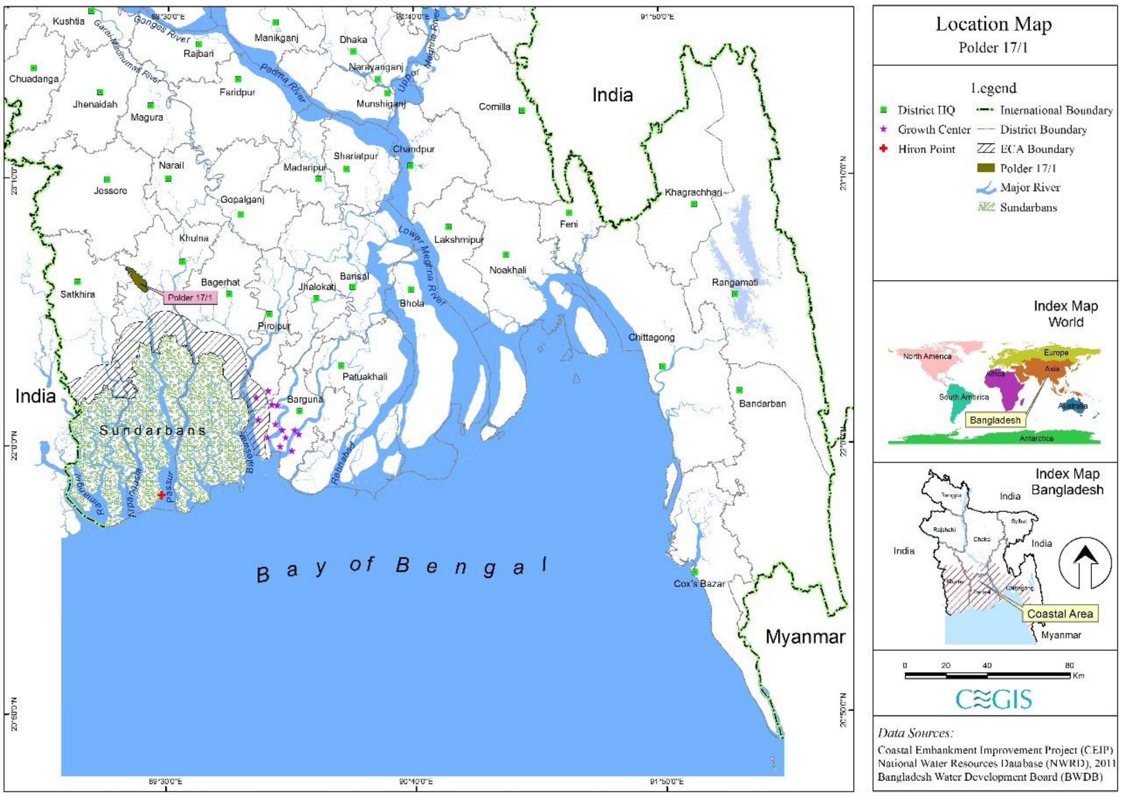
FINAL REPORT

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-17/1

May, 2021

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Study Team

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Abbreviations and Acronyms

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

ESCU	Environment, Social and Communication Unit
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FRSS	Fisheries Resources Survey System
FWIP	Future-with-Project
FWOP	Future-without-Project
GIS	Geographical Information System
GO	Government Organization
GTPE	Ganges Tidal Plain East
GTPW	Ganges Tidal Plain West
ha	Hectare
HTW	Hand Tubewell
HYV	High Yielding Variety
IDA	International Development Association (World Bank)
IEE	Initial Environmental Examination
IESCs	Important Environmental and Social Components
ILO	International Labour Organization
IPMP	Integrated Pest Management Plan
IS	Institutional Survey
IUCN	International Union for Conservation of Nature
IWM	Institue of Water Modelling
JICA	Japan International Cooperation Agency
KCC	Khulna City Corporation
KII	Key Informant Interview
KJDRP	Khulna-Jessore Drainage Rehabilitation Project
LLP	Low Lift Pump
MC	Main Consultant (for CEIP-1 Feasibility study)
MDP	Meghna Deltaic Plain
MSDSs	Material Safety Data Sheets
MOEF	Ministry of Environment and Forest
MOWR	Ministry of Water Resources
MSL	Mean Sea Level
NCA	Net Cultivated Area
NGO	Non-Governmental Organization
NOC	No Objection Certificate
NWRD	National Water Resources Database
O&M	Operation and Maintenance
OP	Operational Policies
PAP	Project Affected Person
PCM	Public Consultation Meeting
PCD	Project Concept Document

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

Glossary

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

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

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

Aratdar: Main actor 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: 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.

Charland: The chars, otherwise known also as charlands, are riverine lands located in the active river basins of the main rivers of Bangladesh. They are formed on the banks of the river and islands in the mid-stream of the main channel that are created by the continual shifting of these rivers and emerge from the deposition of sand and silt from upstream.

Golda: Prawn *(Macrobrachiumrosenbergii*), 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.

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

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

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

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

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

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

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

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

Seasonal Khal:Khals, where water is not available in the khal all year round.

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

T. *Aman*: Transplanted Aman

Upazila: Upazila is an administrative subdivision of a District.

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

Units Conversion

1 m^2	= 10.77 ft^2
1 ecimal**(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)** (Area of Bigha changes in some locations)
1 Bigha**(বিঘা)**	= 20 Katha **(কাঠা)**
1 Acre**(একর)**	= **100 decimals**
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 seventeen polders in the coastal area of the country will be rehabilitated and improved.The GoBhas 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 in three packages. Polders 32, 33, 35/1 and 35/3 are included in the first package of which EIA and EMP studies have already been completed. Polders 43/2C, 47/2, 48, 40/2, 41/1 and 39/2C are included in the second package whereas polders 14/1, 15, 16, 17/1, 17/2, 23 and 34/3 are included in the third package. In Phase-1 of CEIP Package-3 could not be implemented which are decided to implement in the next phase. The EIA and EMP studies of seven more polders under package three have also been conducted. This document presents the EIA report of Polder-17/1, which is one of these seven Polders of Package 3.It may be mentioned that preliminary 17 Polders were selected for rehabilitation in feasibility study considering physical conditions as well as damages of the Polder. Afterwards, these Polders were selected through screening matrix. From 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 17/1 would be moved to a potential second phase of the Project together with additional polders under design. The source of financing for the second phase is not yet determined.The EIA will be updated ahead of starting of physical work of potential second phase as per requirement of change of situation with passage of time

Background

The coastal zone in 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 inducing huge sediment inflows from the upstream.The coastal zone, in its natural state, used to face inundation by high tides, salinity intrusion, cyclonic storms and associated tidal surges. Polderizationin the coastal zone of the countrystarted in 1960s to convert this area into safe agricultural lands. The polders are enclosed in all its sides by dykes or embankments, separating the land from the main river system and offering protection against tidal floods, salinity intrusion and sedimentation.The polders were designed to keep the land safe from the tidal effect and allow agriculture activities.These polders are equipped with outlet sluice gates on the natural drainage channels to control water inside the embanked area.

The polders were originally designed without much attention to storm surges. Recent cyclones caused substantial damage to the embankments and 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 the coastal Polders to suffer from water logging, which led to environmental, social and economical degradation. Poor maintenance and inadequate management of the Polders have also caused internal drainage congestion and heavy external siltation. As a result, soil fertility and good agriculture productionin some areas inside the Polders are declining because of water logging and salinity increase.

The above reasons have led the Government to re-focus its strategy on the coastal area from not only to protect against high tides to but also to provide protection against frequent storm surges. The long-term objective of the Government is to increase the resilience of the entire coastal population to tidal flooding as well as natural disasters by upgrading the entire embankment system. With an existing network of nearly 5,700 km long embankments in 139 Polders, the magnitude of such 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 Polder is located in DumuriaUpazila under Khulna District of Bangladesh. The administrative and management control lies with Khulna O&M Division under its southwestern zone of BWDB.

The project aims to enhance protection against natural disasters, increase resilience during and after any disaster and improve agricultural production by reducing water management problems.The rehabilitation activities planned for the Polder under CEIP-1are: re-sectioning of embankment (38.50 km); re-excavation of drainage channels (30.22 km); construction and repairing of 11 no. drainage sluices; and afforestation (29.53 ha).

Bangladesh Water Development Board is the implementing agency of this project.After implementation of the proposed interventions, local stakeholders' participation in the development and maintenance of this polder will be ensured. Three tier organizational structure comprising 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 include ES (Embankment Settler); EMG (Embankment Maintenance Group); LCS (Landless Contracting Society); and CMG (Canal Maintenance Group).

Regulatory and Policy Framework

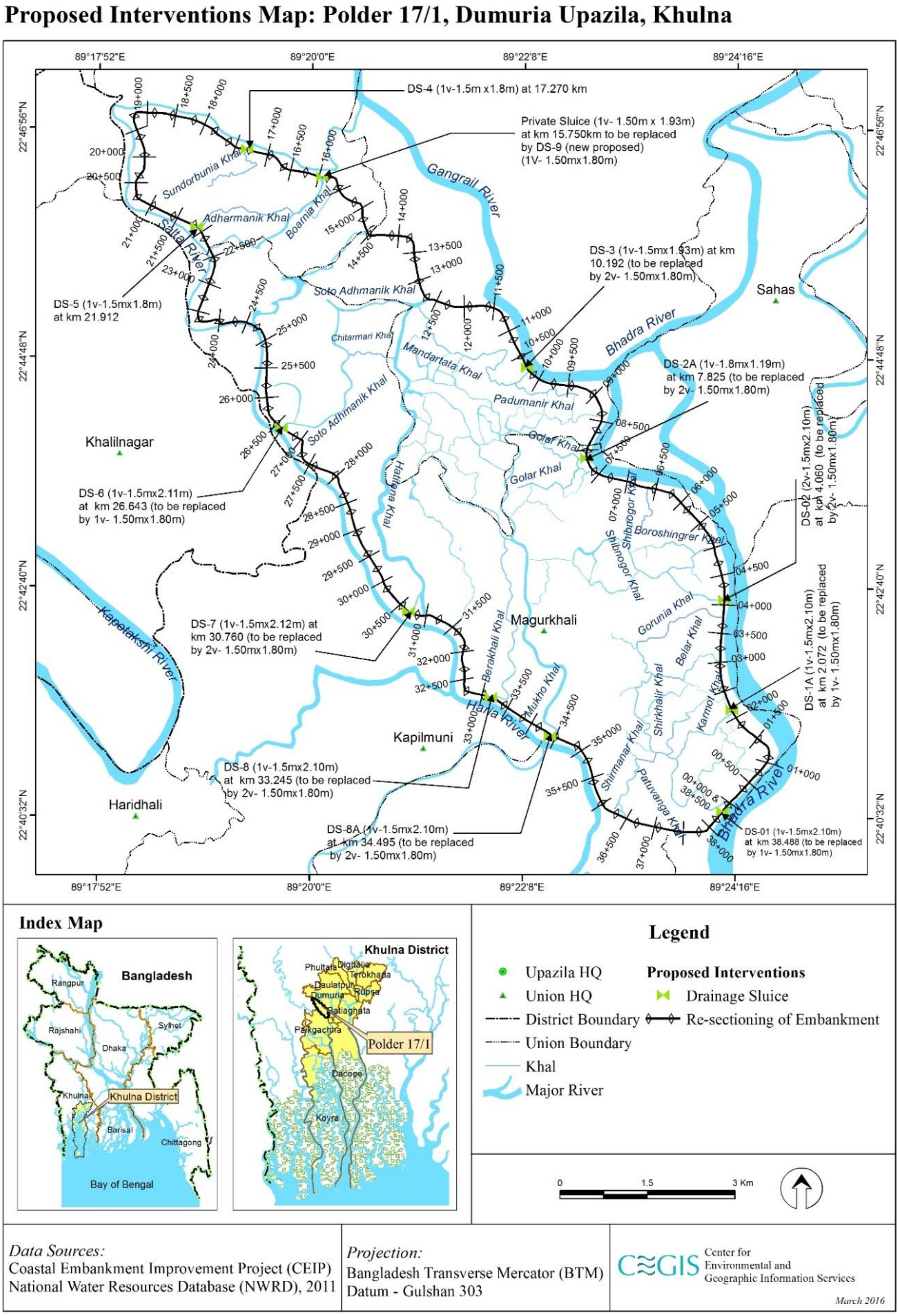
The construction, reconstruction, expansion of Polders and flood control embankment is categorized as Red in accordance with the DoE‘s classification and according to the World Bank safeguard policies, the project has been classified as Category A. The Environmental Impact Assessment (EIA) study has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

Proposed Rehabilitation Plan

The proposed interventions in Polder 17/1 under CEIP-1 are listed in the following table.

Type of Work	Length	Description of activities/works
Re-sectioning of embankment	38.50 km	Strengthening, widening and raising of existing embankment. Re-sectioning of entire embankment will be executed.
Construction/ repair of drainage sluices	12 nos. (construction: 10 and repair: 2)	The structure has been fully damaged and approach embankment washed away during AILA. However, Among 11 existing drainage sluices of the Polder; 9 will be constructed or replaced with new design specifications; two will be repaired and one new drainage sluice will be constructed.
Re-excavation of drainage channels	30.22 km	Whole drainage channels with a total length of 30.22 km will be re-excavated to ease water flow and reduce drainage congestion.
Afforestation	29.53 ha	Afforestation will be implemented within the Polder to ensure the environmental sustainability as well as protection of embankment from erosion and tidal action

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


Proposed Interventions Map: Polder 17/1, Dumuria Upazila, Khulna
DS-4 (1v-1.5m x1.8m) at 17.270 km
Private Sluice (1v- 1.50m x 1.93m) at km 15.750km to be replaced by DS-9 (new proposed) (1V- 1.50mx1.80m)
DS-3 (1v-1.5mx1.93m) at km 10.192 (to be replaced by 2v- 1.50mx1.80m)
DS-2A (1v-1.8mx1.19m) at km 7.825 (to be replaced by 2v- 1.50mx1.80m)
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Gangrail River
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Coastal Embankment Improvement Project (CEIP)
National Water Resources Database (NWRD), 2011
Projection:
Bangladesh Transverse Mercator (BTM)
Datum - Gulshan 303
CEGIS Center for Environmental and Geographic Information Services
March 2016

Environmental Baseline Conditions

Polder-17/1 is locatedin the flat agro-ecological zone of the Ganges Tidal Floodplain in the southern region of Bangladesh.The soil texture varies from clay to clay loam.The polder area is covered by low available soil moisture. Around 20% and 80% of the net cultivable area falls under high land and medium high land respectively.The gross area of the Polder is 5,020 ha of which net cultivate area is 4,000 ha (79.7% of the gross area). The remaining 8.5 % and 11.8% areas are covered by settlements and water bodies.

Gangrail and Bhadra are the two major rivers of polder. Both the rivers and connected khals are characterized by tidal influence and control the flooding and drainage dynamics of the Polder area. No major storm surge flooding occurred in Polder-17/1 during Aila (2009) and Sidr (2007) and existing coastal embankment effectively offers protection from regular tidal flooding in the area. Several water resource related problems like saline intrusion, drainage congestion, sedimentation, shortage of irrigation water etc are prevails in the polder area. Peripheral rivers especially Salta and Taltola River are heavily silted up with silt. The internal drainage channels have also become silted up due to lack of maintenance for a long time and silting up situation of the peripheral rivers. Approximately 60% of the lands are affected by drainage congestion and such drainage problems mostly affect the agriculture and production sector. All the existing drainage sluices are in a very deplorable condition and responsible for saline water intrusion.

The polder area lies inside one of the Bio-ecological zones, i.e., Saline Tidal Floodplain.This polder area contains different landforms as well as different ecosystems such as agricultural land, settlements, road/ Social forest, ponds, gher, khals, ditch, rivers, etc.Homestead area of this polder is little due to having vast agriculture land. Generally polder/ embankment roadside vegetation is dominant by hard wood tree species like Babla, Akashmoni, Khejur, etc. A good number of mangrove vegetations (Picture 5) are found along the river/ foreshore side in the polder area because of tidal nature and salinity, like Hargoja(*Acanthus ilicifolius*), Keora(*Sonneratia apetala*), Ora(*Sonneratia caseolaris*), etc.

The project area has diversified fisheries resources both for fresh and brackish water fish habitats. Fish habitat in the project area is about 2,555 ha of which 212 ha is open water capture fisheries habitat, mostly internal canal (khals). Major Khals of open water fisheries are connected with the external river and khals that act as major routes of fish migration in to the polder area for grazing, feeding and nursing. The internal khals also act as a breeding area of the small indigenous species (SIS) of fishes as well. Among the fish habitat, about 2,343 ha is culture fish habitat of which homestead pond is 89 ha and commercially cultured gher is about 2,254 ha. Carp poly-culture and traditional aquaculture are practiced in the homestead ponds while Bagda (Shrimp) culture is mainly practiced in the gher. However, gher ownersalso culture the fresh water fin fishes (Carp, Tilapia, etc.) in the gher during monsoon along with fresh water giant prawn (Golda). Brackish water fishes (Tengra, Parshe, Bhetki, etc.) are also cultured in the ghers as well.

The most common cropping patterns in the project area are Local T. Aus – Fallow-W. Vegetables and T. Fallow- HYV T. Aman – Fallow, which is 5 % each of the NCA in F_0. In F_1 land Fallow- HYV Aman- Fallow covers 50% of the NCA in. Single, double and triple crops are grown in the polder areas. The cropping intensity of the area is 122%. In the polder area, the annual total crop production is 14,898 m tons of which rice is 10,520 m. tons and non-rice is 4,378 m. tons.

Irrigation is provided mainly in HYV Boro crops which is about 869 ha (22%) of the total NCA. Main source of irrigation is from surface water.

The soil and water salinity gradually increase mainly from December to March.The crop damage during 2009-2015 include rice and non-rice crops that were damaged by Aila,tidal affect, and flooding due to heavy rainfall. Farmers reported that oilseeds and vegetable crops were damaged upto about 85% and 80% respectively.

The population of the Polder area is about 20,511 of which 10,237 are males and 10,274 females with a population density of 1,042 persons per sqkm. The estimated total household number is 4,819and the average household size is 4.2. The literacy rate is 56%, with male 62% literate and female 49%.Agriculture is the main occupation in the Polder area followed by fishing and agriculture labor. A significant number of landless/marginal farmers of Polder-17/1 have migrated out from their villages in search of livelihood.

Potential Impacts and their Mitigations

Impacts during pre-construction

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

Important Environmental Components (IECs)	**Potential Impacts**	**Mitigation Measures**
	Pre-construction Phase	
Environmental Quality (Air and Noise)	Establishment and construction of site facilities in the Polder may potentially cause noise generation. In addition, noise level around the construction sites and in settlement areas will be increased for mobilization of equipment, machineries, construction materials and manpower. Besides, the ambient air quality around the construction site and nearby areas due to exhaust emission from truck/trawler/engine boats containing particulate matter and other ingredients. Fugitive dust emissions from the material stockyards would also deteriorate the ambient air quality of the locality.	• Construction material (sand etc.) should be covered while transporting and stock piled. • The contractors need to be cautious to avoid unnecessary honking of material carrying trawler. • The contractors should be encouraged to move all construction equipment, machinery and materials during day time instead of night. • Stockyard should be covered during non-working period. • Exhaust emissions from vehicles and equipment should comply with standards. • Vehicles, generators and equipment should be properly tuned. • Water will be sprinkled as and where needed to suppress dust emissions. • Speed limits should be enforced for vehicles on earthen tracks. • Vehicles and machinery should have proper mufflers and silencers.
Vegetation	Preparation of construction sites, labor sheds and material stock yards is expected to damage vegetation where the land will be used for these purposes (Details will be illustrated after getting RAP Report).	• Habitat will be restored by planting trees, grasses at the damaged sites after completion of construction works
Land use	Land would be needed to establish temporary facilities including construction camp i.e labor shed and borrow pit areas. It is estimated that about 12 labor sheds would be constructed to established temporary facilities for the rehabilitation works. Therefore, land use will be changed temporary.	• Establish the construction camps within the area owned by BWDB, wherever available. • Compensation/rent are to be paid if private property is acquired on temporary basis, the instructions should be specified in the tender document. • Construct labor shed/camp at government khas land. • Avoid impacts on local stakeholders.
Vehicular Traffic	During mobilization of contractor, equipment, machinery, material, and manpower will be transported to the Polder resulting additional traffic load on roads and	• The contractor should prepare a traffic management plan (TMP) and obtain approval from the Detailed Design Construction Supervision and Project

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
	in waterways. This traffic may potentially cause traffic congestion particularly in roads. Moreover, most of the schools are located near the embankment approximately within 100 m to 500m Four important bazaars are also located besides the embankment. Earth work for re-sectioning of embankment and vehicles movement also may create short term disturbances to the Polder inhabitants.	Management Support Consultant (DDCS&PMSC) • Contractor should also implement mobilization plan considering water vessels and launch movement in the external rivers and, avoid the time of launch movement. • The TMP should be shared with the communities and should be finalized after obtaining their consent. • The TMP should address the existing traffic congestion particularly at Mandartala Bazar and Katalia Bazar. • Ensure minimal hindrance to local communities and commuters. • The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works should be carried out in segments and soil should be placed linearly on one half of the embankment, leaving the other half for use as track. • The works of the second half should be undertaken after completion of the first half • Work schedule should be finalized in coordination and consultation with local representatives and communities, specifically union parishad members of the polder. • Local routes should not be blocked as far as possible. If unavoidable, alternative routes should be identified in consultation with local community. • Vehicular traffic should be limited in the Polder area and the embankment during off peak time. To avoid accident, signal man should be 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

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

Important Environmental Components (IECs)	**Potential Impacts**	**Mitigation Measures**
Environmental (Air and noise) quality	• The construction activities particularly manufacturing of C.C blocks through mixture machines, earth work and its compaction along with operation of construction machinery will generate noise and vibration cause disturbance, nuisance to the nearby communities as well as to the construction workers. • Besides, exhaust emission from the concrete mixture machine and fugitive particulates during construction activities especially for manufacturing CC blocks which are likely to affect the ambient air quality and the nearby communities. • Ambient air and noise quality would be deteriorated	• Construction machineries should have proper mufflers and silencers. • Noise levels from the construction machineries should comply with national noise standards (residential zone) • Provision should be made for noise barriers at construction sites and schools, madrashas and other sensitive receptors as needed. • Water sprinkling and compacting of the materials should be done during construction • Exhaust emissions from the mixture machine should comply with standards • Provision of PPE (ear muffs and plugs) for labors to be ensured. • Installation of fugitive particulate matter system and spraying water on construction materials. • Construction team will be instructed to use the equipment properly, to minimize noise levels. • Installation of acoustic enclosures around generators. • Prohibition of vehicle movement at night • Monitoring noise in the nearby community. • Preparation of noise and vibration management plan as a part of pollution control plan.
Pedestrians and vehicles movement	Construction activities specifically re-sectioning of embankment will cause temporary disturbance in the movement of local people. A considerable number of rural bazaars are situated along the embankment and play vital role for livelihood of the Polder inhabitants as well as meeting up the daily needs of the people. Re-sectioning of embankment may disrupt the daily activities of the local people.	• The works of the embankment should be carried out in segment wise and soil should be placed linearly on one half of the embankment, leaving the other half to be used as public transportation. After completion of the works of the first half, it should be opened for local traffic while works on the other half of the embankment should be undertaken; • Work schedule should be finalized in coordination and consultation with local representatives (Union Parishad Chairman & members) and communities; • Alternative road can be used for movement if possible • The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes; and • Earth work for re-sectioning of embankment during haat day can be

Important Environmental Components (IECs)	**Potential Impacts**	**Mitigation Measures**
		shortened for essay movement of local people.
Noise and Vibration	The construction activities particularly demolition of existing water control structures, excavation, compaction, operation of construction machinery and vehicular traffic will generate noise and vibration which are likely to affect the nearby communities. The sensitive receptors including seven schools which are located close to the embankment (within 500 m) are likely to be more severely affected by noise.	• Demolition of the regulators should not be carried out during school time (8 am to 1 pm) particularly near the schools; • Restricting/limiting construction activities during day time; • Noise levels from vehicles, equipment and machinery to comply with the national and WB noise standards; • Vehicles and machinery should have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors, as needed; • Provision of PPE (ear muffs and plugs) to labor; • The construction crew should be instructed to use proper equipment, to minimize noise levels; • Camps should have to be located at safe distances from communities
Air Quality	Construction machinery and Project vehicles will release exhaust emissions, containing carbon monoxide (CO), sulphur dioxide (SO_2), oxides of nitrogen (NO_X), and particulate matter (PM).These emissions can deteriorate the ambient air quality in the immediate vicinity of the Project sites (particularly along the embankment, and around the channel excavation sites and borrow pit areas).Furthermore, construction activities such as excavation, levelling, filling and vehicular movement on unpaved tracks may also cause fugitive dust emissions.	• Exhaust emissions from vehicles and equipment should comply with standards. • Proper tuning of vehicles, generators and equipment should be carried out, to minimize exhaust emissions. • Construction materials (sand/soil) should be kept covered while transporting and stock piled. • Regular water sprinkling should be carried out as and where needed, particularly on the earthen tracks near communities. • Vehicle speed should be low (15 km per hour) on earthen tracks particularly near communities and school. • Vehicles and other machinery should be turned off when idle • Good quality fuel should be used for minimizing exhaust emissions. • Camps should be located at safe distance from communities and schools.
Water Quality	The construction workers will generate domestic solid waste and waste water including sewage. The contractor's workshops will generate oily water, waste oils, oily rags, and other similar wastes. The stores and warehouse will generate solid waste such as empty cement bags, cardboards, and wooden	• Contractor will prepare and implement pollution control plan. • Contractor workshops should have oil separators/sumps to avoid release of oily water; • Contractor should use plastic sheet or gravel in the workshop and equipment yard to prevent water contamination.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
	crates. Improper disposal of these waste streams can potentially contaminate the water resources of the area. 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.	• Contractor should ensure that there is no leakage, spillage, or release of fuel, oil or any other affluent/waste in the water from boats, trawlers, launches, and barges. • Material borrowing from the river banks should be at a distance sufficiently away from the water line, minimizing the possibility of loose soil to wash away in the river. • Contractor should locate labor sheds/camps including their sanitary installations away from water bodies • Contractor should prepare and implement camp waste management plan (septic tanks, proper solid waste disposal). • Contractor should not release untreated wastes in water bodies. • Contractor should re-use spoil and excavated material where possible. • Contractor should dispose spoil at designated areas with community consent. • Construction material, debris of the demolished structures, and excavated soil/silt should not be allowed to enter into water bodies.
Drainage Congestion	The Project activities particularly on drainage sluices and in water channels may block or clog the drainage channels, potentially causing drainage congestion in the surrounding areas and negatively affecting the cultivation and the associated communities. The project works on the drainage sluices are likely to worsen the situation and exacerbate the drainage congestion problem. In addition, excavation of existing khals in the Polder is likely to disturb the drainage which takes place through these channels.	• Construct diversion channels before replacement of drainage sluices. • Sequence of work on the drainage sluices and on the water channels should be carefully planned to avoid drainage congestion. • Contractor should ensure that drainage channels are not obstructed or clogged by the construction activities which do not causes any drainage congestion situation in the crop fields.
Agriculture crop production	Borrow pits will generally be established on private land after agreement between the contractor and the private land owner, typically involving some compensation from the contractor to the land owner. During collection of earth from Borrow pits, agriculture crop production will be lost.	• It should be considered a priority to establish borrow-pits in foreshore areas • Resettlement Action Plan should be prepared and should also be implemented accordingly • Compensation would be made for any crop damage; • Contractor would avoid cultivable fields during construction;

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
		• Contractor would avoid agricultural land for material borrowing, material stockpiling and labor camps; • Contractor would ensure that no vehicular movements take place through the cultivable fields; • Contractor would ensure that no material is dumped on the cultivation fields; • Re-excavated soil of canals should not be dumped in agricultural land and • Contractor would maintain liaison with the local communities; • Contactor will prepare site specific spoil management and disposal plans for each site to be followed upon approval by the DDCS&PMS Consultant and PMU.
Irrigation	Construction activities particularly the repairing of drainage sluices (2nos.), construction of drainage sluice (9 no.) and re-excavation of khals (43 km) can potentially disrupt the crop irrigation temporarily during both wet and dry season thus negatively affecting 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.
Social unrest	• A numbers of skilled and unskilled labors will be required for the construction activities. Most of the labor will be needed for re-sectioning of embankment and	• Proper awareness programs will have to be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
	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.	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.
Fish Movement and Migration	Most of the brackish and freshwater fish species migrate through the khals at some stages of their life cycle for spawning, nursing and feeding purpose. River resident fishes migrate from the adjacent rivers to the polder area through the existing khals during pre-monsoon and monsoon periods. The lateral migratory route for fishes would be obstructed due to construction and repair of 11 drainage sluice gates and re-excavation of 43 km connecting khals. This would directly hamper the lateral migration of mild to moderate saline tolerant fish species.	• Duration of construction of structures and other interventions should be shortened as much as possible at least should maintain the contract period. • Dismantle bundhs and other obstructions built to support the construction of structures as soon as work is over. • For manual re-excavation of Khals, compartments could be built in a cascade manner and bailing out of water to take place from one compartment to another to avoid damage to fish. • Sequence of construction of regulators and re-excavation of drainage Khals should be set scientifically so that implementation of project could be completed with minimum hindrance to fish migration. • Contractor will maintain liaison with communities so that they could realize the issue. • Liaison of contractor with community would create scope for setting proper time for the construction work
Timber/ fruit tree	The embankment/ polder road is dominant with timber tree like Babla (*Acacia nilotica)*, Akashmoni *(Acacia auriculiformis)* etc. About one sixty two (162) number of treesof different size and height will be damaged/cut down for construction of water control structures (replace).	• Give proper compensation to the tree owners against tree felling. It is mentioned here that a detail Ressetelement Action Paln (RAP) is being prepared for Package-3 under CEIP. According to plan, payment to owners against tree felling will be established. • Implement plantation with native species (i.e Sirish (Albizialebbeck),

Important Environmental Components (IECs)	**Potential Impacts**	**Mitigation Measures**
		Narikel (Cocos nucifera), Tal (Boassus flabelifer), Khejur (Phoneixsylvestirs), etc) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works. • Avoid construction activities during favorable time of wild life movement (early morning and night)
Aquatic flora and fauna	All proposed khals are shallow and no aquatic vegetation is observed because of tidal flow and salinity. But this type of wetland to support with success saline tolerant fauna as well as a number of crab, fishes (details fisheries section), mudskippers and shorebirds like Skipper frog, Bullfrog, Kingfisher, Egret, common aquatic snake, etc. The proposed interventions namely khal re-excavation would damage the aquatic flora and fauna.	• Keep untouched the deepest points of the khal as much as possible. • Use excavated soil spoils for khal dyke re-sectioning • Implement tree plantation with local species at the khal bank side after re-excavation work where excavated soil dumped khal bank side. • Use minimum land as much as possible for excavator/ labor movement
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 procedures to be followed during any emergency. This plan should be submitted to the Construction Supervision Consultants for review and approval; • All workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities. • Liaison should be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets should be kept in all the labor camps for obtaining weather information. • The construction sites should have protective fencing to avoid any

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

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
		• Ensure that no workers are charged fees to gain employment on the Project; • Ensure the rigorous standards for occupational health and safety are in place; • Contractor should establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. • The contractor should adopt a Human Resource Policy appropriate to the size and workforce which indicates the approach for management employees (this could be part requested in the tender process); • Produce job descriptions and provide written contracts and other information that outline the working conditions and terms of employment, including the full range of benefits; • Provide health insurance for employees for the duration of their contracts; • Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts; • Develop a recruitment process community employees that involves local authorities in clearly understood procedures; • Employ a community liaison officer (which could be full time or part of another post's responsibilities); • Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training; • Regularly report the labor force profile, including gender, and location source of workers; • Report regularly the labor and working condition key performance indicators, for instance hours worked (regular and overtime) during period and cumulatively, hours lost, number and type of accidents, near misses, site audits and meetings; trainings, and use of labor grievance mechanism; • Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase; • Organize training program and keep training registers for construction workers;

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
		• Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project. • Availability of safe drinking water should have to be ensured for the construction staff. • First aid boxes should have to be made available at each construction site. Emergency phone numbers (including hospitals, Fire services, and Police) should have to be displayed at key locations within the site. Each site should be occupied with an ambulance. • Firefighting equipment should have to be made available at the camps and worksites. • Waste management plan is to be prepared and implemented in accordance with international best practice. • Liaison with the community should have to be maintained.
Natural hazard	Historically, this area is vulnerable to cyclone, storm and tidal surges. As per construction schedule, the development activities of the proposed new polder will be conducted from October to May while most of the cyclone and storm surges are occurred in this area. According to previous record of occurrence of cyclone and storm surges, October to November and April to May are the pick months of occurrence of cyclone and storm surges. It is suspected that the construction activities during this period may hamper as well as the workers may be injured	• Weather signals should have to be considered by the contractor during construction works. • Radio and television should have to be kept in all labor sheds for getting weather information through these media. • Ensure rigorous standards for occupational health and safety are in place. • Having the Contractor establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.

Impacts during Operation phase

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

IECs	Impact	Mitigation
Embankment failure	Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously accelerates the risk of embankment failure. Counter clockwise circulation of the cyclone of the Bay of Bengal make the embankment more susceptible to breaches too. On the other hands, lifting of saline water through tubewell over the crest of the embankment by the Gher owners for saline shrimp cultivation.this practice will cause seriously weakens the embankment and increases the risk of embankment failure.	Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the eastern side of the Polder will have to be ensured. Monitoring will particularly be carried out before and after monsoon season. Prevent the establishment of hand tube-wells at the crest of the embankment. Available cyclone and flood shelters will have to be prepared as a contingency measure during emergency situation. WMG will have to develop funds for facing any emergency situation. Materials like geo bag and sand bag will have to be kept in stock yard of local BWBD colony.
Salinity intrusion	Mal-operation and leakage of regulators will result in salinity intrusion during dry season, causing severe damage to the soil, water resources, and crops in the Polder. The proposed project has been designed to address such damages which are currently caused by the salinity intrusion. Mishandling and poor maintenance of these control structures will undermine the very objective of the Project.	Regular monitoring and careful maintenance of the water control structures will be ensured. Standard operating procedures will be prepared and implemented for the water control structures. These procedures will be translated in bangle as well. Capacity building of WMOs will be carried out.
Use of agro-chemicals	At present 109 ha and 295 ha of land are under HYV Aman and HYV Boro rice cultivation. Shrimp culture practices are dominating here due to saline water. Presently, 168,460 kg of chemical 2,347 kg of granular pesticide and 293,700ml of liquid pesticides are used in the polder area. It is assumed that the, non-saline water would be available from the internal canal system, after the completion of the project and will reduce the salinity of the Polder area. This would allow expansion of irrigated cultivation of HYV Aman and HYV Boro rice. Due to expansion of HYV Aman and HYV Boro cultivation, additional 8,500 kg of chemical fertilizers and granular pesticide 121 kg and liquid pesticides 14,700 ml would be required for future crop production.	Capacity building and awareness raising of the farmers should be carried out regarding use of practice Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) in order to minimize usage of chemical inputs. Farmers group should have close contact with DAE for adoption of various measures of ICM and GAP. Farmer should be encouraged to use organic and green manure to increase the soil fertility as well as avoid to water contamination of water sources. Farmers should be encouraged to cultivate leguminous crops (N2 fixing) to enhance the soil quality as well as the soil productivity.

IECs	Impact	Mitigation
Fish migration time and extent	The improved drainage sluices would thus hamper the migration behaviour of above mentioned fish species as well as other aquatic fauna. Moreover, the migration of *Pairsa, Vetki, Gulsha, Tengra, Chingri*, etc., would be very much restricted with the replacement of the proposed drainage sluices.	Follow sluice gate operation manual (Appendix-E) for allowing fish migration; Construct fish pass for fish migration Provide training to WMOs for fish friendly operation of sluices; Transferring/stocking juvenile fish from rivers to the Polder.

Risk Assessement

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

Issue	Risk	Mitigation Measures
Fish Migration and movement	The peak velocity considered in designing of drainage sluices ranges from 3-4 m/s. The sustainable velocities of the indicative fish species are estimated in the range of 0.46 m/s to 1.1 m/s and burst velocities are in the range of 1.75 m/s to 4.2 m/s (Section 6.2.10). The peak velocity of the sluice gate would hamper fish migration and movement inside the polder. It is noted that burst velocities of fish are applicable for capturing prey as the duration is only for seconds	• The fish pass friendly aspects in the structures to be constructed in the Polder for the proper management of water. • The structure may be done either by constructing drainage sluices by maintaining the velocities passable for the mentioned indicative fish species or by constructing fish pass structure. • In case of sluice gates, based on catchment flow optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes. • In constructing fish pass, fish swimming speed or velocity and depth preference should be considered. In case of the indicative fishes velocities are mentioned in Table 6.14 and the depth preferences are as follows: Plotosus canius: 2-10 m; Liza Parsia: 1.5-10 m; Mystus gulio: 1.5-10
Function of Water Management Organisations (WMOs)	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	• 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

	the past, there was usually no fund allocated for the WMOs' functions and needs.	Polder without hampering the hydrological and environmental settings of the Polder • In addition to activation of WMOs, BWDB may recruit sluice khalashi for each of the Drainage Sluices for smooth operation of the gates as per initial practice • provide budgetary allocation in the post-operation phase for the O & M related tasks of the WMOs • Borrow pit, embankment slope, water bodies in the khas land may be provided to the WMOs as an income generating sources for their sustainability.
Navigation	Drainage sluices and sluice gates are provided in the Polder, which are being rehabilitated under this project. The gates in those structures are also operated in regular intervals to restrict salinity intrusion. However, such gates or boat passes in the embankment for allowing navigation through the embankment to and from the Polder would allow large volumes of saline water inside the Polder and may damage the soil, water and land – destroying crops.	• In order to maintain navigation scenario, an arrangement may be made for lifting of small size country boat from one side to other side i.e. river side to country side and vise-versa for navigation purposes. • This arrangement will not allow entry of saline water inside the Polder, and thus would not damage soil, water, land and crops.

Cumulative Impact

The cumulative impact of several existing and ongoing projects, as well as the proposed project 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 17/1 were considered in this study. Apart from CEIP interventions, there are some other development projects in the region of Polder 17/1, implemented locally or regionally. Impact on hydrology and flooding situation due to construction and implantation of proposed and existing projects were assessed.

Polder-17/1 is mainly dominated by Bhodra and Gangrail River at the South-East and North direction respectively. Improvement planning of Polder 17/2 and Polder 16 under CEIP-1 has also taken up with this Polder simultaneously.The proposed design crest level is same (4.5 mPWD) for these three Polders. However, Polder-17/1 may be more affected by the peripheral rivers due to raised crest level of Polder 16 and 17/2. Induced hydraulic pressure of Gangrail river may be diverted to the Polder-17/1 as it is located downstream of Polder 17/2. This may cause high salinity intrusion through peripheral khals (Hatitana, Soto Andharmanik Khal etc.) which are connected to Gangrail River. Water level of Bhodra River may increase due to climate change in future that can be assessed by model result. There is a possibility of storm surge effect due to increased surge level of Bhodra River (with or without climate change) on Polder-17/1.

The proposed higher crest level of the embankment may be slightly tending the flow of Salta River and Haria River to Polder-17/1. The surge level of Salta and Haria River due to climate change in future may affect the embankment of Polder-17/1 and deteriorate water quality by salinity intrusion.

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

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

There would be no impact on Sundarbans by the construction activities of the ongoing and proposed projects. During construction of activities of the polder (Polder 17/1), noise, dust and wastewater and other wastage would be generated from labor camp, movement of vehicle and construction of bank protection works which would have a negligible impact on the Sundarban biodiversity because the Sundarban is isolated by the river.

Polderization have a positive impact on shrimp culture in Polder 17/1 that initiated a financial revolution of the Polder area. On the other hand, there are some negative environmental impacts, i.e., infertility of aquatic animals, flora and fauna due to overtopping of 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 of construction sites /damage to dredge spoils	Budget included in RAP		Contractor	During pre-construction

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

Item No.	Description	Cost Million BDT	Cost Million $	Responsible Agency	Timeframe
14)	Training to WMA on "Integrated water Management and Operation and Management of Sluice Gates"	1.5		BWDB	During operation
15)	Compensation for trees	Budet Included in Afforestation Plan		BWDBwith a consultation of Forest Department	During construction
16)	WMOs monitoring cost	1	0.00625		
17)	Conservation and stocking of threatened fish species (at least 3 spots).	120,000	1.5	BWDB with help of UFO	During pre-construction and construction phase
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		**74**	**0.826**		

1 $ = 80 Taka

Extensive monitoring of the environmental concerns of the Polder-17/1 will be required as per World Bank guidelines. The monitoring program will help to evaluate: (i) the extent and severity of the environmental impacts against the predicted impacts and baseline; (ii) the performance of the environmental protection measures or compliance with pertinent rules and regulations; (iii) trends in impacts; and (iv) overall effectiveness of the project environmental protection measures. The monitoring plans should be included in the EMP for specific sub-project. Moreover, for all type of monitoring, a comprehensive database of the polder specific Environmental Impact and Monitoring information should be created, which will help to evaluate the impacts easily.

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

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Construction phase					
Sources of Material	Work Site	Possession of official approval or valid operating license of suppliers materials (Cement, soil).	Before an agreement for the supply of material is finalized.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Operation of borrow site	Borrow pit/site	Visual inspection of borrow site and ensuring operational health and safety	monthly	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Top Soil	Storage area	Top soil of 0.15 m depth will be excavated and stored properly	Beginning of earthwork	Contractor	DDCS&PMSC and BWDB
	do	The stored top soils will be used as cladding material over the filled lands	Immediately after filling and compaction of dredge materials	Contractor	DDCS&PMSC, BWDB
	Work Site	Some of the top soil are placed on top and berm of embankment for turfing and plantation	At the end of filling activity	Contractor	DDSC&PMSC and BWDB
Erosion	Side slopes of the embankments and material storage sites	Visual inspection of erosion prevention measures and occurrence of erosion	At the end of filling activity	Contractor	DDCS&PMSC, M&E Consultant and BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DDCS&PMSC, BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Daily	Contractor	DDCS&PMSC, BWDB
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DDCS and PMSC
Noise	Construction sites andnearby communities	Visual inspection to ensure good standard equipment are in use and recording noise level of nearby communities, if applicable	Weekly	Contractor	DDCS&PMSC, M&E Consultant, BWDB
	Construction sites	Ensure work restriction between 09:00 pm-6:00 am close to School/ Madrasha, Hospital & Villages	Weekly	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each polder	Sampling and analysis of surface water quality	Dry season	Contractor through a nationally recognized laboratory	DDCS&PMSC, M&E Consultant, BWDB
Drinking Water Quality(TDS, Turbidity, pH,FC, as if groundwater etc)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality	yearly	Contractor through a nationally recognized laboratory	DDCS&PMSC, M&E Consultant, BWDB
Sanitation	Construction camp/site	Visual Inspection	Weekly	Contractor	DDCS&PMSC, M&E

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
					Consultant, BWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid waste and solid waste is deposited at designated site	Weekly	Contractor	DDCS and PMSC, M&E Consultant, BWDB
Top Soil	Storage area	Top soil of 0.15 m depth should be excavated and stored properly	Beginning of earthwork	Contractor	DDCS&PMSC,andBWDB
	Storage area	The stored top soils should be used as cladding material over the filled lands	Immediately after filling and compaction of dredge materials	Contractor	DDCS&PMSC, BWDB
	Work Site	Some of the top soil are placed on top and berm of embankment for turfing and plantation	At the end of filling activity	Contractor	DDCS&PMSC, BWDB
Construction and repair of drainage sluices	Construction site	Physical Observation	Weekly	Contractor	BWDB
Bailing out of water from khals	Construction site	Physical Observation	Weekly	Contractor	BWDB
Re-excavation of khals	Construction site	Physical Observation	Weekly	Contractor	BWDB
Cut off trees	Each of construction sites at embankment.	Survey and comparison with baseline environment	Quarterly	Contractor through nationally recognized institute	DDCS&PMSC, M&E Consultant, BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DDCS&PMSC, BWDB
Workers' Health Safety	Workers'camp site/worksite	Provision of safe drinking water,sanitation,facility, first aid facility and PPE for workers (and proper use of PPE by the workers)	Daily	Contractor	DDCS&PMSC and BWDB
Operation phase					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each polder	Sampling and analysis of surface water quality	Yearly	BWDB through a nationally recognized laboratory	M&E Consultant
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Crop production	In the polder area	Compare the production with the baseline	3 (Three) cropping season	BWDB through a nationally recognized institution	M&E Consultant
Soil quality	In the Polder area	Compare the soil qualitywith the baseline	Two (2) times of year (dry & wet season)	SRDI	M&E Consultant
Soil salinity	In the polder area	Compare the soil salinitywith the baseline	Once (1) times of year (dry season)	SRDI	M& E Consultant
Crop production	In the polder area	Compare the production with the baseline	3 (Three) cropping season	BWDB through a nationally recognized institution	M&E Consultant
Fish Species Diversity	Khals and Sluice Gates adjacent River	Catch Assessment and Physical Observation	Two times per year (dry & wet season)	BWDB/ WMA	BWDB with collaboration of DoF
Habitat Condition	Khals and Sluice Gates adjacent River	Physical Observation and Testing of Water Quality Parameter (i.e.DO, pH, Salinity and Turbidity etc.)	Quarterly four times per year (dry & wet season)	BWDB/ WMA	BWDB with Collaboration of DoF
Fish Migration	Water control structure	Migration study & catch assessment	Fish migration period (February to July)	BWDB/ WMA	BWDB with Collaboration of DoF
Fish swimming speed or velocity	In the project area	Measurement of water velocity	Once in a Week	WMO with help of UFO	M&E Consultant
Operation of fish pass	In the project area	Visual inspection and fishermen feedback	Reound the year	BWDB	M&E Consultant

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

Tentative Cost Estimates for Environmental Monitoring

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
1	Soil quality monitoring including N,P,K, S, Zn, salinity, organic Matter, pH etc. samples in	300,000	3.75	Contractor	During pre-construction, construction and post

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	Polder 16 = 6 samples x 3 times @ Tk.5,000				construction period phases
2	Monitoring of Fish Biodiversity, Fish Migration, Fish Production	800,000	10	Contractor with help of UFO	During construction and post-construction
4	Fish swimming speed or velocity and depth preference	150,000	1.8	Contractor with help of UFO	During post-construction
5	Crop Production/Farm Survey for four (4) times of year (dry & wet season).	60,000	0.75	Contractor with help of UFO	During post-construction
6	Air and noise quality monitoring and analysis.	500,000	6.25	Contractor	During construction
7	Surface and ground Water quality monitoring cost (testing for Turbidity, pH, DO, BOD, Salinity etc. + test of As, e etc. for HTWs at workers' camp site) 6 samples in Polder-16 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	0	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

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

Stakeholder Consultation and Disclosure

Three tiers of consultation process e,g FGD/Informal discussion, PCM (Public Consultation Meeting) and PDM (Public Disclosure Meeting)were conducted under this study. A Focus Group Discussion (FGD) and four (04) informal discussion were carried outat different locations of polder. One PCM at Union level was conducted with the participation of local people, representatives of local government (Union Parishad) and representatives of the BWDB with the objective of disclosing the impacts of the project and the EMP.Local people showed interest in the project and were positive minded for its implementation which is vital for their survival. They also expressed that if the monitoring plan is implemented properly during the pre-construction, construction and post-construction periods then they would support the implementing agency positively.

A Regional level Public Disclosure Meeting (PDM) on the EIA report of Polder 17/1 was held on 26 July, 2017 at Dumuria Upazila of Khulna District. The participants of the PDM included Upazila Nirbahi Officer (UNO), Upazila Chairman, Upazila Vice Chairman and other concerned government officials, Journalists, NGO representatives, environmentalists, activists, local stakeholders and other representatives. No national level disclosure meeting yet to be done.

1. Introduction

1. The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase 1(CEIP-1)(here in after referred as 'project'), under which 17 Polders will be rehabilitated and improved in the coastal area of the country by three packages.The GoB has obtained financial assistance from the World Bank (WB) for the project. Primarily 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. From environmental point of view, multi-criteria analysis was conducted which has been mentioned in the Strategic Environmental Assessment (SEA) report for CEIP-1. It may be mentioned that SEA has been carried out before conducting the EIA study and IEE report was prepared and submmitted to the Departemnt of Environment (DoE) and obtained site clearance. The rehabilitation and improvement activities of 17 Polders will be implemented in 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)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 seven Polders under Package-3 have been carried out. This document presents the EIA report of Polder-17/1.

1.1 Background

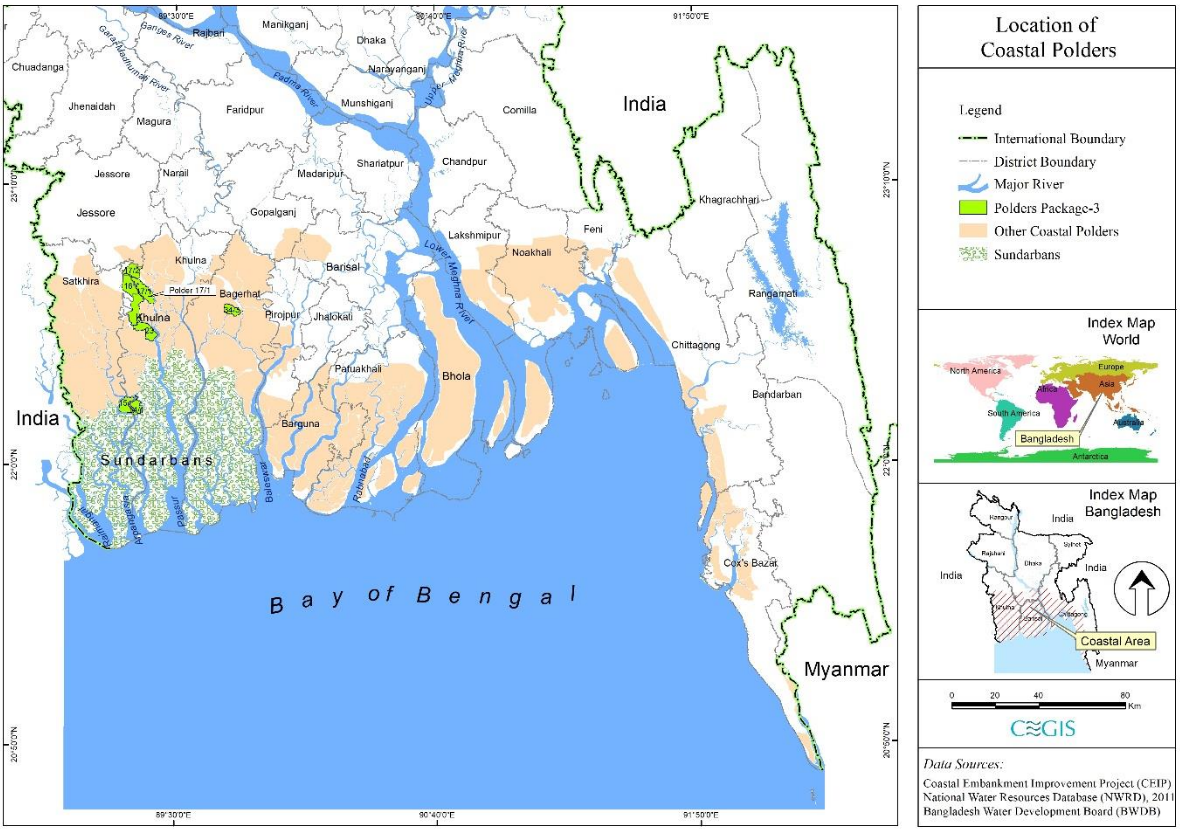
2. The coastal region of Bangladesh consists of 19 districts adjoining the Bay of Bengal. The region is characterized by a delicately modified ecosystem of an evolving flat delta subject to high tides, salinity intrusion and frequent cyclones coming from the Bay of Bengal encountering very large sediment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

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

4. The coastal embankment system of Bangladesh was originally designed without attention to storm surges. Recent cyclones have substantially damaged the embankments and further threatened the integrity of the coastal polders. In addition to breaching due to cyclones, siltation of peripheral rivers surrounding the embankments has caused failures of the drainage systems, creating water logging inside the Polders. This has led to large scale environmental, social and economic degradation. Poor maintenance and inadequate management of the Polders have also caused internal drainage congestion and heavy internal siltation. Soil fertility and agriculture production are declining in thewater logged areas. Other areas suffer from salinity increase due to intrusion of sea water into the Polders.

5. The above reasons have led the Government of Bangladesh (GoB) to readjust its strategy on the coastal area from only ensuring protection against high tides to providing protection against frequent storm surges as well. The long term objective of the GoB is to increase the resilience of the entire coastal population to tidal flooding as well as natural

disasters by upgrading the whole embankment system. With an existing network of nearly 5,700 km long embankments in 139 polders, the magnitude of such a project is daunting and requires prudent planning. Hence a multi-phased approach of embankment improvement and rehabilitation will be adopted over a period of 15 to 20 years. The proposed CEIP-1 is the first phase of this long term program.



Map 1.1: Coastal Polders

1.2 Project Overview

6. Polder-17/1 is located in DumuriaUpazila under Khulna District and covers three Union Parishads (U/P) namely Magurkhali, Shouna and Atlia (Map 1.2).The Polder covers a gross area of 5,020 hectare (ha) with net cultivable area of 4,000 ha. The overall cropping intensity is around 122% (which is much below the national average of 191%) giving a total cropped area of 4,869 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, thereby facilitate an increase in cropping intensity. To meet these objectives, the following key improvement and rehabilitation works will be carried out in Polder-17/1 under Package 3, CEIP-1:

- Re-sectioning of existing embankment : 38.50 km
- CEIP Design Crest Level : 4.50 m PWD
- Repalcement /Repairing ofDrainage sluice : 11nos
- Re excavation of Drainage channels : 30.22 km
- Afforestation : 29.53 ha.

7. Other components of the CEIP-1 will include implementation of social action plan and an environmental management plan; supervision, monitoring and evaluation of project

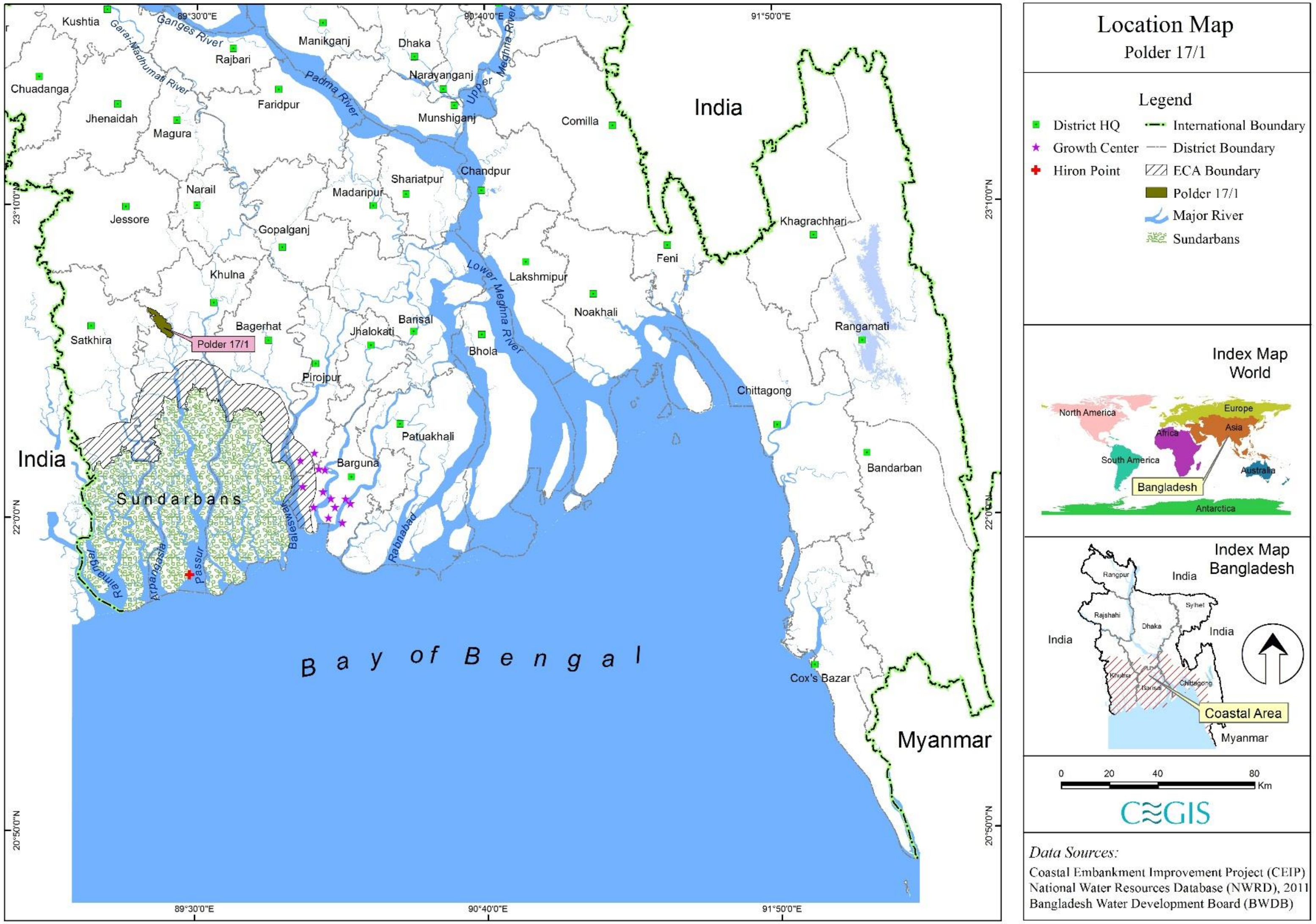
impacts; project management, technical assistance, trainings, and technical studies; and contingent emergency response.

8. The BWDB is the implementing agency of the Project.

9. Detailed information of the Project is presented in the Project description chapter of the report.

1.3 Regulatory and Policy Framework

10. The Bangladesh Environment Conservation Act, 1995 (amended in 2002, 2010), requires that all development projects shall obtain environmental clearance from the Department of Environment (DoE), Ministry of Environment and Forest (MoEF).Similarly, the World Bank's environmental safeguard policies require an environmental assessment to be carried out for projects being considered for its financing. The present EIA fulfils both of these requirements.



Map 1.2: Location of Polder-17/1

1.4 Objectives of the Study

11. The objective of the EIA study for Polder-17/1 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 regulationsand WB environmental policies and guidelines (for further details refer Chapter 3).

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

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

1.5 Scope of work

13. The scope of work of the present EIA study for Polder-17/1 includes the following:

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

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

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

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

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

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

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

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

ix. Describe alternatives that were examined in course of developing the proposed project and identify other alternatives that could achieve the same objectives. The concept of alternatives extends to the siting and design, technology selection, rehabilitation/construction techniques and phasing, and operating and maintenance procedures. Compare alternatives in terms of potential environmental impacts, vulnerability, reliability, suitability under local conditions, and institutional, training, and monitoring requirements. When describing the impacts, indicate which are irreversible or unavoidable and which may be mitigated. To the extent possible, quantify the costs and benefits of each alternative, incorporating the estimated costs of any mitigating measures. Include the alternative fornot constructing embankment under the project anddemonstrate environmental conditions without it.

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

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

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

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

xiv. Prepare the EIA report.

1.6 Structure of the Report

14. The report comprised the following chapters:

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

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

Chapter 4 (Climate Change Impact): discusses 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 phase, manpower, equipment, and material requirements, implementation arrangements, implementation schedule and other related aspects.

Chapter 6 (Environmental Baseline and Existing Conditions) describes the existing environmental and social settings in respect of Physical Environment, Biological Environment and Socio-cultural environment aspects of the project area.

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

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

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

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

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

2. Approach and Methodology

15. This Chapter presents the detailed approach and methodology followed to conduct the EIA study for rehabilitation of Polder-17/1.The Chapter also describes the data sources and methodology of data collection, processing and approach used in the impact assessment.

2.1 Overall Approach

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

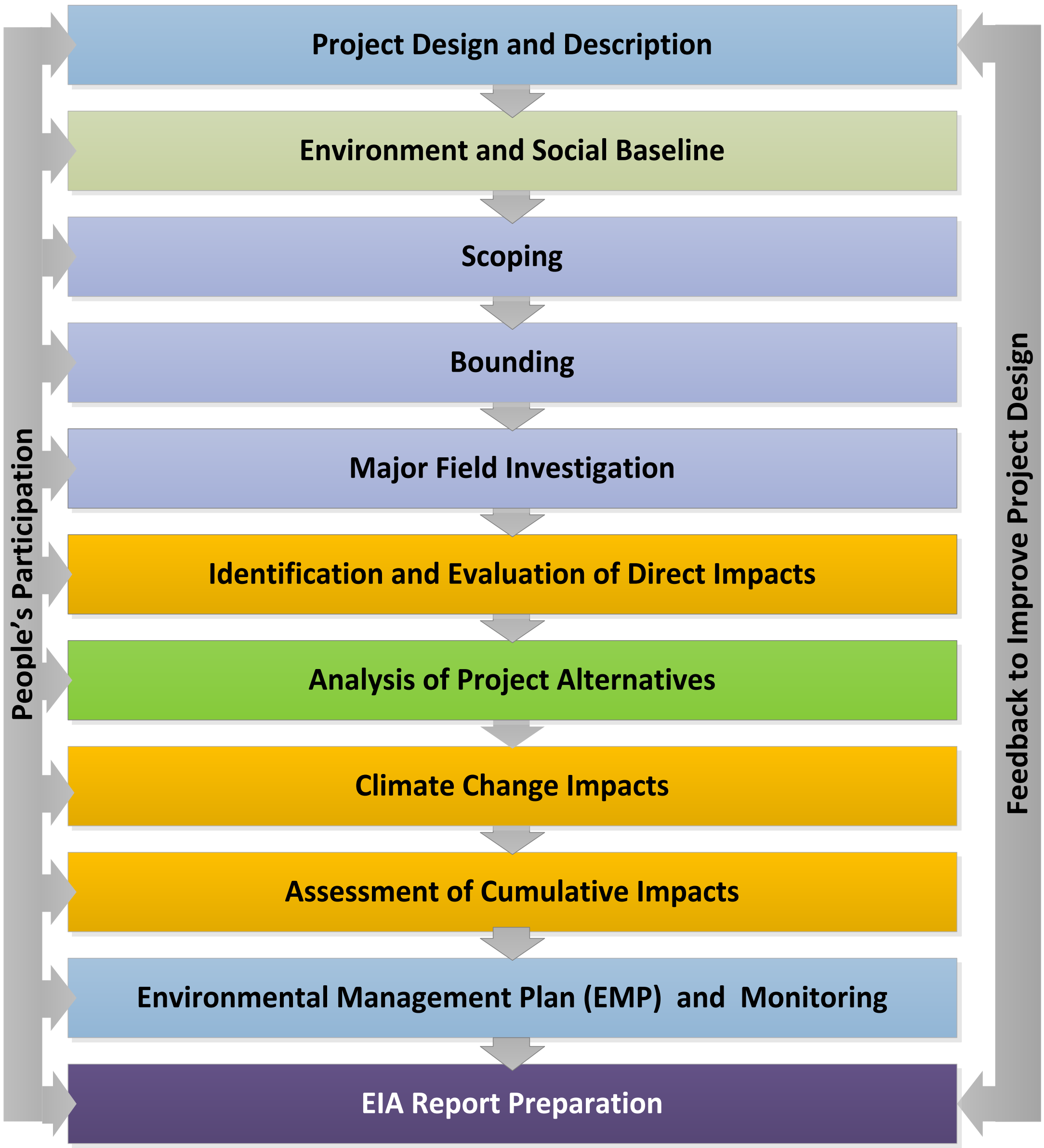


Figure 2.1: Overall approach of the EIA study

2.2 Methodology

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

18. Analysis of the Project Design and Description

19. Detailed informationabout the Polder-17/1 including objective, nature and location of proposed and existing interventions, construction works, and other related aspects were obtained from the DDCS &PMSCs 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.

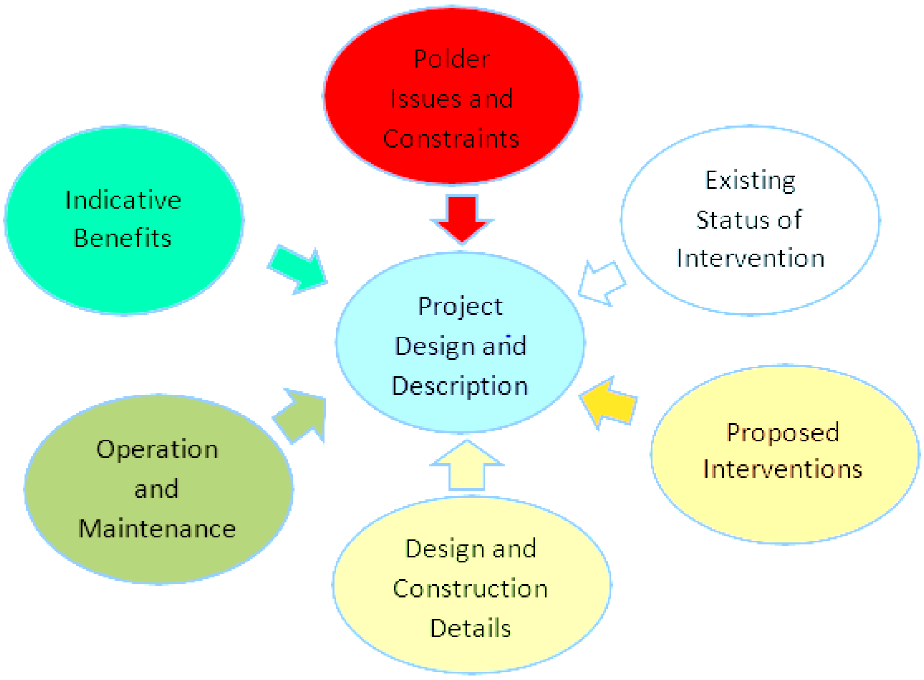


Figure 2.2: Aspects to be addressed in the Project Design and Description

2.2.1 Baseline Data Collection and Analysis

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

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

investigations and consultations with different stakeholders. The baseline settings were established with respect to the physical, biological and socio-cultural environment conditions including identification of problems in respect of the proposed project sites and adjoining area. A checklist was developed (see Appendix A) and approved by the DDCS&PMS Consultant and used to register the information obtained from different stakeholders.

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

26. Meteorological data such as temperature, rainfall, evapo-transpiration, wind speed and humidity were collected from the National Water Resources Database (NWRD) of Water Resources Planning Organization (WARPO), and subsequently analyses. 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 was collected from Upazila[1] Land and Soil Resources Utilization Guide of Soils Resources Development Institute (SRDI). The secondary data of these parameters were verified at field level through physical observations as well as consultations with the local people and officials of the Department of Agriculture Extension (DAE) during field visit.

2.2.3 Biological Environment

Agricultural Resources

29. Land use information was prepared from satellite image classification with field verification. Data on agricultural resources which included existing cropping patterns, crop

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

variety, crop calendar, crop yield, crop damage and agricultural input used were collected from both secondary and primary sources. Agriculture data were 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 (DAE). Crop production was determined using the following formula:

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

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

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

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

Ecological Resources

34. 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 ecosystems were generated through analysis of recent satellite images.

35. 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

36. 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.

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

38. 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.

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

Livestock Resources

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

2.2.4 Socio-cultural Environment

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

- Secndary data were collected from Bangladesh Bureau of Statistics (BBS), 2011.The relevant literatures from BWDB and main consultant were also reviewed;
- Reconnaissance field visit and discussions with BWDB officials and local stakeholders were carried out 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.

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

2.2.5 Major Field Investigation

43. 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, biodiversity, 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 thisexercise attention was given to understand the historical status of the IESCs and the possible condition of the same against the proposed interventions.

2.2.6 Scoping

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

2.2.7 Bounding

45. At the beginning of the study, the Project area of influence was broadly delineated considering the external river system of the Polder.This included the area inside the polder where most of the Project interventions would take place, 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 the Gangrall River to the west, the Salta River to the east. It is noted that project area includes thePolder area whereas the study area includes both project area and peripheral rivers.

2.2.8 Identification and Evaluation of Direct Impacts

46. At this stage, attempts were made to assess the impacts of the proposed interventions of the polder quantitatively. Alternatively, impacts were assessed qualitatively when quantification was not feasible. The impacts of proposed interventions, considering the climate-change scenario (RCP8.6) for 2050, were estimated on the basis of differences between the future-without-project (FWOP) condition and the Future-with-Project (FWIP) condition. The Future-without-Project (FWOP) conditions were generated through trend analysis and consultations with the local people. This reflected conditions of IESCs in absence of the proposed interventions under the polder area. Changes expected to be brought about due to proposed interventions under the Project were assessed to generate the Future-with-Project (FWIP) condition. Comparison and projection methods were used for impact prediction.

47. 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 due to any potential impact of project activities, and will be largely dependent on the extent and duration of change, the number of people or size of the resource affected (receptor) and their sensitivity to the change.Potential impacts can be both negative and positive (beneficial), and the methodology defined below was applied to define both beneficial and adverse potential impacts.

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

Sensitivity

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.

Table2.2:Criteria for Determining Sensitivity

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

Assessment of 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 as per the Table2.3 require appropriate avoidance/ mitigation/compensatory measures to reduce the significance.Impacts having low to negligible significance are considered not to need any mitigation measures.

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

2.2.9 Analysis of the Project 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. In the process, all design alternates or alternatives in project interventions were compared and different possible construction alternatives related to project implementation such as materials to be used, workforce procurement sources, locations of stock yards, sources for material procurement, transportation routes, modes of material and manpower mobilization, scheduling etc., were analyzed.

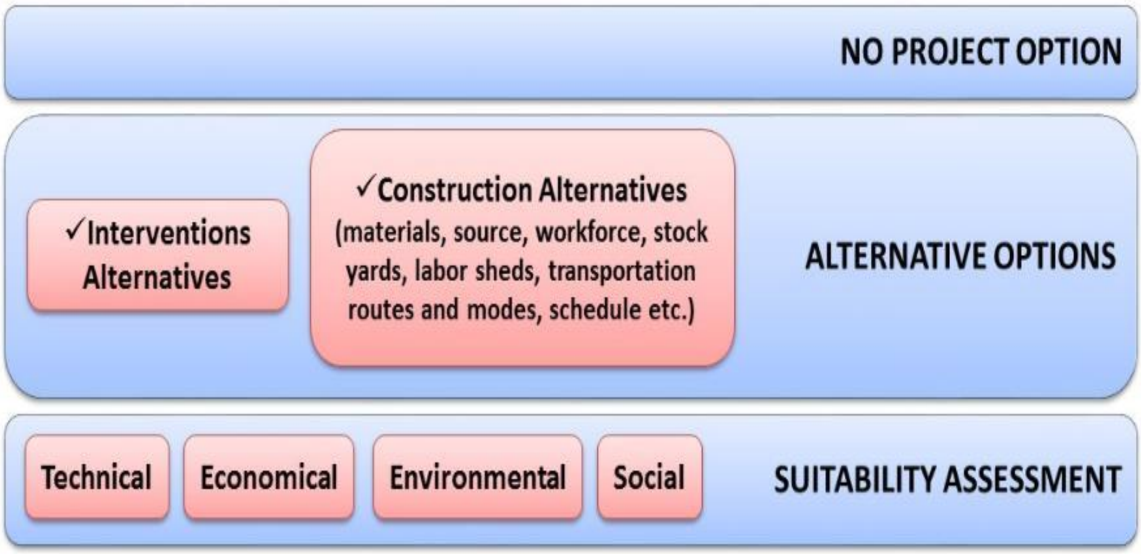


Figure 2.3: Concept of Alternative analysis to be used in the EIA study

2.2.10 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, 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.

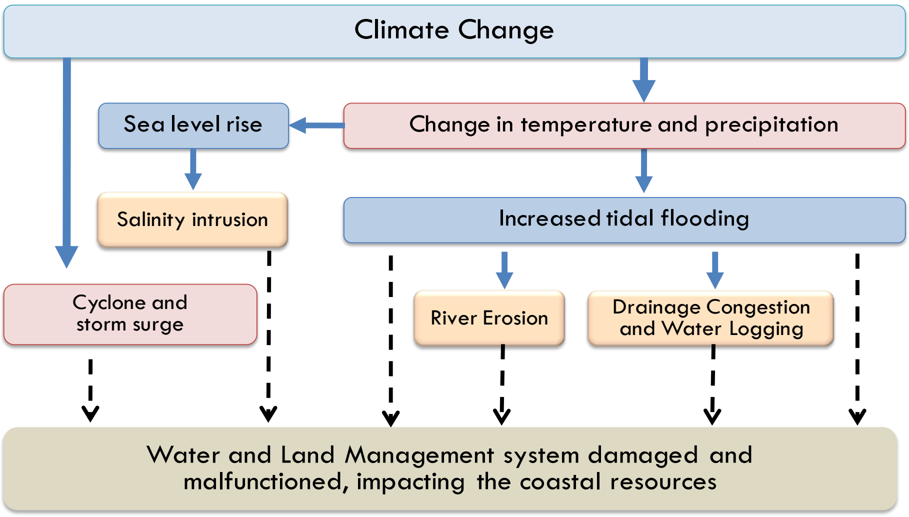


Figure 2.4: Typical process diagram of climate change impacts in coastal areas

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.

2.2.11 Assessment of Cumulative and Residual Impacts

63. 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.

64. 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.

2.2.12 Preparation of Environmental Management and Monitoring Plan

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

2.2.13 EIA Report Preparation

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

3. Policy, Legal and Administrative Framework

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

3.1 Relevant National Policies, Strategies and Plans

68. 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

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

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

(xv) Ethnic Minority Rights in PRSP 2005

70. The details of the above policies, plan, strategies and laws are given in Appendix-B

3.3 Other Relevant Acts

71. There are a number of other laws and regulations relevant to the project as presented in Table 3.1.

Table 3.1:Laws and Acts

Act/Law/Ordinance	Brief Description of Laws and Acts	Responsible Agencies
The Vehicle Act (1927) and the Motor Vehicles Ordinance (1983)	Provides rules for exhaust emission, air and noise pollution and road and traffic safety	Road Authority
Rules for Removal of Wrecks and Obstructions in inland Navigable Water Ways (1973)	Rules for removal of wrecks and obstructions	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 Protection and Conservation of Fish Act (1950)	Deals with the protection/conservation offishes in Government owned water bodies	DoF
The Embankment and Drainage Act (1952)	Describes the protection of embankments and drainage facilities	MoWR
Bangladesh Labor Law (2006)	Deals with occupational rights and safety of factory workers; provision of comfortable work environment and reasonable working conditions	MoL

3.4 International Treaties Signed by GoB

72. Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, such asthe Ramsar Convention, the Convention on the Conservation of Migratory Species of Wild Animals (CMS), the Rio de Janeiro Convention on Biological Diversity (CBD)conservation and the Kyoto protocol on climate change etc. An overview of the relevant international treaties and conventions signed by GoB is 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
Prevention and Control of Occupational hazards	1974	Protect workers against occupational exposure to carcinogenic substances and agents	MoH

Treaty	Year	Brief Description of Treaty and Convention	Relevant Departments
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 ofthe 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

73. 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, under MoEFis the regulatory body responsible for enforcing the ECA'95 and ECR'97 (Amended 2010)..According to the Rule 7 (1) of the Environmental Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every project, in consideration of their site and impact on the environment, has been classified into the four categories and they are: Category I (green), Category II (Orange-A), Category III (Orange B) and Category IV (Red). According to the categorization, all construction/reconstruction/expansion of flood control embankment/polder/dykes etc falls under Red Category. Therefore, the CEIP-1 Project intervention in Polder-17/1 falls under the 'Red' category.

74. 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)

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

76. 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

77. Legislative bases for EIA in Bangladesh are the Environmental Conservation Act1995 (ECA'95) and the Environmental Conservation Rules 1997 (ECR'97). 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 projects/industries which are specified under the Schedule –1 of the Environmental Conservation Rules 1997 require obtaining site clearance and environmental clearance from DoE. For 'Red' category, it is mandatory to carry out an EIA including an EMP and where necessary to develop a Resettlement Plan for getting environmental clearance from DoE. The application procedure for obtaining site clearance and environmental clearance for the sub-projects of Red category is shown in Figure 3.1.

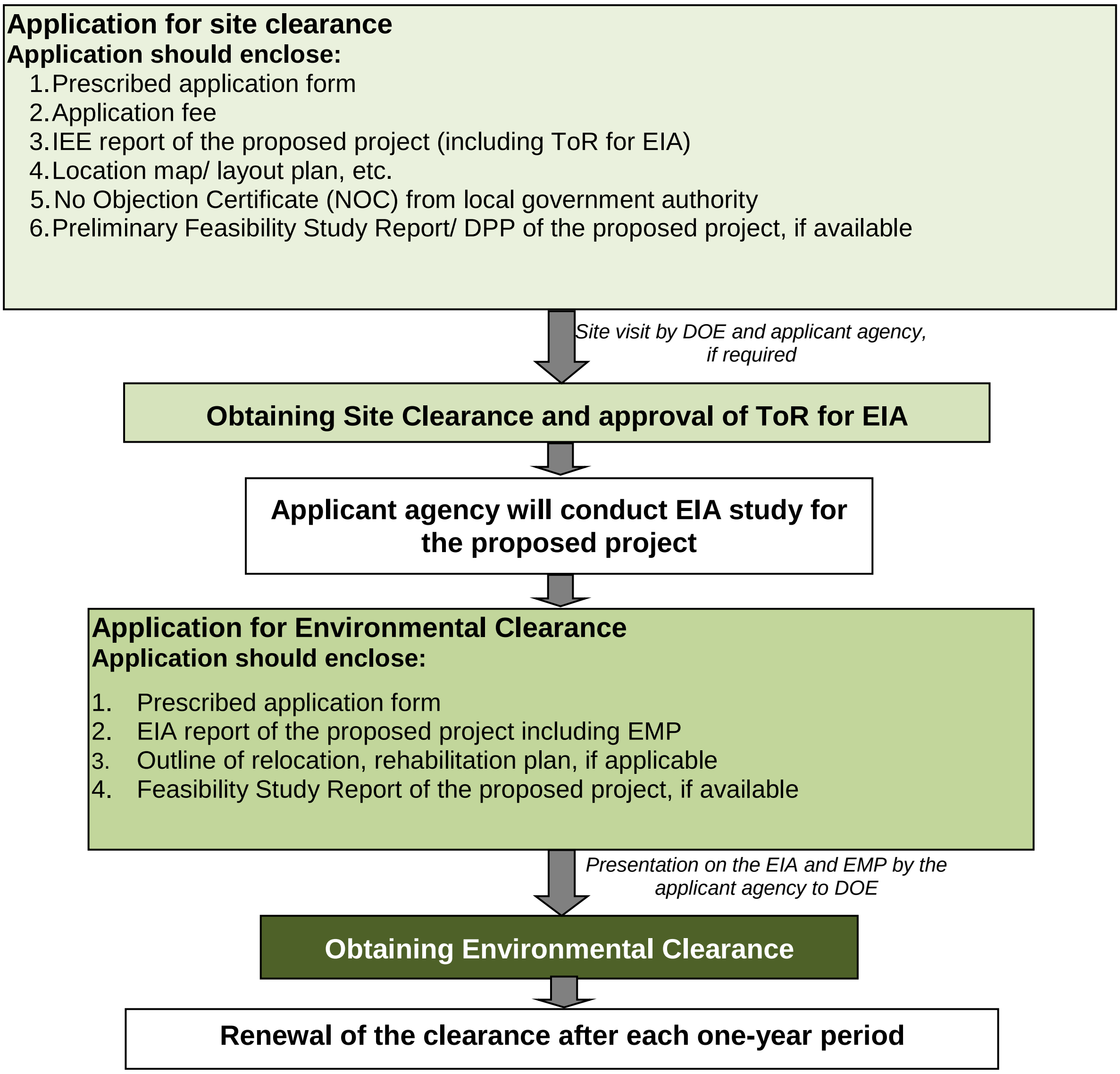


Figure 3.1: Process of obtaining Clearance certificate from DoE

3.7 World Bank's Environmental Safeguard Policies

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

(i) Environmental Assessment (OP 4.01)

(ii) Natural Habitats (OP 4.04)

(iii) Water Resources Management (OP 4.07)

(iv) Physical Cultural Resources (OP 4.11)

(v) Forestry (OP 4.36)

(vi) Projects on International Waterways (OP 7.50)

(vii) Pest Management (OP 4.09)

(viii) Indigenous Peoples (OP 4.10)

(ix) Involuntary Resettlement (OP 4.12)

(x) Projects in Disputed Areas (OP 7.60)

(xi) Safety of Dams (OP 4.37)

(xii) Public Disclosure of Information (BP 17.50)

(xiii) Environment, Health and Safety Guidelines

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

3.8 Implications of WB Policies on CEIP

80. The project interventions for Polder-17/1falloccupiesCategory A, due to the complexity of environmental issues associated with project activities involving major civil works by reconstruction and rehabilitation of the coastal embankment to protect against tidal flooding and storm surges. Since the coastal area is of high ecological sensitivity and vulnerability certain negative environmental impacts may occur during the implementation and operational phase on overall polder system. There may be localized impact on the natural habitats especially on the fish spawning site and protected areas, during the implementation of the civil works.

81. The environment assessment (OP/BP 4.01), natural habitats (OP/BP 4.04) and forests (OP/BP 4.36) policy have been triggered for the proposed operation. Although no direct impacts on physical cultural resources are expected, screening mechanism incorporated into the EA process will identify subprojects with archeological, paleontological, historical, religious, or unique natural values, chance and find procedure will be followed to address physical cultural resources (OP/BP 4.11). The interventions under the proposed Project may result in an increased availability of irrigation water through cleaning and excavation of water courses in the Polder.This increased water availability can inturn potentially increase the usage of chemical fertilizers and pesticides. During regular environment monitoring inoperational phase if the water and soil pollution is observed, the proponent will be responsible for preparing Pest Management Plan with prior approval from Bank.

82. Projects on international waterways (OP 7.50) may affect the relations between the World Bank 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.

83. No Project activities are to be carried out in the rivers except some transportation.However, this will not have any affect whatsoever on the upper riparian water usage or availability.

4. Climate Change Impact

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

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

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

87. One of the best ways of understanding how climate may change in future is toexamine how it has changed in the past based upon long-term observationalrecords.It is mentioned here that Polder-17/1 is located in DumuriaUpazila, Khulna; so meteorological parameters of Khulna station is considered relevant ofPolder-17/1for this study.Meteorological data for 1981-2012 periods were obtainedfrom Bangladesh Meteorological Department (BMD) for Khulna. Climatologically trend of rainfall and temperature have been analyzedfor a 32-year period for Khulna, which is important in considering long-termimpacts of climate change. In addition to mean maximum temperature, mean minimum temperatureandrainfall,for each month of the year were also computed. From the monthly values, annual (January-December) and seasonal (winter: December, January, February; pre-monsoon: March-May; Monsoon: June-

September; Post monsoon: October-November) time series of mean maximum temperature, mean minimum temperature, and rainfall were also analyzed. Annual total rainfall

88. The temporal plots of the annual total rainfall of Polder 17/1 have been drawn to investigate the nature of inter-annual fluctuations. A slightly decreasing trend in the annual rainfall at the rate of -0.19 mm/year, is noted from 1981 to 2012, which is not considered statistically significant.

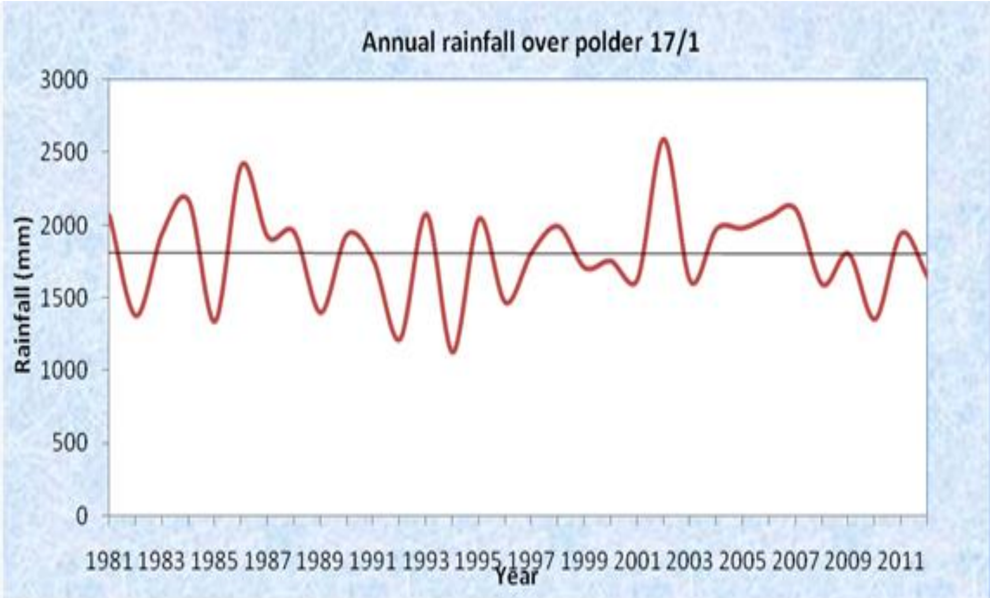


Figure 4.1: Temporal variations of annual rainfall over Polder-17/1 during the period 1981-2012

4.1 Climate Change Trends

4.1.1 Annual mean maximum temperature trend

89. The temporal plots of the time series of annual mean maximum temperature of Polder-17/1isshown in Figure4.2.

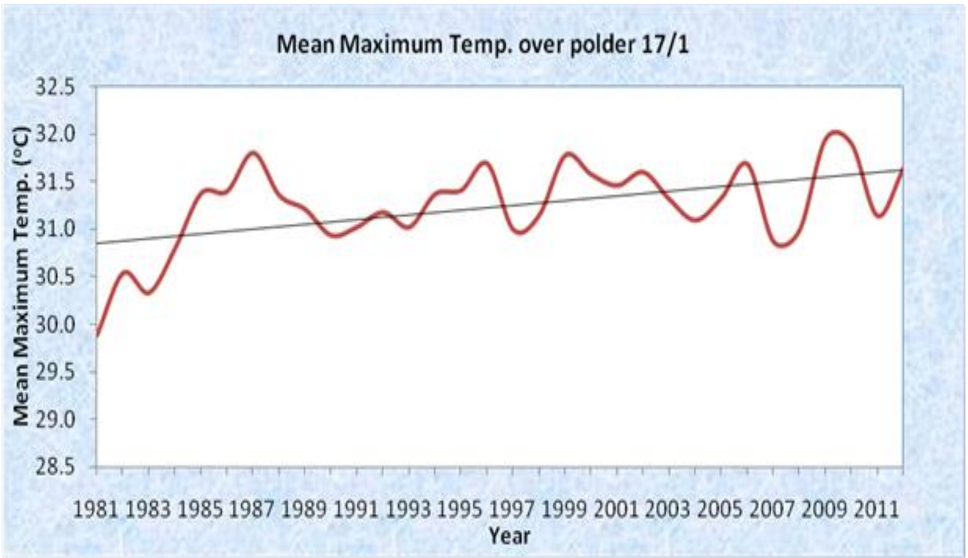


Figure 4.2: Temporal variations of mean maximum temperature over Polder-17/1during the period 1981-2012

90. The annual mean maximum temperature time series have shown increasing trends over Polder-17/1 at the rate of 0.025°C/year, which is statistically significant at 5% level.

4.1.2 Annual mean minimum temperature trend

91. The yearly variation of annual mean minimum surface air temperature for polder 17/1 is shown in Figure 4.3 for the period 1981-2012. The trend analysis of annual mean minimum temperatures shows an increasing trend at the rate of 0.039oC/year which is statistically significant at 1% level.

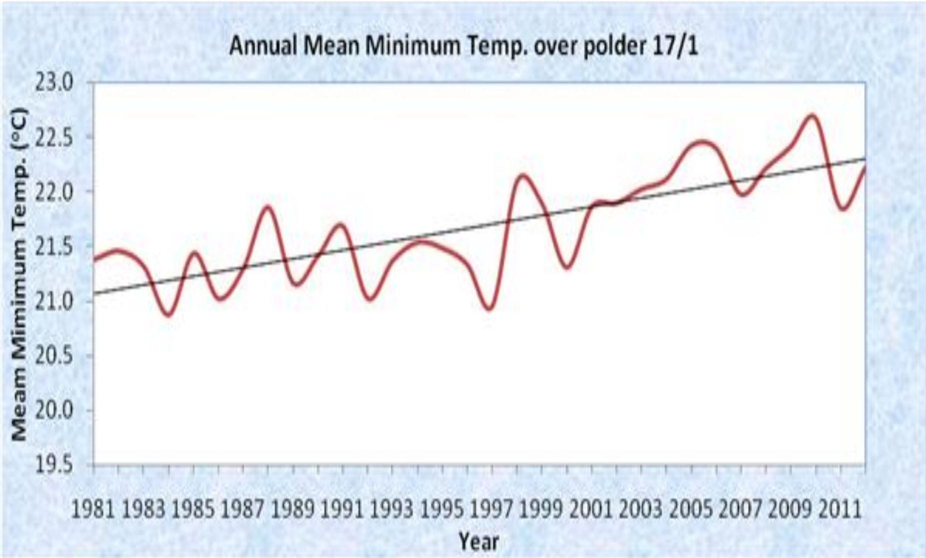


Figure 4.3: Temporal variations of annual mean minimum temperature over Polder-17/1 during the period 1981-2012

4.2 Seasonal climate change trends

92. In this section seasonal climate trend analysis are described.

4.2.1 Winter climate change trend

Winter season rainfall trend

93. The temporal variations of winter rainfall obtained for 1981-2012 show a slightly decreasing trend in the winter rainfall at the rate of -1.32 mm/year (Figure not shown),which is not statistically significant.

Winter mean maximum temperature trend

94. The winter mean maximum surface air temperature shows a slightly increasing trend from 1981 to 2012 (Figure not shown at a rate of 0.0028^{0}C/year, which is not statistically significant.

Winter mean minimum temperature trend

95. The winter mean minimum surface air temperature shows an increasing trend over the period of 1981-2012 (Figure not shown of 0.057^{0}C/year, which is statistically significant at 1% level for the same period.

4.2.2 Pre-monsoon Climate Change Trends

Pre-monsoon total rainfall trend

96. The pre-monsoon total rainfallduring the period 1981-2012 (Figure not shown) shows a decreasing trend at a rate of -6.69 mm/year, which is not statistically significant.

Pre-monsoon mean maximum temperature trend

97. Pre-monsoon mean maximum temperature shows an increasing trend during the period 1981-2012 (Figure not shown) at a rate of 0.034^{0}C/year, which is statistically significant at 5% level.

Pre-monsoon mean minimum temperature trend

98. Pre-monsoon mean minimum temperature shows an increasing trends during the period 1981-2012 (Figure not shown) at a rate of 0.049^{0}C/year, which is statistically significant at 1% level.

4.2.3 Monsoon Climate Change Trends

Monsoon season rainfall trend

99. The temporal plot of the monsoon season rainfall has analyzed to see the nature of inter-annual fluctuations. The linear regression line has also put on the graphs. The temporal variations and the trend of monsoon season rainfall are noticed during the period 1981-2012. It is seen that increasing trend in the monsoon season rainfall are observed over Polder 17/1 at the rate of 4.94 mm/year during the same period, which is not statistically significant.

Monsoon mean maximum temperature trend

100. The polder 34/3 has shown strong warming trend of mean maximum temperature in the monsoon season during the period 1981-2012. The Polder 17/1 exhibits strong warming trend during the monsoon season at the rate of 0.035^0 C/year which is statistically significant at 1% level.

Monsoon season mean minimum temperature trend

101. It is observed that polder 17/1 has shown warming trend of mean minimum temperature in the monsoon season during the period 1981-2012. The Polder 17/1 has the warming trend with the value of 0.017^{0}C/year which is statistically significant at 5% level.

4.2.4 Post-monsoon Climate Change Trends

Post-monsoon season rainfall trend

102. The temporal variations and the trend of post-monsoon rainfall are obtained during the period 1981-2012. It is seen that increasing trend of rainfall in the post-monsoon season is noticed over Polder-17/1at the rate of 1.87 mm/year (Figure not shown) during the above period, which is not statistically significant.

Post-monsoon mean maximum temperature trend

103. The Polder-17/1has shown warming trend for post-monsoon season mean maximum temperature during the period 1981-2012 (Figure not shown). Warming is observed over Polder-17/1at the rate of 0.025^{o}C/year, which is statistically significant at 5% level.

Post-monsoon mean minimum temperature trend

104. Post monsoon mean minimum temperature has shown increasing trend overPolder-17/1 and increasing trend also shows at the rate of 0.041ºC/year for the period 1981-2012, which isstatistically significant at 1% level during the period 1981-2012.

4.3 Climate change projection

4.3.1 Projection of rainfall over Polder-17/1

105. 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 the area is densely populated. Its national economy strongly depends on agriculture and natural resources that are sensitive to climate change and sea-level rise. The impact of higher temperature and more extreme weather events such as floods; cyclone, severe drought and sea-level rise are already being felt in South Asia and will continue to intensify (Huq et al., 1999; Ali, 1999). In this connection proper planning and sensible management of water resources are essential for this region. Long-term planning is not possible without any idea of the change of climate that may happen in future. Climate models are the main tools available for developing projections of climate change in the future (Houghton et al., 2001). In this context, regional climate model data is used to generate the future scenarios for rainfall and temperature over Bangladesh for RCP4.5. It is assumed that the base period 1990 means averaged during the period 1981-2000 and the year 2030 means averaged precipitation/temperature during the period 2021-2040 and year 2050 means averaged precipitation/temperature for the period of 2041-2060.

Rainfall projections for RCP4.5 scenario

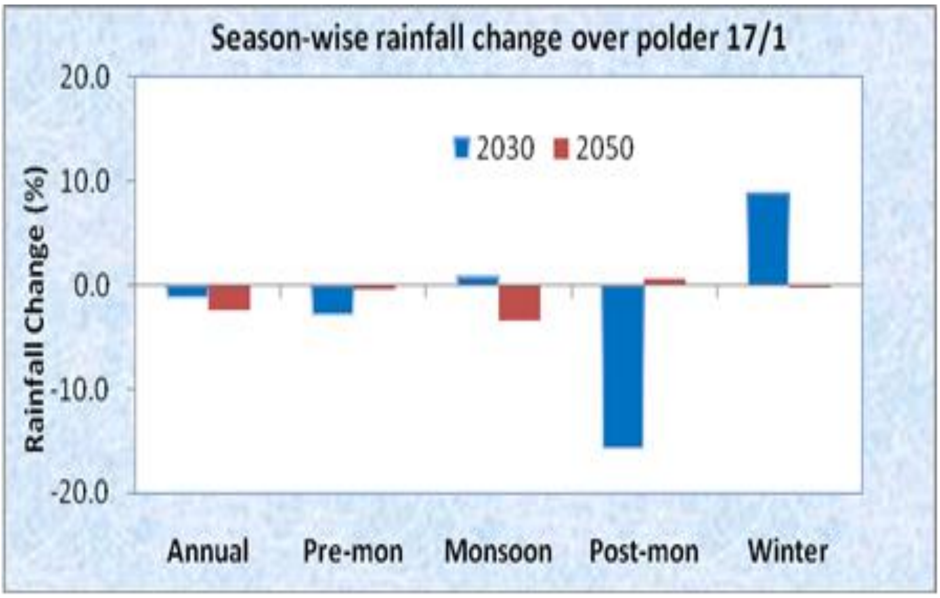


Figure 4.4: Change of seasonal rainfall (%) over Polder-17/1for the years 2030 and 2050

Scenario	Base line	Maximum Temperature Change(°C)												
		Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
RCP4.5	1990 (1981-2000)	2030	1.0	1.0	0.4	-0.1	-0.3	0.9	0.5	0.7	0.7	0.5	1.1	0.8
		2050	2.0	1.7	1.9	1.6	0.6	1.6	1.4	1.7	1.4	0.8	1.3	1.6
Minimum Temperature Change(°C)														
RCP4.5	1990 (1981-2000)	2030	1.6	0.8	2.0	0.7	0.9	1.0	0.9	0.9	1.0	1.1	1.6	2.1
		2050	2.4	1.9	2.7	1.9	1.5	1.5	1.5	1.4	1.5	1.2	1.2	1.8

106. 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 4.4). On an average annual rainfall change over Polder-17/1may be changed by-1.2% for the year 2030. Similarly,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 forthe year 2050 (Figure 4.4). On an average annual rainfall over Polder-17/1may decrease by 2.3% for the year 2050.

4.4 Projection of Maximum and Minimum Temperature over Polder-17/1

107. Maximum and Minimum surface air temperature projection is 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:

4.4.1 Maximum temperature projections over Polder-17/1:

108. 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 as shown in Table 4.1. Maximum surface air temperature in various months over Polder-17/1 may vary by -0.1 to 1.1°C. On an average the maximum surface air temperature is estimated to increase by 0.6°C for the year 2030. Similarly, maximum surface air temperature may be changed 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, March, April, May, June, July, August, September, October, November and December, respectively as shown in Table 4.1. Maximum surface air temperature in various months over Polder-17/1 may be varied by 0.6 - 2.0° C. On an average the maximum surface air temperature is estimated to be increased by 1.5°C for the year 2050.

Table 4.1: The change of maximum and minimum surface air temperature over Polder-17/1 for the year 2030 and 2050, respectively.

4.4.2 Minimum temperature projections over Polder-17/1 for RCP4.5 scenario:

109. The change of minimum surface air temperature is found to be 1.6, 0.8, 2.0, 0.7, 0.9, 1.0, 0.9, 0.9, 1.01.1, 1.6 and 2.1° C for January, February, March, April, May, June, July, August, September, October, November and December, respectivelyas shown in Table 4.1. 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 1.2oC over Polder-17/1area in future for the period 2030.Similarly, the change of minimum surface air temperature is found to be 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^{o} C for January, February, March, April, May, June, July, August, September, October, November and December, respectively as shown in Table 4.1. It is observed that the change lies between 1.2-2.4^{o}C for the year 2050 and on an average, minimum surface air temperature may increase by 1.7^{o}C over Polder-17/1 area in future for the same year.

4.5 Climate Change Induced Natural Hazard

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

4.5.1 Sea Level Rise and Coastal Inundation

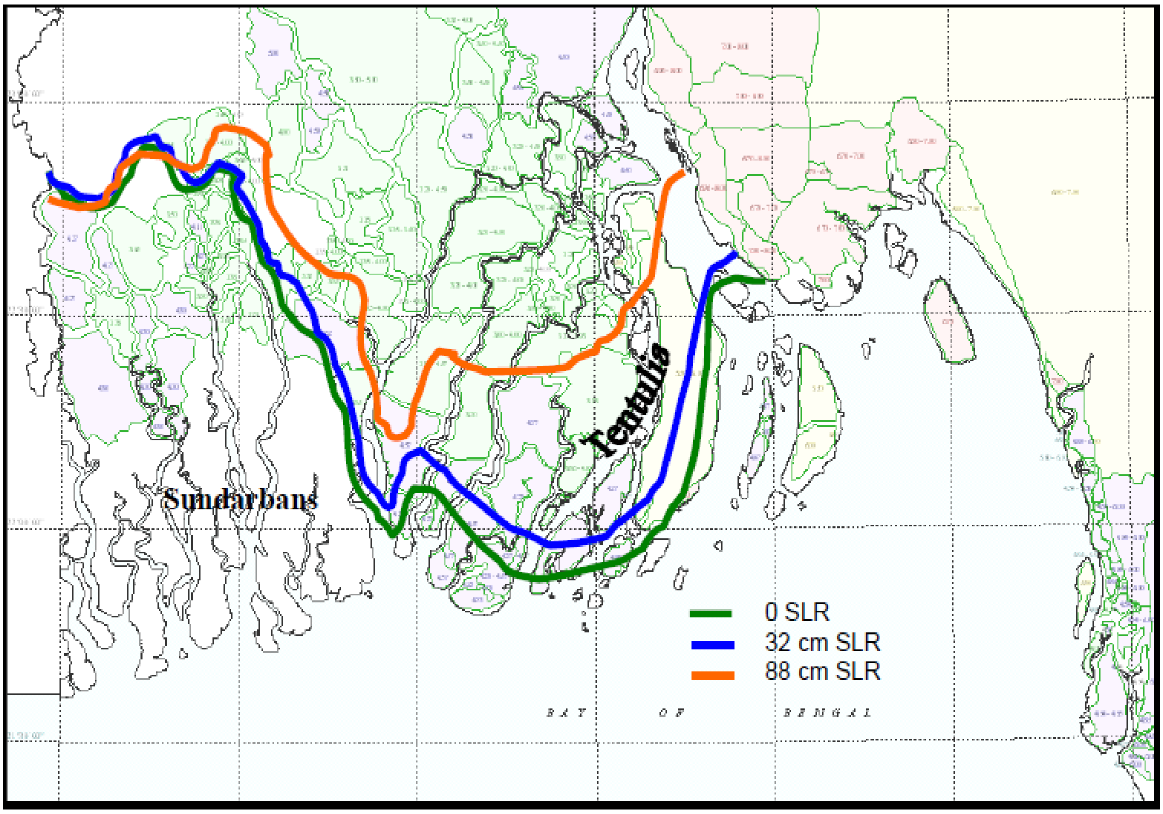
111. Bangladesh is vulnerable to current coastal hazards and anticipated Sea Level Rise (SLR) because of its lower elevation. WARPO (2006) predicted that the Sea Level Rise (SLR) may be increased by 14, 32 and 88 cm in 2030, 2050 and 2100 respectively which may inundate about 8, 10 and 16% respectively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

4.5.2 Tidal Flooding

112. 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.

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

coast of Bangladesh are 14 cm, 32 cm and 88 cm for the year 2030, 2050 and 2100 respectively. In a recent study, IWM (2006) predicted that flooding of coastal lands may increase by 21% by the year 2100 and 10.3% by the year 2050 with respect to the ordinary flooding condition when approximately 50% lands go under flood.



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

4.5.3 Salinity Intrusion

114. 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 10percent of the coastal area is under 1 part per thousand (ppt) salinity and 16percent area is under 5 ppt salinity and this area will be increased to 17.5 percent (1 ppt) from 10 percent and 24percent (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.

4.5.4 Cyclones and Storm Surges

115. 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).

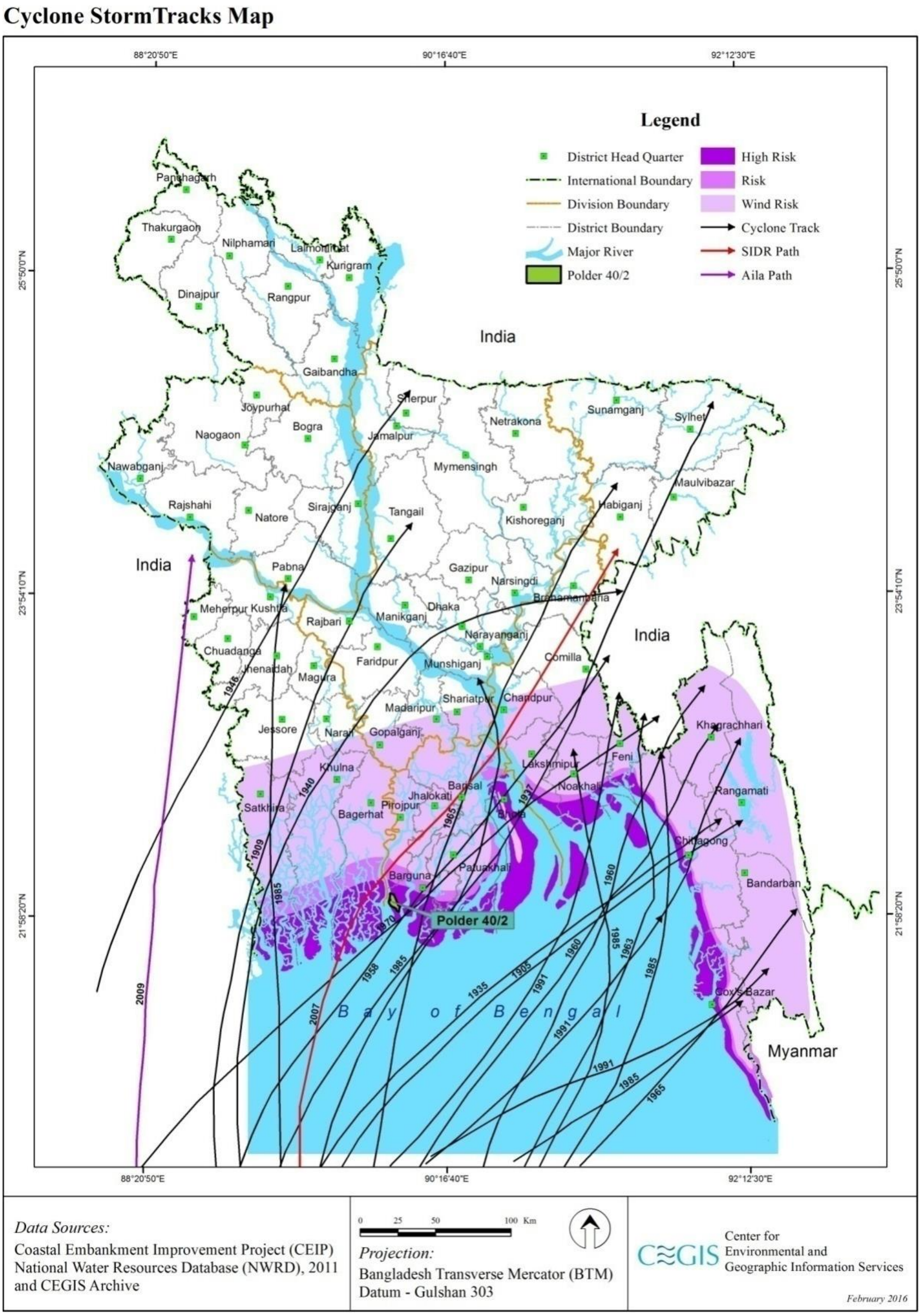
116. Tropical cyclones accompanied by storm surges are among the major disasters that occur in Bangladesh and severely damage lives and standing crops in the study area. Roughly, three to seven severe cyclones hit the coastal area in each decade. There is some evidence that peak intensity may increase 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.

117. 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.

118. 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.

Table 4.2: 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 10.0
25 May (Aila)	2009	120	3.0
Source: MCSP, 1993; Bangladesh Meteorological Department and field survey, 2010			



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

4.5.5 Rainfall and Temperature, Drainage, and Water logging

119. 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).

120. 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

121. Bangladesh is the largest delta of the world where coastal regions frequently face natural calamities i.e. storm surges. Numerous polders in coastal regionswere constructed to protect the southern portions of the country. The Polders are being damaged for the tropical cyclone Aila and hampered its objectives. The Coastal Embankment Improvement Project (CEIP) triggers to safeguard the Polder from tidal flooding, salinity intrusion and climate change induced storm surges. The majorobjective of the project is agricultural safety and improvement. The project activities, construction methodology, construction schedule and the institutional arrangements for implementation of the Project are discussed briefly in this chapter.

5.2 Coastal Embankment Project

122. 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.

123. 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 volume(i.e., the volume of water displaced during a tidal cycle).

124. 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.

125. 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

126. 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.

127. 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).

128. 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. Polder 17/1 is one of the Polders to be rehabilitated under the CEIP-1.

5.4 Overview of Polder

129. The Polder is located in DumuriaUpazila under Khulna District and covers three Union Parishads (UPs) namely Magurkhali, Shouna and Atlia. The Polder is surrounded by Salta and TaltalaRiverson the West and North, Gangrail and Bhadra Riverson the East and South.

5.5 The Polder was conceived in the early 1960s. The construction of the Polder was completed in 1971 after starting in 1969. The original concept of construction of this Polder was only to protect the agricultural lands from salinity intrusion caused due to tidal intrusion from the sea and river. Parts of the Polder are threatened by drainage congestion which would worsen with the changes taking place for climate change. Objective of the Project

130. The primary objective of the project is the restoration of the Polder to protect the coastal population from natural disasters and effects of climate change. This may be fulfilled through a set of specific objectives, such as:

- To raise the embankment and improve thePolder;
- To protect embankment from the river erosion/wave action;
- To prevent saline intrusion;
- To provide improved drainage facilities;
- To prevent sedimentation both in agricultural land and in water resources system;
- To reduce vulnerability to sea level rise due to climate change; and
- Finally, to protect life and properties of the Polder community from storm surges.

5.6 Water Management Problems and Issues in Polder 17/1

131. The existing crest levels are well below the design levels and the entire embankment has to be re-sectioned to comply with the recommended design of CEIP.Most of the hydraulic structures are completely or partially damaged and are non-functioning due to which internal drainage congestion is prevalent. Other structures, though functional, are in an extremely bad condition. The gates are corroded by saline water and concrete surface of the structures are in very deplorable condition. In some places, the reinforcement is found to be exposed. The loose apron both at the C/S & R/S are either been damaged or been washed out. There is a demand to use these structures both for flushing and drainage purposes. Most of the structures are needed to be replaced as they are not repairable. There are some places where khals exist but with no drainage structures. There are shrimp culture ghers inside the Polder occupying about 40% of the total area of land as reported by the local people. There are conflict between gher owners and farmers in this Polder.For continuing agriculture activities, the conflicts between the gher owners and the farmers have to be solved. Some flushing inlets

have been constructed by the Gher owners at their own initiative. But these are not being properly used for which acute internal water management problems have been created within the Polder. A strong “Sluice Committee” and WMA are needed for controlling the operation ofgates and improvement of water management system inside the Polder. The internal drainage channels have been silted up for having no maintenance since long back and needs to be re- excavated.An Index Map showing the alignment of the embankment, existing drainage sluices and drainage channels are shown in Map 5.1.

Map 5.1 Base Map of Polder-17/1

132. Based on opinions gathered from the local people, during major field investigation carried out in January 2016, the study team identified the following key water management problems and issues in the Polder.

- The existing crest levels of the embankment are well below the design levels of CEIP;
- Lack of regular repair and maintenance of water control structures and embankments;
- Deplorable condition of the existing sluices, insufficient number of drainage sluices with their vent size at Hatitana khal and Berakhalikhal ;
- Community abuse of existing infrastructure for fishing, shrimp/ prawn farming through unauthorized and inappropriate operation of sluices;
- High rate of siltation in the internal drainage khals and peripheral rivers which hinders natural overland drainage;
- The external river (Taltala River) at the outer periphery of the embankment and in between Polder-17/1 and Polder-17/2 has been fully silted up causing drainage congestion to the adjacent areas;
- Decrease in carrying capacity of khals through illegal encroachment;
- Absence of functional community organizations for operation and co-management of the polder system.

133. Present Status of Water Management InfrastructuresTo ensure sustainable management, optimal use and equitable sharing of water resources through proper management of the infrastructures; adequate physical interventions are required. There are some typical water management infrastructures such as peripheral embankments, drainage sluices, drainage khals and others in the Polder. Based on field investigation carried out in January 2016, coupling with the information received from CEIP Consultant, the study team gathered the following information regarding the status of existing infrastructure:

Table 5.1: Summary of existing water management infrastructures

Type of Infrastructures	Specification
Total length of Embankment	38.50 km (Design crest level: 4.27 m PWD)
Total number of Drainage Sluices	11 nos
Total length of Drainage Khals (Water Channel)	43.00 km
Gross protected area	5,020 ha
Net Cultivable area	4,000 ha

5.6.1 Embankment

134. The entire length of the embankment has to be re sectioned up to the new design level. There is bitumenous carpeting on the top of the embankment constructed by LGED and RHD on some segments for improved communication.These might have to be replaced during re-sectioning of embankment. About 10 km of the embankment is to be protected through afforestation on foreshore area.


Photo 5.1: Present condition of the embankment of the Polder

5.6.2 Drainage channel

135. The internal drainage channels have been silted up due to lack of maintenance since long back. About 30 km of channel need to be re-excavated on the basis of model results. The bed level of the aforesaid portion of the river is almost similar to the ground level and people are cultivating crops there. The river needs to be re-excavated.

5.6.3 Water Control Structures

136. There are 11 (eleven) drainage sluices in Polder-17/1. The existing drainage sluices are mostly to be replaced by new long lastingsluices to achieve project objectives. Some structures may be required to be repaired. Some sluices are to be replaced with adequate ventage for improvement of drainage system. Some flushing cum-drainage structures are required to be constructed for meeting up the requirement of water inside the polder. Table 5.2 below provides a detail understanding of the existing drainage sluices in Polder-17/1 along with addresses needed for future works.

Table 5.2: Status of existing water control structures

Sl. No.	Location of Structure with Ventage	Present Condition of the Structures	Recommendation forremedy	Remarks
1	DS-9 at km 15.90	There is no drainage sluice in this location for which the area is suffering from drainage congestion. Local people have demand to have a new sluice here.	A new drainage - cum-flushing sluice (1v-1.5x18) is proposed to be constructed.	New sluice is proposed to be constructed
2	DS-1 (1v-1.5 x1.8) at km 38.50	Concrete surface is in a very deplorable condition. U/S and D/S loose aprons and the railings with deck-slab are damaged.	The structure is proposed to be replaced with provision for flushing and drainage.	To be replaced.

Sl. No.	Location of Structure with Ventage	Present Condition of the Structures	Recommendation forremedy	Remarks
3	DS-1A (1v-1.5 x1.8) at km 2.08	The U/S and D/S loose aprons of the structure have totally been damaged. The structure is in a very deplorable condition.	The structure needs to be replaced with provision for flushing and drainage.	To bereplaced
4	DS-2 (1v–1.5 m x 1.8m) at km4.05	Expansion joint of the structure has been damaged and concrete surface is in a very deplorable condition. The structure is also an under ventage one.	The structure needs to be replaced by new one with (2v-1.5 x 1.8) of (1v-1.5 x 1.8) subject to model results.	To be replaced
5	DS-2A (1v–1.5x1.8)at km 7.835	U/S and D/S loose aprons have been damaged and concrete surface is in a very deplorable condition.	The structure is proposed to be replaced with provision of flushing and drainage.	To be replaced.
6	DS-3 (1v-1.5 x1.8) at km 10.20	The barrel wall has been cracked. U/S and D/S loose apron have been damaged. Operating deck-slab is also been damaged. Channel of lift gate has been corroded. The ventage of structure is not adequate.	The structure is proposed to be replaced by new one with (2v-1.5 x1.8) instead of (1v-1.5x1.8).	To be replaced
7	DS-4 (1v-1.5 x1.8) at km 17.25	The barrel portion of the structure has been settled down. Expansion joint has been damaged and wing wall is being separated from barrel-wall. The barrel and the diversion channel have been silted up.	The structure is proposed to be replaced with provision for flushing and drainage.	To be replaced.
8	DS-5 (1v-1.5 x1.8) at km21.90 DS-6 (1v-1.5 x1.8) at km 26.65	U/S and D/S loose aprons, operating deck slab and railing have been damaged.	The structures are proposed to be repaired.	To be repaired
9	DS-7 (1v-1.5 x1.8) at km 30.75	Loose aprons have been damaged. Concrete surface is in a very deplorable condition. Expansion joint and railing have been damaged.	The structure is proposed to be replaced.	To be replaced.
10.	DS-8 (1v-1.5 x1.8) at km 33.24	Loose aprons have been damaged. Concrete surface is in a very deplorable condition. Diversion channel has been silted up.	The structure requires to be replaced.	To be replaced
11.	DS-8A (1v-1.5 x1.8) at km 34.50.	Loose aprons and railing have been damaged. Hoisting device of the gate is lost.	Repairing of the sluice has been taken up under GoB fund.	The structure is being repaired by GOB.

Note: DS = Drainage Sluice

Source: CEIP 2015, and CEGIS Field Investigation, 2016

Photo 5.2: DS-3 at Mandartola

Photo 5.3 : DS-2A at Kathalia Bazar

Photo 5.4 : DS-2 at Shibnagar

Photo 5.5 : DS-1A at Bagardhari

Photo 5.6 : DS-1 at Patuabhanga

Photo 5.7 : DS-8A at Khagrabunia

Photo 5.8 : DS-8 at Magurkhali

Photo 5.9 : DS-7 at Baliahara

Photo 5.10: DS-6 at Soto Andharmanik

Photo 5.11 : DS-5 at Andharmanik

Photo 5.12 : DS-4 at Sudorbunia

5.7 Proposed Rehabilatation Plan

137. The proposed interventions in Polder-17/1 under CEIP-1 are listed in Table 5.3. It is mentionable that drainage modelling of the coastal Polder has been carried out by IWM to find out the design parameters for drainage 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: List of Proposed Interventions in Polder-17/1

Type of Work	Specification
Re-sectioning of embankment	38.50 km
Design crest level of Embankment as designed by CEIP	4.50 m PWD
Construction of Drainage sluice under CEIP	9 nos
Repair of Drainage sluice	2 nos
Construction of a new sluice at Boaria khal	1 no.
Re excavation of drainage channel	30.22 km
TRM	
Afforestation	29.53 ha

Source: DDCS&PMSC Team

138. Map 5.1 shows the location of the proposed interventions of the Polder-17/1 under CEIP-1. However, the proposed intervention will take place in a system that was modified in the past, that is not working properly well and that the social and physical environment is being affected. Therefore, the proposed project will absorb those liabilities.

139. To implement the aforementioned interventions, the following phase-wise activities are to be carried out (Table 5.4). The activities under each of the interventions have further been discussed and specified in the following sections:

Table 5.4: List of activities in Polder-17/1 at different project phases

Pre-construction phase	Construction phase	Post-construction phase
• Planning and design of the proposed infrastructures • Preparation of construction site, labor shed, material stock yard etc • Labor, materials and equipment mobilization • Display of billboard at construction site for public awareness	• Re-sectioning of embankment • Construction/repair of drainage sluices • Re-excavation of Drainage khals • Implementation of afforestation	• Checking of the physical condition and function of embankment and water control structures • Checking of the depth of khals • Checking the condition of R/S and C/S slopes of the embankment • Monitoring the functions of WMOs

5.7.1 Resectioning of Embankment

140. A total length of 38.50 km of embankment is to be re-sectioned under CEIP-1. The estimated earth works for re-sectioning of embankment will be 0.675 m^3. The earth will be dumped in layers as specified by the Engineer in charge and compacted upto the recommended crest level. The bitumen carpeting road (pucca road) on the crest of the embankment constructed by LGED on some segments needs to be replaced during re-sectioning of embankment as per CEIP design. The side slopes of the embankment will also be rehabilitated under CEIP-1 program. Table 5.5a shows detail information about the works to be carried out on the embankment.

Table 5.5a: Detail of Works on Embankments

Sl. No	Chainage	Length (Km)	Proposed Crest Level	Side slopes
Re-sectioning of Embankment				
1	0+000 to 38+500	38.50	4.50 m PWD	R/S 1:3 and C/S 1:2

Source: CEIP, 2015

Description of construction activities

141. The embankment will be resectioned as per design with the soil/earth obtained from borrow pits or other sources or R/S as approved by the Engineer-in-charge. The earth materials will have to be well graded, homogenous and free of logs, stumps, roots, rubbish or any other ingredient, organic/ vegetable matter.

142. Labor sheds construction with proper sanitation and other required allied facilities should be planned before the commencement of construction activities for the embankment works. A suitable site shall be selected and prepared by cleaning bushes, weeds, trees, etc. Alignment of the embankments has to be fixed with adequate base width. Base stripping and removal of trees, weeds, etc., will be done as per instruction of the Engineer-in-charge. The tools required for the re-sectioning of embankments will be procured during this period. After validating the final design, excavated soil/carried earth will be dumped in layers in a selected area. At the same time, each layer (1.5 feet) of dumped soil will have to be compacted

mechanically through a compactor. The sloping and shaping of embankment will be developed after proper compaction in layers. The required turfing with grass will then be provided on the slope of the embankment. Watering and fertilizing will also be provided for growth of turfing.

5.7.2 Construction/Repairing of Drainage Sluices

143. Among eleven existing drainage sluices of the Polder, nine will be constructed or replaced and two drainage sluices will be repaired with new design and specifications. Besides, a new drainage sluice will be constructed at BoariaKhal under the proposed interventions. The summary of design information of the proposed works in these drainage sluices are given in Table 5.6.As per design of Drainage Sluices (DS), The invert level of DS are fixed in consideration of the lowest water level. Hence, the canals bed level which are below the invert level have the capacity of retain some water within it. The water are being used for irrigation, fisheries and domestic purposes.

Table 5.6: Detail of Works in Drainage Sluices

Sl. No.	Name of drainage sluices	Chainage (at km)	Khal Name	Name of outfall river	Length of Khals (Km)	Lowest Tide level (m. PWD)	Lowest elevation of basin (m. PWD)	Existing Sill Level (m. PWD)	Proposed Sill level (m. PWD)	Remarks
1	DS-9 (1v-1.5 x1.8)	15+900	Boaria khal	TaltalaRiver	1.00	-1.20	-0.03	-1.00	-1.00	New construction of Structure as proposed
2	DS-1 (1v-1.5 x1.8)	38+500	Patuvanga khal	Bhadra River	3.785	-1.20	0.11	-1.68	-1.30	Replacement of structure as proposed
3	DS-1A (1v-1.5 x1.8)	2+080	Karamot Khal	Bhadra River	1.15	-1.20	0.05	-1.69	-1.30	Replacement of structure as proposed
4	DS-2 (1v–1.5x 1.8)	4+050	Shibnogor khal	Bhadra River	2.50	-1.20	0.28	-2.02	-1.20	Replacement of structure as proposed
5	DS-2A (1v–1.5x1.8)	7+835	Golar khal	Bhadra River	1.00	-1.20	-0.80	-2.07	-1.20	Replacement of structure as proposed
6	DS-3 (1v-1.5 x1.8)	10+200	Mandartola khal	Gangrail River	3.50	-1.20	-0.23	-1.92	-1.20	Replacement of structure as proposed
7	DS-4 (1v-1.5 x1.8)	17+250	Sudorbunia khal	TaltalaRiver	1.50	-1.20	-0.03	-2.71	-1.00	Replacement of structure as proposed
8	DS-5 (1v-1.5 x1.8)	21+900	Andharmanik khal	Salta River	2.00	-1.20	-0.02	-2.1	-1.00	Replacement of structure as proposed
9	DS-6 (1v-1.5 x1.8)	26+650	Soto Andharmanik khal	Salta River	4.465	-1.20	-0.27	-2.29	-1.00	Replacement of structure as proposed
10	DS-7 (1v-1.5 x1.8)	30+750	Hatitana khal	Salta River	6.76	-1.20	-0.01	-2.05	-1.00	Replacement of structure as proposed
11	DS-8 (1v-1.5 x1.8)	33+240	Berakhali khal	Salta River	3.50	-1.20	0.01	-2.35	-1.00	Replacement of structure as proposed
12	DS-8A (1v-1.5 x1.8)	34+500.	Mukho River	Salta River	5.825	-1.20	0.02	-1.93	-1.00	The structure is being repaired by GOB

Source: Design Team of CEIP-1,2015

Description of construction activities

144. During pre-construction phase of drainage sluices, construction of labor shed with sanitation and other facilities should be completed. During this period, required construction materials (sand, cement, 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 locations and prepare the sites as per instruction of the Engineer-in-charge. After which, the foundation treatment required for the structure will be carried out. CC and RCC works along with cutting, bending and binding of rods will be performed as per specification. CC blocks will be prepared manually and placed as and where required as per design and specification. After construction of approach roads/embankment, fitting and fixing of gates and hoisting devices will be completed. Gates will then be properly painted. The intake and outfall of the gates will be constructed as per design.

5.7.3 Re-excavation of Drainage Khals

145. Eleven (11) drainage channels with a total length of 30.22 km will be re-excavated to ease water flow and reduce drainage congestion. An estimated volume of 0.065 million cubic meters of soil/silt will be excavated.

146. 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. Theexcavated earth will 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...

147. The water channels to be re-excavated under the project are listed in Table 5.7. Figure 5.1 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.

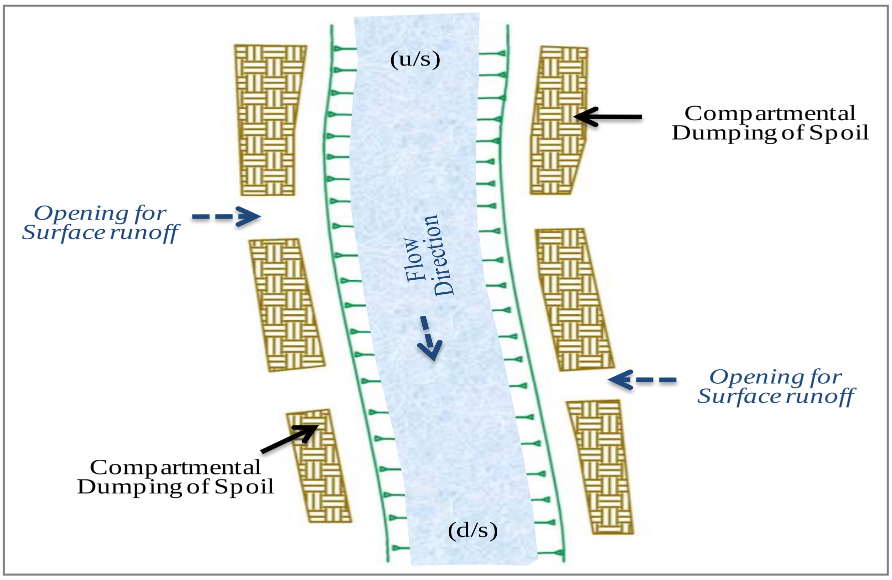


Figure 5.1: Plan form of a typical khal to be re-excavated

Table 5.7: Channels to be Re-excavated

	Name of Khal (Channel)	Length (km)
1	Andarmanik khal	2.00
2	Barakhali khal	3.50
3	Baoria khal	1.00
4	ChotoAndarmanik khal	4.46
5	Golar khal	1.00
6	Karamot khal	1.15
7	Mukho khal	5.825
8	Patuvanga khal	3.78
9	Shibnagar khal	2.50
10	Sundarbunia khal	1.50
	Total	30.22

Source: CEIP-1 Design Study Team, 2017

Description of construction activities

148. For re-excavation of the drainage channels, the required tools will have to be procured 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 channel will then be divided into a number of reaches. The excavation will be started from the upstream end of the channel. Cross dams will be built at both ends of each reach, and soil will be removed from the channels up to the required depth and width. The excavated soil/sludge should be dumped in suitable places, specified by the Engineer-in-charge, so that the sludge or soil can not affect the channel flow by any means. After completing the re-excavation in one reach, the next reach at its immediate downstream would be re-excavated following same procedures as above. Following similar procedure, the entire length of the khals will be re-excavated.

5.7.4 Afforestation

149. To ensure the environmental sustainability as well as protection of embankment from erosion and tidal action, afforestation will be implement within the polder.A total of 29.53 ha area will be afforested of this Polder.

5.8 Construction Details

5.8.1 Construction Schedule

150. The construction works in Polder-17/1 under the CEIP-1 are expected to be completed in four years. The construction schedule is presented in Table 5.8.

Table 5.8: 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 Drainage Sluices (No)							■	■	■	■	■	■

Sl No	Description	Year One								Year Two			
		May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**
3	Re-excavation of Drainage Channels (km)												
4	Other works, including surveys, quality checks, testing, inspections, etc.												

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 Drainage Sluices (No)												
3	Re-excavation of Drainage Channels (km)												
4	Other works, including surveys, quality checks, testing, inspections, etc.												

Part C

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

Source: Engineering and Design Team of CEIP-1, 2015

5.8.2 Manpower RequirementforConstruction

151. 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 5.9. It is mentoined here that labor sheds/camps

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

will be required for house workers (skilled labour). There would be no requirement of labour camp for un-skilled labour because they will be recruited from the local area. The location of labour camp is shown in Figure- 5.2.

Table 5.9: Required manpower for construction

	Required Manpower	Number
1	Senior Professionals	4
1	Site Engineers	5
	Technicians	10
	Admin/ Suppot Staff	15
2	Skilled Labour (Trademan/Craftmen/Drivers etc.)	30
6	Un-skill labours	120

Source: Engineering and Design Team of CEIP-1, 2015

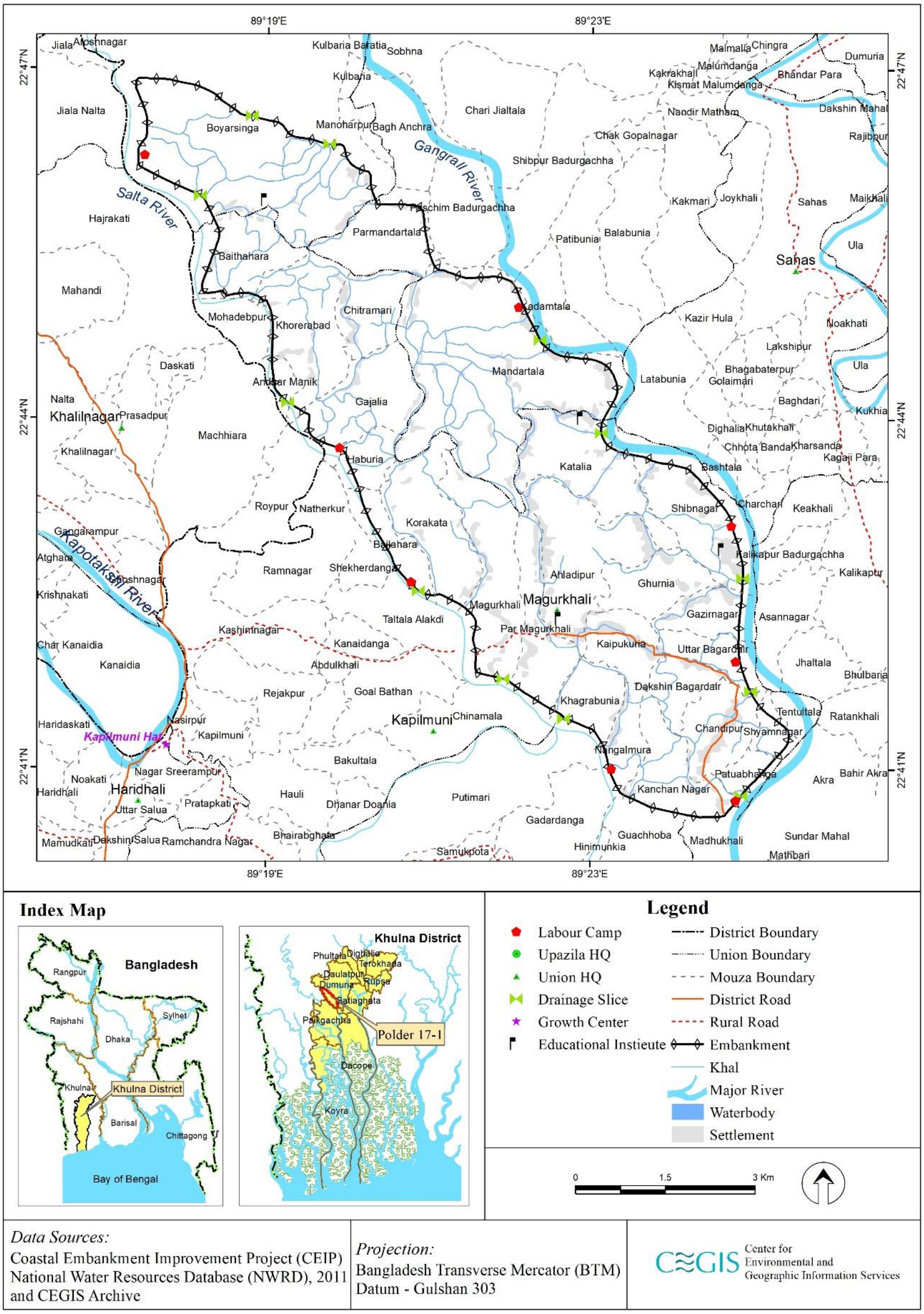


Figure 5.2: Location of labour camp

5.8.3 Construction Material

152. The construction materials required for re-sectioning of the embankment and construction/repair of drainage sluices are soil, cement, steel, stone, sand and vertical gates. Estimated quantities of these materials are presented in Table 5.10.

Table 5.10:Details of Construction materials

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

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

153. For rehabilitation of Polder 17/1 under CEIP-1 no river protection and no slope protection work will be required (Table 5.3). However, some CC block will be required for the construction/repair works of drainage sluices, which can be made manually; thus no CC block manufacturing plant will be required to be established.

5.8.4 Construction Machinery

154. A number of construction machinery and equipment would be required for the construction activities in the polder.A tentative list of these machinery and equipment is presented in the Table 5.11 below.

Table 5.11: List of construction equipment and machinery

Sl	Description	Quantity (number)
1	Bulldozer	5
2	Dump- truck	25
3	Pay Loader	0
4	Excavator	5
5	Barge	2
6	Engine Boat	6
7	Vibrator	3
8	Compactor	15
9	Mixture Machine	10
10	Mixing-Plant	25
11	Automated Mixture Plant Machine	0
12	Truck	10
13	Tractor	15
14	Generator	25
15	Levelling Instrument	2
16	Total Station	2
17	De-watering System	5
18	Low liftpump	25

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

5.9 Project Implementation Arrangements

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

156. Project Steering Committee (PSC). The PSC would be chaired by the Secretary of the Ministry of Water Resources and will include the Secretaries of the Ministry 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.

157. 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 be of the rank of Chief Engineer and will directly report to the Director General (DG).The PMU will have a central project office located at headquarter 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*.

158. 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 the progress of the project, to liaise with the Bank and to prepare annual programs, implementation reporting, updating of all procurement reporting documents and financial management reporting.The procurement staff would consist of one Senior Procurement Specialist and one Procurement Specialist. The finance staff would consist of one Deputy Director, Finance, two Accountants and three support staffs.

159. The Engineering Unit will oversee the work of the consultants to be engaged for 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.

160. An Environment, Social and Communication Unit (ESCU) will supervise the activities/ works related 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.SECU will supervise programs in all the packages including Package 3.

161. 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.

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

- An experienced NGO will be mobilized by the PMU to implement the social afforestation recommended in the EMP, the Social Action Plan including mobilization of Water Management Organization, the RAP and the EMP.
- A Design and Construction Supervision Consultancy Firm will assist the PMU in preparing the detailed design of the remaining polders and supervise all construction works. For contracts on civil works, 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 activities of the Contractor.
- DDCS&PMSC will supervise/assist in the implementation of safeguard instruments.
- A Monitoring and Evaluation Consultant will provide support in monitoring project impacts and supervise the implementation of the EMP/RAP and report to the PMU.
- A Procurement Panel will be appointed by 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.

163. *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, geo-technology, sociology and environment.

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

5.10 Water Management and Operational Plan

5.10.1 Introduction

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

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

5.10.2 Operational Plan

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

(i) Operational Activities

168. 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)

169. 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

170. 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.

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

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

173. Flap Gates of regulators should remain in place at all times except during maintenance and flushing. During the pre-monsoon period, the vertical lift gates of each regulator should remain closed for retention of water for irrigating Aus crops by LLPs. During monsoon (July to September), the vertical lift gates should normally remain closed; but may be opened to regulate the water levels inside the polder and it should not be allowed to exceed the stated maximum permissible level for safety reasons. In order to achieve this, discharges into the river should commence (river levels permitting) 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.

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

175. Operation of Flushing inletsand 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

176. This is a typical monitoring activity to be carried out by the BWDB O&MField Staff. It is intended mainly to detect weak sections, gullies, slips, and 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.

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

(c) Regular Checking of Structures

178. 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

179. 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

180. Preventive maintenance works are done by community-based functional groups (e.g., EMGs, SMGs, and CMGs) as and when required round the year. The works are 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

181. The objective of structures operation is to maintain control over water levels in the polder channels to ensure integrated water management. This means that the operation of water management structures should be directly linked to agricultural requirements and on-farm water management conditions keeping the eyes open on the requirements of other users also like fisher folk community, navigators/boatmen, salt growers (if applicable) and general water users for domestic purpose. 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.

182. The decision making process involved in structure operation is shown in Figure 5.3. This illustrates schematically the procedural steps necessary to translate water management needs into actual structure operation. The water management plan drawn over a season provide the framework upon which water levels in the drainage channels, i.e., operation targets and day-to-day structure operation needs will be based. However, actual field water levels may diverge from the water management targets due to some unpredictable factors like rainfall or other causes. During the cropping season, monthly, weekly or daily operational adjustments will be required. Routine monitoring of water management and hydrological conditions will supply data that together with the water management plan, will dictate the need of adjusting the operational measures.

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

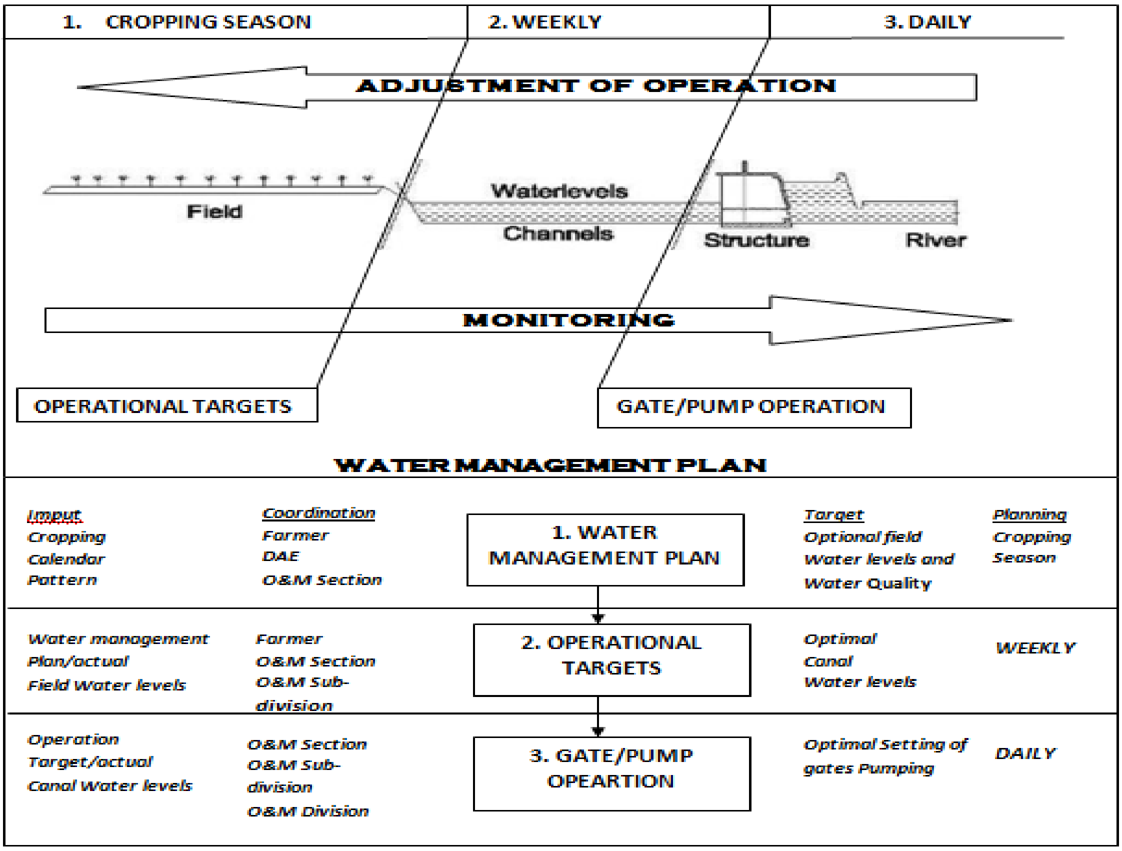


Figure 5.3: Decision making in operation

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

184. In the coastal polders both the drainage and water conservation requirements are equally important; in the wet season drainage will get priority while in the dry season, conservation of sweet water inside the polder becomes the predominant factor. The seasonal water management plan must therefore emerge covering the polder as a whole and on the basis of the requirements of all water users. The plan will have to be prepared jointly by the BWDB's O&M offices, the leaders of WMGs / WMAs and DWM of BWDB. Draft water

management plans will be drawn up at the user level, i.e., at WMGs (Figure 5.4, Planning Procedure); these will be combined into water management plans at WMA (Sub-Division level). In large polders the plans will be compiled by the Executive Engineer (in support and cooperation of the WMF- if it exists) and DWM to produce the final WM plan. This needs to be prepared well ahead of the cropping season so that critical farm operation (e.g. seed bed preparation, fish culture, shrimp) can be carried out in line with the plan.

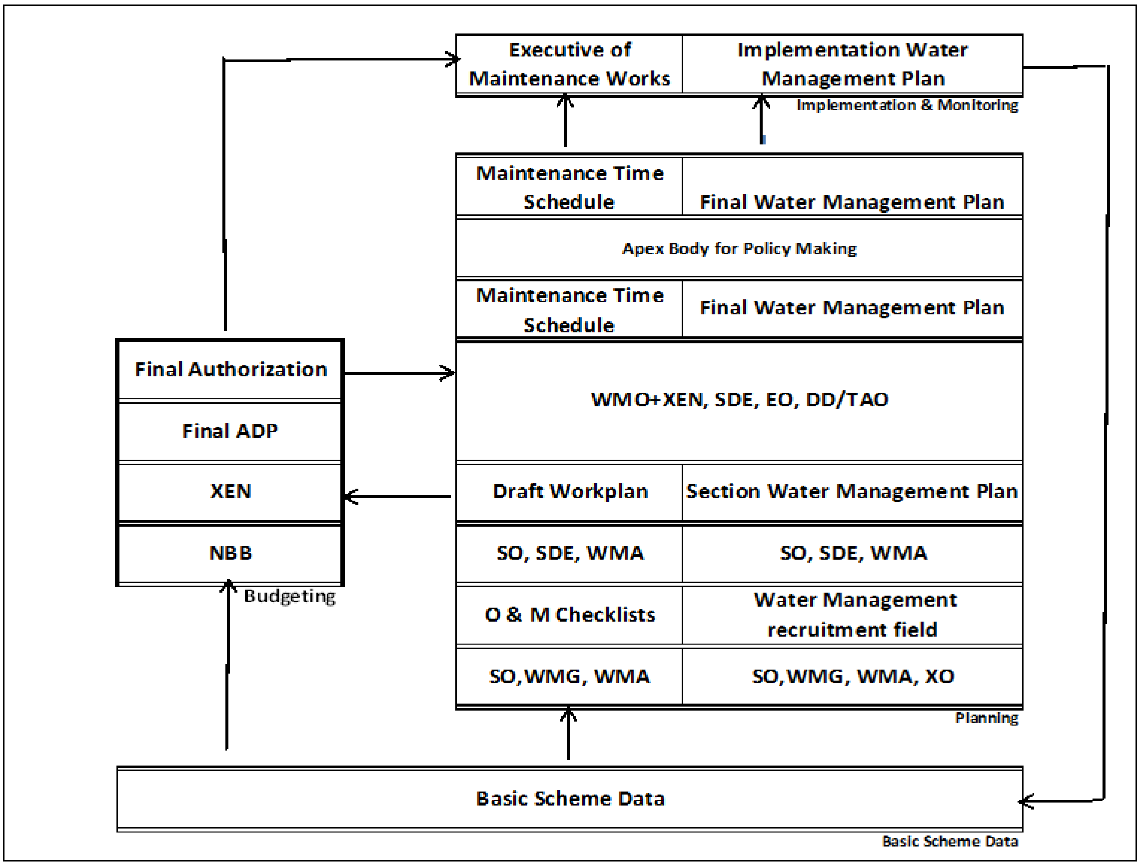


Figure 5.4: Standard Planning Procedure

Note:
DDDeputy Director
TAO Thana Agriculture Officer
BS Block Supervisor

Relationship between WMGs and LGIs

185. Inputs required for the WM plan includes information on crop calendars and cropping pattern to be formulated by the farmers in consultation with agricultural extension services, DWM and BWDB's O&M staffs. Together with information on the system (Basic polder data, O&M guidelines, Design details, etc.) and status of the system (Monitoring data, O&M checklists, Maintenance work plans, and Maintenance time schedules) this will enable drawing up of a detailed water management plan. In large polders, there will have water management computer model to use as an important tool in the planning process. The models can be used to compute several water management scenarios and the effects of certain measures (e.g., extra regulators, early drainage or flushing, etc.) can be simulated. The model can also be used to develop weekly operation targets and may become a very useful tool in the day-to-day management of large polders. Specially trained staff will be required for such advanced calculation.

186. In fact the WM Plan is a formal agreement between the BWDB's O&M offices and the water users' platforms (WMG or WMA) ensuring that operational services are provided. Once the WM Plan is finalized, information can be passed on to other agencies through the apex body of the beneficiaries so that necessary adjustments can be made to accommodate other national programs, work plans, etc.

(b) Weekly Operation Targets:

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

(c) DaytoDay operation:

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

5.10.3 Maintenance Works

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

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

(i) Preventive or Routine Maintenance;

(ii) Periodic Maintenance;
- Minor Periodic Maintenance
- Major Periodic Maintenance

(iii) Emergency Maintenance;

(i) Preventive or Routine Maintenance

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

192. 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;
- CleaningKhalsandOutfallDrainsfromaquaticweedsandfloatingdebris,and removing of silt in wet condition by CMGs.

(ii) Periodic Maintenance

193. 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 to repair works and is identified during the field assessment at (more or less) regular intervals.

194. 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 byLCSs, i.e., shapingand minorfillings 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.

195. The periodic maintenance interventions have been spelled out precisely in Table 5.11 below.

(iii) Emergency Maintenance

196. 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.

(iv) Planning of Maintenance

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

5.11 Project Cost

198. The implementation cost of the rehabilitation of Polder-17/1 is Tk. 10,214 Lakh (102 crore and 14 lakh)

5.11.1 Need of Resettlement Action Plan (RAP)

199. The interventions proposed in Polder-17/1 do not include any major type of works to be carried out in new alignments. All Drainage Sluices proposed to be replaced will be re-constructed on existing alignment. Also for the embankment re-sectioning works, the existing alignment is to be used for the additional set back distance is to be used. Moreover, there is no such intervention of construction of retired embankments. It can therefore be concluded that no major resettlement may occur during project implementation. However, some minor resettlements may be needed as some households still exist over or adjacent to the Polder periphery, which may be displaced during construction works. In this connection, a detail RAP investigation is required, which is being conducted by the consultants.

5.11.2 No Objection Certificate

200. Polder-17/1 is located in the DumuriaUpazila under Khulna District, covering Magurkhali, Shouna and Atlia Unions. No archeological sites or cultural heritages are known to exist in these unions, which might be affected for interventions proposed for the rehabilitation of the Polder. Furthermore, there will be no problems of land acquisition or displacement of people since rehabilitation will be made on the existing infrastructures. This has been addressed in the No Objection Certificates (NOCs) collected from the Union Chairmen, which are attached in Appendix E.

6. Environmental Baseline and Existing Conditions

6.1 Physical Environment

201. Physical environment refers to the physical features of an area. It includes 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.

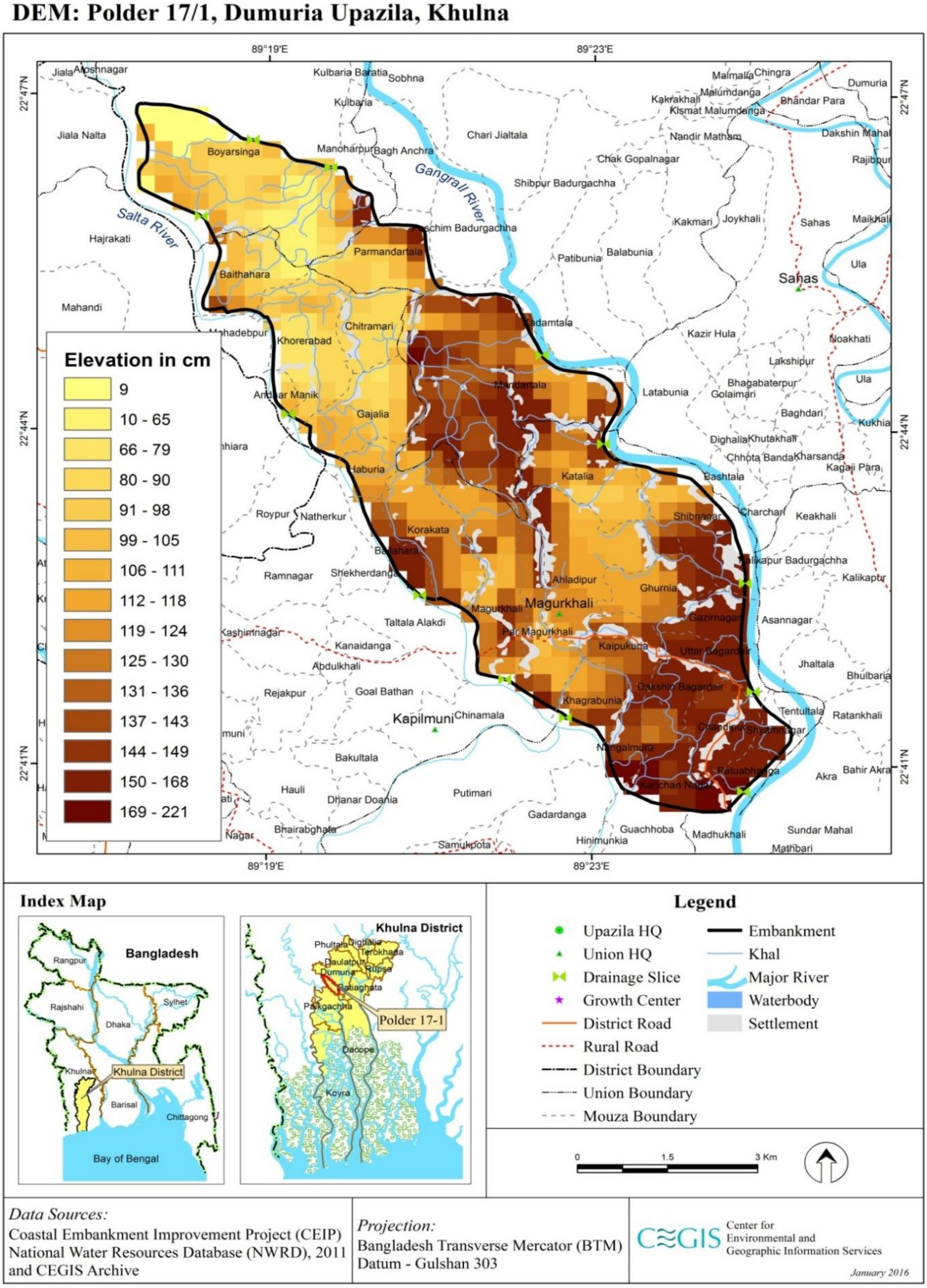
6.1.1 Geology

202. Polder 17/1 is situated in a low-lying coastal region and is composed of Tidal Deltaic sediments deposited sub aqueously in a permanent body of water where tidal waves and currents aid in the transportation and deposition. Typically, a low-lying deltaic environment comprises of soft sediments, and these regions are quite dynamic and changes in coastal geomorphology are quite rapid, e.g., impacted cyclones.

6.1.2 Land Elevation

203. The Polder area is located in the south western hydrological zone of the country, with very low average elevations. Analysis using Digital Elevation Model (DEM) infers that the Reduced Levels[3] (RLs) inside the Polder vary from 0.09 to 2.21 m PWD, with average RL of around 1.2 m PWD. However, during high tide the highest water level at Bhadra River reaches to 2.46 m PWD which is higher than the reduced level of the entire Polder and the lowest water level drops down to 1.48 m PWD which is higher than around 60% of the Polder's reduced level. From the DEM it is also found that around 40% land area in the east of the Polder along the river Bhadra (0.00 km to 9.00 km) and middle part of the Polder has a relatively higher elevation between 1.25 to 2.21 m PWD, whereas 30%, inside various portion of the Polder, has elevation between 1.05 to 1.25 m PWD. The rest 30% land area in the north western side of the Polder has elevation below 1.05 m PWD. Map 6.1 shows the topography of the Polder area, identifying the rivers and water bodies as well as 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: Land topography of the Polder area

6.1.3 Seismicity

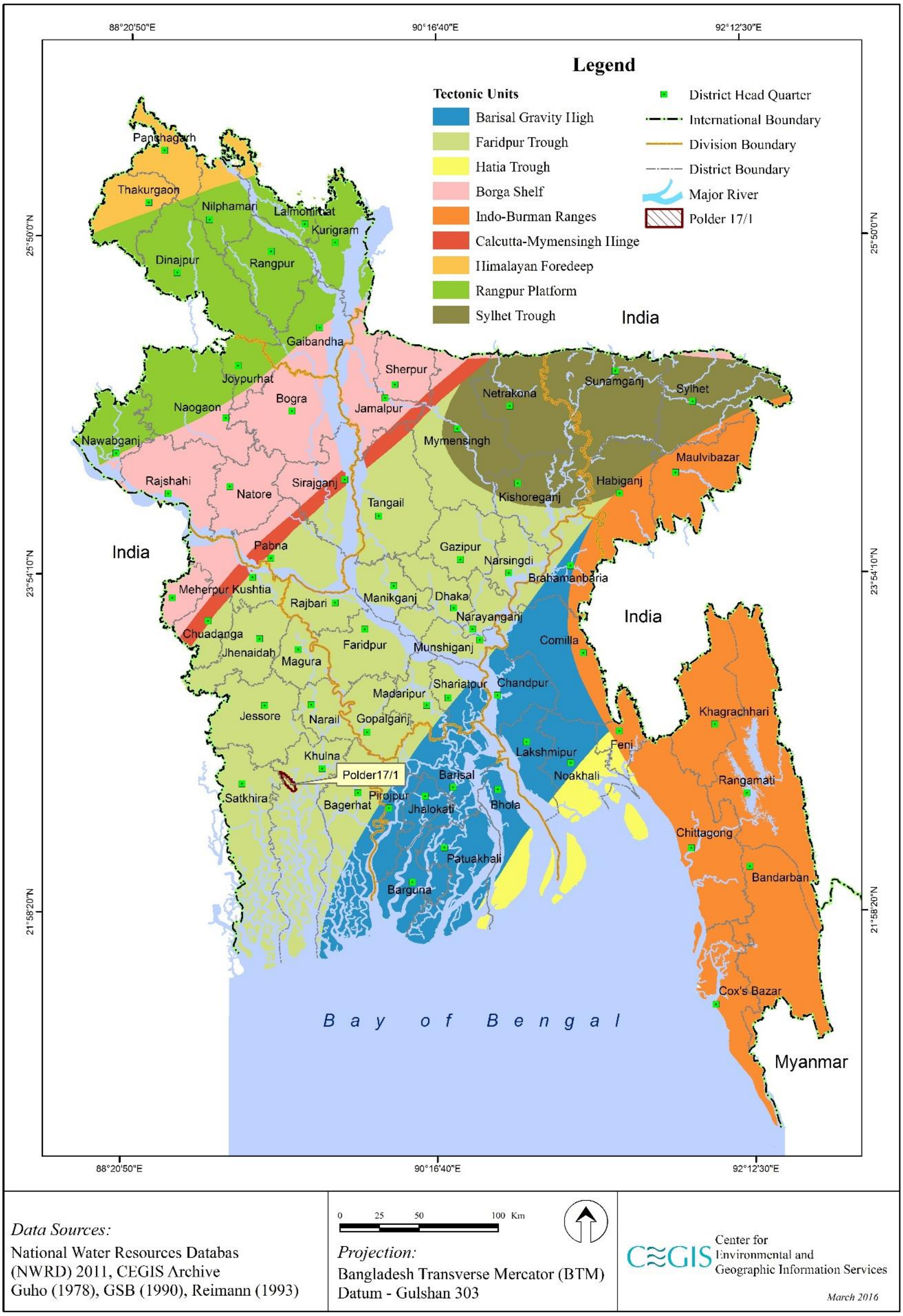
204. Geographical location of Bangladesh has made it ideally suited for natural disasters like earthquake. Tectonic framework of Bangladesh and the adjoining areas indicate that Bangladesh is situated adjacent to the plate margins of India and Eurasia where devastating earthquakes have occurred in the past. Depending on the geological structure, Geological Survey of Bangladesh (GSB) has prepared a seismic zoning map for Bangladesh in 1979 dividing the country into three generalized seismic zones: Zone-I, Zone-II, and Zone-III (Map 6.2) with seismic coefficient of 0.08 g, 0.05 g and 0.04 g respectively. Accordingly, the polder area falls under Zone-III, which is characterized by Low earthquake prone site and has a basic seismic coefficient of 0.04g (Map 6.2).

205. Moreover, the Polder 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 6.3represents the tectonic units available in Bangladesh and the location of the Polder area.

206. It can therefore be inferred that in consideration of seismicity and stratigraphy, the Polder 17/1falls on a relatively safer (seismically quiet and tectonically stable) side.

Map 6.2: Earthquake Zones of Bangladesh and location of Polder-17/1

Tectonic Units in Bangladesh



Map 6.3: Tectonic Units Bangladesh and location of Polder

6.1.4 Agro-Ecological Zones (AEZ)

207. The Land Resources Appraisal of Bangladesh for agricultural development divides Bangladesh into 30 agro-ecological zones and 88 sub zones. The zonation relates tophysiographic characteristics(land forms and parent materials), soil properties, soil salinity, depth and duration of seasonal flooding, agro-climatology(length of kharif and Rabi growing seasons, length of pre-kharif transition period, number of days below certain winter critical temperatures (<15^{0}C) and number of days with extremely high summer temperature (>40^{0}C), which are relevant for land use and for the assessment of present and future agricultural potential (FAO/UNDP,1988, BARC,2012). The Polder-17/1 comprises of one agro-ecological zone, namely: Ganges Tidal Floodplain (AEZ-13), characteristics of which is briefly discussed below.

Ganges Tidal Floodplain (AEZ-13)

208. This region occupies an extensive area of tidal floodplain land in south-west of the country. The greater part of this region has smooth relief. There is a general pattern of grey, slightly calcareous, heavy soils on river banks and grey to dark grey, noncalcareous, heavy silty clays in the extensive basins. Noncalcareous Grey Floodplain soil is the major component of general soil types. Acid Sulphate soil also occupies significant part of the area where it is extremely acidic during dry season. In general, most of the topsoils are acidic and subsoils are neutral to mildly alkaline.General fertility level is high with medium to high organicmatter content.

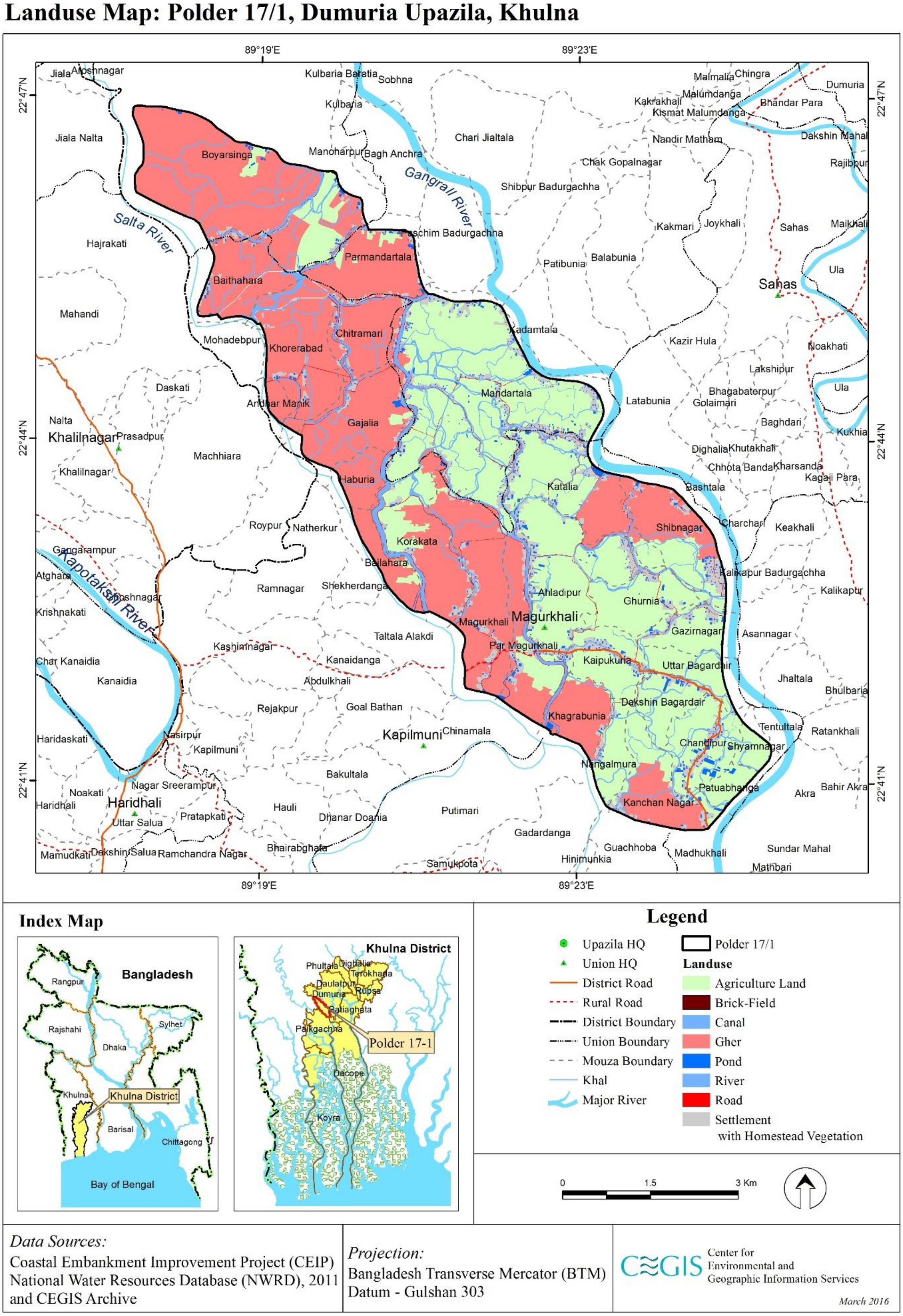
6.1.5 Land use

209. The gross area of the polder is 5,050 ha of which 2,061 ha (41% of the gross area) is Net Cultivable Area (NCA). The remaining 59% areas are covered by canal, gher, ponds roads and settlements with homestead vegetation.About45% (2,285 ha) of the NCA is under gher,where HYV Boro is grown. Data on land use is presented in Table 6.1 and Map 6.4.

Table 6.1: Present Land Use of the Polder Area

Land Use	Area_ha	% of the Gross area
Agriculture Land	**2,061**	**41**
Canal	**212**	**4**
Gher	**2,285**	**45**
Pond	**89**	**2**
Road	**59**	**1**
Settlement with Homestead Vegetation	**344**	**7**
Total	**5,050**	**100**

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006



Map 6.4: Land use of the Polder area

6.1.6 Land type

210. Land type classifications are based on depth of inundation during monsoon season due to normal flooding on agriculture land. There are five land type classes: High land (F_0,Above flood level), Medium highland (F_1, Flooding depth 0-90 cm), Medium lowland (F_2,Flooding depth 90-180 cm), Low land (F_3, Flooding depth 180-275 cm) and Very lowland (F_4,Flooding depth above 275 cm) (SRDI, 1988).Data on land type in thePolder-17/1 is presented in Table 6.2 and Map 6.5.

Table 6.2: Detailed land type of Polder area

Land Type	Description	Flooding depth	Flooding characteristics	Polder area	
				Area (Acre)	% of NCA
F_0	High land	Above flood level	Non-flooded to intermittently flooded	294	14
F_1	Medium Highland	0-90cm	Seasonally flooded	1,189	58
F_2	Medium Low Land	90-180cm	Seasonally flooded	578	28
Total				**2,061**	100

Sources: IWM, 2016

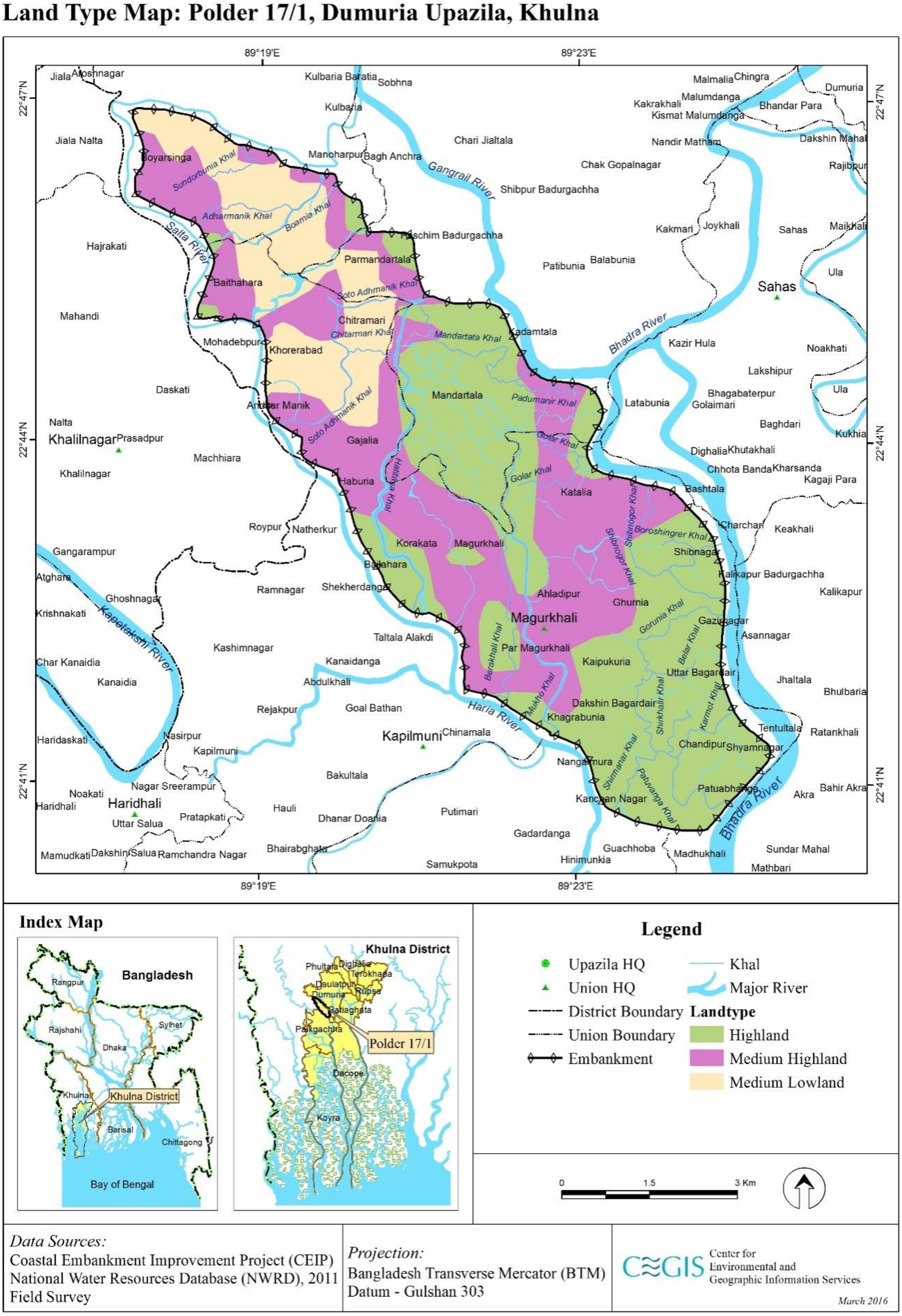
6.1.7 Soil Texture

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

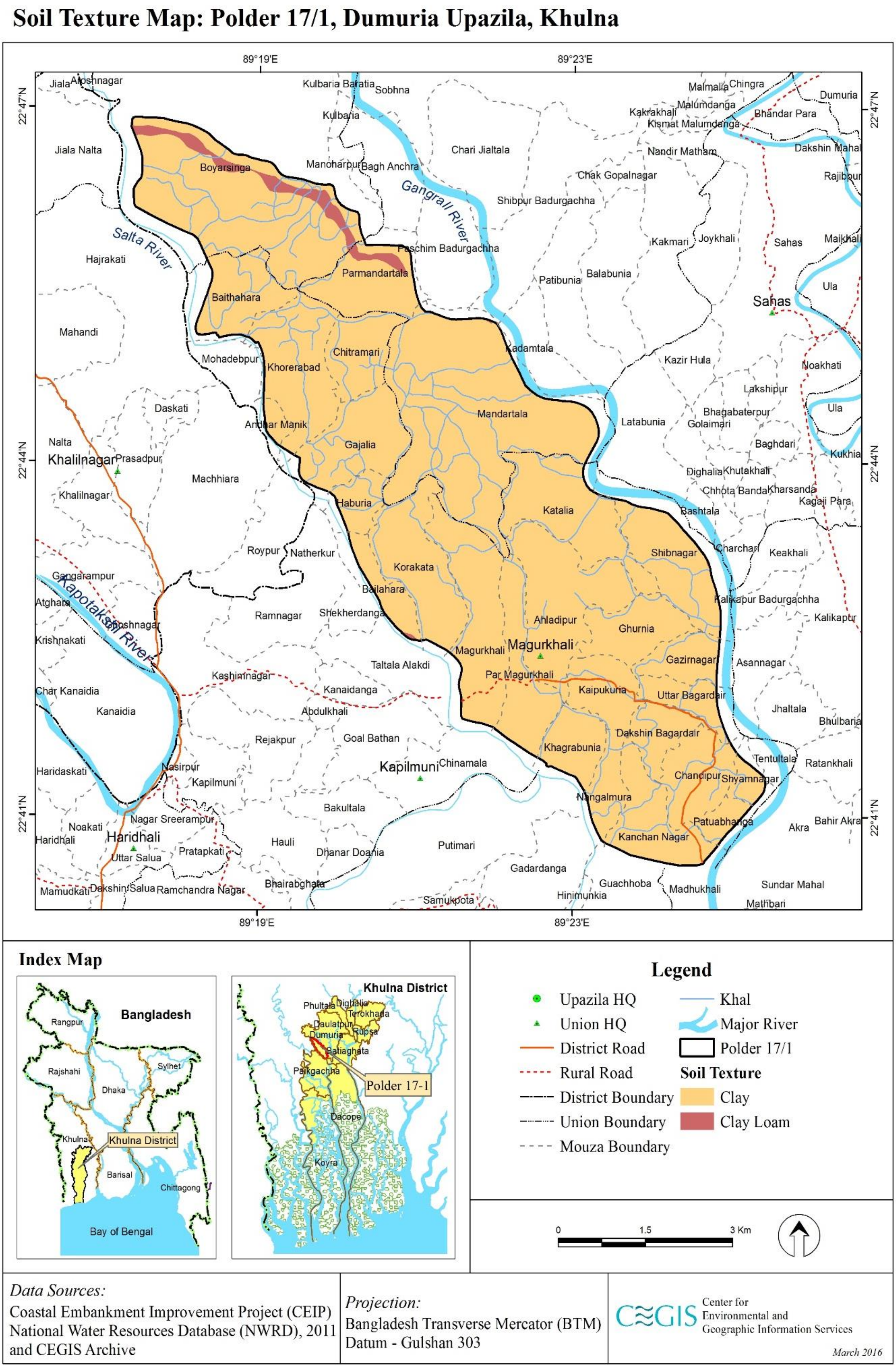
Table 6.3: Present land use of the Polder area

Soil Texture	Area (ha)	% of Gross Area
Clay Loam	82	4
Clay	1,979	96
Total	**2,061**	**100**

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006



Map 6.5: Land Type of the Polder area



Map 6.6: Soil Texture in the Polder area

Available Soil Moisture

212. Soil moisture varies depending on the soil characteristics. Growth of plant as well as crop production depends on soil moisture from which plant uptake essential nutrient and water. In the Polder 17/1soil moisture is low in general(CEGIS Assessment based on SOLARIS–SRDI; 2006).

Soil Quality (Soil fertility analytical data of analytical samples)

213. Soil samples were collected (Picture-6.1) from three locations Mandartala, Ghurnia and Dakshin Bagardair under DumuriaUpazila of Khulna District from a depth of 0-15 cm inside the Polder area on 24th January, 2016. Collected soil samples have been analyzed bythe Soil Resources Development Institute (SRDI), Dhaka and Entomology Division of BARI, Joydebpur, Gazipur. Results of the analysis are presented in the Table 6.4.

214. The soil salinity levels are 2.29 to 9.14 (ds/m) in the top soil (depth of 0-15 cm) in all agricultural land. This indicates that the soil of the respective agricultural land is Non Saline with some Very Slightly Saline (S1) and Very Slightly Saline with some Slightly Saline (S2)

215. The pH levels are observed from 5.4 to7.8. The soils are slightly alkaline, however with pH values within acceptable limits. The Organic Matter (OM %) contents range from 2.2 to 3.8, which corresponds excellentorganic contents (≤1.0-1.7%) (BARC, 2012). In the case of Nitrogen (N) level, it was found to range from 0.12% to 0.18%, which are considered to be a good nutrient content.

216. Potassium (K) contents were found within a range of 0.44 to 0.75 (meq/100g) in all the locations. The K contents are between medium and optimal. The concentration of Phosphorus (P) was within a range of 1.24 to 11.27 (µg/g), which is considered as a very low or high P content.The Sulphur (S) contents were found within a range of 423.30 to 648.10 (µg/g), which are considered as a very high S content.

217. The Zinc (Zn) levels are within the range of 0.86 to 2.52(µg/g) atall locations, which are considered to be optimum.

218. The analyzed results show that no pesticide (Furadan) exists in the soil samples.

Table 6.4: Chemical properties of soil on agriculture land

Location (Mouza / Village)	GPS reading	Land use	Depth (cm)	EC (ds/ m)	pH	OM	N	K	P	S	Zn	Pesticide residue
						%			µg/g			
Jamuluddin Village-Mandartala	22° 45′ 16.2″ 89° 21′ 28.5″	Fallow-HYV.Aman-HYV Boro	0-15	14.37	5.8	3.10	0.18	0.75	1.24	648.10	2.52	0
Asid Kumar Sarker Village:-Ghurnia	22° 42′ 27.94″ 89° 23′ 6.37″	Fallow-HYVAman-Fallow	0-15	5.73	5.4	2.46	0.14	0.66	11.27	472.50	2.09	0
Moti Bishows Village Dakshin Bagardair	22° 41′ 28.4″ 89°29′ 3.5″	Fallow-Lt.Aman-hybrid Boro	0-15	6.20	7.8	2.10	0.12	0.44	7.36	423.30	0.86	0

Sources:SRDI and BARI Laboratory analysis;2016

Photo 6.1: Soil sample collection from Ghurnia Village.

Soil Salinity

219. CEGIS estimate from SOLARIS-SRDI, 2006 showthat soil salinity inside the Polder 17/1 is increasing gradually over the year. Local farmers reported that most of the water control structures are not functioning properly. During field visit local farmers and SAAO reported that about 30% of the Polder area was submersed by saline water. As a result, salinity inside the polder increases with the intrusion of saline water. Some SAAOs of DAE (Mr. Ashok Kumar Golder, Mr. Tushar Kanti Mondal and Mr. Md Satter Moral) reported that the soil and water salinity gradually increases with dryness from January and reaches to maximum level in the month of March-April and then decreases due to onset of monsoon rainfall.

Drainage Characteristics

220. Drainage characteristics play an important rolefor the agricultural crop production. The drainage characteristics have been divided into six classes from the agriculture point of view, e.g., Excessively Drained, Well Drained, Moderately Well Drained, Imperfectly Drained, Poorly Drained and Very Poorly Drained (SRDI; 1988). The entire Polder area supportspoorly drained class (CEGIS Assessment based on SOLARIS–SRDI; 2006). In most cases, the land remains wet/ water logged for a considerable period of time duringthe late rainy season.

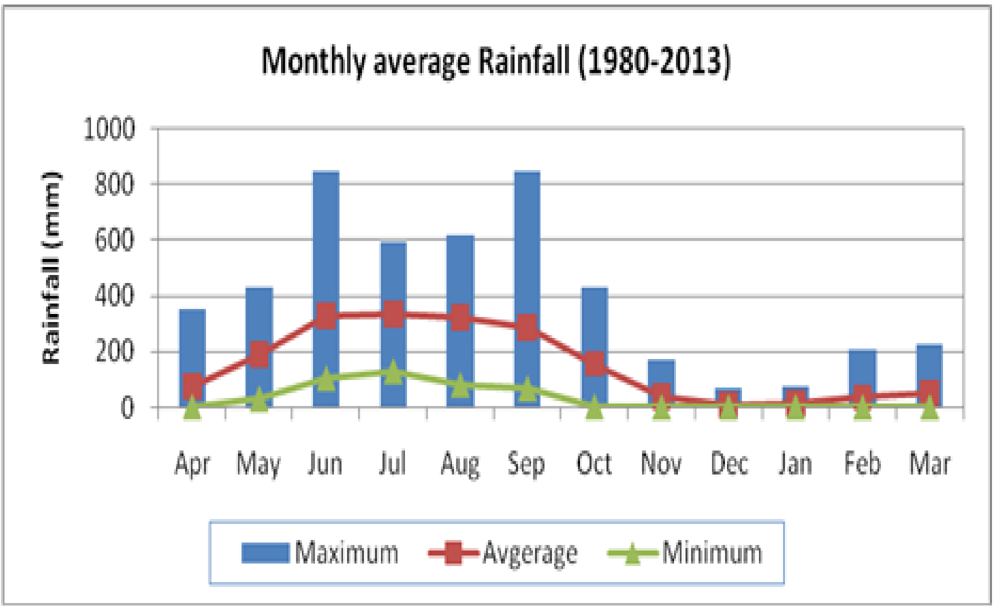
6.1.8 Climate

221. From the map it is evident that, ambient mean temperature of the Polder 17/1 is about 18^0C-19^0C in winter and 28^0C-29^0C in summer and the annual average rainfall is around 2000 mm. Monsoon occurs from June to September and during this period heavy rainfall occurs in this region.

222. Tropical cyclones and storms do occur during summer, i.e., from the month of April to June and again from September to December. These cyclones and storms do not occur frequently but causesserious devastation to the residents of the polder area. The polder area falls in the south-western climatic zone of Bangladesh. Meteorological information on different parameters, i.e., rainfall, temperature, relative humidity, wind speed, evaporation and sunshine hours have been collected from the BMD station atKhulna. A clear understanding on the meteorology of the Polder area can be achieved from the following sections.

(a) Rainfall

223. The rainy season is very significant in the polder area in comparison to the other regions of the country. November to February are the driest months of the year with negligible rainfall while June to September are the wettest months with highest rainfall. The records of last 34 years (1980-2013) shows that, the study area received monthly maximum rainfall of 846 mm, recorded in June 2002. Values of monthly maximum, average and minimum cumulative rainfalls are collected from the BMD station atKhulna (1980-2013). The collected data are shown in Figure 6.1. It shows that significant rainfall occurred during the months of May to October while very insignificant during the months of December to February. The hyetograph shows that the highest and lowest values of maximum rainfall are observed in 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.

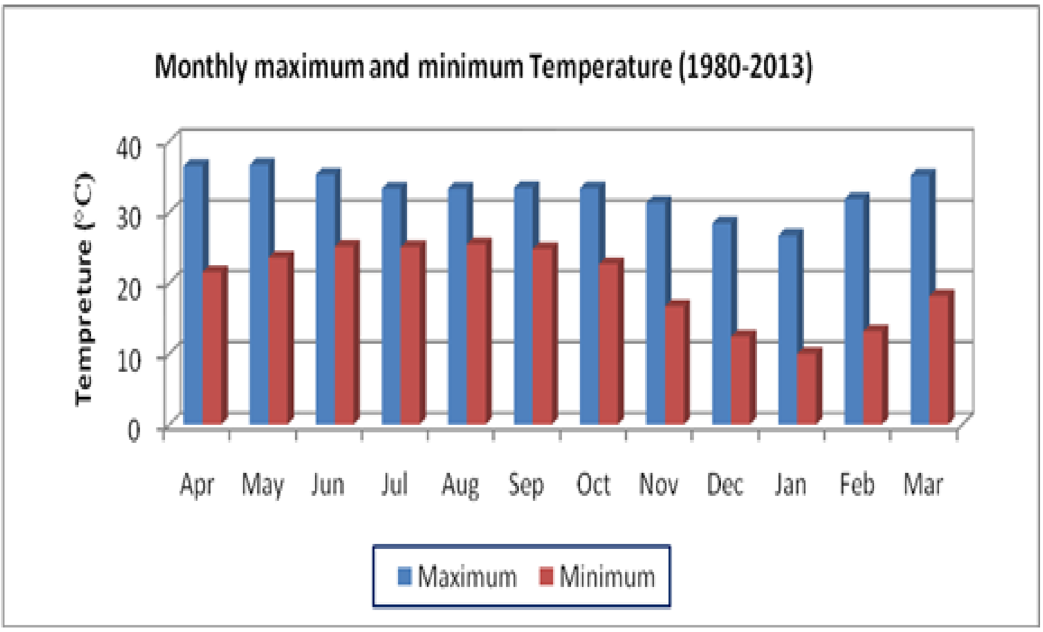


Source: Bangladesh Metrological Department (BMD), 2013

Figure 6.1: Monthly maximum, average and minimum rainfall at Khulna BMD station

(b) Temperature

224. Temperature data of the last 34 years (1980-2013) from the BMD station in Khulna shows that the monthly maximum average temperature varies from 26.7°C (January) to 36.7 °C (May), whereas the monthly minimum temperature varies between 10.0°C (January) to 25.5°C (August). The highest maximum temperature recorded in the last 34 years is 36.71°C, which occurred in the month of May, 2012 while the lowest minimum temperature of 10.0°C was recorded in the month of January, 1989. The monthly maximum and minimum temperature of last 34 years (1980-2013) are shown in Figure 6.2 below:

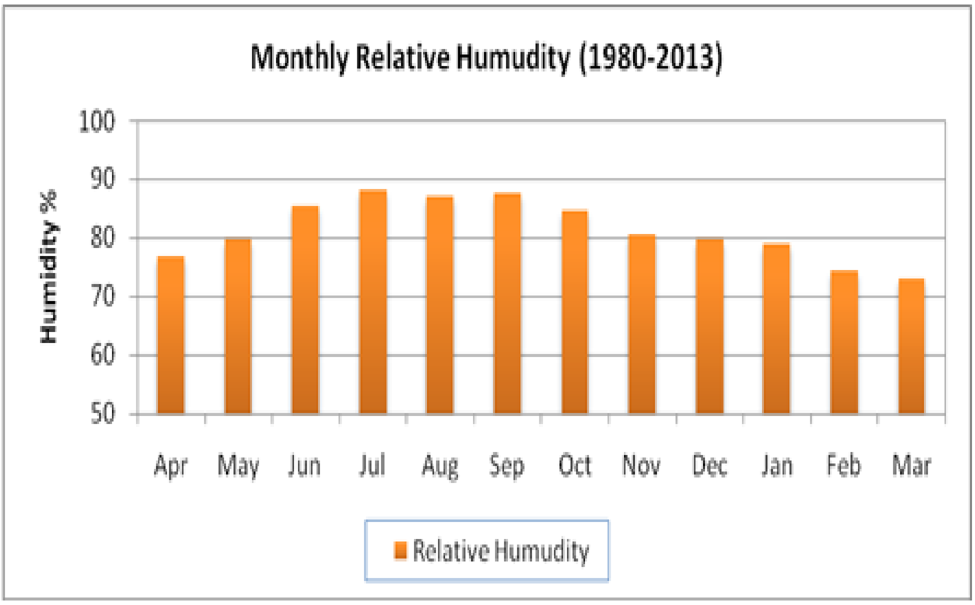


Source: Bangladesh Metrological Department (BMD), 2013

Figure 6.2: Monthly maximum and minimum Temperature at Khulna BMD station

(c) Relative Humidity

225. The monthly average relative humidity at the BMD station at Khulna for the last 34 years varies seasonally from 73.1% (March) to 88.1% (July). The most humid months are June, July, August, September and October with a relative humidity 1980-2013higher than 80%,while from January to March it remains a range from 73 to 79 %. The monthly average relative humidity data are collected from BMD station of Khulna for the last 34 years (1980-2013).

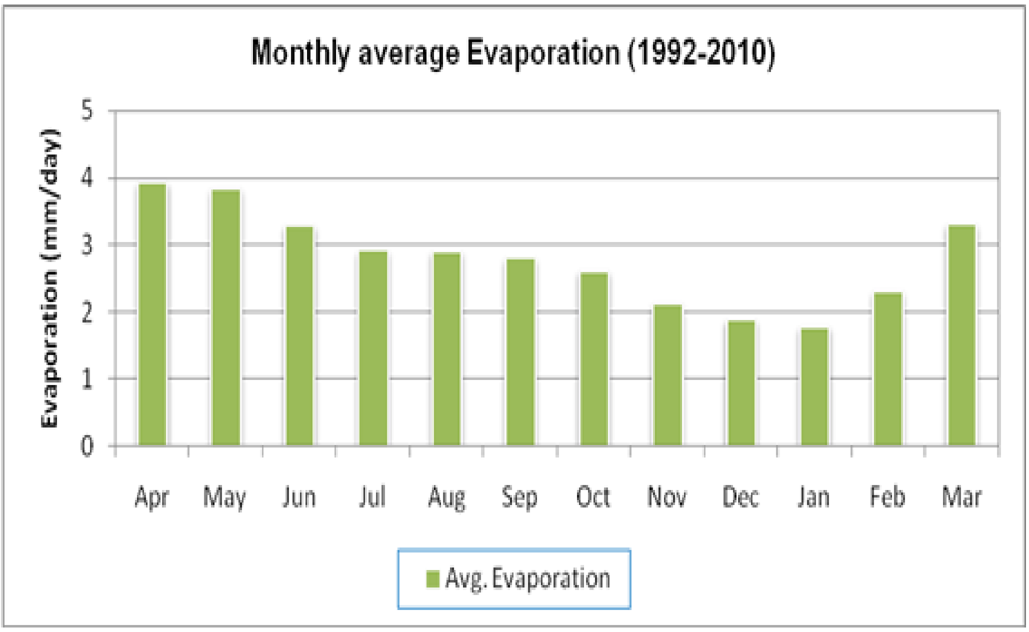


Source: Bangladesh Metrological Department (BMD), 2013

Figure 6.3: Monthly average relative Humidity at Khulna BMD station

(d) Evaporation

226. 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 the 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 study area is shown in Figure 6.4 below:

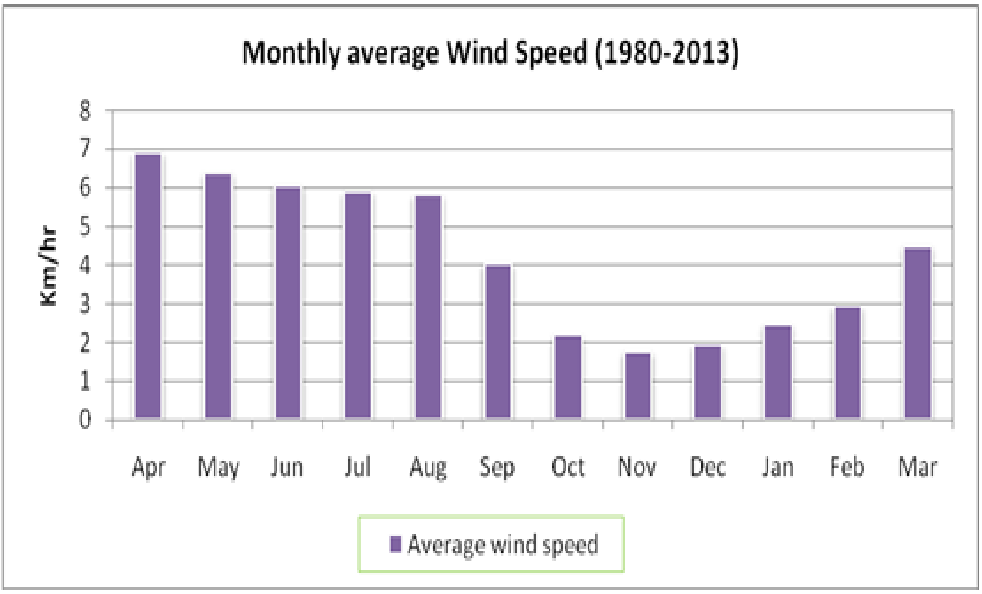


Source: Bangladesh Metrological Department (BMD), 2013

Figure 6.4: Monthly average evaporation rate at Khulna BMD station

(e) Wind Speed

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

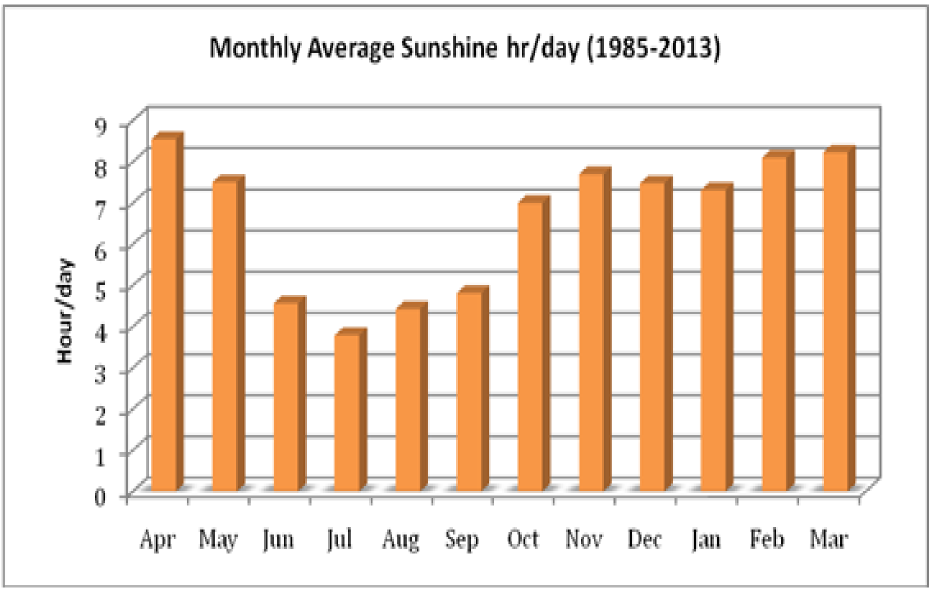


Source: Bangladesh Metrological Department (BMD), 2013

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

(f) Sunshine Hour

228. The data for sunshine hours for the last 34 years (1980-2013) has been collected from the BMD station at Khulna. The monthly average values of sunshine hours in Khulna vary from 4.25 to 8.88 hour/day. The average value of sunshine hours is highest in April (8.54 hr/day) and lowest in July (3.78 hr/day). From November to May, the daily average sunshine hours are higher than 7 hours, but due to increased extent of cloud cover in monsoon (June to September) the values dropped below 5 hr/day.



Source: Bangladesh Metrological Department (BMD), 2013

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

6.1.9 Water Resources System

229. 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.

(i) Major Rivers and Khals

230. Polder-17/1 is surrounded by Salta River in the west, TaltolaRiver in the north, Gangrail River in the east and Bhadra River in the south. Gangrail, Salta and Bhadra are the major rivers of the Polder. Besides numbers of khals exit in the Polder area namely Mandartala khal, Golar khal, Shibnogor khal, Karamot Khal, Patuvanga khal, Berakhali khal, Hatitana khal, Soto Andharmanik khal, Andharmanik khal, Sudorbunia khal and Boaria khal all of which are connected with the periphery rivers of the Polder. The River system of the area is shown in Map 6.7.

231. The main rivers of the Polder are Gangrail and Bhadra which flow from north to south with significant tidal influence. The Bhadra River originates from Kopotakkha River at JhikargachaUpazila of Jessore District and flows to the southern portion of the Polder and its outfall is at Shibsa River in Dacope Upazila of the Khulna District. Another major river of the Polder is Gangrail which originates from the Bhadra River at Dumuria Upazila of Khulna District and flows to the eastern portion of the Polder and its outfall is at Big Gangrail River in the same Upazila. Again, the Salta River originating from Bhadra River and its outfall is at the Kazibacha River after flowing through Dumuria and Batiaghata, while the Taltola River originating from the Salta River in Khulna District travels through Dumuria before meeting the Bhadra River in Khulna District. The internal khals as mentioned above are connected with these peripheral rivers. Both the rivers and khals are characterized by tidal influence and control the flooding and drainage dynamics of the Polder area.

Photo 6.2 :Gangrail river

Photo 6.3 : Bhadra river

Photo 6.4 :Madartola khal

Photo 6.5 :Golar khal

Photo 6.6 :Shibnogor khal

Photo 6.7 :Karamot khal

Photo 6.8 :Patuabhanga khal

Photo 6.9 :Muko river

Photo 6.10 :Berakhali khal

Photo 6.11 :Hatitana khal

Photo 6.12 : Soto Andharmanik khal

Photo 6.13 :Andharmanik khal

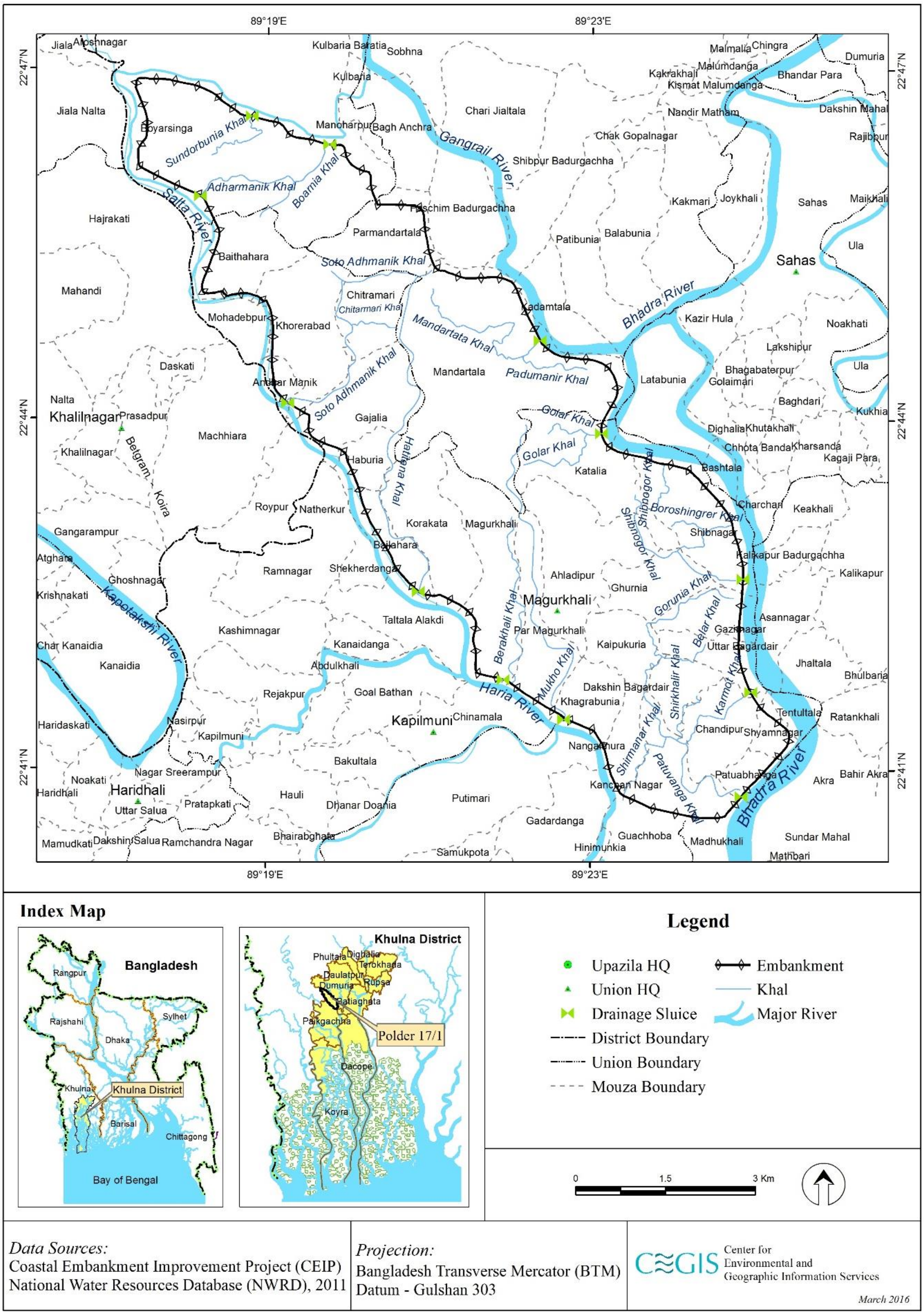
Photo 6.14 :Sundorbunia khal

Photo 6.15 :Boaria khal

Photo 6.16 : Salta river

Photo 6.17 :Taltola river

River System Map: Polder 17/1, Dumuria Upazila, Khulna



Map 6.7: Water Resources System of the Polder

6.1.10 Hydrological Settings

(a) Surface Water Levels

232. To assess the surface water characteristics of the Polder area, data on surface water levels for the Bhadra River have been collected from a station of BWDB at Dumuria station in Dumuria Upazila namely SW-28- Dumuria station (TDWL) which is located at the north-east side of the Polder. But, there is no station of BWDB on Gangrail River, Taltala River and Salta River to assess the surface water characteristics for these rivers.

233. Secondary information on water levels have been collected from the above mentioned BWDB stations from the year 1980 to 2009 for the River. Figure 6.7 denotes a hydrograph showing monthly variation of water levels of the river having tidal influence. The crest portion of the hydrograph indicates the rising in monsoon period. During high tide, the average maximum water level at Dumuria is 2.30 m +PWD (in August) and average minimum is 1.68 m +PWD (in January). During low tide, the average maximum water level is -0.74 m +PWD (in August) and average minimum is -1.24 m +PWD (in March).

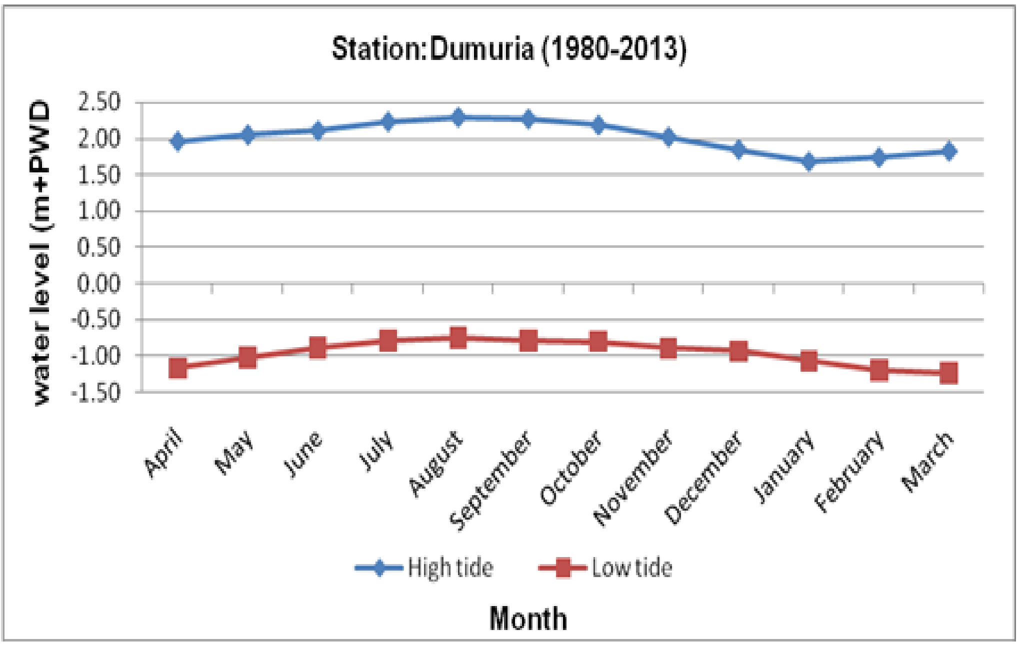


Figure 6.7: Surface Water Level at Dumuria station near Polder area

(b) Ground water Table

234. The Ground Water Table (GWT) measured at ten year intervals at Dumuria station of BWDB observation well named KHU005are shown in Table 6.5. Values are analyzed for the months of April (considered as dry period) and September (considered as wet period). In the dry season, increased dependency of the local people on ground water lowers the GWT. During monsoon, the higher availability of surface water leads to higher recharge of ground water sources. Table 6.5 shows that the GWT with respect to the G.L (Ground Level) in the dry period and wet period differ significantly over the years.

Table 6.5: Depth of GWT (m) at the study area at ten years interval (1980-2000)

Station Id	1980		1990		2000		2010	
	April	September	April	September	April	September	April	September
KHU005	2.54	1.44	2.86	1.66	3.10	1.87	3.48	2.13

Source: NWRD

235. Analyses have also been made to understand the annual variations of GWT at KHU 005 station for April and September (from 1980-2010). The values show a decreasing trend in both cases (Figure 6.8 and 6.9) which indicates that Ground water table (GWT) is lowering with time.

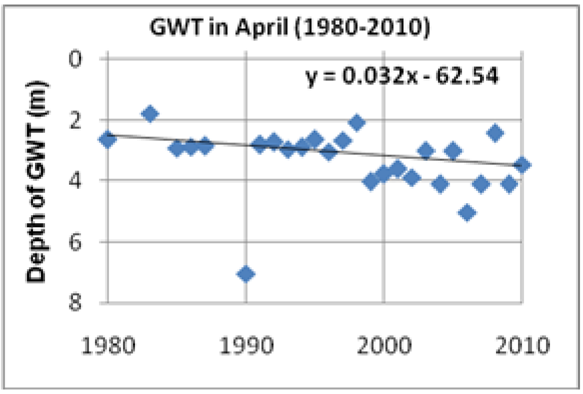


Figure 6.8: Variation of GWT at KHU 005in April (1980 – 2010)

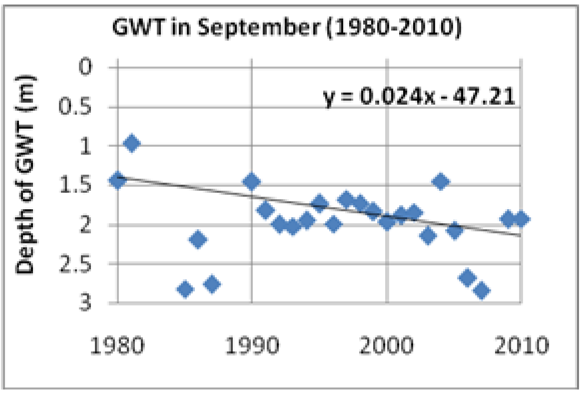


Figure 6.9: Variation of GWT at KHU 005 in September (1980 – 2010)

6.1.11 Water Resources State

(a) Tidal and Storm Surge Flooding

236. Local people in Polder-17/1 opined that the peripheral embankment effectively offers protection from regular tidal flooding in the area. Although most of the water control structures are in deplorable condition and subjected to flow leakage, the amount of flow entering the Polder are minimal. As such it can be said that, no tidal flooding takes place inside Polder-17/1. Local people also alleged that there was no major storm surge flooding in Polder-17/1 during Aila (2009) and Sidr (2007).

(b) Drainage Congestion and Water Logging

237. Drainage congestion has been identified as the major problem inside the Polder. Almost all the khals inside the Polder, which are directly connected to the peripheral rivers, suffer from tremendous drainage congestion. Some of the severely affected khals are Mandartala khal, Golar khal, Shibnogor khal, Karamot Khal, Patuvanga khal, Berakhali khal, Hatitana khal, Soto Andharmanik khal, Andharmanik khal, Sudorbunia khal, Boaria khal etc. During monsoon and post-monsoon periods, these khals cannot cope with the increased rainfall occurrences, leading moderate to severe drainage congestion problems. Local people opined that, around 70% of the khals inside the Polder (Sudorbunia khal, Andharmanik khal, Soto Andharmanik khal, Mukho River, Berakhali khal, Hatitana khal, etc.) suffer from severe drainage congestion[1], whereas almost 30% of the khals (Mandartala khal, Golar khal, Karamot

khal, etc.) suffer from moderate drainage congestion[4] problems. The adjacent areas of the Salta River and Taltola River are mostly affected for this drainage congestion problem. People reported that approximately 80% of the land of Baithahara, Adharmanik, Khorerabad, Gozalia, Chitramari, Jharjharia, Sekhertak,Kanchannagar, Korakata and Khagrabunia are affected by drainage congestion. Such drainage congestion problems mostly affect the agriculture and production sector. Due to the reduced drainage capacity of khals, rainwater often inundates the agricultural fields for a period of 10~15 days, and affects crop cultivation and production.

238. The main reason for drainage congestion problem is silting up of the existing khals and malfunctioning of the structures connected to the khals. During field visit it wasobserved that, most of the drainage sluices were in fully damaged condition. During high tide (monsoon), water enters into the polder through the malfunctioning structures and causes inundation. In addition, insufficient number of drainage sluices small vent size of D/S, encroachment of khals and shrimp culture aggravate the drainage congestion problem tremendously.

239. In the khals which are connected to Salta River, drainage congestion problems have been induced by a gradual sedimentation in the Salta River, which resulted in an increased bed level. For this reason, water from the khals could not pass properly to the Salta River, leading to gradual siltation of khals and drainage congestion problems. This is a reason why most of the sluice gates placed along the western periphery of the polder have been non-functional. Local people opined that, no prolonged water logging situation exists inside the polder, however, minor rain fed inundation exists in some areas as discussed earlier.

(c) Surface Water Salinity

240. The salinity levels are very low during monsoon because of the increased amount of fresh water in the water bodies. According to local people the level of salinity starts increasing in January due to the reduction of upland discharge and reaches the peak in the month of March-April and then starts decreasing again. Saline water intrudes the polder areas due to malfunctioning of the water control structures causing interruption to agricultural practices. Local farmers reported that at the beginning of January of this year (just 15 days before the field visit), saline water intruded through the broken gates of drainage sluices in about 30% of the polder area. In the dry season, the overall salinity levels both in soil and surface water are high. About 40 percent of the polder area is under *gher* culture for which gher owners bring saline water inside the polder area when they require which is another imperative reason for saline water intrusion.

241. Secondary information on salinity has been collected on Bhadra River from Dumuria BWDB station from the year 1980 to 2008. Figure 6.10 demonstrates that the average maximum salinity level at Dumuria is 12.41 ms/cm (in April) and average minimum salinity level is 0.00 ms/cm (in September).

[1] Severe Drainage Congestion has been defined as the water courses which have extremely low conveyance capacity and usually take one week or more to properly drain out rainwater.

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

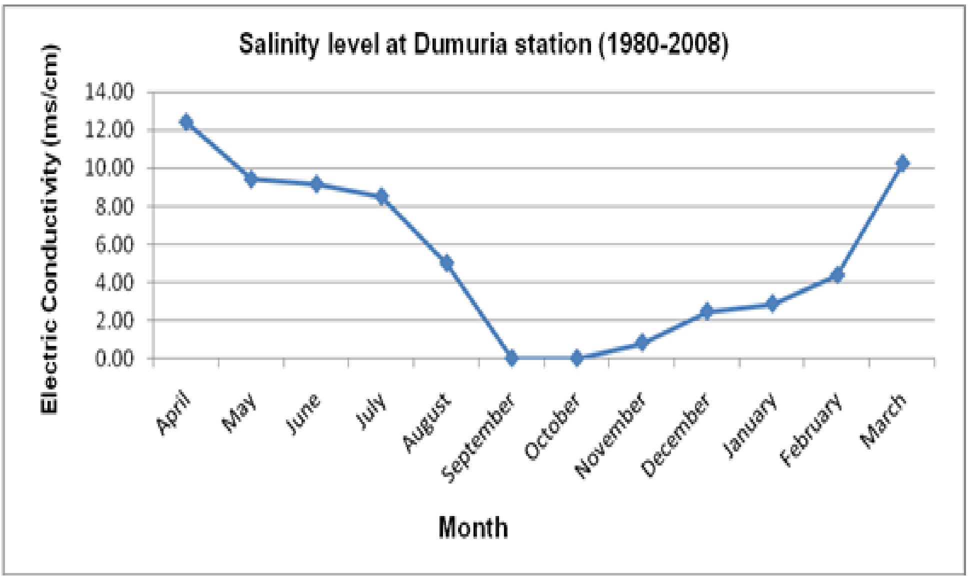


Figure 6.10: Average monthly salinity level at Bhadra River (Dumuria station)

(d) Siltation

242. Siltation is a major problem in the Polder area. The peripheral rivers especially Salta and Taltola Rivers are heavily silted up. Gangrail River also face siltation problem especially from Barbaria to Golapdoho and high amount of silt are deposited in the recent years. During field visit it was observed that the outfall river (Taltola River) at the periphery of embankment in between polder 17/2 and Polder-17/1 (at a length of about 9 km) has been fully silted up. The bed level of the aforesaid portion of the river is almost similar to the ground level and people are cultivating crops there. Upper portion of the Salta River isheavily silted with silt especially from Andharmanik to Boyarsinga,i.e., about a length of 3.0 km are in very dreadful condition. According to local people the siltation rate is very high for the last 4-5 years.Sediments are deposited whenthe river flow is low. Thus, depth of the river is decreasing and the carrying capacity is reducing. One of the main reasons for sediment deposition is the reductionin tidal volume and flow of water through the existing rivers. Other key factor for sediment deposition is the tidal pumping process, where maximum amount of silt comes through high tide but minimum amount is sweptaway during low tide and causes higher deposition of silt in the riverbed.

243. The internal drainage channels have been silted up due to lack of maintenance for a long time. Silting up situation of the peripheral rivers also contribute a lot to siltdeposition in the internal khals. Especially Sundorbunia khal, Andharmanik khal and Soto Andharmanik khal are facing siltation problem significantly due to siltation of Salta river.

Photo 6.18: Siltation at Taltola River near Sundorbunia

Photo 6.19: Siltation at Andharmanik khal

(e) Navigation

244. The peripheral rivers around the polder namely Bhadra, Salta and Gangrail are predominantly used for water-way navigation. Small boats and trawlers navigate through the rivers mainly for fishing purposes and carrying goods. People use these rivers as a mode of transportation to various locations. A very little navigation takes place inside the polder area only fishing boats movethrough the khals inside the Polder.

Photo 6.20: Navigational activity across the Bhadra river

Photo 6.21: Small boats navigate for fishing purposes at Gangrail river

Photo 6.22:Magurkhali kheyaghat at Salta river

6.1.12 Environmental Quality

245. 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**

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

Table 6.6: Standards of ambient air quality

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

Source: Bangladesh National Ambient Air Quality Standard

247. 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 has been carried out for 1 day (24 hr) near the Polder at Kapilmuni bazar in Paikgachaupazila which is situated about 6 km to the southwest of the Polder.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, numerous boats driven by diesel engines ply on the surrounding rivers and numbers of motorcycles and other vehicles movement in the Polder area which are considered to be contributing to the ambient air especially Particulate Matter ($PM_{2.5}$).

Table 6.7: Values of ambient air quality parameters in the project area

Area	Air particulates matter concentration µg/m^3 (24h average)				(mg/m^3) (1h average)
	PM_{10}	$PM_{2.5}$	BC in$PM_{2.5}$	SO_2	NO_2
Kapilmuni, Paikgacha	50.5	36.5	8.1	63.2	0.047

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

- **Surface Water Quality**

248. Water quality parameters (p^H, TDS, DO, EC, Temperature and salinity) have been measured from different locations of the Polder area during major field investigation in January, 2016. Surface water quality of the Polder area is found satisfactory related to DoE standard. Table 6.8 presents the values of the surface water quality parameters with reference to the DoE standards of the Polder area.

Table 6.8: Surface water quality of the Polder area

River/khal	Location	GPS point	Water quality parameter					
			TDS (ppm)	Salinity (ppt)	EC (ms/cm)	DO (mg/L)	Temperature (°C)	p^H
Gangrail River	Kadamtolakheyaghat	22°45'18.4"N 89°21'46.3"E	443	5	3.15	8.3	23.4	6.08
Bhadra River	Patuabhanga	22°40'35.21" N 89°24'10.06"E	380	5	3.0	7.4	26.0	6.4
Salta River	Magurkhalikheyaghat	22°41'55.04" N 89°21'17.70"E	450	5	3.05	7.8	24.4	6.9

River/khal	Location	GPS point	Water quality parameter					
			TDS (ppm)	Salinity (ppt)	EC (ms/cm)	DO (mg/L)	Temperature (°C)	p^H
Madartola khal	Madartola	22°44'43.09" N 89°22'01.04"E	338	5	3.20	7.6	24.4	6.7
Golar khal	Kathalia Bazar	22°43'54.09" N 89°22'36.00"E	275	4	2.77	7.9	24.9	6.5
Shibnagar khal	Shibnagar	22°42'35.08" N 89°23'59.01"E	540	6	4.8	7.9	26.2	6.4
Karamot khal	Bagardhari	22°41'33.07" N 89°24'04.09"E	470	5	3.19	7.7	26.0	6.2
Patuabhanga khal	Patuabhanga	22°40'42.08" N 89°24'01.09"E	330	5	3.10	7.2	25.9	6.38
Mukho river	Khagrabunia	22°41'20.0"N 89°22'17.06"E	245	5	3.30	8.1	25.8	6.4
Berakhali khal	Magurkhali	22°41'40.6"N 89°21'42.00"E	360	4	2.90	7.10	26.0	6.7
Hatitana khal	Baliahara	22°42'28.0"N 89°20'51.02"E	313	5	2.9	7.1	26.0	6.8
Soto Andharmanik khal	Andharmanik	22°44'10.6"N 89°19'34.00"E	360	4	2.7	7.3	25.7	6.2
Boaria khal	Boyarsinga	22°46'31.5"N 89°19'55.8"E	320	4	2.8	7.5	25.0	6.5
DoE Standard Value (Bangladesh)			**2100**	**-**	**0.2-0.7**	**4.5-8.0**	**20-30**	**6.0-9.0**

Source: CEGIS field survey, January, 2016


Photo 6.23: CEGIS professional measuring water quality at field

249. Dissolved Oxygen (DO): 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 to most fishes and other

aerobic aquatic organisms. During field visit in the month of January, values of DO inside the Polder are found to vary from 7.1 to 8.3 mg/L which complies with the DoE standards for irrigation and fisheries as well as aquatic vegetation.

250. p^H:The negative 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 p^H values found during field investigation are lower than the neutral zone (p^H=7) which indicates that water in these locations are acidic in nature. However, all the pH values found in the surface water sources during field investigation comply with the DoE standard (p^H=6 to 9).

251. Temperature: Temperature of water bodies affect the fish habitats and their oxygen holding capacity. The temperature of the water bodies inside the Polder area was found to vary from 23.4°C to 26.2°C, which complies with DoE standard (20°C-30°C) for both irrigation and fish habitats.

252. Total Dissolved Solids (TDS):The values of TDS were found within the range between 245-540 mg/l (Table 6.8) which is within the limit and complies with DoE standard.

253. EC: Electric Conductivity (EC) is another useful water quality indicator for estimating the amount of minerals, assessing the effect of diverse ions on chemical equilibrium, physiological effects on plants or animals and corrosion rates. DoE standard of Electric Conductivity (EC) for drinking water is 1.2 mS/cm and for irrigation water is 0.20 to 0.7 mS/cm. The values of EC found during field investigation ranges between 2.7 to 4.8 mS/cm which exceeded the standard value specified by DoE and indicates significant salinity concentration in the water.

254. Salinity: Salinity is the dissolved salt content of a waterbody and an important factor in determining many aspects and assessing the effects on soil structure, crop yield, animals and corrosion rates. Salinity is also an ecological factor of considerable importance, influencing the types of organisms that live in water body. Moreover, salinity influences the kinds of plants that will grow either in a water body, or on land fed by water. Salts when reach the high levels in fresh water it can cause significant problems to aquatic ecosystems, crop yield and complicated human uses. The values of salinity found during field visit in the month of January ranges between 4 to 6 ppt which will reach the highest value in month of April. These values indicate that salinity problem prevails in the Polder area significantly and hampers the cultivation.

- **Soil quality of Borrowpit and Khal**

255. Soil samples were collected from two locations (borrow pit and internal khal) of Dumuria, Khulna (Polder 17/1) in the month of July, 2017. Collected soil samples were analyzed by Bangladesh Agricultural Research Institute (BARI). Result of the analyzed data reveals that all the parameters are within the average limit except Manganese (Mn) and Lead (Pb) (internal khal) **which may be due to the tidal submergence of those areas.** The sampling location of borrow pit was situated in riverside of the Polder which is submerged in regular high tide. Salt water frequently infiltrate at internal khal during high tide. In both of the cases salt water carry sediments. **As no industries were found within or around the project area**, this sediment may be the only source of excess Mn and Pb.

256. Manganese (Mn) is an essential element, but can be neurotoxic when exceeding the homeostatic range.Studies have shown adverse effect of higher Mn content on cognitive function. Cognitive test (Wechsler Intelligence Scale for Children (WISC) results suggest an inverse association of higher Mn exposure with lower intellligence quotient. Studies focused

on motor effects of Mn found a direct association of higher Mn exposure with increased motor impairment.[56]

Table 6.9: Soil Quality of Borrow pit and Sediment quality of Internal Khal of Polder 17/1.

Sl. No	Parameters	Sampling location		Standard in soil (ppm)
		Borrow pit	Internal khal	
1	Fe(ppm)	13,904	26,521	32,000
2	Mn(ppm)	906	1,263	761
3	Pb(ppm)	5.79	11.01	10
4	Cd(ppm)	0.021	0.012	0.06
5	Cr(ppm)	38.55	52.53	100
6	EC	1.4	3.1	

- **Noise Quality**

257. 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 for any 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 zones. During field inspection, sound levels were collected near the proposed construction sites. The Polder area has fallen under residential zone category and average noise values at all the locations were found within the standard limit.

258. The noise levels have been collected during daytime. The values of noise level with locations are shown in Table 6.10.

Table 6.10: Daytime noise levels of the Polder area

Sl. No	Location	GPS Reading	Average Noise Values (dB)
1	Putimari	22°46'34.09"N 89°19'40.05"E	46.1
2	Madartola	22°45'45.03"N 89°20'40.05"E	38.3
3	Kadamtolakheyaghat	22°45'18.4"N 89°21'46.3"E	49.0
4	Kathalia Bazar	22°43'54.09"N 89°22'36.00"E	42.1
5	Shibnagar	22°42'35.08"N 89°23'59.01"E	40.0
6	Bagardhari	22°41'33.07"N 89°24'04.09"E	45.0
7	Patuabhanga	22°40'42.08"N 89°24'01.09"E	40.1
8	Magurkhalikheyaghat	22°41'55.04"N 89°21'17.70"E	47.6
9	Khagrabunia	22°41'20.0"N 89°22'17.06"E	41.8

[5] Silvia Zonia and Roberto G. Lucchinia. Manganese exposure: cognitive, motor and behavioral effects on children: a review of recent findings. Curr Opin Pediatr. 2013 Apr; 25(2): 255–260.

[6] Khan K, Factor-Litvak P, Wasserman GA, et al. Manganese exposure from drinking water and children's classroom behavior in Bangladesh. Environ Health Perspect. 2011;119:1501–1506.

Sl. No	Location	GPS Reading	Average Noise Values (dB)
10	Magurkhali	22°41'40.6"N 89°21'42.00"E	44.1
11	Baliahara	22°42'28.0"N 89°20'51.02"E	40.4
12	Andharmanik	22°44'10.6"N 89°19'34.00"E	42.5
13	Boyarsinga	22°46'31.5"N 89°19'55.8"E	48.2
14	Sudorbunia	22°45'55.5"N 89°19'04.7"E	42.6

Source: CEGIS field survey, January, 2016

6.2 Biological Environment

6.2.1 Bio-ecological Zone

259. The Polder 17/1 is situated at Dumuria Upazila under Khulna district and is about 37 km north of the Sundarbans, the largest mangrove forest of Bangladesh.This area contains different landforms and ecosystemslike agricultural land, settlements, road/social forests, ponds, ghers, khals, ditches, rivers etc.

260. The World Conservation Union (IUCN) has identified 25 bio-ecological zones (BEZ) in Bangladesh(2002). The polder falls under one of these bio-ecological zones, namely Saline tidal floodplain (5020 ha). Table 6.10 represents the major features of the above mentionedBio-ecological zone.

Table 6.11: Major Ecological features and present status of the Polder 17/1

Major ecological features	Presentstatus ofBEZ
• It has a low ridge and basin relief, crossed by innumerable tidal rivers and creeks.The rivers carry fresh water throughout the year to the east and northeast. The Mango and Jackfruit supply the commonest timber and are used for making doors, windows, boxes, etc. (Bari, 1978). Existence of mangrove patches along the riverside or even beside homestead indicates presence of saline water as well as and soil salinity in this zone.	• The polder is surrounded by Salta and Taltala River on the West and North, Gangrail and Bhadra River on the East and South. Saline intrusion and increase of soil salinity is deteriorating vegetation health, i.e. Jackfruit tree, Deshi Gab, etc. Good number of mangrove vegetation occurs in the river side/foreshore area.

Source: IUCN 2002, CEGIS Field Survey 2016

6.2.2 Ecosystem

261. According to the field survey, the polder areacan be divided into twomajor categories-i) Terrestrial, and ii) Aquatic ecosystems.

262. Terrestrial ecosystem considers landscapes and vegetation patterns of any given area.The polder area has composition of different ecosystems chiefly homestead, cropland and embankment/roadside ecosystems.

263. The homestead ecosystem is dominant among other terrestrial ecosystems nevertheless a vast cultivable area exists in this polder area. Trees are found in low density having different canopies in this area, a similar status of other open area.

Photo 6.24 : Homestead vegetation, Mandartola Village

Photo 6.25: Bablatreesplanted along the embankment

264. In the cropland, flora growing along crops which are not cultivated generally called ***weeds.*** The crop lands usually remain fallow for about 3-4 months during the Kharif-I season. This land covered with grasses includes some wild herbs. This grassland provides habitats to insects and small-sized fauna like arthropods, other invertebrates, reptiles and birds and grazing land to cattle. **The seasonal fallow lands found in this polder area play important roles to the functioning of the terrestrial ecosystem providing grazing landfor cattle and feeding and breeding habitats for some wildlife**The embankment encircling Polder 17/1is occupied by different types of vegetation mainly timber species, e.g. Babla, Sirish and Akashmoni. This vegetation protects land from degradation, embankment from erosion and provides fuelwood and timber. It supports good habitats to many insects, reptiles, bird and small mammals.Undergrowthsfound in the slopes of embankment and roads in the shady areas of the trees offer good habitats to wild fauna.Akand, Bhat and Hatisur are some of the common wild plant species along most of the roadsides in the polder area. A typical view of the embankment/roadside ecosystem is provided in the Photograph6.25.

265. Aquatic ecosystem belongs to different waterbodies of seasonal and perennial characteristics.The aquatic ecosystem in this polder area represents mainly fresh, brackish and saline waterbodies.

266. Aquatic vegetationmainly found in the waterlogged areas of field, internal khals and homestead ponds. A good number of mangrove vegetations are found along the river/foreshore side because of soil salinity. For this reason, no aquatic vegetationswere found inside or along the banks. The domestic ponds and few ditchesof the polder which contain fresh water are found with different types and small amount of aquatic flora namely free floating, submerged and amphibian vegetations like sedges.According to vegetation survey, many terrestrial and aquatic plant species are foundin the polder area. Appendix_Fpresentsdominant terrestrial and aquatic plant species with their use and status.

6.2.3 Wildlife

267. Faunal population and diversity in this polder is low due to flood, improper pesticides use, shrimp gher farming, saline water intrusion, siltation of internal canals, compartmentalization of intertidal areas, various types of human activities and disturbance.The different faunal species with their habitat,IUCN and CITES status in the polder area is given in the following Table 6.12.

Table 6.12: Fauna with habitat, IUCN and CITES status of the polder 17/1

Class	English Name	Scientific name	Habitat	IUCN-Bangladesh (2015)	CITES (2016) Appendix
Amphibia	Common Toad	*Bufo melanosticus*	Wetland areas and the dried areas	LC	-
	Skipper Frog	*Euphlyctiscyanophlyctis*		LC	-
	Cricket Frog	*Fejerveryalimnocharis*		LC	-
Reptilia	House Lizard	*Hemidactylus brooki*	Both wet land and dry areas	LC	-
	Common Lizard	*Hemidactylus frenatus*		LC	-
	Garden Lizard	*Calotes versicolor*		LC	-
	Striped Keelback	*Amphiesmastolata*		LC	-
	Checkered keelback	*Xenocrophis piscator*		NO	-
	Common Krait	*Bungarus caeruleus*		LC	-
	Common wolf snake	*Lycodonaulicus*		LC	-
	Rat Snake	*Ptyasmucosus*		LC	-
Aves	Brahminy Kite	*Heliasturindus*	Mudflats, khal systems and seasonal wetlands	LC	-
	Bronzed Drongo	*Dicrurusaeneus*		LC	-
	House Crow	*Corvussplendens*		LC	-
	Common Myna	*Acridotherestristis*		LC	-
	Red-vented Bulbul	*Pycnonotuscafer*		LC	-
	Magpie Robin	*Copsychussaularis*		LC	-
	Barn Owl	*Tyto alba*		LC	-
	BlueRockPigeon	*Columbalivia*		LC	-
	Spotted Dove	*Streptopeliachinensis*		LC	-
	Little Egret	*Egrettagarzetta*		LC	-
	Great Egret	*Casmerodiousalbus*		LC	-
	Common Kingfisher	*Alcedoatthis*		LC	-
	Little Cormorant	*Phalacrocoraxniger*		LC	-
	Pied Kingfisher	*Cerylerudis*		LC	-
	Indian Pond Heron	*Ardeolagrayii*		LC	-
Mammal	Common House Rat	*Rattus rattus*	Mostly in bamboo thickets, cropped fields, bushy areas.	LC	-
	Field Mouse	*Mus booduga*		LC	-
	Grey Musk Shrew	*Suncusmurinus*		LC	-
	Flying Fox	*Pteropusgiganteus*		LC	-
	Jangle Cat	*Felischaus*		NT	-

Source: Field investigation & Local people interviewed, 2016; Note: NO= Not Threatened; NT= Near Threatened; LC= Least Concern

6.2.4 Threats to ecosystem

268. Wetland degradation is a problem in the Polder area. Human interventions, riverside land encroachment, tidal surges with floods, brackish water shrimp cultivation and siltation are the major causes of wetland degradation. Low height of embankment, silted khals, non-functioning water control structures like regulators indicate insufficient drainage and flushingcapacity creates drainage congestion. AndharManik, Magurkhali, Gajalia, Korakata villages have been affected by drainage congestion. It subsequently impacts severely to the surrounding vegetation specially crop-field vegetation. Loss of vegetation density and succession ultimately impact on wildlife habitats.

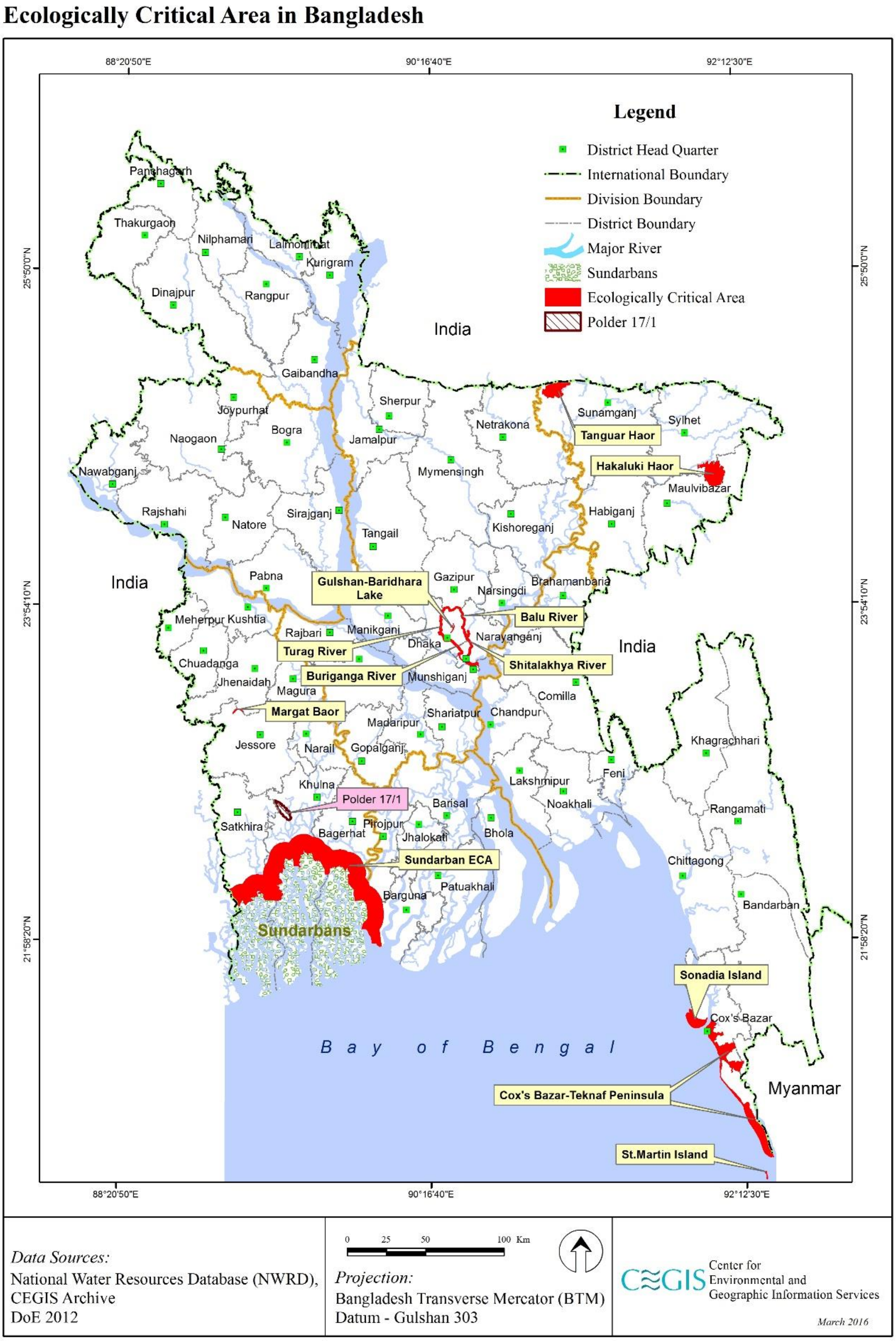
269. Each year during January to May most of the ghers (aquaculture farms) introduce saline water to their Bagda/shrimp farms via tidal river system. By doing this, it creates negative impacts to biodiversity especially vegetation patterns where it has been changing drastically as well as conversion of wildlife habitat into shrimp farms. Moreover, use of pesticides and chemical fertilizers also lead to damaging wildlife habitat, other vegetations and invertebrates.

6.2.5 Indicative species

270. Peripheral embankment of the Polder act as protector fromtidal flooding, saline water intrusion and sluices act as drainage controller. The land of the Polder supports different types of ecosystems. Homesteads and crop fields are dominated with fresh water plant specieslike Kochuripana/Water hyacinth (Eichhorniacrassipes, Cyperus sp.)whereas, khal banks and river foreshore are dominated with saline-water loving mangrove plant species. Hargoza (Acanthus illicifolius), Kewra (Sonneratiaappetala), Ora (Sonneratiacaseolaris) Gewa (Excoecariaagallocha), Golpata (Nypafruticans) indicate the water and soil salinity of khal banks and foreshore area of the Polder. Existence of these plants inside the polder area is an indication of soil and water salinity. On the other hand,freshwater mollusks(bivalve) indicate the fresh water environment found in most of the homestead ponds and dead sectionsof khals inside the Polder. This species is sensitive to water salinity and not suited for areas with high salinity. So, any significant changes of these plants and animal population indicate the change of water salinity due to malfunctioning of water control structures like sluices.

6.2.6 Protected areas

271. The Department of Environment (DoE) in 1999 circulated that no development project is to be implemented within 10 Km of any Environmental Critical Areas (ECAs). Polder 17/1 is not within 10 km of any ECA, see Map 6.8.



Map 6.8: Ecologically Critical Areas in Bangladesh

6.2.7 Fish Habitats

272. Fish habitats of the polder area are classified into capture fisheries and culture fisheries. In Polder 17/1, capture fisheries habitat includes internal khals (canal) and culture fisheries include ponds, ditches and ghers. Khals of open water fisheries act as major routes of fish migration into the polder area. Major khals such as Mandartala khal,Golar khal,Shibnogor khal, Karamot Khal, Patuvanga khal, Mukho River,Berakhali khal, Hatitana khal, Soto Andharmanik khal,Andharmanik khal,Sundorbunia khal,Boaria khal are connected with the outer rivers such as GangrailRiver,Bhadra River,HariaRiver, Salta River andTaltala River. These rivers are flowing along the sides of the Polder and are tidally influenced and play as longitudinal migration route for fishes in the area except Taltala River as it has entirely been silted up. These rivers are tidal in nature and are the potential habitat for saline and brackish water fish species. The Polder area has diversified fisheries resources for fresh and brackish water fish habitats.

273. Almost all the khals are silted and dried during dry season but fishes of different species use these khals to accomplish their biological and physiological needs such as grazing, spawning and nursing during monsoon. Khals in this area are maintained by the inflow of tides and runoffs from the surrounding land mass.

274. The culture fisheries of the Polder area are dominated by cultured ponds and ghers. At present, local people mostly concentrated in bagda (shrimp) farming in this area, usually saline water is taken from the river through khals during January and February and exchange of water is continued throughout the shrimp culture period. Golda (Giant Prawn) along with white fish culture are practiced in some ghers where saline water has no entrance or low salinity exists. Rice-cum-fish (alternative fish culture with rice culture) is also practiced in some parts of the study area. Pond culture practices are mainly semi-intensive method, adopting monoculture, poly-culture and mixed culture method with major carp, exotic carp and other fast growing fish species.

6.2.8 Capture Fisheries

275. Fish habitat in the polder area is about 2,586 ha of which 212 ha is open water fisheries habitat and considered as capture fisheries habitat (Table 6.13). The Polder area consists of several seasonal internal canals/khals with one silted up river. These khals are important as fisheries habitat.

276. Maximum water depth of the internal khals is 0.6 meter in the dry season and not suitable for fish habitation during summer. Therefore, depth of seasonal khals of the project area is insufficient to shelter fish and fish juveniles due to siltation in the khals. Local people reported that siltation rate in the internal khals of the Polder area is gradually increasing (Photo 6.29 and Photo 6.30).

Table 6.13: Fish Habitat Status of the Study Area

Sl	Fisheries Category	Habitat Types	Area (hectare)	% of Habitat
1.	Capture	Canal	212.00	8.20
		Sub-total	***212.00***	**8.20**
3.	Culture	Gher	2285.00	88.4
4.		Pond	89.00	3.40
		Sub-total	***2374.00***	***91.80***
		Total	**2586.00**	**100.00**

Source: CEGIS estimation based on GIS and Field visit data 2016

Photo 6.26 : Capture Fisheries Habitat (Patubanga Khal) inside the Polder Area

Photo 6.27: Silted up Taltala River at Sundarbunia beside the Polder Area

Culture Fisheries

277. The estimated culture fish habitat within the polder is 2,374 ha (Table 6.12) of which homestead ponds occupy 89 ha and commercially culture gher is 2,285 ha. As per views of the local fish farmers and physical observation, about 50% of these ponds are practicing non-commercial and traditional aquaculture. At present, modern aquaculture practice is expanding rapidly in this polder area. Different types of aquaculture are adopted by the local fish farmers-mainly carp poly-culture or mixed culture in homestead ponds (Photo 6.28), although few farmers have started mono-culture of Thai Pungus and Tilapia.

278. Besides, various kinds of aquaculture technology are in practice in the ghers(Photo 5.29) depending on water quality, especially salinity. Bagda (Shrimp) culture (improved extensive) in the gher usually starts from January and mostly continues until July depending on salinity of water. Then, the carp poly-culture or mixed culture along with golda (Prawn) starts and continues until November. In mixed culture, farmers primarily stock the Catla, Rui, Mrigel, Grass carp, Tilapia and sometimes they stock the Thai Pungasdepending on salinity of gher water. They also culture Tengra, Parshe and Khorshola in the gher as well.

Photo 6.28 : Culture Habitat (Pond) inside the Polder Area at Kaipukuria Village

Photo 6.29 : Culture Habitat (Ghers) inside the Polder at Gajalia village

Water Quality of Fish Habitat

279. Water quality is very important for the life of fish and effects on all physiological function such as feeding, digestion, assimilation, growth, reproduction, etc. The surface water quality parameters of major khals and nearby rivers have been measured and compared with the fish habitat suitability standards and are presented in Table 6.14. It is observed that p^H, Dissolve Oxygen (DO) and all other water quality parameters are within the permissible limit for fisheries resources. It is noted that temperature of the surface water is below the standard range of fish culture in winter but this is not harmful for fishes for their survival.

Table 6.14: Summarized Water Quality Parameters of Different Water Bodies in the Polder Area (values in range)

Water Bodies	Temperature (ºC)	pH	DO (mg/l)	TDS (ppm)	Salinity (ppt)
River (Out side Polder)	23.4-26.0	6.08-6.9	7.4-8.3	380-443	5
Khals (Canal)	24.4-26.2	6.2-6.8	7.2-8.1	245-540	4-6
Pond	24.5-27.5	7.2-8.1	5.3-6.4	320-440	nil
Standard Values for Fish	(28-34)**	(6.5-8.5)*	(4.0 -6.0)*	1000*	0-4 for prawn 5-35 for shrimp**
DoE Standards Values (Bangladesh	20-30	6.0-9.0	4.5-8.0	2100	-

*Source: *M A Mazid 2002 **Jack M et al. 2002; CEGIS field survey, 2016*

Loss of Open Water Fish Habitat

280. The open water fish habitat such as internal khals is gradually decreasing in the Polder area. As per information of local people and field observation, presenty most of the internal khals became seasonal khal where negligible amount of water is found in the dry season. Even some of the khals are fully silted up and look like crop lands. The main reason of reduction of fish habitats are siltation, topsoil erosion, decomposition of excessive organic materials from the agricultural land (remaining part of straw of paddy field), encroachment of the khalsby the local power holders for crop land or other purpose and also modified for aquaculture. Due to these reasons, spawning and grazing ground of the resident fish species is being damaged and thus capture fisheries is declining day by day in the Polder area.

Role of Aquatic Vegetation for Fisheries

281. Aquatic vegetation play an important role in the aquatic ecosystem. Different types of hydrophytes like emergent, submerged and floating with leafs are habitats and spawning ground for fish,and for insects and crustaceans. Aquatic vegetation provide substratum for the algae to grow which is eaten by the fishes.So, a low abundance of hydrophytes in open waters may hamper fish breeding and production.

6.2.9 Fish Migration and Movement

282. Fish generally migrate from one habitat to another for breeding and feeding purpose as well as for favorable environment. The rivers and khals have collective purpose of breeding, feeding and shelter of fishes. The peripheral rivers acts as longitudinal migration route through the internal khals of the polder area. The riverine fish species migrate through khals in the polder to some extent during the period of May to August. The internal khals situated in the polder area are used as feeding and nursing ground of the fishes. Fish species such as Tengra, Parshe, Chingri, Baila, Khorsola, Bhetki, Punti, etc., migrate from river to the internal open water bodies through the regulators as part of their life cycle. Local people reported that, now-a-days fish migration status in the polder area is poor due to the existing condition of the

rivers and khals as they are silted up and have reduced the length of successive migration routes. In addition, as per opinion of local people, migration of fishes in polder area is poor due to mal-functioning of water control structures and inactivity of the Water Management Organizations (WMO) for operating the sluices and regulators. Overall fish migration status is partially obstructed during early migration period (April-may) in the study area. The improper management of regulators hinders the migration of fish hatchling/fry.

6.2.10 Fish Biodiversity

283. According to field investigation and consultation with fishers, PL collector, elderly people and local DoF officials it was known that about 40-45 fishes species comprise the regular catch of fishermen in the area. Fish biodiversity in the polder area is moderate although the diversity of fishspecies composition has the declining trend over the years. The causes of gradual decline of fish abundance and biodiversity are due to the morphological changes of outer rivers of the Polders, internal khals, siltation of fish habitats, squeezing of spawning and feeding grounds and illegal fishing, etc. The studied Polder area comprises both fresh water and brackish water fish species (Photo 6.30). The available fish species are Tengra, Baila, Parshe, Bhetki, Punti, Shol, Taki, Shing, Tara baim, Gotum, Koi, etc and Rui, Catla, Mrgel, Carpio, Tilapia, Grass carp, etc. in the closed water bodies. In addition crustaceans like Bagda, Golda chingri,andHorinachingri also occur.List of fish diversity in different habitatsofthe Polder area is provided in Appendix-E.

Photo 6.30: Major Fishes and crustaceans comprisethe Catch Composition of Polder Area

6.2.11 Indicative Fish Species

284. Among the fish species found in the study area mentioned above, the major indicative and migratory fish species are Kaine Magur (*Plotosuscanius*), near threatened in IUCN, Bangladesh; Bhetki (*Latescalcarifer*), not evaluated; Parshe (*Liza parsia*), not evaluated and GuliTengra (*Mystusgulio*), near threatened. These species generally live in the brackish to saline water but during the spawning season they come to brackish to freshwater environment. The spawning of *Latescalcarifer*, *Plotosuscanius* and *Mystusgulio* range from March to August whereas, *Liza parsia* breeds from November to February (Figure 6.11). Usually these fishes enter into the Polder with the tide in drifting mode of migration during the life stages of hatchling to fry.

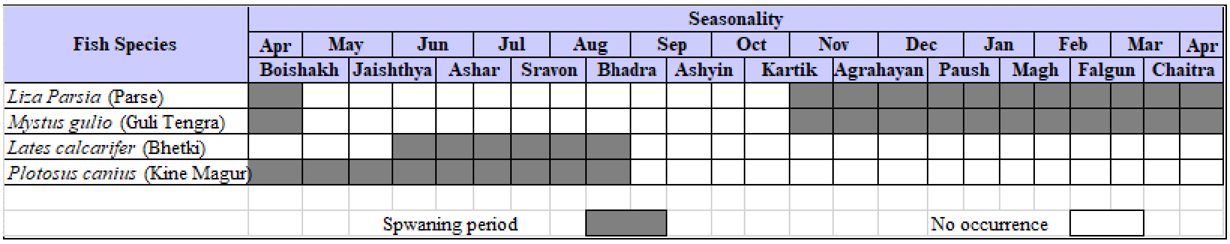


Figure 6.11: Seasonality of fish spawning

Table 6.15: Movement speed or velocity of indicative fish species

Fish Species	Habitat Type	Min Size	Max Size	Water Temperature (^{0}C)	Min Size		Max Size	
		Total Length (cm)	Total Length (cm)		Max Sustainable Velocity (m/s)	Max Burst Velocity (m/s)	Maximum Sustainable Velocity (m/s)	Maximum Burst Velocity (m/s)
Plotosuscanius (KineMagur)	Demersal	36	69	27	0.74	2.84	1.10	4.20
Latescalcarifer(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
Mystusgulio (GuliTengra)	Demersal	15	45	27	0.44	1.68	0.85	3.25

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

6.2.12 Threatened Fish Species

285. Threatened fish species are those, which are locally rare or unavailable for the long time (10-15 years) as reported by the local fishers and concerned elderly people. Threatened fish species, as reported by local fishers and elderly peoples' are noted in Table 6.16. The decline in presence of threatened fish species are due to changes of habitats, declining water depth and deteriorating water quality resulting from decomposition of aquatic weed and residual harmful chemicals coming from access uses of illegal agrochemical and pesticides in

the paddy field, obstruction of fish migration, indiscriminate fishing by sluice net, illegal fishing and destroying the spawning and breeding ground etc.

Table 6.16: List of Threatened Fish Species

Scientific Name	Local Name	Local Status	
		Rare	Unavailable
Notopteruschitala	*Chital*	√	
Nandusnandus	*Bheda/Mini*	√	
Clariasbatrachus	*Magur*	√	
Ompokpabda	*Pabda*	√	
Sperataaor	*Aire*	√	
Wallago attu	*Boal*	√	
Channamarulius	*Gojar*		√

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

6.3 Human and Economic Development

6.3.1 Fish Productivity and Production

286. There are two kinds of fish culture systems in the Polder area- one is pond aquaculture and the other is gher aquaculture. A Gher owner mostly concentrates in bagda (shrimp) farming and starts from January and continues until July depending on the suitable saline water. Bagda farming follows improved extensive to semi intensive systems along with other brackish water fishes (Tengra, Parshe, and Khorshola,etc).If salinity drops in the gher during monsoon, they start to culture freshwater fish (Catla, Rui, Mrigel, Grass carp, Tilapia, etc.) along with golda (prawn). Sometimes they also start paddy culture in the ghers and even they continue the golda and fresh water fish culture along with rice. On the other hand, pond owners are culture fresh water fishes (Catla, Rui, Mrigel, Grass carp, Thai Sarputi Tilapia etc.) in their ponds over the year following poly-culture or mixed culture. The fish productivity of the polder area is presented in Table 6.17. Net fish productivity of different open water habitats is lower than other areas of the country. As per discussion with the local fishers, fish farmers, and local officials of Department of Fisheries (DoF), the productivity of the fisheries resources are presented in the Table 6.17. The fish productivity of khals (canal) and rivers is 120 kg/ha which is comparatively lower than that of the national productivity rate (196 kg/ha). The main reasons for low productivity in the open water fisheries are reduction of water depth due to siltation, illegal fishing by nets close to the sluice gates, obstruction of fish hatchling movement during pre-monsoon and monsoon due to improper management of sluice gate and low enforcement of Fish Conservation and Protection Acts. Fish productivity of cultured pond and ghers is also low. Production of culture fisheriesis low in the polder area due to tidal flooding risk for mal-functioning of sluices and regulators, lack of quality fish and shrimp seed and feed, lack of training of modern fish culture techniques, low stocking density of fishes due to the mixed culture with golda. However, intensification of aquaculture practice in gher is increasing significantly in the Polder area.

Table 6.17: Fish Productivity and Production in the Polder Area

Sl	Fisheries Category	Habitat Types	Productivity (MT / ha)	Production (MT)	Remarks
1.	Capture	Canal	0.120	25.44	-
			Sub-total	***25.44***	
3.	Culture	Gher	1.300	2970.05	Production includes Bagda, Golda and other fresh water and brackish water fish.

Sl	Fisheries Category	Habitat Types	Productivity (MT / ha)	Production (MT)	Remarks
4.		Pond	2.300	204.70	-
			Sub-total	***3174.75***	**-**
	Total			**3200.19**	

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

287. The estimated total fish production of the Polder area is about 3200 metric ton (MT). Most of the fish production are (about 99%) from culture fisheries and very few (less than 1%) from the capture fisheries (Table 6.17). Fish production trend of the capture fisheries is gradually declining in the Polder area as per opinion of fishers and villagers.

6.3.2 Fishing Effort

Fishermen

288. During field investigation and consultations with local people and fishers in different villages of the polder, the respondents informed that, the fishers households in the polder area can be grouped as commercial, subsistence and part time fishers. As per their opinion about 8-10% fishers' households are engaged in commercial fishing, while about 50-55% fishers' households are involved in subsistence level fishing and 30-35% fishers households are involved in part time fishing in an around the habitats of the Polder area. Among the fisher households, commercial fishersspend around 4-6 hours a day in fishing activities throughout the year. Fishermen are mostly Hindus (95%) and few (5%) are from the Muslim community. There is no specific area or Fishers village in the polder area. They usually, catch fish in the nearby rivers, canals of Polders and also harvest fishes in private ghers and ponds on wage basis. They also catch the Post larvae (PL) of Bagda/Golda from the rivers. The socio-economic condition of the commercial fishers is poor.As per opinion of local fishers, the seasonal vulnerability of the fishers starts from December and continues tillMarchof the next year. The fish catch from open water during this period is hardly recorded. Due to insignificant amount of fish catch from open water during this period, most of the fishers maintain their livelihood through daily labour in or outside the Polder. Some fishers are also involved in agricultural activities or fish farming in their own land.

Fishing Season

289. Fishing in canals in the polder area and in peripheral rivers starts in April and continues up to February. Remaining period, fishers get mainly engaged in Shrimp gher as day labour and other activities . Most of the fish catch from capture fisheries by using different gears is from late June to November. Monofilament Gill net (Current Jal) fishing is the major fishing gear in the study area, followed by push net, cast net, lift net, seine net, etc. Moreover, shrimp trap (Atol) is used in the gher to harvest shrimp and prawn while fish trap is used in the open water. It is important to note that Ber jal and Bendijal are also used in the peripheral river round the year. The seasonality of major fishinggearsis presented in the Table 6.18.

Table 6.18: Fishing Seasonality of the Polder Area

Type of Gear	Apr	May	June	July	August	Sept	Oct	Nov	Dec	Jan	Feb	March	April
	Baishak	Jaishthy	Asha	Sraba	Bhadr	Ashyi	Karti	Agrahaya	Pous	Mag	Falgu	Chaitray	
Seine net (Ber Jal)													
Gill net (Current Jal)													
Drag net (Net Jal)													
Push net (Dhela Jal)													
Cast net (Jhaki Jal)													
Sluice net (Dip net)													
Pull net (Tana Jal)													
Lift net (Vesal Jal)													

Type of Gear	Apr	May	June	July	August	Sept	Oct	Nov	Dec	Jan	Feb	March	April
	Baishak	Jaishthy	Asha	Sraba	Bhadr	Ashyi	Karti	Agrahaya	Pous	Mag	Falgu	Chaitray	
Fish Trap (Chau)	None	None / Low	Low	High	High	High	High	Moderate	Moderate	Low	Low / None	None	None
Shrimp Trap (Atol)	High	High	High	High	Moderate	Moderate	Moderate	Low	Low	Low	Low	High	High
Lining (Borshi)	None	None / Low	Low	Low	Low / Moderate	Moderate	Moderate	Moderate	Moderate / None	None	None	None	None

High | Moderate | Low | No Occurrence

Source: CEGIS Field Survey, 2016

Fishing Crafts

290. Different types of fishing gears and traps are used to catch specific fishes in the area depending on fish species as well as season. The commercial fishers of the Polder area catch fish in the peripheral rivers and internal khals by using both small mechanized and traditiona l boats including Nouka,Kusha, Dingi fishing boats, etc. One of the fishing boats used in the Polder area is shown in the Photo 6.31.

Photo 6.31: Traditional Fishing Boats in the Polder Area at Karamot Khal

Fishing Gear

291. Various types of nets/gears are used for fishing as mentioned in Table 6.18.Among the fishing gears, (a) Seine net (Ber jal/Bendijal)is used to catch all types of small and big fishes; (b) Mono filament net (locally known as Current jal) is used to catch poa, chingri, tengra, gulsha, koi and other kinds of fishes; (c) Cast net, locally known as Jhakijal(Photo 6.32),is used to catch puti, chingri, tengra, khorshola, rui, mrigel, etc. (d) Push net, locally known as Thelajal, is used to catch puti, tengra, chingri, etc. (e) Sluice/Dip net locally known as Sluice net or jal is found to be used at the mouth of sluice gate to catch all types of fishes.(f) Drag net, locally known as Net jal is mainly used to catch PL (Post larvae) of shrimp and prawn; (g) Lift net (Vesal Jal) is a common traditional fishing gear and widely used for fishing in the polder area in all kinds of capture fisheries.Besides, Katha is found in the deep pool area of khals inside the Polder to aggregate the fishes. As per information of the local fishers, the Katha is constructed in the internal canal by putting the branches of trees from late October to January to aggregate the fish in a certain area and then catch all types of fishes by using the seine net by a group of fishermen. In addition, shrimp farmers mainly harvest their shrimp/prawn from the ghers by using the bamboo made trap locally called *Atol*(Photo 6.33).Around 5% fishers have fishing boats and around 80% fishers have fishing gears/nets.

Photo 6.32: Fishing Gear (Cast net) is usedfor fishing in the Polder Area at Karamot Khal

Photo 6.33 : Shrimp Trap (Atol) is usedin Ghers to Harvest Shrimp

Photo 6.34: Freshwater Fish Harvested from Gher at Magurkhali

6.3.3 Fish Marketing and Post Harvest Facilities

292. There is no big fish market and no structured fish-landing centers in the polder area. However, Mandartala is the only fish market in the polder area where fishermen and fish farmers can sell their fish daily to the Arats (whole seller). Mandartala fish market opens in the early morning (06:00 - 08:00 am) and the fishers who harvest fish over the night sell their fishes in this market, the fish/shrimp farmers also sell their fish in this market. There is no ice factory or freezing plant in the polder area. Ice is collected from the nearby market naming Kharnia or Khathaltholi bazar. In addition, Shibnagar and Magurkhaliare the local markets where fishers can also sell their daily catches. However, there is one very big wholesale fish market named Kharnia bazar and situated outside the polder area but this is only the nearest big fish market of the polder area. Kharnia fish market opens in the afternoon (01:00 pm - 04:00 pm) every day. Usually, most of the farmers' (Pond and Gher owners) are used to sell their bulk of fishes/shrimps directly in the Mandartala or Kharnia Bazaars.

293. Transportation facility at the root level is moderately developed. There is no private fish/shrimp hatchery inside the polder area. Availability of fish feed and fish fry for culture ponds isinsufficient. Fish seeds for culture fisheries are collected from the hatcheries and

nurseries which are situated outside the polder. In addition, fish feeds are also collected from the local markets or from the mobile traders who come from Khulna, Satkhira and Jessore districts.

6.3.4 Fisheries Management

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

6.3.5 Agriculture Farmimg Practices

295. Farming practices in the Polder area are largely controlled by physical, biological, climatological and socioeconomic factors. There are two distinct cropping seasons in a year. The Kharif season starts from March and continues till October while the Rabi season starts from November and continues upto February. Based on crop adaptability and crop culture, the Kharif season has been further sub-divided into Kharif-I (March-June) and the Kharif-II (July-October) seasons.

296. 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. Local Transplanted Aus (Lt. Aus) and Summer Vegetables are grown in the Kharif-I season.

297. The Kharif-II season is characterized by high rainfall, high temperature, high humidity, low solar radiation and high flood 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 Transplanted Aman (Lt. Aman) and High Yielding Variety of Transplanting Aman (HYV Aman) rice are grown in the Kharif-II season.

298. However, there are occasional overlaps such as, the Kharif-II season crops Lt. Aman and HYV Aman rice are harvested in early Rabi season. High Yielding Variety of Boro (HYV Boro) rice, Chili, Potato, Oilseeds and Winter Vegetables are grown in the early Kharif-I season.

Photo 6.35: Information collection from local farmers of Kaipukuria village.

Photo 6.36: Information collection from two SAAS,s of 17/1 Polder area.

6.3.6 Present Cropping Pattern and Intensity

299. Major present cropping pattern of the Polder area is Fallow- HYV T. Aman - Fallow, which is practiced in 23% in F1 land of the Net Cultivable Area (NCA). Fallow -LT. AmanFallow is the next dominant cropping pattern covering 22% of the NCA in the same type of land. It was observed during the field visit that the farmers harvested HYV T Aman Rice and were ready for HYV Boro cultivation (Photo6.37 and 6.38). In the winter season they grow few vegetable crops in the field as well as in the homestead areas (Photo 6.42 and 6.43). The present cropping intensity of the Polder area is 147%. Detailed cropping patterns by land type are presented in Table 6.19 and varieties used are shown in Table 6.20.

Table 6.19:Present Cropping Pattern by Land Type in Polder area

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Area (ha)	% of NCA
F0 (Highland)	S. Vegetables	HYV T. Aman	Chili	30	1
	Fallow	HYV T. Aman	Fallow	219	11
	Local T. Aus	Fallow	Potato	45	2
Sub- total				**294**	**14**
	Local T. Aus	Fallow	W. Vegetables	202	10
F_1(Medium Highland)	Fallow	Local T. Aman	Fallow	460	22
	Fallow	HYV T. Aman	HYV Boro	61	3
	Fallow	HYV T. Aman	Fallow	466	23
Sub-total				**1,189**	**58**
F2(Medium Low Land)	Fallow	Local T. Aman	HYV Boro	105	5
	Fallow	Local T. Aman	Oilseeds	60	3
	Fallow	Local T. Aman	Fallow	194	9
	Fallow	HYV T. Aman	Fallow	219	11
Sub-total				**578**	**28**
G. Total				**2,061**	**100**
Cropping Intensity (147%)					

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

Photo 6.37: HYV Aman harvested and started transplanting of HYV Boro

Photo 6.38: Collecting HYV Boro seedling for transplantation.

Photo 6.39: View of vegetable crops in the homestead area.

Photo 6.40: View of Vegetable cultivationin the field of Polder area.

Crop Varieties grown by the farmers

Table 6.20: Varieties cultivated in the study area

Crop	Varieties
Lt Aus	Sornobasori, Napali, Lal mota, Shadamota.
HYV Aus	BR 20, BR 24, BR 26, BRRI dhan 43, BRRI dhan 48.
Lt Aman	Benapole, Sadamota, Lal mota, Jataibalam
HYV Boro	BRRI dhan10, BRRI dhan28, BRRI dhan29, BRRI dhan47, BRRI dhan49, Hira, Sonar bangl, Jagoron
Vegetables	BARI Bottle Gouard-1, BARI Laau 1, Provati, Atlas, BARI Cauliflower-1, BARI Alu 23, BARI Alu 26, BARI Jhar seem 1, BARI Seem 1, Hybrid seem, Country bean local, BARI Hybrid tomato 4,
Pulses	BARI Masur 6, Khesari local, BARI Mung 6, BARI Chhola 3, BARI Chola 7,
Oilseed	BARI sarisa 14, Mustard local
Chili	BARI Morich 4, BARI Morich 5
Potato	Diamond, Cardinal

Sources: CEGIS field survey, January, 2016; secondary data from local farmers and SAAO, DAE.

6.3.7 Cropped Area and Production

300. Detailed cropped area, yield rate and crop production are presented in Table 6.21.

Cropped Area

301. Total cropped area is 2,598 ha of which rice occupied 2,227 ha and the rest 367 ha is covered by non-rice crops. The rice and non-rice cropped area are 60% and 40% of the total cropped area respectively. Among the rice crops local T. Aus, Local T. Aman, HYV T. Aman and HYV Boro are grown in 3%, 19%, 31% and5% respectively of total rice area in the polder.

Crop Production

302. After harvesting HYV Aman farmers keep the rice in the field for about 15-20 days for drying the straw after which they carry them to the threshing place (Photo 6.41). Total crop production is 9,393m.tons of which rice production is 5,671 m. tons (Table 6.21) and non-rice production is 3722 m. tons. Table 6.21:Present Cropped Area, Field and Production of the Polder Area

Table 6.21: Present Cropped Area, Field and Production of the Polder Area

Present crop grown	Present crop area, yield & production			
	Cropped area (ha)	Yield/ha (mt)	Production (mt)	% of contribution
Local T. Aus	247	1.9	469	5
Local T. Aman	819	2.2	1,802	19
HYV T. Aman	995	2.9	2,886	31
HYV Boro	166	3.1	515	5
Sub-total	**2,227**	**0**	**5,671**	**60**
S. Vegetables	30	12	360	4
Chili	30	2.8	84	1
Potato	45	8	60	4
W. Vegetables	202	14	2,828	30
Oil Seeds	60	1.5	90	1
Sub-total	**367**		**3,722**	**40**
G. Total	**2,598**		**9,393**	**100**

*Sources:Field information', SAAO of local DAE, January, 2016.*Indicates cleaned rice*

Photo 6.41:Farmers carrying paddy rice after drying in the field

6.3.8 Crop Damage

303. The scenarios of crop damage during 2009-2014 and 2015 are presented in Table 6.22 which shows that crops were damaged by Aila in 2009, Tidal affect in 2012 and Flooding due to heavy rainfall in 2013. In 2009, 80% Vegetables were damaged due to Aila. Farmers reported that 25% HYV T. Aman crops were damaged by water logging in the year 2011 and in this year total 20% of Vegetable crops were damaged by pest and disease infestation. In the 2013, 30% Local T. Aman was damaged by Flooding due to heavy rainfall. 30% of HYV T. Aman was damaged by water logging in 2014 and same crop was damaged by 20% in 2015 by tidal affect. (Field visit; January 2016).

Table 6.22: Crop area Damaged by Different Means and % Losses during 2007-2011 and 2013

Sl. No.	Crops	Damage (%)	Year	Reason of damage
1	Local T. Aman	65%	2009	Aila
	HYV T. Aman	75%	2009	Aila
	Vegetables	80%	2009	Ailla
	Oilseeds	85%	2009	Ailla
2	HYV T. Aman	20%	2010	Heavy rainfall (water logging)
	Vegetables	15%	2010	Pests
3	HYV T. Aman	25%	2011	Water logging
	Vegetables	20%	2011	Pests
4	Local T. Aman	25%	2012	Tidal affect
5	Local T. Aman	30%	2013	Flooding due to heavy rainfall
6	HYV T. Aman	30%	2014	Water logging
	Vegetables	12%	2014	Pests
7	HYV T. Aman	20%	2015	Tidal affect

Sources:Field information', SAAO of local DAE, January, 2016

6.3.9 Agriculture Input Use

Fertilizer and pesticides application

304. According to SAAOs indiscriminate use of chemicals and pesticides for safe production of produce causing concerns of health hazards to human, livestock and fisheries. Integrated Crop Management (ICM) practices though have been initiated but the limited knowledge and availability of the inputs have resulted its wide spread application. However, the rate of use of fertilizer per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability (Table 6.23). The major fertilizers used in this area are Urea, TSP and MP. The quantities of fertilizer are generally lower than the recommended doses and the proportions of Urea, TSP and MP are used not balanced by the majority of farmer. The use of nitrogenous fertilizer (Urea) is higher than other chemical fertilizers. Annually, about 1,843 metric tons of chemical fertilizers are being used in the Polder area of which 37% is urea, 31% is TSP, 18% is MP, 13% is Gypsum and 1% is Zinc. Generally farmers do not use manure or compost in their fields.

Table 6.23: Fertilizer and Pesticides use in the Polder Area

Crop Name	Fertilizer (Kg/ha)					Pesticides (Tk/ha)
	Urea	TSP	MP	Gypsum	Zinc	
Local T. Aus	90	70	50	30	5	500
Local T. Aman	100	120	65	40	5	580
HYV T. Aman	150	130	70	60	5	1500
HYV Boro	270	135	120	70	10	800
S. Vegetables	125	90	75	-	-	1000
Chili	90	50	40	-	-	800
Potato	105	60	35	-	-	1400
W. Vegetables	50	-	20	-	-	700
Oil Seeds	130	80	80	-	-	-

Sources:Field information's, SAAO of local DAE, January, 2016

305. The use of pesticides depends on the degree of pest infestation.Majority of the farmers applied pesticides in Local T. Aus,Local T. Aman, HYV T. Aman,HYV Boro, Chili, Potato and

Vegetable crops. Annually about 31 metric tons of pesticides are being used as a liquid or granular form in the Polder area for pest control. The major insects as reported by the farmers are Yellow Stem borer, Ear cutting caterpillar, Brinjal fruit and shoot borer, Fruit weevil, etc. Local farmers reported that they are using different types of pesticides such as Volian Flexi, Amestartop, Virtako, Aktara, Fighter and Fanfan, etc., to prevent pest infestation in rice, vegetables and other croplands. Granular Liquid and powder pesticides are used for crop protection from the infestation. Farmers of the polder area applied pesticides once or twice in a season (Field visit; January, 2016).

Seeds

306. Seeds playthe major role in crop production. Quality seed is important for obtaining optimum yield from any crop.More than 85% germination rate, free from disease infestation and high yield potential need to be considered for seed selection.

307. Most of the farmers in the polder area use their own seeds in case of local variety, such as T. Aus and T. Aman. Medium and small farmers meet their requirement of seed from neighboring farmers or local markets. Various improved crop seeds (HYV/Hybrid) are provided by BADC and private seed dealers. Market price of the private dealer seeds is higher than BADC seeds. Some farmers are aware about HYV seed production (Photo-6.42). The salt tolerant cultivars are not available in the market and the farmers are not aware of them. The seed rate for different crops is presented in Table 6.24.

Photo 6.42: Seed production in the farmer's level in the Polder area.

Irrigation

308. Irrigation is provided mainly toHYV Boro crops in the project area. Irrigation coverage of the polder area is only 869 ha (22% of the total NCA) during the dry season. As of now, surface water is the only source of irrigation from Khals (*Mandartala khal, Golar khal, Shibnogor khal, Karamot Khal, Berakhali khal, Andharmanik khal, Sudorbunia khal, Soto Andharmanik khal* are the sources of irrigation water). According to local farmers and SAAOs of DAE, farmers provide irrigation with surface water through Low Lift Pumps (LLPs) for raising seedlings, land preparation and transplantation up to mid March. They also use ground water for irrigation during dry season through Shallow Tube Wells (STWs) but water contains iron and most of the STW is lifting saline water.According to nine local farmers there are some

areas where there is no salinity and they are irrigating there land by STW (p). They also provide supplementary irrigation to the crops of high and medium high lands. Cost of supplementary irrigation is 300-800 Taka depending on crops and number of application. Rabi Season (November-February) crops cultivated in the polder area are primarily potato, chilli, winter vegetables, oilseeds, etc. Generally, HYV vegetables are cultivated in winter and summer.

Table 6.24: Cultivation Cost in the Polder Area

Crop Name	Seed (Kg/ha)	Irrigation cost (Tk / ha)	Equipment used for cultivation		Power tiller cost / ha
			Power tiller (%)	Bullock	
Local T. Aus	38	-	90-95	5-10	4,500-5,000
Local T. Aman	32	-	90-95	5-10	4,500
HYV T. Aman	22	2,500	90	10	5,000
HYV Boro	22	6,500	100	-	6,500
S. Vegetables	4-5	1200	85-90	15-10	4,500
Chilli	2	1500	85-95	15-10	4,500
Potato	22,000 (Tuber)	3,000	85-90	15-10	5,000
W. Vegetables	4-5	1,500	80	20	4,500
Oil seeds	5	-	90	10	4,500

Sources:Field information's, SAAO of local DAE, January, 2016

Photo 6.43: Farmers are irrigating HYV Boro crops by STW

Labor for Agriculture

309. Cultivationin the polder areaare mostly performedmanuallythrough labors. Thereby, agricultural labor is considered as one of the essential inputs for crop production. The labor requirement is not uniform throughout the year. The number of labor requirement varies from crop to crop. Annually total 0.808 million man-days labor is used for crop cultivation. The average number of labor used for different crops in the study area is presented in Table 6.25.

Table 6.25:Agricultural Labor used by crop in the Polder Area

Crop name	Labor (No/ha)	Crop name	Labor(No/ha)
Local T. Aus	140	Chili	170
Local T. Aman	160	Potatoes	210

Crop name	Labor (No/ha)	Crop name	Labor(No/ha)
HYV T. Aman	165	W. Vegetables	190
HYV Boro	175	Oilseeds	110
S. Vegetables	180		

Sources:Field information's, SAAO of local DAE, January, 2016

6.3.10 Livestock and Poultry

310. Livestock and poultry, being an essential element of integrated farming system, plays important role in the economy of Polder-17/1. Livestock provides significant draft power for cultivation, threshing; cow dung as a source of manure and fuel; a ready source of funds with meat, milk and eggs for human consumption. At present there is no grass in the field and cattle are reared in the house. They also rear duck (Photo 6.47 and Photo 6.48). Most of the households raise poultry and livestock, a practice that significantly reduce poverty through generating income and employment. The number of livestock and poultry in the Polder area are presented in Table 6.26.

Table 6.26:Number of Livestock and Poultry of the Polder Area

Name of Livestock and Poultry	% of HH having Livestock / Poultry in the Polder Area	Number of Livestock/ poultry in the Polder Area
Cow/Bullock	30	1,446
Buffalo	3	145
Goat	1	48
Sheep	10	482
Duck	30	1,446
Chicken	40	1,928

Sources: CEGIS Assessment based on field information and FW of DLS, January; 2016

Photo 6.44: Cattles are near the cattle's house

Photo 6.45: View of ducks in the pond

6.3.11 Feeds and Fodder

311. The owners of the livestock population are facing problems due to non-availability of fodder and feeds during the months of July to November because of unavailability of grazing land in most of the area. Rice straw is isthe mainfodder for cattle. It is also the only fodder in this wet season.In the Rabi season cattle graze in the field, but have no grass (Photo 6.46 and

6.47) in the Polder area. Shortage of grazing areas throughout the year aggravates the feed problem to the animal population. The poultry population at family level survive by scavenging and generally no feed supplements are provided. However, at times kitchen wastes become feed to the poultry and duck are going heather and thither.

Photo 6.46: Rice straw for cattle feed

Photo 6.47: Cattle grazing

6.3.12 Livestock and Poultry Disease

312. Productions of livestock and poultry are mainly 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 poultry diseases are duck plague, Ranikhet (Newcastle), Fowl Pox and Fowl cholera. During monsoon season, the soggy condition of the animal shelter causes outbreak of various kinds of diseases ofcattles. 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 the outbreak of diseases due to poor drainage conditions.

6.4 Socio-economic Resources

6.4.1 Demography

313. The 4,819 households living in the polder area have a total population of 20,611 of which 10,237 are male and 10,274 are female. The female population is slightlyhigher than the male population. The demographic data of this Polder is presented in Table 6.27.

Table 6.27: The Demographic Data of the polder-17/1

Households	Population			Sex ratio	Population density/km^2
	Total	Male	Female		
4,819	20,511	10,237	10,274	100	1,042
	100(%)	49.90(%)	50.09(%)		

Source: Population Census 2011, BBS

314. The average density of population is1,042 persons per sq. km while the national population density is 1,015 persons per sq. km. The studied area's sex ratio is 100 which is same as the national sex ratio. The inhabitants of this Polder mainly belong to two religious

groups; i.e. the Hindu and Muslim. But there is difference between the CEGIS field data, 2016 and BBS, 2011 data on the distribution of population by religion in the area (Figure 6.11).

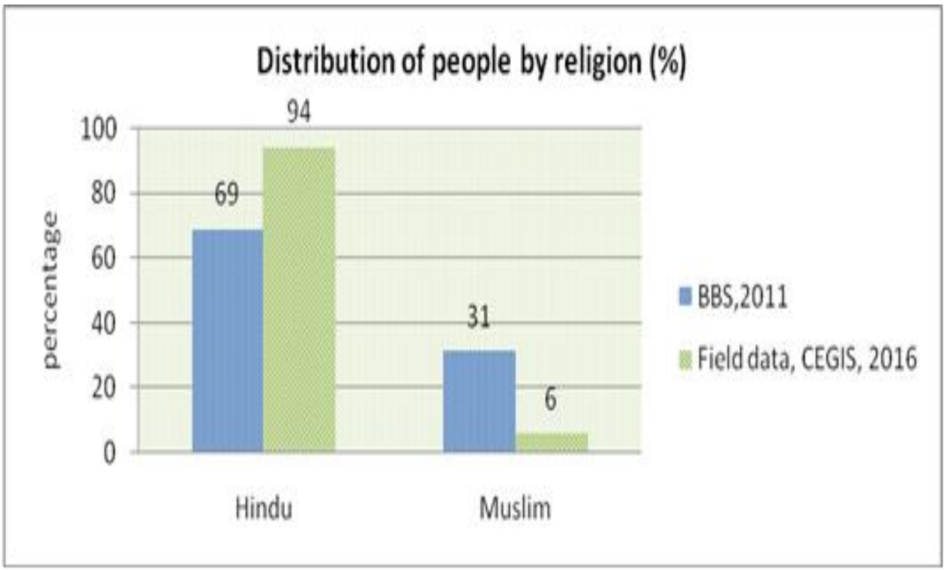


Figure 6.12: Distribution of population by religion at Polder-17/1

Demography for the year 2016

315. According to the BBS 2016, the population growth rate of Bangladesh is 1.37%. Considering linear growth rate, it is also distributed into 5 year (2011-2015). 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 calculator[7]assumes consistent growth. Study area population has been calculated with the number of baseline population. Applying this method, in the year 2016 the total population is 20,511 in which 10,237 are male and 10,274 are female and the total number of households 4,819. The demographic data of this Polder for the year 2016 is presented in Table 6.28.

Table 6.28: The Demographic Data of the Polder-17/1

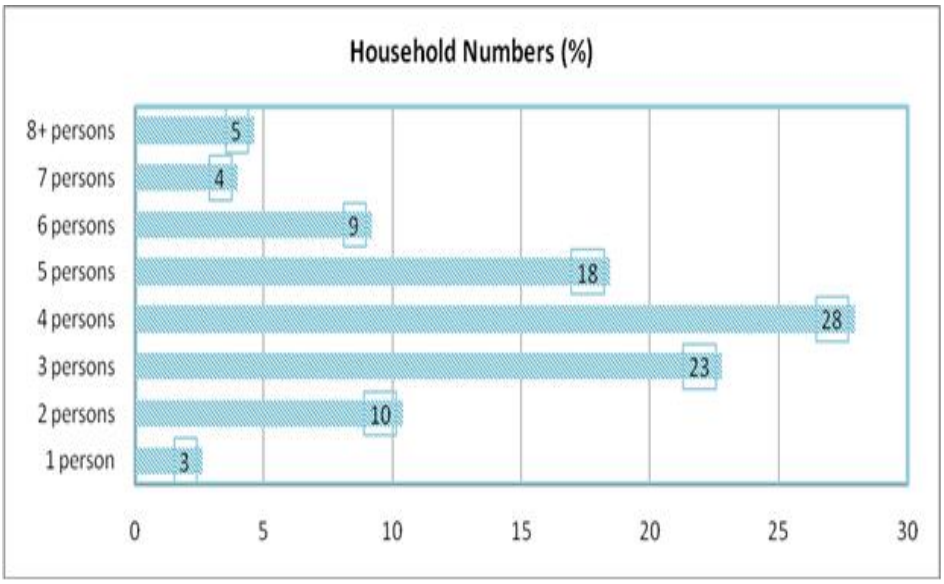
Households	Population			Sex ratio	Population density
	Total	Male	Female		
5,159	21,955	10,958	10,997	107	1116
	100 (%)	49.9 (%)	50.09 (%)		

Source: Population Census 2011, BBS and Population estimation for the year 2016, CEGIS

316. The size of households in Bangladesh continues its long term decline, with an average of 4.4persons per household in 2011, compared to 4.8 in 2001 and 5.5 in 1991. In the overall study areathehousehold's distribution by number of persons is found to be same as the national scenario of 4.2 where the highest percentage (28%) of household comprises of 4 persons in each. The present distribution of household members is presented in figure 6.13.

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

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

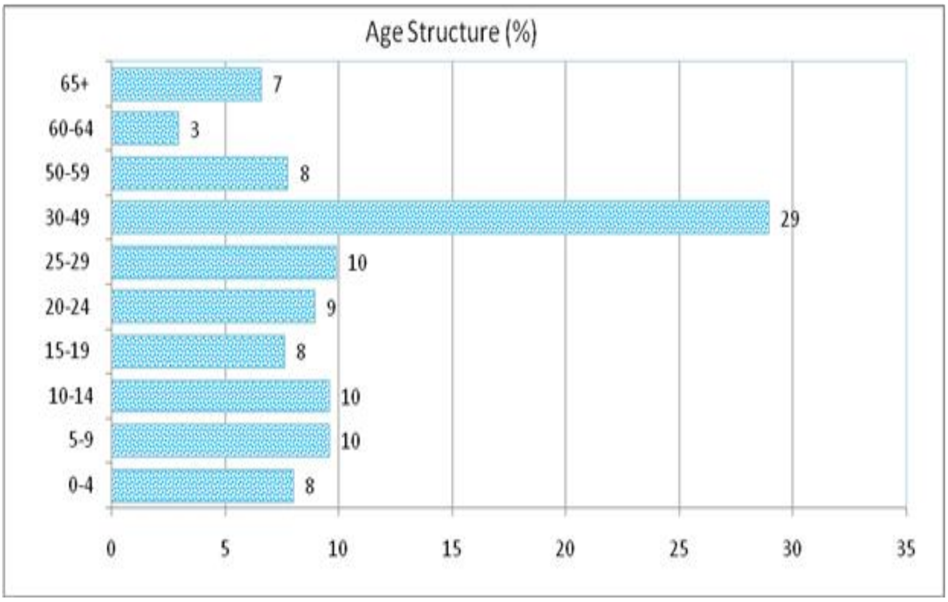


Sources: Housing and Population Census, BBS, 2011

Figure 6.13: Distribution of Households comprising member in each

6.4.2 Age Structure

317. The highest number of population (about 29%) in the study area belongs to age category of 30 to 49 years old. About 3% and 7% people are in 60-64 and 65+ year's category respectively and are presented in Figure 6.14below ;



Sources: Housing and Population Census, BBS, 2011

Figure 6.14: Age Structure of the studied people

318. Age groupsof 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 matured working age and 65 years and over

as elderly people (source: World Fact Book, CIA[8]). This classification is important as the size of young population (under age 15) would need more investment in schools, while size of older populations (ages 65 and over) would call for more investment in health sector.

319. The percentage of the (potentially) active working populationin the age group of 15-64 is 66%, where the national level is 57%. Unfortunately, the high active working population suffers under a severe unemployment problem, which renders aboutone-seventh of them living under the poverty line (Figure 6.15).

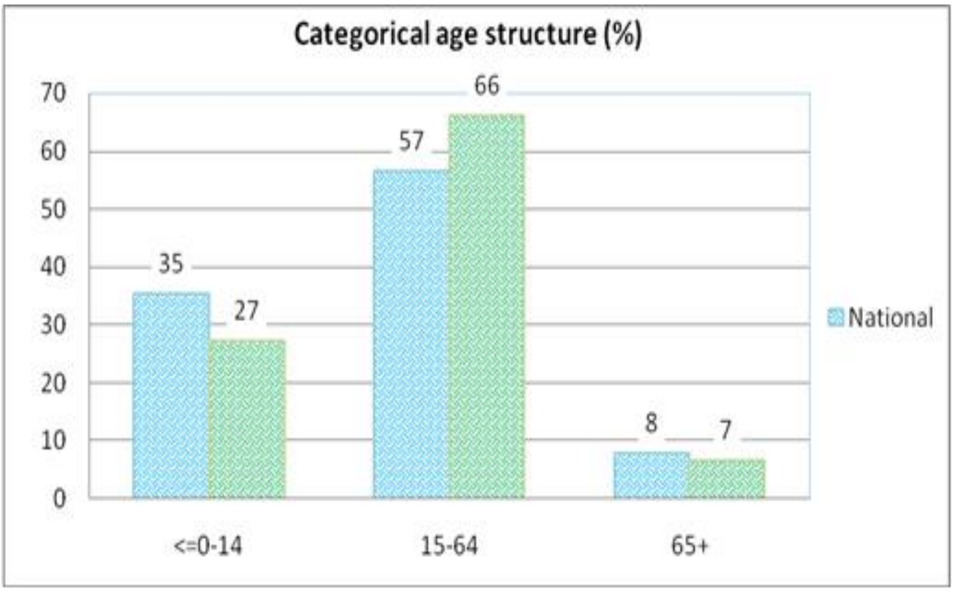


Figure 6.15: Categorical distribution of studied population

320. There is a small percentage (7%) of population with 65 years and above. The categorization is made on the basis of ILO reference for opting out potential labor force and dependent population. Population of 15 to 64 years category is considered as labor force whereas, populations below 14 years and above 65 years are considered as dependent. Thus, the total dependency ratio[9] is about 52 in which child dependency ratio[10] is 41 and aged dependency ratio[11] is 11. It illustrates that total 52 persons are dependent on 100 labor forces in which 41 are children and 11 are elderly people.

6.4.3 Education

321. Literacy rate, based on a definition “ability to write a letter in any language” is 56%, of which male accounts to 62% and female 49%. The rate of literacy reported above is for population of 7 years and over ages (Figure 6.16). Data confirms that similar to the national

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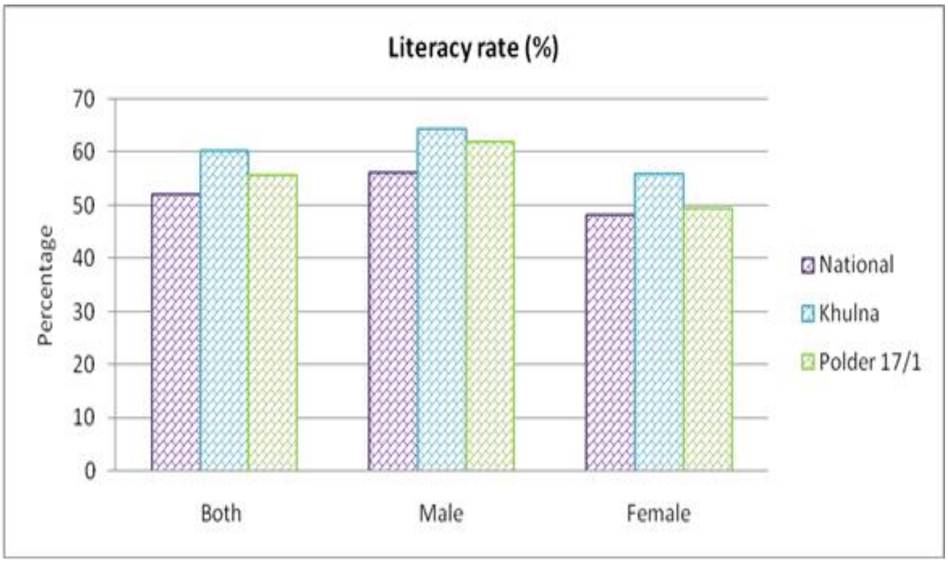
[8] Retrieved on 30/06/2015 from https://www.cia.gov/library/publications/the-world-factbook/docs/notesanddefs.html

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

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

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

picture of Bangladesh (Male 54.1% and Female 49.4%), in the study area the male populations are also more educated than the female counterpart. It is to mention that the education facilities ofthis Polder are better than those of other Polders.



Source: Population Census, BBS 2011

Figure 6.16: Literacy rate among the studied population

322. Field findings show that there are 17 primary schools, 05 high schools and a college in the Polder area. There is a girl's high school among the five high schools althoughthere is no institute likemadrasha in the area. *(Source: CEGIS field work, 2016).*

Source: CEGIS fieldwork, 2016

Photo 6.48: Local educational institutions at the polder area

323. The infrastructures of some of the schools are severely damaged by natural disasters, for example, last few years, saline water intruded in Khagrabunia Reg. Gov. Primary School, as a result it's infrastructure have severely been damaged as shown in the following photographs:

Photo 6.49: Khagrabunia Reg. Gov. Primary School, Magurkhali, DumuriaUpazila

324. Different NGOs and government offices also work for education. BRAC plays an important role for acceleration of education. Even government initiated pre-primary education based on mosque/temple also plays important role in the area.

Photo 6.50: Pre-primary education based on mosque/temple

6.4.4 Access to health service

325. Access to health services and facilities refer to availability and adequacy of supply, affordability, physical accessibility and socio-cultural acceptability. Field data shows that there are 4 community clinics, 1 union family welfare center and more than 20 pharmacies. But there is no private clinic/hospital and upazila health complex. Therefore, a large number ofpatientsreceive services from local chemist and/or village trained physicians.

326. Some people of the area also receive treatment from nearby SadarUpazila (DumuriaUpazila) Health complex and Khulna Medical College and Hospital during the time of serious health problems. However, the economically wellbeing people receive treatment from nearby private clinics like Janata Clinic at Dumuria, Boira Clinic, Rashida Clinic, Shibsa Clinic, Surgical Clinic, Ideal Clinic and Al-Noor Eye Hospital at Khulna, etc.

Photo 6.51: Health facilities in the polder area

327. Field data shows that almost 90% people receive treatment facilities from different sources, only 10% people are out of treatment facilities. It was found that about 16% people receive health services from quack doctors and informal treatment systems, 51% from paramedic/ diploma physicians and 23% from trained doctors. But almost 10% people do not receive treatment facilities due to their impoverishment.

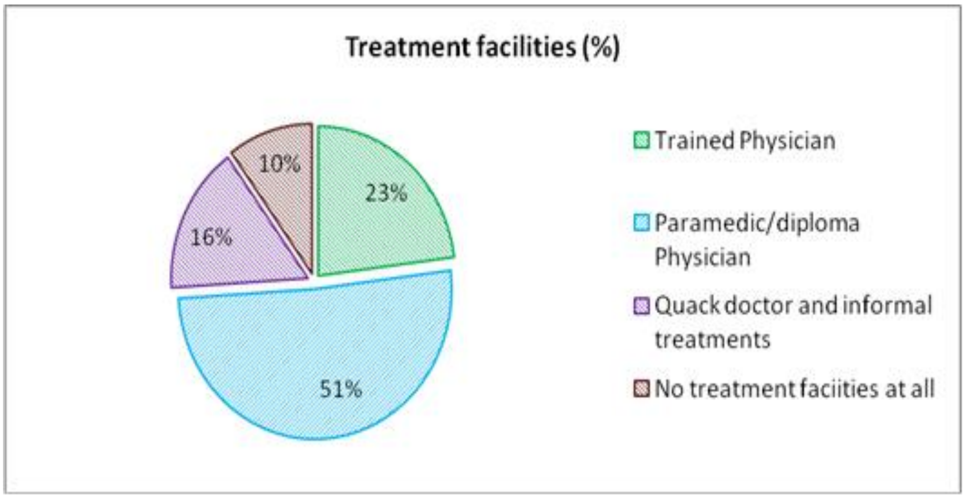


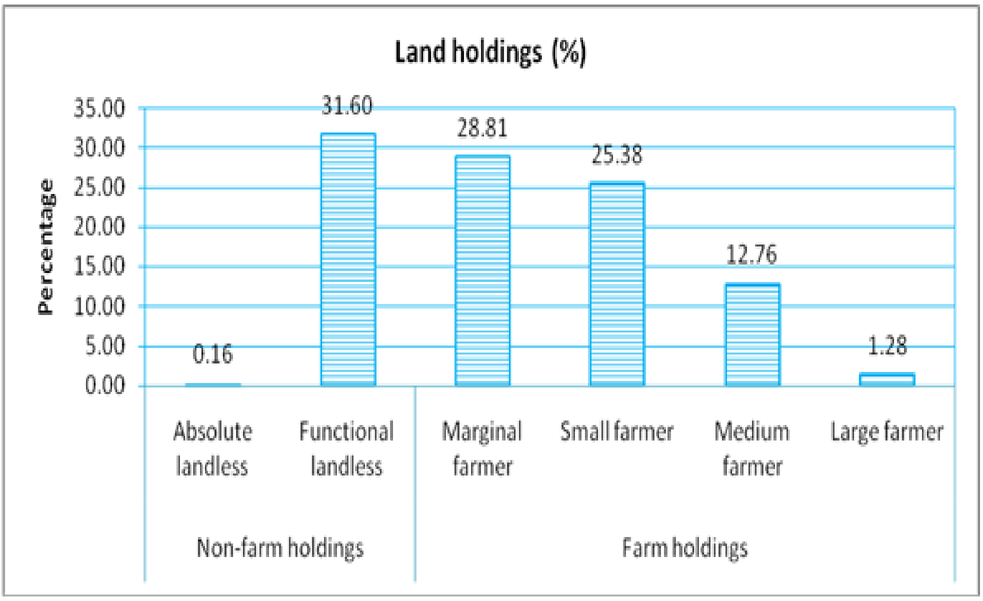
Figure 6.17: Sources treatment facilities of the polder area

328. The Population Census, 2011 identified almost six types of disabilities and their proportionate distribution in the respective area. It was found that 1.42% people of the study area 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 fevers are common in the Polder area.

6.4.5 Ownership and utilization of land

329. The Census of Agriculture, 2008 by BBS classified land holdings into two broad categories- one is farm-holdings and the other is non-farm holdings. A farm holding is defined as being an agricultural production unit having cultivated land equal to or more than 0.05 acre. Conversely, non-farm holding includes landless households and households having lands up to 0.04 acre. The study area shows that out of total holdings 68% is farm and the rest 32% is non-farm holdings.

330. The land holdings in the study area show that 0.16% households are absolute landless, i.e., they have no lands, either homesteads or cultivated. 32% households belong to functional landless category that comprises households those have only homestead lands and 5.08% of those have homestead with 0.01 to 0.04 acre cultivated lands. Here, cultivated lands include mainly kitchen garden produced predominantly by housewives mainly for household consumption.



Source: The Census of Agriculture, 2008, BBS

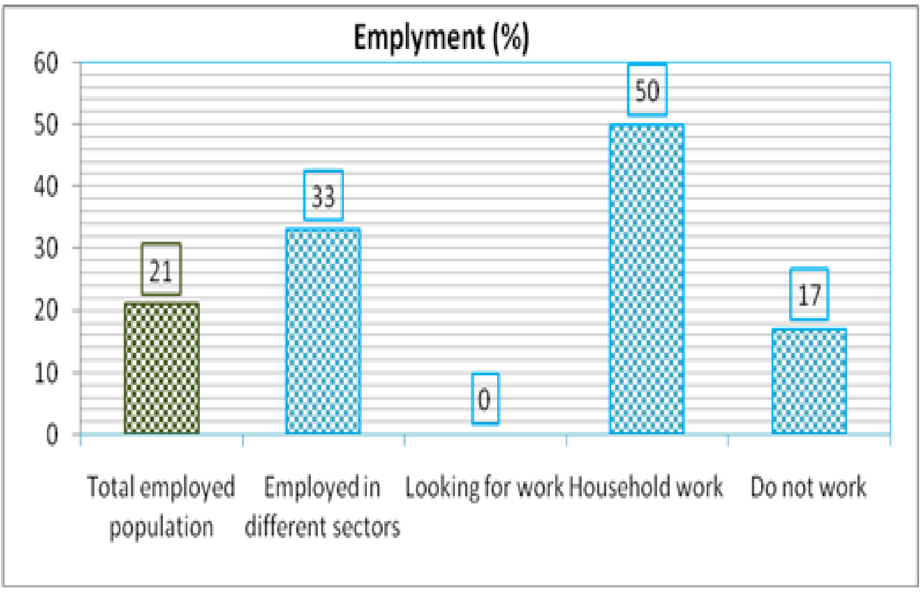
Figure 6.18: Households by land holdings

331. On the other hand, farm holding distribution shows that 28.60% households belong to marginal farmers (0.05 to 0.99 acre), 25.38% belong to small farmers (1.00 to 2.49 acre), 12.76% belong to medium farmers (2.5 to 7.49 acre) and 1.28% belong to large farmers (7.5+ acre) categories. It is evident that land fragmentation decreases the holding size; therefore, large and medium farmers are gradually being converting to marginal farmers.

332. It is really hard to know that the small land owners are unable to prevent the land acquiring from the shrimp cultivators/Gher owners in spite of minimum year-round payment which pressurize them to out-migration for income generation. Field data suggest 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.

6.4.6 Occupations and Livelihood

333. Out of total 20,511 population, 4,373 (21%) are economically active which are 1,444 (33%) employed and 2,174 (50%) engaged in household work but 748 (17%) 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.



Source: Housing and Population Census, BBS, 2011

Figure 6.19: Employment status of the polder

334. For the field data, it was found that the overall employment scenario is comparatively better than the other polders of the coastal area. Nonetheless, unemployed people migrate to other areas like Chittagong, Dhaka, Barisal, Khulna, Narail, Gopalganj, Kushtia districts and nearby upazilas as day laborer.

335. Women participation in direct income generating activities (employed category) are trivial, and they are basically involved in household activities (Figure 5.20). The other women employment activities in the area are agricultural farming, earthworks and brickfield works, etc.

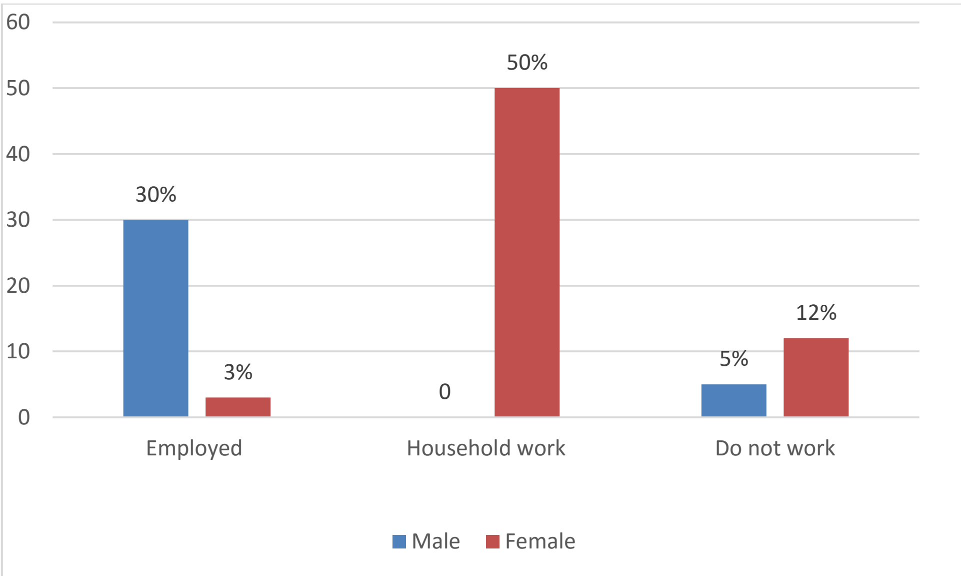


Figure 6.20:Sex-wise employment status of the polder

Photo 6.52: Different modes of livelihood activites at Polder-17/1

336. Agricultural activities broadly include fishery and crop farming. Scope of employment in agricultural sector is gradually decreasing due to lack of sweet water and intrusion of saline water in the area for shrimp cultivation. The Gher cultural practice in area is shown in the Photograph 6.53.

Photo6.53: Practice of shrimp cultivation in agricultural land in the area

337. People stated that once people from near by regions came to their areas for employment, but due to decreaseof agricultural land and farming for cultivationof shrimp hadreducedemployment, as such presently, they have to out-migrate for employment.

Use of modern technology in agricultural activities

338. People of the Polder area use different types of modern technology in agricultural activities. Once they used only traditional equipment for agriculture but now they use modern equipment like tractors, pumps/tubewell for irrigation.

Photo 6.54: Use of modern technology in agricultural activities

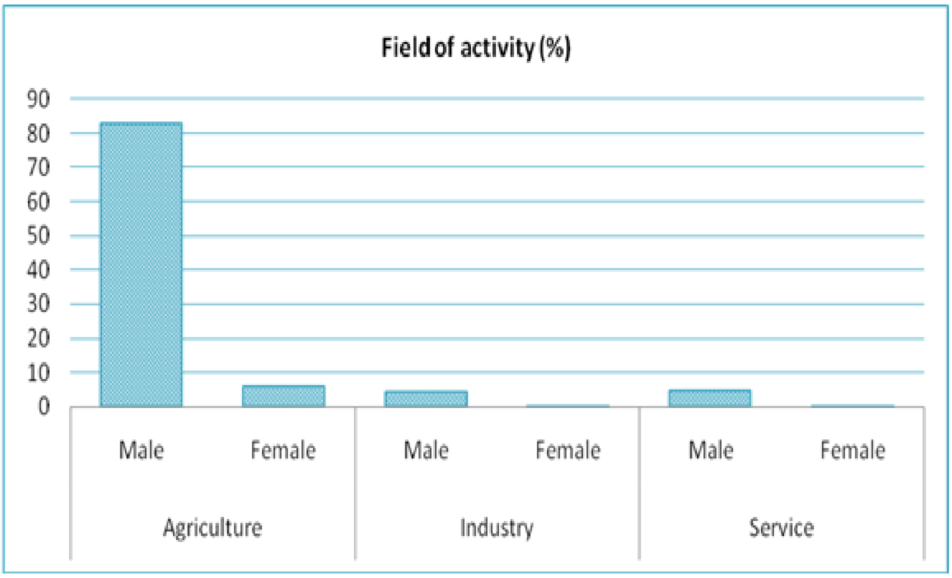
Child labor

339. The poverty have made some people unwilling to send their children to school; instead they send them to labor market where the children work as day laborer. It appears that children also participate in agricultural activities with their parents.

Photo 6.55: Children participate in collecting fish

6.4.7 Labor market

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



Source: Housing and Population Census, BBS, 2011

Figure 6.21: Distribution of population by field of activity

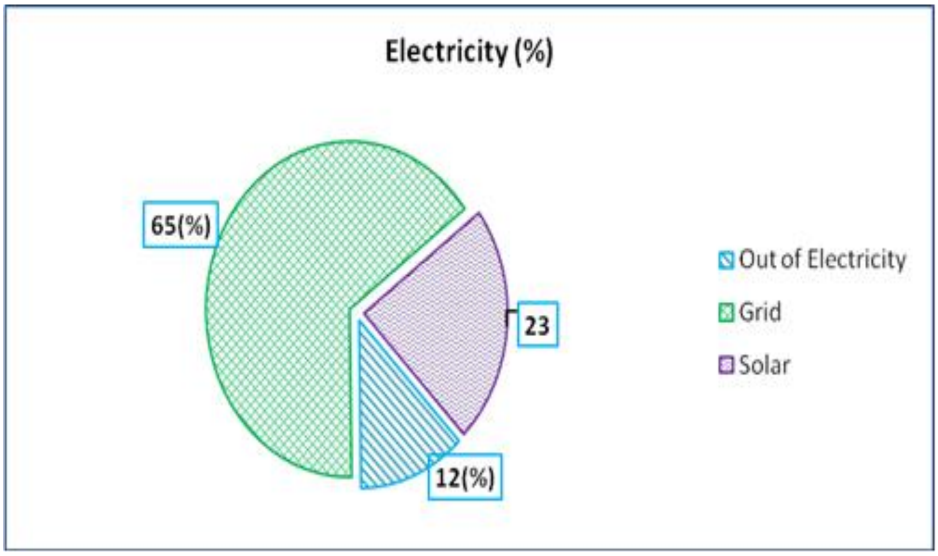
341. The above figure implies that male participation in agriculture sectors is higher than those in industries and services. But the people employed in industry and service have to out-migrate from the area. Field findings documented that during harvesting period, women take part in the agricuturallactivities with men in the same agricultural field. Some women also participate in earthwork and collect fish from river. The wage rate varies between 200 Tk. to 250 Tk. /day for female whereas wage rate for men are within 300 Tk. to 400 Tk.

342. During field visit, people stated that out migration of laborers of the polder is about 25% which is comparatively lower than other polders of the coastal area whereas in-migration is relatively low. These out-migrants are mainly agricultural laborer who usually go to neighboring districts (e.g Chittagong, Dhaka, Barishal, Khulna, Narail, Gopalgong, KushtiaDistrict and nearby upazilas) due to lack of employment opportunities and looking for better livelihood. Additionally, there are few international out-migrants (1%) who tend to go to Middle East in search of better livelihoods. It was found that during the last 5 five years, almost 18 households migrated permanently to Dhaka and most of them are working in the garment sector.

6.4.8 Quality of Life

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

344. According to BBS Report, 2011, 47% peopleof the Polder are have acces to electricity. But field data show a better scenario, it states that almost 88% people are now getting electricity facilities at which 65% from grid connection and 23% from solar connection. Only 12% populations are out of electricity facilities. *(Source: CEGIS fieldwork, 2016).*



Source: CEGIS fieldwork, 2016

Figure 6.22: Electricity facilities of the area

Photo 6.56: Electricity connections of the area

345. According to Housing and Population Census, BBS, 2011; the overall housing condition[12]is not satisfactory. It shows the predominance of kutcha houses (74%) over other three typesof houses. Semi-pucca housesare 13%, puccahomes are 13% while 6% are still jhupri houses.

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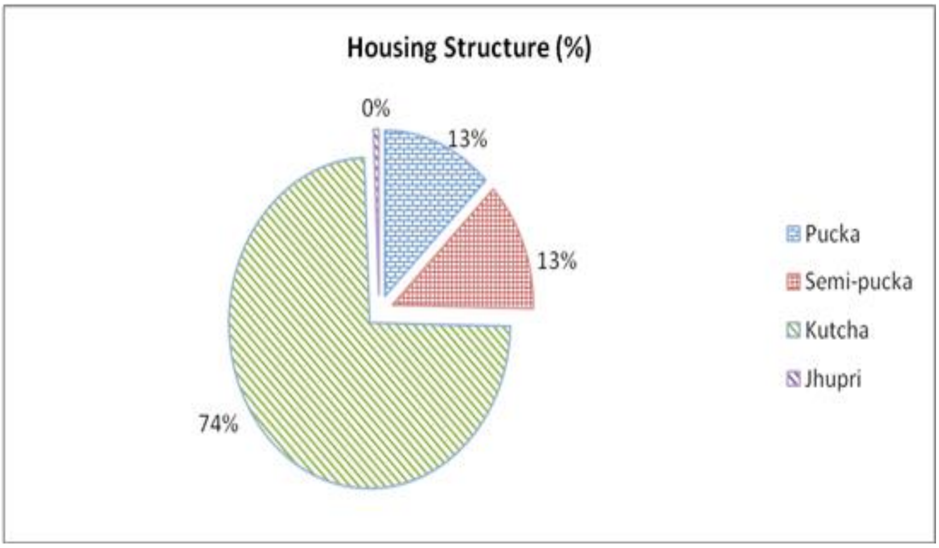
[12]BBS distinguishes housing structures into four classes such as- i) **Jhupri**: House which consist mud walls of 1.5 to 3.0 ft thickness, which carry the roof load. Earthen floor, thatch or CI sheets are used as roofing materials. . There is no monolithic joint between the wall and the roof. ii) **Kutcha**: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

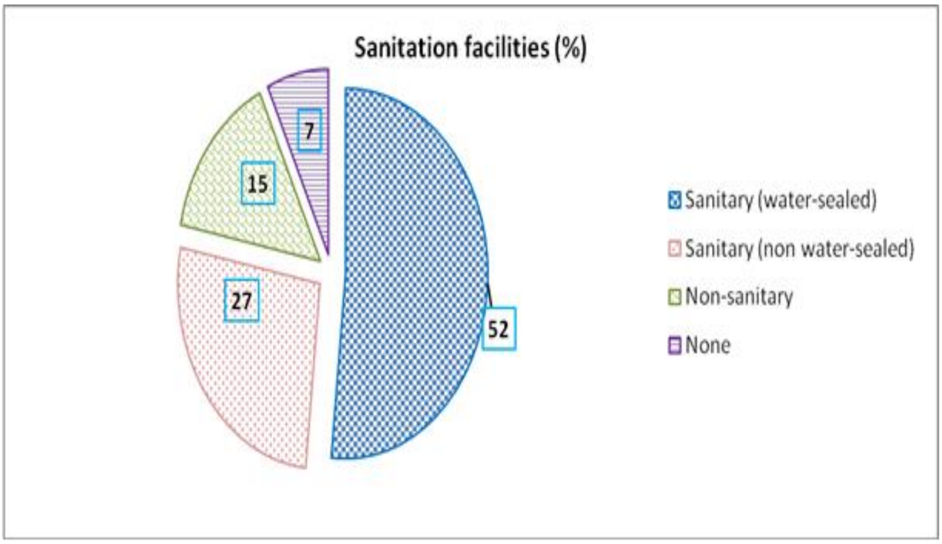


Source: Housing and Population Census, BBS, 2011

Figure 6.23: Housing conditions in the study area

Photo 6.57: Different types housing structure at the polder area

346. Sanitation[13] facilities in the study area show that about 52% households use sanitary (water-sealed) latrines, 27% use non water-sealed sanitary latrines and 15% use latrines. Field findings confirm that non-sanitary latrines are predominant among the kutcha houses where water-sealed sanitary latrines are used in kutcha, semi-pucka and pucka households. However, 7% houses have no sanitation facilities but tend to use on shared basis and in some cases use open spaces (Figure 6.24).



Source: Housing and Population Census, BBS, 2011

Figure 6.24: Distribution of households by sanitation facilities

Photo 6.58: Sanitation facilities of the area

347. According to BBS report 2011, almost 99% people collect drinking water from tube-wells. But field data indicates that there is an arsenic contamination in almost 35% tube-wells.

[13] BBS defined four types sanitation in Bangladesh such as (i) Sanitary (water-sealed): A water sealed latrine is simply a pit latrine that has a water barrier to prevent odors. These latrines are simply pits dug in the ground in which human waste is deposited.(ii) Sanitary (not water-sealed/ring slab), latrine with a slab or other secure cover 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.

Therefore, purified water supply by the government is the main source of drinking water of the people living in the Polder.

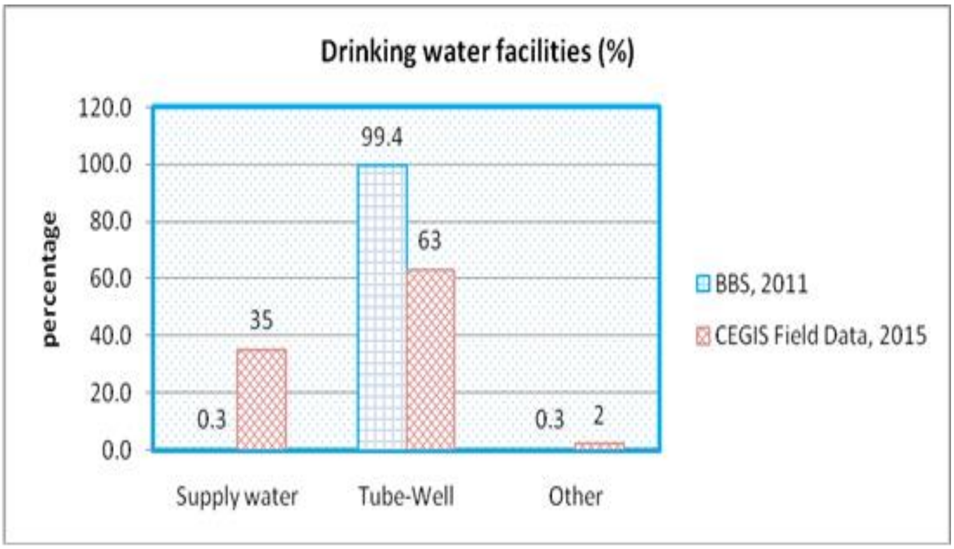


Figure 6.25: Distribution of households by sources of drinking water facilities

Photo 6.59: People collect safe drinking water from different sources

348. Nevertheless crisis of drinking water is also present in the area. Although most of the people collect drinking water from government sponsored purified water supply, tube-wells, and harvested rain water. But poor people of the area collect drinking water from their neighboring tube-wells (Photo 6.60)

Photo 6.60: Women collect drinking water from neighboring household.

6.4.9 Poverty and Safety Net

349. 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 6.26).It is observed that about 4%of the households on average are in the 'deficit' category.These households have been identified in the RRA as the poor households of the Polder area. Considering the standard consumption of food (three meals in a day), the deficit group was usually taking two meals in a day in the lean period since they could not afford three full meals. Only 11% of the households are in surplus category and the rest 85% are in the balance category.

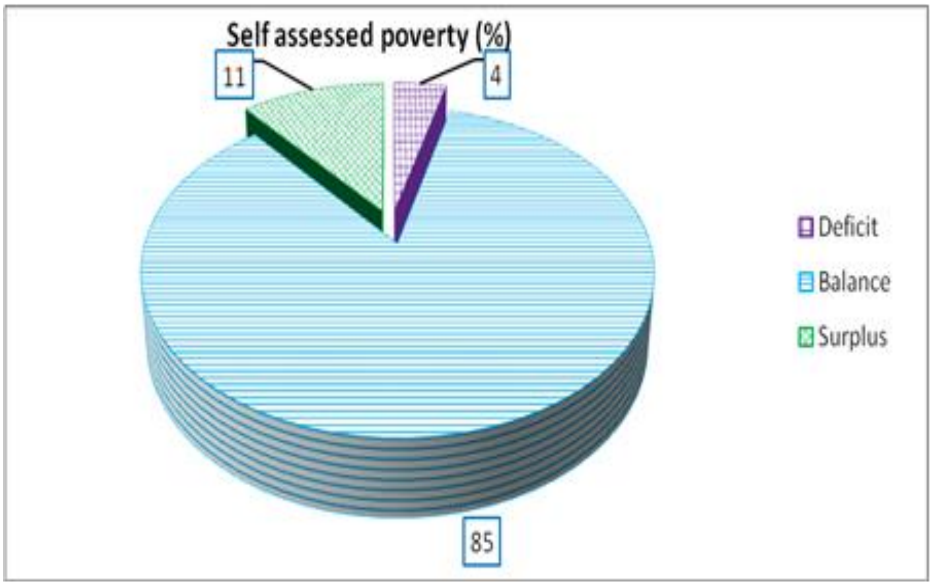


Figure 6.26: Self assessment of poverty status

6.4.10 Social Capital

350. Different types of safety net programs are initiated by the government and NGOs in the polder. The major social safety nets and poverty reduction programs, initiated by the governmentin the area include the Vulnerable Group Development (VGD), Food/Taka for Works (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 of the poor people stated that, in reality, they get very minimum advantage from the government programs, which is basically given on the basis of political consideration. They have to rely more on NGOs activities.

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

352. With micro credit programs, many NGOs are also providingvarioussocial development activities without any charge. For example, HYSAWA is working to supply pure drinking water, 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. Along with micro credit, SMKK gives them adequate information about agricultural cultivation, money for domestic animal rearing, training on fish cultivation and free treatment facilities. Some of the activities and programmes of the NGOs going in the Polder area are shown in Table 6.29

Table 6.29: NGOs and their Programs in the Project Area

Name of theNGOs	Type of Programs							
	Credit	Education	Water and Sanitation	Health	Disaster	Gender	Food security	Others
SMKK	-	✓	✓	✓	-	-	✓	✓
BRAC	✓	✓	✓	✓	-	✓	✓	✓
Uttaran	✓	-	-	✓	-	-	✓	✓
ASA	✓	-	-	-	-	-	-	-
Muslim Aid	-	✓	-	-	-	-	✓	✓
Grameen Bank	-	-	-	-	✓	-	✓	-
Bureau Bangladesh	✓	✓	-	-	-	-	-	✓
Diganto	✓	✓	-	-	-	-	-	-
PolliUnnayan	✓	-	-	-	-	-	-	-
Rupantor	✓	-	-	-	-	-	-	-
Sushilon	✓	-	-	-	-	-	-	✓
HYSAWA	-	-	✓	-	-	-	-	

Source: CEGIS fieldwork, 2015

Photo 6.61: NGOs activities in the area

6.4.11 Roads

353. There are various types of roads providing the means of communication within the Polder area. Basically, the Polder is bounded by Salta and Taltola rivers on the West and North, Gangrail and Bhadra River on the East and South. People of the polder can easily enter

into the upazilasadar by upazila pucka road.According to NWRD database, about 42 km of motorableroad network exists in the studied unions of which about 13.7 km are paved/brick soling and 28 km are earthen. Some portion of the Polder's communication system is well developed and people of the area are satisfied for their communication system like the village of Mandartala, Katalia and Shibnagar,etc, while in the other locations communication is comparatively very poorlike the village of Haburia, Andharmanik and Khorerabad etc. Table6.30presents data on road network in the Polder area; Photograph 6.62 presents some photographs of these roads.

Table 6.30: different roads of the study area

Name of the Unions	Types of the Roads	Description	Length (KM)	Total
Magurkhali Sovna Atlia	Paved/ Brick Soling	Kathalia bazar-Magurkhali UP Office	4.6	13.7
		Kanchannagar Bazar-Magurkhali UP Office Road	1.6	
		Kanchannagar Bazar-Magurkhali UP Office Road	3.3	
		Kanchannagar Bazar-Magurkhali UP Office Road	0.9	
		Baliakhali bazar-Madartala Bazar via Sovna UP Office Road	0.6	
		Madartala-Parmadartala Rd	1.5	
		Katalia-Madartola	1.2	
	Earthen Road	Magurkhali Bazar-Amurbunia High School	3.5	28.1
		Shibnagar- Katalia WAPDA	5.0	
		Kanchannagar UZR-Kanchannagar village road	1.0	
		Boroikati-Madartola	1.1	
		Amurbunia-Karakata	1.5	
		Langolmura-Khagrabunia Rd	1.5	
		Khagrabunia- Aladipur Rd	2.3	
		Baitahara-Khararbad	1.0	
		Bayersing Bazar-Adharmanik	2.4	
		Baitahar-Khararbad Rd	1.1	
		Khagrabunia-Aladipur Rd	0.9	
		Bayersing-Adharmaik	2.1	
		Amurbunia-Karakata	1.1	
		Langolmura-Khagrabunia Rd	2.4	
		KhagrabuniaPrimary.School Rd	1.2	

Source: CEGIS fieldwork and LGED website, 2016


Photo 6.62: Roads of the studied area

6.4.12 Market/growth centre

354. The Polder-17/1 is located at a distance of almost 50-60 km away from Khulna sadar. There are 10 markets in the polder area. Among them, Mandartala Bazar is significant and different types of commodities are available there. Though thereexist a number of markets people have to go to upazilasadar and Khulna for important marketing. The village markets only serve their daily requirements. In this context, people’s first priority is Mandartala Bazar. Moreover, other small markets of the area play important roles for the inhabitants.

Table 6.31: Markets and growth centre in project area

Unions	Number of markets / bazaar	Name of the Markets / bazaar
Magurkhali Sovna Atlia	10	➢ Mandartala Bazar ➢ Shibnagar Bazar ➢ Katalia Bazar ➢ Kanchan Nagar Bazar ➢ Khagrabunia Bazar ➢ Gajalia Bazar ➢ Magurkhali Bazar ➢ Andharmanik Bazar ➢ Boyarsinga Bazar ➢ Ahladipur Bazar

Source: CEGIS Fieldwork 2016

Photo6.63: Markets in the study area

6.4.13 Gender and Women

355. Field observation suggests that the Polder is highly a male dominated area. Roles of women in both decisions making at household level and economic contribution to household income are insignificant. Traditional believe is very strong here that generally males make all major household decisions and at the same time they contribute to household income more than females. Very few women participate in agricultural activities in field while some others work as day labors(Photo 6.64). Wage discrimination is very common where male labor gets Tk. 300 to 350/ day while women labor gets Tk 200 to 250/day.


Photo6.64: Women participate in outside activities

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

357. Women mobility in the area is mostly localized except moving for medical treatment, fetching water, farming activities and visiting relatives. Mortality rate of the pregnant mother during delivery period has been reduced in the area. The growing consciousness among the local people as well as the health services provided by the public and other health centers including the programs of NGOs have contributed to the decrease of the mortality rate.

6.4.14 Social Structure

358. Social stratification is also found in the studied area where the types of capital, e.g. social capital with the people, cultural capital, physical capital, financial capital,etc determine their positions. Gher owners belong to the highest strata and landless to the lowest. The power structure which was earlier operated centering the land ownership is now changing. People withGhers are now dominantingthe rural power structure. Even the land owners obey the Gher owner because they are linked with external power sources and politically powerful. The conditions of the marginal land owners have now worsenedin the Polder area.

359. In social relation, males are considered as the main livelihood earner whereas females are usually confined in household chores. Some women are also involved in shrimp cultivation who basically collect shrimp fry and work as a day laborer in earthwork and brickfield work. Furthermore, kitchen garden is mainlymaintainedby women. For decision making both in society and in family, males are the main contributors. People reported that as female literacy rate is gradually increasing, they are now contributing, although trivial, in household income particularly in service sector such as teaching, factory worker, etc.

6.4.15 Rituals and festivities

360. Anniversaries, Fairs and Festivals play a vital part in the social life of ordinary people of the Polder-17/1. The major religious festivals are Durga Puja for the Hindus and Eid-ul-Fitr and Eid-ul- Azha for the Muslim community, and Christmas for the Christians. Although there are many types of discriminations in the Polder area, but there is no religious discrimination. Different types of religious groups are performing their religious festivals cheerfully. Even

community participate in the festivals with eagerness of other religions' communities. Muslims participate in different types of Pujas whereas the Hindus and the Christians also participate in Eids and many other Muslim festivals. All religious communities also participate in the ethnic community's festivals.

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

Photo 6.65: Fair at the time of Kali Puja (a Hindu Religious Ritual) at Katalia Bazar premises

6.4.16 Common Property Resources

362. The common property resources and community facilities in the area are different social amenities, e.g. mosques, graveyards, temples, cremation grounds, playgrounds, open water bodies and Eidgahs (place for offering Eid prayers). These are used by the local people for the purposes of religious, social and cultural gatherings.In addition, the BWDB embankment is also very commonly used for different livelihood purposes, i.e. living or taking shelter by the local inhabitants. However, there is no known historical and archeological site declared by government in the Polder area. There are 10 local Bazars, 8 club houses, 5 play grounds, a cultural center, a police camp at Magurkhali, 3 cyclone centers, 8 temples, 8 Graveyards, 3 mosques and one Eidgah, etc.

Photo 6.66: Different common property resources in the Polder.

6.4.17 Social conflict

363. The people who are Gher owners are few in numbers in the polder area.But most of the people are sufferers for them. In every year, Gher owners enter saline water in the agricultural lands for shrimp cultivation as a result the few number of Gher owners are benefited at the expense of a large number of populations. Except for embankment sluice and flushing gate, the Gher owners also set up own gate by which they enter saline water to the agricultural lands. Even they closed many gates for keeping water in the area. As a result, every year, people of the area face drainage congestion. Consequently, huge number of people lose- their agricultural production, even the betel-nut cultivation is threatened by the drainage conditions. As a result, there exists a conflict between Gher owners and agricultural land owners.

6.4.18 Impact of manually CC block making

364. For rehabilitation of Polder 17/1 under CEIP-1 few CC block will be required for construction/repair of drainage sluice. The block will be made manually.

365. But there will be some impacts of the activities like generating dusts, risks of accidents, possibility of water and soil pollution and noise pollution.

Mitigations

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

7. Analysis of Project Alternatives

7.1 Overview

366. This chapter presents an analysis of various alternatives considered during the Project feasibility and design stage including the 'no project' alternative.To the extent possible, environmental and social considerations of these alternatives have been considered..

7.2 'No Project' Alternative

367. The 'No-Project' option analysis provides a clear view of the existing situation of the Polder and helps understand the need of the proposed interventions under CEIP-1.At present the people in Polder is extremely vulnerable to cyclones, storm surges, wave action, and climate change effects, as described in Chapter 4. Furthermore, the polder is not in a state to provide required services, i.e. protection against tidal inundation, efficient drainage, and minimizing the impact of cyclonic surges.About 25 percent of the Polder area is vulnerable to salinity intrusion and water logging. The silted water channels are resulting into limited navigation in these waterways, declining fisheries, and increasing environmental pollution.

368. The interventions proposed in Polder 17/1 under CEIP-1 are planned to eliminate the major problems described above.To highlight the present state of various aspects in the Polder and to help understand the importance of the proposed interventions under the Project, the 'No Project' and 'with project' scenarios are compared in Table 7.1 below:

369. Section 7.6 provides a detailed assessment of the high positive impacts of the Project that is considered to improve the security and socio-economic conditions for all strata in Polder 17/1.

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

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
Re-sectioning of embankments (35.58 km) and design crest level (6.00 m, PWD and 5.00 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.
Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario

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

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
		reducing the loss of lives and assets.
Re excavation of Drainage Channels(36.7km)	Depth of water would be further decreased, and drainage congestion and water logging would be further increased.	Depth of water bodies will increase, water logging and drainage congestion will decrease and fish habitats will increase.

7.3 'With project' Alternatives:

370. 'With Project' Alternative describes the proposed interventions in order to solve aforementioned problems under CEIP-1.

7.3.1 Site selection alternative:

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

Table 7.2: Results of Multi-criteria Analysis to Prioritize Polder Rehabilitation

Criteria		**Mark Obtained**
Polder No	17/1	
Type of Dyke	ID	
Location of the Polder	Dumuria	
Gross Area of the Polder (HA)	5020	
Embankment Length(Km)	45	
Breach of Embankment (Km)	-	0
Erosion (Km)	37	14
Requirement of BPW (Km)	-	0
Location in the Risk Zone	LRZ	5
Drainage Congestion (HA)	753	1
Opinion of Stakeholder(marks, MV=15, MDV=10, LV=5)	MV	15
Rehabilitation Cost (Crore BDT)	88	10
Special Criterion		0
Total Marks		44

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

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

372. Steps are taken to appraise the technical, financial, economic, environmental, and social considerations which are presented in Table 7.1 below:

Table 7.3: Technical, Economic, Environmental and Social Considerations

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

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

7.3.3 Alternatives during Construction

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

7.3.4 Material Storage

374. For project works in Polder 17/1, two options are available for material storage: within the Polder at suitable location(s); and outside the Polder at suitable locations.The first option would entail easy transportation of bulk materials from the sources outside the Polder; however it would involve regular transportation of materials from the storage site to the work sites.

375. The required materials would be collected and transported from their respective sources to the Polder and then would be stored in the stock yard to be used during construction phase.

7.3.5 Material Sources

376. The sources of construction materials will be finalizedat this level of study. Following part will reveal the outcome of analysis.

Soil for Embankments

377. Embankment renovation process requires agoodamount of soil. The following options are explored to have the source of soil:

378. Borrow pits are the mainsource of soil. Soil is collected from borrow pits at a huge volume from the river. It minimizes cost of transportation. So it has become a good alternative option. It is quite common that these pits will be filled through siltaccumulationwithin a short period of time. Here BWDB is not owner of any land for borrow pits, these are obtained from the owners with an applicable compensation.

379. Re-excavation of channel might be another option of obtaining soil within the polder.If the material’s quality is up to the mark, then this optionwould minimize the excavation cost.

380. If soil quality at riverside is unsuitable for embankments, then riverbedwould be another option whereas soil quality might be attained at a desirable level.But the option would pertain witha higher cost of material transportation and other social and environment related problems like traffic congestion, air and water pollution.

Sand

381. Sand is the essential part for repairing and renovating embankment, concreting works, manufacturing concrete blocks etc. for protecting slope.So, exploring the sources for sand is the significant analysis to conduct. Here, two options are available.

- Sand will be purchased directly from markets. This one is easier to be aquired with consistent quality and assured supply; however it is associated with increased transportation cost and environmental and social impacts including traffic congestion and air pollution.

- Another alternative source of sand is Riverbed.By reducing transportation requirements, it will not only minimize associated costs but also environmental and social impacts.Since the quality is concerned, this sand may not beconsistent. In some cases, it needs to be washed before using.

7.3.6 Alternatives for Workforce Procurement

382. Alternative two options are available to collect the manpower for the construction works.These are explored below:

- Manpower is sourced mainly from within the polder and only bringing more skilled and technical manpower from outside if it requires.This option can effectively reduce camp sizes and transportation need and associated environmental and social problems. This option creates employment opportunities for the local people. It will ultimately improve their financial status anddevelop the ownership for the project. So, It is convincinglya better option for sourcingmanpower.

- Employing majority of manpower from outside the Polder is another option.But thiscan involve traffic congestion and air pollution as it requires larger camps and labor transport. It may spread resentment among the local mass and may lead to resistance as consequence.

7.3.7 Alternatives for Mode of Transportation

383. Trucks are used mostly to transfer all the construction materials to main stock yard. The materials are conveyed from the main stock yard to the worksitemostly by roadand by river as well. The condition of the road way within the Polder is suitable for larger vehicles, i.e. dump truck, trolley, excavator, etc.

8. Gangrall River is flowing north eastern part of the Polder-17/1. The average depth is about 10 meter. It is navigable all the year round and can beused for transportingconstruction materials at construction site. To transport construction materials and equipments waterway, as well as roadsare the alternative options. However, roadsaregenerally

preferred. Assessment of Environmental and Social Impacts

8.1 Preamble

384. This Chapter identifies the impacts of the project interventions on environment that may potentially be caused during different Project phases and also suggests the appropriate mitigation measures to avoid, offset, reduce, or compensate these impacts. Key potential impact sites are shown in Map 4.1.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

385. As a part of the environmental impact assessment process, a screening matrix has been formulated specifically for the proposed Project, focusing on the potential environmental impacts during 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 are characterized as follows:

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

386. The matrixof Polder17/1 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.The assessment of the impacts follows the methodology and approach described in Chapter 2.

Table 8.1: Environmental Screening Matrix

	Physical								Biological						Social and Socioeconomic												
Project Phases and Activities	**Air and NoiseQuality**	**Salinity**	**Surface Water Quality**	**Drainage congestion**	**Irrigation**	**Vehicular Traffic**	**Sedimentation**	**Land use**	**River/foreshore side vegetation**	**Herbs and Shrubs**	**Fish habitat**	**Fish movement & migration**	**Aquatic Flora & Fauna**	**Timber& Fruit tree**	**Landandagriculture**	**Noise and Vibration**	**Impacts on crop production**	**Impacts on fish production**	**Flooding**	**Communication**	**Disaster Incidence**	**Socialwater use**	**NaturalHazards**	**SeasonalOut-migration**	**Gender promotion**	**Employment Generation**	**Livelihood development**
Design Phase and Pre-Construction Phase																											
Planning and design of the proposed infrastructures	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	0	0	N
Preparation of construction site, labor shed, material stock yard etc.	MN	N	N	N	N	N	N	N	N	N	N	N	N	N	MN	N	N	N	N	0	N	N	N	N	0	0	0
Labor, materials and equipment mobilization	MN	N	N	N	N	N	N	N	N	N	N	N	N	N	MN	N	N	N	N	0	N	N	N	N	0	0	0
Display of billboard at construction site for public awareness	N	N	N	N	N	0	N	N	N	N	N	N	N	N	N	N	N	N	N	0	N	N	N	N	0	0	N
Construction Phase																											
Re-sectioning of embankment	MN	0	0	0	0	MN	0	MN	0	0	0	0	0	0	0	MN	MN	MN	0	HN	MN	MN	HN	0	MN	MP	MP
Construction/repair of drainage sluices	0	0	0	0	0	0	MN	MN	0	0	0	0	0	0	0	0	0	0	0	MN	MN	MN	0	0	MN	MP	MP
Re-excavation of Drainage khals	0	0	0	0	0	0	0	MN	MN	0	0	0	0	MN	0	MN	MN	MN	0	MN	MN	MN	MN	0	MN	HP	MP
Implementation of afforestation	0	0	0	0	0	0	0	MN	MN	0	0	0	0	0	0	MN	HN	MN	0	MN	MN	MN	HN	0	MN	HP	MP
Operation Phase																											**HP**
Checking of the physical condition and function of embankment and water control structures	N	HP	HP	HP	HP	HP	HP	HP	N	HP	HP	HP	N	HP	HP	HP	HP	HP	HP	HP	N	HP	HP	HP	HP	HP	HP
Checking of the depth of khals	N	HP	HP	HP	HP	HP	HP	HP	N	HP	HP	HP	N	HP	HP	HP	HP	HP	HP	HP	N	HP	HP	HP	HP	HP	HP

	Physical								**Biological**						**Social and Socioeconomic**												
Project Phases and Activities	**Air and NoiseQuality**	**Salinity**	**Surface Water Quality**	**Drainage congestion**	**Irrigation**	**Vehicular Traffic**	**Sedimentation**	**Land use**	**River/foreshore side vegetation**	**Herbs and Shrubs**	**Fish habitat**	**Fish movement & migration**	**Aquatic Flora & Fauna**	**Timber& Fruit tree**	**Landandagriculture**	**Noise and Vibration**	**Impacts on crop production**	**Impacts on fish production**	**Flooding**	**Communication**	**Disaster Incidence**	**Socialwater use**	**NaturalHazards**	**SeasonalOut-migration**	**Gender promotion**	**Employment Generation**	**Livelihood development**
Checking the condition of R/S and C/S slopes	N	HP	HP	HP	HP	HP	HP	HP	N	HP	HP	HP	N	HP	HP	HP	HP	HP	HP	HP	N	HP	HP	HP	HP	HP	HP
Monitoring the functions of WMOs	N	HP	HP	HP	HP	HP	HP	HP	N	HP	HP	HP	N	HP	HP	HP	HP	HP	HP	HP	N	HP	HP	HP	HP	HP	HP

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

8.3 Impacts during Pre-construction phase

387. Site development involves the following activities:

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

8.3.1 Deterioration of Environmental Quality (Air and Noise)

Impact

388. Establishment and construction of site facilities in the Polder may potentially cause noise generation. In addition, noise level around the construction sites and in settlement areas will be deteriorated for mobilization of equipment, machineries,constructionmaterialsand manpower. Navigation will be increased in the watercoursesand additional traffic on roads is expected to intense the noise level of the local vicinity. Therefore, settlements, educational institutions, bazar areas and surroundings of the construction site will be affected by the increased noise level.

389. Besides, exhaust emission from truck/trawler/engine boats containing particulate matter and other ingredientswould deteriorate the ambient air quality around the construction site and nearby areas. Fugitive dust emissions from the material stockyards would also deteriorate the ambient air quality of the locality. Moreover, the air and noise pollution are temporal and are reversible and will naturally return back to their baseline condition.

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

Mitigation

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

- Construction material (sand etc.) should be covered while transporting and stock piled.
- The contractors need to be cautiousto 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.

Residual Impacts

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

8.3.2 Change of land use

Impact

393. Land would be needed to establish temporary facilities including construction camp i.e labor shed and borrow pit areas. It is estimated that about 12 labor sheds would be constructed to established temporary facilities for the rehabilitation works. As per consultation with DDCS&PMSC all labor sheds should be constructed in Khas land and requisite land.

394. The use of borrow pit areas are mainly fallow during dry season. In wet season, these borrow pit areasare used scatteredly for seedbed or grazing of livestock by the dwellers of the polder.

395. 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 up within one or two years due to tidal inundation.

Mitigation

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

- 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.

Residual Impacts

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

8.3.3 Impacts on undergrowth herbs and shrubs

Impact

398. Most of the lands in the polder area near the embankment have shrimp gher(low land) or fallow land (Upper dry land). For which, these lands have no timber and fruit tree except low density of undergrowth local wild herbs, shrubs, grass (Poaceae and Cyperaceae are the dominant family).As a result negligible amount of local grasses like Java grass (Cyperusrotundus) and Durbagrass (Cynodondactylon) will be damaged due to preparation of construction sites, labor shed and material stock yards. These grasses are seasonally grown and will regenerate within one year after completion of construction activities.

Mitigation

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

- Use barren land or possible low vegetated land for placing of materials stock yards
- Fuel wood should be collected from local market.
- The work should be completed within the contracted scheduled time (4 month)
- Labor should be made aware about local faunal species.

Residual Impacts

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

8.3.4 Increased Vehicular Traffic during mobilization

Impact

401. During mobilizationof contractor, equipment, machinery, material, and manpower will be transported to the Polder resulting additional traffic load on roads and in waterways. This traffic may potentially cause traffic congestion particularly in roads. The embankment is the main road communication for a large portion of the local people. However, during haat (weekly market)and marketing time, all the stakeholders use this embankment as road for carrying their goods for buying and selling and other purposes.

402. Moreover, most of the schools are located near the embankment approximately within 100 m to 500m namely PollishreeSecondary Girls School, Katalia Govt. Primary School, TopobonSecondary School, Nangalmura Govt. Primary School and Khagrabunia Reg. Gov. Primary School, etc. Four important bazaars are also located besides the embankment namely Mandartala Bazaar, Shibnagar Bazaar, Katalia Bazaar, Kanchan Nagar Bazaar; 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

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

- The contractor should prepare a traffic management plan (TMP) and obtain approval from the Detailed Design Construction Supervision and Project Management Support Consultant (DDCS&PMSC).
- Contractor should also implement mobilization plan considering water vessels and launch movement in the external rivers and, avoid the time of launch movement.
- The TMP should be shared with the communities and should be finalized after obtaining their consent.
- The TMP should address the existing traffic congestion particularly at Mandartala Bazar and Katalia Bazar.
- Ensure minimal hindrance to local communities and commuters.
- The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes.
- The embankment works should be carried out in segments and soil should be placed linearly on one half of the embankment, leaving the other half for useas track.
- The works of the second half should be undertaken after completion of the first half
- Work schedule should be finalized in coordination and consultation with local representatives and communities, specifically union parishad members of the polder.
- Local routes should not be blocked as far as possible.If unavoidable, alternative routes should be identified in consultation with local community.
- Vehicular traffic should be moved in the polder area and also on embankment during off peak time. School time (10:00 am to 14:00 pm) and day of marketing time (Hat-bar) should be considered for vehicular traffic movement.

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

Residual Impacts

404. The impacts on Hindrance for Pedestrian and Vehicle Movement are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Low.

8.4 Impacts during construction phase

405. Implementation of the interventions involves the following activities during construction phase :

- Re-sectioning of embankment
- Placement and compaction of earth
- Construction/repair of drainage sluices
- Re-excavation of Drainage khals
- Disposal of canal excavated wastes
- Implementation of afforestation

8.4.1 Hindrance for pedestrians and vehicles movement

Impacts

406. Construction activities specifically re-sectioning of embankment will cause temporary disturbance in the movement of local people. A considerable number of rural bazaars i.e.,Mandartala Bazaar, Shibnagar Bazaar,AndharManik Bazaar,Boyarsinga Bazaar, KathaliaBazaar are situated along the embankment and play vital role for livelihood of the Polder inhabitants as well as meeting up the daily needs of the people. During *haat*day and marketing time, Polder people use the embankment as road for carrying their goods for buying and selling and other purposes. Re-sectioning of embankment may disrupt the daily activities of the local people.

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

Mitigation

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

- The works of the embankment should be carried out in segment wise and soil should be placed linearly on one half of the embankment, leaving the other half to be used as public transportation.After completion of the works of the first half, it should be opened for local traffic while works on the other half of the embankment should be undertaken;
- Work schedule should be finalized in coordination and consultation with local representatives (Union Parishad Chairman & members) and communities;
- Alternative road can be used for movement if possible
- The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes; and

- Earth work for re-sectioning of embankment during *haat*day can be shortened for essay movement of local people.

Residual Impacts

409. The impacts associated with the hindrance for pedestrians and vehicles movement are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Negligible

8.4.2 Generate Noise and Vibration

Impact

410. The construction activities particularly demolition of existing water control structures, excavation, compaction, operation of construction machinery and vehicular traffic will generate noise and vibration which are likely to affect the nearby communities.In addition, campsites may also generate noise. Increased noise levels may cause disturbance, nuisance and even health hazards for the nearby communities as well as for the construction workers.In particular, the settlements near the working areas will be exposed to noise and vibration generated by the project activities. Therefore, sensitive receptors including seven schools i.ePollishreeSecondary Girls School,Katalia Govt. Primary School,TopobonSecondary School,Nangalmura Govt. Primary School,Khagrabunia Reg. Gov. Primary School,KaipukuriaMagurkhaliUnion Secondary School,Ahladipur Govt. Primary School which are located close to the embankment(within 500 m) are likely to be more severely affected by noise. The students of these schools may face noise and vibration problem during school time (8:00 am to 1:00 pm). Table 8.2 shows the noise level to be expected from the equipment. According to ECR'97 and IFC- EHS guideline 2007, noisetolerable level 60 dBA is applicable for mixed area and 50 dBA for residential respectively (Table 8.3).

Table 8.2: Noise level expected from the equipment

	Equipment	Noise Level (7m away (dB)
1	Bull-dozer	85
2	Excavator	80
3	Compactor	85
4	Concrete Mixer	85
5	Generator	81
6	Scraper	86

Source: CEIP report, 2013

Table 8.3: Bangladesh and IFC Standards for Noise

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

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

Note:

1. Day time is reckoned as the time between 6 a.m. to 9 p.m.
2. Night time is reckoned as the time between 9 pm to 6 am
3. Silent zones are areas up to a radius of 100 meter around hospitals, educational institutes or special establishments declared or to be declared as such by the Government. Use of vehicular horn, other signals and loudspeakers are prohibited in silent zones.

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

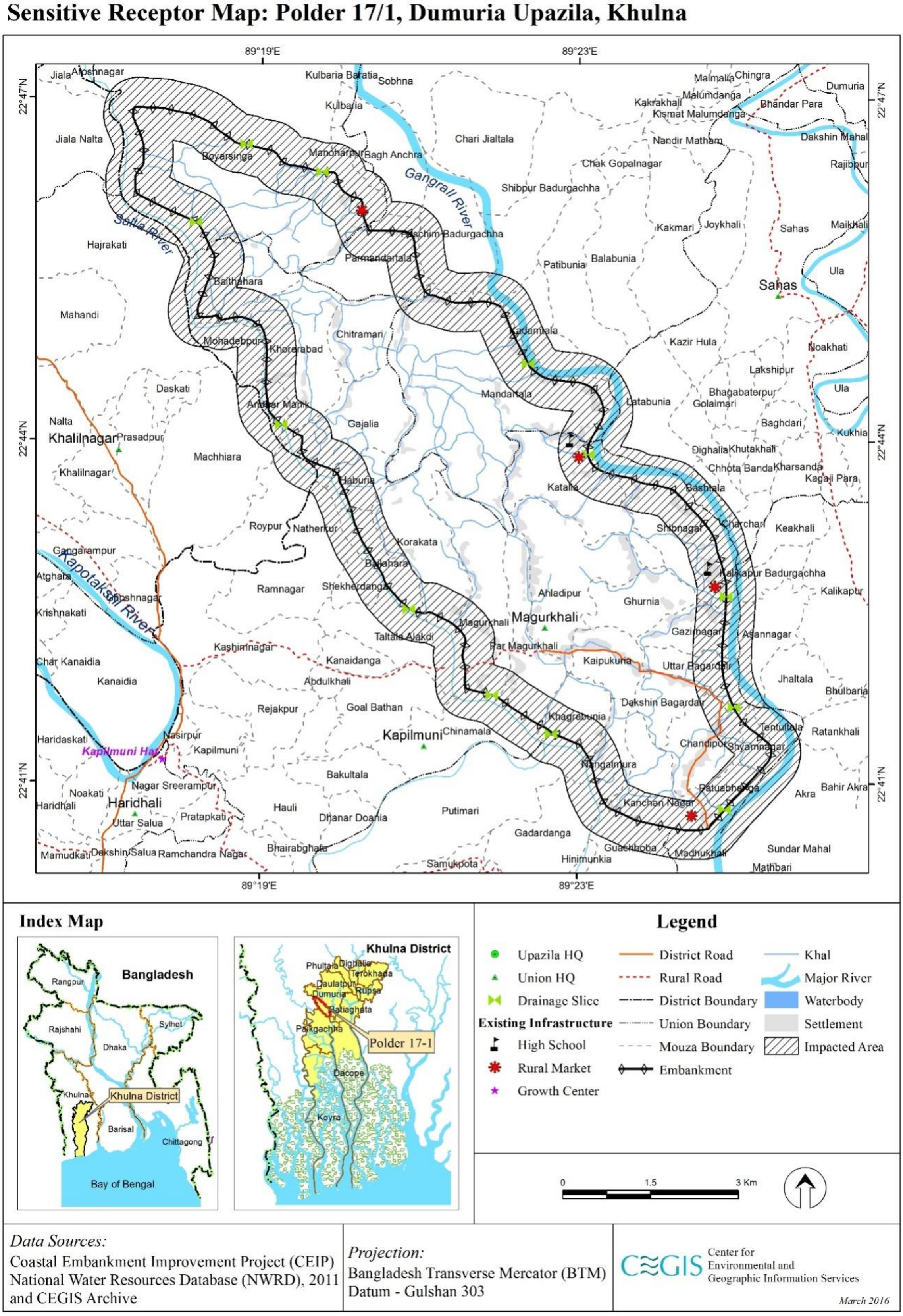
Mitigation

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

- Demolition of the regulators should not be carried out during school time (8 am to 1 pm) particularly near the schools;
- Restricting/limiting construction activities during day time;
- Noise levels from vehicles, equipment and machinery to comply with the national and WB noise standards;
- Vehicles and machinery should have proper mufflers and silencers;
- Provision of noise barriers at schools and other sensitive receptors, as needed;
- Provision of PPE (ear muffs and plugs) to labor;
- The construction crew should be instructed to use proper equipment, to minimize noise levels;
- Camps shouldhave to be located at safe distances from communities

Residual Impacts

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



Map 8.1: Sensitive receptors near the embankment of Polder 17/1

8.4.3 Deterioration of Air Quality

Impact

413. Construction machinery and Project vehicles will release exhaust emissions, containing carbon monoxide (CO), sulphur dioxide (SO_2), oxides of nitrogen (NO_X), and particulate matter (PM).These emissions can deteriorate the ambient air quality in the immediate vicinity of the Project sites (particularly along the embankment, and around the channel excavation sites and borrow pit areas).Furthermore, construction activities such as excavation, levelling, filling and vehicular movement on unpaved tracks may also cause fugitive dust emissions.These emissions pose health hazards for the nearby communities as well as for the construction workers.In particular, the settlements near the working areas will be exposed to air contamination caused by the project activities. The students of seven number of schools i.ePollishreeSecondary Girls School, Katalia Govt. Primary School, TopobonSecondary School, Nangalmura Govt. Primary School, Khagrabunia Reg. Gov. Primary School, KaipukuriaMagurkhaliUnion Secondary School, Ahladipur Govt. Primary School which are located near the embankment, which students is under threat for fugitive dust emissions.

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

Mitigation

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

- Exhaust emissions from vehicles and equipment should comply with standards.
- Proper tuning of vehicles, generators and equipment should be carried out, to minimize exhaust emissions.
- Construction materials (sand/soil) should be kept covered while transporting and stock piled.
- Regular water sprinkling should be carried out as and where needed, particularly on the earthen tracks near communities.
- Vehicle speed should be low (15 km per hour) on earthen tracks particularly near communities and school.
- Vehicles and other machinery should be turned off when idle
- Good quality fuel should be used for minimizing exhaust emissions.
- Camps should be located at safe distance from communities and schools.

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

8.4.4 Degradation of Water Quality

Impact

417. Construction materials, debris of the demolished structures, fuel both from transportation vessels and construction machineries (piling machine, pump etc.) may degrade the water quality. The construction workers will generate domestic solid waste and waste water including sewage.The contractor’s workshops will generate oily water, waste oils, oily rags, and other similar wastes.The stores and warehouse will generate solid waste such as empty cement bags, cardboards, and wooden crates.Improper disposal of these waste

streams can potentially contaminate the water resources of the area. Water contamination can potentially have negative impacts on the local community, natural vegetation, agriculture, and biological resources of the area including aquatic flora and fauna. Borrowing material from the river banks may potentially cause increase turbidity in the rivers. Further, release of effluents, soil, and/or sand in water bodies may increase water turbidity, which would prevent sunlight to enter into the water which is necessary for promoting photosynthesis of aquatic plants.

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

Mitigation

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

- Contractor will prepare and implement pollution control plan.
- Contractor workshops should have oil separators/sumps to avoid release of oily water;
- Contractor should use plastic sheet or gravel in the workshop and equipment yard to prevent water contamination.
- Contractor should ensure that there is no leakage, spillage, or release of fuel, oil or any other affluent/waste in the water from boats, trawlers, launches, and barges.
- Material borrowing from the river banks should be at a distance sufficiently away from the water line, minimizing the possibility of loose soil to wash away in the river.
- Contractor should locate labor sheds/camps including their sanitary installations away from water bodiesContractor should prepare and implement camp waste management plan (septic tanks, proper solid waste disposal).
- Contractor should not release untreated wastes in water bodies.
- Contractor should re-use spoil and excavated material where possible.
- Contractor should dispose spoil at designated areas with community consent.
- Construction material, debris of the demolished structures, and excavated soil/silt should not be allowed to enter into water bodies.

Residual Impacts

420. The impacts associated with water quality are likely to be addressed with the help of the above mitigating measures appropriately and the significance of residual impact will be Low.

8.4.5 Increase of Drainage Congestion

Impact

421. The Project activities particularly on drainage sluices and in water channels may block or clog the drainage channels, potentially causing drainage congestion in the surrounding areas and negatively affecting the cultivation and the associated communities.In particular, areas along Salta, Taltola, Sundorbunia, Andharmanik and ChotoAndharmanik water channels are already facing drainage congestion problems.The project works on the drainage sluices are likely to worsen the situation and exacerbate the drainage congestion problem.In addition, excavation of existing khals in the Polder is likely to disturb the drainage which takes place through these channels.

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

Mitigation

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

- Construct diversion channels before replacement of drainage sluices.
- Sequence of work on the drainage sluices and on the water channels should be carefully planned to avoid drainage congestion.
- Contractor should ensure that drainage channels are not obstructed or clogged by the construction activities which do not causes any drainage congestion situation in the crop fields.

Residual Impacts

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

8.4.6 Increase of Sedimentation

Impact

425. Borrowing material from the river banks may potentially cause increased sedimention in the rivers.Similarly, excavation of water channels if carried out in water can potentially increase their sediment load.Excavated material from the channels if left along their banks may again enter the water thus increasing their sediment load. In addition, construction materials, loose earth/soils, debris of the demolished structures and other materials may enter the river or other water bodies increasingthe sediments in them.Run off from construction sites, camps, and other temporary facilities may enter into water bodies increasing their sediment load.

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

Mitigation

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

- Contractor should excavate channels after dewatering them properly;
- Contractor should not dump the excavated earth and silt on channel banks;
- Contractor should take necessary measures to protect channels from run-off from working areas and camps; and
- Contractor should obtain borrow material from foreshore areasin such a manner so that there is no increase in siltation on the rivers, and should not leave loose soil after excavation.

Residual Impacts

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

8.4.7 Affects on agriculture crop production

Impact

429. Borrow pits for extraction of construction material are expected to be both from inside the Polder and in the foreshore land[14]. Borrow pits will generally be established on private land after agreement between the contractor and the private land owner, typically involving some compensation from the contractor to the land owner. The use of the borrow pit areas inside the polder will typically be converted from agriculture to pond based aquaculture. In the foreshore areas, commonly fallow land will be used. Excavation will take place during the dry season. In wet season, these borrow pits areas are likely to fill up gradually due to sedimentation. The fallow land is used scattered for seedbed or grazing of livestock by the dwellers of the Polder.

430. The significance of this potential unmitigated impact has been assessed as Low based on impact magnitude and receptor sensitivity.

Mitigation

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

- It should be considered a priority to establish borrow-pits in foreshore areas
- Resettlement Action Plan should be prepared and should also be implemented accordingly
- Compensation would be made for any crop damage;
- Contractor would avoid cultivable fields during construction;
- Contractor would avoid agricultural land for material borrowing, material stockpiling and labor camps;
- Contractor would ensure that no vehicular movements take place through the cultivable fields;
- Contractor would ensure that no material is dumped on the cultivation fields;
- Re-excavated soil of canals should not be dumped in agricultural land and
- Contractor would maintain liaison with the local communities;
- Contactor will prepare site specific spoil management and disposal plans for each site to be followed upon approval by the DDCS&PMS Consultant and PMU.

Residual Impacts

432. The impacts associated with loss of agriculture are likely to be adequately addressed with the help of above mitigation measuresand the significance of residual impact would be Low.

8.4.8 Affects on irrigation

Impact

433. Construction activities particularly the repairing of drainage sluices (2nos.), construction of drainage sluice (9 no.) and re-excavation of khals (43 km) can potentially disrupt the crop irrigation temporarily during both wet and dry season thus negatively affecting cultivation. The works on sluices can cut off the incoming water from the river, while the excavation works in water channels can affect water conveyance through them.

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

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

Mitigation

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

- Contractor should construct diversion channels before construction/replacement of each regulator;
- Sequence of work of the regulators andthe 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.

Residual Impacts

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

8.4.9 Declining the Fish Habitat Condition

Impact

437. Construction of diversion channels, construction and repair of sluice gates and bailing out of water from the study area and re-excavation of khals would temporarily damage the present habitats condition of khals. Removal of bottom soil of khals would disturbthe habitat of bottom dwellers such as baim, kuchia (eel) fish, mud crab and benthic organisms of those habitats.

438. Therefore, the significance of this impact has been assessed as Moderate on the basis of impact magnitude and sensitivity.

Mitigation

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

- Contractor should construct diversion channels before constructiing and repairing of each sluice gate.
- Re-excavation work should be done in winter and early dry season i.e., November to February to minimize the hamper of Bagda culture.
- Re-excavation of drainage khals will follow the construction of regulators by spanning a shortest possible time.
- Excavated soil should be dumped on high land at safe distance from the bank of khals.
- Diversion channels should be dismantled just after the completion of the repairing of the sluice gates and excavation work.

Residual Impacts

440. The impacts on fish habitat conditionare likely to be reduced to some extentwith implementing the above mitigation measures. Therefore, the significance of residual impact will be Low.

8.4.10 Obstruction of Fish Movement and Migration

Impact

441. Most of the brackish and freshwater fish species migrate through the khals at some stages of their life cycle for spawning, nursing and feeding purpose. River resident fishes migrate from the adjacent rivers to the polder area through the existing khals during pre-monsoon and monsoon periods. The lateral migratory route for fishes would be obstructed due to construction and repair of 11 drainage sluice gates and re-excavation of 43 km connecting khals. This would directly hamper the lateral migration of mild to moderate saline tolerant fish species.Obstruction to fish migration would result a decline in fish production of the study area and ultimately would affect the dependents livelihoods.

442. Hence, the significance of this impact has been assessed as major on the basis of impact magnitude and receptor sensitivity.

Mitigation

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

- Follow sluice gate operation manual (Appendix-D) for allowing fish migration;
- Duration of construction of structures and other interventions should be shortened as much as possible at least should maintain the contract period.
- Dismantle bundhs and other obstructions built to support the construction of structures as soon as work is over.
- For manual re-excavation of Khals, compartments could be built in a cascade manner and bailing out of water to take place from one compartment to another to avoid damage to fish.
- Sequence of construction of regulators and re-excavation of drainage Khals should be set scientifically so that implementation of project could be completed with minimum hindrance to fish migration.
    - Contractor will maintain liaison with communities so that they could realize the issue. It is more important in case of timing 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 insignificant impact to the shrimp farming and paddy cultivation is caused..

Residual Impacts

444. The impacts on the lateral fish migration are likely to be adequately addressed and reduced to some extentthrough implementing the above mitigation measure. Thus the significance of residual impact will be low

8.4.11 Impact on undergrowth herbs and shrubs

Impacts

445. The Polder/ embankment slopes vegetation is dominant by timber tree, undergrowth herbs and shrubs. Undergrowth herbs, shrubs like vaant *(Clerodendronviscossum)*, akand(*Calotropis procera)*, durbaghas(*Cynodondactylon)* will be damaged both in the embankment slopes and the sites from where soil would be collected during embankment re-sectioning. This type of undergrowth vegetation is seasonally grown and their life time is not more than one year.

Mitigation

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

- Collect soil from barren land as much as possible
- Proper turfing should be made on the embankment slopes with local grasses and ensure regular monitoring of turf grasses till they matured
- Avoid construction activities during favorabletime of wild life movement(early morning and night)

Residual Impacts

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

8.4.12 Impact on timber/ fruit tree

Impact

448. The embankment/ polder road is dominant with timber tree like Babla (*Acacia nilotica)*, Akashmoni *(Acacia auriculiformis)* etc. About one sixty two (162) number of treesof different size and height will be damaged/cut down for construction of water control structures (replace). Wildlife will relocate their habitat for the damage and loss for vegetation damage. Table below represent the total number of trees to be cut down for construction of water control (replace) Structures.

Table 8.4: List of trees to be cut for construction of new structures

Structure ID	Tree to be cut	
	Species Name	No. of trees
DS1	Babla(*Acacia nilotica)*	27
	Akashmoni*(Acacia auriculiformis)*	1
DS1A	Babla*(Acacia nilotica)*	4
DS2	Bot(*Ficus sp.)*	1
DS2A		No timber/ Fruit tree
DS3	Babla*(Acacia nilotica)*	61
DS4	Babla*(Acacia nilotica)*	3
	Geowa*(Excoecariaagallocha)*	4
DS5		No timber/ Fruit tree
DS6		No timber/ Fruit tree
DS7	Babla*(Acacia nilotica)*	4
	Khejur*(Phoneixsylvestirs)*	3
DS8	Babla*(Acacia nilotica)*	10
	Akashmoni*(Acacia auriculiformis)*	8
DS8A	Babla(*Acacianilotica)*	8
	Akashmoni*(Acacia auriculiformis)*	1
DS9	Babla*(Acacia nilotica)*	25
	Khejur*(Phoneixsylvestirs)*	2
	Total	**162**

Mitigation

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

- Give proper compensation to the tree owners against tree felling. It is mentioned here that a detail Ressetlement Action Plan (RAP) is being prepared for Package-3 under CEIP. According to plan, payment to owners against tree felling will be established and the vegetation damage will be compensated according to Resettlement Action Plan (RAP)
- Implement plantation with native species i.eSirish (Albizialebbeck), Narikel (Cocos nucifera), Tal (Boassusflabelifer), Khejur (Phoneixsylvestirs), etc) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works.
- Avoid construction activities during favorabletime of wild life movement(early morning and night)

Residual Impacts

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

8.4.13 Impact on aquatic flora and fauna

Impact

451. All proposed khals are shallow and no aquatic vegetation is observed because of tidal flow and salinity. But this type of wetland to support with success saline tolerant fauna as well as a number of crab, fishes (details fisheries section), mudskippers and shorebirds like Skipper frog, Bullfrog, Kingfisher, Egret, common aquatic snake, etc. The proposed interventions namely khal re-excavation would damage the aquatic flora and fauna.

Mitigation

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

- Keep untouched the deepest points of the khal as much as possible.
- Use excavated soil spoils for khal dyke re-sectioning
- Implement tree plantation with local species at the khal bank side after re-excavation work where excavated soil dumped khal bank side.
- Use minimum land as much as possible for excavator/ labor movement

Residual Impacts

453. The impacts associated with re-excavation of khal are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Low.

8.4.14 Impacts on river/ foreshore side vegetation

Impact

454. Most of the river/ foreshore areas in the polder area have already been consideredfor afforestation. However, further afforestation program may damage existing undergrowth vegetation due to labor movement. Uncautious disposal of sapling's poly bags may cause deterioration of soil quality during plantation at foreshore area. There may be a risk to outbreak of plant diseases to the other existing plants from the disease affected saplingsplanted. Water flow in creeks and strips of planted area may interrupt for aggregation of plant or plant shoots. Inadequate distance between two saplings may hinder proper growth and cause disease outbreak.

Mitigation

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

- Aware labors about plant conservation who are engaged for afforestation activities
- Collect saplings from near by natural sources as much as possible.
- All kinds of polyethylene bags and plastic ropes should bepiled up in a pit for dumping or burning in a proper way
- Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation (i.e. using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers)
- Pre-consultation with Forest Department and other related non-government organizations for selecting suitable species for plantation and spacing of the saplings
- Develop a pest management plan for the holistic afforestation

Residual Impacts

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

8.4.15 Safety and Public Health Hazards

Impact

457. The Polder area is prone to cyclones and storm surges.Although the works will be carried out during dry season, a certain level of safety hazards still exists for the people to be engaged in the construction. 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 can potentially expose the nearby population to communicable diseases.

Mitigation

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

- The contractors should prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants.The Plan should also include awareness building and prevention measures, particularly for communicable diseases such as hepatitis B and C, and HIV/AIDS.
- The WBG’s EHS Guidelines should be included in the contract documents.
- Each contractor should prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan should be submitted to the Construction Supervision Consultants for review and approval;

- All workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.
- Liaison should be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets should be kept in all the labor camps for obtaining weather information.
- The construction sites should have protective fencing to avoid any unauthorized entry, where appropriate and possible
- Health screening of employees would be a Contractors obligation prior to laborers working on site and living in the temporary accommodation facilities. The health screening would entail normal review of physical fitness and also include a review of appropriate vaccinations. Workers would be given vaccinations as and where required;

459. 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;[15]

- 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 theIFC/EBRD workers accommodation guidelines.[16]
  - Public awareness training and workshops on safety and health risks should be conducted for local communities prior to and during construction operations.
  - Observing statutory requirements relating to minimum age for employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activities. The construction contractor(s) should not hire people under the age of 18 on permanent contracts but would include short training activities for youth to the extent possible;
  - Ensurethe acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work;
  - Ensure thatno workers are charged fees to gain employment on the Project;
  - Ensure therigorous standards for occupational health and safety are in place;

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

[16] http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/learning+and+adapting/knowledge+products/publications/publications_gpn_workersaccommodation

- Contractor should establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.
- The contractor should adopt a Human Resource Policy appropriate to the size and workforce which indicates the approach for management employees (this could be part requested in the tender process);
- Produce job descriptions and provide written contracts and other information that outline the working conditions and terms of employment, including the full range of benefits;
- Provide health insurance for employees for the duration of their contracts;
- Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts;
- Develop a recruitment process community employees that involves local authorities in clearly understood procedures;
- Employ a community liaison officer (which could be full time or part of another post's responsibilities);
- Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training;
- Regularly report the labor force profile, including gender, and location source of workers;
- Report regularly the labor and working condition key performance indicators, for instance hours worked (regular and overtime) during period and cumulatively, hours lost, number and type of accidents, near misses, site audits and meetings; trainings, and use of labor grievance mechanism;
- Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase;
- Organize training program and keep training registers for construction workers;
- Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project.
- Availability of safe drinking water should have to be ensured for the construction staff.
- First aid boxes should have to be made available at each construction site.Emergency phone numbers (including hospitals, Fire services, and Police) should have to be displayed at key locations within the site.Each site should be occupied with an ambulance.
- Firefighting equipment should have to be made available at the camps and worksites.
- Waste management plan is to be prepared and implemented in accordance with international best practice.
- Liaison with the community should have to be maintained.

Residual Impacts

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

8.4.16 Increased Inland and Waterway Traffic

Impact

461. Transportation of construction materials is a key concern during implementation of the Project, the Polder-17/1. Two broad options are available for carrying construction materials to the Project stockyards of the Polder. The first option is road transportation and the other option is waterway transportation which is comparatively easier, cost effective and faster. The first option would involve transportation along Khulna-Mongla port. The second option would involve road transportation from Khulna to Dhaka highway.

462. 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.

Mitigation

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

- Contractor is to prepare and implement traffic management plan
- Contractor is to establish new, temporary jetties as and where needed.
- River crossing for material transportation should be during night time as and where possible and appropriate
- Liaison to be maintained with community and BIWTA.

Residual Impacts

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

8.4.17 Hindrance for Pedestrian and Vehicle Movement

Impact

465. Four main markets are located on the embankment; these include Mandartala Bazar, Shibnagar Bazar, Katalia Bazar and Kanchan Nagar 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 especially at Katalia Bazar where DS-2A is within the market even it encompasses some shops of the market. Therefore, it is assumed that the construction activities may disrupt the people of the market.

Mitigation

466. The following mitigation measures should be taken 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.The works when being completed of the first half, should be opened for local traffic while works on the other half of the embankments should be undertaken.

- Work schedule should be finalized in coordination and consultation with local representatives and communities.
- Local routes should not be blocked as far as possible.Alternative routes if unavoidable should be identified in consultation with local community.
- GRM should be put in place.

Residual Impacts

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

8.4.18 Damage to Local Infrastructure

Impact

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

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

- The condition of the instruments, vehicles and eqipments being used for the construction and transportation activities will be regularly monitored.
- All damaged eqipment should be restored to original or better condition.

Residual impact

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

8.4.19 Social unrest between Local worker and outside worker

Impact

471. A large numbers of skilled and unskilled labors will be required for the 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 the Polder area while the remaining will come from other areas.The presence of outside laborers in the area may create friction and conflict between the local labor and outside labor, and between local community and outside labor.

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

Mitigation

472. The following mitigation measures should be taken 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, UpazilaNirbahi Officer (UNO) and BWDB local officers.

- Liaison with the communities shouldhave to be maintained.
- Cultural norms of the local community shouldhave to be respected and honored.
- GRM shouldhave to be established to address the grievances of local as well as outside laborers.
- To be careful is use of local natural resources and project resources, fuel, fuel-wood and electricity.
- Restrictions are to be imposed consumption of alcohol and drugs.
- To be careful about safe driving
- To respect the local community and the cultural norms in which laborers are working.
- Avoid construction activities during Prayer time.

Residual Impacts

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

8.4.20 Natural Hazards

Impact

474. Historically, this area is vulnerable to cyclone, storm and tidal surges. As per construction schedule, the development activities of the proposed new polder will be conducted from October to May while most of the cyclone and storm surges are occurred in this area.According to previous record of occurrence of cyclone and storm surges, October to November and April to May are the pick months of occurrence of cyclone and storm surges. It is suspected that the construction activities during this period may hamper as well as the workers may be injured.

Mitigation

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

- Weather signals shouldhave to be considered by the contractor during construction works.
- Radio and television shouldhave to be kept in all labor sheds for getting weather information through these media.
- Ensure rigorous standards for occupational health and safety are in place.
- Having the Contractor establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.

Residual Impacts

476. The impacts associated with natural hazards are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact will be Moderate.

8.4.21 Safety and Public Health Hazards

Impact

477. 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.

478. Inappropriate waste disposal at the camps and construction sites, and air quality deterioration caused by the Project's vehicular traffic and construction activities potentially pose health hazards for the construction staff and nearby population.Unhygienic condition and unavailability of safe drinking water for the construction staff will expose them to health risks.In addition, influx of construction staff can potentially expose the nearby population to communicable diseases.

Mitigation

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

- The contractors will prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants.The Plan will also include awareness raising 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. 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;[17]
- All temporary facilities including labor camps will meet minimum safety, hygine and sanitation requirements (safe drinking water, proper sewage disposal, solid waste management, general cleanliness, protection against disease vectors, protection against weather elements, fire fighting, and other similar essential services)
- All workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities;
- The construction sites will have protective fencing to avoid any unauthorized entry, where appropriate and possible;
- Health screening of employees would be a Contractor obligation prior to 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 site staff will undergo screening against communicable diseases.Communicable disease careers will not be employed at the site.
- 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.

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

Training would include the provision of appropriate written or visual materials to reinforce learning. Where illiteracy levels are high, OHS issues need to be covered more frequently than normal in toolbox talks;

- Public awareness training and workshops on safety and health risks will be conducted for local communities prior to and during construction operations.
- Observing statutory requirements relating to minimum age for employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activity. The construction contractor(s) would not hire people under the age of 18 on permanent contracts but would include short training activities for youth to the extent possible;
- Ensuring acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work;
- Ensuring no workers are charged fees to gain employment on the Project;
- Ensuring rigorous standards for occupational health and safety are in place;
- Contractor will establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.
- The contractor will adopt a Human Resource Policy appropriate to the size and workforce which indicates the approach for management employees (this could be part requested in the tender process);
- Produce job descriptions and provide written contracts and other information that outline the working conditions and terms of employment, including the full range of benefits;
- Provide health insurance for employees for the duration of their contracts;
- Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts;
- Develop a recruitment process community employees that involves local authorities in clearly understood procedures;
- Employ a community liaison officer (this could be full time or part of another post's responsibilities);
- Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training;
- Report regularly on the labor force profile, including gender, and location source of workers;
- Report regularly on labor and working condition key performance indicators, for instance hours worked (regular and overtime) during period and cumulatively, hours lost, number and type of accidents, near misses, site audits and meetings; trainings, and use of labor grievance mechanism;
- Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase;
- Organize a training program and keep training registers for construction workers;

- Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project:
- Availability of safe drinking water will be ensured for the construction staff.
- First aid boxes will be made available at each construction site.Emergency phone numbers (including hospitals, Fire Department, and Police) will be displayed at key locations within the site.Each site will have an ambulance available.
- Firefighting equipment will be made available at the camps and worksites.
- The camp staff will be provided safety including fire fighting training.
- All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel.
- Waste management plan to be prepared and implemented in accordance with international best practice.
- Liaison with the community will be maintained.

Residual Impacts

480. With the help of above mitigation measu res, the impacts associated with safety and health hazards are likely to be mostly addressed and the significance of residual impact will be Moderate.

8.4.22 Social and Gender Issues

Impact

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

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

Mitigation

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

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

Residual Impacts

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

8.5 Impacts during Post-construction Phase

8.5.1 Increase of sedimentation in water channels and rivers

Impact

485. Sedimentation problem in the external rivers namely Salta, Taltola, Gangrail and Bhadra river will be raised due to absence of silt management plan. Moreover, sediment may be deposited on the intake of regulator which may creates further drainage problem inside the polder if not employ sediment management plan is not applied in future.

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

Mitigation

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

- An ongoing program of de-silting of water channels should be considered with full community involvement and participation.
- Have to provide silt management plan
- The local government institution (union parishad) should be authorized to monitor the development activities.
- To prepare Bangla manual for sluice gate operation and provide training to WMOs; and
- Reduce conflicts between farmers and fishermen.

Residual Impacts

488. The impacts associated with drainage congestion are likely to be mostly addressedwith the help of above mitigation measures and the significance of residual impact will be Negligible.

8.5.2 Increase use of agro-chemicals

Impact

489. Presently, about 447 ha, 814 ha, 995 ha and 166 ha of land are under local Local T. Aus, Local T. Aman, HYV T. Aman and HYV Bororice cultivation respectively.. At Present, 609 tons of chemical fertilizers and 0.9 tons of presticides are required for pesticides for cultivating aus, aman and boro. In future without project, the cultivation cost and uses of pesticides would be increased from the present situation as the farmers would be desperated to cultivate more crops and HYV,s due to their increased demand of crops in adverse situation. According to the initial estimates by the Engineer, about 1.94 m^3 of water would be available in dry season from the internal canal system, after the completion of proposed project.This would allow expansion of area under irrigation for boro and partially aman varieties of rice to about 816 ha of which the areas of T aman and boro are 278 ha and 829 ha respectively. On the other hand local aus and HYV boro area is reduced.This expansion of irrigation cultivation is likely to result decrease in soil fertility and increase the use of chemical including fertilizers and pesticides. Due to expansion of Lt aman and Boro cultivation, additional t449,855 kg or 450 tons of

chemical fertilizers and 6,580 kg or 6.5 tons of pesticides would be required to be purchased in future. Runoff from such cultivation fields might potentially pollute the water bodies and even drinking water sources thus causing health hazards to the communities.

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

Mitigation

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

- Capacity building and awareness raising of the farmers will be carried out to practice Integrated Pest Management (IPM) and Integrated Crop Management (ICM) – in order to minimize usage of chemical inputs.
  - .
  - Farmers group 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.

Residual Impact

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

493. Impacts on cropped areas, requirement of fertilizers and pesticides in present and future scenario are presented in Table 8.4

Table 8.4:Impact on Area (ha), Fertilizers (kg) and Pesticides (kg/ml) required in Present and Future Situation

Crop name	Present cultivate area(ha)	Fertilizer required (kg/ha)	Granular pesticides required kg/ha	Liquid pesticide required ml/ha	Total Fertilizer required(kg)	Total granular pesticides required(kg)	Total liquid pesticides required (ml)	Future cultivated area(ha)	Increased area (Ha)	Total future fertilizer required (kg)	Future granular Pesticides (kg)	Future liquid pesticides required (ml)	Impact		
													Fertilizers (kg)	Pesticides (kg)	Pesticides (ml)
Local T. Aus	247	245	4	500	60,515	988	123,500	150	-97	36,750	600	75,000	-23,765	-388	-48,500
Local T. Aman	814	245	4	400	199,430	3256	325,600	1092	278	267,540	4,368	436,800	68,110	1,112	111,200
HYV T. Aman	995	260	4	700	258,700	3980	696,500	801	-194	208,260	3,204	560,700	-50,440	-776	-135,800
HYV Boro	166	550	8	800	91,300	1328	132,800	995	829	547,250	7,960	796,000	455,950	6,632	663,200
Total	**2222**	**1300**	**20**	**2,400**	**609,945**	**9,552**	**1,278,400**	**3,038**	**816**	**1,059,800**	**16,132**	**1,868,500**	**449,855**	**6,580**	**590,100**

Sources: Feasibility report (Agriculture), CEIP and field information; 2016

8.5.3 Impact of major periodic maintenance works

Impact

494. 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 type of grass and bushes would take place due to soil dumping for re-sectioning work. The repairing works of structure would obstruct movement and migration of fish species like Chingri, Baila, Pairsa and fresh water fish like puti, tengra, bele etc. Fish hatchling movement will also be hampered due to repairing works during hatchling period (May-July). On the other hand, a significant number of local labour will be recruited for earth work, repairing of embankment and afforestation, soil dumping and compaction of earth. Most of the maintenance works will be done by the LCS/WMO involving 60% male and 40% female from the local area. Thus, employment access to both male and females of locality during operation /maintenance phase will be promoted significantly and they can also take part in different decision making processes.

Mitigation/Enhancement Measures

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

8.6 Positive Impacts of the Project

8.6.1 Improve drainage system

495. After implementation of the proposed re-excavation of the internal drainage khals and construction of drainage sluices as per design and specification given by CEIP, the drainage system and situation of the Polder area would be improved significantly. The conveyance capacity of the khals will be increased resulting in proper drainage inside the Polder area. Consequently, the cropping pattern and crop cultivation will be increased while presently about 40% of the net area of the polder is presently covered by shrimp ghers. Drainage congestion in the internal khalsespecially Sudorbunia khal, Andharmanik khal and Soto Andharmanik khal during monsoon will be minimized and drainage pattern will be smoother than in the present condition.

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

8.6.2 Protect intrusion of saline water

Impacts

497. According to the proposed intervention, re-sectioning of embankment and construction of drainage sluices as per design would protect saline water intrusion in the polder area. Proper construction and operation of the sluices will protect saline water intrusion in side the Polder during dry season considering about 40% of the net area of the polder is occupied by shrimp culture ghers. Since operation of sluices play very crucial role, WMOs should be formed and took over the responsibility of the maintenance and operation of the sluices to protect saline water intrusion.

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

8.6.3 Change of cropping pattern and intensity

Impacts

499. Presently, cropping intensity of the polder area is 147%. According to the proposed intervention, the Polder will be protectedfrom tidal and monsoon flooding and will arrest salinity intrusion and would remove drainage congestion in the Polder area. Besides, drainage congestion will be significantly reduced due to re-excavation of internal khals of the Polder area as per proposed plan. Due to improved situation, farmers of the respective areas would be encouraged to cultivate more crops in their lands. Thus, it is expected that cropping intensity would increase to 181% in the Polder area in futureas shown inTable 8.5.So, cropping intensity of the Polder area would be increased around by 34% from the base situation.

Table 8.5: Future cropping patterns of the Polder area

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Area (ha)	% of NCA
F_0 (Highland)	S. Vegetables	HYV T. Aman	Chili	30	1
	Fallow	HYV T. Aman	Fallow	109	5
	Local T. Aus	Fallow	Potato	45	2
Sub- total				**184**	**9**
	Local T. Aus	Fallow	W. Vegetables	105	5
F_1(Medium Highland)	Fallow	Local T. Aman	Fallow	160	8
	Fallow	HYV T. Aman	HYV Boro	225	11
	Fallow	HYV T. Aman	Fallow	139	7
Sub-total				**629**	**31**
F_2(Medium Low Land)	Fallow	Local T. Aman	HYV Boro	487	24
	Fallow	Local T. Aman	Oilseeds	180	9
	Fallow	Local T. Aman	HYV Boro	232	11
	Fallow	HYV T. Aman	Pulses	298	14
Sub-total				**1,197**	58
F_3 (Low Land)	Fallow	Fallow	HYV Boro	18	1
	Fallow	Local T. Aman	HYV Boro	33	2
Sub-total				**51**	**2**
G. Total				**2,061**	**100**
Cropping Intensity (181%)					

Source: Field information; 2015

8.6.4 Increase crop production

Impact

500. Presently, total cropped area is 2,120 ha (NCA 2061 ha) where rice cropped area is 1,951 ha and non-rice cropped area is 169 ha. The project if not implemented the area will remain same as baseline or may reduce. On the other hand, total crop production would be 10,374 tons of which rice would be 5,627 tons (54%) and non rice will be 4,747 tons (46%). Adverse impact may occur due to siltation of river and drainage channels. The production may either remain same as base situation or may decrease as given in Table 8.6.

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

Name of crops	Baseline/FWOP			FWIP			Impact	% of change
	Cropped area (ha)	Yield(ton/ha)	Production (metric ton)	Cropped area (ha)	Yield(ton/ha)	Production (metric ton)	(FWIP-FWOP)	
Local T. Aus	247	1.9	469	150	1.9	285	-184	-18.9
Local T. Aman	814	2.2	1,791	1092	2.2	2402	612	62.7
HYV T. Aman	995	2.9	2,886	801	3.0	2403	-483	-49.5
HYV Boro	166	2.9	481	995	3.1	3085	2603	267.0
Total rice	**1951**	**0**	**5,627**	**3038**	**0**	**8175**	**2548**	261.3
S. Vegetables	249	12	2,988	30	12.0	360	-2,628	-269.6
Chili	60	2.8	168	30	2.8	84	-84	-8.6
Potato	118	8	944	45	8.0	360	-584	-59.9
W. Vegetables	40	14	560	150	14.0	2100	1,540	158.0
Oil Seeds	58	1.5	87	180	1.5	270	183	18.8
Sub-total	**169**	**1.5**	**4,747**	**298**	**1.8**	**3174**	**-1,573**	-161.3
G. Total	**2,120**		**10,374**	**3336**		**11349**	**975**	**100.0**

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

501. The cropped area would be changed if the project is implemented. The cropped area would be 3,336 ha of which rice cropped area would be 3,038 ha and non-rice cropped area would be 298 ha. The crop production might be boosted up significantly under the FWIP condition. The total crop production would be 11,3,49 tons of which rice would be 8,175 tons and non-rice would be 3,174 tons. The rice production would be about 18% higher in FWIP than that of FWOP respectively. Production would be increased mainly due to re-excavation of khal's, construction of structure and repair/replacement of structure with adoption of modern technology in crop production, change in cropping pattern etc. Crop production would increase due to expansion of Local T. Aus, HYV T. Aman, HYV Boro, Chilli, Potato, Oil seeds, summer vegetables and winter vegetables and newly practices of pulses and Wheat cultivation area cultivation area.Additional 975 tons of rice would be produced in FWIP over FWOP Table 8.4

Enhancement

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

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

8.6.5 Reduce soil salinity

503. The proposed interventions such as, re-sectioning of embankment,construction of structure, repair of sluices would protect the polder from tidal and monsoon flooding and will arrest saline water intrusion and would remove drainage congestion from the polder area. Besides, drainage congestion will be significantly reduced due to re-excavation of internal khals of the polder area as per proposed plan. These would increase the area of cultivation thus increase crop production as well as create opportunity of employment.

8.6.6 Fish Habitat Condition

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

Enhancement Measures

- Fisheries Conservation and Protection Acts & rules and fishing ban period should be strictly imposed for protecting indiscriminate fishing, fish eggs, catching of PL of shrimp and other fishes in the khals as well as outer the river adjacent of the Polder area.
- Establishment of fish sanctuary in the deeper part of the khals and there management through fishers' organization.

- Awareness development among the local people through meetings, leaflets/flyers dissemination, demonstration, observation of different days like fish week etc.

8.6.7 Fish Movement and Migration

505. Mending of drainage sluices and re-excavation of khals would facilitate the fish movement and migration would be easier. In addition, increased water depth of khals due to re-excavation would also facilitate the internal fish movement and migration significantly.

Enhancement Measures

- Use of harmful fishing gear like Behundijal, Gill net (current jal) and indiscriminate fishing should be banned during migration period in the study area.
- The illegal fishing in the khals near the sluice gates should be stopped strictly and to be followed by WMAs and fishers.

8.6.8 Fish Diversity and Species Richness

506. It is expected that sufficient freshwater will be available in the khals throughout the year due to re-excavation of the khals and construction/repair of sluice gates. Hopefully, regular migration of indigenous fish species which are locally threatenedwould appear again. Therefore, number of fish species would be increased and availabilityof fishes might be improved.

Enhancement measures

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

8.6.9 Fish Production

507. Culture of fish in ghersand ponds within the polder area would be more secured and protected from saline water and tidal surges due to protection work and re-sectioning of embankment and this will encourage local fish farmers to cultivate fish and shrimp. Re-excavation of 43 km of the internal khals would restore a large area of water body that will increase capture fisheries and facilitate the culture fisheries to promote aquaculture. Capture fisheries productivity would be increased the 40-50 kg/ha due to the intervention and improved management. Beside this, culture fisheries may also be increased significantly 500-600 kg/ha and 400-500 kg/h in the ponds and ghers respectively through applying modern technology.

Enhancement Measures

- Threatened and indigenous fish species should be stocked in the khals to increase fish biodiversity and production.

- Fish sanctuary should be established in the deeper part of each khal to conserve brood fish for the next year spawning as well as protect the juvenile fishes.
- Use of harmful fishing gear like gill net (current jal) should be banned in the capture fisheries.
- Training on environment friendly modern fish, prawn and shrimp culture should be provided to the farmers to intensify the aquaculture.
- The WMAs should be involved in the integrated water management through proper maintenance of sluice gates and khals for expansion of both capture and culture fisheries.

8.6.10 Impacts on foreshore area for afforestation

508. Implementation of afforestation program of this project will mitigate the negative impacts (cutting tree).Therefore, it will enhance vegetation coverage surrounding the polder/ embankment. As a result, this vegetation coverage protects polder/ embankment from tidal surge, erosion and provide wildlife habitat.

8.6.11 Employment Generation

509. The construction work will generate a significant amount of employment opportunity over its construction period for local people and other associated professionals. People will also be involved in carrying out operation and maintenance related jobs to operate the hydraulic structures. It is expected that the agriculture production will be increased; water logging will be decreased due to the project and will create jobs indirectly from agriculture, business and commercial services.

510. On the other hand, during construction period, Earthwork of embankment and construction of structures will create temporary employment opportunities for laborer of the polder area. The employment Generation represents the different way of livelihood by which people can generate their income and improve their living standard.

8.6.12 Gender Promotion

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

8.6.13 Livelihood Development

512. Polder-17/1 was one of the worstly affected Polders in different natural disasters. The project is expected to increase resilience of people within the Polder. The project will increase agriculture production, reduce drainage congestion; generate income which will ultimately improve the livelihood of the people.

8.6.14 Social Use of Water

513. One of the main utility of water is its social uses i.e. taking shower, washing chores and other social uses. During summer, most of the open water bodies i.e. Khals, ponds are

being dried up and causes scarcity of water, the proposed channels will be re-excavated for drainage. 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 the various social use of water.

8.6.15 Disaster incidence

514. Few years back, most of thePolders were severely attacked by Sidr and Aila and almost all the Polders face different natural disasters in every year which cause suffering of people severely. But it is assumed that after implementation of the proposed interventions of the project, the Polder area will be protected directly from different natural disaster e.g. tidal surge, river erosion, flooding etc

8.6.16 Seasonal out-migration

515. The seasonal out migration of day laborers from this Polder area to other areas will be reduced due to creation of employment opportunity in agriculture and other sectors respectively. However, the scale of such out migration will be lowered and in migration in crop harvesting period will increase.

8.7 Summary of Assessed Impacts

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

9. Cumulative Impacts

9.1 Cumulative Impacts

517. 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.

518. 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.

519. 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.

520. Several existing, on-going and planned projects also exist in this region. Such projects may have impact on the hydrological network, life and livelihood of people, environmental quality, natural ecosystem, flora-fauna, etc. of Polder 17/1 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 17/1 under Coastal Embankment Improvement Project-1 (CEIP-1).Besides, necessary mitigation measures based on analysis of cumulative impacts are proposed.

9.2 Proposed CEIP interventions on Polder-17/1

521. 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.

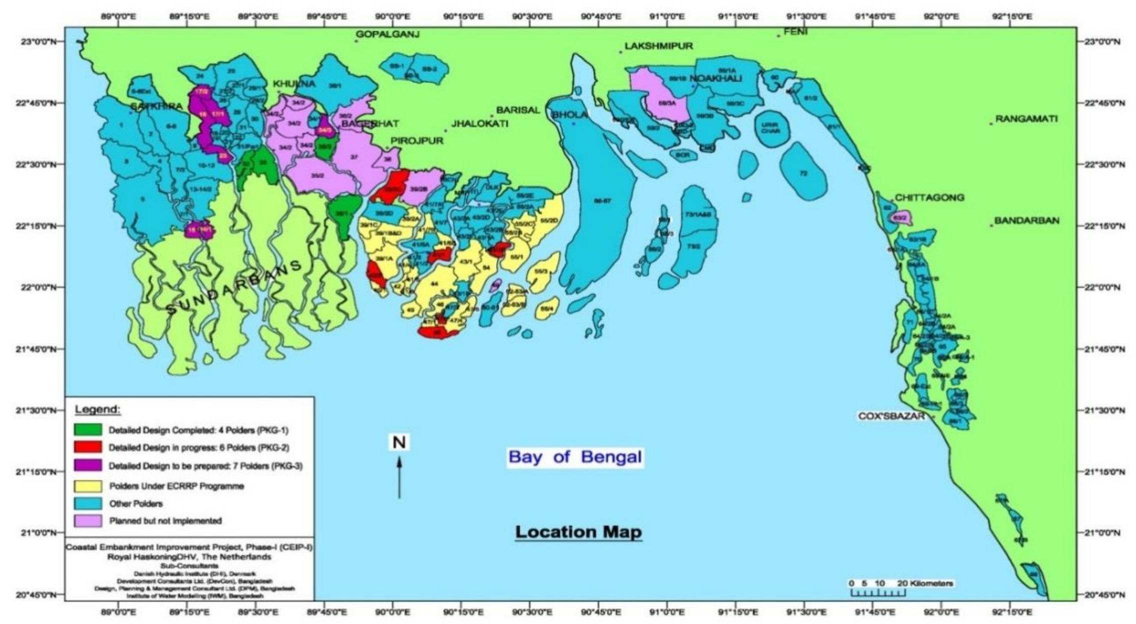
9.3 Synopsis of existing and on-going projects around Polder 17/1

522. Apart from CEIP interventions, there are some other development projects nearby Polder-17/1, implemented locally or regionally.Table 9.1 below shows a list of various projects in relevance with Polder-17/1, undertaken by different line agencies in Khulna, Bagerhat and Satkhira districts.

9.4 Increased Vehicular Traffic during mobilization

523. The contractor should prepare a traffic management plan (TMP) and obtain approval from the Detailed Design Construction Supervision and Project Management Support Consultant (DDCS&PMSC). Contractor should also implement mobilization plan considering water vessels and launch movement in the external rivers and, avoid the time of launch movement. **The TMP should be shared with the communities and should be finalized after obtaining their consent.** The TMP should address the existing traffic congestion particularly at Mandartala Bazar and Katalia Bazar. Ensure minimal hindrance to local communities and commuters. **The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes.**

524. The embankment works should be carried out in segments and soil should be placed linearly on one half of the embankment, leaving the other half for use as track. The works of the second half should be undertaken after completion of the first half Work schedule should be finalized in coordination and consultation with local representatives and communities, specifically union parishad members of the polder. Local routes should not be blocked as far as possible. If unavoidable, alternative routes should be identified in consultation with local community. Vehicular traffic should be limited in the Polder area and the embankment during off peak time. To avoid accident, signal man should be appointed during School time (10:00am to 13:00pm) and weekly marketdays (Hatbar) Keep provision of training Keep provision of training on vehicular traffic moving pattern and management system for the local stakeholders using multimedia presentation and showing Video at different common population gathering places in the Polder area.



Map 9.1: Locations of Polders under CEIP-1

Table 9.1: List of water management projects

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

525. The projects (listed in Table 9.1) which have or may have moderate sensitivities on some of the environmental or social components of Polder 17/1 are briefly discussed in the following sections.

9.5 Cummulative Impacts of proposed and existing projects

9.5.1 Impact on hydrology and flooding situation

526. Polder-17/1 is mainly dominated by Bhodra and Gangrail River at the South-East and North direction respectively. Improvement planning of Polder 17/2 and Polder 16 under CEIP-1 has also taken up with this Polder simultaneously.The proposed design crest level is same (4.5 mPWD) for these three Polders. However, Polder-17/1 may be more affected by the peripheral rivers due to raised crest level of Polder 16 and 17/2. Induced hydraulic pressure of Gangrail river may be diverted to the Polder-17/1 as it is located downstream of Polder 17/2. This may cause high salinity intrusion through peripheral khals (Hatitana, Soto Andharmanik Khal etc.) which are connected to Gangrail River. Water level of Bhodra River may increase due to climate change in future that can be assessed by model result. There is a possibility of storm surge effect due to increased surge level of Bhodra River (with or without climate change) on Polder-17/1.

527. On the contrary, Polders 16 and 17/1 are located parallel and divided by Salta River however, flow of this river has reduced due to siltation at several locations. The proposed higher crest level of the embankment may be slightly tending the flow of Salta River and Haria River to Polder-17/1. The surge level of Salta and Haria River due to climate change in future may affect the embankment of Polder-17/1 and deteriorate water quality by salinity intrusion.

9.5.2 Impact of construction materials on local markets

528. 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.

9.5.3 Impact on Livelihood

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

9.5.4 Impacts on rivers/water courses hydrology

530. 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.

9.5.5 Impacts on fish migration and biodiversity

531. The successive siltation in peripheral rivers and canals of Polder 16 may hamper fish migration. In course of time, fish migration may be fully or partially obstructed in the Polder area due to siltation. As a result, the fisheries biodiversity for both fresh and brackish water may marginally decrease. Due to protection of Polder from flood water, water will move towards the upstream of Salta and downstream of Sibsa and Kabotak rivers during high tide. This increased volume of water will enhance fish migration in that water body. Consequently, fish migration of surrounding canals will be improved. In future, the salinity tolerant fish species will dominate while fresh water fish species may decrease.

9.5.6 Impacts of Blue Gold interventions on Polder-17/1

532. A total number of 17Polders in Satkhira, Khulna and Patuakhali districts have been selected for implementation of the program in the first phase. Among these, Polder 26 and Polder 29 are located very adjacent to Polder-17/1 at North and South-East direction. The Bhodra River has separated Polder 17/2 from Polder 26 and Polder 29. There is a great chance of induced hydraulic pressure of Bhodra River to Polder-17/1 due to proposed higher crest level of Polder 26 and Polder 29. The tidal effect of Bhodra River to Polder-17/1 may cause siltation problem in peripheral canals. The excess siltation may raise the bed level of canals than the peripheral rivers which will hamper natural flow.

9.5.7 Impacts of Marine Shrimp Culture Technology

533. In 1998, Bangladesh Fishery Department (BFD) extended the culture technology of marine shrimp on a macro scale in Khulna, Bagerhat, Sathkhira and Cox's bazaar. Following, the popularity of shrimp culture spread in local level. Shrimp culture during dry season is now a very common practice in Polder 17/1 like in other surrounding Polders. Shrimp culture is less labor intensive compared to agriculture. Therefore, the change of land-use from agriculture to aquaculture reduces the employment opportunities in Polder 17/1. One notable positive impact of shrimp culture in Polder 17/1 is that it initiated a financial revolution of the Polder area. However; it has become a monopoly business with serious impacts on remaining agriculture due to the intrusion of saline water for shrimp culture. Mitigaton Measures:

- Capital dredging as well as maintence dredging of peripheral riversshould be under taken to mitigate the daverse impact.
- Gate operation plan should be maintained considering fish migration period.
- Internal khals linked with Outside River should be re-excavted.
- Prawn culture instead of shrimp culture should be introduced in the Polder area

Reciprocal Impact

534. Reciprocal impacts of Polder 17/1 have been assessed based on the model results conducted by Institute of Water Modelling (IWM). IWM used a rainfall-runoff model, hydrodynamic models and a storm surge model to analyze the existing hydrological situation of the Polder area. IWM evaluated the physical changes in the polder, which may occur due to climate change. All data used in the model setup and calibration (including topography, soil maps, land use maps, and weather data, river network and cross-section, water level, discharge and salinity) were obtained from national/international sources, published reports and surveys by IWM. 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.

535. From the simulation, flood free (FF) area and F0 (0~0.3m) area cover about 13.5% and 8.0% respectively without considering climate change. The fulfillment of drainage criteria requires about 85% to 90% FF and F0 land, whereas 20.6% of FF and F0 land was found from the simulation without climate change.

536. Considering the climate change scenario FF and F0 land cover are reduced to 7.38% and 3.65% respectively. The F1 land class (water depth .03m to 0.9m) also reduced from 45.93% to 17.52%. But the F2 (water depth 0.9m to 1.8m) increased from 32.48% to 70.48%. It implies that about 88.97% land area remains submerged under climate change condition due to inadequate drainage system and needs further attention to obtain a climate resilient Polder management.

537. 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 0.28 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	2.69	2.97	0.28
25	3.32	3.53	0.21
50	3.78	3.95	0.17
100	4.24	4.36	0.12

Sidr	3.22	-	-
Aila	3.13	-	-

538. 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 17/1 are 20.20, 27.75, 33.03 and 38.17 m/s whereas during Sidr and Aila the wind speeds were 29.45and 21.52 m/s respectively.

539. Wind speed for 25 years return period is used for determining the wave height considering climate change. The wave height simulated for Polder 17/1 is 0.35 m.

540. 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 3.16, 3.24, 3.29and 3.34 m + PWD without considering climate change. Water levels considering climate change are 3.68, 3.76, 3.82and 3.87 m +PWD respectively.

541. 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 4.15 m + PWD. The present crest level of the Polder varies from 3.98 to 4.43 m+PWD. So, the present crest level is not sufficient to address future climate change and will be increased to 4.50 m PWD providing additional safety for higher return periods land subsidence as part of the re-sectioning of all embankments in Polder 17/1.

10. Environmental Management Plan(EMP)

542. This Chapter presents the Environmental Management Plan (EMP) for the CEIP-1 activities in the Polder-17/1.The EMP essentially provides the implementation mechanism for the environmental and social mitigation measures discussed in Chapter 8.

10.1 Objectives of EMP

543. The basic objective of the EMP is to manage, prevent, and mitigate potentially adverse impacts of Project interventions in the Polder-17/1.The specific objectives of the EMP are to:

- Facilitate the implementation of the environmental and social mitigation measures identified in the present EIA and discussed in Chapter 8.
- Assign responsibilities for project proponent, contractors, consultants, and other members of the Project team for the environmental and social management of the Project;
- Define a monitoring mechanism and identify monitoring parameters to ensure effective implementation of the mitigation measures.
- Assess environmental training requirements for different stakeholders at various levels.
- Describe communication and documentation requirements.

10.2 EMP Components

544. 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

545. These components are discussed in the following Sections.

10.3 Institutional Arrangement

546. Clearly defined that functional institutional arrangements are essential for ensuring effective and sustainable implementation of the EMP, particularly the mitigation measures identified in the EIA. The institutional arrangements proposed to implement the EMP of Polder 17/1 is shown in Figure 10.1 are described below.

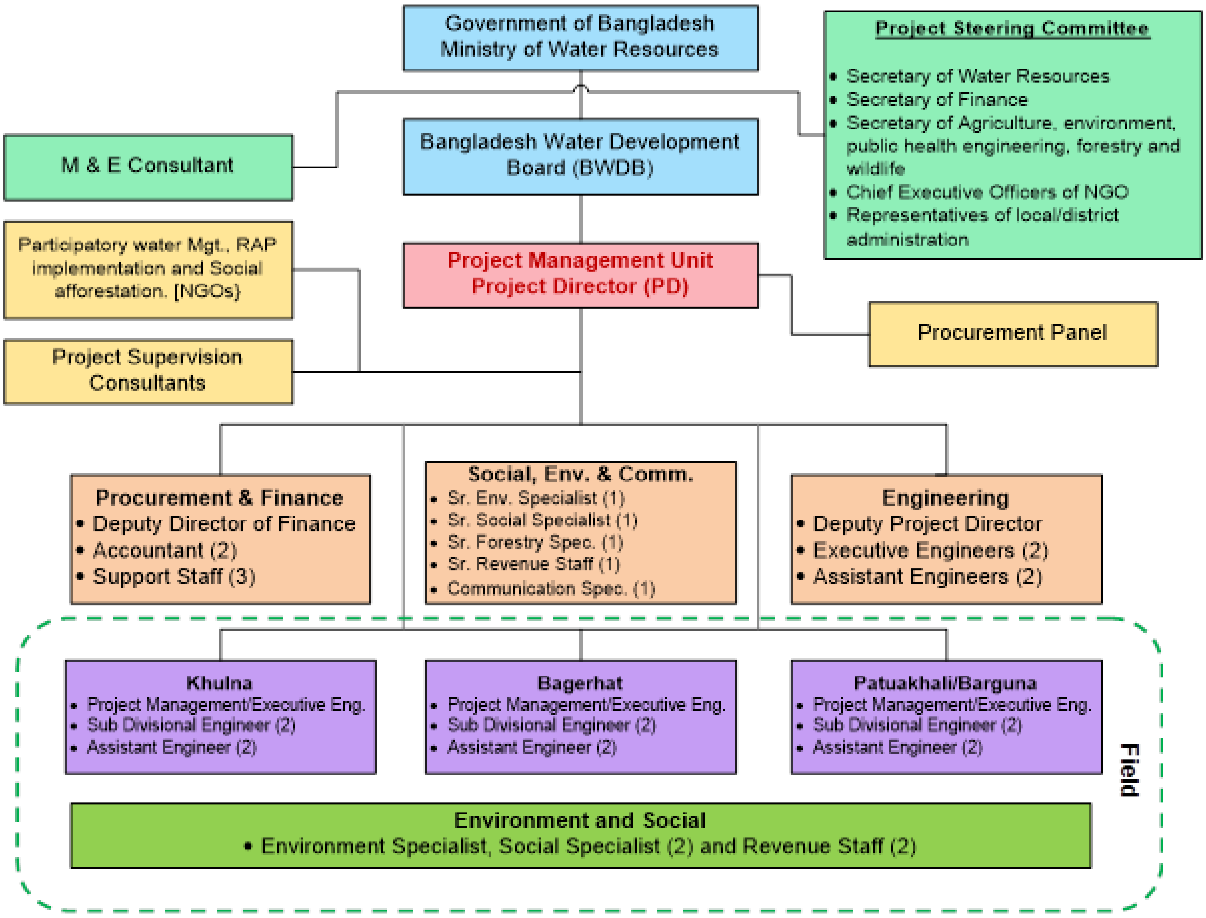


Figure 10.1: Organogram showing the institutional setup for CEIP-1

10.3.1 Overall Responsibility

547. 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, Detailed Design,Construction Supervision and Project Management Support Consultants (DDCS and PMSC) .

10.3.2 Construction phase

Environment and Social Staff in PMU

548. As described in Section 4.8, the BWDB will set up the PMU to manage the implementation of the Project and will be led by the Project Director (PD).To manage and oversee the environmental and social aspects of the Project, the PMU will have an Environment, Social, and Communication Unit(ESCU) .The Unit will supervise compliance with and implementation of the EMP. The Unit will include a Senior Environmental Specialist. One environmental specialist will be posted at the field level to support all the three divisions.The ESCU will maintain liaison with WB safeguard team, regulatory agencies, and other stakeholders during implementation.The ESCU will also coordinate with the environmental staff of the Detailed Design Construction Supervision and Project Management Consultants(DDCS&PMSC). In order to effectively manage the EA process and EMP implementation, the ESCU will be established and made operational before awarding the

contract to the contractor. The ESCU will be responsible for updating the EIA after receiving the pending information.

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

Environment and Social Staff with Detailed Design Construction Supervision and Project Management Consultants(DDCS&PMSC)

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

551. IPoE will review the updated report and guide ESCU for further improvement.

Contractor's Environment Supervisors

552. 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&PMSC at the site. The ESs will also be responsible to conduct environmental trainings for the construction crew.

10.3.3 Post-construction Phase

553. BWDB core unit has post of 4 Assistant Chief and 2 Deputy Chief to oversee the overall environmental compliance of BWDB implemented projects. Under CEIP-1, the ESCU will provide training to the BWDB people responsible for monitoring of environmental compliance. Thus smooth transition to BWDB will take place to ensure environmental compliance during O&M after completion of the project. These staff will be responsible to manage the environmental aspects of the operation and maintenance of one Polder, its water control structures, and other relevant issues such as protection of key environmental resources of the Polder and fish migration. Water Management organizations (WMO) will be formed under the Bangladesh Guidelines for Participatory Water Management (Nov, 2000) and involve the beneficiary communities. WMOs will be trained by BWDB to ensure environmental management during project operation. Environmental Management Unit of BWDB will ensure and oversee the environmental management during project implementation and operation. The Water Management Organization will also be trained and involved in EMP implementation during the operation phase.

10.4 Mitigation Measures and Plan

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

- To eliminate or avoid adverse impacts, where reasonably achievable.

- To reduce adverse impacts to the lowest reasonably achievable level.
- To regulate adverse impacts to an acceptable level, or to an acceptable time period.
- To create other beneficial impacts to partially or fully substitute for, or counter-balance, adverse effects.

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

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

556. Mitigation measures during pre-construction, construction and post-construction operation phases have been presented in a tabular form in Table 10.1The cost related to EMP has been presented in a different Table.T

Table 10.1: Specific mitigation measure

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
Pre-construction Phase			
Deterioration of Environmental Quality (Air and Noise)	• Construction material (sand etc.) should be covered while transporting and stock piled. • The contractors need to be cautious to avoid unnecessary honking of material carrying trawler. • The contractors should be encouraged to move all 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.	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	• Speed limits should be enforced for vehicles on earthen tracks. • Vehicles and machinery should have proper mufflers and silencers.		
Changes in land use	• Establish the construction camps within the area owned by BWDB, wherever available. • Compensation/rent are to be paid if private property is acquired on temporary basis, the instructions should be specified in the tender document. • Construct labor shed/camp at government khas land. • Avoid impacts on local stakeholders.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Impacts on undergrowth herbs and shrubs	• Use barren land or possible low vegetated land for placing of materials stock yards • Fuel wood should be collected from local market. • The work should be completed within the contracted scheduled time (4 month) • Labor should be made aware about local faunal species.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Increased Vehicular Traffic during mobilization	• The contractor should prepare a traffic management plan (TMP) and obtain approval from the Detailed Design Construction Supervision and Project Management Support Consultant (DDCS&PMSC) • Contractor should also implement mobilization plan considering water vessels and launch movement in the external rivers and, avoid the time of launch movement. • The TMP should be shared with the communities and should be finalized after obtaining their consent. • The TMP should address the existing traffic congestion particularly at Mandartala Bazar and Katalia Bazar. • Ensure minimal hindrance to local communities and commuters. • The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works should be carried out in segments and soil should be placed linearly on one half of the embankment, leaving the other half for use as track. • The works of the second half should be undertaken after completion of the first half • Work schedule should be finalized in coordination and consultation with local representatives and communities,	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	specifically union parishad members of the polder. • Local routes should not be blocked as far as possible. If unavoidable, alternative routes should be identified in consultation with local community. • Vehicular traffic should be limited in the Polder area and the embankment during off peak time. To avoid accident, signal man should be appointed during School time (10:00am to 13:00pm) and weekly marketdays (Hatbar) • Keep provision of training Keep provision of training on vehicular traffic moving pattern and management system for the local stakeholders using multimedia presentation and showing Video at different common population gathering places in the Polder area.		
• **Construction Phase**			
Hindrance for pedestrians and vehicles movement	• The works of the embankment should be carried out in segment wise and soil should be placed linearly on one half of the embankment, leaving the other half to be used as public transportation. After completion of the works of the first half, it should be opened for local traffic while works on the other half of the embankment should be undertaken; • Work schedule should be finalized in coordination and consultation with local representatives (Union Parishad Chairman & members) and communities; • Alternative road can be used for movement if possible • The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes; and • Earth work for re-sectioning of embankment during haat day can be shortened for essay movement of local people.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Generate Noise and Vibration	• Demolition of the regulators should not be carried out during school time (8 am to 1 pm) particularly near the schools; • Restricting/limiting construction activities during day time; • Noise levels from vehicles, equipment and machinery to comply with the national and WB noise standards; • Vehicles and machinery should have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors, as needed;	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	• Provision of PPE (ear muffs and plugs) to labor; • The construction crew should be instructed to use proper equipment, to minimize noise levels; • Camps should have to be located at safe distances from communities		
Deterioration of Air Quality	• Exhaust emissions from vehicles and equipment should comply with standards. • Proper tuning of vehicles, generators and equipment should be carried out, to minimize exhaust emissions. • Construction materials (sand/soil) should be kept covered while transporting and stock piled. • Regular water sprinkling should be carried out as and where needed, particularly on the earthen tracks near communities. • Vehicle speed should be low (15 km per hour) on earthen tracks particularly near communities and school. • Vehicles and other machinery should be turned off when idle • Good quality fuel should be used for minimizing exhaust emissions. • Camps should be located at safe distance from communities and schools.		
Degradation of Water Quality	• Contractor will prepare and implement pollution control plan. • Contractor workshops should have oil separators/sumps to avoid release of oily water; • Contractor should use plastic sheet or gravel in the workshop and equipment yard to prevent water contamination. • Contractor should ensure that there is no leakage, spillage, or release of fuel, oil or any other affluent/waste in the water from boats, trawlers, launches, and barges. • Material borrowing from the river banks should be at a distance sufficiently away from the water line, minimizing the possibility of loose soil to wash away in the river. • Contractor should locate labor sheds/camps including their sanitary installations away from water bodiesContractor should prepare and implement camp waste management plan (septic tanks, proper solid waste disposal). • Contractor should not release untreated wastes in water bodies. • Contractor should re-use spoil and excavated material where possible.	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	**Mitigation Measures**	**Responsible Agency for implementation of mitigation**	**Monitoring/ Supervision Agency**
	• Contractor should dispose spoil at designated areas with community consent. • Construction material, debris of the demolished structures, and excavated soil/silt should not be allowed to enter into water bodies.		
Increase of Drainage Congestion	• Construct diversion channels before replacement of drainage sluices. • Sequence of work on the drainage sluices and on the water channels should be carefully planned to avoid drainage congestion. • Contractor should ensure that drainage channels are not obstructed or clogged by the construction activities which do not causes any drainage congestion situation in the crop fields.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Increasing of Sedimentation	• Contractor should excavate channels after dewatering them properly; • Contractor should not dump the excavated earth and silt on channel banks; • Contractor should take necessary measures to protect channels from run-off from working areas and camps; and • Contractor should obtain borrow material from foreshore areas in such a manner so that there is no increase in siltation on the rivers, and should not leave loose soil after excavation.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Effects on agriculture crop production	• It should be considered a priority to establish borrow-pits in foreshore areas • Resettlement Action Plan should be prepared and should also be implemented accordingly • Compensation would be made for any crop damage; • Contractor would avoid cultivable fields during construction; • Contractor would avoid agricultural land for material borrowing, material stockpiling and labor camps; • Contractor would ensure that no vehicular movements take place through the cultivable fields; • Contractor would ensure that no material is dumped on the cultivation fields; • Re-excavated soil of canals should not be dumped in agricultural land and • Contractor would maintain liaison with the local communities; • Contactor will prepare site specific spoil management and disposal plans for each	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	site to be followed upon approval by the DDCS&PMS Consultant and PMU.		
Effects on irrigation	• Contractor should construct diversion channels before construction/replacement of each regulator; • Sequence of work of the regulators and the water channels would be carefully planned to avoid irrigation disruption; • Contractor would ensure having no negative impacts on crop irrigation; • Contractor would maintain liaison with the local communities; and • Contractor would work during dry season.	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	• Duration of construction of structures and other interventions should be shortened as much as possible at least should maintained as per the contract period.Most of the Small Indigenous Species (SIS) of fish spawn during the period of November to April and keep important role in the recruitment to next progeny. For this reason, limit the construction and re-excavation activities in the shallow area and/or maintain the alignment of bank side to keep space in other side for accomplishing migration to meet up the biological needs like spawning, feeding etc. a. • Dismantle bundhs and other obstructions built for supporting the construction of structures as soon as work is over. • In case of manual re-excavation of Khals, compartment could be built and bailing out of water from one compartment to another for less damage to fish and excavate in cascading manner. • Re-excavation of drainage khals will follow the construction of regulators by spanning a shortest	Contractor	DDSCS&PMSC, M&E Consultant, and BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	possible time. Re-excavation of Khals should be implemented by maintaining the alignment of side so that fish can utilize the space on the other side for its migration. As a result, construction activities will have minimum hindrnace to fish migration. • Sequence of construction of regulators and re-excavation of drainage Khals should be set scientifically in such way so that, implementation of project could be done with minimum hindrnace to fish migration. • Contractor will maintain liaison with communities so that they could realize the issue. It is more important in case of timing of entering water into the Polder for shrimp culture along with paddy cultivation and exiting water from the same. Liaison of contractor with community would create scope for setting proper time for the construction work so that no or less impact to the shrimp farming and paddy cultivation is caused.		
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	DDSCS&PMSC, M&E Consultant, BWDB
Impact on timber/ fruit tree	• Give proper compensation to the tree owners against tree felling. It is mentioned here that a detail Ressetlement Action Paln (RAP) is being prepared for Package-3 under CEIP. According to plan, payment to owners against tree felling will be established. • Implement plantation with native species (i.eSirish (Albizialebbeck), Narikel (Cocos nucifera), Tal (Boassusflabelifer), Khejur (Phoneixsylvestirs), etc) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works. • Avoid construction activities during favorable time of wild life movement (early morning and night)	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Impact on aquatic flora and fauna	• Keep untouched the deepest points of the khal as much as possible. • Use excavated soil spoils for khal dyke re-sectioning • Implement tree plantation with local species at the khal bank side after re- excavation work where excavated soil dumped khal bank side. • Use minimum land as much as possible for excavator/ labor movement	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
Clearance of vegetation	• Collect soil for re-sectioning from barren land as much as possible • Proper turfing should be implement at embankment slopes with local grasses and ensure regular monitoring of turf grasses till they matured • Choose barren land for CC Block manufacturing and material storing • Keep close liaison with CREL Project Authority and Forest Department while implementation of earth works • Implement plantation with native species at countryside slope of the embankment to arrest vegetation loss	Contractor	DDCS&PMS CSC, M&E Consultant, BWDB
Impacts on river/ foreshore side vegetation	• Aware labors about plant conservation who are engaged for afforestation activities • Collect saplings from near by natural sources as much as possible. • All kinds of polyethylene bags and plastic ropes should be piled up in a pit for dumping or burning in a proper way • Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation (i.e. using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers) • Pre-consultation with Forest Department and other related non-government organizations for selecting suitable species for plantation and spacing of the saplings • Develop a pest management plan for the holistic afforestation	Contractor	DDCS&PMS C, M&E Consultant, BWDB
Impact on Fish Production	• Provide fisheries training in collaboration with Department of Fisheries (DoF) on environment friendly improved fish/prawn culture technology as well as the rice-cum-golda/fish farming. • Golda farming will be encouraged through campaign/awareness development. • Provide skill development training to the fish farmer for more fish/prawn production in gher and ponds. • Stocking the fresh water fish fry (Carps and other small indigenous fish species) in the khals inside the polder area after completion of construction works.		BWDB, WMA with collaboration of DoF
Safety and 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 building and prevention measures, particularly for	Contractor	DDCS&PMS C, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	communicable diseases such as hepatitis B and C, and HIV/AIDS. • The WBG's EHS Guidelines should be included in the contract documents and that should be followed during construction. • Each contractor should prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan should be submitted to the Construction Supervision Consultants for review and approval; • All workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities. • Liaison should be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets should be kept in all the labor camps for obtaining weather information. • The construction sites should have protective fencing to avoid any unauthorized entry, where appropriate and possible • Health screening of employees would be a Contractors obligation prior to laborers working on site and living in the temporary accommodation facilities. The health screening would entail normal review of physical fitness and also include a review of appropriate vaccinations. Workers would be given vaccinations as and where required; • The WBG's EHS Guidelines will be included in the contract documents. Each contractor will prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan will be submitted to Construction Supervision Consultants for review and approval; • All employees need to provide induction training on health and safety prior to commencement of work. OHS issues would be part of the employee training plan. Training would include the provision of appropriate written or visual materials to reinforce learning. Illiteracy levels where high, the OHS issues should be covered more frequently than normal in toolbox talks; • The labour shed/camps for accommodation of workers should be constructed according to the IFC/EBRD workers accommodation guidelines.		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	• Public awareness training and workshops on safety and health risks should be conducted for local communities prior to and during construction operations. • Observing statutory requirements relating to minimum age for employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activities. The construction contractor(s) should not hire people under the age of 18 on permanent contracts but would include short training activities for youth to the extent possible; • Ensure the acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work; • Ensure that no workers are charged fees to gain employment on the Project; • Ensure the rigorous standards for occupational health and safety are in place; • Contractor should establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. • The contractor should adopt a Human Resource Policy appropriate to the size and workforce which indicates the approach for management employees (this could be part requested in the tender process); • Produce job descriptions and provide written contracts and other information that outline the working conditions and terms of employment, including the full range of benefits; • Provide health insurance for employees for the duration of their contracts; • Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts; • Develop a recruitment process community employees that involves local authorities in clearly understood procedures; • Employ a community liaison officer (which could be full time or part of another post's responsibilities); • Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	opportunities for women to participate in employment and training; • Regularly report the labor force profile, including gender, and location source of workers; • Report regularly the labor and working condition key performance indicators, for instance hours worked (regular and overtime) during period and cumulatively, hours lost, number and type of accidents, near misses, site audits and meetings; trainings, and use of labor grievance mechanism; • Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase; • Organize training program and keep training registers for construction workers; • Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project. • Availability of safe drinking water should have to be ensured for the construction staff. • First aid boxes should have to be made available at each construction site. Emergency phone numbers (including hospitals, Fire services, and Police) should have to be displayed at key locations within the site. Each site should be occupied with an ambulance. • Firefighting equipment should have to be made available at the camps and worksites. • Waste management plan is to be prepared and implemented in accordance with international best practice. • Liaison with the community should have to be maintained.		
Increased Inland and Waterway Traffic	• Contractor is to prepare and implement traffic management plan • Contractor is to establish new, temporary jetties as and where needed. • River crossing for material transportation should be during night time as and where possible and appropriate • Liaison to be maintained with community and BIWTA.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Hindrance for Pedestrian and Vehicle Movement	• The works on embankment should be carefully scheduled to minimize impact on local markets and transportation routes.	Contractor	DDCS&PMSC, M&E

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	• 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. The works when being completed of the first half, should be opened for local traffic while works on the other half of the embankments should be undertaken. • Work schedule should be finalized in coordination and consultation with local representatives and communities. • Local routes should not be blocked as far as possible. Alternative routes if unavoidable should be identified in consultation with local community. • GRM should be put in place.		Consultant, BWDB
Damage to Local Infrastructure	• The condition of the instruments, vehicles and equipment being used for the construction and transportation activities will be regularly monitored. • All damaged equipment should be restored to original or better condition.		
Social unrest between Local worker and outside worker	• Proper awareness programs should be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, UpazilaNirbahi Officer (UNO) and BWDB local officers. • Liaison with the communities shouldhave to be maintained. • Cultural norms of the local community shouldhave to be respected and honored. • GRM shouldhave to be established to address the grievances of local as well as outside laborers. • To be careful is use of local natural resources and project resources, fuel, fuel-wood and electricity. • Restrictions are to be imposed consumption of alcohol and drugs. • To be careful about safe driving • To respect the local community and the cultural norms in which laborers are working. • Avoid construction activities during Prayer time.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Social unrest between Local worker and outside worker	• Proper awareness programs should be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	Chairman, UpazilaNirbahi Officer (UNO) and BWDB local officers. • Liaison with the communities shouldhave to be maintained. • Cultural norms of the local community shouldhave to be respected and honored. • GRM shouldhave to be established to address the grievances of local as well as outside laborers. • To be careful is use of local natural resources and project resources, fuel, fuel-wood and electricity. • Restrictions are to be imposed consumption of alcohol and drugs. • To be careful about safe driving • To respect the local community and the cultural norms in which laborers are working. • Avoid construction activities during Prayer time.		
Natural hazard	• Weather signals should have to be considered by the contractor during construction works. • Radio and television should have to be kept in all labor sheds for getting weather information through these media. • Ensure rigorous standards for occupational health and safety are in place. • Having the Contractor establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.	Contractor	DDCS&PMSC,M&E Consultant, BWDB
Social and Gender Issues	• Proper awareness programs will be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, UpazilaNirbahi Officer (UNO) and BWDB local officers. • Liaison with the communities will be maintained. • Cultural norms of the local community will be respected and honored. • GRM will be established to address the grievances of local as well as outside laborers. • Careful use of local natural resources and project resources, fuel, fuel-wood and electricity; • Restrictions related to consumption of alcohol and drugs for foreign workers; • Safe driving practices;	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	• Respect for the local community and its cultural norms in which laborers are working. • Avoiding construction activities during Prayer time.		
Post Construction Phase			
Increase of sedimentation in water channels and rivers	• An ongoing program of de-silting of water channels should be considered with full community involvement and participation. • Have to provide silt management plan • The local government institution (union parishad) should be authorized to monitor the development activities. • To prepare Bangla manual for sluice gate operation and provide training to WMOs; and • Reduce conflicts between farmers and fishermen.	BWDB	BWDB
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
Hampered fish migration	• Proper sluice gate operation allowing fish migration. • For Sluice gate operation a manual will be prepared for facilitation of fish migration • WMO will be provided training to follow the manual to facilitate fish migration • provide training to WMOs; • Transferring juvenile fish from rivers to Polder.	BWDB with the help of DoF	BWDB
Risk of embankment failure	• Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the eastern side of the Polder will be ensured. This monitoring will particularly be carried out before and after monsoon season. • Prevention of establishing hand tube-wells at the crest of the embankment. • Available cyclone and flood shelter will be prepared as a contingency measure during emergency situation.	BWDB	BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/ Supervision Agency
	• WMG will develop a fund for this kind of emergency situation. • Structural measures like geo bag and sand bag will be kept in stock yard of local BWBD colony.		
Increase use of agro chemicals	• Capacity building and awareness raising of the farmers will be carried out to practice Integrated Pest Management (IPM) and Integrated Crop Management (ICM) – in order to minimize usage of chemical inputs. • Farmers group would have close contact with DAE for adoption of various measures of ICM. • Farmers would be encouraged to use organic manure to increase soil fertility while avoiding water contamination. and • Farmers would be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.	BWDB	BWDB
Impact of major periodic maintenance works	• 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	BWDB	BWDB

557. Based on the past experience, a generic Mitigation Measures for EMP has been presented in Table 10.2for reference. This can be used as a reference material for comprehending the scope of the EMP. Table 10.2 will be used in conjunction with the polder specific mitigation measure stated in Table 10.2.

Table 10.2:Generic Mitigation/Compensation Measures/Guideline

(ECoP: Environmental Code of Practice)

Parameter/Activities	Mitigation/Compensation Measure/Guideline
ECoP 1: Soil/ Land Management	
Sources of Material for Earthwork	• During design the segment wise soil requirement and location of the sources of soil for earthwork for each Polder construction/rehabilitation will be identified.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Selection of Borrow Areas for earthen material collection. • No objection from land owner/Revenue authorities as applicable • Contractor shall ensure that borrow materials used for embankment filling is free from pollutants • Disposal of excess soil will be done at site with no objection from DoE and local authority
Borrowing of Earth	**Borrow Area Selection** • Borrowing close to the toe line on any part of the embankment is prohibited. Earth available from dredging may be used as embankment material (if necessary and applicable), subject to approval of the Engineer, with respect to acceptability of material. Borrowing to be avoided on the following areas: • Lands close to toe line and within 500m from toe line. • Irrigated agricultural lands (In case of necessity for borrowing from such lands, the topsoil shall be preserved in stockpiles, although burrowing of agricultural land need to be avoided. • Grazing land. • Lands within 1km of settlements. • Environmentally sensitive areas such as reserve forests, protected forests, sanctuary, wetlands. Also, a distance of 500 m will be maintained from such areas. • Unstable side • Water-bodies (only if permitted by the local authority, and with specific pre-approved redevelopment plans by the concerned authority and engineer-in-charge) • Streams and seepage areas. • Areas supporting rare plant/ animal species. **Documentation of Borrow Pit** • The contractor must ensure that following data base must be documented for each identified borrow areas before commencing the borrowing activity that provide the basis of the redevelopment plan. • Chainage along with offset distance; • Area (Sq.m); • Photograph and plan of the borrow area from all sides; • Type of access/width/kutcha/pucca etc. from the roadway; • Soil type, Slope/drainage characteristics; • Water table of the area or identify from the nearest well, etc; • Existing land use, for example barren / agricultural /grazing land; • Location/name/population of the nearest settlement from borrow area; • Quantity excavated (likely and actual) and its use; • Copy of agreement with owner/government; and • Community facility in the vicinity of borrow pit. • Rehabilitation certificate from the land owner along with at least four photograph of the rehabilitated site from different angles.
Excavation operation and Management of Excavated Material	To minimize the adverse impact during excavation of material following measures are need to be undertaken: • Adequate drainage system shall be provided to the excavated area • At the stockpiling locations, the Contractor shall construct sediment barriers to prevent the erosion of excavated material due to runoff. The followings precautions shall be undertaken during quarry operations. • Overburden shall be removed. • During excavation slopes shall be flatter than 20 degrees to prevent their sliding. • In case of blasting, the procedure and safety measures shall be taken as per DOE guidelines. • The Contractor shall ensure that all workers related safety measures shall be taken.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• The Contractor shall ensure maintenance of crushers regularly as per manufacturer's recommendation. • During transportation of the material, measures shall be taken to minimize the generation of dust and to prevent accidents.
Handling Dredged/excavated Material from River/khal	• Deposition of dredged material will be away from the channel edge to limit damage to streamside habitats. This also allows a degree of flooding to occur on the floodplain, thereby creating opportunities for wet grassland, scrub/wet woodland, wetlands and seasonally grazed rough grass. • Where possible biotechnical engineering, for example geo textiles, may be used to help stabilize the material and aid re-colonization. • Other possibilities include: drying and spreading the spoil over adjacent land, which can improve soil fertility in some cases, but may also smother important flora and habitats; excavating a trench and infilling it with spoil, thus minimizing disturbance to agriculture and the local environment; dumping off-site is possible but expensive, using spoil to create artificial wetlands.
ECoP 2: Water Resource & Hydrology Management	
Hazardous Waste Management	The contractor will minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes).
Ponding of water/water logging	• Do not allow ponding of water especially near the waste storage areas and construction camps • Discard all the storage containers that are capable of storing of water, after use or store them in inverted position • Reinstate relief and landscape • Monitor drainage pattern after high down pouring and recession flood • Connect water pockets to the nearest drainage structures/canals
Top Soil management	▪ The Contractor shall water the material stockpiles, access roads and bare soils as and required to minimize dust emissions. Increase the watering frequency during periods of high risk (e.g. high winds) ▪ Allworking sites (except permanently occupied by the road and supporting facilities) should be reinstated to its initial conditions (relief, topsoil, vegetation cover). • Ensure that roads used by construction vehicles are swept regularly to remove sediment
Construction activities in water bodies	• Protect water bodies from sediment loads by silt screen or bubble curtains or other barrier. • Do not discharge cement and water curing used for cement concrete directly into water courses and drainage inlets • Monitor the water quality in the runoff from the site or areas affected by dredge plumes, and improve work practices as necessary
ECoP 3: Air Management	
Construction vehicular traffic	The Contractor will • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner • Cover haul vehicles carrying dusty materials (cement, borrow and quarry) moving outside the construction site • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions • Control the movement of construction traffic • Water construction materials prior to loading and transport • Service all vehicles regularly to minimize emissions • Materials will be transported to site in off peak hours.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Construction activities	• Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. • Increase the watering frequency during periods of high risk (e.g. high winds). • Stored materials such as excavated earth, dredged soil, gravel and sand shall be covered and confined to avoid their being wind-drifted • Minimize the extent and period of exposure of the bare surfaces • Reschedule earthwork activities or vegetation clearing activities, where practical, if necessary to avoid during periods of high wind and if visible dust is blowing off-site • Restore disturbed areas/side of the embankment as soon as practicable by plantation/vegetation/grass-turfing • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations • Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems
Odor from Construction labor Camps	• Construction worker‘s camp shall be located at least 500 m away from the nearest habitation. • The waste disposal and sewerage system for the camp shall be properly designed, built and operated so that no odor is generated.
ECoP 4: Noise Management	
Construction vehicular traffic	• Maintain all vehicles in order to keep it in good working order in accordance with manufactures maintenance procedures • Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise at the work site.
Construction machinery	• Appropriately site all noise generating activities to avoid noise pollution to local residents • Maintain all equipment in order to keep it in good working order in accordance with manufactures maintenance procedures.
Construction activity	• Notify adjacent landholders/Schools prior to any typical noise events outside of daylight hours • Employ best available work practices on-site to minimize occupational noise levels • Install temporary noise control barriers where appropriate • Plan activities on site and deliveries to and from site to minimize impact • Monitor and analyze noise and vibration results and adjust construction practices as required • Avoid working during 09:00 pm to 06:00 am within 500m from residences.
ECoP 5: Ecology Management	
Clearances of vegetation	• Use barren land or possible low vegetated land for placing of materials stock yards • Fuel wood should be collected from local market. • The work should be completed within contacted scheduled time (4 month) • Labor should be made aware about local faunal species • Collect soil from barren land as much as possible • Proper turfing should be implement at embankment slopes with local grasses and ensure regular monitoring of turf grasses till they matured • Give proper compensation to the tree owners against tree felling. • Implement plantation with native species (i.eSirish (*Albizialebbeck*), Narikel (*Cocos nucifera*), Tal (*Boassusflabelifer*), Khejur (*Phoneixsylvestirs*), etc) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works. • Avoid construction activities during favorabletime of wild life movement(early morning and night) • Keep untouched the deepest points of the khal as much as possible.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Use excavated soil spoils for khal dyke re-sectioning • Implement tree plantation with local species at the khal bank side after re-excavation work where excavated soil dumped khal bank side. • Use minimum land as much as possible for excavator/ labor movement
Outbreak plant diseases	• Aware labors about plant conservation who are engaged for afforestation activities • Collect saplings from nearer natural source as much as possible. • All kinds of polyethylene bags and plastic ropes should bepiled up in a pit for dumped or burned in a proper way • Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation (i.e.:using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers) • Pre-consultation with Forest Department and other related non-government organizations for selecting of suitable species for plantation and spacing of the saplings • Develop a pest management plan for the holistic afforestation.
ECoP 6: Agriculture Management	
Loss of Top Soil	• Soil from fallow lands/ non-agricultural lands will be used in earthwork in embankment • Collect/strip top soil before earth filling and store and reuse it for final surfacing of embankment top and tree plantation/afforestation. • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m • Remove unwanted materials from top soil like grass, roots of trees and similar others • The stockpiles will be done in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil • Locate topsoil stockpiles in areas outside drainage lines and protect from erosion • Spread the topsoil to maintain the physico-chemical and biological activity of the soil. • The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites • Topsoil stockpiles will be monitored and will any adverse conditions be identified corrective actions will include: o Anaerobic conditions-turning the stockpile or creating ventilation holes through the stockpile; o Erosion – temporary protective silt fencing will be erected;
Soil salinity	• Use of duckweed will remove soil salinity. • Flushing with pre-monsoon rain water will reduce soil salinity. • Saline tolerant crops need to be cultivated. • Environmentally and socially responsive shrimp farming e.g. shrimp-rice farming system is encouraged. • Increasing upland discharge of fresh water will push back ingress of saline water from the sea. • Green manure application is promoted. • Ground water abstraction for shrimp farming will be avoided.
ECoP 7: Fisheries Management	
Earth work for constructing by pass canal	• Earth work for by pass should be done in dry season. By-pass canal should be dismantled just after completing the construction and repairing of sluice gates and re-excavation of khals.
Bailing out of water by manual labor or pump	• Bailing out of water should be done by constructing the compartments in the khals. Entire khals should not be closed during construction work.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Construction works for sluice gate and re-excavation of khals	• Construction and re-excavation should be avoided during spawning of the fishes and peak time of fish and shrimp culture in gher. • Construction work should be done in winter and early dry season (November to February). • Critical breeding area of small indigenous fish species (SIS) will be identified and declared as sanctuaries. • Creation of some deeper part in the khals and declared as sanctuaries where brood fish and juveniles may stay during dry season and can breed in the following year. • Soil removed from the bottom of khals should be placed in safe distance from the bank of khals and compact to avoid the flash out during rainy season. • Open the sluice gates just after completion of construction and repair work to flow the water.
ECoP 8: Ecology Management	
Clearances of vegetation	• Use barren land or possible low vegetated land for placing of materials stock yards • Fuel wood should be collected from local market. • The work should be completed within contacted scheduled time (4 month) • Labor should be made aware about local faunal species • Collect soil from barren land as much as possible • Proper turfing should be implement at embankment slopes with local grasses (i.e. Durba (*Cynodondactylon*),Mutha (*Cyperussp*) and ensure regular monitoring of turf grasses till they matured • Avoid construction activities during favorabletime of wild life movement(early morning and night) • Give proper compensation to the tree owners against tree felling. • Implement plantation with native species (i.eSirish *(Albizialebbeck)*, Narikel *(Cocos nucifera)*, Tal (*Boassusflabelifer*), Khejur(*Phoneixsylvestirs*), etc) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works. • Avoid construction activities during favorabletime of wild life movement(early morning and night) • Keep untouched the deepest points of the khal as much as possible. • Use excavated soil spoils for khal dyke re-sectioning • Implement tree plantation with local species at the khal bank side after re- excavation work where excavated soil dumped khal bank side. • Use minimum land as much as possible for excavator/ labor movement
Outbreak plant diseases	• Aware labors about plant conservation who are engaged for afforestation activities • Collect saplings from nearer natural source as much as possible.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• All kinds of polyethylene bags and plastic ropes should bepiled up in a pit for dumped or burned in a proper way • Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation (i.e.:using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers) • Pre-consultation with Forest Department and other related non-government organizations for selecting of suitable species for plantation and spacing of the saplings • Develop a pest management plan for the holistic afforestation.

10.5 Chance-Find Procedures for Physical Cultural Property

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

- Stop work immediately following the discovery of any materials with possible archaeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;
- Protect artefacts as far as possible using plastic covers, and implement measures to stabilize the area, if necessary, to protect artefactsproperly;
- Prevent and penalize any unauthorized access to the artefacts; and
- Restart construction works only upon the authorization of the relevant authorities (e.g. UpazilaNirbahi Officer, Deputy Commissioner and Department of Archaeology).

10.6 Monitoring Plan

559. Extensive monitoring of the environmental concerns of the CEIP-1will 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

560. The Monitoring activities during design/preconstruction period are:

- checking the contractor's bidding documents, particularly to ensure that all necessary environmental requirements have been included; and
- checking that the contract documents' (Environmental Action Plan)references to environmental mitigation measures requirements have been incorporated as part of contractor's assignment and making sure that any advance works are carried out in good time.

561. Environmental monitoring during construction phase is a function of supervision, and the essential purpose is to ensure adherence to the EMP. The monitoring is a daily process,

which ensures that departures from the EMP are avoided or quickly rectified, or that any unforeseen impacts are quickly discovered and remedied.This monitoring will be carried out by the Detailed Design Construction Supervision and Project Management Support Consultants on regular basis.Additional monitoring will be carried out by the Environmental and Social Unit.DDCS&PMSC will prepare the monthly report on the status of EMP/ESMP implementation.

562. Post project monitoring evaluation will be carried to evaluate the impacts of the Project during first three (3) years of operation of the Project. Regular monitoring of the condition of the embankment, drainage structures and slope protection structures and afforestation are important from the environmental management point of view. In addition to this activity, information on the locations, type and consequences of flooding, erosion, flora and fauna mortality, availability of fish, occupational shift, migration is required. Recommended air, noise and water quality monitoring, greening and landscaping and community feedback are also included in the Monitoring Plan. The monitoring plan and details of monitoring locations for environmental condition indicators of the project during the construction and operation stage are presented in Table 10.2 and Table 10.3

Table 10.3: Environmental Monitoring Plan during Construction and Operation phase

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Construction phase					
Sources of Material	Work Site	Possession of official approval or valid operating license of suppliers materials (Cement, soil).	Before an agreement for the supply of material is finalized.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Operation of borrow site	Borrow pit/site	Visual inspection of borrow 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 and BWDB
	do	The stored top soils will be used as cladding material over the filled lands	Immediately after filling and compaction of dredge materials	Contractor	DDCS&PMSC, BWDB
	Work Site	Some of the top soil are placed on top and berm of embankment for turfing and plantation	At the end of filling activity	Contractor	DDSC&PMSC and BWDB
Erosion	Side slopes of the embankments and material storage sites	Visual inspection of erosion prevention measures and occurrence of erosion	At the end of filling activity	Contractor	DDCS&PMSC, M&E Consultant and BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DDCS&PMSC, BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Daily	Contractor	DDCS&PMSC, BWDB
	Material storage sites	Visual inspection to ensure dust suppression work plan is being	Monthly	Contractor	DDCS and PMSC

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
		implemented			
Noise	Construction sites andnearby communities	Visual inspection to ensure good standard equipment are in use and recording noise level of nearby communities, if applicable	Weekly	Contractor	DDCS&PMSC, M&E Consultant, BWDB
	Construction sites	Ensure work restriction between 09:00 pm-6:00 am close to School/ Madrasha, Hospital & Villages	Weekly	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each polder	Sampling and analysis of surface water quality	Dry season	Contractor through a nationally recognized laboratory	DDCS&PMSC, M&E Consultant, BWDB
Drinking Water Quality(TDS, Turbidity, pH,FC, as if groundwater etc)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality	yearly	Contractor through a nationally recognized laboratory	DDCS&PMSC, M&E 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 waste and solid waste is deposited at designated site	Weekly	Contractor	DDCS and PMSC, M&E Consultant, BWDB
Flora and Fauna	Project area	Survey and comparison with baseline environment	Yearly	Contractor through nationally	DSC DDCS & PMSCDSCDDCS&PMSC, M&E

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
				recognized institute	Consultant and, BWDB
Cultural and archeological Sites	At all work sties	Visual observation for chance finding	Daily	Contractor	DSC DDCS & PMSCDSCDDCS&PMSC, M&E Consultant and , BWDB
Reinstatement of Work Sites	All Work Sites	Visual Inspection	After completion of allworks	Contractor	DSCDDCS & PMSCDDCS&PMSC , M&E Consultant and , BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Daily	Contractor	DSC DDCS & PMSCDDCS&PMSC and, BWDB
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DSCDDCS & PMSCDSCDDCS&PMSC
Air Quality (PM_{10}, $PM_{2.5}$)	Close to School/ Madrasha, Hospital & Villages	Air quality monitoring	Half Yearly	Contractor through a nationally recognized laboratory	DSC DDCS & PMSCDSC,DDCS& PMSC, M&E Consultant and, BWDB
Top Soil	Storage area	Top soil of 0.15 m depth should be excavated and stored properly	Beginning of earthwork	Contractor	DDCS&PMSC,and BWDB
	Storage area	The stored top soils should be used as cladding material over the filled lands	Immediately after filling and compaction of dredge materials	Contractor	DDCS&PMSC, BWDB
	Work Site	Some of the top soil are placed on top and berm of embankment for turfing and plantation	At the end of filling activity	Contractor	DDCS&PMSC, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Construction and repair of drainage sluices	Construction site	Physical Observation	Weekly	Contractor	BWDB
Bailing out of water from khals	Construction site	Physical Observation	Weekly	Contractor	BWDB
Re-excavation of khals	Construction site	Physical Observation	Weekly	Contractor	BWDB
Cut off trees	Each of construction sites at embankment.	Survey and comparison with baseline environment	Quarterly	Contractor through nationally recognized institute	DDCS&PMSC, M&E Consultant, BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DDCS&PMSC, BWDB
Workers' Health Safety	Workers'camp site/worksite	Provision of safe drinking water,sanitation,facility, first aid facility and PPE for workers (and proper use of PPE by the workers)	Daily	Contractor	DDCS&PMSC and BWDB
Operation phase					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each polder	Sampling and analysis of surface water quality	Yearly	BWDB through a nationally recognized laboratory	M&E Consultant
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant
Crop production	In the polder area	Compare the production with the baseline	3 (Three) cropping season	BWDB through a nationally recognized institution	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Soil quality	In the Polder area	Compare the soil qualitywith the baseline	Two (2) times of year (dry & wet season)	SRDI	M&E Consultant
Soil salinity	In the polder area	Compare the soil salinitywith the baseline	Once (1) times of year (dry season)	SRDI	M& E Consultant
Crop production	In the polder area	Compare the production with the baseline	3 (Three) cropping season	BWDB through a nationally recognized institution	M&E Consultant
Fish Species Diversity	Khals and Sluice Gates adjacent River	Catch Assessment and Physical Observation	Two times per year (dry & wet season)	BWDB/ WMA	BWDB with collaboration of DoF
Habitat Condition	Khals and Sluice Gates adjacent River	Physical Observation and Testing of Water Quality Parameter (i.e.DO, pH, Salinity and Turbidity etc.)	Quarterly four times per year (dry & wet season)	BWDB/ WMA	BWDB with Collaboration of DoF
Fish Migration	Water control structure	Migration study & catch assessment	Fish migration period (February to July)	BWDB/ WMA	BWDB with Collaboration of DoF
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

563. Moreover a rapid environmental monitoring will be carried out according the following checklist in terms of visual judgment during field visit as an indirect control to implement Environmental Mitigation plan. Table 10.4 can be followed during project construction and operation process.

Table 10.4: Spot Checking Indicator

Parameter	Visual Judgment			Comments
	Poor	Moderate	Satisfactory	
Provision and use of PPE				
Camp Site Management				
Plant Site Management				
Borrow Area Management				
Top Soil Prevention				
Waste Management				
Noise Management				
Occupational Health and Safety				
FuelArea Management				
Reporting and Documentation				

Third Party Validation

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

10.7 Documentation, Record keeping and Reporting

10.7.1 Record Keeping

565. Proper arrangements are necessary for recording, disseminating and responding to information which emerges from the various environmental monitoring and management programs.They are also necessary for rendering the environmental management system "auditable".However, the primary focus must remain on the pragmatic control of pollution, not creation of complex bureaucratic procedures. BWDB will maintain database of the polder specific Environmental Impact and Monitoring information for keeping all type of monitoring record. 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.

10.7.2 Monitoring Records

Quantitative Physical Monitoring

566. 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. CS will regularly monitor and provide information to ESCU for updating the database. DDCS and 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" (approximately 80 percent of the control limits) at which steps must be taken to prevent the impending breach of the control limit; and
- Any breaches of the control limits, including explanations if available.

567. 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

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

Information Sources

569. A complete and up-to-date file of all relevant sources of information will be maintained by the ESC unit of PMU. This file would be readily accessible and include, as a minimum, copies of the following documents:

- Current environmental permits and consents;
- Action to fulfill the requirement of annual site clearance for polder area
- All relevant national regulations, international guidelines and codes of practice;
- Manufacturers' MSDSs for all hazardous substances used on the plant;
- Manufacturers' operating manuals for all environmental monitoring equipment;
- Current calibration certificates for all equipment which requires calibration by an external organization; and
- The latest version of this Environmental Management and Monitoring Plan.

Non-Compliance Report

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

571. A copy of each completed NCR would be held on file by DDCS&PMSC, to be replaced by the replied copy when it is received.A record of corrective actions would also be made and tracked to their completion.

Monthly Internal Reports by DDCS&PMSC

572. The CS will prepare a monthly report for issuance to the ESCU of PMU.These reports will summarize the following:

- Progress in implementing this EMP;
- Findings of the monitoring programs, with emphasis on any breaches of the control standards, action levels or standards of general site management;

- Any emerging issues where information or data collected is substantially different from the baseline data reported in the Environmental Assessment;
- Outstanding NCRs;
- Summary of any complaints by external bodies and actions taken / to be taken; and
- Relevant changes or possible changes in legislation, regulations and international practices.

Bi-annual Environmental Monitoring Report

573. ESC unit of BWDB will prepare the Bi-annaul monitoring report on which will include the environmental monitoring and the plan for next 6 months during construction phase and will submit to the World Bank for review. The progress report will summarize the information presented in Table 10.2 and Table 10.3 and 10.4 respectively.

Environmental Audit Report &Third Party Monitoring Report

574. It is expected that BWDB will conduct annual environmental audit. In addition, the environmental audit will be carried out before the mid-term evaluation and before project closing. All Environmental Audit Report will be shared with the Bank. Environmental monitoring will be conducted by the Third Party Monitoring Team during project implementation. The Third Party Monitoring report will also be shared with the Bank.The Bank would also supervise the environmental compliance as part of regular implementation support missions.

10.8 Contractual arrangements for EMP implementation

575. Since many contractors do not have clear understanding on the need of environmental management, some quotes very low price for implementation of EMP and eventually cannot implement EMP as per design. To avoid this problem, fixed Budget will be assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting.The contractor needs to submit a ConstructionEnvironmental 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.

10.8.1 Guideline to Incorporate Environmental Management in Bid Document & Preparation ofC/ESMAP

- Prepare cost estimates, to be incorporated in the Bid Documents.
- Environmental Management Plan along with the good environmental construction guidelines to be incorporated in the bid document's work requirements.
- Preparation of work requirement (addendum/corrigendum to polder & hydraulic structure construction/afforestation) and
- Corrigendum / Addendum to polder/embankment specification, if any, as special provisions to be incorporated in bid document.
- Penalty clauses for not complying with EMP requirements to be incorporated. Indicative penalty clauses proposed in the CEIP are presented below (Addendum to Clause 17.2 Contractor's Care of the Works of FIDIC).
  - The contractor has to follow all traffic safety measures as defined in the technical specification. Damage shall be levied at the rate Tk. 3000/- per day per location for non – conformity of traffic safety measures as per the decision of the engineer.

- The contractor has to follow all environmental mitigation measures as defined in the technical specification read along with the Environmental Management Plan for the specific CEIP activities. Damage shall be levied at the rate Tk. 3000/- per day per location for nonconformity of Environmental Management Plan measures as per the decision of the BWDB Engineer.
- The contractor has to ensure that prior to every monsoon season, during the construction period; all the temporary and permanent cross drainage structures are free from debris as defined in the Technical Specifications read along with the Environmental Management Plan. Damage shall be levied at the rate of Tk.3000/- per day per location for non-conformity as per the decision of the Engineer.
- The contractor has to ensure that sufficient numbers and good quality Personnel Protective Equipment (PPE), will be 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

576. 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.

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

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

10.9.1 Afforestation Plan

578. Type of plantation and tentative area are given in following table:

Table 10.5: 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		22.00	2,500	55,000
2	Foreshore Plantation	Golpata Plantation	3.29	2,500	8,214
		Mound Plantation	1.35	1,600	2,163
		Enrichment Plantation	1.90	300	569
		Kewra-Baen Plantation	1.00	4,444	4,438
6	**Total**		**29.53**		**70,384**

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

579. Embankment slope area will be planted with different fruit yielding, medicinal and timber plants. For the Slope Plantation, the lower one third of the slope may be planted with deep rooted tree species, the mid one third may be planted with shallow rooted medium size tree species and the upper one third may be planted with species that have very small root system. Keeping this in view, the lower and middle row along the slope can be planted with *Tamarindusindica* (Tamarind/Tentul), *Acacia nilotica* (Gum Arabic/Babla), *Borassusflabellifer* (Palmyra Palm/Tal), *Cocos nucifera* (Coconut/Narikel) and *Phoenix sylvestris* (Date Palm/Khajur) at a spacing of 2M (6.5 ft) apart. The upper row can be at a distance of 6 to 8 feet i.e. 2 to 3M from the lower row. The upper row will be planted with shallow rooted bushy plants which are available in local area. The *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. The *Borassusflabellifer* (Tal), *Cocos nucifera* (Coconut/Narikel) and *Phoenix sylvestris* (Date Palm/Khajur) seedlings may be purchased from local nurseries. Planting of 2,500 seedlings will make one ha slope plantation. As per that estimation, a total of 55,000 nos of saplings can be planted along the slope of 18.5 Km embankment length.

580. About 7.53 ha foreshore area will be planted with mangrove species to protect against tidal surges, wave attack and strong winds in order to reduce toe erosion and to stabilize the embankment. The areas selected for afforestation in this are shown in detail in Map 5.1. The available foreshore area of the polder can be planted with suitable mangrove species. *Sonneratiaapetala* (Mangrove Apple/Keora), *Avicennia officinalis* (Indian Mangrove/Baen) and *Nypafruticans* (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 3.29 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, more than 15,300 mangrove saplings can be planted in 7.53 ha of available foreshore area of this polder. Figure 10.2 shows the typical cross-section of afforestation.

581. The afforestation regulations (policy) enunciated by the BWDB on June 01, 1998 will be followed. Afforestation plan have been finalize after reviewing previous studies on foreshore afforestation, consultation with Forest Department and field verification for suitable species selection.

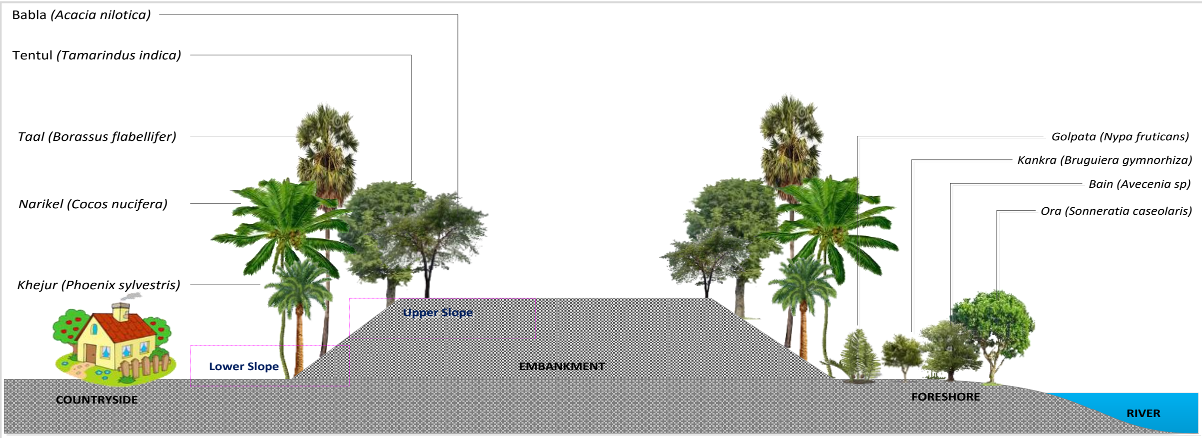


Figure 10.2: Typical cross section of Embankment slope and Foreshore Afforestation

582. Detail Plantation establishment Matrix is presented in following Table:-

Table 10.6: 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.
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

Item of works	Time schedule for the given type				
	Nypa Plantation	Enrichment Plantation	KeoraBaen	Mound Plantation	Polder Slope Plantation
					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

10.10 EMP Implementation Cost

583. The estimated costs for the environmental management and monitoring activities are set out in Table 10.7 below.

Table 10.7: 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 farmers with field demonstration regarding IPM and ICM.	0.4	0.005	BWDB with help of DAE	During post-construction
7	Training to the fisherman/pond owner with field demonstration regarding pond culture.	0.04	0.0005	BWDB & WMO with help of UFO	During post-construction
8	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1	0.0125	BWDB	During post-construction
9	Solid and liquid waste disposal arrangement.	100,000	1.25	BWDB	
9	Updating EMP as per requirement.	1	0.0125	BWDB	During post-construction
10	Establishment of Fish Sanctuaries in khals for the Conservation of indigenous Fishes and stocking of Threatened Fish species and Brood Stock of Indigenous Small Fish Species (2 Nos. Sanctuaries-One sanctuary in each khals @ 0.1 million BDT)	0.04	0.0005	BWDB with cooperation of DoF	During operation
11	Emergency budget allocation for closing breach points of embankments and	1	0.0125	Contractor, BWDB	During construction and post-construction

Item No.	Description	Cost Million BDT	Cost Million $	Responsible Agency	Timeframe
	repairing the damage of structure				
12	Training to the Contractors regarding environmental management	100,000	1.25	BWDB	During pre-construction
12	Training to WMA on "Integrated water Management and Operation and Management of Sluice Gates"	1.5		BWDB	During operation
20	Water sprinkling at re-sectioned/newly constructed embankments (@ Tk.3,000 per km (of embankment 30.50 km)	91,500	1.14	Contractor	During pre-construction and construction phases
13	Compensation for trees	Budet Included in Afforestation Plan		BWDBwith a consultation of Forest Department	During construction
14	WMOs monitoring cost	1	0.00625		
19	Additional Tree Plantation at HH and other grounds to compensate the tree cutting (planting 3 trees for cutting 1tree) @ Tk.50 each tree including the cost of sapling, gabion and nursing etc. (19,834 nos. of trees)	991,700	12.4	BWDB in association of Department of Forest	During post-construction
16	Conservation and stocking of threatened fish species (at least 3 spots).	120,000	1.5	BWDB with help of UFO	During pre-construction and construction phase
18	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	1,200,000	15	Contractor, BWDB	During construction and post-construction
15	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	0.6901	Contractor, BWDB	During construction
	Total Cost	**74**	**0.826**		

1 US$ = 80 Taka

Table 10.8- Tentative Cost Estimate for Environmental Monitoring :

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
1	Soil quality monitoring including N,P,K, S, Zn, salinity, organic Matter, pH etc. samples in Polder 17/1 = 6 samples x 3 times @ Tk.5,000	300,000	3.75	Contractor	During pre-construction, construction and post construction period phases
2	Monitoring of Fish Biodiversity, Fish Migration, Fish Production	800,000	10	Contractor with help of UFO	During construction and post-construction
4	Fish swimming speed or velocity and depth preference	150,000	1.8	Contractor with help of UFO	During post-construction
5	Crop Production/Farm Survey for four (4) times of year (dry & wet season).	60,000	0.75	Contractor with help of UFO	During post-construction
6	Air and noise quality monitoring and analysis.	500,000	6.25	Contractor	During construction
7	Surface and ground Water quality monitoring cost (testing for Turbidity, pH, DO, BOD, Salinity etc. + test of As, Fe etc. for HTWs at workers' camp site) 6 samples in Polder-17/1 during pre-construction, construction and post-construction periods + water quality analysis of HTWs of 10 workers' camp	500,000	6.25	Contractor	During construction and post-construction phases
8	Benthic fauna analysis	200,000	2.5	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	**2,510,000**	**31.3025**		

10.11 EMP Updating

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

10.12 Grievance Redress Mechanism

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

10.12.1 Grievance Redress Focal Points

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

<u>Membership of GRC</u>

1.Executive Engineer (BWDB Division Office)	:	Convener
2. Representative of the RP Implementing NGO	:	Member-Secretary
3. Local UP Chairman /Ward Councillor	:	Member
b. 4. Teacher from Local Educational Institution (nominated by Upazila Administration)	:	Member
c. 5. Representative from Local Women's Group	:	Member
6. Representative from the PAP Group	:	Member

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

10.12.2 Grievance Resolution Process

588. All complaints will be received at the GRCs facilitated by the implementing agency. The aggrieved persons may opt to make complaints directly to the Project Director or

Secretary of the MoWR or even to the court of law for resolution. The Member Secretary will review and sort the cases in terms of nature of grievance, urgency of resolution, and schedule hearings in consultation with the Convener.All cases will be heard within four weeks from the date of receiving the complaints.

589. If the resolution attempt at the local level fails, the GRC will refer the complaint with the minutes of the hearings to the Project Director at PMO for further review.The Project Director will assign the ESC at PMO for review the grievance cases and assist Project Director in making decision. The ESC will review the case records and pay field visits for cross examining and consult the GRC members and aggrieved persons, if required. If a decision at this level is again found unacceptable by the aggrieved person(s), BWDB can refer the case to the MoWR with the minutes of the hearings at local and headquarters levels. At the ministry level, decisions on unresolved cases, if any, will be made in no more than four weeks by an official designated by the Secretary, MoWR. A decision agreed with the aggrieved person(s) at any level of hearing will be binding upon BWDB.

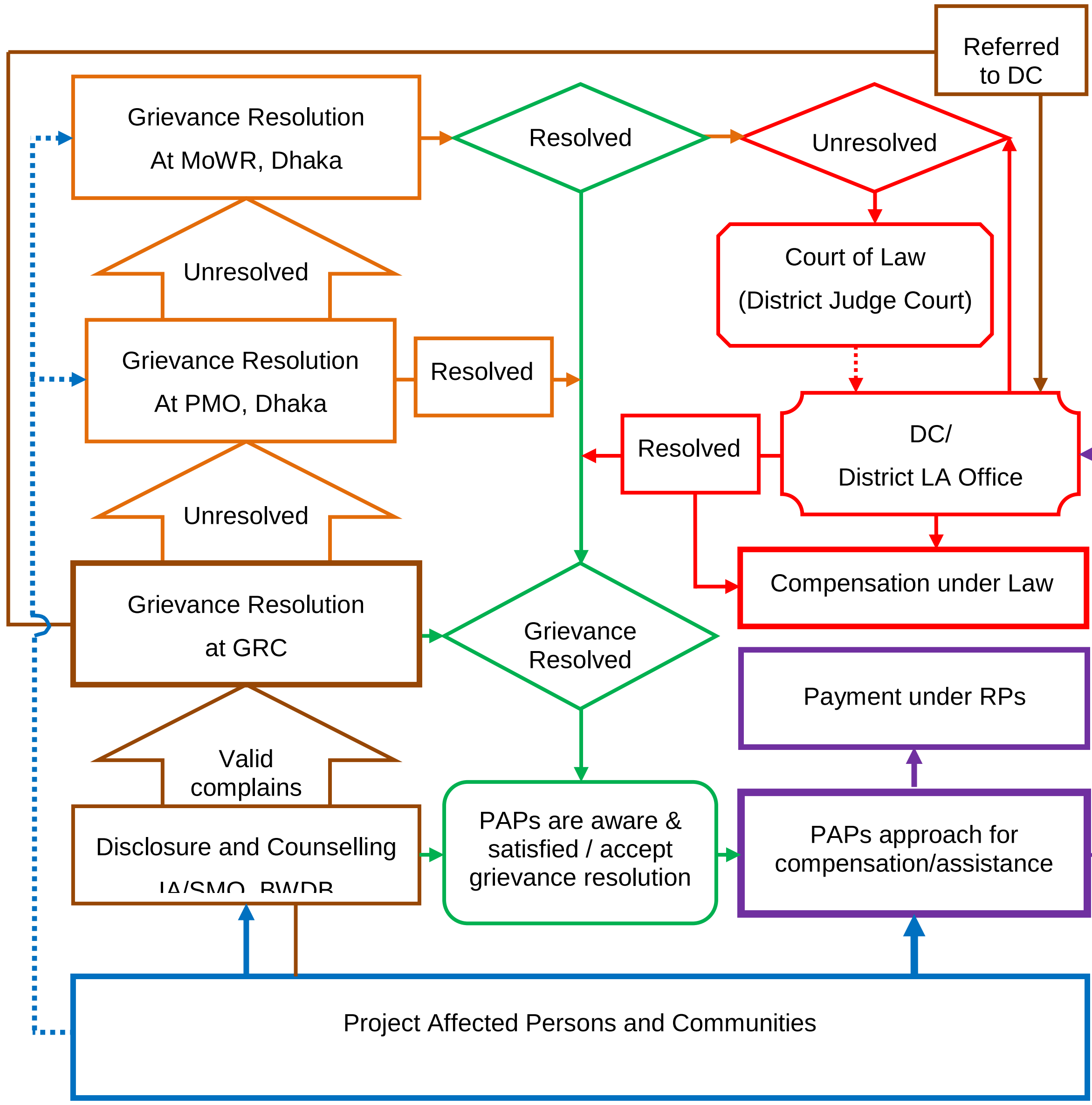


Figure 10.3: GRM Process Flow Chart

590. To ensure that grievance redress decisions are made in formal hearings and in a transparent manner, the Convener will apply the following guidelines:

- Reject a grievance redress application with any recommendations written on it by a GRC member or others such as politicians and other influential persons.
- Remove a recommendation by any person that may separately accompany the grievance redress application.
- Disqualify a GRC member who has made a recommendation on the application separately before the formal hearing:
    - Where a GRC member is removed, appoint another person in consultation with the Project Director.

591. The Convener will also ensure strict adherence to the impact mitigation policies and guidelines adopted in this SMRPF and the mitigation standards, such as compensation rates established through market price surveys.

10.12.3 GRM Disclosure, Documentation and Monitoring

592. The affected persons and their communities will be informed of the project's grievance redress mechanism in open meetings at important locations and in PAP group meetings. Bangla translations of the EIA and the GRM in the form of information brochures will be distributed 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.

593. 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:

594. Intake Register: (1) Case number, (2) Date of receipt, (3) Name of complainant, (4) Gender, (5) Father or husband, (6) Complete address, (7) Main grievance regarding social (loss of land/property or entitlements) or environmental, (8) Complainants' story and expectation with evidence, and (8) Previous records of similar grievances.

595. 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.

596. 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.

597. Grievance resolution will be a continuous process in RP implementation. The PMO and SMOs will keep records of all resolved and unresolved complaints and grievances (one file for each case record) and make them available for review as and when asked for by WB and any other interested persons/entities. The PMO will also prepare periodic reports on the grievance resolution process and publish these on the BWDB website.

10.13 Capacity Building

598. 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 10.5 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.

599. During the O&M phase of the Project, these trainings will continue to be conducted by BWDB staff for all relevant O&M personnel and community.

Table 10.8: 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; PMU; DDCS and PMSCstaff	DDCS and PMSC and ESCU	Prior to the start of the Project activities. (To be repeated as needed.)
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Mitigation measures; Community issues; Awareness of transmissible diseases Social and cultural values.	PMU; DDCS and PMSC; selected contractors' crew	DDCS and PMSC and ESCU	Prior to the start of the field activities. (To be repeated as needed.)
EMP; Waste disposal; HSE	Construction crew	Contractors	Prior to the start of the construction activities. (To be repeated as needed.)
Road/waterway safety; Defensive driving/sailing; Waste disposal; Cultural values and social sensitivity.	Drivers; boat/launch crew	Contractors	Before and during the field operations. (To be repeated as needed.)
Camp operation; Waste disposal; HSE Natural resource conservation; Housekeeping.	Camp staff	Contractors	Before and during the field operations. (To be repeated as needed.)
Restoration requirements; Waste disposal.	BWDB core unit , Restoration teams	Contractors	Before the start of the restoration activities.

Contents	Participants	Responsibilit y	Schedule
Strengthening of water managementorganizations(i.e. WMGs, WMAs and WMF) and beneficiaries organizations	Member of water managementorganizat ions(i.e. WMGs, WMAs and WMF) and beneficiaries organizations	BWDB, ESCU, Contractor	Before and during construction activities

600. Capacity building training programs will be undertaken in the following area:

- Training of the management level officials of BWDB, BWDB environmental compliance personnel on the overall environmental concerns and responsibilities for implementing EMP
- Recruitment of new professionals with background on environment, if required and provide necessary training
- Organizing workshop, seminar, with stakeholders on the environmental concerns of CEIP
- Special training program for the contractors and workers on the EMP and their responsibilities, who will actually be involved in the construction of the project interventions. The Contractors will be provided guideline for preparation of Environmental Action Plan in line with the construction workplan
- Training of the WMOs on successful operation of hydraulic structures
- Training on structured format in reporting for all stages of implementation and those of relevant agencies who are involved in EMP implementation.

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

10.14 Risk Assessment and Mitigation Measures

602. 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 34/3 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) Water Management Organizations (WMO), and (c) Fish migration and movement.

10.14.1 Navigation

603. Navigation in the inland waterways is an important aspect of the coastal economy - facilitating the movement of people and commodities. Hence, empoldering areas are likely to obstruct normal navigational operations in the rivers and connecting khals, and this issue could be a matter of concern in Polder 17/1. However, since the early construction of polders in the 1960s, the problem was recognized and analyzed to reach the conclusion that, in most cases, the benefits obtained from the construction of polders far outweigh the navigational losses.

Field visits to Polder 17/1 also revealed that water bodies and internal khals in the project area are used for transportation of goods and persons, but there is not much marked demand for water traffic to and from the poldered area and the neighboring sites outside the polder. Drainage sluices and sluice gates are provided in the polder, which are being rehabilitated under this project. The gates in those structures are also operated in regular intervals to restrict salinity intrusion. However, such gates or boat passes in the embankment for allowing navigation through the embankment to and from the polder would allow large volumes of saline water inside the Polder and may damage the soil, water and land – destroying crops.

604. 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.

10.14.2 Function of Water Management Organisation

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

10.14.3 Fish Migration and Movement

606. 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 6.2.9). 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.

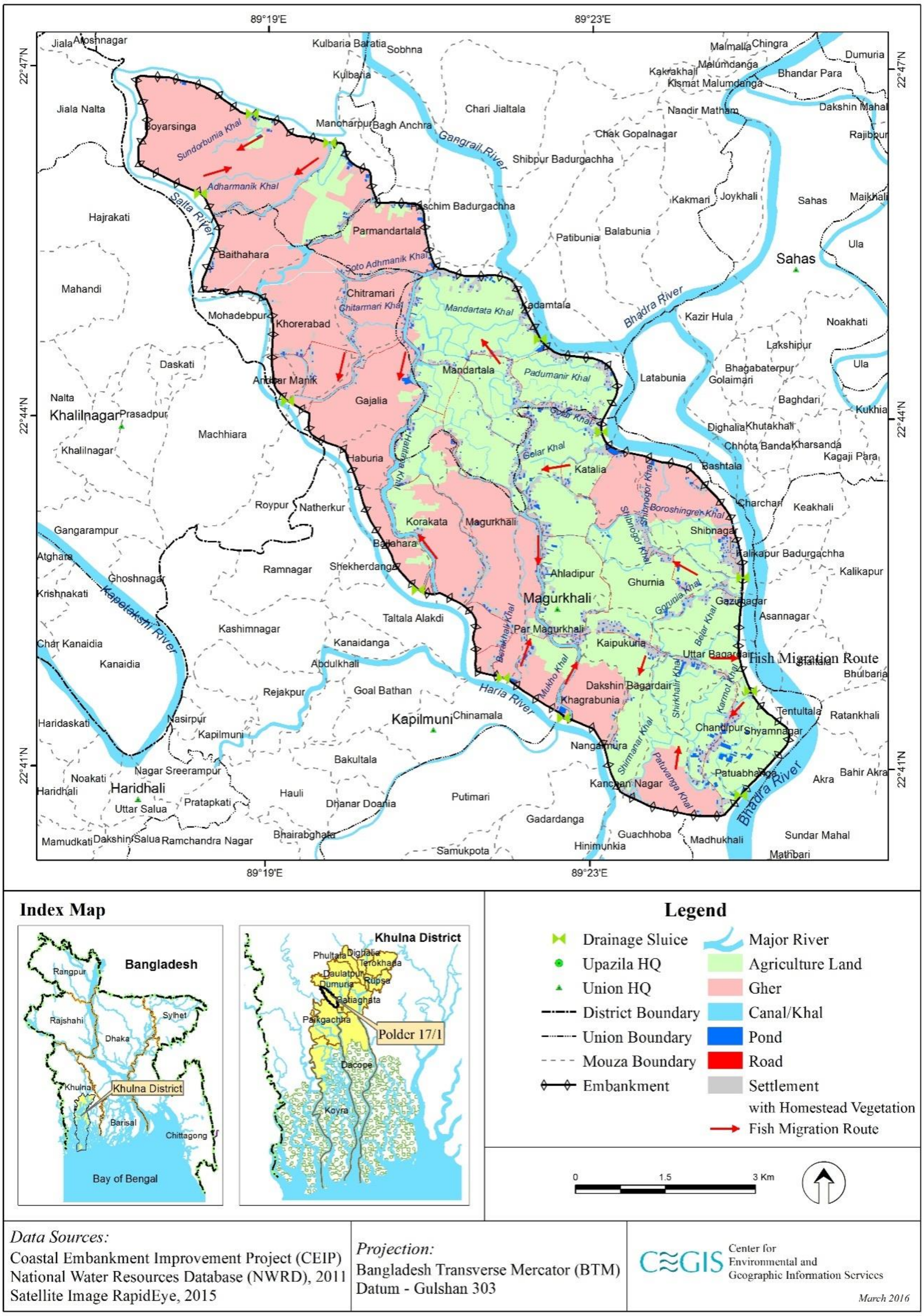
607. On the other hand, during spawning season fish hatchlings and fries will be able to pass through the gates with relatively high mortality. Moreover, there is a conflict of interest between the Gher owners and agriculture farmers regarding the issue of water usage.

608. 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: *Plotosuscanius:* 2-10 m; *Liza Parsia*: 1.5-10 m; *Mystusgulio*: 1.5-10 m and *Latescalcarifer:* 2-20 m.

609. The Ghers in the study area are mostly concentrated in the following mouzas like Boyarsigna, Baithahara, Parmandartala, Khorerabad, Chitramari, Andarmanik, Gaalia, Bailahara and Magurkhali (Map 10.1). These mouzas are relatively less crop intensive. The major drainage canals pass through the mentioned mouzas and Ghers as well includeAndarmanik khal, Soto Andarmanik Khal, Sudorbunia khal, Hatitana khal, Baoria khal etc. So, entry of saline water through these drainage canals in this cluster area made of above mouzas may not harm significantly to the crops if water can be managed in the canals in such a way that water does not spill over the crop fields. In that case, the proper operation of the sluice gates and their distributary canals should be ensured. Moreover, the farmers are suggested to cultivate rice cum golda (prawn) in this area.

610. In other areas where Ghers are less intensive and crops are dominant, there should be a mechanism of water distribution in equitable manner. Generally, surface water irrigation for the Boro crops is done during January to March when drifting migration of hatchling and fry with the tide of *Liza parsia* and *Mystusgulio* 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 Plotosuscanius, *Latescalcarifer*, *Liza parsia* and *Mystusgulio* will be entered with the tide into the Polder area when water will be allowed during the T. Aman cultivation season.

Fish Migration Route Map: Polder 17/1, Dumuria Upazila, Khulna



Map 10.1: Fish Migration Route in the polder area

11. Stakeholder Consultation and Disclosure

11.1 Introduction

611. Public Consultation Meeting (PCM) is mandatory for conducting any Environmental Impact Assessment (EIA) study in accordance with DoE guideline. The aim of Public consultation in EIA process is to ensure the involvement of project stakeholders into the project development and implementation process. The proposed interventions, process of EIA and the EMP were briefly shared with the project stakeholders for getting their perceptions, views and feedback on the probable changes likely to be happened within the project area.

11.2 Overview

612. The GoB as well as international donors (e.g. the World Bank) place great importance on involving primary and secondary stakeholders for determining the environmental and social impacts associated with project implementation. In order to gather local knowledge for baseline conditions, understanding perceptions of the community regarding impact significance, and propose meaningful mitigation measures, participation of stakeholders is an integral part of the EIA process.During the present EIA study, an attempt was made to consult with a full range of stakeholders to obtain their views on project interventions.

613. 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.

614. 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.

11.3 Objectives

615. The overall objective of the PCM was to explore the viewpoint of rehabilitation of Polder-17/1 to the local people and collect their suggestions for strengthening or sustaining the project. Environmental and socio-economic benefits will be accomplished by the implementation of proposed interventions.

11.4 Identification of Stakeholders

616. 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.

11.5 Primary Stakeholders

617. Primary stakeholders are people who would be directly benefited or impacted by a certain project intervention.In case of the proposed Project in Polder-17/1, the primary stakeholders include the people living within the Project area particularly those who reside within and in the immediate vicinity of the Polder. The primary stakeholders of the Project include the farmers, fishermen, local business community as well as the households to be

displaced, women groups, and caretakers of community properties. Primary stakeholders identified and consulted during the present EIA study included communities to be benefitted and/or affected by the Project, local leaders, community members and other local representatives.

11.5.1 Secondary Stakeholders

618. 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 categoryin this Project.

619. Secondary stakeholders for the Project include Local Government Institutions (LGI), Bangladesh Water Development Board, the Ministry of Water Resources, Department of Forest, other government agencies, academia, NGOs, the World Bank and general public at large.

11.6 Approaches and methodology

11.6.1 Approach

620. Participatory approach was applied for identifying the problem and solution across the intervention in public consultation meeting. Initially, the EIA study team members discussed with the BWDB authority of the respective areas in order to obtain their views and suggestions on the project. Key stakeholders were identified through consultation with local people and local government officials. The venue, date and time of those meetings were fixed in consultation with the key persons. The multi-disciplinary EIA team members used convenient and necessary checklists for facilitating the public consultation meetings, which helped to reflect uniformity and relevancy of the opinions and views of participants.

11.6.2 Methodology

621. The important issues like overall briefing of the project including problem of the area with the potential solutions, proposed interventions, probable impacts of selected interventions etc. were incorporated in the checklist.During Public Consultation Meeting (PCM), all relevant issues pertaining to socio-economic, agricultural, hydrological, fisheries, ecological aspects were discussed in detail. A Socio-economist along with the multi-disciplinary consultant team (Water, Agriculture, Fisheries resources and Ecology) facilitated the consultation meeting. The EIA study team members displayed maps of the polder area and explained the initial baseline condition and proposed interventions. The facilitators explained all relevant points and issues in order to enable the participants to comprehend the proposed interventions/activities properly and to respond, accordingly. The stakeholders' perceived views over the impacts on Important Environmental and Social Components (IESCs) along with perceived benefits, risks, threats and demand from the project were identified. The EIA study team memberstook the utmost care in recording opinions and views of the participants relevant to the EIA Report. The EIA study team members also conducted informal meetings with stakeholders as and where required. Unlike the PCMs, the informal meeting placeswere not fixed.

11.7 Consultation Process

622. The EIA study team conducted the meeting. During consultation meeting, the following sequences was followed.

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

624. Introduction: The team members introduced themselves to the participants and gave detail description of the project, spelled out the objectives and anticipated outcome of the meeting.

625. Respect to the participants: The study team showed respect to all participants. They respected not only the individuals but also to their values, cultural practices and social structures.

626. Ensuring peoples' voice: Generally, all participants cannot participate equally. In fact, a substantial number of participants tend to remain silent in any meeting. However, the study team encouraged all to participate willingly by explaining the ethics of the study.

627. Note taking:Discussed issues and opinions were written in notebook carefully. All issues were given equal importance.

628. 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.

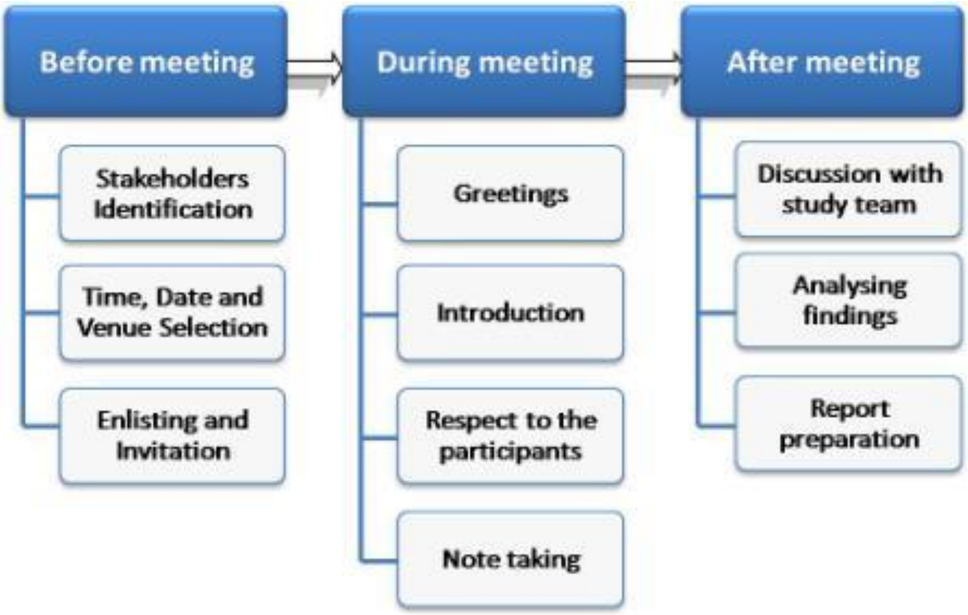


Figure 11.1: Overall consultation process

11.8 Stakeholder consultation and Community Meetings

629. The stakeholders' meetings and community level discussions were conducted in the Polder-17/1 areas using different ways of surveys and consultations techniques. Using different techniques necessary responses were obtained from the stakeholders/communities and they were brought under a good communication and participation process. This consultation process was initiated by CEGIS in January, 2016. In this regard, one (01) PCM and four (04) RRAs were conducted in the Polder-17/1 areas. It is to be noted that the consultation, discussion and peoples' participation process will be continued further during the disclosure stage after having the entitlement policies and implementation. In the PCM, 45 participants from public representatives, community leaders, teachers, service holders,

farmers, day laborers, fishers, traders, women etc. attended. The PCM was held at Magurkhali Union Parishad's hall while the RRAs were held at different locations.

11.9 Location of public consultation meeting and RRA

630. Several numbers of consultation meetings with the mixed group of different occupational people were conducted by the EIA study team. During field visit, the EIA study team formally and informally discussed with the local stake holders in different parts of the polder area. The details of the stakeholders meeting is given in the following table.

Table 11.1: Location of formal and informal stakeholders meetings

District	Upazila	Union	Type of consultation	Meeting place	Date
Khulna	Dumuria	Magurkhali	RRA	Mandartala Bazar	19.01.2016
			RRA	Shibnagar Bazar	19.01.2016
			RRA	KataliaBagar	20.01.2016
		Sobhana	RRA	Boyarsinga	20.01.2016
		Magurkhali	PCM	Magurkhali UP Bhaban	20.01.2016

Photo 11.1:View ofInformal Discussion with local stakeholders

11.10 Participants list

631. A list of participants who attended different meetings is presented in the following Table 11.2 with their ages, occupations and addresses including cell phone numbers (if any).

Table 11.2: Name of the participating in discussion

S.I	Name	Age	Occupation	Mobile No
1	Mr. Devashish Mistri	40	Business	01734713206
2	Mr. JogodishMondol	55	Teacher	01798238063
3	Mr. Ponkhog Mondal	35	Business	01763563057
4	Mr. Ujjal Kumar Biswas	25	Farmer	01747907766

5	Mr. ShibshadBala	50	Farmer	01763616021
6	Mr. Sumon Mondal	21	Driver	01876235583
7	Mr. Shankar	50	Farmer	01838996979
8	Mr. KuberMistri	50	Business	0175644755
9	Mr. ShiuliDhali	25	Housewife	-
10	Mr. ProbashMistri	42	Business	01734713206
11	Mr. BitikaBoiragi	45	Teacher	01719566643
12	Mr. KanonGoldar	32	Teacher	01726305416
13	Mr. Profullo Kumar Mondal	44	Teacher	01761203720
14	Mr. Jogodish Gosh	60	Business	-
15	Mr. Devbroto Mondal	46	Farmer	01923644756
16	Mr. Shuda Bindu Roy	30	Farmer	01949622866
17	Mr. Sobuj Roy	25	Business	01912659359
18	Mr. MilonKanti Sardar	27	Farmer	01959785622
19	Mr. Shonjoy	35	Business	-
20	Mr. Khali Das	40	Farmer	01928846613
21	Mr. Shonjit	33	Business	01733114328
22	Mr. MurariMorol	38	Business	01730931745
23	Mr. Taposh Mondal	35	Farmer	01918849470
24	Mr. SenekaraNibasha	35	Housewife	01725622839
25	Mr. Bilashi Rani Mondal	60	Housewife	-
26	Mr. Bidhan Chandra Mondal	52	Teacher	01725261130
27	Mr. Prodeep Kumar Mondal	45	Teacher	01748917392
28	Mr. Gobinda Mondal	42	Business	01944292146
29	Mr. Manik Mondal	45	Agriculture	01747791372
30	Mr. Nepal Biswas	50	Agriculture	-
31	Mr. Gobinda Mondal	42	Business	01862519058
32	Mr. Shopon Kumar Mondal	52	Agriculture	01957257045
33	Mr. BilashMollick	52	Teacher	01753464797


Photo 11.2:View of consultation meeting with Sub-Divisional Engineers and Sub-Assistant Engineers under Khulna O&M Division-I

11.11 Issues discussed in FGDs and Meetings

632. 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)
- Effect ofClimate changein the polder area (Heavy rainfall, drought, High flooding, tidal surge)
- Water management (flood control, drainage, irrigation)
- Land resources
- Cropping practice
- Production and yield
- water logging and drainage congestion
- crop damage
- Socio-economic aspects:
- Occupation and Employment (unemployment/joblessness)
- Migration (temporary/permanent out-migration)
- Poverty (food and income poverty)
- Education (poor literacy rate, non-schooling, less female education, drop out etc)
- Health and nutrition (illness, diseases, poor nutrition)
- Quality of life (poor housing and sanitation facilities, scarcity of drinking water, fuel and fodder)
- Disasters
- Cyclones
- River erosion
- Associated damages

- Sustainable and integrated solutions of the main problems faced in the Polder
- Water resource management
- Agriculture and fisheries management
- Land resource management
- Disaster management.

11.12 Issues discussed, problems and suggested measures

633. Issues, problems and suggested measures of different disciplines of EIA study are given in the following table (Table 11.3).

Table 11.3: Issues, problems and suggested measures

Sl	Issues	Problems	Suggested measures
1	Water Resource	Tidal Flooding, Salinity intrusion, Drainage congestion, Sedimentation	Construction and repair of drainage sluices to regulate the water flow. Re-excavation of drainage khals Dredging of Salta river and Taltola river Re-sectioning of the embankment and maintaining design slope of the embankment firmly Proper maintenance and management of the water control structures Afforestation along the embankment
2	Agriculture Resource	Every year (Feb. to April) farmers can't cultivate Boro, other cereals and vegetable crops due to soil salinity. Drainage congestion during transplanting period in Aman season. Severe scarcity of irrigation water during dry season especially for rabi crops cultivation. Most of the water control structures (Regulators) are not functioning properly. The siltation caused raise of beds of different internal drainage khals.	Re-excavation ofproposed khals Replacement of sluice gates. Training for WMAs.
3	Fisheries Resource	Depth of internal canals are gradually reducing due to siltation leading to degradation of habitats Illegal fishing in the canals and at the site of Drainage Structure Inundation of ponds and ghers due to drainage congestion, storm surges associated tidal flooding	Re-excavation of khal will improve the habitat condition and also help to increase the richness of fish species in the polder area Enforcement of Fish Conservation and Protection Acts by Government Strengthening of local water management committee or the activities of WMA/WMO Re-sectioning of embankment with reasonable height

Sl	Issues	Problems	Suggested measures
4	Ecology	Soil salinity and internal khal siltation are the main threats on ecosystems of this polder. Non-functioning of water control structures like regulators, causes insufficient drainage and flashing capacity of the polder area that damages vegetation. Intrusion of saline water expands soil salinity that increases stress on vegetation.	Removing siltation and drainage congestion by re-excavation of khal. Embankment re-sectioning and repairing water control structure along the embankment to protect settlement, road, inter tidal area and crop fields from existing problem.
5	Socio-economic	Scarcity of fresh water is one of the main problems in the Polder area during dry season. The typical conflict among different type of users, e.g. *BagdaGher* owner, open water fisher (fishing at sluice gates) and farmer are observed in maximum part of project area Drainage congestion, tidal flooding, salinity intrusion and cyclone are the main concerns in the Polder-17/1 area. 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. Local powerful persons, including the political leaders illegally interfere on the water control/ management infrastructure.	All *khals* should be kept free from illegal occupier (Tulamari and Andharmanik khals); Replace the damaged/non-functional sluices and construct new ones at Boaria*khal* (Manoharpur) where required; Comprehensive rehabilitation of the polder should be taken up at the earliest with the active involvement of the local community especially UP chairman, all members and elite society; The embankment needs to be strengthened andRe-sectioningfor prevention of tidal water or flood in wet season and intrusion of saline water in dry season; Open-up the water connectivity by excavating and dredging of major river (the Salta and Bhadra)and connecting *khals*; Need awareness building about water management among the communities; It is needed to ensure sustainable operation of the project, participation of Water Management Organization (WMO) and Community Based Organizations (CBOs) and also manage properly water control structures i.e. embankment, sluice gate, regulator, inlets, culverts etc and growing of consciousness among the community in the polder.

11.13 Findings

634. Immediate rehabilitation work in Polder-17/1 is the foremost demand of the local people to mitigate the existing irrigation and drainage problem. Local people also demanded that at first Salta Riverand Bhadra River should be re-excavated to mitigate theirrigation and drainage problems in the polder area.Then the proposed interventions should be implemented.They also opined that inlet and outlet of the proposed structures should be re-excavated (*Mandartala khal, Golar khal, Shibnogor khal, Karamot Khal, Patuvanga khal, Mukho River, Berakhali khal, Hatitana khal, Soto Andharmanik khal, Andharmanik khal, Sudorbunia khal, Boaria khal*) considering water flow.Local people expected that if the

proposed interventions are implemented properly as per design, the loss of assets will be reduced which is their desire.

Photo 11.3: Public Consultation Meeting (PCM) at Magurkhali Union Parishad Bhaban, Dumuria, Khulna.

11.14 EIA Disclosure

635. The draft final EIA report of Polder 17/1was disclosed to the public on 26th July (from 11:00am to 13:00pm), 2017 in Dumuria Upazila, Khulna. The aim of the meetings was to present the findings of the draft final EIA report and to receive feedback from the local stakeholders. The report was also finalized through incorporation of comments and suggestions received from the meetings.

636. The participants of the PDM includes, UpazilaNirbahi Officer (UNO),Upazila Chairman, Vice Chairman and other concerned government officials, Journalists, NGO representatives, environmentalists and activists, local stakeholders and other representatives of CEGIS. A total of 45 participants attended the public disclosure meetings. The findings of the Public Disclosure Meeting (PDM) is given below.Some photographs of the meeting are also given below.

Photo 11.4:View of PDM at Upazila Auditorium, Dumuria, Khulna

Findings of the PDM:

637. The communities including the persons to be affected of Polder 17/1 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:

- This plan will be done with the participation of local people and representatives
- Peripheral rivers e,g, Hari river should be re-excavated under this project , otherwise, internal khalre-excavation would not removethe drainage congestion in the Polder area
- The suggested sluice gates should be prepared in a planned way so that saltwater cannot enter into the polder and sluice gates maintenance should be maintained in a proper way.
- Fish movement system in each sluice gate should be considered.
- The Hari river should be connected with Fultola river for reducing drainage congestionin the Polder area
- Proper compensation should be made to the project affected people before starting the construction activities
- Issues like climate change, sustainable development etc should be taken into consideration while implementing the project.
- Effective monitoring should be maintained during the construction of the project activities

- Good coordination should be ensured between BWDB and local administration for better functioning of the Polder
- Engagement of local government for canal excavation should be ensured
- Tree plantation need to be increased.
- Awareness building programamong the communitiesshould be conducted for betterwater management
- Proper O & M for embankments and sluice gates in the Polder area should be ensured
- Water Management Organizations (MWOs) should be formedfor proper management of water control structures.

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Appendix A: Checklist

EIA of Coastal Polders under CEIP

Checklist for Water Resources Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

A. Administrative Information

Name of Polder:	**BWDB Zone:**	**Hydrological Zone:**
BWDB Circle name:	BWDB O & M Division:	
District (s):	Upazila (s):	
Union (s):	Mouza (s):	

B. Project Description

General Information	
a. Type of project:	b. Area of polder (Ha):
c. Objectives of the scheme:	
d. New problems (if any) created by the project activities:	
e. Year of Starting:	f. Year of completion:
g. Name of surrounding polder	
h. Name of the projects hydro-morphologically dependent on the polder	
i. Cumulative hydraulic and morphological impacts as anticipated by local people	
Data Collected by:	Date:

Present Status/condition of Embankment	
Embankment length(……………….Km)	Embankment Type: Submergible / Full flood protection
Breaching:1. Yes2. NoBreaching spot (If yes): (Please specify the spot names, length, GPS reading)	

Location of Breaching	Reasons of breach	Good	Moderately affected	Badly affected/ Vulnerable	Completely damaged

Points (Name of Place)		GPS ID	Length	GPS ID	Length	GPS ID	Length	GPS ID	Length

Public Cuts: 1. Yes2. 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. Yes2. No Re-sectioning (If yes): (Please specify the spot names, length)

From	To	Length	Height	Actual reasons

Regulators

Location of Structure	GPS ID	Type	Vent Size	No of Vent	Service Condition (VG/G/M/B/VB)[18]	Present Condition (Partial/full damage/good)	Present Problems	Reasons for problem	Year of problem	Rehabilitable (Y/N)	Replaceable (Y/N)
Fish pass Structures											
Cross Drainage Structures (Syphon/Aqueduct)											
Barrage											

Pipe Sluices										
Irrigation Inlets										
Bridge/Culverts										

[18] VG – Very Good, G – Good, M – Moderate, B – Bad, VB – Very Bad

Others

Drainage Channels

Name	Length	Flow Direction	Flow (%)	Present Service Condition \Problems	Reasons of Problem	Re-excavation Need(Y/N)	Proposed Re-excavation	From – To (Approx. length)	GPS ID (Structure)

Irrigation Canals

Name	Length	Problems	Reasons	Re-sectioning(Y/	From – To (Approx. length)

Protective Works

Location Name	Type (Temporary/Permanen	Length	Present Condition (G/ MD/ CD)19	Problems	Reasons	From – To (Approx. length)	GPS ID (Protection Work)

Do you think that local people/Stakeholders were involved or could be involved in future for the maintenance work of the above mentioned works? If 'Yes' mention the source of generating funds?	
Persons engaged in operating gates of the structures:	BWDB/Local people or Stakeholders/Beneficiaries
Problems facing in operating the gates of the structures:	
Your suggestions regarding the people to be engaged in operating these gates:	BWDB/Local people or Stakeholders/Beneficiaries

D. Water Resources

1.River system (inside and outside the polder)

Inside	Outside	Main river	Flow direction

2. Name of beels:

Union	Beels	Union	Beels

3. Topography:	4. Drainage pattern:
5. Drainage congestion extent (ha):	Causes: Natural / Man made/Through project activities
Problems:	Reasons:

6. Water logging (% of extent) in the month of February

[19] G – Good, MD – Moderately Damaged, CD – Completely Damaged

Union	Area (%)	Causes

7. Flooding (depth, % of extent, onset, peak and recession)

Flood/Inundation Condition	Area (%)	Reasons of Flooding	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:

EIA of Coastal Polders under CEIP

Checklist for Land Resources, Agriculture and Livesock Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

Land Resources:

Land degradation

Factors	Year from starting LD	Result of LD
Soil erosion		
Sand carpeting		
Salinisation		
Acidification		
Nutrient deficiency		
Farming practices		
Water logging		
Others		

Agriculture Resources: (For small project information collection from filed. For large project both primary and secondary information collection from field and DAE office)

Cropping Pattern by land type

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	% of area

Crop calendar

Crop name	Seedling		Transplanting/Sowing		Harvesting	
	Start	End	Start	End	Start	End

Crop yield

Crop Name	Damage free Yield (ton/ha)	Damage area (%)	Damage Yield (ton/ha)

*Damage area and yield loss calculation:Last 3 years average value

Crop damage

Name of hazard	Ranked	Timing	Causes
Flood			
Drought			
Pest infestation*			
Others:			
*List name of pest and pesticide by crop			

Fertilizer and pesticide application

Crop Name	Seed (Kg/ha)	Fertilizer (Kg/ha)				Pesticide		
		Urea	TSP	MP	Other	No of Appli.	Liq. (ml/ha)	Gran. (Kg/ha

Irrigation, Land preparation and Labour

Crop Name	Irrigation			Land preparation			Labour	
	Mode	% of Area	Charge (Tk/ha)	Power (%of Area)	Animal (% ofArea)	Tk/ha	Nos./ha	Tk/ labour

Note: Support Services of the project areas

Livestock Resources: Primary and Secondary Information collection from field and DLS offices

Livestock and poultry production

Name of Livestock/poultry	% of HH having Livestock/Poultry	No. of Livestock/poultry per HH
Cow/Bullock		
Buffalo		
Goat		
Sheep		
Duck		
Chicken		

Feed and Fodder

Name of Livestock/poultry	Feed/Fodder Scarcity (Timing)	Causes	Remarks
Cow/Bullock			
Buffalo			
Goat			
Sheep			
Duck			
Chicken			

Diseases

Name of Livestock/poultry	Name of Disease	Disease (Timing)	Causes	Remarks
Cow/Bullock				
Buffalo				
Goat				
Sheep				
Duck				
Chicken				
Note: Support Services-				

Where, when, how much and causes of Crop Damage.

Fisheries Baseline Checklist

EIA of Coastal Polders under CEIP

Village: Mouza: Union: Upazila: District: BWDB Circle: BWDB Division:

Background Water bodies: Name: Alphabetic, Area: in Ha/% of area/Ana, Length: in km, Depth/Inundation depth: in Meter, Flood Duration: in Months, Production: metric ton

Problem/ Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
Capture Fisheries:	a. Total No. of fisher HHs: b. %/No. of CFHHs:	River																
Culture Fisheries:	c. %/No. of SFHHS: d. No. of Days spend annually in fishing by CFHHs:	Beel (Leased/ non leased)																
Indiscriminate Fishing Activities:	SFHHs: e. Hrs/Day spend in fishing by CFHHs:	Khal																
		Floodplain																
		Swamp Forest																

Problem/ Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
	SFHHs:	Fish pond																
		Baor																
		Other																

Fish Migration		Fish Biodiversity		Species List					Species Composition				
				River	Khal	Beel	Pond	Other	Group	River	Khal	Beel	Pond
Previous Migration Status		Fish diversity status (Poor/Moderate/Rich)/%							Major carp				
									Exotic carp				
									Other carp				
									Catfish				
									Snakehead				
Present Obstacle to fish migration:	1.	Reasons of increase or decrease	1.						Live fish				
									Other fish				
	2.		2.						Prawn				
									Hilsa				
	3.		3.										
Important breeding, feeding and over wintering ground													
			4.										
			5.						Rui				
									Catla				

Fish Migration				**Fish Biodiversity**		**Species List**					**Species Composition**				
						River	**Khal**	**Beel**	**Pond**	**Other**	**Group**	**River**	**Khal**	**Beel**	**Pond**
Horizontal Migration pattern	Species:	Season (Months):	Routes:	Significant areas	1.						Mrigel				
	1.										Koi				
	2.				2.						Sarpunti				
	3.										Large prawn				
	4. 5.				3.						Small Pprawn				
Vertical Migration Pattern	Species:	Season (Months):	Habitats:	Species of Conservation Significance	Rare:						Silver carp				
	1.										Carpu				
	2.										Grass carp				
	3.										Tengra				
	4.				Unavailable:						Chapila				
	5.										Others				

Post Harvest Activities		Fishermen Lifestyle	
Fish edible quality:		Socio-economic Status of subsistence level fishermen:	
Source of pollution in each habitat:		Socio-economic Status of Commercial fishermen:	
Seasonal vulnerability:		Other conflict (with muscle men/ agriculture/ other sector/laws):	
Ice factory (Number, location and name):		Fishermen community structure (Traditional/Caste/Religion)	
Landing center, whole sale market, other district markets, etc.:		Traditional fishermen vulnerability (Occupation change/others):	
Storage facility (number, location and name):		Existing Fisheries Management	
Fish market (Number, location and name):		Fishermen Community Based Organizations (FCBOs):	
Marketing problems:		WMOs activity:	
Fish diseases (Name, Host species, Season, Syndrome, Reason, etc.):		Fishing right on existing fish habitats (Deprived/Ltd. access/Full access):	
Other backward and forward linkages (Number, location and name):		Leasing system:	
Transport facility (Mode of fish transportation, cost, other involvements)		Enforcement of fisheries regulation (Weak/strong):	

Post Harvest Activities		**Fishermen Lifestyle**	
Dry fish industries (Number, location and name):		Department of Fisheries (DoF) activity:	
Others information:		NGOs activities:	

Note: 1.Major Carp- Rui, Catla, Mrigal, 2.Exotic Carp - Silver Carp, Common Carp, Mirror Carp, Grass Carp, 3.Other Carp- Ghania, Kalbasu, Kalia, 4.Cat Fish - Rita, Boal, Pangas, Silon, Aor, Bacha, 5.Snake Head- Shol, Gazar, Taki, 6.Live Fish - Koi, Singhi, Magur,7.Other Fish - Includes all other fishes except those mentioned above.

Beels: Rui (Labeorohita), Catla (Catlacatla), Mrigal (Cirrhinusmrigala), Kalbasu (Labeocalbasu), Gonia (Labeogonius), Boal (Wallago attu), Air (Mystusaor / Mystusseenghala), Shol/Gazar (Channa spp.), Chital/Phali (Notopteruschitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustesfossilis /Clariasbatrachus), Sarpunti (Puntius sarana), Large Shrimp (Macrobrachiumrosenbergii /M. malcomsonii), Small Shrimp, Silver Carp (Hypophthalmichthys molitrix), Carpio (Cyprinus carpio), Grass Crap (Ctenopharyngodonidellus), Pabda (Ompokpabda), Punti (Puntius spp.), Tengra (Mystus spp.), Baim (Mastacembelus spp.), Chapila (Gudusiachapra), Others.

Pond: Rui (Labeorohita), Catla (Catlacatla), Mrigal (Cirrhinusmrigala), Kalbasu (Labeocalbasu), Mixed Carp, Silver Carp (Hypophthalmichthysmolotrix), Grass Carp(Ctenopharyngodonidellus), Mirror Carp (Cyprinus carpio var. specularis), Tilapia (Oreochromis mossambicus / O. niloticus), Shrimp, Aor (Mystusaor / Mystusseenghala), Boal (Wallago attu), Shol/Gazar& Taki (Channa spp.), Chital/Phali (Notopteruschitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustesfossilis / Clariasbatrachus), Sarpunti (Puntius sarana), Thai Sarpunti (Puntius gonionotus), Punti (Puntius spp.), Others.

EIA of Coastal Polders under CEIP

Checklist for Ecological Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

Basic Information

Date		Prepared by	
Name of the Polder			
BWDB Circle Name			
District/s		Upazila/s	
Location of the FGD			

Habitat Information/Ecosystem Types (Please put tick where is applicable)

Agriculture land		Forest patches including social forestry	
Settlement / Homesteads		Canal and ponds	
Orchard		Grasslands	
Fallow		Reserve forest	
Ridges		Others	

Terrestrial Vegetation Checklist (List of Major Plant Species)

Species Name	**Status**	**Utilization**
Homestead Vegetation		
Mangrove Vegetation		

Species Name	**Status**	**Utilization**
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			

Species Name	**Habitat**	**Status**	**Migration Status**
Birds			
Habitat: 1= Homestead forest, 2= Floodplains, 3= Wetlands, 4= River, 5= Pond, 6=Forest Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Migration Status: 1= Local, 2= Local Migratory, 3= Migratory			

Aquatic Wildlife Checklist

Species Name	**Habitat**	**Status**	**Migration Status**
Mammals			
Amphibians			
Reptiles			

Species Name	**Habitat**	**Status**	**Migration Status**
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**

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

Species Name	**Habit**	**Status**	**Utilization**
Habit1=Submerged, 2=Free floating, 3=Rooted floating, 4=Sedges, 5=Marginal Status 1= High, 2= Moderate, 3= Low Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others			

Forest Information (Surrounding/nearer the polder)

Forest Name with Range/Beet office	**Type**	**Location**	**Area in Acre**	**Major Plant Species**
Type 1=Swamp Forest, 2=Reserve Forest, 3=Vested Forest, 4=Reed forest, 5=Other (specify)				

(9)Anticipated Impacts due to proposed interventions on particular Ecosystems

(Impact from changed land use, noise, human presence etc.)

Name of Intervention	Impacts
Embankment Re-sectioning	
Breach Closing	
Construction of Water control Structures	

(10) Comments (If any):

EIA of Coastal polders under CEIP

RRA/FGD Data Collection Format for Socio-economic Survey

Date of Survey:................................. Name of Polder:

1. Place of Interview:

Name of Mouza(s)...
...

Union(s)/Ward(s)...
....

Municipality(s).if any
....
Upazila(s)/Thana(s)..
District(s)/.....................................

2. Characteristics of Population:

2.1 Total Households, Population (male, female, rural and urban) in Project area

Total Households	Population		
	Male	Female	Total

Source: BBS

2.2 Age distribution

Age range													
0-4 Years		5-9 Years		10-14 Years		15-17 Years		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	Pucca	

Source: RRA

Drinking water (photographs)

Sl. No.	Drinking water sources	Percentage of households use
1	Tap	
2	Tube well	
3	Well	
4	Pond	
5	Other.........................	

Source: BBS

Sanitation (photographs)

Sl. No.	Toilet types	Percentage of households under each type
1	Water Sealed	
2	Ring Slub	
3	Kancha	
4	No facilities	

Source: RRA

2.12 Diseases in polder area

a. Diseases in area

Sl. No.	Disease	Ranking by incidence	Sl. No.	Disease	Ranking by incidence
1	Influenza/ Common fever		9	Chicken pox	
2	Cough/cold		10	Skin disease	
3	Diarrhoea		11	Diabetes	
4	Dysentery		12	Hypertension	
5	Hepatitis		13	Asthma	
6	Malaria		14	T B	
7	Dengue fever		15	Gastric	
8	Typhoid		16	Arsenicosis	

Sources: RRA

b. Health facilities in study area (photographs)

Sl. No.	Type of facility	Number of facilities with name
1	Number of District level Hospitals	
2	Number of Upazila Health Complex	
3	Union Health Center	
4	Private Health Clinic/ Hospitals	

Sources: RRA

b.1 Status of peripheral health facilities used by the study area people:

____
____
____
____
____

Source of treatment facilities in study area

Sl. No.	Source of treatment facilities	% of hhs received
1	Trained Physician	
2	Paramedic/ Diploma Physician	
3	Quack Doctor and Informal Treatments	
4	No treatment facilities at all	

Sources: RRA

2.13 Electricity

Percentage of household having electricity facility: ....BBS

Percentage of household having electricity facility: ....(During Survey)

3. Social overhead capital (photographs)

3.1 Existing road networks in study area and it's level of benefit

a. National Road (km.) ....(GIS) Beneficial: Highly /Moderately / Poorly

b. Regional Road (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

c. Local Road Pucca (km.)...................... .... (GIS) Beneficial: Highly /Moderately / Poorly

d. Local Road Kancha (km.)...................... .... (GIS) Beneficial: Highly /Moderately / Poorly

3.1.1 Status of peripheral road networks (with name) used by the study area people:

____
____
____
____
____
____

____
____

3.2 Existing railway network in study area and it's level of benefit

a. Railway (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

3.2.1 Status of peripheral railway service used by the study area people:

____
____
____
____

____
____

____
____
____

3.3 Existing waterways in study area and it's level of benefit

a. National Route (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

b. Local Route (km.)...................... .... (GIS) Beneficial: Highly /Moderately / Poorly

3.3.1 Status of peripheral water ways (with name) used by the study area people:

____
____
____
____

3.4 Status of the navigation route by season

a. National Route: Served Seasonally/Through out the year

b. Local Route: Served Seasonally/ Through out the year

3.5 Major waterways handicapped

a. by structures.................................... location

b. by siltation................................. location

3.6 Nos. of major ghats/ports and name:

3.7 Academic Institution (school, colleges) (photographs)

Sl. No.	Type of facility	Nos. of Institution	Type of facility	Nos. of Institution
1	Primary School		EbtedayeeMadrasha	
2	High School		DakhilMadrasha	
3	College		Alim/ FazilMadrasha	

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					

Sl. No.	Major Disaster	Severely affected year	% of area affected	% of hhs affected	% of crop damage	Major crop damaged
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, Boyoskobhata, etc.)	% of HHs coverage

Name	Activity (Credit, Education, Health, Forestry, Fishery, Livestock Rearing, Women Empowerment, Human Rights, VGF, Boyoskobhata, etc.)	% of HHs coverage

8. Information on Water Management Organizations (WMOs) (photographs of office building, committee members, resolution etc)

8.1 Do you know about the CEIP project?Y/N

8.2 Existence of WMOs: Yes/No

8.2.1 If WMO exists:

Sl	Issue/Question	Response/Suggestion		
a)	Year of formation (date if possible)			
b)	Registered by whom?			
c)	Number of members (male-female)	Male	Female	Comments
	Farmer			
	Trader			
	Labor			
	Landless			
	Fisher			
	Service holder			
	Others			

Sl	Issue/Question	Response/Suggestion
d)	No. of villages covered	
e)	Existence of fund	
f)	AGM	
g)	Election	
h)	EC meetings	
i)	Present water resources management activities	

8.2.2 Name of EC members with address/phone number:

Sl. No.	Name	Address	Phone Number
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

If WMO does not exist, please state the reasons for

____
____
____

____

____

8.3 Are people willing to form WMO? Y/N

(If yes, give demonstrative proof of their capacity if any)

8.4 Is WMO willing to take up management responsibilities? Y/N

8.4.1 If yes, please give some idea about what to do on management

9. Some other Issues

9.1Any 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: 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 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 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: unauthorised 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

d. 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.

e.

f. 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 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.

(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.

(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 mechanised 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.

Appendix C: World Bank's Environmental Safeguard Policies

(i) Environmental Assessment (OP 4.01)

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

The present EIA has been carried out in compliance with thisOperational Policy (OP).

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

Category A: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.

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-1 has been classified as Category A, since some of the potential impacts are likely to be significant and diverse.

(ii) Natural Habitats (OP 4.04)

The Policy describes the conservation of natural habitats, like other measures that protect and enhance the environment, to be essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank also supports, and expects borrowers to apply a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. The Bank-promotes and supports natural habitat conservation and improved land use by financing projects designed to integrate into national and regional development the conservation of natural habitats and the maintenance of ecological functions. Furthermore, the Bank promotes the rehabilitation of degraded natural habitats. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

The WBOP 4.04 is triggered for the proposed Project. However, the proposed activities will be undertaken in an area where natural habitat has already been modified to farm lands and built-up area.Furthermore, appropriate control measures have been incorporated in the environmental management plan (provided later in the document) to prevent any potential impacts of the Project on the nearby foreshore area.

(iii) Water Resources Management (OP 4.07)

Through this Policy, the Bank seeks to support operations that provide potable water, sanitation facilities, flood control, and water for productive activities in a manner that is economically viable, environmentally sustainable, and socially equitable. The Bank assists borrowers in many priority areas, among which developing a comprehensive framework for designing water resource investments, policies, and institutions is very important. Within this framework, when the borrower develops and allocates water resources, it considers cross-sectoral impacts in a regional setting (e.g., a river basin). Restoring and preserving aquatic ecosystems and guarding against overexploitation of groundwater resources are also given priority to the provision of adequate water and sanitation services for the poor. Furthermore, special attentions are needed by the borrowers to avoid the water logging and salinity problems associated with irrigation investments by (i) monitoring water tables and implementing drainage networks where necessary, and (ii) adopting best management practices to control water pollution.

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

(iv) Physical Cultural Resources (OP 4.11)

The World Bank's general policy regarding cultural properties is to assist in their preservation, and to seek to avoid their elimination.The specific aspects of the Policy are given below. [20]

- The Bank normally declines to finance projects that will significantly damage non-replicable cultural property, and will assist only those projects that are sited or designed so as to prevent such damage.
- The Bank will assist in the protection and enhancement of cultural properties encountered in Bank-financed projects, rather than leaving that protection to chance.In some cases, the project is best relocated in order that sites and structures can be preserved, studied, and restored intact in situ.In other cases, structures can be relocated, preserved, studied, and restored on alternate sites.Often, scientific study, selective salvage, and museum preservation before destruction is all that is necessary.Most such projects should include the training and strengthening of institutions entrusted with safeguarding a nation's cultural patrimony.Such activities should be directly included in the scope of the project, rather than being postponed for some possible future action, and the costs are to be internalized in computing overall project costs.
- Deviations from this policy may be justified only where expected project benefits are great, and the loss of or damage to cultural property is judged by competent

[20] Excerpts from the OPN 11.03.WB Operational Manual. September 1986.

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:[21]

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

[21] Excerpts from the OP 4.10.WB Operational Manual. July 2005.

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

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

No indigenous people - with a social and cultural identity distinct from the dominant society that makes them vulnerable to being disadvantaged in the development process – are known to exist in the Project area.Therefore this OP is not triggered.

However if such groups are identified during the Project implementation, the proponents will develop an Indigenous People Development Plan, in compliance with the OP and get it approved by the Bank.

(ix) Involuntary Resettlement (OP 4.12)

The WB's experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks: production systems are dismantled; people face impoverishment when their productive assets or income sources are lost; people are relocated to environments where their productive skills may be less applicable and the competition for resources greater; community institutions and social networks are weakened; kin groups are dispersed; and cultural identity, traditional authority, and the potential for mutual help are diminished or lost. This policy includes safeguards to address and mitigate these impoverishment risks.[22]

The overall objectives of the Policy are given below.

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

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

(x) Projects in Disputed Areas (OP 7.60)

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

[22] Excerpts from WB OP 4.12.WB Operational Manual. December 2001.

neighboring countries.In order not to prejudice the position of either the Bank or the countries concerned, any dispute over an area in which a proposed project is located is dealt with at the earliest possible stage.

The Bank may proceed with a project in a disputed area if the governments concerned agree that, pending the settlement of the dispute, the project proposed for country A should go forward without prejudice to the claims of country B. [23]

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

(xi) Safety of Dams (OP 4.37)

The Policy seeks to ensure that appropriate measures are taken and sufficient resources provided for the safety of damsthat 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)24 Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities or project by existing technology at reasonable costs.These Guidelines will be applicable to the Project.**

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

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

Appendix D: Gate Operation Plan (Bangla)

<u>পোল্ডারের স্লুইস গেট পরিচালনার ক্ষেত্রেনিয়মাবলী</u>

অতীতেপানিউন্নয়ন বোর্ডেরকর্মচারীরমাধ্যমে স্লুইস গেটগুলোপরিচালিতহতো। বাজেট স্বল্পতারকারণে সে পদগুলোএখন স্থগিতকরাহয়েছে। বর্তমানে গেটগুলোপরিচালনার দায়িত্ব সুবিধাভোগীদেরউপরঅর্পনকরাহয়েছে। প্রতিটি পোল্ডাওে এ জন্য পানিব্যবস্থাপনাসংস্থা (**WMG, WMO, WMA**) গঠনকরা হয়। কৃষিউন্নয়ন ও মৎস্য সম্পদেরকথাবিবেচনাকরে পোল্ডার১৭/১ এর গেট পরিচালনায়পানিব্যবস্থাপনাসংস্থাগুলোকেনিম্নোক্ত বিষয়গুলোবিবেচনাকরতেহবে:

- কৃষিও মৎস্য সম্পদ ব্যবস্থাপনার সাথে সামঞ্জস্য রেখেএকটিনির্দিষ্ট নিয়মেরমধ্য দিয়েপ্রতিটি রেগুলেটরের গেট অবশ্যইনিয়ন্ত্রিণকরতেহবে ;
- প্রকৃতপানিব্যবস্থাপনাবিশেষকরে কৃষি ও মৎস্য সম্পদেরপ্রয়োজনীতারভিত্তিতেপানিউন্নয়ন বোর্ডেরপরিচালনা ও রক্ষণাবেক্ষণশাখাসুবিধাভোগীসংস্থা, কৃষিসম্প্রসারণঅধিদপ্তরএবংমৎস্য অধিদপ্তরেরমাঠকর্মীদের যৌথ পরামর্শক্রমে গেট পরিচালনাকরতেহবে;
- শুধুমাত্র মেরামতও ফ্ল্যাশিং ব্যতীত রেগুলেটরের ফ্ল্যাপএকটিনির্দিষ্ট স্থানে সব সময় একই অবস্থানেরাখতেহবে;
- খালেপানিসংরক্ষণকরে কৃষিকাজে সেচেরজন্য বর্ষার পূর্বে (মার্চ - মে) গেট বন্ধরাখতেহবে;
- বর্ষারসময় (জুলাই -সেপ্টেম্বর)গেট সাধারণতবন্ধ থাকবেতবে পোল্ডারেরভিতর ও বাহিরেরপানির স্তরএকটিনিরাপদ লেভেলেরবাইরেযাতেচলেনাযায় সেদিকেলক্ষ্য রাখতেহবে। এক্ষেত্রে, প্রতিদিনের বৃষ্টিপাত, নদীরঅবস্থা, নদীরএবং পোল্ডারেরভিতরেরপানির লেভেলবিবেচনাকরেযথাযথ সিদ্ধান্তনিতেহবে;
- মাছেরসর্বোচ্চপ্রজননেরসময়ডিমসহমামাছ (ব্রুডমাছ) ও মাছের পোনাঅভিগমনেরবিষয়বিবেচনাকরে মে হতেজুনমাসপর্যন্ত গেট খোলারাখতেহবে;
- বর্ষাপরবর্তীসময় (অক্টোবর-নভেম্বর) গেট এমনভাবেপরিচালনাকরতেহবেযাতেখালে শুষ্ক মৌসুমেওপর্যাপ্তপানি থাকে। এক্ষেত্রেলক্ষ্য রাখতেহবে যেনখালেরপানিতীরউপচেনাযায়এবং কৃষিকার্যক্রম ব্যাহতনা হয়;
- ফ্ল্যাশিং স্লুইস ও পাইপইনলেটপরিচালনারক্ষেত্রেওএকই নিয়মঅনুসরণকরতেহবে;
- কৃষিকার্যক্রম, শষ্যেরনমুনা ও ধরণ, মাছেরপ্রজননসময় ও অভিগমনইত্যাদি পরিবর্তনশীলবিধায়সময়ের সাথে সুবিধাভোগীসংস্থার (কৃষক, মৎস্যজীবি, মৎস্যচাষি) সাথে নিয়মিতপরামর্শ করতেহবে;
- কৃষি ও মৎস্য উভয়সম্পদ বিবেচনায়নিয়েপানিব্যবস্থাপনাসংস্থাগুলোকে (**WMG, WMO, WMA**) সমন্বিতপানিব্যবস্থাপনারউপরপ্রশিক্ষণপ্রদানকরতেহবে।

Appendix E: No Objection Certificates

কার্য্যালয়

১৪নং মাগুরখালী ইউনিয়ন পরিষদ

উপজেলা ঃ ডুমুরিয়া, খুলনা।

বিমল কৃষ্ণ সানা
চেয়ারম্যান
মোবা ঃ ০১৭১১-৩৪৭১০৮

সূত্র ঃ

তারিখ ঃ ১৯/০৭/২০১৬

অবস্থানগত/পরিবেশগত ছাড়পত্রের স্থানীয় কর্তপড়্যা কর্তৃক প্রদেয় অনাপত্তিপত্রের ছক

১। আবেদনকারীর নাম ঃ প্রকল্প পরিচালক, উপকূলীয় বাঁধ উন্নয়ন প্রকল্প (CEIP), বাংলাদেশ পানি উন্নয়ন বোর্ড ।

২। পিতা/স্বামীর নাম ঃ প্রযোজ্য নয়

৩। আবেদনকারীর ঠিকানা ঃ প্রকল্প পরিচালকের কার্যালয়, উপকূলীয় বাঁধ উন্নয়ন প্রকল্প(CEIP)
বাড়ী নং: ১৫ (৫ম তলা), সড়ক নং: ২৪, গুলশান- ২, ঢাকা- ১২১২

৪। প্রকল্পের অবস্থানগত ঠিকানা ঃ পোল্ডার ১৭/১, খুলনা জেলার ডুমুরিয়া উপজেলার মাগুরখালী ইউনিয়নে অবস্থিত।

৫। প্রকল্পের তফছিল ঃ

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
খুলনা	ডুমুরিয়া				মাঝারি উচু ভুমি	হেক্টর

৬। প্রকল্পের কার্যক্রম বাঁধ উঁচুকরন, স্মুইজ গেট ও রেগুলেটর নির্মাণ ও মেরামত, খাল পূনঃখনন ইত্যাদি।
উপরোক্ত তথ্যাদির আলোকে পোল্ডার ১৭/১ পূর্নবাসন প্রকল্প বাস্থবায়নের জন্য নিম্লেবর্ণিত অনাপত্তি প্রদান করা হলো।

শর্তাবলী ঃ

১। প্রকল্প স্থাপন ও পরিচালনার ড়োত্রে পরিবেশ সংরড়্যাণ 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 জরম্নরী 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 উলিস্নখিত যে কোন শর্তলঙ্ঘন করলে যথোপযুক্ত কর্তৃপড়্যা কর্তৃক প্রকল্পের বিরম্নদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

তারিখ ঃ

স্থানীয় কর্তৃপড়্যোর স্বাড়্যার ও সীলঃ

বিমল কৃষ্ণ সানা
চেয়ারম্যান
১৪নং মাগুরখালী ইউ.পি
উপজেলা-ডুমুরিয়া, খুলনা।

Appendix F: Wildlife Species Composition

Checklist of terrestrial plant species found within the Polderarea

Scientific Name	Family	Local Name	Habit
Acacia moniliformis	Mimosaceae	Akashmoni	Tree
Acalyphaindica	Euphorbiaceae	Muktajhuri	Herb
Aegle marmelos	Rutaceae	Bel	Tree
Albizialebbeck	Leguminosae	Sirish	Tree
Albiziaprocera	Leguminosae	Silkaroi	Tree
Albiziarichrdiana	Leguminosae	GogonSirish	Tree
Alstoniascholaris	Apocynaceae	Chatim	Tree
Anthocephaluschinensis	Rubiaceae	Kadom	Tree
Areca catechu	Palmae	Supari	Tree
Artocarpusheterophyllus	Moraceae	Kathal	Tree
Averrhoa carambola	Averrhoaceae	Kamranga	Tree
Azadirachtaindica	Meliaceae	Nim	Tree
Bambusa sp.	Gramineae	Bans	Tree
Barringtoniaacutangula	Barringtoniaceae	Hijal	Shrub
Borassusflabelifer	Palmae	Tal	Tree
Calamus tenuis	Palmae	Bet	Shrub
Calotropis gigantea	Asclepiadaceae	Akand	*Shrub*
Carica papaya	Caricaceae	Papay	Shrub
Carissa carandas	Apocynaceae	Karamcha	*Shrub*
Cassia alata	Leguminosae	Dadmordon	Shrub
Cassia fistula	Leguminosae	Sonalu	Tree
Casuarina equisetifolia	Casurianaceae	Jahu	Shrub
Centellaasitica	Umbelliferae	Thankuni	Herb
Cestrum nocturnum	Compositae	Hasnahena	Shrub
Citrus grandis	Rutaceae	Jambura	Tree
Cleorodendrumviscosum	Verbenaceae	Bhat	Shrub
Clerodendruminerme	Verbenaceae	Bhant	*Herb*
Cocos nucifera	Palmae	Narikel	Tree
Cotulahemispherica	Compositae	Kanchaghash	*Herb*
Crotolariaretusa	Gramineae	Ban-san	*Herb*
Croton bonplandianum	Euphorbiaceae	Banjhal	*Herb*
Cuscutaaustralis	Convolvulaceae	Swarnalata	*Herb*

Scientific Name	Family	Local Name	Habit
Cynodondactylon	Gramineae	Durba	*Herb*
Cyperusdiformis	Cyperaceae	-	*Herb*
Dalbergia sissoo	Fabaceae	Sisso	Tree
Datura suaveolens	Solanaceae	Dutura	Herb
Dentellarepens	Rubiaceae	Hachuti	*Herb*
Dilleniaindica	Dilleniaceae	Chalta	Tree
Diospyros discolor	Ebanaceae	Bilatigab	Tree
Diospyros perigrina	Ebanaceae	Deshigab	Tree
Erythrina ovalifolia	Leguminosae	Talimandar	Tree
Euphorbia hirta	Euphorbiaceae	Dudhia	*Herb*
Ficus benghalensis	Moraceae	Bot	Tree
Ficus heterophylla	Moraceae	BhuiDumur	Herb
Ficus hispida	Moraceae	Dumur	Shrub
Ficus religiosa	Moraceae	Assawath	Tree
Glycosmis pentaphylla	Rutaceae	Daton	Shrub
Lagerstromiaspeciosa	Lythraceae	Jarul	Tree
Leucaunalaucocephalata	Mimisaceae	Ipil ipil	Tree
Litchi chinensis	Sapindaceae	Lichu	Tree
Mangiferaindica	Anacardiaceae	Aum	Tree
Marsileaquadrifolia	Marciliaceae	Susnishak	*Herb*
Mikania scandens	Compositae	Assamlata	Herb
Moringa oleifera	Moringaceae	Sajna	Tree
Nicotiana plumbaginifolia	Solanaceae	Bantamak	*Herb*
Nyctanthesarbortristris	Solanaceae	Sefali	*Herb*
Ocimumamericanum	Labiatae	Tulshi	Herb
Pandanus sp.	Pandanaceae	Keya	Herb
Phoneixsylvestris	Palmae	Khejur	Tree
Pongamiapinnata	Fabaceae	Karoch	Tree
Psidium guajava	Myrtaceae	Peyara	Shrub
Rhynchosporarufescens	Cyperaceae	Shimbhatraji	*Herb*
Ricinus communis	Euphorbiaceae	Reri	Shrub
Rorippaindica	Cruciferae	Bansarisha	*Herb*
Sacciolepisinterrupta	Gramineae	Nardulla	*Herb*
Sesbaniarostrata	Leguminosae	Dhaincha	*Herb*
Spondiasdulcis	Anacardiaceae	Amra	Tree

Scientific Name	Family	Local Name	Habit
Streblus asper	Urticaceae	Sheora	Shrub
Swieteniamahagoni	Meliaceae	Mahogoni	Tree
Syzygiumcumini	Myrtaceae	Kalojam	Tree
Tamarindusindica	Leguminosae	Tetul	Tree
Tectonagrandis	Verbenaceae	Segun	Tree
Terminaliaarjuna	Combretaceae	Arjun	Tree
Terminalia catappa	Combretaceae	Katbadam	Tree
Trewianudiflora	Euphorbiaceae	Pitali/Latim	Tree
Zizyphusmauritiana	Rhamnaceae	Baroi	Tree

Source: Field survey, 2012

Checklist of aquatic flora species found within the Polder area

Scientific Name	Family	Local Name	Habit
Alternanthera philoxiroides	Amaranthaceae	Helencha	Herb
Ceratophyllumdesmersum	Cearatophyllaceae	Jhangi	Herb
Colocasia esculenta	Araceae	Kachu	Herb
Eclipta alba	Compositae	Kalokeshi	Herb
Eichhorniacrassipes	Pontaderiaceae	Kochuripana	Herb
Enhydra fluctuans	Cyperaceae	Helencha	Herb
Hygroryzaaristata	Gramineae	Putki	Herb
Ipomoea aquatica	Convolvulaceae	Kalmisak	Herb
Lemnaperpusilla	Lemnaceae	Khudipana	Herb
Ludwigiaabscendens	Onagraceae	Keshordam	Herb
Ludwigiahyssopifolia	Onagraceae	Keshordam	Herb
Mersileaquadrifoliata	Mersileaceae	Susnisak	Herb
Monochoriahatata	Pontaderiaceae	Kechur	Herb
Nachamendra alternifolia	Hydrocharitaceae	Kaisa	Herb
Najas. sp	Najadaceae	Goisa	Herb
Nymphaea nouchali	Nymphaeaceae	Shapla	Herb
Nymphaea stellata	Nymphaeaceae	Nilshapla	Herb
Phragmites karka	Gramineae	Nol	Herb
Pistia stratiotes	Araceae	Topapana	Herb
Polygonum barbatum	Polygonaceae	Bishkatali	Herb
Polygonum glabrum	Polygonaceae	Bishkatali	Herb

Scientific Name	Family	Local Name	Habit
Sagittariasagittifolia	Alismataceae	Chhotokul	Herb
Scirpusjuncoides	Cyperaceae	Chisra	Herb
Spirodelapolyrhiza	Lemnaceae	Khudipana	Herb
Trapanatans	Trapaceae	Singra	Herb
Vallisnaria spiralis	Hydrocharitaceae	*Bicha*	Herb
Vetiveriazizanioides	Gramineae	*Binna*	Herb
Wolffia microscopica	Lemnaceae	*Guripana*	Herb

Source: Field survey, 2012

Checklist of bird species found within the study area

Status
IUCN Status
VU- Vulnerable
EN-Endangered
CR- Critically Endangered
LC-Least Concern
Birdlife Global Status
Same as IUCN Status
Local Status
CR-Common Resident
UR-Uncommon Resident
CWV- Common Winter Visitor
UWV- Uncommon Winter Visitor
RR-Rare Residant
DD-Data Deficient
WV-Winter Vagrant
RWV-Rare winter visitor
Birdlife Status: LC= Leased Concerned; NT = Near Threatened; NRF = No Record Found

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Acridotheresfuscus	Jungle Myna	JhutiShalik		CR	LC
Actitishypoleucos	Common Sandpiper	PatiBatan		CWV	LC
Aegithinatiphia	Common Iora	PatiFatikjal		CR	LC
Alcedoatthis	Common Kingfisher	PatiMachranga		CR	LC
Amaurornisphoenicurus	White-breasted Water hen	DholabookDahuk		UR	LC
Anastomusoscitans	Asian Open bill	EshioShamkhol		CR	LC
Anthushodgsoni	Olive-backed Pipit	JolpaipithTulika		CWV	LC
Anthusrichardi	Richard's Pipit	RicharderTulika		CWV	LC
Anthusroseatus	Rosy Pipit	GolapiTulika		CWV	LC
Anthusrufulus	Paddy field Pipit	DhaniTulika		CR	LC
Ardeolagrayii	Indian Pond Heron	DeshiKanibok		CR	LC
Artamusfuscus	Ashy Wood swallow	MeteyBonababil		CR	LC

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Athene brama	Spotted Owlet	KhuruleyKutipecha		CR	LC
Bubulcus ibis	Cattle Egret	Go Boga		CR	LC
Caprimulgusmacrurus	Large-tailed Nightjar	LenjaRatchora		CR	LC
Casmerodiusalbus	Great Egret	Boro Boga		CR	LC
Celeusbrachyurus	Rufous Woodpecker	KhoiraKhathkurali		CR	LC
Centropussinensis	Greater Coucal	Boro Kubo		CR	LC
Charadriusdubius	Little Ringed Plover	Soto Nothjiria		CR/CWV	LC
Cisticolajuncidis	Zitting Cisticola	BhomraSoton		CR	LC
Columba livia	Common Pigeon	Gola Paira		CR	LC
Copsychussaularis	Oriental Magpie-Robin	Udoi Doel		CR	LC
Coracias benghalensis	Indian Roller	Bangla Nilkanto		CR	LC
Coracinamacei	Large Cuckoo shrike	Boro Kabashi		CR	LC
Corvusmacrorhynchos	Large-billed Crow	Dar Kak		CR	LC
Corvussplendens	House Crow	PatiKak		CR	LC
Cuculusmicropterus	Indian Cuckoo	BokotakouKokil		CR	LC
Cypsiurusbalasiensis	Asian Palm Swift	AshioTalbatashi		CR	LC
Dendrocittavagabunda	Rufous Treepie	KhoiraHarichacha		CR	LC
Dendrocoposmacei	Fulvous-breasted Woodpecker	BatabiKathkurali		CR	LC
Dendrocygna bicolor	Fulvous Whistling Duck	Raj Shorali		CWV	LC
Dendrocygnajavanica	Lesser Whistling Duck	PatiShorali		CR	LC
Dicrurusmacrocercus	Black Drongo	Kala Fingey		CR	LC
Dinopiumbenghalense	Lesser Golden back	Bangla Kaththokra		CR	LC
Dinopiumjavanense	Common Golden back	PatiKaththokra		CR	LC
Egrettagarzetta	Little Egret	Choto Boga		CR	LC
Egretta intermedia	Yellow-billed Egret	Majhla Boga		CR	NR
Elanus caeruleus	Black-winged Kite	KatuaChil		UR	LC
Eudynamysscolopaceus	Asian Koel	EshioKalakokil		CR	LC
Falco tinnunculus	Common Kestrel	Pati Kestrel		CWV	LC
Gallicrexcinerea	Water cock	Deshi Kora		UR	LC
Gallinagogallinago	Common Snipe	PatiChega		CWV	LC
Gallinagostenura	Pin-tailed Snipe	LenjaChega		CWV	LC
Gallinulachloropus	Common Moorhen	PatiPanmurgi		CR	LC
Glareolalactea	Small Indian Pratincole	Soto Babubatan		CR	LC

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Halcyon smyrnensis	White-throated Kingfisher	DholagolaMachranga		CR	LC
Haliastur Indus	Brahminy Kite	ShonkhoChil		CR	LC
Hierococcyxvarius	Common Hawk-Cuckoo	PatiChokhgelo		CR	LC
Hypothymisazurea	Black-naped Monarch	Kalaghar Rajon		CR	LC
Ixobrychuscinnamomeus	Cinnamon Bittern	KhoiraBogla		UR	LC
Ketupazeylonensis	Brown Fish Owl	KhoiraMechopecha	VU	UR	LC
Laniuscristatus	Brown Shrike	KhoiraLatora		CWV	LC
Laniusschach	Long-tailed Shrike	LenjaLatora		CR	LC
Larusridibundus	Common Black-headed Gull	KalamathaGangchil		CWV	LC
LC*Acridotherestristis*	Common Myna	Bhat Shalik		CR	LC
Leptocomazeylonica	Purple-rumped Sunbird	BegunikomorMoutushi		CR	LC
Lonchuramalabarica	Indian Silver bill	DeshiChandithot		UR	LC
Lonchuramalacca	Black-headed Munia	Kalamatha Munia		UR	LC
Lonchurapunctulata	Scaly-breasted Munia	Butibook Munia		CR	LC
Malacocinclaabbotti	Abbott's Babbler	AboterSatarey		CR	LC
Megalaimaasiatica	Blue-throated Barbet	NeelgolaBoshonto		CR	LC
Megalaimahaemacephala	Coppersmith Barbet	ShekraBoshonto		CR	LC
Megalaimalineata	Lineated Barbet	DagiBoshonto		CR	LC
Megaluruspalustris	Striated Grassbird	DagiGhashpakhi		CR	LC
Meropsorientalis	Green Bee-eater	ShobujShuichora		CR	LC
Metopidius indicus	Bronze-winged Jacana	Dol Pipi		UR	LC
Milvus migrans	Black Kite	BhubonChil		CR	LC
Mirafraassamica	Bengal Bush Lark	Bangla Jharbhorot		CR	LC
Motacilla alba	White Wagtail	DholaKhonjon		CWV	LC
Motacillacinerea	Grey Wagtail	MeteyKhonjon		UWV	LC
Motacillacitreola	Citrine Wagtail	SitrinKhonjon		CWV	LC
Motacillamadaraspatensis	White-browed Wagtail	DholavruKhonjon		UR	LC
Nettapascoromandelianus	Cotton Pygmy Goose	DholaBalihash		UR	LC
Numenius arquata	Eurasian Curlew	EureshioGulinda		V	LC
Numenius glareola	Wood Sandpiper	Bon Batan		CWV	LC
Nycticoraxnycticorax	Black-crowned Night Heron	KalamathaNishibok		CR	LC

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Oriolusxanthornus	Black-hooded Oriole	KalamathaBenebou		CR	LC
Orthotomussutorius	Common Tailorbird	PatiTuntuni		CR	LC
Parusinornata	Plain Prinia	NirolPrina		CR	LC
Parusmajor	Great Tit	Boro Tit		CR	LC
Passer domesticus	House Sparrow	PatiChorui		CR	LC
Pericrocotuscinnamomeus	Small Minivet	Choto Saheli		CR	LC
Phalacrocoraxniger	Little Cormorant	ChotoPankouri		CR	LC
Picusxanthopygaeus	Streak-throated Woodpecker	DagigolaKathkurali		UR	LC
Ploceusphilippinus	Baya Weaver	Deshibabui		CR	LC
Pluvialis fulva	Pacific Golden Plover	ProshantoShonajiria		CWV	LC
Psittaculakrameri	Rose-ringed Parakeet	Modna Tia		CR	LC
Pycnonotuscafer	Red-vented Bulbul	Bangla Bulbul		CR	LC
Rhipiduraalbicollis	White-throated Fantail	DholagolaChatighurani		CR	LC
Spilornischeela	Crested Serpent Eagle	Tila Nag-eegol		CR	LC
Sterna acuticauda	Black-bellied Tern	KalapetPanchil			LC
Sterna aurantia	River Tern	NodiaPanchil		UWV	LC
Sterna hirundo	Common Tern	PatiPanchil		UWV	LC
Streptopeliachinensis	Spotted Dove	TilaGhughu		CR	LC
Streptopeliadecaocta	Eurasian Collared Dove	EurashioKonthighughu		CR	LC
Streptopeliatranquebarica	Red Turtle Dove	Lal Konthighughu		CR	LC
Sturnuscontra	Pied Myna	EshioPakrashalik		CR	LC
Sturnusginginianus	Bank Myna	GaangShalik		UR	LC
Sturnusmalabaricus	Chestnut-tailed Starling	KhoiralejTelshalik		CR	LC
Tadornaferruginea	Ruddy Shelduck	KhoiraChokachoki		CWV	LC
Terpsiphoneparadisi	Asian Paradise-flycatcher	EshioShabulbuli		UR	LC
Treronphoenicopterus	Yellow-footed Green Pigeon	HoldepaHorial		CR	LC
Turdoidesstriatus	Jungle Babbler	Bon Satarey		CR	LC
Turdoidesearlei	Striated Babbler	DagiSatarey		UR	LC
Tyto alba	Barn Owl	Lokkhi Pecha (SA)		UR	LC
Upupa epops	Eurasian Hoopoe	Pati Hoodhood		UR	LC
Vanellusduvaucelii	River Lapwing	NodiTiti	EN	UR	LC

Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status
Vanellus indicus	Red-wattled Lapwing	Hot Titi		UR	LC
Zootheratorquatus	Eurasian Stone Chat	PatiShilafidda		CWV	LC
Zosteropspalpebrosus	Oriental White-eye	UdoiDholachokh		CR	LC

Source: Field survey, 2012

Checklist of Mammals, Amphibians, and Reptiles with status found along the Polder alignment

Local Status code: CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV – Winter Visitor; UWV – Uncommon Winter Visitor

IUCN Status code: CR – Critically Endangered, EN - Endangered, VU – VuMNerabal

Scientific Name	English Name	LocalName	IUCN Status (BD)	Local Status
Mammals				
Bandicotabengalensis	Lesser Bandicoot Rat	Indur	-	CR
Bandicotaindica	Greater Bandicoot Rat	DhariIndur	-	CR
Canis aureus	Asiatic Jackal	PatiShial	VU	RR
Felischaus	Jungle Cat	Ban Biral/Woab	EN	RR
Herpestesjavanicus	Small Indian Mongoose	Beji	-	UR
Hipposiderosgaleritus	Cantor’s Leaf-nosed Bat	Kantor Pata-nakChamchika	NT	UR
Megaderma lyra	Indian False Vampire	DainiChamchika	-	CR
Mus musculus	House Mouse	NengtiIndur	-	UR
Pipistrelluscoromandra	Indian Pipistrelle	Chamchika	-	CR
Platanista gangetica	Ganges River Dolphin	Shishu/Shushuk/Houm	EN	UR
Prionailurusviverrinus	Fishing Cat	Mechho Bagh	EN	UR
Pteropusgiganteus	Flying Fox	Badur		CR
Rattus rattus	Common House Rat	GhorerIndur	-	CR
Rousettus leschenaulti	Fulvous Fruit Bat	Kola badur	LC	UR
Suncusmurinus	Asian House Shrew	Chika	CR	CR
Viverriculaindica	Small Indian Civet	Khatash	VU	RR
Amphibians				
Hoplobactrachustigerinus	Indian Bull Frog	Sona bang	-	C
Microhylaornata	Ornate Microhylid	Cheena Bang	VU	C
Hylaranatytleri	Leaping Frog	Pana Bang	-	U
Polypedatesleucomystax	Asian Brown Tree Frog	Gecho Bang	-	CR
Polypedates maculatus	Indian Tree Frog	Gecho Bang	-	UR
Reptiles				
Pangshura tectum	Indian Roofed Turtle	Kori/Hali Kasim	-	C
Pangshura tentoria	Median Roofed Turtle	Kaitta	-	U
Aspideteresgangeticus	Ganges softshell Turtle	Khalua Kasim	EN	UR
Lissemyspunctata	Spotted Flapshell Turtle	Patapori/ Shundi Kasim	VU	UR
Calotes versicolor	Common Garden Lizard	Roktochosha	-	CR
Gekko gecko	Tokay Gecko	Tokkhak/Kokkay	VU	CR
Hemidactylus brookii	Brooks House Gecko	Tiktiki	-	CR
Hemidactylus flaviviridis	Yellow-bellied House Gecko	GodaTiktiki	-	CR
Hemidactylus frenatus	Common House Gecko	Tiktiki	-	CR
Mabuyacarinata	Keeled Grass skink	Anzoni	-	C
Sphenomorphus maculatus	Spotted Litter skink	Anzoni	-	C
Varanus bengalensis	Bengal Monitor	GuiShap	VU	CR

Scientific Name	English Name	LocalName	IUCN Status (BD)	Local Status
Varanus salvator	WaterMonitor	Sona Gui	EN	RR
Typhlopsjerdoni	Jerdon's Blind Snake	SutanoliShap	-	CR
Atretiumschistosum	Olive Keelback	MatiaShap	-	CR
Amphiesmastolatum	Striped Keelback	ChiluShap	-	CR
Enhydrisenhydris	Common Smooth Water Snake	PainnaShap	-	CR
Lycodonaulicus	Common Wolf Snake	GharginniShap	-	CR
Ptyasmucosus	Indian Rat Snake	DarajShap	-	CR
Xenochropis piscator	Checkered Keelback	DhoraShap	-	C
Bungarus caeruleus	Common Krait	Kal-keuteShap	EN	UR
Najanaja	Spectacled Cobra	KhoiyaGokhraShap	EN	C
Najakaouthia	Monocled Cobra	GokhraShap	VU	RR

Source: Field survey, 2012

Appendix G: Fish Species Diversity of Different habitats in the Study Area

Scientific Name	Local name	English Name	Fish Habitat			
			River	Khal	Gher	Pond
Brackish Water Fish Species						
Liza parsia	Perse	Gold spot Mullet	H	L	NA	NA
Latescalcarifer	Bhetki/Koral	Barramundi	M	L	NA	NA
Polynemusparadiseus	Tapse	Paradise Threadfin	M	L	NA	NA
Rhinomugilcorsula	Khorsula	Corsula	M	L	L	L
Raiamas bola	Bhola	Indian Trout	L	NA	NA	NA
Acentrogobiuscyanomos	NunaBaila	Salin Goby	H	M	NA	NA
Glosssogobiusgiuris	Baila	Tank Goby	M	M	NA	NA
Gadusiachapra	Chapila	Chapila	H	L	NA	NA
Plotosuscanius	Gang Magur	Canine Catfish	L	NA	NA	NA
Setipinnaphasa	Phasa		M	NA	NA	NA
Macrobrachiumrosenbergii	Golda chingri	Giant River Prawn	L	L	L	NA
Acanthus latus	Datina	Yellow Seabream	M	L	NA	NA
Scatophagusargus	Bishtara	Spotted Butter fish	L	L	NA	NA
Penaeus monodon	Bagdachingri	Giant Tiger Shrimp	M	L	L	NA
Metapenaeusmonoceros	Harinachingri	Greasy back Shrimp	M	M	NA	NA
Macrobrachium rude	Kathalichingri	Hairy River Prawn	M	L	NA	NA
Puntius spp	Puti	Spot fin Swamp Barb	M	M	L	LA
Mastacembelusarmatus	Baim	Long fin Snake Eel	M	L	NA	NA
Mastacembeluspancalus	Guchi	Stiped Spiny Eel	M	M	NA	NA
Macrognathus aculeatus	Tara Baim	Lesser Spiny Eel	M	H	NA	NA
Mystusvitatus	Tengra	Mystus	H	H	L	NA
Mystuscavasius	GulshaTengra	Gangetic mystus	M	M	NA	NA
Heteropneustesfossilis	Shing	Stinging Catfish	NA	L	L	L
Channastriatus	Shol	Snakehead Murrel	NA	L	NA	NA
Channa punctatus	Taki	Spotted Snakehead	NA	L	NA	NA
Anabas testudineus	Koi	Climbing perch	NA	L	NA	NA
Ompokpabda	Pabda	-	L	L	NA	NA
Sperataaor	Aor	Cat fishes	L	L	NA	NA
Wallago attu	Boal	Cat fishes	L	L	NA	NA
Pungasiuspungasius	Pungus	Riverine giant cat fish	L	NA	NA	NA
Otolithiesargentatus	Sadapoa	Puma fish	L	NA	NA	NA
Colisafasciata	Khoilsa	Banded gourami	NA	L	NA	NA
Lepidocephalusguntea	Gutum	Gutum	L	L	NA	NA
Scylla serrata	Kankra	Crab	H	H	NA	NA
CultureFish Species						
Labeorohita	Rui	Rohu	L	NA	H	H
Catlacatla	Catla	Catla	NA	NA	H	H
Cirrhinuscirrhosus	Mrigal	Mrigal Carp	NA	NA	H	H
Barbodesgonionotus	Thai/Raj puti	Thai puti /Silver barb	NA	NA	M	H
Hypophthalmichthys molitrix	Silver carp	Silver carp	NA	NA	M	M
Ctenopharyngodonidella	Grass carp	Grass carp	NA	NA	M	M

Scientific Name	Local name	English Name	Fish Habitat			
			River	Khal	Gher	Pond
Oreochromis mossambicus	Tilapia	Mozambique tilapia	NA	NA	M	L
Oreochromis niloticus	Tilapia	Nile tilapia	NA	NA	M	M
Pungasiushypophthalmous	Thai Pangus	Yellow tail catfish	NA	NA	L	M
Cyprinus carpio var. communis	Carpio	Common carp	NA	NA	L	M
Cyprinus carpio var. specularis	Mirror carp	Mirror carp	NA	NA	L	L

Source: CEGISField Survey 2016 and Consultation with local fishers, farmers and elderly people in the study area
Note: Abundance Code: H=High, M= Medium, L=Low, NA=Not available.

Appendix H: Summary of Assessed Impacts

A summary of impacts and their significance, discussed in Impact Chapter is presented below in Tabular form:

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
A. Pre-construction Phase									
Deterioration of Environmental Quality (Air and Noise)	Short term	Local	Reversible (after construction phase)	Certain	Medium	Moderate	• 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. • Stockyard should be covered during non working period. • Exhaust emissions from vehicles and equipment will comply with standards. • Vehicles, generators, and equipment will be properly tuned. • Water will be sprinkled where needed to suppress dust emissions. • Speed limits will be enforced for vehicles on earthen tracks. • Vehicles and machinery will have proper mufflers and silencers.	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Changes in land use (preparation of construction facilities, borrow areas, others)	Short term	Local	Reversible (after construction phase)	Certain	Low to Medium	Low	• All the construction camps should be established within the area owned by BWDB. • Pay compensation/rent if private property is acquired on temporary basis, which instructions should be specified in the tender document. • Labor shed/camp should be constructing at government khas land. • Avoid impacts on local stakeholders.	Very low	Changes in land use (preparation of construction facilities, borrow areas, others)
Clearances of vegetation	Sort term	Local	Reversible (after construction phase)	Certain	Low to Medium	Medium	• Use barren land or possible low vegetated land for placing of materials stock yards • Fuel wood should be collected from local market. • The work should be completed within contacted scheduled time (4 month) • Labor should be made aware about local faunal species	low	Clearances of vegetation
Increased Vehicular Traffic during mobilization	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Moderate	• The contractor will prepare a traffic management plan (TMP) and obtain approval from the Design Consultant (DC) and Construction Supervision (CS) consultant. • Contractor also implement mobilization plan considering water vessels and launch movement in the	Increased Vehicular Traffic during mobilization	Short term

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							external rivers and, avoid the launch movement time. • The TMP will be shared with the communities and will be finalized after obtaining their consent. • The TMP will address the existing traffic congestion. • Ensure minimal hindrance to local communities and commuters. • The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. • The works of the first half when completed, and then of the other half will be undertaken. • Work schedule will be finalized in coordination and consultation with local representatives and communities. Specifically union parishad members of the polder.		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible 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 moved in the polder area and also on embankment during off peak time. No school time (10:00 Am to 14:00Pm) and day of marketing time (Hat bar) should be considered during vehicular traffic movement. • Keep provision of training on vehicular traffic moving pattern and management system for the local stakeholders using multimedia presentation and showing Video at different common population gathering places in the polder area.		
Preparation of Facilities for Contractor and Labor force	Short term	Local	Reversible	Reversible	Medium to high	Moderate	• Contractor will prepare site establishment plan and obtain approval from the Construction Supervision Consultants (CSC) • Approval from CSC will be obtained for the location of temporary facilities.	Preparation of Facilities for Contractor and Labor force	Short term

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Tree felling and vegetation clearing will be minimized to establish site facilities. • Photographic record will be maintained to record pre-construction condition of the area. • Site facilities will be established at a safe distance from communities. • Contractor will prepare and implement pollution control and waste management plans. • No untreated wastes will be released on ground or in water. • Exhaust emissions from vehicles and equipment will comply with standards. • Vehicles, generators, and equipment will be properly tuned. • Water will be sprinkled where needed to suppress dust emissions. • Speed limits will be enforced for vehicles on earthen tracks. Vehicles and machinery will have proper mufflers and silencers. Liaison will be maintained with the communities.		
B. Construction Phase									

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Hindrance for pedestrians and vehicles movement	Short term	Local	Reversible	Likely	Low	Minor	• The embankment works will be carried out in segment wise and soil will be placed linearly on half of the embankment, leaving the other half to be used as public transportation.When the works are completed on the first half, it will be opened for local traffic while works will be undertaken on the other half of the embankment; • Work schedule will be finalized in coordination and consultation with local representatives (Union Parishad Chairman & members) and communities; • Alternative road can be used for movement if possible • The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes; and • Earth work for re-sectioning of embankment during hat day can be shorted for essay movement of local people;	Negligible	BWDB and Contractors
Generate Noise and Vibration	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Moderate	• Demolition of the regulators will not be carried out during the school time (8 am to 1 pm) particularly near the schools;	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Restricting/limiting construction activities during the day time; • Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards; • Vehicles and machinery will have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors, as needed; • Provision of PPE (ear muffs and plugs) to labor; • The construction crew will be instructed to use the proper equipment, to minimize noise levels; • Camps will be located at a safe distance from communities		
Deterioration of Air Quality	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Moderate	• Exhaust emissions from vehicles and equipment will comply with standards. • Proper tuning of vehicles, generators, and equipment will be carried out, to minimize exhaust emissions. • Construction material (sand/soil) will be kept covered while transporting and stock piled. • Regular water sprinkling will be carried out where needed, particularly on the earthen tracks near communities.	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Vehicle speed will be on low (15 km per hour) on earthen tracks particularly near communities and school. • Vehicles and other machinery will be turned off when idle • Good quality fuel will be used, minimizing exhaust emissions. • Camps will be located at a safe distance from communities and schools.		
Degradation of Water Quality	Short term	Local	Reversible (after construction phase)	Certain	Medium	Moderate	• Contractor will prepare and implement pollution control plan. • Contractor workshops will have oil separators/sumps to avoid release of oily water; • Contractor will use plastic sheet or gravel in the workshop and equipment yard to prevent water contamination. • Contractor will ensure that there is no leakage, spillage, or release of fuel, oil or any other affluent/waste in the water from boats, trawlers, launches, and barges. • Material borrowing from the river banks will be carried out sufficiently away from the water line, minimizing the possibility of loose soil to wash away in the river. • Contractor will locate camps away from water bodies.	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Contractor will prepare and implement camp waste management plan (septic tanks, proper solid waste disposal). • Contractor will not release untreated wastes in water. • Contractor will re-use spoil and excavated material where possible. • Contractor will dispose spoil at designated areas with community consent. • Construction material, demolition debris, and excavated soil/silt will not be allowed to enter water bodies.		
Increase of Drainage Congestion	Short term	Local	Reversible (after construction phase)	Certain	Medium	Moderate	• Construct bypass canal before replacement of drainage sluices. • Sequence of work at the drainage sluices and in the water channels will be carefully planned to avoid drainage congestion. • Contractor will ensure that drainage channels are not obstructed or clogged by the construction activities which do not causes any drainage congestion situation in crop fields.	Low	BWDB and Contractors
Increasing of Sedimentation	Short term	May extend beyond Polder	Mostly Irreversible	Likely	Medium	Moderate	• Contractor will excavate channels after dewatering them; • Contractor will not leave excavated earth and silt on channel banks;	Low	BWDB and Contractors

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Contractor will implement measures to protect channels from run-off from work areas and camps; and • Contractor will obtain borrow material from river banks in a manner not to increase siltation in rivers, and will not leave loose soil after excavation.		
Affects on agriculture crop production	Short term	Local	Reversible	Likely	Minor	Low	• Compensation should be paid for any crop damage. • Contractor should avoid cultivation fields during construction. • Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps construction. • Contractor should ensure that no vehicular movements take place inside cultivation fields. • Contractor should ensure that no material is dumped inside cultivation fields. • Re-excavated soil of canals should not be damp in agricultural land. • Contractor should maintain liaison with communities.	Negligible	
Affects on irrigation	Short term	Local	Reversible	Likely	Low to Medium	Major	• Contractor should construct bypass channel before construction/repair of each regulator.	Low	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• 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.		
Impacts on Fish Habitat and Habitat Quality	Short term	Local	Reversible	Certain	Medium	Major	• Contractor will construct by-pass canal before construction and repair of each sluice gate. • Re-excavation work should be done in winter and early dry season i.e., November to February to minimize the hamper of fish and shrimp (bagda) culture. • Sequence of work at sluice gate and in khals will be carefully planned to minimize impacts on fish and their migration. • Excavated soil should be dumped on high land at safe distance from the bank of khals. • By-pass canal should be dismantled just after the completion of the	Low	BWDB and Contractor

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							repairing of the sluice gates and excavation work.		
Impacts on Fish Movement and Migration	Short term	Local	Reversible	Certain	Major	Moderate	• Alternative channel should be excavated for facilitating fish movement and other aquatic organisms during the construction period. • Fish friendly structures will be constructed in the connecting khals. • Establishment of fish sanctuaries in the internal khals. • Operation and maintenance (O&M) of all water regulatory structure will be strengthened. • Proper operation of water regulatory structures and timely opening of the sluice gates during fish breeding period. Gate operation manual (in Bengali) will be prepared with the consultation of local Department of Fisheries (DoF) officials and local fishers and provide to WMAs.	Low	BWDB and Contractor
Impact on Fish Biodiversity	Short term	Local	Reversible	Certain	Medium	Moderate	• Conserve fish species through conservation of deep pool in the major khals. • Establishment of fish sanctuaries in the internal khals.	Low	BWDB, WMA with collaboration of DoF

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Conduct training to the fish farmers on environment friendly improved fish culture technology.		
Impact on Fish Production	Short term	Local	Reversible	Certain	Medium	Moderate	• Provide fisheries training in collaboration with Department of Fisheries (DoF) on environment friendly improved fish/prawn culture technology as well as the rice-cum-golda/fish farming. • Golda farming will be encouraged through campaign/awareness development. • Provide skill development training to the fish farmer for more fish/prawn production in gher and ponds. • Stocking the fresh water fish fry (Carps and other small indigenous fish species) in the khals inside the polder area after completion of construction works.	Low	BWDB, WMA with collaboration of DoF
Clearance of vegetation	Short term	Local	Reversible (after construction phase)	Occasional	Low to Medium	Medium	• Collect soil from barren land as much as possible • Proper turfing should be implement at embankment slopes with local grasses	Low	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							and ensure regular monitoring of turf grasses till they matured • Give proper compensation to the tree owners against tree felling. • Implement plantation with native species (i.eSirish (*Albizialebbeck*), Narikel (*Cocos nucifera*), Tal(*Boassusflabelifer*), Khejur(*Phoneixsylvestirs*), etc) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works. • Avoid construction activities during favorabletime of wild life movement(early morning and night) • Keep untouched the deepest points of the khal as much as possible. • Use excavated soil spoils for khal dyke re-sectioning • Implement tree plantation with local species at the khal bank side after re-excavation work where excavated soil dumped khal bank side. • Use minimum land as much as possible for excavator/ labor movement.		
Outbreak of plant diseases	Short term	Local	Reversible	Occasional	Nil to Medium	Medium	• Aware labors about plant conservation who are engaged for afforestation activities	Nil	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Collect saplings from nearer natural source as much as possible. • All kinds of polyethylene bags and plastic ropes should bepiled up in a pit for dumped or burned in a proper way • Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation (i.e.:using of disease free seeds, proper treatment of nursery soils, using appropriate doses of pesticides and fertilizers) • Pre-consultation with Forest Department and other related non-government organizations for selecting of suitable species for plantation and spacing of the saplings • Develop a pest management plan for the holistic afforestation		
Safety and Public Health Hazards	Short term	Local	Reversible	Likely	High	Major	• The contractors will prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants.The Plan should also include awareness rising and prevention measures for particularly for communicable diseases	Moderate	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							such as hepatitis B and C, and HIV/AIDS. • The WBG's EHS Guidelines will be included in the contract documents. • Liaison will be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets will be kept in all the labor camps for obtaining weather information. • Each contractor will prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan will be submitted to Construction Supervision Consultants for review and approval; • All workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities; • The construction sites will have protective fencing to avoid any unauthorized entry, where appropriate and possible		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• 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		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activity. The construction contractor(s) would not hire people under the age of 18 on permanent contracts but would include short training activities for youth to the extent possible; • Ensuring acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work; • Ensuring no workers are charged fees to gain employment on the Project; • Ensuring rigorous standards for occupational health and safety are in place; • Contractor will establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. • The contractor will adopt a Human Resource Policy appropriate to the size		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							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		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							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.		
Hindrance for Pedestrian and Vehicle Movement	Short term	Local	Reversible	Likely	Medium	Moderate	• The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track.When the works are completed on the first half, it will be opened for local traffic while works will be undertaken on the other half of the embankment. • Work schedule will be finalized in coordination and consultation with local representatives and communities. • Local routes will not be blocked as much as possible.If unavoidable, alternative routes will be identified in consultation with local community.	Low	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Social unrest between Local worker and outside worker	Short term	Local	Reversible	Likely	Medium	Moderate	• Proper awareness programs will be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, UpazilaNirbahi Officer (UNO) and BWDB local officers. • Liaison with the communities will be maintained. • Cultural norms of the local community will be respected and honored. • GRM will be established to address the grievances of local as well as outside laborers. • Careful use of local natural resources and project resources, fuel, fuel-wood and electricity. • Restrictions related to consumption of alcohol and drugs. • Safe driving practices. • Respect for the local community and its cultural norms in which laborers are working. • Avoiding construction activities during Prayer time.		

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Increased inland and waterway traffic	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Moderate	• Contractor to prepare and implement traffic management plan. • Contractor to establish new, temporary jetties where needed. • River crossing for material transportation during nighttime where possible and appropriate • Material transportation through rivers during high tide where needed. • Liaison to be maintained with community and BIWTA.	Low	
Seasonal Impacts (Natural Hazards)	Short term	Local	Reversible	Likely	Medium	Moderate	• Weather signals will be considered by the contractor during construction works. • Radio and television will be provided in all the labor sheds for receiving weather information through these media. • Ensuring rigorous standards for occupational health and safety are in place.	Low	
Damage to Local Infrastructure	Short term	Local	Reversible	Likely	Medium	Moderate	• The condition of the infrastructure being used for the construction and transportation activities will be regularly monitored. • All damaged infrastructure will be restored to original or better condition.	Low	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• To take preventive measures for protection of local infrastructure.		
C. Post Construction Phase									
Increase Salinity Intrusion due to leakage of drainage sluices	Long term	Local	Reversible	Likely	Medium	Moderate	• Formation of WMOs in concern with the structures and embankment • Regular monitoring and careful maintenance of the water control structures will be ensured. • Standard operating procedures will be prepared and implemented for the water control structures.These procedures will be translated in bangle as well. • Capacity building of WMOs will be carried out.	Low	BWDB and WMOs
Increase of sedimentation in water channels and rivers	Long term	Local	Reversible	Likely	Medium to Low	Minor	• An ongoing program of de-silting of water channels will be considered with full community involvement and participation. • Provide silt management plan • The local government (union parishad) will be authorized to monitor the development activities. • Prepare Bangla manual for sluice gate operation and provide training to WMOs; and • Reduce conflicts between farmers and fishermen.	Negligible	BWDB and WMOs

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Soil and water contamination (increased use of chemical inputs) and reduced soil fertility	Long term	Local	Reversible	Likely	High	Major	• Capacity building and awareness rising of the farmers should be carried out to practice Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) in order to minimize usage of chemical inputs. • Farmers group should have close contact with DAE for adoption of various measures of IPM, ICM and GAP. • Farmers should be encouraged to use organic and green manure to increase soil fertility while avoiding water contamination. • Farmers should be encouraged to cultivate leguminous crops (N2 fixing) to enhance the soil quality as well as soil productivity.	Moderate	
Increase salinity intrusion	Long term	Local	Reversible	Likely	High	Major	• Regular monitoring and careful maintenance of the water control structures will have to be ensured. • Standard operating procedures will have to be prepared and implemented for the water control structures.These procedures will be translated in bangla as well. • Capacity building of WMOs will be carried out.	Low	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Fish Habitat and Habitat Quality	Long term	Local	Reversible	Certain	Medium	Moderate	• Fisheries Conservation and Protects Acts and rules and fishing ban period should be strictly imposed for protecting indiscriminate fishing, eggs, catching of PL of shrimp and other fishes in the khals as well as outsides river adjacent of the polder area. • Establishment of fish sanctuary in the deeper part of the khals and managed through fishers' organization. • Awareness development among the local people through meeting, propaganda, leaflet/flyer dissemination, demonstration and observation different day like fish week etc.		BWDB and WMA with collaboration of DoF
Fish Movement and Migration	Long term	Local	reversible	Certain	Medium	Moderate	• Use of harmful fishing gear like Behundijal, Gill net (current jal) and indiscriminate fishing should be stopped during migration period in the study area. • Illegal fishing nearby sluice gate should be stopped strictly and followed by WMA and fishers.		WMA with the assistance of DoF

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
Fish Diversity and Species Richness	Long term	Local	Reversible	Certain	Medium	Moderate	• Fish species which are known as threatened locally should be conserved. • Local fishers should be encouraged not to harvest the threatened fish species. • Local community should protect the deep areas of the khals to protect the brood fish for the propagation in the following year. • Release the threatened brood fish in the khals for the spawning and conserved them. Training may be provided to WMG and WMA on “Integrated Water Management and Operation & Management of Sluice Gates” which enable them to understand the opening time of sluice gate in accordance to fish and shrimp migration and culture period.		WMA & BWDB
Fish Production	Long term	Local	reversible	Certain	High	High	• Threatened and indigenous fish species should be released in the khals to increase fish production. • Fish sanctuary should be established in the deeper part of the khals to conserve the brood fish for the next year		WMAs and BWDB with collaboration of DoF

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							spawning as well as protect the juvenile fishes. • Harmful fishing gear like gill net (current jal) uses should be stopped in the culture fisheries. • Training on improve fish, prawn and shrimp culture should be provided to the farmers to intensify the aquaculture. • The WMAs should be involved in the integrated water management through proper maintenance of sluice gates and khals for the expansion of culture fisheries.		
Risk of embankment failure	Long term	Local	Reversible	unlikely	High	Major	• Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the eastern side of the Polder will be ensured. This monitoring will particularly be carried out before and after monsoon season. • Prevention of establishing hand tube-wells at the crest of the embankment. • Available cyclone and flood shelter will be prepared as a contingency measure during emergency situation. • WMG will develop a fund for this kind of emergency situation.	Low	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact	Responsible Agency
							• Structural measures like geo bag and sand bag will be kept in stock yard of local BWBD colony.		

Appendix I: 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 মাগুরখালী ইউ পি. মিলনায়তন ইউনিয়নঃ মাগুরখালী - উপজেলাঃ ডুমুরিয়া .

জেলাঃ খুলনা সময়ঃ ১১:০০ তারিখঃ ২০/০১/২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
১	নবীন সানা	সুশীল সমাজ	কোড়াকাটি	01724-002210	বিমলসানা
২.	মো: আব্দুল সাত্তার	সচিব		01984108210	[illegible]
৩.	তপন মন্ডল	সুশিল সমাজ প্রতিনিধি	দেবীতলা	০১৭৬০৯১১৮২৪	তপন
৪.	শরিফ মোহাম্মদ মহসীন	হিসাব সহকারী		০১৭১৪০৪৫১১০৬	[illegible]
৫.	উমা মল্লিক	সুশিল সমাজ প্রতিনিধি	মাগুরখালী	01741 748248	[illegible]
৬.	ভগীরথ সানা	,,	কোড়াকাটি	01765 202267	
৭.	সুব্রত সানা	,,	খর্নিয়া	01952 336217	[illegible]
৮.	মহাদেব বাইন	ইউ পি সদস্য		01714593517	[illegible]
৯.	শংকর দাশ	সুশিল সমাজ প্রতিনিধি	বুড়ুলিয়া	01950629719	শংকর দাশ
১০.	প্রহ্লাদ মন্ডল	ইউ: পি. সদস্য		01718700167	[illegible]
১১	বিকাশ মিস্ত্রী	সুশীল সমাজের প্রতিনিধি	হোগলাবুনিয়া	01916526876	বিকাশমিস্ত্রী
১২	চিত্তরঞ্জন মন্ডল	,,	খোর্দ্দবাটরা	01724337268	[illegible]
১৩	নির্মল কান্তি বালা	ব্যবসায়ী	ভুলবাড়িয়া	01719-520073	[illegible]
১৪	অনন্ত কুমার মন্ডল	ইউ, পি, সদস্য ৭ নং ওয়ার্ড	১৪নং মাগুরখালী ইউনিয়ন	01715434306	[illegible]
১৫	অরুন্ধতী মন্ডল	ইউপি সদস্য ৪, ৫, ৬ নং ওয়ার্ড	১৪নং মাগুরখালী ইউনিয়ন	01734024485	[illegible]
১৬।	রামানন্দ মন্ডল		চন্ডীপুর	01917-675285	রামানন্দ
১৭	বিকাশ রায়		হোগলাবুনিয়া	01624722071	বিকাশ রায়
১৮	অনিমা মন্ডল		খর্নিয়া	01818938918	অনিমা
১৯	তরুন কান্তি বৈরাগী	সমাজ সেবক	গজালিয়া	01614597278	তরুন বৈরাগী

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CEGIS Center for Environmental and Geographic Information Services

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মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থানঃ মাগুরখালী ইউ.পি. মিলনায়তন ইউনিয়নঃ মাগুরখালী উপজেলাঃ ডুমুরিয়া
জেলাঃ খুলনা সময়ঃ ১১:০০ তারিখঃ ২০/০১/২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
২০	গৌরাঙ্গ দাস সরকার				গৌরাঙ্গ দাস সরকার
২১	তওহিদা সুলতানা	শিশু	আলাদিপুর	01923407147	সুলতানা
২২	শেফালী রানী মন্ডল	শিশু	মাগুরখালী	01784707927	[illegible]
২৩	দিপালী ঢালী	গৃহিনী	চন্ডীপুর	01711345742	দিপালী
২৪	বিধুভূষণ মন্ডল	কৃষি	শান্তিনগর	01753640660	বিধুভূষণ মন্ডল
২৫	জবা রানী সরকার	গৃহিনী	আলাদিপুর	01725-178134	জবা
২৬	সুচিত্রা রানী রায়	H/A	লাইলেমোড়	01721-023670	[illegible]
২৭.	মো: আলমগীর ব্যবসা	ব্যবসা	কৃষ্ণনগর	01925-676704	[illegible]
২৮.	প্রনব কান্তি মন্ডল	ব্যবসা	চন্ডীপুর	01711-345742	[illegible]
২৯	বিধান চন্দ্র মন্ডল	প্র: শি:	মাগুরখালী	01725-261130	বি, মন্ডল ২০/০১/১৬
৩০	বিমল কৃষ্ণ মানা	চেয়ারম্যান	২নং মাগুরখালী	01711347108	[illegible]
৩১	অশোক কুমার গোলদার	SAAO	মাগুরখালী	01716770570	[illegible]
৩২	তুষার কান্তি মন্ডল	SAAO	শিবনগর	01796-932006	[illegible]
৩৩	মৌসুমী মল্লিক	গৃহিনী	চন্ডীপুর	01726928824	মৌসুমী
৩৪	চৈতালী মল্লিক	ঐ	মাগুরখালী	01717667405	[illegible]
৩৫	রিনা রানী মানা	প্রধান শিক্ষক	শিবনগর	01719503868	[illegible]
৩৬	[illegible]	সহ শিক্ষিকা	লাইলেমোড়	01727439939	[illegible]
৩৭	~~প্রনব কান্তি মন্ডল~~	শিক্ষ			
৩৮	[illegible]	সহ: প্র: শি:	মাগুরখালী	01718-656060	[illegible]

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জেলাঃ খুলনা সময়ঃ ১১:০০ তারিখঃ ২০/০১/২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
৩৯	[illegible] মন্ডল	গন্যমান্য	[illegible]	01918897771	[illegible]
৪০	[illegible] পাল চৌধুরী	চাকুরী	"	01921658425	[illegible]
৪১	সোনালী মন্ডল	ইউ.পি. সদস্য ১, ২, ৩		01737-956952	সোনালী
৪২	চিন্ময়ী সরকার	" ৭, ৮, ৯		01914-666169	চিন্ময়ী সরকার
৪৩	মো: কামাল হোসেন	মাগুরখালী ইউপি	মাগুরখালী	—	কামাল
৪৪	মো: বাদশা মিয়া	[illegible]		0171?-395198	[illegible]
৪৫	[illegible]	[illegible]	[illegible]	—	[illegible]

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Appendix J: 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, Fisheriesresources; Plantation, Marine ecosystem, Terrestrial wildlife employment, income, etc.)
- Project induced opportunities
- Suggestions for mitigation of problems
- Suggestions for enhancement of opportunities
- Suggestions to project implementers and planners

Appendix K:DoE Approved ToR for Environmental Impact Assessment of Polder-17/1

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207
www.doe-bd.org

Memo No : DoE/Clearance/5196/2013/ 125 Date: 05/06/2013

Subject: Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I).

Ref: Your Application dated 31/03/2013.

With reference to the above mentioned subject, the Department of Environment (DOE) hereby accords Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I) at Satkhira, Khulna, Bagerhat, Pirojpur, Patuakhali and Barguna Districts subject to fulfilling the following terms and conditions.

I. This clearance shall only be applicable for the development of the infrastructure of the said project.

II. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) report considering the overall activity of the said Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE).

III. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)

4a. Project activities:
- A list of the main project activities to be undertaken during site clearing, construction as well as operation
- Project Plan, Design, Standard, Specification, Quantification, etc.

4b. Project schedule: The phase and timing for development of the Project

4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.

4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.

5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
   - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
   - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
   - Environment Quality : Air, Water, Soil and Sediment Quality
   - Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions
6. Socio-economic environment should include, inter alia, following:
   - Population: Demographic profile and ethnic composition
   - Settlement and housing
   - Traffic and transport
   - Public utilities: water supply, sanitation and solid waste
   - Economy and employment: employment structure and cultural issues in employment
   - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.
7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).
   In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the

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scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Descriptic of the impacts of the project on air, water, land, hydrology, vegetation-man maid or natural, wildlife, socio-economic aspect shall be incorporated in detail.

8. Management Plan/Procedures:
   For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.
   An outline of the Environmental Management Plan shall be developed for the project.
   In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)
   Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
10. Conclusion and Recommendations

IV. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.

V. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project.

VI. Violation of any of the above conditions shall render this clearance void.

VII. The project authority shall submit the EIA along with an application for Environmental Clearance, the applicable fee in a treasury chalan and the no objection certificates (NOCs) from the local authority to the head office in Dhaka with a copy to the Khulna and Barisal Divisional Office of DOE.

VIII. This clearance is valid for one year from the date of issuance and the project authority shall apply for renewal to Head Office with a copy to the Khulna and Barisal Divisional Office of DOE at least 30 days ahead of expiry.

IX. This Site Clearance Certificate has been issued with the approval of the appropriate authority.

05.06.2013

(Syed Nazmul Ahsan)
Deputy Director (Environmental Clearance)
&
Member Secretary
Environmental Clearance Committee
Phone # 02-8181778

Mr. Md. Sarafat Hossain Khan
Superintending Engineer & Project Coordinator
Coastal Embankment Improvement Project (Phase-I)
Bangladesh Water Development Board (BWDB)
72, Gre[illegible]d, Dhaka-1205.

Copy Forwarded to :

1) PS to Secretary, Ministry of Environment and Forest, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Khulna/Barisal Divisional Office, Khulna/Barisal.
3) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

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Appendix L:Comments and Responses (IPOE)

Comments and Responses on EIA reports of all polder under Package-3

Comments and Responses on EIA report of Polder 14/1 under Package-3

Sl	Comments by IPOE (Professor Dr.Ainun Nishat)	Responses by CEGIS
1	Scoping and bounding need to be mentioned in approach and methodology chapter	It has already been incorporated in the report (sections 2.2.3 & 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 viable and mostly	A doable plan has been suggested in section 10.15.3 (chapter 10) considering conflict between gher owners and farmers

Sl	**Comments by IPOE (Professor Dr.Ainun Nishat)**	**Responses by CEGIS**
	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 M: Comments and Responses (World Bank)

The following are the responses of the comments made by the World Bank for Polder 34/3 as followed for Polder 17/1

Sl	Comments by WB	Responses by EIA Consultant	Action taken
1	Strategic/Sectoral Assessment: Given that multiple polders are being considered and they are part of a larger government intervention, it is recommended to clarify in the EIAs if any Strategic or Sectoral Environmental Assessment has been conducted in relation to the Coastal Zone Policy (2005), the Coastal Development Strategy (2006) or similar government plans informing the rehabilitation of polders, and if so, how those Assessments inform the site-specific EIAs	A strategic Environmental Assessment (SEA) has been carried for CEIP-1 before conducting the EIA study.	Ithas been mentioned in executive summary andchapter-1 (Introduction) and 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, a multi-criteria analysis were conducted which has been mentioned in SEA report.	Ithas been mentioned in executive summary andchapter-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 adverse environmental impacts (e.g. loss of fauna, impacts on sensitive ecosystems, fisheries, etc.) associated to	This issue has been considered and modified the EIA report according to experience from Packages1 &2	

	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 17/1 has not been awarded by 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 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.	This chapter has already been addressed elaborately and appended in the report (Appendix-B).	The updated chapter has been appended again
6	Climate change. The exercise to bring climate	It may be mentioned here that drainage modelling of the	It has been mentioned in section 5.5.3

	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?	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	
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 these general 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.		Thisissue has been addressed in the section 6.4.10 and section 10.15.3
8	Para. 127. Afforestation. How does the EMP follow the BWDB afforestation regulations? How is the EMP including the detail information on plantation program (Table 5.8). It would be good to articulate this chapter with EMP.		Yes, the afforestation plan will be implemented as per regulations of BWDB. As per comments,afforestation plan has been articulated in EMP chapter (section 10.10.1)
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.	
10	Construction schedule. How does the construction schedule impact social and community events? The EIA reports on some cultural		It has been considered in section 8.4.1

	property presence in the area of influence that might be important to consider.		
11	Manpower requirement. We recommend to revisit the numbers of Table 5.10. Otherwise it suggests a huge labor influx (36,000).		The figure mentioned in Table 5.9 has been revised based on the experience from the works implementation in Packages 1 and 2
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 other polders. It is very important to describe in the EMP how the mandate and role of the different stakeholders discussed in section 5.8 articulates with the EMP. Many operational activities described in this section have clear implications at the EMP level. Capacity issues should be discussed.		This issue has been considered and updated the report accordingly
13	Sensitive receptors. How is the baseline defined for education and health affected by the project? Lease also discusses how the market/growth centers and the cultural heritages and common property resources in the polder would be affected by the project. They have been included in the baseline, as part of the area of influence.	Selectionsensitive receptorsas well as growth Centre and common resources properties within 500 m distancefrom the embankment have been considered	It has been considered in section 8.4.2and figure 8.1
14	Pest management. Para 480 includes the development of a pest management plan for the holistic afforestation. It	The afforestation plan has not taken in package-1because the construction	

	would be good to capture the experience from the afforestation actions delivered for the polders under construction.	works under this project in progress	
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 as mentioned in section 8.4.12	
16	EMP and mitigation measures. EMP follow the same footprint as previous reports. In the case of the mitigation measures it is not clear who is responsible for implementation, where and when. This is not fixed by the EMP. While each impacts included a reasonable set of mitigation measures, the EMP chapter of the report includes a generic mitigation guideline. While this is useful it is not enough to guide the preparation of the detailed EMP and the contractor EMP. For example, in terms of obstruction of fish movement and migration, who is going to implement the six proposed mitigation measures, when and where. Is the est6imated implementation cost enough to ensure all the proposed mitigation measures. Our impression is that not all the proposed mitigation measures have been included in the Table 10.4?. Our recommendation is to cut and paste to bring to the table the mitigation measures included in the environmental assessment chapter. The more accurate and defined the EMP is, the better can	This chapterhas beenupdated according to the comment	

	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_workersaccommodation. Please state if the project will involve labor influx or not following the bank definition.		It has been considered in section 8.4.14
18	Traffic Management: The EIAs identify risks and impacts related to the project-related traffic and there are different mitigation measures mentioned in different sections of the EIAs. It is recommended to consolidate traffic-related mitigation measures and ensure that they are consistent throughout the document, and also to clarify the scope of key elements of the Traffic Management Plan that should be prepared. Increase of Vehicular 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	National and WB noise standards have beenincluded in the report to comply Noise levels from vehicles, equipment and machinery etc.	Section 8.4.1 and Table 8.2

	applies to Hindrance of Pedestrian and Vehicular Movement. Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards. Include reference parameters and link.		
19	Mangrove Afforestation: On the foreshore area mangrove species will be replanted and that "Mangrove vegetation has immense contribution to protect the embankments and charland from tidal surge, provides fuel and thatch materials to the local inhabitants as well as creates ideal habitats for the local avifauna and other wild animals." Given the importance of mangroves, and the fact that survival rates of replanted mangroves tends to be very low it is recommended that the EIAs include a specific description of the ration of seedlings to be planted for each lost mangrove tree as well as a survival and growth rate targets and corresponding monitoring indicators.	Survival rate ofeach mangrove species are illustrated in FinalInterimReport on AdditionalTasksAssignedSeptember,2013 (Feasibility report on Afforestation)	This issue has already been included in EMP under section 10.10.1)
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 beenlinked in the report(section 8.4.15)
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	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	

	potentially increase the usage of chemical fertilizers and pesticides. During regular environment monitoring during operational phase if the water and soil pollution is observed, the proponent will be responsible for preparing a Pest Management Plan with prior approval from Bank." On the above, please clarify: a) parameters to be used to determine if there are exceedances in water and soil pollution linked to use of pesticides;and b) what agency will be responsible for preparing and implementing Pest Management Plan, conduct capacity building in Integrated Pest Management (IPM) and Integrated Crop Management (ICM), as stated in the EIA, in a way that it would 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.	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.	
22	<u>Periodic Maintenance Works:</u> 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 (8.5.3)
23	<u>IPoE Assessment</u>: What was the result of the IPoE review of the EIA?	IPoE has reviewed the draft EIA report of Polder 17/1 and has made some comments. Accordingly, the report has been updated in Appendix-L	The comments and responses havebeen appended in the report (appendix-L)
24	<u>Disclosure and consultation:</u> Please include final details	Initially, consultation meetings have been	

	on disclosure and consultation of the EIA	conducted. Disclosure meeting at regional and national levelhave alsobeen conducted	

Appendix N: Participants list of PDM

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

স্থান: ডুমুরিয়া উপজেলা পরিষদ মিলনায়তন

সময়: সকাল ১০:০০

তারিখ: ২৮/০৭/২০১৭

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
০১	মোঃ খান আলী মনসুর	চেয়ারম্যান উপজেলা পরিষদ	০১৭১১৮৬৭৫৪৬	
০২	[illegible]	ইউএনও ডুমুরিয়া		
০৩	মো: আল মামুন	AC (land), ডুমুরিয়া, খুলনা		
০৪	এম এম কামরুজ্জামান	উপজেলা যুব উন্নয়ন কর্মকর্তা	01711-161224	
০৫	খান আনিছুর রহমান	USSO	01924430025	
০৬	মো: [illegible]	PIO	01711448961	
০৭	মো: আবু বকর [illegible]	সমাজ সেবক	01710-752444	
০৮	মো: [illegible]	সমাজ সেবক	01718135605	
০৯	[illegible]	[illegible]	01713519৮0	
১০	মোঃ আবুল হোসেন	চেয়ারম্যান [illegible]	01712651869	
১১	[illegible]	সমাজ সেবক	01711982986	
১২	[illegible] রায়	U.P সদস্য ডুমুরিয়া	01721923446	
১৩	[illegible] মন্ডল	ডুমুরিয়া [illegible]	01711953023	
১৪	শেখ [illegible] আলী		০১৭২২৪০৫৫৭৮	
১৫	মো: [illegible]	[illegible] ডুমুরিয়া	01918.604066	

আয়োজনে

C≋GIS 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 নিরূপণ, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক অবহিতকরণ সভায় অংশগ্রহণকারীদের তালিকা

স্থান: ডুমুরিয়া উপজেলা পরিষদ মিলনায়তন তারিখ: ২৬/০৭/২০১৭
সময়: সকাল ১০:০০

ক্রমিক নং	নাম	পদবী/ ঠিকানা	মোবাইল নম্বর	স্বাক্ষর
১৬	[illegible]	ডুমুরিয়া	[illegible]	[illegible]
১৭	[illegible]	[illegible]	01727026871	[illegible]
১৮	[illegible]	[illegible]	01711056522	[illegible]
১৯	[illegible]	[illegible]	01922260084	[illegible]
২০	[illegible]	UP সদস্য ডুমুরিয়া	01716478614	[illegible]
২১	[illegible]	UP সদস্য ডুমুরিয়া	01711-928314	[illegible]
২২	[illegible]	UP সদস্য ডুমুরিয়া	01343-030820	[illegible]
২৩	[illegible]	UP সদস্য ডুমুরিয়া	01918904733	[illegible]
২৪	[illegible]	ইউপি সদস্য ডুমুরিয়া	01969240869	[illegible]
২৫	[illegible]	[illegible]	[illegible]	[illegible]
২৬	[illegible]	[illegible]	01911833483	[illegible]
২৭	[illegible]	[illegible]	01714-931831	[illegible]
২৮	[illegible]	[illegible]	01712-515407	[illegible]
২৯	[illegible]	[illegible]	01714444266	[illegible]
৩০	[illegible]	ইউ.পি সদস্য	01723421009	[illegible]

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Appendix O: WB Comments on CEIP EIA Draft Report – Package 3

The EIA has been conducted by the Center for Environmental and Geographic Information Services (CEGIS). The team has conducted numerous field visits and ensured participation of the community of Polder 17/1 during field survey and public consultations in order to carry out the study.

The key improvement works to be carried out in Polder 17/1 under CEIP-1 are: re-sectioning of embankment (38.50 km) upto designed level 4.50 PWD;); construction (replacing) of 09 number ofdrainage sluices; repair of 2 drainage sluices,); re-excavation of drainage channels (30.22 km) and afforestation of (29.53 ha). Other components of the CEIP-1 will include implementation of social action plan and environmental management plan; supervision, monitoring and evaluation of project impacts; project management, technical assistance, trainings, and technical studies; and contingent emergency response.

Overall, the EIA is comprehensive and can be streamlined to avoid repetition especially regarding project description and mitigation measures proposed in EIA. The EIA will be also benefitted from including the additional mitigations measures, clarifying project description and implementation arrangement. Please revise the EIA for Polder 17/1 for another review.

9. WB Comments	10. Responses
General: The document title is “EIA” however it includes social aspects as well. Why it is called as EIA rather than ESIA?	Only the baseline information related to the various social aspects has been included in this document, which is appropriate and essential to understand the ground situation of the project area in relation to the ensuing environmental conditions and ecological/natural resources. This report, in fact, is not a social impact assessment; hence the document title only mentions EIA as per the contract.
Executive Summary: Please include EMP/ESMP table, EMP/ESMP implementation cost and monitoring table in Executive Summary.	EMP/ESMP, monitoring plan with cost has beenincluded in the executive summary
Introduction: Please enlarge Map 1.1 so that locations of all polders in Package 3 can be identified	As per comment,location map has been corrected and replaced
Policy and Regulatory Framework: Section 3.7 is overlapped with the figure. Please resolve it	It has been resolved
OP7.50 is triggered for the project. Please revise the text.	The rivers around the polder are local rivers and not international rivers. The OP 7.50 was mentioned in the report by mistake which has already been deleted from the report.
Methodology: Please explain how impact assessment methodology from para. 40-45	Method for impactsscreening has been explained in this chapter

9. WB Comments	10. Responses
relates to impact screening explained in Section 7.	
Climate Change impacts: The climate change impact doesn't mention the flood and storm surges effects which is relevant to the polder. It only covers the rainfall and the temperature projections.	This issue has been considered and addressed in the report
Project Description: Please clarify the details of afforestation activities including who will be responsible for implementation of afforestation, location of afforestation, afforestation period, types of tree species used.	The contractor will work with the Senior Forestry Specialist at PMU for afforestation; indigenous tree species will be selected for plantation; afforestation period is pre-monsoon (Apr-May); local NGOs/CBOs/WMOs will be hired and will be responsible for maintenance of the saplings under social forestry guidelines.
Para 138 states temporary labour camp for local labour during preparing CC block will be established. Please include the basic information of camp sites such as land requirement, number of camp sites, what kinds of facilities would be constructed. Please also assess the potential labor influx. Labor influx plan should be prepared as a part of EMP/ESMP where appropriate.	Location of labour camp is shown in a Map in the report (Figure 5.4). Details of labour camps information has been discussed in section 5.7.4 (chapter 5).
This EIA does not include the environmental and social impact assessment of CC block manufacturing plants. Please prepare the separate assessment	The number of CC block to be required will be minimal since there is river protection and slope protection works. Thus, the CC block will be prepared manually.
Table 5.12 shows construction materials for re-sectioning of embankment and drainage sluices/flushing inlets. Please also explain how to procure the other construction materials used for other project activities such as river bank protection and slope protection. Please also clarify how many CC block manufacturing plants will be established.	This issue has been mentioned in section 5.7.4 and Table 5.10in chapter 5
Para 146 A Social, Environment and Communication Unit: Is this unit established only for Package 3? Is this the same Environmental and social unit for Package 1? Please explain.	It is the same ESCU at PMU for all the Packages
Para 148 Would DCSC supervise/assist implementation of safeguard instruments such as EMP or RAP? Please clarify	Clarified and the relevant paragraphhas beenrephrased
The EIA study presumes that the invert level of the drainage sluice gate have been fixed in manner that about 50-60% of water will be retained in the khal to facilitate in irrigation, fisheries, environment and other purposes. Please explain the reasons that this assumption is made.	As per design of Drainage Sluices (DS), The invert level of DS are fixed inconsideration of the lowest water level. Hence, the canals bed level which are below the invert level have the capacity of retain some water within it. The water are being used for irrigation, fisheries and domestic purposes.

9. WB Comments	10. Responses
Baseline Condition: Land use: No natural vegetation such as forest and wetland? It is not clear in Table 6.1.	There is no natural/mangrove forest or vegetation orperrenialbeel (wetland) within the Polder area which has beenmentioned in section 6.1.5 . However, there is area for vegetation as stated in settlement with homested vegetation (344 ha)
Mangrove: Please show the distribution of Mangrove on a map. Is it also possible to show the size of mangrove forest areas?	It has already been mentioned in the aboveresponse
Has endangered river dolphins been recorded in the rivers along the polder? Please clarify.	Yes, freshwater river dolphin (*Platanista gangetica*) occurs in the peripheral rivers.
Analysis of Alternative: Para 370: Please clarify which, either procuring sand from market or sand collected from riverbed, is the proposed option.	This section has been revised as per comment
Technological alternative analysis is not really conducted. Please include the technological alternative for each proposed work. For example, as a technological alternative for construction of replacement of the existing flushing sluices, would the repair of existing flushing sluices be considered?	Status of the drainage structures has been provided in Table 5.2, which explain the reasons for replacement/construction of the drainage structures/flushing sluices as well as repair of flushing sluices.
Mitigation measures: Please clarify how to manage the excavated soil/silt from drainage channels.	Management of excavated soil/silt from drainage channels have been discussed in section 5.7.6 and a conceptual soil dumping location is shown in figure 5.1
Table 8.1- Please include the potential impacts on involuntary resettlement.	Data is not available as the RAP consultant was not provided it.
Please clarify the contractor will prepare Traffic Management Plan to address potential E&S impacts including traffic safety, noise, vibration and air pollution.	Traffic Management Plan has been prepared by the contractor and included in the Contractor's Environmental & Social Management Plan (C-ESMP) for Packages-1&2, which will be followed for Package-3
All the mitigation measures proposed in Section 7 should be reflected in EMP table which needs to be developed in Section 9.	All mitigation measures proposed in Chapter 8 have been reflected in EMP Table (Table 10.2in Chapter 10)
Please analyze the impacts related to labor and propose the comprehensive mitigation measures including OHS, management plans for workers camp and labor conditions.	The issues have been addressed in section 8.4.15
Please analyze the impacts related to community security, health and safety and propose comprehensive mitigation measures.	impacts related to community security, health and safety as well as mitigation measures have been addressedin section 8.4.15
Please include the impact analysis and mitigation measures for sand excavation from riverbed.	There will be no sand extraction from the river bed for any kind of activities related to the rehabilitation of the polder. Mentionable that repair of embankment will be done by borrow pit earth and sand will be carried from the outside area rather than river bed for concreting and other construction works.

9. WB Comments	10. Responses
Please clarify the prohibition of clearance trees as a mitigation measure in para.385 as indicated in para .384.	Not clear
Please add in para 385 that an approval needs to be obtained from DDCS&PMSC for clearance of vegetation	It has beenadded in the report
Please add in para 385 that the contractor needs to prepare flora and fauna protection plan	It has beenadded in the report
Para 394 (Noise) - Please propose the following measures to be implemented by contractor: installation of acoustic enclosures around generators, notification of major noise generating activities to affected people, prohibition of vehicle movement during night time, monitoring noise in the nearby community where appropriate, preparation of noise and vibration management plan as a part of pollution control plan proposed in para 398.	This issue has been addressed in the report
Para 398 (Soil and water contamination) - Please propose the following measures to be implemented by contractor: Installation of temporary drainage works (channels and bunds) and/or temporary sediment basins where sediment and erosion control are required, preparation of spill control procedure, workshops fully bunded with impervious floors and walls, all containers, drums and drums in good condition, storing all liquid fuels in fully bunded storage containers, refueling only within bunded areas, provision of spill kit and other oil spill response tools, preparation of Emergency Response Plan , refueling only within bunded area.	This issue has been addressed in the report
Para 402(Aggravated Sedimentation) - Please propose the following measures to be implemented by contractor: preparation of borrow area management plan and obtaining necessary permits from government, use of only approved quarry and borrow sites, anti-erosion measures including use of retaining walls and gabions where required.	This issue has been addressed in the report
Para 406 (Impacts on agricultural lands) – Please implement drainage and erosion control measures at the work sites near agricultural fields.	This issue has been addressed in the report
Para 430 (Vegetation/Afforestation) - Please propose the top soil at the construction/ rehabilitation sites should be stored and	This issue has been addressed in the report

9. WB Comments	10. Responses
used for plantation and redevelopment of vegetation.	
Para 433 (Road communication) - Please propose the following measures to be implemented by contractor: provision of clear demarcation of the work sites, application of no authorized entry, appropriate warning signs at strategic locations.	This issue has been addressed in the report
Cumulative Impacts: Necessary mitigation measures need to be proposed based on the analysis of cumulative impacts. Currently, no mitigation measures are proposed.	It has been mentioned in the report (section 9.3.4)
Please also include the assessment of impacts on rivers/watercourses hydrology and fish migration.	Assessment of impacts on rivers/watercourses hydrology and fish migration have been incorporated in the report (sections 9.5
EMP (ESMP): Section 9 should present EMP table consolidating all the mitigation measures proposed in Section 7, ECoP and mitigation measures proposed in Appendix E.	Considered and all mitigation measures have been presented inTable 10.1(Chapter 10)
Environmental and social staff in PMU – It is not clear if the separate Environmental and Social and Communication Unit (ESCU) will be developed for Package 3, or the same institutional arrangement will be maintained. If the same institutional structure is maintained, the expansion of ESCU should be made since the significant increase of supervision/monitoring works regarding EMP/ESMP implementation is expected.	The same institutional structure will be maintained for all packages including Package 3
Para 503- Reference is made on Appendix 10 Environmental Management Framework yet there is neither Appendix 10 nor EMF.	It was written by mistake. This write up has already been removed from the para.
Please revisit Table 10.1 ECoP. There are a number of incomplete or too generic guidance. Please clarify who does what.	???
Monitoring Plan- Please add noise monitoring at nearby communities (where necessary) and visual inspection of spill	It has been added
Para 519- Please clarify DDCS will prepare a monthly report on the status of EMP/ESMP implementation.	The issue has been clarified in section 9.12
Afforestation (Para 530) - Please confirm that there are four locations for foreshore plantation (according to Map 5.2), and its selection criteria. Please also explain who will be responsible to develop afforestation plan and its implementation.	Adetailed afforestation plan has been mentioned in section 9.15.1
Para 534- Please replace the term EMF with EMP.	Corrected as per comment

9. WB Comments	10. Responses
Please include Environmental Committee for the mechanism of project monitoring and supervision.	An ESCU (Environmental and Social Communication Unit) for supervision and monitoring for activities related to implementation works has been mentioned in the report. The ESCU is monitoring the implementation works under Package -1 and Package-2 of CEIP-1.In addition,Committees for Monitoring the implementation of Environment, Health & Safety (EHS) have been formulated during the reporting period whichare functional.
Stakeholder Consultation: Please include the responses to the comments received at Public Disclosure Meeting (para 592).	This paragraph has been revised according to comment.