Final Report

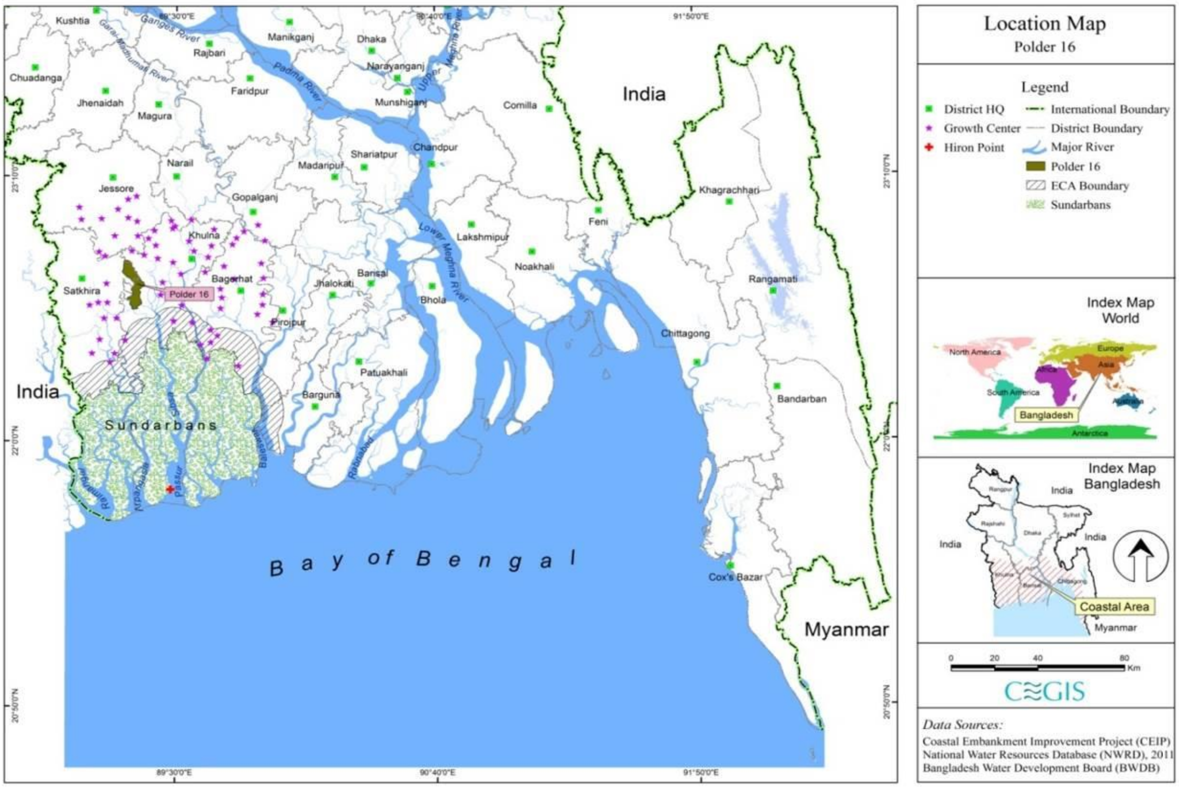
Government of the People's Republic of Bangladesh

Ministry of Water Resources

Bangladesh Water Development Board

COASTAL EMBANKMENT IMPROVEMENT PROJECT

PHASE-1



PACKAGE-3

ENVIRONMENTAL IMPACT ASSESSMENT OF POLDER- 16

May, 2021

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Study Team

A multidisciplinary team from Center for Environmental and Geographic Information Services (CEGIS) conducted the EIA study for Rehabilitation of Polder 16. The study team comprised of the following professionals:

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Acknowledgement

The Center for Environmental and Geographic Information Services (CEGIS) has been entrusted with the responsibility of conducting the Environmental Impact Assessment (EIA) Study for Coastal Embankment Improvement Programme (CEIP)” as a sub-consultant. CEGIS is indebted to the Detailed Design, Construction Supervision and and Project Management Support Consultants (DDCS&PMSC) of CEIP-1engaged by Bangladesh Water Development Board (BWDB) for assigning toCEGIS the task of conducting the environmental impact assessment study of coastal Polders.

The multi-disciplinary team formed by CEGIS for conducting the environmental and social baseline survey of the CEIP-1 remembers with gratitude the guidance and support it received from Mr. Md. Delwar Hossain, Mr. Md. Habibur Rahman and Dr.Md.Mizanur Rahman, Project Directors, CEIP-1, BWDB and other officials of their office, while conducting the baseline survey on coastal Polder 16. CEGIS is thankful to DevConsultant for their co-operation. The study team is also grateful to Engineer Md. Waji Ullah, Executive Director, CEGIS for his continuous guidance, inspiration and support without which it was impossible to complete the study smoothly.

CEGIS is grateful to Mr. Gerard Pichel, Mr.Derk Jan (Dick) kevelam hand Mr. Harrie Laboyrie, Team Leaders and Mr. Habibur Rahman, Deputy Team Leader of CEIP-1 for their direction, guidance and support with necessary data and documents on Polder 16 to the EIA study team. CEGIS also thanks other staffs of CEIP for providing relevant documents during preparation of this report.

CEGIS gratefully acknowledges the support received from the Chief Engineer of Southwestern Zone; Superintending Engineer, Khulna O&M circle, Executive Engineer, and other officials of BWDB, Khulna for providing necessary information and cooperation to the study team during field visits.

Last but not least, successful completion of the EIA study of the CEIP-1 has been made possible with active participation of the community of Polder 16 during field survey and public consultation meetings.

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Abbreviations and Acronyms

ADP	Annual Development Plan
AEO	Assistant Extension Officer
AP	Affected Person
ASA	Association for Social Advancement
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorology Department
BP	Bank Procedure
BRDB	Bangladesh Rural Development Board
BRAC	Bangladesh Rural Advancement Centre
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CBOs	Community Based Organizations
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-I	Coastal Embankment Improvement Project, Phase I
CERP	Coastal Embankment Rehabilitation Project
CMG	Canal Maintenance Group
CES	Consulting Engineering Services
CAFOD	Catholic Fund for Overseas Development
CS	Construction Supervision
CLAC	Central Land Allocation Committee
CZPo	Coastal Zone Policy
DAE	Department of Agricultural Extension
DC	Deputy Commissioner
DCEO	Deputy Chief Extension Officer
DD	Deputy Director
DDCS&PMSC	Detailed Design Construction Supervision and Project Management Support Consultant
DEA	Department of Agricultural Extension
DEM	Digital Elevation Map
DOE	Department of Environment
DOF	Department of Fisheries
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
EC	Executive Committee
ECA	Environment Conservation Act
ECC	Environmental Clearance Certificate
ECoP	Environmental Code of Practice
ECR	Environment Conservation Rules
ECRRP	Emergency 2007 Cyclone Recovery and Restoration project
EDS	Environmental Data Sheet
EIA	Environmental Impact Assessment
EMG	Embankment Maintenance Group
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EO	Extension officer
ES	Environmental Supervisor
ESBN	Estuarine Set Bag Net
ESC	Environmental Social and Communication Unit
ESCU	Environmental, Social and Communication Unit
FAO	Food and Agriculture Organization
FD	Forest Department
FG	Functional Group
FGD	Focus Group Discussion
FRSS	Fisheries Resources Survey System
FWIP	Future-with-Project
FWOP	Future-without-Project
GIS	Geographical Information System
GO	Government Organization
GOB	Government of Bangladesh
GRC	Grievance Redress Committee
GPWM	Guidelines for Participatory Water Management
GTPE	Ganges Tidal Plain East
GTPW	Ganges Tidal Plain West
Ha	Hectare
HTW	Hand Tubewell
HYV	High Yielding Variety
ICZM	Integrated Coastal Zone Management
ICZMP	Integrated Coastal Zone Management Plan
IDA	International Development Association (World Bank)
IEE	Initial Environmental Examination
IESCs	Important Environmental and Social Components
FIDIC	International Federation of Consulting Engineers

ILO	International Labour Organization
IPOE	Independent Panel of Expert
IPCC	Intergovernmental Panel on Climate Change
IS	Institutional Survey
IUCN	International Union for Conservation of Nature
IWM	Institute of Water Modelling
KCC	Khulna City Corporation
KII	Key Informant Interview
KJDRP	Khulna-Jessore Drainage Rehabilitation Project
KMC	Knowledge Management Consultants Limited
LCB	Local Competitive Bidding
LCS	Landless Contracting Society
LGI	Local Government Institution
LLP	Low Lift Pump
MC	Main Consultant (for CEIP-1 Feasibility study)
MDP	Meghna Deltaic Plain
MOEF	Ministry of Environment and Forest
MOL	Ministry of Land
MOWR	Ministry of Water Resources
MP	Muriate of Potash
MSDSs	Material Safety Data Sheets
MSL	Mean Sea Level
NCA	Net Cultivated Area
NCR	Non-Compliance Report
NGO	Non-Governmental Organization
NOC	No Objection Certificate
N,P,K	Nitrogen, Phosphorous, Potassium
NWRD	National Water Resources Database
OMD	Operation and Maintenance Group
O&M	Operation and Maintenance
PAP	Project Affected Person
PCM	Public Consultation Meeting
PCD	Project Concept Document
PD	Project Director
PIC	Project Implementation Committee
PID	Project Information Document
PIO	Project Implementation Office
PL	Post Larva (fish seed)
PMU	Project Management Unit
PPE	Personnel Protective Equipment
PRA	Participatory Rural Appraisal
PSC	Project Steering Committee

PWD	Power Works Department
PRSP	Poverty Reduction Strategy Paper
RAP	Resettlement Action Plan
RCB	Reinforced Concrete Box
RCC	Reinforced Concrete Cement
RL	Reduced Levels
RRA	Rapid Rural appraisal
SAEO	Sub-Assistant Extension Officer
SDE	Sub-Division Engineer
SEA	Strategic Environmental Assessment
SEO	Secondary Education Office
SLR	Sea Level Rise
SMG	Structure Maintenance Group
SO	Sectional Officer
SRDI	Soils Resources Development Institute
SSO	Social Service Office
STW	Shallow Tubewell
TDS	Total Dissolved Solids
TOR	Terms of Reference
TPV	Third Party Validation
TSP	Triple Superphosphate
UAO	Upazila Agriculture Officer
UFO	Upazila Fisheries Office
UNDP	United Nations Development Program
UZ	Upazila
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding
WA	Work Assistant
WAO	Women Affairs Office
WARPO	Water Resources Planning Organization
WMA	Water Management Association
WMF	Water Management Federation
WMG	Water Management Group
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:	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, which is important for fishery resources.
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 *(Macrobrachium rosenbergii*), non-saline/fresh water species
Gher:	Farm lands converted into ponds with low dykes and used for cultivation of shrimp/prawn/fish.
Haor:	A back swamp or bowl-shaped depression located between the natural levees of rivers and comprises of a number of *beel*s.
Jhupri:	Very small shed for living, made of locally available materials. A type of house used by very poor community members.

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

Khal: A drainage channel usually small, sometimes man-made 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.

Pucca: Fully/partial brick made houses

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

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

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

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

T. *Aman*: Transplanted Aman

Upazila: Upazila is an administrative subdivision of a district.

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

Conversion Units

1 m^2	= 10.77 ft^2
1 Decimal	= 435.60 ft^2
1 Decimal	= 40.47 m^2
1 Katha	= 1.653 Decimal
1 Bigha	= 33 Decimal (Area of Bigha varies in some locations)
1 Bigha	= 20 Katha
1 Acre	= 3 Bigha
1 Acre	= 60 Katha
1 Acre	= 100 Decimal
1 Acre	= 4,046.825 sq. meter
1 Hectare	= 247 Decimal
1 Hectare	= 10,000 sq. meter
1 Hectare	= 7.5 Bigha
1 Hectare	= 2.47 Acre
1 metric ton	= 1,000 Kilogram
1 kilometer	= 1,000 meter
1 meter	= 1,000 millimeter
1 inch	= 25.4 millimeter
1 million cubic meter	= 1,000,000 cubic meter

Executive Summary

The Government of Bangladesh (GoB) has planned to implement the Coastal Embankment Improvement Project, Phase-1 (CEIP-1), under which 17 Polders will be rehabilitated and improved in the coastal area of the country. The GoB has obtained financial assistance from the World Bank (WB) for this Project. In accordance with the national regulatory requirements and WB safeguard policies, the rehabilitation and improvement activities of 17 Polders will be implemented with three Packages. EIA and EMP study for Package one (Polders 32, 33, 35/1 and 35/3) and Package two (Polders 43/2C, 47/2, 48, 40/2, 41/1 and 39/2C) have already been done. Polders 14/1, 15, 16, 17/1, 17/2, 23 and 34/3 are included in Package three. In Phase-1 of CEIP Package-3 could not be implemented which are decided to implement in the next phase. In accordance with the national regulatory requirements and WB safeguard policies, EIA and EMP studies of seven Polders under Package three have been carried out. This document presents the EIA report of Polder 16, which is one of these seven Polders of Package-3. It may be mentioned that preliminarily 17 Polders were selected for rehabilitation in feasibility study considering physical conditions as well as damages of the Polder. Afterwards, these Polders were selected through screening matrix. From environmental point of view, amulti-criteria analysis was conducted which has been mentioned in Strategic Environmental Assessment (SEA) report for CEIP-1. The implementation of this EIA of Polder 16 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. The region/zone is subject to very high tides and frequent cyclones emanating from the Bay of Bengal encountering very large sediment inflows from upstream. The coastal zone, in the past, in its natural state, used to face inundation by high tides, salinity intrusion, cyclonic storms and associated tidal surges. In 1960s, polderization started in the coastal areas to convert this area into permanent agricultural lands which also provide safety of the residents. The Polders in this area are enclosed on all sides by dykes or embankments, separating the land from the main river systems and offering protection against tidal floods, salinity intrusion and sedimentation. These Polders are equipped with flap gates to control the water inside the embanked area.

The Polders were originally designed without proper attention to storm surges. Recent cyclones caused substantial damage to the embankments and further threatened the integrity of the coastal Polders. In addition to breaching of the embankment due to cyclones, siltation of peripheral rivers surrounding the embankment caused coastal Polders to suffer from water logging, which led to large scale environmental, social and economical degradation. However, environmental consequences were not virtually considered in the Polder. Poor maintenance and inadequate management of the Polders have also contributed to internal drainage congestion and heavy external siltation. As a result, soil fertility and good agriculture production in some areas are declining because of water logging and salinity increase inside the Polders.

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

Location and Synopsis of Rehabilitation Work

The Polder 16 is covered by 3 (three) Upazilas namely Paikgacha and Dumuria of Khulna District and Tala under Satkhira District and covers 5 Union Parishads (U/P) namely Kapilmuni, Gadaipur, Haridhali, Khalilnagar, Maguraghona. The Polder is bounded by the Kobadak River to the South-West, the Sibsa River to the South and the Salta and Haria Rivers to the East. Khulna-Paikgacha highway is the western boundary and is acting as arm of the Polder.

The Project aims to enhance protection against natural disasters, increase resilience during and after such disasters, and improve agricultural production by reducing saline water intrusion. To meet the objectives of the CEIP-1, the key improvement works to be carried out in Polder 16 under CEIP-1 are: re-sectioning of embankment (43.00 km); construction of retired embankment (2.00 km); bank protection works (0.30 km); slope protection of embankment (1.00km); construction (replacing) of 10 number of drainage sluices; construction (replacing) of 20 (twenty) flushing sluices; repair of 2 drainage sluices, demolishing of flushing inlet (01); re-excavation of drainage channels (20 km) and afforestation of (24.0 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 technical studies; and contingent emergency response.

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

Regulatory and Policy Framework

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

According to the classification of Environmental Conservation Rules (1997, amended 2010) of DoE, the construction, reconstruction, expansion of polders and flood control embankment is categorized as Red. For Red category[1], it is mandatory to conduct Environmental Impact Assessment (EIA), Environmental Management Plan (EMP) and Resettlement Action Plan (RAP) for getting environmental clearance from DoE. On the other hand, according to the, the World Bank Safeguard Policy the project has been classified as Category A[2], because it encompasses high risk with wide involvement of major civil works considering the high ecological sensitivity and vulnerability of the coastal area.

Proposed Rehabilitation Plan

The proposed interventions in Polder 16 under CEIP-1 are listed in the following table.

Type of Work	Length	Description of activities/works
Re-sectioning of embankment	43.00 km	Strengthening, widening and raising of existing embankment. Re-sectioning of entire embankment will be executed.
Construction of retired embankment	2.00 km	Whenever a portion of the existing embankment is subject to erosion, retired embankment is to be constructed at a safe distance from the river towards country side to link with the existing embankment on both sites. The retired embankment will be constructed from Ch 39+600 to Ch 40+600 and Ch 42+000 to Ch 43+000.
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 four existing drainage sluices of the Polder; two will be constructed or replaced with new design specifications.
Construction of Flushing Inlets	20 nos	Flushing Inlets will be constructed at different locations to drain out excess rain water under the proposed rehabilitation plan.

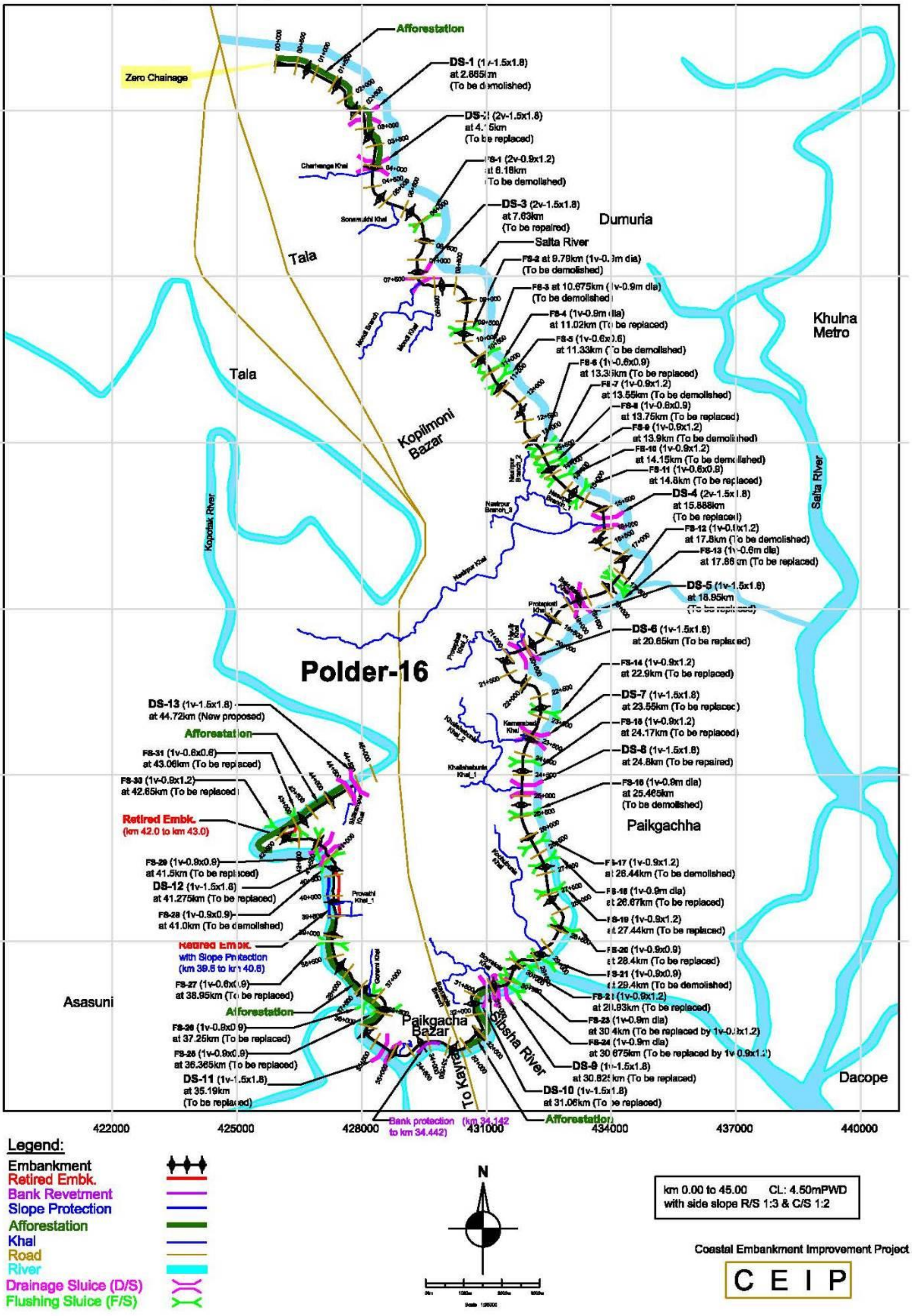
[1] According to DoE Projects likely to have significant negative impacts on environment fall under red category. Both IEE and EIA studies are required for these kinds of projects.

[2] ***Category A:*** According to World Bank safeguards policy 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.

Type of Work	Length	Description of activities/works
Re-excavation of drainage channels	20 km	Whole drainage channels with a total length of 20 km will be re-excavated to ease water flow and reduce drainage congestion.
Slope protection of embankment	1.0 km	Slope protection of the embankment against wave action will be carried out from Ch 12.00 to Ch 12.500 and Ch 24.50 to Ch 25.50 respectively.
Bank revetment	0.3 km	Bank protection works from from Ch.34+142 to Ch. 34+442 will be carried out.
Afforestation	24.0 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 assessed through mathmetical modeling concedering 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.

POLDER: 16, DUMURIA, KHULNA, MAP SHOWING PROPOSED INTERVENTIONS



Technical and non-technical manpower will be required for the construction works. Tentatively, 263 manpower will be required during construction period of which 63 is skilled and 200 (including local and outside) is non-skilled/labour manpower.The skilled manpower will include senior professionals, Engineers, Technicians, Supervisors, Surveyors, Mechanics, Foremen, Machinery operators, Drivers mainly., . A construction camp will be be constructed inside the polder. It is mentoined here that labor sheds/camps will be constructed for house workers (skilled labour). There would be no requirement of labour camp for un-skilled labour because they will be recruited from the local area. But temporary labour camp for local labour during preparing of CC block will be established.

Environmental Baseline Conditions

Polder 16 is located in the flat agro-ecological zone of the Ganges Tidal Floodplain and High Ganges River Floodplain in the south-western region of Bangladesh. The soil texture varies from clay to clay loam. Clay contains 63% of the total soil texture. There are two types (high and medium high) of land in the Polder areas. Around 43% and 57% of the net cultivable area falls under high land and medium high land respectively.

At present, most of the segments of the embankment are in dilapidated condition due to the impact of cyclone Aila. The entire embankment was affected during the cyclone Aila, some segments have been breached and some other has been washed out.

The siltation over the years has made the existing drainage khals incapable for draining excess rainwater in monsoon period. In most of the cases bed level of the drainage khals such as Shilirampur khal, Provati khal, Boira khal, Khoilse moni, Navar khal, etc., are higher than the perennial rivers. The carrying capacity of the perennial rivers (Kobadak and Sibsa) has also been reduced due to siltation. The gates of most of the drainage sluices are damaged and some are not properly working, which has exacerbated the situation.

During field visit (February, 2016) salinity was not found in most of the peripheral canals. However, according to the local people, salinity is a common problem in the Polder area in dry season (4/5 months). Salinity intrusion causes intense problems due to numerous unauthorized inlets installed by local Shrimp Gher owners.

The Polder area has covered three bio-ecological zones, i.e. Saline tidal Floodplain, Gopalgonj/ Khulna peat lands and Ganges Floodplain. This area contains different landforms as well as different ecosystems such as agricultural land, settlements, road/ Social forest, ponds, gher, khals, ditch, rivers, etc. As the Polder is located near Satkhira, both urban and rural homestead vegetation is found in this area. Most of the rural homestead vegetation consists of fruit yielding plant like Narikel/Coconut, Kola/Banana, Safeda/ Sapodilla, Peara/Guava, timber trees and medicinal plants. But urban homestead vegetation consists of mainly exotic timber trees as Akashmoni/ *Acacia auriculiformis*. There are betel leaf gardens in the Polder which have mostly grown beside the homestead premises. A number of saline tolerant aquatic/ mangrove vegetation are observed on the torus and along riverside toe of the embankment, khals and rivers. Unplanned gher/ shrimp farming activities resulting in increased salinity and successively creating continuous pressure on floral (fresh water) and faunal biodiversity as well as total ecosystem of the Polder area. Bigger mammals are not present in this area.

The Polder 16 is situated in one of the most resourceful and productive zones for fisheries in Bangladesh. Out of the gross area of 10,472 ha, fish habitats cover about 4,487 ha which is 42.85 % of the total area. Gher (4,250 ha) covers the lion portion (94.71%) of the fish habitat followed by pond (2.96 %), khal (2.06%) and ditch (0.26 %). The estimated total fish production is about 1998 MT of which 1987 MT (about 99.45%) comes from culture fisheries and the rest 11 MT (0.55%) is from the capture fisheries. Khals connected to the outside rivers (Kobadak River, Sibsha River and Salta river) play as longitudinal migration route for fishes in the area. The peripheral rivers act as longitudinal migration route through the internal khals in the polder area. The riverine fish species migrate through regulated khals in the Polder to some extent during the period of May to August. The available fish species are Bagda, Golda, Horina chingri, Tengra, Baila, Parshe, Bhetki, Punti, Shol, Taki, Shing, Tara baim, Gotum, Koi and Shing. Foli, Veda, Magur, Aire, Pabda, Boal, Gojar and Gang Magur are the species of conservation significance found in the study area. Fish migration status is poor due to present condition of the rivers and khals as they are silted up, which reduce the length and hinder successive migration routes. Fish diversity is moderate. Morphological changes of internal khals due to siltation, natural changes in river flow, inadequate water in the rivers, obstruction of fish hatchling movement during pre-monsoon and monsoon due to improper management and dysfunction of sluice gates, squeezing of spawning and feeding grounds are the main causes for gradual decline of fish abundance and aquatic biodiversity in the Polder area.

Total cropped area is 4,367 ha of which rice is 2,746 ha and the rest 1,622 ha is covered by non-rice crops. The rice and non-rice cropped area are 63% and 37% of the total cropped area respectively. Among the rice crops Local T. Aus, Local T. Aman, HYV T. Aman and HYV Boro are grown on14%, 16%, 52%, and 18% respectively of total rice area in the Polder. Total crop production is 20,178 metric tons of which rice production is 6,250 metric tons and non-rice production is 13,928 metric tons. Among the rice crops the contributions of Local T. Aus, Local T. Aman, HYV T. Aman and HYV Boro are 10%, 15%, 52% and 23% respectively. In case of non-rice crops contribution, the summer vegetables is highest (38%).

The inhabitants of Polder area comprise of 31,478 households and the population size is 98,490 of which 49,170 are male and 49,320 are female. The number of female population is slightly higher than the number of male population. The average density of population is 1019 persons per sq. km, which is equal to the national density of 1,015 persons per sq. km. Among the population, about 76% of total population is Muslim, 23% is Hindu, and one percent is Christian.

The literacy rate in the Polder area is 57.3 % for male and females 47.8% whereas the average national literacy rate for both sexes is 51.8, of which male is 54.1% and female is 49.4%. Agriculture is the main occupation in the polder area. About 81% people are engaged in agricultural activities. 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 Upazila Health Complex, Union Sub-Centers, Union Health and Family Welfare Centers, Maternal and Child Welfare Center, etc., in the study area, which often does not cater to their need. Therefore, they have to receive peripheral health services from Khulna Medical College, which is 56 km away in Khulna city.

The overall housing condition is not satisfactory. The majority of houses are Kutcha houses (57.1%). Semi-pucca household is 26.6% where Pucca is 15.1% and 1.2% is still jhupri. Statistics show Paikgachha Paurashava comprises the highest Pucca household (24.8%) whereas Magurkhali Union comprise the highest Kutcha households (85.6%). It can be concluded that the people living in the study area belong to poor category in terms of housing type. Overall 75% people use sanitary toilet. Water-sealed sanitary latrines are available predominantly in Pucca houses. Collection of drinking water from Tube well is major (94%) throughout the study area and other sources (4%) are prime which is open water bodies as unconventional sources, i.e. PSF (Pond Sand Filter), ponds, rainwater, etc. Khulna- Paikgachha regional road is the main road network in the Polder area. Most of the people use this road as a way of communication and goods transportation.

The Polder is vulnerable to natural disaster notably with cyclonic storm, storm surges, tidal flooding, heavy rainfall, etc. In some areas, embankments are vulnerable to be eroded within short time. Tidal flood water enters into the polder as there are no functional gates in any of the drainage and flushing sluices. This water if coincided with heavy rain water, in turn, makes drainage congestion that eventually floods internal road networks, homesteads, playground and educational institutions. Being a coastal area, cyclonic storm is very common in the study area. Substantial aftermath took place with severe cyclonic storm namely Sidr; of which, human and non-human asset loss is mentionable.

Potential Impacts and their Mitigations

Impacts during pre-construction phase

The potential environmental and social impacts associated with the **pre-construction phase** of the project include deterioration of environmental quality from , clearance of vegetation and increased vehicular traffic as follows:**Important Environmental Components (IECs)**	**Potential Impacts**	**Mitigation Measures**
Environmental quality (Air and Noise)	• Exhaust emission from trawler and containing particulate matter and other ingredients would deteriorate the ambient air quality around the construction site and nearby areas due to movement of equipment carrying trawlers. • Noise level around the construction sites and in settlement areas will be deteriorated for mobilization of construction	• 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, machineryies and materials during day time instead of night. • Exhaust emissions from trawlers and equipment should comply with the standards of DoE. • Regulars sprinkling of water and ramming the materials of stockyard regularly. • Stockyard should be covered during non-working period.

The potential environmental and social impacts associated with the **pre-construction phase** of the project include deterioration of environmental quality from , clearance of vegetation and increased vehicular traffic as follows:**Important Environmental Components (IECs)**	**Potential Impacts**	**Mitigation Measures**
	materials, trawler equipment and man-power. Therefore, settlements, bazaar areas and surroundings of the construction site will be affected by the increased noise level.	
Noise and vibration	Heavy traffic movement with construction materials is a crucial task during pre-construction phase that will generate noise and vibration which are likely to affect the nearby communities. Increased noise levels may cause disturbance, nuisance and even health hazards to the nearby communities as well as to the construction workers.	• Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards; • Vehicles and machinery should have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors should be assured, as needed; • Provision of PPE (ear muffs and plugs) to labor should be made.
Changes in land use	Borrow pits for extraction of construction material are expected to be both from inside the polder and in the foreshore land. 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	• Established all the construction camps within the area owned by BWDB; • Pay compensation/rent if private property is acquired on temporary basis, for which instructions should be specified in the tender document; • Construction of labor shed/camp on government khas land; • Avoid impacts on local stakeholders. • Any areas used for borrow pits in the foreshore should be away from sensitive areas such as mangrove vegetation.

The potential environmental and social impacts associated with the **pre-construction phase** of the project include deterioration of environmental quality from , clearance of vegetation and increased vehicular traffic as follows:**Important Environmental Components (IECs)**	**Potential Impacts**	**Mitigation Measures**
	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 pit 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.	
Vegetation	Eastern portion (from chainage 00 km. to chainage 32 km.) as well as *Chairvanga, Batultala, Mohandhi, Bakultala, Goalbathan, Protapkati, Kachubunia, Boyratala,* etc., villages of the polder area possesses low density of vegetation. Ten construction sites with labor sheds and stock yards would be temporarily established in these locations. Therefore, temporary	• Labors should be made aware about local flora and faunal species; • Labor sheds and stock yards should be established on low vegetative or barren land as much as possible; • Plantation of local species in the selected areas as early as possible after finishing the construction works; • Labor should use gas cylinder for cooking; otherwise should collect fuel wood for their own purpose from local market (*Kopilmuni bazaar*, *Gadaipur bazaar*, *Paikghacha Bazaar*, *Kathbaria bazaar* etc.).

The potential environmental and social impacts associated with the **pre-construction phase** of the project include deterioration of environmental quality from , clearance of vegetation and increased vehicular traffic as follows:**Important Environmental Components (IECs)**	**Potential Impacts**	**Mitigation Measures**
	impacts on existing vegetation especially herbs (*Cynodon, Cyperus croton,* etc.) and shrubs (*Amaranthus, Phylasis,* etc.) would take place. However, this vegetation will regenerate due to natural succession. No trees would be cut down in construction sites, so loss of vegetation would be mainly herbs and shrubs. As such the impact is considered to be low	
Involuntary resettlement		• Compensation should be paid prior to construction in accordance with RAP; • Maintain liaison with communities; and • Grievance redress mechanism (GRM) should be established.
Vehicular traffic	During contractor mobilization, some equipment, machinery, material, and manpower will have to be transported to the Polder by road or waterway resulting in additional traffic on roads and in waterways. This traffic may potentially cause traffic congestion particularly in roads and	• The contractor will prepare a traffic management plan (TMP) and obtain approval from the DDCS&PMSC. • The TMP will be shared with the communities, stakeholders and will be finalized after obtaining their consent. • The TMP will address the existing traffic congestion particularly at the Ghorilal and Jhorshing Bazaars. • Ensure minimal hindrance to local communities and commuters. • Work schedule will be finalized in coordination and consultation with local representatives and communities. Specifically Union Parishad members of

The potential environmental and social impacts associated with the **pre-construction phase** of the project include deterioration of environmental quality from , clearance of vegetation and increased vehicular traffic as follows:**Important Environmental Components (IECs)**	**Potential Impacts**	**Mitigation Measures**
	jetties. Moreover, most of the schools are located near the embankment approximately within 100 m to 500 m and two important bazaars (Ghorilal Bazaar, Jhorshing Bazaar) are also located beside the embankment which will face traffic congestion during *Haat* time.	the Polder. • The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes and works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. • The works of the second half will be started after completion of first half. • Vehicular traffic should be limited in the Polder area and the embankment during off peak time. Appoint signalman during School time (10:00am to 13:00pm) and weekly market days (Hatbar)

Impacts during construction phase

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

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures	
Air and Noise quality	• The construction activities particularly manufacturing of C.C blocks through mixture machines, earth work and its compaction along with operation of construction machinery will generate noise and vibration cause disturbance, nuisance to the nearby communities as well as to the construction workers. • Besides, exhaust emission from the concrete mixture machine and fugitive particulates during construction activities especially for manufacturing CC blocks which are likely to affect the ambient air quality and the nearby communities.	• Construction machineries and vehicles should have proper mufflers and silencers. • Machine in use should have quality in order to restrict emission of poisonous gases to pollute air quality • 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 • Preparation of noise and vibration management plan as a part of pollution control plan.	•

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Noise and Vibration	The construction activities particularly demolition of existing water control structures, excavation, compaction, operation of construction machinery and vehicular traffic will generate noise and vibration which are likely to affect the nearby communities. Increased noise levels may cause disturbance, nuisance and even health hazards to the nearby communities as well as to the construction workers. In particular, the settlements near the working areas will be exposed to noise and vibration generated by the Project activities. However, there are few settlements at the eastern portion (major portion) of the Polder. The south-west portion of the embankment is situated in populated area where settlements (households, schools, etc.) are high. The noise of the construction equipments may seriously affect the local people, i.e., children and patients.	• The regulators should not be demolished during school time (8 am to 1 pm) particularly near the schools and other educational institutions; • Restrict/limit construction activities during the day time; • Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards; • 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 • Contractor will prepare the Traffic Management Plan and will follow accordingly. • ; • Provision of noise barriers at schools and other sensitive receptors should be assured, as needed; • Provision of PPE (ear muffs and plugs) to labor should be made; • Construction crew should be instructed to use the equipment properly, to minimize noise levels; • Camps will be located at a safe distance from communities; and • Liaison with the communities should be maintained and grievance redress mechanism should be established at the site.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Soil and water quality	Construction materials, demolished debris, fuel both from transportation vessel and construction machineries (piling machine, pump, etc.) may degrade the soil and water quality. The construction workers will generate domestic solid waste and waste water including sewage. The amount of domestic wastewater generated by the construction workers is assumed to be equal to the amount of water usage. Oily water, waste oils, oily rags and other similar wastes will be generated from workshop. The stores and warehouse will generate solid waste such as empty cement bags, cardboards and wooden crates. Improper disposal of these wastes can potentially contaminate the soils and water resources of the area. Soil and water contamination can potentially have negative impacts on the local community, natural vegetation, agriculture and biological resources of the area including aquatic flora and fauna.	• Prepare and implement pollution control plan; • Workshops should have oil separators/sumps to avoid release of oily water; • Avoid repairing of vehicles and machinery near the crop field; • Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination; • Dispose contaminated soil appropriately ensuring that it does not contaminate water bodies or affect drinking water sources; • Contractor should ensure that there is no leakage, spillage or release of fuel, oil or any other affluent/waste on the ground or in the water from its construction machinery, vehicles, boats, launches, and barges. Contractor will regularly monitor the condition of its fleet; • Material borrowed from the river banks should be carried out sufficiently away from the water edge, minimizing the possibility of loosing soil and wash out in the river; • Contractor will locate camps far away from communities and drinking water sources; • Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal); • Release treated wastes on ground or in water; • Recycle spoil and excavated material where possible; • Dispose spoil at designated areas with community consent; and • Construction material, demolished debris and excavated soil/silt should not be allowed to enter or disposed in the water bodies. • 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; refueling only within bunded area; • Preparation of Emergency Response Plan.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Sedimentation	Borrowing material from the river banks may potentially cause increased sediments 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 material, loose earth/soil, demolished debris, and other materials may enter the river or drainage khals causing increased sediments. Run off from construction sites, camps, and other temporary facilities may increase sediment load of water bodies.	• Small scale Tidal River Management (TRM) may be implemented where appropriate; • Contractor should protect untreated embankment slopes; • Contractor should excavate channels after dewatering them; • Contractor should not leave excavated earth and silt on channel banks; • Contractor should implement measures to protect channels from run-off from working areas and camps; • Contractor should obtain borrowing material from river banks in such a manner so that there is no increase of siltation in rivers, and should not leave loose soil after excavation; and • Regular monitoring of drainage khals is necessary to maintain the capacity. • Prepare 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.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Agriculture crop production	Borrow pits for extraction of construction material are expected to be both from inside the polder and in the foreshore land. 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. In addition, construction activities, movement of construction machinery, project related vehicular traffic, material borrowing, material stockpiling, re-excavated soil of channels, waste disposal or camp establishment might damage crops or affect the cultivated land.	• Resettlement Action Plan should be prepared and should also be implemented accordingly • • Compensation should be paid for any crop damage; • Contractor should avoid any activity in cultivation fields during construction; • Contractor should ensure that no vehicular movements take place inside cultivation fields; • Contractor should ensure that no material is dumped inside cultivation fields; • Re-excavated soil of canals should not be dumped in agricultural land; • Contractor should maintain liaison with communities. • It should be considered a priority to establish borrow-pits in approved foreshore areas • Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps construction; and • Contractor would maintain liaison with communities; • Implement drainage and erosion control measures at the work sites near agricultural fields.
Irrigation	Re-excavation of drainage channel (20 km) can potentially disrupt the crop irrigation temporarily during both wet and dry seasons which should negatively affect cultivation. The works on sluices can cut off the flow of water from the river, while the excavation works in canals can affect water conveyance through them.	• Contractor should construct bypass channels before construction of drainage sluices; • Sequence of work at the drainage sluices, inlets and water canals should be carefully planned to avoid irrigation disruption; • Contractor should ensure that no negative impacts falls on crop irrigation; • Contractor should maintain liaison with communities; and • Contractor should work during dry season Spawning/breeding period of commercially important fishes should be considered prior to demolishing/construction of drainage sluices.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Vegetation	• Re-sectioning of embankment will damage all undergrowth vegetation both at embankment slopes and the sites from which the soil would be collected. been covered with concrete blocks for slope protection. Embankment toes at Sakbaria, Matiabhanga, Gharilal and Jorshing villages follow strips of dense but small size (not more than 3m height and DBH 4cm) Gewa (Excoecaria agallocha) plants. These strips have been created naturally by germination of floating seeds from nearer mangrove forest. These saplings will be cut down/damaged during embankment re-sectioning. • Collection of soils from foreshore area will also cause vegetation damage of these locations. Most of the foreshore area of this Polder is under plantation program by Climate Resilient Ecosystems and Livelihood (CREL) Project.	• Collect soil from barren land and alternate source like riverbed or nearby burrowpits at countryside as much as possible. • Keep close liaison with CREL Project Authority and Forest Department during implementation of earth works. • Needs approval from the DDCS&PMSC for vegetation clearance, if needed • Create plant strips with same species at the toe of the embankment after completion of earthwork. The community members may be involved for protection of the saplings. • Proper turfing should be made on the embankment slopes with local grasses (i.e., Durba (Cynodon dactylon), Mutha (Cyperus rotundus)) and ensure regular monitoring of turfed grasses till they matured. • The top-soil at the construction and rehabilitation sites should be stored and used for plantation activities. • Choose barren land for CC Block manufacturing and material storing. • Implement plantation with native species along countryside slope of the embankment after finishing of construction works.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Social unrest	• A numbers of skilled and unskilled labors will be required for the construction activities. Most of the labor will be needed for re-sectioning of embankment and constructing retired embankment. It is envisaged that about 60 percent construction workers will be recruited from within the Polder area while the remaining from other areas. The presence of outside laborers in the area may create friction and conflict between the local labor and outside labor., and between local community and outside labor. • Presence of number of labors from outside can potentially cause encroachment in the privacy of local population particularly women and hence their mobility can be negatively affected.	• Proper awareness programs will have to be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, Upazila Nirbahi Officer (UNO) and BWDB local officials. • Cultural norms of the local community will have to be respected and honored. • GRM will be established to address the grievances of local as well as outside laborers. • Careful use of local natural resources and project resources, fuel, fuel-wood and electricity. • Restrictions to be imposed in consumption of alcohol and drugs. • Safe driving practices. • Respect for the local community and its cultural norms in which laborers are working. • Avoid construction activities during prayer time.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Natural hazards	• As per construction schedule, the rehabilitation activities of the Polder will be conducted from October to May when most of the cyclone and storm surges are occurred in this area. According to previous records of occurrence of cyclone and storm surges are within the month from October to November and April to May. It is suspected that the construction activities during this period may be hampered as well as workers may be injured.	• Weather signals will have to be considered by the contractor during construction works. • Radio and television will have to be provided in all the labor sheds for receiving weather information through these media. • Ensuring rigorous standards for occupational health and safety are in place.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Fish Feeding and spawning ground	Polder 16 is bounded by Koboda ,river on the south west Sibsa on the south, Haria and Satla rivers 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.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Fish Migration	Drainage sluice gates are designed to control water for improvement of drainage system of the polder area. Sluice gates are mainly operated in order to meet the drainage purpose. Thus, it would hamper the migration behavior of fish species. Moreover, the extent of *Bagda, Chapila, Chitra, Lal Chewa, Veda Bele*, etc., would be highly restricted with the replacement of the proposed drainage sluices.	• Sluice gate operation manual should be prepared for allowing fish migration in time; • Experienced commercial fishermen should be appointed in WMOS for Operation and Maintenance of sluice gate; • Provide training to WMOs; and • Periodic fish catch monitoring to assess fish stock and species composition and take initiatives, if anything wrong detected.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Aquatic flora and fauna	The proposed construction activities, i.e., construction and repair of drainage sluice, construction of flushing inlets and re-excavation of drainage canals will have direct impact on aquatic flora and fauna which are prone to be damaged. Aquatic biodiversity with flora and fauna specially submerged, floating plants, phytoplankton, zooplankton, etc., inside the re-excavated area may be affected. These interventions may temporarily affect a portion of surroundings mainly the aquatic ecosystem. Aquatic ecosystem as well as primary producer of phytoplankton, zooplankton, etc., would be regenerated when the water flow resumes after completion of construction works.	• Contractor needs to prepare a flora and fauna protection plan • Re-excavated spoil should be properly utilized. It may be used for re-sectioning of embankment (soil placing) and development of internal rural road; • Construction activities should be started in dry season (November-May) for re-excavation of canals; • All types of activities should be finished in scheduled time; • Keep untouched the deepest points of the khal as much as possible; • River/khal bed sediment to be analysed for benthic fauna, and • Implement tree plantation with local species at the khal bank side after re-excavation work.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Road Communication	A number of local people use this embankment as road for regular movement, carrying their goods for buying and selling and other purposes. The construction activities along the embankments will cause temporary disturbance in the movement of local people. The internal roadways are not sufficient to provide alternate means of transportation. Mobilization of equipment, machinery, material and workers may be transported to the Polder resulting additional traffic on roads and in waterways. Therefore, suffering of people will emerge temporarily.	• Re-sectioning work should be done section wise; • Re-sectioning of the embankment would be done in half section-wise and the soil/earth will be placed in specified layers to facilitate the movement of the people; • Work schedule will be finalized in coordination and consultation with local representatives and communities; • Provision of clear demarcation of the work sites; • Application of no authorized entry; • Appropriate warning signs at strategic locations; • Water way can be used especially along the river during construction period ;and • All the works should be conducted in presence of Union Parishad Chairman and members.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
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 will prepare site specific Environment, Health and Safety (EHS) Plans. • The WBG's EHS Guidelines are to be referenced in the contract documents and that should be followed during construction period. • Liaison will 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. • The contractors will prepare site specific Camp management plans, an Occupational health and safety plan including training programs as well as an Emergency response plan with early warning system and training programmes to be approved by the DDCS&PMSC Consultant and PMU. The Plan will also include awareness raising and prevention measures, particularly against communicable diseases such as hepatitis B and C, and HIV/AIDS. Besides: • The WB'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 temporary facilities including labor camps will meet minimum safety, hygiene and sanitation requirements (safe drinking water, proper sewage disposal, solid waste management, general cleanliness, protection against disease vectors, and protection against weather elements, firefighting, and other similar essential services). • • The labour shed/camps for accommodation of workers should be constructed according to the IFC/EBRD workers accommodation guidelines. 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 labourers working on site and living in the temporary accommodation facilities. The health screening would entail normal review of physical fitness and also include a review of appropriate vaccinations. Workers would be given vaccinations as and when required. • All site staff will undergo screening against communicable diseases. Communicable disease careers will not be employed at the working site.

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Impact of manually manufacturing of CC block	For rehabilitation of Polder 16 under CEIP-1 only 0.3 km (300 meters) slope protection work will be undertaken.CC Block manufacturing plant will not be required. The block will be made manually. There will be some of the impacts of the activities like generating dusts, risks of accidents, possibility water and soil pollution.	• 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

Impacts during post-construction phase

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

Important Environmental Components (IECs)	Potential Impacts	Mitigation Measures
Risk of embankment failure	Major reasons for breaching of embankment of the coastal region are runoff, wave action, tidal surge and unauthorized activities like entering saline/brackish water through pipes across the embankment by local people (mainly the Shrimp Cultivators) making the embankment weak. Lack of regular maintenance has created weak point at the sensitive locations of the embankment where the set back is less than 15m to 25m. Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously have	• Regular monitoring and rigorous/timely maintenance of the embankment and existing water control structures especially along the southern and western side of the Polder will be ensured. This monitoring should particularly be carried out before and after monsoon season; • Proper dumping and compaction of soil should be ensured during re-sectioning of the embankment; • Side slope protection works should be maintained with proper design and turfing; • Available cyclone and flood shelter should be prepared as a contingency measure during emergency situation; • WMG should secure fund to attend emergency situations; and • Structural measures like geo bag and sand bag should be kept ready in the Upazila office for emergency need.

	accelerated the risk of embankment failure.	
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.
Soil and water contamination (increased use of chemical inputs) and reduced soil fertility	Implementation of the project interventions especially re-excavation of channels would cause expansion of area under irrigated cultivation of Boro (HYV) and T.Aus (Local) varieties of rice. The expansion of irrigated area would increase use of chemical inputs including fertilizers and pesticides. Runoff from such cultivation fields might potentially pollute the water bodies and even drinking water sources thus causing health hazards to the communities.	• Capacity building and awareness rising of the farmers should be carried out to practice on Integrated Crop Management (ICM) in order to minimize usage of chemical inputs; • Farmers group should have close contact with DAE for adoption of various measures of ICM; • Farmers should be encouraged to use organic manure to increase soil fertility while avoiding water contamination; • Water quality monitoring on a regular basis, take mitigative measures in case of any detection of water contamination/pollution; • Sampling khal bed sediment for analysis of benthic fauna to assess th condition of the khal; and • Farmers should be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.

Risk Assesement

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

Issue	Risk	Mitigation Measures
Fish Migration and movement	The peak velocity considered in designing of drainage sluices ranges from 3-4 m/s. The sustainable velocities of the indicative fish species are estimated in the range of 0.46 m/s to 1.1 m/s and burst velocities are in the range of 1.75 m/s to 4.2 m/s (Section 6.2.10). The peak velocity of the sluice gate would hamper to fish migration and movement inside the Polder. It is noted that burst velocities of fish are applicable for capturing prey as the duration is only for seconds	• The fish pass friendly aspects in the structures to be constructed in the Polder for the proper management of water. • The structure may be done either by constructing drainage sluices by maintaining the velocities passable for the mentioned indicative fish species or by constructing fish pass structure. • In case of sluice gates, based on catchment flow optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes. • In constructing fish pass, fish swimming speed or velocity and depth preference should be considered. In case of the indicative fishes velocities are mentioned in Table 6.14 and the depth preferences are as follows: Plotosus canius: 2-10 m; Liza Parsia: 1.5-10 m; Mystus gulio: 1.5-10 a. 1.
Function of Water Management Organisation (WMO)	At the moment, there are no active WMOs on site, and their activities are almost non-existent. The disrepair and lack of maintenance of the Polder in the past due to financial inadequacies of the WMOs as well as insufficient support from the BWDB had contributed to the general decay of the Polder's structure and utility. In the past, there was usually no fund allocated for the WMOs' functions and needs.	• Ensure the organization/formation of the WMOs before operation of the gates, training them in the operation of structures etc., as well as in records/accounts keeping, and collaboration with NGOs, and CBOs, and most importantly. This would help in developing ownership of the WMOs for realization of benefits from the Polder without hampering the hydrological and environmental settings of the Polder • In addition to activation of WMOs, BWDB may recruit sluice khalashi for each of the Drainage Sluices for smooth operation of the gates as per initial practice • Provide budgetary allocation in the post-operation phase for the O & M related tasks of the WMOs • Borrow pit, embankment slope, water bodies in the khas land may be provided to the WMOs as an income generating sources for their sustainability.
Navigation	Drainage sluices and sluice gates are provided in the Polder,	• In order to maintain navigation scenario, an arrangement may be

	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.	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 Impacts

The cumulative impact of several existing and ongoing project, as well as the proposed project of CEIP-1 around the proposed rehabilitation Polder, will be assessed. Such projects may have impacts on the hydrological network, flooding situation, life and livelihood of people, environmental quality, natural ecosystem, flora-fauna, etc. of Polder 16which have been considered in this study. Apart from CEIP interventions, there are some other development projects in the region of Polder 16, implemented locally or regionally. Impact on hydrology and flooding situation due to construction and implantation of proposed and existing projects were assessed

Polder 16 is adjacent to Polder 17/1 and Polder 17/2 which are located on the East and North direction and both Polders are considered for improvement under CEIP-1. The proposed design crest levels of the three Polders are same. The Salta river originates (offtake) from the Bhodra river and diurnal tidal effect occurs here. The proposed interventions in Polder 16 and Polder 17/1, i.e. higher crest level (4.50 mPWD), renovation of hydraulic structures, etc., will protect the Polders. At the same time, there will be a tendency of increased hydraulic pressure on the embankment of both Polders. Polder 16 has more peripheral rivers, i.e., Salta, Haria and Sibsa which are connected to Bhodra River that may be a threat for this Polder. Salinity intrusion may be increased through peripheral canals such as Nasirpur khal, Protapkathi khal, etc. of Polder 16. Moreover, there remains a chance of excess siltation in the peripheral canals due to tidal effect of Salta, Harai and Sibsa rivers.

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

The socio-economic condition of Polder 16 will be ameliorated due to the overall development of this region, i.e., construction works of Polder 17/1 and Polder 17/2 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 16), 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 16 that initiated a financial revolution of the Polder area. On the other hand, there are some negative environmental impacts, i.e., infertility of aquatic animals, flora and fauna due to overtopping in saline water from shrimp culture ponds.

Environmental Management Plan (EMP)

The Environmental Management Plan (EMP) provides the implementation mechanism for the mitigation measures identified during the EIA process. A comprehensive EMP focusing on managing construction phase-related impacts should suffice in managing the potential construction and operation phase impacts. The total cost of EMP implementation for Polder 16 has been estimated as BDT **73,962,580**. The contractor needs to submit an Environmental Action Plan (EAP) based on the EIA and EMF in line with the construction schedule and guideline which will be reviewed by the supervision consultant and approved by BWDB and World Bank. Tentative cost estimate for environmental management is as as follows:

Tentative Cost Estimates for Environmental Management

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
1	Construction of alternative or bypass channels at each construction sites.	5,061,053	63.2631625	Contrctor	During pre-construction and construction
2	Installation of fugitive particulate matter system and Spraying water on embankment/road	0.5	0.006	Contrctor	During pre-construction and construction
3	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils	Included in contractor budget	0	Contractor	During pre-construction
4	Awareness program on plant and wild life conservation.	200,000	2.5	BWDB	During post-construction
5	Awareness building up campaign(mock drill) may be organized to local community to avoid accidents	200,000	2.5		During pre-construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	from vehicular traffic				
6	Consultancy services cost for supervision and monitoring of EMP	800,000	10	BWDB	During post-construction
7	Training to the farmers with field demonstration regarding IPM and ICM.	400,000	5	BWDB with help of DAE	During post-construction
8	Awareness building up to local community for conservation of threatened fish species.	50,000	0.625	BWDB & WMO with help of UFO	During post-construction
9	Training to the fisherman/pond owner with field demonstration regarding pond culture.	40,000	0.5	BWDB & WMO with help of UFO	During post-construction
10	Solid and liquid waste disposal arrangement.	100,000	1.25	BWDB	
11	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1,000,000	12.5	BWDB	During post-construction
12	Consultancy services cost for river bank erosion monitoring	1,200,000	15	BWDB	During construction
13	Training to the Contractors regarding environmental management	100,000	1.25	BWDB	During pre-construction
14	Training of Environmental awareness of local population	80,000	1	Contractor	During pre-construction and construction phases
15	Updating EMP as per requirement.	1,000,000	12.5	BWDB	During post-construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
16	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)	200000	2.50	BWDB with cooperation of DoF	During operation
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	Campaigning and providing training on improved culture practices as well as the rice cum golda farming.	200,000	2.5	BWDB with help of UFO	During post-construction
19	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
20	Social forestry program along both sides of the embankment and other khas areas	Included in afforestation budget		**BWDB/NGO**	**During construction & operation**
21	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
22	WMOs monitoring cost	500,000	6.25		
23	Construction of fish pass friendly structure (one fish pass)	61,420,026	767.75	Contractor, BWDB	During construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	Optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes				
	Total Cost	**73,962,580**	**922.0701625**		

Extensive monitoring of the environmental concern of the Polder 16 will be required as per World Bank guideline. The monitoring program will help to evaluate: (i) the extent and severity of the environmental impacts against the predicted impacts and baseline; (ii) the performance of the environmental protection measures or compliance with pertinent rules and regulations; (iii) trends in impacts; and (iv) overall effectiveness of the project environmental protection measures. The monitoring plans will be included in the EMP for specific sub-projects. Moreover, for all type of monitoring, a comprehensive database of the polder specific Environmental Impact and Monitoring information will be created, which will help evaluate the impacts easily.

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

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
During Pre-Construction					
Public grievance	All displacement area in the polder	Complaints register	During project time	BWDB	BWDB, Consultant
During Construction					
Sources of Material	Work Site	Possession of official approval or valid operating license of materials suppliers (Cement, soil).	Before an agreement for the supply of material is finalized.	Contractor	DDCS&PMSC, 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
Erosion	Side slopes of the embankments and material storage sites	Visual inspection of erosion prevention measures and occurrence of erosion	At the end of filling activity	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Hydrocarbon	Construction	Visual Inspection	Monthly	Contractor	DDCS&PMSC,

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
and chemical storage	camps	of storage facilities			BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DDCS&PMSC, BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Daily	Contractor	DDCS&PMSC, BWDB
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	DDCS&PMSC
Noise	Construction sites	Visual inspection to ensure good standard equipment are in use	Weekly	Contractor	DDCS&PMSC, 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 from each river of each polder	Sampling and analysis of surface water quality	Only dry season	Contractor through a nationally recognized laboratory	DDCS&PMSC, M&E Consultant, BWDB
Drinking Water Quality (TDS, Turbidity, pH, FC, 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
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid wastes and also inspection of	Weekly	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
		wastes is depositionof at designated site			
Top Soil	Storage area	Top soil of 0.15 m depth should be excavated and stored properly	Beginning of earthwork	Contractor	DDCS&PMSC, BWDB
	Storage area	The stored top soils should be used as cladding material over the filled lands	Immediately after filling and compaction of dredge materials	Contractor	DDCS&PMSC, BWDB
	Work Site	Some of the top soil are placed on top and berm of embankment for turfing and plantation	At the end of filling activity	Contractor	DDCS&PMSC, BWDB
Habitat Condition	Bank side of Kobadak, Sibsa , Salta Rivers and Khals	Observation	Four (4) times in year (dry & wet season)	Contractor	DoF, BFRI, DDCS&PMSC, M&E Consultants, BWDB
Fish Migration		Catch Assessment Survey	Two (2) times of year (dry & wet season)	Contractor	DoF, BFRI, DDCS&PMSC M&E Consultants, BWDB
Clearance of vegetation	Each of construction sites (32 nos.) at embankment (43 km.) and proposed khal bank (42 km.) of both side	Survey and comparison with baseline environment	Quarterly	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Engaged local labour in re-excavation	Khals Re-excavation and embankment resactioning area	Checking address in record book and National Indenty Card or Chairman certificate	During routine monitoring	Contractor	BWDB and Consultant
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample from each river around & in each polder	Sampling and analysis of surface water quality	Only dry season	BWDB through a nationally recognized laboratory	M&E Consultant
Air Quality (Dust)	At the baseline monitoring site	24 hours Air quality monitoring	Yearly	BWDB through a nationally	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
				recognized laboratory	
Flora and Fauna specially fisheries	In the project area	Detailed species assessment and compare with baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant
Agriculture	In the project area	Compare the production with the baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant
Crop production	In the Polder area	Compare the production with the baseline	3 (Three) cropping seasons	BWDB through a nationally recognized institution	M&E Consultant
Soil quality	In the Polder area	Compare the soil quality with the baseline	Two (2) times in a year (dry & wet season)	SRDI	M&E Consultant
Soil salinity	In the Polder area	Compare the soil salinity with the baseline	Once (1) times in a year (dry season)	SRDI	M& E Consultant
Habitat Condition	River bank side of Kobadak, Sibsa, Salta Rivers and Khals	Observation	Four (4) times in a year (dry & wet season)	Consultancy farm	DoF, BFRI, DSC & PMSCand M&E Consultants, BWDB
Fish Migration		Catch Assessment Survey	Two (2) times in a year (dry & wet season)	Consultancy farm	DoF, BFRI, CSC, BWDB
Fishing Activities and Stock susceptibility		Catch Assessment Survey	Two (2) times in a year (dry & wet season)	Consultancy farm	DoF, BFRI, DSC M&E Consultants, BWDB
Golda Gher and Fish Farm	Polder Area	Farm Survey	Four (4) times in a year (dry & wet season)	Consultancy farm	DoF, BFRI, DSC M&E Consultants, BWDB

(Source: LGED, 2011)

Environmental Monitoring Plan during Construction and Operation of Afforestation as given below in a tabular form:

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Locations</th><th rowspan="2">Means of Monitoring</th><th rowspan="2">Frequency</th><th colspan="2">Responsible Agency</th></tr>
<tr><th>Implemented by</th><th>Supervised by</th></tr>
<tr><td colspan="6">During implementation</td></tr>
<tr><td>Plant species selection</td><td>Paikghacha purashava (Number of six nurseries has been located) Kalilnager Union (Number of five nursery has been located)</td><td>Visual quality checking of selected plant species and to be planted of selected areas</td><td>Before plantation</td><td>Contractor</td><td>DDCS&PMSC BWDB, M&E Consultant</td></tr>
<tr><td>Waste Management</td><td>Afforestation sites are:
a) Chairvanga, Batultala,
b) Hitampur, Malakpuraikati,
c) Shilirampur, d) Sibbati (9 no. ward), Boyratala
2. Nursery</td><td>Poly bags, debris etc. waste materials are disposed off at selected sites</td><td>Weekly</td><td>Contractor</td><td>DDCS&PMSC BWDB, M&E Consultant</td></tr>
<tr><td colspan="6">During Operation and Maintenance</td></tr>
<tr><td>Growth and death ratio of planted saplings and turfed grasses</td><td rowspan="2">Proposed afforestation areas are
a) Chairvanga, Batultala,
b) Hitampur, Malakpuraikati,
c) Shilirampur,
d) Sibbati (9 no. ward), Boyratala villages</td><td>Survey and comparison with baseline environment</td><td>Yearly</td><td rowspan="2">Contractor</td><td rowspan="2">DDCS&PMSC, M&E Consultant, BWDB</td></tr>
<tr><td>Fencing preparation</td><td>Visual inspection of fencing condition</td><td>Monthly</td></tr>
<tr><td>Faunal diversity</td><td>Proposed afforestation area</td><td>Survey and comparison with baseline environment</td><td>Yearly</td><td></td><td>DDCS&PMSC, M&E Consultant, BWDB</td></tr>
</table>

BWDB will prepare a Bi-annual Monitoring Report on environmental management and will share this with the World Bank for review during construction phase. The effectiveness of screening, monitoring and implementation of the EMP along with the project component activity monitoring will be carried out by a third-party monitoring firm annually. The Annual

Environmental Audit Report prepared by the third-party monitoring firm will be shared with the safeguards secretariat. The Third-Party M&E Consultants will be responsible for independent monitoring of the implementation of EMP. The tentative cost estimates for Environmental monitoring is as follows:

Tentative Cost Estimates for Environmental Monitoring

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
1	Soil quality monitoring including N,P,K, S, Zn, salinity, organic Matter, pH etc. samples in Polder 16 = 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, coliform 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
	Total Cost	2,510,000	31.3025		

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

Stakeholder Consultation and Disclosure

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

A Regional level Public Disclosure Meeting (PDM) on the EIA report of Polder 16 was held on 25th July, 2017 in Paikgaccha Upazila, Khulna. The participants of the PDM included Upazila Nirbahi Officer (UNO), Upazila Chairman, Upazila Vice Chairman and other concerned government officials, Journalists, NGO representatives, environmentalists, activists, local stakeholders and other representatives. No national level disclosure meeting has yet been carried out.

Local people showed interest in the project and were positive minded for its implementation which is vital for their survival. They also expressed that if the monitoring plan is implemented properly during the pre-construction, construction and post-construction periods then they would support the implementing agency positively.

1. Introduction

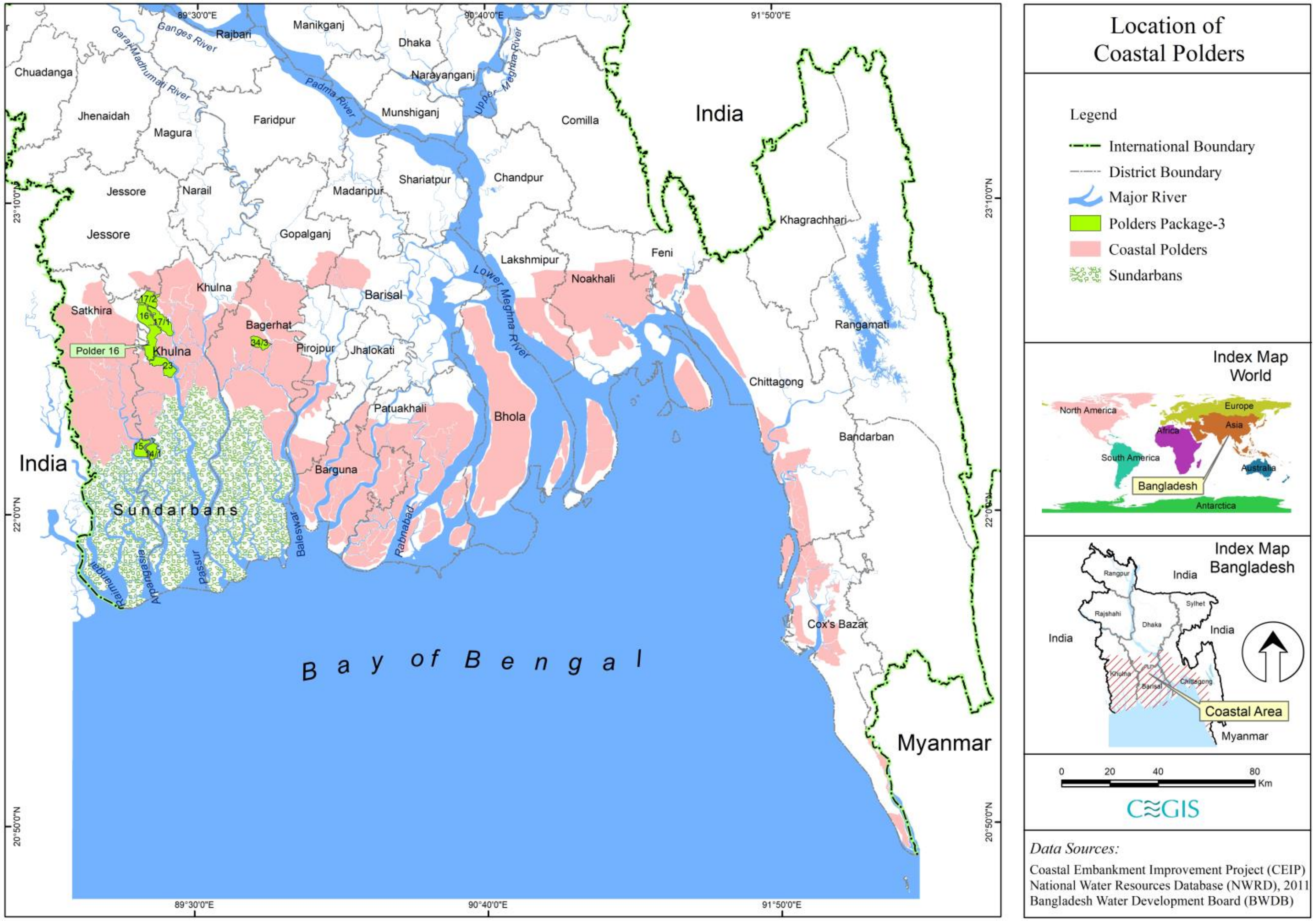
1. Coastal Embankment Improvement Project, Phase-1 (CEIP-1) (here in after referred as ‘project’), under which 17 Polders will be rehabilitated and improved in the coastal area of the country by three packages. Preliminarily 17 polders were selected for rehabilitation in feasibility study considering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

1.1 Background

2. 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 and sedimentation. Without embankments, the coastal communities would be exposed to diurnal tidal flooding. The poldered lands are slightly higher than sea level. These polders are equipped with inlet and outlet sluice gates to control the water inside the embanked area.

3. The polders were originally designed without much attention to storm surges. Recent cyclones did substantial damage to the embankments and further threatened the integrity of the coastal polders. In addition to breaching due to cyclones, siltation of peripheral rivers caused the coastal polders to suffer from water logging, which has led to large scale environmental, social and economical degradation. However, environmental consequences were not virtually considered during polderization. Poor maintenance and inadequate management of the Polders have also contributed to internal drainage congestion and heavy external siltation. Soil fertility and agriculture production in some areas are declining because of water logging and salinity intrusion inside the Polders.

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



Map 1.1: Location of Coastal Polders

1.2 Project Overview

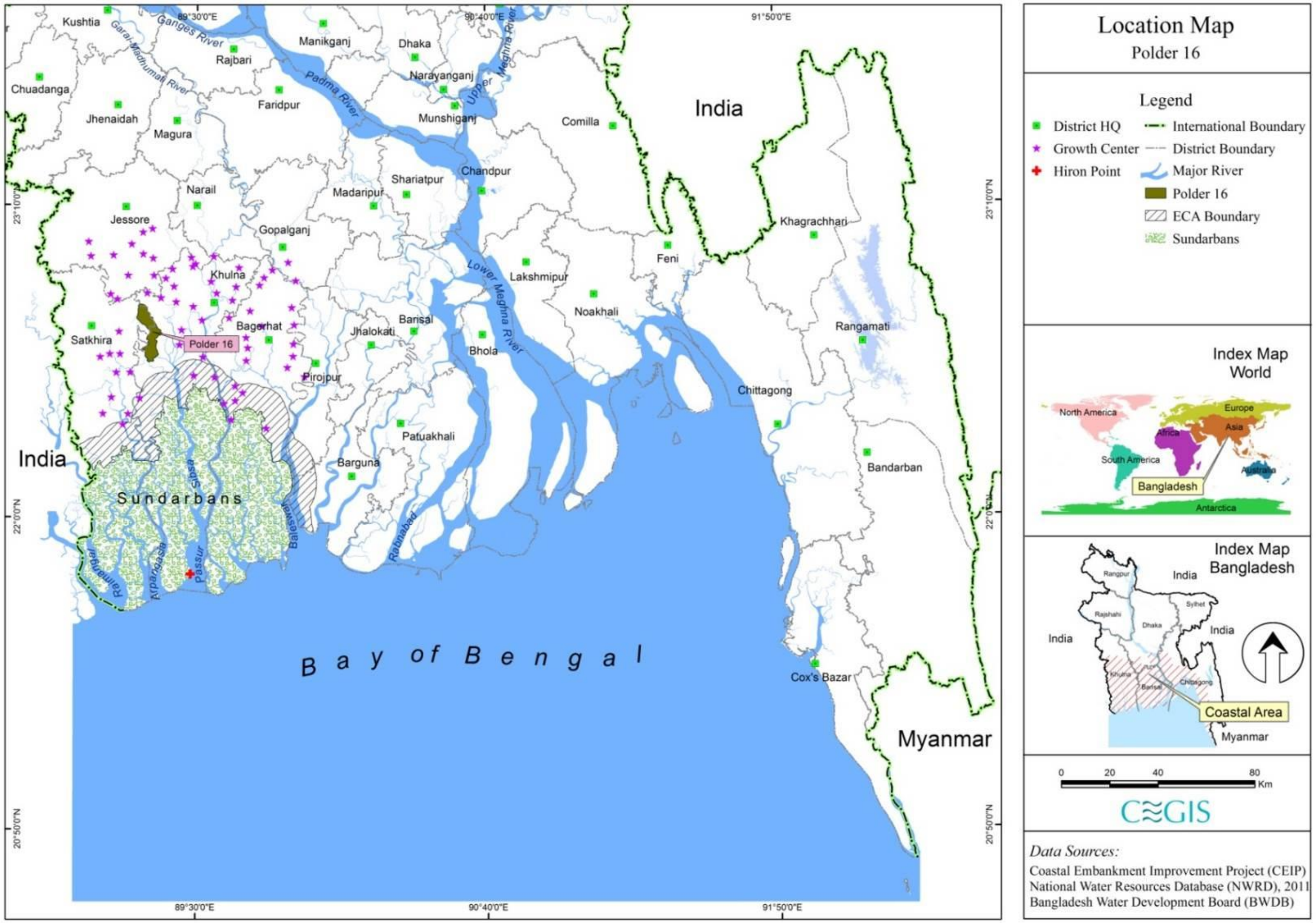
5. The polder is located in 3 (three) Upazilas namely Paikgacha, Dumuria and Tala under Khulna and Satkhira Districts respectively. The total area of the Polder 16 is 10,472 ha of which 2,496 ha (23.84% of the gross area) is Net Cultivable Area (NCA). The major project objective of CEIP-1 is to enhance protection against natural disasters, increase resilience during and after such disasters, and improve agricultural production by reducing drainage congestion. To achieve these goals, the following key improvement and rehabilitation works will be implemented in Polder 16 by BWDB under Package-3, CEIP-1:

- Re sectioning of embankment : 43.00 km
- Construction of retired embankment : 2.00 km
- Construction of drainage sluices : 10 nos.
- Repair of Drainage Sluice : 2 nos.
- Demolishing of drainage sluice : 1 no.
- Construction of Flushing Inlets : 20 nos.
- Demolishing of flushing Inlets : 10 nos.
- Re excavation of drainage channel : 20.00 km
- Bank protection works : 0.30 km
- Slope protection of embankment : 1.00 km
- Afforestation : 24.00 ha

6. Other components of the CEIP-1 study will include 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. Detailed information of the Project is presented in the project description chapter of the report.

1.3 Regulatory and Policy Framework

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



Map 1.2: Location of Polder 16

1.4 Objectives of the Study

8. The objective of the EIA study for Polder-16 is to identify and assess the potential environmental impacts of the proposed project interventions, evaluate alternatives, and design appropriate mitigation, management, and monitoring measures to be addressed in the Environmental Management Plan (EMP)3. In compliance with the national regulatory and WB environmental policies and guidelines (for further details refer to Chapter 3).

1.5 The specific objectives of the EIA study are to

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

1.6 Scope of work

9. The scope of works of the present EIA study for Polder 16 includes the following:

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

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

iii. Determine the cumulative environmental impacts of the project 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.

[3]WB Operation Policy 4.01. 2011 Revision

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

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

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

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

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

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

xiv. Prepare the EIA report.

1.7 Structure of the Report

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

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

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

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

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

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

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

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

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

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

2. Approach and Methodology

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

2.1 Overall Approach

11. The EIA study for the rehabilitation of Polder 16 has been carried out following the approved Terms of References (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**

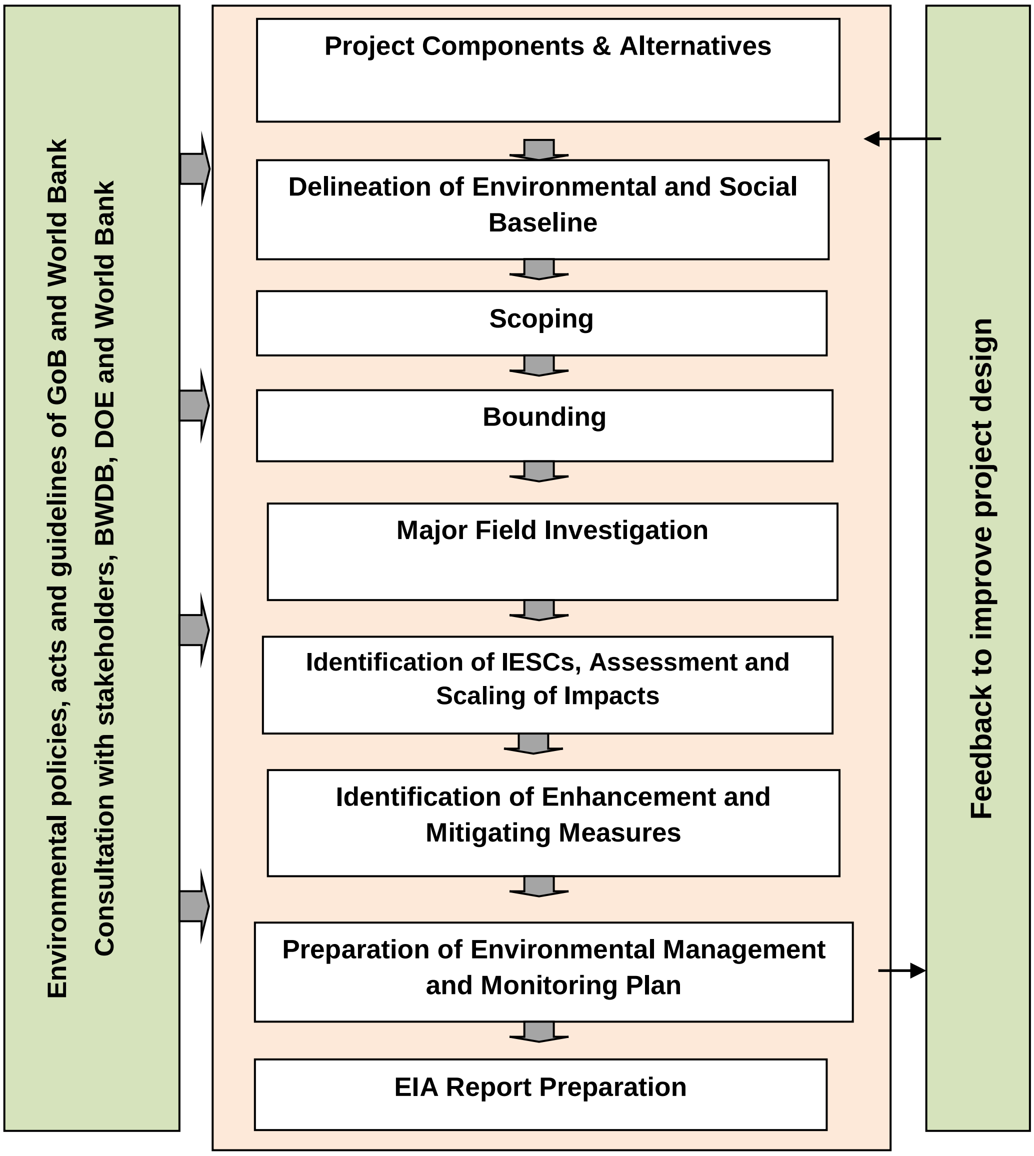


Figure 2.1: Overall approach of the EIA study

2.2 Methodology

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

2.2.1 Analysis of the Project Design and Description

13. Detailed information about the Polder 16 including objective, nature and location of proposed and existing interventions, construction works, and other related aspects were obtained from the Main Consultant of CEIP-1.

14. 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.

15. Since the location of most of the project interventions are already fixed, alternative design options of the interventions were analyzed considering environmental, social, and technological criteria to identify suitable alternatives and appropriate mitigation measures for negative environmental impacts. Figure 2.2 shows the different aspects to be addressed in the Project Design and Description step of the EIA studies.

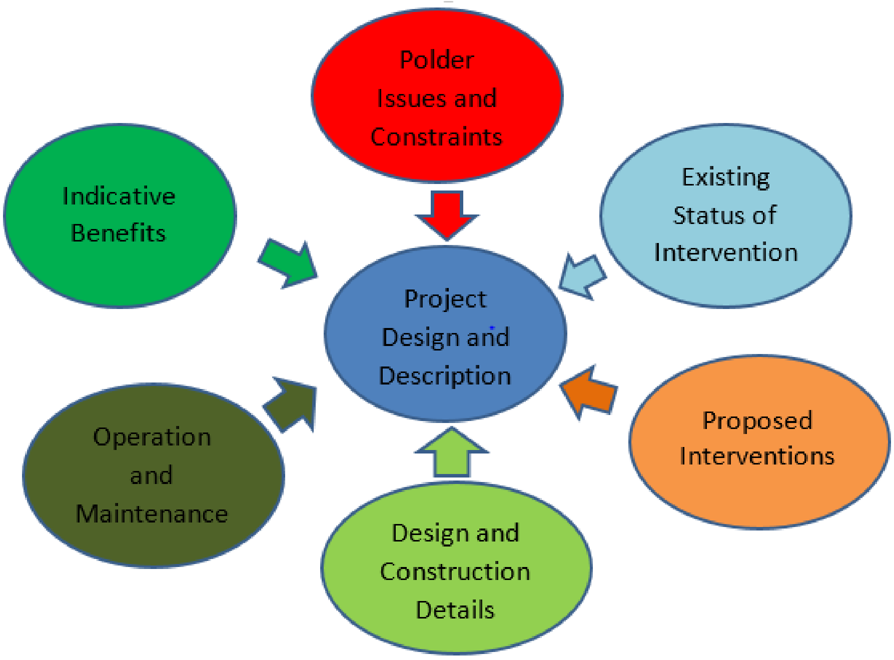


Figure 2.2: Aspects to be addressed in the Project Design and Description

2.2.2 Baseline Data Collection and Analysis

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

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

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

Physical Environment

18. 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

19. Water resource data related to river hydrology and morphology, surface and ground water availability, drainage pattern, ground and surface water quality and water use were collected from secondary sources. Primary data on air, noise, water were collected and analyzed. The professionals of the multi-disciplinary team received feedback from the local people. Major river systems were identified for hydrological and morphological investigation through collection and analysis of historical and current image data. Specific areas or points of interest were selected for collecting data on special hydrological and morphological aspects, water availability, drainage pattern, water quality (surface and ground water), tidal flood, risk of erosion and sedimentation.

20. 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 analyzed. The NWRD contains long series of temporal data showing daily values for meteorological stations maintained by the Bangladesh Meteorological Department (BMD).

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

Land Resources

22. The agro-ecological region of the project area was identified using secondary sources including Food and Agriculture Organization (FAO) and United Nations Development Program (UNDP) information. The land type and soil texture data were collected from Upazila[4] Land and Soil Resources Utilization Guide of Soils Resources Development Institute (SRDI). The secondary data of these parameters was verified at field level through physical observations as well as consultations with the local people and officials of the Department of Agriculture Extension (DAE) during field visit.

Biological Environment

Agricultural Resources

23. Land use information was prepared from satellite image classification followed by field verification. Data on agricultural resources which included existing cropping patterns, crop variety, crop calendar, crop yield, crop damage, and agricultural input were collected from both secondary and primary sources. Agricultural data was collected through extensive

4 Upazila is an administrative subdivision of a district.

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

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

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

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

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

Ecological Resources

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

28. 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

29. 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.

30. 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.

31. 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.

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

Livestock Resources

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

Socio-cultural Environment

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

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

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

2.2.3 Scoping

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

2.2.4 Bounding

36. At the beginning of the study, the Project area of influence was broadly demarcated. This included the area inside the Polder where most of the Project interventions would take place, the area immediately outside the Polder embankments (this area could be used for staging of construction works, material stockpiling, and/or earth borrowing), access routes for the polder, borrow as well as spoil disposal areas if located outside the polder, and labor camps/contractor facilities if located outside the polder. The area of influence is bounded by the river Salta and Haria to the East, Kobadak River to the West, Sibsa and Kobadak to the South. It is noted that project area includes Polder area whereas study area includes both project area and peripheral rivers.

2.2.5 Major Field Investigation

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

2.2.6 Assessment and Scaling of Impacts

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

39. 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

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

41. 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

42. 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.

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

Table 2.1: Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Negligible/Nil
Duration of potential impact	Long term (more than 15 years)	Medium Term Lifespan of the project (5 to 15 years)	Less than project lifespan	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and established professional criteria	Breaches national standards and or international guidelines/ obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Sensitivity

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

Table 2.2: Criteria for Determining Sensitivity

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

Assessment of Significance

45. 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

46. Subsequent to the impact assessment discussed above, appropriate mitigation measures have been proposed to avoid, offset, mitigate/reduce, or compensate for the identified impacts. Generally, impacts having moderate to critical consequence significance as per the Table 2.3 require appropriate avoidance/ mitigation/ compensatory measures to reduce the significance. Impacts having low to negligible significance are considered not to need any mitigation measures.

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

Assessment of Residual Impacts

48. 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

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

2.2.7 Analysis of the Project Components and Alternatives

50. 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.

51. During the suitability assessment process, all design alternates or alternatives in project interventions were compared to the 'without-project' option, which would be generated by projecting the baseline situation for the entire project life, within the Future-Without-Project (FWOP) scenario. Moreover, different possible construction alternatives related to project implementation such as, the materials to be used, workforce procurement sources, locations of stockyards, sources for material procurement, transportation routes, modes of material and manpower mobilization, scheduling, etc., were analyzed during the study.

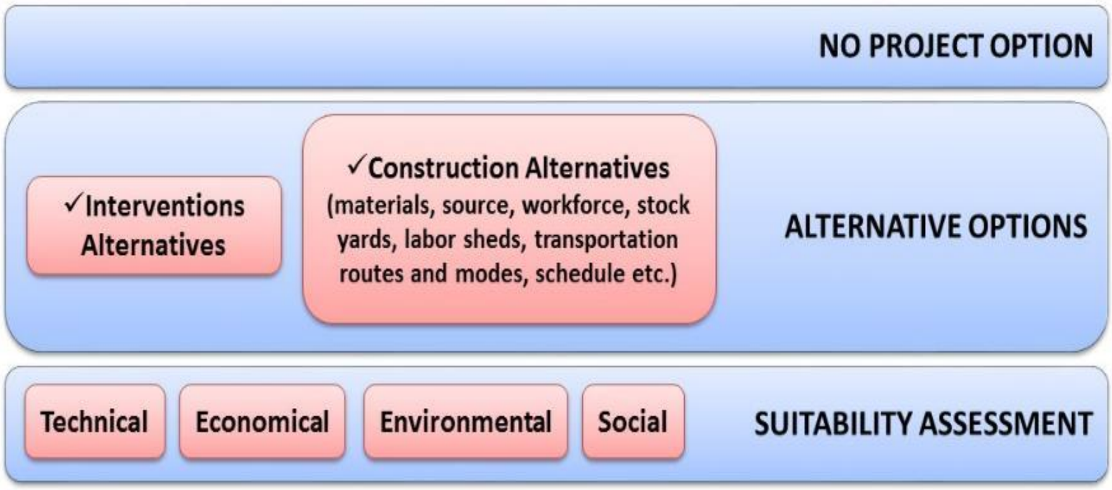


Figure 2.3: Concept of Alternative analysis to be used in the EIA study

2.2.8 Climate Change

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

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

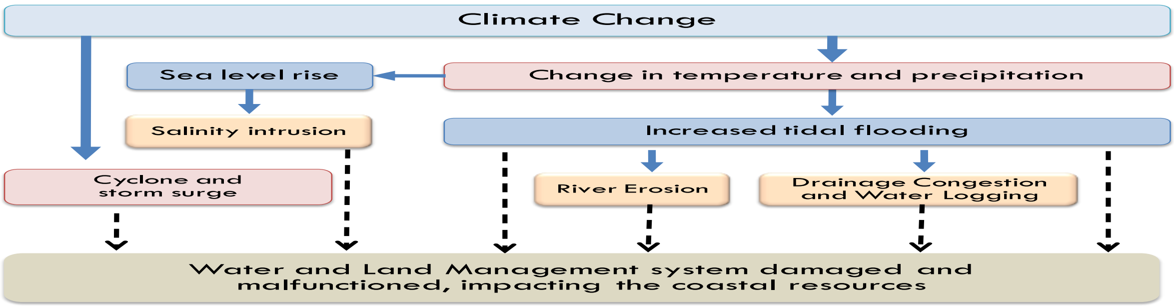


Figure 2.4: Typical process diagram of climate change impacts in coastal areas

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

2.2.9 Assessment of Cumulative and Residual Impacts

55. 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.

56. Drainage modelling of the coastal polder has been carried out by IWM to find out the design parameters for drainage canal systems, drainage regulator, river bank, slope protection works. Climate resilient coastal embankment crest level has been designed considering the combined effects of cyclone storm surge effects and cyclone induced wind wave. The model has been developed and simulated considering climate change condition. The impact of proposed interventions on drainage, flooding, river dynamics has also been analyzed through modeling. The model results have been utilized in the EIA study.

2.2.10 Preparation of Environmental Management and Monitoring Plan

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

2.2.11 EIA Report Preparation

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

3. Policy, Legislative and Regulatory Framework

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

3.1 Relevant National Policies, Strategies and Plans

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

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

3.2 National Environmental Laws

61. 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

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

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

3.3 Other Relevant Acts

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

Table 3.1: Laws and Acts

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

3.4 International Treaties Signed by GoB

63. Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, such as the Ramsar Convention, the Convention on the Conservation of Migratory Species of Wild Animals (CMS), the Rio de Janeiro Convention on Biological Diversity (CBD) conservation and the Kyoto protocol on climate change, etc. An overview of the relevant international treaties and conventions signed by GoB is shown in **Table 3.2** 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
Occupational hazards due to air pollution, noise &vibration (Geneva)	1977	Protect workers against occupational hazards in the working environment	MoH
Occupational safety and health in working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	MoH
Occupational Health services	1985	To promote a safe and healthy working environment	MoH
Convention on oil pollution damage (Brussels)	1969	Civil liability on oil pollution damage from ships	DoE/MoS
Civil liability on transport of dangerous goods (Geneva)	1989	Safe methods for transport of dangerous goods by road, railway and inland vessels	MoC
Safety in use of chemicals during work	1990	Occupational safety of use of chemicals in the work place	DoE
Convention on oil pollution	1990	Legal framework and preparedness for control of oil pollution	DoE/MoS
Vienna Convention	1985	Protection of the ozone layer	DoE
London Protocol	1990	Control of global emissions that deplete ozone layer	DoE
UN framework convention on climate change (Rio de Janeiro)	1992	Regulation of greenhouse gases emissions	DoE
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of bio-diversity, sustainable use of its components and access to genetic resources	DoE
International Convention on Climate Changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases	DoE
Protocol on biological safety (Cartagena protocol)	2000	Biological safety in transport and use of genetically modified organisms	DoE
MoU on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia	2003	Intergovernmental agreement that aims to protect, conserve, replenish and recover sea turtles and their habitats in the Indian Ocean and South-East Asian region	MOEF/FD

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

64. 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 MoEF is the regulatory body responsible for enforcing the ECA'95 and ECR'97 (Amended 2010). According to the Rule 7 (1) of the Environmental Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every project, in consideration of their site and impact on the environment, has been classified into the four categories and they are: Category I (green), Category II (Orange-A), Category III (Orange B) and Category IV (Red). According to the categorization, all construction/reconstruction/expansion of flood control embankment/polder/dykes etc falls under Red Category. Therefore, the CEIP-1 Project intervention in Polder 16 falls under the 'Red' category[5].

65. 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)

66. 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:

67. 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

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

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

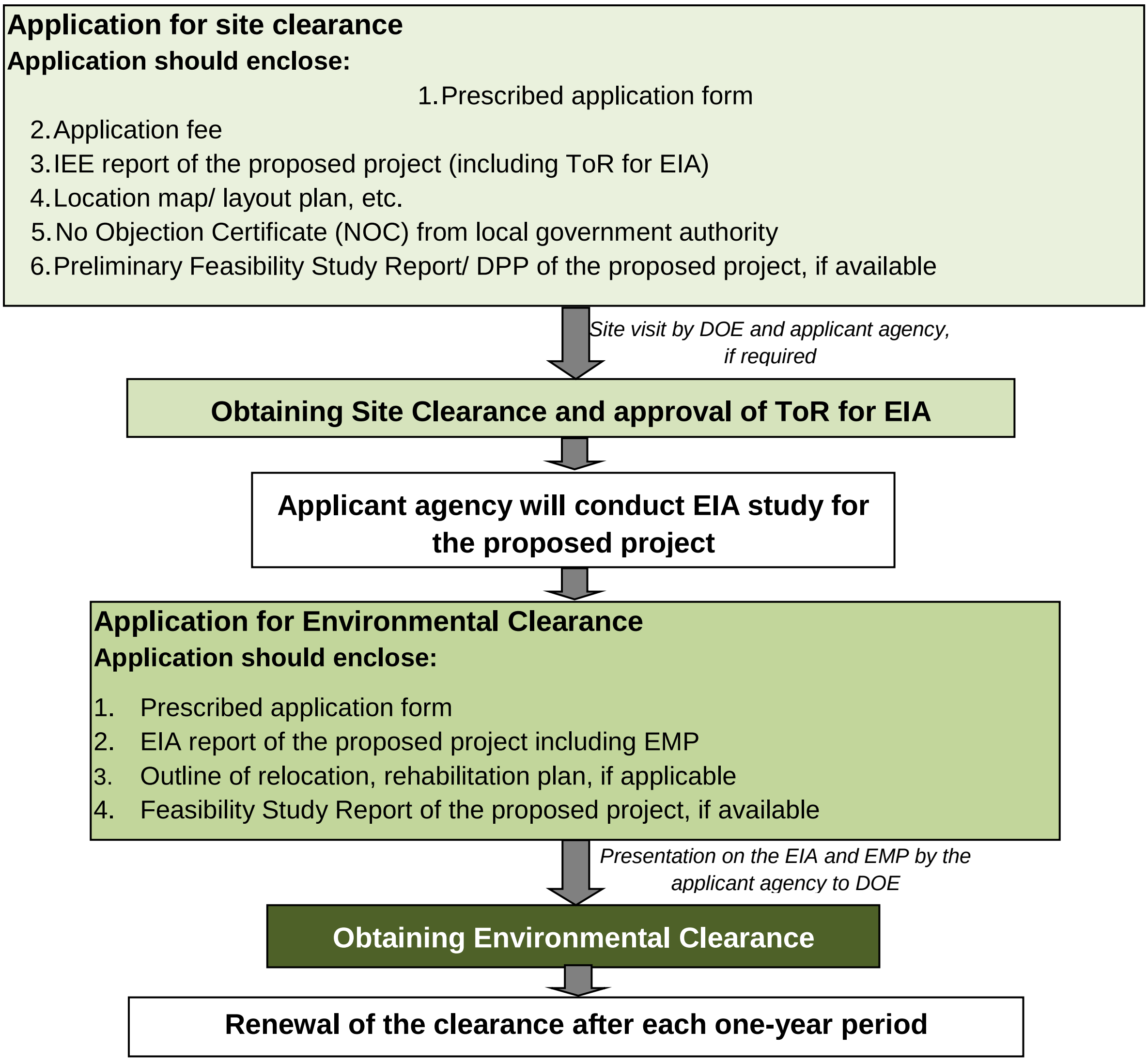


Figure 3.1: Process of obtaining Clearance certificate from DoE

3.7 World Bank's Environmental Safeguard Policies

69. 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

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

3.8 Implications of WB Policies on CEIP

71. The project interventions for Polder 16 fall under Category A[6], 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.

3.8.1 Projects on International Waterways (OP 7.50)

72. 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 in turn potentially increase the usage of chemical fertilizers and pesticides. During regular environment monitoring in operational phase if the water and soil pollution is observed, the proponent will be responsible for preparing Pest Management Plan with prior approval from Bank. No Project activities are to be carried out in the rivers except some transportation.Projects on International Waterways (OP 7.50)

73. Projects on international waterways 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.

[6] ***Category A:*** A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works

4. Climate Changes Impact

4.1 Climate Change analysis

74. Climate is a critical factor in the lives and livelihoods of the people and socioeconomic development as a whole. Climate has shown warming of 0.89 [0.69 to 1.08] ^{0}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^{0}C to 1.6^{0}C for RCP2.6, 0.9^{0}C to 2.0^{0}C for RCP 4.5, 0.8^{0}C to 1.8^{0}C for RCP6.0 and 1.4^{0}C to 2.6^{0}C for RCP 8.5, respectively by 2046-2065 (IPCC 2013). The newer findings indicate that warming is more pronounced than expected. The impact would be particularly severe in the tropical areas, which mainly consist of developing countries, including Bangladesh. Increasing temperature trends of the order of 0.60^{0}C during last 112 years (IMD 2012) and increase in heavy rainfall events and decrease in low and medium rainfall events (Goswami et al. 2006) over India have been observed. Changes in rainfall and temperatures have also been reported by Dash et al. (2009), and others.

75. In this context, monthly and annual mean data of maximum and minimum surface air temperature, and monthly and annual rainfall data are extracted from Regional Climate Model (RCM) for Polder 16 and has been used for the period of 1978-2012 for this study. It is mentioned here that there is no rain-gauge station in polder area so climate model data has been used for this polder for rainfall and temperature. Seasonal mean values have been computed from the monthly data of rainfall and temperature for the four meteorological seasons, e.g., pre-monsoon (March-May), monsoon (June-September), post-monsoon (October-November) and winter (December-February), respectively.

4.2 Climate Variability Analysis

76. With impact on key sectors like agriculture, water resources and economics, climate plays an influential role in human life cycles.

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

4.2.1 Annual Climate Change Trends

Annual mean maximum temperature trend

78. Long-term changes in surface temperature and precipitation over Polder 16 were analyzed using climate model downscaling data from 1978 to 2012. The time series of temporal plots of annual mean maximum temperature of Polder 16 shows that the temperature has the dominant increasing trend as shown in Figure 4.1. The causes of the warming are attributed mainly to the radiative forcing due to the increased greenhouse gases.

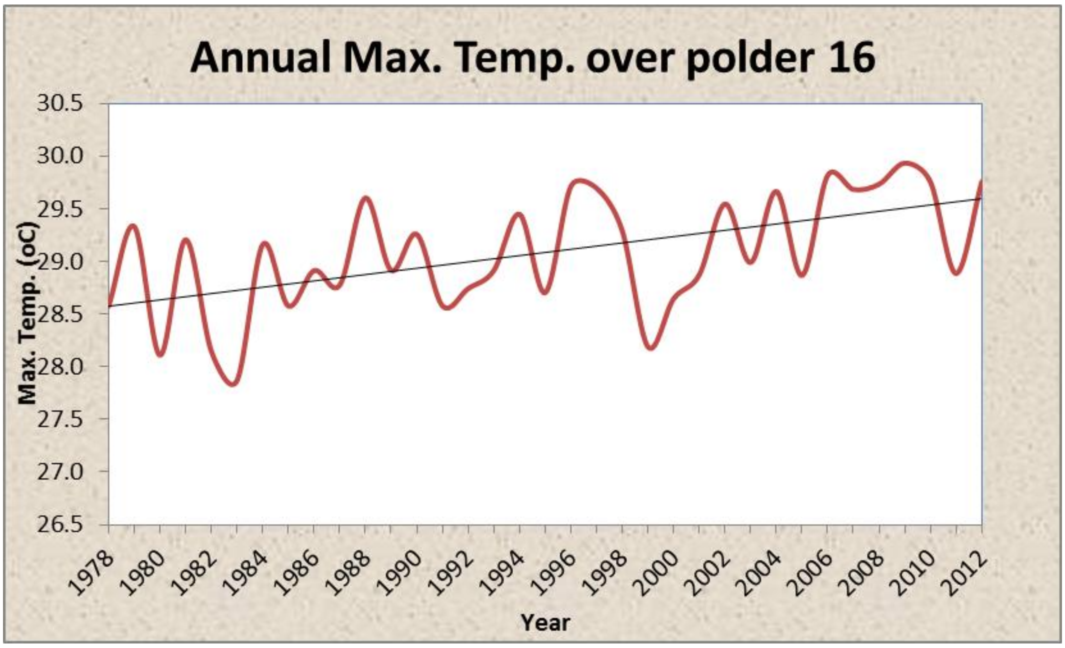


Figure 4.1: Temporal variations of mean maximum temperature over Polder 16 during the period 1978-2012

79. The slope of the linear trends of the regression analysis of the mean maximum temperature has been observed. The annual mean maximum temperature time series have shown increasing trends over polder 16 at the rate of 0.03^{0}C/year, which is statistically significant at 1% level.

Annual mean minimum temperature trend

80. The temporal plots of the time series of annual mean minimum surface air temperature has been analyzed for Polder 16. The yearly variation of annual mean minimum surface air temperature for Polder 16 is shown in Figure 4.2 for the period 1978-2012. The results of the trend analysis of annual mean minimum temperatures have shown increasing trends over Polder 16 at the rate of 0.016^{0}C/year which is statistically significant at 5% level.

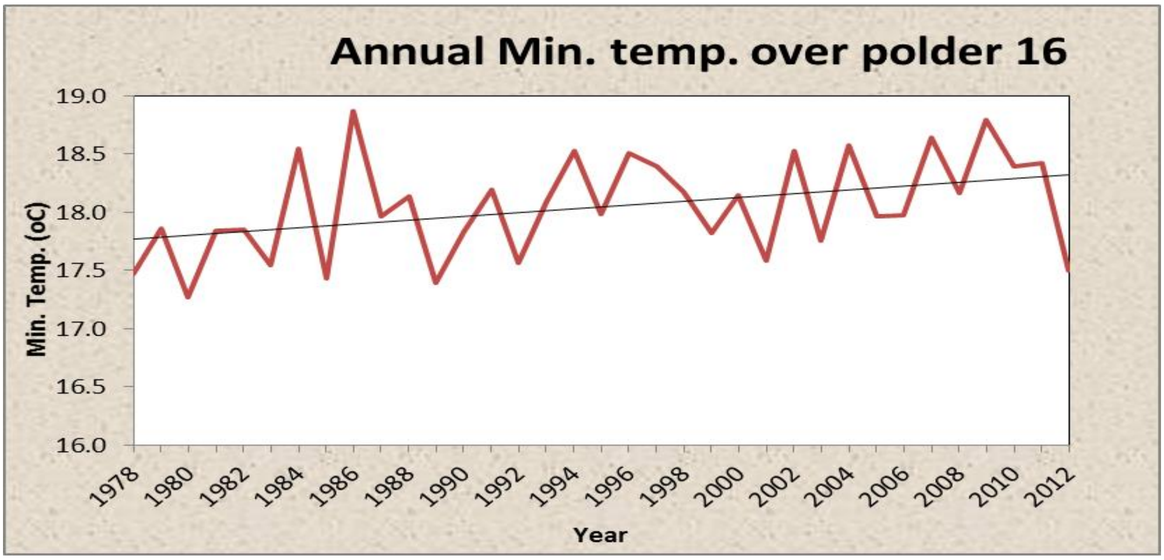


Figure 4.2: Temporal variations of annual mean minimum temperature over Polder 16 during the period 1978-2012

Annual total rainfall

81. The temporal plots of the annual total rainfall of Polder 16 have drawn to investigate the nature of inter-annual fluctuations. The temporal variations of the annual total rainfall (Figure 4.3) are observed during the period 1978-2012. It is noticed that decreasing trends in the annual rainfall at the rate of -1.50 mm/year, during the same period, which is not statistically significant.

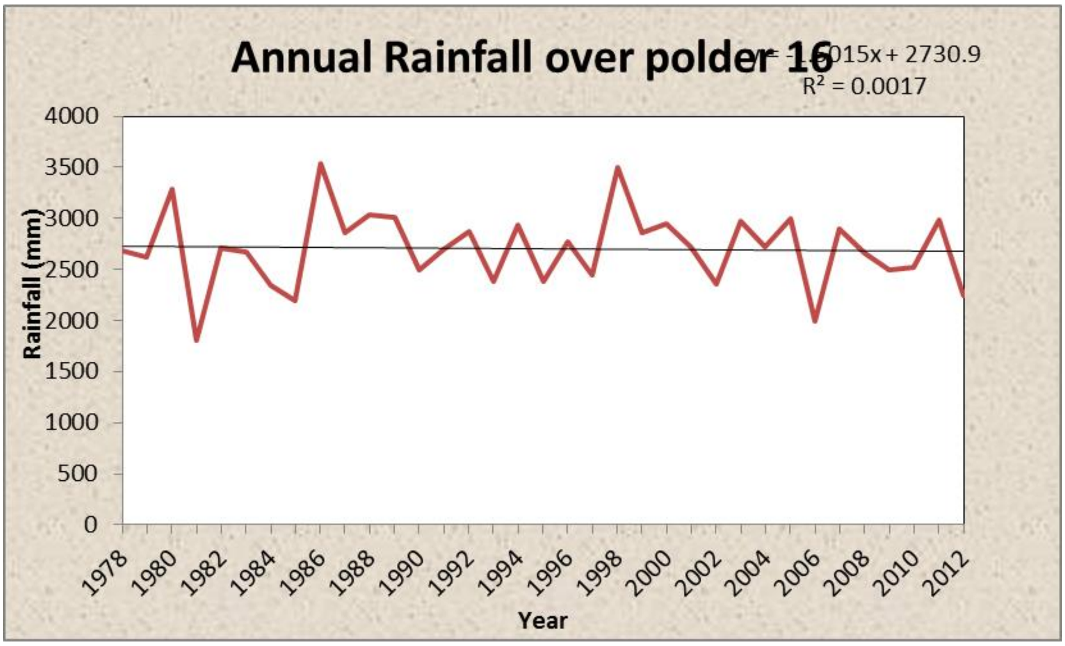


Figure 4.3: Temporal variations of annual rainfall over Polder 16 during the period 1978-2012

4.2.2 Seasonal climate change trends

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

4.2.3 Winter climate change trend

Winter mean maximum temperature trend

83. The winter mean maximum surface air temperature has an increasing trend over Polder 16 during the period of 1978-2012 (Figure not shown). The increasing trend is noticed over Polder 16 at the rate of 0.039^0C/year which is statistically significant at 5% level.

Winter mean minimum temperature trend

84. As per trend analysis, it is found that the winter mean minimum surface air temperature has an increasing trend over Polder 16 during the period of 1978-2012 (Figure not shown). The increasing trend over Polder 16 is 0.0105^0C/year which is not statistically significant.

Winter season rainfall trend

85. The temporal variations of winter rainfall are obtained during the period 1978-2012. It is seen that decreasing trend in the winter rainfall is noticed over Polder 16 at the rate of -0.9799 mm/year (Figure not shown), during the above period, which is not statistically significant.

4.2.4 Pre-monsoon Climate Change Trends

Pre-monsoon mean maximum temperature trend

86. The inter-annual variability in pre-monsoon season mean maximum temperature of Polder 16 has shown increasing trend during the period 1978-2012 (Figure not shown). The observed Increasing trend is shown over Polder 16 at the rate of 0.052^0C/year, which is statistically significant at 1% level.

Pre-monsoon mean minimum temperature trend

87. Mean minimum temperature in pre-monsoon season shows increasing trends over Polder 16 during the period 1978-2012. It is observed that warming trend over Polder 16 at the rate of 0.033^0C/year which is statistically significant at 1% level.

Pre-monsoon total rainfall trend

88. The temporal variations and the trend of pre-monsoon total rainfall are obtained during the period 1978-2012 (Figure not shown). It is observed that decreasing trend in the pre-monsoon season of total rainfall over Polder 16 at the rate of -1.79 mm/year during the same period, which is not statistically significant.

4.2.5 Monsoon Climate Change Trends

Monsoon mean maximum temperature trend

89. The Polder 16 has shown strong warming trend of mean maximum temperature in the monsoon season during the period 1978-2012 (Figure not shown). Polder 16 exhibits strong warming trend during the monsoon season at the rate of 0.012^oC/year which is not statistically significant.

Monsoon season mean minimum temperature trend

90. It is noticed that the Polder 16 has shown warming trend of mean minimum temperature in the monsoon season during the period 1978-2012 (Figure not shown). The warming trend of Polder 16 is 0.016^oC/year which is statistically significant at 5% level.

4.2.6 Monsoon season rainfall trend

91. 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 1978-2012 (Figure not shown). It is seen that increasing trend in the monsoon season rainfall are observed over Polder 16 at the rate of 1.29 mm/year during the same period, which is not statistically significant.

4.2.7 Post-monsoon Climate Change Trends

Post-monsoon means maximum temperature trend

92. The Polder 16 has shown warming trend for post-monsoon season mean maximum temperature during the period 1978-2012 (Figure not shown). The slightly warming temperature is observed over Polder 16 at the rate of 0.017^oC/year, which is not statistically significant.

Post-monsoon means minimum temperature trend

93. Post monsoon mean minimum temperature has shown slightly decreasing trend over Polder 16 and decreasing trend also shows at the rate of- 0.0015°C/year for the period 1978-2012, which is not statistically significant.

Post-monsoon season rainfall trend

94. The temporal variations and the trend of post-monsoon rainfall are obtained during the period 1978-2012. It is seen that decreasing trend in the post-monsoon season is noticed over Polder 16 at the rate of -0.025 mm/year (Figure not shown) during the above period, which is not statistically significant.

4.2.8 Climate change projection

Projection of rainfall over Polder 16

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

Rainfall projections using RCP4.5 scenario:

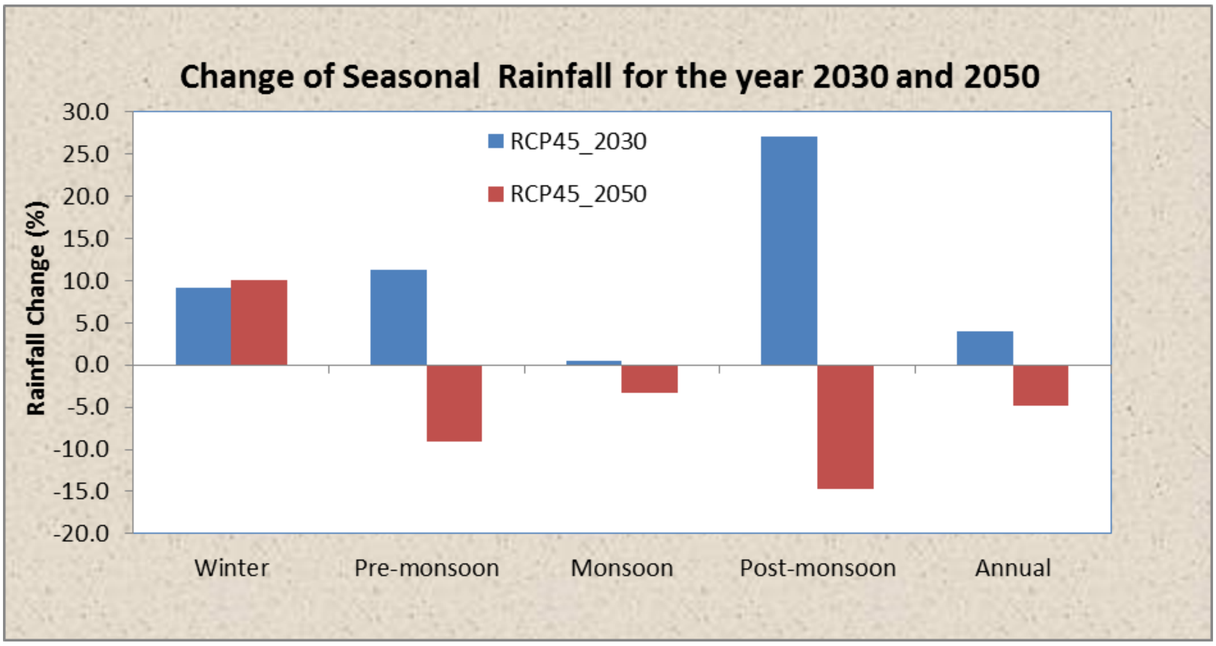


Figure 4.4: Change of seasonal rainfall (%) over Polder 16 for the year 2030 and 2050

96. Rainfall change is found to be 9.1, 11.3, 0.5, 27.1% and 10.1, -9.1, -3.4, -14.7% for winter, pre-monsoon, monsoon and post-monsoon for 2030 and 2050 respectively (Figure 4.4). On an average annual rainfall change over polder 16 may change 4% and -4.8% for the year 2030 and 2050, respectively.

Projection of Maximum and Minimum Temperature over Polder 16:

97. 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). Maximum and minimum surface air temperature projections for the year 2030 and 2050 for RCP4.5 are given below.

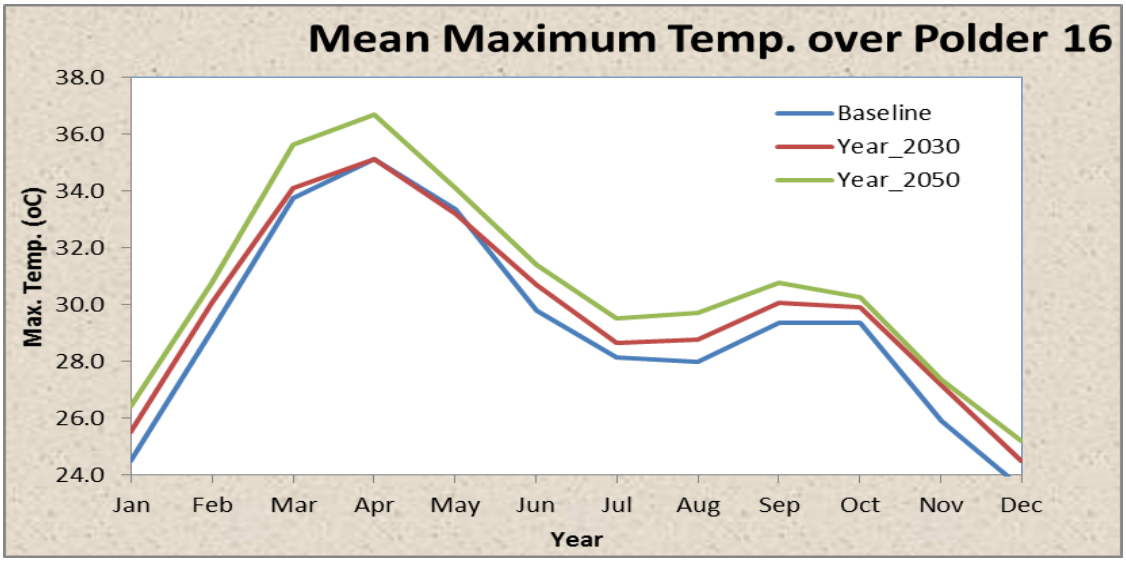


Figure 4.5: Annual cycle of projected maximum temperature with baseline over Polder 16 in 2030 and 2050, respectively.

Maximum temperature projections over Polder 16 for RCP4.5 scenario:

98. Maximum temperature shows the bimodal characteristics. Maximum temperature projection is obtained from the Figure 4.5 for the years 2030 and 2050 respectively. Maximum surface air temperature may change in 2030 by 1.0, 1.0, 0.4, 0.0, -0.2, 0.9, 0.5, 0.8, 0.7, 0.5, 1.2 and 0.9^{0}C for January, February, March, April, May, June, July, August, September, October, November and December, respectively. Maximum surface air temperature in various months may vary by -0.2-1.2^{0}C over Polder 16. On an average the maximum surface air temperature is estimated to be increased by 0.6^{0}C for the 2030. Similarly, maximum temperature may change in 2050 by 2.0, 1.6, 1.9, 1.6, 0.7, 1.6, 1.4, 1.7, 1.4, 0.9, 1.4 and 1.7^{0}C for January, February, April, May, June, July, August, September, October, November and December, respectively. Maximum surface air temperature in various months may vary by 0.7 - 2.0^{0}C over Polder 16. On an average the maximum surface air temperature is estimated to be increased by 1.5^{0}C for the 2050.

Minimum temperature projections over polder 16 for RCP4.5 scenario:

99. Minimum temperature projection is obtained from the Figure 4.6 for the years 2030 and 2050 respectively. Minimum surface air temperature may change in 2030 by 1.7, 1.0, 1.5, 0.7, 0.7, 1.0, 0.8, 1.0, 1.0, 1.1, 1.7 and 2.1^{0}C for January, February, March, April, May, June, July, August, September, October, November and December, respectively. It is observed that the change lies between 0.7-2.1^{0}C for the period 2030 and on an average, minimum surface air temperature may increase 1.2^{0}C over polder 16 in future for the period 2030. Similarly, minimum temperature may change in 2050 by 2.6, 2.2, 2.3, 1.8, 1.4, 1.5, 1.4, 1.5, 1.5, 1.2, 1.3 and 2.0^{0}C for January, February, April, May, June, July, August, September, October, November and December, respectively. Minimum surface air temperature in various months may vary by 1.2-2.6^{0}C for the period 2050. On an average the minimum surface air temperature is estimated to be increased by 1.7^{0}C for the 2050.

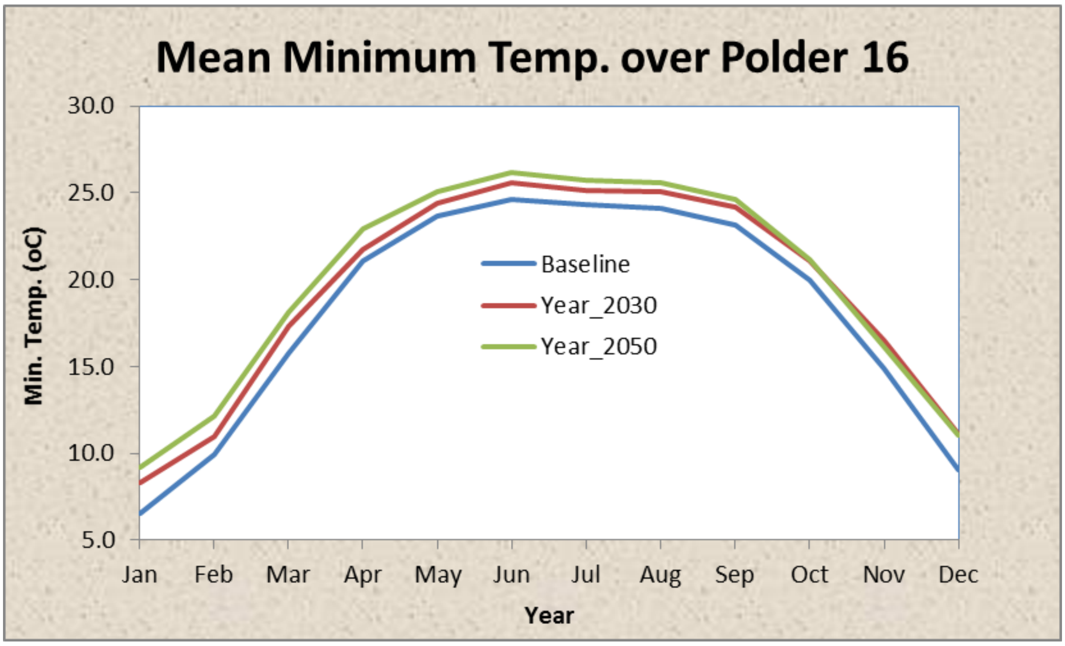


Figure 4.6: Annual cycle of projected minimum temperature with baseline over Polder 16 in 2030 and 2050, respectively.

4.3 Climate Change Induced Natural Hazard

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

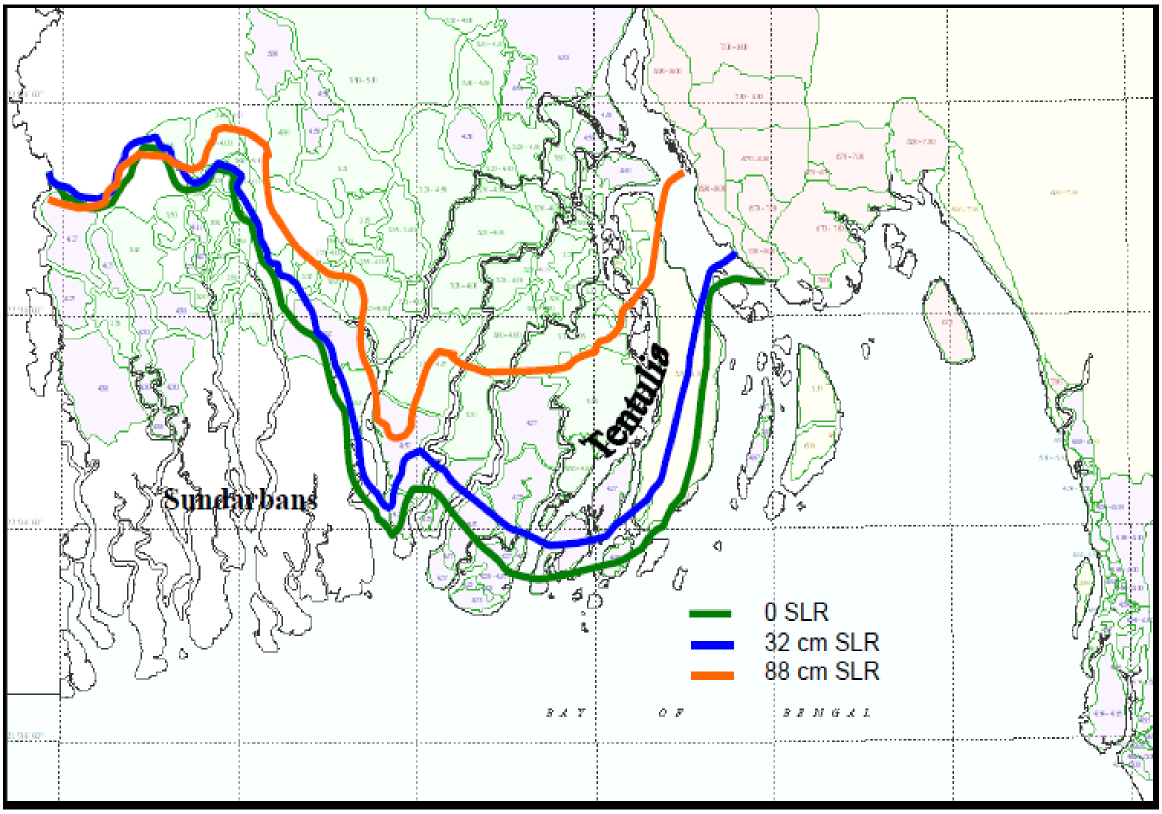
4.3.1 Sea Level Rise and Coastal Inundation

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

4.3.2 Tidal Flooding

102. 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.

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



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

4.3.3 Salinity Intrusion

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

Table 4.1: Major Cyclones Hit the Bangladesh Coast

Major Cyclone year and Dates		Maximum Wind Speed (km/hr)	Storm Surge Height (meter)
30 Oct	1960	211	4.6-6.1
30 May	1961	160	6.1-8.8
28 May	1963	203	4.2-5.2
11 May	1965	160	6.1-7.6
15 Dec	1965	211	4.6-6.1
1 Nov	1966	146	4.6-9.1
23 Oct	1970	163	3.0-4.9
12 Nov	1970	224	6.1-9.1
25 May	1985	154	3.0-4.9

Major Cyclone year and Dates		Maximum Wind Speed (km/hr)	Storm Surge Height (meter)
29 Nov	1988	160	3.0-4.0
29 Apr	1991	225	6.0-7.5
2 May	1994	210	2.0-3.0
25 Nov	1995	140	2.0-3.0
19 May	1997	220	3.1-4.2
15 Nov (Sidr)	2007	240	up to 10
25 May (Aila)	2009	120	3.0

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

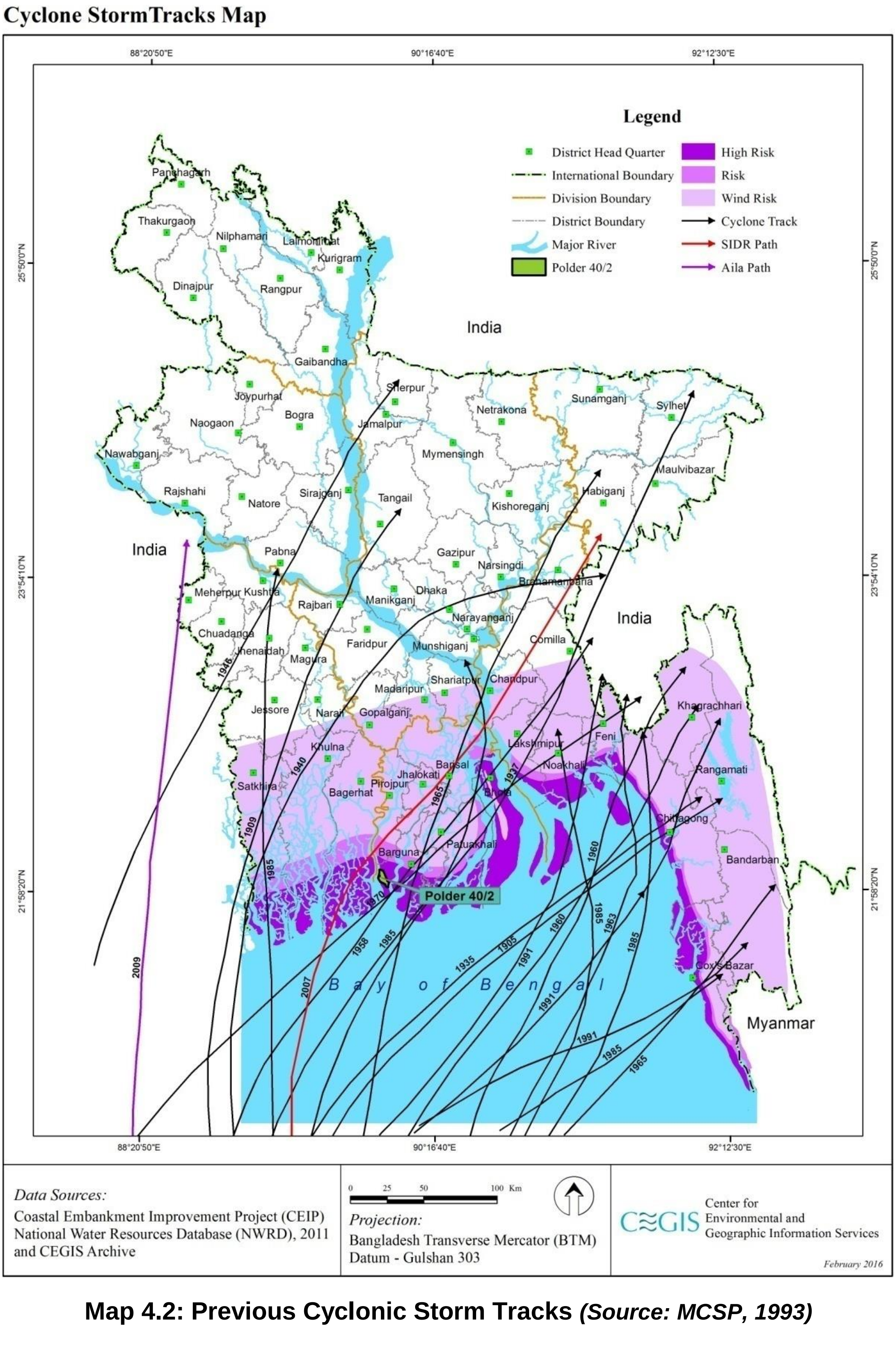
4.3.4 Cyclones and Storm Surges

105. 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).

106. 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.

107. 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 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.

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



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

4.3.5 Rainfall and Temperature, Drainage, and Water logging

109. 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).

110. 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. Project Description

5.1 General

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

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

Coastal Embankment Project

113. 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 of the embankment system bringing immense benefits.

114. 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).

115. 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.

116. 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.

The CEIP Initiative

117. 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 called for systematic restoration and upgrading.

118. 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).

119. 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.

120. Polder 16 is one of the polders to be rehabilitated under the CEIP-1.

5.2 Overview of Polder 16

121. The Polder is located in 3 (three) Upazilas namely Paikgacha and Dumuria under Khulna and Tala under Satkhira Districts. The Polder covers the Union Parishads (U/P) namely Kapilmuni, Gadaipur, Haridhali, Khalilnagar, Maguraghona. The Polder is bounded by the Kobadak River to the South-West, the Sibsa River to the South and the Salta and Haria River to the East. Khulna-Paikgacha highway is located at the western boundary and is acting as arm of the Polder. The Polder was conceived in the early 1960s and its construction was completed in 1968. Cyclone is the main threat to cause damage of lives and properties of the polder area. However, this Polder is mildly threatened by cyclones. The most serious problem of the polder is caused by improper drainage which may be further deteriorated due to lack of proper maintenance.

The entire length of embankment of the Polder is 45.00 km with Side Slopes C/S 1: 2 and R/S 1:3.

5.3 Objective of the Project

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

5.4 Water Management Problems and Issues in Polder 16

123. By now, the major portion of the Polder area is in a vulnerable situation. The entire length of the embankment has been severely damaged due to the wave action. At present, the section of the embankment is inadequate comparison with the design section and needs re-sectioning as per recommended crest level considering sea level rise due to climate change scenarios. The condition of the existing structures is also very deplorable. The

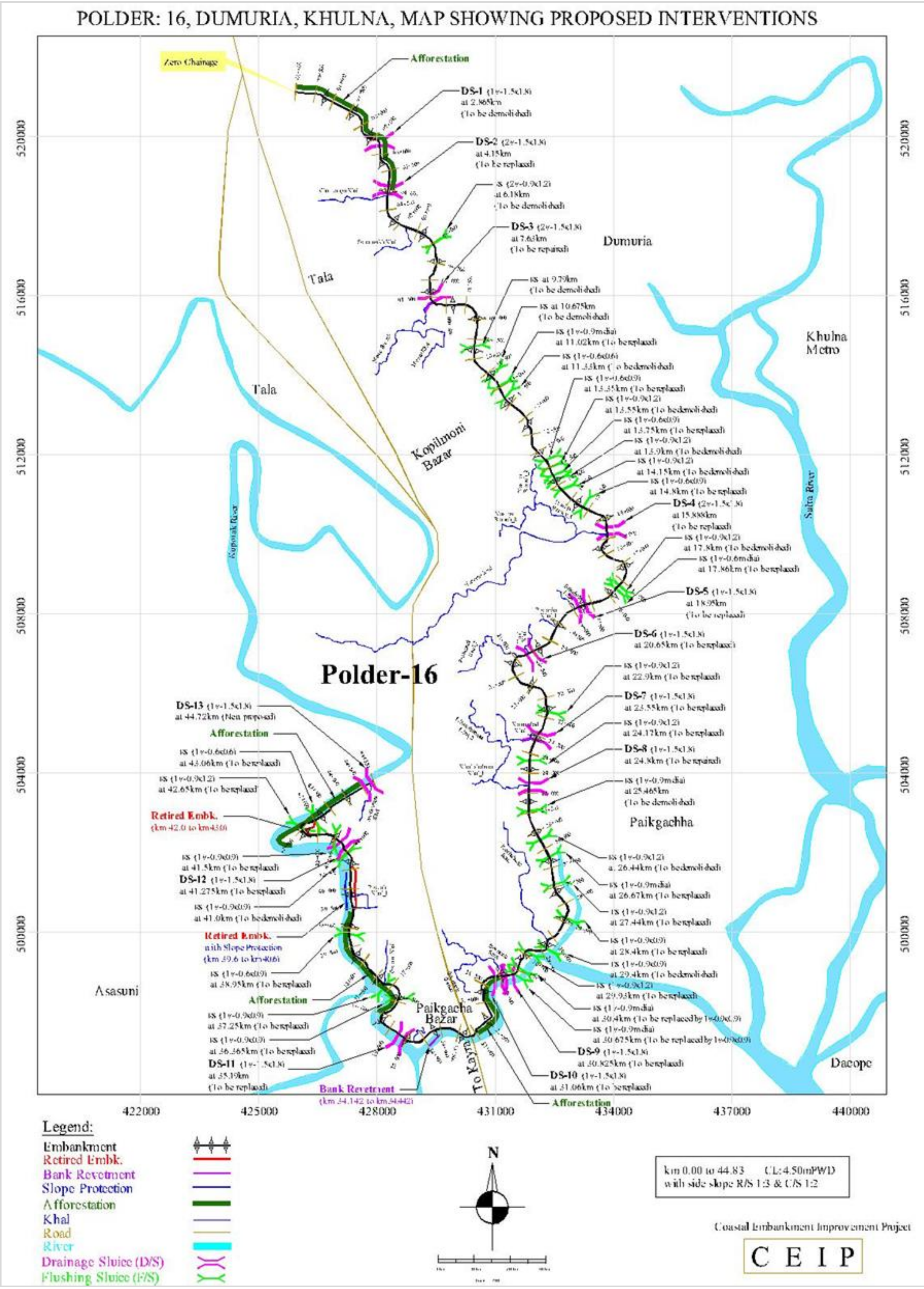
concrete surface of the structures has been deteriorated due to long exposure to saline water. The barrels of some of the structures have been blocked due to siltation and diversion channel have been silted up. Gates have been corroded and loose apron has been damaged. Out of 12 (twelve) sluices, D/S-1 is to be demolished, D/S-3 and D/S-8 are repairable and remaining 9 (nine) needs to be replaced. It appears that one additional sluice (D/S-13) is required at chainage 44+720 for efficient drainage of the polder area. The North-Eastern and North-Western sections of the polder suffers from drainage congestion as the peripheral rivers namely Kobadak and Salta have been silted up. The internal canal system which are connected with the drainage sluices have been silted up and changing the drainage pattern within the polder. These channels are required to be re-excavated to improve the situation. BWDB is presently trying to re-excavate the Kobadak River by dredger.

Photograph 5.1: Existing situation of the Kobadak river and connecting Khal

124. There are shrimp culture ghers inside the Polder occupying about 60% of the total area of land as reported by the local people. Some land owners are using their land for fish culture and others are using it for agriculture demarcating their lands by making compartments. At present the beneficiaries are interested for shrimp culture by allowing saline water to enter inside the Polder. There are numbers of unauthorized pipe inlets constructed by the gher owners for lifting saline water inside the Polder. All these mini-structures (inlets) need to be demolished and replaced by flushing inlets.

Photograph 5.2: Figure showing the unauthorized inlets inside the Polder

An Index Map showing the alignment of the embankment, location of damages and existing structures is given in Map 5.1



Map 5.1: Proposed interventions of Polder 16

125. Currently, about 60% of the Polder area is facing problems of salinity primarily because of ineffective water control structures and silting of water channels. This situation is further compounded by unavailability of suitable ground water at shallow depth from April to May. As a result, irrigated agricultural land area is now limited to only about 499ha (around 20% of net area) out of the total net cultivable area of 2,496 ha. The absence of adequate functioning of local water management organizations has resulted in poor operation and maintenance of the Polder and its water control structures. Based on local opinions clustered during the major field investigation carried out in February 2016, the study team identifies the following key water management problems and issues in Polder 16.

- ✓ High rate of siltation in peripheral rivers which hinders natural overland drainage;
- ✓ Recent cyclones and storm surges, particularly the recent cyclones of 2009 (Aila);
- ✓ Lack of timely repair and maintenance of water control structures and embankments
- ✓ Inadequate budget allocation for O & M and its inefficient use
- ✓ Abuse of existing infrastructure for fishing, shrimp/ prawn farming through unauthorized and inappropriate inlet, pipes which result in weakening of the embankments and malfunctioning of regulators
- ✓ Inadequate plantation in the foreshore and lack of coastal green belt;
- ✓ Absence of functional community organizations for operation and co-management of the polder system.

5.5 Present Status of Water Management Infrastructures

126. Water Management Infrastructures are the physical interventions which ensure sustainable management, optimal use and equitable utilization of water resources. There are some typical water management infrastructures such as peripheral embankments, drainage and flushing sluices, drainage khals, etc. Based on field investigation carried out in February 2016, coupling with the information received from CEIP consultants, the study team gathered the information regarding the status of existing infrastructure in Polder 16.

The details of the existing embankment and other hydraulic structures of the Polder are furnished below:

Table 5.1 Summary Existing Water management Structures

Type	Specification
Total length of embankment	45.00 km
Design Crest Level	4.27 m PWD
Total number of Regulators	12 no.
Flushing Inlets	20 nos.
Total Pipe Inlets	10 nos.
Gross project area	10472 ha
Drainage Khals	21 km
Net Benefitted area	2496 ha

Source: CEIP, 2015

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

127. The length of the peripheral embankment is 45.0 km long. The embankment of the Polder is aligned along the Kobadak, Sibsha, Haria and Salta Rivers as mentioned earlier. At present, most of the segments of the embankment are in dilapidated condition due to the attack of cyclone Aila. The entire embankment was affected during the cyclone Aila, some segments have been breached and some other has been washed out. The Polder was then rehabilitated under CERP but it was not sustainable. The entire embankment needs to be rehabilitated as per new design section determined by CEIP-1.

The entire length embankment of the Polder is below the design level.

Photograph 5.3: Existing condition of the Embankment of the Polder

5.5.1 Hydraulic Structures

128. The concrete surface of the structures (sluices) has deteriorated due to prolonged exposure to saltwater. A number of gates have corroded and the loose aprons have damaged as well. Some of the sluices were found with no gates. Most of the sluices are not in the operational stage. Furthermore, there was mismanagement from local communities in operating the structures. Local people opined that many gates are operated based on the local interest rather than water management interest.

129. There are 12 (twelve) drainage sluices in the Polder among them nine are badly damaged and need to be replaced under CEIP. Two sluices (D/S-3 and D/S-8) are required to be repaired. The rest one (D/S-1) is to be demolished as it became non-functional due to siltation and the bed level of diversion channel is nearly of the same elevation of ground level. One additional sluice (D/S-13;1v-1.5x1.8) is needed as per demand of local people at Ch. 44+200 for efficient drainage within the Polder. There are 20 (twenty) flushing sluices and 10 (ten) pipe inlets constructed in the Polder. Out of which 10 are required to be demolished and 20 have to be replaced.

Photograph 5.4: Partially functioning D/S-12 and D/S-10

Photograph 5.5: Fully damaged D/S-9

Photograph 5.6: Deteriorated condition of F/S-29

Table 5.2 Status of existing hydraulic structures

Sl. No.	Location of Structure with Specifications	Present Condition of the Structures	Recommendation for remedy	Remarks
01.	D/S-1 (1v-1.5x1.8) at km 2.865	The sluice is non-functional. Barrel-box of the structure has been blocked by siltation and the bed level of diversion channel is nearly of same height as that of ground level.	In the present context, the sluice is not required.	To be demolished.
02.	D/S-2 (2v-1.5x1.8) at km 4.15	Concrete face of the wing-wall has been deteriorated. Nose-wall and loose-apron has been damaged. Diversion channel has been silted up.	The structure is proposed to be replaced with provision of flushing and drainage.	To be replaced.
03.	D/S-3(2v-1.5m x1.8m) at km 7.63	Loose apron and nose-wall have been damaged. Expansion-joint has been damaged and reinforcement has been exposed.	Repairing of the sluice is needed.	To be repaired.
04.	D/S-4 (2v-1.5x1.8)	The structures are in deplorable	The structure is	To be

Sl. No.	Location of Structure with Specifications	Present Condition of the Structures	Recommendation for remedy	Remarks
	at km 15.88	condition. Nose-wall has been damaged and reinforcement has been exposed. Loose-apron has also been damaged.	proposed to be replaced with provision of flushing and drainage.	replaced
05.	D/S-5 (2v-0.6m dia.) at km 18.95	It was constructed in the year of 1965-67. Pipe has been damaged and structure has partially been settled.	The structure is proposed to be replaced by RCB sluice (1v-1.5x1.8).	To be replaced
06.	D/S-6 (1v-1.5x1.8) at km 20.65	The surface of wing-wall has deteriorated and some cracks have developed. Diversion channel has silted up.	The structure is proposed to be replaced with provision of flushing and drainage.	To be replaced.
07.	D/s-7 (2v-0.9m dia.) at km 23.55	It was constructed in the year of 1965-67 and pipe has badly damaged. Loose-aprons have damaged and diversion channel has silted up.	The structure is proposed to be replaced by RCB (1v-1.50x1.80) sluice with provision of flushing and drainage.	To be replaced.
08.	D/S-8 (1v-1.5x1.8) at km 24.80	Loose aprons have damaged.	The sluice is proposed to be repaired.	To be repaired.
09.	D/S-9 (1v-1.5x1.8) at km 30.825	The condition of the sluice is very deplorable.	The sluice is proposed to be replaced	To be replaced
10.	D/S-10 (4v-0.9m dia.) at km 31.06	It was constructed in the year of 1965-67 and Flap-gate has been corroded. The sluice is in a very bad condition.	The sluice is proposed to be replaced by RCB (1v-1.50x1.80) sluice with the provision of flushing and drainage.	To be replaced.
11.	D/S-11 (1v-1.5x1.8) at km 35.19	Concrete of the wing wall has been deteriorated and the gates have been corroded. There is no vertical lift gate.	The sluice is required to be replaced with provision of flushing and drainage.	To be replaced
12.	D/S-12 (1v-0.9m dia.) At km 41.275	It was constructed in the year of 1965-67. Loose apron has been damaged and the structure is in deplorable condition.	The structure is proposed to be replaced by RCB (1v-1.50x180) sluice.	To be replaced
13.	Flushing Inlets	There are 30 nos of Flushing Inlets in the Polder out of which 20 nos are Flushing sluice and 10 nos are Pipe Inlets. Most of the Flushing Inlets are in a deplorable condition	Out of 30 nos. Flushing Inlets 10 are proposed to be demolished and 20 are proposed to be replaced.	10 are to be Demolished and 20 are to be replaced

Source: CEIP office, 2015

Table 5.3: Proposed New Drainage Sluice

Sl. No.	Location of Structure with Specifications	Present Condition of the Structures	Recommendation for remedy	Remarks

01.	DS-13 (1v-1.50x1.80) at km 44.720	There is no sluice at this location. Local people are demanding to have a new sluice at km 44.720 for efficient drainage within the Polder area.	An additional drainage-cum-flushing sluice is proposed for efficient drainage.	An additional sluice is proposed at this location.

Source: CEIP, 2015 and Field Survey, 2016


Photograph 5.7: Moderate condition of D/S-8

5.6 Drainage Khals

130. The entire polder area consists of numerous drainage khals; however most of them are in moribund situation due to insufficient water supply from the peripheral rivers. Siltation made the local khals inept for proper drainage. There are 21 km of drainage channel lying inside the Polder and almost the entire length (20 km) is needed to be re-excavated for smooth drainage. Among all drainage khals, the Taltola khal passing through D/S-4 is in good condition with full flow.

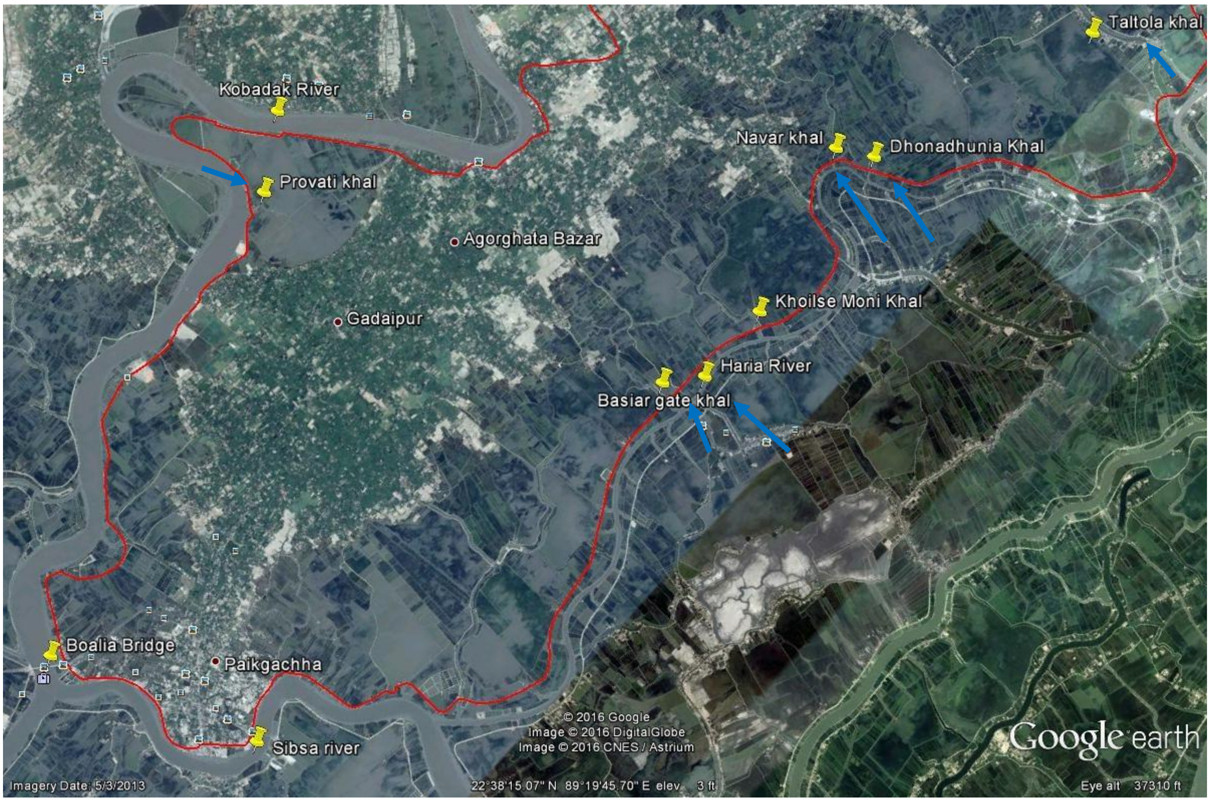


Figure 5.1: Existing drainage Channels of the Polder 16

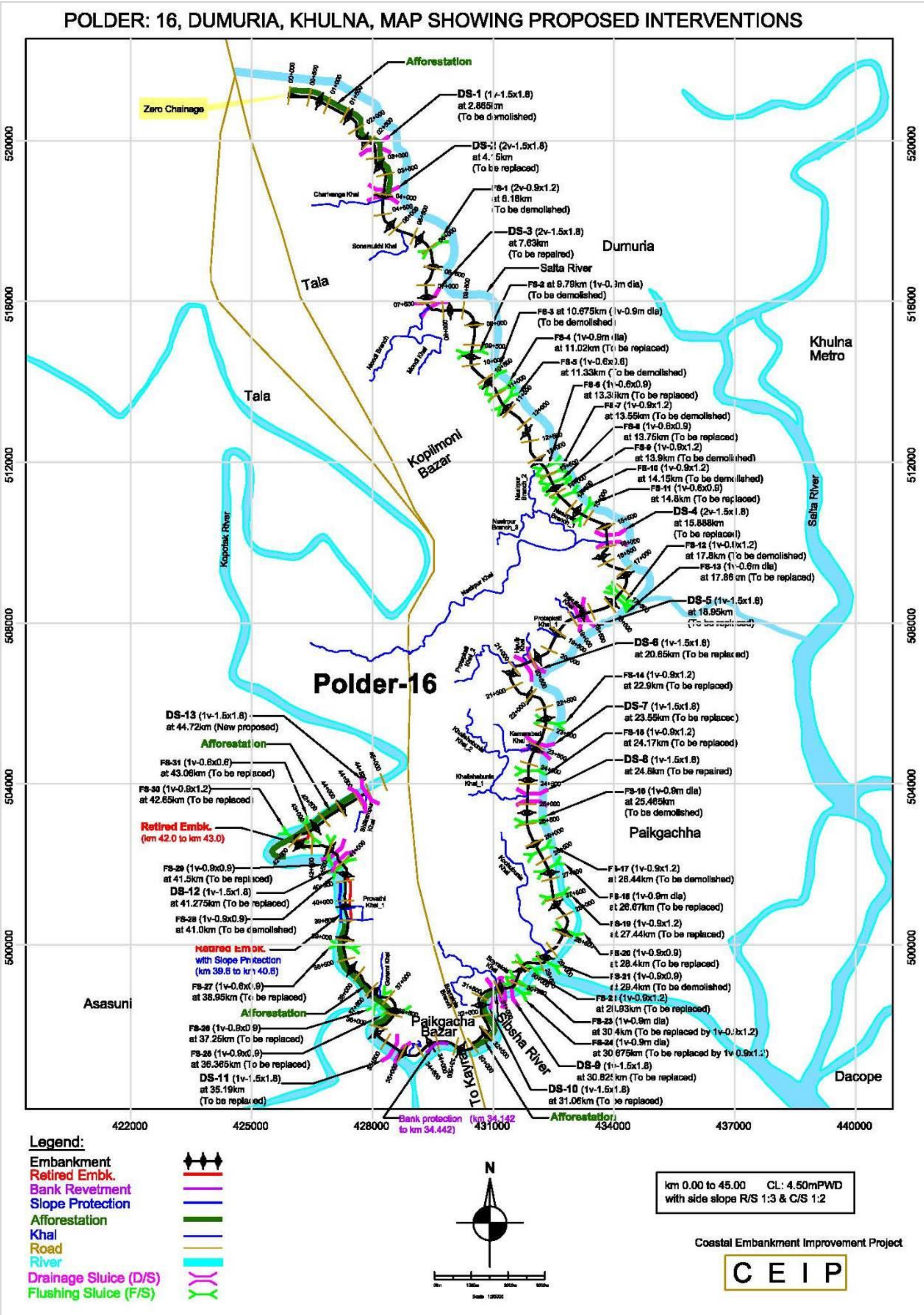
5.7 Proposed Interventions

131. The proposed interventions of Polder 16 (Map 5.2) under CEIP-1 are listed in Table 5.4. The interventions have further been detailed in the following sections.

Table 5.4: Summary of Proposed Interventions in Polder 16

Type	Specification
Re sectioning of embankment	43.00 km
Construction of retired embankment	2.00 km
Design crest level of embankment	4.50 m PWD (Entire)
Side Slope	R/S 1:3 & C/S 1:2
Construction of drainage sluice under CEIP	10 nos.
Repair of Drainage Sluice	2 nos.
Demolishing of drainage sluice	1 no.
Construction of Flushing Inlets	20 nos.
Demolishing of flushing Inlets	10.00
Re excavation of drainage channel	20.00 km
Bank protection works	0.30 km
Slope protection of embankment	1.00 km
Afforestation	24.00 ha

Source: CEIP, 2015



Map 5.2: Proposed interventions of Polder 16

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

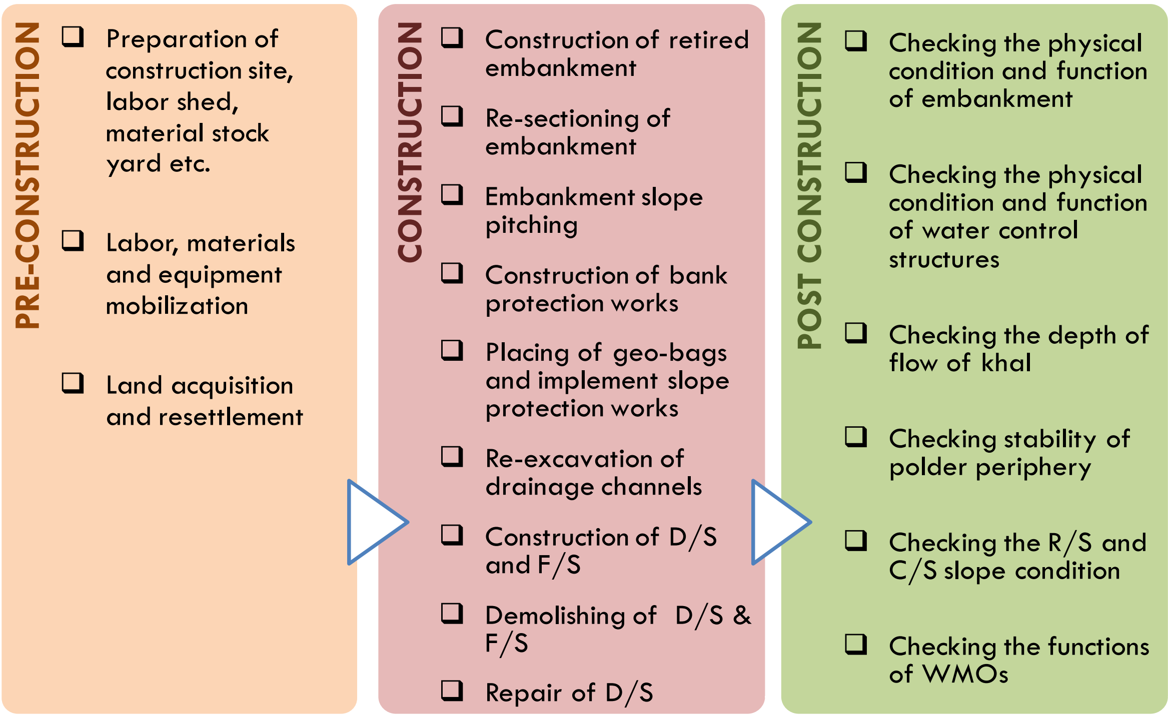


Figure 5.2: List of activities in Polder 16 at different project phases

5.7.1 Re-sectioning of Embankment

133. A total of 43 km length of the embankment will be sectioned under the proposed interventions. The crest level of the embankment will also be raised up-to 4.50 mPWD throughout the length. The crest level of the embankment has been assesd through mathmetical modeling concedering storm surge level and monsoon water level for 25-year return period under climate change scenarios which is shown in Table 5.4b. . The brick-soling road on the crest of the embankment to be upgraded under CEIP program. The side slope of the embankment in River side (R/S) and Country side (C/S) will be 1:3 & 1:2 respectively. However, construction of retired embankment has also been proposed for a length of 2 km in Hetampur village. Moreover, slope protection of the retired embankment is also proposed from Ch. 39+600 to Ch. 40+600 the slope. In addition, a smaller portion (300 m) of the embankment is proposed for slope protection works. **Table 5.5** shows detailed information on the works to be carried out on the embankment.

Table 5.5: Details of Works on Embankments

Sl. No	Chainage	Length (Km)	Proposed Crest Level (mPWD)	Side slopes
Re-sectioning of Embankment				
1	0+000 to 39+600	39.6	4.50	R/S 1:3 & C/S 1:2
2	40+600 to 42+000 and	1.4	4.50	R/S 1:3 & C/S 1:2
3	43+000 to 45+000	2.0	4.50	R/S 1:3 & C/S 1:2
Construction of Retired embankment				
4	39+600 to 40+600	1.0	4.50	R/S 1:3 & C/S 1:2 (Slope protection of embankment)
5	42+000 to 43+000	1.0	4.50	R/S 1:3 & C/S 1:2
Bank protection work				

Sl. No	Chainage	Length (Km)	Proposed Crest Level (mPWD)	Side slopes
6	34+142 to 34+442	0.3	4.50	R/S 1:3 & C/S 1:2

Source: CEIP, 2015

Table 5.4b: Design Parameters for Embankment Crest Level under Climate Change Condition

								Wave Computation								Monsoon Levels				
Point No.	Location	LDL Crest Level (mPWD)	Existing Ave. Crest Level (corrected mPWD)	Modelled Storm Surge level (corrected mPWD)	Standard Deviation (m)	Sidr Simulated surge level (corrected mPWD)	Aila Simulated surge level (corrected mPWD)	Recommended Slope	Free board for Grass or Smooth paved (Roughness coefficient 1.0)	Free board for rough Slope (Roughness coefficient 0.8)	Allowance for Subsidence	Rqd crest Levelw/o roughness + Subsidence & no std	Rqd crest Levelw/o roughness + std + Subsidence	Rqd crest Levelwith roughness + subsidence & no std	Rqd crest Levelwith roughness + Subsidence + std	25 year maximum WL in June-Sept period	Max wind wave height in June Sept period	Free board for Grass or smooth paved(Roughness coefficient 1.0)	Rqd crest Levelw/o roughness with subsidence and freeboard	Crest Level Considering 0.90m freeboard according to Standard Design Manual, Volume 1, standard design

Source: Design Team of DDCS&PMSC, 2019

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

Note 1: At Polder No. 15, Storm Surge is insignificant, Monsoon Water Level governs the fixation of crest level of embankment.

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

Description of construction activities

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

135. Before commencement of construction activities for embankment construction, labor sheds should be constructed with proper sanitation and other required facilities. A suitable site shall be selected and prepared by cleaning bushes, weeds, trees, etc. Alignment of the embankments has to be fixed with adequate base width. Base stripping and removal of trees, weeds, etc., will be done as per the instruction of the Engineer in-charge. The tools required for the construction of embankments will be procured during this period. After validating the final design and preparation of site, earth will be carried and placed on the alignment of embankment. Soil will be dumped in layers. At the same time, each layer (of 1.5

feet) of dumped soil will have to be compacted by a compactor. The slope and shape of specified embankment will be developed after proper compaction in layers. Thereafter, grass will be placed on the slope of the embankment. Water and fertilizer will also be provided for the proper growth of grass.

5.7.2 Retired Embankment

136. The embankment within the reach from chainage 39+600 to chainage 40+600 and from chainage 42+000 to chainage 43+000 have been damaged by wave action of the River Kobadak. These segments of embankments will be retired under CEIP-1.

Photograph 5.8: Retired Embankment at Ch. 43+000 and Ch. 39+600

5.7.3 Construction (Replacing) or Repairing of Drainage Sluices

137. Nine (09) existing drainage sluices (D/S) will be replaced and an additional sluice will be constructed under the proposed rehabilitation works of Polder 16. Furthermore, two (02) other drainage sluices will be repaired. The summary of the proposed works related to the drainage sluices are given in **Table 5.6**

138. 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.

Table 5.6: Details of Works related Drainage Sluices

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

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
12	D/S-11 (1v-1.5x1.8)	35+190	Mandur khal	Kobadak	0.50	-0.47	0.15	-1.416	-1.50	Replacement of structure proposed
13	D/S-12 (1v-1.5 x 1.8)	41+275	DS-12 Khal	Kobadak	-	0.18	0.67	-1.792	-1.50	Replacement of structure proposed
14	D/S-14 (2v-1.5x1.8)	5+180	Sonamukhi khal	Salta	1.50	-0.45	0.20	-1.11	-1.00	Replacement of structure proposed
15	D/S-15 (1v-1.5x1.8)	19+630	Protapkati khal 1	Haria	2.50	-0.46	0.44	0.25	-1.50	Replacement of structure proposed
16	D/S-16 (1v-1.5x1.8)	21+070	Protapkati khal 2	Haria	-	-0.46	0.44	-0.30	-1.50	Replacement of structure proposed
17	D/S-17 (1v-1.5x1.8)	37+000	Gorami khal	Kobadak	1.00	-0.51	0.02	-0.961	-1.50	Replacement of structure proposed
18	D/S-18 (1v-1.5x1.8)	39+700	Provathi khal	Kobadak	0.70	0.05	0.58	-0.501	-1.50	Replacement of structure proposed

Source: CEIP, 2017

Description of construction activities

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

5.7.4 Construction (Replacing) or Repairing of Flushing Sluice

140. There are 20 flushing sluices and 10 (ten) pipe inlets constructed in the polder. Out of these 10 need to be demolished and 20 have to be replaced. A large number of unauthorized inlets structures are constructed along the entire embankment for shrimp culture.

Description of construction activities

141. Before starting the construction activities of flushing sluices, a labor shed will be constructed with proper sanitation and other facilities. The required construction materials (sand, cement, shuttering materials, etc.) will be procured simultaneously. A suitable site for the structure will then be selected and prepared accordingly. Diversion channels will be developed before starting the construction works. After that, the foundation treatment required for flushing sluices will be carried out. RCC works, pipes and machine pipe as well as allied construction and fittings will then be carried out along with construction of collar joints as and where required. After few days of construction, gates will be installed at the upstream end of each flushing sluice. After completion of all construction activities, the embankments will be constructed and turfed with grass. Finally, a channel will be excavated through lead cut and tail cut to divert the flow through the flushing gates.

5.7.5 Bank protection works

142. The segment of the embankment from chainage 33+245 to Ch. 34+442 was subject to river erosion. Out of which, the bank revetment work from Ch.33+245 to Ch. 34+142 have been completed. The bank protection work from Ch.34+142 to Ch. 34+442 is proposed under CEIP.

5.7.6 Slope protection works

143. Damages to the embankment occurred during cyclone and high tide period when depression had formed in the sea. The slope of embankment from Ch. 39+600 to Ch. 40+600 has been damaged due to severe wave action of the River Kobadak which is needed to be retired along with the slope protection works under CEIP. To protect the embankment from wave thrust, slope protection works of the embankment at several segments have been considered under CERP and BWDB. The length of embankment at this

segment is required to be protected by providing slope protection works under CEIP concept.

Photograph 5.9: Proposed slope protection at Ch. 40+600

5.7.7 Re-excavation of drainage khals

144. Ten (10) drainage channels with a total length of 26.88 km will be re-excavated to ease water flow and reduce drainage congestion in the Polder area. An estimated volume of 0.079 million cubic meters of soil/silt will be excavated. The excavated soil will be used for strengthening the khal banks. Local people may be encouraged to take earth from the spoils, as well. The spoil may be used for raising the plinth level of their earthen kutcha houses as well as individual house yards. If the excavated materials are found suitable, the Contractor can use the materials for construction of embankments upon prior approval by the DDCS&PMSC. The water channels to be re-excavated under the project are listed in Table 5.7. Figure 5.3 below shows the conceptual layouts of proposed dumping technique. Compartmental dumping spots will be created along the sides of the excavated khals, allowing any runoff from de-watering of the spoils and from precipitation to drain into the excavated khals.

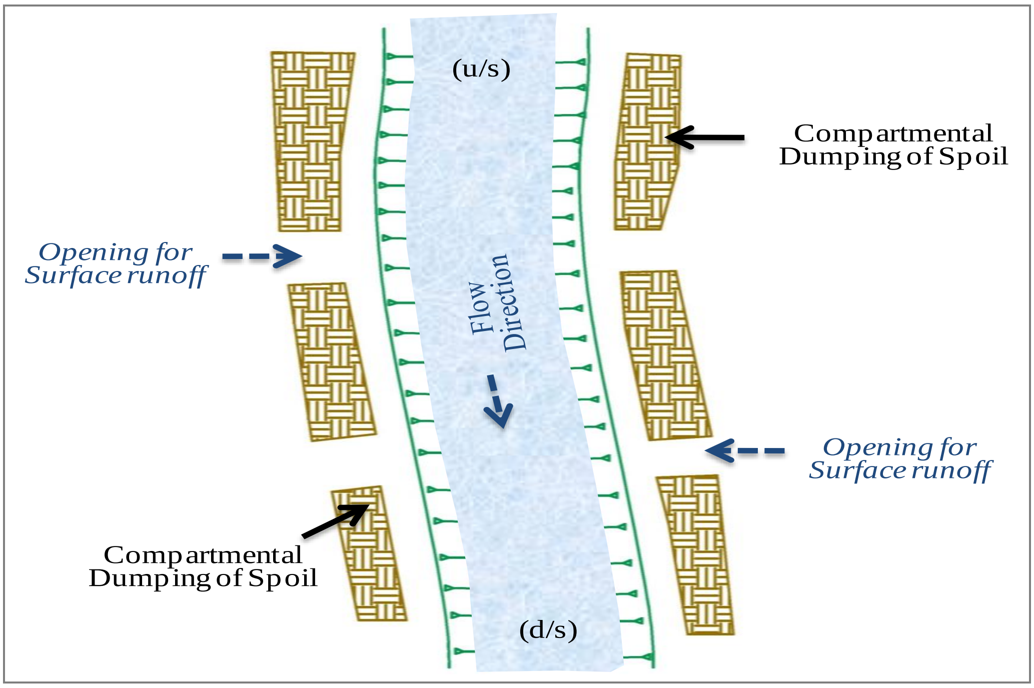


Figure 5.3: Plan form of a typical khal to be re-excavated

Table 5.7: Channels to be Re-excavated

Sl.	Name of Khal (Channel)	Length (km)
1	Bakultala khal	0.70
2	Boyratola khal	2.50
3	Charivanga khal	1.0
4	Haulir khal	0.87
5	Kachubunia khal	4.00
6	Kamarabad khal	1.45
7	Khalisabunia khal-1	1.50
8	Mondir khal	3.86
9	Nasirpur khal	10.00
10	Shirampur khal	1.00

Source: CEIP-1 Design Study Team, 2017s

Description of construction activities

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

5.7.8 Afforestation

146. Afforestation will be implemented within the Polder to ensure the environmental sustainability as well as protection of embankment from erosion and tidal action. A total of 24 ha area will be afforested of this Polder. Construction Details

5.7.9 Construction Schedule

147. The construction works in Polder 16 under the CEIP-1 are expected to be completed in four years. The construction schedule is presented in Table 5.10

Table 5.10: Construction Schedule

(Part A)

Sl.	Description	Year One								Year Two			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Re-sectioning of Embankment (km)												
2	Construction of Drainage Sluices / Flushing Inlets												
3	Re-excavation of Drainage Channels (km)												

Sl.	Description	Year One								Year Two			
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
4	Other works, including surveys, quality checks, testing, inspections etc.												

(Part B)

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

(Part C)

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

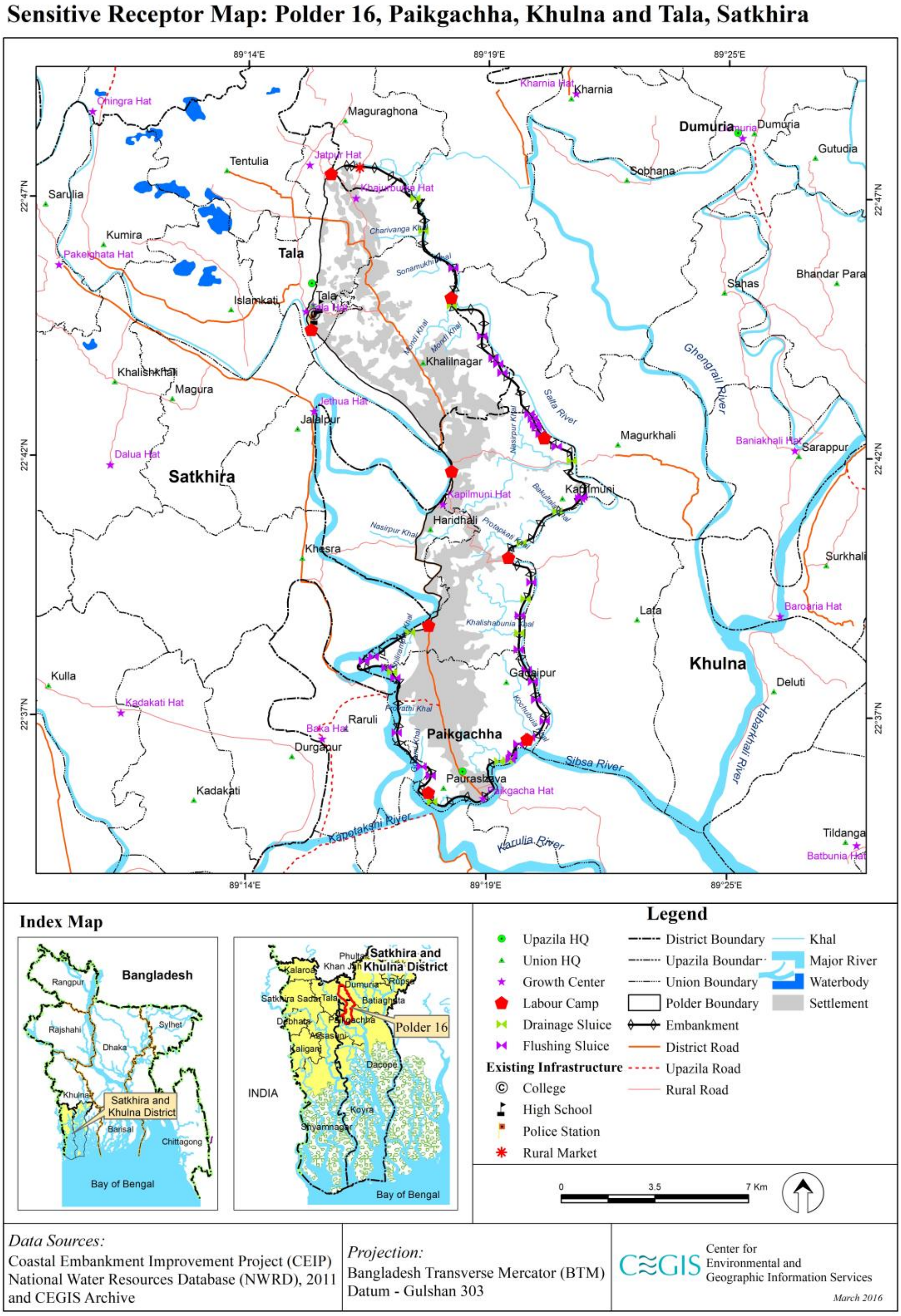
Design Study Finding of CEIP-1, 2015. Construction Manpower Requirement

5.7.10 Construction Manpower Requirement

148. 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[7]. The

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

estimated manpower requirement is presented in Table 5.11. It is mentoined here that labor sheds/camps will be required for house workers (skilled labour). There would be no requirement of labour camp for un-skilled labour because they will be recruited from the local area. But temporary labour camp for local labour during preparing of CC block will be established. The location of labour camp is shown in Figure 5.4.



Map 5.3: Location of labour camp

Table 5.11: Required manpower for construction

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

Source: Main Consultant, 2016

5.7.11 Construction Material

149. The construction materials required for re-sectioning of the embankment and construction/repair of drainage sluices/flushing inlets as well as construction of bank/slope protection works are soil, cement; steel, stone, sand and vertical gates. Estimated quantities of these materials are presented in **Table 5.12**.

Table 5.12: Details of Construction materials

Sl	Description	Quantity	Sources
Re-sectioning of embankment			
1	Earth work	1,961,342.99 m^3	Private lands specially from river side (low excavated land will be filled up by tidal silts within one or two years), spoils from re-excavation of drainage channels
Construction of drainage sluices/flushing inlets			
2	Cement		To be procured from, cement factory (directly)
3	Sand		To be procured from Khulna, Sylhet
4	Stone		To be procured from Khulna, Sylhet or imported from neaighbour countries
5	Steel		To be procured from Khulna,Dhaka steel mill (directly)
Construction of bank / slope protection works			
6	Cement		To be procured from, cement factory (directly)
8	Sand		To be procured from Khulna, Sylhet
9	Stone		To be procured from Khulna, Sylhet or imported from neaighbour countries

Source: Design Study Finding of CEIP-1, 2017

150. For rehabilitation of Polder 16 under CEIP, only 0.3 km slope protection work will be undertaken.CC Block manufacturing plant will not be required. The block will be made manually.

5.7.12 Construction Machinery

151. A number of construction machinery and equipment would be needed for the construction activities in the polder. A tentative list of these machinery and equipment is presented Table 5.13 below:

Table 5.13: List of construction equipment and machinery

Sl	Description	Quantity (number)
1	Bulldozer	4
2	Dump- truck	10

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

Source: Engineering / Procurement Team of CEIP-1

5.8 Project Implementation Arrangements

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

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

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

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

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

157. **An Environment, Soical and Communication Unit (ESCU)** will supervise compliance with the Environmental Management Plan and Social Action Program.This unit, together with the engineering unit will implement the communication strategy. This unit will include a Senior Environmental Specialist, a Senior Social Specialist, a Senior Forestry Specialist, a Revenue Staff and a Communication Specialist. ESCU will supervise programs in all the Packages including Package 3.

158. **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.

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

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

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

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

5.9 Water Management and Operational Plan

5.9.1 Introduction

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

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

5.9.2 Operational Plan

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

(i) Operational Activities

165. 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-1 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)

166. 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

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

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

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

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

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

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

(b) Frequent Watching of Embankments

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

(c) Regular Checking of Structures

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

(d) Survey of Physical Conditions of embankment & structures and Engineering survey

175. 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

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

(ii) Planning of Operation

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

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

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

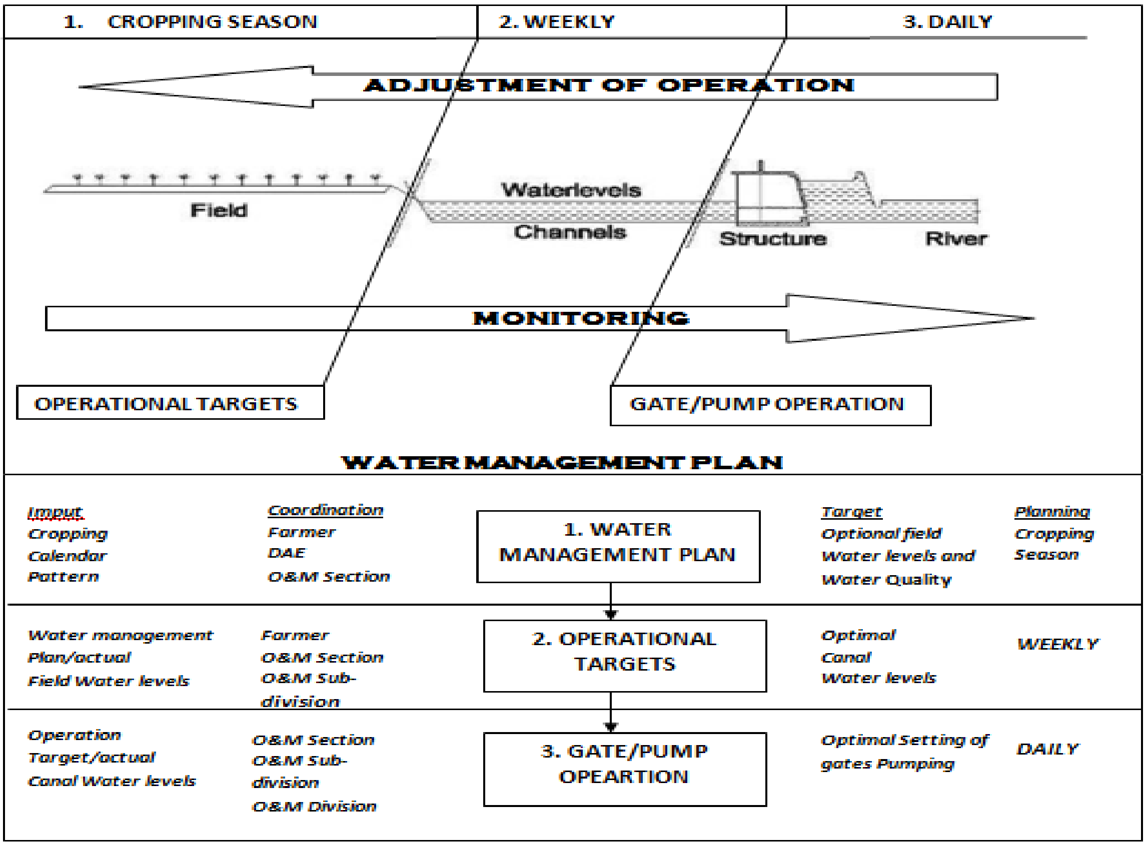


Figure 5.4: Decision making in operation

(a) Seasonal Water Management Plan (WP Plan)

180. In 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 to the user level, i.e., at WMGs (Figure 5.6, 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 exists) and DWM (Directorate of Water Management) 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 or salt production requirements) can be carried out in line with the plan.

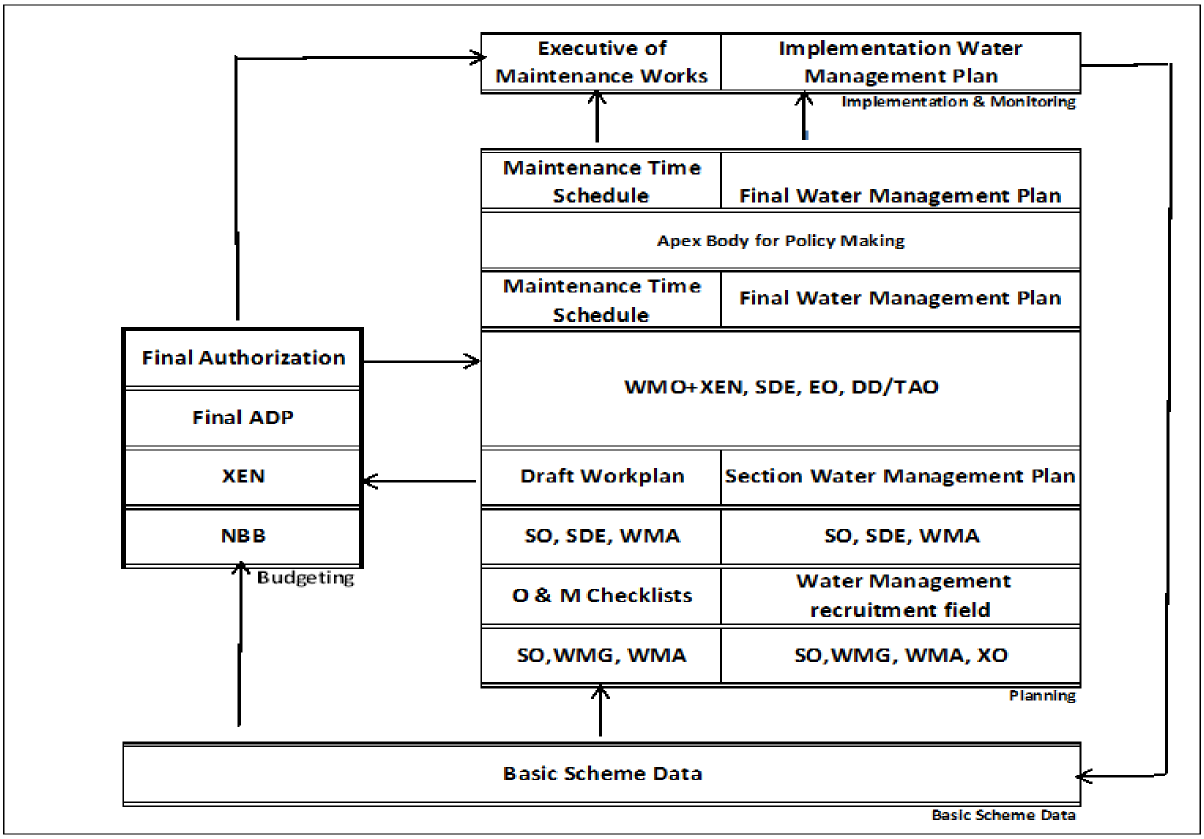


Figure: 5.5: Standard Planning Procedure

Note:
DD Deputy Director
TAO Thana Agriculture Officer
BS Block Supervisor
For other Abbreviations see FIG: Relationship between WMGs and LGIs.

181. Inputs required for the WM plan includes information on cropping calendars and cropping pattern to be formulated by the farmers in consultation with agricultural and fisheries extension services, DWM and BWDB's O&M staffs. Together with information on the system (Basic polder data, O&M guidelines, Design details, etc.) and status of the system (Monitoring data, O&M checklists, Maintenance work plans, and Maintenance time schedules) a detailed water management plan will be drawn up. In large polders, there will be water management model for use as an important tool in the planning process. The models can be used to compute several water management scenarios and the effects of certain measures (e.g. extra regulators, early drainage or flushing, 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.

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

(b) Weekly Operation Targets

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

(c) Day-to-Day operation

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

5.9.3 Maintenance Works

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

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

186. :

i. Preventive or Routine Maintenance;
ii. Periodic Maintenance;
   - Minor Periodic Maintenance
   - Major Periodic Maintenance
iii. Emergency Maintenance;

(i) Preventive or Routine Maintenance

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

- All activities related to vegetative covers on embankment, i.e., new (or re-) planting; enrichment planting; and maintenance of vegetation by EMGs and/or EPGs;
- Small earthworks on the embankment by EMGs;
- Cleaning, greasing, and painting of structures by SMGs;

- Cleaning Khals and Outfall Drains from aquatic weeds and floating debris, and removing of silt in wet condition by CMGs.

188. The preventive maintenance works have been spelled out precisely in Table 5.14:

(ii) Periodic Maintenance

189. Periodic Maintenance intends to bring the components of the hydraulic infrastructure back to its design standard. The works are more expensive than preventive maintenance and are implemented by LCBs, LCSs, and PICs (food for works). Periodic maintenance has the character of repair works and is identified during the field assessment at (more or less) regular intervals.

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

(a) Minor Periodic Maintenance Works:

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

(b) Major Periodic Maintenance Works:

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

The periodic maintenanceworks have been spelled out precisely in Table 5.14.

(iii) Emergency Maintenance

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

(iv) Planning of Maintenance

192. As already stated maintenance activities in BWDB Polders are conceived in three distinct categories, i.e., Preventive Maintenance; Periodic Maintenance; and Emergency Maintenance. Preventive maintenance requires little annual planning because Embankment Maintenance Groups and Canal Maintenance Groups monitors the infrastructures on a continuous basis and undertake maintenance works if necessary. Emergency maintenance cannot be planned as this will be dependent on unexpected conditions and can hardly be foreseen. So, the maintenance planning centers on periodic maintenance. The selection of items to be maintained and repaired, and the ranking of the works, is the recurrent activities in maintenance planning. This selection depends on the project inventory; the O&M checklists filled in by the farmers under the guidance of the Section Officer; and monitoring data produced by BWDB.

193. A clear dichotomy is apparent here; monitoring focuses on the elements of the infrastructure while the O&M checklists help identify the water management bottlenecks and support the system approach. Another important issue in the maintenance planning is the timing of maintenance, i.e., when certain works need to be carried out without hampering water management, and if it does hamper in any area, all these should be reflected in the seasonal water management plan. This concerns mainly the periodic maintenance works. A third planning activity is a part of the implementation phase and concerns the drawing up of physical work plans prior to the start of the works; this is in fact an activity between the contractor and the O&M Offices.

6. Environmental Baseline and Existing Condition

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

6.1 Physical Environment

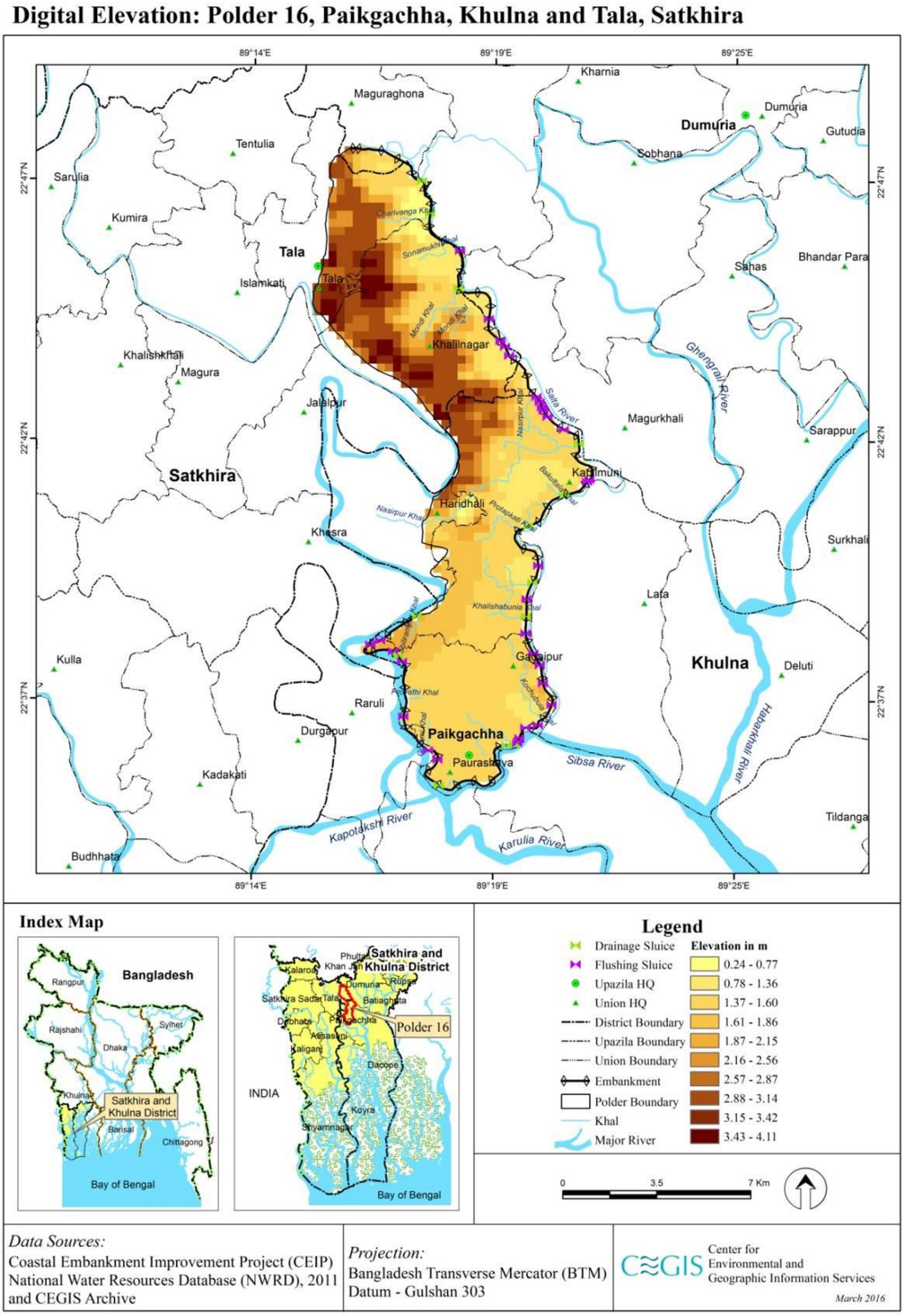
194. Physical environment refers to the physical and chemical features of an area. It includes the climate, water rainfall, wind, land, obtainable nutrients and all other natural resources within the area. The following sections provide analyses on different physical environmental features of Polder 16.

6.1.1 Geology

195. The Polder 16 is situated in a low-lying coastal region. From Spatial analysis, it has been observed that the polder is composed of tidal deltaic deposit. The major portion of this deltaic sediment is deposited in subaqueous form in the permanent body of water where tidal waves and currents aid in the transportation and deposition. Typically low-lying deltaic environment comprises of soft sediments and are densely populated, and these regions are quite dynamic and changes in coastal geomorphology are quite rapid from impact of each cyclone.

6.1.2 Topography

196. The land slope of the study area is a flat landscape and low topography. The elevations are deviated moderately, with a minor downward sloping from north to south. The area is interspersed with intensive network of rivers and khals. Land elevation inside the polder area varies from 0.78 to 3.42 m, PWD. From the Digital Elevation Model it is found that around 68% lands of the areas have elevation between 0.78 to 2.15 m PWD, whereas 32% have elevations between 2.16 to 3.42 m PWD. The Digital Elevation Model of the study area is given in Map 6.1.



Map 6.1: Digital Elevation Model of Polder 16

6.1.3 Seismicity

197. Bangladesh is one of the seismically active regions of the world, experiencing numerous earthquakes in the past 200 years. According to the seismic zoning map of

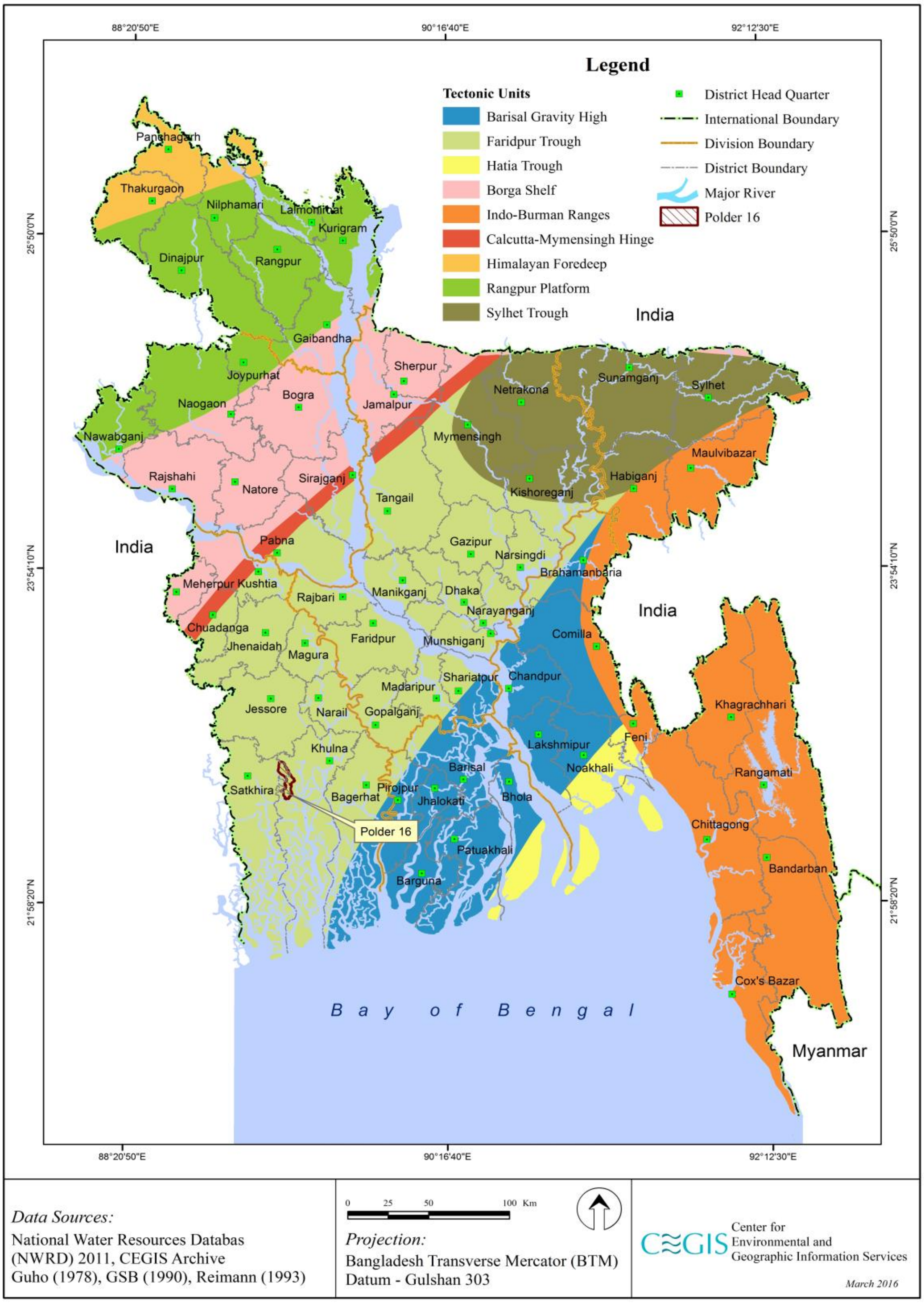
Bangladesh provided by BNBC (Bangladesh National Building Code 1993), the Polder 16 was under Zone III with design Peak Ground Acceleration (PGA) value of 0.04g. In the newer adopted code of BNBC 2010[8] (Map 6.2), it is observed that the Project lies in the low vulnerability area for earthquake in Bangladesh and the Polder area is relatively on safer (seismically quiet) side. Map 6.3 shows the seismic zone map of the study area.

[8]Sarraz A., Ali M. K., Das D. C., 2015; Seismic Vulnerability Assessment of Existing Buildings Stocks at Chandgaon in Chittagong city, Bangladesh, American Journal of Civil Engineering 2015; 3(1): 1-8, retrieved from http://www.sciencepublishinggroup.com/j/ajce

Earthquake Zone Map: Polder 16

Map 6.2: Earthquake Zones of Bangladesh and location of Polder 16

Tectonic Units in Bangladesh



Map 6.3: Tectonic Units of Bangladesh and location of Polder 16

6.1.4 Land Resources

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

(a) Agro-ecological Zones (AEZ)

198. The Polder 16 comprises of two Agro-ecological zones, namely: Ganges Tidal Floodplain and High Ganges River Floodplain, characteristics of which are briefly discussed below (Map 6.4). There are 30 agro-ecological zones and 88 sub zones in Bangladesh as part of Land Resources Appraisal of Bangladesh for agricultural development. The major components of these regions and sub-regions are physiographic (land forms and parent materials), soil properties, soil salinity, depth and duration of seasonal flooding, agro-climatology (length of kharif and rabi growing seasons, length of pre-kharif transition period, number of days below certain winter critical temperatures (<15^0C) and number of days with extremely high summer temperature (>40^0C) which are relevant for land use and for the assessment of present and future agricultural potential (FAO/UNDP,1988, BARC, 2012). In the polder area there are two AEZs.

High Ganges River Floodplain (AEZ-11)

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

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

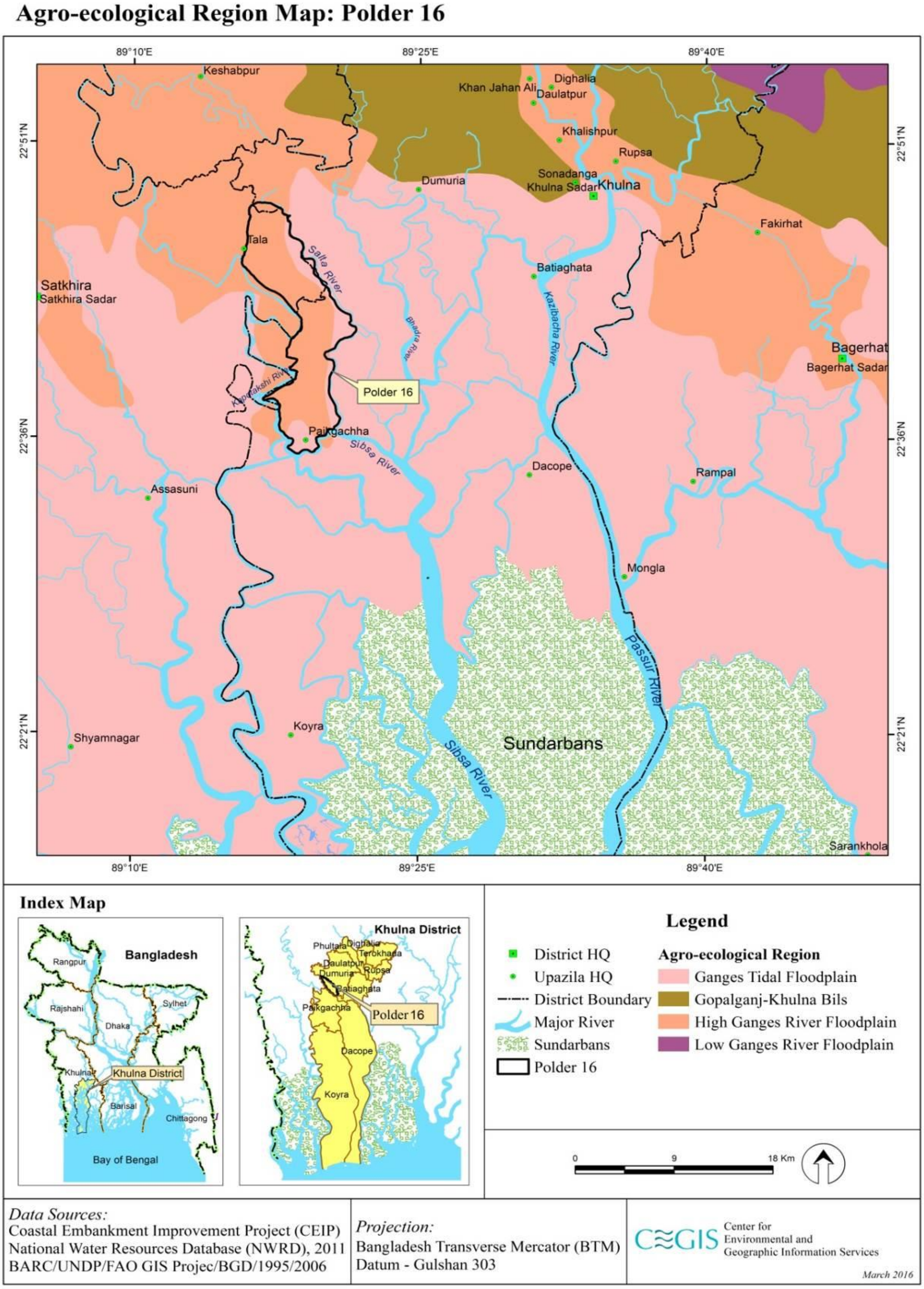
201. In general top soils are slightly acidic to slightly alkaline in reaction, but there is a significant lowering of soil pH in high land in the recent years and in some places top soils become strongly acidic. Sub-soils are slightly alkaline in reaction. General fertility level is low including N,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

Ganges Tidal Floodplain (AEZ-13)

202. This region occupies an extensive area of tidal floodplain land in the south-west of the country. The entire Polder 16 area is covered by this agro-ecological zone (AEZ-13). This region occupies an extensive area of tidal floodplain land in the south-west part of the country. The greater part of this region has smooth relief having large area of salinity. There is general pattern of grey, slightly calcareous, heavy soils on river banks and grey to dark grey, non calcareous, heavy silty clays in the extensive basins. The entire zone is vulnerable to tropical cyclones. The main coastal rivers of Polder 16 are the external Kobadak River, Sibsa River, and Salta River.

203. Non-calcareous Grey Floodplain soil is the major component of General Soil Types. Acid Sulphate soils also occupy a significant part of the area where it is very strongly acidic during dry season. General fertility level is high with low to medium organic matter content and very high CEC and K status. There are limitations of high exchangeable Na and low

Ca/Mg ratio. The Zn status is low to medium while the B and S status are medium to optimum.



Map 6.4 AEZ in Polder 16

(*b) Land Use*

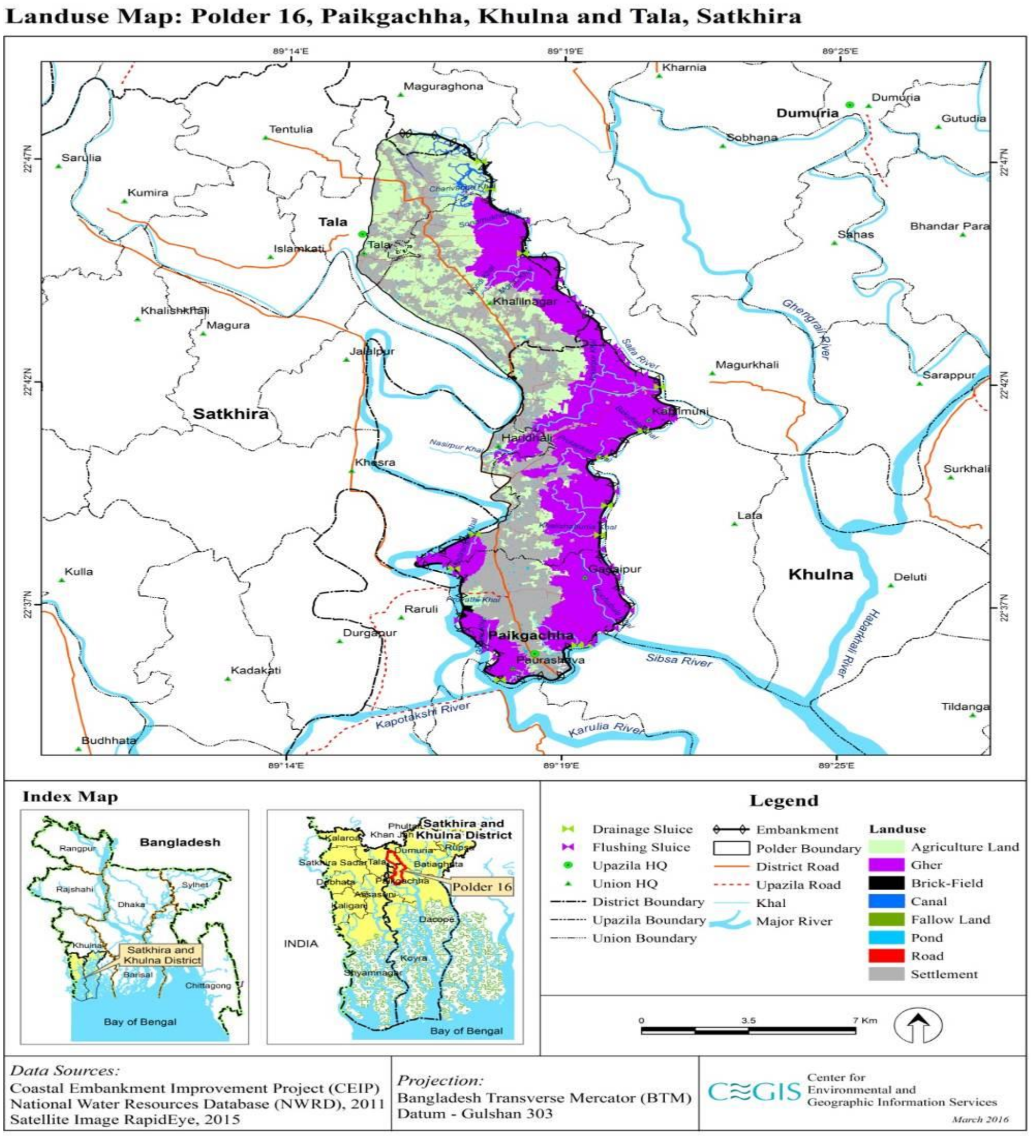
221. The total area of the proposed integrated water management project of Polder-16 is 10,472 ha of which 2,496 ha is Net Cultivable Area (NCA). The remaining 76 % are Canal, Gher [9], Pond, Road and Settlement with Homestead Vegetation. There is no natural/mangrove forest or vegetation or beel (wetland) within the Polder area. Detailed land use is presented in Table 6.1 and Map 6.5.

Table 6.1: Present Land Use of the Polder Area

Land Use	Area (ha)	% of the Gross area
Agriculture Land	2,496	24
Brick-Field	13	0
Canal	92	1
Ditch	13	0
Gher	4,250	41
Pond	133	1
Road	110	1
Settlement with Homestead Vegetation	3,363	32
Grand Total	**10,472**	**100**

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006

[9] Gher farming is a traditional agriculture system in Bangladesh. Generally, farm lands converted into ponds with low dykes and used for cultivation of shrimp/prawn/fish.



Map 6.5: Land use of the polder area

© *Land type*

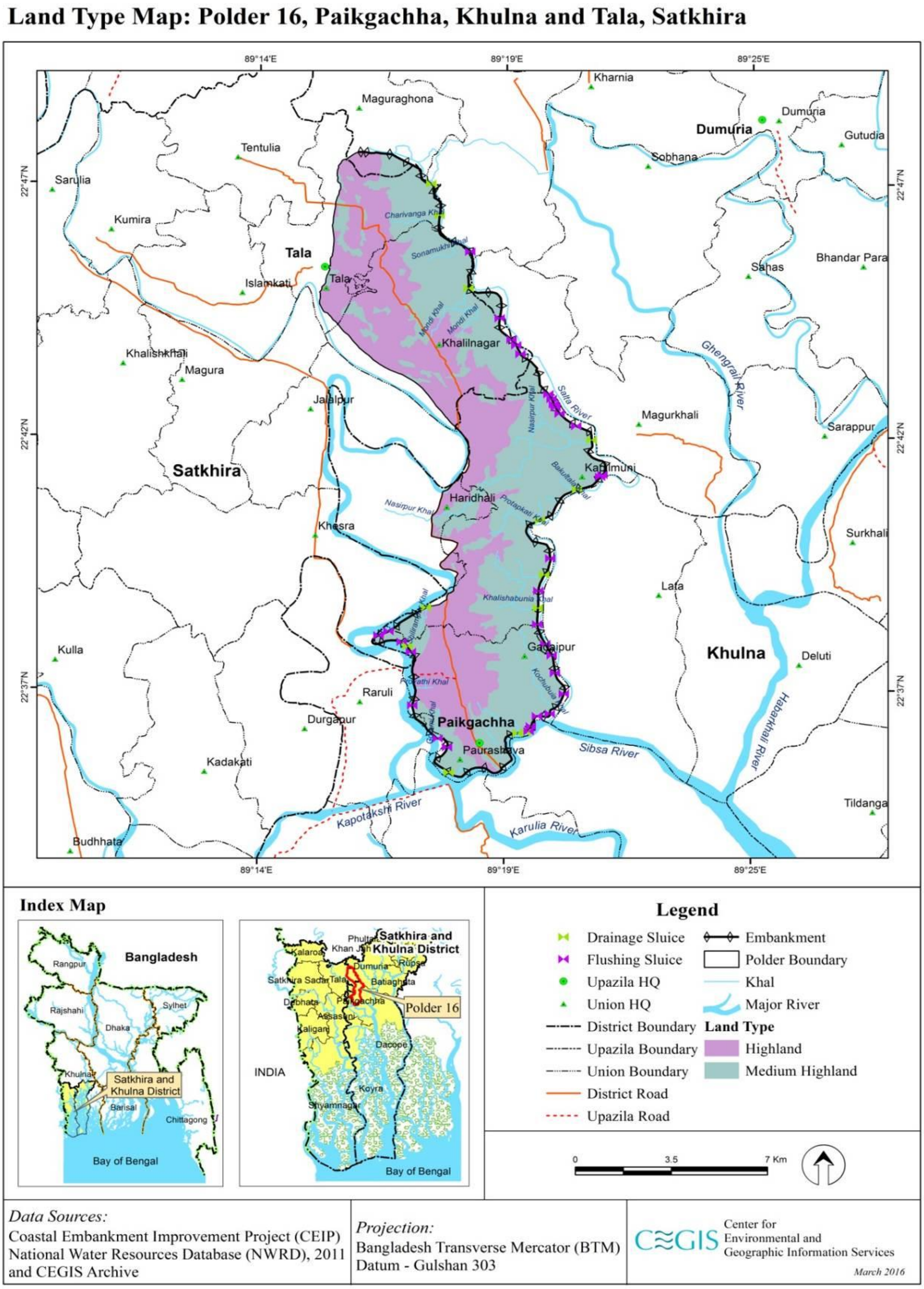
204. Land types are classified based on the depth of inundation during the monsoon season. The land type is very important for utilization of lands for crop production.

205. Around 43% and 57% of the NCA of the polder (Polder 16) fall under high land and medium high land, respectively. Details of the land classification and distribution of land types in Polder 16 are presented in Table 6.2 andMap 6.6.

Table 6.2: Detailed land type of polder area

Land Type	Description	Flooding depth	Flooding characteristics	Polder area	
				Area (Ha)	% of NCA
F_0	High land	Above flood level	Non-flooded to intermittent	1,073	43
F_1	Medium Highland	0-90cm	Seasonal	1,423	57
Total				**2,496**	**100**

Sources: CEGIS estimation from SOLARIS-SRDI, 2006



Map 6.6: Land Type of the Polder area

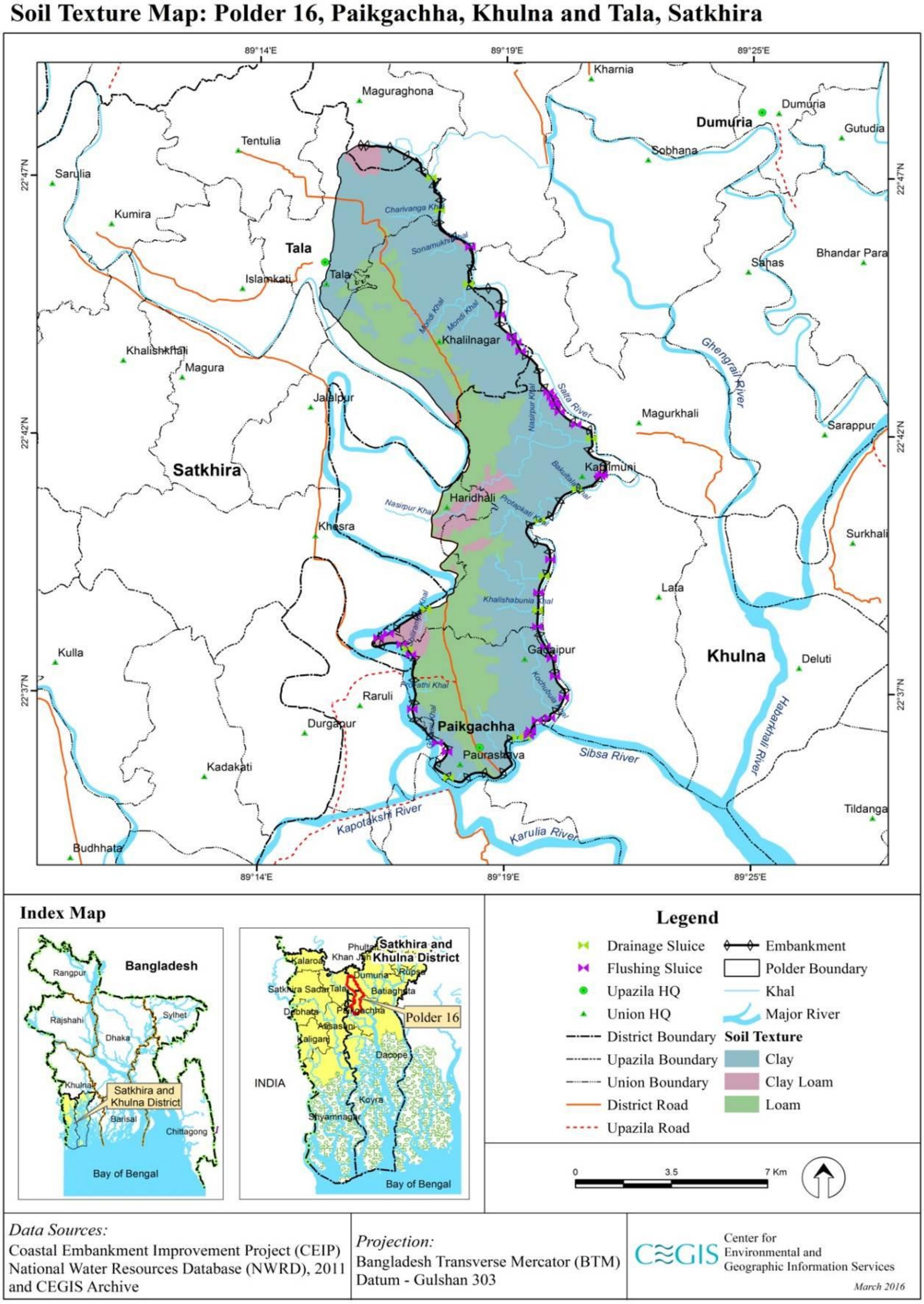
(c) Soil Texture

Soil texture relates to the relative proportions of sand, silt and clay (Map 6.7).. 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 loam, see Table 6.3.

Table 6.3: Present land use of the polder area

Soil Texture	Area (ha)	% of NCA
Clay	1,573	63
Clay Loam	152	6
Loam	771	31
Grand Total	**2,496**	**100**

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006



Map 6.7: Soil Texture of the Polder area

(d) Drainage Characteristics

206. For the agricultural crop production drainage characteristics play an important role. The drainage characteristics have been divided into six classes from the agriculture point of view, e.g., Excessively Drained, Well Drained, Moderately Well Drained, Imperfectly Drained, Poorly Drained and Very Poorly Drained (SRDI; 1988). In Polder 16, the agricultural land area supports three drainage characteristics (Table 6.4), Map 6.8.

Table 6.4: Detailed drainage characteristics of soil in the Polder area

Drainage	Characteristics	Area(ha)	% of Area
Imperfectly Drained	Water is drained from soil badly or slowly. This soil often remains wet in rainy season due to rainfall. In normal situation, water does not stand on land for more than 15 days at a stretch. In rainy season, groundwater stands within 1 meter at least for some time.	1,025	41
Moderately Well Drained	Water is drained from soil slowly. So, soil remains wet for a certain time. In this case, slowly permeable layer or groundwater remains within 1-2 meter of depth in rainy season.	259	10
Poorly Drained	The soil remains under water from 15 days to 7/8 months. Water is drained from the soil slowly. In most cases, the land remains wet/ water logged for a considerable period of time after the rainy season.	1,212	49
	Total:	**2,496**	**100**

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006

(e) Available Soil Moisture

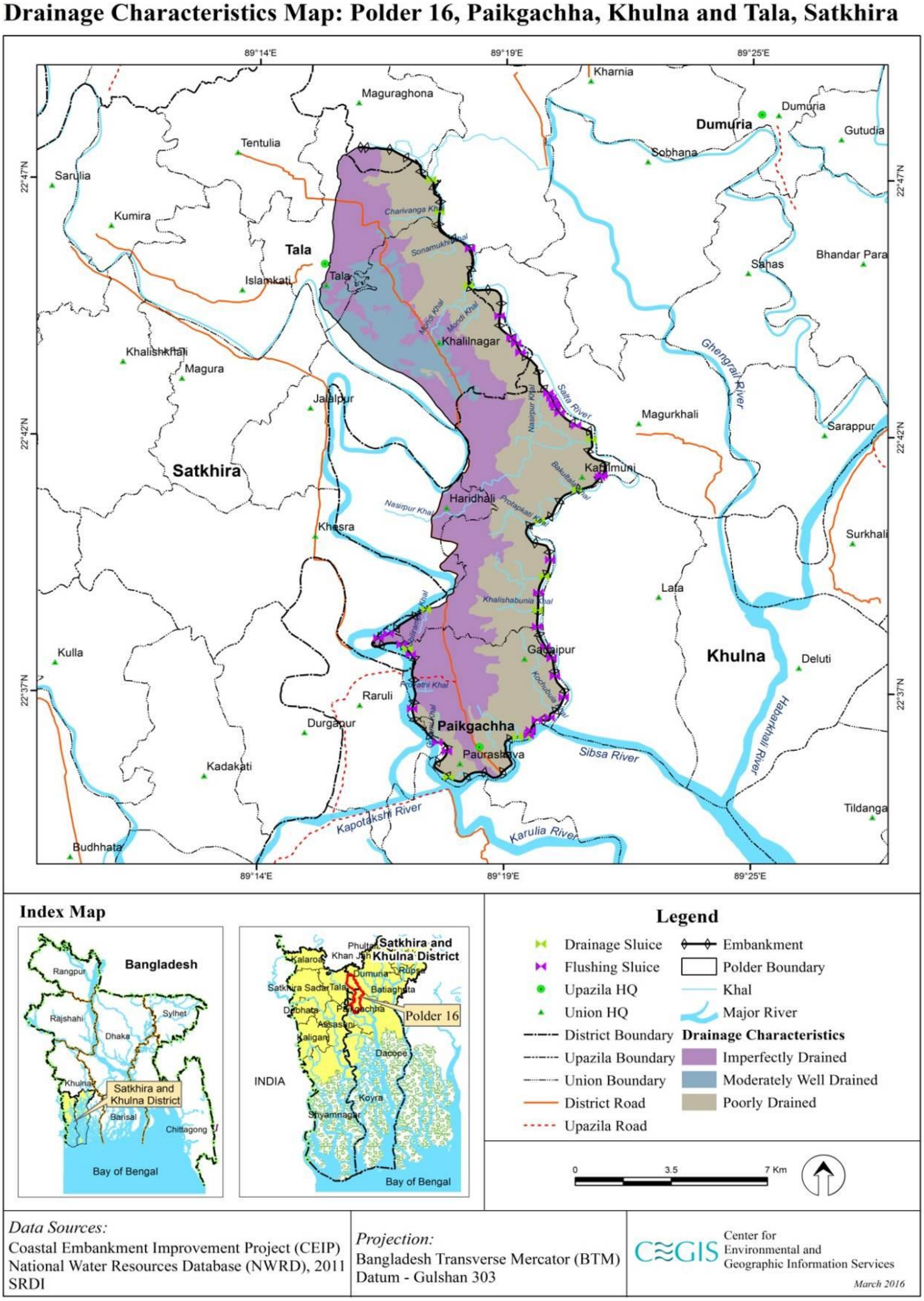
207. Soil moisture varies depending on the soil characteristics. Growth of plants and crop production depends on availability of soil moisture from which plants uptake essential nutrients and water.

208. In Polder 16 the soil moisture is generally low and partial area is high (CEGIS Assessment based on SOLARIS–SRDI; 2006). Details of the soil moisture are presented in Table 6.5 and Map 6.9.

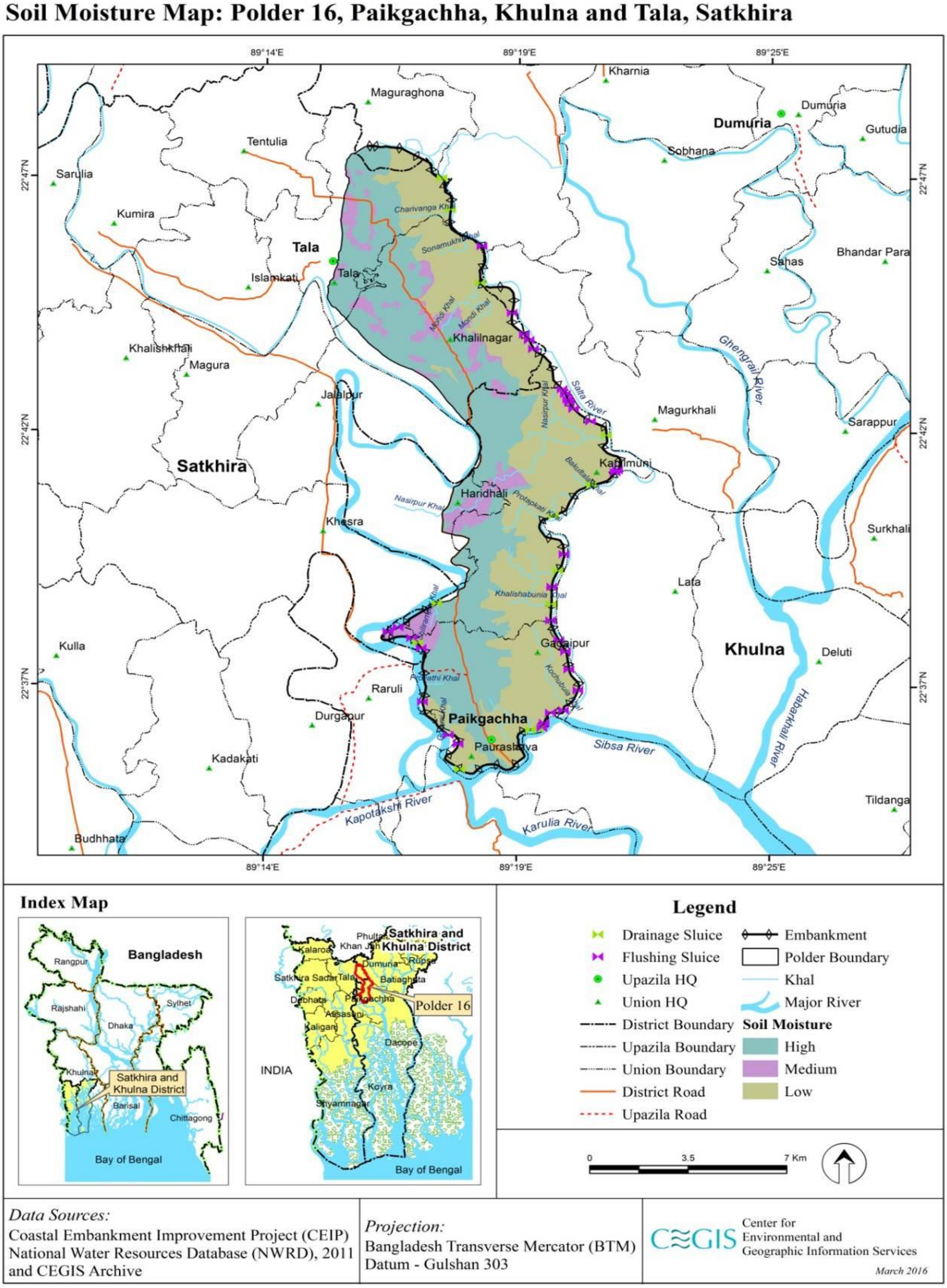
Table 6.5: Detailed distribution of available soil moisture in the Polder 16 Area

Classification of soil based on available soil moisture	Characteristics	Area (ha)	% of NCA
High	Plant extractable soil moisture remained in the field level for two to three months.	1,067	43
Medium	Plant extractable soil moisture remained in the field level for one to two months.	220	9
Low	Plant extractable soil moisture remained in the field level less than one month.	1,209	48
Total		**2,496**	**100**

Sources: CEGIS Assessment based on SOLARIS –SRDI; 2006



Map 6.8: Drainage Characteristics of the Polder area



Map 6.9: Soil Moisture of the polder area

(f)Soil Quality

209. Soil samples were collected from the Polder area at Shibbari, Paikgachha; Charivanga, Tala and Gopalpur, Godaipur under Khulna and Satkhira District from depth 0-15 cm inside the Polder area on 5th February, 2016. Collected soil samples were analyzed

by Soil Resource Development Institute (SRDI), Dhaka. Results of the analysis are presented in the Table 6.6.

Table 6.6: Chemical properties of soil in the 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			
Paschimpara, Shibbari, Paikgahcha	N 22° 13' 59.29" E 89° 18' 09.4"	Fallow-HYV.Aman- Fallow	0-15	13.76	7.8	1.52	0.08	0.73	10.20	490.10	0.43	0
Chariavanga, Tala	N 22° 46' 43.8" E 89° 17' 55.7"	Fallow-Fallow-HYV Boro	0-15	11.20	4.2	1.72	0.10	0.54	3.20	129.90	3.68	0
Gopalpur, Godaipur	N 22° 36' 41.7" E 89° 18' 23.4"	S. Vegetables-HYV Aman-W. Vegetables	0-15	1.92	7.6	3.06	0.17	0.84	92.28	64.58	5.92	0

Sources: SRDI and BARI Laboratory analysis; 2016

6.1.5 Soil Salinity

210. CEGIS estimaties from SRDI, SRMAF Project, Ministry of Agriculture, 2009, reveals that over the period's soil salinity of the area inside the polder increased gradually. Local farmers reported that most of the water control structures are not functioning properly. As a result, they cannot prevent intrusion of saline water inside the polder. Some Farmers and SAAOs of DAE reported that the soil and water salinity gradually increases with dryness from January and reaches maximum level during the months of March-April and then decreases due to onset of monsoon rainfall. Detailed soil salinity of 2009 is presented in Table 6.7.

Table 6.7: Detailed soil salinity in the Polder area

Soil Salinity Class	EC (dS/m)	Area (ha)	% of NCA
Non-saline with some very slightly saline (S1)	2.0 - 4.0	1,557	62
Very slightly saline with some slightly saline (S2)	4.1 - 8.0	87	3
Slightly saline with some moderately saline (S3)	8.1 - 12.0	144	6
Moderately saline with some strongly saline (S4)	12.1 - 16.0	0	0
Strongly saline with some very strongly saline (S5)	> 16.0	708	28
Total		**2,496**	**100**

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

211. Climate Ambient mean temperature of Polder 16 is about 18^0C-19^0C in winter and 28^0C-29^0C in summer and the annual average rainfall is around 2000 mm. Monsoon occurs from June to September and during this period very heavy rainfall.

Tropical cyclones and storms do occur during summer in the month from April to June and then from September till December. These cyclones and storms are not frequent

Rainfall

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

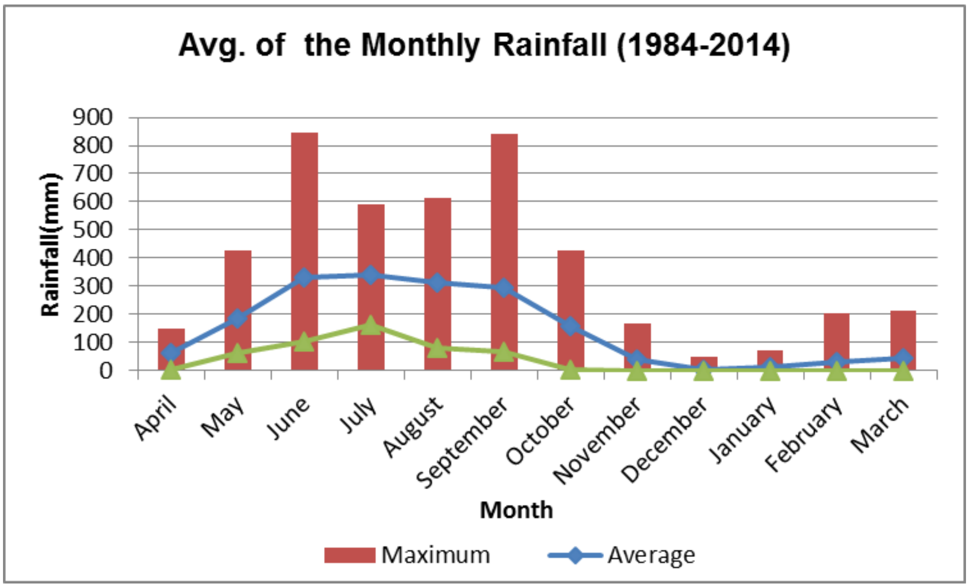


Figure 6.1: Monthly rainfall of Khulna BMD station (1984-2014)

Temperature

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

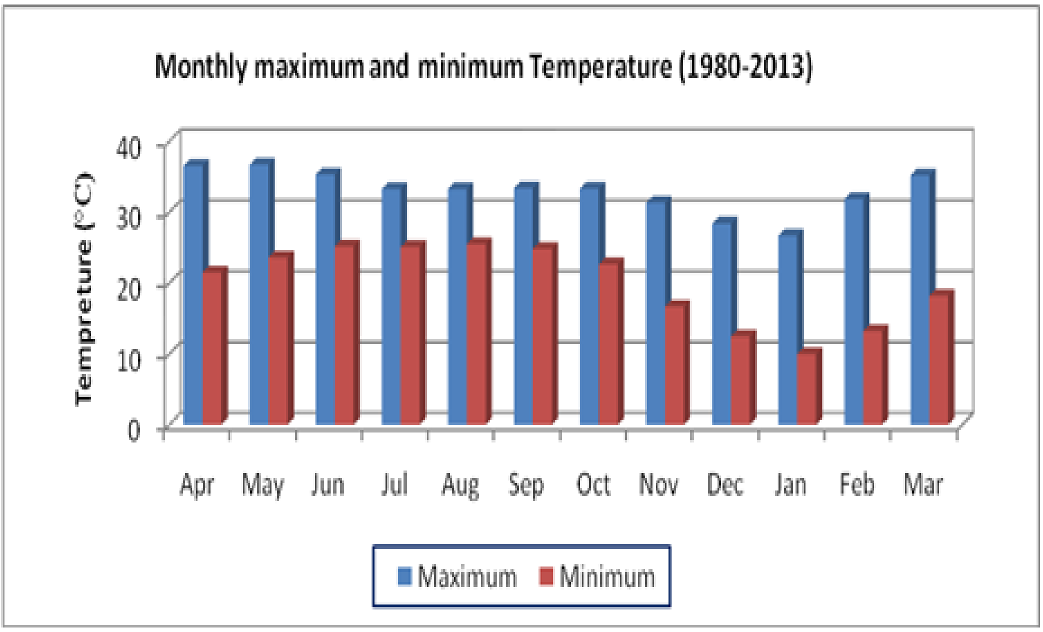


Figure 6.2: Monthly average temperature of Khulna BMD station

Sunshine

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

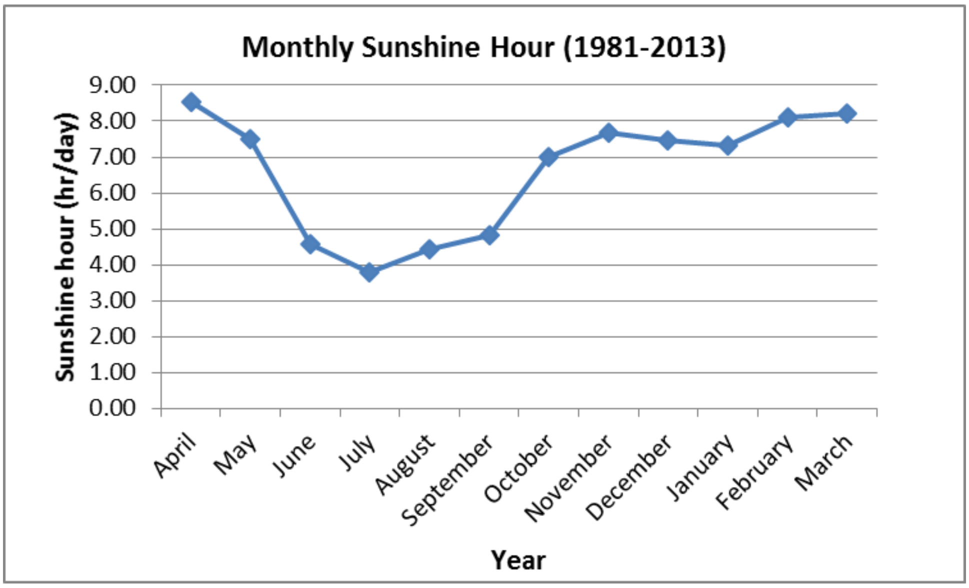


Figure 6.3: Monthly average sunshine hours per day at Khulna BMD station

Evaporation

215. Evaporation is a transformation of water from liquid state to vapour state where temperature plays a crucial role. Moreover, it is an important component of the hydrological cycle, which influences the overall water balance on the earth surface. In Figure 6.4 monthly average evaporation rate of 25 years (Khulna BMD station) is plotted. Maximum evaporation 3.92 mm/day is recorded in the month of April whereas the lowest evaporation is observed in

January (1.78 mm/day). Due to less temperature less amount of evaporation is observed in winter season.

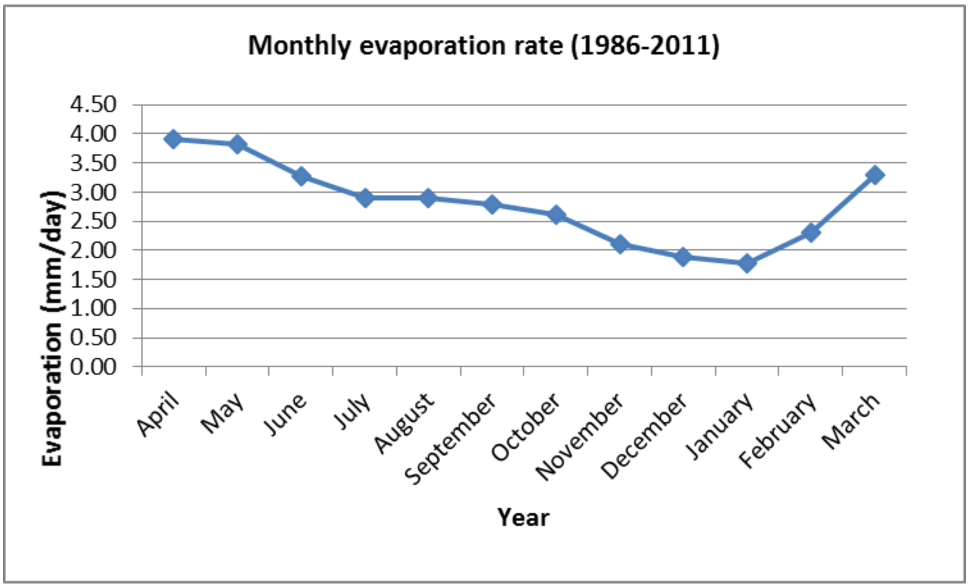


Figure 6.4: Monthly average evaporation rate at Khulna BMD station

Wind Speed

216. In Figure 6.5 thirty years (1983-2013) monthly average wind speed of Khulna BMD station is plotted, where gradual decreases of wind speed from April to November is observed. The highest and the lowest average wind speeds are recorded in the month of April (6.9 kmph) and November (1.67 kmph) respectively.

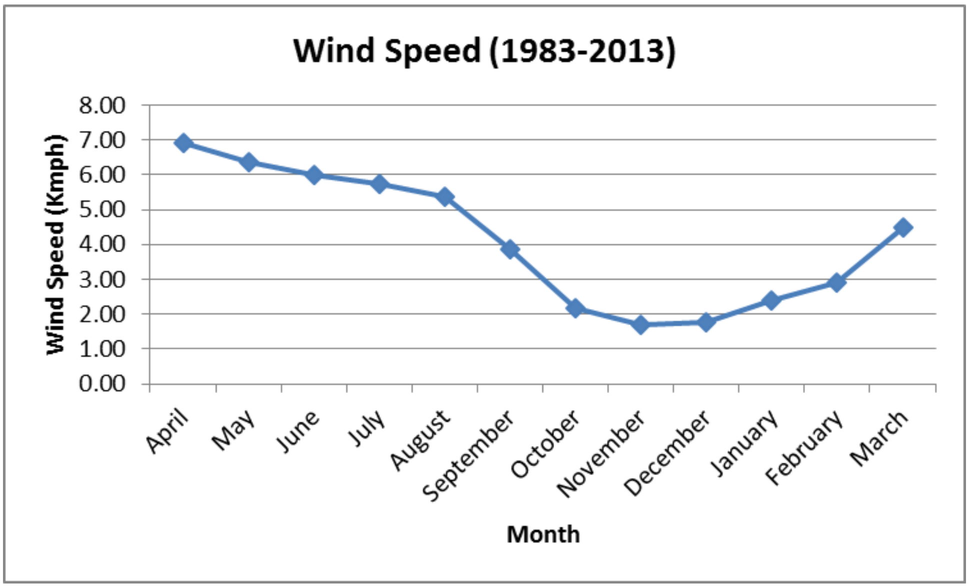


Figure 6.5: Monthly wind speed of Khulna BMD station

6.1.6 Water Resources System

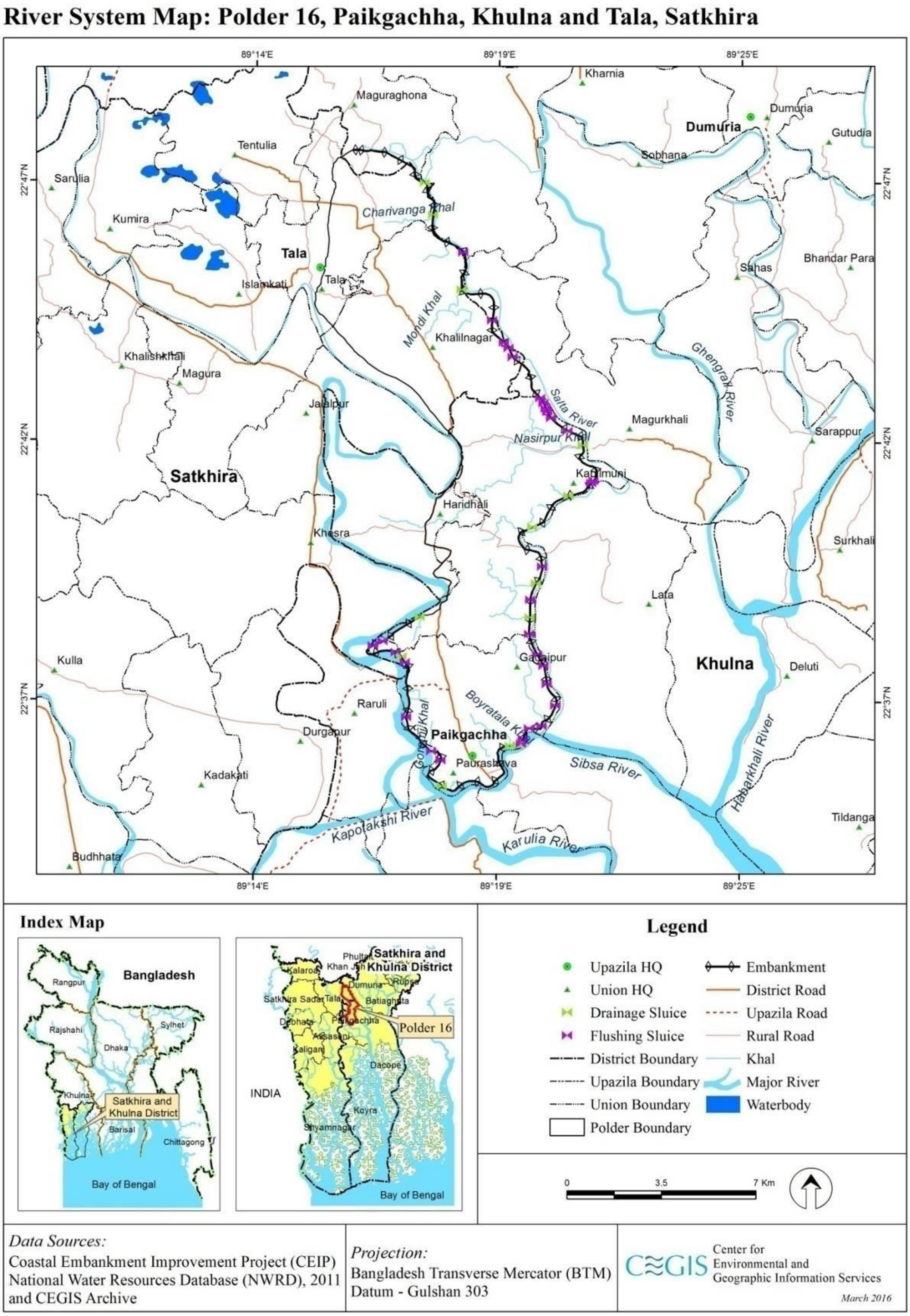
217. The water resource system is the source of water supply and plays an indispensable role in assimilating and diluting waste, attenuating and regulating flood, drainage, recharging into the aquifer, and maintaining the environment for aquatic habitats.

6.1.7 Major Rivers and Khals

218. The polder is bounded by the Kobadak River to the South-West, the Sibsa to the South and the Haria and Salta Rivers to the East direction (Map 6.10). The Upstream of Kobadak River originate (offtake) from Bhoirab River (Jessore). Tidal influence is in the Kobadak River as well as the connected local khals. The offtake of Sibsa River is the Kobadak River and outfall is Passur River. Sibsa River is divided as Haria and Salta in the upstream. Salta River is connected with main Salta River which is around 4 km away. All the perennial rivers of Polder 16 have tidal effect.

Photograph 6.1: Kobadak river

Photograph 6.2: Sibsa River



Map 6.10: River system in the Polder area

6.1.8 Hydrological Settings

219. By now, only Kobadak and Sibsa River are flowing moderately in some locations surrounding Polder 16. The upstream of Sibsa is divided as Haria and Salta Rivers. Haria River is flowing along the Thakurabad village (D/S-7) where Khoilse Moni khal is connected and passes through the D/S. However, the lower portion of Haria River has limited flow but the upper portion is almost dead and untraceable as observed during field visit (February, 2016) due to siltation and increased bed level. In this area the drainage khals, i.e., Khoilse Moni, Navar khal, Dhonadhunia khal are not in proper operation condition because of excessive siltation and unauthorized control of the local people. The Salta River is flowing beside D/S -5 (chainage 18+000) as a branch of main Salta river which is almost 4 km away. Salta River is also in moribund condition, i.e., no flow was found in most of the plocations during the field visit. However, during the monsoon period the river becomes connected with local khals but that is not sufficient due to reduced flows in the perennial rivers. In the Eastern portion of Polder area only Taltola khal was found in full flowing condition that passes through D/S-4 which is connected to Salta River. Moreover, Boira khal (D/S-4) was found in moderate condition. The upstream of the remaining Salta River was totally untraceable. Moreover, the drainage khals at D/S-3 to D/S-1 were in very poor conditions.

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

Photograph 6.3: Boira khal (D/S-9)

Photograph 6.4: Taltola Khal (D/S-4)

Photograph 6.5: Deteriorated drainage khal in D/S-2 and D/S-1

6.1.9 Hydrological Settings

Surface Water Levels

221. The surface water levels of BWDB station at Chandkhali (Kobadak River) from 1980 to 2001 has been analyzed (Figures 6.6). This station lies on the periphery of the Polder. Water levels during high tide range from 1.9 to 2.54 mPWD. On the other hand, the low tidal water levels range from -0.97m PWD to -1.34m PWD. Hence, the surface water level goes below PWD level. The surface water level of Sibsa River is also displayed in Figure 6.7.

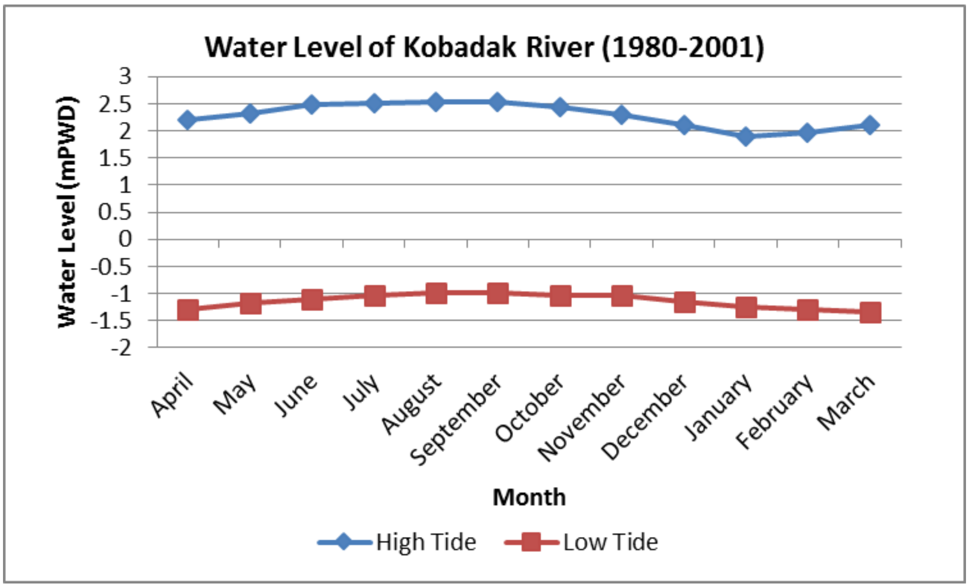


Figure 6.6: Monthly Surface water level of Kobadak River

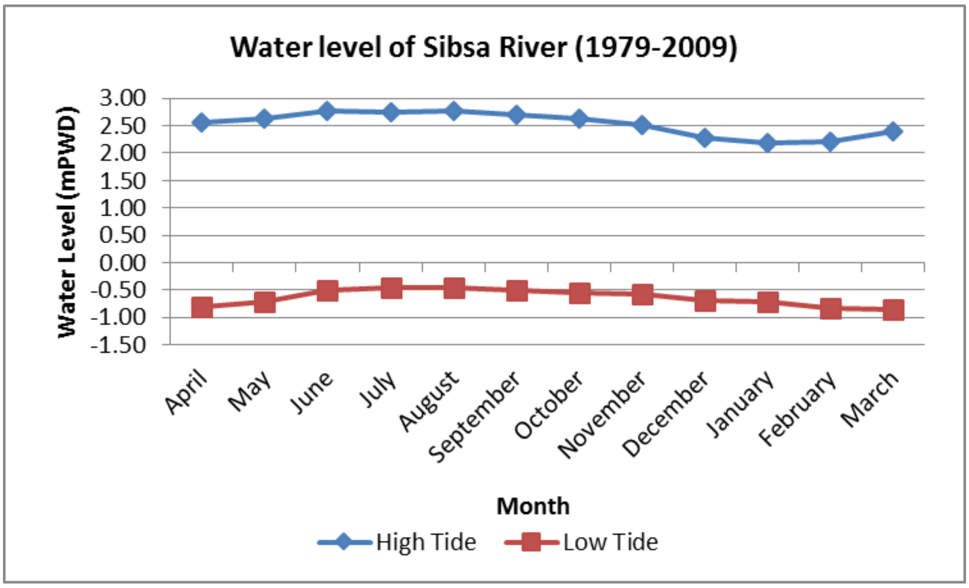


Figure 6.7 : Monthly Surface water level of Sibsa River

Ground Water Table

222. Monthly variations in ground water table for the years 1990 - 2013 have been plotted in Figure 6.8 for the ground water observation well KHU007 (at Paikgacha). The variation patterns for the GWT values are fairly high, the lowest (2.404m) and highest (1.43m) values are found in March and September respectively.

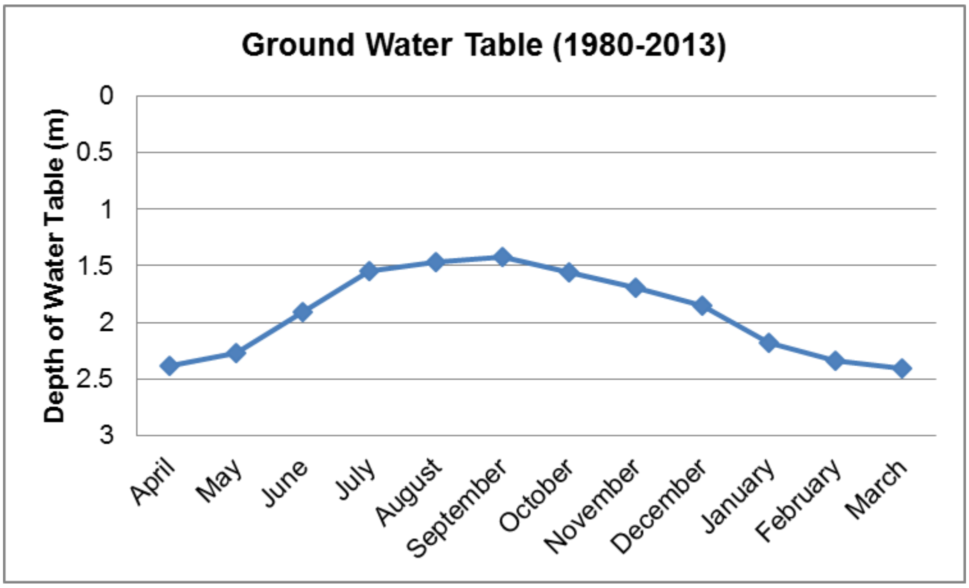


Figure 6.8: Monthly Variation of Average Ground water table

6.1.10 Water Resources Issues and functions

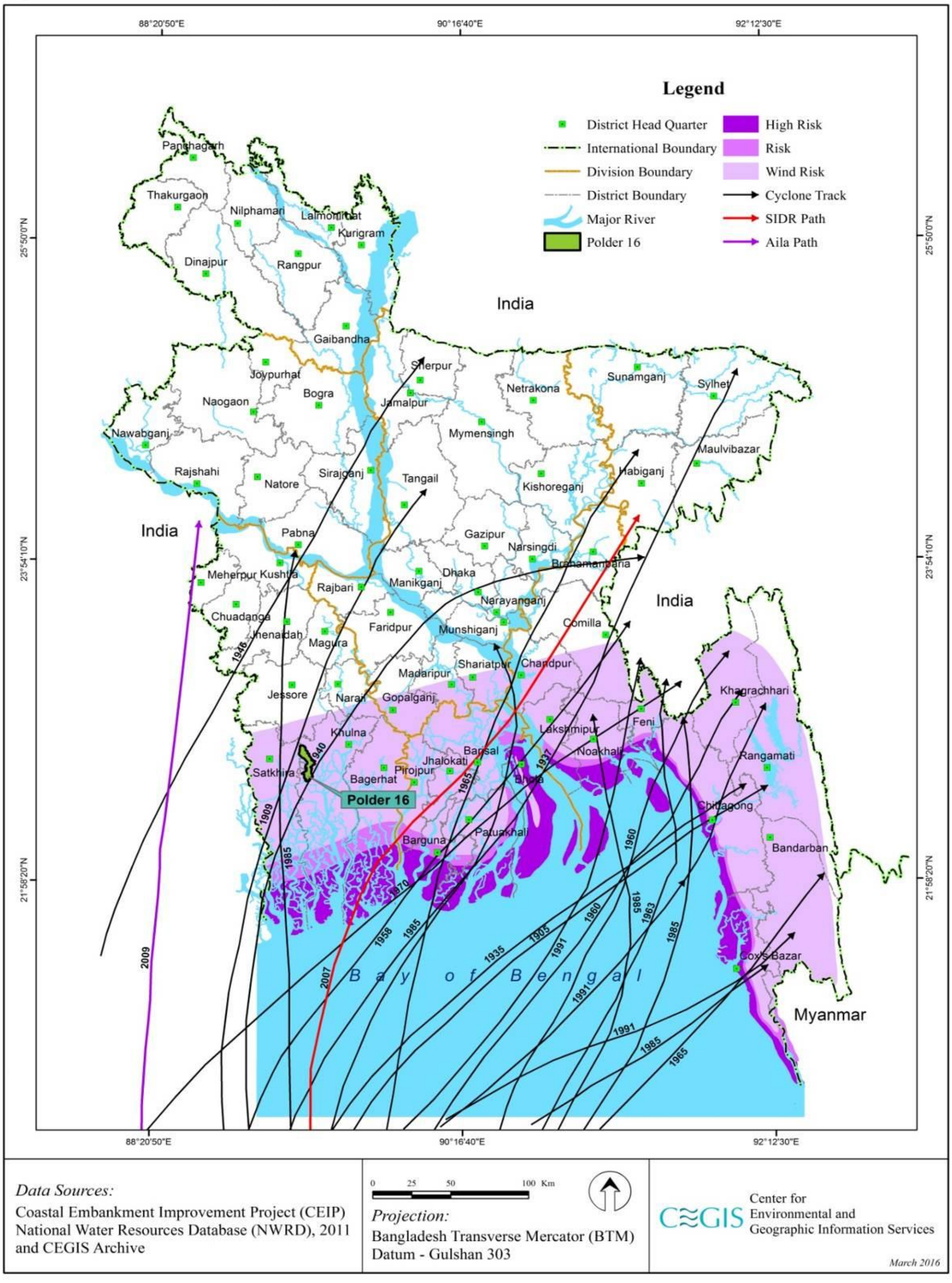
Tidal and Storm Surge Flooding

223. The devastating cyclone “Aila” struck the south-western coastal region of Bangladesh and eastern coast of the neighboring West Bengal province of India at midday on 25 May 2009. Satkhira and Khulna (Paikgacha, Dumuria, etc.) were the worst hit districts, besides nine other districts were also badly affected. The main damage has been caused by flood water breaching the already weakened embankments throughout the affected districts. Communities of Polder 16 have reported that activities associated with shrimp farming, such as the frequent practice of opening the embankments to allow entry of saline water into shrimp ponds, has made the half-century-old earthen embankments weak, causing them to breach during the tidal surge inflicted by the cyclone. Silting up of the river beds, along with rapid coastal subsidence, have also contributed to higher tidal surges and increased strain on the embankments.

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

225. In recent decades people have experienced frequent disasters like “Aila”. There have also been unusual phenomena in the weather patterns. Data from the meteorological department reveals that the frequency of cyclones, hitting the Bangladesh coast has increased consistently since the 1990s, whilst the wind speeds vary between extremes of high and low intensity. The Intergovernmental Panel on Climate Change has said that this phenomenon could be due to the heating up of the sea surface in the Bay of Bengal (FPP E-Newsletter August 2009).

Cyclone StormTracks Map



Map 6.11: Cyclone Storm Track area of Bangladesh

Drainage Congestion

226. Drainage congestion is the vital problem of this polder area and the inhabitants expressed their sufferings during the field visit. Both the Kobadak and Sibsa River have tidal influence that inundates the khals. Over the years, siltation makes the existing drainage khals incapable for drainage of excess rainwater in monsoon period. In most of the cases bed level of the drainage khals, i.e., Shilirampur khal, Provati khal, Boira khal, Khoilse moni khal, Navar khal, etc., is higher than the perennial rivers. However, the perennial rivers, i.e., Kobadak, Sibsa are not in full action in fact their flowing capacity has lessened due to siltation. The gates of most of the drainage sluices are damaged and some are not properly working which has exacerbated the situation. Some villages are suffering from severe water logging problem during monsoon period like Chinimola (beside D/S 5), Machiara, Naba and Silimanpur. According to local people, around 25-30% area of the polder are facing drainage problem during monsoon.

Navigation

227. Polder 16 is surrounded by several rivers however, only Kobadak and some portions of Sibsa River are navigable at the south-western part of the Polder. Due to the construction of Farakka Barrage (India) and water logging in Bhobodaho khal in Jessore water flow in D/S during dry season has reduced drastically. As a result the perennial rivers of the polder are losing their navigability due to reduced flow from upstream and proplonged siltation.

6.1.11 Environmental Quality and Pollution

a. Air Quality

228. The national standards for air quality are given in **Table 6.8.**

Table 6.8: Standards of ambient air quality

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

Source: Bangladesh National Ambient Air Quality Standard

229. The air particulates matter (APM) concentrations of the Polder area were measured by collecting PM samples on Teflon filters using Air Metrics portable sampler and subsequent gravimetric analysis using microbalance. The concentration of black carbon (BC) in the fine fraction ($PM_{2.5}$) of the samples was determined by reflectance measurement using an EEL-type Smoke Stain Reflectometer. The NO_2 and SO_2 concentrations were determined using GENT sampler. The air sampling has been carried out for 1 day (24 hr) in the Polder at Kapilmuni bazar in Paikgacha upazila. The results are presented in **Table 6.9**. The values suggest that the concentrations of the measured air quality parameters ($PM_{2.5}$, PM_{10}, 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 6.8**. However, there are numerous vehicles driven by diesel engines and numbers of motorcycles and other vehicles movement in the polder area which are considered to contribute to the ambient air especially Particulate Matter ($PM_{2.5}$).

Table 6.9: Values of ambient air quality parameters in the project area

Area	Air particulates matter concentration µg/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

b. Water Quality

230. Water quality parameters (TDS, DO, Temperature, pH, and salinity) have been measured from different locations of the Polder area during the major field investigation in February, 2016. Surface water quality of the Polder area is found satisfactory related to DoE standard. **Table 6.10** presents the values of the surface water quality parameters with reference to the DoE standard of the Polder area.

Table 6.10: Water Quality parameters in different water bodies of polder 16

Sl. No	River /Khal	Location	GPS Location	TDS ppm	DO mg/L	Temp °C	pH	Salinity ppt
1	Kobadak River	Shililampur (DS-13)	22°38'30.1'' N 89°17'40.3'' E	1020	4.4	27	8.3	Null
2	Local Gher	Melakpura Kathi, Godaipur	22° 38'15'' N 89°17'17'' E	530	5.9	26	7.8	Null
3	Sluice Gate khal (DS-11)	Shibbari, Godaipur	22°34'59.3'' N 89°18'20.6'' E	220	6.2	22	7.7	1
4	Boira khal	Batikhali, #5 ward, Paikgacha	22° 35'42.6'' N 89 °19'21.6'' E	660	4.8	22	7.8	4
5	Dhonadhuni Khal	DS-06 Dhonadhuni	22° 40'17.3'' N 89°20'01.5''E	240	5.2	25	7.8	1
6	Shalta River	Taltola, Kopilmoni, DS-04	22°41'55.6'' N 89°21'11.0'' E	390	4.4	27	7.6	Null
DoE Standard Value(Bangladesh)				***2100***	***4.5-8.0***	***20-30***	***6.0-9.0***	

Source: CEGIS Field Survey, February, 2016

Total Dissolved Solids (TDS)

231. The values of TDS were found very high inside the Polder area, ranging between 220 to 1020 mg/l (**Table 6.10**) because of low tidal effect in this season. The observed TDS values during field visit were within the limit and complied with DoE standard.

Dissolved Oxygen (DO)

232. DO is an essential parameter for the metabolic process that produces energy for growth and reproduction of fishes and other aerobic aquatic biota. Decrease in DO values below the critical level of 3 mg/l causes death of most fishes and other aerobic aquatic organisms. During field visit in the month of February, values of DO inside the Polder varied from 4.4 to 6.2 mg/L which complies with the DoE standards for irrigation and fisheries as well as aquatic vegetation.

Temperature

233. Temperature of water bodies affects the fish habitats and their oxygen holding capacity. The temperature of the water bodies inside the Polder area was found to vary from 22°C to 27°C, which complies with DoE standard (20°C-30°C) for both irrigation and fish habitats.

pH

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

Salinity

235. Salinity is the saltiness or dissolved salt content of a body of water and an important factor in determining many aspects and assessing the effects on soil structure, crop yield, animals and corrosion rates. Salinity also is an ecological factor of considerable importance, influencing the types of organisms that live in a body of water. As well, salinity influences the kinds of plants that will grow either in a water body, or on land fed by water. When salts reach high levels in fresh water it can causes significant problems for aquatic ecosystems, crop yield and complicated human uses. The values of salinity found in field visit in the month of February ranged between 0 to 4 ppt which will reach the peak in April. These values indicate that salinity is not a significant problem for crop cultivation in the Polder area.

C. Soil Quality of Borrow pit and khal

236. Soil samples were collected from two locations (borrow pit and internal khal) of Paikgacha, Khulna (Polder 16) in the month of July, 2017. Collected soil samples were analyzed by Bangladesh Agricultural Research Institute (BARI). Result of the analyzed data reveals (Table 6.11) that all the parameters are within the average limit except Manganese (Mn) and Lead (Pb) in Borrow pit, 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 industry was found within or around the project area, this sediment may be the only source of excess Mn and Pb (in borrow pit).

Table 6.11: Soil Quality of Borrow pit and Sediment quality of Internal Khal of Polder 16

Sl. No	Parameters	Sampling location		Standard in soil (ppm)
		Borrow pit	Internal khal	
1	Fe	30,450	24,792	32,000
2	Mn	1,524	1,206	761
3	Pb	12.2	8.3	10
4	Cd	0.012	0.011	0.06
5	Cr	72.92	61.88	100
6	EC	3.94	4.26	

6.2 Biological environment

6.2.1 The polder and Bio-ecological zones

Introduction

237. The Polder (16) is located in three Upazilas namely Dumuria and Paikghacha under Khulna and Tala under Sathkhira districts. The Sundarban mangrove forest is situated at southern part about 17 km away from the southern side of the polder area (Paikghacha Sadar). Major ecosystems observed in the polder area are homesteads, canals, ponds, ditches, gher, seasonal and perennial wetlands, etc. The major ecosystem inside the polder area are under threat due to expansion of unplanned shrimp farming, low height of embankment, river siltation, salinity intrusion, water logging, encroachment of canals, loss of connectivity with rivers and depth in internal canals and rivers. These are major concerns and also pose negative impact on local biodiversity inside the Polder area.

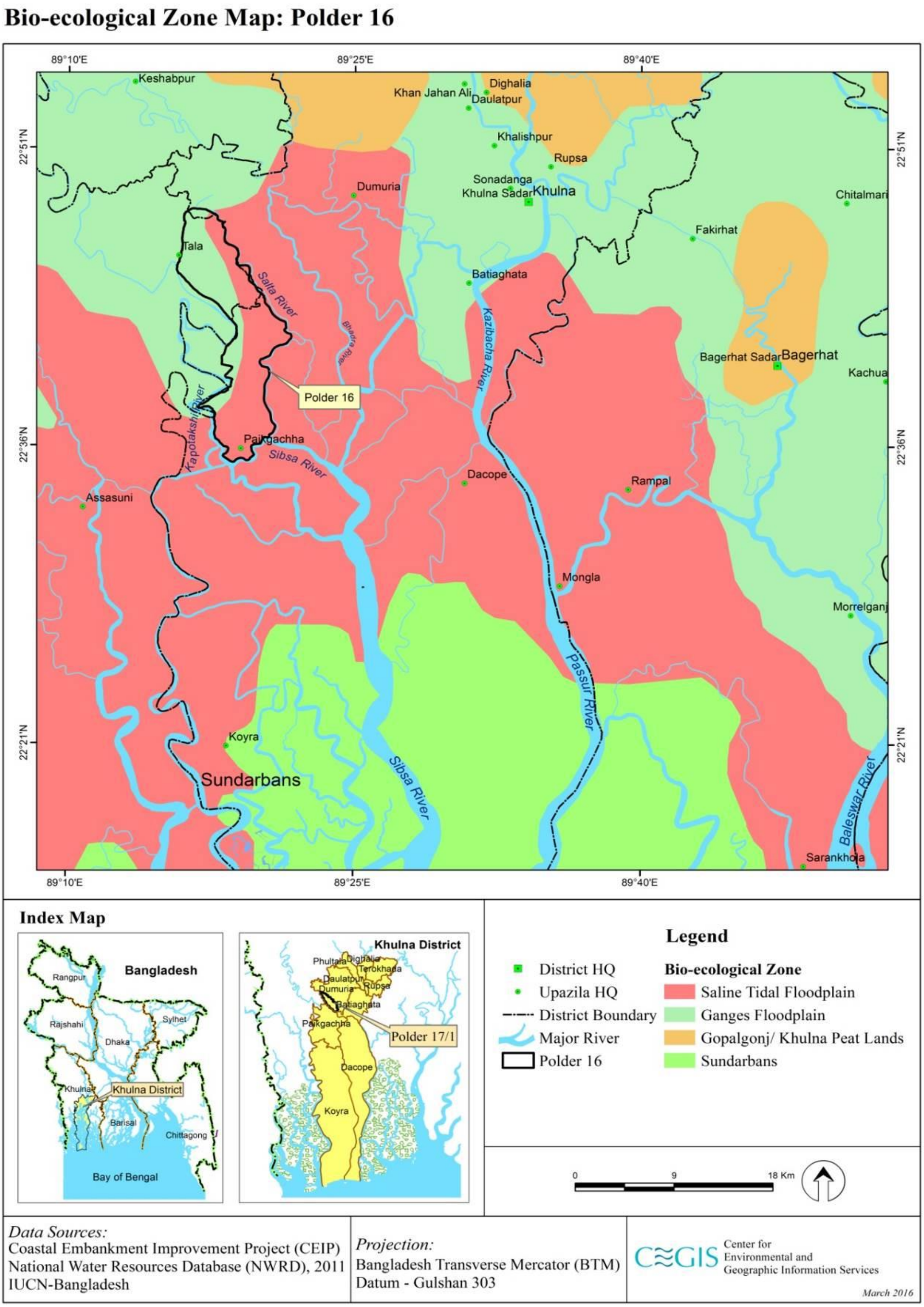
Polder location inside BEZ of Bangladesh

238. The Polder area occupies two Bio-ecological zones, i.e., Ganges Floodplain (6513 ha.) and Saline Tidal Floodplain (3959 ha.). The major portion of the Polder occupies Saline Tidal Floodplain (62%), remaining part falls under Ganges Floodplain (38%). **Table 6.12** represents major ecological features and their present condition. **Map 6.12** shows the bio-ecological zones inside and in the surroundings of the study area.

Table 6.12: Major Ecological features and present condition inside the Polder area

Major Ecological features[1]	Present condition[2]
Saline Tidal Floodplain (10)	
• It has a low ridge and basin relief, crossed by numerous tidal rivers and creeks • Several types of palms and bamboo clumps grow in almost all the villages. • The mango and Jackfruit supply the commonest timber (Bari 1978). • The rivers carry fresh water throughout the year to the east and northeast • A large number of resident and migratory birds (e.g. goose, snipes, wild duck, egrets, and various waterfowl) are found here during the winter season	• Kobadak, Salta and Sibsa are main tidal rivers which flow around the polder areas • Taal, Betel nut are major palms in the study area • Mango is the major cultivated plant for commercial purpose, Jackfruit, Cauwphal, Ata, Desi Gab, etc., are deteriorating due to salinity intrusion as well as increase of soil salinity after Aila (2009). • Major rivers, as well as Kabadak, Salta, Sibsa Rivers carry low volume of fresh water from upstream throughout the year.
Ganges Floodplain (4b)	
• Presence of a lot of stagnant water bodies and channels, rivers and tributaries in this zone support a habitat of rich biodiversity to some extent. • In the beels and other water bodies, free-floating aquatic vegetation is prominent. • Homestead forests, on the other hand, include both cultivated and wild plant species. • Different species of freshwater turtles are also found in the rivers and ponds • Among the mammalian fauna, jackals, rats, mice, are seen everywhere (GoB-IUCN, 1992).	• Wetlands (Beels, Ditches, Floodplains area) has been converted to shrimp farming • Habitat loss of fresh water turtles in the existing rivers and pondsobserved. • Most of the local farmers are converting agricultural land to shrimp farming. • Tidal flow in this area support succession of different mangroves plants • Migratory birds are present in winter season

**Source: 1 = IUCN, 2002 2= CEGIS Field survey, 2016*



Map 6.12: show the Bio-ecological zones within the study area

6.2.2 Ecosystems

Terrestrial ecosystem

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

Homestead vegetation

240. Homestead vegetation occupies most of the floral species in terms of diversity and population. Vegetation density varies in different locations of this study area. Homestead vegetation is dense at north-west and south-west portion of Gadaipur, Hatimpur, Agorghata, Kopilmuni, Bandikat, Goshnager, Kalilnager villages. From eastern to northern portion and eastern to southern portion as well as Goalbathan, Taltola, Kanaiganga, Protapkati, Nasirpur, Kochubunia villages follows low density of homestead vegetation due to expansion of unplanned shrimp farming. Species composition also varies. Narikel *(Cocos nucifera),* Rendi Koroi *(Albizia lebbeck),* Supari (*Areca catechu*)*,* Tal (*Borassus flabellifer*), Mahogony *(Swietenia mahagoni)* are commonly found all over the area. The most common cultivated plants that are now being selected for homestead plants are the exotic Mahogany *(Swietenia mahagoni),* Rendi Koroi *(Albizia lebbeck)* and Akashmoni *(Acacia auriculiformis)* in this area. The natural vegetation took place usually at rural settlement ridges, fallow water bodies and rural road slopes. Homestead vegetation provides roosting area for many resident birds and nesting sites for the waterfowl like egrets and herons. However, this type of vegetation provides major outputs of plant production.

241. Eastern part of the polder area possesses low density of vegetation. Species richness and health of plant community is comparatively lower than other parts (Middle and western part) of the study area. Homestead vegetation of this area has degraded in terms of density, diversity and health after initiation of unplanned shrimp farming. **Table 6.13** shows homestead's vegetation density of different areas of the study area. Trees and shrubs are observed in low density surrounding the homesteads in eastern section except Gadipur and Khalilnager due to salinity intrusion for gher cultivation.

Table 6.13: Homestead vegetation density in different areas within the study area

<table>
<tr><th rowspan="2">Union name</th><th rowspan="2">Total number of Village</th><th rowspan="2">Numbers of Villages within the study area</th><th rowspan="2">Total study area</th><th rowspan="2">Settlement area with vegetation (Ha)</th><th rowspan="2">%</th><th colspan="2">Vegetation density</th></tr>
<tr><th>Western side</th><th>Eastern side</th></tr>
<tr><td>Maguraghona</td><td>12</td><td>3</td><td rowspan="7">10472</td><td rowspan="7">3363</td><td rowspan="7">32</td><td>H</td><td>L</td></tr>
<tr><td>Haridhali</td><td>14</td><td>4</td><td>H</td><td>L</td></tr>
<tr><td>Paikgachha Paurashava</td><td>5</td><td>5</td><td>H</td><td>L</td></tr>
<tr><td>Tala</td><td>21</td><td>10</td><td>H</td><td>L</td></tr>
<tr><td>Gadaipur</td><td>12</td><td>11</td><td>H</td><td>M</td></tr>
<tr><td>Khalilnagar</td><td>16</td><td>14</td><td>M</td><td>M</td></tr>
<tr><td>Kopilmuni</td><td>22</td><td>20</td><td>M</td><td>L</td></tr>
<tr><td>Total</td><td>102</td><td>67</td><td>10472</td><td>3363</td><td>32</td><td></td><td></td></tr>
</table>

Note: H= High, M=Medium, L=Low; Source: Image analysis, Secondary data, CEGIS Field survey, 2016

Photograph 6.6: Homestead vegetation at Gadaipur village

Road and Embankment side vegetation

242. Roadside vegetation are generally planted and developed in an ecosystem which is dominated by hard wood tree species. Major species found along the road side of study area are Sirish (*Albizia lebbeck*), Sisso (*Dalbergia sissoo*), Mahogoni (*Swietenia mahagoni*), Akashmoni (*Acacia auriculiformis*), Sil koroi *(Albizzia procera),* etc*.*

243. The plantation along both sides of the existing embankment are observed in Polder area which is planted by BWDB and local people (about 6 km out of 45 km). Major species observed along the embankment side of the study area are Prickly Pear Cactus (*Opuntia stricta*), Babla (*Acacia nilotica*), Desi neem (*Azadirachta indica*)*,* Keora (*Sonneratia apetala*), Gawa (*Exocearia agallocha*), Golpata (*Nypa fruticans*); etc*.* Moreover, Forest Department has panted different tree species along the river side which include Kewra (*Sonneratia apetala*), Kakra (*Bruguiera gymnorhiza*), Gewa (*Exocearia agallocha*), Sundari (*Heritiera fomes*), Golpata (*Nypa fruticans*) and Bain (*Avicennia alba*). In this project, the community people (Number of 198 beneficiaries) were sensitized to take-care of the plants for creating greenery and to protect embankment from tidal surge and tidal flood.

244. Major weed species growing with the crop are Euphorbia hirta, Rorippa indica, Cynodon dactylon, Marsilea quadrifolia, Calotropis gigantea, Heliotropium indicum, Amaranthus spinosus, Centipeda orbicularis, Cyperus sp, Croton bonplandianum and Chenopodium ambrosoides.

245. Different types of marginal trees like Cactus, Gewa, Golpata, Keora, Ora, Hargoza, Tiger fern are dominant in the inner portion of the canal where as *Cynodon* and various types of grasses are found on upper portion of the canal dykes at southern part of Boyratala, Shibbati villages at Paikghacha Pourashava. Vegetation of this type support good habitats for some small wildlife species of the locality (e.g., Garden lizard, Common skink, Monitor lizard, Field mouse, Shrew, Mongoose, etc).

Photograph 6.7: Prickly Pear Cactus plantation at Shililampur village

Photograph 6.8: Keora plantation at Sibbati village (9 no ward)

Aquatic Ecosystem

246. Aquatic ecosystems in the study area include rivers, canals and homestead ponds provide shelter to most of the aquatic flora and fauna. Homestead ponds are mainly used for domestic purposes. Some of the ponds are used for fresh water fish culture. Homestead ponds (133 ha.) and ditches (12 ha.) are rich in aquatic plant diversity at the western side of the polder area which is mainly dominated by *Eichhornia crassipes, Salvinia natans*,*Nymphoides indicum, Azolla pinnata*, *Pistia stratiotes*, *Lemna purpusilla, Ipomoea aquatica, Monochoria hastata, Eleocharis sp., Alternanthera sessilis,* etc. On the other hand*,* saline water shrimp farm exists over more than 40% of total study area. These farms holdsaline water for the whole of the year or part of the year. The partial water held in the shrimp farms are also used for cultivation of Boro paddy.

Photograph 6.9: Aquatic vegetation at Mohandi Khal

Photograph 6.10: Aquatic vegetation in ditch at Nalta village

Indicative flora/Mangrove vegetation

247. Tide influnced area support succession of different mangroves plants. Ecotone of tidal river levees and khal banks was abounded with mangrove vegetation which has now decreased due to lack of tidal flow by creating dykes for fish culture. However, there are still some mangrove forest patches with Gewa (*Exocearia agallocha*), Kewra (*Sonneratia apetalla*) at river side of Goalbathan, Kanaidanga, Shibbati, Hitampur, and Bakultala villages.

Other mangrove species are Kankra (*Bruguiera gymnorrhiza*), Hargoza (*Acanthus illicifolius*), Ora (*Sonneratia caseolaris*) and Golpata (*Nipa fruticans*).

Photograph 6.11: Mangrove vegetation, Hargoza (*Acanthus ilicifolius*)

Photograph 6.12: Mangrove vegetation, Golpata (*Nypa fruticans*)

6.2.3 Wildlife

248. Diversity of terrestrial fauna is one of the most important ecological indicators to evaluate the quality of habitats. Presently, habitats of birds, mammals, amphibians and reptiles inside the polder area are gradually being reduced due to various reasons including depletion of vegetation cover, expansion of shrimp farming, change in natural vegetation for salinity intrusion, use of pesticides and insecticides, plantation of exotic trees and human interference. Mammals are scarce and most of the mammals have already disappeared.. Among avifauna most common ones in the study area are Red Vented Bulbul (*Pycnonotus cafer*), House Sparrow *(Passer domesticus)*, Common Myna *(Acridotheres tristis)*, Magpie Robins (*Copsychus saularis*), Asian koel (*Eudynamys scolopaceus*), Black Drongo (*Dicrurus macrocercus*), Spotted dove (*Streptopelia chinensis),* etc. Several endangered and threatened wildlife species within the polder area (Table 6.14) are listed in following table:

Table 6.14: List of Endangered and threatened wildlife species inside the study area

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

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

249. The hydrological cycle and the presence of perennial and seasonal wetland provide a diversified habitat for all biota. In the dry period, most of the wetlands in these areas remain completely or partially dry. Among amphibians, Common Toad (*Bufo melanostictus*), Skipper frog (*Euphlyctis cyanophlyctis*), Cricket Frog (*Fajervarya limnocharis*) are common and found in most wetland habitats (e.g., ponds, ghers, canals and ditches) and has been

successful in adapting with the habitat. Common Smooth Water Snake (*Enhydris enhydris*, Pyna sap), Checkered Keelback (*Xenochrophis piscator*, Dhora shap), Common Skink (*Mabuya carinata*, Anjan), aquatic and water-dependent birds (Pankoiri, Machranga, Sada bok, etc.) and small mammals (Bat, Shrew, Mongoose, etc.) are severely affected by the alteration of the natural habitat. Natural wetland degradation has left no place for waterfowl to roost or nest at the eastern part of the polder area. Common wetlands bird species observed in the study area are Indian Pond Heron, Little Egret, Common Kingfisher, , Little Cormorant, Waterhen, etc.

Photograph 6.13: Common Garden Lizard (Roktochusha)

Photograph 6.14: Common rose finch (Carpodacus erythrinus)

6.2.4 Present threats to ecosystem

250. In the study area, aquatic ecosystem and its biodiversity are deteriorating due to canal and river siltation and wetland degradation. On the other hand, terrestrial species diversity both flora and fauna are deteriorating due to deforestation for unplanned shrimp farming, water logging, salinity intrusion. As a result, water bird, small mammals and reptiles are relocating from this area.

6.2.5 Fish Habitat

251. Fish habitats of the polder area are classified into capture fisheries and culture fisheries. Capture fisheries habitat includes internal khals (canals) and culture fisheries include ponds, ditches and ghers. Major khals, such as *Silamanpur khal, Provati khal, Kestokhali khal, Boirar Khal, Bashirer khal, Khalshibuni khal, Navar khal, Dhunadduni khal, Nasirpur khal, Sagorkhali khal* are connected to the peripheral rivers such as *Kobadak* River, *Sibsa River* and *Salta* River. These rivers are tidal and play as longitudinal migration route for fishes in the area. Most khals are silted up and remain dry during lean season. 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 flows from the surrounding land mass.

252. The culture fisheries of the Polder area are dominated by ponds and *ghers* farming. At present, local people mostly concentrate in *bagda* (shrimp) farming in this area, saline water is taken from the river through *khals* during January and February and exchange of water is continued throughout the shrimp culture period. *Golda* (Giant Prawn) along with fin fish are also practiced in some *ghers* where saline water does not enter or low salinity exits.

Rice-cum-fish (alternative fish culture with rice culture) is also practiced in some parts of the study area. Pond culture practice is mainly semi-intensive method by adopting monoculture, poly-culture and mix-culture method with major carp, exotic carp and other fast growing fish species.

Capture Fisheries

253. Among the 4,487ha fish habitat 92 ha is open water fisheries habitat that is considered as capture fisheries habitat (Table 6.15). Maximum water depth of the internal *khals* is 0.5 meter in the dry season and not suitable for fish habitation during this period. Local people reported that siltation rate in the peripheral river and in the internal *khals* of the polder area is gradually increasing **(Photograph 6.15 and 6.16).**

Table 6.15:Fish Habitat Status of the Study Area

Sl	Fisheries Category	Habitat Types	Area (ha)	% of Habitat
1.	Capture	Khal (Canal)	92	2
	Sub-total		**92**	**2**
2.	Culture	Gher	4,250	95
		Pond	133	3
		Ditch	12	0
	Sub-total		4,395	**98**
	Total		**4,487**	**100**

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

Photograph 6.15: River Habitat (Kobadak River) besides the Polder Area (Capture fish)

Photograph 6.16: Khal habitat inside the Polder Area (Capture fish)

Culture Fisheries

254. The estimated culture fish habitat within the polder is 4,395 ha **(Table 6.14)** of which pond is 133 ha, ditch 12 ha and commercially culture *gher* 4,250 ha. Different types of aquaculture are adopted by the local fish farmers-mainly carp polyculture or mixed culture in pond and gher **(Photograph 6.17 and 6.18),** although few farmers started mono-culture of Pangus, Tilapia and Magur.

255. Besides, various kinds of aquaculture technology are practiced in the *gher* depending on water quality, especially salinity of water. *Bagda* (Shrimp) culture (improved intensive) in the gher starts from January and mainly continues till July depending on salinity of water.

Then they start the carp poly-culture or mixed culture along with golda (Prawn) and continue until November. In mixed culture they mainly stock *Catla, Rui, Mrigel*, Grass carp, Silver carp, Big Head carp, *Tilapia,* etc. They also culture *Tengra, Parshe* and *Khorshola* in the gher.

Photograph 6.17: Culture fish habitat (Pond) inside the polder area at Shibbati, Paikgacha, Khulna

Photograph 6.18: Culture fish habitat (Ghers) inside the Polder at Paikgacha, Khulna

Water Quality of Fish Habitat

256. Water quality is very important for the life of fish and also affects all physiological function such as feeding, digestion, assimilation, growth, reproduction, etc. The surface water quality parameters of a representative khal and gher have been measured and compared with the fish habitat suitability standards (**Table 6.16)**. It is observed that pH, dissolved oxygen (DO), and salinity are within the permissible limit for fisheries resources.

Table 6.16: Water quality parameters of different water bodies in the Polder area

Water Bodies	Temperature (ºC)	pH	DO (mg/l)	TDS (ppm)	Salinity (ppt)
Khal (Canal)	27	8.28	4.3	1020	nil
Gher	26	7.8	5.2	530	nil
Standard Values for Fish and shrimp	1.(28-34)** 2. (28-32) for tropical major carps; (25-30) for *P. monodon* culture. ***	(6.5-8.5)*	(4.0-6.0)*	1000*	1.(0-4) for prawn ; (5-35) for shrimp ** 2. (1.5-25)***** for shrimp ; 3.(10-20) for shrimp; (25-28) for *P. indicus; (*10-25) for euryhaline species ***
DoE Standards Values (Bangladesh)	20-30	6.0-9.0	4.5-8.0	2100	-

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

6.2.6 Fish Migration and Movement

257. Fish generally migrate from one habitat to another for breeding, feeding purpose and for favorable environment. The rivers and *khals* serve collective purpose of breeding, feeding

and shelter of fishes. The peripheral rivers act as longitudinal migration route through the internal khals in the polder area. The riverine fish species migrate through regulated *khals* in the polder to some extent during the period of May to August. The internal *khals* situated in the polder area are used as feeding and nursing ground of the fishes. Fish species such as *Tengra, Parshe, Chingires, Baila, Khorsola, Bhetki, Punti* migrate through the regulators to the water bodies as parts of their life cycle. Fish migration status in the polder area is poor due to present condition of the rivers and *khals* as they are silted up-which reduce the length of successive migration routes. 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 hatchlings/fries.

6.2.7 Fish diversity

258. According to field investigation and consultation with fishers, PL collector, elderly people and local DoF officials, it was found that about 37- 45 fish species are captured regularly in the area. Fish diversity in the Polder area is moderate although the diversity of fishes has a declining trend over the years. The causes of gradual decline of fish abundance and biodiversity are due to the morphological changes of internal khals, siltation of fish habitats, reduction of spawning and feeding grounds and illegal fishing, etc. The studied polder area comprises both fresh water and brackish water fish species **(Photograph 6.19).** The available fish species are *Bagda* and *Golda chingri*, *Horina chingri, Tengra, Baila, Parshe, Bhetki, Punti, Shol, Taki, Shing, Tara baim, Gotum, Koi,* and *Shing,* etc. (Table 6.17).

Photograph 6.19: Major fish catch composition

Table 6.17: 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
Lates calcarifer	Bhetki/Koral	Barramundi	M	L	NA	NA
Polynemus paradiseus	Tapse	Paradise Threadfin	M	L	NA	NA
Rhinomugil corsula	Khorsula	Corsula	M	L	L	L
Raiamas bola	Bhola	Indian Trout	L	NA	NA	NA
Acentrogobius cyanomos	Nuna Baila	Salin Goby	H	M	NA	NA
Glosssogobius giuris	Baila	Tank Goby	M	M	NA	NA
Gadusia chapra	Chapila	Chapila	H	L	NA	NA
Plotosus canius	Gang Magur	Canine Catfish	L	NA	NA	NA
Setipinna phasa	Phasa	Hairpin Anchovy	M	NA	NA	NA
Macrobrachium rosenbergii	Golda chingri	Giant River Prawn	L	L	L	NA
Acanthus latus	Datina	Yellow Seabream	M	L	NA	NA
Scatophagus argus	Bishtara	Spotted Butter fish	L	L	NA	NA
Penaeus monodon	Bagda chingri	Giant Tiger Shrimp	M	L	L	NA
Metapenaeus monoceros	Harina chingri	Greasy back Shrimp	M	M	NA	NA
Macrobrachium rude	Kathali chingri	Hairy River Prawn	M	L	NA	NA
Puntius spp	Puti	Spot fin Swamp Barb	M	M	L	LA
Mastacembelus armatus	Baim	Long fin Snake Eel	M	L	NA	NA
Mastacembelus pancalus	Guchi	Stiped Spiny Eel	M	M	NA	NA
Macrognathus aculeatus	Tara Baim	Lesser Spiny Eel	M	H	NA	NA
Mystus vitatus	Tengra	Mystus	H	H	L	NA
Mystus cavasius	Gulsha Tengra	Gangetic mystus	M	M	NA	NA
Heteropneustes fossilis	Jiol	Stinging Catfish	NA	L	L	L
Channa striatus	Shol	Snakehead Murrel	NA	L	NA	NA
Channa punctatus	Taki	Spotted Snakehead	NA	L	NA	NA
Anabas testudineus	Koi	Climbing perch	NA	L	NA	NA
Sperata aor	Aor	Cat fishes	L	L	NA	NA
Wallago attu	Boal	Cat fishes	L	L	NA	NA
Pungasius pungasius	Pungus	Riverine giant cat fish	L	NA	M	M
Otolithies argentatus	Sada poa	Puma fish	L	NA	NA	NA
Colisa fasciata	Khoilsa	Banded gourami	NA	L	NA	NA
Lepidocephalus guntea	Gutum	Gutum	L	L	NA	NA
Scylla serrata	Kankra	Crab	H	H	NA	NA
Culture Fish Species						
Labeo rohita	Rui	Rohu	L	NA	H	H

Scientific Name	Local name	English Name	Fish Habitat			
			River	Khal	Gher	Pond
Catla catla	Catla	Catla	NA	NA	H	H
Cirrhinus cirrhosis	Mrigal	Mrigal Carp	NA	NA	H	H
Rhinomugil corsula	Khorsula	Corsula mullet	M	M	H	L
Barbodes gonionotus	Thai/Raj puti	Thai puti /Silver barb	NA	NA	M	H
Hypophthalmichthys molitrix	Silver carp	Silver carp	NA	NA	M	M
Aristichthys nobilis	Brigade, Big head carp	Big head carp	NA	NA	M	M
Ctenopharyngodon Idella	Grass carp	Grass carp	NA	NA	M	M
Oreochromis mossambicus	Tilapia	Mozambique tilapia	NA	NA	M	L
Oreochromis niloticuss	Tilapia	Nile tilapia	NA	NA	M	M
Pungasius sutchi	Thai Pangus	Yellow tail catfish	NA	NA	L	M
Cyprinus carpio var. communis	Carpio	Common carp	NA	NA	L	M
Cyprinus carpio var. specularis	Mirror carp	Mirror carp	NA	NA	L	L

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

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

6.2.8 Indicative Fish Species

259. Among the fish species found in the study area mentioned above, the major indicative and migratory fish species are Kaine Magur (*Plotosus canius*), near threatened in IUCN, Bangladesh; Bhetki (*Lates calcarifer*), not evaluated; Parshe (*Liza Parsia*), not evaluated and Guli Tengra (*Mystus gulio*), near threatened. These species are generally live in the brackish to saline water but during the spawning season they come to brackish to freshwater environment. The spawning season of *Lates calcarifer, Plotosus canius* and *Mystus gulio* range from March to August whereas *Liza parsia* breeds from November to February (**Figure 6.7**). Usually these fishes enter into the Polder with the tide in drifting mode of migration during the life stages of hatchling to fry. These fishes use the ghers of the Polder as grow up habitat in a culture mode. In addition to this phenomenon, the larger sized fish those cannot withstand the tidal velocity enter into the Polder as most of the fishes generally perform anti-current movement. The sustainable and burst velocities of movement of following fish species are given below in **Table 6.18.** Speeds are generally referred to as 'burst' or 'sustained', which correspond to durations of seconds and hours beyond (>200 min), respectively. Fish generally use burst velocity or swimming speed for capturing prey while sustainable velocity or swimming speed for moving against the current. In calculating the velocities some criteria have been followed. These are: (i) total length of fish, (ii) habitat type (demersal/pelagic), (iii) water temperature, (iv) cruising swimming speed, (v) maximum swimming speed, etc.

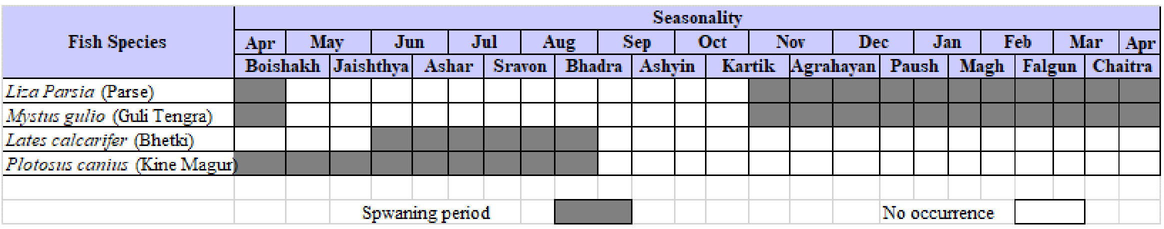


Figure 6.7: Seasonality of fish spawning

Table 6.18: Movement speed or velocity of indicative fish species

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

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

6.2.9 Threatened Fish Species

260. Threatened fish species are those, which are locally rare and unavailable for 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 people are provided in **Table 6.19**.

Table 5.19: List of tthreatened fish species

Scientific Name	Local Name	Local Status	
		Rare	Unavailable
Notopterus chitala	*Chital*	√	
Nandus nandus	*Bheda/Mini*	√	
Clarias batrachus	*Magur*	√	
Sperata aor	*Aire*	√	
Wallago attu	*Boal*	√	
Channa marulius	*Gojar*		√
Plotosus canius	Gang Magur	√	

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

6.3 Human and Economic Development

6.3.1 Fish Production

261. *Gher* owners mostly concentrate in *Bagda* (shrimp) farming and start from January and continue until July-August depending on the suitable saline water. *Bagda* farming follows improved extensive to semi intensive systems along with other brackish water fishes (*Tengra, Parshe, Khoshola*, *Bhetki,* etc). If salinity drops in the *gher* during monsoon, they start to culture fresh water fish (*Catla, Rui, Mirgel*, Grass carp, Silver carp, Big head carp, *Tilapia*, etc.) along with *Golda* (prawn). Sometimes they also start rice culture in the *ghers*

and even they continue the *Golda* and fresh water fish culture along with rice. On the other hand, pond owners culture the fresh water fishes (*Catla, Rui, Mirgel*, Grass carp, *Tilapia,* etc.) in their pond over the years following poly-culture or mixed culture. The production of the fisheries resources are evaluated on the basis of discussion with the fish farmers, fishers and local officials of Department of Fisheries (DoF) are presented in the **Table 6.20.** The fish productivity of *khal* (canal) is 120 kg/ha, which is comparatively lower than the national productivity rate (196 kg/ha). The main reasons for low productivity are reduction of water depth due to siltation, fishing by nets close to the sluice gates, obstruction of fish hatchling movement during pre-monsoon and monsoon due to improper management of sluice gate and low enforcement of Fish Conservation and Protection Acts. Fish productivity of cultured pond and *ghers* is also low. Low production of culture fisheries in the Polder area is due to tidal flooding risk for mal-functioning of sluices and regulator, lack of quality fish and shrimp seed and feed, and lack of training of modern fish culture. However, aquaculture practice in *gher* is increasing significantly in the Polder area.

Table 6.20: Fish Production of the Polder Area

Sl	Fisheries Category	Habitat Types	Production (MT)	Remarks
1.	Capture	Khal (Canal)	11 (0.55%)	-
	Sub-total		**11**	
3.	Culture	Gher	1488	Production includes *Bagda, Golda* and other fresh water and brackish water fish
4.		Homestead Pond	465	-
		Ditch	33	
	Sub-total		**1987** (99.45%)	
	Total		**1998**	

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

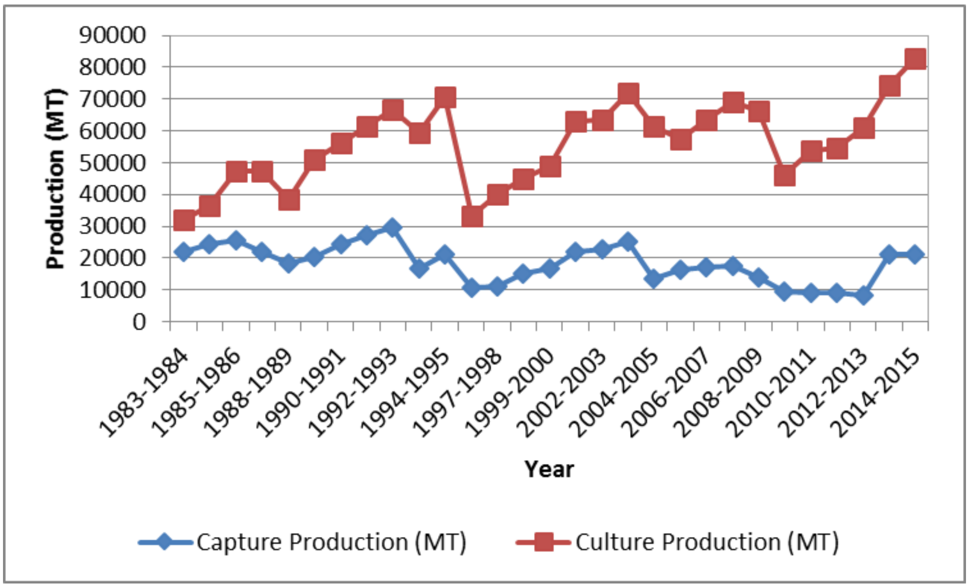
262. The estimated total fish production of the Polder area is about 1998 MT. Most of the fish production (about 99.45%) is from culture fisheries and very few (0.55%) is from the capture fisheries (**Table 6.20**). Capture fisheries production is gradually declining Gover the years in the polder area due to natural changes in river flow, disturbance in spontaneous fish migration, inadequate water in the rivers resulting from increased sedimentation in riverbeds this may not be connect.

Fish production trends of Khulna district

263. The Polder 16 is located in the coastal district Khulna. Once, the area was rich in capture fisheries. After the construction of polders during 1960 to early 70s, a favorable environment was created for the quick spread of brackish water aquaculture inside the polder areas disregarding the ban on entry of saline water through regulating arrangement. As a consequence, growth rate of capture fisheries started to decelerate. Statistical analysis of fish production of the last 30 years revealed that capture fish production (capture fisheries) has declined. It is also found that from 1992-93 to 1997-98 decreasing trends was observed which may be due to the morphological changes of internal khals, reduction of water depth due to siltation, reduction in spawning, breeding and feeding grounds, overfishing, fishing by illegal gears close to the sluice gates, obstruction of fish hatchling movement during pre-monsoon and monsoon due to improper management of sluice gate, lack in enforcement of fish conservation and protection Acts, lack of proper open water management, climate change, etc., but then increases substantially till 2003-04 and afterwards declined gradually up to 2012-13 (figure 6.9). From the fiscal year 2013-14

upward increase (Figure 6.10) in production was observed which may be due to floodplain stocking with carp fingerlings, beel nursery program and the strengthening of conservation measures.

264. On the other hand, comparatively higher growth rate (about 17.76%) was observed in culture fisheries which may be due to dissemination of improved technology packages, intensification, diversification and expansion of aquaculture, supportive/ need based extension services at farmer's level, introduction of high yielding species, etc. Over the last three decades culture fish production increased almost three times (10,056 MT in 1983-84 to 61,595 MT in 2014-15).



Source: FRSS (1983-2015)

Figure 6.9: Fish production trend of Khulna District (1983-2015)

6.3.2 Fishermen and Fishing Effort

Fishers

265. There are mainly three types of Fishers' group in the study area such as commercial, subsistence and part-time fishers. Of them about 8-10% households are engaged in commercial fishing, 50-60% in subsistence fishing and 30-45% households are involved in part time fishing in and around the fish habitats of the Polder area. Commercial fishers are spending around 7-8 hours a day in fishing activities throughout the year. They usually catch fish in the nearby rivers, canals of Polders and also harvest fishes in private *ghers* and ponds as a rental or on wage basis. They also catch the Post Larvae (PL) of Bagda/Golda and crab seed from the rivers. The socio-economic condition of the commercial fishers is poor. The seasonal vulnerability of the fishers starts from late October to April. Being unable to afford their livelihood with the little income from fishing during this period, most of the fishers earns livelihood through daily labor in or outside the Polder. Some fishers are also involved in agricultural activities or fish farming in their own land.

Fishing Season

266. Fishing in canals in the polder area and in peripheral rivers starts in April and continues up to February. Rest of the time they are mainly engaged in other fishing. Most of the fish catch by using different gears takes place during late June to Mid November. Monofilament Gill net (Current Jal) fishing is the major fishing device of the study area, followed by push net, cast net, lift net, seine net, etc. Moreover, shrimp trap (Atol) is used in the gher to harvest shrimp and prawn while fish trap is used in the open water. It is important to note that *Ber jal* and *Bendi jal* are used in the periphery river round the year. The seasonal use of major fishing gears is presented in the **Table 6.21**

Table 6.21: Fishing seasonality of major fishing gear in the study area

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

High | Moderate | Low | No Occurrence

Source: CEGIS Field Survey, 2016

Fishing craft

267. Different kinds of fishing gear and traps are used to catch specific fish in the area according to fish species as well as season. Dingi boat is the widely used craft which is used to collect PL of shrimp, crab seed and fishes from the rivers or khals by using Set bag net (Behundi jal), cast net (Khelpa jal), seine net (Current jal), etc. Fish marketing and post harvest facilities

268. There are some fish and shrimp selling arats (whole sale depots) at Paikgacha, Dumuria, Kharnia, Mandartola, Chupnagar, Kapilmuni in the study area. In addition to the above, a number of daily or weekly bazaars (Hȧat) are found in the study area. Samokpota, Kazimsha bazar, Kathaltola are some of the local fish selling bazaars located in the area. Generally, fishermen sell their harvested fish in the local bazaars. No permanent storage facility is available except for a few ice factories to produce ice for temporary storage. Ice is generally used for transporting the fish and for temporary storage of fish/shrimp. Transportation and communication facilities are not good in all the areas. Van, Rickshaw, Nasimon (converted motorized three-wheelers), pick up, head load, etc., are the commonly used means to transfer products from the producing areas to the consumption centers.There are two private hatcheries (National Shrimp Hatchery & Nursery and Nazrul Shrimp hatchery) situated inside the polder area which can not meet the local demand of fish seed. The rest is supplied from the hatcheries and nurseries of different districts. In addition, fish feeds are also collected from the local market or from the mobile trader who comes from Khulna, Satkhira and Jessore districts. A large number of people find employment in the

fisheries sector in the form of farmers, processors, traders, intermediaries, day laborers and transporters.

6.3.3 Fisheries Management

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

6.3.4 Agriculture Farming Practices

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

271. 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. Some agricultural potential land is fallow in this season. Local Transplanting Aus (Lt. Aus) and Summer Vegetables are grown in the Kharif-I season.

272. The Kharif-II season is characterized by high rainfalls, lower temperatures, high humidity, low solar radiation and high floods that recede towards the end of the season. Rice is the predominant crop grown during this season due to the submergence of soil. Excessive soil moisture also restricts other crops suitable for a high temperature regime. Total Net Cultivable Land is occupied by crops in this season. Local Transplanting Aman (Lt. Aman) and High Yielding Variety of Transplanting Aman (HYV Aman) rice are grown in the Kharif-II season.

273. No crops are grown in Rabi/Boro season. However, there are occasional overlaps such that the Kharif-II season crops (Lt. Aman and HYV Aman) rice is harvested in Rabi season. High Yielding Variety of Boro (HYV Boro) rice, wheat, pulses, potato, oilseeds, spices and winter vegetables, grown in the Rabi season, are often harvested in Kharif-1 season.

6.3.5 Present Cropping Pattern and Intensity

274. The present dominant cropping pattern of the Polder area is Fallow-T Aman (Local/HYV)-Fallow and Fallow-Fallow-HYV Boro, which is practiced in 50% of the Net Cultivable Area (NCA). The cropping intensity of the Polder area is about 175%. Detailed cropping patterns by land type are presented in Table 6.22.

Table 6.22: Present Cropping Pattern by Land Type.

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Area (ha)	% of NCA
Highland	S. Vegetables	HYV T. Aman	Onion/Coriander	225	9
	S. Vegetables	Local T. Aman	W. Vegetables	150	6
	Orchard	Continued	Continued	125	5

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Area (ha)	% of NCA
	Fallow	HYV T. Aman	Oilseeds	200	8
	Local T. Aus	HYV T. Aman	Pulses	274	11
	Local T. Aus	HYV T. Aman	Potato	100	4
Sub- total				**1,073**	**43**
Medium Highland	Fallow	Local T. Aman	Fallow	300	12
	Fallow	HYV T. Aman	Fallow	449	18
	Fallow	HYV T. Aman	Wheat	175	7
	Fallow	Fallow	HYV Boro	499	20
Sub-total				**1,423**	**57**
Total				**2,496**	**100**
Cropping Intensity (175%)					

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

Photograph 6.20: View of HYV Boro field in the Polder Area

Photograph 6.21: View of Orchard in the Polder Area

Photograph 6.22: View of Cabbage field in the Polder Area

Photograph 6.23: View of Wheat field in the Polder Area

6.3.6 Cropped Area and Production

275. Detailed cropped area, yield rate and crop production is presented in Table 6.23.

Crop Production

276. Total crop production is 20,178 metric tons of which rice production is 6,250 metric tons (Table 6.23) and non-rice production is 13,928 metric tons. Among the rice crops the

contributions of Local T. Aus, Local T. Aman, HYV T. Aman and HYV Boroare 10%, 15%, 52% and 23% respectively. In case of non-rice crops contribution of summer vegetables is highest (38%).

Cropped Area

277. Total cropped area is 4,367 ha of which rice are 2,746 ha and the rest 1,622 ha is covered by non-rice crops. The rice and non-rice cropped area are 31% and 69% of the total cropped area respectively. Among the rice crops Local T. Aus, Local T. Aman, HYV T. Aman and HYV Boro are grown on 3%, 5%, 16%, and 7% respectively of total rice area in the Polder. Orchard occupies 11% area of the cropped area. Summer vegetables and pulses are dominant in non-rice cropped area covering 26% and 2% area respectively.

Table 6.23: Present Cropped Area, Yield and Production of the Polder Area

Present crop grown	Present crop area, yield & production			% of contribution
	Cropped area (ha)	Yield/ha (mt)	Production (mt)	
Local T. Aus	374	1.7	636	3
Local T. Aman	449	2.1	944	5
HYV T. Aman	1,423	2.3	3,272	16
HYV Boro	499	2.8	1,398	7
Total rice	**2,746**	**-**	**6,250**	**31**
Wheat	175	3.5	612	3
Pulse	274	1.5	412	2
Oil Seeds	200	1.3	259	1
Spices	225	5.2	1,168	6
Potato	100	16	1,597	8
S. Vegetables	374	14	5,240	26
W. Vegetables	150	16	2,395	12
Orchard	125	18	2,246	11
Total non-rice	**1,622**	**-**	**13,928**	**69**
Total Cropped Area	**4,367**	**-**	**20,178**	**100**

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

Crop Damage

278. The scenarios of crop damage during 2009-2014 and 2015 are presented in **Table 6.24** which shows that crops were damaged by Aila in in 2009, tidal affect in 2012 and flooding due to heavy rainfall in 2013. According to farmers and our field observation, in 2009, 60% Vegetables and 75% Oilseeds 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 2013, local T. Aman was damaged in 30% area by flooding due to heavy rainfall (Field visit; January 2016)

Table 6.24: Crop Damaged by Different Means and % Losses during 2009-2014 and 2015

Crops	Damage (%)	Year	Reason of damage
Local T. Aman	65%	2009	Aila

Crops	Damage (%)	Year	Reason of damage
HYV T. Aman	70%	2009	Aila
Vegetables	60%	2009	Aila
Oilseeds	75%	2009	Aila
Spices	65%	2009	Aila
HYV T. Aman	20%	2010	Heavy rainfall (water logging)
Vegetables	15%	2010	Pests
HYV T. Aman	25%	2011	Water logging
Vegetables	20%	2011	Pests
Local T. Aman	25%	2012	Tidal affect
Local T. Aman	30%	2013	Flooding due to heavy rainfall
HYV T. Aman	30%	2014	Water logging
Vegetables	12%	2014	Pests
HYV T. Aman	20%	2015	Tidal affect

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

Crop Variety use

279. According to local farmers and SAAO, different local and high yielding crop varieties are grown in the polder area. Details are presented in Table 6.25.

Table 6.25: Different crop variety use of the Polder area

Crop	Varieties
Local T. Aus	Sornobasori, Lal mota, Shada mota.
Local T. Aman	Benapole, Sada mota, Lal mota, Jatai balam
HYV T. Aus	BR 20, BR 24, BR 26, BRRI dhan 43, BRRI dhan 48.
HYV Boro	BRRI dhan10, BRRI dhan28, BRRI dhan29, BRRI dhan47, BRRI dhan49, Hira Dhan, Jagoron
Wheat	Kanchan, Shatabdi, Bijoy, BARI Gom-26
Pulses	Utfala, BARI Masur 3, Khesari local, Progoti, BARI Mung 6, BARI Chhola 4, BARI Chola 7.
Oilseed	Rai 5, Kalyania, Sonali, BARI Mustard 14. BARI Groundnut 5, BARI Groundnut 7, Tridana, Dhaka Groundnut 2
Spices	BARI Onion 2, BARI Onion 4. BARI Morich 1, BARI Morich 2, Local variety of Chili.
Potato	Diamond, Cardinal, Kufri sinduri, BARI Potato 43, BARI Potato 44
Vegetables	Kajal, BARI Bt Brinjal 2, BARI Bt Brinjal 3, BARI Bottle Gouard-1, BARI Bottle Gouard-4, Provati, BARI Cabbage 2, BARI Cauliflower-2, BARI Jhar Seem 1, BARI Seem 2, BARI Seem 5 (Short), country bean local, BARI Yard Long Bean 1, Manik, Ratan, Chaiti, Sheela, Apurbo, BARI tomato10, BARI tomato11, BARI tomato14
Orchard	Himshagor, Langra, Ammropali.

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

Crop Calendar

280. Crop calendar of the entire polder area is shown below (Fig. 6.10).

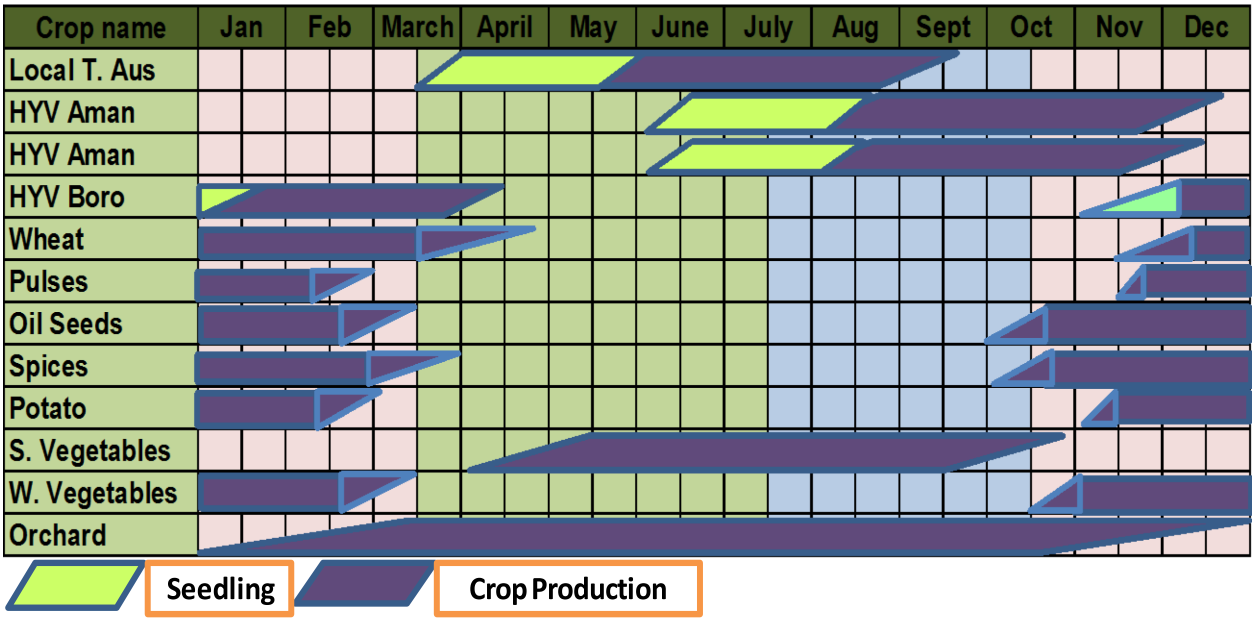


Figure 6.10: Crop calendar entire Polder area

Agriculture Input Use

a. Fertilizer and pesticides application

281. The rate of use of fertilizer per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability (Table 6.26). The major fertilizers used in this area are Urea, TSP and MP. The quantities of fertilizer used are generally lower than the recommended doses. The use of nitrogenous fertilizer (Urea) is higher than other chemical fertilizers. Annually about 1,801 metric tons of chemical fertilizers are used in the Polder area of which 44% is urea, 20% is TSP, 23% is MP, 11% is Gypsum and 2% is Zinc. Generally, farmers do not use manure or compost in their fields. Unbalanced use of chemical fertilizers would affect the soil health which would be ultimately reflected on crop yields.

Table 6.26: Fertilizer and Pesticides use in the Polder Area

Crop Name	Fertilizer (Kg/ha)					Pesticides
	Urea	TSP	MP	Gypsum	Zinc	(Tk/ha)
Local T. Aus	120	50	50	20	5	450
Local T. Aman	140	60	60	35	10	600
HYV T. Aman	170	75	90	50	10	1500
HYV Boro	280	100	140	65	15	1000
Wheat	220	80	120	45	10	1200
Pulses	50	60	40	25	5	500
Oil Seeds	150	80	75	40	8	420
Spices	175	90	95	45	15	800
Potato	300	90	120	50	12	1500
S. Vegetables	240	140	150	60	12	1200
W. Vegetables	280	150	150	80	15	1800
Orchard	170	25	30	18	0	3000

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

282. The use of pesticides depends on the degree of pest infestation. The majority of the farmers applied pesticides in Local T. Aus, Local T. Aman, HYV T. Aman, HYV Boro, Wheat, Pulses, Oil Seeds, Potato, Vegetable crops and Orchard. Annually about 4.92 million BDT is

spent for pesticides (liquid or granular) in the Polder area. The major insects as reported by the farmers are Yellow Stem borer, Ear cutting caterpillar, Brinjal fruit and shoot borer, Aphids, Leaf Hopper, Fruit weevils, etc. Local farmer reported that they are using different types of pesticides such as Volian Flexi, Amestartop, Altima Plus, Virtako, Aktara, Fighter, 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 apply pesticides once or twice in a season (Field visit; February, 2016).

b. Seeds

283. Seed plays a crucial role in crop production. Quality seed is important to get 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.

284. Most of the farmers in the polder area use their own seeds in case of local variety, such as T. Aus and T. Aman. Medium and small farmers meet their requirement from neighboring farmers or local markets. Various improved crop seeds of HYV are provided by BADC and private seed dealers. Market price of the private dealer seeds is higher than BADC seeds. The salt tolerant cultivars are not available in the market and the farmers are also not aware of them. The seed rate for different crops is presented in Table 6.27.

Table 6.27: Cultivation Cost in the Polder Area

Crop Name	Seed (Kg/ha)	Seed cost (Ha)	Irrigation cost (Tk)/ha	Equipments used for cultivation		Power tiller cost (Tk)
				Power tiller (%)	Bullock (%)	
Local T. Aus	40	600	-	85-90	10-15	4,500
Local T. Aman	40	800	-	85-90	10-15	4,500
HYV T. Aman	43	1,505	2,500	90	10	5,000
HYV Boro	45	1,710	6,500	100	-	6,500
Wheat	125	3,125	7,000	100	-	6,800
Pulses	30	1,200	1,500	80	20	2,500
Oil Seeds	8	720	2,500	100	-	3,000
Onion and Coriender	5	7,500	5,000	100	-	4,000
Potato	1500	30,000	6,500	95	5	4,800
S. Vegetables	3-4	1,200	6,000	90	10	5,000
W. Vegetables	3-4	1,200	6,800	95	5	5,500
Orchard	110 tree/ha	3,300	5,000	-	-	-

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

c. Irrigation

285. Irrigation is provided mainly in HYV Boro crops in the Polder area. Irrigation coverage of the polder area is only 499 ha (20% of the NCA) during the dry season. As of now, surface water is the only source of irrigation. Peripheral rivers (Kobadak River, Sibsa River, Salta River), and internal Khals (*Nasipurer Khal, Taltola Khal, Kashimnager Khal, Sagorkhali Khal, Gabtola Khal, Naber Khal, Fatikmari khal, Hoglabunia Khal, Chairvanga Khal, Goshnager Khal, Sonamukhi Khal, Nalta Khal, Mohandi Khal, Boyartala Khal, Shilirampur Khal, Provathi Khal, Boyratala Khal, Gorami Khal, Kalishabunia Khal* and *Kachubunia*) are the sources of irrigation water. Most of the farmers provide irrigation with surface water for raising seedlings, land preparation and transplantation up to mid March. During Boro season

they can use stored water for irrigation purpose by Low Lift Pumps (LLPs). Aus (HYV), Aus (Local), T. Aman (HYV) and T. Aman (Local) crops in the polder area are grown under fully rain-fed condition. In some cases, HYV Aman, Wheat, Spices, Pulses, Potato, Orchard (Banana and Mango) and Vegetables are grown with supplementary irrigation (Field visit; February, 2016). Supplementary irrigation to high land and medium high lands crops is practiced and potato and different winter & summer vegetables sometimes receive one to three irrigations during crop season. Supplementary irrigation cost is 1,500-7,000 taka/ha depending on crops and number of application. Farmers did not apply supplementary irrigation in T.Aus and T.Aman crops. Rabi Season (November-February) crops cultivated in the polder area are primarily pulses, bean, potato, winter vegetables spices (onion, coriander and chilli), oilseeds (mustard and groundnut), etc. Generally, HYV vegetables are cultivated in winter and summer.

d. Labor for Agriculture

286. In the polder area, mostly manual labor is used for cultivation. Thereby, agricultural labor is considered as one of the essential inputs for crop production. The labor requirement is not uniform throughout the year. The number of labor requirement varies from crop to crop. Annual total 0.808 million man-days labor is used for crop cultivation. The average labor used in the Polder area is presented in Table 6.28.

Table 6.28: Agricultural Labor used by crop in the Polder Area

Crop name	Labor (No/ha)	Crop name	Labor(No/ha)
Local T. Aus	135	Oilseeds	115
Local T. Aman	145	Spices	150
HYV T. Aman	160	Potato	190
HYV Boro	170	S. Vegetables	175
Wheat	175	W. Vegetables	190
Pulses	100	Orchard	175

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

Integrated Crop Management

287. Recently, Integrated Crop Management (ICM) is practiced in many places. In this system, insects are controlled biologically. Farmers of the ICM areas use branches of trees, bamboo etc., to make favorable perches for birds in fields with standing crops. The birds eat the insects which help control pest infestation. There are two ICM schools in the Polder area. DAE is providing training from 4.00 pm to 6.00 pm. ICM technique is mainly applied on rice and vegetables crops. Farmers and SAAO of DAE indicate that ICM is being practiced in the fields covering about 15-20% of the cultivated areas and the impact has been found very encouraging. Day by day ICM practice is increasing.

6.3.7 Livestock and Poultry

288. Livestock and poultry, being an essential element of integrated farming system, play an important role in the economy of Polder 16. Livestock provide significant draft power for cultivation, threshing and crushing of oil seeds. Cow dung service as a good source of manure and fuel. Besides, cow dung is a ready source of funds and meat and milk and eggs for human consumption. Most of the households raise poultry and livestock, a practice that significantly reduces poverty through generating income and employment. The Cow, Horse, Goat and Sheep are the common livestock in this polder area in which number of sheep is

increasing gradually as a result of help of the government and NGOs. The numbers of livestock and poultry in the Polder area are presented in Table 6.29.

Table 6.29: 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	35	22,035
Horse	2	1,889
Goat	15	23,609
Sheep	45	84,991
Duck	60	75,547
Chicken	75	118,043

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

Fodder

289. The owners of the livestock population are facing problems with respect to non-availability of fodder and feeds during the months of July to November due to unavailability of grazing land. Rice straw is the main fodder. Oil cake, bran, grass, etc., are other common fodders in this Polder area. Shortage of grazing areas throughout the year aggravates the feed problem to the animal population. The poultry population at family level survives by scavenging and generally no feed supplements are provided. However, at times kitchen waste becomes feed to the poultry and ducks are getting heathier.

Photograph 6.24: View of Chicken in the Polder area

Photograph 6.25: View of Cow and Goat grazing in the Polder area

Photograph 6.26: View of goose in the Polder area

Photograph 6.27: View of horse grazing in the Polder area

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

6.4 Socio-cultural environment

6.4.1 Introduction

291. The Polder 16 comprises of the part of Tala Upazila of Satkhira district as well as part of Paikgacha, and Dumuria Upazila under Khulna district. The Polder area includes eight unions namely Magurkhali, Maguraghona, Haridhali, Paikgachha Paurashava, Kapilmuni, Gadaipur, Khalilnagar and Tala. The percentages of union boundary are shown in **Table 6.30**

Table 6.30: Unions and upazilas in polder 16

Name of district	Name of upazila	Name of unions/ Paurashava	Percentage of union within polder
Khulna	Dumuria	Magurkhali	3
		Maguraghona	8
	Paikgachha	Haridhali	15
		PaikgachhaPaurashava	83
		Kapilmuni	91
		Gadaipur	92
Satkhira	Tala	Khalilnagar	89
		Tala	51

Source: Spatial GIS Analysis, CEGIS, 2016

6.4.2 Demography

292. The polder area has 31,478 households and the population size is 98,490 of which 49,170 are male and 49,320 are female (Housing and Population Census, BBS, 2011, CEGIS estimation, 2015[10]). The number of female population is slightly higher than the number of male population.

293. The average male-female sex ratio[11]is 100 of which there are almost 100 males per 100 females [BBS, (HIES) 2010[12]]. The average density of population is 1,019 persons per sq. km, which is nearly close to the national density of 1,015 persons per sq. km. The

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

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

12 HIES 2010 refers to Household Income and Expenditure Survey conducted by the Bangladesh Bureau of Statistics (BBS) in 2010.

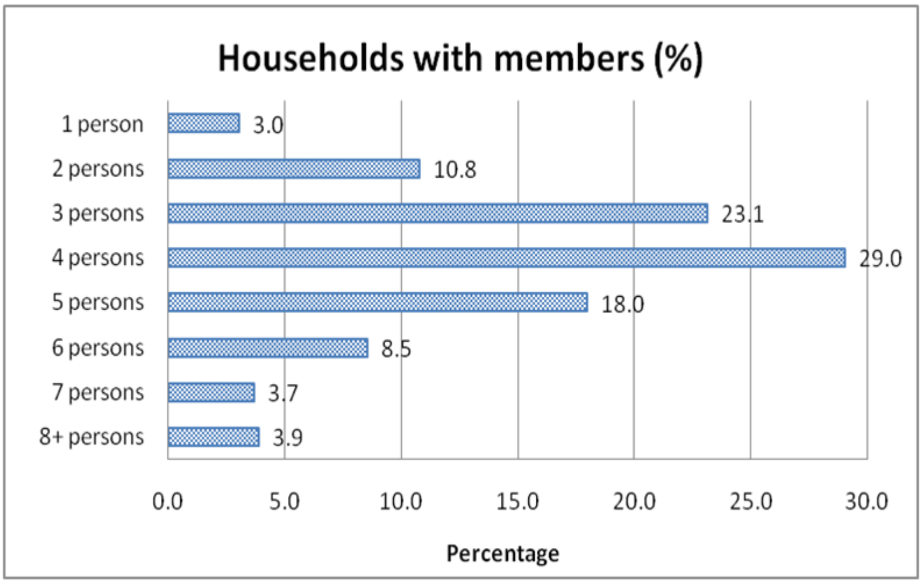
inhabitants of this Polder belong to three main religious groups; the Muslim, Hindu and Christian. About 76% of total population is Muslim, 23% is Hindu, and one percent is Christian. The demographic data of this Polder is presented in **Table 6.31.**

Table 6.31: Demographic Data of Polder-16

Unions	Households	Population			Sex ratio	Population density [sq. km]
		Both	Male	Female		
Magurkhali	100	432	214	218	98	1068
Maguraghona	427	1,837	923	913	101	1063
Haridhali	946	3,783	1,895	1,888	100	988
PaikgachhaPaurashava	3,310	13,997	7,169	6,828	105	-
Kapilmuni	7,899	31,682	15,695	15,986	98	991
Gadaipur	4,654	19,062	9,486	9,576	99	1012
Khalilnagar	6,649	26,670	13,279	13,391	99	991
Tala	7,494	1,028	508	520	98	1022
Total/Average	31,478	98,490	49,170	49,320	100	1019

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

294. It is found that the highest percentage (29%) of household (HH) comprises of four persons in each HH (**Figure 6.11**). Although average household size is 4.1, a significant percentage (34%) of households comprise of five or more persons in each household.



Source: Housing and Population Census, BBS, 2011

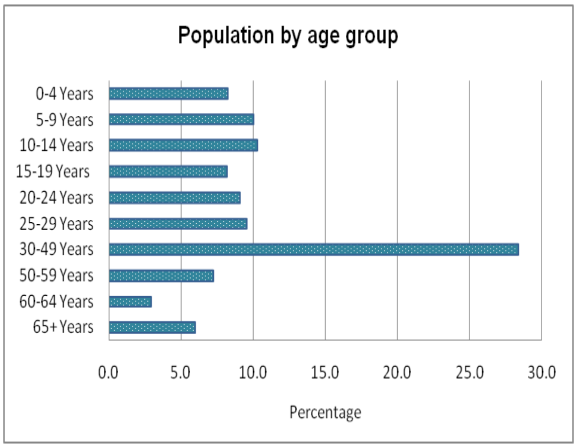
Figure 6.11: Distribution of Households Comprising Numbers of Members in Each HH.

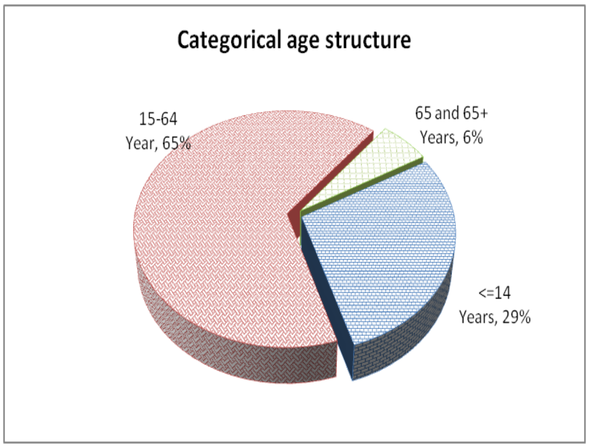
6.4.3 Age Structure

295. Age groups of 0-14 years is defined as children, 15-24 years as early working age, 25-54 years as prime working age, 55-64 years as mature working age and 65 years and

over as elderly people (source: World Fact Book, CIA[13]). 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.

296. Analysis of age structure shows that about 29% of total population are children (age ranges up to 14 years), 65% of total population are youth (age ranges from 15 to 64 years) whose are regarded as man-power and the rest 6% of total people belong to old category (age ranges above 65 years). Population of 15 to 64 years category is considered as labour force whereas, populations below 14 years and above 65 years are considered as dependent. Thus, the total dependency ratio[14] is 53 in which child dependency ratio is 44 and aged dependency ratio is 9. It is found that total 53 persons are dependent on 100 labour forces in which 44 are children and 9 are elderly people.





Source: Housing and Population Census, BBS, 2011

Figure 6.12: Population Age Structure of in the polder area

Figure 6.13: Categorical Age Distribution in the polder area

6.4.4 Education

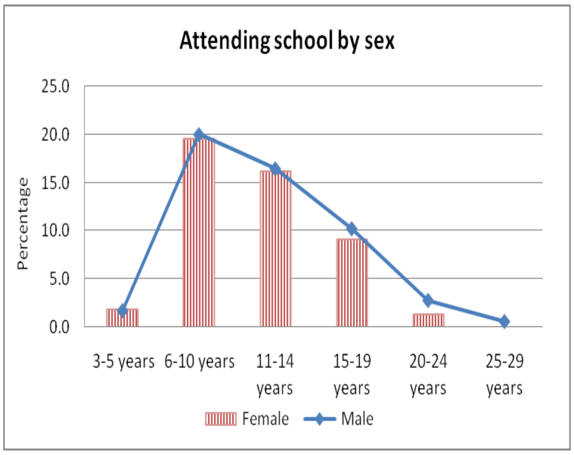
School attendance

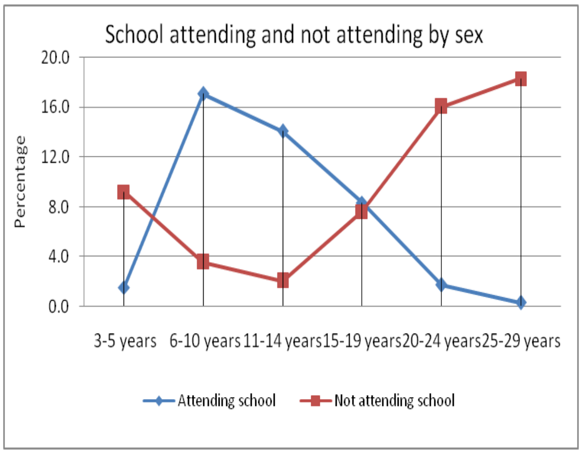
297. School attendance is a major indicator to measure the current and future status of a society. School attendance rate is measured by BBS from 3 years to 29 years by six clusters of age groups. 3 to 5 years is defined as pre-school attendance, 6 to 10 as primary, 11 to 19 years as secondary and higher secondary and finally 20 to 29 years as higher as well as advanced level attendance at educational institutions. Comparative scenario of attending and not attending rate shows that net attendance rate is the highest (19.2%) at Primary education level and the rate starts to fall gradually.

298. However, it is found during the field visit that almost every child of the family goes to school. That means admission into primary or pre-primary school is almost hundred percent. The rate of drop out in high school level has fallen and school attendance in primary and High school level is increasing because of free-schooling and providing free educational books.

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

[14] Dependency ratio=$\frac{numberof\ people\ aged\ 0-14\ \&\ 65\ and\ above}{numberof\ people\ aged\ 15-64}\ x100$





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

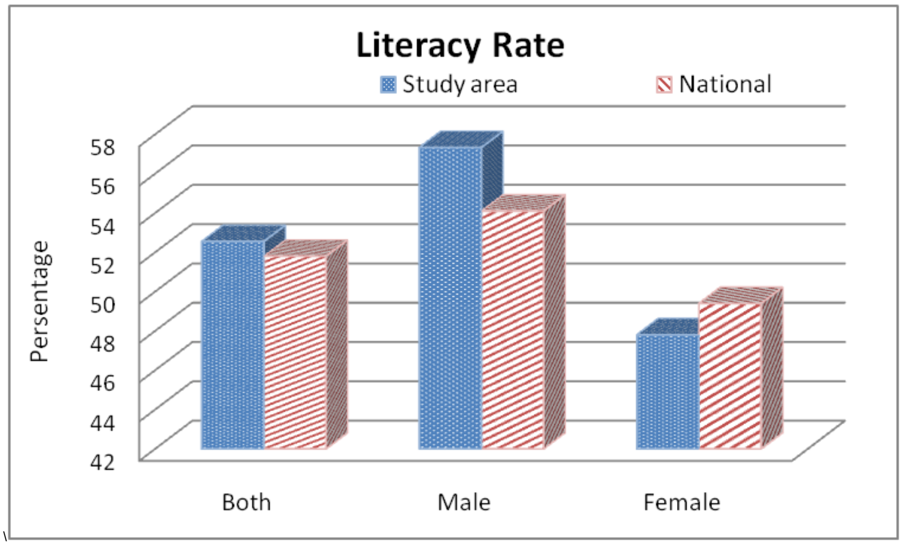
Figure 6.14: Comparative graph of male-female school attendance rate

Figure 6.15: School attendance rate in terms of age groups

299. It is found that the rate of school attendance for both male and female is equal in pre-school and primary level. However, attendance of female students of age structure 15 to 29 years starts to reduce from secondary level. After completing High school education, most of the girls get married that decreases female attendance.

Literacy rate

300. According to BBS 2011, average literacy rate[15], based on a definition "ability to write a letter in any language" is 52.6%; male is 57.3 % and female 47.8%. It may be mentioned that the national literacy rate is 51.8% in which male is 54.1% and female is 49.4%. The rate of literacy reported above is for population of age 7 years and above.



Source: Housing and Population Census, BBS, 2011

Figure 6.16: Literacy rate among the studied population

301. Date shows **(Table 6.32)** that there are 76 primary schools, 24 High schools and eight colleges in the study area. There are also 11 Ebtedaye/ Dakhil Madrashas in the

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

locality that has wide influence on education. The scenario of education of the study area is moderate to satisfactory.

Table 6.32: Academic Institutions in the project area.

Union	Number of College	Number of High School	Number of Primary School	Number of Madrasha
Magurkhali	0	1	8	0
Maguraghona	0	1	4	1
Haridhali	2	2	11	1
Paikgachha Paurashava	2	4	6	2
Kapilmuni	1	4	14	1
Gadaipur	1	3	12	3
Khalilnagar	1	3	13	1
Tala	1	6	8	2

Source: CEGIS fieldwork, 2016

6.4.5 Public Health

Prevalence of diseases

302. It was found from field that waterborne diseases, cold, fever, respiratory and skin disease are the main diseases throughout the study area. The Polder is situated adjacent to coastal area. Therefore, saline humidity causes severe skin diseases. There are water congestion in Kasimnager Malopara, Nasirpur Malopara, Chinamola, Goalbathan, Hauli (Gahordanga), Protapkati (Khabari to Gazibari), Naba, Malot, Kalilnager, Goshnager, etc., villages due to silt deposition in the khals. Local people often use this stagnant water. It eventually leads to skin disease as this water is already contaminated.

303. However, during wet season waterborne and cold are very common. Water congestion takes acute form at the time when high tide pushes water inside the polder area and heavy rainfall add extra water. This dampens the floor of kutcha houses that increases cold and respiratory infections.

Access to health services

304. 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 Upazila Health Complex, Union Sub-Centers, Union Health and Family Welfare Centers, and Maternal and Child Welfare Center in the study area. Therefore, they may receive normal treatment from these health centers. Besides, for major treatment, the inhabitants may also receive treatment facilities from Khulna Medical College Hospital which is 56 km away from the Polder.

Table 6.33: Existing health facilities in the polder area

Facility Type	Number	No. of Beds
Upazila Health Complex	2	100
Union SubCenters	7	0
Union Health and Family Welfare Centers (belongs to DGHS)	6	0
Community Clinics	26	0
Maternal and Child Welfare Center	1	0
Private Clinics/Facilities	15	70
NGO Clinics/Facilities	1	10

Source: CEGIS fieldwork, 2016 and Upazila (Dumuria, Paikgacha and Tala) Health Bulletin 2015

305. Field data shows that the existing services are almost inaccessible to local people. Therefore, a substantial number of populations tend to receive services from the local chemists and/or “village doctors” who are either self-educated or locally trained and have some basic knowledge about health and medicines. There are 352 posts (Doctor and Non-Doctor) in Upazila Health Complex (UHC) in the project area for health services of which almost 26% posts were found vacant during the field visit. On the other hand, there are only 180 beds in different medical service centers which is insufficient compared to population size. One bed is provided for 547 persons. This inaccessibility is further exacerbated due to poor communication network and lack of services and facilities as well as awareness.

Table 6.34.Status of Human Resources (Health) in the Polder area

Type of Resources	Total Post	Vacant	Vacancy %
UHC (Doctor and Non-Doctor)	352	90	25.6
Union Health & Family Welfare Center (under DGHS)	14	0	0.0
Rural Dispensaries	12	3	28.6
Community Clinics	52	0	0.0

Source: Upazila (Dumuria, Paikgacha and Tala) Health Bulletin 2015

306. According to Upazila Health Bulletin 2015, most of the people of Dumuria Upazila receive health services from Upazila Health Complex. They also receive medical services from Union Health and Family Welfare Centre, Community Clinics and NGOs clinics. The trend of receiving health services from private hospital or clinic is very negligible. On the other hand, in the Paikgacha upazila, local people receive medical services widely from Upazila Health Complex & Union Health and Family Welfare Centre. Some people of the locality often receive the services from Community Clinics. On the other hand in the Tala upazila, all the people get medical services from only Upazila Health Complex. According to Health Bulletin 2015, all the people of the Polder area take emergency services from Upazila Health Complex.

Table 6.35: Receive health facilities of OPD and Emergency at health complexes

Health Facility	DumuriaUpazila				PaikgachaUpazila				TalaUpazila			
	OPD		Emergency		OPD		Emergency		OPD		Emergency	
	Above5 Yr	Below 5 Yr	Above 5 Yr	Below 5 Yr	Above 5 Yr	Below 5 Yr	Above 5 Yr	Below 5 Yr	Above 5 Yr	Below 5 Yr	Above 5 Yr	Belo 5 Yr
Upazila Health Complex	74.5	25.5	82	18	78.1	21.9	84	16	78.1	21.9	84	16
Union Sub-Centres	-	-	-	-	84.1	15.9	84.1	15.9		-	-	-
Union Health and Family Welfare Centre (belongs to DGFP)	95.38	4.62	-	-	-	-		-	-	-	-	-
Community Clinics	93	7	-	-	92	8	-	-	-	-	-	-
Private Clinics/Facilities	67.9	32.1	-	-	-	-	-	-	-	-	-	-
NGO Clinics/Facilities	83.9	16.1	-	-	-	-	-	-	-	-	-	-

Source: Upazila (Dumuria, Paikgacha and Tala) Health Bulletin 2015

Child and Mothers' Health

307. IMR is defined as the number of deaths of infants under one year old per 1,000 live births. The average of Infant Mortality Rate (IMR) in the studied upazilas is 40.33. On the other hand, under five years average child mortality rate (U5MR) is 50.67. This rate is comparatively lower than that of national average that is 49 for IMR and 64 for U5MR (Source: Progoti Pathey, MICS, 2009). In addition, average Maternal Mortality Ratio (MMR) of studied upazilas is 106.09 where national average is 197 (Source: Maternal Mortality and Health Care Survey 2010).

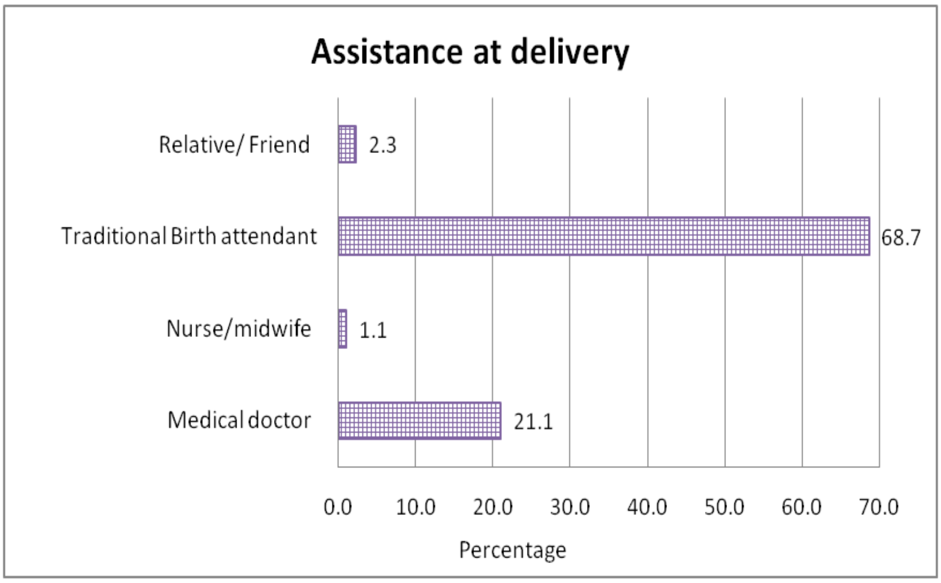
308. Although this scenario represents the entire Uwa3pazila, it is also common for the project area. The child mortality is due to malnutrition, having scarcity of trained attendants at delivery, and more importantly lack of accessibility to health services due to poor communication facilities.

Table 6.36: Child and Mothers Mortality status

Upazila	Infant Mortality Rate (IMR)*	Under-five Mortality Rate (U5MR)*	Maternal Mortality Ratio (MMR)**
Dumuria	45.00	57.00	70.16
Paikgachha	27.00	32.00	152.21
Tala	49.00	63.00	95.9

*Source: *Progoti Pathey, MICS, 2009 and **Upazila (Dumuria, Paikgacha and Tala) Health Bulletin 2015*

309. The following figure shows that the highest percentage (68.7%) of delivery was assisted by traditional birth attendant, about 1.1% by nurse /midwife, and 21.1% by medical doctor. In the study area, it is found that any skilled personnel assisted only 22.1% of delivery. This scenario is common for the study area.



Source: ProgotirPathey, MICS, 2009

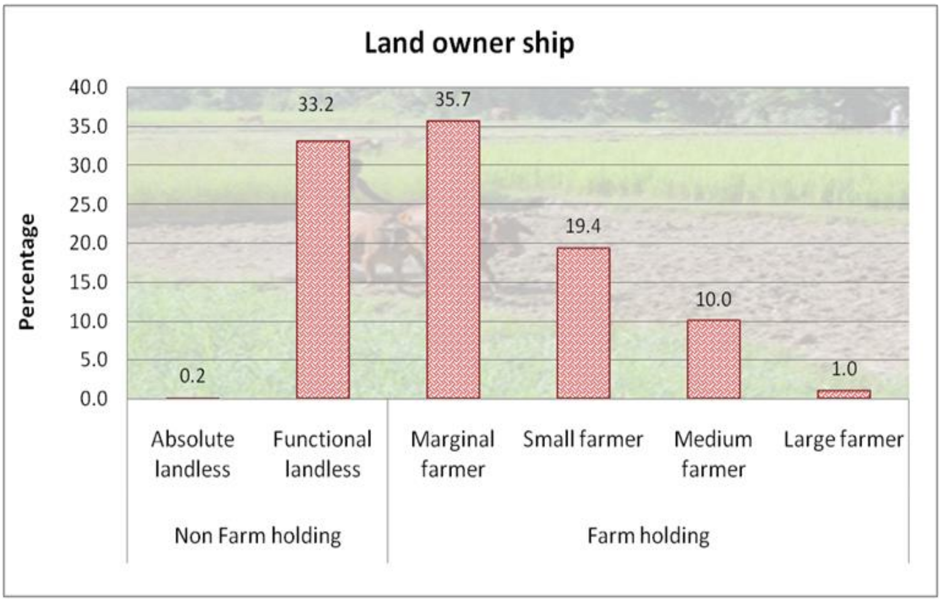
Figure 6.17: Percentage of women assisting birth

6.4.6 Ownership and Utilization of Land

310. The Census of Agriculture, 2008 conducted by BBS classified land holdings into two broad categories - one is farm-holdings and another is non-farm holdings. A farm holding is

defined as being an agricultural production unit having cultivated land equal to or more than 0.05 acre. Conversely, non-farm holding includes landless households and households having lands up to 0.04 acre. The study area shows that out of total holdings 66.7% is farm-holder and the rest 33.3% is non-farm holders.

311. According to BBS 2008 data on land holding distributions, in the study area, only 0.2% households are absolute landless, i.e., they either have no lands for homestead or cultivation. 33.2% households belong to functional landless category, who have land up to 0.04 acres.



Source: The Census of Agriculture, 2008, BBS

Figure 6.18: Households by Land Holdings

312. On the other hand, farm holding distribution shows that 35.7% households belong to marginal farmer (0.05 to 0.99 acre), 19.4% belong to small farmer (1.00 to 2.49 acre),10% belong to medium farmer (2.5 to 7.49 acre) and rest 1.5% belong to large farmer (7.5+ acre) categories. It is found that land fragmentation decreases the holding size. Therefore, large and medium farmers are gradually being turned into marginal farmers.

313. The entire land holdings can be categorized into three classes such as “owned land”, “land given to others” and “land taken from others”. It is found in the study area that about 59.3% holdings are under owned category; which means the land owned by holder including members of his/her family having a title to the land with right to determine nature and extent of its use and to transfer the same. On the other hand, about 32.1% holdings are found to be given by the owners to others in terms of lease and/or rented for a limited time on payment either in cash of kind or in both. About 8.6% holdings are found to be taken by the farmers from others in terms of sharecropping and/or lease on other terms (BBS, 2008).

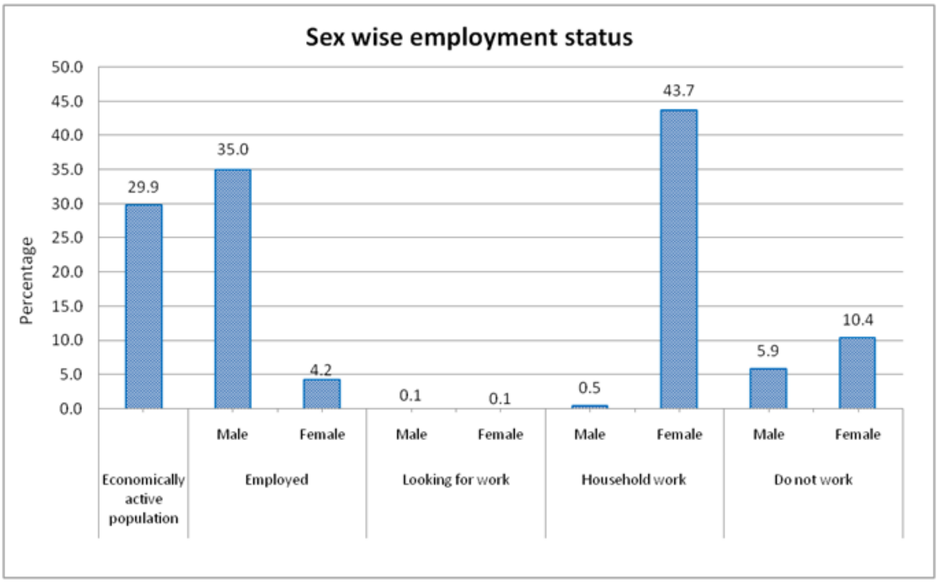
However, field observation shows that only 10% people take the maximum land (75%) as lease (locally called Hari) for shrimp practices. The lease owners occupy the land year after year.

6.4.7 Occupation and Livelihood

314. Employment status is the key indicator to measure the socio-economic condition. It is found that almost 29,408 people (29.9%) of all work forces are economically active of which

11,543 (39.3%) are Employed, 67 (0.2%) are looking for work, Household work 13,001 (44.2%) and rest of the people (4,797) are in 'do not work' category. Females are less engaged in financial activities (4.2%) compared to males. Maximum females are engaged in household activities.

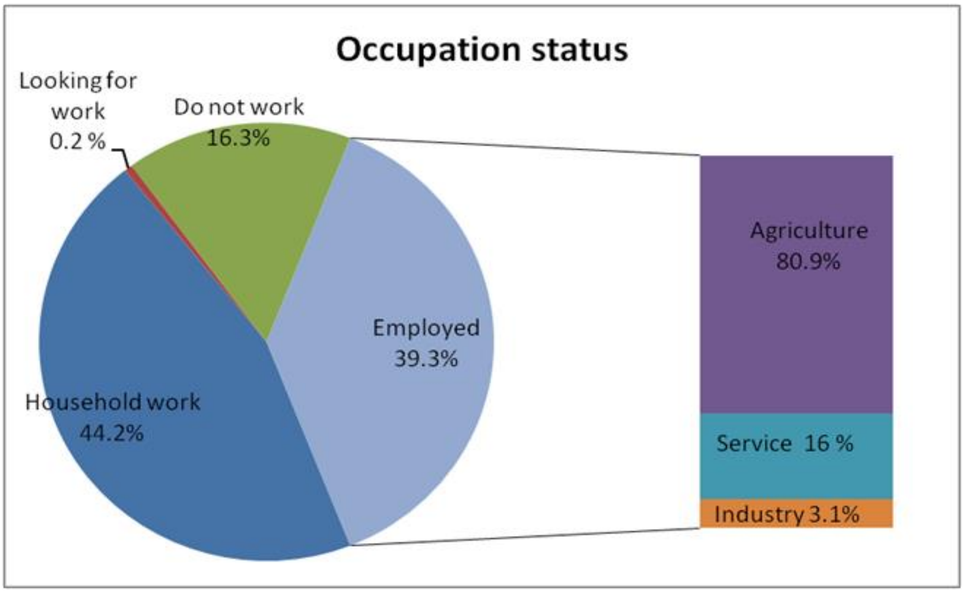
315. Women participation in direct income generating activities (employed category) is stale. Males who do not attend in education are engaged in employment; females are being married and in turn act engaged in household work (43.7%). The employed category also includes child labour as it was accounted from 7 years old population. Empolyment status of the Polder population is provided in figure 6.19 below:



Source: Housing and Population Census, BBS, 2011

Figure 6.19: Employment status of the Polder population

316. It is found in census (2011) that 39.3% population is employed in which 80.9% are engaged in agricultural activities, 3.1% in industry and 16% in service. Agricultural activities include broadly crop farming, fishery, livestock and poultry farming. Field findings suggest that rural women's participation is relatively higher in various post-harvest activities and livestock management activities than other agricultural activities. Scope of employment in agricultural sectors is gradually decreasing due to lack of fresh water leading to converting the lands into shrimp Gher. Few of them participate in some non-agricultural activities like handicrafts making, tailoring, etc.



Source: Housing and Population Census, BBS, 2011

Figure 6.20: Occupation status among the studied population

317. The main occupation according to BBS 2011 is agriculture. But practically the context is being changed and land is given lease for shrimp culture which demands less labour than producing crops that makes a lot of people workless. Field observation also shows that this unemployment makes the local people vulnerable as well as poorer. On the other hands, all the resources are being grabbed by few people.

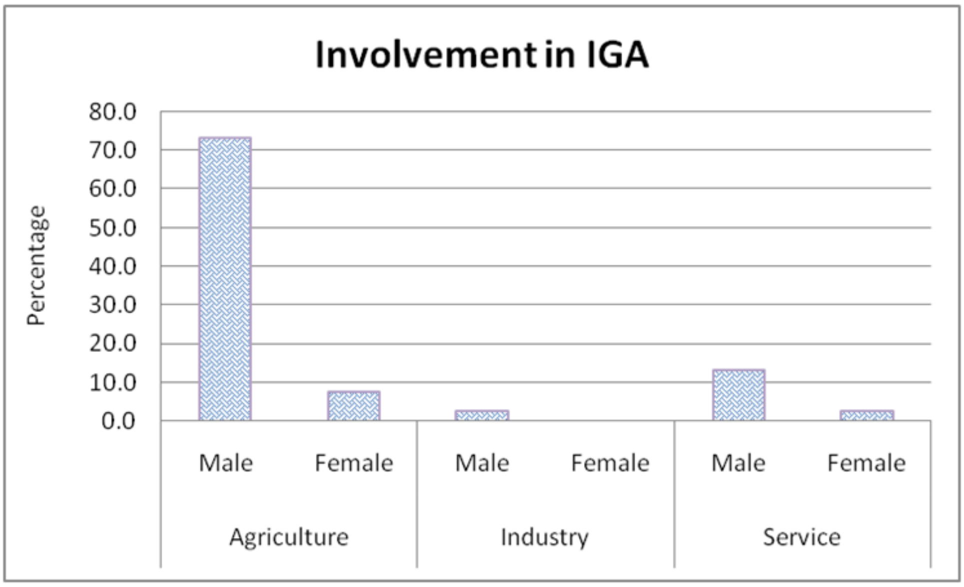
6.4.8 Labor Market

318. The employment rate[16] in the study area is 39 whereas the unemployment rate[17]is 61. It is evident that more than 61% of the total economically active population is still unemployed. Data shows that agriculture, industry and service are the sole sectors to generate employment for the local people. Field findings documented that people who are not permanently employed tend to engage themselves in other sectors such as agricultural labourers, fishers, brick fields, earth works, and cleaning. In agriculture sector, most of the labourers are supplied from the local villages.

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

[16]Employment Rate = $\frac{Employed\ Population}{Total\ labour\ force} X\ 100$

[17] Unemployment Rate= 100-Employment Rate



Source: Housing and Population Census, BBS, 2011

Figure 6.21: Distribution of Population involvment in Income Generating Activity

320. Data confirms that agriculture is the main sector generating employment for the local people. In agricultural sector almost all laborers come from the local villages. Out-migration from study area is very high (30%) during the months from January to April. These out-migrated people are generally engaged as rickshaw puller, mason, non-farm laborer and shoe factory worker. Seasonal out-migrants often go to Dhaka, Khulna, Barisal, and Chittagong districts for better employment. In the study area, the employment opportunity is very limited. Therefore, the seasonal in-migration is insignificant (Source: CEGIS fieldwork, 2016).

6.4.9 Standard of living

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

322. Electricity is the key to modernization and development. The facility of electricity coverage is poor (49.4%) across the polder area. Data shows that Paikgachha Paurashava comprises the highest (73.6%) electricity coverage whereas Khalilnagar union has the lowest (35.7%) coverage [*Source: Housing and Population Census, BBS, 2011*]. Moreover about 15% households are now using solar electricity in the polder area *(CEGIS: fieldwork, 2016).*

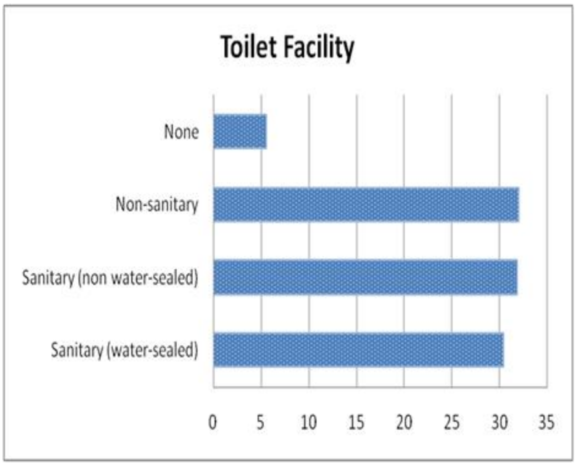
323. The overall housing condition[18] is not satisfactory. The data shows that the majority of houses are *Kutcha* houses (57.1%). Semi-pucca household is 26.6% where *Pucka* is

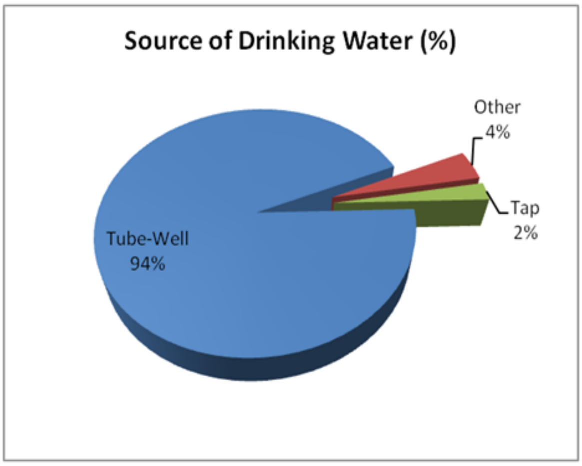
[18]BBS distinguishes housing structures into four classes such as- I) **Jhupri**: House, which consist mud walls of 1.5 to 3.0 ft thickness, which carry the roof load. Earthen floor, thatch or CI sheets are used as roofing materials. . There is no monolithic joint between the wall and the roof. ii) **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

15.1% and 1.2% is still jhupri. Statistics shows that Paikgachha Paurashava comprises the highest *Pucka* households (24.8%) whereas Magurkhali union comprise the highest *Kutcha* households (85.6%). It can be concluded that the people living in the study area belongs to poor category in terms of housing type.

324. Sanitation[19] facilities in the study area shows that about 24% households use non-sanitary latrines and 56% use non water-sealed sanitary latrines. Field findings confirm that non-sanitary latrines are predominant among *Kutcha* houses. Overall 75% people use sanitary toilet. Water-sealed sanitary latrines are available predominantly in *Pucka* houses. However, there are 1% houses with no sanitation facility but tend to use on shared basis and in some cases they use open spaces.

325. Collection of drinking water from Tube well is major (94%) throughout the study area.The remaining is from open water bodies and unconventional sources, i.e., PSF, ponds, rainwater, etc. These households are poor and they are from poor classes living in the rural areas having no access to tube-wells. Supply of “Tap Water” (2%) (Source from Tap) is mainly used in Paurashava areas. This supply system is dependent on ground water.





Source: Housing and Population Census, BBS, 2011

Figure 6.22: Distribution of Households by Sanitation Facilities

Figure 6.23: Distribution of Households by Sources of Drinking Water Facilities

perimeter wall with earth infill; Brick and concrete also use. Roof: CI sheet with timber or bamboo framing; and iv) **Pucka**: House which is made by fully concrete, cement, and iron

[19]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

Photograph 6.28: Drinking water filtering system in the Polder

326. Fire wood and chips are the only source of fuel consumption in the entire study area. People purchased firewood from saw-mill and used round the year. Poor people who cannot afford to buy fuel wood usually collect leaves from neighbours' garden and also collect chips from paddy field. Mainly the people are fully dependent on nature for fuel.

6.4.10 Institutions and infrastructure

Market

327. There are 26 local markets in the polder area which called hat-bazaar. Major markets of the locality are Kapilmuni and Paikgachha. The people of the study area normally buy and sell their goods there. There are some minor markets in the locality such as Magurkhali, Maniktola, Notun Bazar, Gadaipur, Maguraghona (**Table 6.37**). The people often go to Khulna or Satkhira 27 to 56 km far to buy goods, which are not available in the local market.

Table 6.37: Markets/Growth center in Project Area

Unions	Nos of markets/bazaar	Name of the Markets/bazaar
Magurkhali	1	Magurkhali
Maguraghona	4	Maguraghona, Aroshnagor, Atharomail and Chuknagor
Haridhali	3	Kapilmuni, Mahmudkati and Habibnagor
Paikgachha Paurashava	1	Paikgachha
Kapilmuni	3	Kapilmuni, Kashimnagor and Agorghata
Gadaipur	3	Maniktola,Notun Bazar and Gadaipur
Khalilnagar	3	Hazrakati,Mahandi and Khalilnagar
Tala	5	Jatpur, Tala, Khejurbunia,Gheterhat and Shekherhat

Source: CEGIS field work, 2016

Transport network

328. Khulna- Paikgachha regional road is the main road network in the Polder area. Most of the people use this road as a way of communication and goods transportation. Since this is a coastal area, there is no road network surrounding the Polder. People use embankment as the way of communication. But, due to erosion of the embankment, sufferings of the people have increased tremendously. In the wet season, the sufferings increase many folds.

The people of the other area usually use upazila roads, union roads and village roads as the way of communication and transportation. Sidr(2007) and Aila (2009) has eroded the embankment seriously. Overall 211 km of road networks exist in the polder area where 78 km roads is paved, 36 km road is brick soling and 97 km road is earthen (**Table 6.38**).

Table 6.38: Road Utilities in Polder the Area

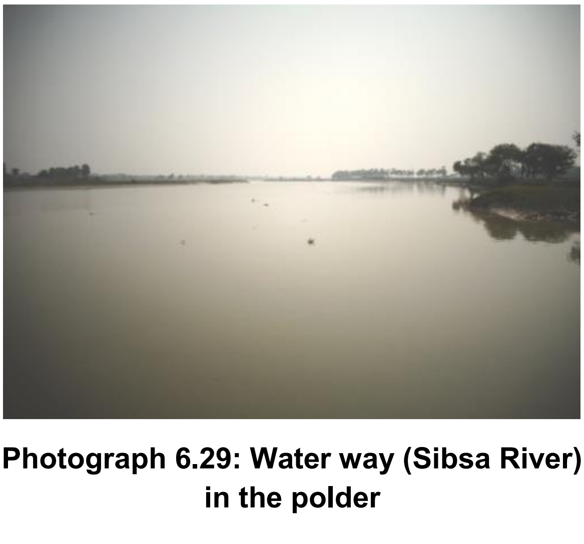
Type of Road	Upazila-wise length (in km)			Total Length (Km)
	Dumuria	Paikgachha	Tala	
Upazila Road (Pucca/ Paved)	-	15	7	22
Union Road (Pucca/ Paved)	12	28	16	56
Village Road-A (Herringbone/ Brick soling)	6	18	12	36
Village Road-B (Earthen road)	8	25	19	52
Embankment cum Road	7	23	16	45

*Source: CEGIS fieldwork, 2015****Waterways***

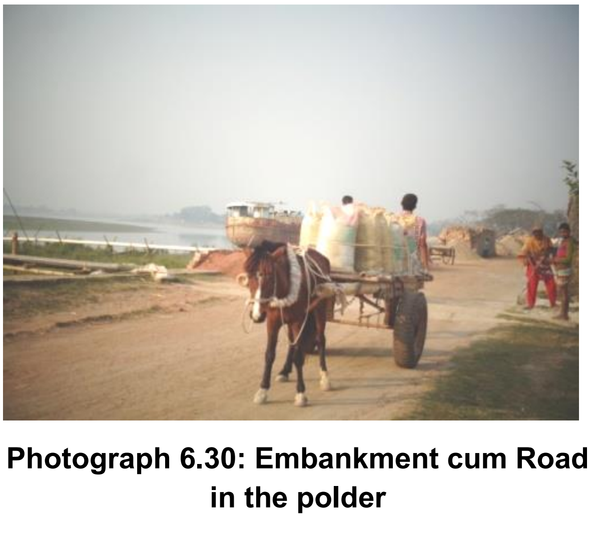
329. Waterway is another mode of communication in this polder. There are three navigation paths used by the local people as the main mode of communication. There are four main internal waterways:

1. Kobadak river
2. Sibsa river
3. Salta river
4. Haria river

330. Local people cannot communicate through waterways due to siltation of existing waterway. The depth of river varies in dry and wet season based on seasonal variation. It is found that Kobadak River has been silted up and dredging of Kobadak is ongoing. The water level of Sibsa and Salta rivers go down and reduce the depth. However, people of the study area use these rivers as major ways of communication and transportation.



Photograph 6.29: Water way (Sibsa River) in the polder



Photograph 6.30: Embankment cum Road in the polder

6.4.11 Poverty

331. Poverty of the study area has been measured following the Multidimensional Poverty Index (MPI) method. The process intended to identify multiple deprivations at the household level in three broad dimensions such as education, health and standard of living. The index uses the same three dimensions as the Human Development Index: health, education, and

standard of living. These are measured using ten indicators. Of them, eight indicators were selected to be analyzed for this study based on data availability and accordingly adapted to the prescribed methodology. The indicators and the threshold for defining poverty are presented in the following table (table 6.39).

Table 6.39: Indicators thresholds along with data sources for MPI calculation

Dimension	Indicator	Definitions/ threshold	Deprivation per indicator (%)	Contribution of deprivation in dimension to overall poverty (%)	Data Source	Factor H20	Factor A21	MPI= H x A
Health	Child Mortality	A child has died in the household within the five years prior to the survey	9	8.4	Progoti Pathey, MICS, 2009	0.59	0.61	0.36
Education	Years of schooling	No household member has completed five years of schooling.	41	34.1	Housing and Population Census, BBS 2011			
	School attendance	No child is attending school up to the age at which they should finish class 6.	32		Housing and Population Census, BBS 2011			
Living Standards	Cooking fuel	The household cooks with dung, wood or charcoal.	100	57.5	CEGIS fieldwork, 2016			
	Toilet	The household's sanitation facility is not improved or it is improved but shared with other households.	69		Housing and Population Census, BBS 2011			
	Water	The household does not have access to safe drinking water or safe drinking water is more than a 30-minute walk from home, roundtrip.	4		Housing and Population Census, BBS 2011			
	Electricity	The household has no electricity.	51		Housing and Population Census, BBS 2011			
	Floor	The household has a dirt, sand or	85		Housing and			

20H= Percentage of people who are MPI poor (incidence of poverty)
21A= Average intensity of MPI poverty across the poor (%)

Dimension	Indicator	Definitions/ threshold	Deprivation per indicator (%)	Contribution of deprivation in dimension to overall poverty (%)	Data Source	Factor H20	Factor A21	MPI= H x A
		dung floor.			Population Census, BBS 2011			

332. It is found that from the analysis of poverty status about 36% households are multidimensional poor (index value 0.36 out of 1= MPI). About 59% populations are living in these poor households [poverty head count =H] and on average 61% poor people are deprived of any indicator (intensity of deprivation=A).

333. The highest deprivation is found in the dimension of standard of living (57.5%). Among them 69% population have no access to improved sanitation facility (water-sealed sanitation), 85% people are living on dirt floored household (considering kutcha and jhupri), 100% of people are using dirt fuel (considering all types of traditional fuel), 50% households have no grid electricity coverage and 4% households are still collecting drinking water from unsafe sources (ponds, river, etc.)

334. The second highest deprivation (34.1%) found in the dimension of education. Considering two dimensions it is found that 41% household members have not completed at least six years of schooling, and 32% school-age children (up to grade 6) are not attending school. In case of the dimension of health, it has one indicator (child mortality), as nutrition data is not available. It contributes 8.4% in overall poverty as 9% children found to be dead in the households within the five years prior to the survey (considering both IMR and U5MR)

6.4.12 Conflict

335. The fishermen have occupied most of the internal khal such as Hasannagar khal. They make embankment across the khal and do fish culture inside the polder area that causes water congestion and create problems for agricultural activities. On the other hand, the fisherman can't catch fish and become unemployed as the khals are occupied by influential people. Therefore, there are conflict between local foreman Vs fisherman and local farmer. The level of conflict is increasing among them day by day due to siltation of khals and water ways.

6.4.13 Common Property Resources

336. There are common property resources and/or community facilities in the area e.g., mosques, graveyards, temples, cremation grounds, playgrounds, open water bodies and *Eidgahs* (place for offering Eid prayers). The local people use these for the purposes of religious, social and cultural gathering. Besides these, the BWDB embankment is also used very commonly for different livelihood purposes, i.e., for living or for taking shelter by the local inhabitants.

6.4.14 Gender and Women

337. Field observation suggests that Polder 16 is male dominated area. Roles of women in decisions making at household level and economic contribution to household income are trivial. Traditional belief is very strong here and all major household decision is taken by the males and at the same time, they contribute to household income more than females. A

very few women work as day labour but in that case wage discrimination is very common where male labor gets BDT 300 to 350 and women labor gets BDT 200 to 250 per day.

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

339. Women mobility in the area is mostly localized except for the purpose of medical treatment, fetching water, farming activities, and visiting relatives. Mortality rate of the pregnant mother during delivery period has been reduced in the area (197/100,000). The growing consciousness among the local people as well as the health services provided by the public and other health centers including the programs of NGOs have contributed to decreasing the mother mortality rate. About 15 percent women are living in good healthy condition and the rest are suffering from various diseases such as low blood pressure and premature delivery (CEGIS fieldwork, 2016). Statistics shows the male literacy rate is higher than female. However, literacy rate of both male and female is increasing than the previous year.

6.4.15 Cultural Sites

340. No notable cultural site is found inside the polder area

6.4.16 Vulnerability

341. It is reported by local people in the Polder area that the polder is vulnerable to natural disaster notably cyclonic storm, storm surges, tidal flooding, heavy rainfall, etc. In some areas, embankments are vulnerable to be eroded within short time. Tidal flood water enters into the polder as the gates of the drainage and flushing sluices are defunct. This water coincide with heavy rain water and in turn, makes drainage congestion that eventually flood the internal road networks, homesteads, playground and educational institutions. Being in coastal area, cyclonic storm is very common in the study area. Substantial damage took place during the aftermath of very severe cyclonic storm namely Sidr; of which, human and non-human asset loss is mentionable.

7. Analysis of Project Alternatives

7.1 Overview

342. The chapter presents ananalysis 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

343. The 'No-Project' option analysis provides a clear view of the existing situation of the Polder and helps understand the need of the proposed interventions under CEIP-1. At present the people in polder are extremely vulnerable to cyclones, storm surges, wave action, and climate change effects, as described in Chapter 4. Furthermore, the polder is not in a state to provide required services i.e., protection against tidal inundation, efficient drainage, and minimizing the impact of cyclonic surges. About 40 percent of the Polder area is vulnerable to salinity intrusion and water logging. The silted water channels allow limited navigation in these waterways, declining fisheries, and increasing environmental pollution.

344. The interventions proposed in Polder 16 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.

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 certain number of points, the embankments will be further deteriorated and fall below the design level. Therefore, cyclones, rise in surge heights due to global warming, and tidal actions will inundate the Polder, causing severe damage to the lives and property of local people.	Re-sectioned embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, reduce loss of lives and assets caused by the natural disasters.
	Because of submergence of the embankments during monsoon, transportation system would further deteriorate inside the Polder, and sufferings of local people would further increase.	Re-sectioned embankments would facilitate transportation within the Polder even during monsoon.
	Reduction of agricultural area, crisis situation for farmers from January to April (salinity intrusion) and May to August (flooding).	Re-sectioned embankments will provide 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 would improve drainage and navigation in internal lakes/khals, increase usage of surface water for irrigation, and reduce water logging problem.

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

7.3 'With project' Alternatives:

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

7.3.1 Site selection alternative:

346. 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	16	
Type of Dyke	ID	
Location of the Polder	Paikgachha, Tala	
Gross Area of the Polder (HA)	10445	
Embankment Length (Km)	45	
Breach of Embankment (Km)	1	2
Erosion (Km)	25	9
Requirement of BPW (Km)	-	0
Location in the Risk Zone	LRZ	5
Drainage Congestion (HA)	1567	1
Opinion of Stakeholder (marks, MV=15, MDV=10, LV=5)	MDV	10
Rehabilitation Cost (Crore BDT)	108	5
Special Criterion	0	0
Total Marks		33

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

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

Table 7.3: Technical, Economic, Environmental and Social Considerations

Intervention	Considerations			
	Technical	**Financial/Economic**	**Environmental**	**Social**
Re-sectioning, embankment with new design heights	Better protection against cyclone surges and water level rise	Financial savings from reduced damages caused by the floods	Improved surface water quality; improved natural vegetation	Reduced loss of lives and assets which would bring poverty reduction; increased employment opportunities for local people.
			Improved surface water quality	
	Prevention of salinity intrusion in the polder	Improved cropping pattern and boosting the local economy		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	Better functional performance in both flushing and drainage; achieving the objectives of	Financial savings against damages due to water logging, drainage congestion, and salinity intrusion.	Removal of inactive sluices would improve the drainage characteristics Water logging,	Better agriculture practice could be achieved which would improve cropping pattern, enhance local

Intervention	Considerations			
	Technical	Financial/Economic	Environmental	Social
construction of new flushing sluices where needed	Polder under CEIP-1	Agricultural production will be boosted as dry season rice cropping would increase	drainage congestion would be reduced.	earnings, and reduce poverty.
Channel re-excavation	Reduce water logging and drainage congestion	Enhanced agriculture output; the dredged soil can later be used in construction works and will save construction cost	Increase navigability of water ways, and fish habitats would be improved, the ecosystem services 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

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

Material Storage

349. For project works in Polder 16, 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.

350. 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.

7.3.4 Material Sources

351. The study on sources of construction materials is very important study, which is done in this section.

Soil for Embankments

352. The re-sectioning of entire Embankment must be done in this Polder which will certainly require a large volume of soil. Following options can be explored in order to pursue the source of soil.

353. Borrow pits are one of the best options of sourcing soil. A huge amount of soil can be acquired from borrow pits. No transport will be required in this case which ultimately minimizes the cost. It can be a better alternative in terms of impact which is mild to ignorable in borrow pit’s areas. These borrow pits are silted up generally within a short period. But, it requires excavation that may pose minimal impacts. By paying an appropriate compensation BWDB may acquire the land from land owners.

354. Re-excavation of channel would be another alternative source of soil from the polder area. However, it depends upon material's quality whether this option would be appropriate or not. If the soil quality is good enough to use, this source would be appropriate. And it would reduce the cost of excavation.

355. If soil quality becomes unsuitable for embankments, then riverbed would be another alternative option. This option however would involve higher cost of transportation, create other social as well as environmental problems like traffic congestion, air and water pollution.

Sand

356. Sand is one of the significant construction materials in repairing and re-sectioning embankment. The alternative analysis focuses on seeking the alternative sources of sand. Two options are presented here. Based on the situation, DDCS&PMSC engineers will decide on the source of the sand.

- First one is sand will be procured directly from market. The option is good one. It has a number of benefits over other. It is consistent in terms of quality and supply; and collection procedure of this option is easier. It however requires higher transportation cost. Furthermore, it associates with environmental and social impacts which include traffic congestion and air pollution.
- Riverbed can be an alternative to previous option as a source of sand. It decreases the cost, by minimizing transportation requirements. As it decreases transportation requirements, it will eventually reduce environmental and social impacts. However, riverbed sand sometimes require washing before use.

7.3.5 Alternatives for Workforce Procurement

357. Two conventional options are available as the sources of manpower for the construction works. These are given below.

- The main source of manpower is from within the Polder. Only the skilled and technical manpower are sourced from outside the Polder. This option convincingly reduce camp sizes and transportation need. So, eventually associated environmental and social problems will be checked. This option would create employment opportunities for the people within the Polder and would improve their financial condition. These are effective for developing the ownership among the people for the project. So, it is absolutely very good option for sourcing manpower.
- Employing maximum people as manpower from outside the Polder is another alternative. This will require rigorous traffic movement which will create congestion and air pollution. The local people however may react and may create resistance.

7.3.6 Alternatives for Mode of Transportation

358. Trucks and trolley are used mainly for conveying construction materials to main stock yard. The materials are conveyed from the main stock yard to the worksite by road only. The condition of the road way is good enough to carry larger vehicles, i.e., dump truck, trolley, excavator, etc. The peripheral river namely Kobadak and Salta have been silted up. BWDB is trying to re-excavate Kobadak River by dredger. So, river way cannot be considered as alternative mode of transport for the Polder 16 at this moment.

8. Assessment of Environmental and Social Impacts

8.1 Preamble

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

- Environmental quality baseline monitoring of air, noise, surface water, groundwater and soil;
- Ecological surveys comprising vegetation, both survey and monitoring river bed and khal bed benthos, 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; and
- 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

360. As part of the environmental impact assessment process, a screening matrix was used specifically for the proposed Project, focusing on the potential environmental impacts during the design, construction and operation phases. . The matrix examined the interaction of project activities with various important components of the environment. The impacts were broadly classified as physical, biological and social impacts, and each of them were further divided into different aspects. The potential impacts thus predicted were characterized as follows:

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

361. The matrix of Polder 16 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.

362. 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 Noise Quality**	**Salinity**	**Surface Water Quality**	**Drainage congestion**	**Sedimentation**	**Impacts on Agriculture and grazing**	**Impact on Fisheries**	**Vegetation**	**Aquatic Fauna**	**Displacement of structure**	**Employment Generation**	**Reduce vulnerability**	**Social conflict**	**Road Communication**
Design Phase and Pre-Construction Phase														
Equipments/Materials/ Contractor Mobilization	MN	0	MN	0	0	MN	MN	0	0	0	0	0	0	MN
Construction Camp Establishment	MN	0	MN	0	0	MN	MN	MN		HP	HP	0	0	0
Construction Phase														
Construction of Bank Protection	MN	0	MN	0	0	MN	0	MN	0	0	MP	0	0	MN
Repair of Drainage Sluice	0	0	MN	MN	0	MN	MN	MN	0	MN	MP	0	0	MN
Construction of Flushing Inlets and Drainage sluice	0	0	MN	MN	0	MN	MN	MN	MN	MN	MP	0	0	MN
Demolishing of Drainage sluice and Flushing sluice	0	0	MN	MN	0	MN	MN	0	MN	0	MP	0	0	MN
Construction of retired embankment	MN	0	MN	0	MN	HN	0	MN	0	MN	HP	0	0	0
Re-excavations of drainage channels	0	MP	HN	0	HP	MN	HN	MN	MN	0	HP	0	0	0
Re-sectioning of Embankments	MN	0	MN	0	MP	MN	0	HN	0	HN	HP	0	0	HN
Replacement/repairing of Sluices	MN	MP	MN	MN	MP	MN	MN	MN	0	0	0	0	0	0
Slope Protection works	0	0	0	0	0	0	0	MN	0	0	MP	0	0	MN
Aforestation program	0	0	0	0	0	0	0	MN	0	0	MN	0	0	0
Operation Phase														

	Physical					Biological				Social and Socioeconomic				
Project Phases and Activities	**Air and Noise Quality**	**Salinity**	**Surface Water Quality**	**Drainage congestion**	**Sedimentation**	**Impacts on Agriculture and grazing**	**Impact on Fisheries**	**Vegetation**	**Aquatic Fauna**	**Displacement of structure**	**Employment Generation**	**Reduce vulnerability**	**Social conflict**	**Road Communication**
Operation of Sluices	0	HP	MP	HP	HP	HP	HP	0	HP	0	MP	HP	HP	MP
Repair and Maintenance	0	MN	MN	MN	0	0	HP	0	HP	0	0	HP	0	HP
Checking of the physical condition and function of embankment and water control structures	0	HP	HP	HP	0	HP	HP	0	HP	0	HP	HP	HP	HP
Checking of the depth of channels	0	0	HP	HP	MN	HP	HP	0	HP	0	0	0	0	0
Monitoring the functions of WMOs	0	HP	HP	HP	0	HP	HP	HP	HP	0	HP	HP	HP	HP

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

8.3 Impacts during Pre-construction phase

363. Site development involves the following activities:

- Labour, equipment and materials mobilization
- Preparation of construction sites, labor sheds, material stock yards

364. The activities will cause the following environmental impacts;

8.3.1 Noise and Vibration due to equipment mobilization

Impact

365. Heavy traffic movement with construction materials is a crucial task during pre-construction phase that will generate noise and vibration which are likely to affect the nearby communities. Increased noise levels may cause disturbance, nuisance and even health hazards to the nearby communities as well as to the construction workers.

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

Mitigation Measures

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

- Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards;
- Vehicles and machinery should have proper mufflers and silencers;
- Provision of noise barriers at schools and other sensitive receptors should be assured, as needed;
- Provision of PPE (ear muffs and plugs) to labor should be made.

Residual Impacts

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

8.3.2 Change of land use

Impact

369. Land would be needed to establish temporary facilities including construction camp (labor shed) and borrow areas. It is estimated that about 20 labor sheds would be constructed to create temporary facilities for the rehabilitation works. However; the main consultant informed that all labor sheds (20) would be constructed on khas land. Materials and equipment mobilization requires land at site of the canals which is used for crop production. The borrow pit areas mainly remain fallow during dry season. In wet season, these borrow pits area is used for seedbed or grazing of livestock by the dwellers of the Polder.

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

371. Borrow pits for extraction of construction material are expected to be both from inside the polder and in the foreshore land[22]. 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 pit 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.

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

Mitigation

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

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

Residual Impacts

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

8.3.3 Impacts on vegetation

Impact:

375. Eastern portion (from chainage 00 km. to chainage 32 km.) as well as *Chairvanga, Batultala, Mohandhi, Bakultala, Goalbathan, Protapkati, Kachubunia, Boyratala,* etc., villages of the polder area possesses low density of vegetation. Ten construction sites with labor sheds and stock yards would be temporarily established in these locations. Therefore, temporary impacts on existing vegetation especially herbs (*Cynodon, Cyperus croton,* etc.) and shrubs (*Amaranthus, Phylasis,* etc.) would take place. However, this vegetation will regenerate due to natural succession. No trees would be cut down in construction sites, so loss of vegetation would be mainly herbs and shrubs. As such the impact is considered to be **low**.

Mitigation:

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

- Labors should be made aware about local flora and faunal species;

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

- Labor sheds and stock yards should be established on low vegetative or barren land as much as possible;
- Plantation of local species in the selected areas as early as possible after finishing the construction works;
- Labor should collect fuel wood for their own purpose from local market (*Kopilmuni bazaar, Gadaipur bazaar, Paikghacha Bazaar, Kathbaria bazaar* etc.).

Residual impact:

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

8.3.4 Involuntary Displacement

Impact

377. Implement eviction of some households which are demanded by the project. These who lose their properties related to housing would bedisplaced to another location as their homestead related activities such gardening, orchard, fish culture would be affected. . So, they would be affected economically.

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

Mitigation

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

- Compensation should be paid prior to construction in accordance with RAP;
- Maintain liaison with communities; and
- Grievance redress mechanism (GRM) should be established.

Residual Impact

380. The above measures would help mitigate the impacts related to involuntary displacement and the degree of impact will be significantly reduced to Moderate **level.**

8.4 Impacts during construction phase

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

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

8.4.1 Noise and Vibration

Impact

382. 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. Increased noise levels may cause disturbance, nuisance and even health hazards to the nearby communities as well as to the construction workers. In particular, the settlements near the working areas will be exposed to noise and vibration generated by the Project activities. However, there are few settlements at the eastern portion (major portion) of the Polder. The south-west portion of the embankment is situated in populated area where settlements (households, schools, etc.) are high. The noise of the construction equipments may seriously affect the local people, i.e., children and patients. Table 8.2 shows the noise level to be expected from the equipment. According to ECR'97 60 dBA is permissible for mixed area in Bangladesh.

Table 8.2: Noise level of different construction equipments and machineries

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

Source: CEIP Report, 2016

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

Mitigation Measures

384. The following mitigation measures are to be undertaken to address the above concerns:

- The regulators should not be demolished during school time (8 am to 1 pm) particularly near the schools;
- Restrict/limit construction activities during the day time;
- Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards;
- 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
- Contractor will prepare the Traffic Management Plan and will follow accordingly.
- Vehicles and machinery should have proper mufflers and silencers;
- Provision of noise barriers at schools and other sensitive receptors should be assured, as needed;
- Provision of PPE (ear muffs and plugs) to labor should be made;
- Construction crew should be instructed to use the equipment properly, to minimize noise levels;

- Camps will be located at a safe distance from communities; and
- Liaison with the communities should be maintained and grievance redress mechanism should be established at the site;

Residual Impacts

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

8.4.2 Soil and Water Contamination

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

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

Mitigation Measures

387. The following measures should be implemented by contractor to address the above concerns:

- Prepare and implement pollution control plan;
- Workshops should have oil separators/sumps to avoid release of oily water;
- Avoid repairing of vehicles and machinery near the crop field;
- Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination;
- Dispose contaminated soil appropriately ensuring that it does not contaminate water bodies or affect drinking water sources;
- Contractor should ensure that there is no leakage, spillage or release of fuel, oil or any other affluent/waste on the ground or in the water from its construction machinery, vehicles, boats, launches, and barges. Contractor will regularly monitor the condition of its fleet;
- Material borrowed from the river banks should be carried out sufficiently away from the water edge, minimizing the possibility of loosing soil and wash out in the river;
- Contractor will locate camps far away from communities and drinking water sources;

- Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal);
- Release treated wastes on ground or in water;
- Recycle spoil and excavated material where possible;
- Dispose spoil at designated areas with community consent;
- Construction material, demolished debris and excavated soil/silt should not be allowed to enter or disposed in the water bodies;
- 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 bounded with impervious floors and walls, all containers, drums and drums in good condition, storing all liquid fuels in fully bounded storage containers, refueling only within bounded areas, provision of spill kit and other oil spill response tools; refueling only within bounded area;
- Preparation of Emergency Response Plan.

Residual Impacts

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

8.4.3 Aggravated Sedimentation

389. Borrowing material from the river banks may potentially cause increased sediments 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 material, loose earth/soil, demolished debris, and other materials may enter the river or drainage khals causing increased sediments. Run off from construction sites, camps, and other temporary facilities may increase sediment load of water bodies.

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

Mitigation Measures

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

- Small scale Tidal River Management (TRM) may be implemented where appropriate;
- Contractor should protect untreated embankment slopes;
- Contractor should excavate channels after dewatering them;
- Contractor should not leave excavated earth and silt on channel banks;
- Contractor should implement measures to protect channels from run-off from working areas and camps;
- Contractor should obtain borrowing material from river banks in such a manner so that there is no increase of siltation in rivers, and should not leave loose soil after excavation; and

- Regular monitoring of drainage khals is necessary to maintain the capacity.
- Prepare 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.

Residual Impacts

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

8.4.4 Affects on agriculture crop production

Impact

393. Borrow pits for extraction of construction material are expected to be both from inside the polder and in the foreshore land[23]. 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.

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

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

Mitigation

- The following measures should be implemented to address the above concerns:Resettlement Action Plan should be prepared and should also be implemented accordingly
  -
  - Compensation should be paid for any crop damage;
  - Contractor should avoid any activity in cultivation fields during construction;
  - Contractor should ensure that no vehicular movements take place inside cultivation fields;
  - Contractor should ensure that no material is dumped inside cultivation fields;
  - Re-excavated soil of canals should not be dumped in agricultural land;
  - Contractor should maintain liaison with communities.
  - It should be considered a priority to establish borrow-pits in approved foreshore areas

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

- Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps construction; and
- Contractor would maintain liaison with communities;
- Implement drainage and erosion control measures at the work sites near agricultural fields.

Residual Impacts

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

8.4.5 Affects on irrigation

Impact

397. Construction activities particularly on construction of drainage sluices (10 nos.), repairing of Drainage Sluice (2 nos.), demolishing of drainage sluices (20nos.), and re-excavation of drainage channel (20 km) can potentially disrupt the crop irrigation temporarily during both wet and dry seasons which should negatively affect cultivation. The works on sluices can cut off the flow of water from the river, , while the excavation works in canals can affect water conveyance through them.

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

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

- Contractor should construct bypass channels before construction of drainage sluices;
- Sequence of work at the drainage sluices, inlets and water canals should be carefully planned to avoid irrigation disruption;
- Contractor should ensure that no negative impacts falls on crop irrigation;
- Contractor should maintain liaison with communities; and
- Contractor should work during dry seasonSpawning/breeding period of commercially important fishes should be considered prior to demolishing/construction of drainage sluices.

Residual Impacts

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

8.4.6 Change in Migration Behavior

Impact

401. Ten drainage sluice gates are proposed to be replaced by new ones which should be used to regulate the water availability and water quality of connected khals. These khals have been found to be used as the feeding, nursing, spawning and even breeding ground by different fish species in different seasons (Table 8.3). It is predicted that because of the activities of replacement of these sluice gates, the habitat of about 1 km around the sluice gates (500 m upstream and 500 m downstream) should be impacted and migration behavior

of the following fish species towards feeding, nursing, spawning and breeding might somewhat be hindered (if in the dry season) or fully hampered (if in the rainy season).

Table 8.3: Migration purpose and time by some major fish species

Sl	Fish Species	Habitat	Purpose	Timing
1	Bagda	All khals	Nursing	All the year round
2	Chitra		Nursing	Ashar-Aswin
3	Gulsha Tengra		Feeding	All the Year Round
			Spawning	Ashar-Aswin
4	Paissa		Nursing	Ashar-Aswin
			Nursing and Spawning	All the Year Round
5	Taki		Nursing	All the Year Round
6	Tit Punti		Spawning	Ashar-Aswin
7	Veda Bele		Nursing	Ashar-Aswin
8	Vetki			

Source: CEGIS Field Survey, 2016

Mitigation Measures

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

- Replacement should be conducted during the dry season (November-May); and
- Contractor might maintain liaison with experienced fishermen.

Residual Impacts

403. The impacts on migration for spawning and breeding are likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be **Moderate**.

8.4.7 Stock Susceptibility to Catch

Impact

404. Re-excavations of khals and installation/replacement/repair of drainage sluices are two major activities in the proposed interventions in Polder 16. It is expected that fishing activities would exponentially increase on completion of these two activities which would in turn increase stock susceptibility to fishing in that location.

Mitigation Measures

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

- Replacement should be conducted during the dry season (November-May); and
- Close monitoring should be conducted during the construction by local commercial fishermen under the supervision of DoF so that allowable biological catch can be ensured.
- Regular sampling and analysis of the benthic fauna as an indicator of the health of the ecosystem

Residual Impacts

406. The impact on stock susceptibility is likely to be adequately addressed with the help of above mitigation measures, and the significance of residual impact will be **low**.

8.4.8 Impact on Fish Migration

Impact

407. Drainage sluice gates are designed to control water for improvement of drainage system of the polder area. Sluice gates are mainly operated in order to meet the drainage purpose. Thus, it would hamper the migration behavior of fish species. Moreover, the extent of *Bagda, Chapila, Chitra, Lal Chewa, Veda Bele,* etc., would be highly restricted with the replacement of the proposed drainage sluices.

Mitigation Measures

408. The following measures may be implemented to address the above concerns:

- Sluice gate operation manual should be prepared for allowing fish migration in time;
- Experienced commercial fishermen should be appointed in WMOS for Operation and Maintenance of sluice gate; and
- Provide training to WMOs.
- Periodic fish catch monitoring to assess fish stock and species composition and take initiatives, if anything wrong detected.

Residual Impacts

409. The impacts on migration status are likely to be adequately addressed with the help of above mitigation measures and the significance of residual impact would be **moderate**.

8.4.9 Impacts on undergrowth herbs and shrubs

Impact:

410. The proposed construction activities like placing of geo textile bags, soil placement and CC blocks will damage all kinds of vegetation at the proposed construction sites. The locations where labor shed will be constructed and construction materials will be kept would also be affected. Moreover, vegetation from where soil would be collected will also be damaged. The preparation of construction yards at the embankment site is apprehended to damage existing vegetation especially the herbs and shrubs. The bank revetment works will temporarily damage mangrove plants mostly the saplings. After completion of works, new vegetation succession will be followed on embankment sides due to tidal flow of *Sibsa, Kobadak* and *Salta* River. There will be no damage of homestead vegetation inside the construction area, so minor vegetation damage or loss is expected at the proposed intervention sites.

Mitigation:

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

- Low vegetative or barren land should be used to the extent possible for CC block manufacturing in construction yard;
- Plantation of mangrove species (Kaora, Ora, Bain, Kakra, etc.) along the embankment side after completion of construction activities;
- Ensure conservation/protection measures at the embankment-river slope side to facilitate natural regeneration of mangrove saplings
- All types of construction works should be finished in scheduled time;

- Proper turfing should be done at embankment slopes with local grasses (i.e Durba (*Cynodon dactylon*), Mutha (*Cyperus rotundus*)) and ensure regular monitoring of turf grasses till they mature;
- Collect soil from barren land and alternate sources like riverbed or nearer borrow pits at countryside as much as possible.

Residual impact:

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

8.4.10 Impacts on timber trees/ fruit trees

Impact:

413. Twelve water control structures would be replaced and one new structure will be constructed at the proposed locations which are connected to three rivers and numerous canals. About 91 numbers of trees of different size and heights need to be cut at the DS area (Table 8.4 instruction of new structure in DS13 and replacement of water control structure in DS3, DS5 and DS13).

Table 8.4: Number of timber and fruit trees to be affected for construction of drainage sluice

Structure ID of DS	Location name	Species name	Number of trees to be cut
1	Batultala	-	No timber/ fruit tree
2	Chairvanga	Sirish (*Albizia lebbeck*)	2
		Babla (*Acacia nilotica*)	2
3	Mohandhi	-	
4	Goalbathan	Gewa (*Exocearia agallocha)*	2
5	Bakultala	-	No timber/ fruit tree
6	Hauli	Khejur (*Phoneix sylvestris*)	4
		Gewa (*Exocearia agallocha)*	17
7	Kamarabad	Gewa (*Exocearia agallocha)*	15
8	Khalishabunia	Nona jaw (*Casurina sp*)	1
9	Boyratala	Keora (*Sonneratia apetala*)	4
		Bain ()	3
		Gewa (*Exocearia agallocha)*	5
10	Boyratala	Narkel (*Cocos nucifera*)	3
		Gewa (*Exocearia agallocha)*	2
		Koroi (*Albizia procera*)	4
11	Shibbati	Gewa *(Exocearia agallocha)*	5
12	Hatimpur	-	No timber/ fruit tree
13	Shirirampur	-	No timber/ fruit tree
			Total= 69

Mitigation:

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

- Approval need to be taken from DDCS&PMSC for clearance of vegetation
- Implement plantation at sluice ground and nearer foreshore mudflats after completion of construction works;
- Local species plantation by the upper and lower portion of the embankment side at proposed Drainage Sluice areas;

- Proper compensation will be given to the tree owners against tree felling according to Resettlement Action Plan (RAP);
- Social aforestation along the countryside of catchment by planting native species as well as salinity tolerant variety (like Desi neem (*Azadirachta indica*), Sirish (*Albizia lebbeck*), Babla (*Acacia nilotica*), Narikel (*Cocos nucifera*), Tal (*Borassus flabelifer*), and river side plantation by mostly mangrove species (i.e. Keora (*Sonneratia apetala*), Gewa (*Exocearia agallocha*), Golpata (*Nypa fruticans*, etc.) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works.

Residual Impacts:

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

8.4.11 Impacts on aquatic flora and fauna

Impact:

416. The proposed construction activities, i.e., construction and repair of drainage sluice, construction of flushing inlets and re-excavation of drainage canals will have direct impact on aquatic flora and fauna which are prone to be damaged. Aquatic biodiversity with flora and fauna specially submerged, floating plants, phytoplankton, zooplankton, etc., inside the re-excavated area may be affected. These interventions may temporarily affect a portion of surroundings mainly the aquatic ecosystem. Aquatic ecosystem as well as primary producer of phytoplankton, zooplankton, etc., would be regenerated when the water flow resumes after completion of construction works.

Mitigation:

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

- Contractor needs to prepare a flora and fauna protection plan
- Re-excavated spoil should be properly utilized. It may be used for re-sectioning of embankment (soil placing) and development of internal rural road;
- Construction activities should be started in dry season for re-excavation of canals;
- All types of activities should be finished in scheduled time;
- Keep untouched the deepest points of the khal as much as possible;
- River/khal bed sediment to be analysed for benthic fauna, and
- Implement tree plantation with local species at the khal bank side after re-excavation work.

Residual impact:

417. With the help of above mitigation measures, the impacts associated with re-sectioning of embankment will be **Moderate**

8.4.12 Impacts on vegetation for afforestation

Impact:

418. Inside polder area, Sustainable Development and Biodiversity Conservation (SDBC) project has taken about 2.5 ha area for plantation which is implemented by FD (Forest Department) and Upazila Nursery center (Paikgacha Sadar). Major species found in this

project along the river side are *Kewra, Kakra, Gewa, Sundari, Golpata, Bain, Caila,* etc. The community people (198 beneficiaries) have been sensitized to take-care of the plant for creating greenery and protecting vulnerable embankment from tidal surge and tidal flood. About 11 km. (25 ha.) in seven villages namely *Chairvanga, Batultala, Hitampur, Malakpuraikati, Shilirampur, Sibbati* (9 no. ward) and *Boyratala* have been selected for plantation program which will be implemented by BWDB under this project. Saplings collection from local nursery is a major concern to protect plant disease where specific non-tolerant species and mangrove plants should be collected. Inadequate distance between two saplings may hinder proper growth and cause outbreak of disease. This plantation will also protect the embankment from tidal flood and tidal wave action.

Mitigation:

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

- Local household should be involved in nursery program for proper seed germination and saplings collection;
- SBDC project authority, FD, BWDB, local people, local nursery should properly implement the plantation program;
- Eco friendly fiber materials like jute bag, ropes, etc. should be used for seed germination and to preserve saplings;
- All kinds of polyethylene bags and plastic ropes should be avoided as much as possible
- Keep proper distance between two saplings as per plantation guideline of BFD
- ; and
- Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation.
- Top soil at the construction/ rehabilitation sites will be stored and used for plantation and redevelopment of vegetation.

Residual Impacts

420. With the help of above mitigation measures, the impacts associated with foreshore afforestation will be **Low**.

8.4.13 Road Communication

Impact

421. A number of local people use this embankment as road for regular movement, carrying their goods for buying and selling and other purposes. The construction activities along the embankments will cause temporary disturbance in the movement of local people. The internal roadways are not sufficient to provide alternate means of transportation. Mobilization of equipment, machinery, material and workers may be transported to the Polder resulting additional traffic on roads and in waterways. Therefore, suffering of people will emerge temporarily.

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

Mitigation

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

- Re-sectioning work should be done section wise;

- Re-sectioning of the embankment would be done in half section-wise and the soil/earth will be placed in specified layers to facilitate the movement of the people;
- Work schedule will be finalized in coordination and consultation with local representatives and communities;
- Provision of clear demarcation of the work sites;
- Application of no authorized entry;
- Appropriate warning signs at strategic locations;
- Water way can be used especially along the river during construction period ;and
- All the works should be conducted in presence of Union Parishad Chairman and members.

Residual Impact

424. The impacts on the communication 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 Safety and Public Health Hazards

Impact

425. 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.

426. 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.

427. 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.

428. The significance of the potential impacts is assessed as **Major** on the basis of impact magnitude and receptor sensitivity.

Mitigation

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

- 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.
- The contractors will prepare site specific Camp management plans, an Occupational health and safety plan including training programs as well as an Emergency response plan with early warning system and training programmes to be approved by

the DDCS&PMSC Consultant and PMU. The Plan will also include awareness raising and prevention measures, particularly against communicable diseases such as hepatitis B and C, and HIV/AIDS. Besides:

- The WB'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; 24
-
- All temporary facilities including labor camps will meet minimum safety, hygiene and sanitation requirements (safe drinking water, proper sewage disposal, solid waste management, general cleanliness, protection against disease vectors, and protection against weather elements, firefighting, and other similar essential services).

- The labour shed/camps for accommodation of workers should be constructed according to the IFC/EBRD workers accommodation guidelines.[25]
- 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 labourers working on site and living in the temporary accommodation facilities. The health screening would entail normal review of physical fitness and also include a review of appropriate vaccinations. Workers would be given vaccinations as and when required.
- All site staff will undergo screening against communicable diseases. Communicable disease careers will not be employed at the working site.
- All employees need to carry out induction health and safety training prior to commencement of work. 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

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

[25] 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

hazardous activities. 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.

- 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 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;
- 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;
- 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 working 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 facility.
- Firefighting equipment will be made available at the camps and worksites.
- The camp staff will be trained for safety against firefighting.
- 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

430. 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.**

8.4.15 Labor force related impacts

Impact

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

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

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

Mitigation

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

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

Residual Impacts

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

8.4.16 Social and Gender Issues

Impact

436. 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.

437. 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

438. 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, Upazila Nirbahi Officer (UNO) and BWDB local officers.

- Liaison with the communities will be maintained.
- Cultural norms of the local community will be respected and honored.
- GRM will be established to address the grievances of local as well as outside laborers.
- Careful use of local natural resources and project resources, fuel, fuel-wood and electricity;
- Restrictions related to consumption of alcohol and drugs for foreign workers;
- Safe driving practices;
- Respect for the local community and its cultural norms in which laborers are working.
- Avoiding construction activities during Prayer time.
- Residual Impacts

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

8.4.17. Impact of manufacturing of CC block

440. For rehabilitation of Polder 16 under CEIP-1 only 0.3 km (300 meters) slope protection work will be undertaken.CC Block manufacturing plant will not be required. The block will be made manually.

441. But there will some of the impact of the activities like generating dusts, risks of accidents, possibility water and soil 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

8.5 Impact during post-construction phase

(a) Positive impact of the project in Operation Phase

8.5.1 Protect tidal flooding and storm surges

Impact

442. The proposed re-sectioning and retirement of embankment with new design section by CEIP, considering5thIPCC (2013) predicted global sea level rise, will protect the Polder area significantly from tidal flooding and further storm surges. At present, the embankment entire of the Polder is under designed and are in extremely vulnerable condition of the

Polder could be protected noticeably after implementation of the proposedinterventions under CEIP.

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

8.5.2 Erosion Protection

Impact

444. The proposed slope protection work and bank revetment works along the embankment would protect the Polder area from river erosion. If the proposed protective works are implemented adequately at the mentioned locations or chainage, the Polder will be protected significantly from erosion. Besides, the proposed afforestation along the rivers will also protect the river erosion by minimizing the wave action during high tide. Moreover, it will safeguard social livelihood and ensure socio-economic security, assets along with the ecosystem of the study area.

445. The significance of this potential positive impact has been assessed as Major on the basis of impact magnitudeand sensitivity to receptors.

8.5.3 Improve drainage system

Impact

446. After implementation of the proposed re-excavation of internal drainage khals and construction of drainage sluices as per design and specification by CEIP, the drainage system and situation of the Polder area would be improved significantly. The conveyance capacity of the khals will be increased which will increase the water retention of the Polder area.

8.5.4 Change of cropping intensity

8.5.5 Impact

447. Presently, cropping intensity of the polder area is 175%.The proposed intervention will protect the polder area from tidal and monsoon flooding and will arrest salinity intrusion. It would remove drainage congestion in the polder area. Besides, drainage congestion will be significantly reduced due to re-excavation of internal channels of the polder area as per proposed plan. Due to improved situation, farmers of the respective areas would feel encouraged to cultivate more crops in their lands. Thus, it is expected that cropping intensity would increase to 181% in the polder area in future.

8.5.6 Increase of crop production

448. Presently, total cropped area is 4,367 ha (NCA 2,496 ha) of which rice cropped area is 2,746 ha and non-rice cropped area is 1,622 ha. If the project is not implemented, the area would remain same as baseline or may be reduced. On the other hand, total crop production would be 20,178 tons of which rice would be 6,250 tons (31%) and non-rice will be 13,928 tons (69%). Adverse impact might occur due to siltation of river and drainage channels. The production should remain same as base situation or may be decreased (Table 8.6).

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

Crop name	Baseline/FWOP			FWIP			Impact	
	Cropped area (ha)	Yield (m.ton/ha)	Production (m.ton)	Cropped area (ha)	Yield (m.ton/ha)	Production (m.ton)	FWIP-FWO	% of Change
Local T. Aus	374	1.7	636	299	1.9	569	-67	-11
Local T. Aman	449	2.1	944	359	2.4	863	-81	-9
HYV T. Aman	1,423	2.3	3,272	1,636	3.2	5,235	1,963	60
HYV Boro	499	2.8	1,398	549	3.8	2,087	689	49
Total rice	**2,746**	**0**	**6,250**	**2,844**	**0**	**8,754**	**2,504**	**40**
Wheat	175	3.5	612	192	3.9	750	138	23
Pulse	274	1.5	412	261	1.9	495	84	20
Oil Seeds	200	1.3	259	210	1.8	377	118	45
Spices	225	5.2	1,168	236	6	1,415	247	21
Potato	100	16	1,597	110	18	1,976	379	24
S. Vegetables	374	14	5,240	393	15	5,895	655	13
W. Vegetables	150	16	2,395	157	17	2,672	277	12
Orchard	125	18	2,246	125	20	2,495	250	0
Total non-rice	**1,622**	**0**	**13,928**	**1,683**	**0**	**16,076**	**2,147**	**15**
Total Cropped Area	**4,367**	**0**	**20,178**	**4,527**	**0**	**24,829**	**4,651**	**23**

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

449. The cropped area would be increased if the project is implemented. The cropped area would be 4,527 ha of which rice cropped area would be 2,844 ha and non-rice cropped area would be 1,683 ha. The crop production might be boosted up significantly under the FWIP condition. The total crop production would be 24,829 tons of which rice would be 8,754 tons and non-rice would be 16,076 tons. The rice and non-rice production would be about 40% and 15% higher in FWIP than that of FWOP respectively. Production would be increased mainly due to re-excavation of chanels; constructions of drainage sluice and repair/replaced of flashing inlet with adoption of modern technology in crop production, change in cropping pattern etc. Crop production would be increase due to expansion of HYV T. Aman, HYV Boro, Wheat, Spices, Potato, Oil seeds and summer vegetables cultivation area. Additional 2,504 tons (40% higher) of rice and 2,147 tons (15% higher) of non-rice would be produced in FWIP over FWOP (Table 8.6).

<u>Enhancement</u>

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

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

8.5.7 Reduce soil salinity

Impact

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

8.5.8 Enhanced Species Evenness

Impact

452. The local people and fishermen informed that previously more than 100 freshwater and brackish fish species were available in the Polder area. Moreover, species compositions vary with different khals, water of which is regulated by different sizes of drainage sluice. It, therefore, is suspected that species evenness of these khals would be improved with the improved water resource condition (described in water resource section). The future changing scenarios are given in the following table (Table 8.7).

Table 8.7: Future scenarios of Species evenness

Sl	Site	Remarks of Species Evenness
1	Kobadak, Sibsa and Salta Rivers	Increased
2	Khals	Slightly Increased

Source: FGD and KII, CEGIS field survey, 2016

8.5.9 Increased fish migration and movement

Impact

453. Due to repairing and replacement of drainage sluices, fish will be able to migrate more easily between the rivers and khals.

8.5.10 Increased Fish Production

Impact

454. It has been found that habitat condition (area, water availability and water quality), fishing activities, stock susceptibility to fishing and proximity to market are highly influential parameters to enhance fish production in the khals controlled by different drainage sluices. It is expected that fish production from water bodies (river and khals) would improve with the future improvement of drainage sluices. Moreover, bank revetment and slope protection would strengthen the tendency of practicing Gher (Bagda and Golda), homestead pond and improved fish culture in the Polder area.

8.5.11 Employment Generation

455. Earthwork will demand a numerous labour that will create employment of day labour class people. Construction of sluice, regulator, slope, etc., will ensure the employment of both technical and non-technical labours. In the long run, agriculture production may be extended. Thus, agriculture may employ 30,607 laborers. The employment generation opportunities may assist in increasing their income and improve their living standard.

Enhancement Measures:

- Local technical and non-technical labor should be recruited in project activities;
- All the earthwork should be done manually to employ more labor.

8.5.12 Reduce vulnerability

456. The people of this Project area are vulnerable to natural disaster incidences since the project area is located in the coastal area. Several disasters hit this area and damaged properties, crops and lives. With implementation of the project, the incident of natural calamities such as water congestion, flood, etc., would reduce as well as the damage by natural disasters is expected to reduce.

Enhancement Measures:

- Raise the height of the embankment;
- Water control infrastructure should be constructed and maintain properly; and
- Constructing shelter house.

8.5.13 Mitigate Conflict

457. After implementation of the project conflict among foremen, peasants and fisherman will be settled due to mutual agreement/consent to abide by the DS operating manual and re-excavating the khals. Social dissatisfaction will remove and social brother-hood and sympathy will grow among them that will strengthen the social bondage among them.

Enhancement Measures:

- A monitoring committee should be formed or Water Management Group (WMG) to free the khals from forcible occupation and other social resources.

8.5.14 Road Communication

458. Some people of the polder area are fully dependent on embankment as a way of communication. After implementation of the project, a revolutionary change in communication system especially in road network will bring out that would minimize the sufferings and cost of goods transportation costs.

Enhancement Measures:

- Embankment should be repaired frequently;
- A committee should be formed to look after the road so that none can damage the road to inlet or outlet the wave.

(b) Negative Impact

8.5.15 Risk of Embankment Failure

Impact

459. Major reasons for breaching of embankment of the coastal region are runoff, wave action, tidal surge and unauthorized activities like entering saline/brackish water through pipes across the embankment by local people (mainly the Shrimp Cultivators) making the embankment weak. Lack of regular maintenance has created weak point at the sensitive locations of the embankment where the set back is less than 15m to 25m. Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously have accelerated the risk of embankment failure. The southern part of the embankment (Ch.41+000 to onward) is erosion prone (beside Kobadak river) and frequent storm surges make this region vulnerable. The eastern part of the embankment is in better condition due to deteriorated condition of Haria and Salta River.

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

Mitigation Measures

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

- Regular monitoring and rigorous/timely maintenance of the embankment and existing water control structures especially along the southern and western side of the Polder will be ensured. This monitoring should particularly be carried out before and after monsoon season;
- Proper dumping and compaction of soil should be ensured during re-sectioning of the embankment;
- Side slope protection works should be maintained with proper design and turfing;
- Available cyclone and flood shelter should be prepared as a contingency measure during emergency situation;
- WMG should secure fund to attend emergency situations; and
- Structural measures like geo bag and sand bag should be kept ready in the Upazila office for emergency need.

Residual Impacts

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

8.5.16 Increased use of agro-chemicals

Impact

463. At present, about 280 ha and 85 ha of lands are under Boro (HYV) and T. Aus (Local) rice cultivation respectively. Presently, 190 tons of chemical fertilizers and 2.8 tons (both granular and liquid) of pesticides are being used for cultivation of Boro and T. Aus. Implementation of the project interventions especially re-excavation of channels would cause expansion of area under irrigated cultivation of Boro (HYV) and T.Aus (Local) varieties of rice. It is expected that about 842 ha would come under cultivation of which Boro (HYV) and T.Aus (Local) area would be 434 ha and 408 ha respectively. The expansion of irrigated

area would increase use of chemical inputs including fertilizers and pesticides. It is estimated that additional 115 tons (115,080 kg) of chemical fertilizers and 1.7tons (1,717kg) of pesticides would be required 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.

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

Mitigation

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

- Capacity building and awareness rising of the farmers should be carried out to practice on Integrated Crop Management (ICM) in order to minimize usage of chemical inputs;
- Farmers group should have close contact with DAE for adoption of various measures of ICM;
- Farmers should be encouraged to use organic manure to increase soil fertility while avoiding water contamination;
- Water quality monitoring on a regular basis, take mitigative measures in case of any detection of water contamination/pollution;
- Sampling khal bed sediment for analysis of benthic fauna to assess th condition of the khal; and
- Farmers should be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.

Residual Impact

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

Table 8.5: Impact on Area (ha), Fertilizers (kg) and Pesticides (kg/ml) required in Present and Future Situation

	Baseline/FWOP							FWIP					Impact		
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)	Fertilizers(kg)	Granular pesticides (kg)	Liquid Pesticides(ml)
Local T. Aus	374	245	4	600	91,696	1,497	224,562	299	(75)	73,357	1,198	179,650	-18,339	(299)	-44,912
Local T. Aman	449	305	6	800	137,038	2,696	359,445	359	(90)	109,631	2,157	287,556	-27,408	(539)	-71,889
HYV T. Aman	1,423	395	7	900	561,930	9,958	1,280,346	1,636	213	646,219	8,180	128,035	84,289	-1778*	-1152311*
HYV Boro	499	600	8	1000	299,598	3,995	499,330	549	50	329,558	4,394	549,263	29,960	399	49,933
Wheat	175	475	5	800	83,014	874	139,812	192	17	91,315	961	153,794	8,301	87	13,981
Pulses	274	180	0	0	49,404	-	-	261	(14)	46,934	-	0	-2,470	-	-
Oil Seeds	200	353	2	400	70,463	399	79,844	210	10	73,986	419	83,837	3,523	20	3,992
Spices	225	420	8	1000	94,316	1,796	224,562	236	11	99,032	1,886	235,791	4,716	90	11,228
Potato	100	572	8	1200	57,089	798	119,767	110	10	62,798	878	131,743	5,709	80	11,977
S. Vegetables	374	602	7	1100	225,311	2,620	411,698	393	19	236,577	2,751	432,283	11,266	131	20,585
W. Vegetables	150	675	8	900	101,053	1,198	134,737	157	7	106,106	1,258	141,474	5,053	60	6,737
Orchard	125	243	6	1200	30,316	749	149,708	125	-	30,316	749	149,708	0	-	0
Total	**4,367**				**1,801,227**	**26,580**	**3,623,813**	**4,527**	**160**	**1,905,827**	**24,830**	**2,473,133**	**104,600**	**29**	**1,632**

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

*Note: * After implementation of the project Granular pesticides (kg) and Liquid Pesticides (ml) will reduice because of ICM use.*

8.6 Summary of Assessed Impacts

467. A summary of these impacts and their significance is presented in a **Table (Appendix E)**

9. Cumulative Impacts

9.1 Cumulative Impacts

468. 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.

469. 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.

470. 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.

471. 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 16. This Chapter attempts to analyze several indirect effects regardingseveral existing and ongoing project, as well as the implementation of different interventions proposed in Polder 16 under Coastal Embankment Improvement Project-1 (CEIP-1).Besides, necessary mitigation measures based on analysis of cumulative impactsare proposed.

9.2 ProposedCEIP-1 interventions on Polder 16

472. CEIP is a multi-phased effort laid down by the GoB to refocus its strategy on the coastal area by providing extra emphasis on frequent storm surges. The long term objective of the project is to increase the resilience of the entire coastal population against tidal flooding, salinity intrusion as well as natural disasters by upgrading the whole embankment system. The embankment improvement and rehabilitation approach will be adopted over a period of 15 to 20 years and in this regard a total number of 17 Polders have been selected through a participatory screening process. Among these 17 Polders (shown in Map 9.1), four Polders (Polders 32, 33, 35/1, 35/3) were selected for rehabilitation works under the first phase of CEIP (CEIP-1), which are being implemented. The other 13 Polders have undergone feasibility studies and would be implemented gradually in later phases.It is

assumed that Implementation of CEIP interventions may cause the following impacts of Polder 16 and its surrounding.

9.3 Synopsis of existing and on going projects around Polder 16

473. Apart from CEIP interventions, there are some other development projects nearby Polder 16, implemented locally or regionally. Activities of these projects may generate cumulative impacts on the polder in future. Table 9.1 shows a list of various projects in relevance with Polder 16, undertaken by different line agencies in Khulna, Bagerhat and Satkhira districts.

Table 9.1: List of water management projects

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

474. The projects (listed in Table 9.1) have or may have moderate sensitivities on some of the environmental or social components of Polder 16 are briefly discussed in the following sections.

9.4 Cummulative Impacts of proposed and existing projects

9.4.1 Impact on hydrology and flooding situation

475. Polder 16 is located adjacent to Polder 17/1 and Polder 17/2 which are located in the East and North direction and both Polders are subject to improvement work under CEIP-1. The proposed design crest levels of three Polders are same. The Salta River has divided Polder 16 and 17/2 and flowing at the downstream of Polder 16 and meets with the Sibsa River. The flow of this river has reduced to a great extent and almost dried at the upstream of both polders. The Salta river originates (offtake) from the Bhodra river and diurnal tidal effect occurs here. Due to the proposed interventions in Polder 16 and Polder 17/1, i.e., higher crest level (4.50 mPWD), renovation of hydraulic structures etc., will protect the Polders. At the same time, there will be a tendency of increased hydraulic pressure on the embankment of both Polders. Polder 16 has more peripheral rivers, i.e., Salta, Haria and Sibsa Rivers are connected to Bhodra River that may be a threat for this Polder. Salinity intrusion may also increase through peripheral canals such as Nasirpur khal, Protapkathi khal, etc., of Polder 16. Moreover, there is also a chance of excess siltation in the peripheral canals due to tidal effect of Salta, Harai and Sibsa Rivers.

Polder 17/2 is located at the upstream of Polder 16 that may also create hydraulic pressure on Polder 16. The proposed crest level of Polder 17/2 may divert storm surges through Salta River towards Polder 16 that may damage the embankment or create breaches at several points. There will always be a chance of salinity intrusion through the weak points of the embankment.

9.4.1 Cumulative Impacts of Blue Gold interventions on Polder 16

476. A total number of 12 Polders in Satkhira, Khulna and Patuakhali districts have been selected for implementation of the program in the first phase. Among this, only Polder 26 and Polder 29 are located in this region but not very close to Polder 16. There is less chance of direct impact on Polder 16 due to the proposed renovation works of Polders under Blue Gold project.

9.4.2 Impacts of Marine Shrimp Culture Technology

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

9.4.3 Impacts on rivers/water courses hydrology

478. 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.

9.4.4 Impacts on fish migration and biodiversity

479. 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.

9.4.5 Impact of construction materials on local markets

480. The construction materials to be required for re-sectioning of the embankment, water regulatory sluices, flushing sluices, and bank protection work will include soil, cement, and steel, stone and sand. The constructions materials especially sand and stone for construction of sluice gate and preparation of CC-block to be procured mainly from Sylhet

directly. Coarse sand available from Sylhet and stone chips (good quality) may be imported from neighbor countries. Cement and Steel will be procured from company sale market of Khulna or will be procured from cement factory and steel factory directly which would not cause any impact on market price. A small amount of sand and cement can be procured from the local market at adjacent to the polder or from Khulna during executions of construction works. No significant impact will be caused due to procurement of sand and cement from local market.

9.4.6 Impact on Livelihood

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

- **Mitigaton Measures:**Capital dredging as well as maintence dredging of periphery river and river bank protection should 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

9.5 Reciprocal Impact

482. Reciprocal impacts of Polder 16 have been assessed based on the model results conducted by the Institute of Water Modelling (IWM). IWM used rainfall runoff model, hydrodynamic models and storm surge model to analyze the existing meteorological situation of the Polder area. They have evaluated the physical changes in the related Polders, which may occur due to climate change. All data used in the model setup and calibration (including topography, soil maps, land use maps, and weather data, river network and cross-section, water level, discharge and salinity) were obtained from different sources. The climate change scenario RCP 8.5 is used in the models to simulate the climate change effects.

483. The runoff inside coastal Polder is simulated using NAM (Nodbor Afstroming Model) of DHI mike package. In the NAM model a lump watershed was defined, which considered the area of Polder 16. The contribution area of internal drainage system of Polder 16 was defined in the mike 11 network module. Taking 2012 as base year, the peak runoff occurred in the beginning of September with a magnitude of 17.43 cumec. The year 1978 was selected as design year corresponding to 10 year return period. The peak runoff without considering climate change is 146.57 cumec whereas 182.188 cumec pick runoff is obtained at the end of September considering climate change. The pick runoffs without considering climate change and considering climate change are 741% and 945% higher than the base year respectively.

484. 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.

485. From the simulation, flood free (FF) area and F0 (0~0.3m) area cover about 24.9% and 15.9% respectively without considering climate change. The fulfillment of drainage criteria requires about 85% to 90% FF and F_0 land, whereas 40.8% of FF and F_0 land was found from the simulation without climate change.

486. Considering the climate change scenario FF and F_0 land cover reduced to 4.5% and 11.7% respectively. The F_1 land class (water depth .03m to 0.9m) increased from 21.3% to 27.9%. It implies that about 83.8% land area remains submerged under climate change condition due to inadequate drainage system and needs further attention to obtain a climate resilient Polder management.

487. 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	2.72	3.00	0.28
25	3.37	3.59	0.22
50	3.86	4.03	0.17
100	4.43	4.47	0.04
Sidr	3.41	-	-
Aila	3.26	-	-

488. 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 coastal region of Bangladesh. The cyclonic wind speed corresponding to 10, 25, 50, 100 years return periods at Polder 16 are 20.03, 27.51, 32.75 and 37.84 m/s whereas during Sidr and Aila the wind speeds were 30.54 and 22.74 m/s respectively.

489. Wind speed for 25 years return period is used for determining the wave height considering climate change. The wave height simulated for Polder 16 is 0.30 m.

490. 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 3.41, 3.48, 3.53 and 3.58 m + PWD without considering climate change. Water levels considering climate change are 3.81, 3.89, 3.93 and 3.98 m +PWD respectively.

491. 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 4.22 m + PWD. The present crest level of the Polder varies from 3.61 to 4.04 m+PWD. So, the crest level is not sufficient to address the future climate change.

10. Environmental Management Plan

492. This Chapter presents the Environmental Management Plan (EMP) required for the rehabilitation activities in the Polder 16. The EMP essentially provides the implementation mechanism for the Environmental and Social mitigation measures discussed in Chapter 8.

10.1 Objectives of EMP

493. The basic objective of the EMP is to manage, prevent, and mitigate potential adverse impacts of Project interventions. The specific objectives of the EMP are to:

- Facilitate the implementation of the environmental and social mitigation measures identified during the present EIA and discussed in Chapter 8.
- Indicate the responsibilities of project proponent, contractors, consultants, and other members of the Project team for the environmental and social management of the Project;
- Define a monitoring mechanism and identify monitoring parameters to ensure effective implementation of the mitigation measures; and
- Assess environmental training requirements for different stakeholders at various levels. Describe communication and documentation requirements.

10.2 EMP Components

494. 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

495. These components are discussed in the following **Sections**

10.3 Institutional Arrangement

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

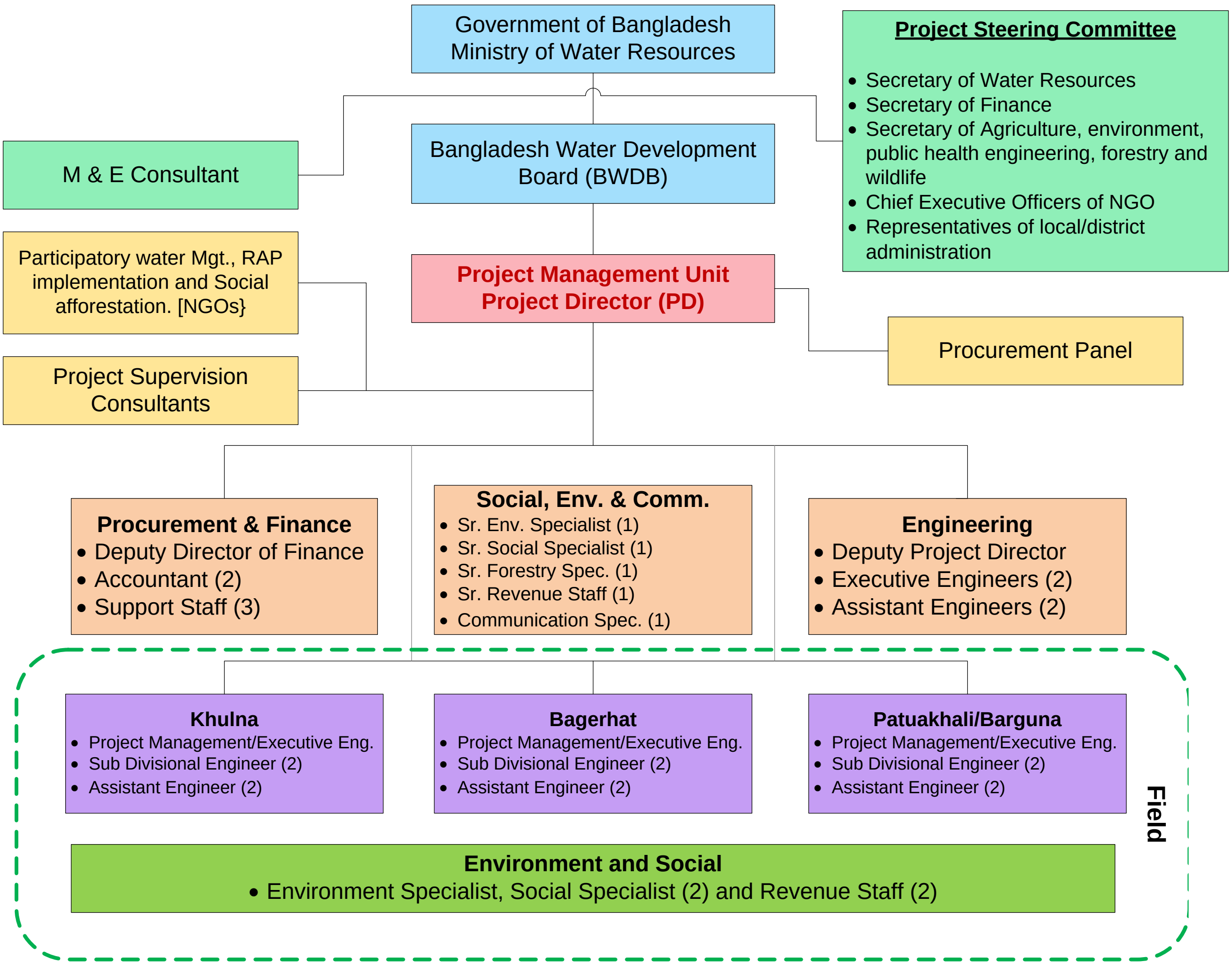


Figure 10.1: Organogram showing the institutional setup for CEIP-1

497. The institutional arrangements proposed to implement the EMP of Polder 16 are described in detail below.

10.3.1 Overall Responsibility

498. The overall responsibility of EMP implementation and fulfilling other environmental obligations during the Project implementation rests with the Project Director (PD). For this purpose, the PD will be supported by environmental and social staff of the PMU, Detailed Design Construction Supervision and Project Management Support Consultants (DDCS&PMSCs), and Contractors.

10.3.2 Construction Phase

<u>**Environment and Social Staff in PMU**</u>

499. As described in **Section 4.8**, the BWDB will set up the PMU to manage the Project implementation. The PMU 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 the implementation of the EMP. The Unit will include a Senior Environmental Specialist. One environment specialist will be posted at the field level to support all three activities of . The

ESCU will maintain liaison with WB safeguards team, regulatory agencies, and other stakeholders during the Project implementation. The ESC unit will also coordinate with the environmental staff of the DDCS&PMSC. In order to manage the EA process and EMP implementation effectively, the ESCU that has been established and made operational for Package-1 and Package-2 will be responsible before awarding the contract to contractor. The ESC unit will be responsible for updating the EIA after receiving the pending information.

500. Environment and Social Staff with Detailed Design Construction Supervision and Project Management Support (DDCS&PMS) Consultants

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

Contractor’s Environment Supervisors

502. 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

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

10.4 Mitigation Measures and Plan

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

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

505. Mitigation measures should be considered starting with the Environmental Assessment process. It is therefore 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 should specify precautions and mitigation measures for construction activities, and to be included with the EMP.

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

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

507. Mitigation measures during pre-construction, construction and post-construction operation phases have been presented in a tabular form in Table 10.1 .. The cost related EMP has been presented in a different Table afterwards.

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

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
Pre-construction phase			
Deteriorated environmental (air and noise) quality	• Construction material (sand) should be kept covered while transporting and stock piled and contractor should supervise. • The contractors need to be	Contractor	DDCS&PMSCSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	conscious avoid unnecessary honking of material carrying trawlers. • The contractors should be encouraged to move all construction equipment, machineries and materials during day time instead of night. • Exhaust emissions from trawler and equipment should comply with standards of DoE. • Mobilization trawler should have proper mufflers and silencers. • Water sprinkling and ramming the material stockyard should be done regularly. • Stockyard should be covered during non-working periods which should monitor by the contractor.		
Noise and vibration due to equipment mobilization	• Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards; • Vehicles and machinery should have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors should be assured, as needed; • Provision of PPE (ear muffs and plugs) to labor should be made.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Changes in land use	• Established all the construction camps within the area owned by BWDB; • Pay compensation/rent if private property is acquired on temporary basis, for which instructions should be specified in the tender document; • Construction of labor	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	shed/camp on government khas land; • Avoid impacts on local stakeholders. • Any areas used for borrow pits in the foreshore should be away from sensitive areas such as mangrove vegetation.		
Involuntary Resettlement	• Implement eviction of some households which are demanded by the project. These who lose their properties related to housing would be displaced to another location as their homestead related activities such gardening, orchard, fish culture would be affected. So, they would be affected economically.	Contractor	DDCS&PMSC, M&E Consultant and, BWDB
Impact on vegetation	• Labors should be made aware about local flora and faunal species; • Labor sheds and stock yards should be established on low vegetative or barren land as much as possible; • Plantation of local species in the selected areas as early as possible after finishing the construction works; • Labor should use gas cylinder for cooking; otherwise should collect fuel wood for their own purpose from local market (*Kopilmuni bazaar*, *Gadaipur bazaar*, *Paikghacha Bazaar*, *Kathbaria bazaar* etc.).	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Increased Vehicular Traffic during mobilization	• The contractor will prepare a traffic management plan (TMP) and obtain approval from the Detailed Design Costruction Supervision	Contractor	DDCS&PMSCSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	and Project Management Support Consultant (DDCS&PMSC) and Construction Supervision (CS) consultant. • Contractor also implement mobilization plan considering water vessels and launch movement in the external rivers and, avoid the launch movement time. • The TMP will be shared with the communities and will be finalized after obtaining their consent. • The TMP will address the existing traffic congestion particularly at the Ghorilal and Zorsing Bazars. • Ensure minimal hindrance to local communities and commuters. • The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. • The works of the first half when completed, and then of the other half will be undertaken. • Work schedule will be finalized in coordination and consultation with local representatives and communities. Specifically, union parishad members of the Polder. • Local routes will not be blocked as much as possible. If unavoidable, alternative routes will be identified in consultation with local community.		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Vehicular traffic should be limited in the Polder area and the embankment during off peak time. Appoint signalman during peak time/ School time (10:00am to 13:00pm) and weekly market days (Hatbar). Vehicular traffic should be moved in the Polder area and also on embankment during off peak time. No school time (10:00 Am to 13:00Pm) and day of marketing time (Hatbar) should be considered during vehicular traffic movement. • Keep provision of training on vehicular traffic moving pattern and management system for the local stakeholders using multimedia presentation and showing Video at different common population gathering places in the Polder area.		
During construction phase			
Deteriorated environmental (air and noise) quality	• Construction machinery should have proper mufflers and silencers. • Noise levels from the construction machinery should comply with national noise standards (residential zone) • Regular recording of noise level at workers' site and adoption of required measure accordingly including monitoring of noise level of the nearby community, where applicable. • Provision should be made for noise barriers at construction sites, schools/madrashas and	Contractor	DSCDDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	other sensitive receptors as needed. • Sprinkling of water and ramming on the material during construction. • Exhaust emissions from trawler and equipment should comply with standards • Restricting/limiting construction activities during the day time; • Provision of PPE (ear muffs and plugs) for labor; • Construction team will be instructed to properly use the equipment, to minimize noise levels; • Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.		
Generate noise and vibration	• The regulators should not be demolished during school time (8 am to 1 pm) particularly near the schools; • Restrict/limit construction activities during the day time; • Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards; • 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	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	vibration management plan as a part of pollution control plan • Contractor will prepare the Traffic Management Plan and will follow accordingly. • Vehicles and machinery should have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors should be assured, as needed; • Provision of PPE (ear muffs and plugs) to labor should be made; • Construction crew should be instructed to use the equipment properly, to minimize noise levels; • Camps will be located at a safe distance from communities; and • Liaison with the communities should be maintained and grievance redress mechanism should be established at the site.		
Safety and Public Health Hazards	• The contractors will prepare site specific Health, Safety and Environment (HSE) Plan and obtain approval from the Construction Supervision Consultants. The Plan should also include awareness rising and prevention measures for particularly for communicable diseases such as hepatitis B and C, and HIV/AIDS. • The WBG's EHS Guidelines will be included in the contract documents. • Liaison will be established with the Bangladesh	Contractor	DDCS&PMSCSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	Meteorological Department for early warning of storms and cyclones. Radio and television sets will be kept in all the labor camps for obtaining weather information. • Each contractor will prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan will be submitted to Construction Supervision Consultants for review and approval; • All workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities; • The construction sites will have protective fencing to avoid any unauthorized entry, where appropriate and possible • Health screening of employees would be a Contractor obligation prior to laborers working on site and living in the temporary accommodation facilities. The health screening would entail normal review of physical fitness and also include a review of appropriate vaccinations. Workers would be given vaccinations where required; • All employees need to carry out induction health and safety training prior to commencement of work.		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	OHS issues would be part of the employee training plan. Training would include the provision of appropriate written or visual materials to reinforce learning. Where illiteracy levels are high, OHS issues need to be covered more frequently than normal in toolbox talks; • Public awareness training and workshops on safety and health risks will be conducted for local communities prior to and during construction operations. • Observing statutory requirements relating to minimum age for employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activity. The construction contractor(s) would not hire people under the age of 18 on permanent contracts but would include short training activities for youth to the extent possible; • 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;		

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

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training; • Report regularly on the labor force profile, including gender, and location source of workers; • Report regularly on labor and working condition key performance indicators, for instance hours worked (regular and overtime) during period and cumulatively, hours lost, number and type of accidents, near misses, site audits and meetings; trainings, and use of labor grievance mechanism; • Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase; • Organize a training program and keep training registers for construction workers; • Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project. • Waste management plan to be prepared and implemented in accordance with international best practice. • Liaison with the community		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	will be maintained.		
Social unrest between Local worker and outside worker	• Proper awareness programs will be conducted through public consultation measures such as village scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, Upazila Nirbahi Officer (UNO) and BWDB local officers. • Liaison with the communities will be maintained. • Cultural norms of the local community will be respected and honored. • GRM will be established to address the grievances of local as well as outside laborers. • Careful use of local natural resources and project resources, fuel, fuel-wood and electricity. • Restrictions related to consumption of alcohol and drugs. • Safe driving practices. • Respect for the local community and its cultural norms in which laborers are working. • Avoiding construction activities during Prayer time.	Contractor	DDSCSPMSC, M&E Consultant, BWDB
Seasonal Impacts (Natural Hazards)	• Weather signals will be considered by the contractor during construction works. • Radio and television will be provided in all the labor sheds for receiving weather information through these media.	Contractor	DDCS&PMSC, M&E Consultant and, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• Ensuring rigorous standards for occupational health and safety are in place.		
Damage to Local Infrastructure	• The condition of the infrastructure being used for the construction and transportation activities will be regularly monitored. • All damaged infrastructure will be restored to original or better condition. • To take preventive measures for protection of local infrastructure.	Contractor	DDSCS&PMSC, M&E Consultant and, BWDB
Soil and water contamination	• Prepare and implement pollution control plan; • Workshops should have oil separators/sumps to avoid release of oily water; • Avoid repairing of vehicles and machinery near the crop field; • Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination; • Dispose contaminated soil appropriately ensuring that it does not contaminate water bodies or affect drinking water sources; • Contractor should ensure that there is no leakage, spillage or release of fuel, oil or any other affluent/waste on the ground or in the water from its construction machinery, vehicles, boats, launches, and barges. Contractor will regularly monitor the condition of its fleet; • Material borrowed from the river banks should be carried out sufficiently away	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	from the water edge, minimizing the possibility of loosing soil and wash out in the river; • Contractor will locate camps far away from communities and drinking water sources; • Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal); • Release treated wastes on ground or in water; • Recycle spoil and excavated material where possible; • Dispose spoil at designated areas with community consent; and • Construction material, demolished debris and excavated soil/silt should not be allowed to enter or disposed in the water bodies. • 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; refueling only within bunded area; • Preparation of Emergency Response Plan.		

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
Aggravated Sedimentation	• Small scale Tidal River Management (TRM) may be implemented where appropriate; • Contractor should protect untreated embankment slopes; • Contractor should excavate channels after dewatering them; • Contractor should not leave excavated earth and silt on channel banks; • Contractor should implement measures to protect channels from run-off from working areas and camps; • Contractor should obtain borrowing material from river banks in such a manner so that there is no increase of siltation in rivers, and should not leave loose soil after excavation; and • Regular monitoring of drainage khals is necessary to maintain the capacity. • Prepare 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.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Affects on agriculture crop production	• Compensation should be paid for any crop damage; • Contractor should avoid any activity in cultivation fields during construction; • Contractor should ensure that no vehicular	Contractor	DDCS&PMSC, M&E Consultant, BWDB, DAE

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	movements take place inside cultivation fields; • Contractor should ensure that no material is dumped inside cultivation fields; • Re-excavated soil of canals should not be dumped in agricultural land; • Contractor should maintain liaison with communities. • It should be considered a priority to establish borrow-pits in approved foreshore areas • Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps construction; and • Contractor would maintain liaison with communities; • Implement drainage and erosion control measures at the work sites near agricultural fields.		
Affects on irrigation	• Contractor should construct bypass channels before construction of drainage sluices; • Sequence of work at the drainage sluices, inlets and water canals should be carefully planned to avoid irrigation disruption; • Contractor should ensure that no negative impacts falls on crop irrigation; • Contractor should maintain liaison with communities; and • Contractor should work during dry season Spawning/breeding period of commercially important fishes should be considered prior to demolishing/construction of	Contractor	DDCS&PMSC, M&E Consultant, BWDB and DAE

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	drainage sluices.		
Change in Migration Behavior	• Replacement should be conducted during the dry season (November-May); and • Contractor might maintain liaison with experienced fishermen	Contractor	DDCS&PMSC, M&E Consultant, BWDB, DoF
Stock Susceptibility of Fish to Catch	• Replacement should be conducted during the dry season (November-May); • Close monitoring should be conducted during the construction by local commercial fishermen under the supervision of DoF so that allowable biological catch can be ensured; • Regular sampling and analysis of the benthic fauna as an indicator of the health of the ecosystem.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Reduced Fish Migration Time and Extent	• Sluice gate operation manual should be prepared for allowing fish migration in time; • Experienced commercial fishermen should be appointed in WMOS for Operation and Maintenance of sluice gate; • Provide training to WMOs; and • Periodic fish catch monitoring to assess fish stock and species composition and take initiatives, if anything wrong detected.	Contractor	DDCS&PMSC, M&E Consultant, BWDB, DOF
Impacts on undergrowth herbs and shrubs	• Low vegetative or barren land should be used to the extent possible for CC block manufacturing in construction yard; • Plantation of mangrove species (Kaora, Ora, Bain,	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	Kakra, etc.) along the embankment side after completion of construction activities; • Ensure conservation/protection measures at the embankment-river slope side to facilitate natural regeneration of mangrove saplings • All types of construction works should be finished in scheduled time; • Proper turfing should be done at embankment slopes with local grasses (i.e. Durba (*Cynodon dactylon*), Mutha (*Cyperus rotundus*) and ensure regular monitoring of turf grasses till they mature; • Collect soil from barren land and alternate sources like riverbed or nearer borrow pits at countryside as much as possible.		
Impacts on timber trees/ fruit trees	• Approval need to be taken from DCSC for clearance of vegetation • Implement plantation at sluice ground and nearer foreshore mudflats after completion of construction works; • Local species plantation by the upper and lower portion of the embankment side at proposed DS area; • Give proper compensation to the tree owners against tree felling; • Social aforestation along the countryside of catchment by planting native species as well as salinity tolerant variety (like	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	Desi neem (*Azadirachta indica*), Sirish (*Albizia lebbeck*), Babla (*Acacia nilotica*), Narikel (*Cocos nucifera*), Tal (*Borassus flabelifer*), and river side plantation by mostly mangrove species (i.e. Keora (*Sonneratia apetala*), Gewa (*Exocearia agallocha*), Golpata (*Nypa fruticans*, etc.) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works.		
Impacts on aquatic flora and fauna	• Contractor needs to prepare a flora and fauna protection plan • Re-excavated spoil should be properly utilized. It may be used for re-sectioning of embankment (soil placing) and development of internal rural road; • Construction activities should be started in dry season for re-excavation of canals; • All types of activities should be finished in scheduled time; • Keep untouched the deepest points of the khal as much as possible; • River/khal bed sediment to be analysed for benthic fauna, and • Implement tree plantation with local species at the khal bank side after re-excavation work.	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Impacts on vegetation for afforestation	• Local household should be involved in nursery program for proper seed germination and saplings collection;	Contractor	DDCS&PMSC, M&E Consultant, BWDB andDepartment of Forest

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	• SBDC project authority, FD, BWDB, local people, local nursery should properly implement the plantation program; • Eco friendly fiber materials like jute bag, ropes, etc. should be used for seed germination and to preserve saplings; • All kinds of polyethylene bags and plastic ropes should be avoided as much as possible Keep proper distance between two saplings as per plantation guideline of BFD; and • Care should be taken for physical and biological control of plant disease while raising nursery and sapling plantation. • Top soil at the construction/ rehabilitation sites should be stored and used for plantation and redevelopment of vegetation.		
Road Communication may be hampered	• Re-sectioning work should be done section wise; • Re-sectioning of the embankment would be done in half section-wise and the soil/earth will be placed in specified layers to facilitate the movement of the people; • Work schedule will be finalized in coordination and consultation with local representatives and communities; • Provision of clear demarcation of the work sites; • Application of no authorized	Contractor	DDCS&PMSC, M&E Consultant, BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	entry; • Appropriate warning signs at strategic locations; • Water way can be used especially along the river during construction period ;and • All the works should be conducted in presence of Union Parishad Chairman and members.		
Impact of manually manufacturing of CC block	• Sprinkling of water will be ensured to control dusts when required • Ensuring use of Personal Protective Equipment (PPE) by the workers • Ensuring proper management of wastes and waste water. • Ensuring proper quality of equipment/vehicles to reduce noise level	Contractor	DDCS&PMSC, M&E Consultant and BWDB
Post-construction/Operation phase			
Increase Salinity Intrusion due to Leakage of Regulators	• Formation of WMOs in concern with the structures and embankment • Regular monitoring and careful maintenance of the water control structures will be ensured. • Concern WMOs and BWDB should monitor for further installation of unauthorized hand tube-well on embankment by gher owner. • Standard operating procedures will be prepared	BWDB with the help of DAE	BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
	and implemented for the water control structures. These procedures will be translated in bangle as well. • Capacity building of WMOs will be carried out.		
Hampered fish migration	For Sluice gate operation a manual will be prepared for facilitation of fish migration • WMO will be provided training to follow the manual to facilitate fish migration • Transferring juvenile fish from rivers to Polder.	BWDB with the help of DoF	BWDB
Risk of embankment failure	• Regular monitoring and rigorous/timely maintenance of the embankment and existing water control structures especially along the southern and western side of the Polder will be ensured. This monitoring should particularly be carried out before and after monsoon season; • Proper dumping and compaction of soil should be ensured during re-sectioning of the embankment; • Side slope protection works should be maintained with proper design and turfing; • Available cyclone and flood shelter should be prepared as a contingency measure during emergency situation; • WMG should secure fund to attend emergency situations; and • Structural measures like geo bag and sand bag should be kept ready in the Upazila office for emergency need.	Contractor	DDCS&PMSC, BWDB
Soil and water	• Capacity building and	BWDB with help	BWDB

Potential Impacts	Mitigation Measures	Responsible Agency for implementation of mitigation	Monitoring/Supervision Agency
contamination (increased use of chemical inputs) and reduced soil fertility	awareness rising of the farmers should be carried out to practice on Integrated Crop Management (ICM) in order to minimize usage of chemical inputs; • Farmers group should have close contact with DAE for adoption of various measures of ICM; • Farmers should be encouraged to use organic manure to increase soil fertility while avoiding water contamination; • Water quality monitoring on a regular basis, take mitigative measures in case of any detection of water contamination/pollution; • Sampling khal bed sediment for analysis of benthic fauna to assess th condition of the khal; and • Farmers should be encouraged to cultivate leguminous crops to enhance the soil quality as well as soil productivity.	of DAE	

508. Based on the experience, a generic Mitigation Measures for EMP has been presented in Table 10.2 for reference. This can be used as a reference material for comprehending the scope of the EMP.

Tabel 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 should be identified. ▪ Selection of Borrow pit Areas or soil borrowing areas for earthen material collection. ▪ No objection from land owner/Revenue authorities as applicable

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	▪ Contractor shall ensure good quality borrow materials used for embankment filling ▪ Disposal of excess soil should be done at site with no objection from DoE and local authority
Borrowing of Earth	▪ Selection of Borrowing Area ▪ Borrowing of soil from 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 from the following areas: ▪ Lands close to toe line and within 500 m from toeline. ▪ Irrigated agricultural lands (In case of necessity for borrowing from such lands, the topsoil shall be preserved in stockpiles). ▪ Grazing land. ▪ Lands within 1km of settlements. ▪ Environmentally sensitive areas such as reserve forests, protected forests, sanctuary, wetlands. A distance of atleast 500 m should be maintained from such areas. ▪ Unstable side-hills. ▪ 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 borrowing areas before commencing the borrowing activity that provide the basis of the redevelopment plan. ▪ Chainage along with offset distance; ▪ Area (Sq.m); ▪ Photograph and plan of the borrowing area from all sides; ▪ Type of access/width/kutcha/pucca, etc. from the roadway; ▪ Soil type, Slope/drainage characteristics; ▪ Water table of the area 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 rquired 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 removal of excavated material due to runoff. ▪ The followings precautions shall be undertaken during quarry operations. ▪ Overburdened machinery/manpower shall be removed. ▪ During excavation slopes shall be flatter than 20 degrees to prevent sliding. ▪ In case of blasting, the procedure and safety measures shall be taken as per DOE guidelines. ▪ The Contractor shall ensure that all workers related safety measures are 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 Material from River Dredging	▪ Deposition of dredged material should be far 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. ▪ Apply biotechnical engineering where possible, for example geotextiles, may be used to stabilize the material and aid re-colonization. ▪ Other possibilities include: drying and spreading the spoil over the adjacent land, which can improve soil fertility in some cases, and also to other 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).
Water logging	▪ Water logging should not be allowed especially near the waste storage areas and construction camps ▪ Discard all storage containers capable of storing of water, after use or store them in inverted positions. ▪ Reinstate relief and landscape ▪ Monitor drainage pattern after high down pouring and recession flood ▪ Connect water pockets to the nearest drainage structures/canals
Soil Erosion and siltation	▪ The Contractor shallwater 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) ▪ All working 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
Dredging	▪ Disturbance can be minimized if mechanical excavators work from a particular bank. If the channel is too wide, the digger must work within the channel. Disruption can be minimized by diverting the river down one side of the channel and dredging the other side while it is 'dry'. Smaller plant equipment generally limits the level of impact on bank-side and in-stream habitats.
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 used for curing 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 should 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

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	▪ Cover haul vehicles carrying dusty materials (cement, borrow and quarry) moving between outside and 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 transportation ▪ Service all vehicles regularly to minimize emissions ▪ Materials will be transported to site in off peak hours.
Construction activities	▪ Water the material stockpiles, access roads and bare soils when neededto 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 ▪ 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 manufacturer’s 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 locate 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. ▪ Noise monitoring of nearby community to be carried out, where applicable
Construction activity	▪ Notify adjacent landholders/Schools prior to any typical noise events during of daylight hours ▪ Employ best available work practices on-site to minimize occupational noise levels ▪ Install temporary noise control barriers where appropriate ▪ Plan activities on site and deliveries to and from site to minimize impact ▪ Monitor and analyze noise and vibration results and adjust construction practices as required ▪ Avoid working during 09:00pm to 06:00 am within 500m from the existing residences.
ECoP 5: Agriculture Management	
Loss of Top Soil	▪ Soil from fallow lands/ non-agricultural lands will be used in earthwork in embankments ▪ Collect/strip top soil before earth filling and store and reuse it for final

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	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 physic-chemical and biological activity of the soil. ▪ The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites ▪ Topsoil stockpiles will be monitored and if any will adverse conditions be identified. The corrective actions for this will include: ▪ Anaerobic conditions-turning the stockpile or creating ventilation holes through the stockpile; ▪ Erosion – temporary protective silt fencing will be erected;
Soil salinity	▪ Use of duckweed will remove soil salinity ▪ Flushing with pre-monsoon rain water will reduce soil salinity. ▪ Saline tolerant crops need to be cultivated. ▪ Environmentally and socially responsive shrimp farming e.g. shrimp-rice farming system is encouraged. ▪ Increasing upland discharge of fresh water will push back ingress of saline water from the sea ▪ Green manure application is promoted ▪ Ground water abstraction for shrimp farming will be avoided.
ECoP 6: Fisheries Management	
Earth work for constructing by pass canal	▪ Earth work for by pass should be done in dry season. ▪ By-pass canal should be dismantled just after completing the construction and repairing of sluice gates and re-excavation of khals.
Bailing out of water by manual labor or pump	▪ Bailing out of water should be done by constructing the compartments in the khals. ▪ Entire khals should not be closed during construction work.
Construction works for drainage sluice gates and re-excavation of khals	▪ Construction and re-excavation should be avoided during spawning of the fishes and peak time of fish and shrimp culture in gher. ▪ Construction work should be done in winter and early dry season (November to February). ▪ Critical breeding area of small indigenous fish species (SIS) will be identified and declared as sanctuaries. ▪ Creation of some deeper part in the khals and declared as sanctuaries where brood fish and juveniles may stay during dry season and can breed in the following year. ▪ Soil removed from the bottom of khals should be placed in safe distance from the bank of khals and compact to avoid the wash out during rainy season. ▪ Open the sluice gates just after completion of construction and repair work to flow the water.
ECoP 7: Ecology Management	
Clearances of vegetation	▪ Labor sheds and stock yards should be established in low vegetative area or barren land as much as possible. ▪ Labors should be made aware about local faunal species

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	▪ Labor should be encouraged to collect fuel wood for their own purpose from local market (Kopilmuni bazzar, Gadaipur bazzar, Paikghacha Bazaar, Tala bazaar and Kathbaria bazaar, etc.) ▪ Low vegetative or barren land should be used as much as possible for CC block manufacturing in construction yard ▪ Plantation with mangrove species (Kaora, Ora, Bain, Kakra etc.) along the embankment side after completing of construction activities. ▪ All types of construction works should be finished in schedule time. ▪ Proper turfing should be implemented at embankment slopes with local grasses (i.e., Durba *(Cynodon dactylon*), Mutha (Cyperus rotundus)) and ensure regular monitoring of turf grasses till they mature. ▪ Collect soil from barren land and alternate source like riverbed or nearer borrow pits at countryside as much as possible ▪ Implement plantation at sluice ground and nearer foreshore mudflats after completion of construction works ▪ Social aforestation should be considered out along the countryside using native species as well as salinity tolerant varieties (i.e Desi neem (*Azadirachta indica*), Sirish (*Albizia lebbeck*), Babla (*Acacia nilotica*), Narikel (*Cocos nucifera*), Tal (*Boassus flabelifer*), and river side plantation mostly using mangrove species (i.e. Kaora (*Sonneratia apetala*), Gawa (*Exocearia agallocha*), Golpata (*Nypa fruticans*), etc.) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works. ▪ Re-excavated spoil should be properly utilized. It may be used for re-sectioning of embankment (soil placing) and development of internal rural road ▪ Construction activities should be started in dry season from April to June for re-excavation of canals ▪ All types of activities should be finished in scheduled time ▪ Keep untouched the deepest points of the khal as much as possible. ▪ Implement tree plantation with local species at the khal bank side after re- excavation work
Outbreak plant diseases	▪ Local people should be involvedin awareness comparing in transit nursery program for proper seed germination, saplings collection and preservation. ▪ Care should be taken for pest management, excessive use of fertilizer, biological control of plant disease while raising nursery and sapling plantation ▪ SBDC project authority, FD, BWDB, local people, local nursery owner should collaboratein plantation program with control of plant disease ▪ Eco friendly fiber materials like jute bag, ropes etc. should be used for seed germination and to preserve saplings ▪ Make local people aware about plant pathogen, indication, cause and distribution of plant disease of affected species ▪ All kinds of polyethylene bags and plastic ropes should be piled up in a pit for disposal in a proper way ▪ Aware labors about plant conservation who are engaged for afforestation activities
ECoP 8: Socio- Economicl Management	
Selection of location and construction of labour shades with allied facilities	▪ The labour shade should be located at area which are acceptable from environmental, cultural or social point of view. ▪ Consider the location of construction camps away from communities in order to avoid social conflict in using the natural resources such as

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. ▪ Responsible local authorities for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters ▪ Ensure adequate housing for all workers ▪ Safe and reliable water supply ▪ Treatment facilities for sewerage of toilet and domestic wastes ▪ Storm water drainage facilities ▪ Disposal of solid wastes should be ensured
Solid Waste Management	▪ Ensure proper collection and disposal of solid wastes within the construction camps ▪ Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. ▪ Establish waste collection, transportation and disposal systems with the manpower and equipment/vehicles needed. ▪ All solid waste will be collected and removed from the work camps and disposed in approved disposal sites
Health and Hygiene	▪ Awareness should be built up about communicable diseases and remedies among the labour and the local people. ▪ Personal Protective Equipment (PPE) should be ensured during work. ▪ The first aid must be provided among the labour and it should be placed where anyone can easily access. ▪ Providing training of all workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work ▪ Place display boards at strategic locations within the camps containing messages on best hygienic practices ▪ Occupational Health and Safety (OHS) should be followed strongly including safe drinking water, displaying poster proper instruction of first aid boxes, emergency phone number, safety equipment etc.
Payment of Wages	▪ The payment of wages will be as per the Minimum Wages Act, Department of Labor, and Government of Bangladesh for both male and female workers. ▪ To display the minimum wages board in local languages at labour camps sites. ▪ Wages will be paid to the labourers only in the presence of BWDB staff; ▪ Contractor is required to maintain register for payment of labor wages with entry of every labor working for him. Also, he has to produce it for verification if and when asked by the Engineer, EMU and/or the concerned BWDB staff/Engineer ‘s representative

10.5 Chance-Find Procedures for Physical Cultural Property

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

- ✓ Stop work immediately following the discovery of any materials with possible archeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;
- ✓ Protect artifacts as well as possible using plastic covers, and implement measures to stabilize the area, if necessary, to properly protect artifacts;

- ✓ Prevent and penalize any unauthorized access to the artifacts; and
- ✓ Restart construction works only upon the authorization of the relevant authorities (e.g., Upazila Nirbahi Officer, Deputy Commissioner and Department of Archeology).

10.6 Monitoring Plan

510. Extensive monitoring of the environmental concerns of the CEIP project will be required as per World Bank guideline. The monitoring program will help to evaluate: (i) the extent and severity of the environmental impacts against the predicted impacts and baseline; (ii) the performance of the environmental protection measures or compliance with pertinent rules and regulations; (iii) trends in impacts; and (iv) overall effectiveness of the project environmental protection measures. The monitoring plans should 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 should be created, which will help to evaluate the impacts easily.

511. The Monitoring activities during design/preconstruction period are:

(i) checking the contractor’s bidding documents, particularly to ensure that all necessary environmental requirements have been included; and

(ii) checking that the contract documents’ (Construction 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 propertime.

512. Construction environmental monitoring 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.

513. Post project monitoring evaluation will be carried to evaluate the impacts of the Project during first three (3) years of operation of the Project. Regular monitoring of the condition of the embankment, drainage structures and slope protection structures and afforestation are important from an environmental management point of view. In addition to this activity, information on the locations, type and consequences of flooding, erosion, flora and fauna mortality, availability of fish, occupational shift, migration is required. Recommended air, noise and water quality monitoring, greening and landscaping and community feedback are also included in the Monitoring Plan. The monitoring plan and details of monitoring locations for environmental condition indicators of the project during the construction and operation stage are presented in Table 10.3 and Table 10.4.

Table 10.3: Environmental Monitoring Plan

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
During Pre-Construction					
Public grievance	All displacement area in the polder	Complaints register	During project time	BWDB	BWDB, Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
During Construction					
Sources of Material	Work Site	Possession of official approval or valid operating license of materials suppliers (Cement, soil).	Before an agreement for the supply of material is finalized.	Contractor	DDCS&PMSC, 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
Erosion	Side slopes of the embankments and material storage sites	Visual inspection of erosion prevention measures and occurrence of erosion	At the end of filling activity	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of spills at storage facilities and workshops	Monthly	Contractor	DDCS&PMSC, BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	DDCS&PMSC, BWDB
Air quality (dust)	Construction site	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Daily	Contractor	DDCS&PMSC, BWDB
	Material	Visual	Monthly	Contractor	DDCS&PMSC

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
	storage sites	inspection to ensure dust suppression work plan is being implemented			
Noise	Construction sites	Physical inspection to ensure good standard equipment are in use and at nearby communities (where 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 from each river of each polder	Sampling and analysis of surface water quality	Only dry season	Contractor through a nationally recognized laboratory	DDCS&PMSC, M&E Consultant, BWDB
Drinking Water Quality(TDS, Turbidity, pH, FC, 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
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid wastes and also inspection of wastes deposition at designated site	Weekly	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Flora and Fauna	Project area	Survey and comparison with baseline environment	Yearly	Contractor through nationally recognized institute	DSC DDCS & PMSCDSCDDCS&PMSC, M&E Consultant and, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
Reinstatement of Work Sites	All Work Sites	Visual Inspection	After completion of allworks	Contractor	DSC DDCS & PMSC 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, 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
Habitat Condition	Bank side of Kobadak, Sibsa , Salta Rivers and Khals	Observation	Four (4) times in year (dry & wet season)	Contractor	DoF, BFRI, DDCS&PMSC M&E Consultants and BWDB
Fish Migration		Catch Assessment Survey	Two (2) times of year (dry & wet season)	Contractor	DoF, BFRI, DDCS&PMSC M&E Consultants andBWDB
Clearance of vegetation	Each of construction sites (32 nos.) at embankment (43 km.) and proposed khal bank (42 km.) of both side	Survey and comparison with baseline environment	Quarterly	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Engaged local labour in re-excavation	Khals Re-excavation and embankment resactioning area	Checking address in record book and National Indenty Card or Chairman certificate	During routine monitoring	Contractor	BWDB and Consultant
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD,	Water sample from each river around & in each	Sampling and analysis of surface water quality	Only dry season	BWDB through a nationally recognized	M&E Consultant

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				To be Implemented by	To be Supervised by
COD etc)	polder			laboratory	
Air Quality (Dust)	At the baseline monitoring site	24 hours Air quality monitoring	Yearly	BWDB through a nationally recognized laboratory	M&E Consultant
Flora and Fauna specially fisheries	In the project area	Detailed species assessment and compare with baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant
Agriculture	In the project area	Compare the production with the baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant
Operation of hydraulic structure	In the project area	Visual inspection and public feedback	Yearly	BWDB	M&E Consultant
Crop production	In the polder area	Compare the production with the baseline	3 (Three) cropping seasons	BWDB through a nationally recognized institution	M&E Consultant
Soil quality	In the Polder area	Compare the soil quality with the baseline	Two (2) times in a year (dry & wet season)	SRDI	M&E Consultant
Soil salinity	In the polder area	Compare the soil salinity with the baseline	Once (1) times in a year (dry season)	SRDI	M& E Consultant
Habitat Condition	River bank side of Kobadak, Sibsa, Salta Rivers and Khals	Observation	Four (4) times in a year (dry & wet season)	Consultancy farm	DoF, BFRI, DDCS&PMSC , M&E Consultants and BWDB
Fish Migration		Catch Assessment Survey	Two (2) times in a year (dry & wet season)	Consultancy farm	DoF, BFRI, DDCS&PMSC, BWDB
Fishing Activities and Stock susceptibility		Catch Assessment Survey	Two (2) times in a year (dry & wet season)	Consultancy farm	DoF, BFRI, DDCS&PMSC, M&E Consultants andBWDB
Golda Gher and Fish Farm	Polder Area	Farm Survey	Four (4) times in a year (dry & wet season)	Consultancy farm	DoF, BFRI, DDCS7PMSC, M&E Consultants, BWDB

(Source: LGED, 2011)

Table 10.4: Environmental Monitoring Plan during Construction and Operation of Afforestation

Parameter	Locations	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
During implementation					
Plant species selection	Paikghacha purashava (Number of six nursery has been located) Kalilnager Union (Number of five nursery has been located)	Visual quality checking of selected plant species and to be planted of selected areas	Before plantation	Contractor	DDCS&PMSC, BWDB, M&E Consultant
Waste Management	Afforestation sites are: a) Chairvanga, Batultala, b) Hitampur, Malakpuraikati, c) Shilirampur, d) Sibbati (9 no. ward), Boyratala 2. Nursery	Poly bags, debris etc waste materials are disposed off at selected sites	Weekly	Contractor	DDCS&PMSC BWDB, M&E Consultant
During Operation and Maintenance					
Growth and death ratio of planted saplings and turfed grasses	Proposed afforestation areas are a) Chairvanga, Batultala, b) Hitampur, Malakpuraikati, c) Shilirampur, d) Sibbati (9 no. ward), Boyratala villages	Survey and comparison with baseline environment	Yearly	Contractor	DDCS&PMSC, M&E Consultant, BWDB
Fencing preparation		Visual inspection of fencing condition	Monthly		
Faunal diversity	Proposed afforestation area	Survey and comparison with baseline environment	Yearly		DDCS&PMSC, M&E Consultant, BWDB

Qualitative Spot Checking Indicators

514. Moreover, a rapid environmental monitoring will be carried out according to the following checklist as given below in terms of visual judgment during field visit as an indirect control to implement Environmental Mitigation plan. Table 10.2 can be followed during project construction and operation process.

10.7 Documentation, Record keeping and Reporting

10.7.1 Record Keeping

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

10.7.2 Monitoring Records

<u>Quantitative Physical Monitoring</u>

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

- ✓ Sampling points;
- ✓ Dates and times of sample collection;
- ✓ Test results;
- ✓ Control limits;
- ✓ "Action limits" (circa 80 percent of the control limits) at which steps must be taken to prevent the impending breach of the control limit; and
- ✓ Any breaches of the control limits, including explanations if available.

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

<u>General Site Inspections and Monitoring</u>

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

10.7.3 Information Sources

519. A complete and up-to-date file of all relevant sources of information should 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 (Material Safety Data Sheets) for all hazardous substances used on the plant;
- ✓ Manufacturers' operating manuals for all the environmental monitoring equipment;
- ✓ Current calibration certificates for all the equipment that requires calibration by an external organization; and
- ✓ The latest version of this Environmental Management and Monitoring Plan.

10.7.4 Non-Compliance Report

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

521. A copy of each completed NCR would be help on file by DDCS & PMSC, to be replaced by the reply copy when it is received. A record of corrective actions would also be made and tracked to their completion.

10.7.5 Monthly Internal Reports by DDCS & PMSC

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

- ✓ Progress in implementing this EMP;
- ✓ 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.

10.7.6 Half Early Progress Report by BWDB

523. ESC of BWDB will prepare the half yearly progress report on environmental management and will submit to the World Bank for review during construction phase. The progress report will summarize the information presented in Article 10.6.

10.7.7 Environmental Audit Report & Third Party Monitoring Report

524. It is expected that BWDB will have an annual environmental audit carried out by the Third Party Validation team. Besides, an 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 during the project. The Third Party Validation and Monitoring report will be shared with the Bank. The Bank would also supervise the environmental compliance as part of their regular implementation support missions.

10.8 Contractual arrangements for EMP implementation

525. A fixed Budget will be assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting. The contractor needs to submit a Construction Environmental Action Plan (CEAP) based on the EIA including the EMP in line with the construction schedule and guideline. The CEAP needs to be reviewed by the supervision consultant and get cleared by BWDB and World Bank.

- ✓ Guideline to Incorporate Environmental Management in Bid Document & Preparation of EAP
- ✓ Prepare cost estimates, to be incorporated in Bid Documents.
- ✓ The EMP 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.

526. The contractor has to ensure that sufficient numbers and good quality Personnel Protective Equipment (PPE), should be provided to staff and labor all times as defined in the labor codes read along with the EMP. Damage shall be levied at the rate of Tk. 1000/- per day for non-conformity as per the decision of the Engineer.

10.8.1 Guideline for Compensation and Contingency Plan during Project Period

527. Compensation becomes necessary when project impacts cannot be mitigated satisfactorily. This can be paid in cash or kind and the emphasis should 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 should be given as per provision of the Resettlement Action Framework. Any disputes over the compensation should be handled by the Grievance Redress Committee.

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

- ✓ Embankment failure during a flood – keep sufficient number of sand bags in reserve.
- ✓ Bank caving/erosion – keep sufficient number of concrete blocks and sand bags in reserve.
- ✓ Have an emergency evacuation plan for the people in the line of danger.

10.9 EMP Implementation Cost

529. The estimated costs for the environmental management and monitoring activities are set in **Table 10.5.**

Table 10.5: Tentative Cost Estimates for Environmental Management

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
1.	Construction of alternative or bypass channels at each construction sites.	5,061,053	63.2631625	Contrctor	During pre-construction and construction
2.	Installation of fugitive particulate matter system and Spraying water on embankment/road	0.5	0.006	Contrctor	During pre-construction and construction
3.	Crop compensation to the indirect loser/ land owner/ share croppers of construction sites /damage to dredge spoils	Included in contractor budget	0	Contractor	During pre-construction
4.	Awareness program on plant and wild life conservation.	200,000	2.5	BWDB	During post-construction
5.	Awareness building up campaign(mock drill) may be organized to local community to avoid accidents	200,000	2.5		During pre-construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	from vehicular traffic				
6.	Consultancy services cost for supervision and monitoring of EMP	800,000	10	BWDB	During post-construction
7.	Training to the farmers with field demonstration regarding IPM and ICM.	400,000	5	BWDB with help of DAE	During post-construction
8.	Awareness building up to local community for conservation of threatened fish species.	50,000	0.625	BWDB & WMO with help of UFO	During post-construction
9.	Training to the fisherman/pond owner with field demonstration regarding pond culture.	40,000	0.5	BWDB & WMO with help of UFO	During post-construction
10.	Solid and liquid waste disposal arrangement.	100,000	1.25	BWDB	
11.	Capacity building and training to the WMOs regarding gate operation, post project monitoring	1,000,000	12.5	BWDB	During post-construction
12.	Consultancy services cost for river bank erosion monitoring	1,200,000	15	BWDB	During construction
13.	Training to the Contractors regarding environmental management	100,000	1.25	BWDB	During pre-construction
14.	Training of Environmental awareness of local population	80,000	1	Contractor	During pre-construction and construction phases
15.	Updating EMP as per requirement.	1,000,000	12.5	BWDB	During post-construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
16.	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)	200000	0.036	BWDB with cooperation of DoF	During operation
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.	Campaigning and providing training on improved culture practices as well as the rice cum golda farming.	200,000	2.5	BWDB with help of UFO	During post-construction
19.	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
20.	Social forestry program along both sides of the embankment and other khas areas	Included in afforestation budget		**BWDB/NGO**	**During construction & operation**
21.	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
22.	WMOs monitoring cost	500,000	6.25		
23.	Construction of fish pass friendly structure (one fish pass)	61,420,026	767.75	Contractor, BWDB	During construction

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
	Optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes				
	Total Cost	**73,962,580**	**922.0701625**		

1 USD= BDT 80

Table 10.6: Tentative Cost Estimates for Environmental Monitoring

Item No.	Description	BDT	In Thousand $	Responsible Agency	Timeframe
1.	Soil quality monitoring including N,P,K, S, Zn, salinity, organic Matter, pH etc. samples in Polder 16 = 6 samples x 3 times @ Tk.5,000	300,000	3.75	Contractor	During pre-construction, construction and post construction period phases
2.	Monitoring of Fish	800,000	10	Contractor	During

	Biodiversity, Fish Migration, Fish Production			with help of UFO	construction and post-construction
3.	Fish Catch Assessment Survey for two (2) times of a year (dry & wet season).	200,000	2.5	Contractor with help of UFO	During post-construction
4.	Fish swimming speed or velocity and depth preference	150,000	1.8	Contractor with help of UFO	During post-construction
5.	Crop Production/Farm Survey for four (4) times of year (dry & wet season).	60,000	0.75	Contractor with help of UFO	During post-construction
6.	Air and noise quality monitoring and analysis.	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

10.10 Implementation of Afforestation

530. 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. An NGO will be selected by PMU to carry out the afforestation at the selected sites under supervision of the Senior Forestry Specialist at PMU.

531. Type of plantation and tentative area are given in following table:

Table 10.7: Details of Plantation types and available area for afforestation of the Polder

Sl. No.	Plantation Type	Sub-type	Approximate Area (ha.) for Plantation	Required Saplings (Nos)/Ha	Total Required Saplings to be planted in the Polder	Implemented by	Responsible agencies
1	Embankment Slope Plantation		15.20	2,500	38,000	Department of Forest, NGO, WMO	BWDB
2	Foreshore Plantation	Golpata Plantation	3.84	2,500	9,601		
		Mound Plantation	1.58	1,600	2,528		
		Enrichment Plantation	2.22	300	665		
		Kewra-Baen Plantation	1.17	4,444	5,187		
Total			**24.00**		**55,981**		

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

532. Slope area of embankment of this polder is not suitable for any fruit yielding, medicinal or timber plants as the soil is unable to keep required moisture in dry season. For this reason, drought tolerant plant like *Acacia nilotica* (Gum Arabic/Babla), *Tamarindus indica* (Tamarind/Tentul), *Parkinsonia aculeate* (Parkinsonia/Bilati Babla) are suggested to plant along the mid-one third and above the lower one third portions. Each of the row gap will be 6 to 8 feet, i.e., 2 to 3M. The upper one-third part of the embankment slope will be without plantation for smooth movement of passers-by and local vehicles as the Gum Arabic or Parkinsonia tree bear thorns. The spacing within two planted saplings will be 2m. Lower row of embankment of this polder is not suitable for planting any non-mangrove species as the embankment toe are saturated by the saline water of river or shrimp farms. Suggested plant species seedlings 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. Planting of 2,500 seedlings will make one ha slope plantation. As per that estimation, a total of 38,000 nos saplings can be planted along the different slope reach of 45 km embankment.

About 8.80 ha foreshore area is available for plantation and will be planted with mangrove species to protect against tidal surges, wave attack and strong winds in order to reduce toe erosion and to stabilize the embankment. The areas selected for afforestation in this are shown in detail in Map 5.2. Sonneratia apetala (Mangrove Apple/Keora), Avicennia officinalis (Indian Mangrove/Baen) and Nypa fruticans (Nipa Palm/Golpata) can be selected as the suitable mangrove species for this polder. Golpata will be planted only along the strips of river and canal banks with an available area of about 3.84 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 8,800 mangrove saplings can be planted in total available foreshore area of this polder.

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

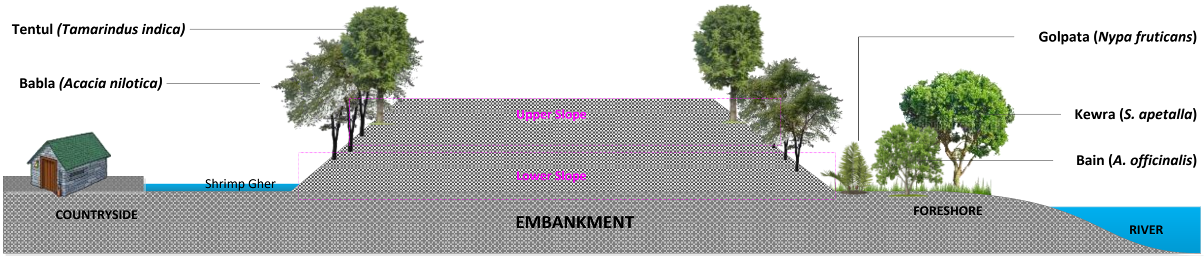


Figure 10.2: Typical cross section of Embankment slope and Foreshore Afforestation

533. Detail Plantation establishment Matrix is presented in following Table 9.6.

Table: 10.8: Detail Plantation establishment Matrix

Item of works	Time schedule for the given type				
	Nypa Plantation	Enrichment Plantation	Keora Baen	Mound Plantation	Polder Slope Plantation
Selection of site, survey the site and prepare plantation site map.	March	January	February and March	February	February
Preparation of mounds	n.a.	n.a.	n.a.	March	n. a.
Cleaning of unwanted growths by cutting them off.	May 3rd week.	April 4th week immediately before planting.	One week before the planting day. May be in the 1st week of May.	March	April 1st week.
Pit making	n.a.	March 2nd week.	n. a.	March 3rd week.	April 1st week.
Application of Compost	n.a.	March 4th week.	n. a.	April 2nd week.	April 3rd week.
Stacking	May 3rd week.	April 1st week.	n. a.	April 4th week	April 3rd week.
Bring seedlings from the nursery to plantation site.	June 1st week.	April 3rd week.	On the day of planting during 1st or 2nd week of May.	April 4th week (after the first shower)	April 4th week.
Planting of seedlings.	June 1st week. Immediately after bringing seedlings from the nursery.	April 4th week.	May be 1st or 2nd week of May.	Immediately after bringing the seedlings.	Immediately after bringing the seedlings.
Fixing of red flags indicating planting sites to avoid fishing.	May 4th week.	n. a.	n. a.	n. a.	n. a.
Application of fertilizers.	n. a.	After of week of planting the seedling.	n. a.	After a week of planting seedlings.	After of week of planting.
First weeding	August 1st week	May 4th week	May 4th week, 1st year.	June 1st week.1st year.	May 2nd week, 1st year, to be done by the watcher free of charges.
Second weeding	November 1st week	June 3rd week	June 1st week.1st year.	June 4th week.1st year.	July 1st week, 1st year, to be done by the watcher free of charges.

Item of works	Time schedule for the given type				
	Nypa Plantation	**Enrichment Plantation**	**Keora Baen**	**Mound Plantation**	**Polder Slope Plantation**
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

10.11 EMP Updating

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

10.12 Grievance Redress Mechanism

535. 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 EMP for assessment and mitigation of social and environmental impacts. Based on consensus, the procedure will help 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 preempt a person's right to go to the courts of law.

10.12.1 Grievance Redress Focal Points

536. 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 PMU. 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 Councilor'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 Councilor : Member
4. Teacher from Local Educational Institution (nominated by Upazila Administration) : Member
5. Representative from Local Women's Group : Member
6. Representative from the PAP Group : Member

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

10.12.2 Grievance Resolution Process

538. 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.

539. 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 PMU for further review. The Project Director will assign the ESC at PMU 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.

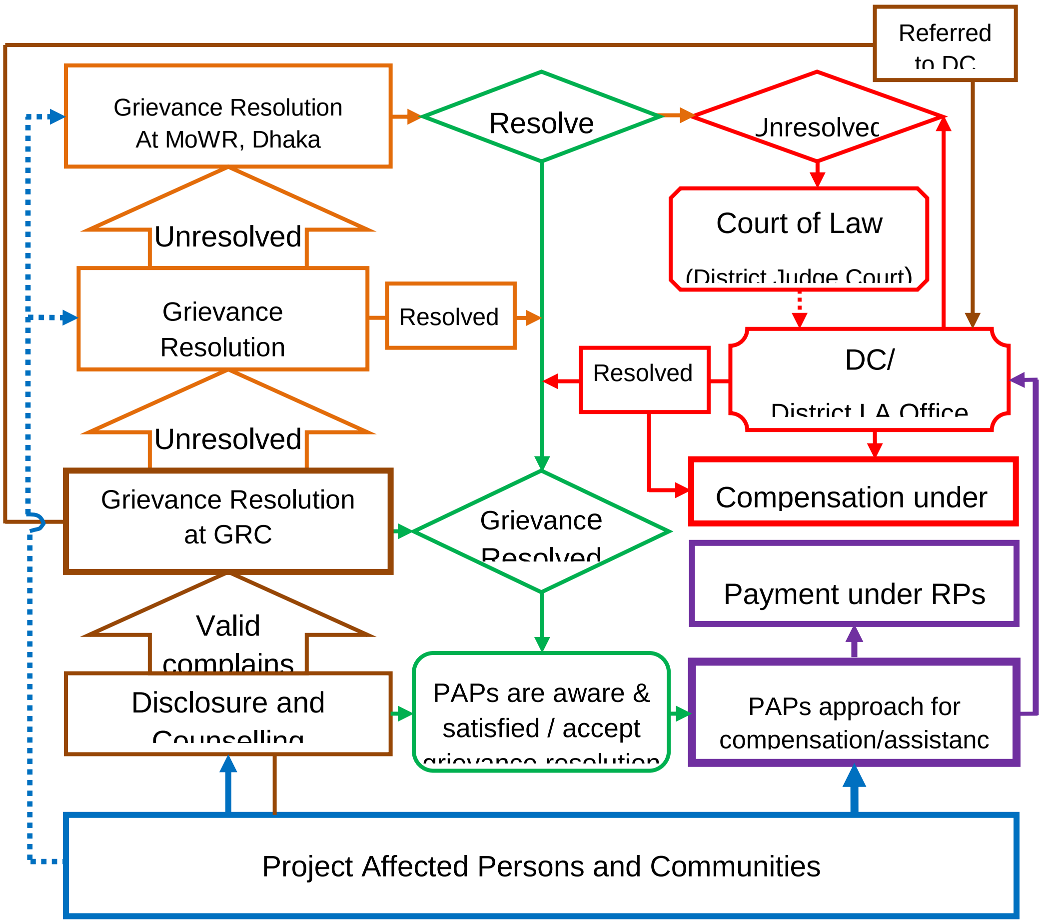


Figure 9.3: GRM Process flow Chart

540. To ensure that grievance redress decisions are made in formal hearings and in a transparent manner, the Convener will apply the following guidelines:

- ✓ Reject a grievance redress application without 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:

541. A GRC member when is removed, appoint another person is to be appointed in consultation with the Project Director.

- ✓ The Convener will also ensure strict adherence to the impact mitigation policies and guidelines adopted in this SMRPF and the mitigation standards, such as compensation rates established through market price surveys.

10.12.3 GRM Disclosure, Documentation and Monitoring

542. 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 about the scope of the GRC, the procedure for lodging grievances cases and the procedure of grievance resolution at the project level.

543. To ensure impartiality and transparency, hearings on complaints will remain open to the public. The GRCs will record the details of the complaints and their resolution in a register, including intake details, resolution process and the closing procedures. BWDB will maintain the following three Grievance Registers:

Intake Register: (1) Case number, (2) Date of receipt, (3) Name of complainant, (4) Gender, (5) Father or husband, (6) Complete address, (7) Main grievance regarding social (loss of land/property or entitlements) or environmental, (8) Complainants' story and expectation with evidence, and (8) Previous records of similar grievances.

Resolution Register: (1) Serial no., (2) Case no., (3) Name of complainant, (4) Complainant's story and expectation, (5) Date of hearing, (6) Date of field investigation (if any), (7) Results of hearing and field investigation, (8) Decision of GRC, (9) Progress (pending, solved), and (10) Agreements or commitments.

Closing Register: (1) Serial no., (2) Case no., (3) Name of complainant, (4) Decisions and response to complainants, (5) Mode and medium of communication, (6) Date of closing, (7) Confirmation of complainants' satisfaction, and (8) Management actions to avoid recurrence.

544. Grievance resolution will be a continuous process in RP implementation. The PMU 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 PMU will also prepare periodic reports on the grievance resolution process and publish these on the BWDB website. The format of SMF may be used for periodic grievance reporting.

10.13 Capacity Building

545. Since the effectiveness of the Environmental Assessment & implementation depends considerably on the understanding and preparedness of their Engineers and in particular their Environmental Team (Consisting of Contractor Environmental specialist, Consultant environmental specialist, and ESCU of BWDB). It is important that the project authority makes effort to sensitize the Engineers and Environmental Team on management of environmental issues, provides guidance, and encourages them to build requisite capacities. Table 10.8 provides a summary of various aspects of the environmental and social trainings to be conducted at the construction site. PMU may revise the plan during the Project implementation as required.

546. During the O&M phase of the Project, these trainings will continue to be conducted by BWDB staff for all relevant O&M personnel and community.

Table 10.9: Environmental Training

Contents	Participants	Responsibility	Schedule
General environmental and socio-economic awareness; Environmental and social sensitivity of the project area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area.	Selected BWDB officials; PMU; DSC staff	DSC& ESCU	Prior to the start of the Project activities. (To be repeated as needed.)
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Mitigation measures; Community issues; Awareness of transmissible diseases Social and cultural values.	PMU; DDCS & PMSC; selected contractors' crew	DDCS&PMSC& ESCU	Prior to the start of the field activities. (To be repeated as needed.)
EMP; Waste disposal; HSE	Construction crew	Contractors	Prior to the start of the construction activities. (To be repeated as needed.)
Road/waterway safety; Defensive driving/sailing; Waste disposal; Cultural values and social sensitivity.	Drivers; boat/launch crew	Contractors	Before and during the field operations. (To be repeated as needed.)
Camp operation; Waste disposal; HSE Natural resource conservation; Housekeeping.	Camp staff	Contractors	Before and during the field operations. (To be repeated as needed.)
Restoration requirements; Waste disposal.	BWDB core unit, Restoration teams	Contractors	Before the start of the restoration activities.
Strengthening of water management	Member of water	BWDB, ESCU,	Before and during

Contents	Participants	Responsibility	Schedule
organizations (i.e. WMGs, WMAs and WMF) and beneficiaries organizations	management organizations (i.e. WMGs, WMAs and WMF) and beneficiaries organizations	Contractor	construction activities

547. Capacity building training programs should 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 work plan;
- ✓ Training of the WMOs on successful operation of hydraulic structures; and
- ✓ Training on structured format in reporting for all stages of implementation and those of relevant agencies who are involved in EMP implementation.

548. The training programs should be arranged before implementation of the interventions in the polder area. Detailed plan can be made by the proposed ESC Unit of BWDB.

10.14 Risk Assessment and Mitigation Measures

549. 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

550. 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 16. 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 16 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.

551. 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 Association

552. 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

553. The peak velocity considered in designing of drainage sluices ranges from 3-4 m/s. The sustainable velocities of the indicative fish species are estimated in the range of 0.46 m/s to 1.1 m/s and burst velocities are in the range of 1.75 m/s to 4.2 m/s (Section 6.2.10). It is noted that burst velocities of fish are applicable for capturing prey as the duration is only for seconds. Considering designed peak velocities of drainage sluices and the estimated sustainable velocities of the indicative fishes, it is observed that no fish will be able to pass through the gates. Gradual decrement of the discharge and corresponding velocity at some

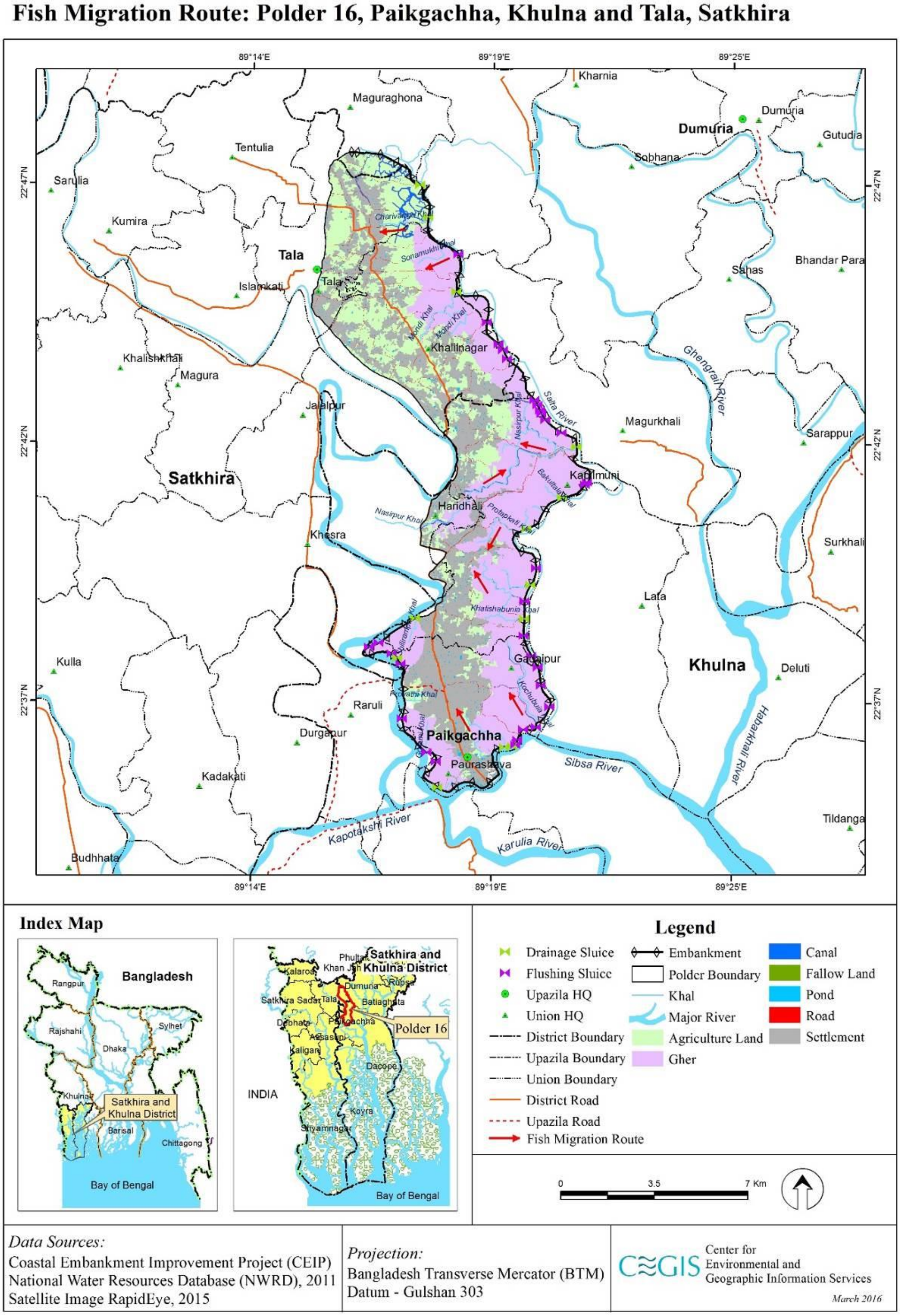
stages the fish can move against the current and eventually can pass through the gates if attain the velocities congenial for such species.

554. 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.

555. For mitigating the fish passing issues through the gates, it is recommended to consider the fish pass friendly aspects in the structures to be constructed in the Polder for the proper management of water. These may be done either by constructing drainage sluices by maintaining the velocities passable for the mentioned indicative fish species or by constructing fish pass structure. In case of sluice gates, based on catchment flow optimum number of vents should be provided with proper opening so that velocity goes down and become passable for fishes. In constructing fish pass, fish swimming speed or velocity and depth preference should be considered. In case of the indicative fishes velocities are mentioned in Table 6.14 and the depth preferences are as follows: *Plotosus canius*: 2-10 m; *Liza Parsia*: 1.5-10 m; *Mystus gulio*: 1.5-10 m and *Lates calcarifer*: 2-20 m.

556. The Ghers in the study area are mostly concentrated in the following mouzas like Mirzapur, Gomati, Satphuli, Kara Para and Singral (**Map 10.1**). These mouzas are relatively less crop intensive. The major drainage canals pass through the mentioned mouzas and Ghers as well include Kata Khal, Mirzapur Khal, Rambabu Khal and Jirthalar Khal. 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.

557. In other areas where Ghers are less intensive and crops are dominant, there should be a mechanism of water distribution in equitable manner. Generally, surface water irrigation for the Boro crops is done during January to March when drifting migration of hatchling and fry with the tide of *Liza parsia* and *Mystus gulio* may be obstructed as the farmers will use the deposited water of the canal and inhibit the entry of saline water. The fishes at all their life stages from hatchling to adult of *Plotosus canius, Lates calcarifer, Liza parsia* and *Mystus gulio* will be entered with the tide into the Polder area when water will be allowed during the T. Aman cultivation season.



Map 10.1: Fish migration route in the Polder area

11. Stakeholder Consultation and Disclosure

558. This Chapter provides details of the consultations held with the stakeholders at the Project site and framework for consultations to be carried out during construction phase.

11.1 Overview

559. The GoB as well as international donors (e.g. the World Bank) attach great importance on involving primary and secondary stakeholders for determining the environmental and social impacts associated with project implementation. In order to gather local knowledge for baseline conditions, understand perceptions of the community regarding impact significance, and propose meaningful mitigation measures, participation of stakeholders is an integral part of the EIA process. During the present EIA, an attempt has been made to consult with a full range of stakeholders to obtain their views on Project interventions.

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

561. The present EIA has been conducted after consulting with local communities, non-governmental organizations (NGOs) and concerned government departments/ organizations dealing particularly with related fields, thus ensuring that their views and concerns are taken into account in the study.

11.2 Objectives of Stakeholder Consultations

562. The following objectives have served as the moving force for the design, implementation and fact findings during the participation process:

- ✓ To provide key Project information and create awareness among various stakeholders about project intervention;
- ✓ To have interaction for primary and secondary data collection with project beneficiaries, affectees, and other stakeholders;
- ✓ To identify environmental and social issues such as displacement, safety hazards, employment, and vulnerable persons;
- ✓ To begin establishing communication and an evolving mechanism for the resolution of social and environmental problems at local and Project level;
- ✓ To involve Project stakeholders in an inclusive manner; and
- ✓ To receive feedback from primary stakeholders on mitigation and enhancement measures to address the environmental and social impacts of the Project.

11.3 Approach and Methodology

563. Participatory approach was followed in conducting the public consultation meetings in the Polder 16. The consultants discussed first with the BWDB officials and then the Upazila Parishad Chairman (UZPC) and/or the Upazila Nirbahi Officers (UNOs) and the Project Implementation Officers (PIOs) of the polder area to share the Feasibility and EIA process of the CEIP-1. The BWDB and local government officials/representatives were consulted to identify the potential stakeholders at the Polder level. With the available support from the UNOs and/or PIOs, the union level public representatives as well as the key persons were informed about the specific consultation meetings and requested them to be present in the meeting.

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

565. During the FGDs and consultation meetings, the EIA team displayed maps of the Project area, shared the initial concepts on proposed interventions and facilitated the response of the participants. The stakeholders of the Polder 16 were asked to share their needs, problems, possible sustainable solutions, and their views on the Project interventions. The stakeholders' perceived views on important environmental and social components (IESCs) and Project's impacts on them, along with perceived benefits, risks, threats and demand from the Project were identified during discussions.

11.4 Identification of Stakeholders

566. 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.

Primary Stakeholders

567. Primary stakeholders are people who would be directly benefited or impacted by a certain project intervention. In case of the proposed Project in Polder 16, the primary stakeholders include the people living within the Project area particularly those who reside within and in the immediate vicinity of the Polder. The primary stakeholders of the Project include the farmers, fishermen, local business community as well as the households to be displaced, women groups, and caretakers of community properties. Primary stakeholders identified and consulted during the present EIA include communities to be benefitted and/or affected by the Project, local leaders, community members and other local representatives.

Secondary Stakeholders

568. This category of stakeholders pertains to those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some

stage, or affect decision making on Project aspects. In this Project NGOs, concerned government departments, and line agencies fall under this category.

569. Secondary stakeholders for the Project include local government institutions (LGI), Bangladesh Water Development Board, the Ministry of Water Resources, Department of Forest, other government agencies, academia, NGOs, the World Bank and general public at large.

Time, Date and Venue Selection

570. Venue, date and time of meeting was selected through the consultation with local people, the project proponent and the consultant. These three groups select an agreed venue considering the closeness to the proposed project, easy accessibility to the venue and which is likely to be neutral. Date and time was also finalized in this way considering availability of the participants, ensuring the maximum participation, weather and compliance with the other arrangement.

Enlisting and Invitation

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

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

Consultation Instrument

Checklist:

573. A checklist covering all possible issues to be addressed was prepared through consultation with the multidisciplinary study team. This checklist was used in the meeting to unveil peoples' perception and opinion along with suggestions.

Attendance list:

574. An inventory of the participants was maintained in attendance sheet containing contact number. Scanned list of participants is attached in Annex-II.

Camera:

575. For visualizing the participants, photographs were taken using camera. These photographs were presented in this chapter. Photographs of the meeting participants are presented at the end of this chapter.

Sound Recorder:

576. For ensuring peoples voice are taken using recorder of each consultation. The study team encouraged all to participate willingly through explaining the ethics of the study and recorded it.

Consultation Process

577. The study team conducted the meeting. During consultation meeting, the following processes were followed with sequences.

Greetings:

578. At the outset, the team expressed greetings to all participants. Welcomed them for attending and stated the entire design of the meeting.

Introduction:

579. The team members introduced themselves to the participants and gave detail description of the project, spelled out about the objectives and anticipated outcome of the meeting.

Respect to the participants:

580. The study team showed respect to all participants. They respected not only to the individuals but also to their values, cultural practices and social structures.

Ensuring peoples' voice:

581. Generally, all participants cannot participate equally. In fact, a substantial number of participants tended to remain silent in any meeting. However, the study team encouraged all to participate willingly through explaining the ethics of the study.

Note taking:

582. Discussed issues and opinions were written in notebook carefully. All issues were given equal importance.

Recapitulation and closing the session:

583. At the end the study team recapitulated the session and responded to the quarries. Finally, the facilitator closed the session thanking the participants.

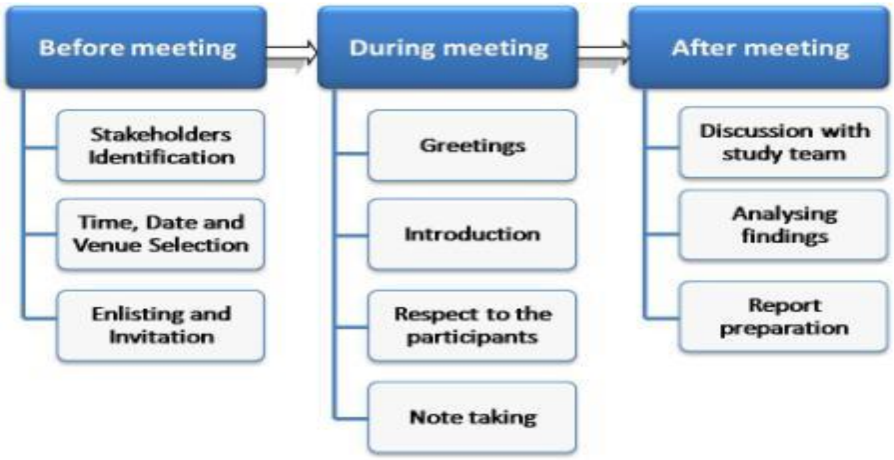


Figure 11.1: Overall consultation process

11.5 Public Consultation Meetings and FDGs

11.5.1 Consultation Process

584. A number of public consultation meetings and FGDs were conducted at different locations of the Polder 16. The details of these meetings and FGDs are presented in **Table 11.1** and some photographs of these meetings are given in **Photograph 11.1 to 11.4**.

Consultation Details

Table 11.1: Meeting venue including time and date

Sl	District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
1	Khulna	Paikghacha	Pourashava	Tea stall	FGD	4/02/2016	5:00 PM
2	"	"	Kopilmuni	Union Porishod Conference room	PCM	7/02/2016	10:00 AM
3	Sathkhira	Tala	Kalilnagar	"	PCM	5/022016	10:00 AM
4	Khulna	Paikghacha	Pourashava	BWDB office	FGD	4/02/2016	10:00 AM

11.5.2 Consultation Participants

585. The main participants of the consultation meetings included public representative, farmer, trader and daily-wage laborers of the Polder 16 and nearby areas. A total of 122 participants attended these consultations. The participant details are provided in **Table 11.2.**

Table 11.2: Participant Details

Sl	Meeting venue	Type of consultation	Type of Participants	No. of participants
1	Tea stall, Pourashava, Paikghacha	FGD	Primary stakeholders	10
2.	Kalilnagar, Union Porishod Conference room	PCM	Primary stakeholders	65
3	Kopilmuni, Union Porishod Conference room	PCM	Primary stakeholders	40
4	BWDB office, Pourashava, Paikghacha	FGD	Secondary stakeholders	7

Photograph 11.1: PCM at Khalilnager Union Auditorium

Photograph 11.2: PCM at Kopilmuni Union Auditorium

11.6 Issues discussed in FGDs and Meetings

586. 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.

- WWater resources:

  - ✓ Surface water (tidal flooding, drainage, salinity, siltation)
  - ✓ Water management (flood control, drainage, irrigation)
- Land resources:
  - ✓ cropping practice,
  - ✓ production and yield,
  - ✓ water logging and drainage congestion
  - ✓ Crop damage.
- SSocio-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)
- DDisasters:
  - ✓ Cyclones
  - ✓ Tidal surge
  - ✓ River erosion
  - ✓ Associated damages
- Tthe sustainable and integrated solutions of the main problems being faced in the Polder:
  - ✓ Water resource management
  - ✓ Agriculture and fisheries management
  - ✓ Land resource management
  - ✓ Disaster management.

11.7 Community Concerns and Suggested Solutions

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

11.7.1 Attitude to the project

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

Photograph 11.3: FGD with officials at BWDB office

Photograph 11.4: FGD with councilor (9 no. ward) at Paikghacha bazaar

589. The outcomes of the FGDs and consultation meetings in terms of concerns and the suggested solutions were noted which are presented in the **Table 11.3** below.

Table 11.3: Community Concerns and Suggested Solutions

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
Overall	- Salinity intrusion, Tidal flood, Tidal surge, Drainage congestion, Low height and vulnerable of Embankment, Encroachment of internal canals, Expansion of unplanned shrimp farming, Kabadak and Salta rivers siltation, water logging due to drainage congestion at certain parts of the polder area.	- Comprehensive rehabilitation of the polder should be taken up at the earliest with the active involvement of the local community. - Proper compensation should be given to affected people - Illegally captured canal should be taken bankand that canal should be excavated - Immediate construction of drainage sluice (Number of 09 nos.) and Repairing of drainage sluice (Number of 02 nos.) - Proposed drainage sluice and flushing sluice linking canals should be excavated.

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
Water resources	- Height of the embankment is being eroding gradually - Water logging is the major concern in this affected area (e.g. Nasirpur Malopara, Chinamola, Protapkati, Naba, Malot, Birashi, Silamanpur, Baruidanga, Kazimucha, Kathbunia, Hazrakathi, Mahandhi etc. villages) - Major canals have been silted up due to unplanned shrimp farming, Illegal DCR cut off, encroachment of canals etc. - Tidal Flooding, Storm surge, salinity intrusion, Encroachment of internal khal, erosion, inactive sluice gates and khal has been silted up	- Strengthening the banks with blocks, spreading stones/Geo-bags along vulnerable spots e.g. Shibbati village (9 no. ward, Paikghacha Pourashava) - Re-sectioning of the embankment to protect erosion and embankment breach Damage sluice gate, inlet, outlet and all water control infrastructures should be made sure in the important water pass area - Internal drainage canal (e.g. Boyratola, Kochubunia, Provati, Nasirpur, Hauli, Sonamukh, Chairvanga canal etc. should be re-excavated - Shatter has to be water proofed
Agriculture resources	- Crop damage due to drainage congestion and water logging - Lack of irrigation water during dry season due to siltation of rivers and internal khals - Aman variety would not be cultivated in during time because of water logging at Nasirpur Malopara, Protapkati, Naba, Malot, Birashi, Silamanpur, Baruidanga, Kazimucha, Kathbunia, Hazrakathi, Mahandhi etc. villages	- Repair the embankment as per design level - Re-excavation of rivers and khals as per design level - Connecting the khals with rivers. - Repairing the sluices and construction of new sluice - Regular operation and maintenance the regulators. - As soon as possible blockd linkage cannel and large cannel should be excavated, such as - Boyratola, Kochubunia, Provati, Nasirpur, Hauli, Sonamukh, Chairvanga canal etc.

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
Fishery resources	- Major canals have already lost their connectivity and depth due to encroachment of canals, damages of drainage sluice, unplanned shrimp farming and saline water intrusion - Reducing depth of internal khals and habitat quality degradation due to siltation - Fish and hatchling movement disrupted due to properly operation of water control structures. - Illegally control khal & water control infrastructure to catch fish - Indiscriminate fishing by Sluice net - Entrance of saline water	- Re-excavation of canals (e.g. Boyratola, Kochubunia, Provati, Nasirpur, Hauli, Sonamukh, Chairvanga canal etc.) will help to increase the richness of fish species in the polder area. - Application of fisheries rules and regulation by the government strongly - Repairing embankment with reasonable height. - Prohibit illegally control khal & water control infrastructure to catch fish - Using angler in an illegal way should be stopped - Illegally captured cannel should be liberated and that cannel should be excavated
Ecological resources	- surrounding area would not be protected from extreme wave action due to insufficient foreshore afforestation - Countryside vegetation would be deteriorated and change of vegetation coverage due to river bank erosion and extreme salinity intrusion. - A number of trees would be felt and existing undergrowth vegetation would be damaged at construction sites for implementation of project intervention.	- Give compensation to the proper owners/authorities against tree felling - Implement social aforestation along the embankment slopes - Social aforestation along the countryside and River side should be done by BWDB, FD, LGI and local people - Proposed afforestation plan would arrest the vulnerabilities of embankment and protect bank erosion from tidal surge - Local people should be engaged on seed germination, sapling management for transit nursery. - Plantation for local suitable Mangrove tree species like Golpata, Kakra, Baim, Kaora, Sundari etc. and proper monitoring for saplings and fencing - Implement social aforestation along the embankment slopes at Sibbati (9 no. ward, Piakghacha) Salekpuraikati, Boyratala, Bakultala etc. villages would be protected to wave action as well as river erosion from Kobadak river and Sibsha River.
Socio-economic resources	- Lack of adequate expertise and experienced manpower to carry out the O&M of the polder and the	- Rehabilitation of affected people should be done according to Resettlement Action Plan (RAP) .

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
	numbers of field staffs are also insufficient and inadequate in some places of the polder with respect to the actual requirement. - Rural power elite captured open water bodies illegally i.e. canals, ditches for their own purposes - Tends of dependency on the Sundarbans area has been increased for last five years due to lack of employment opportunities. - Seasonal migration has been increased for Garments, Brick fields and Agricultural sector	- Ensure proper resettlement of those households which may be affected by the project intervention for re construction of retired embankment - The embankment cum road should repair immediately in places. - After enlarging embankment, a maintenance and monitoring team should be formed for proper maintenance of it. - To Create and strengthening of WMGs so that mass people can access to open water bodies easily. - Should be proper maintenance for re functioning of water control infrastructures - Gate operator (locally called gate khalashi) should be recruited - Illegal DCR cut off should be stopped - In mud work Participation of local people should be given the first priority - Construction materials, instruments should be carried through the roadway

11.8 Framework for Consultations during Project Implementation

590. The stakeholder consultation is a continued process and should be maintained throughout the project. The consultations carried out during the present EIA and reported in this Chapter are essentially a first step in this process. During the subsequent project phases as well, participation of the project stakeholders need to be ensured. **Table 11.4** charts out the proposed participation framework during different project Phases.

Table 11.4: Participation Framework

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
Project Design Phase	Meetings with institutional stakeholders (carried out during the present EIA and RAP preparation); meetings with grass root stakeholders (carried out during the present EIA and RAP preparation)	Institutional stakeholders; Grass root stakeholders, including the communities to be affected by the Project.	EIA consultant
Project Construction Phase	Information disclosure (sharing of the project objectives, project components, major benefits, potential impacts,	Institutional stakeholders; Grass root stakeholders, including the communities to be affected during the	BWDB; Supervision Consultants; Contractors

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
	mitigation measures and Resettlement Plan with the affected communities and other stakeholders).	project implementation.	
	Consultations and liaison	The communities around the work sites, borrow areas, and access routes	BWDB; Supervision Consultants; Contractors
	Grievance Redressal Mechanism and Social Complaint Register (discussed later in the document).	The affected communities.	BWDB; Supervision Consultants; Contractors
	Consultations with the communities during Compliance Monitoring and Effects Monitoring (discussed later in the document).	Affected communities.	BWDB; Supervision Consultants; Contractors
	Consultations with the project affectees / communities during the external monitoring (discussed later in the document).	Affected communities.	External monitoring consultants.
	Consultations with the project affectees / communities during the site visits by the WB monitoring mission.	Project site staff; Contractors; Affected communities.	WB monitoring mission.
Project Operation Phase	Community participation in O&M activities (see Section 4.9)	Institutional stakeholders; Grass root stakeholders, including the beneficiary communities.	BWDB

11.9 EIA Disclosure

591. The findings of the draft final EIA study on Polder 16 was disclosed to the public on 25th July (from 11:00am to 13:00pm), 2017 in Paikgaccha Upazila, Khulna. The principal aim of the meeting was to present the findings of the draft final EIA report and to obtain feedback from the participants of the meeting for the finalization of the report. In disclosure meeting a power point presentation was made, highlighting the project background, project objective as well as EIA study objective, project interventions, potential enviromentals impact due to implemention of proposed interventions, and Environmental Management Plan (EMP) with monitoring plan.

592. The participants of the PDM includes, Upazila Nirbahi Officer (UNO),Upazila Chairman, Vice Chairman and other concerned government officials, Journalists, NGO representatives, environmentalists and activists, local stakeholders and other representatives of CEGIS. A total of 52 participants attended the public disclosure meetings. The findings of the Public Disclosure Meeting (PDM) and some photographs of the meeting are given in Photo 11.4

Photo 11.5: PDM at Upazila Auditorium, Paikgacha, Khulna

11.9.1 Findings of the Public Disclosure Meeting (PDM):

593. The communities including the persons to be affected of Polder 16 by the Project expressed their views in favour of the Project and wanted early implementation to protect them from natural disasters. They demanded following actions for immediate implementation. These are:

Comments from stakeholder /Communities	**Responses**
The situation regarding salinity intrusion is also getting worse, since most of the sluice gates became out of use. There is need to a concrete plan for saline water intrusion for shrimp cultivation.	A Water Management Plan has been proposed for sustaible polder management
Issues like climate change, sustainable development etc should be taken into consideration while implementing the project	Climate change issue has been considered in this study
Effective monitoring should be maintained during the construction of the project activities.	A effective monitoring plan has been suggested

Engagement of local government for canal excavation should be ensured	To be considered
Tree plantation need to be increased.	A detailed tree plantation plan has been undertaken in this project
Adequate compensation for affected by the project activities should be ensured.	Agreed and to be ensured
Awareness building program among the communities should be conducted for better water management;	Agreed and to be initiated
Proper O & M for embankments and sluice gates in the Polder area should be ensured	Agreed and to be ensured
Water Management Organizations (WMOs) should be formed for proper functioning of water control structures.	Agreed and to be formed before operation of the water control structures.

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Appendix A: Checklist

EIA of Coastal Polders under CEIP-1

Checklist for Water Resources Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

A. Administrative Information

Name of Polder:	BWDB Zone:	Hydrological Zone:
BWDB Circle name:	BWDB O & M Division:	
District (s):	Upazila (s):	
Union (s):	Mouza (s):	

B. Project Description

General Information	
a. Type of project:	b. Area of polder (Ha):
c. Objectives of the scheme:	
d. New problems (if any) created by the project activities:	
e. Year of Starting:	f. Year of completion:
g. Name of surrounding polder	
h. Name of the projects hydro-morphologically dependent on the polder	
i. Cumulative hydraulic and morphological impacts as anticipated by local people	
Data Collected by:	Date:
Present Status/condition of Embankment	

Embankment length (……………….Km)	Embankment Type: Submergible / Full flood protection

Breaching: 1. Yes 2. No Breaching spot (If yes): (Please specify the spot names, length, GPS reading)

Location of Breaching Points (Name of Place)	Reasons of breach	Good		Moderately affected		Badly affected/ Vulnerable		Completely damaged	
		GPS ID	Length	GPS ID	Length	GPS ID	Length	GPS ID	Length

Public Cuts: 1. Yes 2. No Public Cuts (If yes): (Please specify the spot names, length, GPS reading)

Location of Public Cuts	Reasons	Moderately affected		Badly affected/ Vulnerable		Completely damaged	
		GPS ID	Length	GPS ID	Length	GPS ID	Length

Re-sectioning: 1. Yes 2. No Re-sectioning (If yes): (Please specify the spot names, length)

From	To	Length	Height	Actual reasons

Regulators												
Location of Structure	GPS ID	Type	Vent Size	No of Vent	Service Condition (VG/G/M/B/VB)[26]	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/Aquaduct)											
Barrage											

Pipe Sluices										
Irrigation Inlets										

26 VG – Very Good, G – Good, M – Moderate, B – Bad, VB – Very Bad

Bridge/Culverts

Others

Drainage Channels

Name	Length	Flow Direction	Flow (%)	Present Service Condition \Problems	Reasons of Problem	Re-excavation Need (Y/N)	Proposed Re-excavation Mode (Manual/ Mechanical)	From – To (Approx. length)	GPS ID (Structure)

Irrigation Canals

Name	Length	Problems	Reasons	Re-sectioning (Y/N)	From – To (Approx. length)

Protective Works

Location Name	Type (Temporary/Permanent)	Length	Present Condition (G/ MD/ CD)[27]	Problems	Reasons	From – To (Approx. length)	GPS ID (Protection Work)

Do you think that local people/Stakeholders were involved or could be involved in future for the maintenance work of the above mentioned works? If 'Yes' mention the source of generating funds?	
Persons engaged in operating gates of the structures:	BWDB/Local people or Stakeholders/Beneficiaries
Problems facing in operating the gates of the structures:	
Your suggestions regarding the people to be engaged in operating these gates:	BWDB/Local people or Stakeholders/Beneficiaries

D. Water Resources

1.River system (inside and outside the polder)

Inside	Outside	Main river	Flow direction

2. Name of beels:

Union	Beels	Union	Beels

3. Topography:	4. Drainage pattern:
5. Drainage congestion extent (ha):	Causes: Natural / Man made/Through project activities
Problems:	Reasons:

6. Water logging (% of extent) in the month of February

Union	Area (%)	Causes

27 G – Good, MD – Moderately Damaged, CD – Completely Damaged

7. Flooding (depth, % of extent, onset, peak and recession)

Flood/Inundation Condition	Area (%)	Reasons of Flooding	Onset:
F0 (< 30 cm)			
F1 (30-90 cm)			Peak:
F2 (90 – 180 cm)			
F3 (180 – 360 cm)			Recession:
F4 (> 360 cm)			

E. River Erosion

River/Khal name	Area (ha)	Length (m)	Reasons

F. Accretion

River/Khal name	Area (ha)	Reasons

G. Water Quality (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 name	Seedling		Transplanting/Sowing		Harvesting	
	Start	End	Start	End	Start	End

Crop yield

Crop Name	Damage free Yield (ton/ha)	Damage area (%)	Damage Yield (ton/ha)

*Damage area and yield loss calculation: Last 3 years average value

Crop damage

Name of hazard	Ranked	Timing	Causes
Flood			
Drought			
Pest infestation*			
Others:			
*List name of pest and pesticide by crop			

Fertilizer and pesticide application

Crop Name	Seed (Kg/ha)	Fertilizer (Kg/ha)				Pesticide		
		Urea	TSP	MP	Other	No of Appli.	Liq. (ml/ha)	Gran. (Kg/ha

Irrigation, Land preparation and Labour

Crop Name	Irrigation			Land preparation			Labour	
	Mode	% of Area	Charge (Tk/ha)	Power (%of Area)	Animal (% of Area)	Tk/ha	Nos./ha	Tk/ labour

Note: Support Services of the project areas

Livestock Resources: Primary and Secondary Information collection from field and DLS offices

Livestock and poultry production

Name of Livestock/poultry	% of HH having Livestock/Poultry	No. of Livestock/poultry per HH
Cow/Bullock		
Buffalo		
Goat		
Sheep		
Duck		
Chicken		

Feed and Fodder

Name of Livestock/poultry	Feed/Fodder Scarcity (Timing)	Causes	Remarks
Cow/Bullock			
Buffalo			
Goat			
Sheep			
Duck			
Chicken			

Diseases

Name of Livestock/poultry	Name of Disease	Disease (Timing)	Causes	Remarks
Cow/Bullock				
Buffalo				
Goat				
Sheep				
Duck				
Chicken				
Note: Support Services-				

Where, when, how much and causes of Crop Damage.

Fisheries Baseline Checklist

EIA of Coastal Polders under CEIP

Village: Mouza: Union: Upazila: District: BWDB Circle: BWDB Division:

Background Water bodies: Name: Alphabetic, Area: in Ha/% of area/Ana, Length: in km, Depth/Inundation depth: in Meter, Flood Duration: in Months, Production: metric ton

Problem/Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
Capture Fisheries:	a. Total No. of fisher HHs: b. %/No. of CFHHs:	River																

Problem/Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
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																
	SFHHs:	Swamp Forest																
		Fish pond																

Problem/Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Dura tion	Area	Length	Width	Depth	Dura tion
		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. 2. 3.	Reasons of increase or decrease	1. 2. 3. 4.						Live fish				
									Other fish				
									Prawn				
									Hilsa				
Important breeding, feeding													

Fish Migration				Fish Biodiversity		Species List					Species Composition				
						River	Khal	Beel	Pond	Other	Group	River	Khal	Beel	Pond
and over wintering ground					5.						Rui				
											Catla				
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):	

Post Harvest Activities		Fishermen Lifestyle	
Other backward and forward linkages (Number, location and name):		Leasing system:	
Transport facility (Mode of fish transportation, cost, other involvements)		Enforcement of fisheries regulation (Weak/strong):	
Dry fish industries (Number, location and name):		Department of Fisheries (DoF) activity:	
Others information:		NGOs activities:	

Note: 1. Major Carp - Rui, Catla, Mrigal, 2. Exotic Carp - Silver Carp, Common Carp, Mirror Carp, Grass Carp, 3. Other Carp - Ghania, Kalbasu, Kalia, 4. Cat Fish - Rita, Boal, Pangas, Silon, Aor, Bacha, 5. Snake Head - Shol, Gazar, Taki, 6. Live Fish - Koi, Singhi, Magur, 7. Other Fish - Includes all other fishes except those mentioned above.

Beels: Rui (Labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus mrigala), Kalbasu (Labeo calbasu), Gonia (Labeo gonius), Boal (Wallago attu), Air (Mystus aor / Mystus seenghala), Shol/Gazar (Channa spp.), Chital/Phali (Notopterus chitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustes fossilis /Clarias batrachus), Sarpunti (Puntius sarana), Large Shrimp (Macrobrachium rosenbergii /M. malcomsonii), Small Shrimp, Silver Carp (Hypophthalmichthys molitrix), Carpio (Cyprinus carpio), Grass Crap (Ctenopharyngodon idellus), Pabda (Ompok pabda), Punti (Puntius spp.), Tengra (Mystus spp.), Baim (Mastacembelus spp.), Chapila (Gudusia chapra), Others.

Pond: Rui (Labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus mrigala), Kalbasu (Labeo calbasu), Mixed Carp, Silver Carp (Hypophthalmichthys molotrix), Grass Carp(Ctenopharyngodon idellus), Mirror Carp (Cyprinus carpio var. specularis), Tilapia (Oreochromis mossambicus / O. niloticus), Shrimp, Aor (Mystus aor / Mystus seenghala), Boal (Wallago attu), Shol/Gazar & Taki (Channa spp.), Chital/Phali (Notopterus chitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustes fossilis / Clarias batrachus), Sarpunti (Puntius sarana), Thai Sarpunti (Puntius gonionotus), Punti (Puntius spp.), Others.

EIA of Coastal Polders under CEIP

Checklist for Ecological Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

Basic Information

Date		Prepared by	
Name of the Polder			
BWDB Circle Name			
District/s		Upazila/s	
Location of the FGD			

Habitat Information/Ecosystem Types (Please put tick where is applicable)

Agriculture land		Forest patches including social forestry	
Settlement/Homesteads		Canal and ponds	
Orchard		Grasslands	
Fallow		Reserve forest	
Ridges		Others	

Terrestrial Vegetation Checklist (List of Major Plant Species)

Species Name	Status	Utilization
Homestead Vegetation		

Species Name	Status	Utilization
Mangrove Vegetation		
Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others		

Terrestrial Wildlife Check List

Species Name	Habitat	Status	Migration Status
Mammals			
Amphibians			
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			

Species Name	Habitat	Status	Migration Status
Reptiles			
Birds			

Habitat: 1= Homestead forest, 2= Floodplains, 3= Wetlands, 4= River, 5= Pond, 6=Forest

Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare

Migration Status: 1= Local, 2= Local Migratory, 3= Migratory

Foreshore vegetation/Mangrove vegetation

Name of the forest patches location (s)	Species Name	Abundance	Utilization

Abundance1= High,2=Moderate,3=Low

Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others

Major Wetland information

Name of wetland	Type of Wetland	Area in Acre	Connectivity		Impor tance
			Khal	River	

Type 1= Beels, 2= Rivers, 3= Open water wetlands, 4= Floodplains, 5= Closed water wetlands, 6= Ponds, 7= Baors (oxbow lake).

1=Fish; 2= migratory bird; 3= other wildlife; 4=aquatic flora

Wetland vegetation Checklist

Species Name	Habit	Status	Utilization

Species Name	Habit	Status	Utilization

Habit 1=Submerged, 2=Free floating, 3=Rooted floating, 4=Sedges, 5=Marginal

Status 1= High, 2= Moderate, 3= Low

Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others

Forest Information (Surrounding/nearer the polder)

Forest Name with Range/Beet office	Type	Location	Area in Acre	Major Plant Species

Type 1=Swamp Forest, 2=Reserve Forest, 3=Vested Forest, 4=Reed forest, 5=Other (specify)

(9) Anticipated Impacts due to proposed interventions on particular Ecosystems

(Impact from changed land use, noise, human presence etc.)

Name of Intervention	Impacts
Embankment Re-sectioning	

Breach Closing	
Construction of Water control Structures	

(10) Comments (If any):

EIA of Coastal polders under CEIP

RRA/FGD Data Collection Format for Socio-economic Survey

Date of Survey:.................................. Name of Polder:

1. Place of Interview:

Name of Mouza(s)...

Union(s)/Ward(s)...

Municipality(s).if any
....
Upazila(s)/Thana(s)...
District(s)/.....................................

2. Characteristics of Population:

2.1 Total Households, Population (male, female, rural and urban) in Project area

Total Households	Population		
	Male	Female	Total

Source: BBS

2.2 Age distribution

Age range													
0-4 Years		5-9 Years		10-14 Years		15-17Years		18-34 Years		35-59 Years		60+Years	
M	F	M	F	M	F	M	F	M	F	M	F	M	F

Source: BBS

2.3 Literacy rate

% of Literacy (Over 7 years)		
Total	Male	Female

Source: BBS

2.4 Occupation and employment

Main occupation by population	% of population
Not working	
Looking for work	
Household work	
Agriculture	
Industry	
Water, Electricity & Gas	
Construction	
Transport	
Hotel & Restaurant	
Business	
Service	
Others…..	

Source: BBS

Main occupation by households:

Main occupation by households	% of households
Agriculture/Forestry/Livestock	
Fishery	
Agriculture Laborer	
Non-agriculture Laborer	
Handloom	
Industry	
Business	
Hawker	
Construction	
Transport	
Religious	
Service	
Rent	
Remittance	
Others…..	

Source: BBS

2.5 Labor availability and wage

a. Labor (Male) for farming (High/Medium/Low), Av. Wage/Day (Tk.) Max:............Min: ....

b. Labor (M) for non-farming (High/ Medium/ Low), Av. Wage/Day (Tk.) Max:............Min: ....

c. Labor (Female) for farming (High/Medium/Low), Av. Wage/Day (Tk.) Max:............Min: ....

d. Labor (F) for non-farming (High/ Medium/ Low), Av. Wage/Day (Tk.) Max:............Min: ....

2.6 Migration (seasonal/permanent)

a. Seasonal out migration from study area (% per year with location):

b. Seasonal in migration to study area (% per year with location):

c. Permanent out migration from study area (Number per 1/2 years with location):

d. Permanent in migration to study area (Number per 1/2 years with location):

2.7 Annual Expenditure and Income by range

a. Expenditure

Expenditure group (in taka)	Percentage of households
<=12,000	
12,000-24,000	
24,000-60,000	
60,000-1,08,000	
1,08,000-2,40,000	
>=2,40,000	

Sources: RRA

b. Income

Expenditure group (in taka)	Percentage of households
<=12,000	
12,000-24,000	
24,000-60,000	
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 (hotographgraphs)

Sl. No.	Housing status	% of hhs having
1	Jhupri	
2	Kutcha	
3	Semi Pucka	
4	Pucca	

Source: RRA

Drinking water (hotographgraphs)

Sl. No.	Drinking water sources	Percentage of households use
1	Tap	
2	Tube well	
3	Well	
4	Pond	
5	Other.........................	

Source: BBS

Sanitation (hotographgraphs)

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	

Sl. No.	Disease	Ranking by incidence	Sl. No.	Disease	Ranking by incidence
8	Typhoid		16	Arsenicosis	

Sources: RRA

b. Health facilities in study area (hotographgraphs)

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 (hotographgraphs)

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) (hotographgraphs)

Sl. No.	Type of facility	Nos. of Institution	Type of facility	Nos. of Institution
1	Primary School		Ebtedayee Madrasha	
2	High School		Dakhil Madrasha	
3	College		Alim/ Fazil Madrasha	

Sources: RRA

3.6.1 Status of peripheral academic institutions (with name) used by people of the study area:

____
____
____
____
____
____
____
____

3.8 Markets and GC (hotographgraphs)

Sl. No.	Type of facility	Nos. of markets	Comments with name
1	Major markets		
2	Minor markets		
3	Growth Centers		

Sources: RRA

3.8.1 Status of peripheral markets used by people of the study area:

____
____
____
____
____

____

4. Land holding categories

4.1 Percentage of HH who have owned agricultural land: ....(BBS)

Percentage of households with different land ownership category in the area:

Land ownership classes	**Percentage of household**
Land less/ No land (0 decimal)	
Land less (up to 49 decimal)	
Marginal (50-100 decimal)	
Small (101-249 decimal)	
Medium (250-749 decimal)	
Large (750 + decimal)	

Sources: RRA

5. Conflict between different land owner group and professional group

Reasons of Conflicts	Present status of problem	Solution they want with location
Water control infrastructures		
Land elevation		

Reasons of Conflicts	Present status of problem	Solution they want with location
Cross-interest		

6. Disaster related information: (hotographgraphs)

6.1 Type of major disaster and damage occurred in the area after completion of the Project

Sl. No.	Major Disaster	Severely affected year	% of area affected	% of hhs affected	% of crop damage	Major crop damaged
1	Flood					
2	Drought					
3	Tidal flood					
4	Storm					
5	Cyclone					
6	Hail storm					
7	Salinity intrusion					

Sl. No.	Major Disaster	Severely affected year	% of area affected	% of hhs affected	% of crop damage	Major crop damaged
8	Water logging					
9	Erosion					

Sources: RRA

7. Safety Nets and Poverty Reduction Measures in the area:

7.1 Name and activity of GO/ NGOs working in this area

Name	Activity (Credit, Education, Health, Forestry, Fishery, Livestock Rearing, Women Empowerment, Human Rights, VGF, Boyosko bhata, etc.)	% of HHs coverage

8. Information on Water Management Organizations (WMOs) (hotographgraphs 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:

<table>
<tr><th>Sl</th><th>Issue/Question</th><th colspan="3">Response/Suggestion</th></tr>
<tr><td>a)</td><td>Year of formation
(date if possible)</td><td colspan="3"></td></tr>
<tr><td>b)</td><td>Registered by whom?</td><td colspan="3"></td></tr>
<tr><td>c)</td><td>Number of members (male-female)</td><td>Male</td><td>Female</td><td>Comments</td></tr>
<tr><td></td><td>Farmer</td><td></td><td></td><td rowspan="7"></td></tr>
<tr><td></td><td>Trader</td><td></td><td></td></tr>
<tr><td></td><td>Labor</td><td></td><td></td></tr>
<tr><td></td><td>Landless</td><td></td><td></td></tr>
<tr><td></td><td>Fisher</td><td></td><td></td></tr>
<tr><td></td><td>Service holder</td><td></td><td></td></tr>
<tr><td></td><td>Others</td><td></td><td></td></tr>
<tr><td>d)</td><td>No. of villages covered</td><td colspan="3"></td></tr>
<tr><td>e)</td><td>Existence of fund</td><td colspan="3"></td></tr>
<tr><td>f)</td><td>AGM</td><td colspan="3"></td></tr>
<tr><td>g)</td><td>Election</td><td colspan="3"></td></tr>
<tr><td>h)</td><td>EC meetings</td><td colspan="3"></td></tr>
</table>

Sl	Issue/Question	Response/Suggestion
i)	Present water resources management activities	

8.2.2 Name of EC members with address/phone number:

Sl. No.	Name	Address	Phone Number
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

If WMO does not exist, please state the reasons for

____
____
____

____

____

8.3 Are people willing to form WMO? Y/N

(If yes, give demonstrative proof of their capacity if any)

8.4 Is WMO willing to take up management responsibilities? Y/N

8.4.1 If yes, please give some idea about what to do on management

9. Some other Issues

9.1 Any land acquisition to be needed for the rehabilitation of the polder ? Yes/No

9.1.1 If yes, size of the area? ________________________________(acre)

9.1.2 If yes, are they willing to provide land for acquisition? Yes/No

9.2 Any replacement of people to be needed for the rehabilitation of the scheme? Yes/No

9.2.1 If yes, how many? ___________________________ (number of household)

9.3 Have any cultural heritage /archeological sites in the polder? Yes/No

Give some description

9.4 Have any vulnerable communities (e.g. landless, fishermen, boatmen, destitute women without food and/or shelter) in the scheme area? Yes/No

a. Give some description

9.5 Have any common property resources (e.g. irrigation systems, fishing grounds (wetlands), pastures, forests, graveyard, cremation ground, mosque, temple, etc.) in the scheme area? Yes/No

a. Give some description

10. Comments of Facilitator:

Name of the RRA/FGD Participants:

Name	Age	Occupation	Address/Phone No.

Name	Age	Occupation	Address/Phone No.

Appendix B: DoE Approved ToR

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207
www.doe-bd.org

Memo No : DoE/Clearance/5196/2013/ 125

Date: 05/06/2013

Subject: Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I).

Ref: Your Application dated 31/03/2013.

With reference to the above mentioned subject, the Department of Environment (DOE) hereby accords Site Clearance in favor of Coastal Embankment Improvement Project (Phase-I) at Satkhira, Khulna, Bagerhat, Pirojpur, Patuakhali and Barguna Districts subject to fulfilling the following terms and conditions.

I. This clearance shall only be applicable for the development of the infrastructure of the said project.

II. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) report considering the overall activity of the said Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE).

III. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)

4a. Project activities:
- A list of the main project activities to be undertaken during site clearing, construction as well as operation
- Project Plan, Design, Standard, Specification, Quantification, etc.

4b. Project schedule: The phase and timing for development of the Project

4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.

4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.

5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
   - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
   - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
   - Environment Quality : Air, Water, Soil and Sediment Quality
   - Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions
6. Socio-economic environment should include, inter alia, following:
   - Population: Demographic profile and ethnic composition
   - Settlement and housing
   - Traffic and transport
   - Public utilities: water supply, sanitation and solid waste
   - Economy and employment: employment structure and cultural issues in employment
   - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.
7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).
   In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the

1/2

scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man maid or natural, wildlife, socio-economic aspect shall be incorporated in detail.

8. Management Plan/Procedures:
   For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.
   An outline of the Environmental Management Plan shall be developed for the project.
   In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)
   Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
10. Conclusion and Recommendations

IV. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.

V. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project.

VI. Violation of any of the above conditions shall render this clearance void.

VII. The project authority shall submit the EIA along with an application for Environmental Clearance, the applicable fee in a treasury chalan and the no objection certificates (NOCs) from the local authority to the head office in Dhaka with a copy to the Khulna and Barisal Divisional Office of DOE.

VIII. This clearance is valid for one year from the date of issuance and the project authority shall apply for renewal to Head Office with a copy to the Khulna and Barisal Divisional Office of DOE at least 30 days ahead of expiry.

IX. This Site Clearance Certificate has been issued with the approval of the appropriate authority.

05.06.2013

(Syed Nazmul Ahsan)
Deputy Director (Environmental Clearance)
&
Member Secretary
Environmental Clearance Committee
Phone # 02-8181778

Mr. Md. Sarafat Hossain Khan
Superintending Engineer & Project Coordinator
Coastal Embankment Improvement Project (Phase-I)
Bangladesh Water Development Board (BWDB)
72, Gre[illegible]d, Dhaka-1205.

Copy Forwarded to :

1) PS to Secretary, Ministry of Environment and Forest, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Khulna/Barisal Divisional Office, Khulna/Barisal.
3) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

2/2

Appendix C: Detailsof Relevant Policies and Laws

(A) Relevant National Policies, Strategies and Plans

(i) National Environment Policy, 1992

The National Environment Policy (NEP) is one of the key policy documents of the Government. The policy addresses 15 sectors in all, in addition to providing directives on the legal framework and institutional arrangements. Coastal and marine environment is one of the key sectors covered in this policy. The policy declarations that have particular bearing on the Integrated Coastal Zone Management (ICZM) are listed below.

- Sustainable use of coastal and marine resources and preservation of coastal ecosystem
- Prevention of national and international activities causing pollution in coastal and marine environment
- Strengthening research in protection and development of coastal and marine resources and environment
- Exploration of coastal and marine fisheries to a maximum sustainable limit

Regarding water resource development, flood control and irrigation sector, the policy seeks to:

- ensure environmentally-sound utilization of all water resources;
- ensure that water development activities and irrigation networks do not create adverse environmental impact;
- ensure that all steps are taken for flood control, including construction of embankments, dredging of rivers, digging of canals, etc, be environmentally sound at local, zonal and national levels;
- ensure mitigation measures of adverse environmental impact of completed water resources development and flood control projects;
- keep the rivers, canals, ponds, lakes, haors, baors and all other water bodies and water resources free from pollution;
- ensure sustainable, long-term, environmentally sound and scientific exploitation and management of the underground and surface water resources; and
- conduct environmental impact assessment before undertaking projects for water resources development and management.

The Policy is applicable to the Package 2 under CEIP-1 and the proposed interventions are required to comply with all the policy directives emphasizing particularly on reducing adverse environmental impacts. The EIA studies of the coastal Polders are required to clearly address the potential impacts and propose mitigation measures.

(ii) National Environment Management Action Plan, 1995

The National Environment Management Action Plan (NEMAP, 1995) identifies the main national environmental issues, including those related to the water sector. The main water related national concerns include flood damage, river bank erosion, environmental degradation of water bodies, increased water pollution, shortage of irrigation water and drainage congestion; various specific regional concerns are also identified.

(iii) National Water Policy, 1999

Endorsed by the GoB in 1999, the National Water Policy (NWP) aims to provide guidance to the major players in water sector for ensuring optimal development and management of water. According to the policy, all agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation, and maintenance) are required to enhance environmental amenities and ensure that environmental resources are protected and restored in executing their tasks.

The policy has several clauses related to water resource development projects for ensuring environmental protection. Some of the relevant clauses are:

- Clause 4.5b: Planning and feasibility studies of all projects will follow the Guidelines for Project Assessment, the Guidelines for People's Participation (GPP), the Guidelines for Environmental Impact Assessment, and all other instructions that may be issued from time to time by the Government.
- Clause 4.9b: Measures will be taken to minimize disruption to the natural aquatic environment in streams and water channels.
- Clause 4.9e: Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding.
- Clause 4.10a: Water development projects should cause minimal disruption to navigation and, where necessary, adequate mitigation measures should be taken.
- Clause 4.12a: Give full consideration to environmental protection, restoration and enhancement measures consistent with National Environmental Management Action Plan (NEMAP) and the National Water Management Plan (NWMP).
- Clause 4.12b: Adhere to a formal environment impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects, in each water resources development project or rehabilitation program of size and scope specified by the Government from time to time.
- Clause 4.12c: Ensure adequate upland flow in water channels to preserve the coastal estuary ecosystem threatened by intrusion of salinity from the sea.
- Clause 4.13b: Only those water related projects will be taken up for execution that will not interfere with aquatic characteristics of those water bodies.

Most of the above clauses will be applicable to the Package 2 under CEIP-1CEIP-1. The Project design and present EIA study will be required to comply with these requirements.

(iv) Guidelines for Participatory Water Management 2014

The Guidelines for Participatory Water Management 2014 have been prepared under “Bangladesh Water Development Board Act 2000”. The Rules relate to formation and functions of water management organizations (WMOs) in water resources projects.

The Guidelines for Participatory Water Management (GPWM) in Bangladesh provides the following:

• Participation is an important voluntary process in which local stakeholders influence policy formulation, alternative plans/designs, investment choices and management decisions affecting their communities and establish the sense of ownership.

• Give the local stakeholders a decisive voice at all stages of water management.

• Participation of local stakeholders to prepare production plans on agriculture, fishery, forestry and livestock development and environmental management plan based on the feasibility study by the implementing agencies.

• According to this rule, every water management group will form cluster groups including landless men and women of the project area for infrastructure development or maintenance related activities of which 30 percent will be women.

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

The National Water Management Plan (NWMP) 2001, approved by the National Water Resources Council in 2004, envisions establishing an integrated development, management and use of water resources in Bangladesh over a period of 25 years. WARPO has been assigned to monitor the national water management plan. The major programs in the Plan have been organized under eight sub-sectoral clusters: (i) Institutional Development, ii) Enabling Environment, (iii) Main River, (iv) Towns and Rural Areas, v) Major Cities; (vi) Disaster Management; (vii) Agriculture and Water Management, and (viii) Environment and Aquatic Resources. Each cluster comprises of a number of individual programs, and a total of 84 sub-sectoral programs have been identified and presented in the investment portfolio. Most of the programs are likely to be implemented in coastal areas.

The CEIP-1CEIP-1 has been designed in line with this Plan and addresses its key objectives for the water resource management in the coastal areas.

(vi) Coastal Zone Policy, 2005

The Government has formulated the Coastal Zone Policy that provides a general guidance to all concerned for the management and development of the coastal zone in a manner so that the coastal people are able to pursue their life and livelihoods within secure and conducive environment.

The coast of Bangladesh is known as a zone of vulnerabilities as well as opportunities. It is prone to natural disasters like cyclone, storm surge and flood. In this regard, for reducing risk, the policy emphasizes the improvement of coastal polders and seeks to enhance safety measures by combining cyclone shelters, multi-purpose embankments, road system and disaster warning system.

The CEIP-1 addresses some aspects of this Policy particularly those relating to the polder improvements.

(vii) Coastal Development Strategy, 2006

The Coastal Development Strategy (CDS) focuses on the implementation of the coastal zone policy. The CDS was approved at the second meeting of the Inter-Ministerial Steering

Committee on ICZMP held on 13 February 2006. Nine strategic priorities, evolved through a consultation process, guide interventions and investments in the coastal zone:

- ensuring fresh and safe water availability
- safety from man-made and natural hazards
- optimizing use of coastal lands
- promoting economic growth emphasizing non-farm rural employment
- sustainable management of natural resources: exploiting untapped and less explored opportunities
- improving livelihood conditions of people especially women
- environmental conservation
- empowerment through knowledge management
- creating an enabling institutional environment

The proposed interventions under CEIP-1 are in line with this strategy and support most of the above listed priorities.

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

The National Land Use Policy (NLUP), enacted in 2001, aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities. The NLUP urges that increasing the land area of the country may not be possible through artificial land reclamation processes, which are cost-effective only in the long run. Therefore, land use planning should be based on the existing and available land resources. The policy suggests establishing land data banks where, among others, information on accreted riverine and coastal chars will be maintained. Among the 28 policy statements of NLUP, the following are relevant to coastal area:

- forests declared by the Ministry of Environment and Forests will remain as forest lands;
- reclassification of forest lands will be prevented; and
- effective green belts will be created all along the coast.

CEIP-1 is designed in accordance with this Policy and will comply with the above listed requirements.

(ix) National Agriculture Policy, 1999

The overall objective of the National Agriculture Policy is to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable food security system for all. Although the policy does not emphasize the coastal zone separately, all specific objectives are applicable to the development of coastal zone agriculture. The policy particularly stressed on minor irrigation capturing tidal water in reservoirs in coastal areas and research on the development of improved varieties and technologies for cultivation in coastal, hilly, water-logged and salinity affected areas. The policy also recognizes that adequate measures should be taken to reduce water-logging, salinity and provide irrigation facilities for crop production.

The proposed CEIP-1 is expected to contribute to achieve the objectives of the agriculture policy.

(x) National Fisheries Policy, 1996

The National Fisheries Policy (NFP), 1996 recognizes that fish production has declined due to environmental imbalances, adverse environmental impact and improper implementation of fish culture and management programs. The policy particularly focuses on coastal shrimp, aquaculture and marine fisheries development.

The policy suggests following actions:

- Shrimp and fish culture will not be expanded to the areas which could damage mangrove forest in the coastal region
- Biodiversity will be maintained in all natural water bodies and in marine environment
- Chemicals harmful to the environment will not be used in fish shrimp farms
- Environment friendly fish shrimp culture technology will be used
- Expand fisheries areas and integrate rice, fish and shrimp cultivation
- Control measures will be taken against activities that have a negative impact on fisheries resources and vice-versa
- Laws will be formulated to ban the disposal of any untreated industrial effluents into the water bodies.

The CEIP-1 integratesthe guidelines of NFP in design and implementing the proposed interventions.

(xi) National Forest Policy, 1994

The Forest Policy 1994 recognizes the importance of biodiversity for environmental sustenance. The policy is explicitly mentioned that habitats for the wildlife and vegetation will be conserved through afforestation and by bringing forest lands under Protected Areas. The policy targets to bring 20% of the total land area of the country under forest cover, and at least 10% of which under protected areas by 2015. It also declared that measures will be taken to improve degraded forests. The Policy, at the same time, advocated social forestry, which includes agro forestry, woodlot plantations, strip plantations in vacant public and private lands of the country. Afforestation could directly contribute to climate change mitigation efforts and efforts to improve forest quality add to forest resilience.

(xii) Private Forest Policy 1994

The policy suggested for extended effort to bring about 20% of the country's land under the afforestation programs of the government and private sector by year 2015 by accelerating the pace of the program through the coordinated efforts of the government and NGOs and active participation of the people in order to achieve self reliance in forest products and maintenance of ecological balance. The policy viewed equitable distribution of benefits among the people, especially those whose livelihood depend on trees and forests; and people's participation in afforestation programs and incorporation of people's opinions and suggestions in the planning and decision-making process. The people-centered objectives of the policy are: creation of rural employment opportunities and expansion of forest-based rural development sectors; and prevention of illegal occupation of forest lands and other forest offences through people's participation. The policy statements envisage: massive afforestation on marginal public lands through partnerships with local people and NGOs; afforestation of denuded/encroached reserved forests with an agroforestry model through participation of people and NGOs; giving ownership of a certain amount of land to the tribal people through forest settlement processes; strengthening of the Forest Department; strengthening of educational, training and research facilities; and amendment of laws, rules and regulations relating to the forestry sector and if necessary, promulgation of new laws and rules. Thus, over time the policy has shifted somewhat from total state control to a management regime involving local communities in specific categories of forests.

Because of limited amount of forestland, the policy underscores for effective measures for afforestation in rural areas, in the newly accreted char in the coastal areas and in the denuded Unclassed State Forest areas of Chittagong Hill Tract and northern zone of the country including the Barind tract. The policy also encourages the private sector participation in afforestation.

(xiii) National Livestock Development Policy, 2007

The National Livestock Development Policy (NLDP) has been prepared to address the key challenges and opportunity for a comprehensive sustainable development of the livestock subsector by creating an enabling policy framework. Among 60 or more policy statements, the following two policy statements address the coastal zone:

- Specific areas will be identified to implement programs for fattening of cattle and livestock. For this purpose, the Chittagong Hill Tracts, the coastal areas and the islands will be included under the fattening of livestock and cattle program.
- Special programs will be taken up for the production of grass in the Chittagong Hill-tracts and the coastal areas.

As livestock is one of the key assets in coastal livelihoods, and protection of livestock from cyclones and tidal surges should be emphasized along with security of human life. The proposed CEIP-1 interventions will contribute to the safety of livestock and thus increase livestock productivity in coastal areas.

(B) National Environmental Laws

The key national policies, strategies, and plans relevant to environmental management are briefly discussed below.

(i) Bangladesh Environment Conservation Act (ECA), 1995 and all its subsequent amendments

The Environmental Conservation Act (ECA) of 1995 is the main legislative framework relating to environmental protection in Bangladesh. This umbrella Act includes laws for conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution. This Act has established the Department of Environment (DoE), and empowers its Director General to take measures as he considers necessary which includes conducting inquiries, preventing probable accidents, advising the Government, coordinating with other authorities or agencies, and collecting and publishing information about environmental pollution. According to this act

(Section 12), no industrial unit or project shall be established or undertaken without obtaining, in a manner prescribed by the accompanying Rules, an Environmental Clearance Certificate (ECC) from the Director General of DoE.

In accordance with this Act, the CEIP-1 will need to be cleared by DoE before commencing the project following procedures given in the Environment Conservation Rules (ECR) 1997 (discussed below). Also the Ecologically Critical Areas in coastal zone, defined by DoE under this act, will be considered while planning and designing of the CEIP-1 project interventions.

The present EIA has been carried out in compliance with this Act.

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

The ECA 1995 was amended in 2010, which provided clarification of defining wetlands as well as Ecologically Critical Areas and included many important environmental concerns such as conservation of wetlands, hill cutting, ship breaking, and hazardous waste disposal. This amendment empowered the government to enforce more penalties than before. Moreover, affected persons were given provision for putting objections or taking legal actions against the polluters or any entity creating nuisance to affected person.

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

The Environment Conservation Rules, 1997 were issued by the Government of Bangladesh in exercise of the power conferred under the Environment Conservation Act (Section 20), 1995. Under these Rules, the following aspects, among others, are covered:

- Declaration of ecologically critical areas
- Classification of industries and projects into four categories
- Procedures for issuing the Environmental Clearance Certificate
- Determination of environmental standards.

The Rule 3 defines the factors to be considered in declaring an area 'ecologically critical area' (ECA) as per Section 5 of ECA95. It empowers the Government to declare an area 'ECA', if it is satisfied that the ecosystem of the area has reached or is threatened to reach a critical state or condition due to environmental degradation. The Government is also empowered to specify which of the operations or processes shall not be carried out or shall not be initiated in the ecologically critical area. Under this mandate, MoEF has declared the Sundarbans, Cox's Bazar - Teknaf Sea Beach, Saint Martin’s Island, Sonadia Island, Hakaluki Haor, Tanguar Haor, Marzat Baor and Gulshan - Baridhara Lake as ECA and prohibited certain activities in those areas. Beside these, the government of Bangladesh declared four rivers around Dhaka: the Buriganga River, Turag River, Shitalakha River and Balu River as ECA in 2009. Recently the thirteenth ECA - Jaflong-Dauki River, Sylhet was declared in 2015.

Rule 7 classifies projects into four categories depending on environmental impact and location for the purpose of issuance of ECC. These categories are: Green, Orange A, Orange B, and Red.

All existing and proposed i projects, that are considered to be low polluting are categorized under "Green" and shall be granted Environmental Clearance. For proposed projects falling in the Orange-A, Orange-B and Red Categories, firstly a site clearance certificate and thereafter an environmental clearance certificate will be required. A detailed description of these four categories of projectshas been given in Schedule-1 of ECR'97. Apart from the general requirements, for every Red category proposed project, the application must be accompanied with feasibility report, Initial Environmental Examination (IEE), and an Environmental Impact Assessment (EIA) based on approved ToR by DoE, as well as an Environmental Management Plan (EMP). As per ECR’97, water resources development projects, such as the present CEIP-1 is considered asarecategory ‘Red’.

The ECR'97 describes the procedures for obtaining the ECC from the DoE for different types of proposed projects. Any person or organization wishing to establish a project must obtain an ECC from the Director General, DoE. The application for such certificate must be in the prescribed form together with the prescribed fees laid down in Schedule 13, through the deposit of a Treasury Chalan in favor of the DG, DoE. The fees for clearance certificates have been revised in 2010. Rule 8 prescribes the duration of validity of such certificate (three years for green category and one year for other categories) and compulsory requirement for renewal of certificate at least 30 days before expiry of its validity.

(iii) Bangladesh Environment Court Act, 2010

Bangladesh Environment Court Act, 2010 has been enacted to resolve the disputes and establishing justice over environmental and social damage raised due to any development activities. This act allows government to take necessary legal action against any parties who creates environmental hazards/ damage to environmentally sensitive areas as well as human society. According to this act, government can take legal actions if any environmental problem occurs due to CEIP-1 interventions.

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

According to the Act the Government (Forest Department) can prohibit certain activities in the declared Reserved Forest area such as any intervention kindles, keeps or carries any fire; trespasses or pastures cattle, or permits cattle to trespass; causes any damage by negligence in felling any tree or cutting or dragging any timber; etc.

“26. Acts prohibited in such forests. -

(1) Any person who, in a reserved forest-

(a) Kindles, keeps or carries any fire except at such seasons as the Forest-Officer may notify in this behalf;

(b) Trespasses or pastures cattle, or permits cattle to trespass;

(c) causes any damage by negligence in felling any tree or cutting or dragging any timber;

(d) quarries stone, burns lime or charcoal, or collects, subjects to any manufacturing process, or removes any forest produce other than timber; or who enters a reserved forest with firearms without prior permission from the Divisional Forest Officer concerned, shall be punishable with imprisonment for a term which may extend to six months and shall also be liable to fine which may extend to two thousand taka, in

addition to such compensation for damage done to the forest as the convicting Court may direct to be paid."

The proposed intervention should not carry out any such activities that may cause damage or adversely impact on the natural resources including wildlife of the Sundarbans Reserve Forest.

(v) Private Forest Ordinance (PFO), 1959

The Private Forest Act of 1959 allows the Government to take over management of improperly managed private forest lands, any private lands that can be afforested, and any land lying fallow for more than three years. The Private Forest Ordinance was originally enacted in 1945, as the Bengal Private Forest Act, and was re-enacted by the Bangladesh (then East Pakistan) in 1949 before being issued as an Act in 1959. These government managed lands under this act are called "vested forests". The Forest Department manages approximately 8,500 hectares in the country as "vested forests". This area is relatively small, but the area historically affected by this law is much larger.

PFA, 1959 empowers the government to require management plans for private forests and to assume control of private forests as vested forests. Government has broad powers to write rules regarding use and protection of vested forests, and apply rules to "controlled forests," which include all private forests subject to any requirement of the Act.

(vi) Social Forestry Rules, 2004 and Amendments

Social forestry was included in the Forest (Amendment) Act 2000 and the Social Forestry Rules were approved in 2004 (amended in 2010 and 2011). The Rules defined the process of beneficiaries' selection, roles and responsibilities of different stakeholders, management, capacity building and distribution of earnings from social afforestation. According to the rules, the beneficiaries shall be selected from amongst the local communities and shall preferably be from the amongst the followings persons, namely: (a) landless persons; (b) owners or occupants of less than 50 decimals of land; (c) destitute women; (d) unprivileged community; (e) poor ethnic minority; (f) poor forest villages; and (g) insolvent freedom fighters or insolvent successor of freedom fighters. The rules provided the rotation period for different plantation and benefit sharing. In general, the communities responsible for maintenance of plantation will receive around 45% of timber value of the forest.

(vii) Antiquities Act, 1968

An Act to consolidate and amend the law relating to the preservation and protection of antiquities.This Act may be called the Antiquities Act, 1968.

In this Act, unless there is anything repugnant in the subject or context, -

a) "immovable antiquity" means an antiquity of any of the following descriptions, namely :-

    i. any archaeological deposits on land or under water,
    ii. any archaeological mound, tumulus, burial place or place of interment, or any ancient garden, structure, building erection or other work of historical, archaeological, military or scientific interest,

iii. any rock, cave or other natural object of historical, archaeological, artistic or scientific interest or containing sculpture, engraving, inscription or painting of such interest,also includes -

iv. any gate, door, window, paneling dados, ceiling, inscription, wall-painting, wood work, iron work or sculpture of other thing which is attached or fastened to an immovable antiquity ;

v. the remains of an immovable antiquity ;

vi. the site of an immovable antiquity ;

vii. such portions of land or water adjoining the site of an immovable antiquity as are reasonably required for fencing or covering or otherwise preserving such antiquity ;

viii. the reasonable means of access to, and convenient inspection of, an immovable antiquity; and

ix. any urban site, street, group of buildings or public square of special value which the Central Government, being of the opinion that its preservation is a matter of public interest by reason of its arrangement, architecture or materials of construction, by notification in the official Gazette, declares to be an immovable antiquity for the purposes of this Act ;

3. Advisory Committee**.** - For the purposes of this Act, the Central Government shall constitute an Advisory Committee consisting of the following members, namely: -

(a) the Director, who shall also be its Chairman ;
(b) two members of the National Assembly of Pakistan, one being from each Province ; and
(c) three other persons having special knowledge of antiquities.

4. Dispute as **to whether any product, etc., is an antiquity.** - If any question arises whether any product, object or site is an antiquity within the meaning of this Act, it shall be referred to the Central Government which shall, after consultation with the Advisory Committee, decide the same; and the decision of the Central Government shall be final.

19. Prohibition of destruction, damage, etc., of antiquities.

- Subject to the provisions of this Act or of any agreement under section 12, no person shall, except for carrying out the purposes of this Act, destroy, break, damage, alter, injure, deface or mutilate, or scribble, write or engrave any inscription or sign on, any antiquity in respect of which the Director has accepted guardianship or the Central Government has acquired any right.
- The court trying an offence under sub-section (2) may direct that the whole or any part of the fine recovered shall be applied in defraying the expenses of restoring the antiquity to the condition in which it was before the commission of the offence.

21. Dealing in antiquities.

1. No person shall deal in antiquities except under and in accordance with a license granted by the Director.
2. Every dealer shall maintain a register in such manner and form as the Director may prescribe from time to time.
3. A license granted under sub-section (1) may be cancelled by the Director for the breach of any condition of the license.

4. The Director may, with a view to securing compliance with the provisions of this section, -
    a. require any person dealing in antiquities to give such information in his possession with respect to any business carried on by him as the Director may demand ;
    b. inspect or cause to be inspected any book, register or other document belonging to or under the control or any person dealing in antiquities; and
    c. enter and search, or authorize any officer subordinate to him to enter and search, any premises and seize, or authorize any such officer, to seize, any antiquity in respect or which he has reason to believe that a breach or any condition or the license has been committed.

23. Prohibition of movement of antiquity.

2. No person shall transport an antiquity from one place in Pakistan to another with the object of exporting it in contravention of section 22.
3. Whoever contravenes the provisions of sub-section (1) shall be punishable with imprisonment for a term which may extend to three months, or with fine, or with both.
4. The court trying an offence under sub-section (2) may direct that any antiquity in respect of which the offence has been committed shall be forfeited to the Central Government.

(viii) Bangladesh National Building Code, 2006

Part-7, Chapter -1 of the Bangladesh National Building Code (BNBC) clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety of the workmen. According to section 1.2.1 of chapter 1 of part 7, "In a construction or demolition work, the terms of contract between the owner and the contractor and between a consultant and the owner shall be clearly defined and put in writing. These however will not absolve the owner from any of his responsibilities under the various provisions of this Code and other applicable regulations and bye-laws. The terms of contract between the owner and the contractor will determine the responsibilities and liabilities of either party in the concerned matters, within the provisions of the relevant Acts and Codes (e.g.) the Employers' Liability Act, 1938, the Factories Act 1965, the Fatal Accident Act, 1955 and Workmen's Compensation Act 1923". (After the introduction of the Bangladesh Labor Act, 2006, these Acts have been repealed).

Section 1.4.1 of chapter-1, part-7 of the BNBC, states the general duties of the employer to the public as well as workers. According to this section, "All equipments and safeguards required for the construction work such as temporary stair, ladder, ramp, scaffold, hoist, run way, barricade, chute, lift etc shall be substantially constructed and erected so as not to create any unsafe situation for the workmen using them or the workmen and general public passing under, on or near them".

Part-7, Chapter-3 of the Code has clarified the issue of safety of workmen during construction and with relation to this, set out the details about the different safety tools of specified standard. In relation with the health hazards of the workers during construction, this chapter describes the nature of the different health hazards that normally occur in the site during construction and at the same time specifies the specific measures to be taken to prevent such health hazards. According to this chapter, exhaust ventilation, use of protective devices, medical checkups etc. are the measures to be taken by the particular employer to ensure a healthy workplace for the workers.

To prevent workers falling from heights, the Code in section 3.7.1 to 3.7.6 of chapter 3 of part 7 sets out the detailed requirements on the formation and use of scaffolding. According to section 3.9.2 of the same chapter, “every temporary floor opening shall either have railing of at least 900 mm height or shall be constantly attended. Every floor hole shall be guarded by either a railing with toe board or a hinged cover. Alternatively, the hole may be constantly attended or protected by a removable railing. Every stairway floor opening shall be guarded by railing at least 900 mm high on the exposed sides except at entrance to stairway. Every ladder way floor opening or platform shall be guarded by a guard railing with toe board except at entrance to opening. Every open sided floor or platform 1.2 meters or more above adjacent ground level shall be guarded by a railing on all open sides except where there is entrance to ramp, stairway or fixed ladderthe above precautions shall also be taken near the open edges of the floors and the roofs”.

The major challenge is the proper implementation of the Code as section 2.1 of chapter 2 of part 1 duly states that, “The Government shall establish a new or designate an existing agency responsible for the enforcement of this Code with a given area of jurisdiction. For the purpose of administering and enforcing the provisions of the Code, the enforcing agency shall have the authority of the Government and shall herein be referred to as the Authority.”

Part 9, 1.2.1 states that if the land is changed and the occupants of the area are against the change, no change in use of an existing building will be allowed.

(ix) Standing Orders on Disaster, 2010

The Standing Orders on Disaster is designed to enhance capacity at all tiers of government administrative and social structures for coping with and recovering from disasters. The document contains guidelines for construction, management, maintenance and use of cyclone shelters. Accordingly to the guideline, geographical information system (GIS) technology will be applied at the planning stage to select the location of cyclone shelter considering habitation, communication facilities, and distance from the nearest cyclone centre. The advice of the concerned District Committee is to be obtained before final decision. The cyclone shelters should have easier communication facilities so that in times of distress delay does not occur to go there. For this reason, the road communication from the cyclone shelters should not only link up with city or main road but also with neighboring village areas. Provision of emergency water, food and sanitation and shelter space for livestock during period should also be kept in view for future construction of shelters.

Improvement of coastal polders under CEIP-1 will provide better communication facilities in the coastal areas, which is crucial for emergency response to disasters.

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

This Ordinance is the basic instrument governing land acquisition in Bangladesh. It is restricted to “legal” owners of property as supported by records of ownership such as deeds, title or agreements to compensating for land as well as any business, structure, trees and crops on the land. The owners of acquired land receive cash compensation at market value with a premium of 50 per cent on the assessed price. The law specifies methods for calculation of market value of property based on recorded prices obtained from relevant Government departments such as Registrar (land), Public Works Department (structures), Department of Forest (trees), Department of Agriculture (crops) and Department of Fisheries (fish stock).

The Ministry of Land (MoL) is authorized to deal with land acquisition. The MoL delegates some of its authority to the Commissioner at Divisional level and to the Deputy Commissioner at the District level. The Deputy Commissioners (DCs) are empowered by the MOL to process land acquisition under the Ordinance and pay compensation to the legal owners of the acquired property. *Khas* (government owned land) lands should be acquired first when a project requires both *khas* and private land. If a project requires only *khas* land, the land will be transferred through an inter-ministerial meeting following the acquisition proposal submitted to DC or MoL as the case may be. The DC is empowered to acquire a maximum of 50 standard *bigha* (6.75 ha) of land without any litigation where the Divisional Commissioner is involved for approval. Acquisition of land more than 50 standard *bigha* is approved from the central land allocation committee (CLAC) headed by the chief executive of the Government of Bangladesh proposed by the MOL.

The land owner needs to establish ownership by producing record-of-rights in order to be eligible for compensation under the law. The record of rights prepared under Section 143 or 144 of the State Acquisition and Tenancy Act 1950 (revised 1994) are not always updated and as a result legal land owners have faced difficulties trying to “prove” ownership. The affected person (AP) has also to produce rent receipt or receipt of land development tax, but this does not assist in some situations as a person is exempted from payment of rent if the area of land is less than 25 *bighas* (3.37 ha).

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

The State Acquisition and Tenancy Act (Sections 86 and 87) also define the ownership and use right of alluvium (payosti or reformation in situ or original site) and diluvion land (nadi sikosti) in the country. In legal terms, eroded lands (sikosti) inside the alluvion-diluvion (AD) line (i.e. including submerged land or underwater land) are considered khas land once declared by concerned Deputy Commissioner (DC) demarcating the AD Line.28

(xii) Constitutional Right of the Tribal Peoples Rights

The Constitution of Bangladesh does not mention the existence of cultural and ethnic minorities in Bangladesh. The only protective provision for the ethnic minorities that the policy makers often refer to in the context is Article 28 (4) which states that: Nothing shall prevent the state from making special provision in favor of women and children or for the advancement of any backward section of the citizens. The above provision is an ambiguous one and it does not define who or what constitutes "backward". However, the Government recognizes existence of “tribal peoples” and the need for special attention and in general tribal people are essentially viewed as backward, poor and socio-economically & culturally

[28] The Assistant Commissioner of Lands (AC Land) in respective districts demarcates the AD Line each year in areas where rivers frequently erode their banks. According to law, if the land classified by an AD Line re-appears within 30 years from the date of erosion, the original owner(s) can claim the land. The original private owners cannot claim any eroded land if developed by the government through land filling for use in public purpose.

inferior. Towards this end a special program was initiated in 1996-97 by the Prime Minister's Secretariat aimed at improving the socio-economic situation of the indigenous people of Bangladesh, resident outside the Chittagong Hill Tracts.

(xiii) Ethnic Minority Rights in PRSP 2005

Relevant strategic suggestions in the Poverty Reduction Strategy Paper (PRSP) 2005 to preserve the cultural, social and economic identity and interests of the ethnic populations in and outside CHT are as follows:

- Effective recognition of ethnic minority communities and their specific needs in all relevant government policies and programs towards improving the socio-economic conditions of these communities.
- Proper actions for protecting the rights of ethnic minority people, particularly their rights to land and forests.
- Transfer of land administration in CHT to the hill districts councils in accordance with the 'Hill District Councils Acts of 1989'.
- Provide education to ethnic minority people with a curriculum that allows learning in their own language at the primary level.
- Strengthen their competence in job markets through affirmative actions at higher levels of education and skill training to promote their inclusion in mainstream economic life.
- Scale-up efforts to provide health care, clean water and sanitation facilities to ethnic minority areas in general and to the more disadvantaged groups among them in particular.
- Increase and utilize property the fund available in the Prime Minister's office for the development of the ethnic minority people of the plain lands.
- Provide wider access to electrification and telecommunications for ethnic minority communities, particularly in the Hill Tracts.

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

The principal legal instrument governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable Property Ordinance, 1982(Ordinance II of 1982 with amendments up to 1994) and other land laws and administrative manuals relevant to land administration in Bangladesh. According to the Ordinance, whenever it appears to the GoB that any property in any locality is needed or is likely to be needed for any public purpose or in the public interest, the Government can acquire the land provided that the property is not used by the public for the purpose of religious worship, graveyard and cremation ground. The 1982 Ordinance requires that compensation be paid for (i) land and assets permanently acquired (including standing crops, trees, houses); and (ii) any other damages caused by such acquisition. The Deputy Commissioner (DC) determines (a) market value of acquired assets on the date of notice of acquisition (based on the registered value of similar property bought and/or sold in the area over the preceding 12 months), and (b) 50% premium on the assessed value (other than crops) due to compulsory acquisition. The 1994 amendment made provisions for payment of crop compensation to tenant cultivators. Given that people devalue land during title transfer to minimize tax payment, compensation for land paid by DC including premium largely remains less than the actual market price.

The Ordinance, however, is not adequate to deal with the adverse impacts associated with land acquisition and involuntary displacement. Land is acquired under this ordinance but its provisions do not fully satisfy the requirements of the WB's OP 4.12 on Involuntary Resettlement. There are no other policies in Bangladesh to complement the acquisition law in ways to assess, mitigate and monitor the adverse impacts that the affected persons may suffer. The law does not cover project-affected persons without title or ownership record, such as informal settler/squatters, occupiers, and informal tenants and lease-holders (without registration document) and does not ensure replacement value of the property acquired. The Ordinance has no provisions for resettlement of the affected households/businesses or any assistance for restoration of livelihoods of the affected persons. As a result, land acquisition potentially diminishes productive base of affected farm families and infringe impoverishment risks to those physically or economically displaced due to undertaking of infrastructure projects.

As the legal framework falls short of the provisions of the World Bank OP 4.12 on Involuntary Resettlement, the project proposes added mechanisms to meet the Bank's requirements:

- Avoid or minimize resettlement: The law only implicitly discourages unnecessary acquisition, as lands acquired for one purpose cannot be used for a different purpose. However, there are no mechanisms to monitor if this condition is actually adhered to.
- Eligibility for compensation: The law stipulates compensation only for the persons who appear in the land administration records as the owners. It does not recognize the rights of those, such as squatters, who do not possess legal title to the lands they live in or make a living from.
- Compensation: The law provides compensation for lands and other objects built and grown on them (structures, trees and orchards, crops and any other developments like ponds, built amenities, etc.). No provisions are there to assess and restore lost income stream or income sources that acquisition causes to the affected persons, be they legal titleholders or others like squatters, tenants and employees of affected businesses.
- Compensation standards: Although the law stipulates 'market prices' of the acquired lands as the just compensation, the legal assessment method almost always results in prices that are far below the actual market prices[29]. Certain pricing standards, which are regarded as unrealistic, are used to assess other losses like structures and various built amenities, trees, crops and the like.
- Relocation of households and other establishments: No legal obligation is there to relocate, or assist with relocation of, those whose homesteads have been acquired or whose place of residence or livelihoods has been affected. Such persons/households, be they titleholders or squatters, are left on their own.
- Ensuring payment of compensation: Lands are legally acquired and handed over to the project execution agency as soon as the acquisition authority identifies the owners (or 'awardees'), by examining the records, and sends a legal notice advising them to claim the compensation (or 'awards'). It is the obligation of the

[29] According to the law, the 'market price' is calculated by averaging the sales prices recorded in the previousone year, in terms of land characteristics by land administration units or *mauzas*. But it is a widely acceptedfact that prices determined as such hardly reflect the true market value of the lands. As the sale/acquisitionprices are grossly under-reported to evade on sale taxes, assessment of legal compensation almost always fallfar too short of the real market prices.

affected landowners to prove, by producing an array of documents that the acquired lands legally belong to them. As gathering these documents is a long, expensive and cumbersome process, many landowners may remain unable to claim their awards30.

- Socioeconomic rehabilitation: The law shows no concern whatsoever about the long-term socioeconomic changes the affected persons and households might undergo in the post-acquisition period. There is no provision in the law except compensation for ensure economic rehabilitation and social reintegration of the displaced persons.

These shortfalls in the legal provisions have been widely recognized as not fulfilling the requirements of the OP 4.12, ever since Bangladesh started to address resettlement issues in the Bank-financed projects in the early 1990s starting with the Jamuna Multipurpose Bridge Project. All infrastructure agencies in Bangladesh using finance from international development financing institutions like the World Bank, the ADB, JICA, and DFID are now undertaking resettlement of project affected persons as an integral part of development projects.

(C) World Bank's Environmental Safeguard Policies

(i) Environmental Assessment (OP 4.01)

EA requirement. The World Bank requires environmental assessment (EA) of projects proposed for Bank support to ensure that they are environmentally sound and sustainable, and thus to improve decision making. The Bank Policy OP 4.01 considers that EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout the project implementation period. EA takes into account the natural environment (air, water and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples and physical cultural resources); and trans-boundary and global environmental aspects. The Bank Policy also envisages that the borrower Government is responsible for carrying out the EA and the Bank advises the borrower on the Bank's EA requirements.

The present EIA has been carried out in compliance with thisOperational Policy (OP).

EA classification. The World Bank classifies the proposed project into oneof the four categories, depending on the type, location, sensitivity, and scale of the project and the

[30] In the present land administration system, which is widely accepted as antiquated, land transactions, especially in the rural areas, often remain incomplete. Even after the sale/purchase deeds are legally executed, the sellers continue to remain as owners in the legal records until mutations are completed. As the transaction process is cumbersome and involves costs beyond those mandated by the law, and the practice that lands can be used with the deeds alone, most land transactions do not follow the process beyond deed execution. Many land purchasers are even not aware of the mutation or its significance.

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. [31]

- The Bank normally declines to finance projects that will significantly damage non-replicable cultural property, and will assist only those projects that are sited or designed so as to prevent such damage.
- The Bank will assist in the protection and enhancement of cultural properties encountered in Bank-financed projects, rather than leaving that protection to chance. In some cases, the project is best relocated in order that sites and structures can be preserved, studied, and restored intact in situ. In other cases, structures can be relocated, preserved, studied, and restored on alternate sites. Often, scientific study, selective salvage, and museum preservation before destruction is all that is necessary. Most such projects should include the training and strengthening of institutions entrusted with safeguarding a nation's cultural patrimony. Such activities should be directly included in the scope of the project, rather than being postponed for some possible future action, and the costs are to be internalized in computing overall project costs.
- Deviations from this policy may be justified only where expected project benefits are great, and the loss of or damage to cultural property is judged by competent authorities to be unavoidable, minor, or otherwise acceptable. Specific details of the justification should be discussed in project documents.
- This policy pertains to any project in which the Bank is involved, irrespective of whether the Bank is itself financing the part of the project that may affect cultural property.

This OP is not triggered since no cultural or archaeological resources are known to exist in the vicinity of the Project nor have any such resources been identified during field investigations. However, 'chance find' procedures will be implemented in the EMP.

(v) Forestry (OP 4.36)

[31] Excerpts from the OPN 11.03. WB Operational Manual. September 1986.

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:[32]

- self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
- collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and
- an indigenous language, often different from the official language of the country or region.

The OP defines the process to be followed if the project affects the indigenous people.

[32] Excerpts from the OP 4.10. WB Operational Manual. July 2005.

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.[33]

The overall objectives of the Policy are given below.

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.
- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

Since the proposed Project will involve land acquisition as well as displacement of houses and other assets, a Resettlement Action Plan (RAP) has been prepared, under a separate cover, in accordance with this Policy.

(x) Projects in Disputed Areas (OP 7.60)

Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighboring countries. In order not to prejudice the position of either the Bank or the countries concerned, any dispute over an area in which a proposed project is located is dealt with at the earliest possible stage.

33 Excerpts from WB OP 4.12. WB Operational Manual. December 2001.

The Bank may proceed with a project in a disputed area if the governments concerned agree that, pending the settlement of the dispute, the project proposed for country A should go forward without prejudice to the claims of country B. [34]

This OP is not triggered since no part of the Project area is located in any disputed territory.

(xi) Safety of Dams (OP 4.37)

The Policy seeks to ensure that appropriate measures are taken and sufficient resources provided for the safety of dams that the WB finances. However this OP is not relevant since the proposed Project does not involve construction of dams.

(xii) Public Disclosure of Information (BP 17.50)

This BP deals with the World Bank policy on disclosure of information. It is a mandatory procedure to be followed by the borrower and Bank and supports public access to information on environmental and social aspects of projects.

Once finalized, the EIA report will be disclosed to the public and will also be available on the official website of the BWDB. EIA will also be sent to the WB InfoShop.

(xiii) Environment, Health and Safety Guidelines

The Environment, Health, and Safety (EHS) 35 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.

[34] Excerpts from the OP 7.60. WB Operational Manual. November 1994.

[35] Environmental, Health and Safety Guidelines. IFC/WB Group, April 30, 2007.

Appendix D: Gate Operation Manual in Bangla

পোল্ডারের স্লুইস গেট পরিচালনার ক্ষেত্রে নিয়মাবলী

অতীতে পানি উন্নয়ন বোর্ডের কর্মচারীর মাধ্যমে স্লুইস গেটগুলো পরিচালিত হতো। বাজেট স্বল্পতার কারণে সে পদগুলো এখন স্থগিত করা হয়েছে। বর্তমানে গেটগুলো পরিচালনার দায়িত্ব সুবিধাভোগীদের উপর অর্পন করা হয়েছে। প্রতিটি পোল্ডাওে এ জন্য পানি ব্যবস্থাপনা সংস্থা (WMG, WMO, WMA) গঠন করা হয়। কৃষি উন্নয়ন ও মৎস্য সম্পদের কথা বিবেচনা করে পোল্ডার ১৬ এর গেট পরিচালনায় পানি ব্যবস্থাপনা সংস্থাগুলোকে নিম্নোক্ত বিষয়গুলো বিবেচনা করতে হবে:

- কৃষি ও মৎস্য সম্পদ ব্যবস্থাপনার সাথে সামঞ্জস্য রেখে একটি নির্দিষ্ট নিয়মের মধ্য দিয়ে প্রতিটি রেগুলেটরের গেট অবশ্যই নিয়ন্ত্রিণ করতে হবে ;
- প্রকৃত পানি ব্যবস্থাপনা বিশেষ করে কৃষি ও মৎস্য সম্পদের প্রয়োজনীতার ভিত্তিতে পানি উন্নয়ন বোর্ডের পরিচালনা ও রক্ষণাবেক্ষণ শাখা সুবিধাভোগী সংস্থা, কৃষি সম্প্রসারণ অধিদপ্তর এবং মৎস্য অধিদপ্তরের মাঠ কর্মীদের যৌথ পরামর্শক্রমে গেট পরিচালনা করতে হবে;
- শুধুমাত্র মেরামত ও ফ্ল্যাশিং ব্যতীত রেগুলেটরের ফ্ল্যাপ একটি নির্দিষ্ট স্থানে সব সময় একই অবস্থানে রাখতে হবে;
- খালে পানি সংরক্ষণ করে কৃষি কাজে সেচের জন্য বর্ষার পূর্বে (মার্চ - মে) গেট বন্ধ রাখতে হবে;
- বর্ষার সময় (জুলাই -সেপ্টেম্বর) গেট সাধারণত বন্ধ থাকবে তবে পোল্ডারের ভিতর ও বাহিরের পানির স্তর একটি নিরাপদ লেভেলের বাইরে যাতে চলে না যায় সেদিকে লক্ষ্য রাখতে হবে। এক্ষেত্রে, প্রতিদিনের বৃষ্টিপাত, নদীর অবস্থা, নদীর এবং পোল্ডারের ভিতরের পানির লেভেল বিবেচনা করে যথাযথ সিদ্ধান্ত নিতে হবে;
- মাছের সর্বোচ্চ প্রজননের সময় ডিমসহ মা মাছ (ব্রুড মাছ) ও মাছের পোনা অভিগমনের বিষয় বিবেচনা করে মে হতে জুন মাস পর্যন্ত গেট খোলা রাখতে হবে;
- বর্ষা পরবর্তী সময় (অক্টোবর-নভেম্বর) গেট এমনভাবে পরিচালনা করতে হবে যাতে খালে শুষ্ক মৌসুমেও পর্যাপ্ত পানি থাকে। এক্ষেত্রে লক্ষ্য রাখতে হবে যেন খালের পানি তীর উপচে না যায় এবং কৃষি কার্যক্রম ব্যাহত না হয়;
- ফ্ল্যাশিং স্লুইস ও পাইপ ইনলেট পরিচালনার ক্ষেত্রেও একই নিয়ম অনুসরণ করতে হবে;
- কৃষি কার্যক্রম, শষ্যের নমুনা ও ধরণ, মাছের প্রজনন সময় ও অভিগমন ইত্যাদি পরিবর্তনশীল বিধায় সময়ের সাথে সুবিধাভোগী সংস্থার (কৃষক, মৎস্যজীবি, মৎস্যচাষি) সাথে নিয়মিত পরামর্শ করতে হবে;
- কৃষি ও মৎস্য উভয় সম্পদ বিবেচনায় নিয়ে পানি ব্যবস্থাপনা সংস্থাগুলোকে (WMG, WMO, WMA) সমন্বিত পানি ব্যবস্থাপনার উপর প্রশিক্ষণ প্রদান করতে হবে।

Appendix E: Summary of Impacts

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
Pre-Construction Phase								
Generate noise and vibration equipment mobilization	Short term	Local	Reversible	Certain	Medium	Moderate	• Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards; • Vehicles and machinery should have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors should be assured, as needed; • Provision of PPE (ear muffs and plugs) to labor.	Low
Changes in land use (preparation of construction facilities, borrow areas, others)	Short term	Local	Reversible (after construction phase)	Certain	Very Low to Low	Low	• All the construction camps should be established within the area owned by BWDB. • Pay compensation/rent if private property is acquired on temporary basis, which instructions should be specified in the tender document. • Labor shed/camp should be constructing at government khas land. • Avoid impacts on local stakeholders.	Very low
Clearance of vegetation	Short term	Local	Reversible (after construction	Certain	Moderate	Moderate	• Labor sheds and stock yards should be established on low vegetative area or barren land as much as	low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
			phase)				possible. • Labors should be made aware about local faunal species • Labor should be encouraged to collect fuel wood for their own purpose from local market (Kopilmuni bazzar, Gadaipur bazzar, Paikghacha, Bazzar, Tala bazzar and Kathbaria bazzar etc.)	
Involuntary resettlement	Permanent	Local	Permanent	Negative	Moderate to Major	Major	• Compensation would be paid prior to construction in accordance with RAP. • Maintain liaison with communities. • Grievance redress mechanism (GRM) would be established.	Moderate
Construction Phase								
Generate noise and vibration	Short term	Local	Reversible (after construction phase)	Certain	Medium	Moderate	• The regulators should not be demolished during school time (8 am to 1 pm) particularly near the schools; • Restrict/limit construction activities during the day time; • Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards; • Vehicles and machinery should have proper mufflers and silencers; • Provision of noise barriers at schools and other sensitive receptors should	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							be assured, as needed; • Provision of PPE (ear muffs and plugs) to labor; • Construction crew should be instructed to use the equipment propoerly, to minimize noise levels; • Camps should be located at a safe distance from communities	
Soil and water contamination due to wastes	Short term	Local	Reversible (after construction phase)	Certain	High	Major	• Prepare and implement pollution control plan; • Workshops should have oil separators avoid release of oily water; • Avoid repairing of vehicles and machinery in the field; • Use plastic sheet or gravel in the workshop and equipment yard to prevent soil and water contamination; • Dispose contaminated soil appropriately ensuring that it does not contaminate water bodies or affect drinking water sources; • Contractor should ensure that there is no leakage, spillage or release of fuel, oil or any other affluent/waste on the ground or in the water from its construction machinery, vehicles, boats, launches, and barges. Contractor will regularly monitor the condition of its fleet;	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							• Material borrowing from the river banks should be carried out sufficiently away from the water line, minimizing the possibility of loose soil to wash away in the river; • Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal); • Release untreated wastes on ground or in water; • Construction material, demolished debris and excavated soil/silt should not be allowed to enter the water bodies.	
Aggravated Sedimentation	Short term	May extend beyond Polder	Mostly Irreversible	Likely	High	Moderate	• Small scale Tidal River Management (TRM) may be implemented where appropriate; • Contractor should protect untreated embankment slopes; • Contractor should excavate channels after dewatering them; • Contractor should not leave excavated earth and silt on channel banks; • Contractor should implement measures to protect channels from run-off from working areas and camps; and • Contractor should obtain borrowing material from river banks in such a manner so that there is no increase	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							of siltation in rivers and will not leave loose soil after excavation. • Regular monitoring of drainage khals is necessary to maintain the capacity.	
Affects on agriculture crop production	Short term	Local	Reversible	Likely	Minor	Low	• Compensation should be paid for any crop damage. • Contractor should avoid cultivation fields during construction. • Contractor should avoid agricultural land for material borrowing, material stockpiling and labor camps construction. • Contractor should ensure that no vehicular movements take place inside cultivation fields. • Contractor should ensure that no material is dumped inside cultivation fields. • Re-excavated soil of canals should not be damp in agricultural land. • Contractor should maintain liaison with communities.	Negligible
Affects on irrigation	Short term	Local	Reversible	Likely	Low to Medium	Major	• Contractor should construct bypass channel before construction/ repair of each sluices and Inlets. • Sequence of work at the sluices and in the water channels should be carefully planned to avoid irrigation disruption. • Contractor should ensure no	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							negative impacts on crop irrigation. • Contractor should maintain liaison with communities. • Contractor should work during dry season.	
Change in Migration Behavior	Short term	Local	Reversible	Likely	Medium	Minor	• Repair of drainage and flushing sluices should be conducted during the dry season (December-January). • Contractor might maintain liaison with experienced fishers during construction works.	Low
Increased Stock Susceptibility of Fish to Catch	Short term	Local	Reversible	Likely	High	Major	• Replacement should be conducted during the dry season (December-January) • Close monitoring should be conducted during the construction by local commercial fisher under the supervision of DoF so that allowable biological catch can be ensured.	Low
Reduced Fish Migration Time and Extent	Long term	Local	Not reversible	Likely	Medium	Moderate	• Proper sluice gate operation allowing fish migration in time. • Core commercial fishers having more than 20 years experience should be appointed in Operation and Maintenance of sluice gate. • Provide training to WMOs	Low
Increased Stock Susceptibility of Fish to Catch	Long term	Local	Reversible	Likely	Medium	Moderate	• Awareness building program should be promoted to commercial and subsistence fisher around the sluice gate. • Monitoring cell should be formed to	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							monitor the fishing activities to allow the allowable biological catch.	
Clearance of vegetation	Short term	Local	Reversible (after construction phase)	Occasional	Low to Medium	Medium	• Utilize low vegetated or barren land as much as possible for cc block manufacturing in construction yard • Plantation with mangrove species (Kaora, Ora, Bain, Kakra etc.) along the embankment side after completion of construction activities • All types of construction works should be finished in schedule time • Proper turfing should be implemented at embankment slopes with local grasses (i.e Durba (Cynodon dactylon), Mutha (Cyperus rotundus)) and ensure regular monitoring of turf grasses till they mature • Collect soil from barren land and alternate source like riverbed or nearer borrow pits at countryside as much as possible • Implement plantation at sluice ground and nearer foreshore mudflats after completion of construction works • Social aforestation along the countryside are planted by native species as well as salinity non tolerant variety (i.e Desi neem (Azadirachta indica),Sirish (Albizia	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							lebbeck), Babla (Acacia nilotica), Narikel (Cocos nucifera), Tal (Boassus flabelifer), and river side plantation are mostly used for mangrove species (i.e. Kaora (Sonneratia apetala), Gawa (Exocearia agallocha), Golpata (Nypa fruticans) etc.) at the damaged sites (sluice ground and nearer foreshore mudflats) after construction works. • Re-excavated spoil should be properly utilized. It may be used for re-sectioning of embankment (soil placing) and development of internal rural road • Construction activities should be started in dry season from April to June for re-excavation of canals • All types of activities would be finished in schedule time • Keep untouched the deepest points of the khal as much as possible. • Implement tree plantation with local species at the khal bank side after re- excavation work	
Outbreak of plant diseases	Short term	Local	Reversible	Occasional	Nil to Medium	Medium	• Local people should be involved and awareness in transit nursery program for proper seed germination, saplings collection and preserve • Care should be taken for pest	Nill

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							management, excessive use of fertilizer, biological control of plant disease while raising nursery and sapling plantation • SBDC project authority, FD, BWDB, local people, local nursery owner should collaborate for plantation program with control of plant disease • Eco-friendly fiber materials like jute bag, ropes etc. should be used for seed germination and to preserve saplings • Aware local people about plant pathogen, indication, cause and distribution of plant disease of affected species • All kinds of polyethylene bags and plastic ropes should be piled up in a pit and disposed in a proper way • Aware labors about plant conservation who are engaged for afforestation activities	
Road Communication may be hampered	Temporal	Local	Reversible (after construction phase)	Irregular	Medium	Minor	• Re-sectioning work should be done section wisely • The embankment works should be carried out in section and soil should be placed lineup on half of the embankment, leaving the other half to be used as road. • Work schedule should be finalized in coordination and consultation with	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							local representatives and communities. • Water way can be used especially along the river during construction period • Earthwork for re-section of embankment can be shorted for essay movement of local people. • All the works should be conducted in presence of Union Parishad Chairman and members.	
Post-Construction Phase								
Risk of embankment failure	Long term	Local	Reversible	Unlikely	High	Major	• Regular monitoring and rigorous maintenance of the embankment and existing water control structures especially along the southern and western side of the Polder should be ensured. This monitoring should particularly be carried out before and after monsoon season. • Proper dumping and compaction of soil should be ensured during re-sectioning of the embankment. • Side slope protection works should be maintained with proper design. • Available cyclone and flood shelter should be prepared as a contingency measure during emergency situation. • WMG should develop fund for such emergency situation. and • Structural measures like geo bag	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
							and sand bagshould be kept in the Upazila office for emergency need.	
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

Appendix F: List of Participants of PCM

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রমমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থানঃ খলিলনগর ইউনিয়ন পরিষদ ইউনিয়নঃ খলিলনগর উপজেলাঃ তালা

জেলাঃ সাতক্ষীরা সময়ঃ তারিখঃ ০৬।০২।২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
১.	প্রনব ঘোষ [illegible]	চেয়ারম্যান	[illegible]	০১৭২০[illegible]	[illegible]
২.	মোসাঃ [illegible]	সদস্যা	[illegible]	01711824012	[illegible]
৩.	[illegible]	ইউপি সদস্য	খলিলনগর	০১৭৬৮৬৮১৬৮০	[illegible]
৪.	মোঃ [illegible]	ইউপি [illegible]	[illegible]	০১৭২৪২[illegible]	[illegible]
৫.	প্রকাশ [illegible]	সমাজ সেবক	[illegible]	০১৭১১-২১১৬১৭	[illegible]
৬.	আমিনুর রহমান বাচ্চু	ইউ.পি. সদস্য	[illegible]	01740884777	[illegible]
৭.	মোঃ [illegible]	[illegible] সমাজ সেবক	মহানদী -		[illegible]
৮.	মোঃ আনিচুর রহমান		মহানদী	01731-434238	আনিচ
৯.	মোঃ [illegible] মিজানুর	সমাজ সেবক	খলিলনগর	01916980898	[illegible]
১০.	মোঃ [illegible] উদ্দীন	সদস্য	[illegible]	10722510642	[illegible]
১১.	আনোয়ার সাদী	[illegible]	[illegible]	০১৭১৩[illegible]	আনোয়ার সাদী
১২.	মোঃ [illegible]	[illegible]	খলিলনগর	01912055875	[illegible]
১৩.	মোঃ রিপন ঘোষ	সমাজ সেবক		01748-955654	রিপন
১৪.	মোঃ [illegible]	সমাজ সেবক			[illegible]
১৫.	মোঃ [illegible]		খলিলনগর	০১৭[illegible]	[illegible]
১৬.	মোঃ হারুন অর রশিদ	[illegible]	[illegible]	০১৭২৪-২২০[illegible]	harun
১৭.	[illegible]	[illegible]	[illegible]	০১৭৩২ [illegible]	
১৮.	মোঃ কামরুল ইসলাম	সমাজসেবক	খলিলনগর	০১৭২২[illegible]	[illegible]
১৯.	[illegible]	[illegible]	[illegible]	০১৭৭০[illegible]	[illegible]

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উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রমমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থানঃ খলিশ নগর ইউনিয়ন পরিষদ ইউনিয়নঃ খলিশনগর উপজেলাঃ তালা

জেলাঃ সাতক্ষীরা সময়ঃ তারিখঃ ০৬।০২।২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
২০.	হেরেন সরদার	কৃষি	মাগুরা	01727496106	হেরেন
২১.	আলোক সরকার	কৃষি	শুকদেবপুর	01736 [illegible]	আলোক
২২.	তপন কুমার মন্ডল	কৃষি	নলতা	০১৭২৪-৯৬১৪৬০	তপন
২৩.	আবুজাহিদ বিশ্বাস	মৎস্য ব্যবসায়ী	মাছিয়াড়া	01716-040025	[illegible]
২৪.	শহিদুল ইসলাম	মৎস্য ব্যবসায়ী	মাছিয়াড়া	01956659141	শহিদুল
২৫.	রফিকুল ইসলাম	চাকুরী	নলতা	০১৭১৭-২৪৭৫৫৯	[illegible]
২৬.	অহিদুল	মৎস্য	নলতা	01700-[illegible]	অহিদ
২৭.	মোস্তফা সরদার	কৃষি	খলিশনগর	017[illegible]9049[illegible]	মোস্তফা
২৮.	রফিকুল বিশ্বাস	মৎস্য ব্যবসায়ী	মাছিয়াড়া	01740-580343	রফিকুল
২৯.	আবু সাঈদ বিশ্বাস	মৎস্য ব্যবসায়ী	মাছিয়াড়া	01915-746345	[illegible]
৩০.	মিজানুর ইসলাম খাঁ	মৎস্য ব্যবসায়ী	" "	০১৭১১-২০৭৩৭৭	[illegible]
৩১.	আলামিন	ব্যবসা	খলিশনগর	01710-125753	আলামিন
৩২.	মিজানুর বিশ্বাস	মৎস্য ব্যবসায়ী	মাছিয়াড়া	01740-580343	মিজানুর
৩৩.	উজ্জল মোল্লা	চাকরী	নলতা	0172-854184	উজ্জল মোল্লা
৩৪.	আবদার আলী	মৎস্য ব্যবসায়ী	মাছিয়াড়া	01797919115	আবদার আলী
৩৫.	মিজানুর বিশ্বাস	মৎস্য ব্যবসায়ী	মাছিয়াড়া	01918-335886	মিজানুর বিশ্বাস
৩৬.	রাজ্জাক বিশ্বাস	মৎস্য ব্যবসায়ী	মাছিয়াড়া	01845-879682	রাজ্জাক
৩৭.	[illegible]	[illegible]	[illegible]	০১৭২৫২৩১৭৮৩	[illegible]
৩৮	মোঃ মহসিন গাজী	ব্যবসা	খলিশনগর	০১৭৫৪৬৯৩১০১	মহসিন

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উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রশমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থানঃ খলিল নগর ইউ: পরিষদ ইউনিয়নঃ খলিলনগর উপজেলাঃ তালা
জেলাঃ সাতক্ষীরা সময়ঃ তারিখঃ ০৫/০৩/২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
	[illegible]	কৃষি	খলিলনগর	01721 688218	[illegible]
	[illegible]	[illegible]	[illegible]	01930-225901	[illegible]
	রফিকুল ইসলাম	কৃষি	[illegible]	01928908294	[illegible]
	[illegible]	কৃষি	[illegible]	01750 389692	[illegible]
	[illegible]	ইউপি সদস্য	[illegible]	01729652029	[illegible]
	[illegible]	ইউ.পি. সদস্য	[illegible]	01915209565	[illegible]
	মেহেদী হাসান	ইউপি সদস্য	[illegible]	01977882925	[illegible]
	[illegible]		খলিলনগর	01710024178	[illegible]
	[illegible]		[illegible]		[illegible]
	[illegible]		[illegible]	01868890790	[illegible]
	[illegible]			01965965224	[illegible]
	[illegible]		[illegible]	01754886597	[illegible]
	[illegible]		[illegible]		[illegible]
	[illegible]		[illegible]		[illegible]
	মো: [illegible]			01931-056960	[illegible]
	[illegible]		[illegible]	01754886980	[illegible]
	[illegible]		[illegible]		[illegible]
	[illegible]	ইউ.পি. সদস্য	[illegible]	01728-228299	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থানঃ কপিলমুনি ইউ: পরিষদ ইউনিয়নঃ কপিলমুনি উপজেলাঃ পাইকগাছা

জেলাঃ খুলনা সময়ঃ তারিখঃ ০৭।০২।২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
১.	[illegible]	চেয়ারম্যান, কপিলমুনি ইউপি	কপিলমুনি	01255903131	[illegible]
২.	মো: আলমগীর [illegible]	ইউপি	[illegible]	[illegible]	আলমগীর
৩.	মো: [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
৪.	মো: ইমরান আলী	ইউ পি সদস্য ওয়ার্ড-৬	[illegible]	০১৭২৪৭১৮৮৮২	মো: ইমরান আলি
৫.	মোঃ [illegible]	ইউ: পি: সদস্য 08	[illegible]	[illegible]	[illegible]
৬.	মো: রবিকুল ইসলাম	ইউপি সদস্য ৬ নং ওয়ার্ড	তালতলা	[illegible]	[illegible]
৭.	মো: হাসানুর রহমান	২ নং ওয়ার্ড সদস্য	কাশিমনগর	01711261458	[illegible]
৮.	[illegible]	২ নং কপিলমুনি ইউ.পি ৪,৫,৬	[illegible]	[illegible]	[illegible]
৯.	ফাজিলাতুন্নেছা	২নং কপিলমুনি ইউপি ৭,৮,৯	[illegible]	[illegible]	[illegible]
১০.	নরোত্তম [illegible]	[illegible]		[illegible]	[illegible]
১১.	[illegible]	[illegible]		[illegible]	[illegible]
১২.	মো: মামুনুর রশিদ	V.P D-NGO	কপিলমুনি	01911179622	[illegible]
১৩.	[illegible] মান্নান		কপিলমুনি	[illegible]	[illegible]
১৪.	নাজমা বেগম	~~[illegible]~~ গ্রাম কর্মী			নাজমা
১৫.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
১৬.	ইসলাম	কৃষি	[illegible]		ইসলাম
১৭.	মাহিনুর	কৃষি	"		মাহিনুর
১৮.	তারক দাস	কৃষি	"		তারক দাস
১৯.	মুসলিমা	কৃষি/গৃহিনী	"		মুসলিমা

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উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব নিরুপন, প্রমমনের উপায় ও ব্যবস্থাপনা বিষয়ক

মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

স্থানঃ কপিলমুনি ইউ: পরিষদ ইউনিয়নঃ কপিলমুনি উপজেলাঃ পাইকগাছা

জেলাঃ খুলনা সময়ঃ তারিখঃ ০৭/০২/২০১৬

ক্রমিক নং	নাম	পদবী	গ্রাম/ঠিকানা	মোবাইল নং	স্বাক্ষর
২০.	[illegible]	কৃষি	কপিলমুনি	-	[illegible]
২১.	[illegible]	সভাপতি প্রেসক্লাব	[illegible]	০১৩০৯-৭১১০২১	[illegible]
২২.	মোঃ আজিজুল [illegible]	"	"	—	মোঃ আজিজুল [illegible]
২৩.	রবীন্দ্র নাথ অধিকারী	ইউ পি সদস্য ৪-৬ ওয়ার্ড	কপিলমুনি	01716064454	[illegible]
২৪.	[illegible]	[illegible]	[illegible]	০১৯১৫০২২২৭৫	[illegible]
২৫.	[illegible]				[illegible]
২৬.	আব্দুল্লাহ মোল্লা	কৃষক	[illegible]	0176175859	[illegible]
২৭.	মোঃ [illegible]	সমাজসেবক	"	01714633538	[illegible]
২৮.	প্রদীপ কুমার ঘোষ	সমাজসেবক	নাসিরপুর	01736757686	প্রদীপ ঘোষ
২৯.	[illegible]	সমাজসেবক	নাসিরপুর	০১৭৬০২৪৫৫৬৬	[illegible]
৩০.	ইউনুছ আলি	সদস্য	[illegible]	০১৭২৫-১৭৬৫০৪	[illegible]
৩১.	মোঃ মনিরুল ইসলাম	উদ্যোক্তা	[illegible]	০১৭১৯-০৩২৭১১	[illegible]
৩২.	[illegible]			০১৯৪৫০০৭১৭০	[illegible]
৩৩.	মোঃ হেকমত আলী সরদার	[illegible]	[illegible]	০১৭১৮৫০৩৪০৮	[illegible]
৩৪.					
৩৫.					
৩৬.					
৩৭.					
৩৮.					

আয়োজনে:

CEGIS Center for Environmental and Geographic Information Services

House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

Appendix G: No Objection Certificate (NOC)

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
চেয়ারম্যানের কার্যালয়

১২ নং খলিলনগর ইউনিয়ন পরিষদ

ডাকঘর : খলিলনগর, উপজেলা : তালা, জেলা : সাতক্ষীরা।
(স্যানিটেশন কভারেজ অর্জনে জাতীয় পুরস্কার প্রাপ্ত)

সূত্র ঃ খইউপি/ তারিখ :

স্মারক নং- তারিখ-

অবস্থানগত/পরিবেশগত ছাড়পত্রের স্থানীয় কর্তপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্রের ছক

১। আবেদনকারীর নাম ঃ প্রকল্প পরিচালক, উপকূলীয় বাঁধ উন্নয়ন প্রকল্প (CEIP) বাংলাদেশ পানি উন্নয়ন বোর্ড ।

২। পিতা/স্বামীর নাম ঃ প্রযোজ্য নয়

৩। আবেদনকারীর ঠিকানা ঃ প্রকল্প পরিচালকের কার্যালয়, উপকূলীয় বাঁধ উন্নয়ন প্রকল্প (CEIP) বাড়ী নংঃ ১৫ (৫ম তলা), সড়ক নংঃ ২৪, গুলশান-২, ঢাকা-১২১২

৪। প্রকল্পের অবস্থানগত ঠিকানা ঃ পোল্ডার ১৬, সাতক্ষীরা জেলার তালা উপজেলার খলিলনগর ইউনিয়নে অবস্থিত।

৫। প্রকল্পের তফছিল ঃ

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
সাতক্ষীরা	তালা				মাঝারি উচু ভূমি	হেক্টর

৬। প্রকল্পের কার্যক্রম ঃ বাঁধ উঁচুকরন, স্লুইজ গেট ও রেগুলেটর নির্মাণ ও মেরামত, খাল পূনঃখনন ইত্যাদি।
উপরোক্ত তথ্যাদির আলোকে পোল্ডার পোল্ডার ১৬ পূর্নবাসন প্রকল্প বাস্তবায়নের জন্য নিম্নেবর্ণিত অনাপত্তি প্রদান করা হলো।

শর্তাবলী ঃ

১। প্রকল্প স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষণ আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে।
২। পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত ছাড়পত্র গ্রহণ করতে হবে।
৩। কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তার নিশ্চিত করতে হবে।
৪। উপযুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে। এবং অগ্নিকান্ড কিংবা অন্য কোন দূর্ঘটনার সময় জরুরী নির্গমন ব্যবস্থা থাকতে হবে।
৫। বায়ু ও শব্দ দূষন করা যাবে না।
৬। প্রকল্প সৃষ্ট তরল বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না।

উপরে উল্লিখিত যে কোন শর্তলঙ্ঘন করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক প্রকল্পের বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

১/২/২৩

তারিখ ঃ

প্রভাষক প্রনব ঘোষ বাবলু
স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও সীল
চেয়ারম্যান
১২নং খলিলনগর ইউনিয়ন পরিষদ
তালা, সাতক্ষীরা।

No objection certificate (NOC) of Khalilnager Union

বিসমিল্লাহির রহমানির রহিম
গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

মোঃ শাহাদাৎ হোসেন ডাবলু
চেয়ারম্যান
গ্রামঃ কাশিমনগর
ডাকঃ কাশিমনগর
পাইকগাছা, খুলনা।
মোবাঃ ০১৭১১-৩৮৩১৩১

চেয়ারম্যানের কার্যালয়

২নং কপিলমুনি ইউনিয়ন পরিষদ

ডাকঘরঃ কপিলমুনি, উপজেলাঃ পাইকগাছা
জেলাঃ খুলনা।

সকল বিষয়ে ইউনিয়ন তথ্য সেবা কেন্দ্রের সহায়তা নিন।

পূর্ব সূত্রঃ-------------
স্মারক নং-

তারিখঃ ০৭-২-২০১৮

অবস্থানগত/পরিবেশগত ছাড়পত্রের স্থানীয় কর্তপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্রের ছক

১। আবেদনকারীর নাম ঃ প্রকল্প পরিচালক, উপকূলীয় বাঁধ উন্নয়ন প্রকল্প (CEIP)
বাংলাদেশ পানি উন্নয়ন বোর্ড ।

২। পিতা/স্বামীর নাম ঃ প্রযোজ্য নয়

৩। আবেদনকারীর ঠিকানা ঃ প্রকল্প পরিচালকের কার্যালয়,উপকূলীয় বাঁধ উন্নয়ন প্রকল্প (CEIP)
বাড়ী নংঃ ১৫ (৫ম তলা), সড়ক নংঃ ২৪, গুলশান-২, ঢাকা-১২১২

৪। প্রকল্পের অবস্থানগত ঠিকানা ঃ পোল্ডার ১৬, খুলনা জেলার পাইকগাছা উপজেলাধীন ২নং কপিলমুনি ইউনিয়নে অবস্থিত।

৫। প্রকল্পের তফছিল ঃ

জেলার নাম	থানার নাম মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
খুলনা	পাইকগাছা			মাঝারি উচু ভূমি	হেক্টর

৬। প্রকল্পের কার্যক্রম ঃ বাঁধ উঁচুকরন, স্লুইজ গেট ও রেগুলেটর নির্মাণ ও মেরামত, খাল পূনঃখনন ইত্যাদি।
উপরোক্ত তথ্যাদির আলোকে পোল্ডার পোল্ডার ১৬ পূর্নবাসন প্রকল্প বাস্তবায়নের জন্য নিম্নেবর্ণিত অনাপত্তি প্রদান করা হলো।

শর্তাবলী ঃ

১। প্রকল্প স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষণ আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে।
২। পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত ছাড়পত্র গ্রহণ করতে হবে।
৩। কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তার নিশ্চিত করতে হবে।
৪। উপযুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে। এবং অগ্নিকান্ড কিংবা অন্য কোন দূর্ঘটনার সময় জরুরী নির্গমন ব্যবস্থা থাকতে হবে।
৫। বায়ু ও শব্দ দূষন করা যাবে না।
৬। প্রকল্প সৃষ্ট তরল বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না।

উপরে উল্লিখিত যে কোন শর্তলজ্ঞন করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক প্রকল্পের বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

৭/২/১৮

(শাহাদাৎ হোসেন ডাবলু)
স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও সীল
২নং কপিলমুনি ইউনিয়ন
পাইকগাছা, খুলনা।

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
চেয়ারম্যানের কার্যালয়

১২ নং খলিলনগর ইউনিয়ন পরিষদ

ডাকঘর : খলিলনগর, উপজেলা : তালা, জেলা : সাতক্ষীরা।
(স্যানিটেশন কভারেজ অর্জনে জাতীয় পুরস্কার প্রাপ্ত)

সূত্র ঃ খইউপি/ তারিখ :

স্মারক নং- তারিখ-

অবস্থানগত/পরিবেশগত ছাড়পত্রের স্থানীয় কর্তপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্রের ছক

১। আবেদনকারীর নাম ঃ প্রকল্প পরিচালক, উপকূলীয় বাঁধ উন্নয়ন প্রকল্প (CEIP) বাংলাদেশ পানি উন্নয়ন বোর্ড ।

২। পিতা/স্বামীর নাম ঃ প্রযোজ্য নয়

৩। আবেদনকারীর ঠিকানা ঃ প্রকল্প পরিচালকের কার্যালয়, উপকূলীয় বাঁধ উন্নয়ন প্রকল্প (CEIP) বাড়ী নং: ১৫ (৫ম তলা), সড়ক নং: ২৪, গুলশান-২, ঢাকা-১২১২

৪। প্রকল্পের অবস্থানগত ঠিকানা ঃ পোল্ডার ১৬, সাতক্ষীরা জেলার তালা উপজেলার খলিলনগর ইউনিয়নে অবস্থিত।

৫। প্রকল্পের তফছিল ঃ

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমান
সাতক্ষীরা	তালা				মাঝারি উচু ভূমি	হেক্টর

৬। প্রকল্পের কার্যক্রম ঃ বাঁধ উঁচুকরন, স্লুইজ গেট ও রেগুলেটর নির্মাণ ও মেরামত, খাল পূনঃখনন ইত্যাদি।
উপরোক্ত তথ্যাদির আলোকে পোল্ডার পোল্ডার ১৬ পূর্নবাসন প্রকল্প বাস্তবায়নের জন্য নিম্নেবর্ণিত অনাপত্তি প্রদান করা হলো।

শর্তাবলী ঃ

১। প্রকল্প স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষণ আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে।
২। পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত ছাড়পত্র গ্রহণ করতে হবে।
৩। কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তার নিশ্চিত করতে হবে।
৪। উপযুক্ত অগ্নি নির্বাপিক ব্যবস্থা রাখতে হবে। এবং অগ্নিকান্ড কিংবা অন্য কোন দূর্ঘটনার সময় জরুরী নির্গমন ব্যবস্থা থাকতে হবে।
৫। বায়ু ও শব্দ দূষন করা যাবে না।
৬। প্রকল্প সৃষ্ট তরল বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না।

উপরে উল্লিখিত যে কোন শর্তলঙ্ঘন করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক প্রকল্পের বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

৯/১২/১৩

তারিখ ঃ স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও সীল

প্রভাষক প্রনব ঘোষ বাবলু
চেয়ারম্যান
১২নং খলিলনগর ইউনিয়ন পরিষদ
তালা, সাতক্ষীরা।

Appendix H: Checklist for PCM

Checklist of Public Consultation Meeting

ENVIRONMENTAL IMPACT ASSESSMENT OF

Coastal Embankment Improvement Project (CEIP)

Checklist for Public Consultation Meeting (PCM)

- Self and organization's introduction
- Orientation of the participants
- Purpose of the meeting (Generic and specific)
- Brief introduction about the project (by facilitator)
- Outlining the general problems of the studied area
- Knowledge about the project
- Attitude towards the project
- Project related problems (especially drainage, tidal water, agricultural practice, land source, ground water, intake and discharge of water, quality of water, Fisheries resources; Plantation, Marine ecosystem, Terrestrial wildlife employment, income, etc.)
- Project induced opportunities
- Suggestions for mitigation of problems
- Suggestions for enhancement of opportunities
- Suggestions to project implementers and planners

Appendix I: Comments and Responses (IPOE)

Comments and Responses on EIA report of Polder 16 under Package-3

Sl	Comments by IPOE (Professor Dr.Ainun Nishat)	Responses by CEGIS
1	Scoping and bounding need to be mentioned in approach and methodology chapter	It has already been incorporated in the report (sections 2.2.3 & 2.2.4). This chapter has also been re-organized according to theEIA steps
2	Characteristics of brackish fish species and indicative fish speciesin the Polder area	Characteristics of brackish fish species and indicative fish specieshave been addressedin section 6.2.10
3	Mention exist velocity to the gate	Exist velocity has been mentioned in section 10.15.3
4	Timing of the fish fry movement	It hasbeen mentioned in the report (section 6.2.10 and figure 6.11)
5	Restore the connectivity /Boat pass or someother way tobe provided as per as for boat movement	Boat pass arrangementhas been suggested in thereport(section 10.15.1 in Chapter 10)
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 EIAteam	A detailed gate operation plan has been provided in the report (section 5.9 in chapter 5). In addition, gate operation plan in Bengali has been prepared and providedin Appendix - E
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 occupied by local influential people. How to solve this problem?	A doable plan has been suggested in section 10.15.3 (chapter 10) considering conflict between gher owners and farmers

Sl	Comments by IPOE (Professor Dr.Ainun Nishat)	Responses by CEGIS
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 J: Responses to World Bank Comments

Sl	Comments by WB	Responses by EIA Consultant	Action taken
1	Strategic/Sectoral Assessment: Given that multiple polders are being considered and they are part of a larger government intervention, it is recommended to clarify in the EIAs if any Strategic or Sectoral Environmental Assessment has been conducted in relation to the Coastal Zone Policy (2005), the Coastal Development Strategy (2006) or similar government plans informing the rehabilitation of polders, and if so, how those Assessments inform the site-specific EIAs	A strategic Environmental Assessment (SEA) has been carried for CEIP-1 before conducting the EIA study.	It has been mentioned in Executive Summary (para 1) and Chapter-1 (Introduction: para-1)
2	Selection Criteria: Similarly, the EIA states that "This polder is one of the 17 Polders selected for rehabilitation through feasibility study under CEIP-1.". The EIA, in the Executive Summary and other relevant sections (e.g. Alternative Analysis) should explain any environmental criteria that was used to select the polders.	Preliminary 17 polders were selected for rehabilitation in feasibility study considering physical conditions as well as damages of the polder. Afterwards, these polders were selected through screening matrix. In environmental point of view, multi-criteria analysis was conducted which has been mentioned in SEA report.	It has been mentioned in Executive Summary and Chapter-1 (Introduction) and para-1
3	Past Experiences: Since a number of polders under Works Package 1 have started the construction phase, it is recommended to include a brief	This issue will be considered	

	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 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 16 has not been awarded to DoE yet because this report is in the progress of finalization. After finalization, it will be submitted at DoE for Clearance. IEE report was submitted to DoE and obtained site clearance.	
5	Legal framework. How does the EIA and the project apply the policy, legislative and regulatory framework? The chapter presents a compilation of laws and regulation, but	This chapter has already been addressed elaborately and appended in the report (Appendix-C).	The updated chapter has been appended.

	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.		
6	Climate change. The exercise to bring climate change data to the EIA and to make the CC case is interesting. However, the EIA does not conclude how project design responds to those projections and how project design mitigates the effect of climate change. What is the connection between data and the model utilized for project design?	It may be mentioned here that drainage modelling of the coastal polder has been carried out by IWM to find out the design parameters for drainage channel systems, drainage regulator, river bank, slope protection works. Climate resilient coastal embankment crest level has been design considering the combined effects of cyclone storm surge effects and cyclone induced wind wave. The model has been developed and simulated considering climate change condition considering with and without interventions by IWM, 2016	It has been mentioned in Section 4.1, para 75
7	Enhancement of conflicting uses. In various sections the EIA mentions an existing conflict		This issue has been addressed in the Section 5.4

	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.		
8	Afforestation. How does the EMP follow the BWDB afforestation regulations? How is the EMP including the detail information on plantation program (Table 10.6). It would be good to articulate this chapter with EMP.		Yes, the afforestation plan will be implemented as per regulations of BWDB (Section 10.4, para 531) As per suggestion articulated in the EMP (Table 10.6)
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 property presence in the area of influence that might be important to consider.		It has been considered in Section 5.7; para 137, Table 5.10
11	Manpower requirement. We recommend to revisit the numbers.		The figure mentioned in Table 5.11 has been revised based on the experience from the works implementation in Package-1.
12	Project implementation arrangements. We		This issue has been considered and updated

	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 articulates with the EMP. Many operational activities described in this section have clear implications at the EMP level. Capacity issues should be discussed.		accordingly, Section 5.9, paras 141- 150.
13	Sensitive receptors. How is the baseline defined for education and health affected by the project? Please also discuss how the market/growth centers and the cultural heritages and common property resources in the polder would be affected by the project. They have been included in the baseline, as part of the area of influence.	Selection of sensitive receptors as well as growth Centre and common resources properties within 500 m distance from the embankment have been considered	It has been considered in section 6.4, para 316, 317, 321.
14	Pest management. The development of a pest management plan for the holistic afforestation. It	The afforestation plan has not been taken up in package-1 because the construction works under	Capacity building for pest management in agricultural sector mentioned in para 454,

	would be good to capture the experience from the afforestation actions delivered for the polders under construction.	this project is in progress	Table 10.1, ECoP7.
15	Compensation mechanisms. Where in the report is the compensation criteria to establish the payments to the owners against tree felling? How is this implemented?	A detail Resettlement Action Plan (RAP) is being prepared by the Consultant. According to the plan, payment to the owners against tree felling will be established. It would be included after getting the RAP report.	Mentioned in Section 9.8, para 524 and subsequent paras
16	EMP and mitigation measures. EMP follows the same footprint as previous reports. In the case of the mitigation measures it is not clear who is responsible for implementation, where and when. This is not fixed by the EMP. While each impact included a reasonable set of mitigation measures, the EMP chapter of the report includes a generic mitigation guideline. While this is useful it is not enough to guide the preparation of the detailed EMP and the contractor EMP. For example, in terms of obstruction of fish movement and migration, who is going to implement the six proposed mitigation measures, when and where? Is the estimated implementation cost enough to ensure all the proposed mitigation measures? Our impression is that not all the proposed mitigation	This chapter has been updated according to the comment	Chapter 9

	measures have been included in the Table 10.4?. Our recommendation is to cut and paste to bring to the table the mitigation measures included in the environmental assessment chapter. The more accurate and defined the EMP is, the better can support the future bidding document directly.		
17	Construction Camps: In various sections of the EIA it is stated that labor sheds and camps will be constructed, but the EIAs should clarify if such labor sheds/camps will house workers or not. If those structures are to house workers it is recommended to include in the EMP section a reference to internationally recognized guidelines for construction and operation of such camps, such as the IFC/EBRD workers accommodation guidelines http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/learning+and+adapting/knowledge+products/publications/publications_gpn_workers accommodation. Please state if the project will involve labor influx or not following the bank definition.		It has been clarified in Section 5.8 ; para 138
18	Traffic Management: The EIAs identify risks and impacts related to the project-related traffic and	National and WB noise standards have been included in the report to comply Noise levels from	Mentioned in several sections, see Section 9.4 and Table 10.1

	there are different mitigation measures mentioned in different sections of the EIAs. It is recommended to consolidate traffic-related mitigation measures and ensure that they are consistent throughout the document, and also to clarify the scope of key elements of the Traffic Management Plan that should be prepared. Increase of Vehicular Traffic during mobilization – it is recommended to include procedures to ensure: adequate signaling for traffic and pedestrian safety, speed limits for project-related trucks when crossing heavily populated areas and dust control measures. This also applies to Hindrance of Pedestrian and Vehicular Movement. Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards. Include reference parameters and link.	vehicles, equipment and machinery etc.	
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	Survival rate of each mangrove species are illustrated in Final Interim Report on Additional Tasks Assigned September, 2013 (Feasibility report on Afforestation)	This issue has already been mentioned in para 530, included in EMP (Section 9; ECoP 7, Table 10.1), also in Appendix E

	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.		
20	EHS Guidelines: The section on *Environment, Health and Safety Guidelines* should specify that the most relevant EHS Guideline is the General one and provide a link in the document: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines		The health and safety issue has been considered and the guideline has been linked in several sections of the report
21	Pesticides: The interventions under the proposed Project may result in an increased availability of irrigation water through cleaning and excavation of watercourses in the Polder. This increased water availability can in turn potentially increase the usage of chemical fertilizers and pesticides. During regular environment monitoring during operational phase if the water and soil pollution	Level of chemicals including heavy metals will be measured during monitoring to check if the environmental quality standards (EQS) are exceeded in which case IPM and ICM will be prepared by the Department of Agricultural Extension (DAE). Objective of the infrastructure project is agricultural crop production which has been addressed. DAE will be the agency responsible for	

	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 crop production through reduced dependence on agro-chemicals.	
22	Periodic Maintenance Works: The EIAs should describe the environmental management procedures that will be in place during the operational phase of the project for conducting “Major Periodic Maintenance Works”, which could have considerable impacts.		It has been mentioned in the report-Section 9.6, Table 10.2
23	IPoE Assessment: What was the result of the IPoE review of the EIA?	IPoE has reviewed the draft EIA report of Polder 16 and has made some	The comments and responses has been appended in the report

		comments. Accordingly, the report has been updated.	(Appendix-I)
24	<u>Disclosure and consultation:</u> Please include final details on disclosure and consultation of the EIA	Initially, consultation meetings have been conducted. Disclosure meeting at regional and national level have also been conducted	Section 10.9

Appendix K: WB Comments on CEIP EIA Draft Report – Package 3

The EIA has been conducted by the Center for Environmental and Geographic Information Services (CEGIS). The team has conducted numerous field visits and ensured participation of the community of polder 16 during field survey and public consultations in order to carry out the study.

The key improvement works to be carried out in Polder 16 under CEIP-1 are: re-sectioning of embankment (43.00 km); construction of retired embankment (2.00 km); bank protection works (0.30 km); slope protection of embankment (1.00km); construction (replacing) of 10 number of drainage sluices; construction (replacing) of 20 (twenty) flushing sluices; repair of 2 drainage sluices, demolishing of flushing inlet (01); re-excavation of drainage channels (20 km) and afforestation of (24.0 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 16 for another review.

WB Comments	Responses
General: The document title is “EIA” however it includes social aspects as well. Why it is called as EIA rather than ESIA?	Only the baseline information related to the various social aspects has been included in this document, which is appropriate and essential to understand the ground situation of the project area in relation to the ensuing environmental conditions and ecological/ natural resources. This report, in fact, is not a social impact assessment; hence the document title only mentions EIA as per the contract.
Executive Summary: Please include EMP/ESMP table, EMP/ESMP implementation cost and monitoring table in Executive Summary.	EMP/ESMP, monitoring plan with cost has been included in the executive summary
Introduction: Please enlarge Map 1.1 so that locations of all polders in Package 3 can be identified	As per comment, location map has been corrected and replaced
Policy and Regulatory Framework: Section 3.7 is overlapped with the figure. Please resolve it	It has been resolved
OP7.50 is triggered for the project. Please revise the text.	The rivers around the polder are local rivers and not international rivers. The OP 7.50 was mentioned in the report by mistake which has already been deleted from the report.
Methodology: Please explain how impact	Method for impacts screening has been

WB Comments	Responses
assessment methodology from ~~para. 40-45~~ relates to impact screening explained in Section 7.	explained in this chapter
Climate Change impacts: The climate change impact doesn't mention the flood and storm surges effects which is relevant to the polder. It only covers the rainfall and the temperature projections.	This issue has been considered and addressed in the report
Project Description: Please clarify the details of afforestation activities including who will be responsible for implementation of afforestation, location of afforestation, afforestation period, types of tree species used.	The contractor will work with the Senior Forestry Specialist at PMU for afforestation; indigenous tree species will be selected for plantation; afforestation period is pre-monsoon (Apr-May); local NGOs/ CBOs/ WMOs will be hired and will be responsible for maintenance of the saplings under social forestry guidelines.
~~Para 138~~ states temporary labour camp for local labour during preparing CC block will be established. Please include the basic information of camp sites such as land requirement, number of camp sites, what kinds of facilities would be constructed. Please also assess the potential labor influx. Labor influx plan should be prepared as a part of EMP/ESMP where appropriate.	Location of labour camp is shown in a Map in the report (Figure 5.4). Detailed of labour camps information has been discussed in section 5.7.10 (chapter 5).
This EIA does not include the environmental and social impact assessment of CC block manufacturing plants. Please prepare the separate assessment	Only 0.3 km bank protection works (Table 5.4) will be carried out for rehabilitation of Polder 16. The CC block will be prepared manually. Hence, CC block manufacturing plants will not be used.
Table 5.12 shows construction materials for pre-sectioning of embankment and drainage sluices/flushing inlets. Please also explain how to procure the other construction materials used for other project activities such as river bank protection and slope protection. Please also clarify how many CC block manufacturing plants will be established.	This issue has been mentioned in section 5.7.1 in chapter 5
Para 146 A Social, Environment and Communication Unit: Is this unit established only for Package 3? Is this the same Environmental and social unit for Package 1? Please explain.	It is the same SECU at PMU for all the packages
~~Para 148~~ Would DCSC supervise/assist implementation of safeguard instruments such as EMP or RAP? Please clarify	Clarified and the relevant paragraph has been rephrased
The EIA study presumes that the invert level of the drainage sluice gate have been fixed in manner that about 50-60% of water will be retained in the khal to facilitate in irrigation, fisheries, environment and other purposes.	As per design of Drainage Sluices (DS), The invert level of DS are fixed inconsideration of the lowest water level. Hence, the canals bed level which are below the invert level have the capacity of retain some water within

WB Comments	Responses
Please explain the reasons that this assumption is made.	it. The water are being used for irrigation, fisheries and domestic purposes.
Baseline Condition: Land use: No natural vegetation such as forest and wetland? It is not clear in Table 6.1.	There is no natural/ mangrove forest or vegetation or beel (wetland) within the Polder area which has been mentioned in section 6.1.7 & Table 6.1
Mangrove: Please show the distribution of Mangrove on a map. Is it also possible to show the size of mangrove forest areas?	It has already been mentioned in the above response
Has endangered river dolphins been recorded in the rivers along the polder? Please clarify.	Yes, freshwater river dolphin (*Platanista gangetica*) occurs in the peripheral rivers.
Analysis of Alternative: ~~Para 370~~: Please clarify which, either procuring sand from market or sand collected from riverbed, is the proposed option.	This section has been revised as per comment
Technological alternative analysis is not really conducted. Please include the technological alternative for each proposed work. For example, as a technological alternative for construction of replacement of the existing flushing sluices, would the repair of existing flushing sluices be considered?	Status of the hydrological 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 5.7.7 and a conceptual soil dumping location is shown in figure 5.3
Table 8.1- Please include the potential impacts on involuntary resettlement.	Data is not available as the RAP consultant was not provided it.
Please clarify the contractor will prepare Traffic Management Plan to address potential E&S impacts including traffic safety, noise, vibration and air pollution.	Traffic Management Plan will be prepared by the Contractor and included in the Contractor's Environmental & Social Management Plan (C-ESMP) as has been prepared for the Polders of Package-1 and Package-2 for EHS impacts including traffic safety, noise &vibration and air pollution.
All the mitigation measures proposed in Section 7 should be reflected in EMP table which needs to be developed in Section 9.	All mitigation measures proposed in chapter 8 have been reflected in EMP Table (Table 10.1 in Chapter 10)
Please analyze the impacts related to labor and propose the comprehensive mitigation measures including OHS, management plans for workers camp and labor conditions.	Addressed in section 8.4.14
Please analyze the impacts related to community security, health and safety and propose comprehensive mitigation measures.	impacts related to community security, health and safety as well as mitigation measures have been addressed in section 8.4.14
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

WB Comments	Responses
	the outside area rather than river bed for concreting and other construction works.
Please clarify the prohibition of clearance trees as a mitigation measure in para.385 as indicated in para .384.	Not clear
Please add in para 385 that an approval needs to be obtained from DCSC for clearance of vegetation	It has been added in the report
Please add in para 385 that the contractor needs to prepare flora and fauna protection plan	It has been added in the report
~~Para 394~~ (Noise) - Please propose the following measures to be implemented by contractor: installation of acoustic enclosures around generators, notification of major noise generating activities to affected people, prohibition of vehicle movement during night time, monitoring noise in the nearby community where appropriate, preparation of noise and vibration management plan as a part of pollution control plan proposed in para 398.	This issue has been addressed in the report
~~Para 398~~ (Soil and water contamination) - Please propose the following measures to be implemented by contractor: Installation of temporary drainage works (channels and bunds) and/or temporary sediment basins where sediment and erosion control are required, preparation of spill control procedure, workshops fully bunded with impervious floors and walls, all containers, drums and drums in good condition, storing all liquid fuels in fully bunded storage containers, refueling only within bunded areas, provision of spill kit and other oil spill response tools, preparation of Emergency Response Plan , refueling only within bunded area.	This issue has been addressed in the report
~~Para 402~~ (Aggravated Sedimentation) - Please propose the following measures to be implemented by contractor: preparation of borrow area management plan and obtaining necessary permits 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

WB Comments	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 9.3.2
EMP (ESMP): Section 9 should present EMP table consolidating all the mitigation measures proposed in Section 7, ECoP and mitigation measures proposed in Appendix E.	Considered and all mitigation measures have been presented in Table 10.1 (Chapter 10)
Environmental and social staff in PMU – It is not clear if the separate Environmental and Social and Communication Unit (ESCU) will be developed for Package 3, or the same institutional arrangement will be maintained. If the same institutional structure is maintained, the expansion of ESCU should be made since the significant increase of supervision/monitoring works regarding EMP/ESMP implementation is expected.	The same institutional structure will be maintained for all packages including Package 3
~~Para 503-~~ Reference is made on Appendix 10 Environmental Management Framework yet there is neither Appendix 10 nor EMF.	It was written by mistake. This write up has already been removed from the para.
Please revisit Table 10.1 ECoP. There are a number of incomplete or too generic guidance. Please clarify who does what.	???
Monitoring Plan- Please add noise monitoring at nearby communities (where necessary) and visual inspection of spill	It has been added
Para 519- Please clarify DDCS will prepare a monthly report on the status of EMP/ESMP implementation.	The issue has been clarified in section 10.7.5
Afforestation ~~(Para 530)~~ - Please confirm that there are four locations for foreshore plantation (according to Map 5.2), and its selection criteria. Please also explain who will be responsible to develop afforestation plan and its implementation.	A detailed afforestation plan has been mentioned in section 10.10
~~Para 534-~~ Please replace the term EMF with EMP.	Corrected as per comment
Please include Environmental Committee for the mechanism of project monitoring and	An ESCU (Environmental and Social Communication Unit) for supervision and

WB Comments	Responses
supervision.	monitoring for activities related to implementation works has been mentioned in the report. The ESCU is being monitored the implementation works under Package -1 and Package-2 of CEIP-1. Therefore, further environmental committee is not required.
Stakeholder Consultation: Please include the responses to the comments received at Public Disclosure Meeting ~~(para 592).~~	This paragraph has been revised according to comment.