented in chapter 4 on project description of this report.

1.2. Regulatory and Policy Framework

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



Map 1-2: Location of Polder 23

1.3. Objectives of the Study

12. The objective of the EIA study for Polder-23 is to identify and assess the potential environmental impacts of the proposed project interventions, evaluate alternatives, and design appropriate mitigation and management measures as well as monitoring guidelines to be addressed in the Environmental Management Plan (EMP) in compliance with the national regulatory and WB environmental policies and guidelines (for further details refer Chapter 3).

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

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

1.4. Scope of Works

14. The scope of works for conducting the EIA for Polder 23 included the following:

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

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

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

iv. Distinguish between significant positive and negative impacts, direct and indirect impacts, immediate and long-term impacts, and unavoidable and 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. Identification of 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. Consultation with modeling consultants to establish conformity of the impact assessment with existing and ongoing mathematical model due to climate change developed by a number of reputed organizations. The developed models may be available from the main consultant and implementing agency;

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

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

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

xi. Prepare detail EMP along with respective EIA separately to monitor the implementation of mitigation 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.

1.5. Structure of the Report

15. 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 members.

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

Chapter 3 (Policy, Legal and Administrative Framework) reviews the national legislative, regulatory and policy framework relevant to the EIA study. A discussion on the WB safeguard policies and their applicability for the Project has also been reviewed.

Chapter 4 (Climate Change) descrives 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 of the project area.

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

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

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

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

Chapter 11 (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. Community concerns and their suggestedsolution and attitude towards the project is included in this chapter as a part of EIA requirement

2. Approach and Methodology

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

2.1. Overall Approach

17. The EIA study for the rehabilitation of Polder 23 has been carried out following the approved Terms of References (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 below:

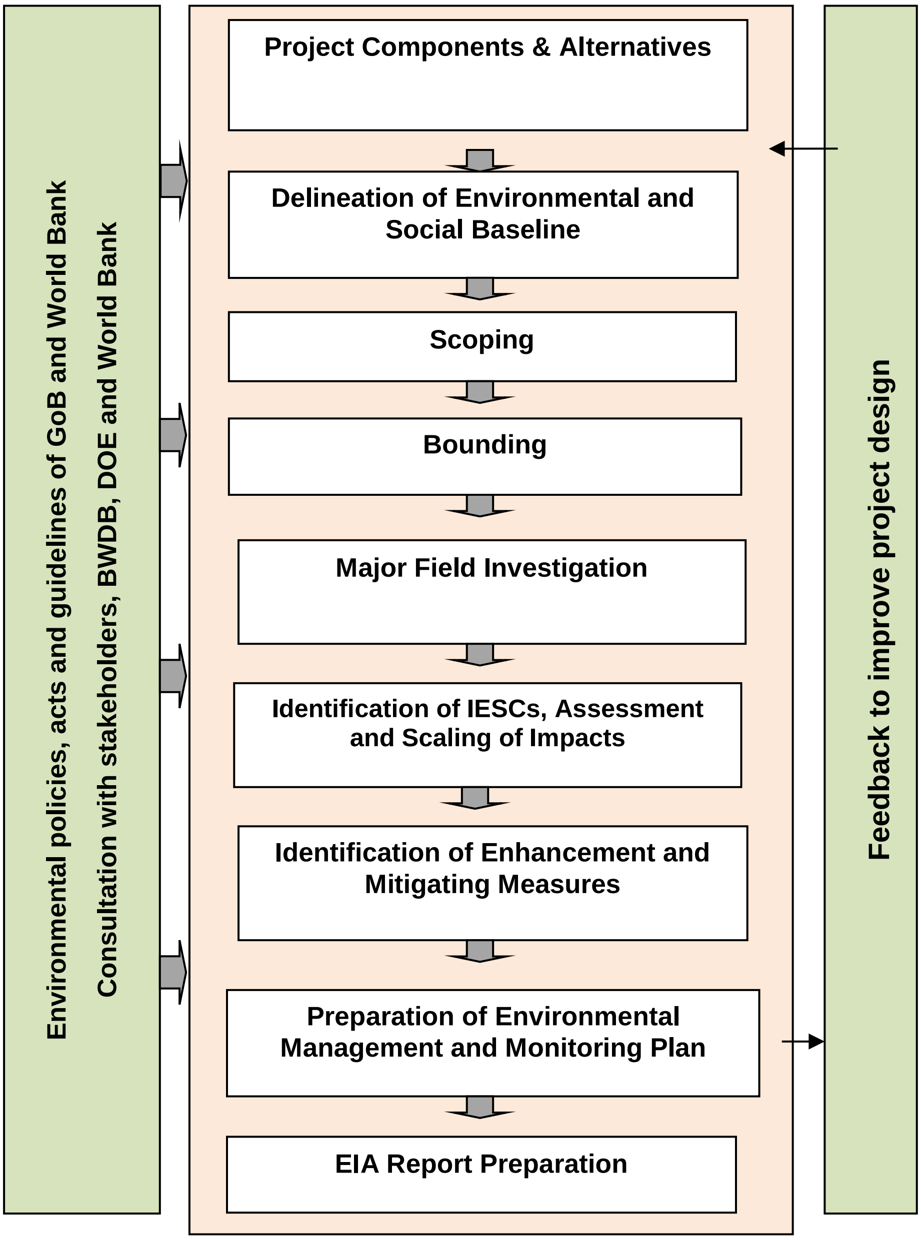


Figure 2.1: Overall approach of the EIA study

2.2. Methodology

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

Analysis of the Project Design and Description

19. Detailed information about the Polder23 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.

20. 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.

21. 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.

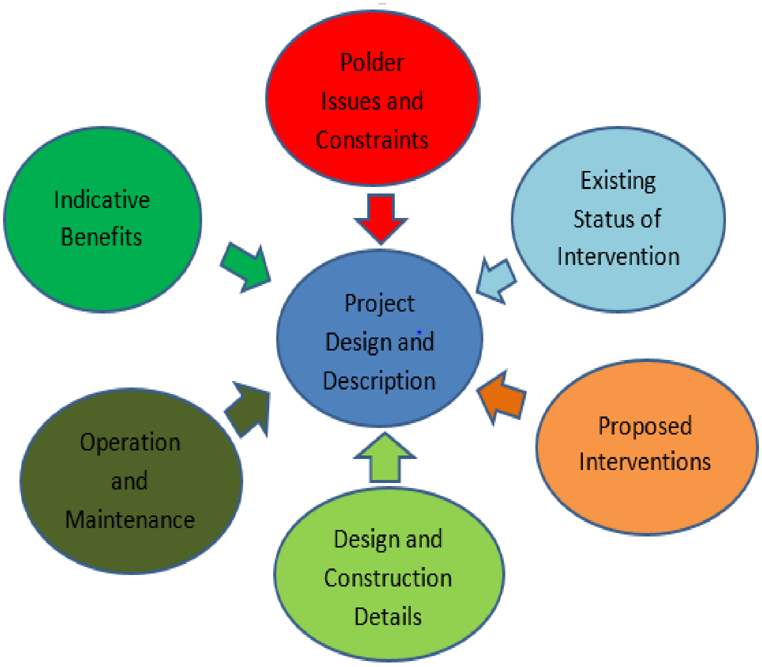


Figure 2.2: Aspects to be addressed in the Project Design and Description

Baseline Data Collection and Analysis

22. 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.

23. The baseline condition of the Polder area was determined according to the information collected from secondary and primary data sources through literature review, field

investigations and consultations with different stakeholders. The baseline settings were established with respect to the physical, biological and socio-cultural environmentincluding identification of problems in respect of the proposed project sites and adjoining area. A checklist was developed (**Appendix A**) and approved by the Detailed Design, Construction Supervision and Project Management Support Consultant (DDCS&PMSC) and used to register the information obtained from different stakeholders.

Physical Environment

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

Water Resources

25. Water resource data related to river hydrology and morphology, surface and ground water availability, drainage pattern, ground and surface water quality and water use were collected from secondary sources. Primary data on air, noise water were collected and analyzed. The professionals of the multi-disciplinary teamreceived by 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.

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

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

Land Resources

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

Biological Environment

Agricultural Resources

29. Land use information was prepared from satellite image classification followed byfield verification. Data on agricultural resources which included existing cropping patterns, crop variety, crop calendar, crop yield, crop damage, and agricultural input were collected from both

secondary and primary sources. Agricultural data was collected through extensive field surveys with the help of questionnaires and consultations with local people and concerned agricultural officials. Agricultural resources data were also collected from secondary sources from the DAE. Crop production was determined using the following formula:

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

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

Ecological Resources

31. The ecological component of the EIA study focused on terrestrial and riverine ecology including flora, birds (including migratory birds), reptiles, amphibians, and mammals. 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 imageries.

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

Fish and Fisheries

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

34. Fish habitat classification was made 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.

35. 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.

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

Livestock Resources

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

Socio-cultural Environment

38. 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;
- Institutional surveys were conducted for primary data collection from district and upazila level.

39. 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.

Climate Change

40. 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 National Geographic, 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 raises thesea level andcause 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 environmental and socio-economic impacts in a Climate Change perspective. Figure 2.3shows a process diagram of possible climate change impacts in the coastal areas of Bangladesh.

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

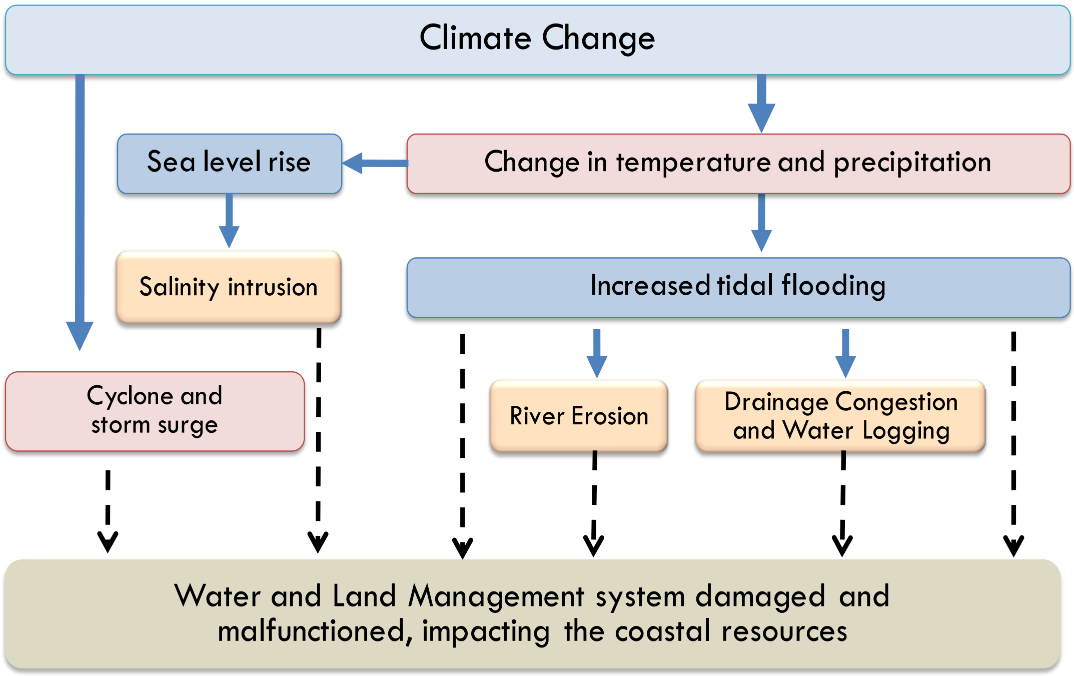


Figure 2.3: Typical process diagram of climate change impacts in coastal areas

42. 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 has been inferred. Moreover, intensive reviews of existing literatures and national reports were made to validate the identified climate change the issues and concerns.

Scoping

43. 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.

Bounding

44. At the beginning of the study, the Project area of influence was broadly demarcated. This included the area inside the polder where most of the Project interventions would take place, the area immediately outside the polder embankments (this area could be used for staging of construction works, material stockpiling, and/or earth borrowing), access routes for the polder, borrow as well as spoil disposal areas if located outside the polder, and labor camps/contractor facilities if located outside the polder. The area of influence is bounded by SibsaRiver to the north and west, Karulia and Minaj Rivers to the south and south west and

SibsaRiver to the North East and Habukhali Khal in the east. It is noted that project area includes polder area whereas study area includes both project area and peripheral rivers.

Major Field Investigation

45. 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.

Assessment and Scaling of Impacts

46. 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 future-without-project (FWOP) conditions were generated through trend analysis and consultations with the local people. This reflected conditions of IESCs in absence of the proposed interventions in the polder area. Expected changes due to proposed interventions were assessed to generate the Future-with-Project (FWIP) condition. Comparison and projection methods were used for impact prediction.

47. 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

48. The assessment of effects and identification of residual impacts takes account of any incorporated mitigation measures adopted 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.

49. 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

50. 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.

51. 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 baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and established professional criteria	Breaches national standards and or international guidelines/obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Sensitivity

52. 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

Assigning Significance

53. 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

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

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

Assessment of Residual Impacts

56. 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

57. 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.

Analysis of the Project Components and Alternatives

58. 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.

59. 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.

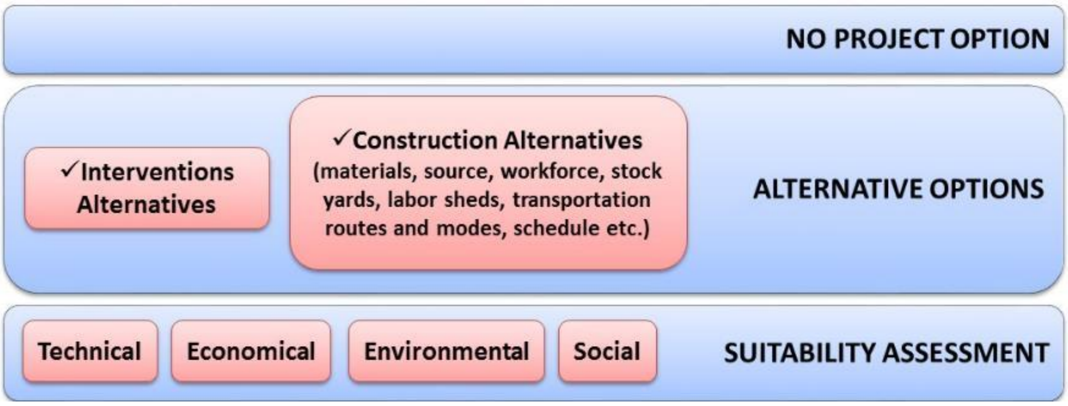


Figure 2.4: Concept of Alternative analysis to be used in the EIA study

Climate Change

60. 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 (*Kreft, S. et. al 2014*), 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.

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

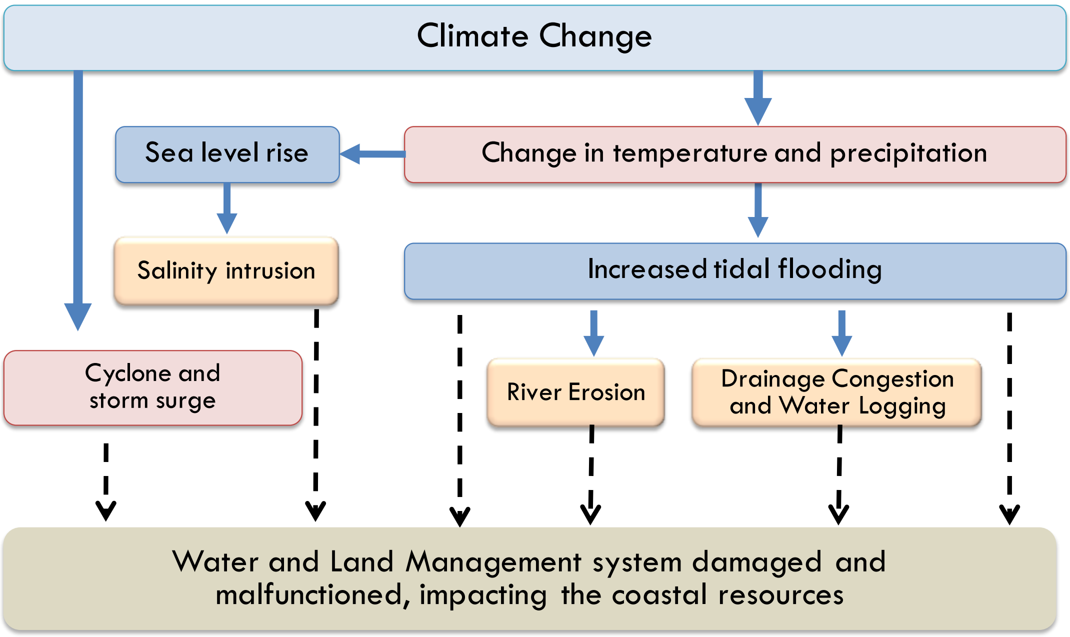


Figure 2.5: Typical process diagram of climate change impacts in coastal areas

62. 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.

Assessment of Cumulative and Residual Impacts

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 conditions, geographical position of polders, etc., have been considered to quantify the impact assessment. Finally, the impacts for development works of other adjacent polders have been considered for cumulative impact assessment. The cumulative impact of existing and ongoing project as well as proposed project of CEIP-1 around the proposed rehabilitation Polder has been assessed. During assessing cumulative impacts, rivers/watercourses hydrology, flooding situation, flora and fauna, shrimp farming and livelihood in and around the polder has been considered under this study.

63. 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 has 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.

Preparation of Environmental Management and Monitoring Plan

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

EIA Report Preparation

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

3. Policy, Legal and Administrative Framework

66. 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 ofthe WB environmental and social safeguard policies and guidelines are also incorporated in this chapter.

3.1. Relevant National Policies, Strategies and Plans

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

(i) National Environment Policy, 1992
(ii) National Environment Management Action Plan, 1995
(iii) National Water Policy, 1999
(iv) Guidelines for Participatory Water Management (GPWM), 2014
(v) National Water Management Plan, 2001 (Approved in 2004)
(vi) Coastal Zone Policy, 2005
(vii) Coastal Development Strategy, 2006
(viii) National Land Use Policy (MoL, 2001)
(ix) National Agriculture Policy, 1999
(x) National Fisheries Policy, 1996
(xi) National Forest Policy, 1994
(xii) Private Forest Policy 1994
(xiii) National Livestock Development Policy, 2007

3.2. National Environmental Laws

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

(i) Bangladesh Water Act, 2013
(ii) National River Protection Commission Act, 2013
(i) Bangladesh Environment Conservation Rules (ECR), 1997, Amended in 2010Bangladesh Environment Court Act, 2010
(ii) The Forest Act, 1927 & Amendment Act 2000
(iii) Private Forest Ordinance (PFO), 1959
(iv) Social Forestry Rules, 2004 and Amendments
(v) Antiquities Act, 1968
(vi) Bangladesh National Building Code, 2006
(vii) Standing Orders on Disaster, 2010
(viii) The Acquisition and Requisition of Immovable Property Ordinance, 1982
(ix) The East Bengal State Acquisition and Tenancy Act, 1950 (Revised 1994)
(x) Constitutional Right of the Tribal Peoples Rights
(xi) Ethnic Minority Rights in PRSP 2005
(xii) Acquisition and Requisition of Immovable Property Ordinance, 1982

69. Details of policies and laws are given in **appendix (C)**

3.3. Other Relevant Acts

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

Table 3-1: Laws and Acts

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

3.4. International Treaties Signed by GoB

71. Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate changesuch 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 changeetc. An overview of the relevant international treaties and conventions signed by GoB is provided in Table 3.2 below:

Table 3-2: Treaty or Convention and Responsible Agency

Treaty	Year	Brief Description of Treaty and Convention	Relevant Departments
Protection of birds (Paris)	1950	Protection of birds in wild state	DoE/DoF
Ramsar Convention	1971	Protection of wetlands	DoE/DoF
Protocol Waterfowl Habitat	1982	Amendment of Ramsar Convention to protect specific habitats for waterfowl	DoE/DoF
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural monuments	DoA
CITES convention	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	DoE/DoF
Bonn Convention	1979	Conservation of migratory species of wild animals	DoE/DoF

Treaty	Year	Brief Description of Treaty and Convention	Relevant Departments
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

72. The environmental legislative basis for approval of the CEIP-1 project is the Environmental Conservation Act 1995 (ECA'95) and the Environmental Conservation Rules 1997 (ECR'97, 2010). DoE).MoEFis the regulatory body responsible for enforcing the ECA'95 and ECR'97. According to the Rule 7 (1) of the Environmental Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every project, in consideration of their site and impact on the environment, hasbeen 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 23falls under the 'Red' category.

73. 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)

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

75. 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

76. Departmentof Environment (DoE), under the Ministry of Environment and Forest (MoEF), is the regulatorybody responsible for enforcing the ECA'95 and ECR'97. According to the Environment Conservation Act 1995 no industrial unit or project will be established or undertaken without obtaining, in the manner prescribed by the Environment Conservation Rules 1997, an Environmental Clearance Certificate from the Director General. Therefore, every development project/industry which are specified under the Schedule –1 of the Environmental Conservation Rules 1997 require obtaining site clearance and environmental clearance from DoE. For ‘Red’ category, it is mandatory to carry out an EIA including an EMP and where necessary to develop a Resettlement Plan for getting environmental clearance from DoE. The application procedure for obtaining site clearance and environmental clearance for the sub-projects of Red category is shown in Figure 3.1.

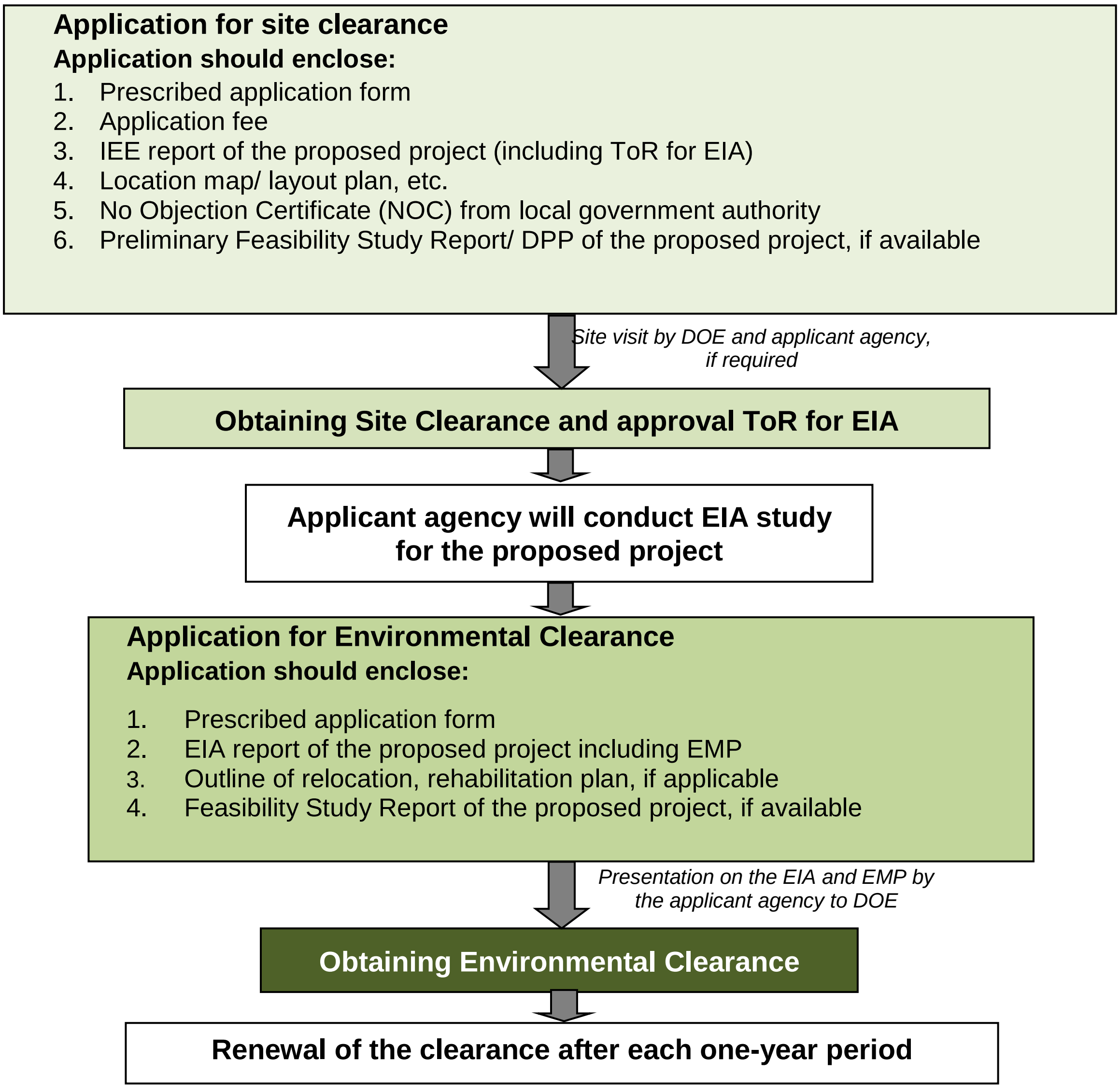


Figure 3.1: Process of obtaining Clearance certificate from DoE

3.7. World Bank's Environmental Safeguard Policies

77. 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) Indigenous Peoples (OP 4.10)
- (vii) Involuntary Resettlement (OP 4.12)
- (viii) Projects in Disputed Areas (OP 7.60)
- (ix) Safety of Dams (OP 4.37)
- (x) Public Disclosure of Information (BP 17.50)
- (xi) Environment, Health and Safety Guidelines

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

3.8. Implications of WB Policies on CEIP

79. The project interventions for Polder 23 fall under Category A, due to the complexity of environmental issues associated with project activities involving major civil works by reconstruction and rehabilitation of the coastal embankment to protect against tidal flooding and storm surges. Since the coastal area is of high ecological sensitivity and vulnerability certain negative environmental impacts may occur during the implementation and operational phase on overall Polder system. The environment assessment (OP/BP 4.01), natural habitats (OP/BP 4.04) and forests (OP/BP 4.36) policy have been triggered for the proposed project. Although no direct impacts on physical cultural resources are expected, screening mechanism incorporated into the EA process will identify subprojects with archeological, paleontological, historical, religious, or unique natural values, chance and find procedure will be followed to address physical cultural resources (OP/BP 4.11). The interventions under the proposed Project may result in an increased availability of irrigation water through cleaning and excavation of water courses in the Polder. This increased water availability can in turn potentially increase the usage of chemical fertilizers and pesticides. 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 Bank. No Project activities are to be carried out in the rivers except some transportation.

4. Climate Change Impact

80. 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 is 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.

81. One of the best ways of understanding how climate may change in future is to examine how it has changed in the past based upon long-term observational records.. Polder 23 is located near Khulna, so, meteorological parameters of Khulna station has been considered as a Polder 23 in the study. Khulna station data (Polder 23) 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 Khulna station (Polder 23) 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 climate change studies, it would have been better if longer period of data is available. With impact on key sectors like agriculture, water resources and economics, climate plays an influential role in human life cycles.

82. People and economies in Asia depend on rainfall for many purposes. Variations in duration and quantity of rainfall bring profound impacts on water resources, human life, economies and ecosystems. Extreme events such as floods, droughts and cyclones affect lives and livelihoods, and often result in damages worth millions.

4.1. Annual Climate Change Trends

Annual mean maximum temperature trend

83. Long-term changes in surface temperature and precipitation over Polder 23 were analyzed using observational records of BMD from 1976 to 2005. The temperature has the dominant increasing trend as shown in **Figure 4.1**.

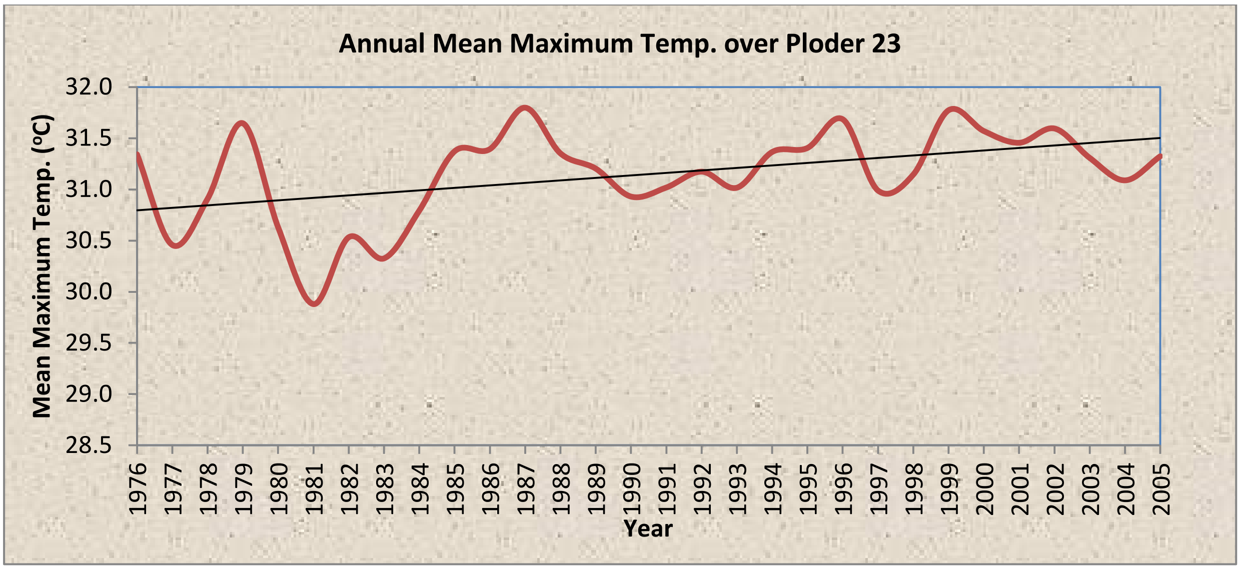


Figure 4.1: Temporal variations of mean maximum temperature over Polder 23 during the period 1976-2005.

84. The slope of the linear trends of the regression analysis of the mean maximum temperature has been observed. The annual mean maximum temperature time series have shown increasing trends over Polder 23 at the rate of 0.024ºC/year, which is statistically significant at 5% level.

Annual mean minimum temperature trend

85. The temporal plots of the time series of annual mean minimum surface air temperature has been analyzed for Polder 23.. A slightly increasing trends over Polder 23 at the rate of 0.0024ºC/yearis noted from 1976 to 2005, which is not considered statistically significant during the same period.

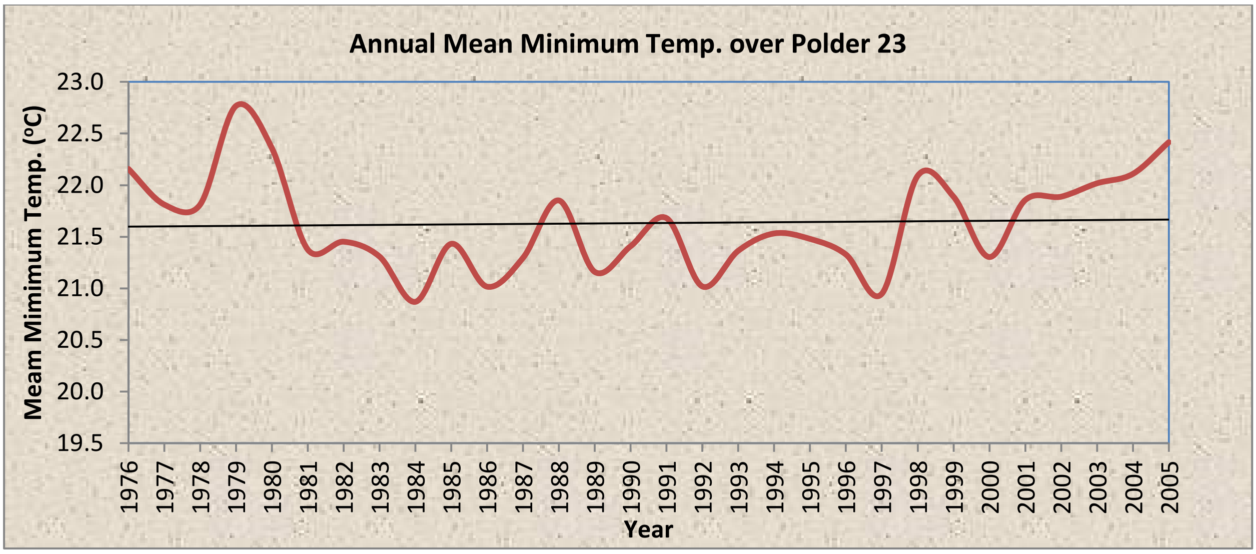


Figure 4.2: Temporal variations of annual mean minimum temperature over Polder 23 during the period 1976-2005.

Annual total rainfall

86. The temporal plots of the annual total rainfall of Polder 23 have been drawn to investigate the nature of inter-annual fluctuations. Anincreasing trend in the annual rainfall noticed at the rate of 3.721 mm/yearas noted from 1976 to 2005, which is notconsidered statistically significant.

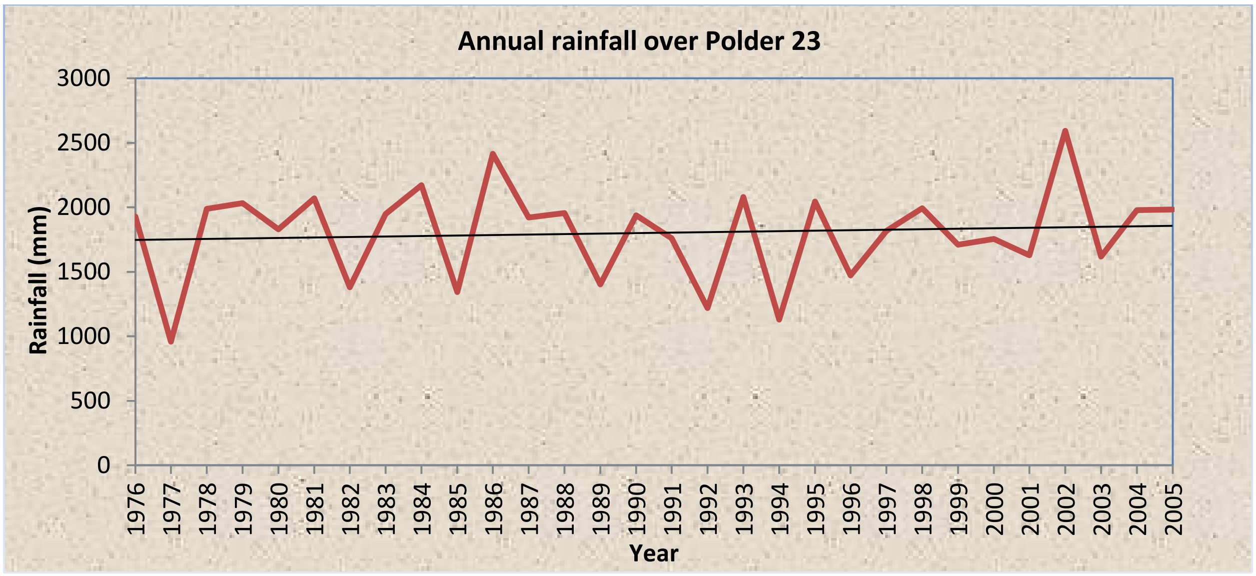


Figure 4.3: Temporal variations of annual rainfall over Polder 23 during the period 1976-2005.

4.2. Seasonal climate change trends

Winter climate change trend

a. Winter means maximum temperature trend

87. The winter mean maximum surface air temperature has an increasing trend over Polder 23 during the period of 1976-2005 (Figure not shown). The increasing trend is observed over Polder 23 at the rate of 0.022^{o}C/year which is statistically significant at 5% level.

b. Winter means minimum temperature trend

88. According to the trend analysis, it is found that the winter mean minimum surface air temperature has a decreasing trend over Polder 23 during the period of 1976-2005 (Figure not shown). The decreasing/cooling trend over Polder 23 is -0.0061^{o}C/year which is not statistically significant.

c. Winter season rainfall trend

89. The temporal variations of winter rainfall during the period 1976-2005 have been obtained. Slightly decreasing trend in the winter rainfall is noticed over Polder 23 at the rate of -0.734 mm/year (Figure not shown), during the above period, which is not statistically significant.

Pre-monsoon Climate Change Trends

a. Pre-monsoon mean maximum temperature trend

90. Pre-monsoon mean maximum temperature of Polder 23 has shown increasing trend during the period 1976-2005 (Figure not shown). Increasing trend is observed over Polder 23 at the rate of 0.0096^{o}C/year, which is not statistically significant.

b. Pre-monsoon mean minimum temperature trend

91. Pre-monsoon mean minimum temperature shows increasing trends over Polder 23 during the period 1976-2005. Warming trend is observed over Polder 23 at the rate of 0.014^{o}C/year which is not statistically significant.

c. Pre-monsoon total rainfall trend

92. The temporal variations and the trend of pre-monsoon total rainfall during the period 1976-2005 have been obtained (Figure not shown). Decreasing trend is noticed in the pre-monsoon season total rainfall over Polder 23 at the rate of -2.588 mm/year during the same period, which is not statistically significant.

Monsoon Climate Change Trends

a. Monsoon mean maximum temperature trend

93. The Polder 23 has shown strong warming trend of mean maximum temperature in the monsoon season during the period 1976-2005 (Figure not shown here). Polder 23 exhibits strong warming trend during the monsoon season at the rate of 0.037^{o}C/year which is statistically significant at 1% level.

b. Monsoon season mean minimum temperature trend

94. It is observed that the Polder 23 has shown warming trend of mean minimum temperature in the monsoon season during the period 1976-2005 (Figure not shown). Polder 23 has the warming trend with the value of 0.0048^{o}C/year which is not statistically significant.

c. Monsoon season rainfall trend

95. The temporal variations and the trend of monsoon season rainfall are noticed during the period 1976-2005 (Figure not shown). Increasing trend in the monsoon season rainfall are observed over Polder 23 at the rate of 0.554 mm/year during the same period, which is not statistically significant.

Post-monsoon Climate Change Trends

a. Post-monsoon mean maximum temperature trend

96. The Polder 23 has shown warming trend for post-monsoon mean maximum temperature during the period 1976-2005 (Figure not shown). Slightly warming is observed over Polder 23 at the rate of 0.023^{o}C/year, which is not statistically significant.

b. Post-monsoon mean minimum temperature trend

97. Post monsoon mean minimum temperature has shown slightly decreasing trend over Polder 23 and decreasing trend also shows at the rate of- 0.0072^{o}C/year for the period 1976-2005, which is not statistically significant.

c. Post-monsoon season rainfall trend

98. Increasing trend in the post-monsoon season is noticed over Polder 23 at the rate of 5.1049 mm/year (Figure not shown) during the above period, which is not statistically significant.

4.3. Climate change projection

Projection of rainfall over Polder 23

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

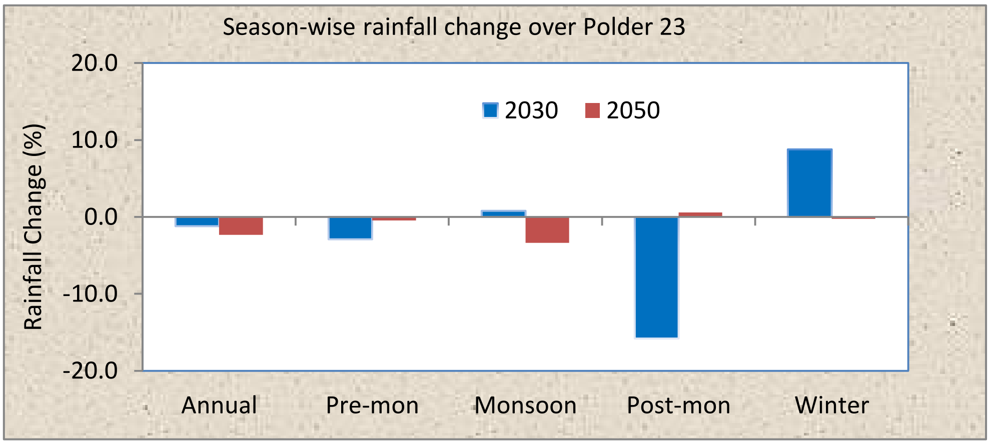


Figure 4.4: Change of seasonal rainfall (%) over Polder 23 for the year 2030 and 2050.

100. **Year-2030**: Rainfall change is found to be -2.9, 0.8, -15.8 and 8.8 for pre-monsoon, monsoon, post-monsoon and winter, respectively for 2030 (Figure 8.4). On an average annual rainfall change over Polder 23 may be changed by -1.2% for the year 2030.

101. **Year-2050**: The change of rainfall is observed to be -0.5, -3.4, 0.6 and -0.3% for pre-**monsoon**, monsoon, post-monsoon and winter, respectively for 2050 (Figure 4). On an average annual rainfall change over Polder 23 may be decreased by -2.3% for the year 2050.

Projection of Maximum and Minimum Temperature over Polder 23:

102. Maximum and Minimum surface air temperature projection has been obtained using a new set of scenarios RCP4.5 (Assessment Report, AR5) which is called Representative Concentration Pathway (RCP). The year of 2030 and 2050 of maximum and minimum surface air temperature projections for RCP4.5 is given below:

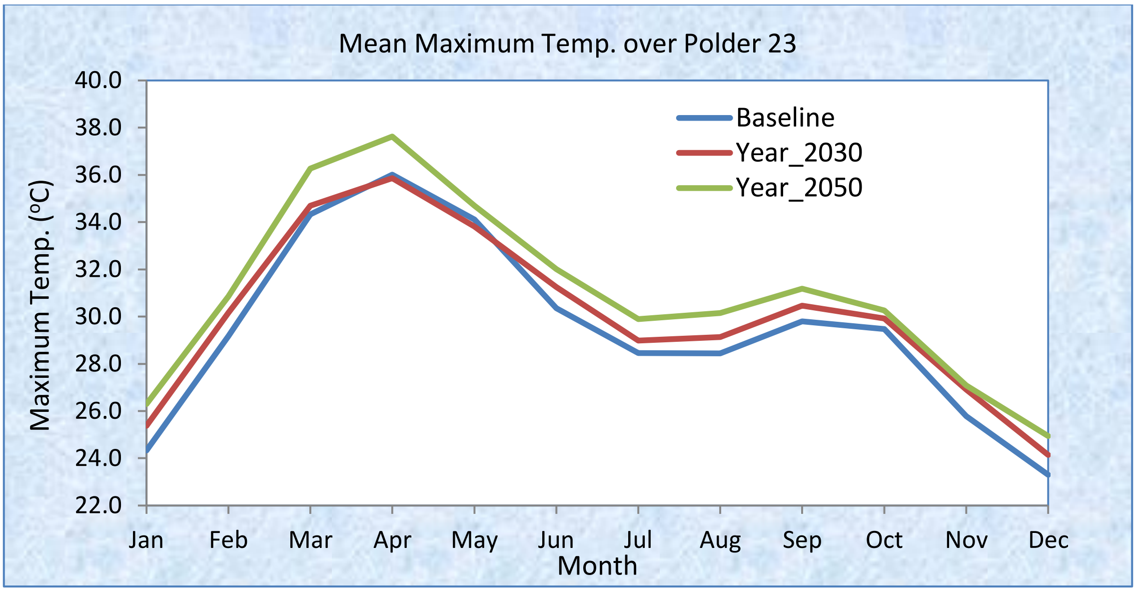


Figure 4.5: Annual cycle of projected maximum temperature with baseline over Polder 23 in 2030 and 2050.

Maximum temperature projections over Polder 23 for RCP4.5 scenario

103. Maximum surface air temperature may change in 2030 by 1.0, 1.0, 0.4, -0.1, -0.3, 0.9, 0.5, 0.7, 0.7, 0.5, 1.1 and 0.8°C for January, February, March, April, May, June, July, August, September, October, November and December, respectively. Maximum surface air temperature in various months may vary by -0.1-1.1°C over Polder 23. On an average the maximum surface air temperature is estimated to be increased by 0.6°C for the 2030. Similarly, maximum temperature may change in 2050 by 2.0, 1.7, 1.9, 1.6, 0.6, 1.6, 1.4, 1.7, 1.4, 0.8, 1.3 and 1.6° C for January, February, April, May, June, July, August, September, October, November and December, respectively. Maximum surface air temperature in various months may vary by 0.6 - 2.0° C over Polder 23. On an average the maximum surface air temperature is estimated to be increased by 1.5°C for the 2050.

Minimum temperature projections over Polder 23 for RCP4.5 scenario:

104. Minimum surface air temperature may change in 2030 by 1.6, 0.8, 2.0, 0.7, 0.9, 1.0, 0.9, 0.9, 1.0, 1.1, 1.6 and 2.1° C for January, February, March, April, May, June, July, August, September, October, November and December, respectively. It is observed that the change lies between 0.7-2.1°C for the period 2030 and on an average, minimum surface air temperature may increase by 1.2°C over Polder 23 in future for the period 2030. Similarly, minimum temperature may change in 2050 by 2.4, 1.9, 2.7, 1.9, 1.5, 1.5, 1.5, 1.4, 1.5, 1.2, 1.2 and 1.8° C for January, February, April, May, June, July, August, September, October,

November and December, respectively. Minimum surface air temperature in various months may vary by 1.2-2.4ºC for the period 2050. On an average the minimum surface air temperature is estimated to be increased by 1.7ºC for the 2050.

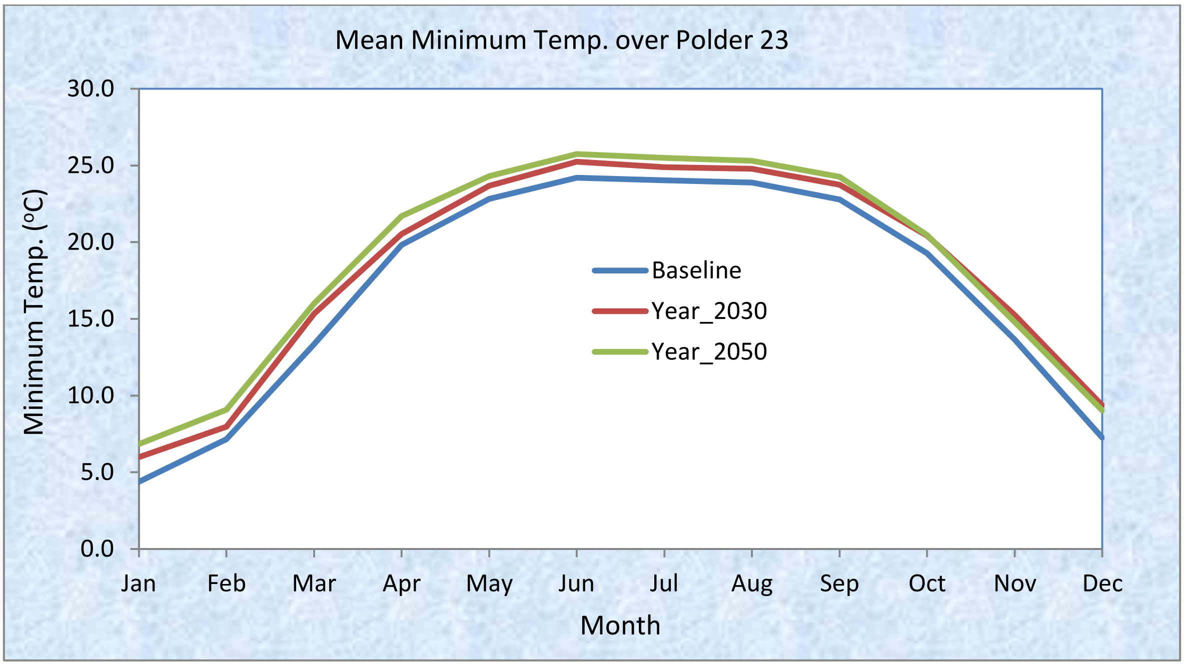


Figure 4.6: Annual cycle of projected minimum temperature with baseline over Polder 23 in 2030 and 2050.

4.4. Climate Change Induced Natural Hazard

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

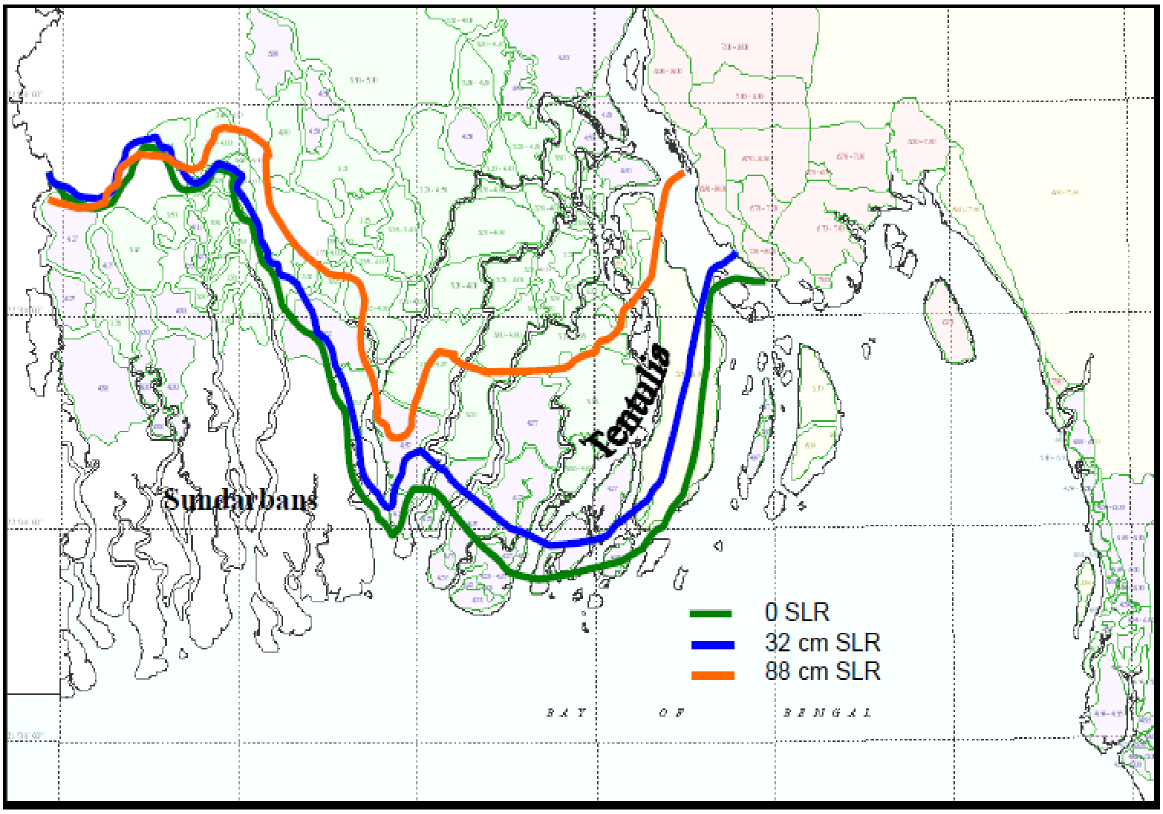
Sea Level Rise and Coastal Inundation

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

Tidal Flooding

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

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

Salinity Intrusion

109. Saline water intrusion is highly seasonal in the coastal area of Bangladesh. Salinity and its seasonal variation are dominant factors for the coastal ecosystem, fisheries and agriculture. Therefore, any change in the present spatial and temporal variation of salinity will affect the biophysical system of the coastal area. IWM and CEGIS (2007) found that the base condition, about 10 percent of the coastal area is under 1 part per thousand (ppt) salinity and

16 percent area is under 5 ppt salinity and this area will be increased to 17.5 percent (1 ppt) from 10 percent and 24 percent (5 ppt) from 16 percent by 2050 considering 88 cm sea level rise. So, there will be an increase of about 8 percent in the area under 5 ppt salinity levels due to sea level rise. The areas of influence of 5 ppt salinity line under different sea level rise are shown in Map 4.1. The intrusion of salinity will increase soil salinity and surface water salinity and might affect agriculture crop production.

Table 4-1: Major Cyclones Hit the Bangladesh Coast

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

Source: MCSP, 1993; Bangladesh Meteorological Department and field survey, 2010

Cyclones and Storm Surges

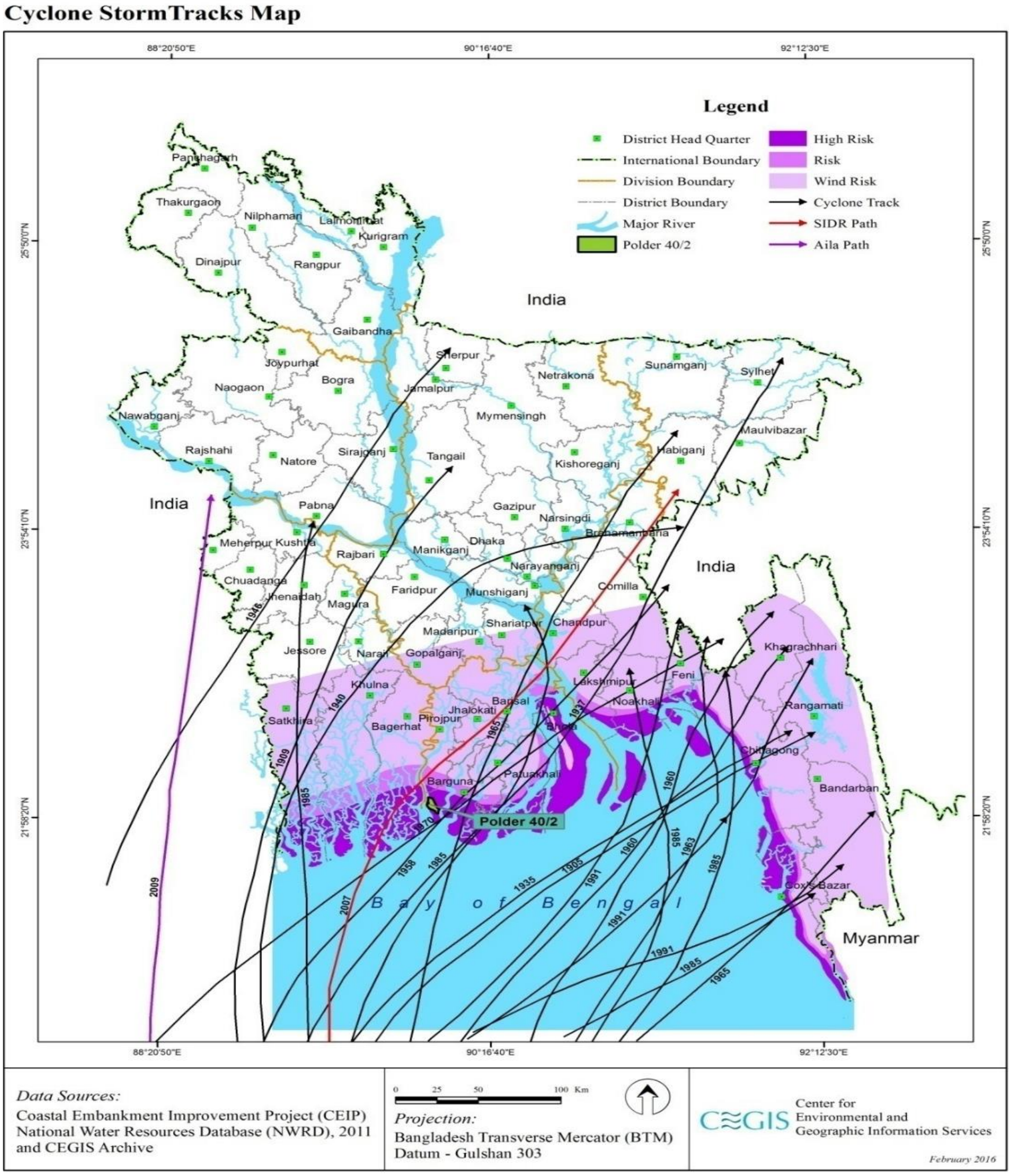
110. Bangladesh is especially vulnerable to cyclones because of its location at the triangular shaped head of the Bay of Bengal, the sea-level geography of its coastal area, its high population density and the lack of coastal protection systems. During pre-monsoon (April–May) or post-monsoon (October–November)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

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

112. Tropical cyclones and surges are the major threats to the coastal areas, causing loss of human lives and livestock and severe damage to crops and properties. During last 125 years, more than 42 cyclones had hit the coastal areas (Map 4.2) 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.

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



Map 4-2: Previous Cyclonic Storm Tracks ***(Source: MCSP, 1993)***

Rainfall and Temperature, Drainage, and Water logging

114. Global warming is an important issue, with a variety of influences on agriculture, water, health and economy. It is now recognized that climate variability and extreme events affect the society more than changes in the mean climate (IPCC, 2001). Human induced changes in the global climate and associated sea-level rise are widely accepted by the policy makers and scientists. The IPCC concluded that the balance of evidence suggests a discernible human influence on global climate (IPCC-AR4, 2007). The exact magnitude of the changes in the

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

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

5. Description of the Project

5.1. General

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

117. The Coastal Zone of Bangladesh has been defined as the area within which the river 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

118. 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.

119. 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).

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

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

5.3. The CEIP Initiative

122. 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.

123. 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).

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

125. Polder 23 is one of the polders to be rehabilitated under the CEIP-1.

5.4. Overview of Polder 23

126. Polder 23 is located in Paikgachha Upazila under Khulna District. The Polder covers two Union Parishad (UP) namely Sholadana and Laskar. The Polder is surrounded by three rivers, Sibsa River to the North and East, Karulia River to the West and Minaj River to the South. Sundarban is the biggest mangrove forest and a World heritage site is located about 10 km to south of the Polder.

127. The Polder was conceived in the early 1960s. Construction of the Polder was started in 1965 and completed in 1968. Cyclone is the main threat to life and property in the area. The original concept of construction of this Polder was to protect low lying coastal areas against tidal flooding and salinity intrusion, considering only the tidal effects but ignoring effects of wind, wave and cyclonic storm surges. The south-east corner of the Polder is under heavy threat of cyclone surge, and wave overtopping aggravated by climate change.

5.5. Objective of the Project

128. The primary objective of the project is to restoration of the Polder that may protect the coastal population from natural disasters and climate change. This may be fulfilled through a set of specific objectives, such as (a) to protect embankment from river erosion and wave action; (b) to prevent saline 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 23

129. The Polder 23, 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 for overtopping of cyclones and storm surges especially *Aila* (2009). Many segments of the embankment have been damaged by wave action and eroded due to high pressure of tidal prism and continuous water flow. At many places especially along the Sibsa River, the embankment was overtopped during *Aila*. There is an abrupt ecological change inside the Polder area. More than 80% of the Polder area is now under shrimp culture Gher[1] and few agriculture lands remains inside the Polder. It was observed that there are so many unauthorised mini structures constructed by the Gher owners for lifting saline water from the river for the purpose of shrimp culture. These structures make the embankment weaker. The entire embankment is under sectioned than design section with deteriorated condition and is being aggravated day by day due to climate change effect. The total length of the embankment needs to be re-sectioned as per

[1]Farms lands converted into ponds with low dykes and used for cultivation of shrimp/prawn/fish

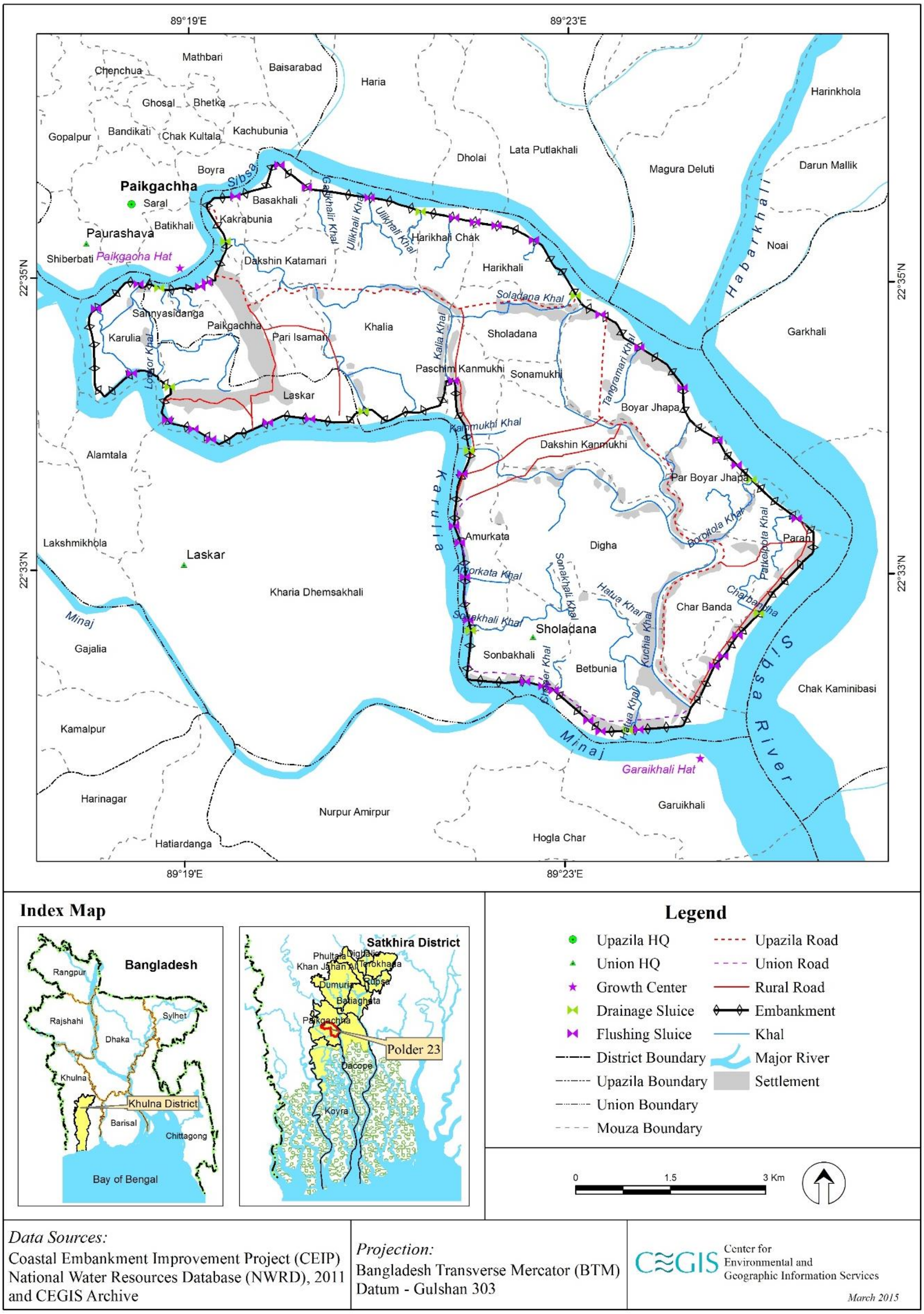
recommended crest level by CEIP. There are brick soling and bitumen carpeting on the top of embankment as road, which is needed to be upgraded accordingly.

130. There are 11 numbers of drainage sluices in the Polder. The condition of the drainage sluices is 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 be exposed and corroded in the saline environment. Most of the structures are not repairable condition. Loose aprons of the structures have been damaged. Out of which one is fully damaged (DS-1 at Ch. 21.35 km) and need to be reconstructed according to the new design by CEIP.

131. Besides, there are 39 numbers of flushing sluices in the Polder which were constructed under 3rd fishery and 4th fishery projects. Out of which 14 numbers of flushing sluices are required to be demolished as there is no need of flushing of water at those locations. About 8 numbers of the flushing sluices are functioning well and needed minor repairing and the remaining 17 numbers of flushing sluices have been severely damaged but needs flushing at the locality so that it required to be replaced as per new design by CEIP-1.

132. Similarly, most of the internal drainage channels have silted up which are needed to be re-excavated for efficient drainage within the polder area.

133. An Index Map showing the alignment of the embankment, drainage sluice, drainage channels are given below:



Map 5-1: Existing Interventions of Polder 23

134. Based on local opinions clustered during the major field investigation carried out in November 2015, the following key water management problems and issues were indentified in Polder 23.

- Lack of regular repair and maintenance of water control structures and embankments;
- Inadequate allocation of budget for O&M and its inefficient use;
- Community abuse of existing infrastructure for fishing, shrimp/ prawn farming through unauthorized and inappropriate sluices which ultimately resulted the weakening of the embankment and malfunctioning of regulators;
- High rate of siltation in internal drainage *Khal*s and peripheral rivers which hinders natural overland drainage;
- Inadequate plantation in the foreshore and lack of coastal green belt;
- Decrease carrying capacity of *Khals* through illegal encroachment;
- Effects of recent cyclones and storm surges, particularly the recent cyclones *Aila* (2009);
- Absence of functional community organizations for operation and co-management of the Polder system.

5.7. Present Status of Water Management Infrastructures

There are some typical water management infrastructures such as peripheral embankments, drainage sluices, drainage *Khals* and others. 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 infrastructure in Polder 23.

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

Table 5-1: Summary of existing water management infrastructures of Polder 23

Type of Infrastructures	Specification
Total length of Embankment	37.00 km (Design crest: 4.27 mPWD)
Total number of Drainage Sluices	11 nos
Total number of Flushing sluices	39 nos
Total length of Drainage *Khal*s (Water Channel)	36 Km
Gross protected area	4,489 ha
Net Cultivable area	3,969 ha

Source: CEIP and CEGIS estimation, 2015

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

Embankment

137. The total length of the embankment is 37.0 km. Embankment of the polder is aligned along the periphery Sibsa, Kurulia and Minaj Rivers as mentioned above. At present, many segments of the embankment are in dilapidated condition at reason to the recent cyclone *Aila* (2009) and high tide prism. During the cyclone *Aila*, the most of the segments of the embankment was damaged, some segments were breached. The entire embankment needs to rehabilitate as per new design section determined by CEIP.

138. During field visit in November 2015, it is observed that the entire length of embankment of the polder is below the design section. There are some brick soling and bitumen carpeting

on the crest of the embankment at some segments as the main communication system of the Polder. In addition to this, there are so many unauthorised and harmful mini-structures constructed by the *Gher* owners for their water demand of shrimp culture. These unauthorised structures trend to become the embankment weaker day by day.

Photo 5-1: Present condition of the embankment of the Polder

Photo 5-2: Brick soling on the crest of the embankment

Photo 5-3: Bitumen carpeting on the crest of the embankment

Slope protection

139. The existing slope condition of embankments is found in moderate condition. 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 works of embankment at several segments taken under BWDB after *Aila*. The length of embankment at various segments is required to be protected by providing slope protection works as determined by CEIP.


Photo 5-4: Present condition of existing slope protection work

Water Control Structures

140. There are 11 numbers of drainage sluices and 39 numbers of flushing sluices in Polder 23. During field visit, most of the drainage sluices are found damaged and deplorable condition except DS-1 which was repaired in the year of 2014 by BWDB and found in functioning condition. Besides, the flushing sluices are found mostly deplorable condition. Out of which, 14 numbers of the flushing sluices are proposed to be demolished and 17 numbers of flushing are proposed to be replaced and 8 numbers of the flushing sluices are proposed to be repaired. 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, brick masonry have been damaged severely. 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 the existing flushing sluices in the Polder are malfunctioning, flushing sluices are required to be repaired and make them functioning. Otherwise, more un-authorized mini structure will be installed by *Gher* owners for taking water inside the Polder as well endangering the stability of the embankment. Formation of strong "Sluice Committees" and WMA is needed for gate operation and for improve water management system inside the Polder. **Table 5.2** below provides a detail understanding of the existing drainage sluices in Polder 23 and addresses the need for future works.

Table 5-2: Status of existing water control structures

Sl.	Structures	Chainage (km)	Type and Size	Present condition	Recommendation for remedy
			Drainage Sluice		
1	DS-1	Ch. 0.00	RCB (1vent-1.5mx1.8m)	The structure has been repaired in the year of 2014 and found functioning	Minor repairing and maintenance to be needed for smooth functioning
2	DS-2	Ch. 4.55	RCB (1vent-1.5mx1.8m)	The U/S and D/S loose aprons of the structure have totally been damaged. The vertical lift-gate channel have also been damaged and gates are corroded.	The structure is proposed to be replaced with provision for flushing and drainage.
3	DS-3	Ch. 7.55	RCB (1vent-1.5mx1.8m)	The concrete surface has been deteriorated and gate	The structure is proposed to be

Sl.	Structures	Chainage (km)	Type and Size	Present condition	Recommendation for remedy
				is corroded. Loose-apron and expansion-joint have been damaged.	replaced with provision for flushing and drainage.
4	DS-4	Ch. 11.80	RCP (4 vent-0.9m dia)	It is a brick masonry structure and was constructed in the year of 1965-68. Loose apron has been damaged.	The structure is proposed to be replaced by RCB sluice (1v-1.5x1.8) in place of pipe sluice with provision of flushing and drainage.
5	DS-5	Ch. 14.65	RCB (1 vent-1.5mx 1.8m)	It is a brick-masonry structure and constructed in the year of 1965-68. Loose-apron have been damaged.	The structure is proposed to be replaced with provision for flushing and drainage.
6	DS-6	Ch. 17.65	RCB (1 vent-1.5mx 1.8m)	It was constructed in the year of 1965-68 and concrete surface has been deteriorated. Gate has lost and it is reported that crack has been developed at Barrel –wall.	The structure is proposed to be replaced with provision for flushing and drainage.
7	DS-7	Ch. 21.35	RCB (1 vent-1.5mx 1.8m)	The structure has been fully damaged.	The structure is proposed to be replaced with provision for flushing and drainage.
8	DS-8	Ch. 24.20	RCP (4 vent-0.9m dia)	It was constructed in the year of 1965-68 and some pipes have been damaged. Loose-apron have also been damaged.	The structure is propose to be replaced by RCB sluice (1v-1.5x1.8) in place of pipe sluice with provision for flushing and drainage.
9	DS-9	Ch. 27.22	RCB (1 vent-1.5mx 1.8m)	It is a brick masonry work and was constructed in the year of 1965-68. Loose-apron have been damaged and lift-gates channel is corroded.	The structure is proposed to be replaced with provision for flushing cum-drainage.
10	DS-10	Ch. 31.20	RCB (2v-0.9mx1.2m)	Partial functioning	The structure is proposed to be repaired.
11	DS-11	Ch. 35.40	RCP (4 vent-0.9m dia)	The pipes of the sluice have been blocked by heavy siltation.	Replaced by drainage-cum-flushing RCB sluice (1v-1.5x1.8) is proposed
Flushing Sluice					
1	FS-1	Ch. 1.15	RCB (2v-0.9mx0.9m)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
2	FS-2	Ch. 2.15	RCB (1v-0.9mx0.9m)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
3	FS-3	Ch. 2.72	RCB (2v-0.9mx1.2m)	Partial functioning condition	The structure is proposed to be repaired

Sl.	Structures	Chainage (km)	Type and Size	Present condition	Recommendation for remedy
4	FS-4	Ch. 3.73	RCB (1v-0.9mx1.2m)	Partial functioning condition	The structure is proposed to be repaired
5	FS-5	Ch. 5.09	RCB (2v-0.9mx0.9m)	Moderately damaged condition	The structure is proposed to be replaced
6	FS-6	Ch. 5.50	RCB (3v-0.9mx1.2m)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
7	FS-7	Ch. 5.80	RCB (3v-0.9mx1.2m)	Moderately damaged condition	The structure is proposed to be replaced
8	FS-8	Ch. 6.45	RCB (2v-0.9mx1.2m)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
9	FS-9	Ch. 8.05	RCP (5v-0.9m dia)	Moderately damaged condition	The structure is proposed to be replaced by RCB (1v-0.9mx1.2m)
10	FS-10	Ch. 8.90	RCP (1v-0.9m dia)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
11	FS-11	Ch. 9.90	RCP (2v-0.9m dia)	Moderately damaged condition	The structure is proposed to be replaced by RCB (1v-0.9mx0.9m)
12	FS-12	Ch. 10.95	RCP (2v-0.9m dia)	Moderately damaged condition	The structure is proposed to be replaced by RCB (1v-0.9mx0.9m)
13	FS-13	Ch. 11.45	RCP (2v-0.9m dia)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
14	FS-14	Ch. 12.75	RCP (2v-0.9m dia)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
15	FS-15	Ch. 15.15	RCP (1v-0.9m dia)	Moderately damaged condition	The structure is proposed to be replaced by RCB (1v-0.9mx0.9m)
16	FS-16	Ch. 15.50	RCP (1v-0.75m dia)	Moderately damaged condition	The structure is proposed to be replaced by RCB (1v-0.9mx0.9m)
17	FS-17	Ch. 15.75	RCP (2v-0.9m dia)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
18	FS-18	Ch. 17.575	RCB (5v-0.9mx1.2m)	Moderately damaged condition	The structure is proposed to be replaced
19	FS-19	Ch. 18.115	RCP (1v-0.9m dia)	Moderately damaged condition	The structure is proposed to be

Sl.	Structures	Chainage (km)	Type and Size	Present condition	Recommendation for remedy
					replaced by RCB (1v-0.9mx0.9m)
20	FS-20	Ch. 18.40	RCP (3v-0.75m dia)	Moderately damaged condition	The structure is proposed to be replaced by RCB (1v-0.9mx0.9m)
21	FS-21	Ch. 19.10	RCP (5v-0.9m dia)	Moderately damaged condition	The structure is proposed to be replaced by RCB (1v-0.9mx1.2m)
22	FS-22	Ch. 19.275	RCB (1v-0.9mx1.2m)	Moderately damaged condition	The structure is proposed to be repaired
23	FS-23	Ch. 19.60	RCB (1v-0.9mx0.9m)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
24	FS-24	Ch. 21.45	RCB (1v-0.9mx1.2m)	Partial functioning condition	The structure is proposed to be repaired
25	FS-25	Ch. 22.15	RCB (1v-0.9mx1.2m)	Moderately damaged condition	The structure is proposed to be replaced
26	FS-26	Ch. 22.86	RCB (1v-0.9mx0.9m)	Moderately damaged condition	The structure is proposed to be replaced
27	FS-27	Ch. 22.985	RCP (5v-0.9m dia)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
28	FS-28	Ch. 23.80	RCP (1v-0.9m dia)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
29	FS-29	Ch. 25.332	RCB (4v-0.9mx1.2m)	Partial functioning condition	The structure is proposed to be repaired
30	FS-30	Ch. 28.15	RCB (1v-0.9mx1.2m)	Partial functioning condition	The structure is proposed to be repaired
31	FS-31	Ch. 28.85	RCP (1v-0.9m dia)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
32	FS-32	Ch. 29.85	RCB (1v-0.9mx0.9m)	Moderately damaged condition	The structure is proposed to be replaced
33	FS-33	Ch. 30.15	RCP (1v-0.9m dia)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
34	FS-34	Ch. 30.60	RCB (1v-0.9mx0.9m)	Partial functioning condition	The structure is proposed to be repaired
35	FS-35	Ch. 31.95	RCB (2v-0.9mx1.2m)	Partial functioning condition	The structure is proposed to be repaired

Sl.	Structures	Chainage (km)	Type and Size	Present condition	Recommendation for remedy
36	FS-36	Ch. 34.00	RCB (2v-0.9mx0.9m)	Moderately damaged condition	The structure is proposed to be replaced
37	FS-37	Ch. 34.90	RCB (2v-0.9mx0.9m)	Fully damaged condition Pipe of the sluice have been blocked by heavy siltation.	The structure is proposed to be demolished
38	FS-38	Ch. 35.95	RCB (2v-0.9mx0.9m)	Moderately damaged condition	The structure is proposed to be replaced
39	FS-39	Ch. 36.00	RCB (1v-0.9mx0.9m)	Moderately damaged condition	The structure is proposed to be replaced

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

Source: CEIP 2015, and CEGIS Field Investigation, 2015

Photo 5-5: Functioning condition of DS-1

Photo 5-6: Moderately functioning condition of DS-2

Photo 5-7: Moderately functioning condition of DS-3

Photo 5-8: Deplorable condition of FS-9

Drainage Khals

141. There are a number of drainage*Khals* in the Polder area. Total length of the drainage channels isaround 36 km inside the polder. Most of the *Khals* are silted up and needs to be re-excavated for smooth drainage through the structures and retention fresh water as well. During *Aila*, storm surge water entered into Polder through the *Khals* and overtopped

embankment at tremendous pressure resulting beaches at many segments of the embankment.

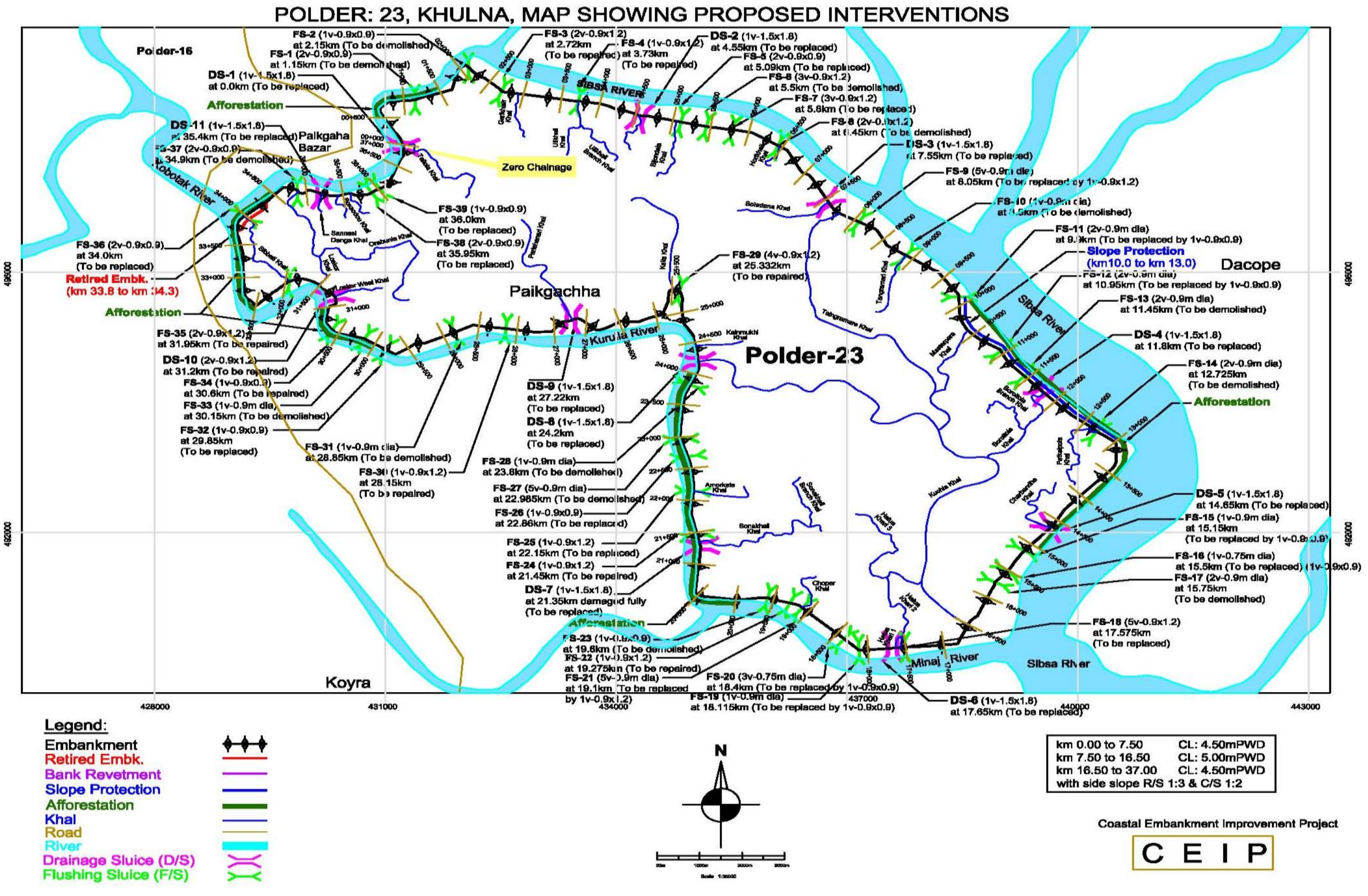
5.8. Proposed interventions

142. The proposed interventions in Polder-23 under CEIP-1 are listed in Table 5.3 and shown in Map 5.2. It is mentionable that drainage modelling of the coastal Polder has been carried out by IWM to find out the design parameters for drainage channel systems, drainage regulator, river bank, slope protection works. Climate resilient coastal embankment crest levels have been estimated considering the combined effects of climate change projected cyclone storm surge effects and wave generated by cyclone induced winds. The model has been developed considering climate change condition both with and without Project interventions (IWM, 2016). The Project interventions are further detailed in the following sections.

Table 5-3: Summary of Proposed Interventions in Polder 23

Type of Work	Specification
Re sectioning of embankment	36.50 km
Construction of Retired embankment	0.50 km
CEIP design crest level of embankment	5.00 (Ch. 7.50 to 16.50 km) and 4.50 mPWD (remaining chainage)
Slope protection work of embankment	3.00 km
Construction (Replacement) of Drainage Sluices	09 nos.
Repairing of Drainage Sluices	03 nos.
Construction (Replacement) of Flushing Sluices	17 nos.
Repairing of Flushing Sluices	08 nos.
Demolish of Flushing Sluices	14 nos.
Re-excavation of drainage channels	20.15 km
Afforestation	7.23 ha

Source: CEIP, 2015



Map 5-2: Proposed Interventions of Polder 23

143. To implement the aforementioned project interventions, the following phase-wise activities are to be carried out (Figure 5.1). The activities under each of the interventions have further been discussed and specified in the following sections:

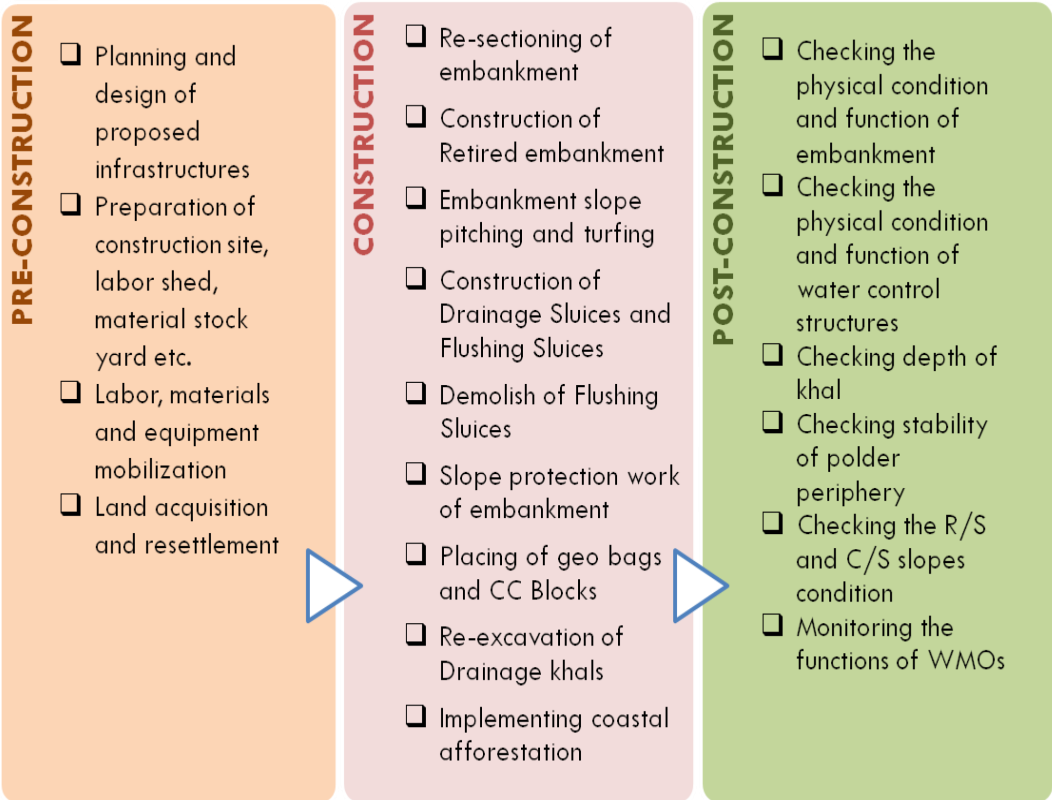


Figure 5.1: List of activities in Polder 23 at different project phases

Re-sectioning of Embankment

144. A total of 36.50 km of embankment will be re-sectionedunder the proposed interventions in the polder. The process will be done with mechanical compaction as per recommended crest level which has been assesd through mathmetical modeling concedering storm surge level and monsoon water level for 25-year return period under climate change scenarios which is shown in Table 5.4b. Another work is construction of retired embankment for a length of 0.50 km at Kurulia Laskar of the polder, which will also be implemented as per recommended crest level by CEIP. The brick-soling and bitumen carpeting road on the crest of the embankment will to be upgraded under CEIP-1 program. The side slopes of the embankment will also be rehabilitated as per CEIP-1 Design. Table 5.4a shows detail information on the works to be carried out on the embankment and Table 5.4b shows the design parameters determining the embankment crest level counting the climate change scenario

Table 5-4a: Detail Works of Embankments

Sl.No	Chainage	Length (Km)	Proposed Crest Level	Side slopes
Re-sectioning of Embankment				
1	0.00 to 7.50	7.50	4.5 mPWD	R/S 1:3 and C/S 1:2
2	7.50 to 16.50	9.00	5.0 mPWD	R/S 1:3 and C/S 1:2
3	16.50 to 33.80	17.30	4.5 mPWD	R/S 1:3 and C/S 1:2
4	34.30 to 37.00	2.70	4.5 mPWD	R/S 1:3 and C/S 1:2
Construction of Retired embankment				

Sl.No	Chainage	Length (Km)	Proposed Crest Level	Side slopes
5	33+800 to 34+300	0.50	4.5 mPWD	R/S 1:3 and C/S 1:2

Source: CEIP, 2015

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

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

Source: Design Team of DDCS&PMSC, 2019

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

Note 1: At Polder No. 23, 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

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

146. Labor sheds construction with proper sanitation and other required allied facilities should be planned before the commencement of construction activities for embankment construction. A suitable site shall be selected and prepared by cleaning bushes, weeds, trees etc. Alignment of the embankments has to be fixed with adequate base width. Base stripping and removal of trees, weeds etc. will be done as per the instruction of the Engineer in-charge. The tools required for the construction of embankments will be procured during this period. After validating the final design, and preparation of siteearth will becarried and placed on the alignment of the embankment. At the same time, each layer (of 1.5 feet) of dumped soil will have to be compacted by a compactor machine. The slope and shaping of specified embankment will be developed after proper compaction in layers. Thereaftergrass will placed

on the slope of the embankment. Water and fertilizer will also be provided for the proper growth of grass.

Construction (Replacing) and Repairing of Drainage Sluices and Flushing Sluices

147. There are 9 (nine) numbers of drainage sluices and 17 numbers of existing flushing sluices of Polder 23 will be constructed or replaced with new design specifications by CEIP. Besides, three numbers of existing drainage sluices and eight numbers of flushing sluices will be repaired at different locations under the proposed interventions for rehabilitation of Polder 23 under CEIP. Furthermore, 14 numbers of flushing sluices will be demolished according the proposed rehabilitation plan of the polder under CEIP-1. The summary of design information of the proposed works in drainage sluices is given in Table 5.6.

148. The EIA study presumes that the invert level of the drainage sluice gate have been fixed inmanner that about 50-60% of water will be retained in the khal tofacilitate irrigation, fisheries, environment and other purposes.

Table 5-6: Details of Works related Drainage Sluices

Sl. No.	Name of drainage sluices	Chainage (at km)	Khal Name	Name of outfall river	Length of Khals (Km)	Lowest Tide level (m. PWD)	Lowest elevation of basin (m. PWD)	Existing Sill Level (m. PWD)	Proposed Sill level (m. PWD)	Remarks
01	DS-13 (1v-1.50x1.80)	44+700	Shilirampur Khal	Kobadak	1.00	0.35	0.48	0.915	-1.50	Proposed new sluice
02	D/S-1 (1v-1.5x1.8)	2+865	Hulor Biler khal	Salta		-0.46	-0.32	-1.90	-1.00	Demolished as proposed
03	D/S-2 (2v-1.5x1.8)	4+150	Charivanga khal	Salta	1.00	-0.46	-0.09	-1.89	-1.00	Replacement of structure proposed
04	D/S-3(2v-1.5x1.8)	7+630	Mondi khal	Salta	3.86	-0.46	0.25	-1.87	-1.00	Repairing of structure proposed
05	D/S-4 (2v-1.5x1.8)	15+880	Nasirpur khal	Haria	10.00	-0.46	0.18	-2.07	-1.00	Replacement of structure proposed
06	D/S-5 (1v-1.5 x 1.8)	18+950	Bakultala khal	Haria	0.70	-0.48	0.30	-1.79	-1.50	Replacement of structure proposed
07	D/S-6 (1v-1.5x1.8)	20+650	Haulir khal	Haria	0.87	-0.48	0.35	-1.3	-1.50	Replacement of structure proposed
08	D/s-7 (2v-1.5x1.8)	23+550	Kamarabad khal +Khalishabunia khal	Haria	3.85	-0.49	0.34	-1.82	-1.50	Replacement of structure proposed
09	D/S-8 (1v-1.5x1.8)	24+800	Khalishabunia khal	Sibsa/Haria	1.50	-0.49	0.30	-1.5	-1.50	Repairing of structure proposed
10	D/S-9 (1v-1.5x1.8)	30+825	Kochubunia khal	Sibsa	4.00	-0.49	0.47	-1.26	-1.50	Replacement of structure proposed
11	D/S-10 (3v-1.5x1.8)	31+060	Boyratola khal	Sibsa	2.50	-0.49	0.25	-1.38	-1.50	Replacement of structure proposed
12	D/S-11 (1v-1.5x1.8)	35+190	Mandur khal	Kobadak	0.50	-0.47	0.15	-1.416	-1.50	Replacement of structure proposed
13	D/S-12 (1v-1.5 x 1.8)	41+275	DS-12 Khal	Kobadak	-	0.18	0.67	-1.792	-1.50	Replacement of structure proposed

Sl. No.	Name of drainage sluices	Chainage (at km)	Khal Name	Name of outfall river	Length of Khals (Km)	Lowest Tide level (m. PWD)	Lowest elevation of basin (m. PWD)	Existing Sill Level (m. PWD)	Proposed Sill level (m. PWD)	Remarks
14	D/S-14 (2v-1.5x1.8)	5+180	Sonamukhi khal	Salta	1.50	-0.45	0.20	-1.11	-1.00	Replacement of structure proposed
15	D/S-15 (1v-1.5x1.8)	19+630	Protapkati khal 1	Haria	2.50	-0.46	0.44	0.25	-1.50	Replacement of structure proposed
16	D/S-16 (1v-1.5x1.8)	21+070	Protapkati khal 2	Haria	-	-0.46	0.44	-0.30	-1.50	Replacement of structure proposed
17	D/S-17 (1v-1.5x1.8)	37+000	Gorami khal	Kobadak	1.00	-0.51	0.02	-0.961	-1.50	Replacement of structure proposed
18	D/S-18 (1v-1.5x1.8)	39+700	Provathi khal	Kobadak	0.70	0.05	0.58	-0.501	-1.50	Replacement of structure proposed

Source: CEIP, 2015

Description of construction activities

149. During pre-construction phase of drainage sluices, flushing inlets, construction of labor shed with sanitation and other facilities will 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 for it 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.

Slope Protection Works

150. Slope protection work for a total length of 3.00 km works will be carried out from chainage 10.00 km to 13.00 km along the Sibsa river of Polder 23.

Description of construction activities

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

Re-excavation of Drainage Khals

152. Ten (10) drainage channels with a total length of 20.15 km will be re-excavated to ease water flow and reduce drainage congestion. An estimated volume of 0.0746 million 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 materialswill be used for raising the plinth level of their earthen kutcha 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 5.7.

Table 5-7: Channels to be Re-excavated

Sl	Name of Khal (Channel)	Length (km)
1	**Boroitola khal**	1.50
2	Charbamdha khal	1.00
3	Hatuakhari khal-2	1.50
4	Kuchia kahl	8.50
5	Loskor West khal	0.35
6	Parishanari khal	2.00

Sl	Name of Khal (Channel)	Length (km)
7	Soladana khal	0.80
8	Sonakhali khal	2.00
9	Taltola khal	1.50
10	Ulikhali khal	1.00

Source: CEIP-I Design Study Team, 2017

153. Figure 5.2 below shows the conceptual layouts of proposed dumping technique. Compartmental dumping spots will be created along the sides of the excavated khals, allowing any runoff from de-watering of the spoils and from precipitation to drain into the excavated khals.

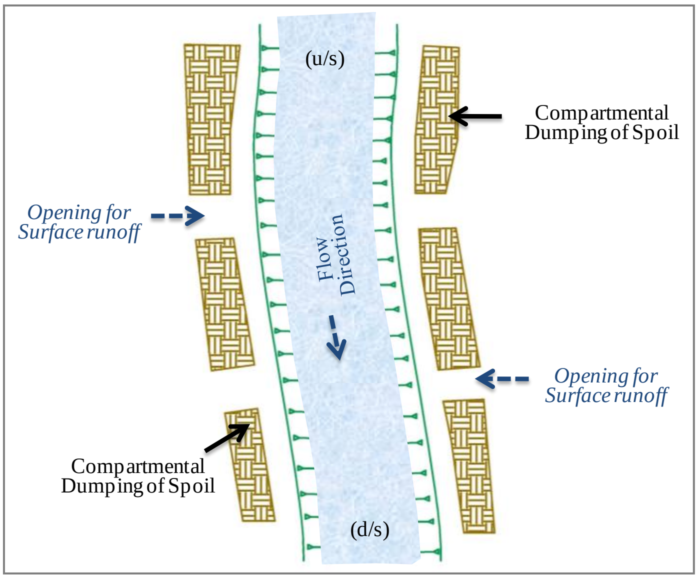


Figure 5.2: Plan form of a typical khal to be re-excavated

Description of construction activities

154. 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 be started from the upstream of the channel. Cross dams will be built in the reach, and soil will be removed from the channels up to the required depth and width. The excavated soil/sludge should be dumped in a suitable place, specified by the Engineer in-charge, so that the sludge or soil will not affect the channel flow by any means. After finalizing excavation in one reach, the next reach in the downstream would be excavated following the same procedures as stated above. The entire length of the channel will thus be re-excavated.

Afforestation

155. Afforestation will be implemented in this Polder to expand vegetation coverage as well as enhance environmental sustainability. A total of 19.04 ha area will be afforested of this Polder. Type of plantation and tentative area are given in following table:

Table 5-8: 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	Embankment Slope Plantation		11.8	2,500	29,500
2	Foreshore Plantation	Golpata Plantation	3.16	2,500	7,900
		Mound Plantation	1.29	1,600	2,064
		Enrichment Plantation	1.82	300	546
		Kewra-Baen Plantation	0.96	4,444	4,266
Total			**19.03**		**44,276**

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

5.9. Construction Details

Construction Schedule

156. The construction works in Polder 23 under the CEIP-1 are expected to be completed in four years. The construction schedule is presented in Table 5.9.

Table 5-9: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	Repairing of Drainage sluices and flushing sluices												
5	Slope Protection Works (km)		Manufacture of CC blocks and procurement of hard rock										
6	Re-excavation of Drainage Channels (km)												
7	Other works, including surveys, quality checks, testing, inspections and the like												

Part B

Sl No	Description	Year Two								Year Three			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)					Turfing							
2	Construction of retired embankment (km)												
3	Construction of Drainage Sluices and flushing inlets (nos)												
4	Repairing of Drainage sluices and flushing sluices												
5	Slope Protection Works (km)												
6	Re-excavation of Drainage Channels (km)												
7	Other works, including surveys, quality checks, testing, inspections and the like												

Part C

Sl No	Description	Year Three								Year Four			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)												
2	Construction of retired embankment (km)												
3	Construction of Drainage Sluices and flushing inlets (nos)												
4	Repairing of Drainage sluices and flushing sluices												

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

Source: Design Study Finding, 2015

Construction Manpower Requirement

157. 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[2]. The estimated manpower requirement is presented in Table 5.8. It is mentoined here that labor sheds/camps will be required for housed 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. The estimated manpower requirement is presented in Table 5.10.

Table 5-10: Required manpower for construction

S.L	Required Manpower	Number
1	Engineer	6
2	Machinery operator	12
3	Mechanics	25
4	Surveyor	20
5	Skill labour	100
6	Un-skill labour	200

Source: Design and Procurement Team of CEIP-1

Construction Material

158. 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 5.11.

Table 5-11: Details of Construction materials

	Description	Quantity	Sources
Re-sectioning and retired embankment			

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

	Description	Quantity	Sources
1	Earth work	746617.95 m^3	Private lands specially from river side (low excavated land will be filled up by tidal silts within one or two years), spoils from re-excavation of drainage channels
Construction of sluices and flushing sluices			
2	Cement		To be procured from, cement factory (directly)
3	Sand		To be procured from Khulna, Sylhet
4	Stone		To be procured from Khulna, Sylhet or imported from neaighbour countries
5	Steel		To be procured from Khulna, Dhaka steel mill (directly)
Bank protection(CC blocks-60,00,000nos)			
6	Cement		To be procured from, cement factory (directly)
7	Sand		To be procured from Khulna, Sylhet
8	Stone		To be procured from Khulna, Sylhet or imported from neaighbour countries

Source: Design Team of DDCS and PMSCs,2017

159. The carried earth for embankment rehabilitation will be collected from the offshore area of Polder 23.

Construction Machinery

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

Table 5-12: List of construction equipment and machinery

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

Source: Engineering and Engineering Team of CEIP-1, 2017

5.10. Project Implementation Arrangements

161. **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).

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

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

164. **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, 2Accountants and 3support staffs.

165. **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.

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

167. **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.

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

- An experienced NGO will be mobilized by the PMU to implement the social afforestation recommended in the the EMP, the Social Action Plan including mobilization of Water Management Organization, the RAP and the EMP.
- A Design and Construction Supervision Consultancy Firm will assist the PMU in preparing the detailed design of the remaining polders and supervise all construction. For civil works contracts, the Project Director will serve as the Employer, and the Project Supervision Consultant will serve as the Engineer for

construction supervision. At site, a Resident Engineer, appointed by the consultant, with a team of specialists and inspectors will supervise the Contractor.

- A Monitoring and Evaluation Consultant will provide support in monitoring project impacts and supervise the implementation of the EMP/RAP and report to the PMU.
- A Procurement Panel will be appointed by the BWDB to oversee the procurement process of large value contracts subject to prior review under the Project. The panel will consist of two international/expatriate specialists and one national specialist.

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

170. This Institutional arrangement is effective and are being implemented in Package 1 and Package 2 of CEIP-1 and they are found to work effectively and satisfactorily.

5.11. Water Management and Operation Plan

Introduction

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

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

Operation Plan

173. Operational plan involves setting out the schedule of activities related to operation of gates of structures by the users' organization to control water levels best suited to water management and agricultural needs. In the coastal Polders, operation of gates mainly focuses on protecting the saline water out of the Polder during high tides and allowing drainage of excess water from inside the polder during low tides to minimize the depth of flooding but storing enough water on the paddy fields. The trend however changes in the dry season where

the operational plan aims in storing as much water in the canal networks as possible by closing the gates. The water thus stored should have the basis of a balancing mechanism among all categories of user viz paddy growers; salt producers (if there is any); shrimp producers (also including other fish culture practices); and also domestic users. Operation of structures should therefore be an organizational, low-cost activity requiring quick communication with the beneficiaries and with project staffs at the lowest level.

(i) Operational Activities

174. The operational plan provides the framework upon which canal water levels (also referred to as operation target) and day-to-day structure operation will be based. More specifically, the operational plan for the CEIP Polders can be thought of as a hub for the following operational activities:

- Operation of drainage regulators;
- Operation of flushing sluices/irrigation inlets; and
- Operation of privately owned Low Lift Pumps (LLPs)

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

(a) Regulation of gates

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

177. The 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.

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

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

180. During post monsoon season (October to November), the vertical lift gates will be operated to retain water in the drainage canals without overtopping the canal banks and increasing the soil moisture level for cultivation. In all these cases there should be enough

consultation with the beneficiaries' organizations because agricultural practices, crop varieties; and cropping pattern changes with over time.

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

(b) Frequent Watching of Embankments

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

(c) Regular Checking of Structures

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

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

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

(e) Supervision of preventive maintenance works

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

(ii) Planning of Operation

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

(III) Maintenance Works

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

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

(i)Preventive or Routine Maintenance;

(ii)Periodic Maintenance;

- Minor Periodic Maintenance
- Major Periodic Maintenance

(iii) Emergency Maintenance;

(i) Preventive or Routine Maintenance

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

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

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

(ii) Periodic Maintenance

191. 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.

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

(a) Minor Periodic Maintenance Works:

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

(b) Major Periodic Maintenance Works:

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

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

(iii) Emergency Maintenance

194. Emergency works cover unforeseen interventions that require immediate actions to protect the polder as a whole or a part thereof from the adverse effects of flooding or uncontrolled saline intrusion etc. associated with damage of lives and properties. This type of work requiring immediate attention includes the closure of an embankment breach, the repair and replacement of flap gates, or the construction of cross dams over canals if structure fails. As the title implies planning of these kinds of works is not possible. Table 5.13 indicates each type of emergency maintenance works.

Table 5-13: Types and Classification of Maintenance Works

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

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	
18	Protective Works Re-positioning/replacing of incidentally displaced blocks/ boulders /concrete frames, small repair to sand/gravel filter		√								√
19	Channels Cleaning khal and outfall drains and de-silting outfall drains	√					√				
20	Re-excavation of khal		√						√		
21	Removing cross dams (used as access roads, flashing bunds or water retention)		√			√					

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

(iv) Planning of Maintenance

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

5.12. Project Cost

196. The implementation cost of the rehabilitation of Polder 23 is BDT Tk 11,495lakh.

5.13. Need of Resettlement Action Plan (RAP)

197. The interventions proposed in Polder 23 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.

5.14. No Objection Certificate

198. Polder 23 is located in the Paikgachha Upazila under Khulna District, covering Sholadana and Laskar 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**.

6. Environmental Baseline and Existing Conditions

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

Physical environment refers to the physical and chemical features of an area. It includes the climate, rainfall, wind, soil, obtainable nutrients and all other natural resources within the area. The following sections provide analyses on different physical environmental features of the Polder 23.

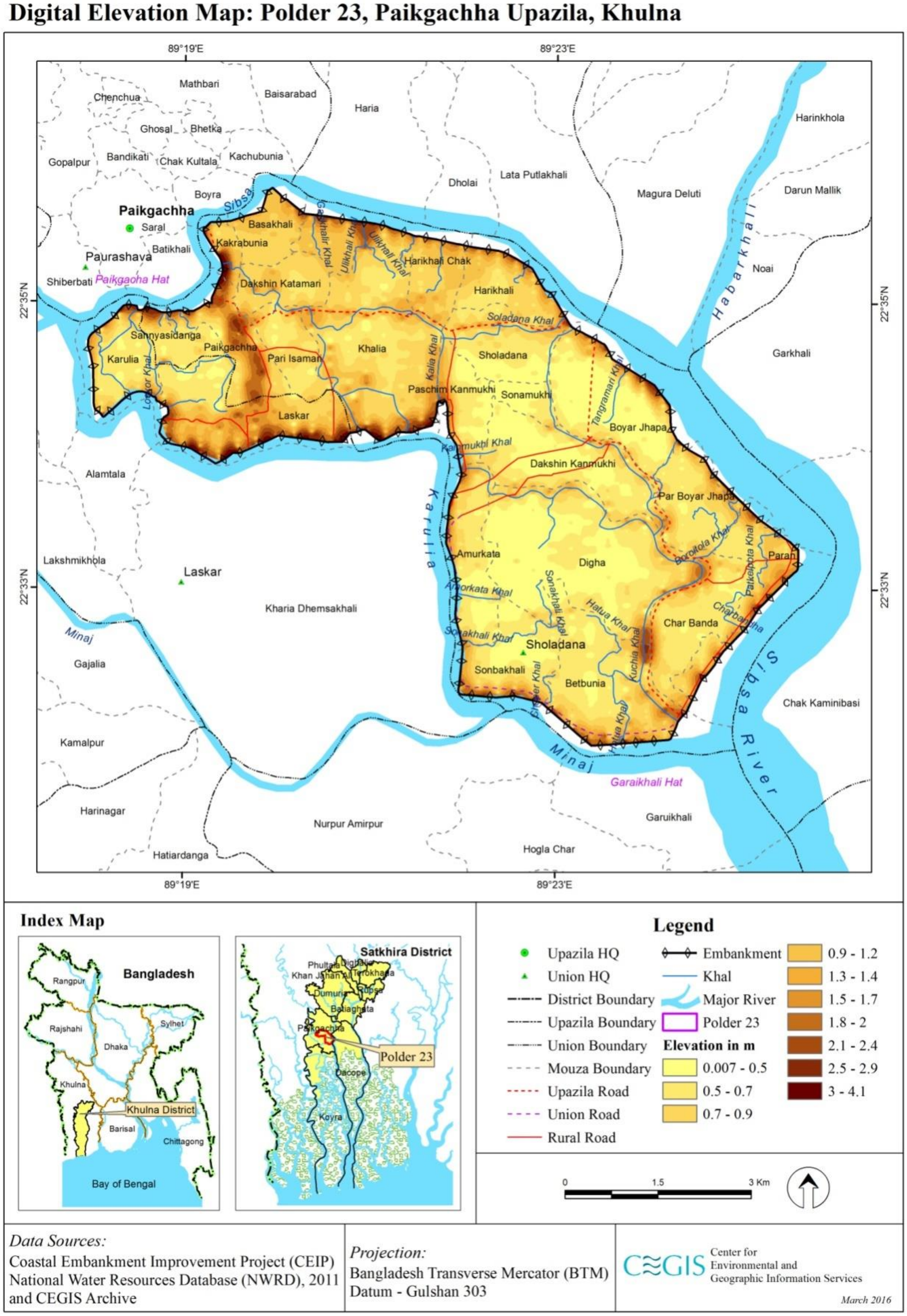
Geology

Polder 23 is situated in a low-lying coastal region. From Spatial analysis, it is observed that the polder is composed of Tidal Deltaic Deposit. The major portion of this deltaic sediment is deposited subaqueously in the permanent water bodies where tidal waves and currents aid in transportation and deposition. Typically low-lying deltaic environment comprises of soft sediments and are densely populated and these regions are quite dynamic and the changes in coastal geomorphology are quite rapid from impact of each cyclone.

Topography

199. The Polder area is located in the southern hydrological zone of the country, with very low average elevations. In order to assess the topography of the Polder area, the Reduced Levels (RLs) 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[3] (RLs) inside the polder vary from 0.66 to 1.68 m+PWD, with average RL of around 1.14 m+PWD. From the DEM it is also found that around 15% of the land area in the northwest part of the polder along the river Sibsa and Kurulia has relatively high elevation between 1.40 to 1.68 m+PWD , whereas around 70% of the land inside the polder area has elevation between 0.90 to 1.22 m+PWD. The rest 15% land area in the southwest side of the polder has elevation below 0.81 m+PWD. **Map 6.1** shows the topography of the Polder area, identifying the rivers and categorizing land elevations.

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



Map 6.1: Digital Elevation Model (DEM) of Polder 23

Seismicity

200. Geographical location of Bangladesh has made it ideal suited for natural disasters like earthquake. Tectonic framework of Bangladesh and adjoining areas indicate that Bangladesh is suited adjacent to the plate margins of India and Eurasia where devastating earthquakes have occurred in the past. Depending on the geological structure, Geological Survey of Bangladesh (GSB) has prepared a seismic zoning map of Bangladesh in 1979 dividing the country into three generalized seismic zones: Zone-I, Zone-II, and Zone-III (Map 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 5.2). Moreover, the Polder area 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 represents the tectonic units available in Bangladesh and the location of the Polder area (within the Faridpur Trough).

201. It can therefore be inferred that in consideration of both seismicity and stratigraphy, the Polder area occupies a relatively safer (seismically quiet and tectonically stable) side.

Earthquake Zone Map: Polder 23

Map 6.2: Earthquake Zones of Bangladesh and location of Polder 23

Tectonic Units Map: Polder 23

Map 6.3: Tectonic Units Bangladesh and location of Polder 23

6.2. Land Resources

202. Land is the surface of the earth that is not covered by water or area of ground, especially when used for a particularpurpose 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) Agroecological zones

203. Thirty agro-ecological zones and 88 sub-zones have been identified by adding successive layers of information on the physical environment which are relevant for land use and assessing agricultural potential. The Polder area comprises of two Agro-ecological regions: namely (a) High Ganges River Floodplain (AEZ-11) 110 ha and (b) Ganges Tidal Floodplain (AEZ-13) 4,379 ha.

Land use

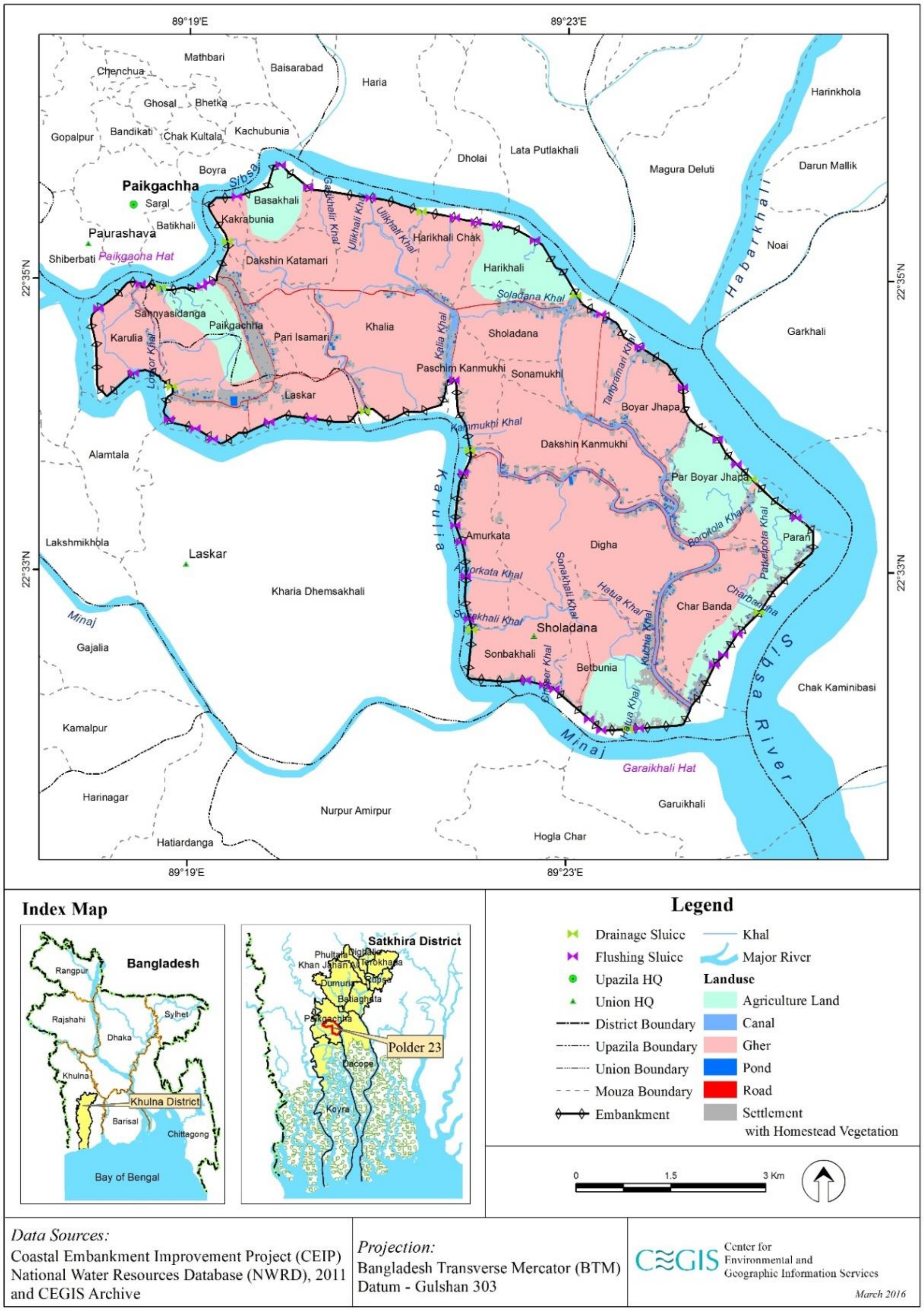
204. Land use involves the management and modification of natural environment of land into built environment such as settlements, arable fields, pastures and managed forest land. In this project the gross polder area is 4,489 ha where agriculture land is 422 ha which is 9% of gross area. The land use detailed of the Polder area is given in the Table 5.1and Map 6.4.

Table 6.1: Detailed Land Use of the Polder Area

Land use	Area (ha)	% of Gross Area
Agriculture land	422	9
Canal	82	2
Gher	3,547	79
Ponds	39	1
Roads	85	2
Settlement with homestead vegetation	314	7
Total area	**4,489**	**100**

Sources: CEGIS Assessment based on SOLARIS-SRDI; 2006 and CEGIS estimation from image analysis; 2015

Landuse Map: Polder 23, Paikgachha Upazila, Khulna



Map 6.4: Land use in Polder 23

(b) Land type

205. Land type classification is based on the depth of inundation during monsoon season due to normal flooding on agriculture land. According to SRDI, there are five land type classes: High land (0-30 cm), Medium highland (Flooding depth 0-90 cm), Medium lowland (Flooding depth 90-180 cm), Low land (Flooding depth 180-360 cm) and Very lowland (Flooding depth above 360 cm). The entire Polder area is under medium highland (F_1) which is normally flooded between 0-90 cm depth of water continuously for two weeks to few months during the monsoon season.

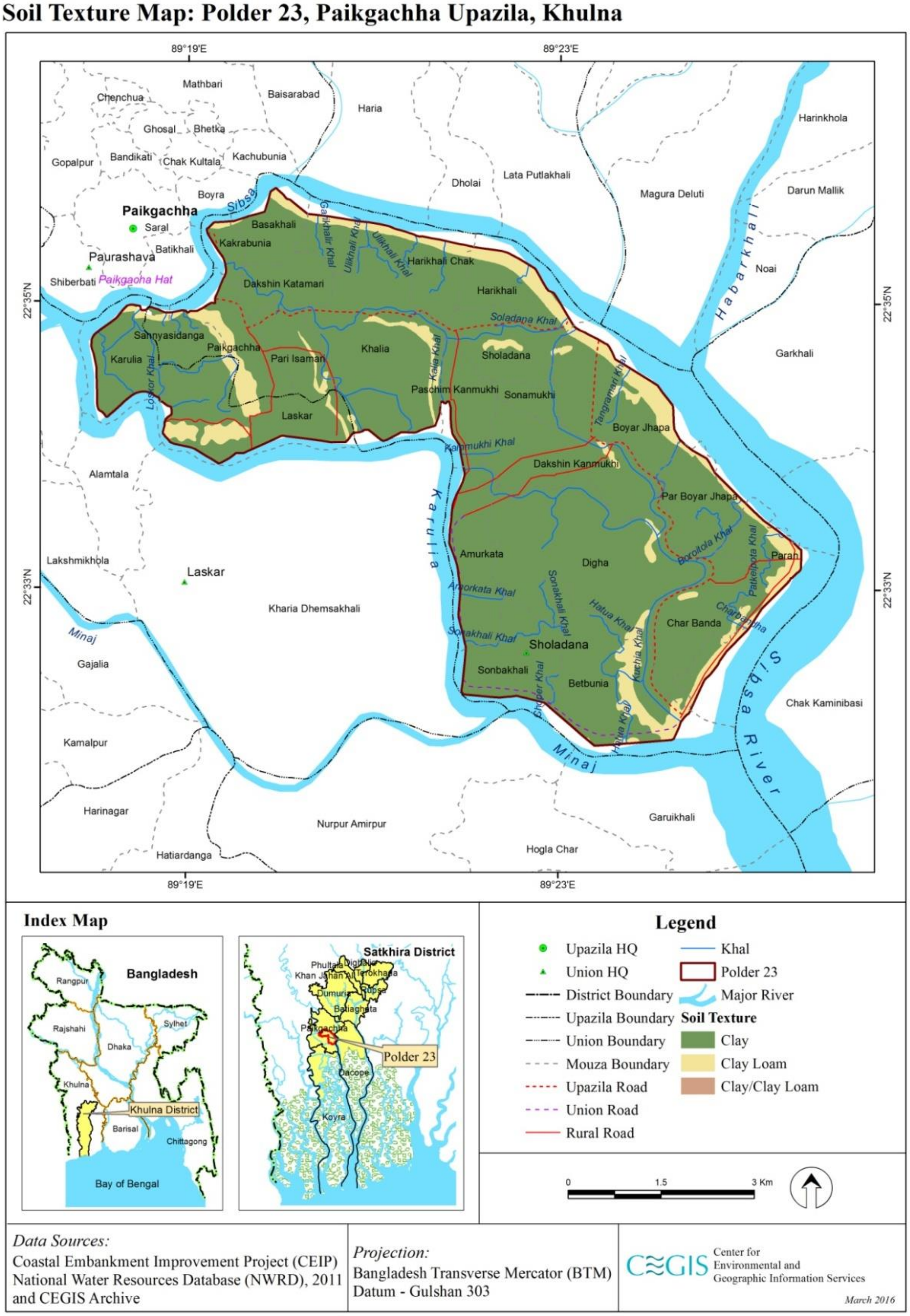
(c) Soil texture

206. Soil texture is the relative proportions of sand, silt and clay.Itis a unique property of the soil that will have a profound effect on the behavior of soils, such as water holding capacity, nutrient retention and supply, drainage, and nutrient *leaching* which is very *important* for agriculture crop production. Soil can be classified into four major textural classes: a) sands b) silts c) loams and d) clays. Clay soil is dominant which contains more than 98% of the total NCA. Detailed distribution of soil texture of the polder area is presented in Table 6.2 and Map 6.5.

Table 6.2: Detailed Soil Texture of the Top Soil (0-15 cm) in the Polder Area

Texture	Area(ha)	% of NCA
Clay	416	98
Clay Loam	6	2
Total	**422**	**100**

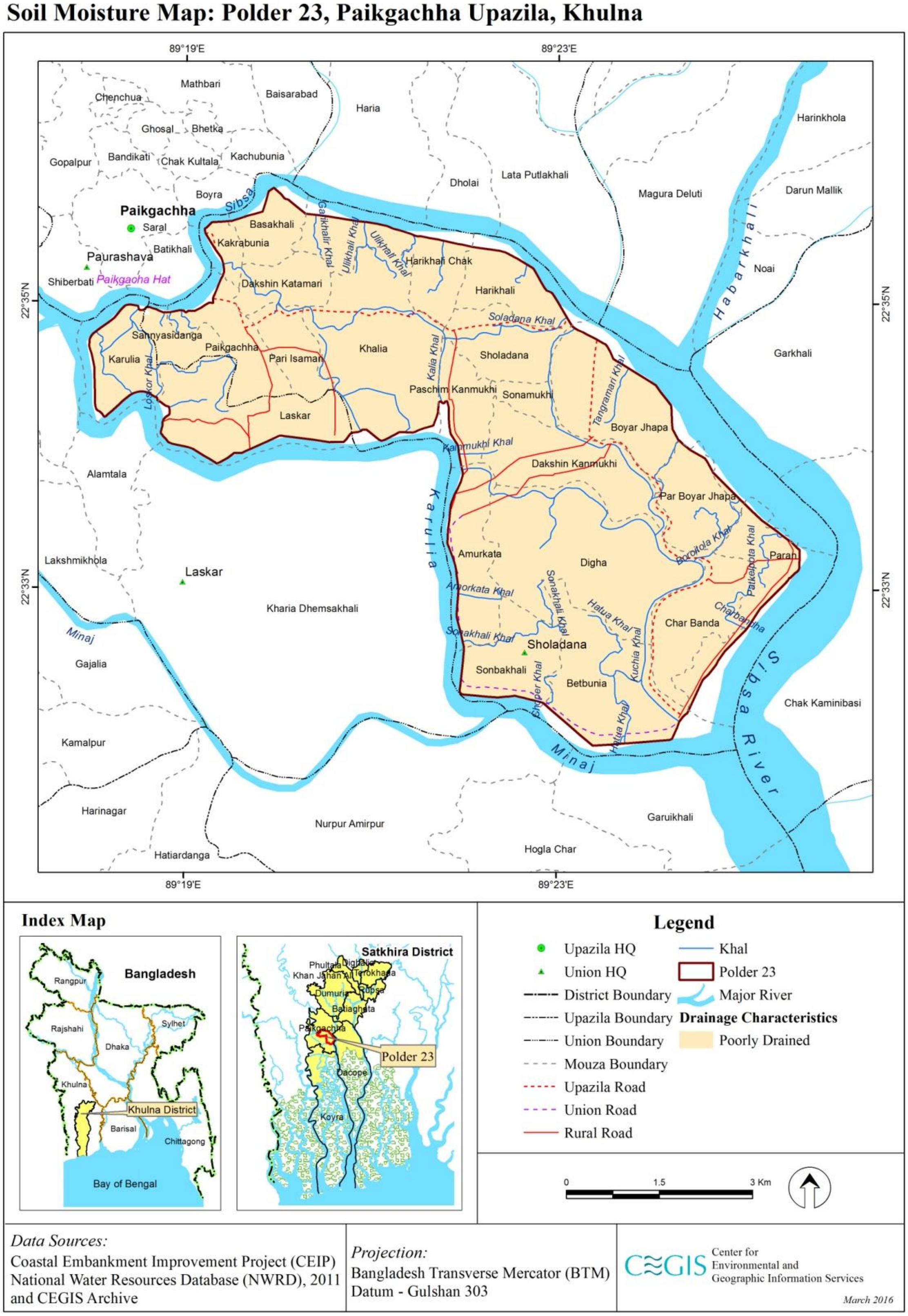
Sources: CEGIS Assessment based on SOLARIS-SRDI, 2006



Map 6.5: Soil Texture of the Polder Area

(d) Drainage characteristics

207. Drainage plays a vital role in the management of soil productivity in the polder area. The drainage characteristics have been divided into six classes (Excessively Drained, Well Drained, Moderately well Drained, Imperfectly Drained, Poorly Drained and Very Poorly Drained) by SRDI for agricultural uses. The Polder area is included in Poorly Drained class.



Map 6.6: Drainage characteristics of the Polder area

(e) Available soil moisture

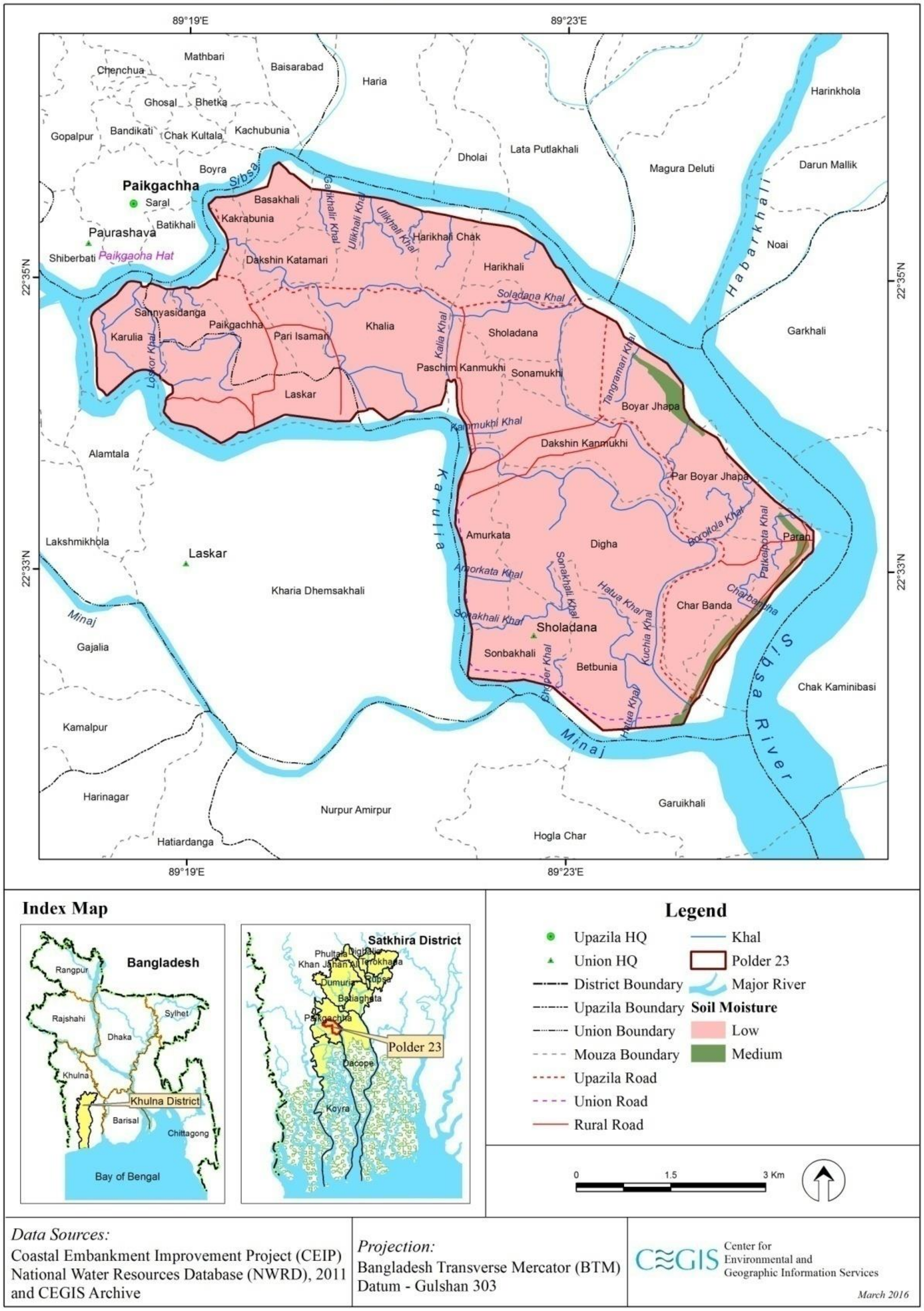
208. The availability of soil moisture varies depending on the soil characteristics. Growth of plant as well as crop production depend on availability of soil moisture from which plant uptake the essential nutrients and water. Two types of soil moisture with medium and low moisture are available in the Polder area. Detailed of soil moisture with the percentage of the NCA is presented in Table 6.3 and Map 6.7.

Table 6.3: Detailed Distribution of Available Soil Moisture in the Polder Area

Classification of soil based on available soil moisture	Characteristics	Area/ha	% of NCA
Medium	Plant extractable soil moisture remained in the field level for one to two months.	6	2
Low	Plant extractable soil moisture remained in the field level less than one month.	416	98
	Total	**422**	**100**

Sources: CEGIS Assessment based on SOLARIS-SRDI, 2006

Soil Moisture Map: Polder 23, Paikgachha Upazila, Khulna



Map 6.7: Available Soil Moisture Map of the Polder area

(f) Soil fertility analytical data of analytical samples

209. Soil sample were collected from 3locations in one depth (0-15 cm) inside the Polder area on 11th November, 2015. Collected soil samples were analyzed by Soil Resource Development Institute (SRDI), Dhaka. Results of the analysis are presented in the Table 6.4.

Table 6.4: Chemical properties of soil on agriculture land

Location (Mouza / Village)	GPS reading	Land use	Depth (cm)	CEC	EC (ds/m)	pH	OM	N	K	P	S	Zn	Pesticide residue
							%			µg/g			
Taltola	220 35'18.2 '' N 89019' 43..6'' E	Fallow-HYV.Aman -Fallow	0-15										
Horikhali	220 25'44.9 '' N 89021' 1.5'' E	Fallow-HYVAman-Fallow	0-15										
Vakotmar y	220 31'50 '' N 89024' 17'' E	Fallow-Lt.Aman-Fallow	0-15										

Note: CEGIS field information and SRDI soil sample analysis, 2015.

(d) Soil Quality

210. Soil sample were collected from inside the Polder area at Taltola Village Paikgachha (22°35'18.2"N, 89°19'43.6"E), Horikhali (22°25'44.9''N, 89°21'1.5"E) and Vakotmari (22°31''50.0"N, 89°24'17.0"E) on 11th 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-Fallow of the soil sampling locations. The sample 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 pesticides residues (Carbofurane) from Entomolgy Division, BARI, Gazipur. The result shows that organic matter content is medium. Soils are deficient in N, P status is low to medium, 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 very slightly saline to moderately saline during the sampling period (November, 2015). The pH range varies from 8.3-8.6 among the soil sampling sites. The soil quality test result with methods by location is presented in Table 6.5.

211.

Table 6.5: Chemical Properties of Soil on Agriculture Land

Parameters	Unit	Taltola village Paikgachha	Horikhali	Vakotmari	Method
EC	ds/m	8.53	5.60	5.35	Glass Electrode
pH	-	8.3	8.3	8.6	Glass Electrode
OM	%	2.03	2.03	2.65	Wet Oxidation
N	%	0.11	0.11	0.15	Kjeldahl distillation
K	meq/100gm	0.86	0.68	0.66	Olsen/ Bray and Kurtz
P	µg/g	7.40	5.50	5.80	NH4OAc
S	µg/g	564.01	611.80	477.41	CaH2PO4 Extracting
Zn	µg/g	2.64	2.83	3.06	DTPA Extraction
Carbofuran	ppm	ND	ND	ND	Thermo Electron & Pekin Elmer

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

Climate

(a) Rainfall

212. Rainy season is very nominal in the Polder area in comparison to the other region of the country. November to February is the driest months of the year with negligible rainfall and June to September is the wettest months with highest rainfall. The record of last 34 years (1980-2013) shows that, the Polder area received monthly maximum rainfall of 846 mm which was recorded in June 2002. Values of monthly maximum, average and minimum cumulative rainfalls are collected from the BMD station of Khulna (1980-2013). The collected data are shown in Figure 6.1 below. 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 are observed during the months of June (846 mm) and January (70 mm) respectively while the line graph illustrates that the highest and lowest values of average rainfall are observed during the months of July (334 mm) and January (13.2 mm) respectively.

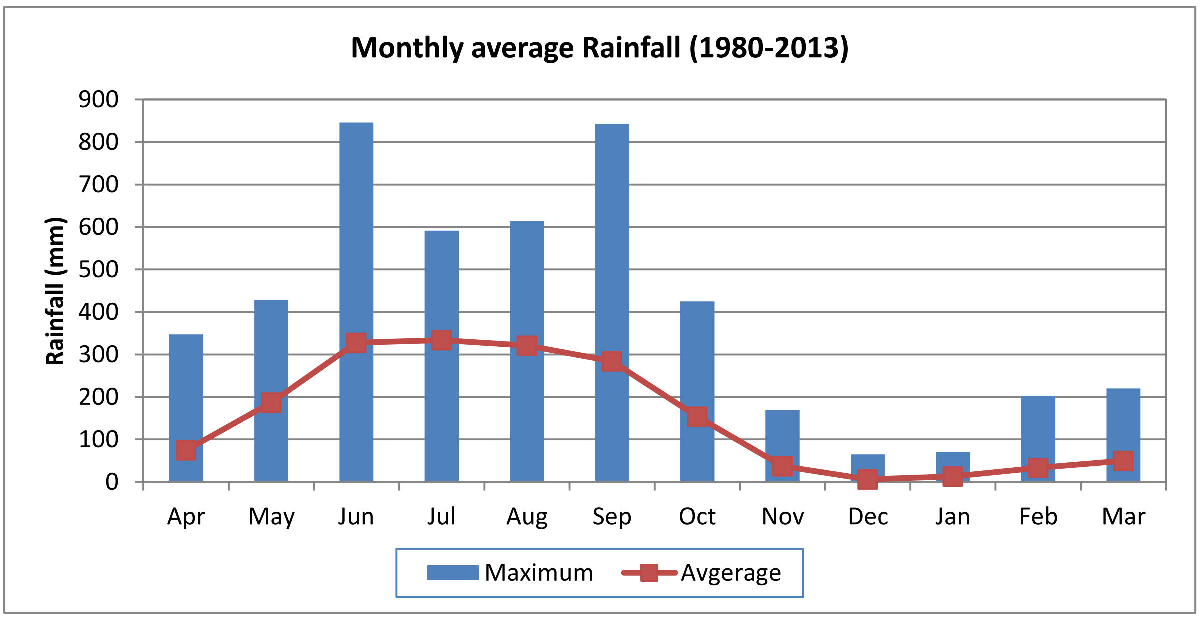


Figure 6.1: Monthly maximum, average and minimum Rainfall at Khulna BMD Station

213. The historical trend analysis of annual rainfall of last 30 years (1983-2013) shows a trend of slight increase with respect to time. Figure 6.2 reflects the rainfall trend of the Polder area and shows an increasing trend which is 0.626 mm per year.

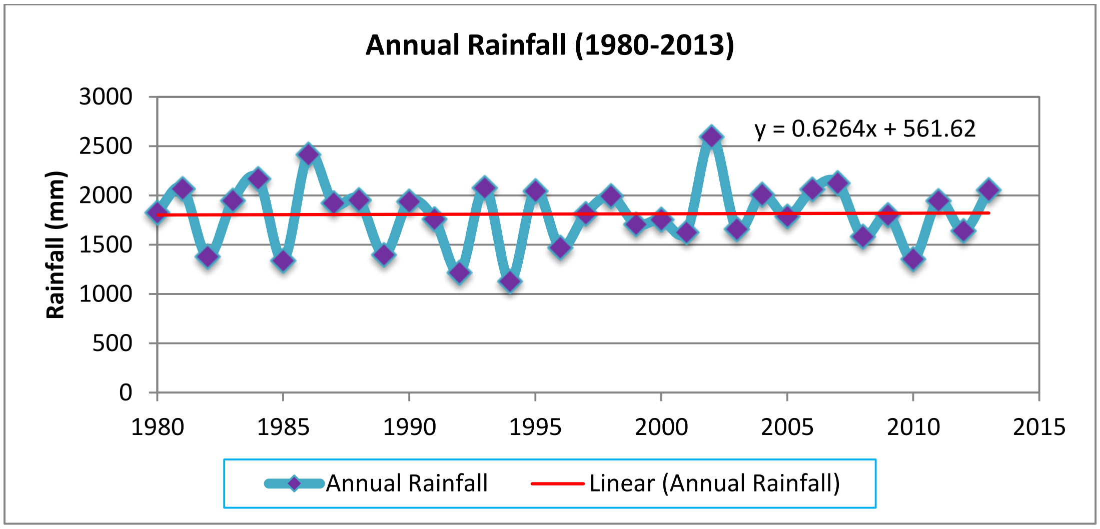


Figure 6.2: Annual rainfall (mm) trend in the Polder area

(b) Temperature

214. Temperature data of last 34 years (1980-2013) from the BMD station shows that the monthly maximum average temperature varies from 26.68°C (January) to 36.71°C (May), and May is the warmest month where as the monthly minimum temperature varies within the range of 9.96°C (January) to 25.50°C (August), and January is the coldest month of the Polder area. The highest maximum temperature ever recorded in the last 34 years is 36.71°C which occured in the month of May, 2012 while the lowest ever recorded minimum temperature is 9.96°C, recorded in the month of January, 1989. Values of monthly maximum and minimum temperature are collected from the BMD station of Khulna (1980-2013). The monthly maximum and minimum temperature of last 34 years (1980-2013) are shown in Figure 6.3.

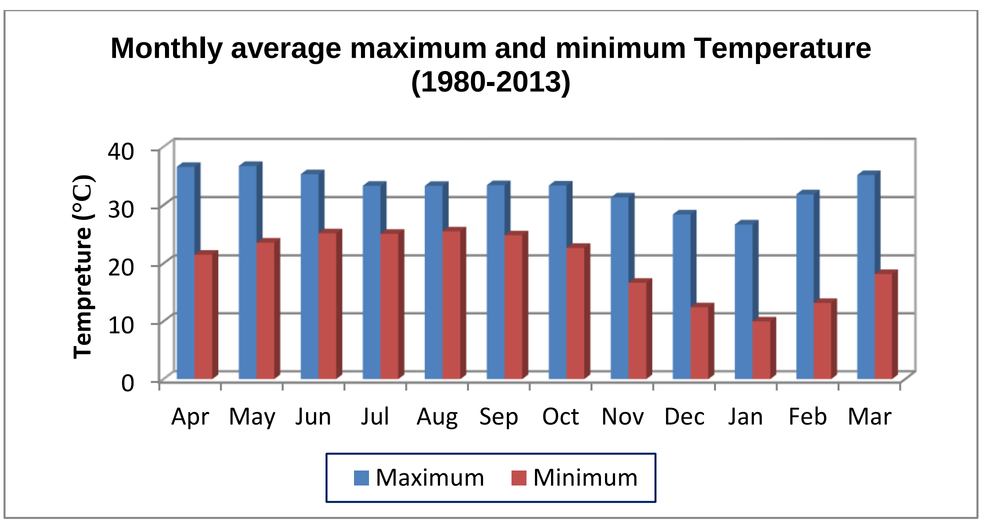


Figure 6.3: Monthly variation of Temperature at Khulna BMD station

(c) Relative Humidity

215. 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.

216. Figure 6.4 shows the monthly average relative humidity in the Polder area and it indicates to vary seasonally from 73.06% (March) to 88.13% (July).The most humid months are June, July, August, September and October (relative humidity greater than 80%) and vary from 84 to 88 % while during January to March it remains within a ranges from 73 to 79 %. The line graph of average relative humidity demonstrates a significant fluctuation as values start to increase from April due to the increase in atmospheric water vapors coupled with temperature rise. Relative humidity rises above 88 % in monsoon (June to September) and starts decreasing from post monsoon season following the monsoon rainfall. The monthly average relative humidity data collected from BMD station of Khulna for the last 33 years (1980-2012) is shown in Figure 6.4.

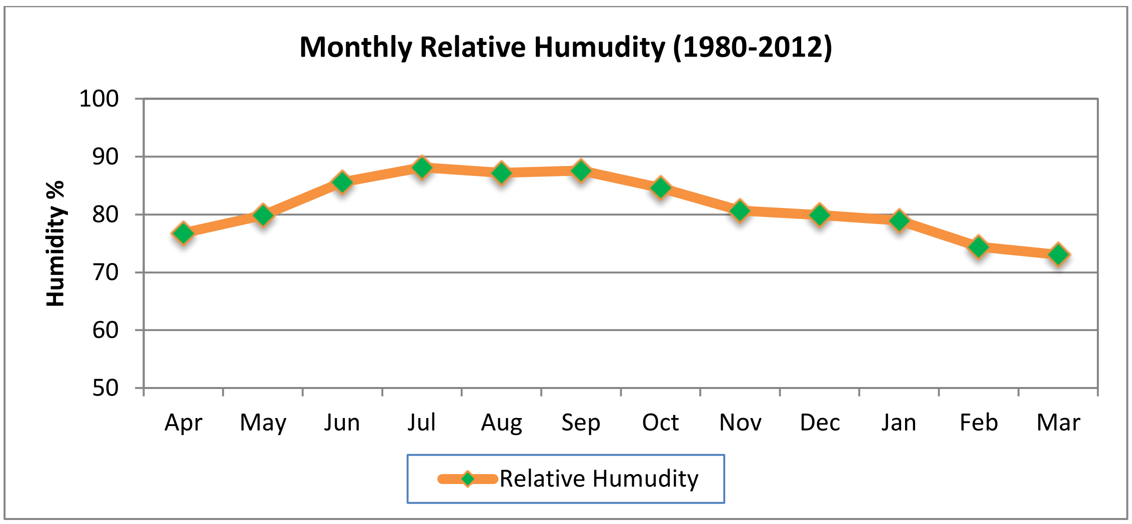


Figure 6.4: Monthly average relative Humidity at Khulna BMD station

(d) Evaporation

217. Water is transformed from the surface to the atmosphere through a process of evaporation. Therefore, evaporation is another important component of the hydrological cycle which influences the overall water balance on the earth surface. Historical data on evaporation available for last 19 years (1992-2010) has been collected from the BMD station at Khulna which reveals that the average evaporation rate varies from 1.78 mm/day (January) to 3.92 mm/day (April). The variation of average evaporation rate for the Polder area is shown in Figure 6.5 below:

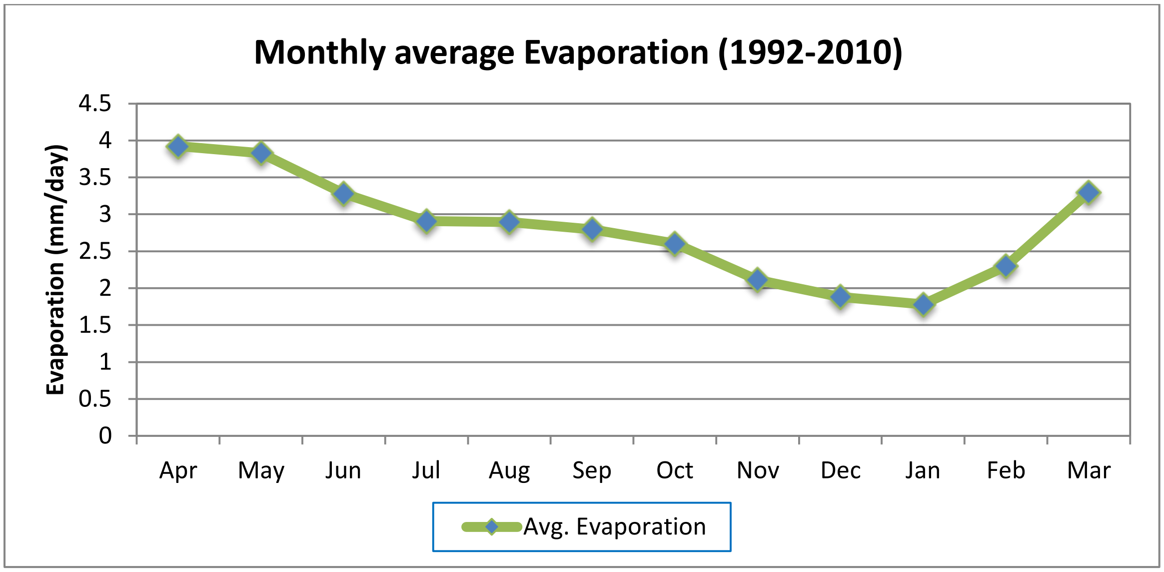


Figure 6.5: Monthly average evaporation rate at Khulna BMD station

(e) Wind Speed

218. Historical data on wind speed for last 33 years (1980-2012) has been collected from the BMD station at Khulna. The monthly average wind speed in Khulna region varies from 1.74 to 6.88 km/hr. The variation of monthly average wind speed is shown in Figure 6.6 below. The figure shows that the average speed of wind is highest in April (6.88 km/hr) and lowest in November (1.74 Km/hr).

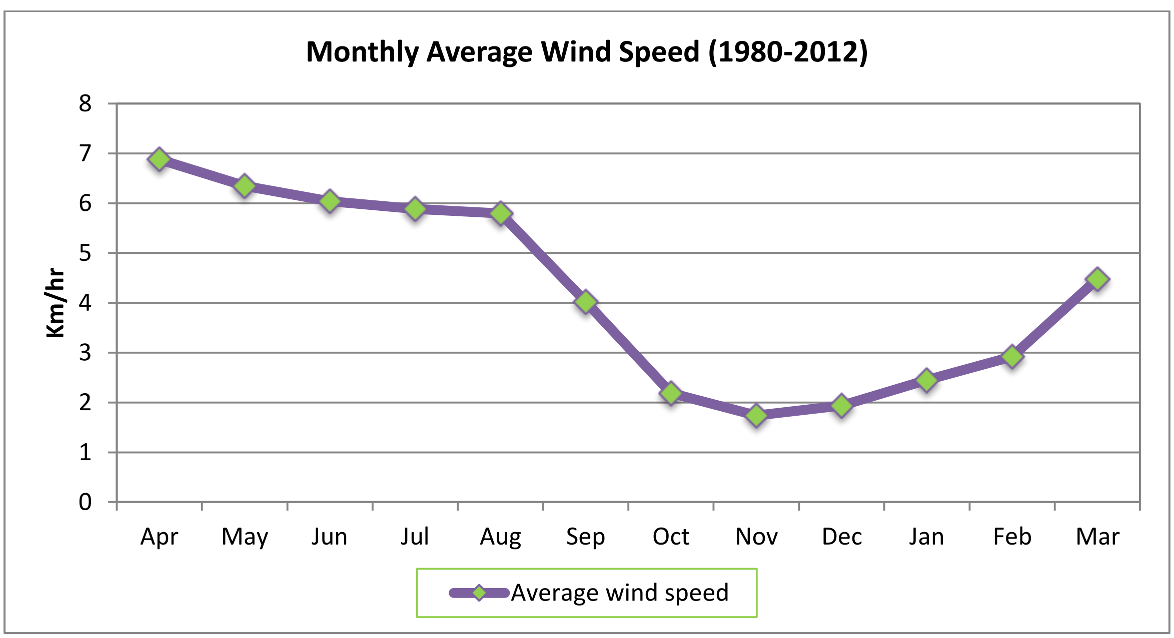


Figure 6.6: Monthly variation of average wind speed at Khulna BMD station

(f) Sunshine Hours

219. The data for sunshine hours for last 30 years (1984-2013) has been collected from the BMD station at Khulna. The monthly average values of sunshine hours in Khulna vary from 3.78 to 8.54 hours/day. The average value of sunshine hours is highest in April (8.54 hr/day) and lowest in July (3.78 hr/day). Figure 6.7 shows that from October 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.

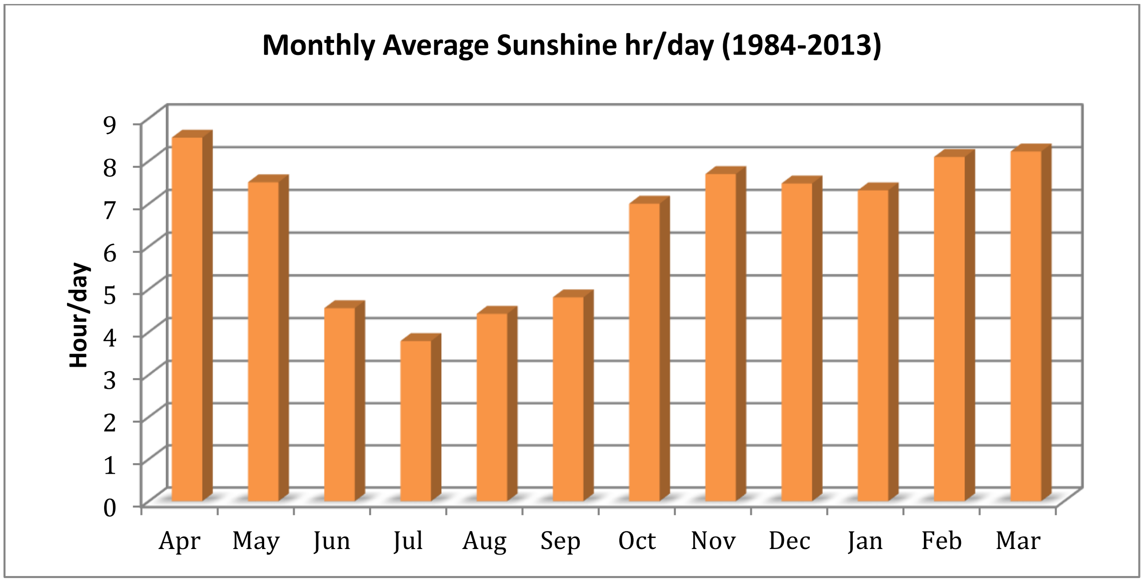


Figure 6.7: Monthly average sunshine hours per day at Khulna BMD station

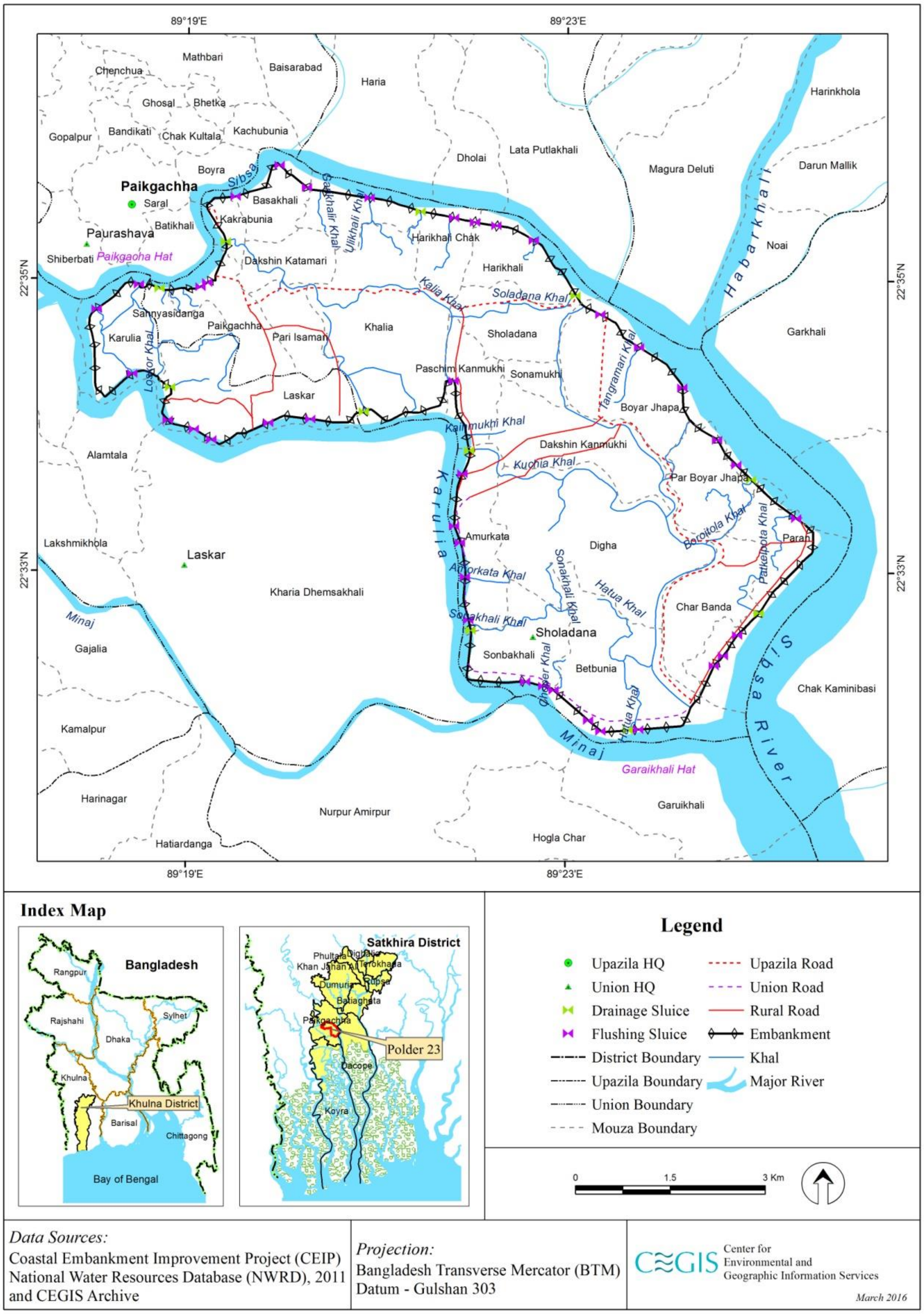
Water Resources System

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

(a) Major Rivers and *Khals*

221. Polder 23 is surrounded by the Sibsa River in the East, Kurulia River in the West and Minaj River in the South. Sibsa is the major river of the Polder. Besides, numbers of *Khals* exits in the polder area namely *Taltola khal*, *Garikhalir khal*, *Ulikhali khal*, *Sholadana khal*, *Tangramari khal*, *Masterpara khal*, *Boroitola khal*, *Patkelpota khal*, *Charbandha khal*, *Kuchia khal*, *Burimara/Hatuakhari khal*, *Choper khal*, *Sonakhali khal*, *Amorkata khal*, *Kainmukhi khal*, *Kalia khal*, *Parishanari khal*, *Loskar khal*, *Sibbati khal*, *Sannasidanga khal*, *Boxsodou khal* and all of these are connected with the rivers through water control structures of the polder. The River system of the area is shown in Map 6.8.

River System Map: Polder 23, Paikgachha Upazila, Khulna



Map 6.8: Water Resources System of the Polder

(b) Hydrological Connectivity

222. The main river of the Polder is Sibsa which flows from North to South with high tidal influence. The Sibsa River originates from Kobadak River at north-west of the Polder near Laskar union in Paikgachha Upazila of Khulna District and flows to the eastern portion of the polder and finally falls on the Pasur River in Dacope Upazila of the same District. Another river of the Polder, Kurulia also originates from the same river and same place which flows to the West of the polder and meets with the Minaj River by the side of South-West of the polder in Laskar union of Paikgachha Upazila. Again, the Minaj River originates from low lying area i.e. Chandkhali beel in Chandkhali union of Paikchachha Upazila and falls on the Sibsa river at the south of the Polder. Kurulia River is a tributary of the Minaj River.

Hydrological Settings

(a) Surface Water Levels

223. To assess the surface water characteristics of the Polder area, data on surface water levels for the Sibsa River have been collected from the station SW-258-Paikgachha (TDWL)of BWDB at Gadaipur Union in PaikgachhaUpazila.

224. Secondary information on water levels have been collected from the above mentioned BWDB station from the year 1980 to 2009 for the River. Figure 5.8 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 Paikgachha is 4.91 m +PWD (in June) and average minimum is 3.0 m +PWD (in January). During low tide, the average maximum water level is -0.82 m +PWD (in September) and average minimum is -1.29 m +PWD (in December).

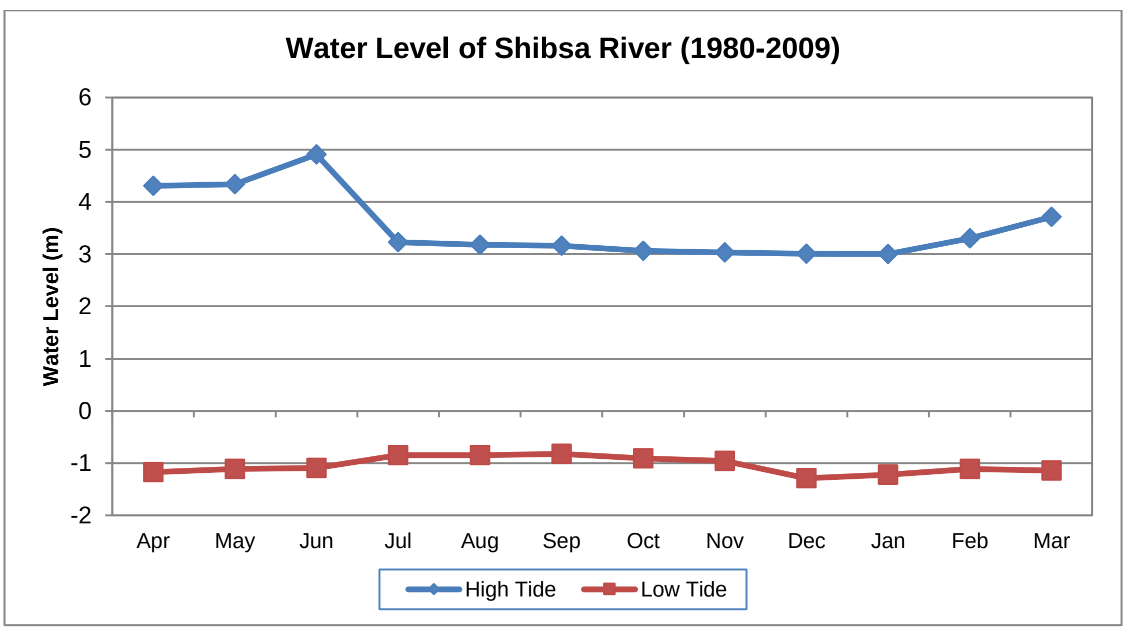


Figure 6.8: Surface Water Level of Sibsa River

Picture 6.1: Sibsa river during high tide

Picture 6.2: Sibsa river during low tide

(a) Groundwater Table

225. Groundwater level data have been collected from NWRD-CEGIS Database Archives and analyzed for a BWDB observation wells located at Batikhali mouza in Gadaipur Union of Paikgachha Upazila (KHU007). This station is selected as there is no station exists inside the Polder. The ground water data from 1980 to 2011 were available for this station.

226. It is observed that the depth of Ground water table (GWT) in dry season is found lowest i.e. lowers down at 2.25 m while the highest depth of GWT is 1.26 m in post-monsoon in the month of September after recharged. **Figure 6.9** shows the monthly variations of mean ground water level for the station.

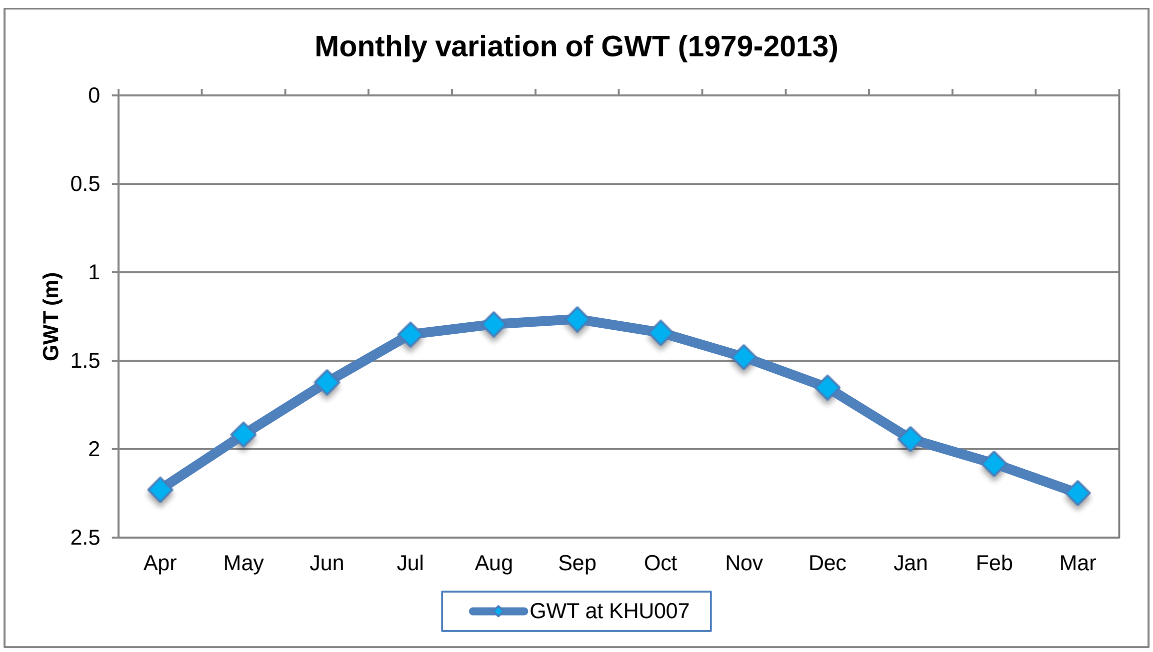


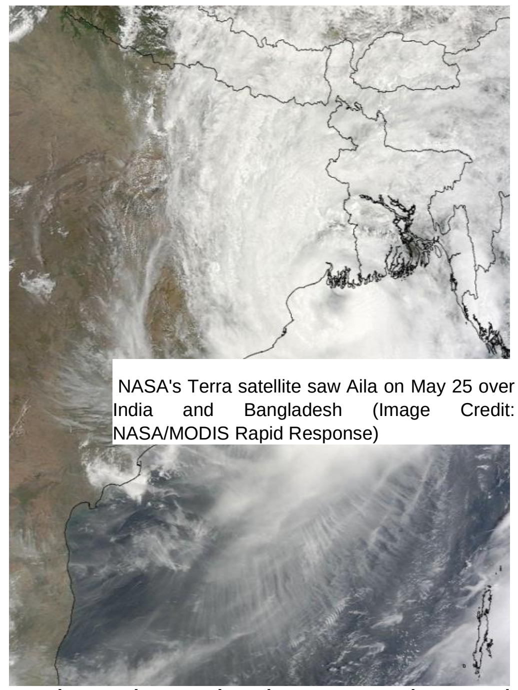
Figure 6.9: Monthly Variations of Average GWT

Water Resources Issues and functions

(a) Tropical cyclones and Tidal Storm Surge Flooding

227. Tropical cyclones are the major threats to the coastal polder areas. The most devastating cyclone that stroke the polder is *Aila* and was a furious cyclone ever.*Aila*was a *Cat-1*(hurricane) cyclonic storm that hit the south-western coastline of Bangladesh especially the Satkhira and Khulna districts on the mid-day of 25 May 2009 creating enormous sufferings of the people as well as damages to the properties.

228. 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 breach at several points and flooded the polder areas. The surge water also entered the polder area by overtopping the embankment along Sibsa River and Kurulia River trough different locations.



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

229. At present, the flood control embankment is 37 km, Most of the segments of the embankment are in vulnerable condition. Especially from Boyar Jhapa to Patkelpota along the Sibsa River, Paschim Kanmukhi, Karulia, Laskar the embankment are in worst condition. Local people opined that during high tide surge water reaches at the edge of the existing crest of the embankment and sometimes it overtops. There are several segments of the embankment which are in poor condition and storm surge may wash out causing the polder area flooded at any time. This situation exists at about 60% of the flood control embankment.

230. Besides, there are numbers of unauthorized mini structures constructed by the Gher owners for lifting water for shrimp culture. These unauthorized structures made to the embankment weaker and increases the possibility of breaching the embankment during cyclone.

Photograph 6.3: Present condition of Embankment near DS-2, Harikhali

Photograph 6.4: Present condition of Embankment at Karulia

Photograph 6.5: Present condition of embankment along Sibsa river

Photograph 6.6: Vulnerable condition of the embankment at Paschim Kanmukhi

(b) Drainage Congestion and Water Logging

231. According to the local people, no drainage congestion and water logging problem exists in the polder area. There are 11 numbers of drainage sluices, 22 numbers of flushing inlets and 21 numbers of pipe inlets in the polder to control water related with drainage, irrigation, fishing etc. Most of the structures are found in damaged condition during field visit. During high tide, water enters into the polder through the *Khals* connected with the structures. During field visit it is observed that about 90% of thePolder area has been converted into shrimp culture ghers. The shrimp culture practices started over three decades and stands throughout the year. Besides, numbers ofunauthorized mini structures are constructed by the Gher owners for lifting saline water from the river for the shrimp culture. Hence, local people opined that there is no problem related with drainage congestion and water logging in general. But during heavy monsoon, they face drainage congestion for three to five days after the ebb tide excessive water drain out to the rivers.

232.

(c) Navigation

233. The peripheral rivers around the Polder are predominantly used for water-way navigation. Small boats andtrawlers navigate through the rivers mainly for fishing purposes and carrying goods. However, negligible navigation takes place through the channels inside the Polder area, only the fishing boats more through the *Khals*.

Photograph 6.7: Navigation in the rivers mainly for fishing

Environmental Quality

234. 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.

- **Air Quality**

235. From field visits, it was observed that the overall air quality in the Polder area is good. The standards of ambient air quality are given in **Table 6.6.**

Table 6.6: Standards of ambient air quality

Areas	Concentration of micrograms per meter cube		
	SPM (µg/m3)	SO_2 (µg/m3)	NO_x (µg/m3)
Industry	500	120	100
Commercial	400	100	100
Residential and rural area	200	80	80
Sensitive	100	30	30

Source: EnvironmentConservation Rules, 1997

236. The air particulate 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 was performed for 1day (24 hr) duration in the Polder at Betbunia near *kheya ghat* in Paikgachaupazila. The results are presented in **Table 6.7**.The values suggest that the concentrations of the measured air quality parameters ($PM_{2.5}$, PM_{10}, 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 6.6. However, there are numerous boats driven by diesel engines ply on the surrounding rivers and numbers of Motorcycles and light vehicles movement in the Polder area which considered contributing to the ambient air especially Particulate Matter ($PM_{2.5}$).

Table 6.7: Values of ambient air quality parameters in the Polder 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

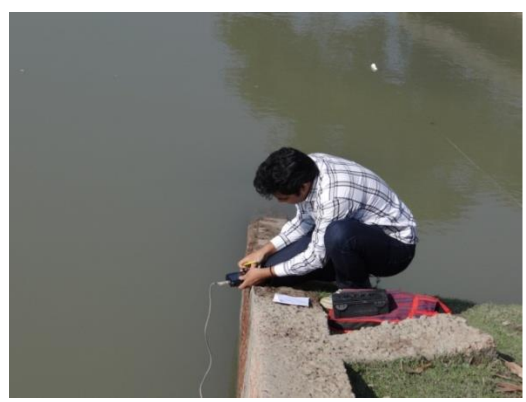
- **Surface Water Quality**

237. Five major water quality parameters (pH, TDS, DO, temperature and salinity) have been measured at different locations of the Polder area during the major field investigation in November, 2015. Surface water quality of the Polder area is found satisfactory for irrigation and fishing purposes. Table 6.8 presents the values of the surface water quality parameters with reference to the DoE standard of the Polder area.

Table 6.8: Surface water quality of the Polder area

Source of surface water	Location	GPS point	Water quality parameter				
			TDS (ppm)	Salinity (ppt)	DO (mg/L)	Temperature (°C)	pH
Taltola khal	Village Paikgachha	22° 35'21.8"N 89°19'41.5"E	201	14	6.5	19.8	7.81
Sholadana khal	Sholadana	22° 34'54.7"N 89°22'55.8"E	286	15	6.3	21.3	8.1
Sibsa River	Par Boyar Jhapa	22° 33'18.4"N 89°24'38.3"E	246	15	6.7	18.9	8.2
Hatua khal	Betbunia	22° 34'54.7"N 89°22'55.8"E	187	15	6.5	22.4	8.2
DoE Standard Value(Bangladesh)			***2100***	***-***	***4.5-8.0***	***20-30***	***6.0-9.0***

Source: CEGIS field survey, November, 2015



Photograph 6.8: CEGIS Professional measuring water quality at field

238. **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.

239. In dry season in month of January, the overall salinity levels in surface water was found moderate to high as 14 to 15 ppt (Table 5.7) and about 15-20 percent of the Polder area is affected. This happens because of the following reasons: (i) about 80-90 percent of the Polder area is under *gher* culture, (ii) saline water enters through gher owners' inlets and (iii) malfunctioning of sluices.

240. **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 found to vary from 6.3 to 6.5 mg/L at four locations (Table 5.7) which complies with the DoE standards for both irrigationand fisheries as well as aquatic vegetation.

241. **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 arehigher 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 is satisfactory with the DoE standard (pH=6 to 9).

242. **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 18.9°C to 22.4°C, which complies with the DoE standard (20°C-30°C) for both irrigation and fish habitats.

243. **Total Dissolved Solids (TDS).**The values of TDS were found relatively low inside the Polder area varies from 187 to 286 mg/l (**Table 6.7**) which may relate to low tidal effect. TDS values during field visit which is within the limit and complies with DoE standard.

- **Noise Quality**

244. A number of suitable sites were selected within the Polder area for sound level measurements, considering some criterion in connection with sound generation (project interventions and other secondary activities) and places which are to be affected by the anomalies in sound level (settlements, schools). The Environmental Conservation Rules 1997, of Department of Environment (DoE), Bangladesh has defined standard noise levels as **50 dB** during day time for residential area.The Polder area has fallen under the category of residential area and the values of noise levels were found within the standard limit. The noise level has been measured during daytime. The values of noise level (location wise) are shown in **Table 6.9**.

Table 6.9: Daytime noise levels of the Polder area

Sl.No	Location	GPS Reading	Values (dB)	Area Category by ECR'97
1	Village Paikgachha	22° 35'21.8"N 89°19'41.5"E	48.6	Residential area
2	Harikhali	22° 35'44.9"N 89°21'1.5"E	44.8	Residential area
3	Sholadana	22° 34'54.7"N 89°22'55.8"E	48.3	Residential area

Sl.No	Location	GPS Reading	Values (dB)	Area Category by ECR'97
4	Boroitola trawler ghat	22° 33'18.4"N 89°24'38.3"E	43.3	Residential area
5	Sonakhali	22°32'4.57"N 89°21'57.33"E	44.2	Residential area
6	Amurkata	22°33'34.79"N 89°21'56.48"E	45.6	Residential area
7	Loskar	22°34'6.92"N 89°19'10.91"E	43.6	Residential area

Source: CEGIS field survey, November, 2015

6.3. Biological Environment

Bio-ecological Zone

245. Polder 23 is located at south-west zone of the country consisting brackish nature of vegetation and saline prone wetlands. 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 where ecosystems are derived from tidal action.

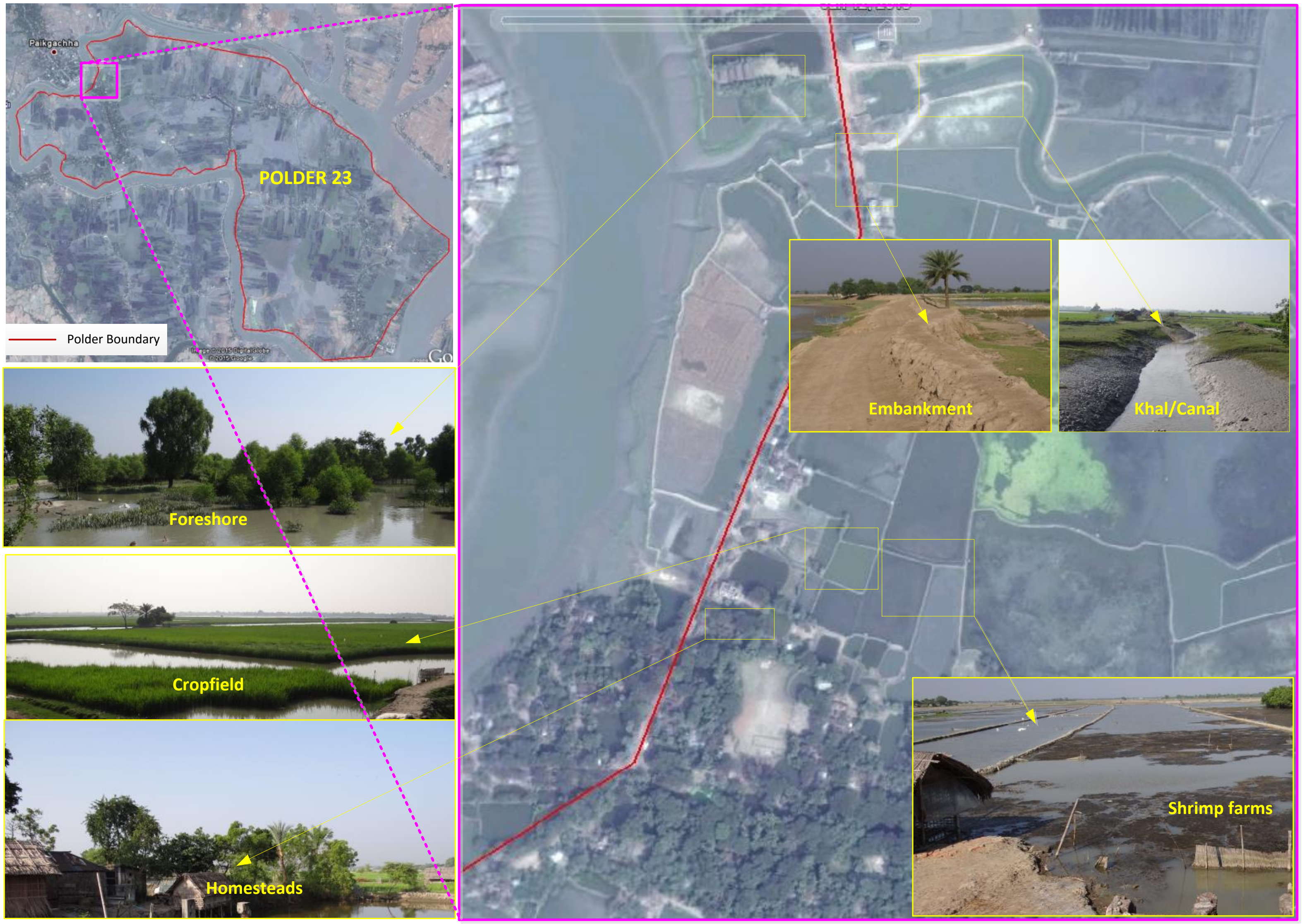
Ecosystem Diversity

246. Ecosystems of this polder vary with land types, elevation from sea level, availabilities of tidal influences and interventions by human activities.

a. Terrestrial Ecosystems

247. Homesteads, crop fields and embankments are the major forms of terrestrial ecosystems. In terms of floral diversity as well wildlife habitat suitability, homestead bears higher population of flora and fauna compared to other terrestrial ecosystems. Crop fields of this Polder are exclusively cultivated with rain fed Aman paddy for three/ four months and the rest of the year used for shrimp farming.

248. The encircled embankment of this Polder is barren or lightly vegetated due to having low moisture holding capacity of the soil. Adaptation of xerophytic species is remarkable in entire the Polder area. However, some portions (Taltala and Boyarjhanpa) of the embankments are planted with Babla and Tamarind tree under social Afforestation Program taken by Forest Division.



Photograph 6.9: Satellite image (Jan, 2015) of the Polder showing different ecosystems

b. Aquatic Ecosystems

249. Saline water shrimp farms occupy most of the open land inside the Polder that acts as controlled aquatic ecosystem. Beside this, a number of canals have criss-crossed through the Polder that support another form of aquatic ecosystem. Almost each of the homestead platforms contains a pond that holds sweet/brackish water for whole of the year.

250. Foreshore area of the Polder is called intertidal ecosystem that is infused by tidal effects of peripheral rivers. This land is usually fragmented with numerous dykes for the purpose of aquaculture and also for paddy cultivation in monsoon. Intertidal area of this Polder supports various avifauna, crabs, mudskipper and scattered mangrove vegetation.

Photograph 6.10: Overview of homestead and aquatic vegetation pattern of Soladana Village from embankment

Floral Composition

251. Vegetation pattern of this Polder vary according to land elevation and tidal influence. Homestead vegetation is dominated by Narikel *(Cocos nucifera),* Khejur *(Phoenix sylvestris),* Neem *(Azadichta indica),* and Khaibabla *(Pithocelobium dulci).* Rendi Koroi *(Albizia saman)* is the commonest timber tree that occupy the top canopy of most of the homestead vegetation. Homestead boundaries along the embankment are fenced with xerophytic plants like Fanimonsha *(Opuntia dilenii)* and Sezi *(Euphorbia grandialata).* Herbs and shrubs are absent in most of the homestead platforms all over the Polder area due to having soil salinity and scarcity of soil moisture during dry season. Species richness and health of plant community is comparatively lower than other part of the country. Homestead vegetation density of this area has degraded after the devastating Cyclone *Aila* in 2009. However, this type of vegetation provides major outputs of plant production for meeting timber, fruits, fuel and thatching materils. Homestead vegetation composition of the Polder have been presented in **Appendix E.**

252. Maximum portion of embankment of this Polder is barren or scatteredly vegetated because of unsuitability of soil. However, most common tree on vegetated parts of the embankment is Babla (*Acacia nilotica*). Fonimonsha *(Opuntia dilenii)* and *Sezi (Euphorbia grandialata)* are two indicator species of south-west Polders of Bangladesh which are commonly found along the embankment. These xerophytes are also used as fencing plant of local homesteads. Embankment toes are occupied by grasses as this ecotones are saturated by shrimp farm or river water whole of the year.

253. Kewra *(Sonneratia apetalla)* are dominant in the foreshore area. In addition, Bain *(Avecenia alba),* Kankra *(Bruguiera sexangula),* Hargoza *(Acanthus illicifolius)* etc are also noted. But coverage of this mangrove species have been limited for expansion of paddy cultivation and aquafarming at foreshore area. Knot grass *(Paspalum disticum)* cover all the foreshore and shrimp farms area.

254. Aquatic floral diversity of this area is poor for presence of saline water in the maximum types of wetlands. Existence of aquatic plant community is concentrated in stagnant water of ponds and ditches except shrimp farms, tidal rivers and *Khals*. Kochuripana *(Eicchornia crassipes)*, Topa pana *(Pistia strateotes)* and Khudipana *(Lemna sp)* are common free floating community whereas Shapla *(Nymphaea spp)* is grown during monsoon in ditches between two settlement platforms.

255. Overall floral diversity has changed and followed higher in center of the polder than peripheral area and proportion of salt water talerant and fresh water loving trees are varied due to intensity of salt water of nearer water flow. Figure 6.10 represents the tree species occurrence in Polder area according to salinity frontline from the embankment.

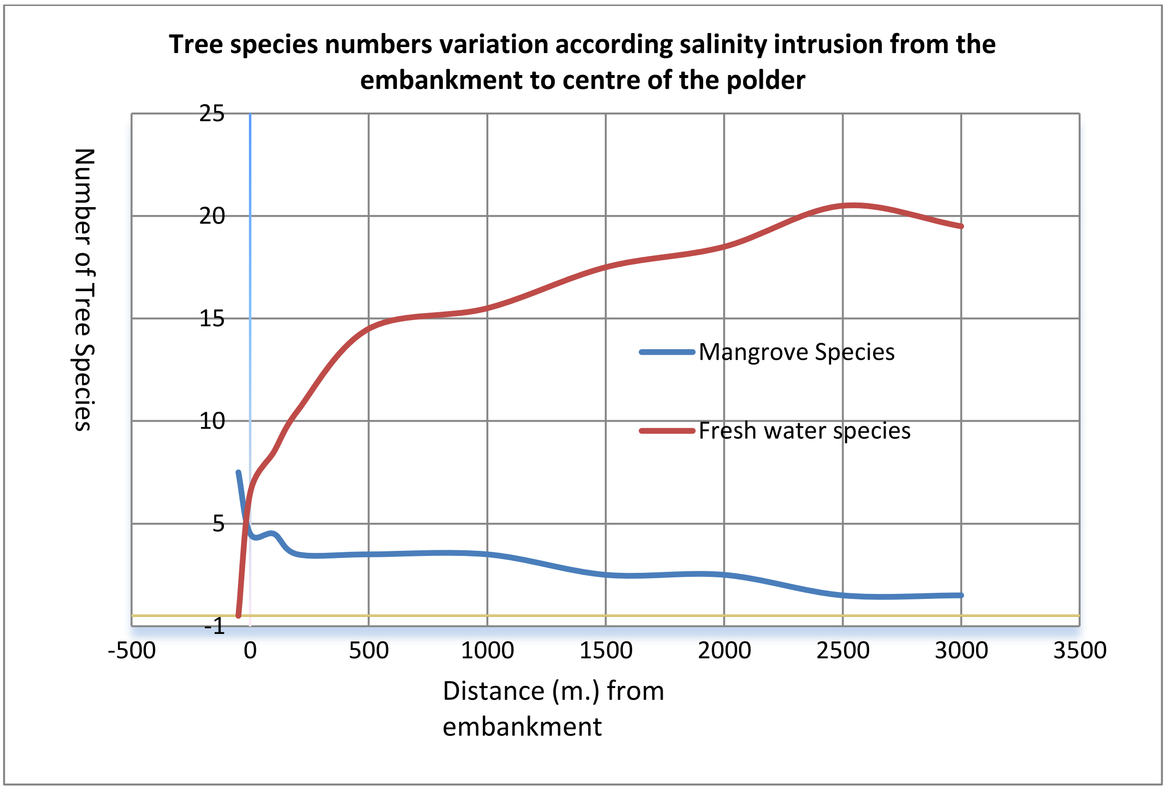


Figure 6.10: Tree Species occurrence according to salinity frontline from the embankment


Photograph 6.11: Social Afforestation along Embankment side of the Polder (Left: at Taltala and Right: at Boyarjhanpa)

Wildlife Diversity

256. Occurrence of terrestrial Fauna is low inside the Polder area due to absence of sufficient vegetation density and diversity. Among the amphibians, Common toad *(Duttaphrynus melanostictus)* is found at moist and cool places of homesteads platforms. Terrestrial reptiles are composed of only two or three species of snakes and two species of lizards. Common Wolf snake (italics ycodon aulicus), Stripped Keelback *(Amphiastma stolatum)*, Garden Lizard *(Calotes versicolor)* and House Lizard *(Hemidactylus brooki)* are common among this type.

257. Avifauna is the highest faunal group among all the wildlife communities. Birds are mainly concentrated in homestead forest and foreshore grounds. Common birds of this locality are Asian pied Starling *(Sturnus contra)*, Common myna *(Acridotheres tristis)*, House Crow *(Corvus splendens),* House Sparrow *(Passer domesticus),* etc which occur in homestead forest. Fishes occupy a major portion of aquatic faunal biodiversity. Detail description of fish population and species are presented in the section of fisheries resources in this report. Amphibian like Skipper Frog *(Euphylictis cyanophlyctis) and* Indian bull Frog *(Hoplobactrachus tigerinus)*are common species sighted near most of the wetlands during monsoon.

258. Population of aquatic reptiles has decreased for habitat degradation. Among the snakes, Stripped Keelback *(Xenocraphis piscator),* Glossy marsh Snake *(Gerardia prevostiana)* and Common wolf snake *(Lycodon aulicus)* are recorded here. Population of terrestrial wildlife has dropped down due to massive destruction of vegetation during attack of Cyclone *Aila*.

259. Mammals in the polder include mongoose, mouse and bats. No bigger mammals exist in the study area for lack of habitats. Common species are House rat *(Rattus rattus)*, Common mongoose *(Herpestes edwardsi)*, Indian flying fox *(Pteropus giganteus),* Indian Pipistrelli *(Pipistrellus coromandra),* etc.

Indicative species

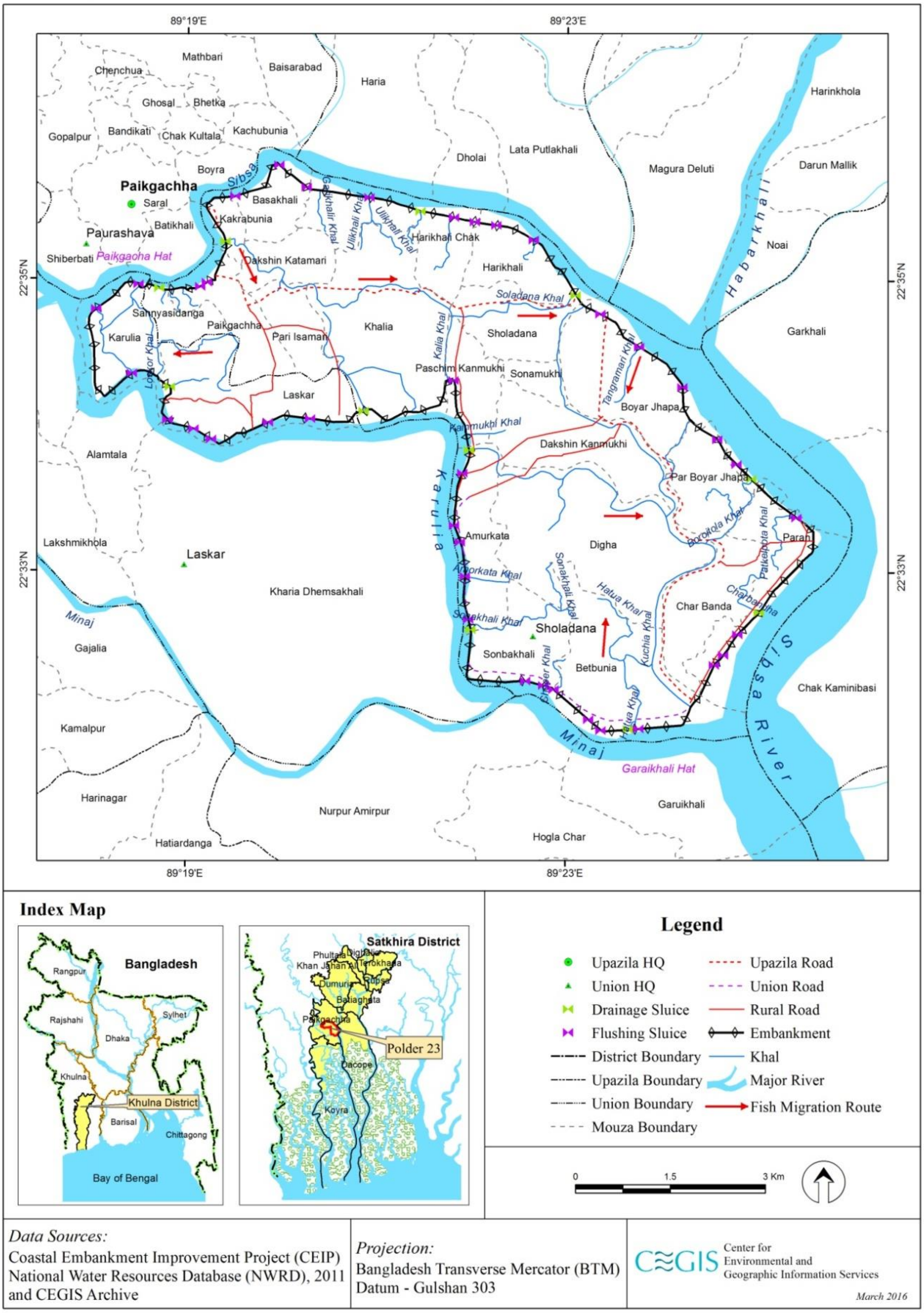
260. As the land area of the polder is below the sea level, so the encircled embankment acts as a protector of saline water intrusion and sluices act as drainage controller. Accordingly, the land inside the Polder supports different ecosystems. Homesteads and cropfields are

dominated with fresh water loving plant species whereas khal banks and river foreshore are dominated with saline water loving /mangrove plant species. Kewra *(Sonneratia appetala)* and Gewa *(Excoecaria agallocha)* are the indicator species of this polder those indicate saline water intrusion through *Khals*/canals inside the polder. Though maximum open land of the polder are occupied by saline water shrimp farming (*ghers*) and tidal water allow all the seasons inside the polder for flashing of *ghers,* so succession of saline tolerant species are usually found at all the canal banks and even some of the gher dykes at south-eastern portion. Fresh water shell (bivalve) is another indicator species of this area found in most of the pond of this polder. This species have disappeared from ponds of this area due to tidal flood during Cyclone *Aila*. Non-functionality of water control structures is also a cause for saline water intrusion that negatively impact homestead vegetation.

Fish Habitat

261. Fish habitats of the polder area are primarily classified under two broad categories, such as capture and culture fishery. Capture fisheries habitat include mainly internal *Khals* (**Map 5.9**). A number of Khals include *Sonakhali khal, Hatuakhari khal, Boroitola khal, Sonakhali khal, Loskor khal, Parishanari khal, Orabunia khal, Taltola khal,* etc. have criss-crossedin the Polder area. Most of the Khalsare encroached bygher owner and controlled by own constructed inlet. Therefore, capture fisheries in the Polder contribute negligible to local fish production. The culture fishery of the Polder area is dominated by Bagda gher. The contribution of cultured pond in the Polder area is reported as very low.

River System Map: Polder 23, Paikgachha Upazila, Khulna



Map 6.9: Fish habitat in the study area

Capture fisheries

262. The total fish habitat in the Polder area is about 4,190 hectare (ha) of which capture fish habitat is 82 ha (Table 6.10). The area of capture fish habitat is very low compared to culture fisheries. Capture (open water) fish habitat in the Polder area mainly consists of a number of seasonal and perennial *Khals* (canals). There is no wetland in the Polder area.

Table 6.10: Fish habitat status of the polder area

Fishery Category	Habitat Type	Area (Ha)
Capture	Khal	*82*
	Sub-Total=	**82**
Culture	Bagda Gher (permanent)	*3,547*
	Bagda Gher/rice (seasonal)	*422*
	Homestead Pond	*139*
	Sub-Total=	***4,108***
	Grand Total=	**4,190**

Source: Feasibility Report (Final Fisheries Report), 2012 and Field Survey, 2015

263. Average depth of internal *Khals* varies from 0.5 to 1.5 meter which is not sufficient for fish and aquatic biota habitation. During field visit, it was observed that most portion of *Khals* have been occupied by the local people for gher practice. There is no way to differentiate between khal and gher in the polder area. Local elite gher owners have made barrier at the inlet of the *Khals* illegally for controlling water flow for gher practice. Thus, natural flow is being obstructed in some places.

(a) Taltola khal (seasonal)

(b) Soladana khal (perennial)

(c) Khal converted into gher

(d) Water flow obstructed

Photograph 6.12: Open water fish habitats in the Polder area

Culture fisheries

264. Culture fish habitat in the polder area mainly includes Bagda gher. Two types of gherspermanent bagda gher and seasonal bagda gher are found in the polder area. Seasonal bagda gher means where bagda is cultured for six months (February to July) and rice is cultivated the remaining months of the year. The estimated culture fish habitat is 4,108 ha of which permanent Bagda gher is 3,547 ha and seasonal gher is 422 ha (**Table 6.12**). Permanent Bagda gher constitute about 90% of total fish habitat. The area of pond is low which mainly include in homestead. The size of the pond mostly varies from 5-15 decimal. Such type of pond mainly is used for domestic purposes. There is no cultured pond in the polder area. Local people reported that salinity in both soil and water are the main obstacle for improvement of pond fish culture.

(a) Bagda gher (Perenial)

(b) Bagda gher seasonal

Photograph 6.13: Culture fish habitats in the Polder area

Fish Habitat Quality

Water Quality

265. Some parameters of the surface water quality of Periphery Rivers and *Khals* related to fish habitat suitability have been measured and presented in Table (**Table 6.11**). From the measured data, it is observed that all water quality parameters are within the permissible limit for fisheries resources. The salinity in water bodies (both internal and river) is nil.

Table 6.11: Water quality parameters of capture fish habitat in the polder area

Water bodies	Parameters				
	Temp(ºC)	pH	DO(mg/l)	TDS(ppm)	Salinity(ppt)
Sibsa	18.9	8.2	6.7	246	15
Internal Khal	19.8	7.8	6.5	201	14
Standard values for fish	(28-34)**	(6.5-8.5)*	4.0-6.0*	1000*	(0-4) for prawn and (5 -35) for shrimp**

*Source - *M AMazid 2002 ** Jack M. et al, 2002(Water quality measured in January, 2016)*

Aquatic Vegetation

266. Aquatic plants or vegetation play important role in the structure and function of the aquatic ecosystem. It provides important habitat for small animals like aquatic insects, snails and freshwater shrimp, which in turn supply food for fish and waterfowl. Moreover, different type of hydrophytes like emergent, submerged and floating with leaves are used as spawning ground of fisheries and other insects and crustaceans. In the wetland, some fishes lay eggs

in the body of plants. Beside these, some fishes live on the rotten part of the aquatic plants (Khondker, 2004). In case of Polder 23, water bodies in the polder area are devoid of aquatic vegetation due to salinity for extensive gher practice and mal-function of water control structures. Some aquatic floras like duck weed were observed only in the closed Harikhali khal near the Bakkar Gazir More inside the Polder area.

Fish Migration

267. The riverine fish species migrate through regulated *Khals* in the polder area to some extent during the period of June to August. Fish species such as Chingri, Pairsa, Koral/Vetki, Tengra, etc. migrate through the regulators to the water bodies as part of their life cycle. Fish migration status in the Polder area is found as very poor due to construction of barrier at the inlet of Khal for gher practice, siltation, Khal encroachment for fish culture, using of net jal, mal-functioning of water control structures, absence of Water Management Organizations (WMOs) for operating sluices and regulators etc.

Fish diversity

268. The study area is poor in fish biodiversity which is in declining trend over the years. The study area comprises an assemblage of both fresh and brackish water fish species (Photograph below). List of fishes of different habitat in the study area is presented in **Table 6.12**.

Photograph 6.14: Composition of Fish Catch of the Polder Area

Table 6.12: Status of available Fish Species Diversity of Different Habitats in the Study Area

Scientific Name	Local Name	Habitat type		
		Periphery River	Khal	Fish pond/Gher
Brackish Fish Species				
Lates calcarifer	Koral/Bhetki	H	L	L
Otolithes argentatus	Sada Poa	L	NA	NA
Liza parsia	Pairsa	H	M	L
Liza tade	Bata mach	M	L	L
Mystus gulio	Tengra	M	M	L
Polynemous paradiseus	Tapasi / Muni	L	NA	NA
Sillaginopsis panijus	Tolar dandi	H	NA	NA
Scylla serrata	Kankra	H	H	L
Macrobrachium rosenbergii	Golda chingri	L	NA	NA

Scientific Name	Local Name	Habitat type		
		Periphery River	Khal	Fish pond/Gher
Metapenaeus monoceros	Horina chingri	H	L	NA
Penaeus monodon	Bagda chingri	M	L	H
Fresh Water Fish Species				
Channa punctatus	Taki	NA	L*	NA
Channa orientalis	Cheng taki	NA	L*	NA
Channa striatus	Shol	NA	L*	NA
Heteropneustes fossilis	Shing	NA	L*	NA
Puntius puntio	Puti	NA	L*	NA
Clarius batrachus	Magur	NA	L*	NA
Mystus vittatus	Tengra	M	L*	NA
Macrognathus pancalus	Chirka baim	M	NA	NA
Macrognathus aral	Tara baim	M	NA	NA
Lepidocephalus guntea	Gutum	L	NA	NA
Wallago attu	Boal	L	NA	NA
Glossogobius giuris	Baila	M	L	L
Eutropiichthyes vacha	Bacha	M	L	NA
Culture Fish Species				
Telapia nilotica	Telapia	NA	NA	H
Hypophthalmichthys molitrix	Silver Carp	NA	NA	M
Puntius gonionotus	Thai Sharputi	NA	NA	M
Hypophthalmicthys molitrix	Silver carp	NA	NA	L
Catla catla	Catla	NA	NA	L
Labeo rohita	Rui	NA	NA	L

Source: Field Survey, 2015;

Note: Abundance Code: H= High; M= Medium; L= Low; NA= Not available; L = fishes are found only in the Harinkhali Khal (Closure)*

269. Brackish water fish species like Chingri, Vetki, Pairsa, Khorkona are available in both gher and *Khals* in the Polder area. Freshwater fish species arerare to extinct in the polder area. Local people reported that the freshwater fishes disappeared due to saltwater intrusion for extensive gher practice and obstruction of fish migration route by the gher owner. Freshwater fishes like *Taki, Shol, Cheng, Puti, Koi, Shing, Puti,* etc are found only in the Harinkhali closure khal in the Polder area but their abundance and contribution to fish production is negligible. Local people informed that aforementioned fresh water fish species were commonly found in the agriculture field and internal *Khals* in the past. The dominant cultured fish species include Tilapia, Silver carp, Pangus. Moreover, Carp fish species like Rui, Catla, Mrigel are also cultured in some homestead pond but their growth is very low compared to other parts of the country because of salinity in pond water.

Indicative Fish Species

270. 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 evalusted; Parshe (*Liza Parsia*), not evaluated and Guli Tengra (*Mystus gulio*), near threatened. These species are generally live in the brackish to saline water but during the spawning season they come to brackish to freshwater environment. The spawning season of *Lates calcarifer*, *Plotosus canius* and *Mystus gulio* range from March to August whereas *Liza parsia* breeds from November to February (Figure 6.9). Usually these fishes enter into the Polder with the tide in drifting mode of migration during the life stages of hatchling to fry. These fishes use the Ghers of the Polder as grow up habitat in a culture mode. In addition to this phenomenon, the larger sized fish those cannot withstand

the tidal velocity enter into the Polder as most of the fishes generally perform anti-current movement. The sustainable and burst velocities of movement of following fish species are given below in Table 6.13. Speeds are generally referred to as 'burst' or 'sustained', which correspond to durations of seconds and hours beyond (>200 min), respectively. Fish generally use burst velocity or swimming speed for capturing prey while sustainable velocity or swimming speed for moving against the current. In calculating the velocities some criteria have been followed. These are: (i) total length of fish, (ii) habitat type (demersal/pelagic), (iii) water temperature, (iv) cruising swimming speed, (v) maximum swimming speed, etc.

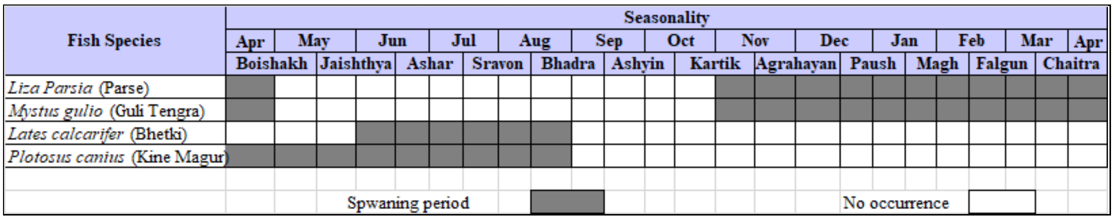


Figure 6.9: Seasonality of fish spawning

Table 6.13: Movement speed or velocity of indicative fish species

Fish Species	Habitat Type	Min Size	Max Size	Water Temperature (⁰C)	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

Threatened fish species

271. Threatened fish species which are locally rare and unavailable for the last 10-15 years as reported by the local fishermen and elderly people are given in **Table 6.14**. Local people reported that Gojal, Boal, Ayre which werefound in the Polder area are locally extinct. Other fishes like *Shol, Taki, Shing, Puti*are rare in the Polder area due to destruction of fish habitat for gher practices, salt water intrusion, obstruction of fish hatchling migration route because of improper and irregular operation of water control structures.

Table 6.14: List of Threatened Fish Species

Scientific Name	Local Name	Local Status		
		Rare	Unavailable	Locally Extinct
Channa punctatus	Taki	√		
Channa orientalis	Cheng taki	√		
Channa striatus	Shol	√		
Heteropneustes fossilis	Shing	√		
Puntius puntio	Puti	√		
Clarius batrachus	Magur	√		
Plotosus canius	Gang Magur	√		
Mystus vittatus	Tengra	√		
Channa marulius	Gojal			√
Wallago attu italies	Boal			√
Aorichthyes aor	Ayre			√
Nandus nandus italies	Meni			√

Source: Field Survey, 2015

6.4. Human and Economic Development

Fish Production

272. The estimated total fish production of the polder area is 3,990 Metric tons (MT) (**Table 6.15**). Large amount of fish production about 91% is coming from bagda gher followed by homestead pond and khal. Fish production trend of the capture fishery in the Polder area is decreasing due to siltation and low water flow in the internal khal, obstruction of fish migration, improper and mal-function of water control structures, encroachment of *Khals* for gher practices, etc.

Table 6.15: Fish Production from Different Habitats of the Polder Area

Fishery Category	Habitat type	Habitat Area (Ha)	Production (MT)
Capture	Khal	82	5
	Sub-Total=	**82**	**5**
Culture	Bagda Gher (Permanent)	3,547	3,902
	Bagda Gher (Seasonal)	422	253
	Homestead Pond	314	83
	Sub-Total=	**4,283**	**3,985**
	Grand Total=	**4,365**	**3,990**

Source: Draft Final of Fisheries Report (from main consultant), FRSS and CEGIS field survey 2015

Fishing Effort

Fisher number

273. The fishers' households in the Polder include commercial and subsistence fishers. Among them, 50% households are engaged as professional/commercial fishers and they spend almost 12-16 hours of a day during 8-10 months of a year in fishing activities. Remaining 50% of households are subsistence level fishers. According to field visit, it is reported that 50% fishers are Muslim and 50% are Hindu. There is no specific "Fishers village" in the polder area. Most of the fishers are living along the periphery of the Polder. The socio-economic condition of the commercial fisher is poor. They have no fishing net and trawlers/boats. They are dependent on fish traders (local elite) who provide fish trawlers and nets. The seasonal vulnerability of the fishers starts from the late January and continue up to April. During this period, fish catch is hardly recorded due to cool water as well as depression of the sea. In this

circumstances, the fisher maintain their livelihood through *Dadon* (money borrowing from local merchant with high interest) or taking loan from local NGOs.

Fishing Season

274. Fishing season in the Polder area starts in April / May and continues up to December. Most of the fish catch by different gears take place during late June to mid November. *Current jal* and *Ben jal* are commonly used in the peripheral river round the year. The seasonality of major fishing is furnished in the**Table 6.16**.

Table 6.16: 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	High	High	High	High	High	High	High	High	High	High	Medium	Medium	Low	Low	Low	Low
Net jal	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence	No occurrence	Medium	Medium	High	High	High	High	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Ben jal	No occurrence	No occurrence	High	High	High	High	High	High	No occurrence	No occurrence	High	High	High	High	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Jhaki jal	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	High	High	High	High	High	High	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium

High | Medium | Low | No occurrence

Source: Field Survey, 2015

Fishing Crafts and Location

275. 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. Fishing boat used in the Polder area is shown in the Photograph 5.15.

Photograph 6.15: Fishing boat used in the Polder area

Fishing Gear

276. Different types of nets/gears are used for fishing as mentioned in **Table 5.16.** of the fishing gear; (a) mono filament net, locally fishes in the *Khal,* (c) seine net (*Ben jal)* is used to catch small fishes; (d) cast net, locally known as *Current jal* is used to catch white fish (Vetki, Pairsa, Tilapia etc) in the gher (b) drag net locally known as *Net jal*is used to catch Puti, Tengra, Chingri as well as all kinds of small known as *Jhaki jal* is used to catch Puti, Chingri, Tengra, etc. Around 80% fishers have fishing gears/nets. *Jhaki jal* (cast net) is a common traditional fishing gear which is used in all water bodies round the year.

Photograph 6.16: Common fishing gear in the Polder area

Fish Marketing and Post Harvest Facilities

277. Local fishers sell bulk of their catch in the local fish market, e.g,*Soladana Bazar*, *Paikgachhaa Bazar* directly or fisheries Depot in the Polder area. There are about 40 fisheries Depot in the Polder area where fish are preserved temporarily for few days. Fish traders purchase fishes from these Depots. Sometime Depot owner sells their preserved fish to the *Paikgachhaa Arot* directly. There is no fish landing center in the area. There is no ice factory inside the Polder area. Transportation facility at root level is moderately developed. There is no private hatchery inside the polder area. Availability of fish feeds for culture ponds are insufficient. Fish seeds for culture fishery are collected from the hatcheries and nurseries which are situated at Khulna. In addition to this, fish fry are also collected from the mobile sellers coming from Khulna and Satkhira districts. Shrimp fry for gher are collected from Paikacha, Satkira and Jessore. Sometime, shrimp fry are collected from the local fishers which are caught from the Peripheral Rivers.

Fisheries Management

278. There is no government registered fisher's association in the polder area. The fishers have full access to fishing on existing fish habitats. There is no leased water body in the polder. 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. Enforcement of fisheries regulation is weak in and outside the Polder area.

Agricultural practices

279. Farming practices in the Polder area are largely controlled by physical, biological, climatologicall and socioeconomic factors. Agricultural crops are grown by cropping seasons. There are two distinct cropping seasons in a year. They are Kharif and Rabi seasons. The Kharif season starts from March to October while the Rabi season starts from November to February. Based on crop adaptability and crop culture, the Kharif season has been further sub-divided into the Kharif-1 (March-June) and the Kharif-II (July-October) seasons.

280. The Kharif-I season is characterized by high temperature, low humidity, high evaporation, high solar radiation and uncertainty of rainfall of low alternating dry and wet spells. Total land is fallow in this season.

281. 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. Local TransplantingAman (Lt. Aman) and High Yielding Variety of Transplanting Aman (HYV. Aman) rice is grown in the Kharif-II season.

282. In Rabi/Boro season, no crops are grown in the Polder area due to occupation of land for for shrimp culture (by the influential gher owners. In the month of February gher farmers are lifting saline water from Sibsa, Kurulia and Kobothak rivers for shrimp culture. In the rainy season it is possible to grow some crops if rain water is retained in the *Khals*. However, there are occasional overlaps such that the Kharif-II season crops Lt. Aman and HYV Aman rice are harvested in Rabi season.

Cropping patterns by land type

283. The dominant cropping pattern in the medium high land is Fallow-HYV Aman-Fallow which occupies 84% of the NCA. Detailed cropping patterns by land type are presented in Table 6.17.

Table 6.17: 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	Fallow	354	84
	Fallow	Lt. Aman	Fallow	68	16
	Total			**422**	**100**

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

Photograph 6.17: View of Lt. Aman field in the Polder area

Photograph 6.18: View of HYV Aman field in the Polder area

Cropping intensity

284. The entire cultivable area is single cropped with rice grown in the kharif-II season. Therefore, cropping intensity of the Polder is 100%.

Cropped Area and Production

285. Total cropped area is 422 ha in Kachubunia, Soladana, Horikhali, Vatokmari and Taltola village where they grow only Lt Aman (16%) and HYV Aman (84%) rice (Table 5.7).

286. Total crop production is 1,206 metric tons of rice. Among the rice crops the contributions of Lt. Aman and HYV Aman are 11% and 89% respectively. Detailed are presented in Table 6.18.

Table 6.18: Present croppedarea, 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	354	3.02*	1,069
Total	**422**		**1,206**

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

287. The following crops varieties are used by the farmers in the study area (Table 6.19).

Table 6.19: Varieties cultivated in the study area

Crop	Varieties
Lt. Aman	Patnai, Orkoch, Asfol and Moriceshail
HYV Aman	BR 10 and BR 11

Sources: CEGIS field survey, November; 2015.

Crop damage

288. Crops were damaged due to various causes in Kachubonia and Taltola village of the polder area during 2010 to 2015. About 20% field crops (Lt. Aman and HYV Aman rice) were damaged in the year 2010 by natural calamities (heavy rainfall). HYV Amon rice was damage due to salinity and pest infestation during 2012 to 2015. Salinity is increasing day by day asfish farmers are allowing saline water in the Polder area Detailed causes of damage for the last six years is presented in the Table 6.20.

Table 6.20: Crop area damaged during 2010-2015 in the polder area

Sl No.	Crops	Damage (%)	Year	Reason of damage
1	Lt. Aman	10	2015	Pests
	HYV Aman	20	2015	Salinity
2	Lt. Aman	10	2014	Pests
	HYV Aman	15	2014	Salinity
3	Lt. Aman	15	2013	Pests
	HYV Aman	10	2013	Salinity
4	Lt. Aman	20	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	20	2010	Heavy rainfall(Water logging)

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

Agricultural Inputs

Seeds

289. The seed rate used by the farmers in the Polder area is presented in Table 5.22. In case of rice, farmers are using more seed than recommended.Most of the cases, seedlings are affected by monsoon flood. According to the SAAOs and farmers, two years ago, they were compelled to re-transplant seedlings due to damage by heavy rainfall during monsoon season. Most of the farmers used their own seeds in case of Lt. Aman and HYV Aman. There are three seed dealers in the Polder area, where seeds are available. The dealer got training for all input use from Upazila Argiculture Office (UAO).

Fertilizer

290. The rate of fertilizer use per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability. The major fertilizers used in the polder are Urea, TSP/ SSP/DAP, MP and Gypsum. In most cases, farmers use fertilizers in unbalanced way. Organic manures are not used by the farmers in the field crops. Local women, farmers and local SAAO of DAE reported that cowdung is used mainly for fuel purpose. According to local farmers and three SAAO's, there are fertilizer dealers in every local market. About 25% local farmers reported that they don't have enough money to buy all types of fertilizers at a time. Detailed information of chemical fertilizer use by the farmers is presented in Table 6.21.

Table 6.21: Fertilizer, pesticide and seed used within Polder 23

Crops	Seeds used / ha (kg)	Fertilizer/ha (kg)					Irrigation cost /ha (Tk)	Pesticide (ha/Tk)	Used cultivation equipments (%)	Cost power tiller (Tk./ha)
		Urea	TSP	MP	Gypsum	Zinc				
Lt. Aman	60	120	70	40	0	8	0	700-800	90	4,500
HYV Aman	45	190	120	90	0	15	0	1000-1200	90	,4500

Sources: Field information; November 2015

Pesticides

291. The use of pesticide depends on the degree of pest infestation. According to feasibility report, all farmers (100%) applied pesticides in all crops such as T. Aman (Local), T. Aman (HYV). But it isobserved that all farmers are not using pesticide in rice field. In the Polder area farmers use pesticides one or two times even more. The major insects as reported by the farmers were Yellow stem borer, Brown Plant Hopper, Rice bug and Ear cutting cater pillar. Local farmers reported that they were using different types of pesticides such as Kartap, Fortunate, Amithrin, Korazan and Ultimato for preventing pest infestation in crop field.

Labor

292. In the Polder area, almost 70% of the cultural practices for crop production are being done manually. So, agricultural labor (seed sowing, intercultural operations, and harvesting and post harvest technologies) is considered as one of the essential inputs for crop production. The labor requirement is not equal throughout the year. The number of labor requirement varies from crop to crop also. The average labor used in the Polder area for Lt Aman about 150 nos./ha and for HYV Aman it is about 165 nos./ha.

Integrated Crop Management (ICM)

293. Recently, Integrated Crop Management (ICM) is practiced in many places of the Polder area. In this system, insects are controlled biologically. Farmers of the ICM areas use branches of trees, bamboo etc. to make favorable perches for birds in fields with standing crops. The birds eat the insects which help control infestation. Department of Agricultural Extension(DAE) is providing training to the farmers.In ICM process, about 5-8% of the crops are protected without applying pesticides. It is possible to control the harmful insects without the application of pesticides. ICM technique is mainly applied on rice crop.

Irrigation

294. There is no irrigated crop in this Polder area; Lt. Aman and HYV Aman are cultivated under rain-fed condition.

Crop production constraints

295. According to local farmers and two SAAOs of DAE in one agriculture block, the main constraints in the Polder area are:

- Soil salinity for crop production
- Lack of suitable irrigation water in rabi season for growing vegetables and Boro crops
- Siltation and drainage congestion.

Livestock and Poultry

296. A large number of populations of the polder area carry their livelihood depending on raising livestock/poultry. Farmers are using cattle for land preparation but cattle health is very poor.The numbers of livestock and poultry in the Polder area are presented in Table 6.22.

Table 6.22: 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	20	2010
Goat	65	13,065
Sheep	3	754
Duck	65	16,331
Chicken	85	25,627

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

Fodder

297. The owners of the livestock population are facing problems withrespect of non-availability of fodder and feeds during the months of July to November due to unavailability of grazing land. Rice straw is the main fodder in the Polder area. They are using oil cake, bran, grass. Shortage of grazing areas throughout the year aggravates the feed problem forthe animal population. Poultry and goat population at family level survive by scavenging and generally no feed supplements are provided. However, at times kitchen waste becomes feed to the poultry and ducks are going hither and thitherin search of food.

Photograph 6.19: View of duck in the Polder area

Photograph 6.20: View of Goat grazing in the Polder area

Disease

298. Productionof livestock and poultry ismainly constrained due to diseases and death of the population. Every year livestock population is affected by different diseases like Tarka; Anthrax, Foot and Mouth Disease (FMD), Black Quarter (BQ) and Hemorrhagic Septicemia (HS), Diarrhoea and Pest Des Petits Ruminants (PPR). Major of the poultry diseases are duck plague, Ranikhet (Newcastle), Fowl Pox and Fowl cholera. During monsoon season, the soggy condition of the animal shelter promotes various kinds of diseases to the bullock and cows. Moreover, the unhygienic condition of the courtyard during this season increases the diseases of poultry birds. July to October (rainy season) months are periods of spreading diseases to livestock and poultry population in large scale. There are many deaths of animal and birds every year within in the Polder areas because of outbreaks of diseases due to poor drainage conditions.

6.5. Socio-cultural Environment

299. The Polder 23 is situated in Paikgaccha upazila under Khulna district. The Polder area encompasses two unions namely Sholadana and Laskar. Percentages of union boundary are shown in **Table 6.23.**

Table 6.23: Upazila and unions in polder-23

Name of district	Name of upazila	Name of unions	Percentage of union within polder
Khulna	Paikgaccha	Sholadana	90.3
		Laskar	9.7

Source: Spatial GIS Analysis, CEGIS, 2015

Demography

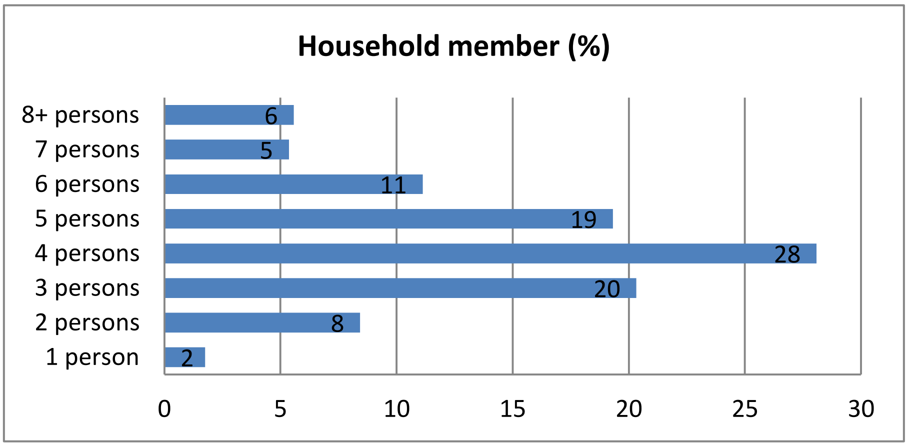
300. The Polder consists a total of 5,025 households with22,128 population of which 11,086 are male and 11,042 are female. Average density of population is1,094 persons per sq. km while the national population density is 1,015 persons per sq. km. The inhabitants of this Polder belong to two main religious groups; i.e. the Muslim and Hindu. About 57.62% of total populations are Muslim, 42.18% are Hindus and the rest (0.19) are Christian. Sex ratio of thePolder area is 101 which are slightly higher than of the national level. There is no ethnic community in the Polder. The demographic data of this Polder is presented in **Table 6.24**.

Table 6.24: The Demographic Data of the polder-23

Households	Population			Sex ratio	Population density
	Total	Male	Female		
5,025	22,128	11,086	11,042	101	1,094
	100 (%)	50.10 (%)	49.90 (%)		

Source: Population Census 2011, BBS

301. Average Households size of the Polder is 4.4persons in 2011. In the overall study area, household distribution by number of persons is same as the national scenario of 4.4 where the highest percentage (28.09%) of household comprises 4 persons in each household.Distribution of household members have been presented in **Figure 6.11**;



Sources: Housing and Population Census, BBS, 2011

Figure 6.11: Distribution of Households comprising member in each

Population estimation for the year 2015

302. According to the BBS 2015, the population growth rate of Bangladesh is 1.37%. Considering as linear growth rate it is also distributed into 4 year (2011-2014). Culture, infant mortality, quality of health care, life expectancy, availability of birth control, illiteracy, education, war and pestilence all effect growth, but for the sake of simplicity this calculation[4] assumes consistent growth. Polder area population has been calculated with the number of baseline population. Applying this method in the year 2015, the total population of the Polder is 23,366 of which 11,086 are male and 11042 are female.

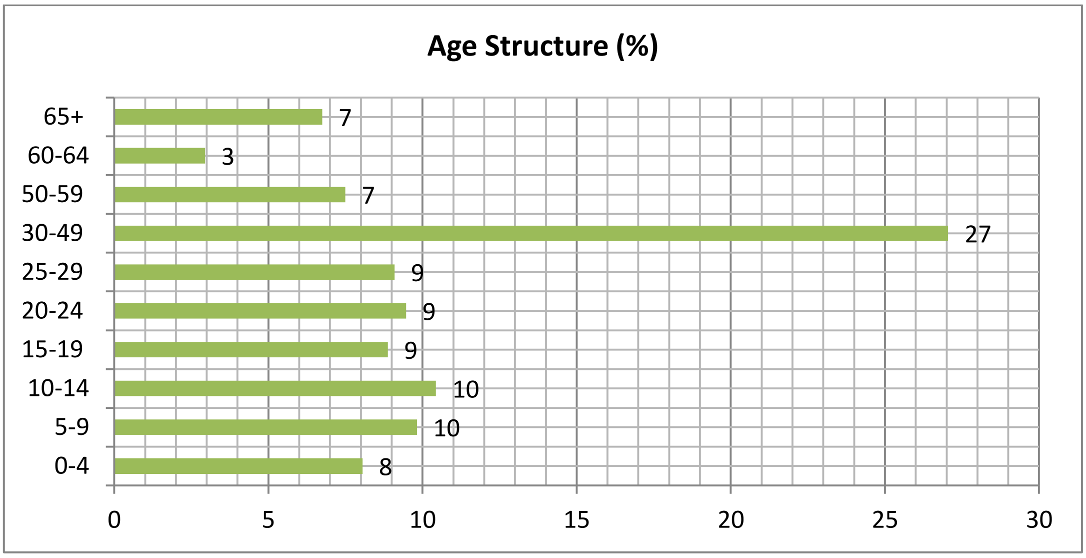
Age Structure

303. In the study area, the highest number of population (about 27%) belong to age category of 30 to 49 years. About 3% and 7% people are in 60-64 and 65+ year's category respectively which is presented, according to Housing and Population Census, BBS 2011, (**Figure 6.12).**

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

Where:

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



Sources: Housing and Population Census, BBS, 2011

Figure 6.12: Age Structure of the studied people

304. 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[5]). This classification is important as the size of young population (under age 15) would need more investment in schools, while size of older populations (ages 65 and over) would call for more investment in health sector.

305. It appears that 65% population, who are in the age group of 15-64 can be classified under active working peoplecategory, where in the national level it is 56.5%. Unfortunately, the huge active populationsuffer for severe unemployment problem which keep almost one-third of them under poverty line (**Figure 6.13)**, according to, the categorical distribution of age structureof *Housing and Population Census, BBS 2011.*

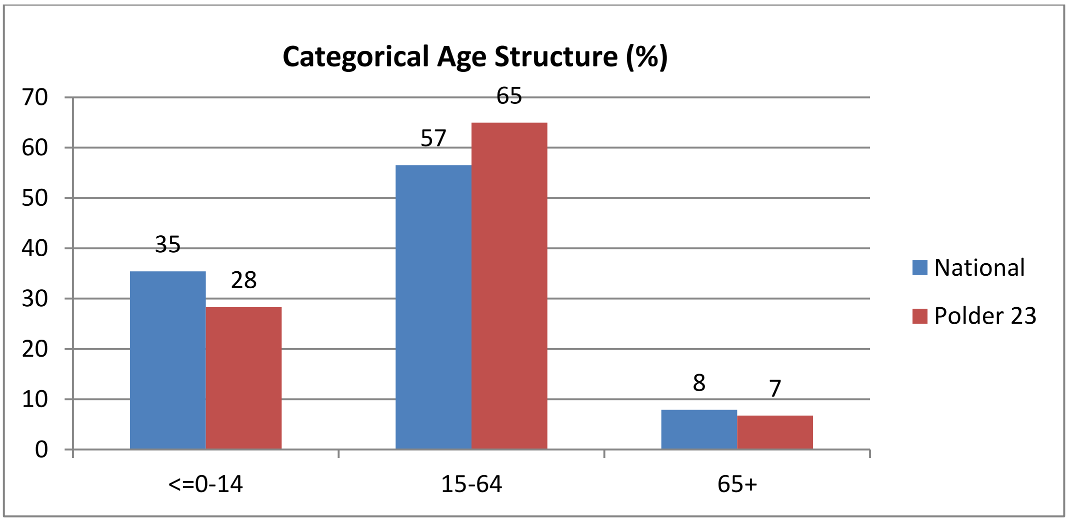


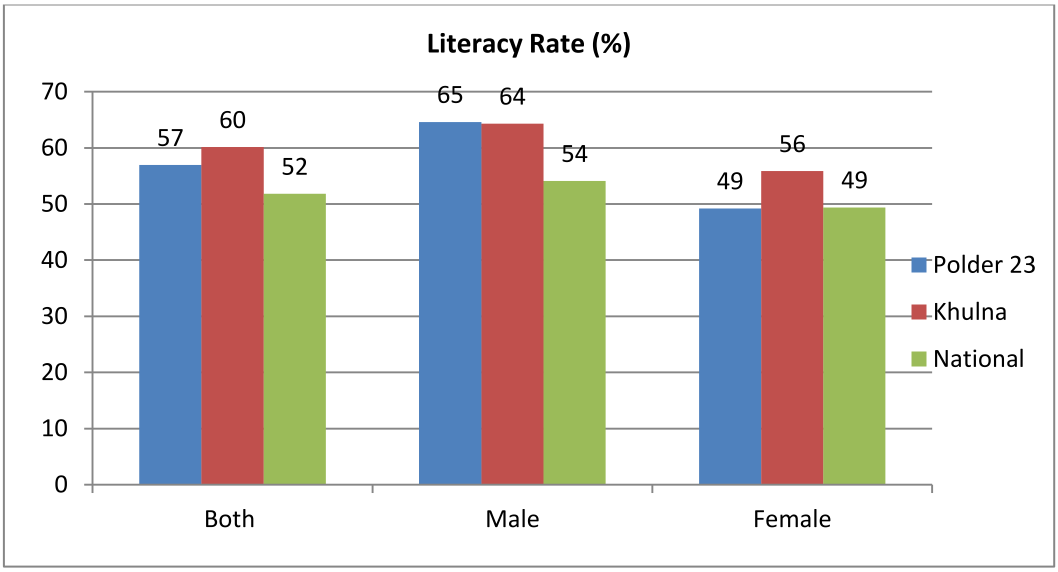
Figure 6.13: Categorical distribution of studied population

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

306. There is a small percentage (7%) of people above 65 years. The categorization is made on the basis of ILO reference for opting out potential labor force and dependent population. Population of 15 to 64 years category is considered as labor force whereas, populations below 14 years and above 65 years are considered as dependent. Thus, the total dependency ratio[6] is 54 in which child dependency ratio[7] is 43 and aged dependency ratio[8] is 11. It illustrates that total 54 persons are dependent on 100 labor forces in which 43 are children and 11 are elderly people.

Education

307. Literacy rate, based on the definition "ability to write a letter in any language" is 57%, while for male it accounts to 65% and female 49%. The rate of literacy reported above is for population of 7 years and over ages (**Figure 6.14**). Data confirms that like the national Photograph of Bangladesh (Male 54.1% and Female 49.4%), in the study area the male populations are more educated than the female counterpart.



Source: Population Census, BBS 2011

Figure 6.14: Literacy rate among the studied population

308. Field findings shows that there are 20 primary schools, 6 high schools and 6 Ebtedaye/ Dakhil Madrashas and a college in the Polder area. *(Source: CEGIS field work, 2015).*

309. There are many types of discriminationsfaced by the villagers. For example, most of the schools and madrasas are located in *Village Paikgachha, Pari Isamari, Boyar Jhapa and Sholadana.* Butthere is no school in the villages *Kakrabunia, Dakshin Katamari, Baskhali* and *Harikhali*. Communication condition is also weak among the villages. So it is difficult for the villagers to go for education to the nearer schools, therefore, most people of the villages are illiterate.

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

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

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

Source: CEGIS fieldwork, 2015

Photograph 6.21: Local educational institution at Polder area

Access to health service

310. 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 sub-center, 1 union family welfare center and 16 pharmacies. But there is no private clinic/hospital and upazila health complex. Therefore, a substantial portion of people tend to receive services from local chemist and/or village trained physicians. Most of the people of the area also receive treatment from nearby Sadar Upazila (Paikgaccha Upazila) Health complex at the time of serious health problems. However, the economically well-to-do people receive treatment from nearby private clinics like Nurjahan Clinic, Surgical Diagnostics Center and even they go to private clinics in Khulna.

311. It was found that nearly 38% people receive health services from quack doctors and informal treatment systems, 32% from paramedic/ diploma physicians and only 5% from trained doctor. But 25% people do not receive treatment facility due to their impoverishment.

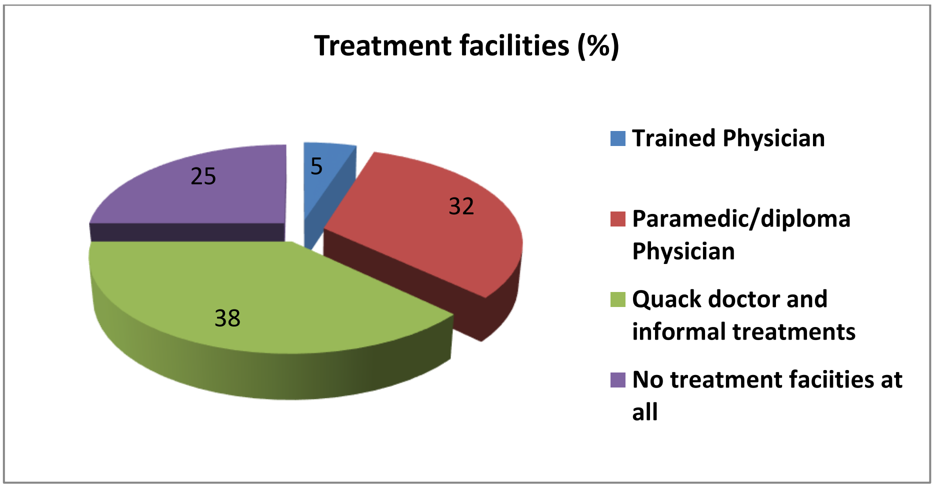


Figure 6.15: Sources treatment facilities of the Polder Population

312. There are discriminations among the villages in respect of access to health, communication and education facilities. For instance, People reported that the inhabitants of *Village Paikgaccha* frequently received treatment from trained doctors from the upazila sadar

because most of them are Gher owner and local elite. It is assumed that economic wellbeing of the people of *Village Paikgaccha* may drive them toward receiving treatment facilities from trained physicians although it is expensive or cost effective.

313. On the other hand, in some villages like *Kakrabunia, Dakshin Katamari, Baskhali* and *Harikhali* etc; there is no health complex, family welfare center and even a pharmacy. Therefore, people of the villages are seriously deprived from health facilities.

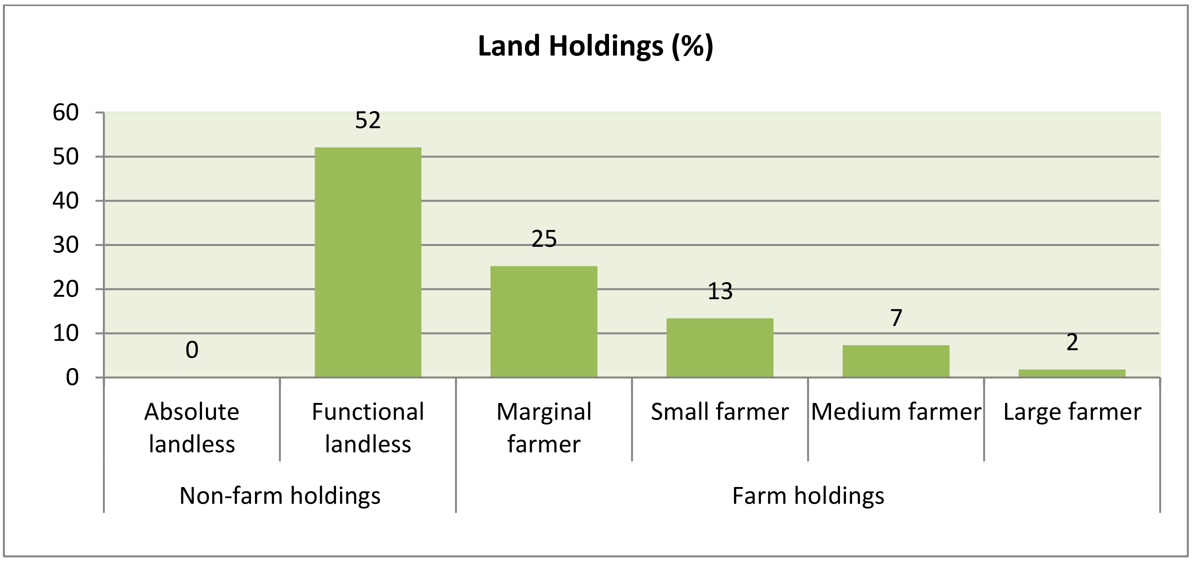
314. Communication condition is also too much weak. So at the time of emergency medical services, they fall into risk of life; e.g. at pregnancy case. The Population Census, 2011 identified al*most six types of disabilities and thei*r p*roportiona*te distribution in the respective area. It is found that the study area comprises 2% of all types of disabilities and 1% people reported that they are physically challenged. Local people opined that the incidence of Diarrhea is the most prevalent ailment in the area. Dysentery, skin diseases, cough, flux, worms, tumor, hypertension and common fever are also common in the Polder.

Photograph 6.22: A local village doctor providing treatment to a patient

Ownership and utilization of land

315. 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 47.79% is farm and the rest 52.21% is non-farm (Fig 6.16).

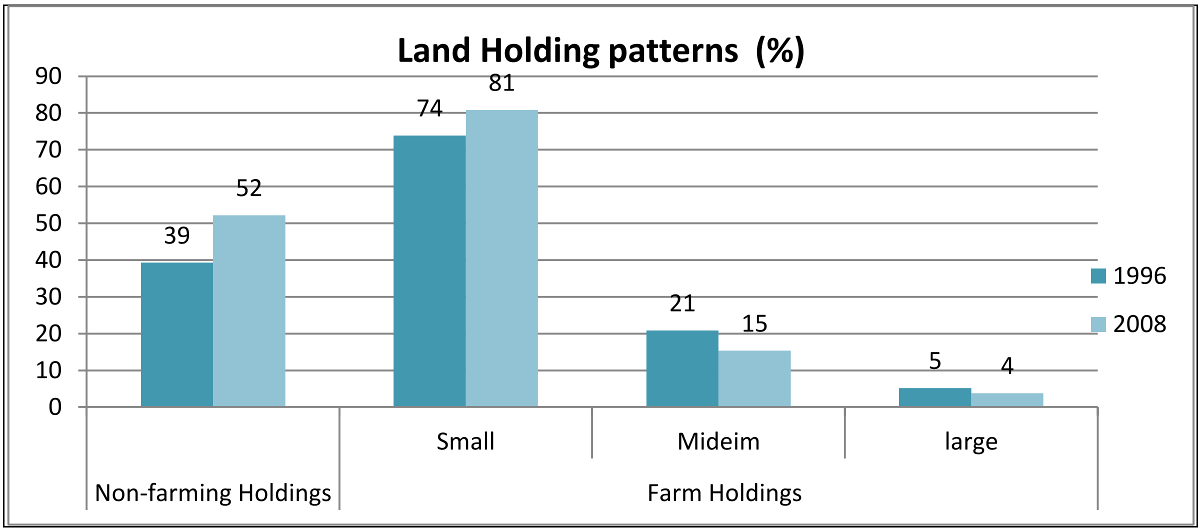
316. Therefore, the land holdings in the study area show that about 0.1% households are absolute landless, i.e. they have no land either homestead or cultivated. About 52% households belong to functional landless category that comprises households those have only homestead lands. Here, cultivated lands include mainly kitchen gardening operated predominantly by housewives mainly for household consumption.



Source: The Census of Agriculture, 2008, BBS

Figure 6.16: Households by land holdings

317. On the other hand, farm holding distribution shows that 25.25% households belong to marginal farmer (0.05 to 0.99 acre), 13.39% belong to small farmer (1.00 to 2.49 acre), 7.33% belong to medium farmer (2.5 to 7.49 acre) and 1.82% belong to large farmer (7.5+ acre) categories. It is evidential that land fragmentation decreases the holding size. Therefore, large and medium farmers are gradually being converted to marginal farmers (Fig ure 6.17).



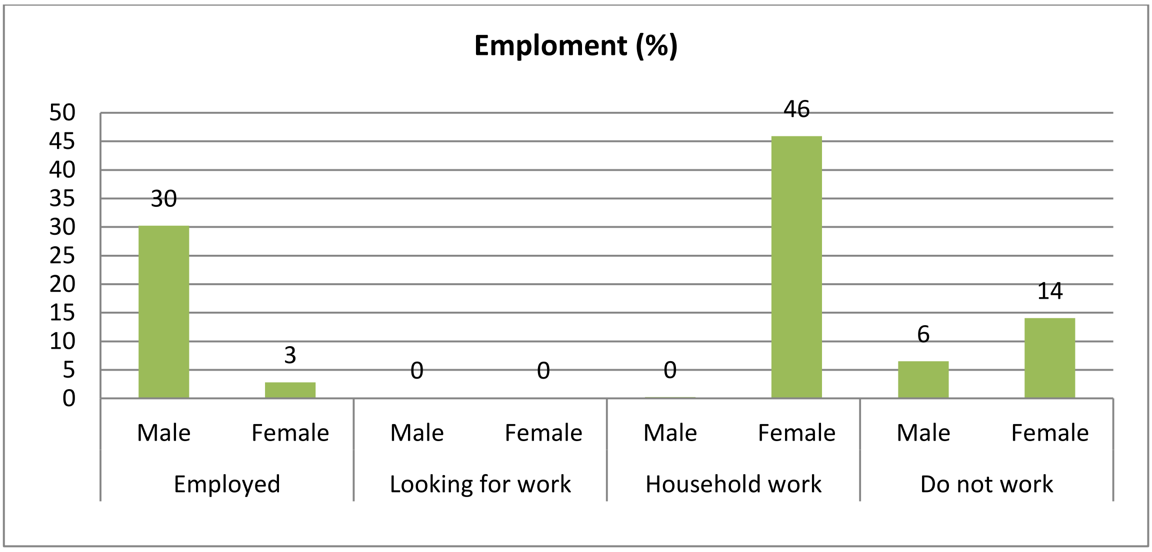
Source: The Census of Agriculture, 2008, BBS

Figure 6.17: Comparison of land holdings patterns

318. In 1996 and 2008, total non-farming holdings was 39 and 52; and farm holdings was 61 and 48 respectively. From the comparison of the holding patterns from1996 to 2008 of the area, non-farming holdings has remained as before and small farm holdings increased. The small land owners are unable to resist 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, usually adopt alternative livelihood options, for instances; farm and non-farm laboring, driving, earth work, working for shrimp farm and other manual works.

Occupations and Livelihood

319. Out of total 22,128 population, 4,986 (23%) are economically active of which 1,645 (33%) are employed, 50 (1%) are looking for work and 2,294 (46%) are engaged in household work while 997 (20%) 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, attending school population, 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 (Figure 6.18).



Source: Housing and Population Census, BBS, 2011

Figure 6.18: Employment status of the polder

320. But in the field, it was found that most of the people are unemployed and have to migrate to other regions like Chittagong, Dhaka, Barisal, Khulna, Narail, Gopalganj, Kushtia district and nearby upazilas as a day laborer because of the lack of the employment opportunities

321. Women participation in direct income generating activities (employed category) is trivial as education status confirms that are employed, females are getting married and in turn, contributeto the highest participation in household work (46%). The employed category also includes child labor as it was accounted from 7 years old population. A main occupation in the area is shrimp cultivation. So many women participate to collect shrimp friesfrom the river nearby but this shrimp fry is now, relatively, unavailable in the rivers. As a result, women engaged in shrimp fry collection are becoming unemployed. The other main occupation in the area are agricultural farming, earthworks and brickfield works.

Photograph 6.23: Different modes of livelihood activites at Polder 23

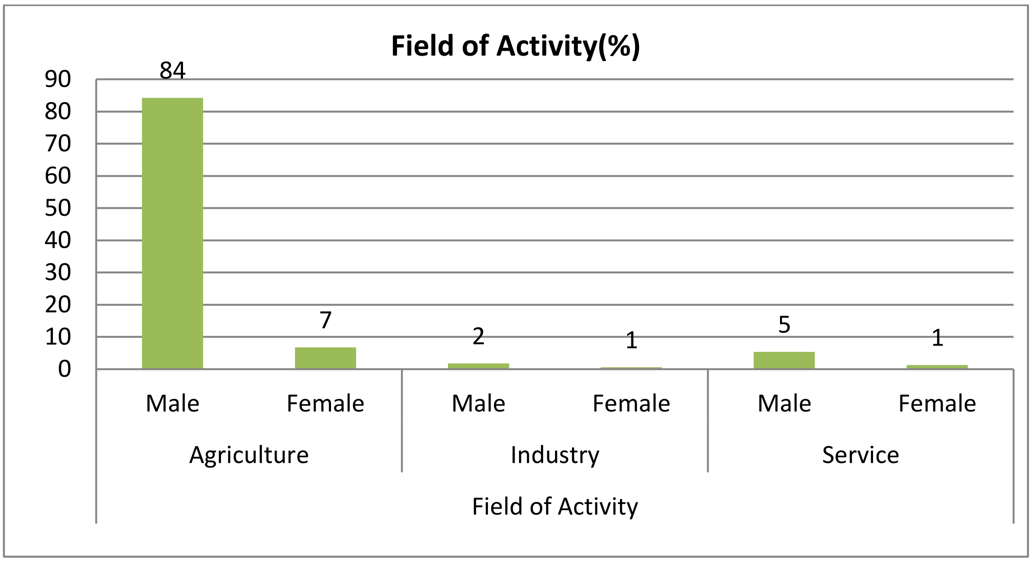
322. Agricultural activities include broadly fishery and crop farming. Scope of employment in agricultural sector is gradually decreasing due to lack of sweet water and saline water in the area for shrimp cultivation Crops are grown in only 422 hectares but shrimp cultivation, is practiced in 3,969 hectares. The Gher cultural practice in the area is shown in the **Photograph 6.24.**

Photograph 6.24: Practice of shrimp cultivation in agricultural land in the area

323. People stated that once people from nearer regions came for employment in their area, but as a result of decreasing agricultural land and farming, as a result of cultivating shrimp which reduces employment, therefore, they have to out migrate for employment.

Labor market

324. 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 worker and earth workers. In agricultural sectors, most of the laborers are supplied from the local villages.



Source: Housing and Population Census, BBS, 2011

Figure 6.19: Distribution of population by field of activity

325. The above figure shows 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 from river, earthwork, etc. The wage rate varies between 200 Tk. to 250 Tk. /day for female whereas men's wage rate is Tk.300 to Tk.350

326. During field visit, people stated that out migration of laborers is found higher (about 60%) in the study area whereas in-migration is relatively low. 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 and due to lack of employment opportunity. Additionally, there is a few international out migrants (0.5%) who tend to go to Middle East in search of better livelihood options.

327. It was found that in the last 5 five years, 13 households migrated permanently to Dhaka where most of them are working in garment sectors. On the other hand, some households also migrated from Bedbunia, An adjacent union, to the polder 23 to government sponsored Ghuccha gram[9] namely Ghuccha gram, Ahdarsho gram, Harikhali Chak, Basakhali etc.

Standard of living

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

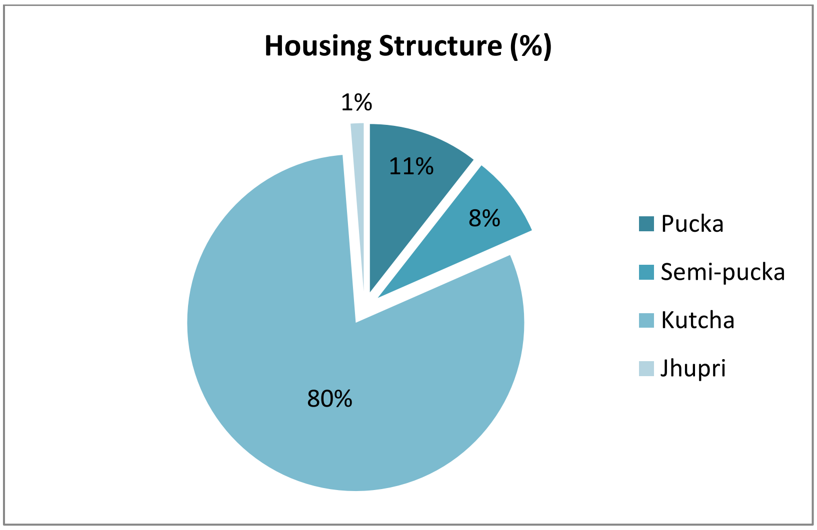
329. According to BBS Report, 2011, electricity is available to 50% of the people of Polder-23. But field data showeda better scenario, it states that 62% people are, now, getting electricity facilities,53% is from solar and only 9% from grid connection. But almost 38%, a large portion of the people, are out of electricity facilities.*(Source: CEGIS fieldwork, 2015).*

[9]*Ghuccha gram, a government sponsored village where government made houses for vulnerable communities.*


Photograph 6.25: Solarconnections of the area

330. The overall housing condition[10]is not satisfactory. The study area shows that the predominance of kutcha houses (80%) over other three types. Semi-pucca household is 8%, pucca is 11% and 1% is still jhupri houses.

331. Field data shows that most of the local elites, basically the Gher owners, live in pucca houses, businessmen in semi-pucka houses, drivers and medium land holders in kutcha houses and laboresin jhupri. It is true that economic condition determines the people's living standard. (**Figure 6.20**)



Source: Housing and Population Census, BBS, 2011

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

Figure 6.20: Housing condition in the study area

332. But field data show that about 90% of houses *of* village *Paikgachha* are Pucca and Kutcha while about 95% houses of *Kakrabunia, Dakshin Katamari* and *Basakhali* are Jhupri and Kutcha which prove that the people living in the area belong to poor category in term of housing type.

Photograph 6.26: Different types housing structure at the Polder area

333. Sanitation[11] facilities in the study area show that about 12% households use sanitary (water sealed) latrines and 31% use non water-sealed sanitary latrines and a large proportion of population (52%) use non-sanitary latrines. Field findings confirm that non-sanitary latrines are predominant among kutcha houses while water-sealed sanitary latrines are used in kutcha, semi-pucka and pucca households. However, there are 5% houses, which have no sanitation facilities but tend to use on shared basis and in some cases uses open spaces (**Figure 6.21**).

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

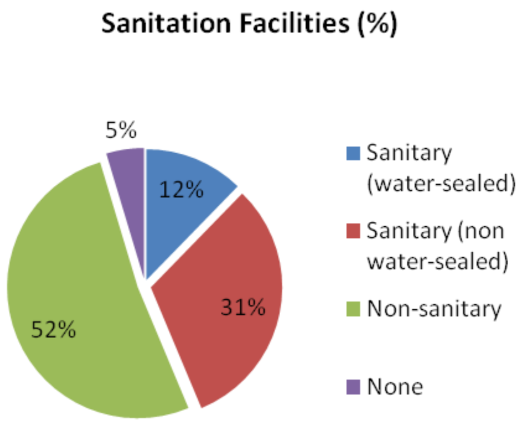


Figure 6.21: Distribution of households by sanitation facilities

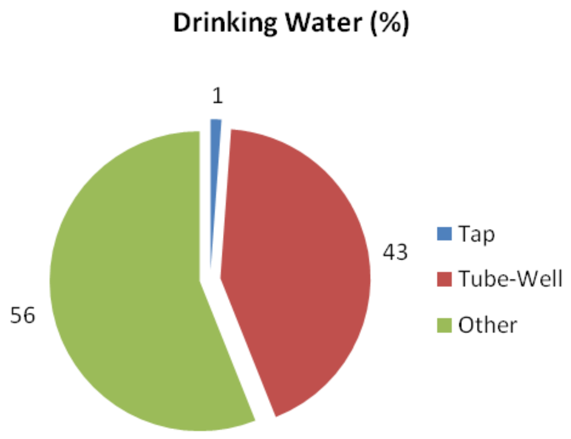


Figure 6.22: Distribution of households by sources of drinking water facilities

Source: Housing and Population Census, BBS, 2011

334. Crisis of drinking water is present in the area. Most of the people collect drinking water from tube-well, harvest rain water, and purified water supply by different NGOs. But poorer people of the area collect the drinking water from their neighbored tube-well Fig.5.22). Crisis of drinking water is more acute in the village of *Kakrabunia, Basakhali* and *Harikhali*.

Poverty Situation

335. 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 6.23).** It is observed that about 12% percent of the households are in the 'deficit' category. These households have been identified in the RRA as the poor households of the Polder area. Considering the standard consumption of food (three meals in a day), the deficit group was usually taking two meals in a day in the lean period since they could not afford three full meals. But only 7% of the households in average are in surplus category and rest of them are in balance category. Most of the people of deficit category live in the *guccha gram*. On the other hand, the surplus category households are the *Gher* owners.

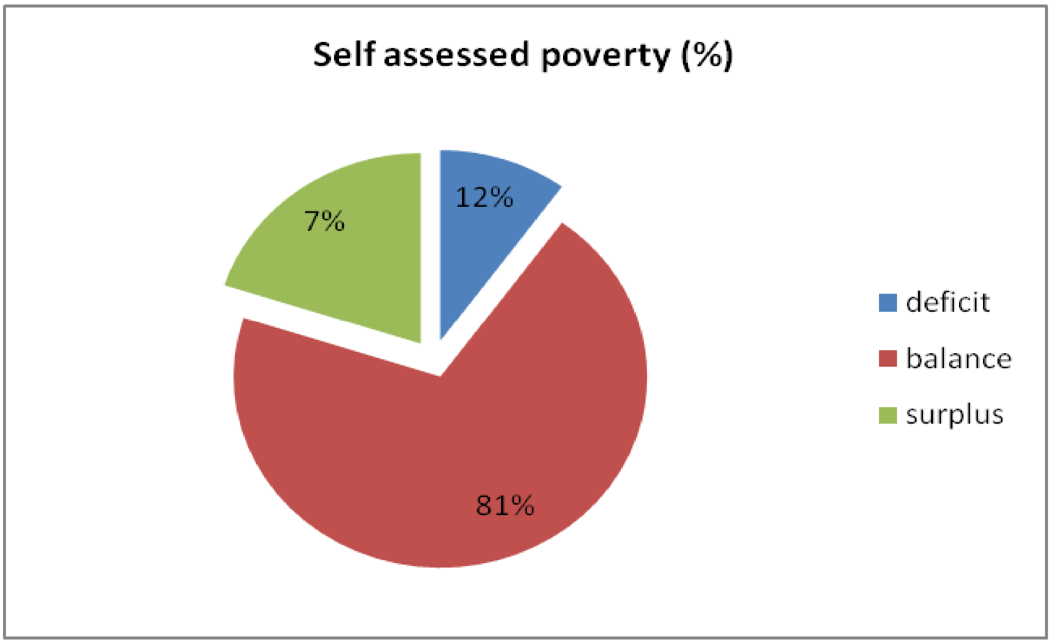


Figure 6.23: Self assessment of poverty status

Social Capital

336. Different types of safety net programs have been initiated by government and NGOs in the Polder 23. The major social safety nets and poverty reduction programs, 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 like the vulnerable people of Ghuccha Gram stated that, in reality, they get only a minimum advantage from the government programs, which is basically given on basis of political consideration. However, they are able to sustain for the NGOs activities.

337. A number of local, national and international NGOs are working in the Polder 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 BRAC (Bangladesh Rural Advancement Centre), ASA (Association for Social Advancement), Muslim Aid, Grameen Bank, Bureau Bangladesh, Diganto, Polli Unnayan, Uttaran, Rupantor, Sushilon and different local associations (Table 5.25).

338. These NGOs are serving with micro credit while BRAC is working for non-formal education, Health, human rights, water and sanitation, gender and children development programs; Uttaran gives them free capital for business, cow, goat different types of medicine and vaccine etc. About 80 percent of households are found to benefit from the NGOs interventions. After *Aila*, Islamic Relief has appeared to be the most important NGO for the local people; it has rehabilitated them by making new houses for them those were damaged by the disaster.

Table 6.25: NGOs and their Programs in the Project Area

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

Source: CEGIS fieldwork, 2015

Roads

339. There are various types of roads which provide means of communication mostly within the Polder. The Polder is surrounded by three major rivers namely, *Karulia, Sibsa* and *Minaj*. People of the Polder can easily enter into the upazila sadar because it is nearby the Pauroshava. According to NWRD database 2015, about 54.5 km of notable road network exists in the studied unions of which 3 km roads are paved/Brick soling, 51.5 km roads are earthen. **Table 6.26**presents data on road network in the polder area.**Photograph 6.26** presents some photographs of these roads.

Table 6.26: Road Network in Polder 23

Name of the Unions	Types of the Roads	Description	Length (Km)	Total (km)
Sholadana	Paved/Brick Soling	Garaikhali GC-Amurkata Bazar	1	3
		Betbunia-Amurkata	1.1	
		Soladana kironsana house near bridge to Golder house road	.9	
	Earthen Road	Paikgachhaa Lasker Madrasa-Parshemari to Soladana Bazar-Betbunia via Boraitala Kheyaghat	8.2	51.5
		Lata UP Office (Katamari bazer) to Soladana bazer to Shonkardana	13.65	
		Amurkata Bazar-BoyarJhapa Eidgha	4.85	
Laskar		Betbunia-Amurkata to Minaj bazer to Kharia khalpar	7.5	
		Village Paikgachhaa) to Paikgachhaa Dakhinpara	2	
		Khatuamari WAPDA embankment to Betbunia madrasha via Nutun chalk	4.2	
		Gazalia bridge to Kalmibunia bridge via katabunia junior madhamik bidyalay	5	
		Basakhali WAPDA (Minaj embankment) to surikhali UZR road via kachibunia	6.1	

Source: CEGIS fieldwork and LGED website, 2015


Photograph 6.27: Roads of the studied area

Market/growth centre

340. There are five growth centers and many small markets in the Polder 23 (Table 6.27).The biggest growth centers in the area are *Minaz Bazar* and *Sholadana Bazar*. The other small markets are situated in Villages*Paikgaccha, Par Boyar Jhapa, Char Banda, Betbunia, Sonabakhali, amarkata, laskar* and *Paschim Kanmukhi*.

Table 6.27: Markets in project area

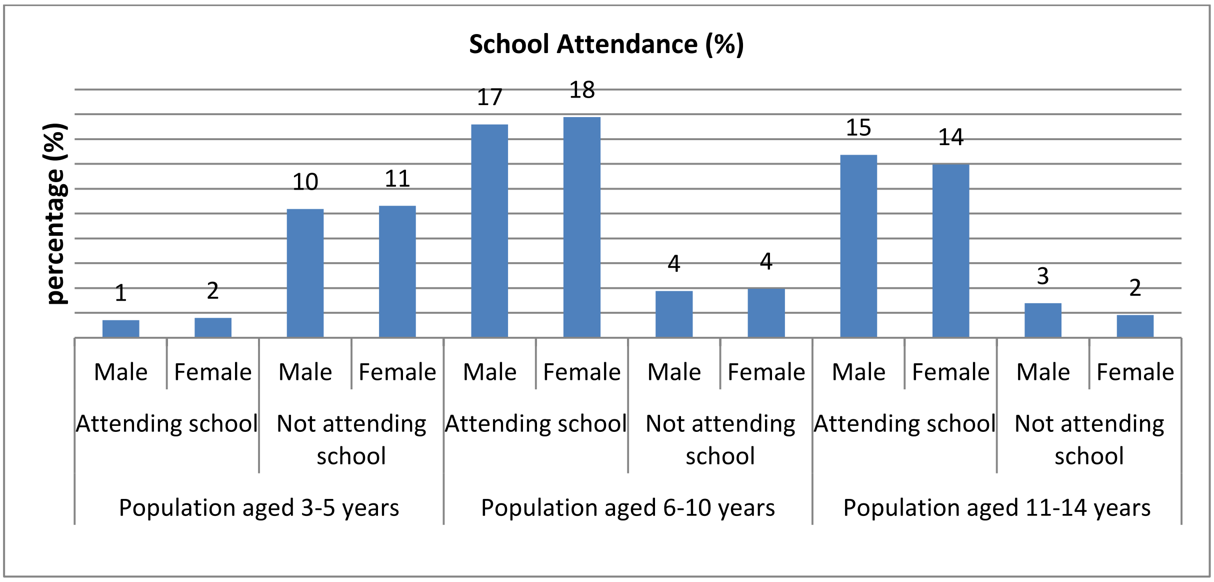
Unions	Number of markets/ bazar	Name of the Markets/bazar
Sholadana	*5*	➢ Paikgaccha Bazar ➢ Sholadana Bazar ➢ Minaz bazar ➢ Baintala Bazar ➢ Amurkata Bazar

Source: CEGIS Fieldwork 2015

Gender and Women

341. Local people reported that Polder 23 is highly male dominated area. Role of women in decisions making both at household level and economic contribution to household income are inconsequential. 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. Very few women work as day labor, but in that case also wage discrimination is very common where male labor get Tk. 300 to Tk. 350 per day while women labor get Tk. 200 to Tk.250 per day.

342. Over time the government has adopted strong policy towards women education which has also changed a lot in polder area where women education rate has increased and dropping school due to early marriage has reduced. **Figure 6.24** shows the comparative positive of school going scenario of the area. NGOs have changed the perception of rural society to a significant extent in terms of awareness rising. Different NGOs along with community health clinics work for women health and reduce women maternal mortality rate. The studied people stated that there are 4 union health workers who play important roles for women health improvement.



Source: Population Census, BBS 2011

Figure 6.24: Male and female school attendance in the area

343. 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 15% women are living with good health condition and the rest are suffering from various diseases including premature delivery. About 10% women are getting proper nutrition and about 10% have access to the health centers, which is around 15 km away from their residence. *(CEGIS field work, 2015).*

Cultural heritage

344. Historically, Bangladesh has earned the reputation of being at the crossroads of many cultures. The ruins of magnificent cities and monuments left behind in many parts of the country by the vanishing dynasties of rulers still bear testimony to the richness of its cultural heritage. Bangladesh has always been known as a land full of nature's bounties as evident from the vast expanses of its lush crop fields, borderland hills thickly covered with virgin forests and innumerable rivers and their tributaries, making it the world's largest delta. Like the many other regions, the studied area is also surrounded by two rivers namely *Minaj*River and *Sibsa*River. But there is no known historical and archeological site declared by government in the Polder area. Natural scenario of the area is as like the other coastal areas.

Social Structure

345. Social stratification is present in the studied 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 power structure was operated centering the land ownership in earlier time, the trend is now changing. The people who are the *Gher* owner are now dominant in rural power structure. Even land owners cannot resist the *Gher* owner because they are linked with external power sources and politically powerful. Here, marginal land owners are in worse condition.

346. In social relation, males are considered as the main livelihood earner whereas females are usually confined to household chores. But some women are involved in shrimp cultivation

who basically collect shrimp fry. Some women work as a day laborer in earthwork and brick field work. Furthermore, kitchen garden is main task done by 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.

Vulnerable Communities

347. In the studied area, there are some vulnerable people, who have lost everything during the time of *Aila* and are living at government sponsored shelter centers in the village of *Harikhali, Harikhali Chak,* and *Basakhali*. The vulnerable people suffer from safe drinking water, without electricity, and terrible sanitation facility. In the area, there is no educational institution, health complex and communication system is also terrible. In short, they don't get minimum standard of living in here rather they stay with a fear of river water breaching the BWDB embankment.

Rituals and festivities

348. Anniversaries, fairs and festivals form a vital part in the social life of ordinary people of the Polder 23. 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*.

349. Although there are many types of discriminations in the polder area, but there is no religious discrimination. Different types of religious groups perform their religious festivals with due feastivity. Even other religious communities participate in the festivals with eagerness. Muslims participate in different types of *Pujas* where Hindus and Christians also participate in *Eids* and many Muslim festivals.

350. Among the non-religious festivals Bengali 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 of these festivals are performed by the students of schools and college of the area.

Common Property Resources

351. 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 gathering. Besides these, the BWDB embankment is also used very commonly for different livelihood purposes i.e. living or taking shelter by the local inhabitants. However, there is no known historical and archeological site declared by government in the Polder area. There are 29 Mosques, 7 Graveyards, 38 Temples, 4 Crematoriums, 3 Playgrounds, 12 *Eidgahs*, 9 Cyclone centers, 5 *Bazars* and a Cultural center.

Photograph 6.28: A temple of the studied area

Photograph 6.29: A mosque of the studied area

7. Analysis of Project Alternatives

352. This chapter is dedicated to portray the emerging consequences of two alternatives and make the consequential comparison between these 'with alternative' and 'no alternative' analyzing the scenery under socio technical as well as environmental context.

7.1. 'No Project' Alternative

353. A perception upon contemporary situation of the Polder 23 can be reflected by the 'no project alternative' scenario and that's why the significance of proposed interventions under CEIP-1 would be realized. At this point, the Polder which is undoubtedly vulnerable condition and is being deteriorated by the continuous action of coastal wave. Climate change, storm surge, cyclones in that zone have put the Polder under alarming condition. In addition, the required services i.e. protection against tidal inundation, efficient drainage, and minimizing the impact of cyclonic surges can be hardly given at this state. Around 40 percent of the Polder area is exposed to salinity intrusion and even water logging. The silted water channels have made navigation system limited in these waterways and as a consequence, declining fisheries and increasing environmental pollution are being observed within the Polder area. As such no alternatives has been explained.

7.2. With Project Scenerion

Site Selection Alternatives

354. Alternative site selection is not at all required. This is because, it is a rehabilitation project.But, a wide-ranging multi-criteria analysis has been done upon the Polders to prioritize the Polder rehabilitation under CEIP-1. As per result, Polders 61/A, 35/3, 32, 33, 58/2, 41/1, 23 and 15 are found to be the most vulnerable.

Technical Alternatives

355. Since the problems are being faced by the Polder and the inhabitants within the Polder had also identified, a number of technical alternatives have been proposed addressing those issues. These alternatives are related to strengthening the Polder embankment, protection of river banks, protection of embankment slope, improving the sluices and their performance, and reducing drainage congestion and water logging. All the proposed technical alternatives are summarized here in **Table 7.1.**

Table 7.1: Technical Alternatives for Polder 23

Proposed Interventions	Alternative Options	Consequence
Strengthening of the embankment	No change in alignment and no re-sectioning/repairing of the existing embankment	The present vulnerable situation of the embankment and thus the entire polder would continue (similar to the 'no project' scenario discussed in earlier).
	Retirement/relocation of the existing embankment, as and where required	Partial achievements of the Project objectives. No protection against storm surges and sea water rise.
	Backing/minor inward shifting of embankment with slope protection	Same as above.
	Constructing new embankments (selected option)	New embankments will safeguard the Polder against storm surges, floods, and higher tides due to global warming.

Proposed Interventions	Alternative Options	Consequence
		Hence, reduction in loss of lives and assets will be caused by the natural disasters.
	Re-sectioning of existing embankment with new design heights (selected option).	Higher and wide embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, reduction in loss of lives and assets caused by the natural disasters.
Protection of embankment slope (against wave action)	No change in the existing embankment	Continued weakening of embankments; continuous subsidence of embankments due to traffic load and wave action; land resources would continue to be damaged/ lost (similar to the 'no project' scenario discussed earlier).
	Slope protection (selected option)	Slope protection works will strengthen the embankments and protect them against subsidence, wave action, and wear and tear.
	Foreshore plantation (selected option)	Effects of cyclone surge, wave action and wind could be mitigated to some extent, reducing loss of lives and assets.
Replacement of drainage sluices	No change in the existing structures	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 (similar to the 'no project' scenario discussed in earlier).
	Repairing of structures (possible where there is no need of re-sizing) (selected option for some structures)	For sluices which are beyond repair, this option would be similar to the 'no project' scenario described above.
	Replacement of existing Drainage Sluice with Drainage-cum-flushing sluice (selected option for some of the sluices depending upon need)	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
	Regulators with provision for appropriate passages for fish and small boats.	In addition to the above advantages, the structures will facilitate fish migration and navigation across them. The cost of such structure is likely to be high.
Replacement of flushing sluices	No change in the existing structure	No dry season agriculture practice will be possible. Shrimp culture during January to May, as sweet water cannot be used in the periods of low rainfall (similar to the 'no project' scenario discussed earlier).
	Repair of the existing structures	For sluices which are beyond repair, this option would be similar to the 'no project' scenario described above.
	Replacement of the existing Flushing Sluices (selected option)	Replaced flushing sluices will facilitate better agriculture practices, increased dry

Proposed Interventions	Alternative Options	Consequence
		season rice cropping, and reduced shrimp culture - thus benefiting the poor farmers.
Re-excavation of drainage channels	No action is taken.	Depth of water bodies would further decrease; drainage congestion and water logging will further increase (similar to the 'no project' scenario discussed earlier).
	Channel re-excavation (selected option)	Depth of water bodies will increase, water logging and drainage congestion will decrease and fish habitats will increase.

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

356. Following initiatives are chosen for assessing the technical, financial, economic, environmental, and social considerations. Table 7.2 below has disclosed all the options.

Table 7.2: Technical, Economical, 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 for reduction of reduced damages from floods	Improve surface water quality; improve natural vegetation	Reduce loss of lives and assets which would alleviate poverty; increase employment opportunities for local people.
	Protection to river bank erosion	Financial savings as the embankments will provide good road transportation.	Reduce 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	Improve earnings of local people during construction		Improve crop production particularly for small farmers thus alleviating poverty.
		Improve cropping pattern and boost up the local economy		
Bank revetment, slope protection	Enhanced embankment protection against tidal wave action of rivers, provide erosion protection	Financial savings for reduction of damages from floods; increase life span of the infrastructure and associated water control structures; improve earnings of local people through employment during bank revetment works and slope protection works.	Improve embankment stability; reduce soil erosion; and provide good means of transportation	Reduce loss of lives and assets which would alleviate poverty; increase employment opportunities for local people.
Replacement of existing drainage sluice with drainage-cum-	Better functional performance in both flushing and drainage; achievethe	Financial savings against damages from water logging, drainage congestion, and salinity intrusion.	Removal of inactive sluices would improve the drainage characteristics	Better agriculture practice could be achieved which would improve cropping pattern,

Intervention	Considerations			
	Technical	Financial/Economic	Environmental	Social
flushing sluice and construction of new flushing sluices where needed	objectives of Polder and CEIP-1	Agricultural production will boost up as dry season rice cropping would increase	Water logging, drainage congestion would be reduced.	enhance local earnings, and alleviate poverty.
Channel re-excavation	Reduce water logging and drainage congestion	Enhance agriculture output; the dredged soil can later be used in construction works and will save construction cost	Increase navigability of water ways and fish habitats will improve, the ecosystem will be enhanced	Increase cultivable area, increase availability of irrigation water thus increase farm income for local community; increase farm labor opportunities.

7.3. Alternatives during Construction

357. A number of important aspects i.e. material stockpiling, material sourcing, manpower sourcing, and transportation for all form of requirements (materials, equipment, manpower, etc.) of construction site. Alternatives of the aforementioned issues are described consecutively in the following sub-sections:

Material Storage

358. To store construction material two options are seemingly available, i.e. a) inside the Polder 23) Outside the Polder. In case of the first option bulk of materials can be transported easily within the Polder but regular shipping of construction materials would still remain.

359. The selected site for the storage of materials is located at Soladana Bazaar beside Sibsa Riverwhich is navigable throughout the year. The required materials are collected and transported from corresponding sources to the Polder and those are stocked in the stock yard until construction phase.

Material Sources

360. Construction materials are sourced from various sources. The sources of construction materials will be highlighted describing their pros and cons.

Soil for Embankments

361. Re-sectioning and forwarding of embankments require a certain volume of soil. The following options may ensure the amount being good sources:

362. Borrow pits of the river as usual would be the best option of sourcing soil. It has been always a pivotal and crucial source by minimizing soil transportation requirement, ensuring cost effective transportation, having minimum impacts in the borrow areas since these areas will be silted-up within a few seasons, and eventually having minimum environmental and social impacts related to excavation and transportation.

363. The required materials can be acquired partly from re-excavation of the water channel within the Polder, provided the technically acceptable quality of material. Re-excavation of the

channels can ensure a considerable amount of earth during implementation of rehabilitation works inside the Polder. This would curtail the cost of excavation for the borrow material, although the cost of transportation to construction site would be slightly higher than the first option, furthermore, some environmental and social impacts such as traffic congestion and air pollution would be emerged within the Polder.

364. A considerable part of soil could be sourced from the borrow pits within the Polder. It is done generally by mutual agreement with the land owners on the basis of compensation. This option would involve the cost of excavation as like first option. Transportation cost, social and environmental impacts and other parameters are almost similar to the second option, but land degradation might be added with other environmental problems.

365. The material can be obtained from the river beds ensuring required quality unless the soil from the riverside at outside the Polder embankment is suitably accepted;this option will associate higher cost of material transportation along with other related environmental and social problems such as traffic congestion, air and water pollution.

366. The final decision regarding the material source has not been finalized. This decision is likely to be taken during construction period.

Sand

367. Sand is one of the fundamental part of constructions. It is usedbroadly to renovate embankment, concret works, and manufacturing concrete blocks for protecting slope. Two alternative options are available for acquiring sand.

368. Sand willbe procured directly from markets. This would entail consistent quality and assured supply; however it would also entail increased transportation cost and associated environmental and social impacts including traffic congestion and air pollution.

369. River bed is another option of obtaining sand. This source abolishes transportation needs minimizing the associated costs, environmental as well as social impacts. However quality of this sand may not be persistent in terms of quality and it is washed generally before using.

370. However, the final decision regarding the source sand is yet to be decided. This decision is generally taken during the construction phase.

Alternatives for Workforce Procurement

371. Two options of sourcing manpower for construction work are widely recognized. These are explicated below.

372. Manpower is sourced as employing bulk from outside the Polder. But it creates a chance of traffic congestion and air pollution as it requires larger camps and labor transport. So, there is a probability of developing resentment which may lead to resistance from the local community.

373. And definitely manpower from within the Polder as employing bulk would be another option whereas only skilled and technical manpower would be brought from outside the Polder. This option might be considered as better reducing labor camp sizes, and decreasing transportationneed and associated environmental and social problems. This option offers employment opportunities to the local community. So, it can increase their economic condition

and also increase the local ownership of the project. Due to having all these advantages, this option is preferred for manpower sourcing.

Alternatives for Mode of Transportation

374. In order to transport all construction materials from the source to main stock yard, trucks are crucial and extensively used. And the materials are transferred from main stock to construction site mostly in water ways, sometimes by roadway if feasible. Most of the roads within the Polder is not suitable to carry heavy load vehicles, i.e. dump truck, trolley, excavator,etc. That's why sometimes small carts, non-motorized vehicles, manual labor, etc. are used in road ways; and small boats, trawlers in waterways.

Waterways

375. Polder 23 is surrounded by Sibsa, Minaj and Kurulia River. Here mainly Sibsa River flows perennially whereas other two are intermittent. Sibsa River generally remains navigable all the year round and is used for transportation purposes during construction. The depth of the River varies approximately from 10 meter to 15 meter with tide and ebb. Deposition process and char (island) formation are not seen in the river.

Roadways

376. Upazila Road is still unsuitable to carry the heavy vehicular movement within Polder area. That's why waterway is used as the only way to transmit construction materials.

7.4. Comparison between No project and with Project Scenerio

377. The proposed interventions in order to get rid of above mentioned problems of Polder 23 under CEIP-1 are enlisted describing below. To pointout various aspects and comprehending the significance of the proposed interventions within the Polder under the Project, the 'no project' and 'with project' scenarios are compared in **Table 7.3.**

Table7.3: Comparison of 'No Project' and 'With Project' Scenarios

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
Re-sectioning of embankments (36.5km) and design crest level (5.00 m, PWD and 4.50 m, PWD)	At a certain number of points, the embankments will be further deteriorated and dropped below the design level. Therefore, cyclones, rise in surge heights due to global warming, and tidal actions will inundate the Polder, causing severe 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	Decreased silt deposition in the Polder will result into improved

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
	floods would increase and cause water logging, drainage congestion and other associated problems.	drainage and navigation in internal lakes/khals, increased usage of surface water for irrigation, and reduced water logging problem.
	Local farmers and labor will remain financially stressed. Livelihood opportunities will remain limited, and local people will migrate outside the Polder for employment.	Enhanced agricultural activity will increase the demand for farm workers. Local people can engage themselves in the construction works inside the Polder. Improve earnings of local people during the construction phase of the project.
Slope protection work of Embankment (3.00 km)	Continued weakening of embankments; continuous subsidence of embankments due to traffic load and wave action; land resources would continue to be damaged.	Slope protection works will strengthen the embankments and protect them against subsidence, wave action, and wear and tear.
Replacement of drainage sluices (09 nos)	Continue use of the existing drainage sluices for both flushing and drainage and would cause further damage to these structures. As a result, water logging and drainage congestion would be increased due to malfunctioning of the sluices.	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
Repairing of drainage and 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 (20.15 km)	Depth of water would be further decreased; 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 as well as quality will increase.
Afforestation (26 ha)	Wind and wave action during cyclones would cause severe damages.	Effects of cyclone surge, wave action and gusty wind could be mitigated to a certain extent, reducing the loss of lives and assets.

8. Environmental Impacts and Mitigation Measures

8.1. Preamble

378. 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 5. The following detailed investigations have been carried out to assess the magnitude of these impacts:

- Environmental quality baseline monitoring of air, noise, surface water, groundwater and soil;
- Ecological surveys comprising vegetation, wildlife and fisheries covering both mainland and offshore area;
- Offshore surveys comprising 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

379. As part of the environmental impact assessment process, a screening matrix was used specifically for the proposed Project, focusing 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.

380. The matrix 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**							
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	-	-	-	-	LP	-	-
Labor, materials and equipment mobilization	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	LP	-	-
Land acquisition and resettlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Construction Phase																			
Re-sectioning of embankment	MN	-	-	-	-	-	-	-	-	0	-	-	MN	-	0	MN	MP	-	LP
Construction of Retired embankment	MN	-	-	-	-	-	-	-	-	0	-	-	MN	-	-	MN	MP	LP	MP
Embankment slope pitching and turfing	MN	-	-	-	-	-	-	-	-	-	-	-	MN	-	-	MN	MP	MP	LP
Construction of Drainage Sluices and Flushing inlets	MN	-	-	-	-	0	MN	MN	MN	0	-	-	MN	MN	MN	0	LP	-	-
Slope protection work of embankment	0	-	-	-	-	-	-	0	-	-	-	-	MN	-	0	MN	MP	-	LP
Bank Revetment work	MN	-	-	MN	-	-	-	0	-	-	-	-	MN	MN	0	MN	MP	-	LP
Placing of geo bags and CC Blocks	-	MN	0	MN	-	0	-	MN	-	0	-	-	MN	-	0	0	MP	-	LP
Re-excavation of Drainage *Khals*	MN	-	-	-	-	0	MN	MN	MN	-	-	-	MN	-	-	MN	MP	-	MP
Implementing coastal afforestation	-	-	-	-	-	-	-	-		-	0	-	-	-	-	MN	MP	LP	MP
Operation Phase																			
Monitoring and Maintenance of protective and earth works by BWDB.	MP	HP	HP	HP	-	-	-	-	-	-	-	-	-	-	-	-	-		
Formation of local committees for monitoring the works properly.	HP	HP	HP	HP	-	-	-	-	-	-	-	-	-	-	-	-	-		

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

381. The following activities should be carried out at pre-construction phase:

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

382. The above activities may create impact on the following environmental and social components;

Deterioration of Air and Noise quality

Impact

383. Noise level around the construction sites and in settlement areas will be deteriorated for mobilization of construction, materials, trawler equipment and man-power. Navigation will be increased in the watercourses i.e. *Sibsa*, *Kurulia* and *Minaj* River. The increased navigation is expected to intense the noise level of the local vicinity. Therefore, settlements, *Bazar* areas and surroundings of the construction site will be affected by the increased noise level.Besides, exhaust emission from materials and equipment mobilization trawlers and containing particulate matter and other ingredients would deteriorate the ambient air quality around the construction site and nearby areas due to movement of equipment carrying 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.

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

Mitigation

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

- Construction material (sand) should be covered while transporting and stock piled.
- The contractors need to be cautious to avoid unnecessary honking of material carrying trawler.
- The contractors should be encouraged to move all construction equipment, machineries and materials during day time instead of night.
- Exhaust emissions from trawler and equipment should comply with the standards of DoE.
- Sprinkling of water and ramming the materials of stockyard regularly.
- Stockyard should be covered during non working period.

Residual Impacts

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

Change of Land Use

Impact

387. Land would be needed to establish temporary facilities including construction camp (Labour shed) and borrow areas. Labour sheds would be constructed to establish temporary facilities for the rehabilitation works. As per consultation with main consultant all labour sheds (13-15) would be constructed in *Khas* land and requisition land.

388. For the re-excavation of canals, materials and equipment mobilization requires land at site of the canals which is used for crops production.

389. The use of borrow pits area mainly remain fallow during dry season. In wet season, these borrow pit area is used scattered for seedbed or grazing of livestock.

390. The significance of this potential unmitigated impact has been assessed as **Low** on the basis of impact magnitude and receptor sensitivity. All the borrow pits of the foreshore areas will be filled within one or two years due to tidal inundation.

Mitigation

391. 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, the instructions should be specified in the tender document.
- Labor shed/camp should be constructed on government khas land.
- Avoid impacts on local stakeholders.
- Any areas used for borrow pits in the foreshore should be away from sensitive areas such as mangrove vegetation, known fish spawning ground, habitatfor any endangered flora /fauna species.
-

Residual Impacts

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

Clearances of vegetation

Impacts:

393. About 50 nos of timber trees (preliminary survey by EIA Team, to be finalized after completion of RAP Survey) will need to be cut for trenching at proposed points ofembankment for construction of drainage/flushing sluices. Except this, the fallow land beside embankment can be used for all types of construction activities

394. In addition, there is a strips of about 1.5 km social afforestation from Chainage 10.0 to 11.5 km comprisingsaplings of Babla (*Acacia nilotica*) having average density of 9 saplings/m^2. All the saplings along the riverside slope will need to be cut during site preparation for slope protection activities. However, the strip along countryside slope is not suspected to be damaged.

Mitigation:

- Choose barren land and ground of Sluice Gateman's houses for stocking construction materials
- Proper compensation against tree felling inprivate land willbe given to the owners according to Resettlement Action Plan (RAP)
- Implement tree plantation at the damaged sites and sluice surroundings after completion of construction works
- Labor should be given early notice about plant conservation especially for prescuring the countryside strips of plantation at slope protection site (Chainage 10.0 to 11.5 km).

Residual Impacts

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

Increase in vehicular traffic during mobilization

Impact

396. During contractor mobilization, equipment, machinery, material, and manpower will be transported to the Polder resulting in additional traffic on roads and waterways. This traffic may potentially cause traffic congestion particularly at roads and jetties. The embankment is the main road for communication for a large numberof 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 *Haat* and marketing time, all the stakeholders use this embankment as road for carrying their goods for buying and selling and other purposes. Mobilization of contractor, equipment and machinery, construction material and manpower will be transported to the Polder resulting in additional traffic on roads and in water ways. This may potentially cause traffic congestion. Moreover, most of the schools are located near the embankment and three important *Bazars* are also located besides the embankment. These will face traffic congestion during *Haat* time. Earth work for re-sectioning of embankment and vehicles movement also may create short term disturbances to the polder inhabitants.

Mitigation

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

- The contractor should prepare a traffic management plan (TMP) and obtain approval from the DDCS&PMSConsultant.
- Contractor should also implement mobilization plan considering water vessels and launch movement in the external rivers and avoid the launch movement time.

- The TMP should be shared with the communities and should be finalized after obtaining their consent.
- The TMP should address the existing traffic congestion particularly at the *Paikgaccha Bazar*, *Sholadana Bazar* and *Amurkata Bazar*.
- Ensure minimal hindrance to local communities and commuters.
- The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes.
- The embankment works should be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track.
- The works of the first half should be completed, and then of the other half should be undertaken.
- Work schedule tobe finalized in coordination and consultation with local representatives and communities, specifically the 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 limitedin 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 moving pattern and management system for the local stakeholders using multimedia presentation and showing video at different common population gathering places in the Polder area.

<u>Residual Impacts</u>

398. The impacts on hindrance for pedestrian and vehicle movement are likely to be adequately addressed with the help of above mitigation measuresand the significance of residual impact will be Low.

8.4. Impacts during construction phase

399. The construction phase involves the following activities:

- Re-sectioning of embankment
- Construction of Retired embankment
- Embankment slope pitching and turfing
- Construction of Drainage Sluices and Flushing Sluices
- Demolishment of Flushing Sluices
- Slope protection work of embankment
- Placing of geo bags and CC Blocks
- Re-excavation of Drainage *Khals*
- Implementing coastal afforestation

400. The above activities would cause the following environmental and social impacts:

Generationof Noise vibration and deterioration of Air quality

Impact

401. The construction activities particularly manufacturing of C.C blocks through mixture machines, earth work and its compaction, operation of construction machinery and demolishing of flushing sluices will generate noise and vibration which are likely to affect the nearby communities. Increased noise levels may cause disturbance, nuisance to the nearby communities as well as to the construction workers. In particular, the settlements near the construction site will be exposed to noise and vibration generated by the Project activities. Therefore, sensitive receptors and pedestrians through the embankment cum road will likely to be severely affected by noise pollution which may create disturbance in performing the commercial activities. Moreover, sensitive receptors such as school, college, family welfare centre, community clinic/hospital etc. which are located close to the interventions (within 500 m from the embankment) are likely to be affected by noise during movement of vehicle as well as construction activities of water control structures, although there exists no educational institution in the sensitive buffer zone of noise quality deterioration as shown in figure 8.1

402. Table 8.2 shows the probable noise level from the equipment. According to ECR'97, 50 dBA is applicable during day time for residential area in Bangladesh.

Table 8.2: Probable noise level of some equipment

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

403. Besides, exhaust emission from the concrete mixture machine and fugitive particulates during construction activities especially for manufacturing CC blocks which are likely to affect to 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.

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

405.

Sensitive Receptor Map: Polder 23, Paikgachha Upazila, Khulna

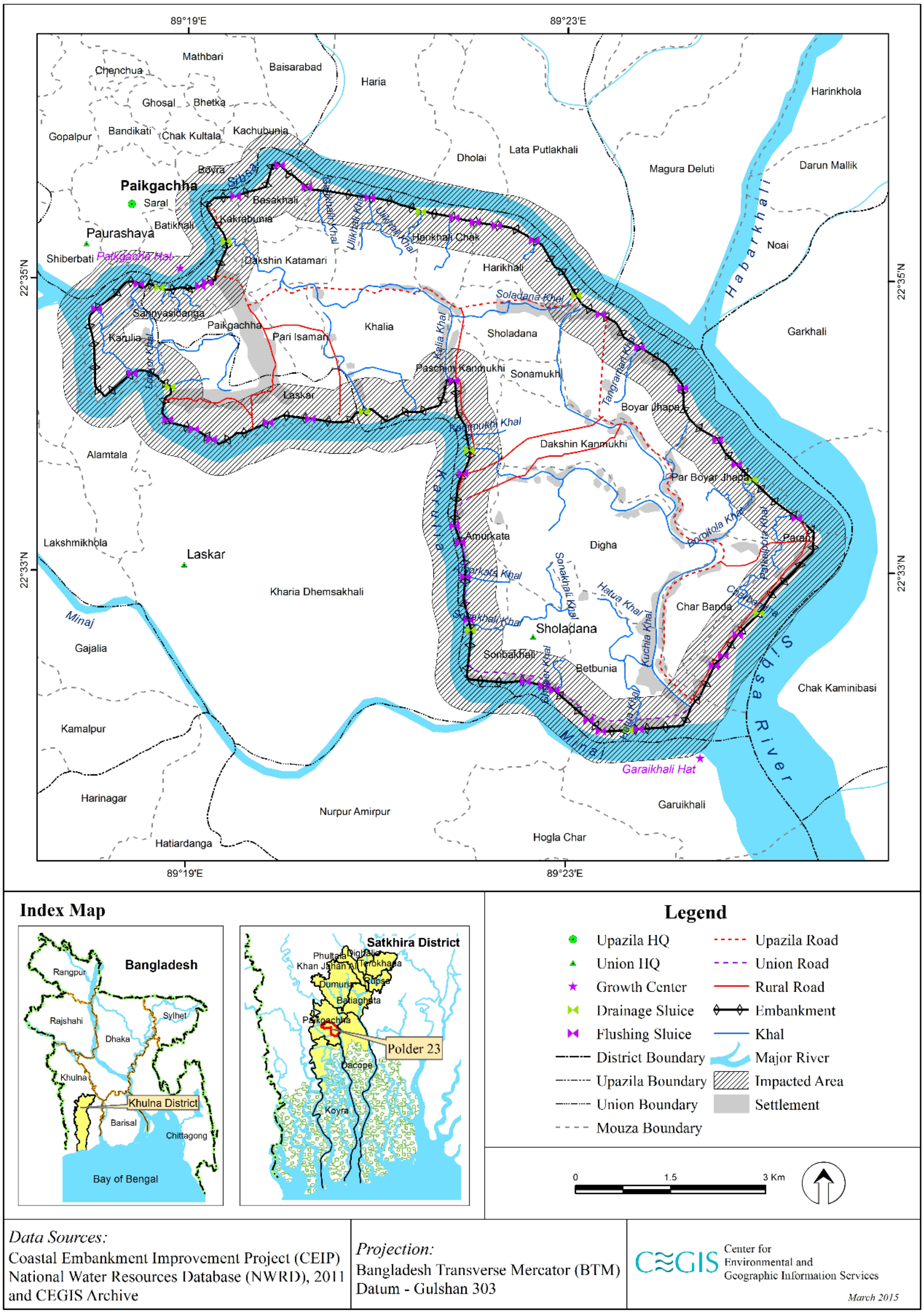


Figure 8.1: Sensitive receptors near the embankment of Polder 23

Mitigation

406. 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 near 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 should be instructed to use the equipment properly, to minimize noise levels.
- Liaison with the communities should be maintained and grievance redress mechanism will be established at the site.

Residual Impacts

407. 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**.

Hindrance to the natural drainage system

Impact

408. The construction activity particularly for construction of drainage sluices, flushing 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 temporarily drainage congestion in the *Khals*.Additionally, spoil earth from the excavation of *Khals*, would create also disturbance to the natural drainage system.

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

Mitigation

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

- Some temporaryearthen 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 temporary earthen dams during construction work.
- Both contractor and BWDB should supervise the construction work
- Contractor should ensure that drainage channels are not obstructed or clogged by the construction activities.
- Contractor should ensure that construction activities do not inundate cultivation fields.

Residual Impacts

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

Impact on crop production

Impact

412. About 1.52 ha of land is likely to be acquired for construction of retired embankment along the junction point of *Kurula* and *Kobadak* River. This land includes single cropped area (Ch 33.800km-Ch 34.300 km) which is likely to be impacted. This land includes cultivated areas (here, only single cropped land 1.25 ha), others are covered by shrimp culture in addition to houses and other structures. The losses of production under the acquired land are given in **Table 8.3.**

413. During collection of earth from the Borrow pit areas no agriculture land would be impacted in the Polder area as all spoil earth would be collected from offshore area through manual excavation and river bed of *Kobadak, Kurula, Minaj* and *Sibsa* rivers as well as *Soladana Khal, Tangramari Khal, Boroitola Khal, Patkelpota khal, Kuchia Khal, Sonakhali Khal, Loskor Khal and Taltola 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)
Aman (HYV)	1.25	3.02	4.0
		Total	**4.0**

Source: Fieldinformation; 2015

414. 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.

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

Mitigation

416. 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 crop fields during construction activities.

- 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 dumped in agricultural land.
- Contractor should maintain liaison with communities.

Residual Impacts

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

Impact on irrigation

Impact

418. Construction activities particularly on regulators, water channels and re-excavation (20.15 km) activity of canals can potentially disrupt irrigation during both wet and dry season, thus negatively impacting 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 could enter the Polder area which can disrupt the crop production.

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

Mitigation

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

- Contractorshould construct bypass channel before construction/replacement/demolishing 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.

Residual Impacts

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

8.4.1. Impacts on Feeding and Spawning Ground of Fish Habitat

Impact

- Polder 14/1 is bounded by Kobodak and Arpangasia rivers on the west and Sakbaria River on the eastern part of the Polder. As per consultation with local fishers during field visit it is learnt that, the bank sides of these rivers have been reported as the feeding, nursery and spawning ground of brackish water fish species like *Chewa, Pairsha, Gulsha Tengra, Bagda, chingri*, etc. It is expected that activities of bank revetment (earth work from km 5.3 to km 5.7 and km 28.7 to km 29.3) and slope protection (earth work from km 1.0 to km 2.0, km 3.0 to km 5.26, km 5.5 to km , km 7.0 to km 7.3, km 7.8 to km 8.8 and km 12.0 to km 12.5) would cause the partial destruction (if in the dry season) and full destruction (if in the rainy season) the feeding, nursery and even spawning ground of these fish species.

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

<u>Mitigation</u>

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

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

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

Contractor will maintain liason with experienced local fishermen.

<u>Residual Impacts)</u>

- 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.

422.

Impacts on Fish Habitat and Migration

<u>Impact</u>

423. A total of 20.15 km of internal *Khals* will be re-excavated under CEIP. It is expected that *khal* re-excavation activities especially bailing out of water would damage fish habitat in Khals and hamper fish migration temporarily during this phase. Migration of fish species particularly *Pairsa, Vetki* (juvenile), *Chingri, Gulsa,* etc. are expected to be affected. Moreover, feeding and breeding ground of the bottom dweller fishes will be lost. But after 1-2 year the habitat quality will be improved. Impact magnitude of which thus is assessed as Major.Similarly, 17 flushing inlets will be constructed on the *Khals* which would also obstruct fish migration in the polder area. As damaged or mal-functioning drainage sluices will be replaced by new one near the existing places, the drainage channels will not be clogged by such activity. However, impact magnitude of such activities on fish migration is assessed as Moderate.

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

<u>Mitigation</u>

425. The following mitigation measures will 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 hindrnace to fish migration.
- Contractor will maintain liaison with fishers and farmers so that they could realize the issue for minimum impact to the shrimp farming and paddy cultivation.

Residual Impacts

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

Impact on Benthic Founa

Impact

427. During activities of re-excavation of *Khals* especially bailing out of water from the *Khals* would hamper the khal habitat condition. The habitat of Mud eel fish species (*chew, baim* etc) and benthic organisms will be affected by this activity.

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:

- Khal re-excavation should be carried out segment wise.
- Contractor will carry out khal excavation in segment thus minimizing impacts on benthic fauna.
- Monitor pre and post analysis of benthic fauna.

Residual Impacts

430. 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**. Monitoring required.

Clearance of vegetation

Impacts:

431. Existing undergrowth vegetation along the embankment slopes would be buried byplacing of earth during re-section. The foreshore undergrowth vegetation will also be damaged at places from where soil would be collected. In the case of this polder, most of the plant species at the proposed re-sectioned alignment and soil collection sites are seasonally grown and life span is not more than one year. So, it is expected that the damaged sites will recover within 1 to 2 years by natural regeneration of herbs and shrubs. Existing big trees at the embankment slopes will not be cut for re-sectioning in most of the cases. For this reason, this negative impact is temporary and recoverable.

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

Mitigation:

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

Residual Impacts

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

Outbreak of plant diseases

Impacts:

434. There is a chance of damageto existing undergrowth vegetation (i.e. brackish grasses, saplings of mangrove trees) due to movement of labor who will be engaged for plantation. Incautious disposal of sapling's poly bags may cause deterioration of soil quality. Besides there may be a risk of outbreak of plant diseases to the other existing plants from the planted disease affected saplings. Water flow in creeks and strips of planted area may be interrupted byaccumulationof plant or plant shoots. Inadequate distance between two saplings may hinder proper growth and cause disease outbreak.

435. Foreshore area of this Polder is not abounding with mangrove vegetation. There are some small mangrove patches along the foreshore area at Patkelpota village. However, incautious movement of labor may damage the vegetation.

Mitigation:

- Labor should be aware about the right way of plantation works without damaging any existing vegetation
- Keep setback distance in plantation plan layout from the water passes
- 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
- Collect saplings from nearer natural source (i.e. from The Sundarbans forests beside *Shibsha* river) as much as possible and consult with Forest Department for providing required saplings

Safety and Public Health Hazards

Impact

436. The area is prone to cyclones and storm surges. Although the works will be carried out during the dry season, a certain level of safety hazards still exists for the construction staff. The construction activities will involve operation of heavy construction machinery, vehicular traffic, excavation and filling operations. These activities may pose some safety hazards to the local population as well as for the construction workers. The fuel storage at the camp sites may also pose safety hazards for the construction staff as well as 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 might potentially expose the nearby population to communicable diseases.

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

Mitigation

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

- The contractors should prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants. The Plan should also include awareness rising and preventive measures particularly for communicable diseases such as hepatitis B and C, and HIV/AIDS.
- The WBG's EHS Guidelines should be included in the contract documents and that should be followed during construction.
- Liaison should 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 should 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 appropriate Personal Protective Equipment (PPE) and should use them. First aid must be provided and there should be procedures in place to access appropriate emergency facilities; procedures to be notified all

- The construction sites should have protective fencing to avoid any unauthorized entry, where appropriate and possible
- Health screening of employees would be a Contractor obligation prior to laborers working on site and living in the temporary accommodation facilities. The health screening would entail normal review of physical fitness and also include a review of appropriate vaccinations. Workers would be given vaccinations where required;
- All employees need to carry out induction health and safety training prior to commencement of work. OHS issues would be part of the employee training plan. Training would include the provision of appropriate written or visual materials to reinforce learning. Where illiteracy levels are high, OHS issues need to 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 person 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 should establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.
- The contractor should adopt a Human Resource Policy appropriate to the size and workforce which indicates the approach for management employees (this could be part requested in the tender process);
- Produce job descriptions and provide written contracts and other information that outline the working conditions and terms of employment, including the full range of benefits;
- Provide health insurance for employees for the duration of their contracts;
- Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts;
- Develop a recruitment process community employees that involves local authorities in clearly understood procedures;
- Employ a community liaison officer (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 will provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project.
  - Availability of safe drinking water should be ensured for the construction staff.
  - First aid boxes should be made available at each construction site. Emergency phone numbers (including hospitals, Fire Department, and Police) should be displayed at key locations within the site. Each site should have an ambulance available.
  - Firefighting equipment should 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 should be maintained.

Residual Impacts

439. With the help of above mitigation measures, the impacts associated with safety and health hazards are likely to be mostly addressed and the significance of residual impact will be low.

Labor force related impacts

Impact

440. Around 100 skilled workers/technical staff/operators/drivers and about 100 common labour are considered required for construction activities[12]. The common labours are considered to be recruited among the local people in the Polder. No need for any worker's camp is considered .

441. Contractor's staff may not be accustomed to local conditions and people's culture, causing incidents of tension with the local population.

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

Mitigation

[12] Lessons learnt from the implementation of Package-I. Source: Package-I contractors Progress Reporting.

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

- The Contractor will provide proper housing for his staffs at a site with adequate facilities securing neighbours arenot disturbed.
- The Contractor will prepare and implement a Code-of-Conduct for his staff showing respect to comply with and not offend local customs and cultural norms.

Residual Impacts

444. The impacts associated with labor force related impacts are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be Low.

Increased Inland and Waterway Traffic

Impact

445. Transportation of construction materials is a key concern during the Project since the Polder 23 is located in a remote area of Paikgachha Upazila under Khulna district. Two broad options are available for carrying construction materials to the Project stockyards in the Polder. The first option is road transportation and the 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 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.

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

Mitigation

447. The following measures will 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 nighttime where possible and appropriate
- Material transportation through rivers during high tide where needed.
- Liaison should be maintained with community and BIWTA.

Residual Impacts

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

Hindrance for Pedestrian and Vehicle Movement

Impact

449. Three main markets are located in the polder near the embankment; these include the *Paikgaccha Bazar, Sholadana Bazar* and *Amurkata Bazar*. These markets play an important role by providing source of livelihood of the Polder inhabitants as well as meeting the daily needs of the people. 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.

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

Mitigation

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

- The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes.
- The embankment works should be carried out in segments and soil should be placed linearly on 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 should be finalized in coordination and consultation with local representatives and communities.
- Local routes shouldnot be blocked as much as possible. If unavoidable, alternative routes will be identified in consultation with local community.
- GRM will be put in place.

Residual Impacts

452. With the help of above mitigation measures, the impacts on the floral resources are likely to be adequately addressed and the significance of residual impact will be Low.

Social unrest between Local and outside workers

Impact

453. A large number of skilled and unskilled labors will be required for construction activities. Most of the labors 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 labors, and between local community and outside labors.

- 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.

454. 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.

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

Mitigation

456. 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 should be respected and honored.
- GRM should 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.

Residual Impacts

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

Seasonal Impacts due to natural hazards

Impact

458. Historically, this area is vulnerable to cyclones, storms 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 occurr in this area. According to previous records of cyclones and storm surges, October to November and April to May are the peak monthsof occurrence of cyclones and storm surges. It is suspected that the construction activities during this period may be hampered as well as workers may get injured.

Mitigation

459. The following measures should be undertaken to address the above concerns:

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

Residual Impacts

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

8.5. Impacts during Post-construction Phase

461. After rehabilitation of the Polder, the following environmental and social impact may occur.

Increased Use of Agro-chemical

Impact

462. At present, 356 ha of land are under Aman rice cultivation. Shrimp culture practices are dominating here due to availability of saline water. After the fulfillment of intervention at Polder area, agricultural practices covered land would increase instead of shrimp farming. Continuousagriculture practices cause reduction of soil fertility and increase use of agro-chemicals.

463. Presently, 148 tons of chemical fertilizers are required for cultivation of Aman rice. The pesticide requirement for total rice production is 1.4 tons (Granular) and 0.25 tons (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 reduce the salinity problem of entire polder area. This would allow expansion of area under irrigation for initiation of Boro cultivation 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 Aman cultivation, additional 9.1 tons of chemical fertilizers and 0.088 tons (Granular) 0.015 tons (Liquid) pesticide would be required for crop production in future (Table 8.4). Runoff from such cultivation fields might potentially pollute the water bodies and even drinking water sources thus causing health hazards to the communities.

Table 8.4: Impact on area (ha) fertilizers (kg) and pesticides (kg/ml) required in present and future situation

Crop name	resent cultivate area(ha)	rtilizer required (kg/ha)	ranular pesticides required kg/ha	Liquid pesticide required ml/ha	al Fertilizer required(kg)	tal granular pesticides required(kg)	otal liquid pesticides required(ml)	Future cultivated area(ha)	reased area(ha)	al future fertilizer required (kg)	tal future granular Pesticides (kg)	tal future liquid pesticides required (ml)	Impact		
													Fertilizers (kg)	Pesticides (kg)	sticides (ml)
HYV Aman	356	415	4	700	147,740	1,424	249,200	378	22	156,870	1,512	264,600	9,130	88	15,400
Total	356	415	4	700	147,740	1,424	249,200	378	22	156,870	1,512	264,600	9,130	88	15,400

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

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

<u>Mitigation</u>

465. 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.

<u>Residual Impacts</u>

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

Reduced Fish Migration Time

Impact

467. The mal-function drainage sluices in the polder area are still facilitating the migration of *Pairsa, Vetki*,*Gulsha, Tengraand Chingri* fishes from river to internal khal and vice-versa. However, drainage sluice gates are designed to control water for improvement of drainage system of the Polder area. Sluice gates are mainly operated in order to meet the irrigation purpose. Thus, the improved drainage sluices would hamper the migration behavior of the above mentioned fish species. Moreover, the migration of fish specieswould be very restricted with the replacement of the proposed drainage sluices.

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

Mitigation

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

- Follow sluice gate operation manual (Appendix-E) for allowing fish migration;
- Provide training to WMOs regarding gate operations;and
- Transferring juvenile fish from rivers to Polder.
- Fish pass may assist in the fish migration.

Residual Impacts

470. 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 very low.

Impact on Shrimp Farming and Livelihood

Impact

471. Shrimp farming is a common practice in this polder area. From the field visit, it wasfound that about 80% of the total area of land inside the polder has been converted to shrimp culture *Ghers*. A few area of paddy land wasfound at the periphery of the embankment near the Kurulia River. There is no paddy land in the middle of the polder area. A significant number of farmers are involved in shrimp farming in this area 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 unauthorized structures and water control structures will be stopped. As a result, paddy land area will increase compared to its base condition. On the other hand, shrimp farming area may be impacted due to reduction in saltwater intrusion. Thus, fish production from shrimp *Gher* may decline. The livelihood of the shrimp farmers will be impacted.

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

Mitigation

- 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 sweet water was available as these are eco-friendly in nature
- Alternative income generation, i.e. livestock rearing, poultry and integrated fish culture may create scope of alternative income for shrimp farm labour; and
- Implementationoflandzoning for shrimp *Gher* in the polder area.

Residual Impacts

473. 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**.

Risk of Embankment Failure

Impact

474. 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 point at the sensitive locations of the embankment. Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge 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 hands, 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 hass seriously weakened the embankment which increasingthe risk of embankment failure.

Mitigation

475. The following measures will 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 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 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 previses.

Residual Impacts

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

8.6. Positive Impact of the Project

Protect tidal flooding and storm surges

Impact

477. 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 60% of the embankment is under designed section and extremely vulnerable condition at Boyar Jhapa to Patkelpota along the Sibsa River, Paschim Kanmukhi, Karulia, Laskar areas of the polder which will be protected noticeably after implementation of the proposed interventions under CEIP.

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

Erosion protection

Impact

479. The proposed slope protection works along the embankment would protect the polder area from river erosion. If the proposed protective work is 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 due towave action during high tide. Moreover, it will safeguard social livelihood and ensure socio-economic security, assets along with the ecosystem of the study area.

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

Improved drainage system

Impact

481. After implementation of the proposed re-excavation of internal drainage *Khals* and construction (replacement and repairing) of drainage sluices and flushing 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 increase andalso increased water retention capacity of the polder area. Consequently, the cropping pattern will increase while presently about 80% of the Polder net area is covered by shrimp culture ghers. Drainage congestion in *Taltola khal, Garikhalir khal, Ulikhali khal, Sholadana khal, Tangramari khal, Masterpara khal, Boroitola khal, Patkelpota khal, Charbandha khal, Kuchia khal, Burimara/Hatuakhari khal, Choper khal, Sonakhali khal, Amorkata khal, Kainmukhi khal, Kalia khal, Parishanari khal, Loskar khal, Sibbati khal, Sannasidanga khal* and *Boxsodou khal* during monsoon will be removed and drainage pattern will be smoother than present condition.

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

Protect salinity intrusion

483. According to the proposed intervention, re-sectioning and retired embankment and construction (replacing and repairing) of drainage sluices and flushing sluices as per design

would preventsaline water intrusion in the polder area. Proper construction of sluices and adequate operation of the sluices will protect from saline water intrusion in the polder during dry season while about 80% of the net area of the polder is occupied by shrimp culture ghers. It is very important to operate the sluices properly so that WMOs would be formed in the polder and takeover the maintenance and operation of the sluices adequately to preventsaline water intrusion.

Change of cropping pattern

484. Presently, cropping intensity of the polder area is 100%. According to the proposed intervention, the polder would be protected from tidal and monsoon flooding and will arrest salinity intrusion and would remove drainage congestion in the polder area. Besides, drainage congestion will significantly reduce 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 feel to increase the production by using more HYV variety. Thus, it is expected that cropping intensity would be same as before in the polder area but production would be increased in future (Table 8.5).

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	Fallow	378	89
	Fallow	Lt. Aman	Fallow	44	11
Total				**422**	**100**

Source: Fieldinformation; 2015

Increased crop production

485. Presently, total cropped area is about 422 ha (NCA 422ha) which is totally occupied by rice crops. The farmers would be unwilling to produce crops for their increased demand of food under FWOP condition. In this situation about 1206 tons of crops is produced in the polder area (Table 8.6).

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

Baseline/FWOP				FWIP			Impacted area (ha)	Impacted production (m.tons)	% Change of production
Crop name	Crop area(ha)	Yield (m.tons /ha)	Production (m.tons)	Crop area (ha)	Yield (m.tons/ha)	Production (m.tons)			
Lt.Aman	66	2.01	132	44	2.2	97	-22	-35	-26
HYV Aman	356	3.02	1073	378	3.4	1284	22	210	20
Total	**422**	**0**	**1206**	**422**	**0**	**1381**	**0**	**175**	**15**

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

486. The crop production might be boosted moderately under the FWIP condition. The total crop production would be 1,381 tons. Rice production would increase mainly due to protection of agricultural land from river bank erosion, construction of structure and repair/replacement of structure with adoption of modern technology in crop production, change in cropping pattern, etc. Production would increase due to expansion of HYV Aman cultivation area. Additional 175tons (15% higher than base/FWOP situation) of rice would be produced in FWIP over FWOP (Table 6.5).

Impact

487. Agriculture production increase, reduction of drainage congestion, income generation is expected to improve the livelihood of the people. The 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

488. The following measures should be implemented to make project more beneficial to people:

- Irrigation should be provided atoptimum level with minimum conveyance loss.
- Involvement of WMOs in project activities would 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.

Afforestation

489. Implementation of afforestation program of this project will mitigate negative impacts associated with tree felling. Consequently, foreshore afforestation will enhance mangrove vegetation coverage surrounding the polder. Enhancement of mangrove vegetation will provide habitats especially for local wildifeand fishes.

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 the 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 hands, during construction period, Earthwork of embankment and constructing structure will create temporary employment opportunities for laborer of the polder. The employment Generation represents the different way of livelihood by which people can generate their income and improve their living standard.

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 females. In including distressed and widows who are dependent on others and do not have any definite source of income. 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.

Livelihood Development

492. Polder 23 was one of the worst affected polders during cyclone *Aila*. The project is expected to increase resilience of people within Polder 23. On the other hand, intrusionof 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.

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 are being dry up and cause scarcity of water, As a result, people cannot use water for their social needs at the time. Hence, if the proposed channels are re-excavated for drainage, it will ensure water for the various social uses.

Disaster incidence

494. The study area being nearest to the Bay-of-Bengal natural disasters often hit this area withouthaving 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 the polder area will protect them from different natural disaster e.g. tidal surge, river erosion, flooding, etc.

Seasonal out-migration

495. Due to lack of employment opportunities, out-migration is most frequent in the area. But it is expected that the intervention may reduce the seasonal out migration of day laborers from this polder due to creation of employment opportunity 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.

496.

497.

Impact of major periodic maintenance works

Impact

498. The major periodic maintenance works during project operation phase include (i) re-sectioning of embankments including turfing; (ii) repair or replacement of metal works/hinges, lifting mechanisms, gates, block works, head / wing walls etc.; and re-excavation of khals by LCSs / PICs. It is expected that these periodic maintenance works would have minor negative and positive environmental and social impacts. However, re-sectioning of embankment along with turfing may hamper movement of local people temporarily. Besides, temporary damages of herbs, shrubs, various species of grass and bushes would take place due to soil dumping for re-sectioning work. The repairing works of structure would obstruct movement and migration of fish species like Chingri, Baila, Pairsa and fresh water fish like puti, tengra, bele, etc. Fish hatchling movement will also be hampered due to repairing works during hatchling period (May-July). On the other hand, a significant number of local labour will be recruited for earth work, repairing of embankment and afforestation, soil dumping and compaction of earth. Most of the maintenance works will be done by the LCS/WMO involving 60% male and 40% female from the local area. Thus, employment access to both male and females of locality during operation /maintenance phase will be promoted significantly and they can also take part in different decision making processes.

Mitigation/Enhancement Measures

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

8.7. Impacts from CC-Block Manufacturing Plant

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

8.7.1. Operation phase

500. 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

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

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

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

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

8.7.2. Beneficial impacts

504. 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.

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

8.7.3. Negative impacts

Negative Environmental Impacts

8.7.4. Emissions to air and ambient air quality

Potential Impacts

506. 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

507. 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.

508.

509. 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)

510. 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.

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

Residual impact

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

8.7.5. Noise

Potential Impacts

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

Mitigation

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

- Restricting/limiting operation activities during day time
- Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards
- Vehicles and machinery will have proper mufflers and silencers
- Provision of noise barriers at residential areas and other sensitive receptors
- Installing vibration isolation for mechanical equipment
- The plant operators will be instructed to properly use the equipment, to minimize noise levels
- Liaison with the communities will be maintained and grievance redress mechanism will be established.
- Provision and use of effective earmuffs and where necessary additional earplugs and other PPEs by workers to be ensured.

• Introduction of rotational works of workers at high noise area to limit the time spent at work site and conduct of regular hearing test of workers

Residual impact

515. 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

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

Table 8.7: Noise Level Guidelines (Source: WB Guidelines)

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

8.7.6. Waste Management

Potential Impacts

517. 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

518. 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.

519. 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

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

8.7.7. Contaminated Land and Hazardous Materials Management

Potential Impacts

521. 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.

522. 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

523. 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.

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

Residual impact

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

8.7.8. Occupational Health and Safety

Potential Impacts

526. 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

527. 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

528. 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.

- 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:
  - 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).
  - 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).
  - 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.
  - 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

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

8.7.9. Community Health and Safety

Potential Impacts

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

Mitigation Measures

531. 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

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

8.7.10. Cumulative and Induced Impacts

533. 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.

534. With the construction of the automated CC plant land use has changed for the time being but may remain so in the long run.

8.8. Decommissioning phase

535. This section provides additional, specific guidance on prevention and control of potential impacts that may occur during decommissioning of the CC block plant. In order to avoid repetition, cross-referencing is made to above sections.

8.8.1. EnvironmentalIssues

Air Quality, Noise and Vibration

Potential Impacts

536. 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.

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

8.8.2. Solid waste and contaminated land

Potential Impacts

538. 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.

539. 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.

540. 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

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

8.8.3. Surface water

Potential Impact

542. 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

543. 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

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

8.8.4. Occupational and community health and safety

Potential Impacts

545. 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

546. 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

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

8.9. Summary of Assessed Impacts

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

9. Cumulative Impacts

9.1. Cumulative Impacts

549. 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.

550. 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.

551. 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.

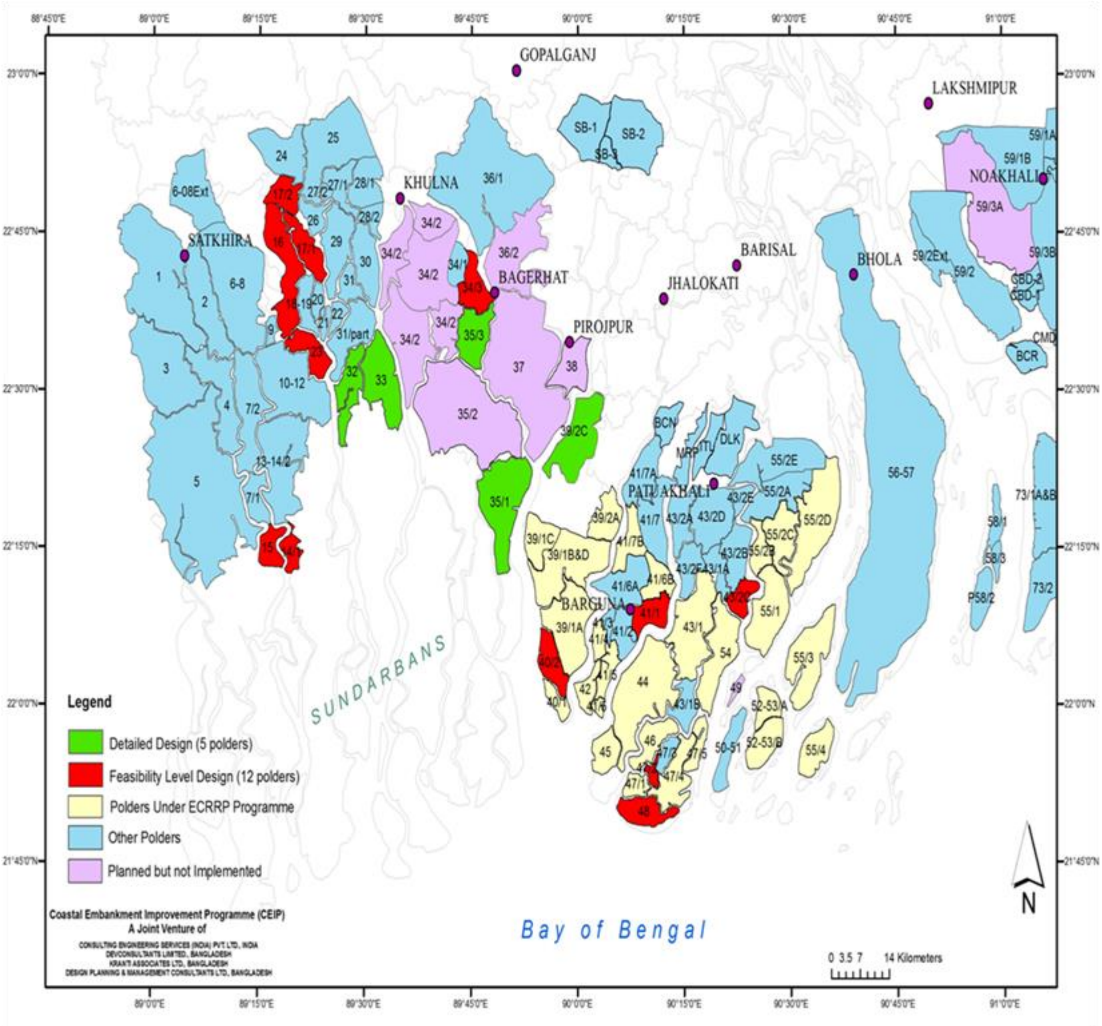
552. Several existing, on-going and planned projects also exist in this region. Such projects may have impact on the hydrological network, life and livelihood of people, environmental quality, natural ecosystem, flora-fauna, etc. of Polder 23 This Chapter attempts to analyze several indirect effects regarding several existing and ongoing projects, as well as the implementation of different interventions proposed in Polder 23 under Coastal Embankment Improvement Project-1 (CEIP-1). Besides, necessary mitigation measures based on analysis of cumulative impacts are proposed.

9.2. Proposed CEIP interventions on Polder 23

553. 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 to tidal flooding as well as natural disasters by upgrading the whole embankment system. The embankment improvement and rehabilitation approach will be adopted over a period of 15 to 20 years and in this regard a total number of 17 polders have been selected through a participatory screening process. Among these 17 polders (shown in **Map 9.1**), 4 polders (Polders 32, 33, 35/1, 35/3) were selected for rehabilitation works under the first phase of CEIP (CEIP-I), which are being implemented. The other 13 polders have undergone pre-feasibility studies and would be implemented gradually in later phases.

9.2.1. Synopsis of existing and on-going projects around Polder 23

554. Apart from CEIP interventions, there are some other development projects nearby Polder 23, implemented locally or regionally. Activities of these projects may generate cumulative impacts on the polder in future. **Table 9.1** below shows a list of various projects in relevance with Polder 23, undertaken by different line agencies in Khulna, Bagerhat and Satkhira districts.



Map9.1: Locations of Polders under CEIP-I

Table 9.1: List of water management projects

Agency	Project Name	Duration	Location	Sensitivity
	National			
MoDMR	Comprehensive Disaster Management Program (CDMP), Phase II	2010-ongoing	Entire country	Negligible
BWDB	Projects under Climate Change Trust Fund	2013-ongoing	Entire country	Low
	Water Management Improvement Project (WMIP)	2010-ongoing	Entire country	Low
	Regional			
BWDB	Blue Gold Program	2013-ongoing	Coastal zone	Moderate

Agency	Project Name	Duration	Location	Sensitivity
	Coastal Embankment Rehabilitation Project (CERP)	1995-2004	Coastal zone	Negligible
BFD	Marine Shrimp culture technology	1998-2004	Coastal zone	Moderate

555. The projects (listed in **Table 9.1**) which have or may have **moderate sensitivities** on some of the environmental or social components of Polder 23 are briefly discussed in the following sections.

9.3. Cummulative Impacts of proposed and existing projects

9.3.1. Impact on hydrology and flooding situation

556. The major part of Polder 23 is surrounded by the Sibsa in North-Eastern direction. The Kurulia and the Minaj river is flowing along West and South direction of the polder respectively. The existing crest levels of the polder ranges from 4.27 mPWD above MSL. Re-sectioning works are proposed in the polder under CEIP, which would increase its crest level from 4.5 to 5.0 mPWD above MSL. This increase would reduce storm surge and saline water to enter into the polder.

557. Among all CEIP polders, Polder 18-19 is located at the upstream (North-West direction) of Polder 23. The existing crest level of Polder 18-19 is 3.85 mPwd which will be increased up to 5.8 mPWD due to proposed interventions. The proposed protective interventions of Polder 18 and19 may divert the seasonal storm surges to the Polder 23. As a result of this diversion, salinity intrusion into the Polder 23 may be increased that will deteriorate the agricultural production and exacerbate the social life. There is a tendency of accumulating silts along the perennial rivers which will increase in volume by wastes of proposed construction works that may cause induced hydraulic pressure on Polder 23. However, the downstream part of Polder 23 may have less effect of the following impact.

558. The other CEIP polders are far away from the project area that’s why their interventions have negligible impact on Polder 23.

9.3.2. Impact of construction materials on local markets

559. The construction materials to be required for re-sectioning of the embankment, water regulatory sluices, flushing sluices, and bank protection work will include soil, cement, and steel, stone and sand. The constructions materials especially sand and stone for construction of sluice gate to be procured mainly from Sylhet directly. Coarse sand available from Sylhet and stone chips (good quality) may be imported from neighbor countries. Cement and Steel will be procured from company sale market of Khulna or will be procured from cement factory and steel factory directly which would not cause any impact on market price. A small amount of sand and cement can be procured from the local market at adjacent to the polder or from Khulna during executions of construction works. No significant impact will be caused due to sand procurement of sand and cement from local market.

9.3.3. Impact on Livelihood

560. The socio-economic condition of Polder 23 will be ameliorated due to the overall development of this region, i.e., construction works of Polder 16 will attract labors from outside as well as local people will also get working opportunity.

9.3.4. Impacts on rivers/water courses hydrology

561. Because of polderization, the sediments which earlier (before polderization) could spread out over the Polder area is being deposited in the river course. As a consequence, river bed has been rising and aggravating erosion situation of the Polder area as well as affecting navigation. This situation will also continue after rehabilitation of Polder. Tidal influx would also remain within the river course and exert hydraulic pressure on the Polder and deteriorate erosion.

9.3.5. Impacts on fish migration and biodiversity

562. The successive siltation in peripheral rivers and canals of Polder 23 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 Kurulia and Minaj rivers and downstream of Sibsa River during high tide. This increased volume of water will enhance fish migration in that water body. Consequently, fish migration of surrounding canals will be improved. In future, the salinity tolerant fish species will dominate while fresh water fish species may decrease.

impacts of Blue Gold interventionson on Polder 23

563. A total number of 12 Polders in Satkhira, Khulna and Patuakhali districts have been selected for implementation of the program in the first phase. Among these, Polder 22 is adjacent to Polder 23 in the North direction and therefore may generate some impacts in future. The existing crest level of Polder 22 is 3.45mPWD above Mean Sea Level. The proposed re-sectioning works are carried out along the periphery of these Polders up to the design elevation of around 5.8 mPwd, there would be more floodplain sedimentation adjacent to the downstream Polders. This may result increased sedimentation along the Sibsa river system. Due to renovated elevation of embankment, tidal flow velocity might increase in the downstream which would create more pressure along the peripheral embankment of Polder 23.

Impacts of Marine Shrimp Culture Technology

564. In 1998, Bangladesh Forest Department (FD) extended the culture technology of marine shrimp on macro scale in Khulna, Bagerhat, Sathkhira and Cox's bazar. The project continued upto 2004, seeing viral attacks (of white spot syndrome virus, taura syndrome virus, and infectious hypodermal and haematopoietic necrosis virus) on shrimps in the later stages of the project implementation. However, the popularity of shrimp culture spread in local level. Shrimp culture in Polder 23 during dry season is a very common practice like other surrounding Polders. The shrimp culture is not labor intensive, thus creates more unemployment problem. In the dry season, a number of places in the embankment were cut down to allow the entry of saline water through Taingramari khal, Kuchia khal etc which may reduce the strength of the embankment by creating weak points. One notable positive impact of shrimp culture in Polder 23 is that it initiated a financial revolution of the Polder area however; it has become a monopoly business. By now, the local people have fallen in an ambivalent situation that they are suffering by loosing agricultural land and increased shrimp culture in their land. Moreover, there are some negative environmental impacts i.e. infertility

of aquatic animals, flora and fauna due to overtopping ofsaline water from shrimp culture ponds.

9.4. Reciprocal Impact

565. Reciprocal impacts of Polder 23 have been assessed based on the model results conducted Institute of Water Modelling (IWM). IWM used Rainfall runoff model, hydrodynamic models and Storm surge model to analyze the existing meteorological situation of the polder area. They have evaluated the physical changes in the relative polders, which may occur due to climate change. All data used in the model setup and calibration (including topography, soil maps, land use maps, and weather data, river network and cross-section, water level, discharge and salinity) were obtained from different sources. The climate change scenario RCP 8.5 is used in the models to simulate the climate change effects.

566. The runoff inside costal Polder is simulated using NAM (Nodbor Afstroming Model) of DHI mike package. In the NAM model a lump watershed was defined, which considered the area of polder 23. The contribution area of internal drainage system of Polder 23 was defined in the mike 11 network module. Taking 2012 as base year, the peak runoff occurred in the beginning of August with a magnitude of 36.11 cumec. The year 1986 was selected as design year corresponding to 10 year return period. The peak runoff without considering climate change is 52.62 cumec whereas 65.23 cumec peak runoff is obtained at the end of September considering climate change. The peak runoffs without considering climate change and considering climate change are 46% and 81% higher than the base year respectively.

567. The assessment of effectiveness of existing drainage system is performed under climate change scenario RCP 8.5. Climate change condition is added to the model by considering sea level rise of 50 cm at downstream boundary, increase of flow of Ganges with 16% to 28%, Brahmaputra with 8.5 % to 18.5% and Upper Meghna with 8% to 11%. Five days rainfall event is considered with 10-year return period for the simulation for the existing drainage system.

568. From the simulation, flood free (FF) area and F0 (0~0.3m) area cover about 73.06% and 17.05% respectively without considering climate change. The fulfillment of drainage criteria requires about 85% to 90% FF and F0 land, whereas 90.1% of FF and F0 land was found from the simulation without climate change.

569. Considering the climate change scenario FF and F0 land cover are reduced to 53.30% and 23.78% respectively. However, F1 land class (water depth .03m to 0.9m) increases from 9.88% to 21.76%. 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.

570. The newly developed, calibrated and validated Bay of Bengal Model has been applied for the study of storm surge modeling. It is a combination of Cyclone and Hydrodynamic (MIKE21FM) models. Three open boundaries are defined in the model, two in the North in the Upper Meghna River at Bhairab and in the Padma River at Baruria. Another one is in the South in the Southern Bay of Bengal up to 16° latitude. The coastal Polders are included in this model as dike. The surge water levels in different return period are presented in Table 9.2. It is observed that due to climate change, surge level increases up to 0.17 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	2.52	2.90	0.38
25	3.09	3.42	0.33
50	3.51	3.81	0.3
100	3.92	4.20	0.28
Sidr	3.16	-	-
Aila	3.16	-	-

571. 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 23 are 21.20, 29.61, 35.52 and 41.26 m/s whereas during Sidr and Aila the wind speeds were 33.52 and 22.0 m/s respectively.

572. Wind speed for 25 years return period is used for determining the wave height considering climate change. The wave height simulated for Polder 23 is 0.32 m.

573. The South West Regional Model (SWRM) has been calibrated and validated using annual maximum monsoon water level of 27 years (1982-2011) for monsoon water level analysis. Water level corresponding to log-normal return period of 10, 25, 50 and 100 are 3.07, 3.15, 3.21and 3.26 m + PWD without considering climate change. Water levels considering climate change are 3.58, 3.67, 3.73 and 3.77 m+PWD respectively.

574. 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 4.16 m + PWD. The present crest level of the Polder varies from 3.78 to 4.15 m+PWD. So, the crest level is poorly sufficient to address the future climate change.

10. Environmental Management Plan

575. This Chapter presents the Environmental Management Plan (EMP) for the CEIP-I activities in the Polder 23. The EMP essentially provides the implementation mechanism for the environmental and social mitigation measures discussed in **Chapter 8**

10.1. Objectives of EMP

576. The basic objective of the EMP is to manage, prevent, and mitigate potentially adverse impacts of Project interventions in the Polder 23. 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 8**.
- Assign responsibilities of project proponent, contractors, consultants, and other members of the Project team for the environmental and social management of the Project;
- Define a monitoring mechanism and identify monitoring parameters to ensure effective implementation of the mitigation measures.
- Assess environmental training requirements for different stakeholders at various levels.
- Describe communication and documentation requirements.

> The EMP should be included in all the bid documents of Polder 23 and will become a part of the civil works contact. The strict implementation of the EMP and project management's strict enforcement of the adequate construction practices and standards will greatly reduce the negative impacts of the Project.

10.2. EMP Components

577. 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

578. These components are discussed in following sections.

10.3. Institutional Arrangement

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

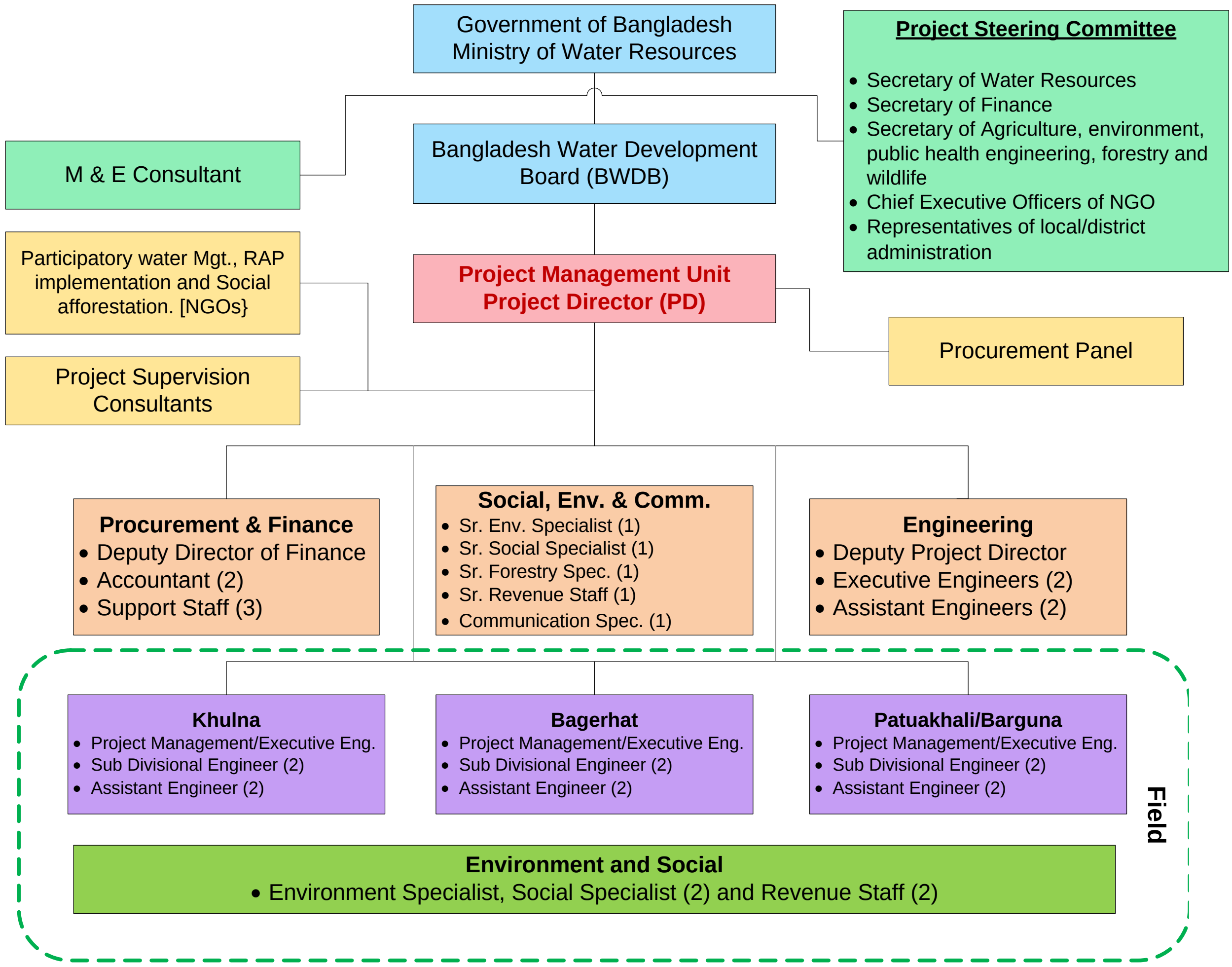


Figure 10.1: Organogram showing the institutional setup for CEIP-1

580. The institutional arrangements proposed to implement the EMP of Polder 23 are described in detail below.

Overall Responsibility

581. 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.

Construction Phase

Environment and Social Staff in PMU

582. 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.

583. 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)

584. The DDCS&PMSCSCswill be responsible for the overall supervision of Polder rehabilitation related activities. The DDCS&PMSCwill ensure quality control and report to PD. Theywill also assist the ESCU for ensuring environmental compliance and monitoring of progress including EMP and/or ECP implementation. The DDSC&PMSCwill supervise the Contractors, ensuring design compliance and quality of works.For supervising the EMP implementation, DDCS&PMSCwill have dedicated and adequately qualified and experienced environmental staff including field-based environmental monitors (EMs).The EMs will supervise and monitor contractors to ensure compliance of the EMP.The DDCS&PMSenvironmental staff will maintain coordination with the ESCU for the effective implementation of EMP and other environmental commitments and obligations of the Project.

Contractor's Environment Supervisors

585. The construction Contractors will have an adequate number of dedicated, properly qualified and experienced, site-based Environmental Supervisors (ESs) at the construction sites. The ESs will be responsible to implement various aspects of the EMP particularly the mitigation measures to ensure that the environmental impacts of the construction works remain within acceptable limits. The ESs will maintain coordination with the DDCS& PMSCs at the site. The ESs will also be responsible to conduct environmental trainings for the construction crew.

Post-Construction Phase

586. BWDB core unit has post of 4 Assistant Chiefs and 2 Deputy Chiefs to oversee the overall environmental compliance of BWDB implemented projects. Under CEIP, the ESCU will provide training to the BWDB people responsible for monitoring of environmental compliance. Thus, a smooth transition to BWDB will happen to ensure environmental compliance during the O&M after the project completion. These staff will be responsible to manage the environmental aspects of the operation and maintenance of Polder, its water control structures, and other relevant issues such as protection of key environmental resources of the polder and maintain fish migration. Water Management organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (Nov 2000) and involved the beneficiary communities. WMOs will be trained by BWDB to ensure environmental management during project operation. The Environmental Management Unit of BWDB will ensure and oversee the environmental management during project implementation and operation. The Water Management Organization will also be trained and involved in EMP implementation during the operation phase.

10.4. Mitigation Measures and Plan

587. 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.

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

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

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

590. 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 Chapter8. Moreover, cost related EMP has been presented in a different Table 10.6.

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

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
A. Pre-construction Phase			
Deterioration of 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 materials during day time instead of night. • Exhaust emissions from trawler and equipment should comply with the standards of DoE.	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Sprinkling of water and ramming the materials of stockyard regularly. • Stockyard should be covered during non-working period		
Change of 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, the instructions should be specified in the tender document. • Labor shed/camp should be constructed on government khas land. • Avoid impacts on local stakeholders.	Contractor	DDCS&PM SC, M&E Consultant, BWDB
Clearances of vegetation	• Choose barren land and ground of Sluice Gateman's houses for stocking construction materials • Proper compensation against tree felling inprivate land should be given to the owners • Implement tree plantation at the damaged sites and sluice surroundings after completion of construction works • Labor should be given early notice about plant conservation especially for prescuring the countryside strips of plantation at slope protection site (Chainage 10.0 to 11.5 km).	Contractor	DDCS&PM SC, M&E Consultant, BWDB
Increase in vehicular during mobilization	• The contractor should prepare a traffic management plan (TMP) and obtain approval from the Design Consultant (DC) and Construction Supervision (CS) consultant. • Contractor should also implement mobilization plan considering water vessels and launch movement in the external rivers and avoid the launch movement time. • The TMP should be shared with the communities and should be finalized after obtaining their consent. • The TMP should address the existing traffic congestion particularly at the Paikgaccha Bazar, Sholadana Bazar and Amurkata Bazar. • Ensure minimal hindrance to local communities and commuters. • The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works should be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. • The works of the first half should be completed, and then of the other half should be undertaken. • Work schedule tobe finalized in coordination and consultation with local representatives and communities, specifically the Union Parishad members of the polder.	Contractor	DDCS&PM SC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• 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 limitedin 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 moving pattern and management system for the local stakeholders using multimedia presentation and showing video at different common population gathering places in the polder area.		
B. Construction Phase			
Deterioration of air and noise quality	• 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 near 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 should be instructed to use the equipment properly, to minimize noise levels. • Liaison with the communities should be maintained and grievance redress mechanism will be established at the site.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Hindrance to the natural drainage system	• Some temporary 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 temporary earthen dams during construction work. • Both contractor and BWDB should supervise the construction work • Contractor should ensure that drainage channels are not obstructed or clogged by the construction activities. • Contractor should ensure that construction activities do not inundate cultivation fields.	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
Impact 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 crop fields during construction activities. • 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 dumped in agricultural land. • Contractor should maintain liaison with communities.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Impact on irrigation	• Contractor should construct bypass channel before construction / replacement / demolishing 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 between November to May	Contractor	DDCS&PMSC, M&E Consultant, 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 condtion to minimize impacts on spawning and subsequently nursery ground of fish. • Earth work should be conducted during the dry season (November-February) • Sequence of work at the bank side of Kobodak and Sakbaria rivers will be carefully planned to minimize impacts on spawning and subsequently nursery ground of fish. • Contractor will maintain liason with experienced fishermen.	Contractor	DDSCS&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 • 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	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	bank side to keep space in other side for accomplishing migration to meet up the biological needs like spawning, feeding etc. • Dismantle the bunds and other obstructions built for supporting the construction of structures as soon as the construction is over. • In case of manual re-excavation of khals, compartment would be built and bailing out of water from one compartment to another for less damage to fish and excavate in cascading manner. • Re-excavation of drainage khals will follow the construction of regulators by spanning a shortest possible time. Re-excavation of Khals should be implemented by maintaining the alignment of side so that fish can utilize the space on the other side for its migration. As a result, construction activities will have minimum hindrnace to fish migration. • Contractor will maintain liaison with fishers and farmers so that they could realize the issue for minimum impact to the shrimp farming and paddy cultivation. •		
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&PM SC, M&E Consultant, BWDB
Clearance of vegetation	• Collect soil from barren land as much as possible • Proper turfing should be implement at embankment slopes with local grasses (i.e. Durba (Cynodon dactylon) , Mutha (Cyperus rotundus)) and ensure regular monitoring of turf grasses till they matured		
Outbreak of plant diseases	• Labor should be aware about the right way of plantation works without damaging any existing vegetation • Keep setback distance in plantation plan layout from the water passes • All kinds of polyethylene bags and plastic ropes should be piled up in a pit for recycling • 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 suitable species for plantation and spacing of the saplings • Develop a pest management plan for the holistic afforestation	Contractor	DDCS&PM SC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Collect saplings from nearer natural source (i.e. from The Sundarbans forests beside Shibsha river) as much as possible and consult with Forest Department for providing required saplings		
Safety and Public Health Hazards	• The contractors should prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants. The Plan should also include awareness 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 should 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 should 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 should have protective fencing to avoid any unauthorized entry, where appropriate and possible • Health screening of employees would be a Contractor obligation prior to laborers working on site and living in the temporary accommodation facilities. The health screening would entail normal review of physical fitness and also include a review of appropriate vaccinations. Workers would be given vaccinations where required; • All employees need to carry out induction health and safety training prior to commencement of work. OHS issues would be part of the employee training plan. Training would include the provision of appropriate written or visual materials to reinforce learning. Where illiteracy levels are high, OHS issues need to be covered more frequently than normal in toolbox talks; • Public awareness training and workshops on safety and health risks should be conducted for local communities prior to and during construction operations. • Observing statutory requirements relating to minimum age for employment of children and	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	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 should establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. • The contractor should adopt a Human Resource Policy appropriate to the size and workforce which indicates the approach for management employees (this could be part requested in the tender process); • Produce job descriptions and provide written contracts and other information that outline the working conditions and terms of employment, including the full range of benefits; • Provide health insurance for employees for the duration of their contracts; • Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts; • Develop a recruitment process for community employees that involves local authorities in clearly understood procedures; • Employ a community liaison officer (this could be full time or part of another post's responsibilities); • Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training; • Report regularly on the labor force profile, including gender, and location source of workers; • Report regularly on labor and working condition key performance indicators, for instance hours worked (regular and overtime) during period and cumulatively, hours lost, number and type of accidents, near misses, site audits and meetings; trainings, and use of labor grievance mechanism;		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase; • Organize a training program and keep training registers for construction workers; • Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project. • Waste management plan to be prepared and implemented in accordance with international best practice. • Liaison with the community will be maintained.		
Labor force related impacts	• The Contractor will provide proper housing for his staffs at a site with adequate facilities securing neighbours are not disturbed. • The Contractor will prepare and implement a Code-of-Conduct for his staff showing respect to comply with and not offend local customs and cultural norms.	Contractor	DDCS&PM SC, M&E Consultant, BWDB
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&PM SC,, M&E Consultant, BWDB
Hindrance for Pedestrian and Vehicle Movement	• The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works should be carried out in segments and soil should be placed linearly on 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 should be finalized in coordination and consultation with local representatives and communities. • Local routes shouldnot be blocked as much as possible. If unavoidable, alternative routes will be identified in consultation with local community. • GRM will be put in place.	Contractor	DDCS&PM SC, M&E Consultant, BWDB
Social unrest between Local worker and outside worker	• Awareness programs should be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from	Contractor	DDCS&PM SC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	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 should be respected and honored. • GRM should 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.		
Seasonal Impacts due to Natural Hazards	• Weather signals should be considered by the contractor during construction works. • Radio and television should be provided in all the labor sheds for receiving weather information through these media. • Ensuring rigorous standards for occupational health and safety are in place.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Damage to Local Infrastructure	• The condition of the infrastructure being used for the construction and transportation activities will be regularly monitored. • All damaged infrastructure will be restored to original or better condition. • To take preventive measures for protection of local infrastructure.	Contractor	DDSCS&PMSC, M&E Consultant and , BWDB
C. Post Construction 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 will be prepared and implemented for the water control structures. These procedures will be translated in bangle as well. • Capacity building of WMOs will be carried out.	BWDB with the help of DAE	BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
Increased Use of Agro-chemical	• Capacity building and awareness rising of the farmers should be carried out to practice Integrated Pest Management (IPM), Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) in order to minimize usage of chemical inputs. • Farmers group should have close contact with DAE for adoption of various measures of IPM, ICM and GAP. • Farmers should be encouraged to use organic and green manure to increase soil fertility while avoiding water contamination. • Farmers should be encouraged to cultivate leguminous crops (Nitrogen fixing) to enhance the soil quality as well as soil productivity.	BWDB	BWDB
Reduced Fish Migration Time	• Follow sluice gate operation manual (Appendix-E) for allowing fish migration; • ; • Provide training to WMOs regarding gate operations; and • Transferring juvenile fish from rivers to Polder. • Fish pass may assist in the fish migration.	BWDB	BWDB
Impact on income generation	• 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 as these are eco-friendly in nature • Alternative income generation i.e. livestock rearing, poultry and integrated fish culture may create scope of alternative income for shrimp farm labour; and • Implementation of land zoning for shrimp Gher in the polder area.	BWDB	BWDB
Risk of Embankment Failure	• Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the eastern side of the Polder should 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 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 previses	BWDB	BWDB
	•		

591. Based on the experience, a generic Mitigation Measures for EMP has been presented in Table 10.2 for reference. This can be used as a reference material for comprehending the scope of the EMP.

Table10.2: 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 the polder construction/rehabilitation will be identified. • Selection of borrow pit areas for earthen material collection. • No objection from land owners as well as Revenue authorities as applicable • Contractor shall ensure that borrow pit materials used for embankment filling is free of pollutants • Disposal of excess soil will be made at site with no objection from DoE and local authority
Borrowing of Earth	**Borrow Area Selection** Borrowing of earth from a close area of the toe line on any part of the embankment is prohibited. Earth available from dredging as per design, may be used as embankment material (if necessary and applicable), subject to approval of the Engineer, with respect to acceptability of material. Borrowing is to be avoided from the following areas: • Lands close to the toe line and within 500 m from the toe line. • Irrigated agricultural lands (In case of necessity for borrowing from such lands, the topsoil shall be preserved in stockpiles. • Grazing land. • Lands within 1km of settlements. • Environmentally sensitive areas such as reserve forests, protected forests, sanctuary, wetlands. A distance of atleast 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 the following data base are documented for each identified borrow areas before commencing the borrowing activity that provide the basis of the redevelopment plan. • Chainage along with offset distance; • Area (Sq.m); • Photograph and plan of the borrowing area from all sides; • 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 borrowing area; • Quantity excavated (likely and actual) and its use; • Copy of agreement with owner/government;

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Community facility in the vicinity of the borrow pit. • Rehabilitation certificate from the land owner along with at least four photograph of the rehabilitated site from different angles.
Excavation operation and Management of Excavated Material	To minimize the adverse impact during excavation of material the following measures are to be undertaken: • Adequate drainage system shall be provided to the excavated area • At the stockpiling locations, the Contractor shall construct sediment barriers to prevent erosion of excavated material due to runoff. The followings precautions shall be undertaken during quarry operations. • Overburden shall be avoided. • During excavation slopes shall be flatter than 20 degrees to prevent any sliding. • In case of blasting, the procedure and safety measures shall be taken as per DOE guidelines. • The Contractor shall ensure that safety measures of all workers will be taken. • The Contractor shall ensure maintenance of crushers regularly as per manufacturer‘s recommendation. • During transportation of the material, measures shall be taken to minimize the generation of dust and to prevent accidents.
Contamination of soil by fuel and lubrication	Ensure leakproof carriers (i.e, containers, barrels or lorries) for oil and lubricants .
ECoP 2: Water Resource & Hydrology Management	
Hazardous Waste Management	The contractor will minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes).
Ponding of water/water logging	• No ponding of water especially near the waste storage areas and construction camps is to be allowed • Discard all the storage containers which are capable of storing of water, after use or store them in inverted position • Reinstate relief and landscape • Monitor drainage pattern after high down pouring and recession flood • Connect water pockets to the nearest drainage structures/canals
Soil Erosion and siltation	The Contractor shall • Water the material stockpiles, access roads and bare soils on an as required basis to minimize dust • Increase the watering frequency during periods of high risk (e.g. high winds) • All the work sites (except permanently occupied by the road and supporting facilities) will be reinstated to its initial conditions (relief, topsoil, vegetation cover) • Ensure that roads used by construction vehicles are swept regularly to remove sediment.
Construction activities in water bodies	• Protect water bodies from sediment loads by silt screen or bubble curtains or other barrier. • No cement and water used for curing the cement concrete is to be discharged directly into water courses and drainage inlets

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Monitor the water quality in the runoff from the site or areas affected by dredge plumes, and improve work practices as necessary
ECoP 3: Air Management	
Construction vehicular traffic	The Contractor will • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner • Cover haul vehicles carrying dusty materials (cement, borrow and quarry) moving outside the construction site • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions • Control the movement of construction traffic • Water construction materials before loading and being transported • Service all vehicles regularly to minimize emissions • Materials will be transported to site in off peak hours.
Construction activities	• Water the material stockpiles, access roads and bare soils as and when required to minimize the potential environmental nuisance due to dust. • Increase the watering frequency during periods of high risk (e.g. high winds). • Stored materials such as excavated earth, dredged soil, gravel and sand shall be covered and confined to avoid being wind-drifted • Minimize the extent and period of exposure of the bare surfaces • Reschedule earthwork activities or vegetation clearing activities, where practical, if necessary avoid during periods of high wind and if visible dust is blowing off-site • Restore disturbed areas/side of the embankment as much as practicable by plantation/vegetation/grass-turfing • Establish adequate locations for storage, mixing and loading of construction materials, in such a way that dust dispersion is prevented for such operations • Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems
Odor from Construction labor Camps	• Construction worker‘s camp shall be located at least500 m away from the nearest habitation. • The waste disposal and sewerage system for the camp shall be properly designed, built and operated so that no odor is generated.
ECoP 3: Agriculture Management	
Loss of Top Soil	• Soil from fallow lands/ non-agricultural lands will be used in earthwork of the embankments • Collect/strip top soil before earth filling and store for reusing them during final surfacing of embankment top and tree plantation/afforestation. • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m • Remove unwanted materials from top soil like grass, roots of trees and similar others • The stockpiles will maintain slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil • Locate topsoil stockpiles in areas outside drainage lines and protect from erosion

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Spread the topsoil to maintain the physico-chemical and biological activity of the soil. • The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites • Topsoil stockpiles will be monitored and if any will adverse conditions if identified are to be minimized through corrective actions whice will include: • Anaerobic conditions-turning the stockpile or creating ventilation holes through the stockpile; • Erosion – temporary protective silt fencing will be erected;
Soil salinity	Use of duckweed will remove soil salinity • Flushing with pre-monsoon rain water will reduce soil salinity. • Saline tolerant crops need to be cultivated. • Environmentally and socially responsive shrimp farming e.g. shrimp-rice farming system to be encouraged. • Increase upland discharge of fresh water will push back ingress of saline water from the sea • Green manure application is to be promoted • Ground water abstraction for shrimp farming will be avoided.
ECoP 4: Noise Management	
Construction vehicular traffic	• Maintain all vehicles in order to keep them in good working condition in accordance with manufactures maintenance procedures • Organize the loading and unloading of trucks, and handling operations for minimizing construction noise at the work site.
Construction machinery	• Select appropriate site for all noise generating activities to avoid noise pollution to local residents • Maintain all equipment in order to keep it in good working condition in accordance with manufactures maintenance procedures.
Construction activity	• Notify adjacent landholders/Schools prior to any typical noise events outside of daylight hours • Employ best available work practices on-site to minimize occupational noise levels • Install temporary noise control barriers where appropriate • Plan activities on site and deliveries to and from site to minimize impact • Monitor and analyze noise and vibration results and adjust construction practices as required • Avoid working during 09:00pm to 06:00 am within 500m from residences.
ECoP 5: Ecology Management	
Flora	
Vegetation Clearance	• Tree felling will be performed upon preliminary notification to the relevant authority (Divisional Forest Office, DoE). • Preparation of maps in GIS format, cadastral description of trees to be felled, marking, and supervision of Forest Department are necessary elements of the procedure. • Provide adequate knowledge to the workers regarding nature protection and the need of avoiding felling trees during construction • Fruit and timber trees owned by local population will be compensated at their replacement cost according to market prices

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Plant Management	• Tree seedlings are planted in a way that minimizes damage to the soil, while facilitating seedling survival. Appropriate tree seedling species are to be selected for maintaining long-term productivity. • Focus on tree species suitable for site condition • Prevent unreasonable species resulting slow growth, less water and soil conservation and pest or disease outbreaks • Local species as planting materials, since natural selection and succession are most suitable for local climates and natural conditions • Single species or clone monoculture are to be avoided • Choose suitable species for berm andturfing
Planting	• Leave set back requirements around streams, restricted areas e.g. native vegetation, protected riparian strips, historic and heritage sites, research areas. • For nursery raising, physical and biological controls are practiced to control the pests and diseases in the nurseries. • Do not plant spread-prone species on sites where there is a high risk of uncontrollable wilding spread beyond the boundaries of the plantation. • Consider appropriate species, patterns and layout when planting areas with high visual values and/or with important recreational values
Polypropylene Bags Handling	• Make a Borrow Pit at each site for collection of poly bags • Collect all bags at the pits after plantation • If feasible, inform private sector to collect those bags for recycling
Pest Management to Nursery	• During outbreak of any deadly plant disease develop a plan to manage pest in coordination with neighbors by identifying existing pests and diseases and the risks for introduction of new pests and diseases. • Share the plan with financial Bank before application.
Water Management	• Install temporary sediment basins, where appropriate, to capture sediment-laden run-off from nursery • Divert runoff from undisturbed areas around the harvesting site • Stockpile of fertilizer or agrochemical away from drainage lines • Prevent all solid and liquid wastes against entering the waterways by collecting solid waste, oils, chemicals, fertilizers waste and transport to an approved waste disposal site
Fauna	
Construction works in the surrounding lands	• Pre-entry survey and prevention of damage to fauna prior to the start up of works • Limit the construction works within the designated sites allocated to the contractors • Not be allow any destruction of nests or eggs of migratory birds • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching.
ECoP 6: Fisheries Management	
Construction works in the rivers and on the surrounding lands	• Critical breeding areas of major fish species will be identified and declared as sanctuaries. • Creation of small ditches and pools that may trap the fishes will be avoided.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Creation of artificial waterfalls and other barriers for migration will be avoided. • Natural river channels are to be reinstated after completion of construction works
Hydraulic Structure	• Sufficient free flow will have be guaranteed in the design and construction work to ensure free passages of migrating fishes. • Hydraulic structure will be operated considering fish migration and spawning time • A guideline for area specific hydraulic structure operation will be developed
Dredging	• Ensure that the dredging activity will create minimum sediment load in the water • Avoid dredging during spawning period of fish
ECoP 7: Socio-Economic Management	
Construction Camp Management	
Siting and Location of construction camps (MRDI, 2011)	• The contractor shall establish signboard at worksite mentioning the details of activities, cost and ensure of works,name and address of contractor and Supervision arganisations. • Locate the construction camps in the areas which are acceptable from environmental, cultural or social point of view. • Consider the location of construction camps far away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • BWDB will endorse detailed layout plan for the development of the construction camp submitted by the contractor. The plan will show the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed about the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters
Construction Camp Facilities	The following facilities will have to be provided by the Contractor • Adequate housing for all workers • Safe and reliable water supply • Hygienic sanitary facilities and sewerage system. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities • Provide in-house community/common entertainment facilities, dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Solid Waste Management	• Ensure proper collection and disposal of solid wastes within the construction camps • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. • Establish waste collection, transportation and disposal systems with the manpower and equipment/vehicles needed.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• All solid waste should be collected and removed from the work camps and disposed in approved disposal sites
Fuel Supplies for Cooking and Heatingpurposes	• Provide fuel to the construction camps for their domestic purpose, in order to discourage use of fuel wood or other biomass. • Conduct awareness campaigns to educate workers to protect the biodiversity and wildlife of the project area, and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	• Provide adequate health care facilities within construction sites • Provide first aid facility round the clock. Maintain steady stock of medicines in the facility • Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outside areas • Train all construction workers regarding basic sanitation and health care issues and safety matters, and on the specific hazards of the work • Provide HIV awareness programming, including STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Assure regular mosquito repellant sprays during monsoon. • Conduct short training sessions on best hygiene practices and make of mandatorily participation by all workers. • Place display boards at strategic locations within the camps containing messages on best hygienic practices
Payment of Wages	• The payment of wages will be as per the Minimum Wages Act, Department of Labor, and Government of Bangladesh for both male and female workers. • To display the minimum wages board in local languages at labourcamps sites. • Wages will be paid to the labourers only in presence of BWDB staff; • Contractor is required to maintain register for payment of labor wages with entry of every labor working for him. It should be produced for verification if and when asked by the Engineer, EMU and/or the concerned BWDB staff/Engineer‘s representative
Rehabilitation of Labor and Construction Camp	• At the completion of construction, all construction camp facilities shall be dismantled and removed from the site. The site shall be restored to a condition in no way inferior to the condition prior to commencement of the works. • Various activities to be carried out for site rehabilitation and include: • Oil and fuel contaminated soil shall be removed and transported or buried in waste disposal areas. • Soak pits, septic tanks shall be covered and effectively sealed off. • Debris (rejected material) will be disposed off suitably. • Underground water tank in a barren/non-agricultural land can be covered. • If the construction camp site is on an agricultural land, the top soil should be preserved and good earth can be spread back for a minimum 30cm for faster rejuvenation of the land.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Proper documentation of rehabilitation site is necessary. • This shall include the following: • Photograph of rehabilitated site; • Land owner consent letter for satisfaction in measurements taken for rehabilitation of site; and • Undertaking from contractor; • In cases, where the construction camps site is located on a private land holding, the contractor should still have to restore the campsite as per this guideline. The rehabilitation is mandatory and will be include in the agreement with the landowner by the contractor. A certificate of satisfaction from the landowner should have to be obtained.
Damage and Loss of Cultural Properties	
Conservation of Religious Structures and Shrines	• All necessary and adequate care should be taken to minimize impact on cultural properties which includes cultural sites and places of worship including temples, mosques, churches and shrines, etc., graveyards, monuments and any other important structures as identified during design and all properties / sites / remains notified. No work shall spillover to these properties and premises. The design options for cultural property relocation and enhancement need to be prepared. • All conservation and protection measures will be taken up as per design. Cleanliness at the access to such properties along with the road should be maintained.
	• During earth excavation, if any property is unearthed and seems to be culturally significant or likely to have archaeological significance, the same shall be intimated to the Engineer. Work shall be suspended until further deciscion from the PD. The Archaeological Department shall be intimated about the chance of such findings and the Engineer shall carry out a join inspection with the department. Actions as appropriate shall be intimated to the Contractor along with the probable date for resuming the work. • All fossils, coins, articles of value of antiquity and structures along with all other things of geological or archaeological interest discovered on the site shall be the property of the Government, and shall be dealt with as per provisions of the relevant legislation.
Worker's Accident Risk	
Risk from Operations	The Contractor is required to comply with all the precautions as required for the safety of the workers as per the International Labor Organization(ILO) convention. The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, books, etc., to the workers and staff. The contractor has to comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and exit.
Risk from Electrical Equipment	Adequate precautions will have to be taken to prevent any danger from electrical equipment. No materials on any of the sites will be stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machineries to be used in the construction will conform to the relevant Bangladesh Standards (BS) codes, will be free from patent defect, will be in

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	good working condition, will be regularly inspected and properly maintained as per BS provisions and to the satisfaction of the Engineer.
Risk from Hazardous Activity	All workers employed on mixing material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals.
Malarial Risk	The Contractor shall, at his own cost, conform all anti-malarial instructions given to him by the Engineer and the EMU, including filling up of the borrow pits whichhave been dug by him.
Disruption to Users	
Loss of Access	• At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock. Work that affects the use of existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the Engineer. • The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, and any other access footpaths to or of properties whether public or private.
Traffic Management	• Special consideration shall be given in preparation of the traffic control plan to the safety of pedestrians and workers at night • The temporary traffic detours in settlement areas shall be kept free from dust by frequent application of water
Traffic Control and Safety	The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the cross section.
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

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• 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

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

- Stop work immediately following the discovery of any materials with possible archeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;
- Protect artifacts as well as possible using plastic covers, and to take measures to stabilize the area, if necessary, properly protect artifacts;
- Prevent and penalize any unauthorized access to the artifacts; and
- Restart construction works only upon the authorization of the relevant authorities (e.g. Upazila Nirbahi Officer, Deputy Commissioner and Department of Archeology).

10.6. Monitoring Plan

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

594. The Monitoring activities during design/preconstruction period are:

- checking the contractor's bidding documents, particularly to ensure that all necessary environmental requirements have been included; and
- checking that the contract documents' (Environmental Social Managemen 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 proper time

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

596. **Post project monitoring evaluation** will be carried to evaluate the impacts of the Project during first three (3) years of operation of the Project. Regular monitoring of the condition of the embankment, drainage structures and slope protection structures and afforestation are important from an environmental management point of view. In addition to this, information on the locations, type and consequences of flooding, erosion, flora and fauna mortality, availability of fish, occupational shift, migration is required. Recommended air, noise and water quality monitoring, greening and landscaping and community feedback are also included in the Monitoring Plan. The monitoring plan and details of monitoring locations for environmental condition indicators of the project during construction and operation stage are presented in Table 10.3 and Table 10.4

Table 10.3: Environmental Monitoring Plan during Construction and Operation 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 materials suppliers (Cement, soil).	Before the agreement for the supply of material is finalized.	Contractor	DDCS & PMSC, M&E Consultant, BWDB
Operation of borrow pit site	Borrow pit/site	Visual inspection of borrow pit site and ensuring operational health and safety	monthly	Contractor	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 earth materials	Contractor	DDCS & PMSC, BWDB
	Work Site	Some of the top soil are placed on top and berm of embankment for	At the end of filling activity	Contractor	DDCS & PMSC, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
		turfing and plantation			
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	DDCS & PMSC, BWDB
Traffic safety	Construction area	Visual inspection to observe 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
Air Quality (PM_{10}, $PM_{2.5}$)	Close to School/ Madrasha, Hospital &Villages	Air quality monitoring	Half Yearly	Contractor through a nationally reputed 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 Consultant, BWDB
		Ensure restriction of work between 09:00 p.m.-6:00 a.m. close to School/	Weekly	Contractor	DDCS & PMSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
		Madrasha, Hospital & Villages			
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample from the river of each polder	Sampling and analysis of surface water quality	Dry season	Contractor through a nationally reputed laboratory	DDCS & PMSC, M&E Consultant, BWDB
Drinking Water Quality(TDS, Turbidity, pH, FC, as of if groundwater etc)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality	yearly	Contractor through a nationally reputed laboratory	DDCS & PMSC, M&E Consultant, 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 wastes and also inspection of wastes is depositionof at designated site	Weekly	Contractor	DDCS & PMSC, M&E Consultant, BWDB
Flora and Fauna	Project area	Survey and comparison with baseline environment	Yearly	Contractor through nationally reputed institute	DDCS & PMSC, M&E Consultant, 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	Aftercompletion of allworks	Contractor	DDCS & PMSC, M&E Consultant, BWDB
Safety of workers Monitoring and reporting accidents	At work sites	Usage of Personal Protective equipment	Monthly	Contractor	DDCS & PMSC, M&E Consultant, BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample on each river of each polder	Sampling and analysis of surface water quality	Dry season	BWDB through a nationally reputed laboratory	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Air Quality (Dust PM_{10}, $PM_{2.5}$)	At the baseline monitoring site	24 hours Air quality monitoring	Yearly	BWDB through a nationally reputed laboratory	M&E Consultant
Flora and Fauna specially fisheries	In the project area	Detail species assessment and compare with baseline	Yearly	BWDB through a nationally reputed institution	M&E Consultant
Agriculture	In the project area	Compare the production with the baseline	Yearly	BWDB through a nationally reputed institution	M&E Consultant
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant

Source: MRDI, 2011, LGED, 2011

Table 10.4: 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, M&E Consultant
Water Quality	Water bodies near nursery	Odor and chemical testing	Dry season	Contractor through nationally reputed laboratory	DDCS & PMSC, BWDB, M&E Consultant
Waste Management	Work site and Nursery	Visual inspection of collection, transportation and disposal of grasses, debris and is deposited at designated site	Weekly	Contractor	DDCS & PMSC, BWDB, M&E Consultant
	Work site and Nursery	Visual inspection of Water bars & cut-offs .sediment traps to prevent water pollution caused by run-off from harvesting areas	Beginning of works	Contractor	DDCS & PMSC, BWDB, M&E Consultant
Nursery Embankment Management	Nursery	Visual inspection of height of embankment, possibility of water logging and connection to the waterbodies	Beginning of each nursery	Contractor	DDCS & PMSC, BWDB, M&E Consultant
During Operation and Management					

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Multilevel belt of trees	Polder top and along the polder	Visual inspection	yearly	BWDB through nationally recognized institution	M&E Consultant
Flora and Fauna	In the project area	Detail species assessment and compare with baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant
Erosion	Along Alignment	Visual Inspection presence of gullies or erosion	Yearly	BWDB	M&E Consultant
Fish Habitat Observation	In the project area	Physical observation	Four (4) times of year (dry & wet season)	Contractor with help of UFO	M&E Consultant
Fish Catch assessmen survey	In the project area	Catch survey	two (2) times of a year (dry & wet season)	Contractor with help of UFO	M&E Consultant
Fish swimming speed or velocity	In the project area	Measurement of water velocity	Once in a Week	WMO with help of UFO	M&E Consultant
Operation of fish pass	In the project area	Visual inspection and fishermen feedback	Reound the year	BWDB	M&E Consultant

Qualitative Spot-Checking Indicators

597. Moreover, a rapid environmental monitoring will be carried out as per following checklist in terms of visual judgment during field visit as an indirect control to implement Environmental Mitigation Plan. **Table 10.5** can be followed during project construction and operation process.

Table 10.5: Spot Checking Indicator

Parameter	Visual Judgment			Comments
	Poor	Moderate	Satisfactory	
Workers Safety				
Camp Site Management				
Plant Site Management				
Borrowpit Area Management				
Top Soil Prevention				
Waste Management				
Occupational Health and Safety				
Stockpiling of construction materials				
Reporting and Documentation				

Third Party Validation

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

10.7. Documentation, Record Keeping and Reporting

Record Keeping

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

Monitoring Records

Quantitative Physical Monitoring

600. The objective of quantitative physical monitoring is to ensure that the mitigation measures designed to prevent, reduce and where possible offset any significant adverse impacts on the environment are being implemented throughout the Project lifecycle. DDCS & PMSCwill regularly monitor and provide information to ESCU for updating the database. DDCS & 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" (about 80 percent of the control limits) at which steps must be taken to prevent the impending breach of the control limit; and
- Any breaches of the control limits, including explanations if available.

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

General Site Inspections and Monitoring

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

Information Sources

603. A complete and up-to-date file of all relevant sources of information will be maintained by the ESC unit of PMU. This file would be readily accessible and include, as a minimum, copies of the following documents:

- Current environmental permits and consents;
- Action to fulfill the requirement of annual site clearance for polder area
- All relevant national regulations, international guidelines and codes of practice;
- Manufacturers' MSDSs for all hazardous substances used on the project;

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

Non-Compliance Report

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

605. A copy of each completed NCR would be kept maintained on file by DDCS&PMSC, 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

606. The DDCS & PMSC will prepare a monthly report for issuance to the ESCU of PMU. These reports will summarize the followings:

- Progress of implementation of this EMP;
- Findings of the monitoring programs, with emphasis on any breaches of the control standards, action levels or standards of general site management;
- Any emerging issues where information or data collected is substantially different from the baseline data reported in the Environmental Assessment;
- Outstanding NCRs;
- Summary of any complaints by external bodies and actions taken / to be taken; and
- Relevant changes or possible changes in legislation, regulations and international practices.

Bi-annual Progress Report by BWDB

607. ESC unit of BWDB will prepare the Bi-annaul monitoring report on which will include the environmental monitoring and the plan for next 6 months during construction phase and will submit to the World Bank for review. The progress report will summarize the information presented in Table 10.2, Table 10.3 and Table 10.4 respectivelyEnvironmental Audit Report &Third-Party Monitoring Report

608. It is expected that BWDB will conduct annual environmental audit. In addition, the environmental audit will be carried out before the mid-term evaluation and before project closing. All Environmental Audit Report will be shared with 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.

10.8. Contractual arrangements for EMP implementation

609. Most of the contractors do not have any clear understanding about the need of environmental management, some quoted very low price for implementation of EMP and eventually cannot implement EMP as per design. To avoid this problem, fixed Budget will be

assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting. The contractor needs to submit a **Contractor Environmental Social Management Action Plan (C-ESMAP)** based on the EIA in line with the construction schedule and guideline. The EAP needs to be reviewed by the supervision consultant and cleared by BWDB and World Bank.

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

- Prepare cost estimates, to be incorporated in the Bid Documents.
- Environmental Management Plan along with good environmental construction guidelines to be incorporated in the bid document's work requirements.
- Preparation of work requirement (addendum/corrigendum to polder & hydraulic structure construction/afforestation)
- Corrigendum / Addendum to polder/embankment specification, if any, as special provisions to be incorporated in the bid documents.
- 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 decision of the Engineer.

➢ The contractor has to follow all environmental mitigation measures as defined in the technical specification along with the Environmental Management Plan for the specific CEIP activities. Damage shall be levied at the rate Tk. 3000/- per day per location for nonconformity of Environmental Management Plan measures as perdecision of the Engineer.

➢ The contractor has to ensure that prior to every monsoon season, during the construction period; all temporary and permanent cross drainage structures are free from debris as defined in the Technical Specifications along with the Environmental Management Plan. Damage shall be levied at the rate of Tk.3000/- per day per location for non-conformity as per the decision of the Engineer.

➢ The contractor is to ensure that sufficient numbers and good quality Personnel Protective Equipment (PPE), will be provide to staff and labor all time as defined in the labor codes read along with the EMP. Damage shall be levied at the rate of Tk. 1000/- per day for non-conformity as per the decision of the Engineer.

10.9. Guideline for Compensation and Contingency Plan during Project Period

610. 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.

611. In addition to the compensation, water management projects should also have a contingency plan to deal with emergencies and accidents. Such incidences encompass a

whole range of situations from personal injury during operation of a machine to breaching of an embankment. Therefore, BWDB should be prepared for the following emergency situations:

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

10.10. EMP Implementation Cost

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

Table 10.6: Tentative Cost Estimates for Environmental Management Plan

Item No.	Description	Cost Million BDT	Cost Million $	Responsible Agency	Timeframe
1.	Construction of alternative or bypass channels at each construction sites.	5.6	0.07	Contrctor	During pre-construction and construction
2.	Installation of fugitive particulate matter system and Spraying water on embankment/road	0.5	0.00625	Contrctor	During pre-construction and construction
3.	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils	Budget included in RAP		Contractor	During pre-construction
4.	Awareness program on plant and wild life conservation.	0.02	0.00025	BWDB	During post-construction
5.	Consultancy services cost for supervision and monitoring of EMP	1	0.01	BWDB	During post-construction
6.	Training to the Contractors regarding environmental management	100,000	1.25	BWDB	During pre-construction

Item No.	Description	Cost Million BDT	Cost Million $	Responsible Agency	Timeframe
7.	Training to the farmers with field demonstration regarding IPM and ICM.	0.4	0.005	BWDB with help of DAE	During post-construction
8.	Training to the fisherman/pond owner with field demonstration regarding pond culture.	0.04	0.0005	BWDB & WMO with help of UFO	During post-construction
9.	Training on improved fish culture	1.5	0.019		
10.	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1	0.0125	BWDB	During post-construction
11.	Updating EMP as per requirement.	1	0.0125	BWDB	During post-construction
12.	Establishment of Fish Sanctuaries in khals for the Conservation of indigenous Fishes and stocking of Threatened Fish species and Brood Stock of Indigenous Small Fish Species (2 Nos. Sanctuaries-One sanctuary in each khals @ 0.1 million BDT)	0.04	0.0005	BWDB with cooperation of DoF	During operation
13.	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	1	0.0125	Contractor, BWDB	During construction and post-construction
14.	Training to WMA on "Integrated water Management and Operation and Management of Sluice Gates"	1.5	0	BWDB	During operation
15.	Social forestry program along both sides of the embankment and other khas areas	Included in afforestation budget	0	BWDB	During operation

Item No.	Description	Cost Million BDT	Cost Million $	Responsible Agency	Timeframe
16.	Compensation for trees	Budet Included in Afforestation Plan	0	BWDBwith a consultation of Forest Department	During construction
17.	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
18.	Construction of fish pass friendly structure (one fish pass) Optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes	61	0.690112652	Contractor, BWDB	During construction
Total Cost		**75**	**0.839**		

Note: 1 US$=80 BDT

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 23 = 6 samples x 3 times @ Tk.5,000	300,000	3.75	Contractor	During pre-construction, construction and post construction period phases
2	Monitoring of Fish Biodiversity, Fish Migration, Fish Production	800,000	10	Contractor with help of UFO	During construction and post-construction
4	Fish swimming speed or velocity and depth preference	150,000	1.8	Contractor with help of UFO	During post-construction
5	Crop Production/Farm Survey for four (4) times of year (dry & wet season).	100,000	1.25	Contractor with help of UFO	During post-construction
6	Air and noise quality monitoring and analysis.	500,000	6.25	Contractor	During construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
7	Surface and ground Water quality monitoring cost (testing for Turbidity, pH, DO, BOD, Salinity etc. + test of As, e etc. for HTWs at workers' camp site) 6 samples in Polder-23 during pre-construction, construction and post-construction periods + water quality analysis of HTWs of 10 workers' camp	500,000	6.25	Contractor	During construction and post-construction phases
8	Benthic fauna analysis	200,000	0.0025	Contractor & DOF	Before, during and regularly after construction
9	Diversity of Flora and fauna	200,000	2.5	Contractor	During construction and post-construction phases
	Total Cost	**2,750,000**	**31.8025**		

10.11. Afforestation Plan

613. Slope area of Embankment will be planted with different fruit yielding, medicinal and timber plants. For the Slope Plantation, the lower one third of the slope may be planted with deep rooted tree species, the mid one third may be planted with shallow rooted medium size tree species and the upper one third may be planted with species that have very small root system. Keeping this in view, the middle row along the slope can be planted with *Acacia nilotica* (Gum Arabic/Babla), *Tamarindusindica* (Tamarind/Tentul) and *Phoenix sylvestris* (Date Palm/Khajur) at a spacing of 2M (6.5 ft) apart. The upper row can be at a distance of 6 to 8 feet i.e. 2 to 3M from the lower row. The upper row will be planted with shallow rooted bushy plants which are available in local area. Lower row of embankment of this Polder is not suitable for planting any non-mangrove species as the embankment toe are saturated by the saline water of river or shrimp farms. *Tamarindusindica* (Tentul) and *Acacia nilotica* (Babla) seedlings have to be raised in 10"x 6" poly bags. Before plantation, a temporary nursery will be established in the polder area to ensure the availability of seedlings. Nursery costing has been shown separately in Feasibility Report. Seedlings of other suggested plant species may be purchased from local nurseries. Planting of 2,500 seedlings will make one ha slope plantation. As per that estimation, a total of 29,500 nos saplings can be planted along the slope of 13 Km embankment length.

614. About 7.23 ha foreshore area will be planted with mangrove speciesto protect against tidal surges, wave attack and strong winds in order to reduce toe erosion and to stabilize the embankment. The areas selected for afforestation in this are shown in detail in Map 5.1. The available foreshore area of the polder can be planted with suitable mangrove species. *Sonneratia apetala* (Mangrove Apple/Keora), *Avicennia officinalis* (Indian Mangrove/Baen) and *Nypa fruticans* (Nipa Palm/Golpata) can be selected as the suitable species for this polder. Golpata will be planted only along the strips of river and canal banks with an available area of about 1.82 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 15,000 mangrove saplings can be planted in 7.23 ha of available foreshore area of this Polder.

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

616. Detail Plantation establishment Matrix is presented in following Table 5.7.

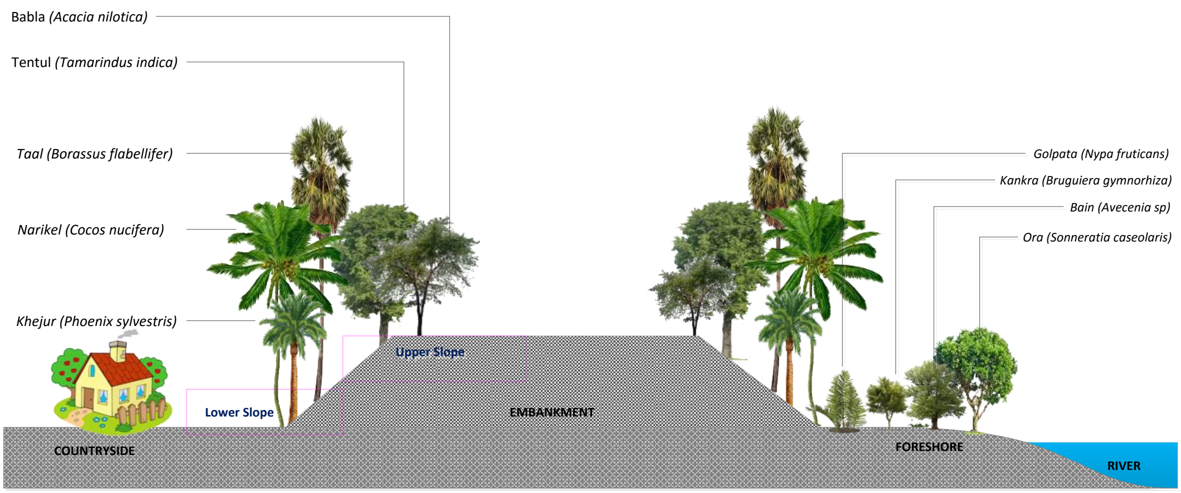


Figure 10.2: Typical cross section of Embankment slope and Foreshore Afforestation

Table 10.7: Detail Plantation establishment Matrix

Item of works	Time schedule for the given type				
	Nypa Plantation	**Enrichment Plantation**	**KeoraBaen**	**Mound Plantation**	**Polder Slope Plantation**
Selection of site, survey the site and prepare plantation site map.	March	January	February and March	February	February
Preparation of mounds	n.a.	n.a.	n.a.	March	n. a.
Cleaning of unwanted growths by cutting them off.	May 3rd week.	April 4th week immediately before planting.	One week before the planting day. May be in the 1st week of May.	March	April 1st week.
Pit making	n.a.	March 2nd week.	n. a.	March 3rd week.	April 1st week.
Application of Compost	n.a.	March 4th week.	n. a.	April 2nd week.	April 3rd week.
Stacking	May 3rd week.	April 1st week.	n. a.	April 4th week	April 3rd week.
Bring seedlings from the nursery to plantation site.	June 1st week.	April 3rd week.	On the day of planting during 1st or 2nd week of May.	April 4th week (after the first shower)	April 4th week.
Planting of seedlings.	June 1st week. Immediately after bringing seedlings from the nursery.	April 4th week.	May be 1st or 2nd week of May.	Immediately after bringing the seedlings.	Immediately after bringing the seedlings.
Fixing of red flags indicating planting sites to avoid fishing.	May 4th week.	n. a.	n. a.	n. a.	n. a.
Application of fertilizers.	n. a.	After of week of planting the seedling.	n. a.	After a week of planting seedlings.	After of week of planting.
First weeding	August 1st week	May 4th week	May 4th week, 1st year.	June 1st week.1st year.	May 2nd week, 1st year, to be done by the watcher free of charges.

Item of works	Time schedule for the given type				
	Nypa Plantation	**Enrichment Plantation**	**KeoraBaen**	**Mound Plantation**	**Polder Slope Plantation**
Second weeding	November 1st week	June 3rd week	June 1st week.1st year.	June 4th week.1st year.	July 1st week, 1st year, to be done by the watcher free of charges.
Third weeding	May 1st week next year	July 2nd week	June 4th week.	July 4th week 1st year.	May 1st week, 2nd year, to be done by the watcher free of charges.
Fourth weeding		August 4th week.	May 1st week. 2nd year.	July 1st week. 2nd year.	August 1st week, 2nd year, to be done by the watcher free of charges.
Fifth weeding with light pruning if necessary.	n. a.	April 1st week next year.	October 1st week. 2nd year.	August 4th week. 2nd year.	n. a.
Sixth weeding (Climber cutting)	n. a.	June 1st week next year.	n. a.	n. a.	n. a.
Seventh weeding (Climber cutting)	n. a.	August 1st week. Next year.	n. a.	n. a.	n. a.
Pruning.	n. a.	n. a.	n. a.	October 4th week	n. a.
Watching	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.	For 30 months by involving the participants on wages @ Taka 8000 per month. Each will get Taka 2000 per month.
Since these activities are related to biological science the time frame may not be kept very rigid. Some adjustments may be required depending on rainfall, temperature, wind speed, tide, etc.					

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

10.12. Grievance Redress Mechanism

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

Grievance Redress Focal Points

618. 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 arranged at the Convener's office or at Union Parishad/Ward Councillor's office as agreed by the committee members. The membership of the GRCs will ensure proper presentation of complaints and grievances as well as impartial hearings and investigations, and transparent resolutions.

Membership of GRC

1.	Executive Engineer (BWDB Division Office)	:	Convener
2.	Representative of the RP Implementing NGO	:	Member-Secretary
3.	Local UP Chairman /Ward Councillor	:	Member
4.	Teacher from Local Educational Institution (nominated by Upazila Administration)	:	Member
5.	Representative from Local Women's Group	:	Member
6.	Representative from the PAP Group	:	Member

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

Grievance Resolution Process

620. 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 out 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.

621. If the resolution attempt at the local level fails, the GRC will refer the complaint with the minutes of the hearings to the Project Director at PMO for further review. The Project

Director will assign the ESCU at PMO to 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.

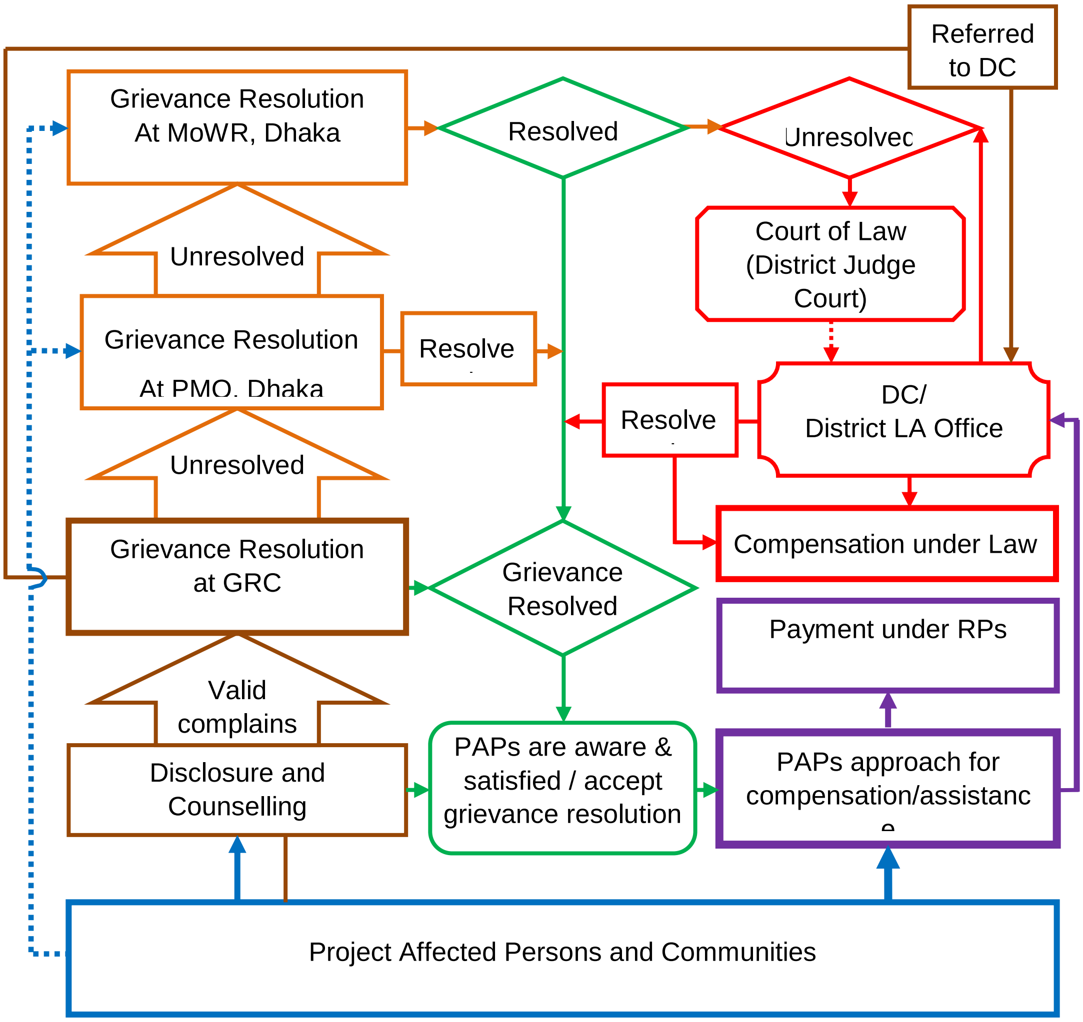


Figure 10.3: GRM Process Flow Chart

622. 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:
- When a GRC member is removed, another person is tobe appointed prior 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.

GRM Disclosure, Documentation and Monitoring

623. 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.

624. To ensure impartiality and transparency, hearings on complaints will remain open to the public. The GRCs will record the details of the complaints and their resolution in a register, including intake details, resolution process and the closing procedures. BWDB will maintain the following three Grievance Registers:

- **Intake Register:** (1) Case number, (2) Date of receipt, (3) Name of complainant, (4) Gender, (5) name of Father or husband, (6) Complete address, (7) Main grievance regarding social (loss of land/property or entitlements) or environmental, (8) Complainants' story and expectation with evidence, and (8) Previous records of similar grievances.
- **Resolution Register:** (1) Serial no., (2) Case no.,(3) Name of complainant, (4) Complainant's story and expectation, (5) Date of hearing, (6) Date of field investigation (if any), (7) Results of hearing and field investigation, (8) Decision of GRC, (9) Progress (pending, solved), and (10) Agreements or commitments.
- **Closing Register:** (1) Serial no., (2) Case no., (3) Name of complainant, (4) Decisions and response to complainants, (5) Mode and medium of communication, (6) Date of closing, (7) Confirmation of complainants' satisfaction, and (8) Management actions to avoid recurrence.

625. 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 the 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.

10.13. Capacity Building

626. Since the effectiveness of the Environmental Assessment & implementation depends considerably on the understanding and preparedness of their Engineers and in particular their Environmental Team (**Consisting of Contractor Environmental specialist, Consultant environmental specialist, and ESCU of BWDB**). It is important that the project authority makes effort to sensitize the Engineers and Environmental Team on management of environmental issues, provides guidance, and encourages them to build requisite capacities. **Table 10.8** 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.

627. During the O&M phase of the Project, these trainings will be continued by BWDB staff for all relevant O&M personnel and community.

Table 10.8: Environmental Trainings

Contents	Participants	Responsibility	Schedule
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area.	Selected BWDB Officials; PMU; DDCS&PMSC staff	DDCS&PMSC and ESCU	Prior to the start of the Project activities. (To be repeated as needed.)
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Mitigation measures; Community issues; Awareness of transmissible diseases Social and cultural values.	PMU; DC & CSC; selected contractors' crew	DDCS&PMSC,ESCU	Prior to the start of the field activities. (To be repeated as needed.)
EMP; Waste disposal; HSE	Construction crew	Contractors	Prior to the start of the construction activities. (To be repeated as needed.)
Road/waterway safety; Defensive driving/sailing; Waste disposal; Cultural values and social sensitivity.	Drivers; boat/launch crew	Contractors	Before and during 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

628. 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 of the relevant agencies involved in EMP implementation.

629. The training programs will be arranged before implementation of the interventions in the polder area. Detailed plan can be made by the proposed ESC Unit of BWDB.

10.14. Risk Assessment and Mitigation Measures

630. 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 23 have the dual purpose of prevention of saline water intrusion into the polder area and agricultural improvement within that area. The expected positive impacts from the project interventions have been summarized below, while the potential adverse impacts have been identified and quantified above as well as their mitigation measures have also been suggested in this report. Yet, challenges or threats do remain in two sectors, which are addressed in this section. These relate to (a) navigation (b) function of water management association and (c) fish migration and movement.

Navigation

631. 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 23. 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 23 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.

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

Function of Water Management Association

633. 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.

Fish Migration and Movement

634. 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.

635. On the other hand, during spawning season fish hatchlings and fries will be able to pass through the gates with relatively high mortality. Moreover, there is a conflict of interest between the Gher owners and agriculture farmers regarding the issue of water usage.

636. 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.

637. The Ghers are mostly concentrated in all over the Polder area. So, entry of saline water through drainage canals in the Polder area may not harm significantly to the crops if water can be managed in the canals in such a way that water does not spill over the crop fields. In that case, the proper operation of the sluice gates and their distributary canals should be ensured.

638. There are Ghers in the polder where there is no boro crops are grown. In the months of January to March when drifting migration of hatchling and fry with the tide of *Liza parsia* and *Mystus gulio* may be obstructed as the farmers will use the deposited water of the canal and inhibit the entry of saline water. The fishes at all their life stages from hatchling to adult of *Plotosus canius, Lates calcarifer*, *Liza parsia* and *Mystus gulio* will be able to enter with the tide into the Polder area when water will be allowed during the T. Aman cultivation season and that will not hampar for crop cultivation. In future farmers can grow boro. Hence, the Sluice Gates operation will be maintained properly.

11. Stakeholder Consultation and Disclosure

639. 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

640. The GoB as well as international donors (e.g. the World Bank) attach 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 in order 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.

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

642. The present EIA study 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

643. Objectives of the stakeholder consultation were as follows:

- To provide key Project information and create awareness among various stakeholders about project intervention;
- To have interaction for primary and secondary data collection with project beneficiaries, affectees, and other stakeholders;
- To identify environmental and social issues such as displacement, safety hazards, employment, and vulnerable persons;
- To begin establishing communication and an evolving mechanism for the resolution of social and environmental problems at local and Project level;
- To involve Project stakeholders in an inclusive manner; and
- To receive feedback from primary stakeholders on mitigation and enhancement measures to address the environmental and social impacts of the Project.

11.3. Approach and Methodology

644. Participatory approach was followed in conducting the public consultation meetings in the Polder 23. The EIA study team discussed first with the BWDB officials and then the Upazila Parishad Chairman (UZPC) and/or the Upazila Nirbahi Officers (UNOs) and the Project Implementation Officers (PIOs) of the polder area to share the Feasibility and EIA process of the CEIP-1. The BWDB and local government officials/representatives were consulted to

identify the potential stakeholders at the Polder level. With the available support from the UNOs and/or PIOs, the union level public representatives as well as the key persons were informed about the specific consultation meetings and requested them to participate in the meeting.

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

646. 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 23 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

647. 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.

648. ***Primary Stakeholders:*** Primary stakeholders are people who would be directly benefited or impacted by a certain project intervention. In case of the proposed Project in Polder 23, 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 study include communities to be benefitted and/or affected by the Project, local leaders, community members and other local representatives.

649. ***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.

650. Secondary stakeholders for the Project include local government institutions (LGI), Bangladesh Water Development Board, the Ministry of Water Resources, Department of Forest, other government agencies, academia, NGOs, the World Bank, and general public at large.

Time, Date and Venue Selection

651. Venue, date and time of meeting was selected through consultation with local people, the project proponent and the EIA study team. These three groups selected an agreed venue considering the closeness to the proposed project, easy accessibility to the venue and which

is likely to be neutral. Date and time were also finalized in this way considering availability of the participants, ensuring the maximum participation, weather and compliance with the other arrangement.

Enlisting and Invitation

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

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

Consultation Instrument

654. **Checklist:** A checklist covering all possible issues to be addressed was prepared through consultation with the multidisciplinary study team. This checklist was used in the meeting to unveil peoples' perception and opinion along with suggestions (checklist is attached in Appendix H).

655. **Attendance list:** An inventory of the participants was maintained in attendance sheet containing contact number. Scanned list of participants is attached in Appendix G.

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

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

Consultation Process

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

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

660. **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.

661. **Respect to the participants:** The study team showed respect to all participants. They respected not only to the individuals but also their values, cultural practices and social structures.

662. **Ensuring peoples' voice:** Generally, all participants do not participate equally. In fact, a substantial number of participants tended to remain silent in the meeting. However, the study team encouraged all to participate willingly by explaining the ethics of the study.

663. **Note taking:** Discussed issues and opinions were written in notebook carefully. All issues were given equal importance.

664. **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 by thanking the participants.

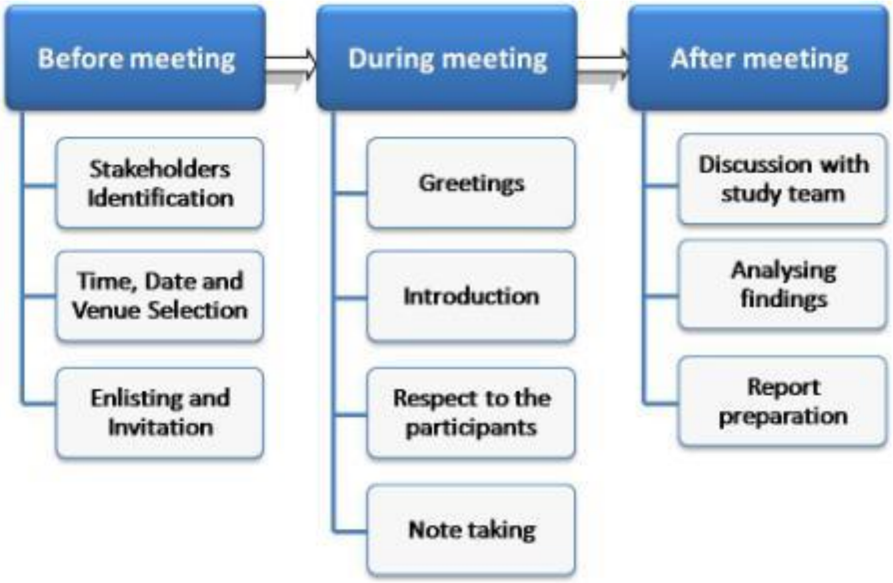


Figure 11.1: Overall consultation process

11.5. Public Consultation Meetings and FGDs

Consultation Process

665. A number of public consultation meetings and FGDs were conducted at different locations of the Polder 23. The details of these meetings and FGDs are presented in **Table 11.1** and some photographs of these meetings are given in **Photograph 11.1 to11.3.**

Table 11.1: Meeting venue including time and date

Sl	District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
1	Khulna	Paikgachhaa	Sholadana	Sholadana Union Parishad Conference room	PCM	20/01/2016	10:00
2	Khulna	Paikgachhaa	Sholadana	Paikghacha village	FGD	25/12/2015	15:30
3	Khulna	Paikgachhaa	Sholadana	Sholadana village	,,	26/12/2015	11:00

Consultation Participants

666. The main participants of the consultation meetings included public representative, farmer, trader and daily-wage laborers of the Polder 23 and nearby areas. A total of 56 participants attended these consultations. The participant details are provided in **Table 11.2**.

Table 11.2: Participant Details

Sl	Meeting venue	Type of consultation	Type of Participants	No. of participants
1	Sholadana Union Porishod Conference room	PCM	Secondary and Primary stakeholders	35
2	Paikghacha village	FGD	Primary stakeholders	11
3	Sholadana village	FGD	Primary stakeholders	10

Photograph 11.1: PCM at Sholadana Union Auditorium

11.6. Issues discussed in FGDs and Meetings

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

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

- ***The sustainable and integrated solutions of the main problems being faced in the Polder:***
  - Water resource management
  - Agriculture and fisheries management
  - Land resource management
  - Disaster management.

11.7. Community Concerns and Suggested Solutions

668. 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 the objectives and process of the project clear.

Attitude to the project

669. 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.

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

Photograph 11.2: FGD at Paikghacha village

Photograph 11.3: FGD at Sholadana village

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 of Embankment, Encroachment of internal canals, Sibsa river erosion, water logging due to siltation at certain parts of the Polder and poor communication system are the main community concerns in the polder area.	• Comprehensive rehabilitation of the polder should be taken up at the earliest with the active involvement of the local community. • Proper compensation should be given to affected people • Illegally captured cannal should be liberated and re-excavated • Embankment height should be raised from 5.30 to 6.00 meter. • Immediate construction of all (11 nos.) drainage sluice at the location of Sannashidanga, Paikghacha, Kakrabunia, Harikhali, Sholadana, Baroitala, Khatuamari, Sonakhali, Amurkata, Parishamari (Sholadana Union) and Lasker (Lasker union) and Repairing of all flushing sluice (39 nos.) • Proposed drainage sluice and flushing sluice linking cannel should be re-excavated.
Water resources	• Major canals have been silted up due to unplanned shrimp farming, Illegal DCR cut off, encroachment of canals etc. • Tidal Flooding, Storm surge, salinity intrusion, Encroachment of internal khal, erosion, inactive sluice gate and khal has been silted up • Height of the embankment is being eroding gradually	• -Strengthening the banks with blocks, spreading stones/Geo-bags along vulnerable spots e.g. Patkelpota, Vakotmari, Narkeltala, Khatuamari villages • -Re-sectioning of the embankment to protect erosion and embankment breach • Damaged sluice gate (e.g. Sannashidanga, Paikghacha, Kakrabunia, Harikhali, Sholadana,

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
		Baroitala, Khatuamari, Sonakhali, Amurkata, Parishamari and Lasker), inlet, outlet and all water control infrastructures should be repaired • Internal drainage canal (e.g. Sholadana, Kainmukhi, Boroitala, Patkelpota, Lasker, Sannashidanga, Kaila, Hatua khal etc should be re-excavated • Shutter has to be water proofed
Agriculture resources	• Crop damage due to drainage congestion and water logging • Lack of irrigation water during dry season due to siltation of rivers and internal khals	• Repair the embankment as per design level • Re-excavation of rivers and khals as per design level. • Connecting the khals with rivers. • Repairing the sluices and construction of new sluice • Regular operation and maintenance of the regulators. • As soon as possible blocked linkage cannel and large cannel. like – Ammrkata, Sonakhali, Sholadana, Kainmukhi, Boroitala, Patkelpota, Lasker, Sannashidanga, Kaila, Hatua khaletc. 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 • Reduced depth of internal khals and habitat quality degradation due to siltation • Fish and hatchling movement have been disrupted due to lack of properoperation of water control structures. • Illegally control khal & water control infrastructure to catch fish • Indiscriminate fishing by sluice net • Entrance of saline water	• Re-excavation of canals (e.g. Ammrkata, Sonakhali, Sholadana, Kainmukhi, Boroitala, Patkelpota, Lasker, Sannashidanga, Kaila, Hatua khal etc.) will help to increase the richness of fish species in the Polder area. • Application of fisheries rules and regulation by the government • Repairing embankment with reasonable height (from 5.30 to 6.00 meter). • Prohibit illegally control khals & water control infrastructure to catch fish • Using angler in an illegal way should be stopped • Illegally captured canal should be liberated and re-excavated • Integrated cultivation should be practiced.
Ecological resources	• Countryside vegetation deteriorated and change of vegetation coverage due to river	• Keep compensation to the proper owners/authorities against tree felling

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
	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.	• Implement social aforestation along the embankment slopes • Social aforestation along the countryside are completion by local people and River side plantation are implemented by concern forest authority • Proposed aforestation plan would arrest the vulnerabilities of embankment and protect bank erosion from tidal surge • Local people should be engaged on seed germination, sapling management for transit nursery. • Plantation for local suitable Mangrove tree species like Golpata, Kakra, Baim, Kaora, Sundari etc. and proper monitoring for saplings and fencing • Implement social aforestation along the embankment slopes at • Vakotmari, Paikghacha, Patkelpota, Lasker, Parsimari, Amoorkata, Sonakhali villages should be protected to check soil erosion as well as wave action of the surrounding Polder area.
Socio-economic resources	• Above 500 HHs will be displaced and their life and livelihood may be hampered. • Rural power elite has captured open water bodies illegally i.e. canals, ditches for their own purposes • Tends of dependency on the Sundarbans area has increased for last ten years due to lack of employment opportunities. • Seasonal migration has increased for Garments, Brick field and Agricultural sector • Main internal communication and transportation system are extremely very poor • 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.	• Rehabilitation of affected people should be done according to Resettlement action plan. • Ensure proper resettlement of those households which may be affected by the project intervention for reconstruction of retired embankment (e.g. Kululia, Paikghacha villages). • The embankment cum road (e.g. from Patkelpota to Khatuamari village, from Sonakhali to Nuniapara and Parshimari to Boyerjapa village) should be repaired immediately in places. • After enlarging/construction of embankment, a maintenance and monitoring team should be formed for proper maintenance of it. • To organize and strengthen of WMGs so that mass people can access to open water bodies easily. • Water control infrastructures at Sannashidanga, Paikghacha,

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
		Kakrabunia, Harikhali, Sholadana, Baroitala, Khatuamari, Sonakhali, Amurkata, Parishamari and Lasker villages should be properly maintained • Gate operator (locally called gate khalashi) should be recruited • Illegal DCR cut off should be stopped • To create opportunity for tourism industry at the Vakotmari village of Sholadana union and it should be done not only for the improvement of employment status of this area, but also for the reduction of dependency on Sundarbans. • 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, Kurulia and Sibsa River) and Sholadana Bazar Keya Ghat, Vakotmari Keya ghat, Laskar Kheya Ghat etc. can be used to unload the construction materials

11.8. Framework for Consultations during Project Implementation

671. The stakeholder consultation is a continuous process, and should be maintained throughout the project. The consultations carried out during the present EIA and reported in this Chapter are essentially a first step in this process. During the subsequent project phases as well, participation of the project stakeholders needs to be ensured. **Table 11.4** contains the proposed participation framework during different project Phases.

Table 11.4: Participation Framework

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
Project Design Phase	Meetings with institutional stakeholders (carried out during the present EIA and RAP preparation); meetings with grass root stakeholders (carried out during the present EIA and RAP preparation)	Institutional stakeholders; Grass root stakeholders, including the communities to be affected by the Project.	EIA consultant.
Project Construction Phase	Information disclosure (sharing of the project objectives, project components, major benefits, potential impacts, mitigation measures and Resettlement Plan with the affected	Institutional stakeholders; Grass root stakeholders, including the communities to be affected during the project implementation.	BWDB; Supervision Consultants; Contractors

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
	communities and other stakeholders).		
	Consultations and liaison	The communities around the work sites, borrow areas, and access routes	BWDB; Supervision Consultants; Contractors
	Grievance Redressal Mechanism and Social Complaint Register (discussed later in the document).	The affected communities.	BWDB; Supervision Consultants; Contractors
	Consultations with the communities during Compliance Monitoring and Effects Monitoring (discussed later in the document).	Affected communities.	BWDB; Supervision Consultants; Contractors
	Consultations with the project affectees / communities during the external monitoring (discussed later in the document).	Affected communities.	External monitoring consultants.
	Consultations with the project affectees / communities during the site visits by the WB monitoring mission.	Project site staff; Contractors; Affected communities.	WB monitoring mission.
Project Operation Phase	Community participation in O&M activities (see Section 4.9)	Institutional stakeholders; Grass root stakeholders, including the beneficiary communities.	BWDB

11.9. EIA Disclosure

The findings of the draft final EIA study on Polder 23 were disclosed to the public on 25th July (from 11:00am to 13:00pm), 2017 in Paikgaccha Upazila, Khulna. The principal aim of the meeting was to present the findings of the draft final EIA report and to obtain feedback from the participants of the meeting for the finalization of the report. In disclosure meeting a power point presentation was made, highlighting the project background, project objective as well as EIA study objective, project interventions, potential enviromentals impact due to implemention of proposed interventions, and Environmental Management Plan (EMP) with monitoring plan.

The participants of the PDM includes, Upazila Nirbahi Officer (UNO), Upazila Chairman, Vice Chairman and other concerned government officials, Journalists, NGO representatives, environmentalists and activists, local stakeholders and other representatives of CEGIS. A total of 52 participants attended the public disclosure meetings. The findings of the Public Disclosure Meeting (PDM) and some photographs of the meeting are given in Photo 11.4

Photograph 11.5: PDM at Upazila Auditorium, Paikgacha, Khulna

11.9.1. Findings of the Public Disclosure Meeting (PDM):

The communities including the persons to be affected of Polder 16 by the Project expressed their views in favour of the Project and wanted early implementation to protect them from natural disasters. They demanded following actions for immediate implementation. These are:

Comments from stakeholder /Communities	Responses
The situation regarding salinity intrusion is also getting worse, since most of the sluice gates became out of use. There is need to a concrete plan for saline water intrusion for shrimp cultivation.	A Water Management Plan has been proposed for sustaible polder management
Issues like climate change, sustainable development etc should be taken into consideration while implementing the project	Climate change issue has been considered in this study
Effective monitoring should be maintained during the construction of the project activities.	An effective monitoring plan has been suggested

Comments from stakeholder /Communities	Responses
Engagement of local government for canal excavation should be ensured	To be considered
Tree plantation need to be increased.	A detailed tree plantation plan has been undertaken in this project
Adequate compensation for affected by the project activities should be ensured.	Agreed and to be ensured
Awareness building program among the communities should be conducted for better water management;	Agreed and to be initiated
Proper O & M for embankments and sluice gates in the polder area should be ensured	Agreed and to be ensured
Water Management Organizations (MWOs) should be formed for proper functioning of water control structures.	Agreed and to be formed before operation of the water control structures.

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Appendix A: Checklist

EIA of Coastal Polders under CEIP

Checklist for Water Resources Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

A. Administrative Information

Name of Polder:	BWDB Zone:	Hydrological Zone:
BWDB Circle name:	BWDB O & M Division:	
District (s):	Upazila (s):	
Union (s):	Mouza (s):	

B. Project Description

General Information	
a. Type of project:	b. Area of Polder (Ha):
c. Objectives of the scheme:	
d. New problems (if any) created by the project activities:	
e. Year of Starting:	f. Year of completion:
g. Name of surrounding polder	
h. Name of the projects hydro-morphologically dependent on the polder	
i. Cumulative hydraulic and morphological impacts as anticipated by local people	
Data Collected by:	Date:
Present Status/condition of Embankment	
Embankment length (……………….Km)	Embankment Type: Submergible / Full flood protection
Breaching: 1. Yes 2. No Breaching spot (If yes): (Please specify the spot names, length, GPS reading)	

Location of Breaching Points (Name of Place)	Reasons of breach	Good		Moderately affected		Badly affected/ Vulnerable		Completely damaged	
		GPS ID	Length	GPS ID	Length	GPS ID	Length	GPS ID	Length

Public Cuts: 1. Yes 2. No Public Cuts (If yes): (Please specify the spot names, length, GPS reading)

Location of Public Cuts	Reasons	Moderately affected		Badly affected/ Vulnerable		Completely damaged	
		GPS ID	Length	GPS ID	Length	GPS ID	Length

Re-sectioning: 1. Yes 2. No Re-sectioning (If yes): (Please specify the spot names, length)

From	To	Length	Height	Actual reasons

Regulators

Location of Structure	GPS ID	Type	Vent Size	No of Vent	Service Condition (VG/G/M/B/VB)13	Present Condition (Partial/full damage/good)	Present Problems	Reasons for problem	Year of problem	Rehabilitable (Y/N)	Replaceable (Y/N)

[13]VG – Very Good, G – Good, M – Moderate, B – Bad, VB – Very Bad

Fish pass Structures											
Cross Drainage Structures (Syphon/Aqueduct)											
Barrage											

Pipe Sluices										
Irrigation Inlets										
Bridge/Culverts										
Others										
Drainage Channels										

Name	Length	Flow Direction	Flow (%)	Present Service Condition \Problems	Reasons of Problem	Re-excavation Need (Y/N)	Proposed Re-excavation Mode (Manual/ Mechanical)	From – To (Approx. length)	GPS ID (Structure)

Irrigation Canals					
Name	Length	Problems	Reasons	Re-sectioning (Y/N)	From – To (Approx. length)

Protective Works							
Location Name	Type (Temporary/Permanent)	Length	Present Condition (G/ MD/ CD)14	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

[14]G – Good, MD – Moderately Damaged, CD – Completely Damaged

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

7. Flooding (depth, % of extent, onset, peak and recession)			
Flood/Inundation Condition	Area (%)	Reasons of Flooding	Onset:
F0 (< 30 cm)			
F1 (30-90 cm)			Peak:
F2 (90 – 180 cm)			
F3 (180 – 360 cm)			Recession:
F4 (> 360 cm)			

E. River Erosion			
River/Khal name	Area (ha)	Length (m)	Reasons

F. Accretion		
River/Khal name	Area (ha)	Reasons

G. Water Quality (Peoples perception)	
1. Ground water (Presence of pollutant)	
Arsenic (Yes/No)	Location:
Iron (Yes/No)	Location:

2. Surface water			
River/Khal name	Quality of water (Good/Bad/Avg.)	Type of Pollutant	Sources of pollutant

H. Historical severe flood:

Recent flood	**Extent (Days)**	**Flood level (cm)**	**Damage of resources**	
1988				
1994				
1998				
2004				
2007				
Last five years	Flood year			Flooding areas:
	Non flood year			

I. Participatory Social Mapping by stakeholders (Name of regulators, name of public cuts points, Name of breaching points, location of water logged area, identification of encroached canal with name and their location on map)

J. Peoples opinion of the project

Pre-project condition:
Period of project benefits:
Present condition and Present problems:
Causes of problems:
Probable Solution/Improvement:

Checklist for Land Resources, Agriculture and Livesock Information Collection

EIA of Coastal Polders under CEIP

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

Vill: 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 Month, Production: metric ton*

Problem/Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
Capture Fisheries: 1. 2. Culture Fisheries: 1. 2. Indiscriminate Fishing Activities: 1. 2.	Total no. of fisher HHs: % / No. of CFHHs: % / No. of SFHHS: No. of Days spend annually in fishing by CFHHs: SFHHs: Hrs/Day spend in fishing by CFHHs: SFHHs:	River																
		Beel (Leased/non leased)																
		Khal																
		Floodplain																
		Mangrove area																
		Fish pond																
		Baor																

Problem/Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
		Ghers																

Fish Migration		Fish Biodiversity		Species List					Species Composition				
				River	Khal	Beel	Pond	Other	Group	River	Khal	Beel	Pond
Previous Migration Status		Fish diversity status (%)							Major carp				
									Exotic carp				
									Other carp				
									Catfish				
									Snakehead				
Present Obstacle to fish migration:	1. 2. 3.	Reasons of increase or decrease	1. 2. 3. 4. 5.						Live fish				
									Other fish				
									Shrimp/prawn				
									Hilsa/Indian salmon				
									Pomfret				
Important breeding, feeding and over wintering ground									Jew fish				
									Sea cat fish				
									Shark/ Rays				
									Rui				
									Catla				

Problem/Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration

Horizontal Migration pattern	Species: 1. 2. 3. 4. 5.	Season (Months):	Routes:	Significant areas	1. 2. 3.						Mrigal				
											Koi				
											Sarputi				
											Large shrimp				
											Small shrimp				
											Silver carp				
											Carpio				
Longitudinal Migration pattern	Species: 1. 2. 3. 4. 5.	Season (Months):	Habitats:	Species of Conservation Significance	Rare:						Grass carp				
											Tengera				
											Chapila				
					Unavailable:						Others				

Post Harvest Activities		**Fishermen Lifestyle**	
Fish edible quality:		Socio-economic Status of subsistence level fishermen:	
Source of pollution in each habitat:		Socio-economic Status of part time fishermen:	
Seasonal vulnerability:		Socio-economic Status of Commercial fishermen:	
Ice factory (Number, location and name):		Other conflict (with muscle men/ agriculture/ other sector/laws):	
Landing center, whole sale market, other district markets, etc.:		Fishermen community structure (Traditional/Caste/Religion)	

Problem/Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration

Storage facility (number, location and name):		Traditional fishermen vulnerability (Occupation change/others):	
Fish market (Number, location and name):		**Existing Fisheries Management**	
Marketing problems:		Fishermen Community Based Organizations (FCBOs):	
Fish diseases (Name, Host species, Season, Syndrome, Reason, etc.):		WMOs activity:	
Other backward and forward linkages (Number, location and name):		Fishing right on existing fish habitats (Deprived/Ltd. access/Full access):	
Transport facility (Mode of fish transportation, cost, other involvements)		Leasing system:	
Dry fish industries (Number, location and name):		Enforcement of fisheries regulation (Weak/strong):	
Others information:		Sanctuary/ Beel Fisheries	
		Department of Fisheries (DoF) activity:	
		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.

<u>Marine:</u>

Hilsa/Illish, Bombay Duck (*Harpondon nehereus),* Indian Salmon (*Polydactylus indicus),* Pomfret (*Rup_Hail_Foli Chanda),* Jew Fish (*Poa, Lambu, Kaladatina* etc.), Sea Cat Fish (*Tachysurus spp.),* Sharks, Skates & Rays, Other Marine Fish.

<u>Beels:</u>

Rui (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*), Kalbaus (*Labeo calbasu*), Ghonia (*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.

<u>Pond:</u>

Rui (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*), Kalbasu (*Labeo calbasu*), Mixed Carp, Silver Carp (*Hypophthalmichthys molotrix*), Grass Carp (*Ctenopharyngodon idellus*), Mirror Carp (*Cyprinuscarpio var. specularis*), Tilapia (*Oreochromis mossambicus* / *O. niloticus*), Shrimp, Aor (*Mystus aor / Mystus seenghala*), Boal (*Wallago attu),* Shol/Gazar & Taki (*Channa spp.),* Chital/Foli (*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

Basic Information

Date		**Prepared by**	
Name of the Polder			
BWDB Circle Name			
District/s		Upazila/s	
Location of the FGD			

Habitat Information/Ecosystem Types (Please put tick where is applicable)

Agriculture land		**Forest patches including social forestry**	
Settlement/Homesteads		Canal and ponds	
Orchard		Grasslands	
Fallow		Reserve forest	
Ridges		Others	

Terrestrial Vegetation Checklist (List of Major Plant Species)

Species Name	**Status**	**Utilization**
Homestead Vegetation		
Mangrove Vegetation		
Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others		

Terrestrial Wildlife Check List

Species Name	Habitat	Status	Migration Status
Mammals			
Amphibians			
Reptiles			
Birds			
Habitat: 1= Homestead forest, 2= Floodplains, 3= Wetlands, 4= River, 5= Pond, 6=Forest Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Migration Status: 1= Local, 2= Local Migratory, 3= Migratory			

Aquatic Wildlife Checklist

Species Name	Habitat	Status	Migration Status
Mammals			
Amphibians			

Species Name	Habitat	Status	Migration Status
Reptiles			
Birds			
Habitat: 1= Homestead forest, 2= Floodplains, 3= Wetlands, 4= River, 5= Pond, 6=Forest Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Migration Status: 1= Local, 2= Local Migratory, 3= Migratory			

Foreshore vegetation/Mangrove vegetation

Name of the forest patches location (s)	Species Name	Abundance	Utilization
Abundance1= High,2=Moderate,3=Low Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others			

Major Wetland information

Name of wetland	Type of Wetland	Area 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	
Slope Protection/Revetment	
Construction of Water control Structures	
Afforestation	

(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 ofMouza(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	
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	Pucka	

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	Kacha	
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			
	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.**

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/ 128 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, Khuina, Bagerhat, Pirojpur, Patuakhali and Barguna Districts subject to fulfilling the following terms and conditions.

I. This clearance shall only be applicable for the development of the infrastructure of the said project.

II. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) report considering the overall activity of the said Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE).

III. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)

4a. Project activities:
- A list of the main project activities to be undertaken during site clearing, construction as well as operation
- Project Plan, Design, Standard, Specification, Quantification, etc.

4b. Project schedule: The phase and timing for development of the Project

4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.

4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.

5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
   - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
   - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
   - Environment Quality : Air, Water, Soil and Sediment Quality
   - Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions
6. Socio-economic environment should include, inter alia, following:
   - Population: Demographic profile and ethnic composition
   - Settlement and housing
   - Traffic and transport
   - Public utilities: water supply, sanitation and solid waste
   - Economy and employment: employment structure and cultural issues in employment
   - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.
7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).
   In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the

1/2

scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man maid or natural, wildlife, socio-economic aspect shall be incorporated in detail.

8. Management Plan/Procedures:
For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.
An outline of the Environmental Management Plan shall be developed for the project.
In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)
Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
10. Conclusion and Recommendations

IV. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.

V. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project..

VI. Violation of any of the above conditions shall render this clearance void.

VII. The project authority shall submit the EIA along with an application for Environmental Clearance, the applicable fee in a treasury chalan and the no objection certificates (NOCs) from the local authority to the head office in Dhaka with a copy to the Khulna and Barisal Divisional Office of DOE.

VIII. This clearance is valid for one year from the date of issuance and the project authority shall apply for renewal to Head Office with a copy to the Khulna and Barisal Divisional Office of DOE at least 30 days ahead of expiry.

IX. This Site Clearance Certificate has been issued with the approval of the appropriate authority.

05.06.2013

(Syed Nazmul Ahsan)
Deputy Director (Environmental Clearance)
&
Member Secretary
Environmental Clearance Committee
Phone # 02-8181778

Mr. Md. Sarafat Hossain Khan
Superintending Engineer & Project Coordinator
Coastal Embankment Improvement Project (Phase-I)
Bangladesh Water Development Board (BWDB)
72, Gre[illegible]d, Dhaka-1205.

__Copy Forwarded to :__

1) PS to Secretary, Ministry of Environment and Forest, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Khulna/Barisal Divisional Office, Khulna/Barisal.
3) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

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Appendix C: Details of Relevant Policies and Laws

(A) National Legislation

(i) Environment Conservation Act, 1995

The national environmental legislation is known as Environmental Conservation Act (ECA), 1995 (subsequent amendments) is currently the main legislative document relevant to environmental protection in Bangladesh. It was promulgated in 1995 and has repealed the earlier environment pollution control ordinance of 1977. The main objectives of ECA 1995 are:

- Conservation and improvement of environment, and
- Control and mitigation of pollution of environment.

The main strategies of the Act can be summarized as:

- Declaration of ecologically critical areas, and restriction on the operation and process, which can be carried, out or cannot be initiated in the ecologically critical areas.
- Regulation in respect of vehicles emitting smoke harmful for the environment.
- Environmental clearance.
- Regulation of the industries and other development activities – discharge permit.
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes.
- Promulgation of standard limit for discharging and emitting waste.
- Formulation and declaration of environmental guidelines.

Bangladesh Environmental Conservation Act (Amendment 2000) focuses on: (1) ascertaining responsibility for Compensation in cases of damage to ecosystems, (2) increased provision of punitive measures both for fines and imprisonment and (3) fixing authority on cognizance of offences.

Bangladesh Environmental Conservation Act (Amendment 2002) elaborates on: (1) restriction on polluting automobiles, (2) restriction on the sale and production of environmentally harmful items like polythene bags, (3) assistance from law enforcement agencies for environmental actions, (4) break up of punitive measures and (5) authority to try environmental cases.

Bangladesh Environmental Conservation Act (Amendment 2010) elaborates on (1) demarcation of wetlands and water bodies, (2) Hazardous waste import, transportation, storage etc., (3) Cutting of hills, mountains (4) Ecologically Critical Areas.

Failure to comply with any part of the Environment Conservation Act 1995 may result in punishment to a maximum of 5 years imprisonment or a maximum fine of Tk. 100,000, or both.

(ii) Environment Conservation Rules, 1997 (amendments in 2002 and 2003)

A set of the relevant rules promulgated to implement the ECA 1995. There have been three amendments to the Rules until now in February and August 2002 and April 2003 respectively. The Rules mainly consist of:

- The national Environmental Quality Standards (EQS) for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhaust;

- Categorization of industries, development projects and other activities on the basis of pollution activities of the existing or proposed industries/development projects/activities.
- Procedure for obtaining environmental clearance;
- Requirement for undertaking IEE and EIA as well as formulating EMP according to categories of industries/development projects/activities;
- Procedure for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.

The proposed projectbelongs to the Red Category according to the classification of industrial units or projects described in the Schedule-1 in the Rules. The procedure for issuing Environmental Clearance Certificate is elaborated in the Rules that must have to follow by the BWDB.

Another rule of the ECR is to determine environmental standards. The standards for air, water, sound, odor and other components of the environment shall be determined in accordance with the standards specified in Schedules - 2, 3, 4, 5, 6, 7 and 8. The proposed project must comply these standards during carrying out the activities.

(iii) The Environment Court Act, 2000

The Environment Court Act, 2000 has been enacted in order to establish environmental courts in each administrative division of Bangladesh. Under this Act, the court has concurrent jurisdiction i.e. to try both civil and criminal cases. The basis for instituting a case is a violation of the “environmental law”, meaning the Bangladesh Environment Conservation Act, 1995 and Rules made there under. In particular the environment court is empowered to:

- Impose penalties for violating court orders;
- Confiscate any article, equipment and transport used for the commission of the offence2;
- Pass any order or decree for compensation;
- Issue directions to the offender or any person (a) not to repeat or continue the offence; (b) to take preventive or remedial measures with relation to any injury, specifying the time limit and reporting to the DOE regarding the implementation of the directions.

(iv) Bangladesh Water Act, 2013

The Water Act 2013 exists for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh.

As per this Act, all forms of water (e.g., surface water, ground water, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people. Without prior permission issued by the Executive Committee, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor they will be allowed to build any structure that impede the natural flow of rivers and creeks. Issuance of clearance certificate must be obtained by all organizations or appropriate authorities that are involved in undertaking, making or implementing a Water Resource Development Project before initiating the project, according to section 16.

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

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

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

• Participation is an important voluntary process in which local stakeholders influence policy formulation, alternative plans/designs, investment choices and management decisions affecting their communities and establish the sense of ownership.

• Give the local stakeholders a decisive voice at all stages of water management.

• Participation of local stakeholders to prepare production plans on agriculture, fishery, forestry and livestock development and environmental management plan based on the feasibility study by the implementing agencies.

• According to this rule, every water management group will form cluster groups including landless men and women of the project area for infrastructure development or maintenance related activities of which 30 percent will be women.

(vi) The Embankment and Drainage Act, 1952

This is an Act to consolidate the laws relating to embankment and drainage and make better provisions for the construction, maintenance, management, removal and control of embankments and watercourses or the better drainage of lands and for their protection from floods, erosion or other damage by water. The major provisions are:

According to the Section 4 (1) every embankment, watercourse and embanked tow-path maintained by the Government or the Authority, and all land, earth, pathways, gates, berms and hedges belonging to or forming part of, or standing on, any such embankment or water-course shall vest in the Government or the Authority.

Section 25 describes the restoration of land etc. that any person who shall have sustained damage by the execution of such works shall receive compensation from the Government or the Authority. Any alteration if appear unnecessary shall be restored as nearly as possible to the state in which they were before the activity at the expense of the Government or the Authority.

Section 28 outlines the provisions of compensation of damages of any land or any right of fishery, right of drainage, right to the use of water or other right of property shall be compensated.

Section 55 to 59 outline penalties for following cases: unauthorized interference and abetment, injuring embankments, diverting rivers or grazing cattle on embankments, removal of obstruction and repair of damage, and obstructing persons in exercise of powers under this Act.

(vii) Wildlife (Conservation and Security) Act, 2012

The Bangladesh Wildlife (Conservation and Security) Act of 2012 has been formulated by repealing previous laws i.e. Wildlife (Preservation) Act of 1973 and it aims at conservation and safety of biodiversity, forest and wildlife of the country. The Department of Forest (DoF) has the primary responsibility for implementing this Act. The key issues in the Act are:

- Prohibition made related to wild animals and plants that no person can hunt any wild animal without a license or willfully pick, uproot, destroy or collect any plant
- Determination of vulnerable, endangered and critically endangered species of wild animals and plants
- Declaration of sanctuary for the conservation of forest and habitat of wildlife and prohibitions made on such sanctuary.
- Requirement of license to cultivate, extract, manufacture, rear, export or import any wild animal or part of its body, meat, trophy, uncured trophy or any plant.
- Restriction on import, export and re-export of wild animals and plants.

The regulation of the Wildlife Act prohibits establishing or operating any industrial factory within 2 (two) kilometers from the boundary of a sanctuary. This applies to the Polders improvement activity near the Sundarbans Reserve Forest area. Capturing, killing, shooting or trapping of wildlife is prohibited in sanctuary and conservation of all natural resources such as vegetation, soil and water are managed mainly for undisturbed breeding of wildlife. Clause 14 articulates the activities prohibited in a sanctuary listed below:

- cultivate any land;
- establish or undertake any industrial operation;
- harvest, destroy or collect any plant;
- set any kind of fire;
- enter into a sanctuary with any weapon without the permission of the Chief Warden or the officer authorised by him in this behalf;
- disturb or threat any wildlife, or use chemicals, explosives or any other weapon or substances which may destroy wildlife habitat;
- introduce any exotic animal or plant;
- introduce any domestic animal or allow any domestic animal to stray;
- dump any materials detrimental to wildlife;
- explore or dig for extraction of minerals;
- fell any plant or part thereof except silvicultural operations required for natural regeneration of plants;
- divert, stop or pollute watercourse; or
- Introduce any alien and invasive plant species.

This Act is particularly relevant to this study because “biodiversity “is dealt under the Act and according to the Act, “biodiversity” means genetic and species diversity of all species or sub-species of flora and fauna living in aquatic, terrestrial and marine ecosystems or diversity of their ecosystems. It is to be ensured that sufficient mitigation measures are taken for ensuring the safety of biodiversity and protection of flora and fauna. The EIA provides mitigation measures for biodiversity conservation including ecology and fisheries in chapter 8.

(viii) The Protection and Conservation of Fish Act, 1950 and Rules, 1985

The Act aims for the protection and conservation of fish in Bangladesh which has amendment in 1995. This Act provides power to the government to:

- Make and apply rules in any water or waters for the purposes of protection of fisheries.
- Prohibit or regulate the erection and use of fixed engines; and the construction, temporary or permanent, of weirs, dams, bunds, embankments and other structures.
- Prohibit the destruction of fish by explosives, guns, and bows in inland or coastal areas.
- Prohibit the destruction of fish by means of poisoning, pollution and effluents.

- Prescribe the seasons during which fishing is allowed.
- Prohibit fishing in all waters during spawning periods.
- Specify the officials with authority to detect breaches.

The Government made Rules in 1985 which contains 11 sections about various measures of protection and conservation and 2 Schedules specifying waters in which the catching of certain fish species is prohibited without a valid license, specifying fish species of which the catching or sale in certain periods is prohibited, and containing a form of a license for catching of carps in Prohibited Waters. Regulation 3 prohibits the erection of fixed engines in rivers and canals. No fish shall be destroyed by making use of poison or explosives (regulations 4 and 5). Licenses issued under regulation 8 only for purposes of pisciculture. Regulations prohibit the catching, carrying, transporting, offering for sale or possessing of frogs.

(ix) The Forest Act, 1927

The Forest Act was passed in 1927 in order to consolidatethe lawrelating to forests, The forest Act was enacted to preserve and safeguardforest in general, both public and private. The Forest Act of 1927 was amended in 1989 to provide deterrent penalties for certain forest offences and latest amendment came 2000 to add provision for social forestry. To elaborate the social forestry procedure Social Forestry Rules were framed in 2004 under the Forest Act, 1927 and Forest Transit Rules were framed in 2011.

This Act bears some important provisions suchas constitution of reserved forest, formation of any forestlandor wasteland or any land suitable for afforestation willbe the property of Government. This Act covers all procedural matters in implementationin all aspects related to forest conservation and developmentin Bangladesh. The key issues in the Act are:

- Section 3: The Government may declare any forest land which is property of the Government to be reserved forest land.
- Section 4: The Government shall issue a notice to that effect in the Official Gazette.
- Section 5: No rights shall be acquired in reserved forest land other than those acquired by succession or by government grant or contract and no clearing of cultivation shall be carried out other than in accordance with rules made by the Government for the reserved area.
- Section 28 provides for settlement of claims in the reserved area, prohibited activities, and powers of the Forest Officer in respect of such area. The Government may assign to any village community reserved forests and such forest land shall be called Village Forest.
- Section 32: Other public forest or waste land may be declared protected forests and the Government may make rules in respect of all matters listed in the section for such areas.
- Section 76 defines additional regulation making powers of the Government.

(x) Acquisition and Requisition of Immovable Property Ordinance 1982

The principal legal instrument governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable Property Ordinance, 1982 and subsequent amendments during 1993 - 1994. The 1982 Ordinance requires that compensation be paid for (i) land and assets permanently acquired (including standing crops, trees, and houses) and (ii) any other damages caused by such acquisition. The Ordinance provides certain safeguards for the owners and has provision for payment of “fair value” for the property acquired.

Deputy Commissioners (DC) will pay compensation for the land to be acquired based on Land Acquisition Proposals to be submitted by the requiring body. DCs, in all the cases, determine market value of acquired assets on the date of notice of acquisition (notice under section 3 of the Ordinance). The DCs then adds 50% premium on the assessed value for cash compensation under law (CCL) of all acquired assets except standing crops due to compulsory acquisition. The CCL paid for land is generally less than the “current market price” as owners customarily report undervalued land transaction prices in order to pay lower stamp duty and registration fees. If the land acquired has standing crops cultivated by tenant (bargadar) under a legally constituted agreement, the law requires that part of the compensation money be paid in cash to the tenants as per the agreement. Places of worship, graveyard and cremation grounds are not to be acquired for any purpose. The law requires that the salvaged materials upon payment of compensation will be auctioned out by the government. Under the 1982 Ordinance, the Government is obliged to pay compensation only for the assets acquired.

However, the provisions under this law are not adequate to cope with the adverse effects related to land acquisition and involuntary resettlement, nor do they do fully match the requirements of the WB’s Operational Polices (OP 4.12) or international standards. Some of such gaps in existing land acquisition law of the country are:

- Existing GOB laws recognize title owners only; informal settlers are not covered
- Consultation with affected community not legally required
- No support or program for income and livelihood restoration.

In light of addressing these shortcomings, the Government of Bangladesh is working on preparation of a **national policy on involuntary resettlement**, which is consistent with the general policy of the Government that the rights of those displaced by development projects shall be fully respected, and persons being displaced shall be treated with dignity and assisted in such a way that safeguards their welfare and livelihoods irrespective of title, gender, and ethnicity. The Government will undertake further work towards legislative changes to safeguard resettlement rights by law once the draft policy is approved in the Cabinet.

This proposed project requires land acquisition in each Polder area, which should be done following the procedure mentioned in this Act.

(xi) Noise Pollution (Control) Rules, 2006

According to Environment Protection Act 1995, the government formulated the noise pollution Rules & Regulation in 2006. This regulation recommends to keep the sound level 50 dB at the quieter area from 6am until 9pm and at night 40 dB, similarly, at residential area on the day of 55 dB and at night 45 dB, a mixed area, 60 dB at day time and at night 50 dB, a commercial area on the day of 70 dB and at night 60 dB and the industrial areas of the day 75 dB and at night 70 dB.

(xii) Disaster Management Act, 2012

The Disaster Management Act 2012 aims at coordinating the activities of disaster management and making these object oriented and strengthened to build up infrastructure of effective disaster management to fight all types of disaster. Disastermeans any such incidents created by nature or human.

This Act is particularly relevant to avoiding accidental hazard both in construction and post-construction phase. The relevance of this act for this proposed project arises as following:

- To make a disaster management plan for rehabilitation to bring back any infrastructure, life, livelihood and working environment damaged by disaster to previous condition or better condition.
- To create effective disaster management infrastructure to fight disaster and to make the public concerned and strengthened to face the disasters.
- To ensure that obstacle is created in plying fire brigade and rescue vehicles during fire, earthquake, building slide or other disaster.

Disaster (to certain degree) may occur in present project if any harmful situation occurs during the normal work or construction activity. Therefore, appropriate management plan should have to be taken by the project proponent to prevent any unwanted disaster in the location.

(xiii) Antiquities Act, 1968

The Antiquities Act 1968 (amended in 1976) establishes the legal framework for the preservation and protection of antiquities. According to the Act, any ancient monument (minimum 100 years old) illustrative of architecture, warfare, politics or culture can be regarded as an article of antiquity.The law terms the archeological sites and monuments as antiquities. The Act has defined the procedure in dealing with antiquities in following matters, i.e. custody, preservation of ownerless antiquity, prohibition of movement of antiquity, right of access to protected immovable antiquities etc.

If the proposed project finds any archaeological sites or national antics during carrying out the activity, then it will be dealt under this Act. Discovery or existence of an antiquity will immediately be notified to the Advisory committee formed under this law for the protection of national antiquities. Mitigation measures are outlined for the potential damage and loss of cultural propertiesin chapter 10.

(xiv) Bangladesh Labour Act, 2006 and Rules, 2015

Bangladesh Labour Act was promulgated in 2006. The legislation pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions. The amendment in 2013 has introduced a good number of important items like workers' welfare, rights and safety and industrial safety and expansion of the industry are particularly relevant for this proposed study.

In 2015, Bangladesh government has introduced the Bangladesh Labour Rules. Some of the relevant points of this Rules are health and fire safety, prescribe from for filling case in Labour Court, and approval of factory plan and any extension among others.

The Bangladesh Labour Act 2006 consolidated and repealed 25 previous labour related laws including the Dock Labourers Act, 1934, the Factories Act, 1965 among others.

The proposed project is required to obey occupation health and safety of the workers covered under this Act while carrying out the activities.

(B) Relevant National Policies, Plans and Strategies

(i) National Environment Policy, 1992

The National Environment Policy (NEP) is one of the key policy documents of the Government. The policy addresses 15 sectors in all, in addition to providing directives on the legal framework and institutional arrangements. Coastal and marine environment is one of the key sectors covered in this policy. The policy declarations that have particular bearing on the Integrated Coastal Zone Management (ICZM) are listed below.

- Sustainable use of coastal and marine resources and preservation of coastal ecosystem
- Prevention of national and international activities causing pollution in coastal and marine environment
- Strengthening research in protection and development of coastal and marine resources and environment
- Exploration of coastal and marine fisheries to a maximum sustainable limit

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

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

The Policy is applicable to the Package 3 under CEIP-1and the proposed interventions are required to comply with all the policy directives emphasizing particularly on reducing adverse environmental impacts. The EIA studies of the coastal polders are required to clearly address the potential impacts and propose mitigation measures.

(ii) National Water Policy, 1999

The National Water Policy (NWP) was adopted in 1999 with the objectives of improved water resources management and protection of the environment.

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

- Clause 4.5b: Planning and feasibility studies of all projects will follow the Guidelines for Project Assessment, the Guidelines for People's Participation (GPP), the Guidelines for Environmental Impact Assessment, and all other instructions that may be issued from time to time by the Government.
- Clause 4.9b: Measures will be taken to minimize disruption to the natural aquatic environment in streams and water channels.
- Clause 4.9e: Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding.
- Clause 4.10a: Water development projects should cause minimal disruption to navigation and, where necessary, adequate mitigation measures should be taken.

- Clause 4.12a: Give full consideration to environmental protection, restoration and enhancement measures consistent with National Environmental Management Action Plan (NEMAP) and the National Water Management Plan (NWMP).
- Clause 4.12b: Adhere to a formal environment impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects, in each water resources development project or rehabilitation program of size and scope specified by the Government from time to time.
- Clause 4.12c: Ensure adequate upland flow in water channels to preserve the coastal estuary ecosystem threatened by intrusion of salinity from the sea.
- Clause 4.13b: Only those water related projects will be taken up for execution that will not interfere with aquatic characteristics of those water bodies.

Most of the above clauses will be applicable to the Package 3 under CEIP-1. The Project design and present EIA study will be required to comply with these requirements.

(iii) National Water Management Plan, 2004

The National Water Management Plan (NWMP) has been prepared with three central objectives consistent with Water Policy aims and national goals. These objectives are:

- Rational management and wise-use of Bangladesh’s water resources
- People’s quality of life improved by the equitable, safe and reliable access to water for production, health and hygiene
- Clean water in sufficient and timely quantities for multi-purpose use and preservation of the aquatic and water dependent eco-systems.

The Plan is structured in a manner that the objectives of 84 different programmes planned for the next 25 years contribute individually and collectively to attainment of both the overall objectives as well as to intermediate sub-sectoral goals. The major programs in the Plan have been organized under eight sub-sectoral clusters: (i) Institutional Development, ii) Enabling Environment, (iii) Main River, (iv) Towns and Rural Areas, v) Major Cities; (vi) Disaster Management; (vii) Agriculture and Water Management, and (viii) Environment and Aquatic Resources.

The CEIP-1 is itself a project designed under this Plan and addresses its key objectives for the water resource management in the coastal areas.

(iv) Coastal Zone Policy, 2005

The Government has formulated the Coastal Zone Policy that provides a general guidance to all concerned for the management and development of the coastal zone in a manner so that the coastal people are able to pursue their life and livelihoods within secure and conducive environment.

The Policy has relevance in proposed project in following matters:

- Reduction of *vulnerabilities:* Safety measures will be enhanced by combining cyclone shelters, multi-purpose embankments, killas, road system and disaster warning system. It should include special measures for children, women, the disabled and the old;
- Sustainable management of natural resources: Small water reservoirs shall be built to capture tidal water in order to enhance minor irrigation in coastal areas. Appropriate water management system within the polder utilizing

existinginfrastructures will be established for freshwater storage and other water utilization.

(v) National Land-use Policy 2001

The Government of Bangladesh has adopted national Land use Policy, 2001. The salient features of the policy objectives are:

- To prevent the current tendency of gradual and consistent decrease of cultivable land for the production of food to meet the demand of expanding population;
- To promote sustainable and planned utilization ofland through 'zoning system' of land for commercial and other purposes;
- To ensure the best utilization of char lands by land accretion for rehabilitation of landless people,
- To protect state-owned land which can be used to meet the needs of development projects;
- To ensure that land use is in harmony with natural environment;
- To use land resources in the best possible way and to play supplementary role in controlling the consistent increase in the number of land less people towards the elimination of poverty and the increase of employment;
- To protect natural forest areas, prevent river erosion and destruction of hills;
- To prevent land pollution; and
- To ensure the minimal use of land for construction of both government and nongovernment buildings.

The land-use policy has specific section for the coastal region, where strengthening the protection against cyclone through implementing various activities has been guided. The extent of activities that will affect the land will ensure that the existing national land use policy is adhered.

(vi) National Agriculture Policy, 1999

The overall objective of the National Agriculture Policy is to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable food security system for all. The policy has some specific guidelines related to coastal areas ensuring to the development of coastal zone agriculture.

- To increase production of potential crops suitable for the coastal areas.
- To build water reservoir to capture tidal water and thereby expanding mechanized irrigation facilities in the coastal areas.
- To research the development of improved crop varieties and technologies suitable for cultivation in coastal, hilly, water logged and salinity affected areas.

The above policies are not directly relevant to the responsibility of the project proponent; however, the proposed CEIP-1is expected to contribute to achieving the objectives of the agriculture policy.

(vii) Guidelines for Environmental Assessment of Water Management (Flood Control, Drainage and Irrigation- FCD/I) Projects

The Guidelines for Environmental Assessmentof Water Management (Flood Control, Drainage and Irrigation- FCD/I) Projects is prepared by the Water Resources Planning

Organization (WARPO) on 2001 and approved on 2003 by the Ministry ofEnvironment and Forestwith assistancefrom National Water Management Plan Project (NWMPP).

The Guidelines are intended to be a mandatory part of planning FCD/I projects of all sizes.The aim of this document is to provide the framework for EA of FCD/I projects in Bangladesh. The steps for EA include project appreciation, data collection and environmental baseline description, fieldinvestigations, people's participation, scoping and bounding, impact assessment, analysis ofalternatives and the environmental management plan, which are within the national framework of environmental and social planning.

However, these EA Guidelines for FCD/I projects do not contain details of all the necessary environmentalissues and procedures. EA practitioners must follow the relevant instructions in other nationalregulations and guidelines, as well as those of bilateral or international funding agencies whenapplicable. Therefore, ECR 1997 has been followed primarily along with this for the procedures for obtaining ECC from DoE along with these Guidelines. There is no major deviation in the process.

Implication of legal aspects on this project

(i) Administrative Procedures for Obtaining Location/Environmental Clearance

The legislative bases for environmental assessment for the proposed project intervention are the Environmental Conservation Act 1995 and the Environmental Conservation Rules 1997. According to the ECA 1995, the proponent must need to obtain an Environmental Clearance Certificate from the Department of Environment (DoE) in the manner prescribed by the Rules.

Environmental clearance has to be obtained in two steps: first location clearance and thereafter environmental clearance. Environmental Clearance Certificate is issued to all existing and proposed industrial units and projects falling in the Green category, but it is required to obtain a Location Clearance Certificate for industrial units and projects falling in the Orange – A, Orange – B and Red categories, and then the Environmental Clearance Certificate will be issued. According to the categorization, construction/reconstruction/expansion of flood control embankments, polders, and dykes related activities fall into the Red category. **Therefore, the proposed water supply project falls under the 'Red' category and hence necessitates a full-scale EIA**.

Like all other projects, this project also needs to meet the requirement of the DOE. An environmental assessment (EA) study needs to be undertaken for obtaining the environmental clearance. The procedure to obtain an Environmental Clearance Certificate for this "Red" category project requires submission of following documents along with the application:

- Feasibility Report for the Project (where applicable)
- Environmental Impact Assessment (EIA) Report
- Environmental Management Plan (EMP)
- No Objection Certificate from relevant Local Authority (where applicable)
- Other necessary information, (where applicable)

Public participation or consultation is not a condition in the ECR 1997 and/or EIA Guidelines, however, DoE prefers the proponent to do public consultation during the assessment and puts condition for it while providing site clearance or during the approval of the EIA TOR.

Steps to be followed for obtaining Environmental Clearance Certificate (ECC) in connection with the Red Category from DOE are outlined in **Figure 3.1**.

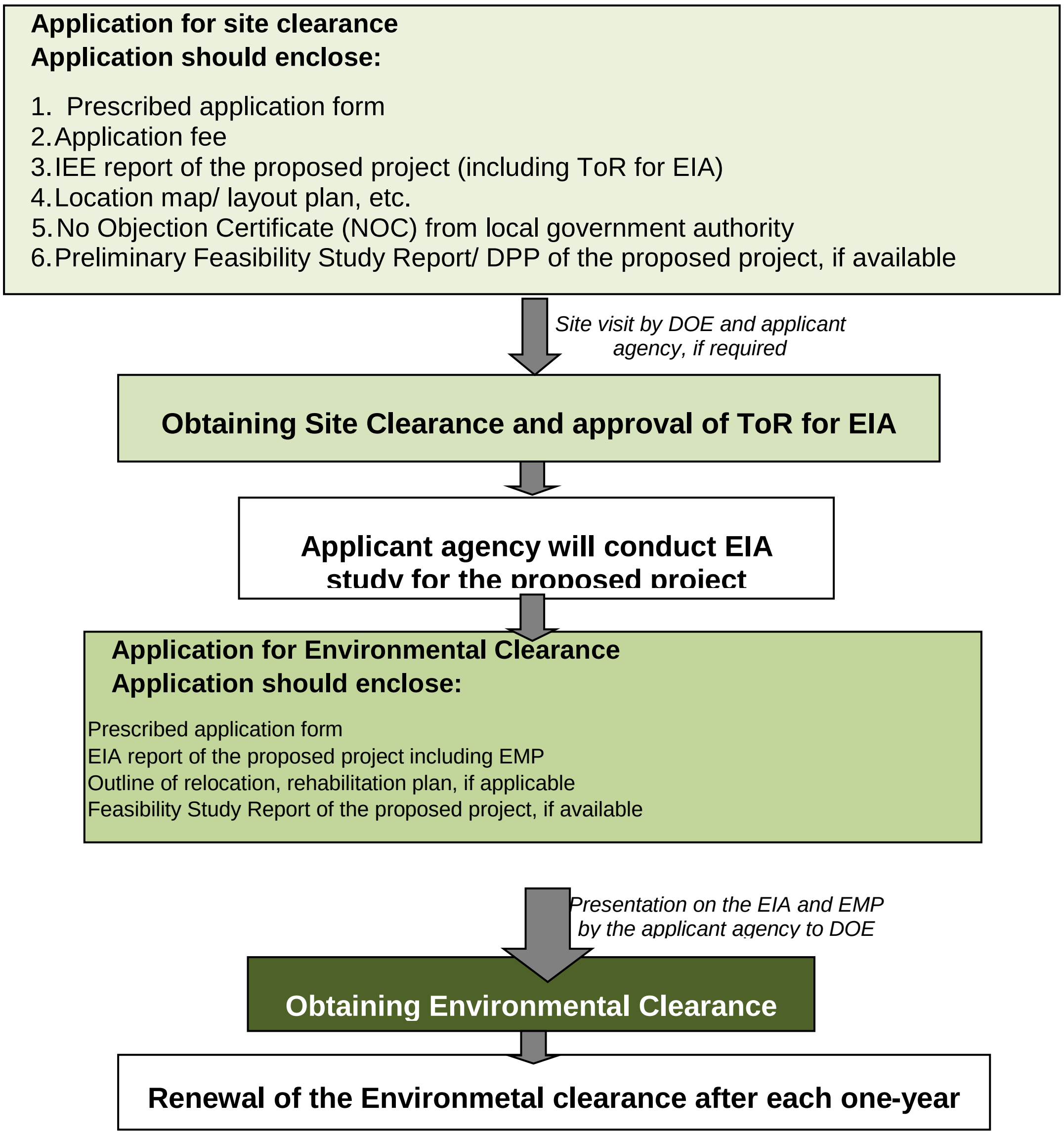

Figure 11.1: Process of obtaining Clearance certificate from DoE

(ii) Organization related to Enforcement of Environmental Standards

The **Department of Environment (DoE),** the technical arm of the Ministry of Environment and Forest (MoEF) is the regulatory body and the enforcement agency of all environmental related activities. It is the responsible body for reviewing and approving the EIA reports in Bangladesh.

The DOE is headed by a Director General (DG). The DG has complete control over the DoE. The power of the DG, as given in the Act, may be outlined as follows:

- The DG has the power to close down the activities considered harmful to human life or the environment. The operator has the right to appeal and procedures are in place for this. However, if the incident is considered an emergency, there is no opportunity for appeal.
- The DG has the power to declare an area affected by pollution as an ecologically critical area. The DoE governs the type of work or process, which can take place in such an area.

- Before undertaking any new development project, the project proponent must take an Environmental Clearance from the DoE. The procedures to take such clearance are in place.

Failure to comply with any part of ECA 1995 may result in punishment by a maximum of 10 years imprisonment or a maximum fine of Tk. 1000,000 or both.

World Bank's Environmental Safeguard Policies

(i) Environmental Assessment (OP 4.01)

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

The present EIA has been carried out in compliance with this Operational Policy(OP).

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

Category A: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.

Category B: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas--including wetlands, forests, grasslands, and other natural habitats--are less adverse than those of Category A projects.

Category C: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.

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

The proposed CEIP-1has been classified as Category A, since some of the potential impacts are likely to be significant and diverse.

(ii) Natural Habitats (OP 4.04)

The Policy describes the conservation of natural habitats, like other measures that protect and enhance the environment, to be essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank also supports, and expects borrowers to apply a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. The Bank-promotes and supports natural habitat conservation and improved land use by financing projects designed to integrate into national and regional development the conservation of natural habitats and the maintenance of ecological functions. Furthermore, the Bank promotes the rehabilitation of degraded natural habitats. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

The WBOP 4.04 is triggered for the proposed Project. However, the proposed activities will be undertaken in an area where natural habitat has already been modified to farm lands and built-up area. Furthermore, appropriate control measures have been incorporated in the environmental management plan (provided later in the document) to prevent any potential impacts of the Project on the nearby foreshore area.

(iii) Water Resources Management (OP 4.07)

Through this Policy, the Bank seeks to support operations that provide potable water, sanitation facilities, flood control, and water for productive activities in a manner that is economically viable, environmentally sustainable, and socially equitable. The Bank assists borrowers in many priority areas, among which developing a comprehensive framework for designing water resource investments, policies, and institutions is very important. Within this framework, when the borrower develops and allocates water resources, it considers cross-sectoral impacts in a regional setting (e.g., a river basin). Restoring and preserving aquatic ecosystems and guarding against overexploitation of groundwater resources are also given priority to the provision of adequate water and sanitation services for the poor. Furthermore, special attentions are needed by the borrowers to avoid the water logging and salinity problems associated with irrigation investments by (i) monitoring water tables and implementing drainage networks where necessary, and (ii) adopting best management practices to control water pollution.

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

(iv) Physical Cultural Resources (OP 4.11)

The World Bank's general policy regarding cultural properties is to assist in their preservation, and to seek to avoid their elimination. The specific aspects of the Policy are given below. [15]

- 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,

[15] Excerpts from the OPN 11.03. WB Operational Manual. September 1986.

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:[16]

- 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.[17]

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.

[16] Excerpts from the OP 4.10. WB Operational Manual. July 2005.

[17] Excerpts from WB OP 4.12. WB Operational Manual. December 2001.

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

(x) Projects in Disputed Areas (OP 7.60)

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

The Bank may proceed with a project in a disputed area if the governments concerned agree that, pending the settlement of the dispute, the project proposed for country A should go forward without prejudice to the claims of country B. [18]

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)19 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.

(C) World Bank's Environmental Safeguard Policies

(xiv) 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

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

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

the natural environment (air, water and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples and physical cultural resources); and trans-boundary and global environmental aspects. The Bank Policy also envisages that the borrower Government is responsible for carrying out the EA and the Bank advises the borrower on the Bank's EA requirements.

The present EIA has been carried out in compliance with thisOperational Policy(OP).

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

Category A: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.

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.

(xv) 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.

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(xxv) Public Disclosure of Information (BP 17.50)

[22] Excerpts from WB OP 4.12. WB Operational Manual. December 2001.

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

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.

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The Environment, Health, and Safety (EHS)24 Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities or project by existing technology at reasonable costs. These Guidelines will be applicable to the Project.

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

Appendix D: Gate Operation Plan in Bengali

<u>পোল্ডারের স্লুইস গেট পরিচালনার ক্ষেত্রে নিয়মাবলী</u>

অতীতে পানি উন্নয়ন বোর্ডের কর্মচারীর মাধ্যমে স্লুইস গেটগুলো পরিচালিত হতো। বাজেট স্বল্পতার কারণে সে পদগুলো এখন স্থগিত করা হয়েছে। বর্তমানে গেটগুলো পরিচালনার দায়িত্ব সুবিধাভোগীদের উপর অর্পন করা হয়েছে। প্রতিটি পোল্ডাওে এ জন্য পানি ব্যবস্থাপনা সংস্থা (**WMG, WMO, WMA**) গঠন করা হয়। কৃষি উন্নয়ন ও মৎস্য সম্পদের কথা বিবেচনা করে পোল্ডার ২৩ এর গেটপরিচালনায় পানি ব্যবস্থাপনা সংস্থাগুলোকে নিম্নোক্ত বিষয়গুলো বিবেচনা করতে হবেঃ

- কৃষি ও মৎস্য সম্পদ ব্যবস্থাপনার সাথে সামঞ্জস্য রেখে একটি নির্দিষ্ট নিয়মের মধ্য দিয়ে প্রতিটি রেগুলেটরের গেট অবশ্যই নিয়ন্ত্রিণ করতে হবে ;
- প্রকৃত পানি ব্যবস্থাপনা বিশেষ করে কৃষি ও মৎস্য সম্পদের প্রয়োজনীতার ভিত্তিতে পানি উন্নয়ন বোর্ডের পরিচালনা ও রক্ষণাবেক্ষণ শাখা সুবিধাভোগী সংস্থা, কৃষি সম্প্রসারণ অধিদপ্তর এবং মৎস্য অধিদপ্তরের মাঠ কর্মীদের যৌথ পরামর্শক্রমে গেট পরিচালনা করতে হবে;
- শুধুমাত্র মেরামত ও ফ্ল্যাশিং ব্যতীত রেগুলেটরের ফ্ল্যাপ একটি নির্দিষ্ট স্থানে সব সময় একই অবস্থানে রাখতে হবে;
- খালে পানি সংরক্ষণ করে কৃষি কাজে সেচের জন্য বর্ষার পূর্বে (মার্চ - মে) গেট বন্ধ রাখতে হবে;
- বর্ষার সময় (জুলাই -সেপ্টেম্বর) গেট সাধারণত বন্ধ থাকবে তবে পোল্ডারের ভিতর ও বাহিরের পানির স্তর একটি নিরাপদ লেভেলের বাইরে যাতে চলে না যায় সেদিকে লক্ষ্য রাখতে হবে। এক্ষেত্রে, প্রতিদিনের বৃষ্টিপাত, নদীর অবস্থা, নদীর এবং পোল্ডারের ভিতরের পানির লেভেল বিবেচনা করে যথাযথ সিদ্ধান্ত নিতে হবে;
- মাছের সর্বোচ্চ প্রজননের সময় ডিমসহ মা মাছ (ব্রুড মাছ) ও মাছের পোনা অভিগমনের বিষয় বিবেচনা করে মে হতে জুন মাস পর্যন্ত গেট খোলা রাখতে হবে;
- বর্ষাপরবর্তীসময় (অক্টোবর-নভেম্বর) গেট এমনভাবে পরিচালনা করতে হবে যাতে খালে শুষ্ক মৌসুমেও পর্যাপ্ত পানি থাকে। এক্ষেত্রে লক্ষ্য রাখতে হবে যেন খালের পানি তীর উপচে না যায় এবং কৃষি কার্যক্রম ব্যাহত না হয়;
- ফ্ল্যাশিং স্লুইস ও পাইপ ইনলেট পরিচালনার ক্ষেত্রেওএকই নিয়ম অনুসরণ করতে হবে;
- কৃষি কার্যক্রম, শষ্যের নমুনা ও ধরণ, মাছের প্রজনন সময় ও অভিগমন ইত্যাদি পরিবর্তনশীল বিধায় সময়ের সাথে সুবিধাভোগী সংস্থার (কৃষক, মৎস্যজীবি, মৎস্যচাষি) সাথে নিয়মিত পরামর্শ করতে হবে;
- কৃষি ও মৎস্য উভয় সম্পদ বিবেচনায় নিয়ে পানি ব্যবস্থাপনা সংস্থাগুলোকে (**WMG, WMO, WMA**) সমন্বিত পানি ব্যবস্থাপনার উপর প্রশিক্ষণ প্রদান করতে হবে।

Appendix E: No Objection Certificates (NOC)

বিসমিল্লা-হির রাহ্মা-নির রাহীম
গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
চেয়ারম্যানের কার্য্যালয়

৫নং সোলাদানা ইউনিয়ন পরিষদ

উপজেলা ঃ পাইকগাছা, জেলা ঃ খুলনা।

স্মারক নং·························   তারিখ ·······································

অবস্থানগত/পরিবেশগত ছাড়পত্রের স্থানীয় কর্তপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্রের ছক

১। আবেদনকারীর নাম ঃ প্রকল্প পরিচালক, উপকূলীয় বাঁধ উন্নয়ন প্রকল্প (CEIP)
বাংলাদেশ পানি উন্নয়ন বোর্ড ।

২। পিতা/স্বামীর নাম ঃ প্রযোজ্য নয়

৩। আবেদনকারীর ঠিকানা ঃ প্রকল্প পরিচালকের কার্যলয় , উপকূলীয় বাঁধ উন্নয়ন প্রকল্প (CEIP)
বাড়ী নং: ১৫ (৫ম তলা), সড়ক নং: ২৪, গুলশান-২, ঢাকা-১২১২

৪। প্রকল্পের অবস্থানগত ঠিকানা ঃ পোল্ডার ২৩ , খুলনা জেলার পাইকগাছা উপজেলায় সোলাদানা ইউনিয়নে অবস্থিত।

৫। প্রকল্পের তফছিল ঃ

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
খুলনা	পাইকগাছা				মাঝারি উচু ভূমি	হেক্টর

৬। প্রকল্পের কার্যক্রম ঃ বাঁধ উঁচুকরন, স্লুইজ গেট ও রেগুলেটর নির্মাণ ও মেরামত, খাল পূনঃখনন ইত্যাদি।
উপরোক্ত তথ্যাদির আলোকে পোল্ডার পোল্ডার ২৩ পূর্নবাসন প্রকল্প বাস্তবায়নের জন্য নিম্নেবর্ণিত অনাপত্তি প্রদান করা হলো।

শর্তাবলী ঃ

১। প্রকল্প স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষণ আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে।
২। পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত ছাড়পত্র গ্রহণ করতে হবে।
৩। কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তার নিশ্চিত করতে হবে।
৪। উপযুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে। এবং অগ্নিকান্ড কিংবা অন্য কোন দূর্ঘটনার সময় জরুরী নির্গমন ব্যবস্থা থাকতে হবে।
৫। বায়ু ও শব্দ দূষন করা যাবে না।
৬। প্রকল্প সৃষ্ট তরল বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না।

উপরে উল্লিখিত যে কোন শর্তলজ্ঞন করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক প্রকল্পের বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

হক
চেয়ারম্যান
ইউনিয়ন পরিষদ
পাইকগাছা, খুলনা।

তারিখ ঃ   স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও সীলঃ

❖ আপনার শিশুর জন্মের পরপরই ইউনিয়ন পরিষদে জন্ম নিবন্ধন করুন ❖ আপনার শিশুকে স্কুলে পাঠান ❖ সময় মত ইউপি কর পরিশোধ করুন।

Appendix F: Floral Composition and their status of the Polder area

Sl. No.	Species Name	Local Name	Family	Biodiversity Index	Density	Frequency	Abundance
Taltala							
1	*Cocos nucifera*	Narikel	Palmae	2.44	0.80	60	133
2	*Phoenix sylvestris*	Khejur	Palmae		1.80	60	300
3	*Albizia saman*	Rendi Koroi	Leguminosae		0.40	40	100
4	*Swietenia mehagoni*	Mehogani	Meliaceae		0.40	40	100
5	*Mangifera indica*	Aam	Anacardiaceae		0.60	20	300
6	*Manilkara zapota*	Safeda	Zapotaceae		0.20	20	100
7	*Feronia lemonia*	Kaotbel	Rutaceae		0.20	20	100
8	*Psidium guajava*	Peyara	Myrtaceae		0.40	20	200
9	*Tamarindus indica*	Tentul	Leguminosae		0.40	40	100
10	*Zizyphus mauritiana*	Kul Boroi	Rhamnaceae		0.40	40	100
11	*Sonneratia apetalla*	Kewra	Lyrthaceae		0.20	20	100
12	*Azadirachta indica*	Neem	Meliaceae		0.80	60	133
13	*Pithocelobium dulci*	Khai Babla	Leguminosae		0.80	40	200
14	*Excoecaria agallocha*	Gewa	Euphorbiaceae		0.60	40	150
Village Paikgachha							
1	*Cocos nucifera*	Narikel	Palmae	2.53	1.00	80	125
2	*Phoenix sylvestris*	Khejur	Palmae		1.00	60	100
3	*Borassus flabeliffer*	Taal	Palmae		0.40	40	100
4	*Albizia saman*	Sirish/Rendi Koroi	Leguminosae		0.20	20	100
5	*Areca catechu*	Supari	Palmae		0.40	40	100
6	*Swietenia mehagoni*	Mehogani	Meliaceae		0.40	20	200
7	*Musa sp*	Kola	Musaceae		1.80	60	450
8	*Mangifera indica*	Aam	Anacardiaceae		0.60	40	150
9	*Albizia richardiana*	Chambol	Leguminosae		0.20	20	100
10	*Manilkara zapota*	Safeda	Zapotaceae		0.40	40	100
11	*Feronia lemonia*	Kaotbel	Rutaceae		0.20	20	100
12	*Ficus hispida*	Dumur	Moraceae		0.60	40	150
13	*Psidium guajava*	Peyara	Myrtaceae		0.40	20	200
14	*Tamarindus indica*	Tentul	Leguminosae		0.40	20	100
15	*Lennea coromandelica*	Jiga	Leguminosae		1.40	60	233
16	*Excoecaria agallocha*	Gewa	Euphorbiaceae		1.60	40	400
Soladana							
1	*Cocos nucifera*	Narikel	Palmae	2.70	1.20	80	150
2	*Areca catechu*	Supari	Palmae		1.40	80	175
3	*Mangifera indica*	Aam	Anacardiaceae		0.20	20	100
4	*Albizia richardiana*	Chambol	Leguminosae		0.20	20	100
5	*Swietenia mehagoni*	Mehogani	Meliaceae		0.40	40	200
6	*Manilkara zapota*	Safeda	Zapotaceae		0.40	40	100
7	*Thespesia populnea*	Parash-pipul	Myrtaceae		1.00	80	125
8	*Zizyphus sp*	Kul	Rhamnaceae		0.40	40	100
9	*Excoecharia agallocha*	Gewa	Euphorbiaceae		1.20	20	600
10	*Hibiscus rosa sinensis*	Jaba	Malvaceae		0.40	20	200
11	*Tamarindus indica*	Tentul	Leguminosae		0.40	20	100
12	*Mimusops elengii*	Bakul	Zapotaceae		0.20	20	100
13	*Albizia saman*	Sirish/Rendi koroi	Leguminosae		0.40	40	200
14	*Borassus flabeliffer*	Taal	Palmae		0.60	60	100

Sl. No.	Species Name	Local Name	Family	Biodiversity Index	Density	Frequency	Abundance
15	*Anona squamosa*	Ata	Anonaceae		0.20	20	100
16	*Pithocelobium dulci*	Khai Babla	Leguminosae		1.00	60	167
17	*Azadirachta indica*	Neem	Meliaceae		0.80	60	133
18	*Phoenix sylvestris*	Khejur	Palmae		0.60	40	150
Patkelpota							
1	*Cocos nucifera*	Narikel	Palmae	2.23	1.20	80	150
2	*Manilkara zapota*	Safeda	Zapotaceae		0.40	40	100
3	*Thespesia populnea*	Parash-pipul	Myrtaceae		0.40	40	100
4	*Zizyphus sp*	Kul	Rhamnaceae		0.40	40	100
5	*Excoecharia agallocha*	Gewa	Euphorbiaceae		2.40	80	300
6	*Tamarindus indica*	Tentul	Leguminosae		0.40	40	100
7	*Acacia arabica*	Babla	Mimsae		0.80	60	133
8	*Albizia saman*	Sirish/Rendi koroi	Leguminosae		0.40	40	100
9	*Borassus flabeliffer*	Taal	Palmae		0.20	20	100
10	*Sonneratia apetala*	Kewra	Lyrthaceae		0.60	60	100
11	*Laucaenia leucocephala*	Ipil-ipil	Mimsae		0.40	40	100
12	*Phoenix sylvestris*	Khejur	Palmae		0.60	40	150

Note: Data Taken 5 Quadrates (10mx10m) in each location

Source: CEGIS Field Survey, November, 2015

Appendix G: Wildlife Species Composition

Table: Wildlife composition of the polder

Scientific Name	**Common Name**	**Local Name**	**Status**		**CITES Appendix**	**Habitat Preference inside Project**
			Local	**IUCN**		
CLASS MAMMALIA						
Order Rodentia						
Family Muridae						
Bandicota bengalensis	Mole Rat	Indur	VC			HF
Bandicota indica	Bandicot Rat	Dhari indur	C			HF, EM, CF
Mus booduga	Field Mouse	Metho indur	VC			,,
Mus musculus	House Mouse	Nengti indur	C			‘’
Rattus rattus	Common House Rat	Indur	VC			HF
Family Soricidae						
Suncus murinus	Grey Musk Shrew	Chika	C			HF
Family Pteropodidae						
Cynopterus sphinx	Short-nosed Bat	Bocha Kola Badur	C			HF
Pteropus giganteus	Flying fox	Badur	C		II	HF, MF
Family Vespertilionidae						
Pipistrellus coromandra	Indian Pipistrelle	Khudi Chamchika	C			HF, MF
Order Carnivora						
Family Canidae						
Canis aureus	Jackal	Pati Shail	R	VU		HF, CF
Family Herpestidae						
Herpestes edwardsi	Common Mongoose	Bara Beji	C	VU	III	HF, EM
Family Viverridae						
Viverricula indica	Small Indian Civet	Khatash	R		III	HF
Family Felidae						
Felis chaus	Jangle Cat	Bon Biral	R	EN	II	HF, EM, CF
CLASS REPTILIA						
Order Testudines						
Family Emydidae						
Hardella thurjii	Brahminy Turtle	Kali Kaitta	VR	EN	II	EN
Kachuga tecta tecta	Common Roof Turtle	Kori Kaitta	R	EN	II	EN
Family Trionychidae						

Scientific Name	Common Name	Local Name	Status		CITES Appendix	Habitat Preference inside Project
			Local	IUCN		
Lissemys punctata punctata	Flap-shelled Spotted Turtle	Sundi Kachap	R	VU	III	WL
Order Sauria						
Family Gekkonidae						
Hemidactylus brooki	House Lizard	Tiktiki	VC			HF
Hemidactylus frenatus	Common Lizard	Tiktiki	C			HF
Family Agamidae						
Calotes versicolor	Garden Lizard	Raktochusa	C			HF, EM, CF,MF
Mabuya carinata	Common Skink	Anjan	O			HF,CF,WL
Family Varanidar						
Varanus bengalensis	Bengal Grey Monitor	Gui Shap	O	VU	I	HF, MF
Varanus flavescens	Yellow Common Monitor	Shona Gui	O	EN	I	WL
Order Serpentes						
Family Dipradidae						
Lycodon jara	Yellow Wolf Snake	Ghorginni	C			HF, CF
Family Natricidae						
Amphiesma stolata	Stripes Keelback	Dora Sap	C			HF, WL
Atretium schistosum	Olive Keelback	Mete Sap	O			HF
Xenochrophis cerasogaster	Dark-bellied Marsh Snake	Kalo Mete Dora	R	VU		HF, WL
Xenochrophis piscator	Checkered Keelback	Dhora Sap	C			HF, WL
Family Colubridae						
Ahaetulla nasutus	Common Vine Snake	Laodoga	C	VU		HF, CF, MF
Ptyas mucosus	Rat Snake	Daraj/Darash	C		II	HF, CF
Family Homalopsidae						
Cerberus rhynchops	Dog-faced Water Snake	Jalbora	C	VU	WL, CF	
Enhydris enhydris	Smooth Water Snake	Pyna Sap	C		WL	
Family Elaphidae						
Bungarus caeruleus	Common Krait	Kal Keotey	R		R	HF
Bungarus fasiciatus	Banded Krait	Sankini	VR		VR	HF, MF
Naja naja kaouthia	Monocellate Cobra	Gokhra	R	VU		HF
Naja naja naja	Binocellate Cobra	Khoia Gokhra	R	EN	II	HF

Scientific Name	Common Name	Local Name	Status		CITES Appendix	Habitat Preference inside Project
			Local	IUCN		
CLASS AMPHIBIA						
Order Anura						
Family Bufonidae						
Bufo melanostictus	Common Toad	Kuno Bang	VC			HF, EM
Family Ranidae						
Euphlyctis hexadactylus	Green Frog	Sobuj Bang	O		II	HF, CF
Hoplobactrachus tigerinus	Bull Frog	Sona Bang	VC			CF
Rana cyanophlyctis	Skipper Frog	Kotkoti Bang	C			WL
Rana limnocharis	Cricket Frog	Jhi Jhi Bang	C			HF, CF
Rana temporalis	Tree Frog	Gecho Bang	O			HF, MF

Note:

Local Status Code: “C” =Common, “VC” = Very Common, “O” = Occasional, “R” = Rare, “VR” = Very Rare

IUCN Status Code: VU = Vulnerable, EN=Endangered

Habitat Preference Code: HF=Homestead Forest, “CF” = Cropfields, “MF” = Mangrove Forest, “WL” = Wetland

Appendix H: List of participants of PCM

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থানঃ সোলাদানা ইউ: পরিষদ ইউনিয়নঃ সোলাদানা উপজেলাঃ পাইকগাছা

জেলাঃ খুলনা সময়ঃ তারিখঃ ২৭/০১/২০১৫

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
১.	বি,এম, মিজানুর রহমান	চেয়ারম্যান	বয়ারঝাপা	01711-309025	
২.	পরিতোষ কুমার মন্ডল	ইউ.পি.সদস্য ৩নং ওয়ার্ড	সুরিয়াখালী	01718-976822	
৩.	সুপদ কুমার সরকার	প্রধান শিক্ষক	সোনাখালী	01798314527	
৪.	অসীম কুমার ঢালী	প্রধান শিক্ষক	পারিশামারী	01715915652	
৫.	উৎপলেন্দু রায়	সহঃ শিক্ষক	সোলাদানা	01712-751114	
৬.	মো:ওদুদ রহমান	ব্যবসা	বেতবুনিয়া	01942945375	
৭.	মোঃ ইলিয়াস সরদার	ব্যবসা	বেতবুনিয়া	01729458312	
৮.	মো: ইয়াকুব মল্লিক	ব্যবসা	বেতবুনিয়া	০১৭৩৪২৩৭৭৭	
৯.	এস, এম, আব্দুল গফফার	ব্যবসা	পাইকগাছা	০১৭১২৬৫৭৮১১	
১০.	বি.এম. আ: মজিদ	ব্যবসা	ভাঙ্গারমাথা	০১৭১৩৪৫৭১৬৫	
১১.	মো: মাহবুব কিবরিয়া	ব্যবসা	সাং টেকশালী পোঃ ভাং	০১৭২৫৪৬৫৬৬৬	মো:মাহবুব কিবরিয়া
১২.	মো: আব্দুল হোসেন	ব্যবসা	পাইকগাছা	০১৭২৩-৭১১৬৮৯	
১৩.	মো: ফজলুর রহমান	৫ নং ওয়ার্ড সদস্য	খাটুয়ামারী	০১৭১২-৯৬৯৯৫০	
১৪.	মোছা: মাফুজা বেগম	গৃহিনী	ভাঙ্গামারী		মাহফুজা
১৫.	" হাচিনা "	"	গোপালমারী		হাসিনা
১৬.	মো: আবু সাইদ মোল্লা	৪নং ওয়ার্ড সদস্য	বেতবুনিয়া	০১৭২২-৩৬৪২৬৯	
১৭.	মো: আনছুর আলী গাজী	২নং ওয়ার্ড সদস্য	পাইকগাছা	০১৭১৯৯১২৬৮৫৫	
১৮.	মোছা: নাছিমা বেগম	১/২/৩নং ওয়ার্ড সদস্যা	পাইকগাছা	01925967054	নাছিমা বেগম
১৯.	কল্যানি মন্ডল	৭/৮/৯নং ওয়ার্ড সদস্যা	সোলাদানা	01724439376	কল্যানী

আয়োজনে:

Center for Environmental and Geographic Information Services

House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থানঃ গোলাদানা ইউঃ পরিষদ ইউনিয়নঃ গোলাদানা উপজেলাঃ পাইকগাছা
জেলাঃ খুলনা সময়ঃ তারিখঃ ২৭ ০১/২০১৫

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
২০.	মাসুমা খাতুন	গৃহিনী	ডাকাতমারী	01980-129603	মাসুমা
২১.	আজমিরা সুলতানা	”	ডাকাতমারী	01989-134534	আজমিরা
২২.	রাবেয়া খাতুন	”	ডাকাতমারী	01938-117589	রাবেয়া
২৩.	মমতাজ বেগম	”	ডাকাতমারী	01936-164324	মমতাজ
২৪.	আনোয়ারা	”	বেতবুনিয়া	01924-979029	আনোয়ারা
২৫.	রাফিজা আক্তার.	”	ডাকাতমারী	01936-164324	রাফিজা
২৬.	শামীমা সুলতানা	”	ডাকাতমারী	01918-395411	শামীমা
২৭.	মোঃ ফিরোজুর রহমান		ডাকাতমারী	০১৯৫২-৭২৯৬৩৫	ফিরোজুর রহমান
২৮.	~~মোঃ [illegible]~~			01994-979029	
২৯.	[illegible]		পাতিখালী	01916-409110	[illegible]
৩০.	সুকান্ত কুমার রায়		পাতিখালী	০১৯[illegible]	সুকান্ত রায়
৩১.	হরেন্দ্র নাথ রায়	প্রধান শিক্ষক	[illegible] বালিকা বিদ্যালয়	01918788219	হরেন্দ্রনাথ
৩২.	কাজী মুজিবর		পাইকগাছা	[illegible]	মুজিবর
৩৩.	মোঃ আবু সাঈদ সানা	৭নং ওয়ার্ড	ডাকাতমারী	01912-881287	[illegible]
৩৪.	মোঃ বাহাউদ্দিন [illegible]		পাই [illegible]	01915-393069	বাহাউদ্দীন
৩৫.	শাহাদাত		ডাকাতমারী	০১৭[illegible]৭১০	
৩৬.					
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৩৮.					

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

Appendix I: Checklist of Public Consultation Meeting

ENVIRONMENTAL IMPACT ASSESSMENT OF

Coastal Embankment Improvement Project (CEIP)

Checklist for Public Consultation Meeting (PCM)

- Self and organization's introduction
- Orientation of the participants
- Purpose of the meeting (Generic and specific)
- Brief introduction about the project (by facilitator)
- Outlining the general problems of the studied area
- Knowledge about the project
- Attitude towards the project
- Project related problems (especially drainage, tidal water, agricultural practice, land source, ground water, intake and discharge of water, quality of water, Fisheries resources; Plantation, Marine ecosystem, Terrestrial wildlife employment, income, etc.)
- Project induced opportunities
- Suggestions for mitigation of problems
- Suggestions for enhancement of opportunities
- Suggestions to project implementers and planners

Appendix J: Summary of Assessed Impacts

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
A. Pre-construction Phase									
Deterioration of 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 vehicles • 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 regularly. • Stockyard should be covered during non-working period	Low	BWDB and Contractors
Change of 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, the instructions should be specified in the tender document. • Labor shed/camp should be constructed on government khas land. • Avoid impacts on local stakeholders.	Very low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Clearances of vegetation	Sort term	Local	Reversible (after construction phase)	Certain	Low	Low	• Choose barren land and ground of Sluice Gateman's houses for stocking construction materials • Proper compensation against tree felling in private land should be given to the owners • Implement tree plantation at the damaged sites and sluice surroundings after completion of construction works • Labor should be given early notice about plant conservation especially for pressuring the countryside strips of plantation at slope protection site (Chainage 10.0 to 11.5 km).	Very low	BWDB and Contractors
Increase in vehicular during mobilization							• The contractor should prepare a traffic management plan (TMP) and obtain approval from the Design Consultant (DC) and Construction Supervision (CS) consultant. • Contractor should also implement mobilization plan considering water vessels and launch movement in the external rivers and avoid the launch movement time. • The TMP should be shared with the communities and should be finalized after obtaining their consent. • The TMP should address the existing traffic congestion particularly at the Paikgaccha Bazar, Sholadana Bazar and Amurkata Bazar. • Ensure minimal hindrance to local communities and commuters.	Low	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works should be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. • The works of the first half should be completed, and then of the other half should be undertaken. • Work schedule tobe finalized in coordination and consultation with local representatives and communities, specifically the 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 limitedin 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 moving pattern and management system for the local stakeholders using multimedia presentation and showing video at different		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							common population gathering places in the polder area.		
B. Construction Phase									
Deterioration of air and noise quality	Short term	Local	Reversible (after construction phase)	Occasional	Medium	Minor	• 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 near 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 should be instructed to use the equipment properly, to minimize noise levels.	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Liaison with the communities should be maintained and grievance redress mechanism will be established at the site.		
Hindrance to the natural drainage system	Short term	Local	Reversible (after construction phase)	Likely	Medium	Minor	• Some temporary 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 temporary earthen dams during construction work. • Both contractor and BWDB should supervise the construction work • Contractor should ensure that drainage channels are not obstructed or clogged by the construction activities. • Contractor should ensure that construction activities do not inundate cultivation fields.	Low	BWDB and Contractors
Impact on crop production	Short term	Local	Reversible	Likely	Minor	Low	• Compensation should be paid for any crop damage. • Contractor should avoid crop fields during construction activities. • 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.	Very low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Re-excavated soil of canals should not be dumped in agricultural land. • Contractor should maintain liaison with communities.		
Impact on irrigation	Short term	Local	Reversible	Likely	Low to Medium	Moderate	• Contractor should construct bypass channel before construction / replacement / demolishing 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	BWDB and Contractors
Impact on fish habitat and migration	Short term	Local	Reversible	Likely	Medium	Moderate	• Fish migration period may be avoided. • 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. • 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. • Duration of construction of structures and other interventions should be shortened as much as	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							possible at least should maintain the contract period. • Contractor will maintain liaison with communities so that they could realize the issue. It is more important in case of timing of entering water into the polder for shrimp culture along with paddy cultivation and exiting water from the same. Liaison of contractor with community would create scope for setting proper time for the construction work so that no or less impact to the shrimp farming and paddy cultivation is caused.		
Impacts on benthic fauna	Short term	Local	Reversible	Likely	High	Major	• Khal re-excavation should be carried out segment wise. • Contractor will carry out khal excavation in segment thus minimizing impacts on benthic fauna.	Low	BWDB and Contractors
Clearance of vegetation	Short term	Local	Reversible (after construction phase)	Occasional	Low	Low	• Collect soil from barren land as much as possible • Proper turfing should be implement at embankment slopes with local grasses (i.e. Durba (Cynodon dactylon) , Mutha (Cyperus rotundus)) and ensure regular monitoring of turf grasses till they matured		BWDB and Contractors
Outbreak of plant diseases	Long term	Local	Reversible	Occasional	Medium to high	Moderate	• Labor should be aware about the right way of plantation works without damaging any existing vegetation	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Keep setback distance in plantation plan layout from the water passes • All kinds of polyethylene bags and plastic ropes should be piled up in a pit for recycling • 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 suitable species for plantation and spacing of the saplings • Develop a pest management plan for the holistic afforestation • Collect saplings from nearer natural source (i.e. from The Sundarbans forests beside Shibsha river) as much as possible and consult with Forest Department for providing required saplings		
Safety and Public Health Hazards	Short term	Local	Reversible	Likely	High	Moderate	• The contractors should prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants. The Plan should also include awareness rising and prevention measures for particularly for communicable	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							diseases such as hepatitis B and C, and HIV/AIDS. • The WBG's EHS Guidelines will be included in the contract documents. • Liaison should 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 should 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 should 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		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							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 should be conducted for local communities prior to and during construction operations. • Observing statutory requirements relating to minimum age for employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous 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		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							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 should establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. • The contractor should adopt a Human Resource Policy appropriate to the size and workforce which indicates the approach for management employees (this could be part requested in the tender process); • Produce job descriptions and provide written contracts and other information that outline the working conditions and terms of employment, including the full range of benefits; • Provide health insurance for employees for the duration of their contracts; • Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts; • Develop a recruitment process community employee that involves local authorities in clearly understood procedures;		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• 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.		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Waste management plan to be prepared and implemented in accordance with international best practice. • Liaison with the community will be maintained.		
Labor force related impacts							• The Contractor will provide proper housing for his staffs at a site with adequate facilities securing neighbours are not disturbed. • The Contractor will prepare and implement a Code-of-Conduct for his staff showing respect to comply with and not offend local customs and cultural norms.	Low	
Increased Inland and Waterway Traffic	Short term	Local	Reversible	Likely	Medium	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	BWDB and Contractors
Hindrance for Pedestrian and Vehicle Movement	Short term	Local	Reversible	Likely	Medium	Moderate	• The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works should be carried out in segments and soil should be placed linearly on half of the embankment, leaving the other	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							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 should be finalized in coordination and consultation with local representatives and communities. • Local routes shouldnot be blocked as much as possible. If unavoidable, alternative routes will be identified in consultation with local community. • GRM will be put in place.		
Damage to Local Infrastructure	Short term	Local	Reversible	Likely	Medium	Moderate	• The condition of the infrastructure being used for the construction and transportation activities will be regularly monitored. • All damaged infrastructure should be restored to original or better condition. • To take preventive measures for protection of local infrastructure.	Low	BWDB and Contractors
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.	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Cultural norms of the local community should be respected and honored. • GRM should 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.		
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 due	Short term	Local	Reversible	Likely	Medium	Moderate	• Weather signals should be considered by the contractor during construction works.	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
to Natural Hazards							• Radio and television should 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.		
C. Post Construction Phase									
								Low	BWDB and WMOs
Increased Use of Agro-chemical	Long term	Local	Reversible	Likely	High	Major	• Capacity building and awareness rising of the farmers should be carried out to practice Integrated Pest Management (IPM), Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) in order to minimize usage of chemical inputs. • Farmers group should have close contact with DAE for adoption of various measures of IPM, ICM and GAP. • Farmers should be encouraged to use organic and green manure to increase soil fertility while avoiding water contamination. • Farmers should be encouraged to cultivate leguminous crops (N2 fixing) to enhance the soil quality as well as soil productivity.	Moderate	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Reduced Fish Migration Time	Long term	Local	Reversible	Likely	Medium	Moderate	• Follow sluice gate operation allowing fish migration; • Provide training to WMOs regarding gate operations; and • Transferring juvenile fish from rivers to Polder. • Fish pass may assist in the fish migration.	Low	BWDB and Contractors
Impact on Shrimp Farming and Livelihood	Long term	Local	Reversible	Likely	Medium	Moderate	• 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 as these are eco-friendly in nature • Alternative income generation i.e. livestock rearing, poultry and integrated fish culture may create scope of alternative income for shrimp farm labour; and • Implementation of land zoning for shrimp Gher in the polder area.	Moderate	BWDB and Contractors
Risk of Embankment Failure	Long term	Local	Reversible	Likely	High	Major	• 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 will particularly be carried out before and after monsoon season. • Prevention of establishing hand tube-wells at the crest of the embankment.	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• 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 previses		
								Low	BWDB and Contractors

Appendix K: Comments and Responses (IPOE)

Comments and Responses on EIA report of Polder 23 under Package-3

(NB: EIA report of Polder 16 was taken as the sample base report; other Polder reports were asked to be corrected/modified based on the comments for Polder 16 report)

Sl. No.	Comments by IPOE (Professor Dr. Ainun Nishat)	Responses by CEGIS
1.	Scoping and bounding need to be mentioned in approach and methodology chapter	It has already been incorporated in the report (sections 2.2.3 & 2.2.4). This chapter has also been re-organized according to the EIA steps
2.	Characteristics of brackish fish species and indicative fish species in the Polder area	Characteristics of brackish fish species and indicative fish species have been addressed in section 6.2.10
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 has been mentioned in the report (section 6.2.10 and figure 6.11)
5.	Restore the connectivity /Boat pass or some other way to be provided as per as for boat movement	Boat pass arrangement has been suggested in the report (section 10.15.1 in Chapter 10)
6.	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
7.	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)
8.	Operation of the gates to be voiced/point out by the EIA team	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 provided in Appendix -E
9.	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
10.	Polder to be used for paddy cultivation not shrimp cultivation, but shrimp cultivation is economically	A doable plan has been suggested in section 10.15.3 (chapter 10) considering conflict between gher owners and farmers

Sl. No.	Comments by IPOE (Professor Dr. Ainun Nishat)	Responses by CEGIS
	viable and mostly occupied by local influential people. How to solve this problem?	
11.	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 been 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.
12.	Stakeholder list may be collected from BWDB before conducting the EIA disclosure meeting	Will be collected as per suggestion

Appendix L: Responses to World Bank Comments

Sl. No.	Comments by WB	Responses by EIA Consultant	Action taken
1.	Strategic/Sectoral Assessment: Given that multiple polders are being considered and they are part of a larger government intervention, it is recommended to clarify in the EIAs if any Strategic or Sectoral Environmental Assessment has been conducted in relation to the Coastal Zone Policy (2005), the Coastal Development Strategy (2006) or similar government plans informing the rehabilitation of polders, and if so, how those Assessments inform the site-specific EIAs	A strategic Environmental Assessment (SEA) has been carried for CEIP-1 before conducting the EIA study.	It has been mentioned in Executive Summary (para 1) and Chapter-1 (Introduction: para-1)
2.	Selection Criteria: Similarly, the EIA states that "This polder is one of the 17 Polders selected for rehabilitation through feasibility study under CEIP-1.". The EIA, in the Executive Summary and other relevant sections (e.g. Alternative Analysis) should explain any environmental criteria that was used to select the polders.	Preliminary 17 polders were selected for rehabilitation in feasibility study considering physical conditions as well as damages of the polder. Afterwards, these polders were selected through screening matrix. In environmental point of view, multi-criteria analysis was conducted which has been mentioned in SEA report.	It has been mentioned in Executive Summary and Chapter-1 (Introduction) and para-1
3.	Past Experiences: Since a number of polders under Works Package 1 have started the construction phase, it is recommended to include a brief explanation of any past experiences or evidence on terms of potential significant	This issue will be considered	

	adverse environmental impacts (e.g. loss of fauna, impacts on sensitive ecosystems, fisheries, etc.) associated to such projects as well as the track record of the Project in managing such impacts and the effectiveness and efficiency of the set of proposed mitigation measures, especially those related to water management and biological/ecological aspects (shrimp culture, fish sanctuaries, etc.). We think the project is already in a situation to learn from the experience and to introduce adjustments (if necessary) and to avoid copying exactly the same measures from other polders without reflecting on them.		
4.	DoE Clearance. Has the EIA been awarded by the DoE clearance? What is the status of the process? Has the IEE been processed and issued?	EIA report of Polder 23 has not been awarded to DoE yet because this report is in the progress of finalization. After finalization, it will be submitted at DoE for Clearance. IEE report was submitted to DoE and obtained site clearance.	
5.	Legal framework. How does the EIA and the project apply the policy, legislative and regulatory framework? The chapter presents a compilation of laws and regulation, but how the project understands and ensures its compliance? It is also important to understand how such laws will be implemented and enforced, in the specific circumstances of the project. It is important therefore to conduct a gap analysis to confirm whether the national	This chapter has already been addressed elaborately and appended in the report (Appendix-C).	The updated chapter has been appended.

	framework enables or requires risk and impacts to be addressed in accordance with Bank requirements. Where this is not the case, options need to be identified to address such gaps.		
6.	Climate change. The exercise to bring climate change data to the EIA and to make the CC case is interesting. However, the EIA does not conclude how project design responds to those projections and how project design mitigates the effect of climate change. What is the connection between data and the model utilized for project design?	It may be mentioned here that drainage modelling of the coastal polder has been carried out by IWM to find out the design parameters for drainage channel systems, drainage regulator, river bank, slope protection works. Climate resilient coastal embankment crest level has been design considering the combined effects of cyclone storm surge effects and cyclone induced wind wave. The model has been developed and simulated considering climate change condition considering with and without interventions by IWM, 2016	It has been mentioned in Chapter 5.4
7.	Enhancement of conflicting uses. In various sections the EIA mentions an existing conflict between Gher owners and farmers in the polder. We believe that this is an important aspect that the EIA does not analyze beyond thesegeneral mention. The EIA should explain how the interventions of the Project would impact this existing conflict and the EMP should include specific measures to address it.		This issue has been addressed in the Chapter 5.4 and chapter 6.3 (with heading "Agricultural practices")

8.	Afforestation. How does the EMP follow the BWDB afforestation regulations? How is the EMP including the detail information on plantation program (Table 10.6). It would be good to articulate this chapter with EMP.		Yes, the afforestation plan will be implemented as per regulations of BWDB as specified in Chapter 10,11 and as per suggestion articulatedin EMP Table 10.7
9.	Re-excavation of drainage khals. Local people may be encouraged to take earth from the spoils. How will the aptitude of use of the earth be determined?	As per consultation, local people are interested to take re-excavated materials for societal use.	It has been discussed in chapter 5.5 (with heading “re-excavation of Drainage Khals)
10.	Construction schedule. How does the construction schedule impact social and community events? The EIA reports on some cultural property presence in the area of influence that might be important to consider.		It has been considered in Chapter 5.6 , Table 5.7
11.	Manpower requirement. We recommend to revisit the numbers.		The figure mentioned in Table 5.8 has been revisited based on the experience from the works implementation in Package-1.
12.	Project implementation arrangements. We mentioned this in previous reviews before. This section should be adjusted to describe the realism and level of implementation of the proposed arrangements. What we want to say is that part of these arrangements are already existing, such as the IPoE and at this stage of project development and evolution it would be good to reflect about these existing arrangements and how they have performed in		This issue has been considered and updated accordingly, Section 5.7, .

	other polders. It is very important to describe in the EMP how the mandate and role of the different stakeholders articulates with the EMP. Many operational activities described in this section have clear implications at the EMP level. Capacity issues should be discussed.		
13.	Sensitive receptors. How is the baseline defined for education and health affected by the project? Please also discuss how the market/growth centers and the cultural heritages and common property resources in the polder would be affected by the project. They have been included in the baseline, as part of the area of influence.	Selection of sensitive receptors as well as growth Centre and common resources properties within 500 m distance from the embankment have been considered	It has been considered in Chapter 8.4.1
14.	Pest management. The development of a pest management plan for the holistic afforestation. It would be good to capture the experience from the afforestation actions delivered for the polders under construction.	The afforestation plan has not been taken up in package-1 because the construction works under this project is in progress	Capacity building for pest management in , Table 10.2, ECoP5: Ecology Management. It has also been mentioned in Table 10.1. Mitigation plan with heading “outbreak of plant diseases”
15.	Compensation mechanisms. Where in the report is the compensation criteria to establish the payments to the owners against tree felling? How is this implemented?	A detail Resettlement Action Plan (RAP) is being prepared by the Consultant. According to the plan, payment to the owners against tree felling will be established. It would be included after getting the RAP report.	Mentioned in Table 10.2, ECoP 5: Ecology Management, vegetation clearance,
16.	EMP and mitigation measures. EMP follows the same footprint as previous reports. In the case of the mitigation measures it is not clear who is responsible for implementation, where and when. This is not fixed by the EMP. While each impact included a reasonable set of mitigation measures, the EMP chapter of the report	This chapter has been updated according to the comment	Chapter 10

	includes a generic mitigation guideline. While this is useful it is not enough to guide the preparation of the detailed EMP and the contractor EMP. For example, in terms of obstruction of fish movement and migration, who is going to implement the six proposed mitigation measures, when and where? Is the estimated implementation cost enough to ensure all the proposed mitigation measures? Our impression is that not all the proposed mitigation measures have been included in the Table 10.4?. Our recommendation is to cut and paste to bring to the table the mitigation measures included in the environmental assessment chapter. The more accurate and defined the EMP is, the better can support the future bidding document directly.		
17.	Construction Camps: In various sections of the EIA it is stated that labor sheds and camps will be constructed, but the EIAs should clarify if such labor sheds/camps will house workers or not. If those structures are to house workers it is recommended to include in the EMP section a reference to internationally recognized guidelines for construction and operation of such camps, such as the IFC/EBRD workers accommodation guidelines http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/learning+and+adapting/knowledge+products/publications/publications_gpn_workersaccom		It has been discussed in Chapter 5.5 with heading "Description of costruction activities 5.5under Re-sectioning of Embankment. It has also been explained in paragraphentiled"Construction Manpower requiremeng" in the same Chapter. Construction camp facilities have been described in Table 10.2 (ECoP 7)

	modation. Please state if the project will involve labor influx or not following the bank definition.		
18.	Traffic Management: The EIAs identify risks and impacts related to the project-related traffic and there are different mitigation measures mentioned in different sections of the EIAs. It is recommended to consolidate traffic-related mitigation measures and ensure that they are consistent throughout the document, and also to clarify the scope of key elements of the Traffic Management Plan that should be prepared. Increase of Vehicular Traffic during mobilization – it is recommended to include procedures to ensure: adequate signaling for traffic and pedestrian safety, speed limits for project-related trucks when crossing heavily populated areas and dust control measures. This also applies to Hindrance of Pedestrian and Vehicular Movement. Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards. Include reference parameters and link.	National and WB noise standards have been included in the report to comply Noise levels from vehicles, equipment and machinery etc.	Mentioned in several sections, see Section 8.4 and Table 10.1 The Contractor will prepare a Traffic Management Plan in C-ESMP as prepared by the Package-1 and Package-2 Contractors.
19.	Mangrove Afforestation: On the foreshore area mangrove species will be replanted and that “Mangrove vegetation has immense contribution to protect the embankments and charland from tidal surge, provides fuel and thatch materials to the local inhabitants as well as creates ideal habitats for the local avifauna and other wild animals.” Given the importance of mangroves,	Survival rate of each mangrove species are illustrated in FinalInterimReport on AdditionalTasksAssignedSeptember,2013 (Feasibility report on Afforestation)	This issue has been descrbed in Chapter 10.11, of the EMP Section

	and the fact that survival rates of replanted mangroves tends to be very low it is recommended that the EIAs include a specific description of the ration of seedlings to be planted for each lost mangrove tree as well as a survival and growth rate targets and corresponding monitoring indicators.		
20.	EHS Guidelines: The section on *Environment, Health and Safety Guidelines* should specify that the most relevant EHS Guideline is the General one and provide a link in the document: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines		The health and safety issue has been considered and the guideline has been linked in several sections of the report
21.	Pesticides: The interventions under the proposed Project may result in an increased availability of irrigation water through cleaning and excavation of watercourses in the Polder. This increased water availability can in turn potentially increase the usage of chemical fertilizers and pesticides. During regular environment monitoring during operational phase if the water and soil pollution is observed, the proponent will be responsible for preparing a Pest Management Plan with prior approval from Bank." On the above, please clarify: a) parameters to be used to determine if there are exceedances in water and soil pollution linked to use of pesticides; and b) what agency will be	Level of chemicals including heavy metals will be measured during monitoring to check if the environmental quality standards (EQS) are exceeded in which case IPM and ICM will be prepared by the Department of Agricultural Extension (DAE). Objective of the infrastructure project is agricultural crop production which has been addressed. DAE will be the agency responsible for agricultural crop production through reduced dependence on agro-chemicals.	

	responsible for preparing and implementing Pest Management Plan, conduct capacity building in Integrated Pest Management (IPM) and Integrated Crop Management (ICM), as stated in the EIA, in a way that it would effectively mitigate the impact; this allocation of responsibilities if important given that this is basically an infrastructure project and not an agricultural project and purchase and handling of pesticides is not part of project activities.		
22.	Periodic Maintenance Works: The EIAs should describe the environmental management procedures that will be in place during the operational phase of the project for conducting "Major Periodic Maintenance Works", which could have considerable impacts.		It has been mentioned in the report-Section 8.6
23.	IPoE Assessment: What was the result of the IPoE review of the EIA?	IPoE has reviewed the draft EIA report of Polder 16 and has made some comments. Accordingly, the report has been updated.	The comments and responses has been appended in the report (Appendix-K)
24.	Disclosure and consultation: Please include final details on disclosure and consultation of the EIA	Initially, consultation meetings have been conducted. Disclosure meeting at regional and national level have also been conducted	Chapter 11