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Ministry of Water Resources

BANGLADESH WATER DEVELOPMENT BOARD

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COASTAL EMBANKMENT IMPROVEMENT PROJECT, PHASE-I (CEIP-I)

DETAILED DESIGN OF FIVE POLDERS

Volume III: Environmental Impact Assessment

Part A: Polder No 32

Joint Venture of

CONSULTING ENGINEERING SERVICES (INDIA) PVT. LTD., INDIA
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GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

MINISTRY OF WATER RESOURCES

BANGLADESH WATER DEVELOPMENT BOARD (BWDB)

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VOLUME III: ENVIRONMENTAL IMPACT ASSESSMENT

PART- A: POLDER NO. 32

Reviewed and Revised by

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Abbreviations and Acronyms

ASA	Association for Social Advancement
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorology Department
BRDB	Bangladesh Rural development Board
BRAC	Bangladesh Rural Advancement Centre
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CCP	Chittagong Coastal Plain
CDS	Coastal Development Strategy
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
CES	Consulting Engineering Services
CAFOD	Catholic Fund for Overseas Development
CZPo	Coastal Zone Policy
DAE	Department of Agricultural Extension
DevCon	Dev Consultants Ltd
DOE	Department of Environment
DPHE	Department of Public Health engineering
DPM	Design Planning & Management Consultants
DTW	Deep Tubewell
EA	Environment Assessment
ECA	Environment Conservation Act
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules
ECRRP	Emergency 2007 Cyclone Recovery and Restoration project
EDS	Environmental Data Sheet
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ES	Environmental Screening
ESBN	Estuarine Set Bag Net
FAO	Food and Agriculture Organization

FGD	Focus group Discussion
FRSS	Fisheries Resources Survey System
FWIP	Future-with-Project
FWOP	Future-without-Project
GIS	Geographical Information System
GO	Government organization
GTPE	Ganges Tidal Plain East
GTPW	Ganges Tidal Plain West
ha	hectare
HTW	Hand Tubewell
HYV	High Yielding Variety
IDA	International Development Association (World Bank)
IEE	Initial Environmental Examination
IESCs	Important Environmental and Social Components
IS	Institutional Survey
IUCN	International Union for Conservation of Nature
KAL	Kranti Associates Ltd Bangladesh
KII	Key Informant Interview
KJDRP	Khulna-Jessore Drainage Rehabilitation Project
LLP	Low Lift Pump
MC	Main Consultant (for CEIP-I Feasibility study)
MDP	Meghna Deltaic Plain
MOEF	Ministry of Environment and Forest
MOWR	Ministry of Water Resources
MSL	Mean Sea Level
NCA	Net Cultivated Area
NGO	Non-Governmental Organization
NOC	No Objection Certificate
NWRD	National water Resources database
O&M	Operation and Maintenance
PAP	Project Affected Person
PCM	Public Consultation Meeting
PCD	Project Concept Document
PID	Project Information Document
PIO	Project Implementation Office
PL	Post Larva (fish seed)

PRA	Participatory Rural Appraisal
PRSP	Poverty Reduction Strategy Paper
RCB	Reinforced Concrete Box
RRA	Rapid Rural appraisal
SEA	Strategic Environmental Assessment
SEO	Secondary Education Office
SLR	Sea Level Rise
SRDI	Soils Resources Development Institute
SSO	Social Service Office
STW	Shallow Tubewell
TDS	Total Dissolved Solids
TOR	Terms of Reference
UFO	Upazila Fisheries Office
UNDP	United Nations Development Program
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding
WAO	Women Affairs Office
WARPO	Water Resources Planning Organization
WMIP	Water Management Improvement Project
WB	World Bank
WMO	Water Management Organization
YDD	Youth Development Department

Glossary

Aila	Major Cyclone, which hit Bangladesh coast on May 25, 2009
Aman	Group of rice varieties grown in the monsoon season and harvested in the post-monsoon season. This is generally transplanted at the beginning of monsoon from July-August and harvested in November-Dec. Mostly rain-fed, supplemental irrigation needed in places during dry spell.
Arat	Generally an office, a store or a warehouse in a market place from which Aratdar conducts his business.
Aratdar	Main actor act 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	When preceding a crop means broadcast (B. Aus)
Bagda	Shrimp (*Penaeus monodon),* brackish/slightly saline water species.
Bazar	Market
Baor	Baor dead arm of a river in the Moribund Delta as in the case of the Ganges; also called oxbow lake. It appears as a saucer shaped depression. The term baor is synonymous to beel, familiar in the southwestern part of Bangladesh
Beel	A saucer-shaped natural depression, which generally retains water throughout the year and in some cases seasonally connected to the river system.
Bepari	Middleman in the marketing chain who transports the products to the other places, use of term depends on the location, sometimes also used synonymously with retailer.
Boro	A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January and harvested before the onset of monsoon in April- May.
Charland	The chars, otherwise know as charlands, are riverine lands located in the active river basins of the main rivers of Bangladesh. They are located on the banks of the river and islands in the mid-steam of the main channel that are created by the continual shifting of these rivers and emerge from the deposition of sand and silt from upstream
Faria	Local trader/agent/intermediary.
Golda	Prawn *(Macrobrachium rosenbergii*), non-saline/fresh water species
Gher	Farmlands converted into ponds with low dykes and used for cultivation of shrimp/prawn/fish.
Haor	A back swamp or bowl-shaped depression located between the natural levees of

rivers and comprises of a number of *beel*s.

Haat Market place where market exchanges are carried out either once, twice or thrice a week, however not every day.

Jaal Different types of fishing net to catch fish from the water bodies.

Jolmohol Section of river, individual or group of *beel*s (depression), or individual pond owned by the government but leased out for fishing. They are also called Jalkar, or Fishery.

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

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

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

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

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

Kutcha Toilet The earthen made latrine consist of a hole without cover.

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

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

Pacca Well constructed building using modern masonry materials.

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

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

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

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

T. *Aman* When preceding a crop means transplanted (T. 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.

Executive Summary

The Government of Bangladesh (GoB) is planning to implement the Coastal Embankment Improvement Project, Phase I (CEIP-I), under which seventeen polders will be rehabilitated and improved in the coastal area of the country. The GoB is seeking financial assistance from the World Bank (WB) for this Project. In accordance with the national regulatory requirements and WB safeguard policies, Environmental Impact Assessments (EIAs) of the first batch of five polders have been carried out. This document presents the EIA report of Polder 32, which is one of these five polders.

Background

In 1960s, polderization was started in the coastal zone of the country to convert the area into permanent agricultural lands. The polders in this area are enclosed on all sides by dykes or embankments, separating the land from the main river system and protecting against tidal floods, salinity intrusion and sedimentation. The lands inside the polders are slightly higher than sea level. The polders were designed to keep the land safe from the daily tides and allow agriculture activities inside the polder. Without embankments the coastal communities would be exposed to diurnal tidal fluctuations. These polders are equipped with in- and outlet sluice gates to manage 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 lead to large scale environmental, social and economical degradation. Poor maintenance and inadequate management of the polders have also accelerated the internal drainage congestion and heavy external siltation. As a result, soil fertility and agriculture production in some areas are declining because of water logging and salinity increase inside the polders.

The above reasons led the Government to re-focus its strategy on the coastal area from one that only protects against high tides to one that would provide protection against frequent storm surges as well. 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-I is the first phase of this long term program.

Location and Synopsis of Rehabilitation Work

The polder 32 is situated in Dacope upazila of Khulna District. The management of the water control structures in the Polder lies with Khulna Operation and Maintenance (O&M) Division of BWDB. The polder is surrounded by Sibsha and Dhaki River to the west and North, Chunkuri, Bhadra and Sutarkhali River to the east and south. The Polder covers a gross area of 8097 ha with net cultivable area of 6,500 ha. 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, the key improvement and rehabilitation works to be carried out in Polder 32 under CEIP-I are: re-sectioning of embankment (44.80 km); construction of retired embankment (3.50 km); forwarding of embankment (0.50 km); construction of 11 drainage sluices; construction of two flushing inlets; repairing of 21 flushing inlets; demolishing of three drainage sluices; demolishing of three flushing inlets; re-excavation of drainage channels (17.50 km); bank revetment works (1.50 km); slope protection of embankment (3.30 km); a cross dam in Nalian River and afforestation on the foreshore areas (19 ha). Other components of the CEIP-I 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.

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

Regulatory and Policy Framework

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

Under the Environmental Conservation Rules (1997), a classification system has been established for development projects and industries on the basis of the project objective. These categories include Green, Orange A, Orange B, and Red. The construction, reconstruction, expansion of polders and flood control embankment is categorized as Red in accordance with the DoE‘s classification. For 'Red' category projects, it is mandatory to carry out an Environmental Impact Assessment (EIA) including Environmental Management Plan (EMP) and develop a Resettlement Plan and as where necessary for getting environmental clearance from DoE. According to the World Bank safeguard policies, the project has been classified as Category A, in view of high risk associated with widely involved major civil works in the project and also considering the high ecological sensitivity and vulnerability of the coastal area.

Alternative Analysis

Several alternatives were considered during the design phase of the project. These included 'no-project' alternative and technical alternatives.

Three alternatives scenarios have been considered for the Project during feasibility study. These are 'no project' alternative, site selection alternative and technical alternative. Theres alternative have been used to prepare the rehabilitation plan of the polder 32. A comprehensive multi criteria analysis was carried out to prioritize the polder the polder rehabilitation under CEIP-I.

The present situation of the polder is extremely vulnerable to cyclones, storm surges, wave action, and climate change effects, and the Polder is not in a state to provide required services particularly protection against tidal inundation, efficient drainage, and minimizing the impact of cyclonic surges. A significant proportion of the Polder area is vulnerable to salinity intrusion and water logging. Due to high salinity and scarcity of ground water during the periods of low rainfall, a very limited area is under irrigation. The silted up water channels are resulting in limited navigation in their waterways, declining fisheries, and increasing environmental pollution. The proposed interventions under CEIP-I have been designed to address the above mentioned problems of the Polder. If proposed interventions are not implemented, the present poor state of the Polder will continue and may further deteriorate; therefore the 'no-project' alternative is not a recommended option.

Several technical alternatives were considered to address each of the problems being faced in the Polder. These included alternatives for embankment strengthening, river bank protection works, protection of embankment slopes, replacement of drainage sluices, rehabilitation of flushing sluices, addressing water logging and drainage congestion.

Baseline Condition

The Polder 32 is located in the southwest region of Bangladesh near Sundarban. Topographically, this area is flat and developed by sedimentation process of the three mighty rivers of the country. The polder area is crisscrossed by a large number of creeks. The total area is basically flat with the central part a bit higher than the surrounding land. Administratively, the Polder covers part of Dacope upazila under Khulna district. The Polder area is situated in two unions namely Kamarkhula and Sutarkhali.

The country has been subdivided into 30 agro-ecological regions and 88 sub-regions, as a part of land resources appraisal of Bangladesh for agricultural development. The key parameters on the basis of which this classification has been carried out include physiography, soil properties, soil salinity, and depth and duration of flooding. These parameters are relevant for land use and the assessment of present and future agricultural potential. The Polder 32 lies in agro-ecological zone of the Ganges Tidal Floodplain.

The soil texture varies from clay to clay loam in the Polder 32. Non-calcareous grey floodplain soil is the major soil type in the Polder. Acid sulfate soils also occupy significant part of the area where it is extensively acidic during dry season. In general, most of the top soils are acidic and sub-soils are neutral to mildly alkaline.

The total Polder area is about 8097 ha, of which net cultivable area (NCA) is 6500 ha (90%) followed by settlement (7.64%) and water bodies (2.36%). About 5358 ha, 444 ha, and 695 ha area are single, double and triple cropped respectively. The existing dominant cropping pattern practiced on 60% of NCA is Fallow-T Aman (HYV)-Fallow. The second prominent cropping pattern is Fallow-T Aman (Local) – Fallow practiced in about 21.9% of the NCA. The existing cropping intensity is about 128%. Total cropped area was about 8331 ha of which rice occupied about 7482 ha and the rest 849 ha is covered with non-rice crops. The contribution of T Aman (Local) towards rice production is 53% of total production.

Sedimentation is a major problem in the polder area. Sedimentation in most of the internal khals caused rise of bed level and reduced the conveyance capacity of the khals. Drainage congestion as a key vulnerability issue has been defined for the total project area though intensity varies from place to place. The internal drainage congestion in some areas has also occurred due to mal-functioning of water regulator structures and siltation in the internal khals. The dry season water logging is around 30-40% (approximate 53 ha in Kalinagar-Sreenagar, 668 ha is Gulbunia) in the low lying areas in existing polder sites.

The climate of the project area is tropical in nature with three seasons. The trend analysis shows that Mean maximum temperature varies between 19.3°C to 30.4°C over the year with the highest temperature experienced in the month of May. Mean monthly rainfall rate varies within the range of 7 to 400 mm.

In the Polder area, estimated total fish production is about 171 metric ton. Bulk of the inland fish production about (78.9%) is coming from culture fisheries while the rest comes from capture fisheries habitats. Perennial khals such as *Nalian river, Kamargoda khal, Golbunia khal, Hatkhola khal* along with other seasonal internal khals are used as feeding and shelter ground of most of the open water fishes. Many fish species like Phasa (*Setipinna taty*), Betki (*Lates calcarifer*), Horina Chingri (*Metapeneaus monocerus*), Khorsula (*Mugil corsula*), Chatka Chingri etc migrate horizontally to these water bodies as part of their life cycle. These khals are marked as the area of conservation significance.

Polder 32 falls under Saline Tidal Floodplain bio-ecological zone. Mangrove and aquatic ecosystems support different aquatic life-forms for their survival. In general, brackish water ecosystem is dominant in the polder area. The Project area supports different types of habitats with many species of flora and fauna including globally and nationally threatened shore birds and other wildlife species. Except for the Sundarban, the floral diversity of this zone is similar to those of adjoining zones. Innumerable indigenous weeds grow in beel areas. Several types of palms and bamboo clumps grow in almost all the villages. Mango *(Mangifera indica)* and Jackfruit *(Artocarpus heterophyllus)* are most common timber in the polder area.

The aquatic floral species observed frequently within the project area are Shapla/Shaluk (*Nymphaea* Spp.), Padma (*Nelumbo nucifera*), Kachuripana (*Eichhornia crassipes*), Kolmi (*Ipomoea fistulosa*), Dhol Kolmi (*Ipomoea fistulosa*), Khudipana (*Lemna Sp.*), Topapana (*Pistia strateotes*), Kutipana (*Azolla Sp*), etc. Indian Pond Frog (*Euphlytis haxadactylus*), White-breasted Waterhen (*Amaurornis phoenicurus*), Great Egret (*Casmerodius albus*), Little Egret (*Egretta garzetta*), Indian Pond Heron (*Ardeola grayii*) are common among the fauna. Gangetic River Dolphin (*Platanista gangetica*) is available in the surrounding rivers.

The population in the Polder 32 is 33,456 of which 16, 985 are males and 16,471 females. A total of 8,399 households exist in the polder with average size of 3.98 persons per household. The density of population is about 980 persons per square kilometer. The main occupation of the household is agriculture. Around 76% households are engaged in agriculture. Overall status of drinking water in the area is not satisfactory. Most of the people collect drinking water from other sources such as ponds, PSF, rain water. The hygienic sanitation facilities in the polder area are poor. About 30% households have hygienic sanitation facility (water-sealed), 22 % have not water-sealed sanitation facility, 30 % have non-sanitary sanitation facility and 18 % have no sanitation facility respectively.

Consultation and Disclosure

9 local, 1 regional and 1 national consultation meeting were conducted with the participation of local people, representatives of local government (Union Parishad) and BWDB’s representatives. Local people showed interest to the project implementation for their existence. They have no objection to implement the project. They also expressed that if the monitoring plan is implemented properly during the pre-construction, construction, post-construction and operation period, the local people within the polder area would help the implementing agency spontaneously. Public disclosure meeting have also been carried out for disclosing impact and EMP of the project. The national level consultation has been carried out at the end of February in presence of Department of Environment, other Government Institutions, local and national Non Government Organizations. The EIA was updated incorporating findings of National level workshop.

Potential Impacts and their Mitigation

The project will include 44.8 km of resectioning of embankment, construction of 3.5 km retired embankment and 0.5 km of forwarding embankment, 11 drainage sluices, 2 new flushing inlets, 1 cross dam/canal closure establishment of construction camps, dredged soil disposal on the two sides of the dredged channel.

The potential environmental and social impacts associated with the pre-construction phase of the Project include loss of agricultural land, loss of biomass, siltation due to loose soil, air and noise pollution, change in landscape, displacement of people, and psychological impact on people who have to change livelihood. . It is estimated that 67 ha of land would be acquired resulting in displacement of about 56 households having land within project area. Out of total acquisition land the highest quantity is single cropped (64 ha) followed by double cropped (2.41 ha) and Homestead (0.54 ha). A total of 47 labour sheds will be constructed near the embankment and interventions sites. Due to cyclone Aila and Sidr, polder 32 is almost like a desert and a few trees are found beside the embankment. According to field visit, around 265 trees exist on both side of the embankment which are like to be felled down during construction of retired embankment, re-sectioning of embankment and regulators structures.

The potential impacts during the construction phase include air pollution, noise pollution, degradation of landscape, soil erosion, water contamination, increased siltation in water bodies, loss of agriculture, damage to fish and other aquatic fauna, traffic congestion, and safety hazards. The key construction activities that are likely to cause these environmental and social impacts include construction camp establishment and operation, equipment and material transportation, material borrowing, excavation, embankment raising, dismantling, repair and construction of regulators, re-excavation of water channels, and waste disposal. A total of 172.2 metric ton of rice and non-rice crop production loss is expected due to construction of retired embankment. The fish spawning will be impacted if canal excavation and collection of earth from Dhaki, Shibsha and Bhadra rivers happens during spawning period. Hatkhola, Parar, jaliakhali will be reexcavated. A closure dam/canal closure regualator will be constructed to reopen the drainage paths from the lands to Nalian khal. Construction of 11 new drainage sluices, 2 flushing inlets and repairement of 21 flushing inlet will hamper fish migration and availability if propoer planning for civil work and design is not done. The specific name of the drainage congestion khals are Charar Khal, Hatkhola Khal, Para Khal, Kayratoli Khal, Clozarer Khal and Jaliakhali Khal. If the replacement of regulators is not properly dewatered during initiation of construction works then the upstream area of the regulators will face major drainage congestion problem and create water logging.

The social impact include affect on common properties, social conflict between local worker and outside worker, The presence of outside labor can potentially disrupt the privacy of the local population particularly women whose mobility can be negatively affected. A total number of four of markets are located near the embankment. The name of the markets are Kalinagar (Ch 26.00 km) Gunary (Ch 8.00 km), Joynagar (Ch. 10.00 km), and Talirkona bazaar. Embankment is the main road for communication of the local people. There is no alternative road for transportation of vehicles. Most of the internal roads in the polder area have been damaged by Aila (2009) which are not suitable for movement of vehicle. However, during hut and marketing time, all the stakeholders use this embankment as road for carrying their goods for buying and selling and other purposes. Earth work for re-sectioning of embankment and vehicles movement may create short term disturbances to the polder inhabitants.

The potential impacts during the operation phase include soil and water contamination associated with increased usage of fertilizers and pesticides and hindrance in fish migration, increased soil and water salinity due to cross dam and also due to leakage of regulators failure.

To address the involuntary resettlement issues arising from acquisition of 67 ha of land and loss of other private and or community structures, a resettlement action plan (RAP) has been prepared. The RAP defines the entitlement criteria and estimates the total compensation to be paid to the affected people. To address the impacts associated with material and equipment transportation and traffic congestion, the contractor will prepare and implement a traffic management plan, which will ensure that sensitive receptors such as schools and busy markets and bazaars are avoided during the peak hours. To address the air and water pollution, contractor will prepare and implement a pollution control plan. Similarly, to address the safety and public health concerns, the contractor will prepare and implement an occupational health and safety plan.

The potential impacts during operation phase include soil and water contamination associated with increased usage of fertilizers and hindrance in fish migration. Rain cuts and public cuts are the major causes of embankment breaching of the Polder 32. At present, about 300 ha of land are under boro (rice) cultivation. According to the initial estimates, about 1.50 Mm^3 of water will be available from the internal canal system, after the completion of the proposed Project. This will allow expansion of area under irrigated cultivation of boro and aus varieties of rice to about 670 ha. This expansion of irrigation is likely to result in decrease of soil fertility and increase use of chemicals including fertilizers and pesticides. Runoff from such cultivation fields may pollute the water bodies and even drinking water sources thus causing health hazards to the communities. This runoff may also lead to eutrophication of the water bodies. Construction of cross dam at the upstream of Nalian river system will result in trapping of saline water in Nalian River in the long run. Inundation by saline water may increase the persistence of salinity in both soil and water along Nalian River inside the polder. Soil and water salinity can potentially have negative impacts on the agriculture, and biological resources of the area including aquatic flora and fauna. 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 or poor upkeep and maintenance of these control structures will undermine the very objective of the Project. Lack of regular maintenance has creates weak point at the sensitive locations of the embankment. Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously have accelerated the risk of embankment failure.

Sundarbans is 35 km away in the south-eastern part of polder 32. Sutarkhali river is in between Sundarbans and Polder 32 from chainage 29500 to 42500. The main impact of the polder on the Sundarban ecosystem situated across the river is the intrusion of more water on the forest floor of Sundarban. This may enhance the height of the tidal inundation of the forest. This enhanced tidal inundation, may imbalance the natural tide inundation features of the given ecosystem. It is commonly observed that in areas that have higher tide inundations, the species composition is different than that is found in the areas that have lower tide inundations. Again if the quantity of water entering the Sundarbans increases, consequently the speed at which the water enters the forest floor also increases, which in turn may cause two things, namely

- brings in more of coarser soil particles on the forest floor as it enters and majority of these get deposited on the river banks or nearby
- drains off more of the heavier detritus from the forest floor as it recede s, which otherwise would have got retained by the given ecosystem.This may ultimately cause the loss of soil fertility. Interviewing forest department it was revealed that

It is however very difficult to isolate what part or what quantum of these above said impacts are because of the polders alone. It needs to be mentioned herein that the quantum of these impacts will be lower if the width of the river between the Sundarban & Polder is more.

On the positive aspect, the construction work will generate a significant opportunity of employment over its construction period to local people and other associated professionals. People will also be involved to carry out operation and maintenance related jobs to operate the hydraulic structures. It is expected that the agriculture production will be increased; water logging will be decreased due to the project which will create jobs indirectly from agriculture, business and commercial services.

Environmental Management Plan

The environmental management plan (EMP) provides the implementation mechanism for the mitigation measures identified during the present EIA.A comprehensive EMP which focuses on managing construction phase-related impacts should suffice in managing the potential construction and operation phase impacts. The EMP will be attached with the Bidding Document. The environmental management parameter will be included in the BoQ. Since most of the contractors do not have clear understanding on the need of environmental management, some tend to quote very low price for implementation of EMP and eventually cannot implement EMP as per design. To avoid this problem, Fixed Budget will be assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting. The total cost of EMP implementation for Polder 32 has been estimated as BDT 29.8 million (without Training and Field trip costing).The contractor needs to submit an Environmental Action Plan (EAP) based on the EIA and EMF in line with the construction schedule and guideline. The EAP needs to be reviewed by the supervision consultant and cleared by BWDB and World Bank.

Extensive monitoring of the environmental concerns of the Polder 32 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.

Furthermore, EMP identifies capacity building needs with respect to environmental management of the Project, in addition to defining reporting and record keeping protocol.

Impacts on Nearby Area

Polder 32 is surrounded by a number of rivers and lakes/ khals. There is Sibsa river along the western periphery, Dhaki River along the north-west periphery, Bhadra and Sutarkhali rivers along the eastern periphery of the polder. Polder 31, 23 are located on the north direction of Polder 32. In the eastern direction, Polder 33 is located. In the west, Polder 23 and Polder 10-12 are located.

Polder 33 is located in the opposite direction of Polder 32 with a design crest level of 4.5 m. The design crest level of Polder 32 is 5 m (above MSL) along the periphery of Shibsa river and 4.5 m in the remaining parts. The construction works in Polder 33 will have significant effects on Polder 32. The major impact would be the transferring of risk of inundation into Polder 32. The embankment constructed around Polder 33 would prevent the entry of cyclonic surge and hence there will be immense hydraulic pressure created on the eastern part of embankment around Polder 32.

The proposed interventions will guard the Polder against direct intrusion of tidal water during high tides or cyclonic hazards. The water of the rivers (Shibsa, Dhaki, Bhadra) carrying huge amount of sediments will move further downstream or upstream and may cause sedimentation.

In the next few years, there is possibility of the Sutarkhali river (on the south-east, connected to the Sundarbans) to be filled up permanently due to accumulation of silts, lower velocity of flow etc. The effects of congestion in the surrounding rivers would directly affect the nearby areas (sundarbans, Polder 33, 31 etc.). The polders beyond these locations may undergo some congestion affects but these are negligible in the context of Polder 32.

Institutional Responsibility and Report Requirement

The **contractor** is responsible for implementation of EMP during construction works and Project Supervision Consultant is primarily responsible for supervision of the implementation of the EMP. BWDB will conduct field inspections and surveys by the environment specialist (to be employed by BWDB on regular basis) at field. S/he will report to the Senior Environment Specialist at Head Quarter. The M&E consultant will be responsible for independent monitoring and implementation of EMP, and external monitoring and evaluation. DoE will be consulted if any complicated issues arise during construction and operation stages. BWDB will apply for annual site clearance from DoE. WMOs will be trained up to ensure environmental management during project operation. Environmental Management Unit of BWDB, strengthened through this project, will ensure and oversee the environmental management during project operation.

BWDB will prepare the **Half Yearly Progress Report** on environmental management and will share with World Bank for review. Contributing development partners (if any) may join the field visit to understand the environmental compliance of the project. In addition, the effectiveness of screening, monitoring and implementation of EMP will be carried out by the third party monitoring firm along with the project component activity monitoring annually. The **Annual Environmental Audit Report** prepared by the third party monitoring firm will be shared with the safeguards secretariat.

The Environment, Social and Communication Unit (ESC) to be established to implement and manage 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 mitigation measures. At least one of the two environmental specialists must be on board before effectiveness of the project. The specialists will prepare subproject specific environment screening/assessment report with EMP, supervise the implementation of EMP and support capacity building of the field level staff of BWDB and contractor. ESC will review the EMF and ensure quality of the environmental screening/assessment with EMP

1. Introduction

1.1 Background

The Government of Bangladesh (GoB) is planning to implement the Coastal Embankment Improvement Project, Phase I (CEIP-I), under which seventeen polders will be rehabilitated and improved in the coastal area of the country. The GoB is seeking financial assistance from the World Bank (WB) for this Project. In accordance with the national regulatory requirements and WB safeguard policies, Environmental Impact Assessments (EIAs) of the first batch of five polders have been carried out. This document presents the EIA report of the Polder 32, which is one of these five polders. The remaining four EIA reports are presented under separate covers.

Bangladesh is a low lying country. The coastal zone in southern Bangladesh adjoining the Bay of Bengal is characterized by a delicately balanced natural morphology of an evolving flat delta subject to very high tides and frequent cyclones coming from the Bay of Bengal encountering a very large volume of sediment inflowing from upstream. The strength of the tides and the flatness of the delta causes the tides to influence river processes a long way upstream in the southern estuaries. This entire area is called the coastal zone. The coastal zone, in its natural state, used to undergo to inundation by high tides, salinity intrusion, cyclonic storms and associated tidal surges. In 1960s, polderization was started in the coastal zone of the country to convert the area into permanent agricultural lands (see Figure 1.1 for coastal polders). The polders in this area are enclosed on all sides by dykes or embankments, separating the land from the main river system and protecting against tidal floods, salinity intrusion and sedimentation. The lands inside the polders are slightly higher than sea level. The polders were designed to keep the land safe from the daily tides and allow agriculture activities inside the polder. Without embankments the coastal communities would be exposed to diurnal tidal fluctuations. These polders are equipped with in- and outlet sluice gates to control the water inside the embanked area.

1.2 Need of the Project

The coastal embankment system of Bangladesh was originally designed without significant attention to storm surges. Recent cyclones brought substantial damage to the embankments and further threatened the integrity of the coastal polders. In addition to breaching of the embankment due to cyclones, siltation of peripheral rivers surrounding the embankment caused the coastal polders to create water logging, resulting a large scale environmental, social and economical degradation. Poor maintenance and inadequate management of the polders have also contributed internal drainage congestion along with salinity intrusion and heavy external siltation. As a result, soil fertility and agriculture production are declining in some areas inside the polders.

The above reasons have led the Government to re-focus its strategy on the coastal area from one that only protects against high tides to one that would provide protection against frequent storm surges as well. 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-I is the first phase of this long term program.

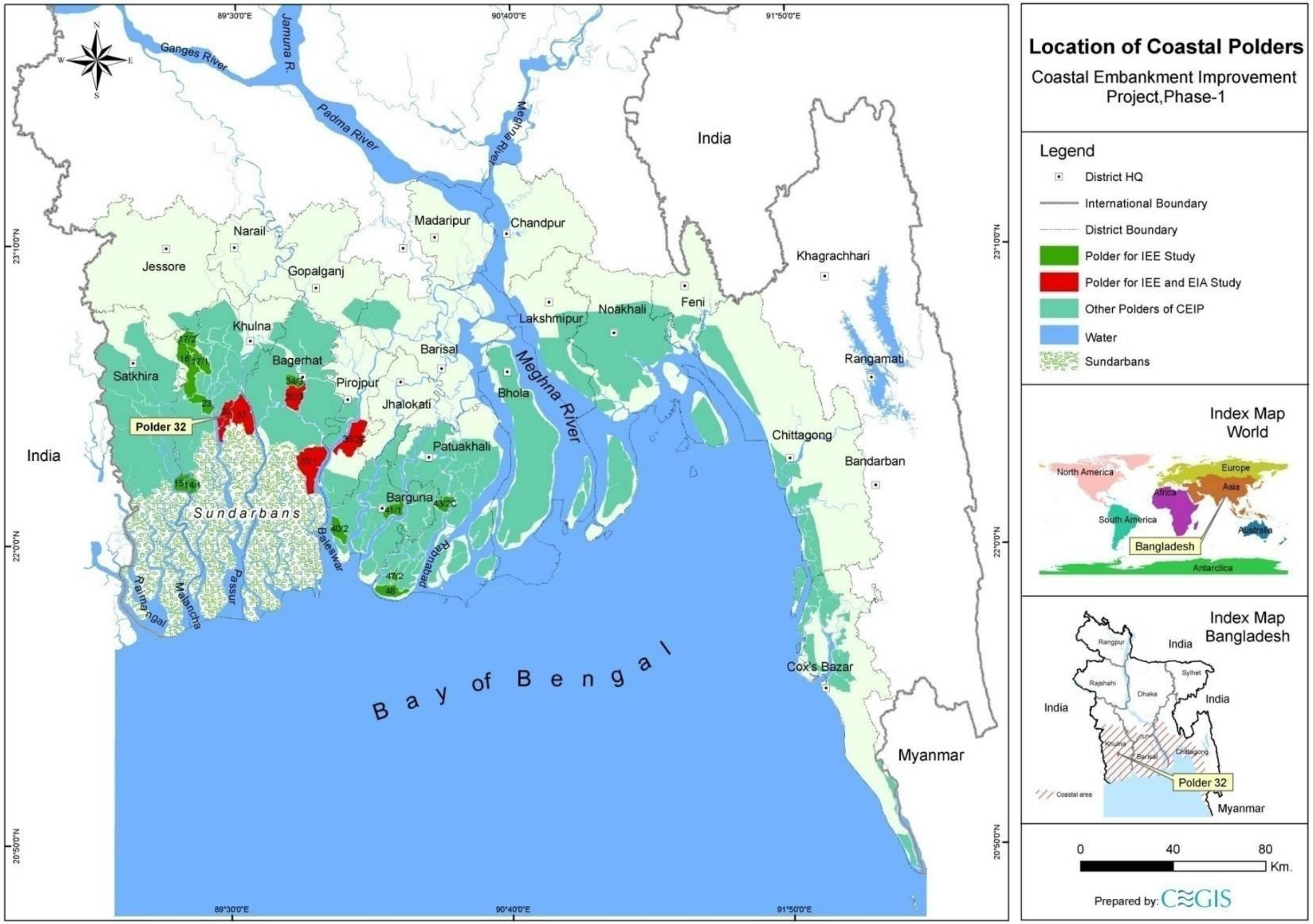

Figure 1.1: Coastal Polders

1.3 Polder 32 Location and Synopsis of Rehabilitation Work

The Polder 32 is located in the upazila namely, Dacope under Khulna District of southwestern region of Bangladesh (see Figure 1.2). The Polder covers a gross area of 8,097 hectare (ha) with net cultivable area of 6,500 ha. 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 up these objectives, the following key improvement and rehabilitation works will be carried out in Polder 32 under CEIP-I:

Re-sectioning of embankment	: 45.30 km
Construction of retired embankment	: 3.50
Construction of forward embankment	: 0.70 km
Construction of drainage sluice	: 7
Construction of drainage sluice under Aila	: 7
Demolish of existing drainage sluice	: 3
Construction of flushing inlets	: 2
Repairing of flushing inlets	: 21
Demolition of flushing inlets	: 2
Re excavation of drainage channel	: 17.50 km.
Bank protection works	: 1.5 km
Slope protection of embankment	: 4.30km
Construction of cross dam	: 1
Afforestation	: 58.00 ha

Other components of the CEIP-I 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.

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

Detail information of the Project are presented in the later part of the document.

1.4 Regulatory and Policy Framework

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

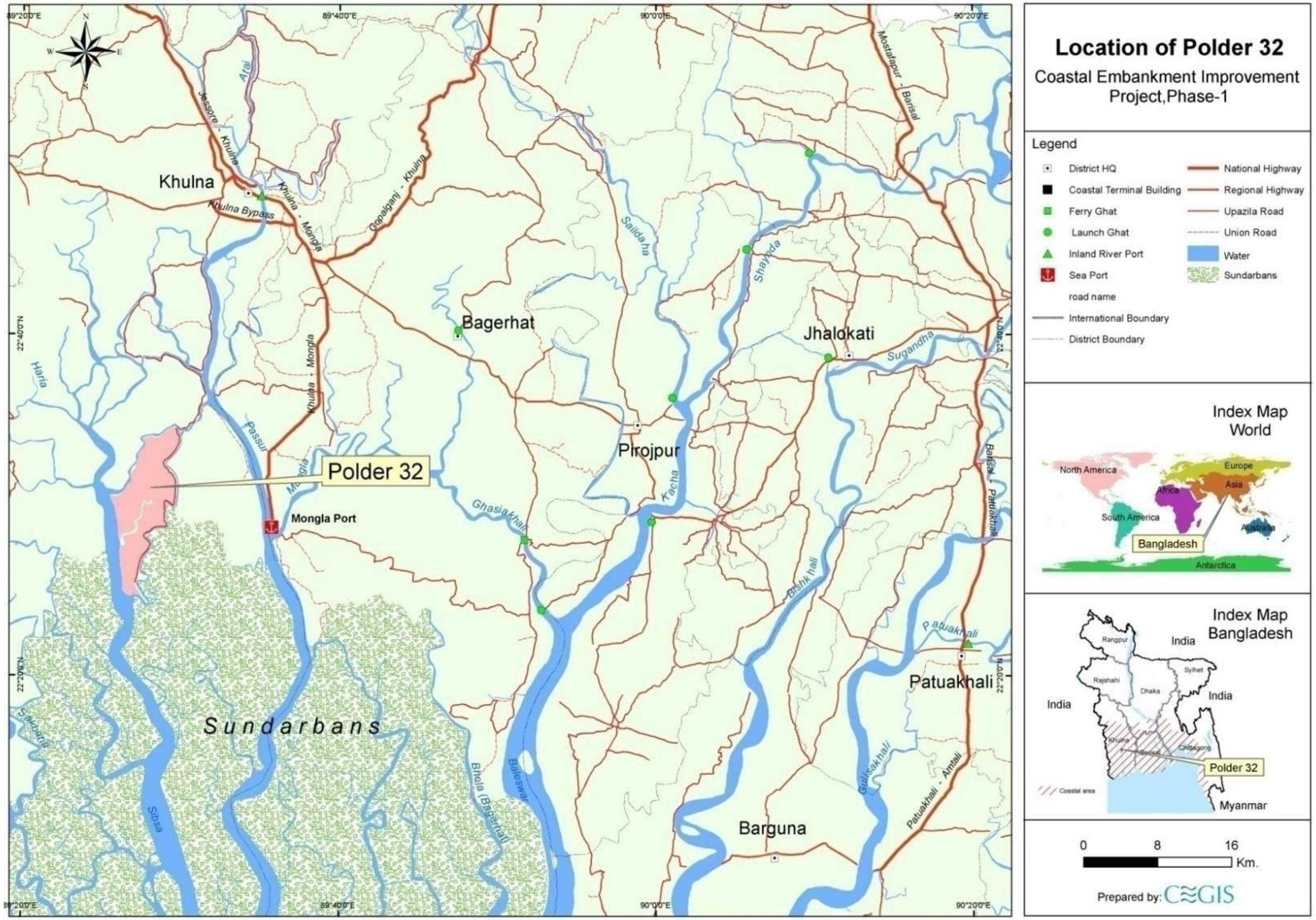

Figure 1.2: Location of Polders 32

1.5 Objectives of the Study

The overall objective of the EIA study of Polder 32 is to ensure that the environmental and social management practices are integrated in the design, construction, operation and maintenance of the polder. 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 conditions of the Project area (the Project area is defined as the entire area inside the polder, working area outside the polder i.e. the embankments, borrow pits and spoil disposal 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 Environmental Management Plan (EMP).

1.6 Structure of the Report

Chapter 1 (*Introduction*) describes the background of the project, project overview, regulatory and policy framework, objectives of the study, scope of works with a list of the EIA study team.

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

Chapter 3 (*Policy, Legal and Administrative Framework)* reviews the national legislative, regulatory and policy framework relevant to the EIA study. Also given in the Chapter is a discussion on the WB safeguard policies and their applicability for the Project.

Chapter 4 (*Description of Proposed Intervention of Polder 32*) provides the simplified description of the Project and its phases, key activities, manpower, equipment, and material requirements, implementation arrangements, implementation schedule, and other related aspects.

Chapter 5 (*Analysis of Project Alternatives*) discusses various alternatives considered during the feasibility and design stage of the Project, and their environmental and social considerations.

Chapter 6 (*Environmental and Social Baseline*) describes the existing environmental and social conditions in respect of water resources, land resources, agriculture, livestock, fisheries, ecosystems and socio-economic aspects of the Project area.

Chapter 7 (*Climate Change*) discusses the climate change aspects in global, regional and local perspectives and the likely impacts on the Project area and its surroundings.

Chapter 8 (*Stakeholder Consultations 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. Also included in the Chapter are the disclosure requirements for the EIA.

Chapter 9 (*Assessment of Environmental and Social Impacts*) assesses the potential impacts of proposed interventions on the environmental components. The Chapter also proposes appropriate mitigation measures to eliminate, offset, or reduce the potential impacts.

Chapter 10 (*Cumulative and Induced Impacts*) assesses the impact of the project on the surrounding areas of upstream and downstream considering spatial and temporal induced impact.

Chapter 11 (*Environmental Management Plan - EMP)* specifies the implementation arrangements for the mitigation measures identified during the EIA study and described in the previous Chapter. The EMP includes among others mitigation plan, enhancement plan, contingency plan and the environmental monitoring plan.

2. Approach and Methodology

This Chapter presents the detailed approach and procedure employed to conduct the EIA study. Data sources, methodology of data collection, processing and impact assessment are also described here.

2.1 Overall Approach

The EIA study for the rehabilitation of Polder 32 has been carried out following the DoE requirements, the Environmental Management Framework (EMF) for CEIP-I and the WB guidelines. The overall approach of the study is shown in **Figure 2.1** below.

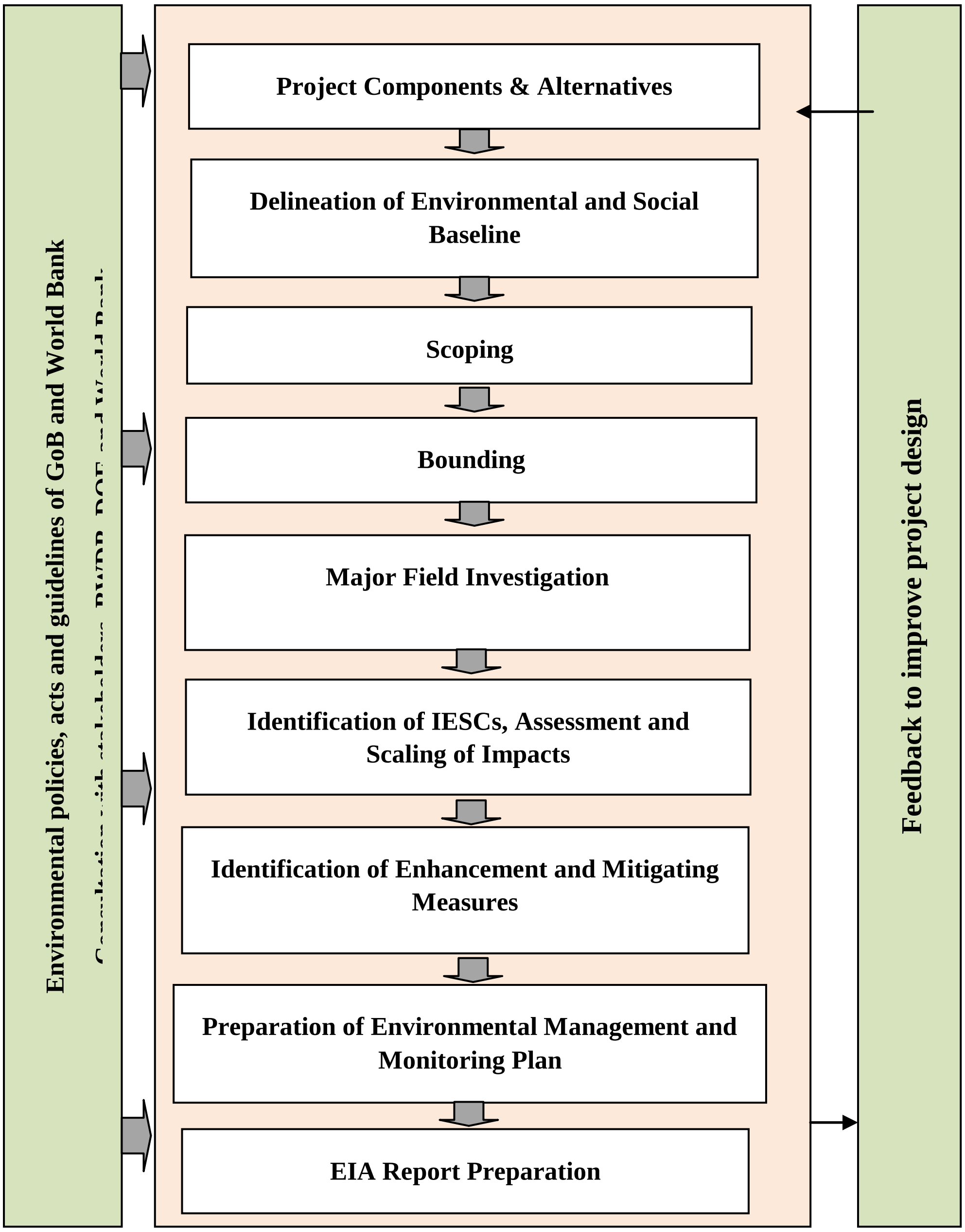

Figure 2.1: Overall approach of the EIA study

2.2 Methodology

The step-wise detail methodology followed for the EIA study is briefly described below.

2.2.1 Project Area of Influence

At the outset of the study, the Project area of influence (or Project area for short) was broadly demarcated. This included the area inside the polder where most of the Project interventions would take place, 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.

2.2.2 Analysis of the Project Components and Alternatives

Detailed information on the proposed Project including objective, nature and location of interventions, construction works, and other related aspects is obtained from the Main Consultant of CEIP-I.

The Water Resources Engineer of the EIA study team interpreted this information for the multi-disciplinary team members for assessing the environmental and social impacts of the proposed interventions.

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.

2.2.3 Data Collection for Environmental and Social Baseline

Initially a reconnaissance field visit was conducted in the Project area to identify the project and its functional objectives. Subsequently, rapid rural appraisals (RRAs), participatory rural appraisals (PRAs), focused group discussions (FGDs) and interviews with key informants were conducted to collect data and information on the environmental and social aspects of the Project area. Local knowledgeable persons including community representatives, traders, teachers, 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.

The baseline condition of the project area was formulated according to the information collected from secondary and primary data sources through literature review, field investigations and consultations with different stakeholders. The baseline condition has been established with respect to water resources, land resources, agriculture, livestock, fisheries, ecosystems and socio-economic conditions including identification of problems in respect of the proposed project sites and adjoining area.

Source and methodology of both primary and secondary baseline data collection on water resources, land resources, agriculture, livestock, fishery, ecosystems, and socio-economic resources are presented in the following sections.

Water Resources

Water resource data in connection with river hydrology, river morphology, surface and ground water availability, drainage pattern, ground and surface water quality and water use were collected from the secondary sources, primary data collection and analysis as well as observations by the professionals of the multi-disciplinary team backed up by feedback from the local people during field visits in the Project area. Major river systems were identified for hydrological and morphological investigation through historical and current data collection and analysis. Specific areas or points of interest were selected for collecting data on special hydrological and morphological aspects, water availability, drainage pattern, water quality (surface and ground water), flash flood, risk of erosion and sedimentation.

Field visits at different stages of the study were made into the Project area and primary data on water resources components were collected. A checklist (**Annex A**) was developed and used to obtain the information on different resources. Local knowledgeable persons and community representatives were also interviewed. During field visits, the multidisciplinary EIA study team members made professional observations pertaining to their individual areas of expertise.

Meteorological data such as temperature, rainfall, evapo-transpiration, and humidity were collected and analyzed for assessing local climate which are directly related to water resources of the study area and the project area. Meteorological data for selected stations were collected from the National Water Resources Database (NWRD) of Water Resources Planning Organization (WARPO), which contains long series of temporal data showing daily values for meteorological stations maintained by the Bangladesh Meteorological Department (BMD). The topographical data were collected from Geological Survey of Bangladesh and NWRD.

Land Resources

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). The land type and soil texture data were collected from Upazila[1] Land and Soil Resources Utilization Guide of Soils Resources Development Institute (SRDI). The secondary data of these parameters were verified at field level through physical observations as well as consultations with the local people and officials of the Department of Agriculture Extension (DAE) during field visit. Land use information and maps were prepared from satellite image classification with field verification.

Agricultural Resources

Data on agricultural resources which included existing cropping patterns, crop variety, crop calendar, crop yield, crop damage, and agricultural input used were collected from both secondary and primary sources. Agriculture data were collected through extensive field surveys with the help of questionnaire and consultations with local people and concerned agricultural officials. Agricultural resources data were also collected from secondary sources from the DAE. Crop production was determined using the following formula:

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

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

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

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

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

Livestock Resources

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

Fish and Fisheries

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.

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 river, khal (water drainage channel), floodplain, borrow pit, and beel (a natural depression, which generally retains water throughout the year and in some cases seasonally connected to the river system). The culture fish habitats included homestead culture fish pond, commercial fish farm, shrimp ghers (farm lands converted into ponds with low dykes and used for cultivation of shrimp/prawn/fish).

Capture fish habitat was assessed on the basis of species diversity and composition, identification of species of conservation significance, identification of potential fish habitat prescribing to restore for fish conservation, fish migration survey, habitat identification for fish conservation. Culture fish habitat was assessed through homestead culture fish pond survey and commercial fish farm/ *gher* survey.

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

Relevant secondary data were collected from the UFO’s annual reports and various literature/study reports.

Fish productions for individual habitats were obtained from secondary information those were collected from the UFOs and literatures were blended with primary data in production estimation.

Ecological Resources

The ecological component of the EIA study focused on terrestrial and riverine ecology including flora, birds, reptiles, amphibians, mammals, and migratory birds. The field activities included collection of ecosystem and habitat information, sensitive habitat identification, identifying ecological changes and potential ecological impact. The land use information on different ecosystem was generated through analysis of recent satellite imagery. Field investigation methods included physical observations, transect walk, habitat survey and consultations with local people. Field visits were carried out for establishing the ecological baseline condition. 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 survey and data base of the International Union for Conservation of Nature (IUCN).

Socio-economic Data

Demographic information, such as population, occupation and employment, literacy rate, drinking water, sanitation, and electricity facilities were collected form 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.

The steps followed for collecting socio-economic data are as follows:

- Data were collected from Bangladesh Bureau of Statistics (BBS), 2001 and enumerated for 2010, the relevant literatures from BWDB and main consultant were also reviewed;
- Reconnaissance field visit and discussions with BWDB officials and local stakeholders were made for primary data collection;
- PRA /RRA, FGDs, KII were carried out for primary data collection;
- Institutional survey was conducted for primary data collection from district and upazila level.

2.2.4 Scoping

A structured scoping process was followed for identification of the Important Environmental and Social Components (IESCs) which would potentially be impacted by the proposed Project. This was achieved in two stages as follows. The EIA team made a preliminary list of the components which could be impacted by the Project. The second stage included village scoping sessions 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.

2.2.5 Assessment and Scaling of Impacts

At this stage, attempts were made to quantify the impacts of the proposed interventions of the Project as much as possible. Where quantification was not possible, qualitative impacts were assessed and the scores were assigned with (+) sign for positive impacts and (-) sign for negative impacts. The magnitude of both positive and negative impacts was indicated in a scale of 1 to 10 based upon extent, magnitude, reversibility, duration and sustainability considerations. 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 under the Project area. Changes expected to be brought about due to proposed interventions under the Project were assessed to generate the future-with-project (FWIP) condition. Comparison and projection methods were used for impact prediction.

2.3 Assessment Methodology

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

The criteria for determining significance are generally specific for each environmental and social aspect but generally the magnitude of each potential impact is defined along with the sensitivity of the receptor. Generic criteria for defining magnitude and sensitivity used for the Project are summarized below.

2.3.1 Magnitude

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.

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 35 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

Parameter	Major	Moderate	Minor	Negligible/Nil
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

2.3.2 Sensitivity

The sensitivity of a receptor has been determined based on review of the population (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

2.3.3 Assigning Significance

Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor has been determined and the significance of each potential impact 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

2.3.4 Mitigation Measures

Subsequent to the impact assessment discussed above, appropriate mitigation measures have been proposed to avoid, offset, mitigate/reduce, or compensate for the identified impacts. Generally, impacts having moderate to critical consequence significance per the **Table 2.3** require appropriate avoidance/ mitigation/compensatory measures to reduce the significance. Impacts having low to negligible significance can be left alone not needing any mitigation measures.

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. Finally, if impact reduction is not possible, compensatory measures are proposed.

2.3.5 Assessment of Residual Impacts

The final step in the impact assessment process is determining the significance of the residual impacts, which essentially are the 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. For any residual impacts having moderate significance, monitoring mechanism is necessary to ensure that their significance does not increase. No residual impacts having major or critical significance are generally acceptable.

2.3.6 Identification of Enhancement and Mitigating Measures

From literature survey, applying expert judgment and consultation with stakeholders, possible enhancement and mitigating measures were identified for beneficial and adverse effects respectively.

2.3.7 Preparation of Environmental Management and Monitoring Plan

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

2.3.8 EIA Report Preparation

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

3. Policy, Legal and Administrative Framework

This Chapter presents a review of the national policy, legal, and regulatory framework relevant to the environmental and social aspects of the Project. Also reviewed in the Chapter are the WB environmental and social safeguard policies.

3.1 National Environmental Laws

The key national policies, strategies, and plans relevant to environmental management are briefly discussed below.

3.1.1 Bangladesh Environment Conservation Act (ECA), 1995

The Environmental Conservation Act (ECA) of 1995 is the main legislative framework relating to environmental protection in Bangladesh. This umbrella Act includes laws for conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution. This Act has established the Department of Environment (DOE), and empowers its Director General to take measures as he considers necessary which includes conducting inquiries, preventing probable accidents, advising the Government, coordinating with other authorities or agencies, and collecting and publishing information about environmental pollution. According to this act (Section 12), no industrial unit or project shall be established or undertaken without obtaining, in a manner prescribed by the accompanying Rules, an Environmental Clearance Certificate (ECC) from the Director General of DOE.

In accordance with this Act, the CEIP-I will need to be cleared by DOE before commencing the project following procedures given in the Environment Conservation Rules (ECR) 1997 (discussed below). Also the Ecologically Critical Areas in coastal zone, defined by DOE under this act, will be considered while planning and designing of the CEIP-I project interventions.

The present EIA has been carried out in compliance with this Act.

3.1.2 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.

3.1.3 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 Sundarban, Cox's Bazar - Teknaf Sea Shore, Saint Martin Island, Sonadia Island, Hakaluki Haor, Tanguar Haor, Marzat Baor and Gulshan - Baridhara Lake as ECA and prohibited certain activities in those areas. Beside these, recently the government of Bangladesh has declared four rivers such as Buriganga River, Turag River, Shitalakha River and Balu River around the Dhaka City as ECA.

The Rule 7 classifies industrial units and 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 industrial units and projects and proposed industrial units and projects, that are considered to be low polluting are categorized under "Green" and shall be granted Environmental Clearance. For proposed industrial units and 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 industries has been given in Schedule-1 of ECR'97. Apart from general requirement, for every Red category proposed industrial unit or project, the application must be accompanied with feasibility report, Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA) based on approved ToR by DOE, Environmental Management Plan (EMP). As per ECR’97, water resources development projects fall under ‘Red’ category project. Therefore CEIP-I project is ‘Red’ category project which requires IEE, EIA and EMP for environmental clearance from DOE.

The ECR'97 describes the procedures for obtaining Environmental Clearance Certificates (ECC) from the Department of Environment for different types of proposed units or projects. Any person or organization wishing to establish an industrial unit or project must obtain ECC from the Director General. 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 Director General. 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.

3.1.4 Bangladesh Environment Court Act, 2010

Bangladesh Environment Court Act, 2010 has been enacted to resolve the disputes and establishing justice over environmental and social damage raised due to any development activities. This act allows government to take necessary legal action against any parties who creates environmental hazards/ damage to environmentally sensitive areas as well as human society. According to this act, government can take legal actions if any environmental problem occurs due to CEIP-I interventions.

3.1.5 Administrative framework of DOE for clearing and monitoring of projects

According to the Environment Conservation Act 1995 no industrial unit or project will be established or undertaken without obtaining, in the manner prescribed by the Environment Conservation Rules 1997, an Environmental Clearance Certificate from the Director General. Therefore, every development projects/industries which are specified under the Schedule – 1 of the Environmental Conservation Rules 1997 require obtaining site clearance and environmental clearance from the Department of Environment. According to the Rule 7 (1) of the Environmental Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every industrial units or projects, in consideration of their site and impact on the environment, will be 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 FC and FCD/I projects fall under the 'Red' category. For this category, it is mandatory to carry out Environmental Impact Assessment (EIA) including Environmental Management Plan (EMP) and where necessary 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 CEIP is shown in Figure 3.1.

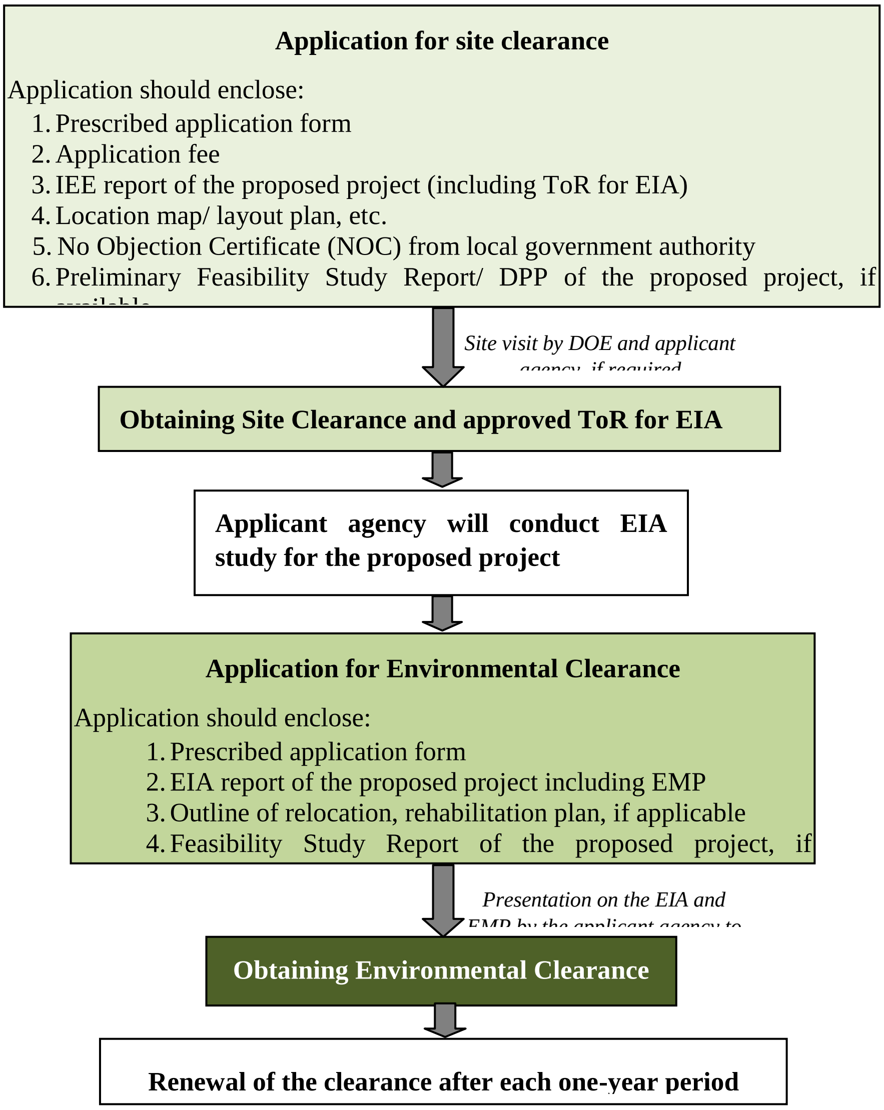

Figure 3.1: Process of obtaining Clearance certificate from DOE

3.2 Relevant National Policies, Strategies and Plans

3.2.1 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 CEIP-I and the proposed interventions are required to comply with all the policy directives emphasizing particularly on reducing adverse environmental impacts. The EIA studies of the coastal polders are required to clearly address the potential impacts and propose mitigation measures.

3.2.2 National Environment Management Action Plan, 1995

The National Environment Management Action Plan (NEMAP, 1995) identifies the main national environmental issues, including those related to the water sector. The main water related national concerns include flood damage, riverbank erosion, environmental degradation of water bodies, increased water pollution, shortage of irrigation water and drainage congestion; various specific regional concerns are also identified.

3.2.3 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 CEIP-I. The Project design and present EIA study will be required to comply with these requirements.

3.2.4 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 to establish an integrated development, management and use of water resources in Bangladesh over a period of 25 years. Water Resources Planning Organization (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 has been designed in line with this Plan and addresses its key objectives for the water resource management in the coastal areas.

3.2.5 Coastal Zone Policy, 2005

The Government has formulated the Coastal Zone Policy (CZP) 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 CIEP-I addresses some aspects of this Policy particularly those relating to the polder improvements.

3.2.6 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 the CEIP are in line with this strategy and support most of the above listed priorities.

3.2.7 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 be not possible through artificial land reclamation process, which is 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.

The CEIP will be designed in accordance with this Strategy and will comply with the above listed requirements.

3.2.8 National Agriculture Policy, 1999

The overall objective of the National Agriculture Policy is to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable food security system for all. Although the policy does not emphasize the coastal zone separately, all specific objectives are applicable to the development of coastal zone agriculture. The policy particularly stressed on minor irrigation capturing tidal water in reservoirs in coastal areas and research on the development of improved varieties and technologies for cultivation in coastal, hilly, water-logged and salinity affected areas. The policy also recognizes that adequate measures should be taken to reduce water-logging, salinity and provide irrigation facilities for crop production.

The proposed CEIP-I is expected to contribute to achieve the objectives of the agriculture policy.

3.2.9 National Fisheries Policy, 1996

The National Fisheries Policy (NFP), 1996 recognizes that fish production has declined due to environmental imbalances, adverse environmental impact and improper implementation of fish culture and management programs. The policy particularly focuses on coastal shrimp, aquaculture and marine fisheries development.

The policy suggests following actions:

- Shrimp and fish culture will not be expanded to the areas which could damage mangrove forest in the coastal region
- Biodiversity will be maintained in all natural water bodies and in marine environment
- Chemicals harmful to the environment will not be used in fish shrimp farms
- Environment friendly fish shrimp culture technology will be used
- Expand fisheries areas and integrate rice, fish and shrimp cultivation
- Control measures will be taken against activities that have a negative impact on fisheries resources and vice-versa
- Laws will be formulated to ban the disposal of any untreated industrial effluents into the water bodies.

The CEIP-I interventions may facilitate fisheries production in coastal area. The guidelines of NFP may be integrated while designing and implementing the CEIP-I interventions. However, conflicts over agriculture and fisheries cultivation may accelerate in future.

3.2.10 National Livestock Development Policy, 2007

The National Livestock Development Policy (NLDP) has been prepared to address the key challenges and opportunity for a comprehensive sustainable development of the livestock subsector by creating an enabling policy framework. Among 60 or more policy statements, the following two policy statements address the coastal zone:

- Specific areas will be identified to implement programs for fattening of cattle and livestock. For this purpose, the Chittagong Hill Tracts, the coastal areas and the islands will be included under the fattening of livestock and cattle program.
- Special programs will be taken up for the production of grass in the Chittagong Hill-tracts and the coastal areas.

As livestock is one of the key assets in coastal livelihoods, and protection of livestock from cyclones and tidal surges should be emphasized along with security of human life. The proposed CEIP-I interventions will contribute to the safety of livestock and thus increase livestock productivity in coastal areas.

3.2.11 The Forest Act, 1927 & Amendment Act 2000

The National Forestry Policy of 1994 is the revised version of the National Forest Policy of 1977 in the light of the National Forestry Master Plan. The major targets of the Policy are to conserve the existing forest areas; bring about 20% of the country's land area under the afforestation program, and increase the reserve forest land by 10% by the year 2015 through coordinated efforts of GO-NGOs and active participation of the people.

The need of amendments of the existing forestry sector related laws and adoption of new laws for sectoral activities have been recognized as important conditions for achieving the policy goals and objectives. The Forest Policy also recognizes the importance of fulfilling the responsibilities and commitments under international multilateral environmental agreements.

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.

3.2.12 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 shelter center. 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, distance from the nearest cyclone centre. The advice of the concerned District Committee is to be obtained before final decision. The cyclone shelters should have easier communication facilities so that in times of distress delay does not occur to go there. For this reason, the road communication from the cyclone shelters should not only link up with city or main road but also with neighboring village areas. Provision of emergency water, food and sanitation and shelter space for livestock during period should also be kept in view for future construction of shelters.

Improvement of coastal polders under CEIP-I will provide better communication facilities in the coastal areas, which is crucial for emergency response to disasters.

3.2.13 National Adaptation Programme of Action (NAPA)

In 2005, the Ministry of Environment and Forest (MOEF), Government of the People's Republic of Bangladesh has prepared the National Adaptation Program of Action (NAPA) for Bangladesh, as a response to the decision of the Seventh Session of the Conference of the Parties (COP7) of the United Nations Framework Convention on Climate Change (UNFCCC). The basic approach to NAPA preparation was along with the sustainable development goals and objectives of the country where it has recognized the necessity of addressing climate change and environmental issue and natural resource management. The NAPA is the beginning of a long journey to address adverse impacts of climate change including variability and extreme events and to promote sustainable development of the country. There are 15 adaptation strategies suggested to address adverse effects of climate change. Among the 15 adaptation strategies the following strategies address the coastal region for reducing climate change induced vulnerability.

- Reduction of climate change hazards through coastal afforestation with community participation.
- Providing drinking water to coastal communities to combat enhanced salinity due to sea level rise.
- Construction of flood shelter, and information and assistance centre to cope with enhanced recurrent floods in major floodplains
- Promotion of research on drought, flood and saline tolerant varieties of crops to facilitate adaptation in future.
- Promoting adaptation to coastal crop agriculture to combat increased salinity.
- Promoting adaptation to coastal fisheries through culture of salt tolerant fish special in coastal areas of Bangladesh.

The CEIP-I broadly contributes toward achieving g the aims and objectives of the climate change adaptation strategies.

3.2.14 Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009

The Government of Bangladesh has prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009. The BCCSAP is built on six pillars: (i) food security, social safety and health; (ii) comprehensive disaster management; (iii) infrastructure; (iv) research and knowledge management; (v) mitigation and low carbon development; and (vi) capacity building. Five programs have been suggested related to improvement of the water management infrastructures in coastal areas of Bangladesh under pillar 3 (Infrastructure) of BCCSAP, including:

- Repair and maintenance of existing flood embankments
- Repair and maintenance of existing coastal polders
- Improvement of urban drainage
- Planning, design and construction of river training works
- Planning, design and implementation of resuscitation of the network of rivers and *khals* through dredging and de-siltation work.

CEIP-I is relevant to the above mentioned programs and will contribute towards achieving the objective of other pillars such as (i), (ii) and (iv).

3.2.15 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).

3.2.16 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 alluvion (*payosti* or reformation in situ or original site) and diluvion land (*nadisikosti*) 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.[2] However, the "original" owner(s) can claim the land if it reappears through natural process within 30 years. The original private owners cannot claim any eroded land if developed by the government through land filling for use in public purpose.

3.2.17 Constitutional Right of the Tribal Peoples Rights

In the context of People's Republic of Bangladesh, the Constitution of Bangladesh does not mention the existence of the cultural and ethnic minorities in Bangladesh. The only protective provision for the ethnic minorities that the policy makers often refer to in the context is Article 28 (4) which states that: Nothing shall prevent the state from making special provision in favor of women and children or for the advancement of any backward section of the citizens. The above provision is an ambiguous one and it does not define who or what constitutes "backward". However, the Government recognizes existence of “tribal peoples” and the need for special attention and in general tribal people are essentially viewed as backward, poor and socio-economically & culturally inferior. Towards this end a special program was initiated in 1996-97 by the Prime Minister's Secretariat aimed at improving the socio-economic situation of the indigenous people of Bangladesh, resident outside the Chittagong Hill Tracts.

3.2.18 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.

[2] 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.

- 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.

3.2.19 GoB Laws on Land Acquisition

The principle 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 Government of Bangladesh 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 no property 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.

Inadequacies of 1982 Ordinance

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 Bank'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[3]. Certain pricing standards, which are regarded as unrealistic, are used to assess other losses like structures and various built amenities, trees, crops and the like.
- *Relocation of households and other establishments:* No legal obligation is there to relocate, or assist with relocation of, those whose homesteads have been acquired or whose place of residence or livelihoods has been affected. Such persons/households, be they titleholders or squatters, are left on their own.
- *Ensuring payment of compensation*: Lands are legally acquired and handed over to the project execution agency as soon as the acquisition authority identifies the owners (or 'awardees'), by examining the records, and sends a legal notice advising them to claim the compensation (or 'awards'). It is the obligation of the affected landowners to 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 awards[4].
- *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.

3.2.20 Other Relevant Acts

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

[3]According to the law, the 'market price' is calculated by averaging the sales prices recorded in the previous one year, in terms of land characteristics by land administration units or mauzas. But it is a widely accepted fact that prices determined as such hardly reflect the true market value of the lands. As the sale/acquisition prices are grossly under-reported to evade on sale taxes, assessment of legal compensation almost always fall far too short of the real market prices.

[4]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.

Table 3.1: Laws and Acts

Act/Law/Ordinance	Brief description	Responsible Agency
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	IBWTA
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	UpazilaParishad
The Forest Act (1927)	Regulates the protection of forests reserves, protected forests and village forests	MOEF
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 offices 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	DO Arch
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

3.3 International Treaties Signed by GoB

Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, including the Ramsar Convention, the Bonn Convention on migratory birds, the Rio de Janeiro Convention on biodiversity conservation and the Kyoto protocol on climate change. 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	Relevant Department
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 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

3.4 Implication of GoB Polices, Acts and Rules on CEIP & Classification

The CEIP project intervention Legislative bases for environmental assessment 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 Rule 7 (1) of the Environmental Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every industrial units or projects, in consideration of their site and impact on the environment, will be 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 Project intervention in polder 35/1 falls under the '**Red**' category.

It is the responsibility of the proponent to conduct an EIA of 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)

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

Application to DOE →Obtaining Site Clearance →Applying for Environmental Clearance →Obtaining Environmental Clearance → Clearance Subject to annual renewal.

The detail DoE clearance procedure is presented in the Environmental Management Framework.

3.5 World Bank's Environmental Safeguard Policies

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

3.5.1 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 4.1 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 project implementation. EA takes into account the natural environment (air, water and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples and physical cultural resources); and trans-boundary and global environmental aspects. The Bank Policy also envisages that the borrower Government is responsible for carrying out the EA and the Bank advises the borrower on the Bank's EA requirements.

The present EIA has been carried out in compliance with this OP.

EA classification. The World Bank classifies the proposed project into oneof the four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. These categories are defined below.

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

Category B: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas--including wetlands, forests, grasslands, and other natural habitats--are less adverse than those of Category A projects.

Category C: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.

Category FI: A proposed project is classified as Category FI if it involves investment of Bank funds through a financial intermediary, in subprojects that may result in adverse environmental impacts.

The proposed CEIP-I has been classified as Category A, since some of the potential impacts are likely to be significant and diverse. Furthermore, Sundarban – a protected area – is in the close vicinity of the Project location, and if appropriate safeguards are not integrated in the Project design and implementation, the adverse impacts can potentially extend to this sensitive area.

3.5.2 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.

This OP is not triggered for the proposed Project since 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 (EMP) (provided later in the document) to prevent any potential impacts of the Project on the nearby Sundarban, which is a protected area.

3.5.3 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.

3.5.4 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. [5]

- 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.

[5] Excerpts from the OPN 11.03.WB Operational Manual. September 1986.

3.5.5 Forestry (OP 4.36)

This Policy recognizes the need to reduce deforestation and promote sustainable forest conservation and management in reducing poverty. The Bank believes that forests are very much essential for poverty reduction and sustainable development irrespective of their location in the world. The Bank assists borrowers with forest restoration activities that maintain or enhance biodiversity and ecosystem functionality. The Bank also assists borrowers with the establishment and sustainable management of environmentally appropriate, socially beneficial, and economically viable forest plantations to help meet growing demands for forest goods and services. The Bank does not finance projects that, in its opinion, would involve significant conversion or degradation of critical forest areas or related critical natural habitats. Furthermore, the Bank does not finance projects that contravene applicable international environmental agreements.

This OP is not triggered since the proposed Project is not located in any forested area and will therefore not have any direct impact on forests. Any potential impacts on the nearby Sundarban forest will be forestalled with the help of appropriate mitigation measures included in the EMP, as stated earlier as well.

3.5.6 Projects on International Waterways (OP 7.50)

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.

3.5.7 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.

3.5.8 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:[6]

- 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

6 Excerpts from the OP 4.10.WB Operational Manual. July 2005.

- an indigenous language, often different from the official language of the country or region.

The OP defines the process to be followed if the project affects the indigenous people.

No indigenous people - with a social and cultural identity distinct from the dominant society that makes them vulnerable to being disadvantaged in the development process – are known to exist in the Project area. Therefore this OP is not triggered.

However if such groups are identified during the Project implementation, the proponents will develop an Indigenous People Development Plan, in compliance with the OP and get it approved by the Bank.

3.5.9 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.[7]

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.

3.5.10 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.

[7] 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. [8]

This OP is not triggered since no part of the Project area is located in any disputed territory.

3.5.11 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 the WB finances. However this OP is not relevant since the proposed Project does not involve construction of dams.

3.5.12 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 and Bengali translation of its executive summary 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.

3.5.13 Environment, Health and Safety Guidelines

The Environment, Health, and Safety (EHS) 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.

3.6 Implications of the World Bank Policies on CEIP & Environmental Category

The project intervention for polder 32 falls under Category A project, 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. Sutarkhali River is in between the east of polder 32 and Sundarbans the largest Mangrove forest of South Asia. Rehabilitation and reconstruction of polders may have indirect impact on the water flow quality and pattern within the channels of Sundarbans.

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

8 Excerpts from the OP 7.60.WB Operational Manual. November 1994.

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 during 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. However this will not have any effect whatsoever on the upper riparian water usage or availability.

4. Description of Proposed Interventions in Polder 32

The project description chapter is simplified the rehabilitation/development works of this polder. The construction methodology, construction schedule, and the institutional arrangements for implementation of the Project is also been discussed in this chapter

4.1 Project Background

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 the tides in the Bay of Bengal which could vary in range from 3 m in the west to nearly 6 m in the north-eastern corner of the Bay near Sandwip.

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

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 are now under the protection of the coastal embankment system bringing immense benefits. However, there have been unintended consequences of this project. The very act of preventing the high tides from spreading over the land and confining them within the river channels initially increased the tidal range by about 30 per cent which might have had an immediate beneficial impact on drainage. However, the reduction of upstream and overbank storage also decreased the tidal cubature (ie, the volume of water displaced during a tidal cycle). The reduction in cubature induced sedimentation or more correctly a reduction in cross sectional areas of the rivers of all types – the large rivers such as the Pussur which have sandy bottoms and clay/silt banks and the smaller rivers which have an excess of silt and clay. The consequent choking of smaller rivers resulted in drainage congestion within some internal polders, and navigation problems in some.

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

The CEIP Initiative

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 ad crops. However, some effectiveness of the infrastructures in most cases has been compromised through poor and inadequate maintenance and sometimes by shifting the embankments towards country sides. With the occurrence of the frequent storms in the recent period the Coastal Embankment Systems (CES) has weakened and calls for systematic restoration and upgrading.

After cyclone SIDR struck the coastal area causing severe damage to the infrastructure, lives and properties of the coastal belt, the Government of Bangladesh (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).

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

The Polder 32 is one of the polders to be rehabilitated under the CEIP-I.

4.2 Polder Overview

The Polder 32 is situated in Dacope upazila of Khulna District (Figures 1.2 and 4.1). The management of the water control structures in the Polder lies with Khulna Operation and Maintenance (O&M) Division of BWDB. The Polder covers two union parishads namely Sutarkhali, and Kamarkhola of Dacope upazila. The polder is surrounded by Sibsha and Dhaki River to the west and North, Chunkuri, Bhadra and Sutarkhali river to the east and south. The Polder covers a gross area of 8,097 ha of which net cultivable area is 6,500 ha.

In 1960, Polder 32 was constructed under Coastal Embankment Project (CEP). The main objective of construction of this Polder was only to protect the agricultural lands from salinity intrusion caused due to tidal inundation from the sea through rivers. Protection against storm surges was not considered at that time. At present, the embankment of the Polder is under tremendous threat of cyclone surge, wave attack, river erosion and increasing risks brought about by climate change.

The Polder is surrounded by embankment including various water controlling structures for draining and flushing the Polder area. The summary of the existing infrastructure is given below.

1.	Embankment:	49.50 km.
2.	Regulators (drainage / flushing):	16
3.	Flushing inlets:	32
4.	Internal *khals* (water channels):	45.00 km.

4.3 Objectives of Improving Polder 32 under CEIP- I

The overall objective of the Project is to increase the resilience of coastal population from natural disasters and climate change. Specifically, the Project aims at (a) reducing the loss of assets, crops and livestock during natural disasters; (b) reducing the time of recovery after natural disasters such as cyclones; (c) improving agricultural production by reducing saline water intrusion which is expected to worsen due to climate change; and (d) improving the Government of Bangladesh’s capacity to respond promptly and effectively to an eligible crisis or emergency.

4.4 Water Management Problems and Issues in Polder 32

In the polder area, many segments of the embankment system are damaged mainly by overtopping due to cyclone and storm surges induced Sidr (2007) and Aila (2009). The river side slope and berm in many places are subject to river erosion and damaged by wave action. The remaining length of the embankment is now under-sectioned relative to the original design section and in a deteriorated condition. Many of the hydraulic structures are fully or partially damaged and are non-functioning. The gates are corroded by saline water and concrete surfaces of the structures are very much in deplorable condition. As a result internal drainage congestion has been prevalent for long and also saline water enters into the Polder area. Moreover, construction of temporary embankment without regulators after Aila, poor maintenance of existing structures, the drainage canals cannot safely drain out the design discharges which ultimately cause drainage congestion inside the polder area. The life and livelihood of the Polder's community have been disrupted. In this situation, the entire embankments including all kind of structures of the polder need rehabilitation or improvement to improve the socio-economic condition as well as quality of the life of the people of Polder 32.

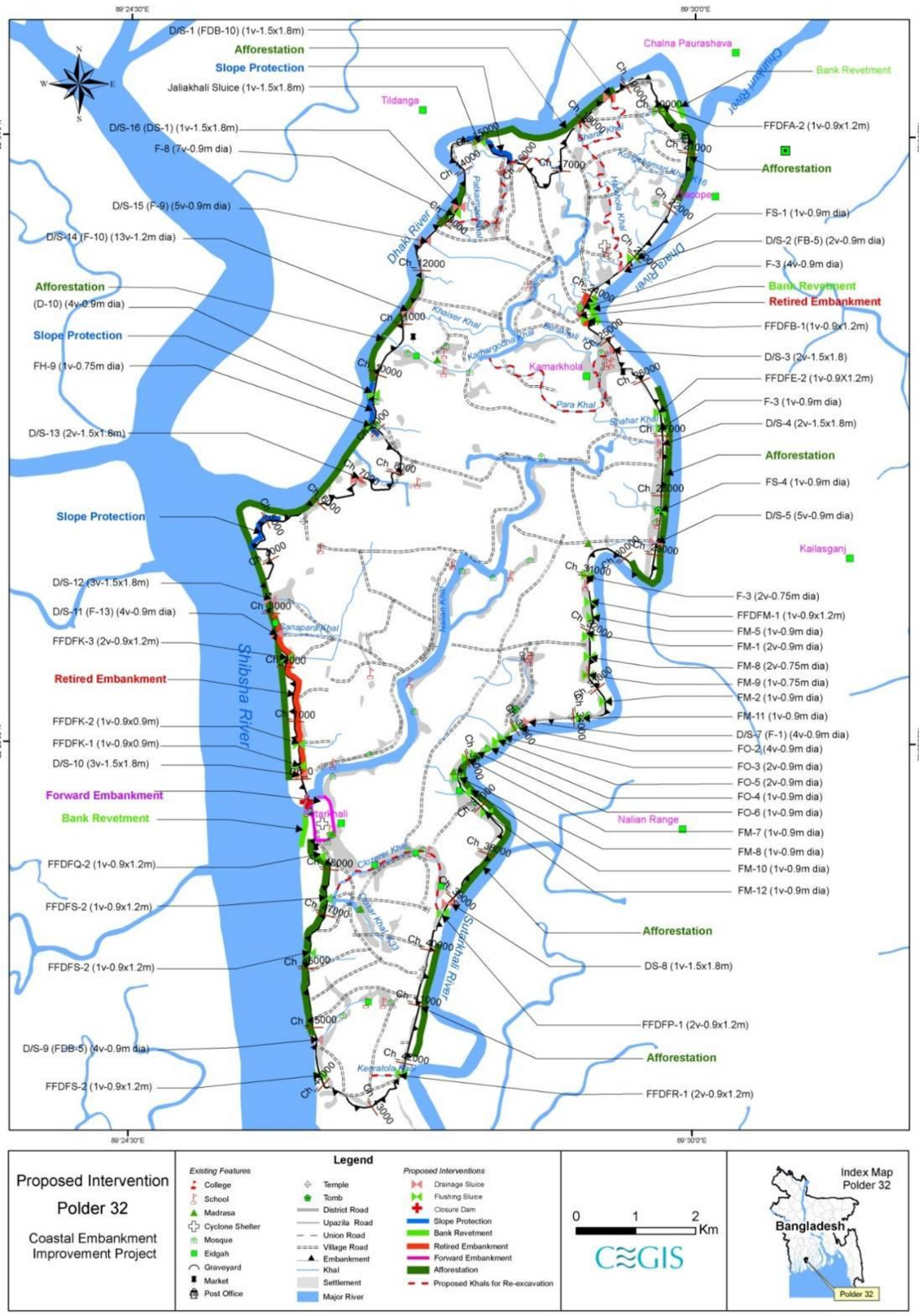

Figure 4.1: Alignment of the embankment and existing structures of the polder

4.5 Present Status of Water Management Infrastructures

4.5.1 Embankments

Present status of embankment and works required for Polder 32 are described below:

- The segment of embankment from km 0.50 to 3.50, km 24.20 to 24.70 and km 42.60 to 44.00 have been badly damaged by the River Sibsa. These segments of the embankment have to be retired. But the segment of embankment from km 42.60 to 44.00 has already been taken up for execution under on-going Aila (GoB) Programme. The remaining segments of embankment at km 0.50 to 3.5 and km 24.20 to km 24.70 are to be considered for retirement under CEIP -I.
- The segment of embankment from km 48.80 to 49.50 will be shifted towards river side to protect some important government and private installations like Bazar, homestead, school, cyclone shelter, mosque etc. from tidal inundation and cyclone surge.
- The remaining length of embankment has to be re-sectioned up to the design level with mechanical compaction. There is brick soling on the top of the embankment constructed by LGED at some segments without following BWDB's design and specification which need to be upgraded under CEIP- I Program.
- The segment of the embankment at km 20.00 to 20.50, km 24.20 to 24.70, km 48.80 to 49.30 has fallen under the thrust of river erosion. Out of which, the bank revetment work at km 20.60 to 21.00 has been taken up for execution under on-going AILA (GoB) Program. The segment of embankment at km.20.00 to 20.50, km 24.20 to 24.70 and km 48.80 to 49.30 are to be protected by bank protective works under CEIP-I.
- The slope of embankments at km 0.50 to 5.50, km 6.10 to 7.70, km 8.20 to 10.00, km 15.00 to 16.00, km 43.00 to 47.00and km 48.50 to 48.80 have been damaged due to severe wave action of the River Sibsa. Out of which the slope protection works at km 0.500 to 4.80, km 6.10 to 7.10, km 8.20 to 9.00, km 44.00 to 47.00 and km 48.50 to 48.80 have already been taken under on-going Aila (GOB) Program. The remaining segments of embankment at km 4.80 to 5.50, km 7.10 to 7.70, km 9.00 to 10.00,km 15.00 to 16.00 and km 43.00 to 44.00 are needed to be protected by providing slope protection works under CEIP-I.

4.5.2 Water Control Structures

There are 16 drainage sluices, 32 flushing inlet structures in Polder 32. The present condition of the structures along with the required remedial actions is presented in Table 4.1 below; some photographs of these structures are provided in Figures 4.2 to 4.5.

Table 4.1: Status of Structures and Recommendations for Improvement

	Structure Description and Location	Chainage (km)	Present Condition of the Structures	Action Required
1.	Drainage Sluice -1 (D/S-1) (FDB-10) (1v-1.5m x 1.8m) (Hatkhola)	18.90	The structure is badly damaged.	A new RCB drainage-cum-flushing sluice (1v-1.5m x1.8m) is required to be constructed in place of existing one.
2.	D/S-2 (FB-5) (2v-0.90m dia) (Sotodonga)	23.44	The structure is in deplorable condition.	The structure is proposed to be replaced by Regulator Cum Road Bridge (RCB) (1v-1.5m x 1.8m) in place of pipe sluice with provision for flushing and drainage.

	Structure Description and Location	Chainage (km)	Present Condition of the Structures	Action Required
3.	D/S-3 (DS-2) (2v–1.5mx 1.8m) (Kalinagar Sluice)	25.08	The construction work of the structure has been completed during the year 2010-2011 under SAIWRPMP-Aila programme	The structure is functioning well.
4.	D/S-4 (2v-1.5m x 1.8m) (Shrinagar sluice)	26.89	The construction work of the structure has been completed during the year 2010-11 under SAIWRPMP-Aila programme	The structure is functioning well.
5.	D/S-5 (F2) (5v-0.9m dia) (Suturkhali Slucie)	28.78	The structure is damaged and non-functional.	The construction work of the structure (2v-1.5mx 1.8m) has been taken up under GoB: Aila during 2011-2012.
6.	D/S-6 (F-3) (2v-0.75 m dia) (Suturkhali)	31.10	Loose apron have been damaged.	Based on model study it is observed that no drainage sluice is required at this location.
7.	D/S-7 (F1) (4v-0.90m dia) (Koyratoli khal)	35.00	The structure is in deplorable condition.	A new RCB drainage-cum-flushing sluice (1v-1.5mx1.8m) is proposed to be constructed.
8.	DS-8 (DS-9) (1v-1.5m x 1.8m) (North Box Doani)	39.28	The structure is in deplorable condition.	The structure is proposed to be replaced with provision for flushing-cum-drainage.
9.	D/S-9(FDB-5) (4v-0.9m dia) (Kalabogi)	45.00	The structure is badly damaged.	A new RCB drainage-cum-flushing sluice (1v-1.5mx1.8m) is proposed to be constructed.
10.	D/S-10(3v-1.5mx1.8m) (Nalian Sluice)	0.10	Nalian River could not be closed by BWDB in spite of several attempts. To protect the area from saline water intrusion, the Nalian River has been closed at the upstream by constructing Ring-dyke on the either sides	A cross dam is proposed to be constructed.

	Structure Description and Location	Chainage (km)	Present Condition of the Structures	Action Required
			without providing any sluice which has become the cause of drainage congestion in the area. At this situation it is proposed to be closed at the mouth by providing a drainage sluice at this point.	
11.	D/S-11 (F-13) (4v-0.90m dia) (Sanapara)	3.18	The structure is in deplorable condition.	Based on model study it is observed that no drainage sluice is required at this point.
12.	D/S-12 (F-12) (9v-0.9m dia) (Gunari sluice)	3.78	Structure is in deplorable condition	Construction work of F12 (3v-1.5mx1.8m) has been going on under Aila fund.
13.	D/S-13 (Gulbunia sluice)	7.20	There is no drainage sluice at this location and the area is suffering from drainage congestion.	The construction of one new sluice (2v-1.5m x1.8m) has been taken up under GoB: Aila.
14.	D/S-14 (F-10) (13v – 1.2m dia) (Joynagar sluice)	11.375	Structure is in deplorable condition.	Construction of a new (3v – 1.5m x 1.8m) RCB sluice has been taken up under AILA fund in place of the existing pipe sluice.
15.	D/S-15) (F-9) (5v-0.9m dia) (Joynagar khal)	12.60	The structures are in deplorable condition.	Based on model study it is observed that no drainage sluice is required at this point.
16.	D/S-16 (DS-1) (1v-1.5mx1.8m) (patkeimari khal)	13.50	The structures are in deplorable condition.	A new (2v-1.5mx1.8m) RCB sluice is proposed to be constructed in between DS-1 (1v-1.5mx1.8m) and F-8(7v-0.9m dia).
17.	FFDFA2 (1v-0.9mx1.2m) (Kongsiomari khal).	20.15	The structures are functioning well.	It will serve the purposes.
18.	Flushing Sluice 1 (FS-1) (1v-0.90m dia)	23.23 (required	Loose apron has been damaged and gates are	Repairing of structure is needed.

	Structure Description and Location	Chainage (km)	Present Condition of the Structures	Action Required
	(Majhir khal)	to be replaced)	required to be replaced.	
19.	F-3 (4v-0.9m dia) (Shibnagar)	24.315km	The structure is badly damaged.	The structure is proposed to be replaced by (1v-.9mx1.2m) RCB flushing cum drainage sluice.
20.	FFDFB1, (1v-0.90mx1.20m) (Shibnagar khal)	24.385	The U/S and D/S loose apprones of the structure have totally been damaged.	Minor repairing of the structure is needed.
21.	FFDFE2 (1v-0.9mX1.2m) (Sahar)	26.45	The structure is functioning well.	It will serve the purpose.
22.	FS-3 (1v-0.9m) (Sahar khal)	26.65	The structure is badly damaged.	There is no structure required.
23.	FS-4 (1v-0.9m Ø) (Vitavanga 01)	28.20	There is minor damage of the structure.	The structure is needed to be repaired.
24.	FFDFM-1 1v-0.9mx1.2m) (Suterkhali)	31.62	There is minor damage of the structure.	Minor repair of the structure is required.
25.	FM-5 (1v-0.9m Ø)	31.84	There are minor damages of all the structures.	Repairing of structures are needed.
	FM-1 (2v-0.9m Ø)	32.20		
	FM -8 (2v-0.75m Ø)	32.55		
	FM-9 (1v-0.75m Ø)	32.845		
	FM-2 (1v-0.9m Ø)	33.38		
	FM-11 (1v-0.9m Ø) (Suterkhali)	34.00		
26.	Fo-2 (4v-0.9m dia) (kayratoli khal)	35.075 km	There is one existing drainage sluice at ch. 35.00 km. The structure has been fully damaged.	There is no structure required at this location.
27.	FO-3 (2v-0.9m Ø),	35.40 km	There are minor	Repairing of all sluices

	Structure Description and Location	Chainage (km)	Present Condition of the Structures	Action Required
	FO-5 (2v-0.9m Ø) FO-4 (1v-0.9m Ø), FO-6 (1v-0.9m Ø), FM-7 (1v-0.9m Ø), FM-8 (1v-0.9m Ø), FM-10 (1v-0.9m Ø), FM-12 (1v-0.9m Ø) (Dholibari)	35.50 km 35.70 km 35.95 km 36.08 km 36.53 km 36.80 km 37.33 km	damages of all these structures.	are needed.
28.	FFDFP1 (2v-0.9m X 1.2m) (North Box Doani)	39.44 km	The structure is functioning well.	It will serve the purposes
29.	FFDFR1 (2v-0.9m x 1.2m) (Keoratola khal)	42.34 km.	There is minor damage of the structure.	Repairing of structure is needed.
30.	FFDFT1 (1v-0.9mx1.2m) (Keoratola)	44.44 km	The structure is functioning well	It will serve the purpose.
31.	FFDFS1 (1v-0.9mx1.2m) (Kasaribari khal) and FFDFS2 (1v-0.9m x 1.2m) (Closer khal)	46.48 km 47.50 km	The structures are functioning well.	It will serve the purpose.
32.	FFDFQ2 (1v-0.9m x 1.2m)	48.315 km	The structure is functioning well.	It will serve the purpose.
33.	FFDFK1 (1v-0.9mx0.9m) FFDFK2 (1v-0.9mx0.9m) FFDFK3 (2v-0.9mx1.2m) (Gunary)	0.74 km 1.1km. 2.76 km	The structures are functioning well.	It will serve the purpose.

	Structure Description and Location	Chainage (km)	Present Condition of the Structures	Action Required
34.	FS (FH-9) (1v-0.75m dia)	9.22 km	There is minor damage of the structure.	Repairing of the structure is needed.
35.	D-10 (4v-0.9m Ø)	9.765 km	Structure is in deplorable condition.	The structure is proposed to be replaced by RCB (1V-0.9mx1.2m) sluice.
36.	FO-2 (2v-0.9m Ø) (Sotri khal)	15.20 km	There is minor damage of the structure.	Repairing of the structure is needed.

Figure 4.2: 5 vent Drainage Regulator

Figure 4.3: Drainage Regulator

Figure 4.4: Damaged Sluice

Figure 4.5: Temporary embankment

4.6 Rehabilitation/Improvement Activities in Polder 32

The proposed interventions in Polder 32 under CEIP-I are listed in Table 4.2 and shown in Figure 4.1.

Table 4.2: Proposed Interventions in Polder 32

1	Re-sectioning of embankment	44.80 km
2	Construction of retired embankment	3.50 km
3	Forwarding of embankment	0.50 km
4	Construction of drainage sluices	11
5	Construction of flushing inlets	2
6	Repairing of flushing inlets	21
7	Demolishing of drainage sluices	3
8	Demolishing of flushing inlets	3
9	Re-excavation of drainage channels	17.50 km
10	Bank revetment works	1.50 km
11	Slope protection of embankment	3.30 km
12	Cross dam	1 no.
13	Afforestation on the foreshore areas	19 ha

Source: Feasibility Report of CEIP, 2012

4.6.1 Works on Embankments

Under the proposed interventions in the Polder, a total of 44.80 km of embankments will be re-sectioned and their height will be increased to 5.00m (Ch. 0.00 km-5.50 km and Ch. 44.00 km- 49.50 km) and 4.50 m (Ch. 5.50km- 44.00 km) a total of 3.50 km of embankments will be retired, and a total of 0.50 km of embankments will be forwarded, as shown in the Table 4.3 below.

Table 4.3: Detail of Works on Embankments

	Description	Chainage (km)	Height m	Length (km)
1.	Re-sectioning (Increasing the height of embankments)	3.50 to 5.50	5.00	2.00
		5.50 to 24.20	4.50	18.70
		24.70 to 44.00	4.50	19.30
		44.00to 48.80	5.00	4.80
2.	Retirement	24.20 to 24.70	4.50	0.50
		0.50 to 3.50	5.00	3.00
3.	Forwarding of Embankment	48.80 to 49.30	5.00	0.50

Source: Feasibility Report of CEIP, 2012

Description of construction activities

During pre-construction phase, labor sheds should be constructed with proper sanitation and other required facilities before the commencement of construction activities for embankment works. A suitable site shall be selected and prepared by cleaning bushes, weed, trees etc. Alignment of embankments has to be fixed with adequate base width. Base stripping and removal of trees, weed etc will be done as per instruction of the Engineer in charge. The tools required for construction of embankments will be procured during this period. After validating the final design, excavation of soil/carried earth will be followed and deposited in a selected area. Soil will be dumped with layers. At the same time, each layer (of 1.5 feet) of dumped soil will be compacted by compactor machine. The sloping and shaping of embankment will be developed after proper compaction of layers. Then required turfing with grass will be provided on embankment. Watering and fertilizing will also be provided.

4.6.2 Construction/Repairing of Drainage Sluices

Eleven drainage sluices will be replaced under the proposed interventions of the rehabilitation works of the Polder 32. Moreover, three sluices will be demolished under this Project. The details description of these sluices has been given in Table 4.1.

Description of construction activities

At the beginning of the work i.e. during pre-construction activities for construction of drainage sluices i.e. construction of labor shed, development of sanitation and other facilities etc should be done. During this period, required construction materials (sand, cement, wood, shuttering materials etc.) will be procured by the contractor as per tender schedule. Meanwhile, a suitable site will be selected and prepared for construction of the sluices. Before starting the construction activities of drainage sluices, Ring bundh and diversion channel will have to be constructed. After that the foundation treatment required for the structure will be carried out. The concrete cement (CC) and reinforced concrete cement (RCC) works along with cutting, bending and binding of rods will then be performed as per specification. CC blocks will be prepared and placed as and where required as per design. After construction of approach roads, fitting and fixing of gates and hoisting device will be carried out. Gates will be properly painted. The intake and outfall of the gate will be constructed as per design. The CC blocks will be made for river training works and pitching works will then be conducted.

4.6.3 Construction/Repairing of Flushing Inlets

Only two new flushing inlets will be constructed under the proposed interventions for rehabilitation work of Polder 32. Moreover, twenty one flushing inlets which affected by Aila (2009) will be repaired. The details description has been given in Table 4.1.

Description of construction activities

Before starting the construction activities of flushing inlets a labor shed will be constructed with proper sanitation and other facilities. The required construction materials (sand, cement, wood, shuttering materials etc.) will be procured simultaneously. A suitable site of the structure will then be selected and prepared accordingly. Alternative diversion channels will be constructed before the starting of construction works. After that the foundation treatment required for flushing inlets will be carried out. Then the RCC works, pipe and machine pipe along with construction allied and fittings will be made along with construction of and collar joints will be made as and where required. After few days of constructions the gates both in the upstream of each flushing inlets will be executed. After completion of all construction activities, the approach embankments will be constructed and turfed with grass. Finally, a channel is to be excavated through lead cut and tail cut to make the flow to be channeled through the flushing gate.

4.6.4 Re-excavation of Drainage Channels

A total 17.5 km length from six channels of the polder will be re-excavated to continue water flow and decrease the drainage congestion. An estimated volume of 0.093 million cubic meters of soil/silt will be excavated from these channels. The excavated soil will be used for strengthening the khal banks, in addition to making it available to the farmers. The water channels to be re-excavated under the project are presented in Table 4.4.

Description of construction activities

At first the required tools will have to be procured for re-excavation of the drainage channels. A schematic diagram showing centerline and layout plan will be made for the re-excavation more and the design depth and width of excavation are to be noted. The entire channel will then be divided into a number of reaches. The excavation will be started from the upstream of the channel. Cross dams are to be provided of the starting and final locations of the reach, and then soil from the channels will be removed upto required depth and width. The excavated soil/sludge should be disposed into a suitable place, specified by the Engineer in charge, from where the sludge or soil will not affect the channel flow by any means. After finalizing excavation on one reach, the other reach in the downstream would be excavated using the above procedures.

Table 4.4: Channels to be Re-excavated

	Name of Khal (Channel)	Length (km)	Chainage (km)
1	Charar khal	1.50	18.90
2	Hatkhola khal	3.50	23.44
3	Parar khal	4.50	26.89
4	Kayratoli khal	3.00	42.30
5	Clozarer khal	3.00	39.44
6	Jaliakhali khal	2.00	13.50
	Total	17.5	

Source: Feasibility Report of CEIP, 2012

4.6.5 Bank Protection and Slope Protection Works

The proposed intervention of the rehabilitation works of the project has considered slope protection works. A total of 3.3 km of slope protection of embankment along the Dhaki River will be carried out at different locations from chainage 4.8 km to 5.5 km, 7.1 km to 7.7 km, 9 km to 10 km and 15 km to 16 km (Figure 4.12).

Description of construction activities

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

4.6.6 Bank Revetment

The proposed interventions for the rehabilitation works under CEIP-I include Bank revetment works in some places along the riverside. Bank revetment works are to be provided along 1.5 km of lengths. The construction phase of providing Bank revetment entails the following key activities

Description of construction activities

Labor shed needs to be constructed with proper sanitation facility. Construction materials (sand, cement, wood, shuttering materials etc.) would be procured. The required CC blocks will be casted or manufactured and guard walls will be constructed. After completion of the preparation of CC blocks, Geo-textile bags will be placed along the slope and CC blocks will be placed on it. A launching apron will be prepared with CC blocks along with dumping of CC blocks in assorted form will be completed up to toe of the river banks

4.6.7 Afforestation

Afforestation program has been undertaken with suitable mangrove species on the foreshore area of the rivers along the embankment of the Polder 32 to protect the embankment from the wave action of surrounding rivers. Under CEIP-I, about 25.55 km afforestation will be made in different locations of this polder (**Figure 4.1**) for which 19 ha land will be required. Before plantation, a temporary nursery will be established in the polder area to ensure the availability of seedlings. The spacing of seedling plantation will be 1.5m X 1.5m. Suitable climate resilient mangrove species have been selected for the foreshore afforestation.

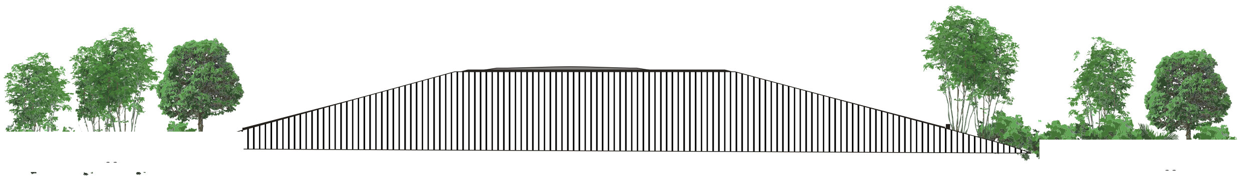

Figure 4.6: Typical Cross Section of afforestation works

4.7 Construction Details

4.7.1 Construction Schedule

The works in Polder 32 under the CEIP-I are expected to be completed in four years. The construction schedule is present in Table 4.5.

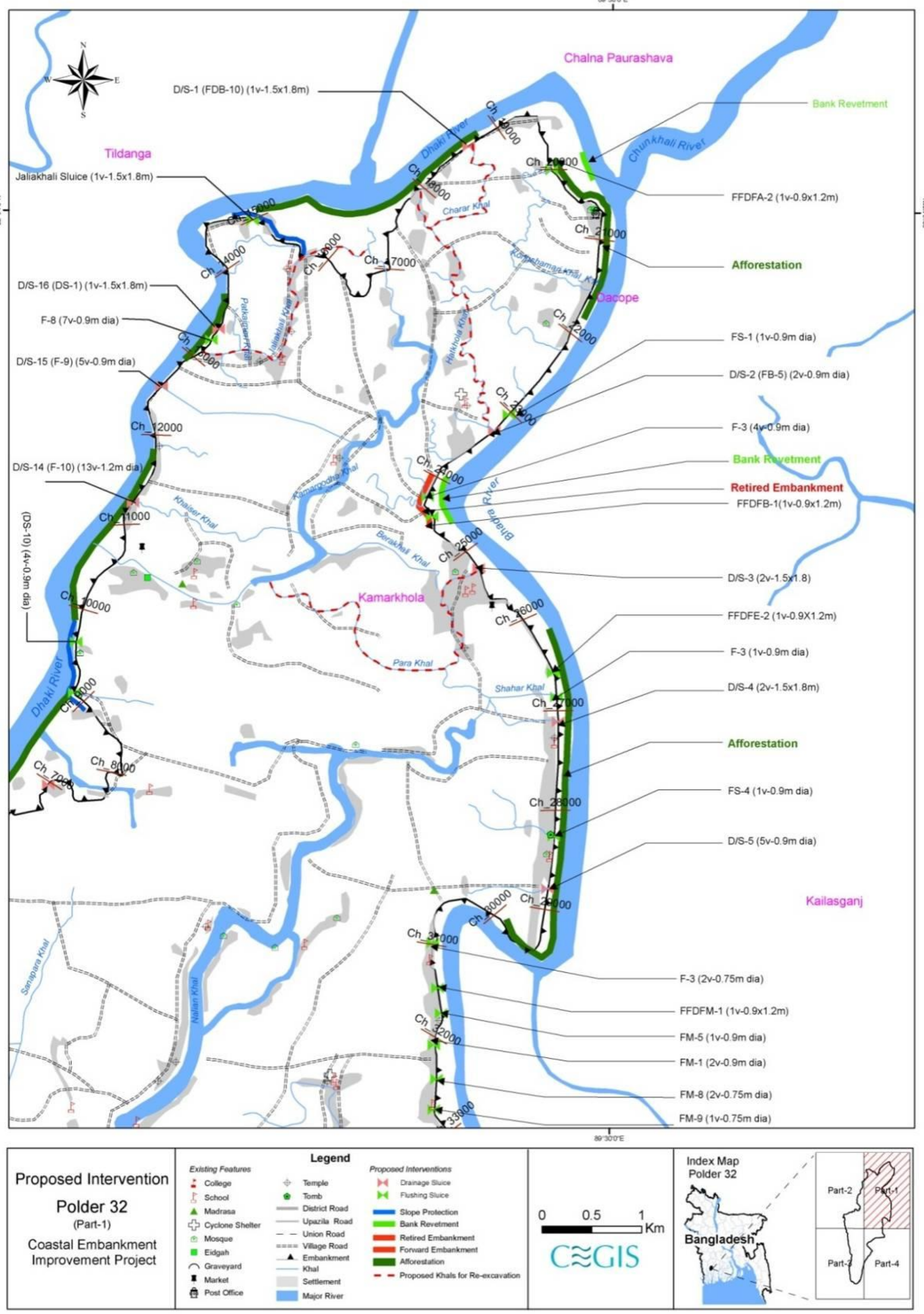

Figure 4.7: Location of Proposed Interventions in Polder 32 (Part 1)

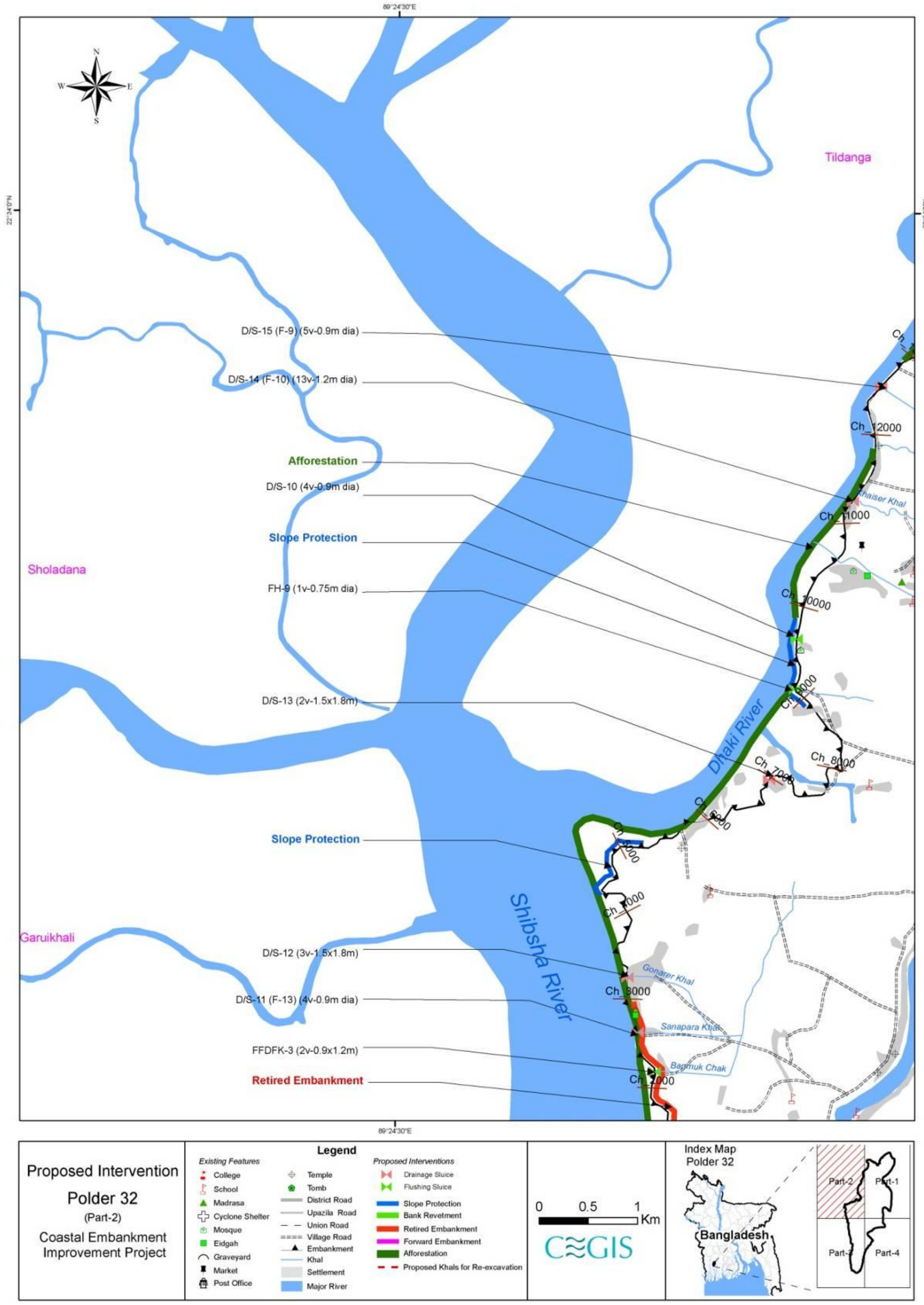

Figure 4.8: Location of Proposed Interventions in Polder 32 (Part 2)

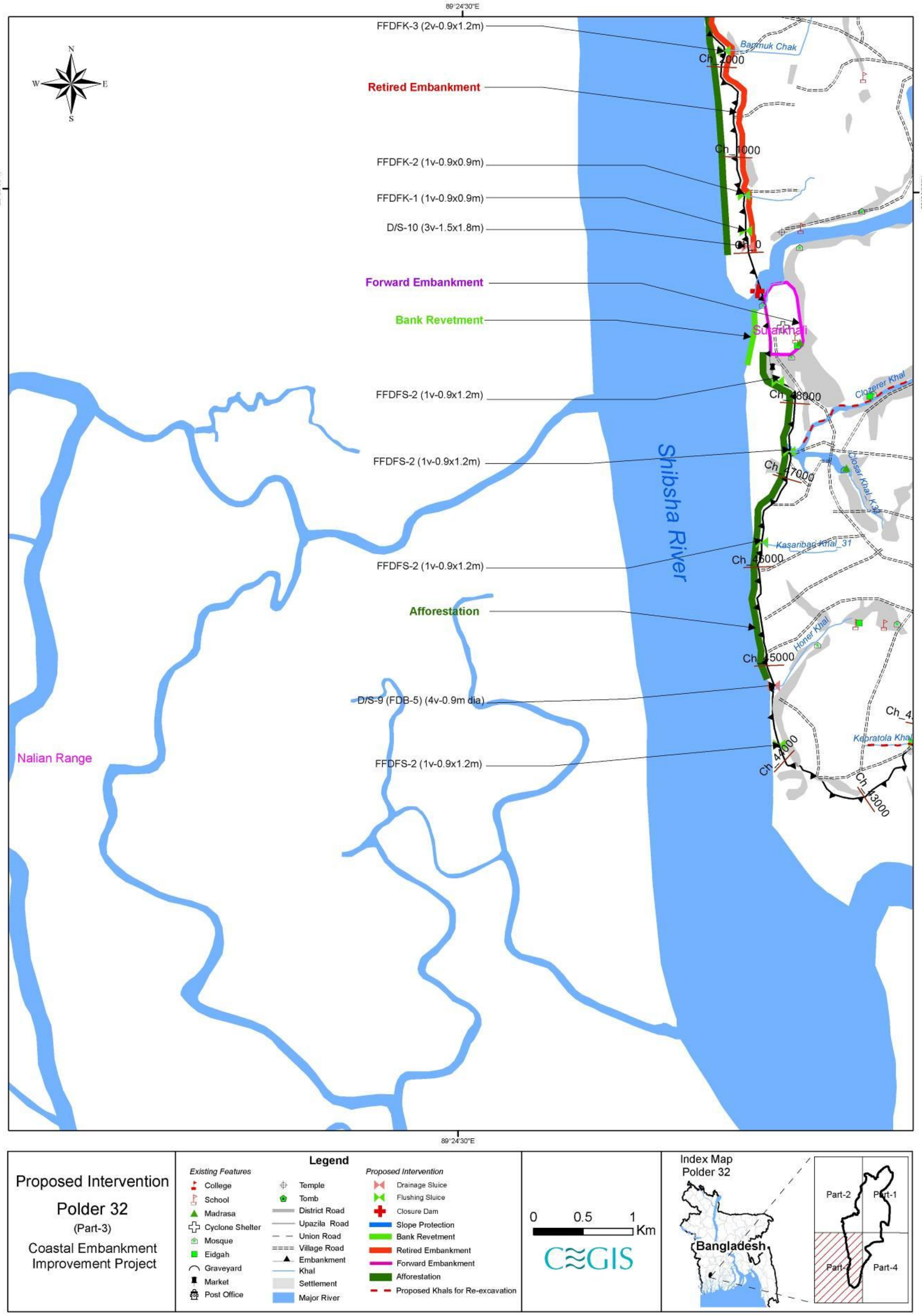
FFDFK-3 (2v-0.9x1.2m)
Retired Embankment
FFDFK-2 (1v-0.9x0.9m)
FFDFK-1 (1v-0.9x0.9m)
D/S-10 (3v-1.5x1.8m)
Forward Embankment
Bank Revetment
FFDFS-2 (1v-0.9x1.2m)
FFDFS-2 (1v-0.9x1.2m)
FFDFS-2 (1v-0.9x1.2m)
Afforestation
D/S-9 (FDB-5) (4v-0.9m dia)
FFDFS-2 (1v-0.9x1.2m)
Nalian Range
Shibsha River
Sutarkhali
Kasaribari Khal_31
Honer Khal
Kepratola Khal
89°24'30"E
22°28'30"N
Proposed Intervention
Polder 32
(Part-3)
Coastal Embankment Improvement Project
Legend
Existing Features
College
School
Madrasa
Cyclone Shelter
Mosque
Eidgah
Graveyard
Market
Post Office
Temple
Tomb
District Road
Upazila Road
Union Road
Village Road
Embankment
Khal
Settlement
Major River
Proposed Intervention
Drainage Sluice
Flushing Sluice
Closure Dam
Slope Protection
Bank Revetment
Retired Embankment
Forward Embankment
Afforestation
Proposed Khals for Re-excavation
0 0.5 1 Km
CEGIS
Index Map
Polder 32
Bangladesh
Part-1
Part-2
Part-3
Part-4

Figure 4.9: Location of Proposed Interventions in Polder 32 (Part 3)

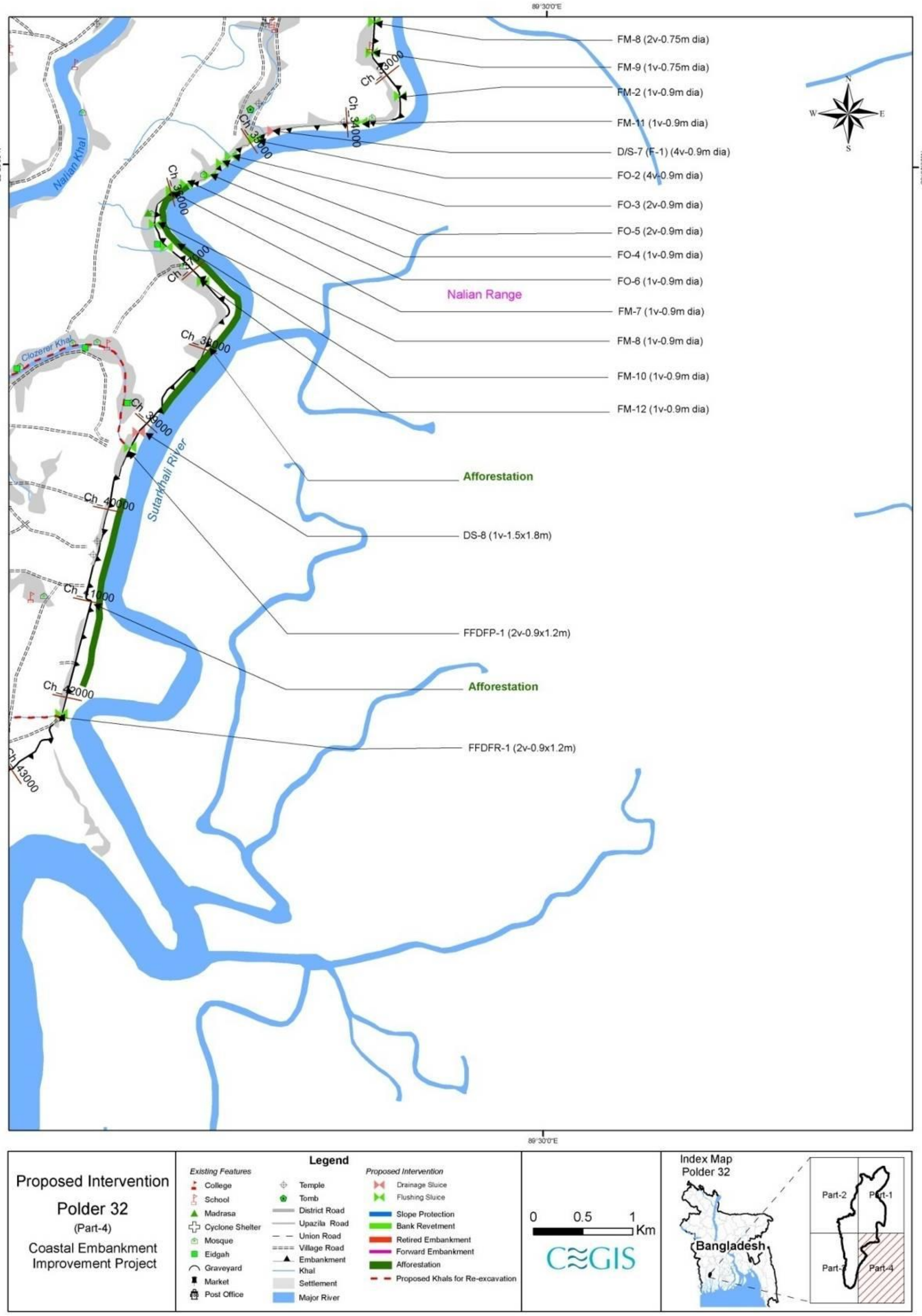

Figure 4.10: Location of Proposed Interventions in Polder 32 (Part 4)

Table 4.5: Construction Schedule

	Description	**Year 1**				**Year 2**				**Year 3**				**Year 4**			
		Jan-Mar	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**	**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**	**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**	**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**
A.	**Pre-Construction Activities**																
A1	Discussion with local stakeholders about the project and interventions																
A2	Disclose rehabilitation plan																
A3	Distribute acquisition and requisition money before the construction works																
A4	Display Bill board on the intervention site for public awareness																
A5	Preparation of Stockyard for construction materials																
A6	Mobilization and site preparation																
A7	Higher Contractors through tendering procedure																
A8	Construction of labor shed and site office																
A1	*Labor shed and site office preparation*																
A2	*Installment of water and sanitation facilities*																
A3	*Installment of Garbage disposal system*																

	Description	**Year 1**				**Year 2**				**Year 3**				**Year 4**			
		Jan-Mar	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**	**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**	**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**	**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**
B.	**Construction activities**																
C	**Procurement system of the project**																
C1	Procurement of construction materials																
C2	Procurement of construction machineries and equipments																
D	**Rehabilitation of embankment**																
D1	Collection of earth materials from the borrow pit area from outside of the embankment through excavator, pay loader and dump truck and trolley																
D2	Collection of earth materials from Baleswar river through dredging																
D3	Use slow moving vehicles/head load for carrying earth materials																
D4	Dumping of earthen materials on the embankment																
D5	Keeping earthen materials for drying																
D6	Breaking dried earthen materials through Clod Breaker																
D7	Embankment surface labeling through dumper machine																

	Description	Year 1				Year 2				Year 3				Year 4			
		Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
D8	Embankment slope pitching and turfing																
E	**Re-excavation of Canal**																
E1	Bailing out of water with all leads and lifts by manual labor or pump, with all arrangements for protection of ring bund and side slopes of foundation pit against erosion and washout																
E2	Earth work by manual labor with clayey soil (minimum 30% clay, 0-40% silt and 0-30% sand) in construction of cross bund as per design and specification with all leads and lifts, throwing the earth in layers not exceeding 150 mm in thickness including breaking clods, rough dressing, cleaning the jungle, removing stumps, dug baling and 75mm cambering complete as per direction of Environmental specialist.																
E3	De-silting works of canal through excavator																
E4	Deposited the spoil earth both bank of the canal through pay loader ,																

	Description	**Year 1**				**Year 2**				**Year 3**				**Year 4**			
		Jan-Mar	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**	**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**	**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**	**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**
	dump truck and trolley if necessary using head load as per design and specification																
E5	Earth work by manual labor in all kinds of soil in removing the gross bund/ring bund, including all leads and lifts complete and placing the spoils to a safe distance (minimum 15m apart from the bank) as per design																
F	**Replacement and repairing of regulator**																
F1	construction and repairing of drainage sluices																
F2	construction and repairing of flushing inlets																
G	**Bank revetment and slope protection works**																
H	***Afforestation***																
H1	Land preparation																
H2	Fencing preparation and setting																
H3	Plantation of mangrove trees																

4.7.2 Construction Manpower Requirement

Technical and nontechnical manpower will be required for the Project construction works. This will include engineers, technicians, supervisors, surveyors, mechanics, foremen, machinery operators, drivers, and skill and un-skilled labors. Around 60 percent of labor will be engaged from the local area and remaining will be from outside. The estimated manpower requirement is presented in Table 4.6.

Table 4.6: Required manpower for construction

	Required Manpower	Number
1	Engineer	3
2	Machhinery operator	45
3	Mechanics	2
4	Surveyor	4
5	Skill labour	2962
6	Un-skill labour	48591

Source: FS Report, 2012

4.7.3 Construction Material

The construction materials required for re-sectioning and retired embankment, water regulatory sluices and flushing inlets, and bank protection work will include soil, cement, steel, and sand. Estimated quantities of these materials are presented in Table 4.7.

Table 4.7: Construction Materials

	Description	Quantity	Sources
Re-sectioning and retired embankment			
1	Earth work	12,50,788 m^3	Borrow pits, dredging spoils from re-excavation of drainage channels
Construction of sluices and flushing inlets			
2	Cement	114,942 bag	To be procured from local market
3	Sand	6,991 m^3	To be procured from Khulna
4	Stone	15,730 m^3	To be procured from Khulna
5	Steel	270.0 Ton	To be procured from Khulna
Bank protection			
6	CC Blocks	79,264 nos	To be made at construction site during construction
7	Stones	30,000 m^3	To be collected from Khulna

The carried earth for embankment rehabilitation will be collected from the offshore area of the polder 32. The spatial location of the borrow pit areas are delineated in the Annex - 4. The details of borrow pit area are attributed in the following Table 4.8:

Table 4.8: Availability of earth in the borrow pit area

Sl. No.	Quantity of Earth available from Borrow pit area			Quantity of Earth available from River bed		Details
	Location (chainage)	Size (Length x width x depth)	Quantity (m^3)	Name of River	Location (Chainage)	
1	1) 42.60 Km to 43.70 K.m	1.1 Km X 100m X 1.5m	1,65,000	Shibsha	1) 42 Km to 50.0 Km	90% of earth is available at borrow pit area.
	2) 46 Km to 48.20 Km	1.7 Km X 50m X 1.5m	1,27,500			
			2,92,500			
2	1) 41.3 Km to 42 K.m	700m X 65m X 1.5m	68,000	Bhodra	1) 37.5 Km to 42 Km	90% of earth is availble at borrow pit area.
	2) 39.9 Km to 40.4 Km	500m X 10m X 1.5m	7,500			
	3) 37.5 Km to 38.3 Km	800m X 23m X 1.5m	27,600			
			1,03,100			
3	1) 32 Km to 35 K.m	3 Km X 50m X 1.5m	2,25,000	Bhodra	1) 28 Km to 37.5 Km	Earth is available at borrow pit area.
4	1) 25.5 Km to 28 K.m	2.5 Km X 22m X 1.5m	82,500	Bhodra	1) 23.25 Km to 28 Km	90% of earth is available at borrow pit area.
5	1) 21.25 Km to 23.25 K.m	2 Km X 10m X 1.5m	30,000	Dhaki and Bhodra	1) 15 Km to 23.25 Km	Earth is available at borrow pit area.
	2) 18.7 Km to 19.5 Km	800 m X 15m X 1.5m	18,000			
	3) 18.2 Km to 16 Km	2.2 Km X 50m X 1.5m	1,65,000			
			2,13,000			

Sl. No.	Quantity of Earth available from Borrow pit area			Quantity of Earth available from River bed		Details
	Location (chainage)	Size (Length x width x depth)	Quantity (m^3)	Name of River	Location (Chainage)	
6	1) 14.9 Km to 14.7 K.m	200 m X 20m X 1.5m	6,000	Dhaki	1) 5.7 Km to 15 Km	90% of earth is available at borrow pit area.
	2) 12.7 Km to 12 Km	700m X 10m X 1.5m	10,500			
	3) 11 Km to 10 Km	1 Km X 90m X 1.5m	1,35,000			
	4) 7.8 Km to 6.3 Km	1.5 Km X 10m X 1.5m	22,500			
			1,74,000			
7	1) 5.7 Km to 5 K.m	700m X 50m X 1.5m	52,500	Shibsha	1) 0.0 Km to 5.7 Km	Earth is available at borrow pit area.
	2) 5 Km to 3.5 K.m	1.5 Km X 50m X 1.5m	1,12,500			
	3) 0.0 Km to 3.5 K.m	3 Km X 50m X 1.5m	2,25,000			
			3,90,000			

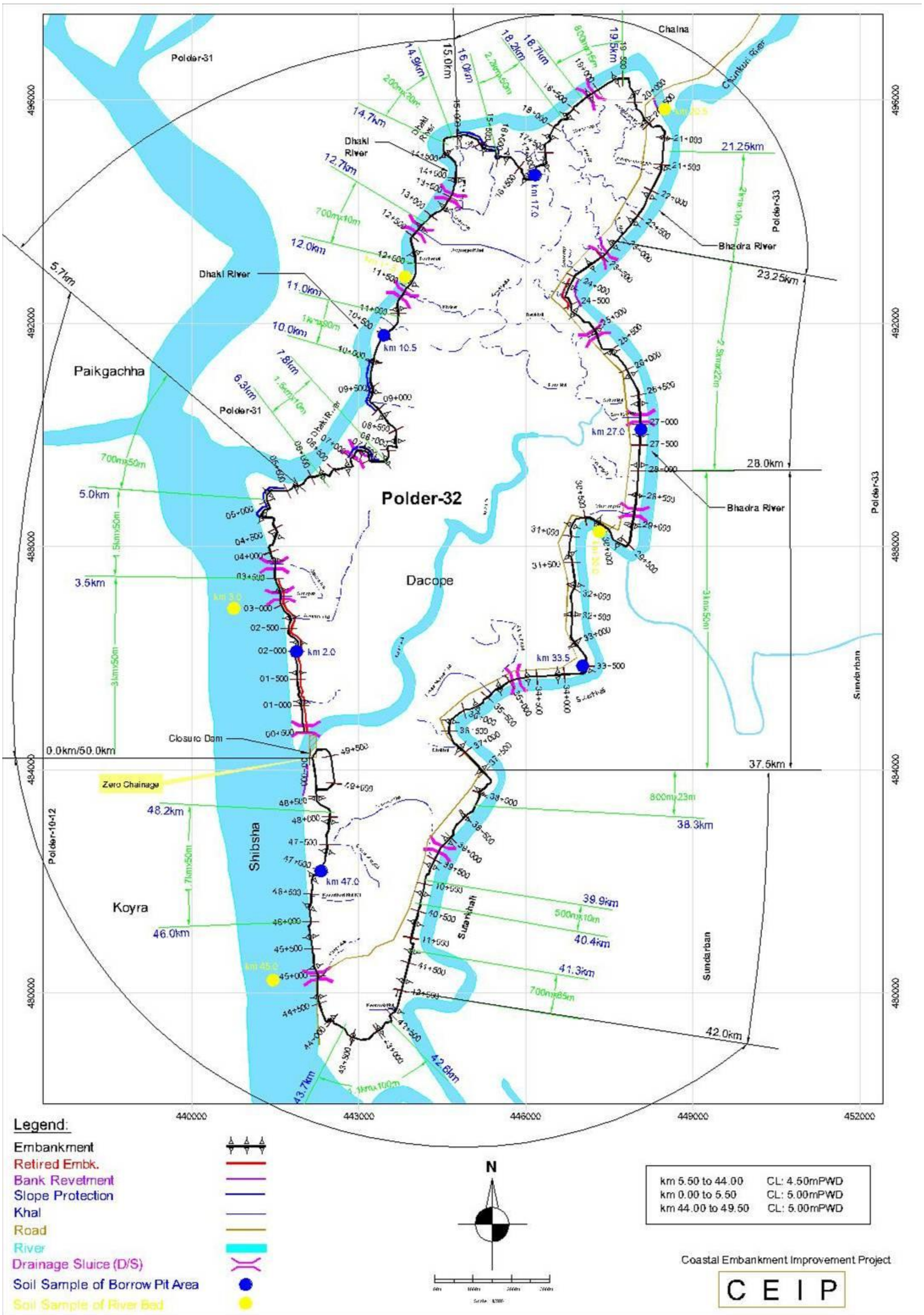

Figure 4.11: Potential Area for Borrow Material

4.7.4 Construction Machinery

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

Table 4.9: List of Construction Equipment and Machinery

Sl. No.	Description	Quantity (number)
1	Bulldozer	3
2	Dump- truck	4
3	Pay Loader	3
4	Excavator	3
5	Barge	2
6	Engine Boat	2
7	Vibrator	20
8	Compactor	5
9	Mixture Machine	20
10	Mixing-Plant	1
11	Truck	3
12	Tractor	2
13	Generator	9
14	Leveling Instrument	2
15	Total Station	1
16	De-watering System	7
17	Low lift pump	7

4.7.5 Construction Camps

Construction camp for each construction sites will be established. A total of 47 camps for labor will be established during construction period. Out of the total camp, 25 camps for embankment works, 7 camps for sluice works, 6 camps for flushing inlet works, four camps for slope protection works, one cam for bank protection works, and four camps for cross dam works will be established. All of the camps will be constructed near the construction sites of BWDB acquired land. Contractor will select the location of the camp through consultation with local union parishad chairman and the local community inside the Polder, and after obtaining permission from the Supervision Consultants (Engineer).

Drinking Water and Sanitation System of Camps

A total number of 28 tube wells will be installed in the labor camps premises near the construction sites for obtaining water for the camps and also for construction activities. For sanitation, latrines will be constructed along with septic tanks for safe disposal of sewage.

4.7.6 Vehicular Traffic during Construction

For development of embankment of the proposed polder, major quantity of earth will be carried to the embankment by mechanical equipment like excavators, pay loaders, dump trucks, trolleys and some minor quantity by manual labor.

The polder is surrounded by Sibsa river (west) Dhaki river (north) and Bhodra river (east and south). All rivers are navigable throughout the years. There is no direct road communication between polder to upazila and district head quarter. Even, there is no paved road inside polder area. Embankment of polder is used as road communication for local people. The existing condition of embankment and inside road of the polder is very bad. Only motor cycle and motorized van can move in these roads. Therefore, during construction of project activities, all kind of materials for construction sites would be collected from the stock yard at Dacope BWDB colony using engine boat.

Heavy equipment and construction materials including hard rock dumping materials and sluice gate equipment will be transported from Khulna on water vessels through Kazibacha, Chunkuri and Dhaki river.

4.7.7 Jetty Construction

A temporary jetty near the Dacope stock yard of BWDB colony will be constructed for unloading of construction materials.

4.8 Project Implementation Arrangements

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 addressing the inter-agency issues. BWDB will act as the Project Implementing Agency and will implement the project through a Project Management Unit (PMU).

Project Steering Committee (PSC). The PSC would be chaired by the Secretary of Water Resources and will include the Secretaries of Finance, Agriculture, Environment, Public Health Engineering, Forestry and Wildlife, the Chief Executive officer of selected NGO, and representatives of the local/district administration as its members. The PSC will oversee the project; 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.

Project Management Unit (PMU). BWDB will set up a PMU to oversee the development and management of the project. The PMU, will be led by a project director appointed by BWDB. The PD will have the rank of Chief Engineer, and will report directly to the Director General (DG). The PMU will have a central project office located at the headquarters of 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.

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. 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 staff.

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 will spend about half of his/her time at the site to provide coordination between the PMU, the supervising consultant and the three Field Offices. In addition to the Deputy Project Director, the engineering unit will also include two Executive Engineers, two Assistant Engineers.

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

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 three field offices.

The PMU will be supported by the following consultancy:

- An *experienced NGO* will be mobilized by the PMU to implement the social afforestation the EMP; the Social Action Plan including the mobilization of Water Management Organization; the RAP and the EMP.
- A *Design and Construction Supervision Consultancy* Firm that will assist the PMU in preparing the detail design of the remaining polders and supervise all the 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 the site, a *Resident Engineer*, appointed by the consultant, with a team of specialists and inspectors will supervise the Contractor.
- A *Monitoring and Evaluation* Consultants will provide support in monitoring project impacts and supervise the implementation of the EMP/RAP and will report to the PMU.
- *Procurement Panel.* A Procurement Panel will be appointed by BWDB to oversee the procurement process of large value contracts subject to prior review under the project. The panel consists of two international/expatriate specialists and one national specialist.
- *An Independent Panel of Expert (IPOE).* BWDB will also appoint an IPOE 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 field of: morphology/river engineering; tidal river management/sediment specialist; geotechnical specialist, social specialist and environment/polderization specialist.

4.9 Community Participation

4.9.1 People's Participation of WMO/CBO

The National Water Policy (NWP) through its various provisions emphasizes the issues of participatory water management and highlights the importance of stakeholder participation for sustainable operation of the project. To ensure the stakeholders participation, Ministry of Water Resources, GoB has prepared guidelines namely The Guidelines for Participatory Water Management (MoWR 2001) usually known as GPWM. The aim and objectives of GPWM are as follows:

- Manage, operate and maintain the Project/ Sub-project/ Scheme;
- Maintain liaison with the Implementing Agencies, other concerned Public Sector Agencies, Local Government Institutions, Non-Government Organizations and Community Self-help Groups;
- Plan and coordinate the activities of the local stakeholders;
- Mobilize local resources for contribution towards construction operation and maintenance costs.

BWDB managers and field staffs in divisions, sub-divisions and sections offices do not have adequate expertise and experienced manpower to carry out the O&M of coastal polders properly. Moreover at many places the numbers of field staffs are also insufficient and inadequate to the actual requirement. In this case to ensure sustainable operation of the project, participation of Water Management Organization (WMO) and Community Based Organizations (CBOs) is needed.

The GPWM has outlined a three tier organizational structure comprising Water Management Groups (WMG) at the lowest level, Water Management Associations (WMA) at the mid-tier and Water Management Federation (WMF) at the apex. The combination of groups, associations and federations in a particular sub-project is together termed as the Water Management Organization (WMO) which has been considered in this project.

4.9.2 Water Management Groups (WMGs)

This organization, at the grass-root level will provide the platform for all those who live inside or adjacent (close vicinity) to the Polder and will be treated as the primary society. The entire command area of the Polder will be sub-divided into few hydrological units preferably on the basis of hydrological consideration and each of these Units will have one WMG. The size of the units may vary depending on the land topography, actual alignment of the existing roads, canals or embankment, and location of structure, turn-outs or even the field channels. Preferably the size of such hydrological units should vary within the range of 500 ha to 1500 ha. The areas of the units so demarcated usually comprise two or three villages and part thereof. One WMG may therefore include several hundreds to a few thousand as its primary members. As per GPWM, the registration of WMG is a must.

4.9.3 Water Management Association (WMA)

A numbers of WMGs functioning in Polder area will form a Water Management Association (WMA) as a coordinating body at the mid-level of the polder/ sub-project. The WMGs are the grass-root people who would be directly involved in water management while the WMAs will provide necessary coordination at the mid-level. The WMAs are chosen as the point of formal interface between BWDB and WMGs. This is the level where formal agreements relating to respective duties and obligations of the water sector agency (BWDB) and primary societies, i.e WMGs are reached and signed. For this reason, this level needs to have a legal status and hence the question of registration arises. Registration of WMA is a must.

4.9.4 Water Management Federation (WMF)

This is conceived as the supervisory type of organization functioning at the apex level of the hierarchy and is needed to establish linkages with other higher level organizations for support and mobilization of resources. The requirement of WMF's registration may therefore be kept optional. The WMFs may exist on the basis of actual functioning strength of WMGs and WMAs. Usually in a district or in a bigger hydrological basin comprising of several districts may have one or more federating bodies functioning at the top level of the hierarchy. The office bearers of the WMF, the 5-member federating body will be selected from among the MC members of WMAs. Important personalities in the area like Member of Parliament or local leader may be nominated as the chair-person of the WMF and other members (not exceeding 04 nos.) may come from the WMAs by virtue of their importance in controlling the numbers of WMGs.

4.9.5 Participation of Community Based Organizations

Community Based Organizations often termed as CBOs can also play a vital role in maintenance activities. While engaging any of the functional groups of these CBOs in this polder, care should be taken to twist and turn the methodologies slightly in some of the aspects as per local situation and project provisions so that it really fits in. Under this project, CBOs are conceived to have been included in the Water Management Groups (WMGs) as Functional Groups (FGs). The FGs have the scope of working in the polder O&M under the purview of WMG.

The Following CBOs have been recommended for this polder under CEIP.

Embankment Settler (ES)

ESs are families selected from squatters and project affected persons who do not have any land or lost it by land acquisition. They can be organized in functional groups for taking part in preventive maintenance of the embankments in specified reach (approximately 0.5 ha) where they are allowed to settle on the toe of the embankment. The maintenance activities include small earthworks, new plantation, re-plantation or enrichment in planting and maintenance of vegetation cover. ESs may be engaged in embankment maintenance activities through a contract agreement for certain period.

Embankment Maintenance Group (EMG)

EMGs are the groups formed from the destitute women (maximum 10 members per group) selected from landless families, who are responsible for carrying out preventive earthwork maintenance of a specified reach of embankment including grass turfs lying. They are the paid laborers on a daily basis payment.

Canal Maintenance Group (CMG)

CMGs are the groups consisting of 10 members selected from landless people and destitute women. Under this concept, they will be responsible for preventive maintenance of canals capacity improvement inside the polder and outfall drains. Activities of CMG include the removal of floating debris, aquatic weeds and water hyacinths; and to some extent disposal of silt deposits in wet condition. CMGs are paid on a daily basis and not on the basis of volumes of actual works done.

Landless Contracting Society (LCS)

LCSs are the groups selected from landless people consisting of nearly 60 members or more per group (as the case may be). They are responsible to carryout earthworks only up to a limit of Taka 3.00 lacs in a single contract. During formation of CBOs women participation in above mentioned groups will be ensured.

4.10 Operation and Maintenance Plan

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. Most of the polders were constructed in the pre-liberation period i.e during the decades of sixties and early seventies. Over and above the polders have been playing a vital role in safeguarding the coastal area; ensuring and increasing agricultural production; improving livelihoods of the people; and mitigating environmental damages. But these are vulnerable to storm surges; high tides; annual floods; land erosion and drainage congestion. In many cases the structures as built have not been found adequate to cater to the diverse needs of the local people. Changes in the land use pattern also have created water management conflicts and newer dimension needs asking the structures to allow flows of water both ways. So maintaining the polder system with embankments and structural elements built over there has become a permanently important task.

The Coastal Embankment Improvement Program (CEIP) is one of the latest such interventions to address a systematic restoration and upgrading of polder systems in the coastal region. Under this long term phased program of polders improvement, Operation and Maintenance issues with special reference to Local Government Institutions (LGIs) as well as local stakeholders participation and need based budgeting will continue to remain at the apex.

The most relevant to the current assignment i.e "Guidelines for O&M Planning and Budgeting, August 2001; CERP-II" has been consulted very carefully to prepare O&M plan for CEIP. Moreover, all the pros and cons of polders' O&M issues with BWDB's field staffs and local stakeholders have been considered for preparation of polder O&M planning. A brief description of O&M is given below.

4.10.1 Operational Plan

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. The activities given below have been recommended for the operation plan of Polder 32.

Regulation of Gates

During the pre-monsoon period, the vertical lift gates of each regulator should remain closed for retention of water for irrigating Aus rice (group of rice varieties sown in the pre-monsoon season and harvested in the monsoon season) crops by LLPs (Low lift pumps). During monsoon (July to September), the vertical lift gates should normally remain closed; but may be opened to regulate the water levels inside the polder and it should not be allowed to exceed the stated maximum permissible level for safety reasons. In order to achieve this, discharges into the river should commence (river levels permitting) as soon as this level is attained. This type of water management decisions should be taken after due consideration of daily rainfall, river stages, water levels inside the polder, gate opening schedules. However, the frequency and type of this decision making process will vary with the seasonal conditions.

During the post monsoon season (October to November), the vertical lift gates will be operated to retain water in the drainage canals without overtopping the canal banks and increasing the soil moisture level for cultivation. In all these cases there should have enough consultation with the beneficiaries' organizations because agricultural practices, crop varieties; and cropping pattern are changing over time. 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.

Frequent Watching of Embankments

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

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

Regular Checking of Structures

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. The functional groups under WMGs in the polders will assist the O&M Sectional Office of BWDB to identify and report the damages for rectification.

Condition Survey and Engineering survey

The survey data obtained by the O&M field staff 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.

Supervision of Preventive Maintenance Works

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

A good planning for operation of structures is very essential to avoid social conflict. In this situation, during the cropping season, monthly, weekly or daily operational adjustments will be required. Routine monitoring of water management and hydrological conditions will supply data that together with the water management plan, will dictate the needs of adjusting the operational measures.

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

4.10.2 Maintenance Works

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

In the coastal Polder 32, only those works which directly serve water management should be regularly maintained.

Preventive or Routine Maintenance

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 round the year, almost continuously or as and when required. The works are mentioned 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

Periodic Maintenance

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.

- Minor Periodic Maintenance Works
    1. Minor earth works on the embankments by LCSs, i.e., shaping and minor fillings including repair of access ramps;
    2. Minor repair of protective works by LCSs i.e re-positioning of the displaced blocks;
    3. Minor repair of structures by LCSs i.e small patching of brick works, replacing rubber seals; and
    4. Re-excavation of Khals (costs< Tk.2.0 lacs/km) and removal of earthen cross dams by LCSs and / or PICs;
- 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;
    - Re-excavation of Khals (costs > 2.0 lacs/km) by LCSs / PICs.

Total allocated maintenance cost including preventive and periodic have been estimated as Tk. 478.42 lacs for Polder 32.

Emergency Maintenance

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 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. The estimated emergency maintenance amount is at Tk. 250.00 lacs. The budget items do not cover unforeseen works as a result of major calamities like cyclones or tidal surges. Other sources of funding viz. donor assisted emergency programs should also be explored.

4.11 Need of Resettlement Action Plan (RAP)

Any development project that requires land acquisition may entail some impacts on people or commercial units and may bring about the changes in the patterns of use of land or other natural resources. For this reason resettlement program addresses loss of affected people or commercial units for statutory compensation payment to the affected units. In this respect, Resettlement Plan must be prepared to ensure that the affected people or commercial units receive fair and adequate compensation and rehabilitation if needed. It is noted that the Resettlement Action Plan (RAP) study is conducted by another sub-consultant of CEIP-I for the Polder 32 project.

4.12 No Objection Certificate

Polder 32 is located in the south-western hydrological zone in Dacope Upazila of Khulna District. The names of the unions in the polder are: a) Sutarkhali, and b) Kamarkhola. There are no archeological sites or any cultural heritage in the polder area that might affect the normal activities of the polder after rehabilitation. There will be no problem of land acquisition or displacement of people since rehabilitation will be made on existing structures. The No Objection Certificates (NOCs) from the union chairmen have been obtained and are attached in **Annex- B**.

5. Analysis of Project Alternatives

This chapter presents an analysis of various alternatives considered during the Project feasibility and design stage including the 'no project' alternative. As much as possible, environmental and social considerations of these alternatives have also been discussed.

5.1 'No Project' Alternative

The analysis of 'no-project' option gives a clear understanding of the existing situation of the Polder and helps understand the need of the proposed interventions under CEIP-I. The present situation of the polder is extremely vulnerable to cyclones, storm surges, wave action, and climate change effects, as described in Section 1.1 of the study. 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. Due to the inability of the embankments of the polder, about 40-50 percent of the polder area is vulnerable to salinity intrusion and about 30-40 percent area undergoes frequent water logging and drainage congestion problems. The silted water channels are leading to limited navigation in these waterways, declining fisheries, and increasing environmental pollution.

The interventions proposed in Polder 32 under CEIP-I are planned to eliminate the aforementioned problems. To highlight the present state of the Polder and to help understand the requirements of the proposed interventions under CEIP-I, the 'no project' and 'with project' scenarios of different aspects are compared in Table 5.1 below.

Table 5.1: Comparison of 'No Project' and 'With Project' Scenarios

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
Re-sectioning of embankments (44.80 km)	At a number of locations, the embankments will further deteriorate and will drop below 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.	Higher and wide embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, reduction in loss of lives and assets caused by the natural disasters.
	Because of submerge the embankments during monsoon, transportation system would further deteriorate inside the Polder, and sufferings of local people would further increase.	Higher and wider embankments will provide enhanced protection to Polder, facilitating transportation within the Polder even during monsoon.
	Reduction of agricultural area, crisis situation for farmers from January to April (salinity intrusion) and May to August (flooding).	Higher and wider embankments will provide enhanced protection to Polder, facilitating enhanced agriculture activities and increased area for cultivation, thus increasing agriculture output.

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
	Continued silt deposition inside the Polder due to cyclonic surges and floods would increase and cause water logging, drainage congestion and other associated problems.	Decreased silt deposition in the Polder will result into improved drainage and navigation in internal lakes/khals, increased usage of surface water for irrigation, and reduced water logging problem.
	Local farmers and labor will remain financially stressed. Livelihood opportunities will remain limited, and local people will migrate outside the Polder for employment.	Enhanced agricultural activity will increase the demand for farm workers. Local people can engage themselves in the construction works inside the Polder. Improve earnings of local people during the construction phase of the project.
Retirement/re-location of the existing embankment (3.50 km)	Embankments will be more vulnerable to wave action of river, Polder area will be more prone to inundation, and agricultural loss will increase due to salinity intrusion.	Enhanced protection against floods and wave action, decreased salinity intrusion, and increased agricultural productivity.
	Further damage to the non-retired portion of embankments, further deteriorating the transportation system	Retirement/relocation of embankments will facilitate transportation within the Polder throughout the year.
	Continued silt deposition inside the Polder due to cyclonic surges and floods would increase and cause water logging, drainage congestion and other associated problems.	Decreased silt deposition in the Polder will result into improved drainage and navigation in internal lakes/khals, increased usage of surface water for irrigation, and reduced water logging problem.
Bank revetment (1.50 km)	River bank erosion would further deteriorate the embankments and land resources would be damaged/ lost.	Enhanced protection against land erosion, and the polder and its land/agriculture resources will be preserved.
	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 (3.30 km)	Continued weakening of embankments; continuous subsidence of embankments due to traffic load and wave action; land resources would continue to be damaged/ lost.	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 sweet water can be stored and used later in the dry season for irrigation.
Replacement of the	No dry season agriculture practice will	Replaced flushing sluices will

Proposed Works under CEIP-1	'No Project' Scenario	'With Project' Scenario
existing flushing sluices	be possible. Shrimp culture during January to May, as sweet water cannot be used in the periods of low rainfall.	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 and irrigable lands will further decrease in future.	New flushing sluices will facilitate increased availability of surface water, better control on irrigation during periods of low rainfall and increased agricultural production.
Aforestation (19 ha)	Wind and wave action during cyclones would cause severe damage.	Effects of cyclone surge, wave action and wind could be mitigated to some extent, reducing loss of lives and assets.
Re excavation of Drainage Channels (17.50 km)	Depth of water bodies would further decrease, and drainage congestion and water logging will further increase.	Depth of water bodies will increase, water logging and drainage congestion will decrease and fish habitats will increase.
Providing Cross Dam (1 no)	Water Will enter freely through the embankment breach (at the start of Nalian river). Therefore saline water will enter the polder and cause subsequent damage to boro cropping practice.	Saline water would be restricted. The Nalian river would therefore be silt and salinity free.

5.2 Site Selection Alternatives

Since CEIP-I 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-I. The analysis results are presented in Table 5.2.

Table 5.2: Results of Multi-criteria Analysis to Prioritize Polder Rehabilitation

SL No.	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
1	63/1A	SD, ID, MD	Anowara	7500	48	7	11	17	6	10	6	HRZ	15	0	0	MV	15	117	5		0	59	Breach caused by the cyclonic surge(AILA) and wave action. The embankment section is partly damaged due to erosion
2	35/3	ID	Bagerhat	6790	40	9	14	8	3	8	5	MRZ	10	0	0	MV	15	89	10		0	57	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
3	32	MD	Dacope	8097	50	3	4	5	2	25	15	HRZ	15	1215	1	MV	15	108	5		0	57	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
4	59/3C	SD, MD	Companigonj	16200	42	8	13	-	0	5	3	MRZ	10	0	0	MV	15	115	5		0	46	Breach caused by the cyclonic surge and wave action.
5	48	SD, ID	Kalapara	5400	38	-	0	3	1.125	7	4	HRZ	15	0	0	MV	15	112.19	5		0	40	Severe damage of embankment due to wave action
6	14/1	ID	Koyara	2933	25	5	9	14	5	-	0	LRZ	5	450	0	MV	15	88	10		0	44	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
7	47/5	SD, ID, MD	Kalapara	7500	33	2	3	7	3	5	3	HRZ	15	0	0	MV	15	103.61	10		0	49	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
8	46	SD, ID	Kalapara	4697	40	5	7	3	1	-	0	HRZ	15	0	0	MDV	10	124.24	5		0	38	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
9	15	ID	Shymnagar	3441	27	3	5	22	8	-	0	LRZ	5	516	0	MV	15	68	15		0	48	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
10	64/2B	SD, ID, MD	Chakoria	7736	96	5	7.167	15.500	6	-	0	HRZ	15	0	0	MV	15	163	5		0	48	The embankment section is partly damaged due to erosion & wave action.
11	71	SD	Kutubdia	5116	40	0	0	20	8	-	0	HRZ	15	0	0	MV	15	72	10		0	48	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
12	47/1	SD, ID	Kalapara	2478	22	4	6.371	-	0	2	1	HRZ	15	0	0	MV	15	71	10		0	48	Breach caused by the cyclonic surge and wave action during SIDR & AILA
13	42	SD, ID, MD	Barguna Sadar	2794	28	-	0	3	1.125	2	1	LRZ	5	0	0	MV	15	80	10		0	32	Embankment damaged and erosion cost due to wave action.
14	41/6B	ID, MD	Barguna Sadar	7280	44	2	2.389	6	2.250	5	3	LRZ	5	0	0	MV	15	74	10		0	37	Embankment damaged and erosion cost due to wave action.
15	41/5	SD, ID, MD	Barguna Sadar	3880	50	4	6	3	1	1	1	HRZ	15	0	0	MV	15	104	10		0	47	Breach caused by the cyclonic surge(SIDR & AILA) and wave action. The embankment section is partly damaged due to erosion
16	65	ID	Chakaria	6649	48	-	0	16	6	2	1	HRZ	15	0	0	MV	15	119	5		0	42	The embankment section is partly damaged due to erosion

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17	58/1	SD, ID	Manpura	4200	32	1	1	2	1	-	0	HRZ	15	630	1	MV	15	58	15		0	47	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
18	69/NE	ID	Moheshkhali	2226	16	2	4	8	3	-	0	HRZ	15	0	0	MDV	10	36	15		0	47	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
19	66/2	ID	Cox's Bazar & Ramu	2621	20	-	0	5	2	-	0	HRZ	15	0	0	MV	15	43	15		0	47	The embankment section is partly damaged due to erosion
20	66/4	ID	Chakaria	3324	24	9	15	5	2		0	HRZ	15	0	0	MDV	10	53	15		0	57	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
21	65/A	ID	Chakoria	806	9	-	0	5	2	-	0	HRZ	15	0	0	MV	15	18	15		0	47	The embankment section is partly damaged due to erosion
22	66/1	SD, ID, MD	Cox's Bazar	4930	20	1	1	1	0	1	1	HRZ	15	0	0	MV	15	61	15		0	47	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
23	62	SD	Bandar, Patenga & Pahartali	5600	22	-	0	5	2	-	0	HRZ	15	0	0	MV	15	59	15		0	47	The embankment section is partly damaged due to erosion
24	41/7	ID, MD	Mirzaganj	6984	51	6	10	1.50	0	3	2	LRZ	5	0	0	MV	15	84	10		0	41	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
25	56/57	ID	Bhola Sadar, Borhanuddin, Charfassion, Daulatkhan	123800	250	5	7	15	6	15	9	HRZ	15	5571	5	MV	15	534	-10		0	46	Breach caused by the cyclonic surge(AILA) and wave action. The embankment section is partly damaged due to erosion
26	33	ID	Dacope	8100	52	3	4	10	4	12	7	HRZ	15	1215	1	MV	15	128	5		0	51	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
27	65/A1	ID	Chakaria	2800	20	-	0	2	1	0	0	HRZ	15	0	0	MV	15	40	15		0	46	The embankment section is partly damaged due to erosion
28	58/3	SD	Manpura, Sudaram	1308	17	-	0	7	3	5	3	HRZ	15	0	0	MDV	10	31	15		0	46	The embankment section is partly damaged due to erosion
29	58/2	SD	Manpura	4312	28	-	0	7	2	4	2	HRZ	15	647	1	MV	15	50	15		0	50	The embankment section is partly damaged due to erosion
30	64/1C	SD, ID	Bashkhali	2151	23	1	1.115	11	4.031	-	0	HRZ	15	0	0	MDV	10	53	15		0	45	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion

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31	63/1B	ID, MD	Anowara	7300	21	-	0	-	0	-	0	MRZ	10	0	0	MV	15	36	15		0	40	-
32	72	SD, MD	Swandip	22700	58	9	15	-	0	-	0	HRZ	15	0	0	MDV	10	192	5		0	45	Breach caused by the cyclonic surge(SIDR) and wave action
33	17/1	ID	Dumuria	5020	45	-	0	37	14	-	0	LRZ	5	753	1	MV	15	88	10		0	44	The embankment section is partly damaged due to erosion
34	7/1	ID	Assasuni, Shamnagar	3110	34	1	1	18	7	-	0	LRZ	5	467	0	MV	15	81	10		0	38	Breach caused by the cyclonic surge(AILA) and wave action. The embankment section is partly damaged due to erosion
35	55/3	SD, ID	Galachipa, Charfassion	9845	56	-	0	-	0	5	3	HRZ	15	0	0	MV	15	236	-10		0	23	-
36	55/2D	SD, MD	Patuakhali, Dashmia	8540												MV		99					
37	55/2E	MD, ID	Patuakhali, Dashmina, Bouphol	10535												MV		123					
38	67/B	ID	Teknaf	900	8	-	0	7	3	-	0	MRZ	10	0	0	MDV	10	26	15	Naf River	5	43	The embankment section is partly damaged due to erosion
39	69/P1	SD	Moheshkhali	1800	13	1	1	5	2	-	0	HRZ	15	0	0	MDV	10	96	10		0	38	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
40	64/1B	ID, MD	Bashkhali	8000	53	5	7.167	-	0	-	0	HRZ	15	0	0	MDV	10	144	5		0	37	Breach caused by the cyclonic surge(SIDR & AILA) and wave action.
41	61/1	SD	Sitakunda	8769	27	1	2.150	-	0	-	0	HRZ	15	0	0	MDV	10	107	5		0	32	Breach caused by the cyclonic surge(SIDR & AILA) and wave action
42	67/A	MD	Teknaf & Ukhiya	1500	13	0	0	5	2	-	0	MRZ	10	0	0	MDV	10	48	15	Naf River	5	42	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
43	70	SD, ID, MD	Moheshkhali	3025	32	-	0	5	2	-	0	HRZ	15	0	0	MDV	10	122	5		0	32	The embankment section is partly damaged due to erosion
44	67	ID	Teknaf	2000	13	-	0	5	2	-	0	MRZ	10	0	0	MDV	10	46	15	Naf River	5	42	The embankment section is partly damaged due to erosion
45	65/A3	ID	Chakaria	604	10	0	0	-	0	1	1	HRZ	15	0	0	MDV	10	26	15		0	41	Breach caused by the cyclonic surge and wave action
46	59/2	ID	Ramgati	21255	82	6	9	4	1	1	1	MRZ	10	0	0	MV	15	190	5		0	41	Breach caused by the cyclonic surge and wave

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																							action. The embankment section is partly damaged due to erosion
47	3	ID	Debhata, Kaliganj	22267	64	1	1	1	0	2	1	LRZ	5	3340	3	MV	15	155	5	Issamoti River	10	40	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
48	41/1	SD, MD	Barguna Sadar	4048	34	-	0	-	0	1	0	MRZ	10	0	0	MV	15	83	10		0	35	-
49	36/1	ID	Bagerhat, Chitalmari, Fakirhat, Morelgonj, Rupsa	40343	95	0	0	40	15	-	0	LRZ	5	6051	5	MDV	10	190	5		0	40	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
50	47/2	ID, MD	Kalapara	2065	17	-	0	-	0	1	0	HRZ	15	0	0	MDV	10	39	15		0	40	-
51	47/4	SD, ID, MD	Kalapara	6600	57	0	0	-	0	-	0	HRZ	15	0	0	MV	15	150	5		0	35	Breach caused by the cyclonic surge(SIDR) and wave action
52	40/1	SD, ID, MD	Pathargatha	2105	23	-	0	-	0	-	0	MRZ	10	0	0	MV	15	91	10		0	35	-
53	40/2	SD, ID, MD	Pathargatha	4453	36	-	0	-	0	-	0	MRZ	10	0	0	MV	15	85	10		0	35	-
54	45	SD, ID	Amtali	4089	27	-	0	-	0	-	0	MRZ	10	0	0	MV	15	96	10		0	35	-
55	23	ID	Paikgacha	5910	37	1	2	19	7	-	0	LRZ	5	887	1	MDV	10	123	5		0	30	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
56	66/3	SD, ID, MD	Cox's Bazar	4832	52	-	0	11	4	-	0	HRZ	15	0	0	MDV	10	133	5		0	34	The embankment section is partly damaged due to erosion
57	55/1	SD, ID	Galachipa	10325	46	1	1	0	0	5	3	LRZ	5	0	0	MV	15	145	5		0	29	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
58	55/2B	ID, MD	Galachipa	2600	30	2	2	1	0	2	1	LRZ	5	0	0	MV	15	81	10		0	34	Breach caused by the cyclonic surge(AILA) and wave action. The embankment section is partly damaged due to erosion
59	29	ID	Batiaghata, Dumuria	8218	49	2	3	13	5	-	0	LRZ	5	1233	1	MV	15	102	10		0	39	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
60	16	ID	Paikgacha, Tala	10445	45	1	2	25	9	-	0	LRZ	5	1567	1	MDV	10	108	5		0	33	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
61	68	SD, ID	Teknaf	3500	27	0	0	5	2	-	0	MRZ	10	0	0	MDV	10	95	10		0	32	Breach caused by the cyclonic surge and wave action. The embankment section is partly

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																							damaged due to erosion
62	64/1A	SD, ID	Bashkhali	5750	58	1	0.796	2	0.750	-	0	HRZ	15	0	0	MV	15	137	5		0	37	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
63	43/1A	ID, MD	Amtali	2675	27	0	1	-	0	2	1	MRZ	10	0	0	MDV	10	51	15		0	37	Breach caused by the cyclonic surge (SIDR) and wave action. Breach closed by constructing ring bundh
64	43/2C	SD, ID, MD	Galachipa	2753	26	1	1	-	0	1	1	LRZ	5	0	0	MV	15	54	15		0	36	Breach caused by the cyclonic surge (SIDR) and wave action
65	34/3	ID	Bagerhat	3656	17	-	0	17	6	-	0	LRZ	5	0	0	MDV	10	55	15		0	36	The embankment section is partly damaged due to erosion
66	43/2A	ID, MD	Patuakhali	5182	39	2.00	0	-	0	2	1	LRZ	5	0	0	MV	15	73	10		0	31	Breach caused by the cyclonic surge(SIDR & AILA) and wave action
67	73/1 (A & B)	SD, ID, MD	Hatiya	21377	80	4	6	28	11	-	0	HRZ	15	0	0	MV	15	219	-10		0	36	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
68	17/2	ID	Dumuria	3400	11	-	0	-	0	-	0	LRZ	5	510	0	MV	15	28	15		0	35	-
69	43/1	SD, ID, MD	Amtali	10600	65	1.50	0	1	0	-	0	MRZ	10	0	0	MV	15	128	5		0	30	Breach caused by the cyclonic surge(SIDR & AILA) and wave action The embankment section is partly damaged due to erosion
70	28/2	ID	Batiaghata	2590	20	-	0	-	0	-	0	LRZ	5	389	0	MV	15	48	15		0	35	-
71	32	SD, ID	Sharankhola	13058	63	2	2	21	8	-	0	HRZ	15	0	0	MV	15	126	5		0	45	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
72	61/2	SD	Mirsharai	19855	10	0	0	-	0	-	0	MRZ	10	0	0	MDV	10	54	15		0	35	Breach caused by the cyclonic surge and wave action
73	73/2	SD, MD	Hatiya	11134	48	-	0	0	0	-	0	HRZ	15	0	0	MDV	10	214	-10		0	15	The embankment section is partly damaged due to erosion
74	39/1A	SD, MD	Pathargatha	11740	58	-	0	-	0	-	0	MRZ	10	0	0	MV	15	123	5		0	30	-
75	39/2C	SD, MD	Matbaria	10748	55	-	0	-	0	-	0	LRZ	5	0	0	MV	15	122	15		0	35	-

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76	41/4	SD, ID, MD	Barguna Sadar	1741	19	-	0	-	0	-	0	LRZ	5	0	0	MV	15	46	15		0	35	-
77	44	SD, ID	Amta!i, Kalapara	17530	82	-	0	-	0	-	0	HRZ	15	0	0	MV	15	174	5		0	35	-
78	47/3	ID, MD	Kalapara	2025	20	-	0	-	0	-	0	HRZ	15	0	0	LV	5	42	15		0	35	-
79	52/53A	SD, ID, MD	Galachipa	3663	25	-	0	-	0	-	0	LRZ	5	0	0	MV	15	76	10		0	30	-
80	60	ID	Sonagazi	9150	38	-	0	-	0	-	0	MRZ	10	0	0	MDV	10	63	15		0	35	-
81	64/2A	ID, MD	Chakoria	3750	34	-	0	-	0	-	0	HRZ	15	0	0	LV	5	34	15		0	35	-
82	31	MD	Dacope	7288	47	-	0	4	2	4	2	LRZ	5	1093	1	MV	15	126	5		0	29	The embankment section is partly damaged due to erosion
83	13-14/2	ID	Koyara	17854	93	0	0	17	6	-	0	LRZ	5	2678	2	MV	15	156	5		0	34	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
84	31/Part	MD	Batiaghata	4848	29	-	0	9	3	-	0	LRZ	5	727	1	MDV	10	86	10		0	29	The embankment section is partly damaged due to erosion
85	22	MD	Paikgacha	1630	20	-	0	10	4	-	0	LRZ	5	245	0	MDV	10	50	15		0	34	The embankment section is partly damaged due to erosion
86	06-08 (Ext)	ID	Satkhira, Kalarua	8330	9	-	0	8	3	-	0	LRZ	5	1250	1	MDV	10	26	15		0	34	The embankment section is partly damaged due to erosion
87	18-19	ID	Paikgacha	3380	32	-	0	9	3	-	0	LRZ	5	507	0	MDV	10	76	10		0	29	The embankment section is partly damaged due to erosion
88	43/2E	ID, MD	Patuakhali	1650	20	-	0	-	0	6	4	LRZ	5	0	0	MDV	10	89	10		0	29	-

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89	34/1	ID	Bagerhat	2212	10	-	0	8	3	-	0	LRZ	5	332	0	MDV	10	28	15		0	33	The embankment section is partly damaged due to erosion
90	9	ID	Paikgacha.	1255	8	-	0	6	2	-	0	LRZ	5	188	0	MDV	10	28	15		0	32	The embankment section is partly damaged due to erosion
91	39/2A	ID, MD	Bamna	5080	32	-	0	-	0	4	2	LRZ	5	0	0	MDV	10	88	10		0	27	-
92	55/4	SD	Galachipa	5142	33	-	0	-	0	4	2	LRZ	5	0	0	MDV	10	136	5		0	22	-
93	21	MD	Paikgacha	1417	17	-	0	5	2	-	0	LRZ	5	213	0	MDV	10	37	15		0	32	The embankment section is partly damaged due to erosion
94	20, 20/1	MD	Paikgacha	1600	23	-	0	5	2	-	0	LRZ	10	240	0	MDV	20	59	30		0	93	The embankment section is partly damaged due to erosion
95	4	ID	Assasuni	10500	80	2	2	21	8	-	0	LRZ	5	1575	1	MDV	10	153	5		0	32	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
96	1	ID	Assasuni, Debhata & Satkhira	28381	96	1	1	1	0	3	2	LRZ	5	4257	3	MV	15	171	5		0	31	Lowest Pocket Silted Up. Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
97	Kumiriya to Sonaichari Flood Control Project	SD	Sitakunda	1610	5	0	0.557	-	0	-	0	HRZ	15	0	0	MV	15	8	15		0	46	Breach caused by the cyclonic surge(SIDR & AILA) and wave action
98	41/2	SD, ID, MD	Barguna Sadar	3644	39	-	0	-	0	1	0	LRZ	5	0	0	MDV	10	118	5		0	20	-
99	43/2F	ID, MD	Amtali	4453	32	-	0	-	0	-	0	MRZ	10	0	0	LV	5	53	15		0	30	-
100	7/2	ID	Assasuni.	10486	60	1	2	18	7	-	0	LRZ	5	1573	1	MDV	10	116	5		0	30	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
101	24	ID	Abhaynagar, Dumuria, Keshobpur, Manarampur	28340	26	-	0	-	0	-	0	LRZ	5	4251	3	LV	5	61	15		0	28	-
102	06-08	ID	Assasuni, Satkhira, Tala	18450	53	1	2	10	4	-	0	LRZ	5	2768	2	MDV	10	128	5		0	28	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
103	55/2C	ID, MD	Galachipa	6275	48	-	0	-	0	3	2	LRZ	5	0	0	MDV	10	73	10		0	27	-

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104	26	ID	Dumuria	2696	29	-	0	2	1	-	0	LRZ	5	404	0	LV	5	66	15		0	26	The embankment section is partly damaged due to erosion
105	28/1	ID	Dumuria	5600	23	-	0	-	0	-	0	LRZ	5	840	1	LV	5	65	15		0	26	-
106	2	ID	Assasuni, Satkhira	11296	64	0	1	10	4	-	0	LRZ	5	1694	1	MDV	10	129	5		0	26	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
107	10-12	ID	Koyara, Paikgacha	16315	67	2	2	3	1	-	0	LRZ	5	2447	2	MDV	10	119	5		0	25	Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion
108	27/1, 27/2	ID	Dumuria	4260	45	-	0	-	0	-	0	LRZ	5	713	1	LV	10	109	30		0	86	-
109	41/3	ID, MD	Barguna Sadar	1053	20	-	0	-	0	-	0	LRZ	5	0	0	LV	5	43	15		0	25	-
110	41/6A	SD, MD	Barguna Sadar	3850	33	-	0	-	0	-	0	LRZ	5	0	0	LV	5	49	15		0	25	-
111	41/7A	ID, MD	Betagi	6220	39	-	0	-	0	-	0	LRZ	5	0	0	LV	5	51	15		0	25	-
112	43/2B	ID, MD	Galachipa, Amtai, Patuakhali	5460	42	-	0	-	0	-	0	MRZ	10	0	0	LV		49	15		0	25	-
113	43/2D	ID, MD	Patuakhali	6500	43	-	0	-	0	-	0	LRZ	5	0	0	LV	5	50	15		0	25	-
114	52/53B	SD, ID, MD	Galachipa	4064	34	-	0	-	0	-	0	LRZ	5	0	0	LV	5	96	10		0	20	-
115	55/2A	ID, MD	Patuakhali, Galachipa, Amtoli	7166	43	-	0	-	0	-	0	LRZ	5	0	0	LV	5	80	10		0	20	-
116	59/1A	ID	Companiganj,	15506	36	-	0	-	0	-	0	LRZ	5	0	0	LV	5	98	10		0	20	-
117	5	ID, MD	Kaliganj, Shymnagar	55061	192	2	3	12	5	-	0	LRZ	5	8259	7	MV	15	272	-10		0	24	Lowest Pocket Silted Up Breach caused by the cyclonic surge and wave action. The embankment section is partly damaged due to erosion

SL No.	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
118	25	ID	Dumuria Fultala	17400	46	-	0	-	0	-	0	LRZ	5	2610	2	LV	5	83	10		0	22	-
119	30	MD	Batiaghata	6396	40	-	0	-	0	-	0	LRZ	5	959	1	LV	5	110	5		0	16	-
120	59/1B	ID	Sudharam, Laxipur	18218	40	-	0	-	0	-	0	LRZ	5	0	0	LV	5	156	5		0	15	-
121	59/3B	SD, ID, MD	Shudharam	31376	63	-	0	-	0	-	0	MRZ	10	0	0	LV	5	182	5		0	20	-
122	39/1B		Matbaria	13100	63	-	1	-				LRZ	5		0			138	5		0	11	-
123	41/7B		Betagi	6150		-		-				LRZ	5		0			58	15		2	22	-
124	Bibichini		Betagi	4600		-		-				LRZ	5		0			33	15		3	23	-
125	43/1B		Kalapara	3000		-		-				HRZ	15		0			63	15		4	34	-
126	CDSP-II		Sonagazi	1981		-		-				HRZ	15		0			35	15		5	35	-
127	Dumki Laukathi		Patukhali	18550		-		-				LRZ	5		0			61	15		6	26	-
128	Itbaria Labukhali		Patukhali	9650		-		-				LRZ	5		0			53	15		7	27	-
129	Mirzagonj Rampura		Mirzagonj, Patuakhali	16500		-		-				LRZ	5		0			69	15		8	28	-
130	50/51		Galachipa	6935		-		-				HRZ	15		0			138	5		9	29	-

SL No.	Polder No	Type of Dyke	Location of the Polder	Gross Area of the Polder (HA)	Embankment Length (Km)	Breach of Embankment (Km)	Mark Obtained	Erosion (Km)	Mark Obtained	Requirement of BPW (Km)	Mark Obtained	Location in the Risk Zone	Mark Obtained	Drainage Congestion (HA)	Mark Obtained	Opinion of Stakeholder	Marks (MV=15, MDV=10, LV=5)	Rehabilitation Cost (Crore BDT)	Mark Obtained	Special Criterion	Mark Obtained	Total Marks	Remarks
131	54		Kalapara, Amtoli, Galachipa	13954		-		-				HRZ	15		0			174	5		10	30	-
132	Satla Bagda-1		Agailjhara, Wazirpur			-		-				LRZ	5		0			59	15		11	31	-
133	Satla Bagda-2		Uzirpur, Agailjhara			-		-				LRZ	5		0			196	5		12	22	-
134	Satla Bagda-3		Uzirpur, Agailjhara			-		-				LRZ	5		0			25	15		13	33	-
135	59/2 Ext.		Ramgati	4000		-		-				HRZ	15		0			52	15		14	44	-
136	Boychar		Hatiya			-		-				HRZ	15		0			159	5		15	35	-
137	Char Bagardona-1		Subornachar	1350		-		-				HRZ	15		0			24	15		16	46	-
138	Char Bagardona-2		Subornachar	1200		-		-				HRZ	15		0			21	15		16	46	-
139	Char Mojid		Subornachar	850		-		-				HRZ	15		0			15	15		16	46	-

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 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.

5.3 Technical Alternatives

Once the problems being faced by the Polder and its inhabitants had been identified, several technical alternatives were considered to address these issues. These alternatives pertained to strengthening the Polder embankment, protection of river banks, protection of embankment slope, improving the sluices and their performance, and reducing drainage congestion and water logging. These technical alternatives are discussed in Table 5.3 below.

Table 5.3: Technical Alternatives for Polder 32

Proposed Interventions	Alternative Options	Consequence
Strengthening of the embankment	No change in alignment and no re-sectioning/repairing of the existing embankment	The present vulnerable situation of the embankment and thus the entire polder would continue (similar to the 'no project' scenario discussed in earlier).
	Retirement/relocation of the existing embankment, as and where required	Partial achievements of the Project objectives. NO protection against storm surges and sea water rise.
	Backing/minor inward shifting of embankment with slope protection	Same as above.
	Re-sectioning of existing embankment with new design heights (selected option).	Higher and wide embankments would be more effective and resilient, and will safeguard the Polder against storm surges, floods, and higher tides due to global warming. Hence, reduction in loss of lives and assets caused by the natural disasters.
River bank protection works	No change in the existing embankment	River bank erosion would further deteriorate the embankments and land resources would be damaged/lost (similar to the 'no project' scenario discussed in earlier).
	Retirement of embankment	Partial achievements of the Project objectives; decrease in Polder area; and continued erosion of the river bank.
	Bank Revetment (selected option)	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.
Protection of embankment slope (against wave action)	No change in the existing embankment	Continued weakening of embankments; continuous subsidence of embankments due to traffic load and wave action; land resources would continue to be damaged/ lost (similar to the 'no project' scenario discussed in earlier).
	Slope Protection (selected option)	Slope protection works will strengthen the embankments and protect them against subsidence, wave action, and wear and tear.

Proposed Interventions	Alternative Options	Consequence
	Foreshore plantation (selected option)	Effects of cyclone surge, wave action and wind could be mitigated to some extent, reducing loss of lives and assets.
Replacement of drainage sluices	No change in the existing structures	Continued use of the existing drainage sluices for both flushing and drainage would cause further damage to these structures. As a result, water logging and drainage congestion would be increased due to malfunctioning of the sluices (similar to the 'no project' scenario discussed in earlier).
	Repairing of structures (possible where there is no need of re-sizing) (selected option for some structures)	For sluices which are beyond repair, this option would be similar to the 'no project' scenario described above.
	Replacement of existing Drainage Sluice with Drainage-cum-flushing sluice (selected option for some of the sluices depending upon need)	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
	Regulators with provision for appropriate passages for fish and small boats.	In addition to the above advantages, the structures will facilitate fish migration and navigation across them. The cost of such structure is likely to be high.
Rehabilitation of flushing sluices	No change in the existing structure	No dry season agriculture practice will be possible. Shrimp culture during January to May, as sweet water cannot be used in the periods of low rainfall (similar to the 'no project' scenario discussed in earlier).
	Repair of the existing structures	For sluices which are beyond repair, this option would be similar to the 'no project' scenario described above.
	Replacement of the existing Flushing Sluices (selected option)	Replaced flushing sluices will facilitate better agriculture practices, increased dry season rice cropping, and reduced shrimp culture - thus benefiting the poor farmers.
Constructing new water drainage structure	Not constructing any Flushing Sluices	Cultivable lands and irrigable lands will continue to decrease (similar to the 'no project' scenario discussed in earlier).
	Construction of drainage cum flushing (selected options in certain cases)	Drainage-cum-flushing sluices will be more efficient and dry season rice cropping practice will be possible as sweet water can be stored and used later in the dry season for irrigation.
	Construction of new Flushing Sluices (selected options in certain cases)	New flushing sluices will facilitate increased availability of surface water, better control on irrigation during periods of low rainfall and increased agricultural production.

Proposed Interventions	Alternative Options	Consequence
	Providing cross dam (selected options in one location)	Providing cross dam at the starting point of a water body would restrict the entry of silt and saline water into the internal rivers.
Reducing water logging and drainage congestion	No action is taken.	Depth of water bodies would further decrease, and drainage congestion and water logging will further increase (similar to the 'no project' scenario discussed in earlier).
	Channel re-excavation (Selected option)	Depth of water bodies will increase, water logging and drainage congestion will decrease and fish habitats will increase.

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

An attempt has been made to evaluate the technical, financial, economic, environmental, and social considerations of the selected options discussed above. This evaluation is presented in Table 5.4 below.

Table 5.4: Technical, Economic, Environmental and Social Considerations

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

Intervention	**Considerations**			
	Technical	Financial/ Economic	Environmental	Social
Bank revetment, slope protection	Enhanced embankment protection against tidal wave action of rivers, provide erosion protection	Financial savings from reduced damages caused by the floods; increased life span for the infrastructure and associated water control structures; improved earnings of local people through employment during bank revetment works and slope protection works.	Improved embankment stability; reduced soil erosion; and provide good means of transportation	Reduced loss of lives and assets which would bring poverty reduction; increased employment opportunities for local people.
Foreshore plantation	Enhanced embankment protection against tidal wave action of rivers, provide erosion protection	Financial savings from reduced damages caused by the floods and storms; increased life span for the infrastructure and associated water control structures; improved earnings of local people through employment during bank revetment works and slope protection works.	Improved embankment stability; reduced soil erosion; enhanced soil quality; improved air quality; enhanced aesthetic value of the area.	Reduced loss of lives and assets which would bring poverty reduction; increased employment opportunities for local people; income from timber and other plantation products.
Replacement of existing drainage sluice with drainage-cum-flushing sluice and construction of new flushing sluices where needed	Better functional performance in both flushing and drainage; achieving the objectives of Polder and CEIP-I	Financial savings against damages due to water logging, drainage congestion, and salinity intrusion. Agricultural production will be boosted as dry season rice cropping would increase	Removal of inactive sluices would improve the drainage characteristics Water logging, drainage congestion would be reduced.	Better agriculture practice could be achieved which would improve cropping pattern, enhance local earnings, and reduce poverty.

Intervention	Considerations			
	Technical	Financial/ Economic	Environmental	Social
Channel re-excavation	Reduce water logging and drainage congestion	Enhanced agriculture output; the dredged soil can later be used in construction works and will save construction cost	Increase navigability of water ways and fish habitats would improve, the ecosystem will be enhanced	Increase in cultivable area, increased availability of irrigation water thus increased farm income for local community; increased farm labor opportunities.
Cross Dam	Better control against entry of silt free water. Restricts the entry of saline water as well.	Financial savings. Damages would be minimized. Better agricultural prospects (dry season boro cropping would be possible)	Environmentally compatible. Surface water quality inside the polder would be enhanced.	Better agriculture practice could be achieved which would improve cropping pattern, enhance local earnings, and reduce poverty.

5.5 Alternatives during Construction

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

5.5.1 Material Storage

For project works in Polder 32, 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.

The storage site selected at this stage is located in the BWDB colony at Dakop, which is situated within the Polder. 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.

5.5.2 Material Sources

The sources from which the construction materials will be brought have been discussed below.

Soil for Embankments

For retirement, re-sectioning, and forwarding of embankments, about 1.25 million cubic meters of soil will be required. The following options are available for sourcing this material:

- Substantial amount of soil can be obtained from borrow pits along the river bank just outside the embankments, provided the soil quality is appropriate for this purpose. This will be one the better options since it will minimize soil transportation needs, minimizing any additional traffic related to material transportation, having minimal negative impacts in the borrow areas since these areas will be silted-up within a few seasons, and having minimum environmental and social impacts related to excavation and transportation.
- Part of the required material can be obtained from the re-excavation of the water channel within the Polder, provided the quality of this material is technically acceptable. About 0.093 million cubic meters of earth will be obtained from re-excavation of channels during implementation of rehabilitation works inside the Polder. This option minimize the cost of excavation for the borrow material, though the cost of transportation to work site will be slightly more than the first option, in addition to some environmental and social impacts such as traffic congestion and air pollution within the Polder.
- Some quantity of soil can be sourced from borrow pits inside the Polder. For this purpose consent of the land owners will have to be obtained and mutually agreed compensation will have to be paid them. This option will entail cost of excavation similar to the first option but more than the second option discussed above. Other considerations including cost of transportation and environmental and social impacts are likely to be similar the ones for the second option, though land degradation may take place in addition to the air quality and traffic congestion.
- If the soil from the riverside just outside the Polder embankment is not suitable, the material may be obtained from the river beds having required material quality. This option will entail higher cost of material transportation and other related environmental and social problems such as traffic congestion, air and water pollution.

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

Sand

Sand would be needed for embankment improvement works, concreting works, and for manufacturing concrete blocks for slope protection works. Two broad options are available to source this material as discussed below.

- Sand could be procured from markets. This would entail consistent quality and assured supply; however it would also entail increased transportation cost and associated environmental and social impacts including traffic congestion and air pollution.
- The send option is to obtain sand from the river beds. This would reduce the transportation needs along with the associated costs and environmental as well as social impacts. However quality of this sand may not be consistent and this sand may need to be washed before its use.

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

5.5.3 Alternatives for Workforce Procurement

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

- Employing bulk of the manpower from outside the Polder. This will entail requirement of larger labor camps, need for labor transportation causing traffic congestion and air pollution, and possible resistance and resentment from the local community.
- Employing bulk of the manpower from within the Polder and only bringing more skilled and technical manpower from outside. This option will entail reduced labor camp sizes, and decreased transportation needs and associated environmental and social problem. This option will also offer employment opportunities for the local community thus increasing their economic condition and also increasing the local ownership of the project. In view of these advantages, this is the preferred option for manpower sourcing.

5.5.4 Alternatives for Mode of Transportation

All the construction materials are to be transported through the river by Cargo, Burge, Troller and Engine Boats. The road way conditions inside the polder are not suitable for transportation of larger vehicles i.e. dump truck, trolley, excavator etc. Therefore carrying of earth and other construction materials should be done by small carts, non motorized vehicles, manual labor etc.

Waterways

Polder 32 is located along the left bank of Sibsa river. On the western periphery the polder is bounded by Sibsa river and Dhaki river. On the east the polder is surrounded by Bhadra and Sutarkhali river. The Sibsa river (west), is a large river considering its depth and width. The river remains navigable throughout the year and can be used for transportation purposes during construction.

For construction works in the north and east portions of the Polder, Dhaki and Bhadra rivers can be used respectively whereas the construction works on the southern part of the polder should be carried out using Sibsa river.

Apart from the Sibsa river, all the other surrounding rivers are relatively narrow and shallow and therefore small boats are recommended in these water bodies (Dhaki river, Bhadra river, Sutarkhali river). For construction in other parts of the Polder, Sibsa river is the most feasible route for waterway transportation considering the overall effectiveness in transportation through this river.

Roadways

While transporting materials to the stock yard from Khulna, the regional road through Chalna from Khulna city bypass high way is to be used. This is in fact the only feasible route available to enter the polder crossing the Dhaki River by ferri. The roads inside the polder are extremely to be deteriorated as this area has suffered the most due to the occurrences of Aila and Sidr.

6. Environmental and Social Baseline

This Chapter describes the existing environmental and social conditions in respect of water resources, land resources, agriculture, livestock, fisheries, ecosystems and socio-economic aspects of the Project area.

6.1 Land Resources

6.1.1 Topography

Polder 32 is located in the coastal area which consists of extremely low and flat land. It is also located near the Sundarbans. The whole polder is surrounded by rivers. This area is frequently inundated by tidal flooding and is vulnerable due to storm surge for its flat topography. The elevation of the land varies within the range from 0.4 m to 4.34 m. Average land level is 2.12 meters above the mean sea level (MSL). The land of the middle part of this polder is comparative low and gently slopes down towards Nalian and Sibsa rivers. The northeastern and southwestern side of the polder has high elevation (**Figure 6.1**).

6.1.2 Agro-ecological regions

As a part of Land Resources Appraisal of Bangladesh for agricultural development, Bangladesh has been subdivided into 30 agro-ecological regions and 88 sub-regions. The major components of these regions and sub-regions are physiography, soil properties, soil salinity, depth and duration of flooding which are relevant for land use and for assessment of present and future agricultural potential.

Polder 32 comprises of one Agro-ecological region, namely Ganges Tidal Floodplain (AEZ-13) (Figure 6.2). The characteristics of this region are discussed briefly as follows:

Ganges Tidal Floodplain (AEZ-13)

This region occupies an extensive area of tidal floodplain land in the south-west part of the country. The entire polder is covered by this region. The Ganges Tidal Floodplain has low relief compared to the Ganges River Floodplain. The area is criss-crossed by innumerable tidal rivers and creeks whose banks generally stand less than a meter above the adjoining basins. The entire zone lies within the cyclone prone area. The main tidal rivers in the project areas (Polders 32) are Rupsa, Passur, Nalua, Maidara, Ichamoti, Daudkhali, Kumarkhali, Bishnu, Mungla, Bhola, Bhairab etc.

There is a 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. Non-calcareous Grey Floodplain soil is the major component of general soil types. Acid sulphate soil also occupies significant part of the area where it is extensively acidic during dry season. In general, most of the top soils are acidic and sub-soils are neutral to mildly alkaline. Soils of the Sundarbans area are strongly alkaline. The fertility level is generally high with medium to high organic matter content. The Ganges Tidal Floodplain region occupies an extensive area of tidal floodplain land in the south-west of the country.

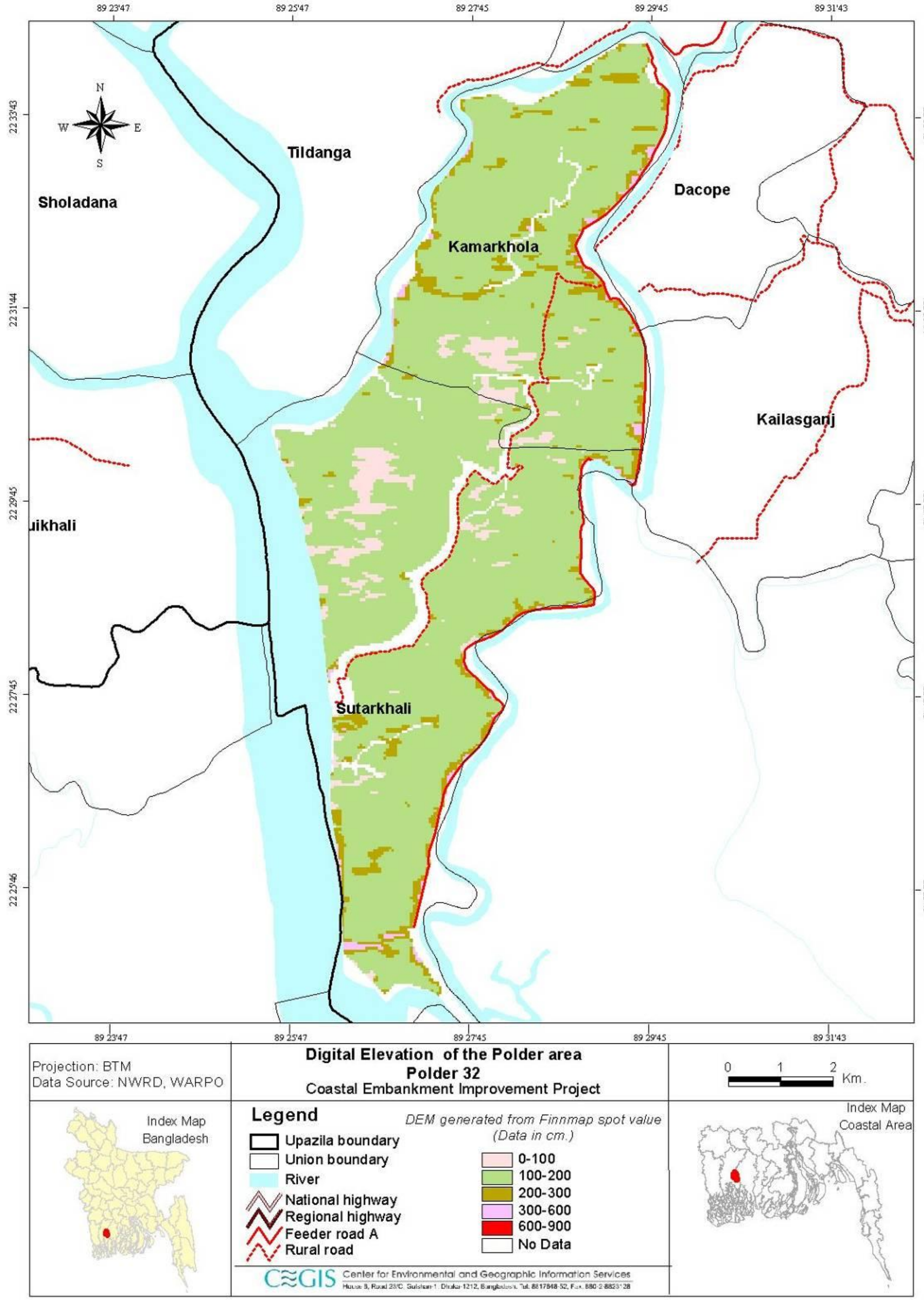

Figure 6.1: Land elevation of Polder 32

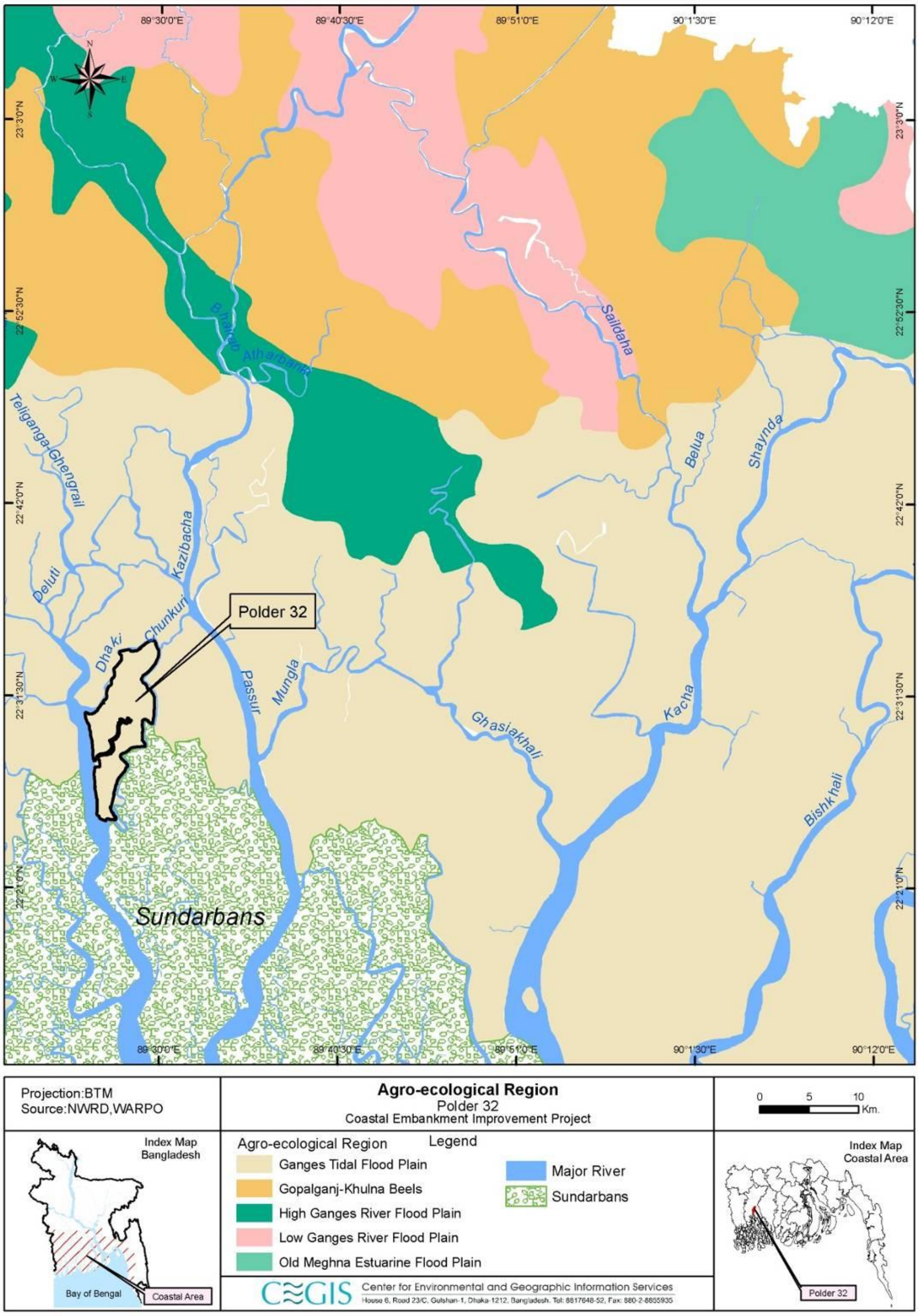

Figure 6.2: Agro-ecological Zone in the Polder area

6.1.3 Soil

There is a pattern of grey, slightly calcareous, heavy soils on river banks and grey to dark grey, non-calcareous, heavy silty clays in the extensive basins. Non-calcareous grey floodplain soil is the major soil type. Acid sulfate soils also occupy significant part of the area where it is extensively acidic during dry season. In general, most of the top soils are acidic and sub-soils are neutral to mildly alkaline. The soils are formed from clay-loam, loam and clay sediments and seasonally flooded, poorly drained except soils of high land areas.

Soil texture is the relative proportions of sand, silt and clay. It is very important for agriculture crop production. The texture of topsoil of the Polder area is mainly clay (65%) and clay loam (35%). Detailed soil texture in the study area is presented in Table 6.1.

Table 6.1: Soil texture of the project area

Soil texture with depth (cm)	% of NCA					
	Clay	Loam	Clay Loam	Sandy Loam	Sand	Total
Topsoil (0-15cm)	65	-	36	-	-	-

Sources: SRDI, 2012

6.1.4 Land type

Land type classifications are based on depth of inundation during monsoon season due to normal flooding on agriculture land. There are five land type classes: F0- High land (Above flood level), F1- Medium highland (Flooding depth 0-90 cm), F2- Medium lowland (Flooding depth 90-180 cm), F3- Low land (Flooding depth 90-270 cm) and F4- Very lowland (Flooding depth >270 cm). The percentages of highland and medium highland are 44% and 56% respectively. Detailed land type is presented in Table 6.2.

Table 6.2: Area under different land types by flooding depth

Land type	Area (ha)	% of NCA
High land (F_0)	2847	44
Medium high land (F_1)	3650	56
Medium low land (F_2)	0	0
Low land (F_3)	0	0
Very low land (F_4)	0	0
Total	6497	100

Source: Estimation from main consultant

6.1.5 Land use

The total Polder area is about 7,238 ha, of which net cultivable area (NCA) is 6,497ha (90%) followed by settlement (7.64%) and water bodies (2.36%). About 5358 ha, 444 ha, and 695 ha area are single, double and triple cropped respectively. Detailed land use is presented in **Table 6.3**. The detail land use map is shown in **Figure 6.3**.

Table 6.3: Present land use of the Polder area

Land use	Area (ha)	%
Total area	7,238	100
Agriculture land	6,497	90
Single crop	5,358	82.5
Double crop	444	6.8
Triple crop	695	10.7
Water bodies	171	2.36
Settlement	552	7.64

Source: Estimation from main consultant

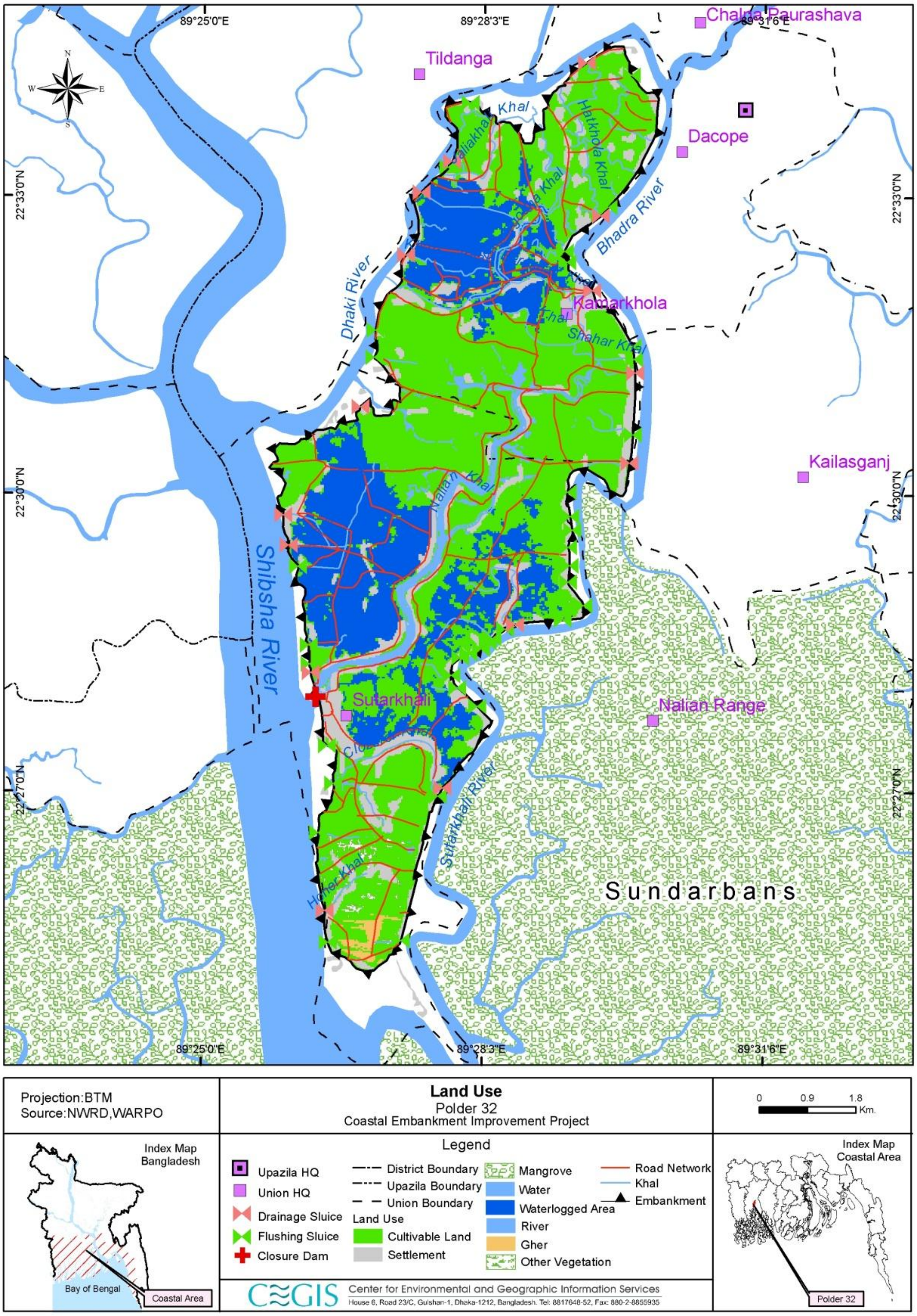

Figure 6.3: Land use Map

6.1.6 Farming practices

Farming practices within most of the Polder 32 area have adjusted to agro-climatic conditions prevailing in Kharif (March-October) and Rabi (November-February) seasons. The crop year starts from the Kharif-I season which is characterized by high temperature, high evaporation, low humidity and low rainfall. 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. The Rabi season is characterized by low temperatures, high solar radiation, low evaporation, insignificant rainfalls and low humidity. Kharif-II crops are harvested in the Rabi season and Rabi crops are harvested in Rabi season.

The farming practices in the Polder 32 are complicated due to physical, biological, climatological and socioeconomic factors. The siltation of rivers and channels caused drainage congestion/ water logging during monsoon. Natural calamities like cyclone and surge cause devastating crop damage in the project area. Scarcity of sweet water for irrigation during dry season is also responsible for the non-expansion of the agriculture farming practices. The environment of polder is also suitable for fish cum rice cultivation. A limited variety of crops are grown due to unfavorable situation prevailing in the project area. Rice is the main crop grown because of its adaptability in diversified ecological conditions.

6.1.7 Cropping pattern and intensity

Existing dominant cropping pattern practiced on 60% of NCA is Fallow-T Aman (HYV)-Fallow. The second prominent cropping pattern is Fallow-T Aman (Local) – Fallow practiced in about 21.9% of the NCA. The existing cropping intensity is about 128%. Detailed cropping patterns along with land type are presented in Table 6.4.

Table 6.4: Present Cropping Pattern by land type

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-Feb.)	Area (ha)	% of NCA
High land	Sugarcane	Sugarcane	Sugarcane	5	0.07
High land	Orchard	Orchard	Orchard	5	0.07
High land	Vegetables	T. Aman (Local)	Fallow	384	6
High land	T. Aus (Local)	T. Aman (Local)	Vegetables	270	4
High land	Fallow	Taman (Local)	Fallow	500	7.6
High land	Fallow	T. Aman (HYV)	Fallow	1683	25.9
Sub-total				*2847*	*43.7*
Medium High	T. Aus ((Local)	Fallow	Pulse	35	0.5
Medium High	T. AusLocal)	Fallow	Spices	10	0.15
Medium High	T. Aus (Local)	T. Aman (Local)	Oilseeds	35	0.5
Medium High	T. Aus (HYV)	T. Aman (Local)	Boro (HYV)	300	4.6
Medium High	B. Aus		Pulse	90	1.3
Medium High	Fallow	T. Aman (Local)	Fallow	930	14.3
Medium High	Fallow	T. Aman (HYV)	Fallow	2235	34.4
Medium High	T. Aus (HYV)	Fallow	Chilli	15	0.23
Sub-total				*3650*	*56.2*
Grand Total				6497	100

Sources: Feasibility report (agriculture) of CEIP, 2012

Figure 6.4: Fallow land in Boro season

6.1.8 Cropped area and production

Total cropped area was about 8331 ha of which rice occupied about 7482 ha and the rest 849 ha was covered with non-rice crops. Among the rice, about 53.5%, 32.3%, 4.2%, 4.6% , and 1.2% of NCA was under T Aman (HYV), T Aman (Local), T.Aus (HYV), T. Aus (Local) and Boro (HYV) respectively. The non-rice crops were Pulses, Oilseeds, Spices, Chilis, Vegetables, Sugarcane and Orchard covering 125 ha, 35 ha, 10 ha, 15 ha, 654 ha, 5 ha and 5 ha respectively.

The total crop production has been calculated on the basis of damage-free area and damaged area. In the damaged free area, the normal yield of crops has been considered under the study. In the damaged area the damaged yield against the damaged area has been considered. This may be expressed as:

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

Total rice production was about 13504 metric ton of which the contribution of T Aman (HYV), T Aman (Local), T.Aus (HYV), T. Aus (Local) and Boro (HYV) were 7152 metric ton, 3459 metric ton, 752 metric ton, 497 metric ton, 144 metric ton and 1500 metric ton respectively. The contribution of T Aman (HYV), and T Aman (Local), T.Aus (HYV), T. Aus (Local) and Boro (HYV) towards rice production were 52.9%, 25.6%, 5.5%, 3.6%, 1.0%, and 11.1% respectively. About 5879 metric ton of non-rice crops were also produced. The production of Pulses, Oilseeds, Spices, Chilies, Vegetables, Sugarcane and Orchard were 188, 40, 35, 19, 5396, 150, and 53 metric tons respectively (**Table 6.5**).

Table 6.5: Cropped area, production, damaged area and production loss in polder 32

Crop name	Total Cropped Area (ha)	Damage-free area		Damaged area		Total produc-tion (ton)	Produc-tion lost (ton)
		Area (ha)	Yield (ton/ha)	Area (ha)	Yield (ton/ha)		
T. Aman (HYV)	4,008	1,804	3	2,204	1	7,152	2,868
T. Aman (Local)	2,419	2,177	2	242	1	3,459	169
T. Aus (HYV)	315	255	3	61	1	752	99
T.Aus (Local)	350	280	2	70	1	497	416

Crop name	Total Cropped Area (ha)	Damage-free area		Damaged area		Total produc-tion (ton)	Produc-tion lost (ton)
		Area (ha)	Yield (ton/ha)	Area (ha)	Yield (ton/ha)		
B. Aus	90	90	2	-	-	144	-
Boro (HYV)	300	300	5	-	-	1,500	-
Total rice	7,482	4,906		2,577		13,504	3,552
Pulses	125	125	2	-	-	1,883	
Oilseeds	35	32	1	3	0	39	3
Spices	10	10	4	-	-	35	
Chilies	15	15	1	-	-	19	
S.Vegetables	384	192	12	192	5	5,396	2,452
W.Vegetables	270	270	12	-	-	3,240	
Sugarcane	5	5	30	-	-	150	
Orchards	5	5	11	-	-	53	-
Total non -rice	849	649		195		10,815	2,455
Total	8,331	5,555		2,772		24,319	6,007

Source: Feasibility report (agriculture) of CEIP, 2012

6.1.9 Crop Damage

Crop damage data for the years 2007-2011 periods (year) have been collected from the field in consultation with stakeholder/ farmers and officials of the DAE. Average crop damage was calculated using the formula: Crop production loss = Total cropped area ×damage free yield - (damaged area ×damaged yield+ damaged free area × damage free yield).

In the project area, about 2,577 ha and 195 ha area of rice and non-rice crop fields were affected due to drainage congestion, drought, salinity, natural calamities, pest and diseases infestation etc. Total production loss of rice and non-rice has been estimated as 3,552 metric ton and 2,455 metric ton respectively (**Table 6.5**).

6.1.10 Agricultural inputs

Fertilizer and pesticides application

The rate of use of fertilizer per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability (Table 6.6). The major fertilizers used in this area are Urea, TSP and MP. The quantities of fertilizer used by the majority of farmers are generally lower than the recommended doses and the proportions of Urea, TSP and MP applied are unbalanced. The use of nitrogenous fertilizer (Urea) is higher than other chemical fertilizers. Some farmers used manure in vegetables fields, oilseeds and spices fields. Unbalanced used of chemical fertilizers would affect the soil health which would be ultimately reflected on crop yields.

Table 6.6: Fertilizer and pesticide use in the project area

Crop Name	Fertilizer (Kg/ha)						Pesticide (Tk /ha)
	Urea	TSP	MP	Gypsum	Zinc	Manure	
T.Aus (LV)	112	75	48	-	-	-	500
T.Aus (HYV)	180	175	140	-	-	-	1000
S. Vegetables	130	100	67	-	-	-	2000

Crop Name	Fertilizer (Kg/ha)						Pesticide (Tk /ha)
	Urea	TSP	MP	Gypsum	Zinc	Manure	
T.Aman (Local)	40	30	20	-	-	-	1100
T.Aman (HYV)	150	130	60	-	-	-	1400
Chilli	40-50	40	30	-	-	-	500
Potatoes	250	130	80	-	-	-	1500
W. Vegetables	120	80	70	-	-	500	800
Spices	150	40	20	-	-	200	300
Oil seeds	140	30	30	-	-	-	540

Source: Feasibility report (agriculture) of CEIP, 2012

The use of pesticides depends on the degree of pest infestation. Majority (80%) of the farmers applied pesticides in T. Aus (Local/HYV), T. Aman (Local/HYV), Boro, Chilies, Potatoes, Vegetables and Spices. The major insects as reported by the farmers are Yellow Stem borer, rice hispa, Ear cutting caterpillar, Brinjal shoot and fruit borer, Fruit weevil, etc. Local farmers reported that they are using different types of pesticides such as Ripcord, Furadan (granular), Basudin (liquid) and Theovit (powder) etc. to prevent pest infestation in rice, vegetables and other croplands.

Seeds

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.

Most of the farmers in the project area used their own seeds in case of local variety, such as T. Aus & T. Aman. Medium and small farmers meet their requirement from neighboring farmers or local markets. Various improved crop seeds (HYV/Hybrid) are provided by BADC and private seed dealers. Price of seeds from the private dealers are higher than BADC seeds. Seeds of 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 6.7**.

Table 6.7: Cultivation cost in the polder area

Crop Name	Seed (Kg/ha)	Irrigation cost (Tk)	Equipments used for cultivation		Power tiller cost
			Power tiller (%)	Bullock	
T.Aus (LV)	38	-	90	-	4500
T.Aus (HYV)	35	-	90	-	4500
S. Vegetables	3-4	500-700	90	-	4500
T.Aman (Local)	40-45	-	90	-	4500
T.Aman (HYV)	30-35	-	90	-	4500
Chilli	1-1.5	-	90	-	4500
Potatoes	3500-4000	1000	90	-	4500
W. Vegetables	2.5-3	675	90	-	4500
Spices	1-2	200	90	-	4500
Oil seeds	10	300	90	-	4500

Source: Feasibility report (agriculture) of CEIP, 2012

Irrigation

Irrigation coverage of the study area is about 4% of the total NCA during the dry season. Only surface water is used for irrigation using LLPs. The sources of surface water are the external rivers (Dhaki, Nalua, Sibsha and Bhadra), Khals (Nodbox, Anuar) and beel. But the availability of surface water for irrigation has declined due to siltation of the rivers, beels and khals. Irrigation cost for different crops in the project area is presented in **Table 6.7**.

Labor

In the study 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 equal throughout the year. The number of labor requirement varies from crop to crop. The average labor used in the study area is presented in **Table 6.8**.

Table 6.8: Labor used in the polder area

Crop name	Labor (No/ha)
T.Aus (Local)	150
T.Aus (HYV)	160
S. Vegetables	180
T. Aman (Local)	160
T. Aman (HYV)	170
Boro (HYV)	170
B. Aus	100
Chilli	180
Potatoes	140
W. Vegetables	180
Spices	170
Oil seeds	120
Pulses	120
Sugarcane	180
Orchard	120

Source: CEGIS estimation, 2012

6.2 Water Resources

6.2.1 River System

The Polder 32 is located in Dacope Upazila of Khulna District. The Polder covers two Unions namely (1) Sutarkhali and (2) Kamarkhola. The polder is surrounded by Sibsa and Dhaki River to the west and North, Chunkuri, Bhadra and Sutarkhali River to the East and South. The surrounding rivers with tidal influence control the flood and drainage dynamics of the polder. There are several khals inside the polder namely Joynagarkhal, Charar khal, para khal, Sahar khal, Kaynatoli khal, Samsur moktar khal, Clozarer khal and other khals having tidal effects which flow from north to south and control the main drainage system and supplementary irrigation during monsoon. Figure 6.5 and Figure 6.6 show a couple of water bodies related to Polder 32.

Figure 6.5 Dhaki river on the Northern side of the Polder

Figure 6.6: Closer's lake, Sutarkhali

6.2.2 Navigation in Rivers and Khals

The Sibsa river (west), is a large river considering its depth and width. The river remains navigable throughout the year and provides effective waterway transportation. Apart from the Sibsa river, all the other surrounding rivers ((Dhaki river, Bhadra river, Sutarkhali river) are relatively narrow and shallow.

In the north and east portions of the Polder, Dhaki and Bhadra rivers can be used respectively for waterway transportation whereas in the south direction of the polder Sibsa river should be used.

6.2.3 Drainage Congestion and Water Logging

The project area comprises of a number of khals and channels with tidal influence. Most of these khals are used for drainage of the polder area. These channels are also interconnected by a lateral channel draining into the main rivers.

Drainage congestion as a key vulnerability issue has been defined for the total project area though intensity varies from place to place. The drainage performance through linked canals has been gradually decreasing in the existing sub-project sites due to sedimentation both at the upstream and downstream of the regulators and also poor operation and maintenance. The internal drainage congestion in some areas have also occurred due to Nalian cross dam constructed at the upstream of the Nalian river without providing any drainage structures at the mouth of the existing internal tributaries. The dry season water logging is around 30-40% (400 Bighas in Kalinagar-Sreenagar, 5000 Bighas is Gulbunia) in the low lying areas in existing polder sites.

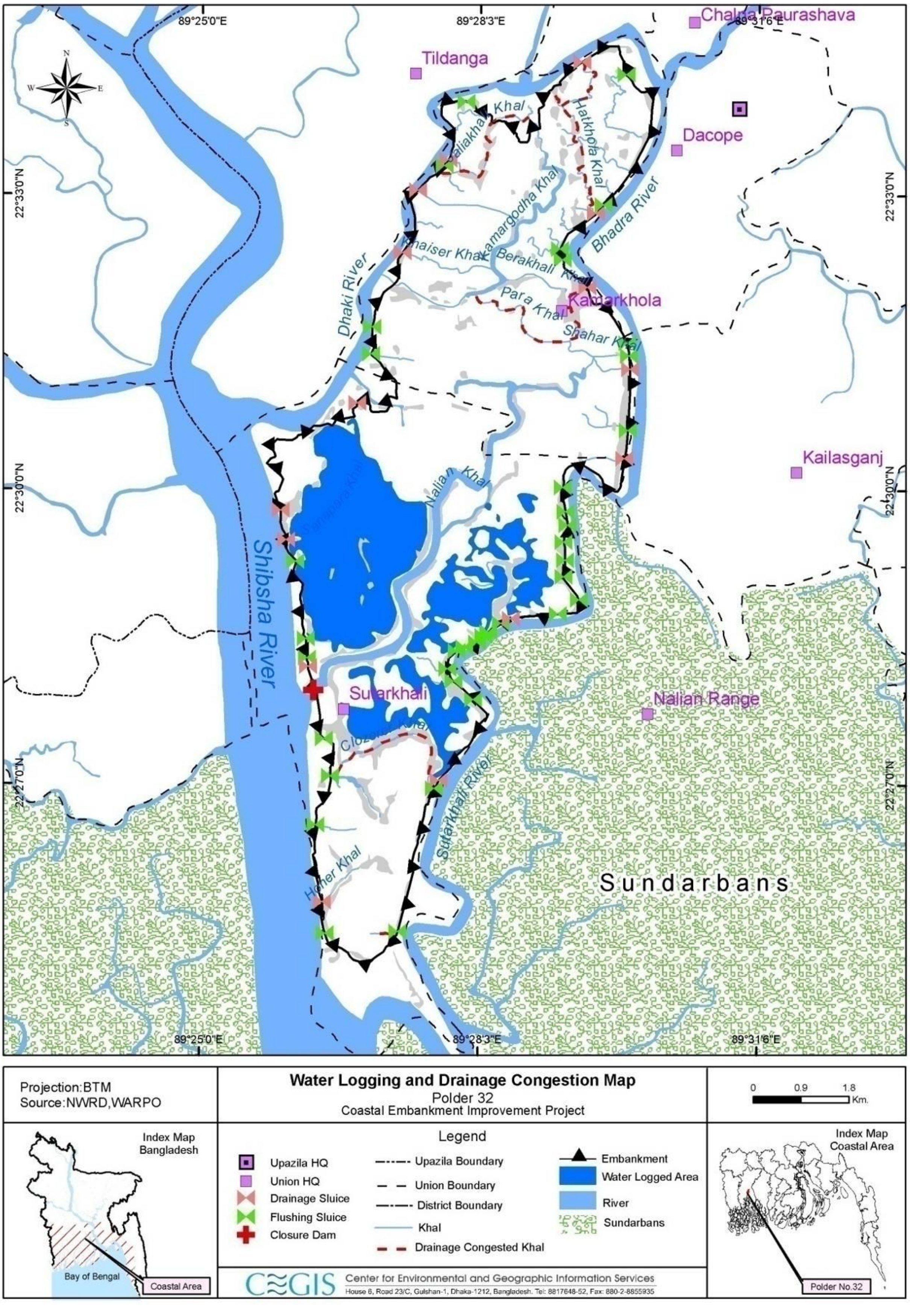

Figure 6.7: Drainage Congestion in Polder 32

6.2.4 Tropical Cyclones and Tidal Flooding

Tropical cyclones are major threat to the coastal areas, causing loss of human lives and livestock and severe damage to crops, fisheries and properties. During last 125 years more than 42 cyclones had hit the coastal areas and 15 have occurred in the last 30 years. The recent most devastating cyclones hitting the SW coast under Khulna district were in 2007 (Sidr) and 2009 (Aila).

These cyclones directly affected 70% people of the total project area. Aila, the latest devastating cyclone hit the study area and project site on 25th May 2009. During Aila, surge water entered into the project area by overtopping the left bank of Sibsa. At that time the water level on the project site from the ground was 3-5 feet. People reported that 15-20% of left bank of Sibsa River was inundated during this cyclone.

Tidal motion dominates during pre-monsoon and post monsoon period. However, fresh water from the river plays a very important role, especially during the monsoon. During storms and cyclones, the short waves and storm surges are important morphologic factors. The tidal range varies between about 1.2 and 3.1 meters. Tidal flooding is very common in the project area especially in the proposed project sites. Floodwater enters the project area by overtopping the embankment during the wet season. Extreme tidal floods inundate roughly about 35-40% of area while 10-15% area is inundated during normal floods.

Cyclones have been hitting the coasts of Bangladesh very frequently in the recent decades. From 1901-1957 only 11 cyclones had hit the coastal areas of Bangladesh, while from 1957 to 2009 a total number of 55 cyclones have hit the area. So, in the last 52 years, the number of cyclones hitting coastal areas of Bangladesh has increased 5 times compared to the previous 57 years. (BMD)

In a frequency study carried out by Hennon, P. et al. (2010), Bay of Bengal has been found to be the second most frequently visited place in the world by cyclones with about 20 cyclones per decade.

6.2.5 Land Erosion and Sedimentation

Sedimentation is a common problem in the south west coastal area. The rate of sedimentation in the Sibsa–Dhaki stream is more during dry season due to shortage of upstream pressure of river flow. On an average, roughly 1 to 1.5 feet sedimentation takes place in most of the main channels in the study area each year. As the rate of siltation is very high in Sutarkhali River, the dredging action cannot sustain any more. The rate of sedimentation on river bed and bank side deposition is increasing day by day in the study area due to malfunctioning of water control structures. Sedimentation in most of the internal khals in existing sub-project sites is not controlled and the cumulative sedimentation causes rise of bed level and reduces the conveyance capacity of the canal. This site is not subject to severe erosion. Some erosion has been found only at Sibsa River. People reported that the erosion rate in the Sibsa River is very low but accretion rate on the right side river bed is high. Average thick ness of sedimention is 43 cm over the year May 2009 to May 2011 found by a study conducted by Steven Goodbred of Vanderbilt University.

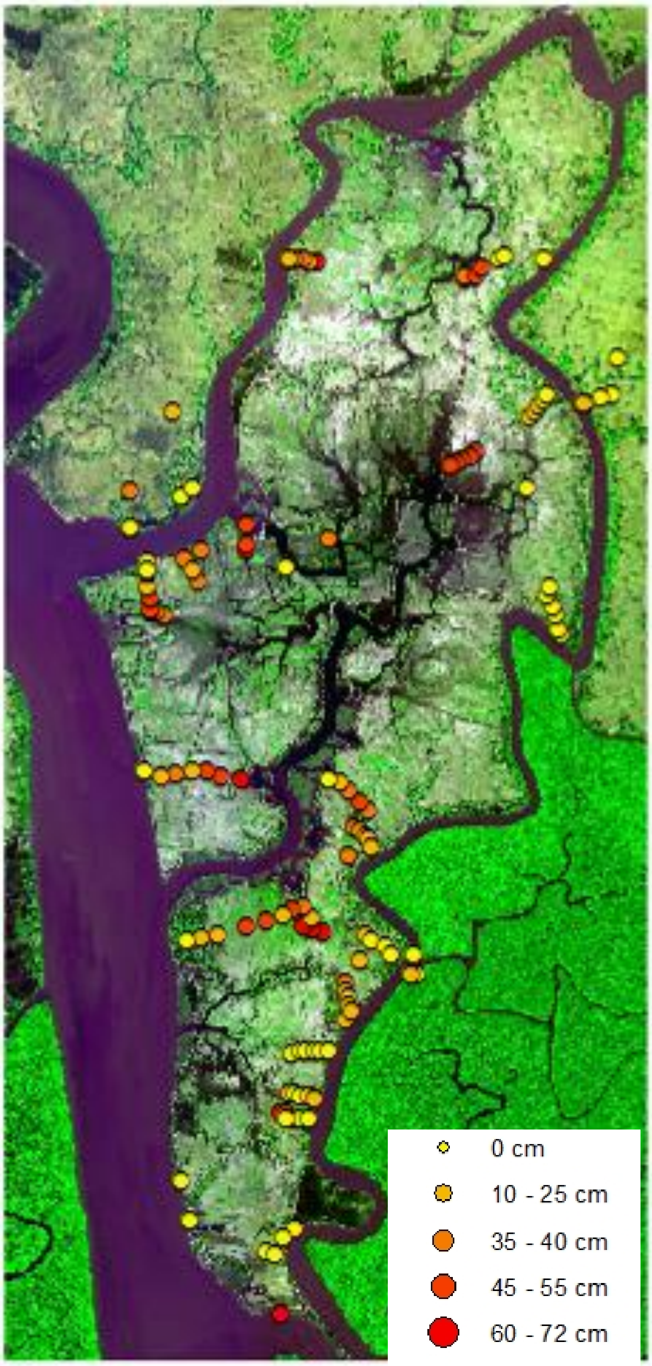

Figure 6.8: Locations of Sedimentation Measurement from May 2009 to 2011

6.3 Environmental Quality

Air, noise, water and soil quality were measured during the field survey. The objective of the measurement was to set up a strong baseline which will help to monitor the impact of the present during construction and operation phase. The sampling locations for air, water, and noise and soil quality are shown in Figure 6.9.

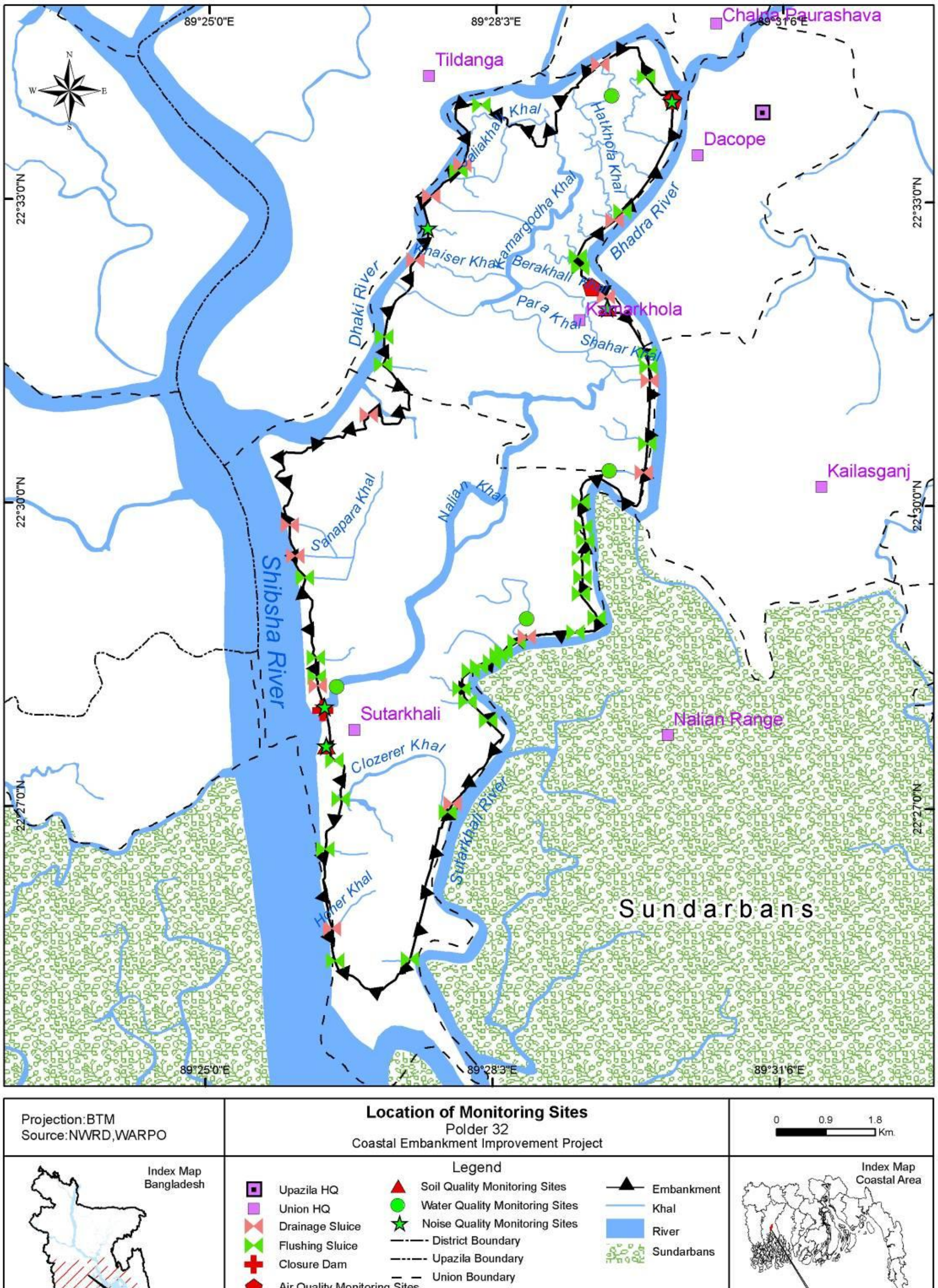

Figure 6.9: Locations of air, water and noise quality monitoring stations

6.3.1 Air Quality

Air pollution is not of much significance in the coastal area of Bangladesh. From field visits, it was observed that overall air quality in the study area is good. The standards of ambient air quality should be maintained at the project site. The standards of air quality are given in **Table 6.9**.

Table 6.9: Standards of ambient air quality

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

Source: Environment Conservation Rules, 1997

Table 6.10 shows the air quality data measured at Dakop upazila, under Khulna district. The values suggest that the concentrations of the measured air quality parameters (suspended particulate matter - SPM, oxides of sulpher - SOx, and oxides of nitrogen - NOx) lie within the range of standard values for Bangladesh (Table 6.9).

Table 6.10: Values of ambient air quality parameters in the study area

Sample Location	Air Quality Parameters		
	SPM(μg/m3)	SOx(μg/m3)	NOx(μg/m3)
Bazar, Kamarkhola , Dakop, Khulna	109	<25	18
Kalinagar, Dakop, Khulna	103	<25	20

Source: CEGIS field survey, December 2012

6.3.2 Noise

The noise values have been measured in the field. The values of noise level are shown in Table 6.11:

Table 6.11: Daytime noise levels of the study area

	Location	Sound level (dB)	GPS
1	WAPDA Colony Khay Ghat	47.2	N 22°34’02.2” E 89°29’45.8”
2	Kamarkhola UP office	51.7	N 22°31’59.3” E 89°29’05.0”
3	Sreenaga, Kalinagar	50.2	N 22° 32’46.5” E 89° 27’10.2”
4	Nalian Bazar	58.6	N 22°27’39.2” E 89°26’6.7”
5	Gunary Closer	49.3	N 22° 28’ 02.4” E 89° 26’ 05.7”

Source: CEGIS field survey, December 2012

Table 6.12 shows the standard values for noise in Bangladesh. Noise levels exceeding 80dB is usually considered as Noise pollution in our country. However the permissible limits for the country are less (Table 6.11). The study area can be regarded as a mixed area, and the noise levels observed in the study area has been found to be within the permissible limits (standards) of mixed zones for daytime.

Table 6.12: Standards of Noise levels for different zones of Bangladesh

Zone Class	Limits in dB	
	Daytime	Nighttime
	(6 am – 9 pm)	(9 pm-6 am)
Silent zone	45	35

Zone Class	Limits in dB	
	Daytime	Nighttime
	(6 am – 9 pm)	(9 pm-6 am)
Residential zone	50	40
Mixed	60	50
Commercial zone	70	60
Industrial zone	75	70

Source: Bangladesh Gadget, 2006

6.3.3 Water Quality

As described earlier, there has been a decline in the effectiveness of the Polder because of the lack of repair and maintenance of embankments and water control structures as well as frequent attacks by minor to major cyclonic surges, and absence of functional community organizations. As a consequence, during the periods of low rainfall, the surface water of the entire area gets affected by salinity intrusion.

In order to provide a clear view of the existing condition of the water quality inside the Polder area, a number of water quality parameters – including salinity, dissolved oxygen (DO), temperature, electrical conductivity (EC), pH, total dissolved solids (TDS), chlorides (Cl), suspended solids (SS), and arsenic (As) - were selected by the study team for monitoring and evaluation. The surface water and ground water was analyzed during the field level survey conducted in two different periods of the year. The surface water quality was measured at six different locations in the month of December and the ground water quality was tested in the month of May. The results obtained in the two field surveys provided an understanding of the water quality in the Polder, discussed below.

Surface Water Quality

The surface water quality in Polder 32 is influenced by the hydrological connections of the internal water channels with the surrounding rivers of the polder. The rivers and lakes around the polder provide tidal inflow into the Polder during the periods of high tide or low rainfall. The water bodies inside the Polder are mostly free flowing khals, and apart from salinity intrusion during January to April, the other water quality parameters remain within the acceptable range. Table 6.13 presents the values of the water quality parameters measured in a number of selected locations of the Polder. The standard values of these indicators set by DoE, Bangladesh have also been shown for the comparison purposes.

Table 6.13: Water Quality in Polder 32

Sample Location	Water Quality Parameters					
	Salinity (ppt)	Temperature (°C)	TDS (ppm)	EC (mS/cm)	DO (mg/L)	pH
Kalinagar Bazar kheyaghat, bhadra river	4	23.0°C	621	0.86	5.9	7
Junction of Khamargoda river, berakhali and joynagar khal	5	22.6°C	1233	1.67	5.8	7.1
Parakhal (jaynagar)	1	22.8°C	1320	1.72	7.7	7.1
Sarabadh (downstream of nalian river)	-	23.2°C	1667	2.24	9.1	7.2
Kayratoli khal (sutarkhalii maddhomik bidyaloy)	-	22.7°C	1850	2.45	6	6.9
Closer khal (closer number 13,	1	22.3°C	1	2.82	7	7.2

Sample Location		Water Quality Parameters					
		Salinity (ppt)	Temperature (°C)	TDS (ppm)	EC (mS/cm)	DO (mg/L)	pH
alekgajipara, sutarkhali)							
Standard Value (Bangladesh)	Irrigation	-	20-30	-	-	5.0	7.0-8.5
	Fishing	-	20-30	-	-	4.0-6.0	6.7-9.5

Source: CEGIS field survey, December 2012

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

In the dry season, the overall salinity levels both in soil and surface water are high and roughly about 15-20 percent of the Polder area is affected. This happens because of the following reasons: (i) about 3-4 percent of the polder area is under golda (prawn) culture, (ii) saline water enters through breached embankments, and (iii) malfunctioning of sluices with/without gates. However in the month of December, the salinity value was low (0-5 parts per thousand) as shown in Table 6.13 above, since rain water inside the Polder was still present and tidal flow from the ocean was yet to intrude. The embankments and water controlling structures have experienced significant deterioration over the years and as a result the salinity values inside the polder have increased. Especially after the occurrences of Aila and Sidr, the salinity intrusion in the polder during dry season has become a common phenomenon.

Dissolved Oxygen (DO). This 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. DO is relatively low in dry season than in wet season. The values of DO inside the Polder (measured in the month of December) ranged between 5 to 6 mg/L at two locations (Kalinagar Bazar kheyaghat and Junction of Khamargoda river, berakhali and joynagar khal) which complies with the DoE standards for irrigation as well as for fisheries and aquatic life. However, values found in Closure khal, Kayratori khal, Para khan, Sarabadh were found exceeding the range of standard values for irrigation and fisheries whereas the water of the Botolbunia khal has higher DO values.

pH. The hydrogen ion concentration of water is expressed by its pH value. A pH value of 7 indicates a neutral solution, neither alkaline nor acidic. In most of the water bodies of the Polder, the pH range is found well within the DoE standards.

Temperature. Temperature of water bodies affects the fish habitats and their oxygen holding capacity. The mean temperature of the water bodies inside the Polder area was around 22°C- 23°C in December. This value lies within the DoE standards for both irrigation and fish habitats.

Total Dissolved Solids (TDS). The natural range of total dissolved solids concentration for most lakes occupying open basins is usually between 100 and 200 mg/l. However the values of TDS were found very high inside the Polder area (ranged between 600-1,900 mg/l (see Table 6.13) because of the saline water intrusion. Livestock and wildlife may be adversely affected by drinking this water containing excessive dissolved solids. Continuous use of such water may cause a general loss of condition, weakness, scouring, reduced production, bone degeneration and ultimately death. TDS may influence the toxicity of heavy metals and organic compounds for fish and other aquatic life. This takes place primarily because of the antagonistic effect of hardness on metals. The quantity and quality of dissolved solids often determines the variety and abundance of plants and animals in a given aquatic situation.

Electrical Conductivity (EC). EC is a useful water quality indicator for estimating the amount of minerals, assessing the effect of diverse ions on chemical equilibrium, physiological effects on plants or animals, and corrosion rates. It is an indirect measure of the TDS (TDS = 640 × EC), the effects of which have been discussed above. The values of EC inside the Polder ranged between 0.5 – 3.0 mS/cm. The higher values of EC indicate that the water bodies inside the Polder area are more affected by saline water rather than fresh water.

Ground Water Quality

The ground water quality parameters, measured in the Polder during the month of May were found to comply with the drinking water quality standards (ECR'97). The values of the ground water quality parameters of the Polder area as well as the standard values of these parameters set in ECR'97 are presented in Table 6.14. The values show that the ground water quality parameters were well within the range of standard values of ECR'97.

Table 6.14: Groundwater Quality at Dacope

Sample Location	Temp (°C)	pH	Chloride (mg/l)	Iron (Fe) (mg/l)	SS (mg/l)	Pb (mg/l)	Coliforms	As (mg/l)
DTW of Alekgajipara, Sutarkhali, Dakop	23.1	7.01	532	0.84	6	>0.02	Nil	0
Drinking water quality standard as per ECR'97		6.5 – 8.5	150 – 600	0.3 – 1.0	10	0.05	Nil	0.05

Source: CEGIS field survey, May 2012

6.3.4 Soil Quality

Soil Salinity

Salinity is an inherent characteristic of coastal area. Coastal area is saline with tidal flow, capillary rise of saline groundwater and irrigation with saline water. Soil salinity is flushed out with rainwater in monsoon season and from upstream flow. There is also a relationship between river flow and salinity levels, the lower the flow the higher the level of salinity. The degree of salinity varies widely with area and season, depending on availability of freshwater, intensity of tidal flooding and nature of saline groundwater movement.

The saline water of sea enters the polder areas through coastal rivers, channels, creeks twice every day during high tide. The main reason of soil salinization in the area is inundation of the soils by saline tidal water. Repeated inundation of soil by the tidal impregnates them with soluble salts thereby rendering the soils saline. These lands are not favorable for most of the crop production. The polder area is strongly saline with some very strongly saline which comprises 6182 ha of the total land.

Soil sample were collected for polder 32. The collected soil samples were sent to the Agrochemical & Environmental Research Division, Institute of Food and Radiation Biology of Atomic Energy Research Establishment, Savar, Dhaka for detecting pesticide residues. As the desired pesticide residues were analyzed with a detection limit of 0.004 ppm using GC-MC (Thermo Electron & Pekin Elmer). The analyzed result shows that no pesticide (furadan) exists in the soil samples (Table 6.15).

Table 6.1: Pesticide Residues Analysis Report

Sl No.	Location	Sample ID	Carbofuran (ppm)
1	Polder 32	1A(0-15cm)	ND
2	Polder 32	1B(15-30cm)	ND

6.3.5 Climate and Meteorology

The projected area is located in a typical monsoon climate area. It has three main seasons: Summer (pre-monsoon) – March to May; Rainy season (monsoon) – June to October; and winter season – November to February. The rainy season is hot and humid having about 80 percent of the annual rainfall. The winter is predominately cool and dry. The summer is hot and dry and interrupted by occasional heavy rainfall. Meteorological information (temperature, rainfall, humidity, evaporation) of the projected area has been taken from Khulna station of Bangladesh Meteorological Division (BMD) and is presented in Figure 6.10 to Figure 6.16.

Temperature

Mean maximum temperature stays between 19.3°C to 30.4°C over the year with the highest temperature experienced in the month of May. There is also significant fluctuation in minimum temperature, which varies between 15.37°C to 25.2°C. The lowest temperature is experienced in the month of January.

The results of monthly average, maximum and minimum temperature variations of the polder are shown in **Figure 6.9**.

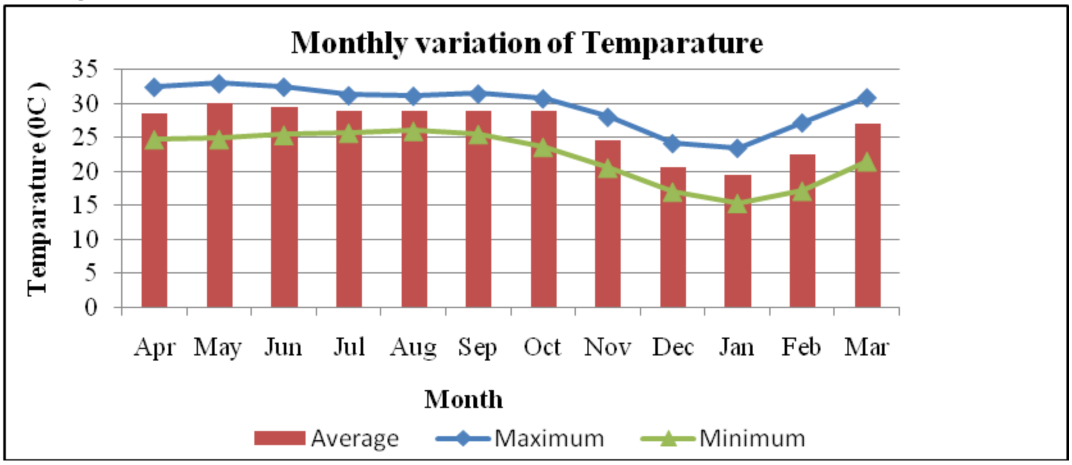

Figure 6.10: Maximum, average and minimum temperature at the project area

Yearly data of mean temperature have also been analyzed for the same station (from year 1961-2011). The trend analysis shows that the average temperature for Polder 32 is increasing by approximately 0.001 °C each year (Figure 6.10).

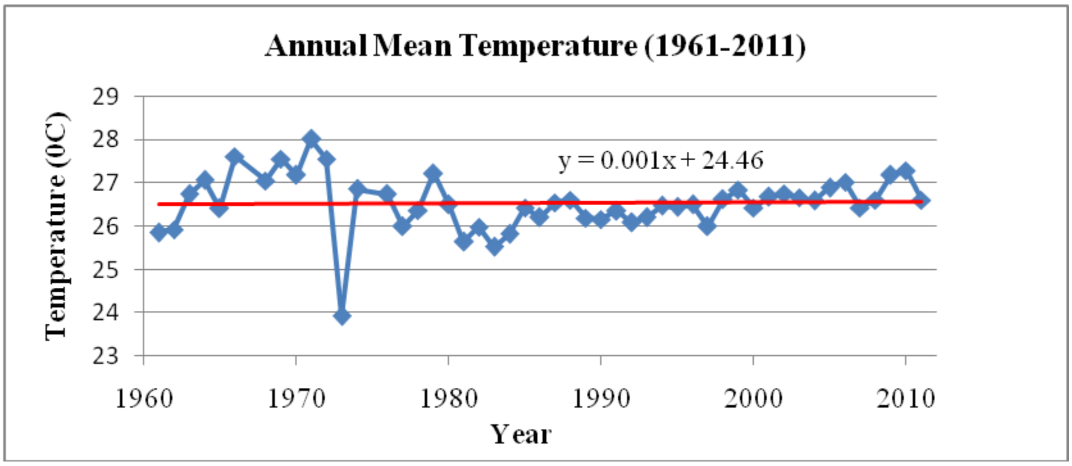

Figure 6.11: Annual Mean Temperature in Project Area

Humidity

The range of mean relative humidity is 74% to 88%. Humidity is highest during July-September.

The results of mean monthly humidity analysis are shown in **Figure 6.11.**

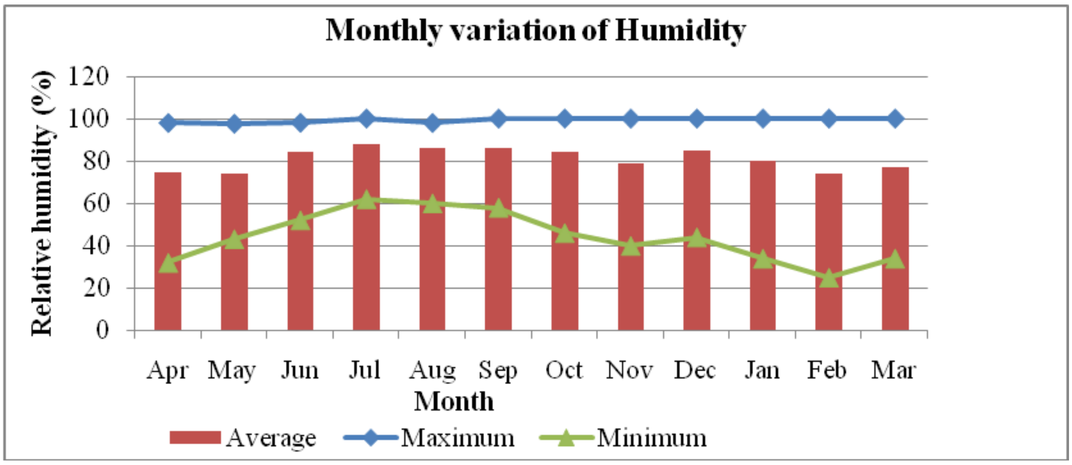

Figure 6.12: Maximum, average and minimum humidity at the project area

Data of yearly average relative humidity have also been collected. The trend analysis for the relative humidity values of Polder 32 shows that the relative humidity increases by approximately 0.073 percent each year (Figure 6.12).

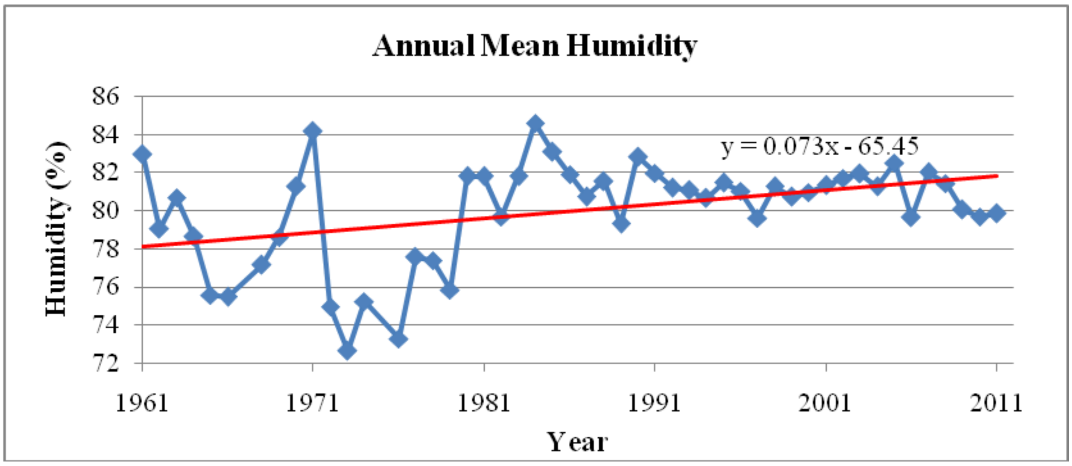

Figure 6.13: Annual Mean Humidity in Project Area

Rainfall

Mean rainfall rate varies within the range of 7 to 400 mm where the highest and lowest values are observed during the months of August and December. The results of mean monthly rainfall analysis are given in **Figure 6.13** for identification of the monthly distribution of mean rainfall.

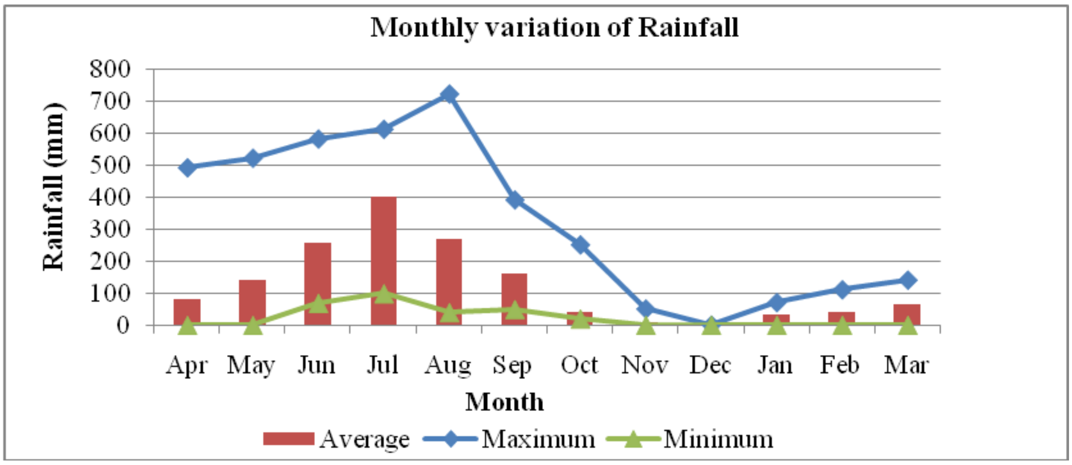

Figure 6.14: Maximum, average and minimum rainfall at the project area

A trend analysis has also been carried out collecting the summation of annual rainfall data from the BMD station at Khulna. The trend reflects that each year, the summation of rainfall in the Project area is increasing by approximately 12.30 mm (Figure 6.14).

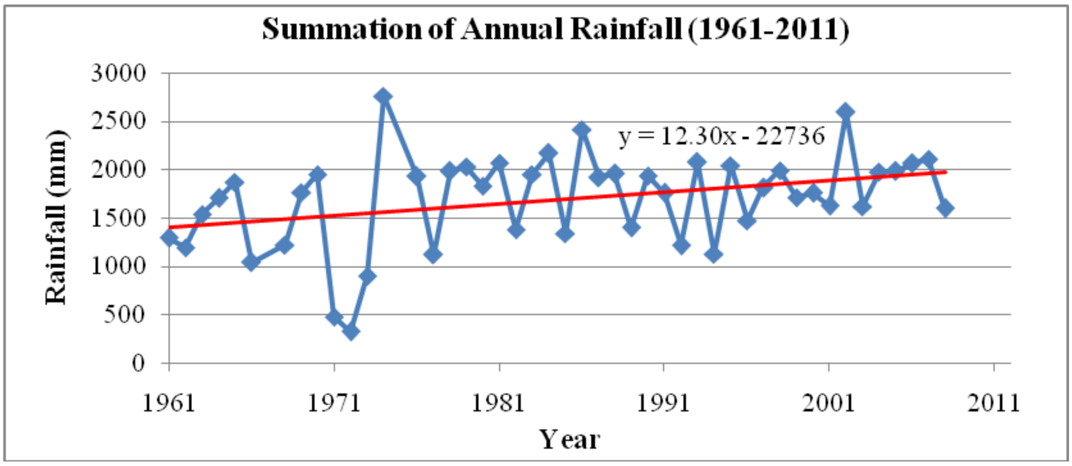

Figure 6.15: Summation of Annual Rainfall

Evaporation

Mean evaporation rate varies within the range of 1.12 to 3.4 mm/day where the highest and lowest values are observed during the months of April and November respectively. The results of mean monthly evaporation analysis are shown in Figure 6.15.

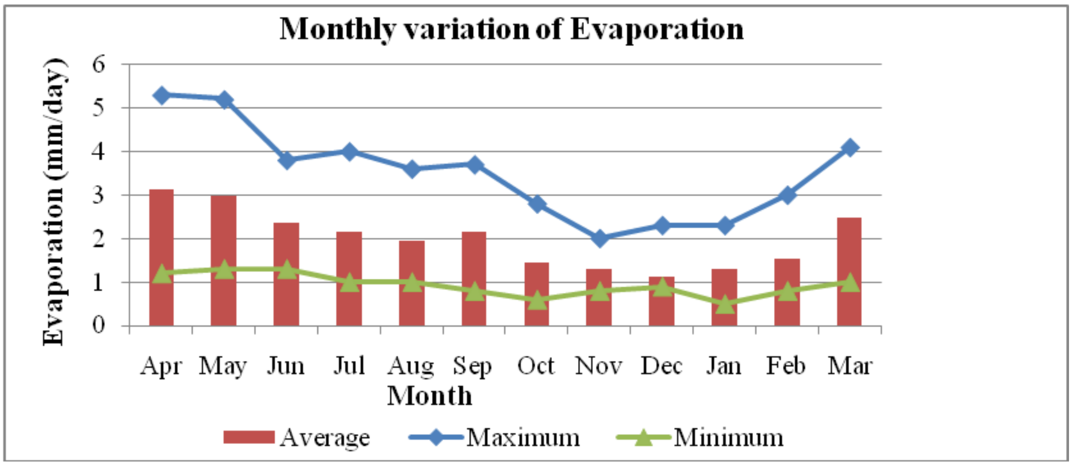

Figure 6.16: Maximum, average and minimum evaporation at the project area

6.4 Fisheries Resources

6.4.1 Background

Fisheries resources of the study area are diversified with different fresh and brackish water fish habitats. Open water fish habitat of the study includes rivers and khal, such as *Nalian River, Kamargoda khal, Golbunia khal, Jalia khal, Pacherdoani khal, Katakhali khal, Uluruar khal, Nadaken khal, Goler khal, Thakuronbari khal, Kashiar khal, Parar khal, Chotkatola khal, Hatkhola khal, etc* are acting as major arteries of fish migration into the study area. These are playing vital role in maintaining fisheries productivity of internal open water. Bulk of the commercial fish production is coming from culture fish habitats and capture fish habitat. The productions from the capture fisheries are come from the capture habitat e.g. different seasonal and perennial khals. The study area is bounded by Sibsa and Dhaki River to the west and north, Chunkuri, Bhadra and Sutra khali Rivers to the east and south. Fish production from the peripheral rivers is not considered for fish production estimation of polder area. Fish production trend is declining gradually from the open water sources. After devastating Aila, the open water fisheries resources are decreased extensively due to saline water intrusion. The numbers of fishermen have decreased due to reduction of open water fish habitat, loss khal-river connectivity, and damage of water regulatory structures on the khals as well as improper operations. Aquaculture is developing in suitable ponds of congestion free highland area in the polder.

Figure 6.17: Open water fish habitat in the Polder area (Nalian River during low tide)

The area is relatively moderate in fish biodiversity. But the fish biodiversity has a decreasing trend because of morphological changes, obstruction to spawning migration, natural and anthropogenic drying up of wild fish habitats, indiscriminate fishing, loss of river-khal connectivity and water regulatory structures on khals. Aquatic environmental quality is not so satisfactory in the polder area. Some pollutants are released from crop fields and, are substantially causing damage to fish. On the other hand, water quality of internal khal is suspected to be degrading particularly during dry season. Moreover, fish migration from river to internal khals is obstructed due to improper management water regulator on khal off-take. Fisheries sector is contributing in small scale to the local economy for improving the local livelihoods.

6.4.2 Fisheries problems and issues

Major fisheries problems and issues so far identified during baseline survey in the Polder area are as follows:

- saline water intrusion in the polder area due to non-functioning of water regulator structures
- siltation of internal khals are causing loss to the year round river-khal connectivity;
- indiscriminate fishing using monofilament gill net, net jal, etc and overexploitation of fishes by using huge number of narrow meshed ESBN (Estuarine Set Bag Net) fishing;
- reduction of spawning and feeding grounds;
- indiscriminate harvest of shrimp PL (Post Larvae) by local dwellers;
- hindrances to fish migration and movement due to improper management and mal-functioning of the water regulatory structures along with encroachment and barriers;
- lack of quality fish seed and feed for the improved aquaculture practices. Moreover, increasing salinity adversely affects pond fish culture;
- insufficient loan facilities for aquaculture practices.

6.4.3 Fish habitat description

Habitat classification

Fish habitat of the polder area is primarily classified under two broad categories, for instance capture fishery and culture fishery. Internal khals are considered under capture fish habitat. The culture fish habitats are of three types such as, galda gher, homestead pond and commercial pond. Internal khal habitat occupies about 71.8% of the total habitat of Polder area followed by homestead pond, galda gher and commercial pond. Culture fish ponds occupy 21.2% of the water bodies of the Polder area. Fish habitats of the Polder area are shown in **Figure 6.19**.

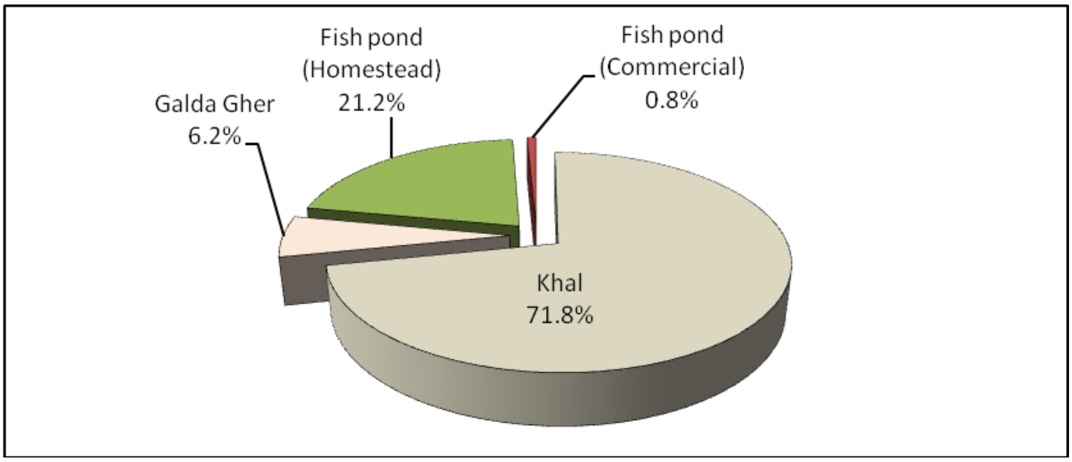

Figure 6.18: Fish Habitat in the Polder area

Habitat Distribution

Nearly 59% of the Polder area fish habitats are situated in Sutrakhali union followed by Kamarkhola union as shown in the **Figure 6.18**.

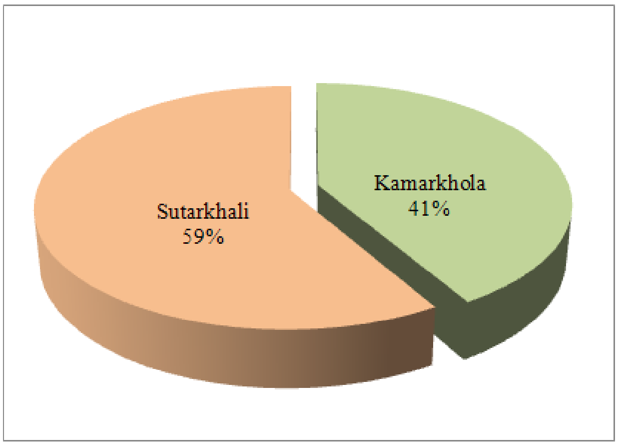

Figure 6.19: Distribution of fish habitat at different Union

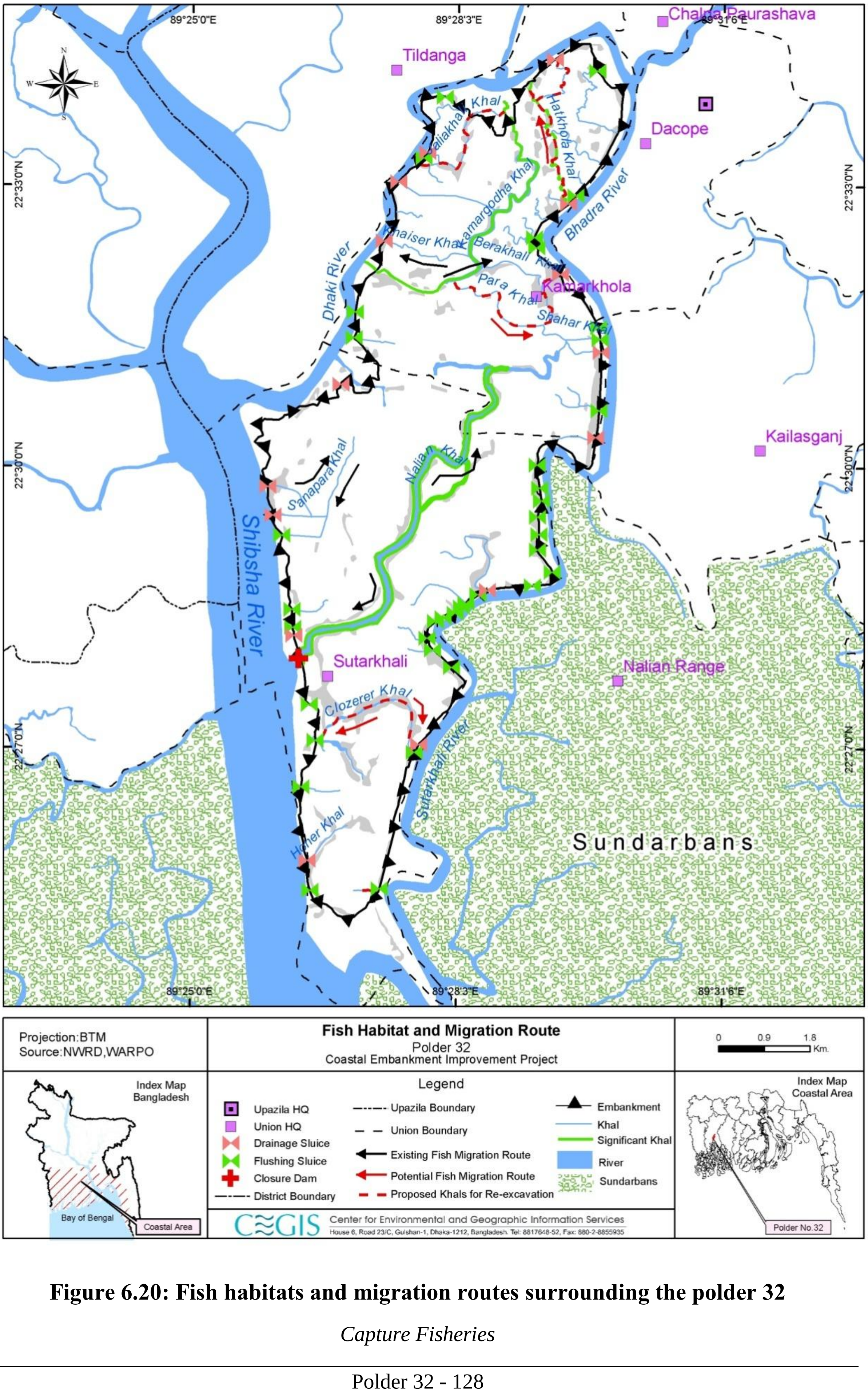

Figure 6.20: Fish habitats and migration routes surrounding the polder 32

Capture Fisheries

The estimated open water fish habitat of the Polder area is 241 ha which is distributed in khal. The culture fish habitat area is 95 ha which is distributed between golda gher, homestead pond and commercial pond as shown in the following **Table 6.16**.

Table 6.16: Fish habitat status of the Polder area

Sl. No.	Fisheries Category	Habitat Types	Area (Ha)
1	Capture	Khal	241
Sub-total			*241*
2	Culture	Golda gher	21
3		Fish pond (Homestead)	71
4		Fish pond (Commercial)	3
Sub-total			*95*
Grand Total			335

Source: Draft final fishery report, Volume-II, CEIP I

The Polder area consists of a number of seasonal and perennial canals/khals as mentioned above. Among those the *Nalian river, Hatkhola khal, Kamargoda river, Nadaken khal, Hetal Bonia khal,* etc are important in respect to fisheries habitat.

Figure 6.21: PL collection from the periphery river

Average depth of internal khals is (1-1.5) m which is sufficient for fish habitation. Depth of seasonal canals of the Polder area is insufficient for sheltering fish juveniles and is getting silted up. Local people reported that siltation rate in the internal fish habitats of the Polder is (2-3) cm per year. Khal beds are silted up due to deposition of loose soil coming from agriculture field and tidal action carry lot of sediment.

Culture fisheries

Aquaculture practice is expanding gradually in the Polder area. Various types of fish culture systems are adopted by the local people including mono-, poly-, and mix-culture. Exclusively poly-culture practice is adopted by the local people. Estimated area under culture pond is 74 ha. Most of these ponds are non-commercial and traditional in nature.

Commercial pond

Homestead pond

Figure 6.22 : Fish culture in different types of pond in the Polder area

6.4.4 Fish Production

Estimated total fish production of the Polder area is about 171 MT. Bulk of the inland fish production about (78.9%) is coming from culture fisheries while the rest comes from capture fisheries habitats (Table 6.17 and Figure 6.22). Fish production trend from capture fisheries is declining in the Polder area. The production is declining mostly due to obstacles to fish migration and decreasing fish habitat. Aquaculture is expanding gradually in the area by converting the cultivated land, as well as the medium low lands of the Polder area. Primary objective of this Polder is to increase the rice production by exploiting as much as land available and thus continues to decrease the open water fish habitats.

Table 6.17: Fish production from different habitats of the Polder area

Sl. No.	Fisheries Category	Habitat Types	Total production (MT)
1	Capture	Khal	36.1
	Sub-total		*36*
2	Culture	Golda gher	9.58
3		Homestead pond	119.28
4		Commercial pond	6.10
	Sub-total		*134.95*
Grand Total			171

Source: Draft final of fishery report, Volume-II, CEIP- I

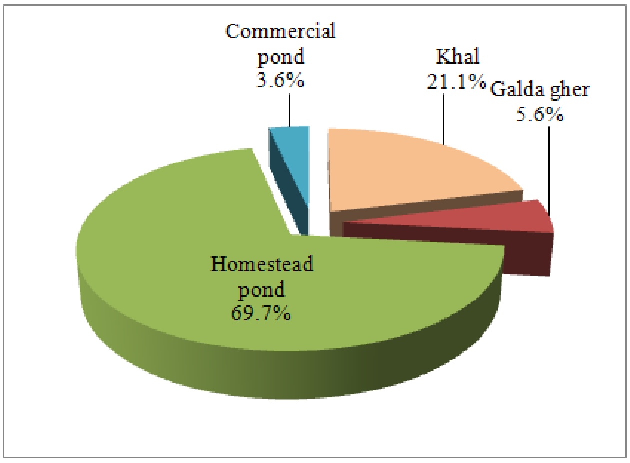

Figure 6.23: Fish production from different sources in the Polder

6.4.5 Fishing effort

Fishermen Number

It is reported during the field investigation and consultations with the local people that about 2% of the total households are engaged in commercial fishing while about 8% of households are involved as part time, 5% of households are in subsistence level fishing in and around the habitats of the Polder area. Fishermen mostly come from the Muslim (75%) and rest of (25%) from Hindu communities. They usually catch fish in the nearby tidal floodplain, rivers and khals. The available fisheries occupations of the area are mainly fishermen, fish traders and fish farmers.

Around (5-10) % women of the traditional fishermen families are involved in collection of shrimp PL in the Polder area.

Fishing season

Monofilament Gill net (Current jal) fishing is the major fishery of the Polder area. Next to seine net (Ber jal), cast net (Jhaki jal), push net (Thela Jal), charpata jal, fish trap (Borshi, Aton) fishing is prominent in the Polder area fish habitats. Fishing in seasonal canals as well as in peripheral rivers starts in May and continues up to March. Rest of the time they are mainly engaged in other fishing. The traditional fishermen catch fish in the rivers and perennial khals which are still open all the year round in most cases. The seasonality of major fishery is furnished in the **Table 6.18**.

Table 6.18: Fishing seasonality of the Polder area

Seasonality of fishing types

Fishing types	Seasonality																							
	Apr	May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr
	Boishakh		Jaishthya		Ashar		Sravon		Bhadra		Ashyin		Kartik		Agrahayan		Paush		Magh		Falgun		Chaitra	
Scine net (Ber jal/Kona jal)																								
Gill net (Current jal)																								
Cast net (Jhaki jal)																								
Push net (Thela jal/Net jal)																								
Charpata jal																								
Trap gear (Aton/Baim jal)																								
Lining (Borshi)																								
Hand Picking																								

High | Medium | Low | No occurrence

Source: CEGIS field data, 2012

Fishing Crafts and Location

The commercial fishermen of the Polder area catch fish in the peripheral rivers by using engine boat, jele nauka and dingi fishing boats.

Fishing Gears

Five types of nets/gears are used for fishing: (a) Mono filament net, locally known as Current jal, used to catch poa, ghagla, chingri, tengra, gulsha, along with other estuarine fish as well; (b) Seine net, locally known as Kona jal, used to catch all types of small and big fishes; (c) Cast net, locally known as Jhaki jal, used to catch rui, catla, puti, pua, bagda, golda, phasa, etc. (d) Push net, locally known as thela jal, which is used to catch punti, tengra, chingri, etc.; (e) Drag net locally known as net jal used to catch PL of shrimp and prawn; etc. Around 20% of fishermen have fishing boats and around 70% fishermen have fishing gears/nets. Traditional fishing gears of the Polder area are cast net (Jhaki jal), drag net (net jal), push net (Thela jal), lining (Borshi), fishing traps (Aton) etc. (**Figure 6.24**).

Local fishing boat (Dingi nauka)

Bota jal using in the Polder area

Figure 6.24: Different types of fishing gears of the Polder areas

6.4.6 Fish migration

Reportedly, feeding and spawning migration of riverine and Polder area resident fish species occur through open and regulated khals to some extent during the period of late June to August. Perennial khals such as *Nalian river, Kamargoda khal, Golbunia khal, Jalia khal, Pachordoani khal, Katakhali khal, Uluruar khal, Nadaken khal, Goler khal, Thakuronbari khal, Kashiar khal, Parar khal, Chotkatola khal, Hatkhola khal* along with other seasonal internal khals are used as feeding and shelter ground of most of the open water fishes. Many fish species like Phasa (*Setipinna taty*), Betki (*Lates calcarifer*), Horina Chingri (*Metapeneaus monocerus*), Khorsula (*Mugil corsula*), Chatka Chingri (etc migrate horizontally to these water bodies as part of their life cycle. Peripheral rivers along with internal river and khals of the Polder area are silted up naturally and due to structures on the khals cause the reduction the length of successive migration routes. Longitudinal migration of fish species e.g. Poa (*Sillago domina*), Tulardandi (*Polynemous paradiseus),* Ilish (*Tenualosa ilisha*), Phasa (*Setipinna taty),* Boal (*Wallago attu*), Cheowa (*Taeniodes anguillaries*), Rui (*Labeo rohita*) etc. is therefore obstructed. For this reason, overall fish migration status is poor to moderate in the Polder area.

6.4.7 Fish biodiversity

The Polder area is moderate in fish biodiversity though the biodiversity of fishes has the declining trend over the years. Obstruction in fish migration routes, morphological changes of internal khals, siltation of fish habitats, squeezing of spawning and feeding grounds and further expansion of both culture fishery and *Aman* cultivation are responsible for gradual declining of fish abundance and biodiversity. The Polder area comprises an assemblage of both fresh and brackish water fish species (Figure 6.25).

Figure 6.25: Typical catch composition in the Polder/ Study area consisting mostly indigenous species

Checklist of the fishes of different habitats reported by local fishermen is analyzed to draw a tentative scenario of the local fish biodiversity of the Polder area. Among the local fish species Cheowa (*Taeniodes anguillaries)*, Cheowa bele (*Apocryptes bato*), Poa (*Sillago domina)*, Bata (*Liza spp*), Phasa (*Setipinna taty)*, Chingri (*Peneanus sp*), Puti (*Puntius spp*), Shol (*Channa striatus*), Taki (*Channa puctatus*), Baim (*Mastacembelus spp*) etc. are common in the Polder area. List of the fishes of different habitats of the Polder area are given in Table 6.19.

Table 6.19: Indicative fish species diversity of different fish habitats in the Study area

Scientific Name	Local Name	Habitat Type			
		River	Khal	Gher	Fish pond
Brackish fish species					
Harpodon nehereus	Lotia	P	A	A	A
Terapon jarbua	Barguni	P	A	A	A
Lates calcarifer	Koral/Bhetki	P	P	A	A
Tenualosa ilisha	Ilish	P	P	A	A
Liza parsia	Bata mach	P	P	P	P
Liza tade	Bata mach	P	P	P	P
Mystus gulio	Tengra	P	P	P	P
Setipinna taty	Phasa	P	P	A	P
Mugil cephalus	Bata	P	P	A	A
Pangasius pangasius	Pangs	P	P	A	A
Polynemous paradiseus	Topshe	P	P	A	A
Sillago domina	Tolardandi	P	P	A	A
Pama pama	Poa	P	P	P	A
Taeniodes anguillaries	Cheowa	P	P	P	A
Apocryptes bato	Chewa bele	P	A	A	A
Trichiurus haumela	Chhuri mach	P	P	A	A
Scylla serrata	Kankra	P	A	A	A
Macrobrachium rosenbergii	Golda chingri	P	P	A	P
Metapeneaus monocerus	Horina Chingri	P	P	P	A
Penaeus monodon	Bagda chingri	P	P	P	P
Fresh water fish species					
Wallago attu	Boal	P	P	A	A
Sperata seenghala	Guijja Ayre	P	P	A	A
Puntius sophore	Datina puti	P	A	P	A
Glossogobius giuris	Bele	P	P	A	A
Puntius chola	Chola puti	A	P	P	P
Channa punctatus	Taki	A	P	A	P
Channa striatus	Shole	A	P	A	P
Heteropneustes fossilis	Shing	A	P	A	P
Eutropichthyes vacha	Bacha	P	P	A	P
Mystus vittatus	Tengra	P	P	A	P
Mastacembelus pancalus	Chirka baim	P	P	A	A
Mastacembelus aculeatus	Tara baim	P	P	A	A
Lepidocephalus guntea	Gutum	P	P	A	A
Culture fish species					
Labeo ruhita	Rui	P	A	A	P
Labeo calbasu	Kalibaus	P	A	A	P
Catla catla	Catla	P	A	A	P
Cirrihinus mrigala	Mrigal	P	P	A	P
Hypophthalmichthys molitrix	Silver Carp	A	A	A	P
Ctenopharyngodon idella	Grass Carp	A	A	A	P
Cyprinus carpio	Carpio	A	A	A	P
Puntius sarana	Sharputi	P	A	A	P

Here, A=Absent and P=Present

Source: Feasibility report (fisheries) of CEIP and field survey, 2012

6.4.8 Species of conservation significance

Fish species varieties which are locally unavailable for last 10 years or became rare reported by the local fishermen and concerned elderly people are given in the following Table 6.20.

Table 6.20: List of species of conservation significance

Scientific Name	Local Name	Local Status	
		Rare	Unavailable
Labeo rohita	Rui	√	
Catla catla	Katla	√	
Pangasius pangasius	Pangus	√	
Puntius sarana	Sharputi		√
Heteropneustes fossilis	Shing		√
Wallago attu	Boal		√

6.4.9 Area of conservation significance

Nalian river, Kamargoda river, Golbunia khal, Hatkhola khal, etc are used as feeding and spawning ground of most of the open water fishes. These are marked as the area of conservation significance. There is no scope for fish sanctuary development in the existing khals in the Polder area.

6.4.10 Fish marketing and post harvest facilities

Fish edible quality is in good condition for human intake. But due to lack of proper fish processing is deteriorating the fish edible quality and causing fish diseases especially during the dry season. Local fishers sell bulk of their catch either directly to the local fish market (Kamarkhola bazar, Kalabagi bazar, Nalian bazar, etc.) or to fish traders or buyers (Bapari) coming from Khulna, Bagerhat, Satkhira, and other districts. Fish farmers sell their fishes either to the fish traders or the local people directly. There is no real fish arat in this Polder area. No structured fish landing centers are found in the area. Ice from ice plants is used for icing the harvested fish. There is no well fish storage facility in this area. Fish transportation facility at the root level is moderately developed. There is no private/ Govt. fisheries hatchery inside the polder area. Fish seeds for culture fishery are collected from different fish hatcheries and nurseries which are mostly situated at Bagerhat, Khulna. Post Larvae (PL) of Golda and Bagdha are collected from Cox’s Bazar, ChaMNa, Paikgacha, etc. Availability of fish feeds for culture ponds are insufficient. Fish feeds are collected from the fish feed mills of Khulna, Bagerhat, and other districts. Low quality of fish feeds is the immense threat for the fish farmers which hinder expected fish production.

6.4.11 Fishermen lifestyle

Average daily income of commercial (traditional), part time and subsistence fishers are Tk. 300-400, Tk. 200-250 and Tk. 100-120 respectively. Previously daily income level of traditional fisher was Tk 400-500. Now a days, income level of traditional fisher is decreasing. This is due to destruction of fresh water fish habitats, silted up internal khals, intrusion of saline water into agriculture land, over exploitation of fisheries resources, increased risk of natural hazards, etc. Consequently, they are changing their occupation. They are also vulnerable to the musclemen who are responsible to convert open water fish habitats into culture fishery (gher) as well as natural degradation of fish habitats. Both traditional and modern methods fish culture are mostly practiced in the Polder area.

6.4.12 Fisheries management

There is no community based fisherman association. Fishing right on existing fish habitats is significant particularly on common resources. Department of Fisheries (DoF) has limited activity (observe fishing ban, technology transfer on pond and gher aquaculture practices through training etc.) for fisheries resource conservation and management in this area. Some NGOs are working, but they have much more micro credit function rather than extension services and aquaculture training. Enforcement of fisheries regulation is very weak.

6.4.13 Fish damage and wastage

Tidal flood as well as riverine flood sometimes washes away the aquaculture ponds, damages the pond dykes, aggrades the pond beds and cause to loss to the pond owner as fishes escape from the ponds. The magnitude of fish loss from the aquaculture ponds ranges 70% to 80%. Tidal flood also causes sand carpeting on the khals and thus created as less suitable for fish habitation. Inadequacy or lack of fish landing centers causes the wastage of fish at least by 4% of the total catch.

6.5 Ecological Resources

Polder 32 is located in the southern part of Bangladesh and is surrounded by mainly two tidal rivers namely Shibsha and Sutarkhali. These river systems deposited sediments in the polder area before 1960 and provided a vast area for agricultural crop production. It also holds many canals, fish ponds and ditches. The terrestrial and aquatic habitats are not intact, because disaster often affects habitat's natural functions and make this area very vulnerable for the biota. So, population and species richness in this polder area is low due to habitat fluctuation. As a disaster prone area, habitat and species fluctuation are common.

6.5.1 Bio-ecological zone

International Union for Conservation of Nature (IUCN-Bangladesh) classified the whole Bangladesh into 25 bio-ecological zones on the basis of ecological importance. Polder 32 falls under Saline Tidal Floodplain bio-ecological zone (**Figure 6.26**).

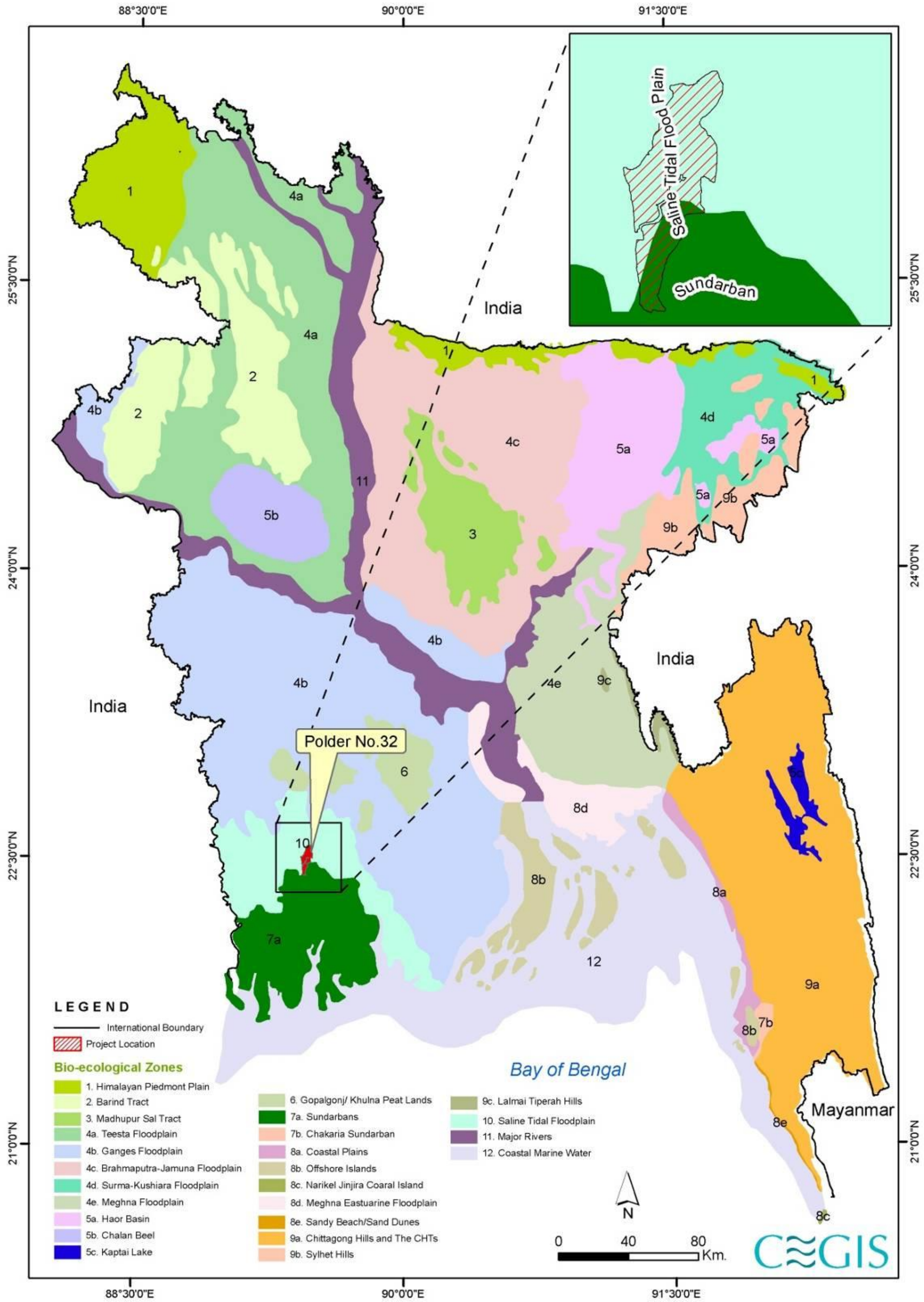

Figure 6.26: Location of polder area in Bio-ecological zone of Bangladesh

Saline Tidal Floodplain

Saline tidal floodplain bio-ecological zone is located the administrative districts of Satkhira, Khulna, Bagerhat, Jhalokathi and Borguna has a transitional physiography. It has a low ridge and basin relief, crossed by innumerable tidal rivers and creeks. Local differences in elevation are less than 1 m. The sediments are mainly composed of non-calcareous clays, although in the riverbanks, they are silty and slightly calcareous. The soil is non-saline throughout the year over substantial amount of areas in the north and east, but they become saline to varying degrees in the dry season in the south west and are saline for most of the year in the Sundarban. The rivers carry fresh water throughout the year to the east and northeast, but saline water penetrates towards west more and more mainly in the dry season, and for most or all of the monsoon season in the southwest. In the northeast, there is moderately deep flooding during the monsoon season, mainly due to accumulation of rainwater on the land when the water level in Ganges distributaries and the lower Meghna are high. Elsewhere, there is mainly shallow flooding at high tide, either throughout the year or only in the monsoon season, except where tidal flooding is prevented by embankments. Within embankments, seasonal flooding only occurs through accumulation of rainwater (Brammer, 1996).

Except for the Sundarban, the floral diversity of this zone is similar to those of adjoining zones. Innumerable indigenous weeds grow in beel areas. Several types of palms and bamboo clumps grow in almost all the villages. Mango *(Mangifera indica)* and Jackfruit *(Artocarpus heterophyllus)* supply the commonest timber and are used for making doors, windows, boxes etc (Bari, 1978).

The zone affords very lucrative place to game bird watchers. At the advent of winter season, numerous game birds which include wild goose, wild duck, cranes, spines, jungle fowl and various waterfowl, begin to flock both in the Sundarban and the beel and char areas of this zone. Mangrove, the network of rivers and expanse of beels of this zone teem with different species of fishes (IUCN-Bangladesh, 2000).

6.5.2 Ecosystem

Ecosystem of the polder area is mainly divided into two categories:

(a) Terrestrial and

(b) Aquatic

Terrestrial Ecosystem

Terrestrial ecosystem contains homestead and roadside vegetations. Few tree species like Narikel (*Cocos nucifera*), Rendikoroi (*Albizia saman*), Khejur (*Phoenix sylvestris*), Kola (*Musa* Sp.) etc exist in the project area. Most of the homestead plants are damaged by devastation of Cyclone Aila in 2009. The roadside vegetations mainly hold herbs and shrubs. These two types of flora are quite low in diversity because of high soil salinity. Extension of shrimp farming and inundation by the tidal surge are responsible for high soil salinity. **Table 1 under Annex C** shows available homestead plants and their status inside the polder area.

Figure 6:27(a): Homestead vegetation pattern of the polder area damaged by the cyclonic Aila (2009)

Aquatic Ecosystem

Aquatic ecosystem of this polder is composed of surrounding rivers especially Shibsha, Sutarkhali and Dhaki, meandered internal canals, saline water shrimp farms and homesteads ponds. Very few aquatic plants are available in internal canals due to having connectivity with surrounding tidal river and existing of continuous tidal flow. Canal margins are vegetated by saline tolerant grasses and abound with Hargoza (*Acanthus illicifolious*). Homestead ponds consist fresh or brackish water is dominated by Helencha *(Enhydra fluctuans),* Pani Kolmi (*Ipomoea aquatica*)*,* Topa Pana (*Pistia strateotes*)*,* Indurkanipana (*Salvinia* Sp.) etc. Shrimp farms are not such abounded by aquatic flora except one or two species of grasses and algae. **Table 2 under Annex C** provides a list of available plant species and their status of the polder area.

6.5.3 Mangrove Vegetation

Mangrove vegetation located at foreshores of the Sibsha and Sutarkhali river systems and found scattered throughout the polder area. Of the mangrove species, Kewra *(Sonneratia appetala)* is the commonest species followed by Gewa (*Excoecharia agallocha*), Bain (*Avicenia alba*), Golpata (*Nypa fruticans*) and Hargoza (*Acanthus illicifolius*).

Figure 6. 27(b): Golpata (Nypa fruticans) clumps at foreshore of the polder

6.5.4 Wildlife

Bangladesh is considered a biodiversity rich country and also a part of the Indo-Burma biodiversity hotspot. But the polder area is the most vulnerable to the natural calamities. Indeed, wildlife of the project area is in leased in terms of diversity and population. The main causes of this situation are for severe destruction of homestead forest and other natural vegetation by cyclone Aila in 2009. Wildlife species are classified as amphibians, reptiles, birds and mammals.

Among the amphibians, Common Toad (*Bufo melanostictus*) is quite common with different habitats and seasonally abounded Indian Bullfrog *(Hoplobatrachus tigerinus*) available in waterside bushes, banks of ditches, ponds, canals and rivers.

Reptiles are concentrated on Common House Lizard (*Hemidactylus brookii*), Common Garden Lizard (*Calotes versicolor*) and Common Skink *(Mabuya carinata*). Common House Lizard (*Hemidactylus brookii*) habituated in human habitation and latter two species prefer bushes or leaf- litter in the forest edges or gardens.

Bird population is large than other groups because polder 32 is situated close to the Sunadarban mangrove forest. The common terrestrial birds occur inside the polder are Drongo (*Dicrurus micrococcus*), House Crow (*Corvus splendens*), Red-vented Bulbul (*Pycnonotus cafer*), Spotted Dove (*Streptopelia chinensis*), Asian Pied Starling (*Sturnus contra*) and House Sparrow *(Passer domesticus*). Most of the above mentioned species inhabit homestead, pasturelands or vicinity of homestead vegetations. Wetland faunal diversity of this area is not rich. However, White Wagtail *(Motacilla alba),* Great Egret (*Casmerodius albus*), Little Egret (*Egretta garzetta*), Northern Pintail

(*Anas acuta*) etc are commonly found along mudflats, river foreshores and inside shrimp farms. Grey Heron *(Ardea cinerea)* occasionally found at surrounding aquatic environment.

The large mammals are in peril due to hunting pressure and habitat destruction. Mammal diversity is not high compared with other polder in this locality. Some small mammals like House Rat (*Rattus rattus*), Field Mouse (*Mus booduga*), Common Asian House Shrew (*Suncus murinus*), Mongoose (*Herpestes edwarsii*) and Indian Flying Fox (*Pteropus gangeticus*) sighted within the project territory. House Rat (*Rattus rattus*) and Common Asian House Shrew (*Suncus murinus*) associated with human habitation with good populations. The common mongoose (*Herpestes edwarsii*) considered a vulnerable species in the country (IUCN-Bangladesh) found in thickets, cultivated fields or in broken, bushy vegetations. It also visits open areas, grasslands and scrub lands. Indian Flying Fox (*Pteropus gangeticus*) roosts usually trees in the vicinity of water body.

6.5.5 Protected areas

The polder is located near the Sundarbans Reserved Forest and it is isolated by Sutarkhali River system from its eastern portion. The protected area, Sundarbans Wildlife Sanctuary (South) is about 35 Km south from this polder boundary.

6.6 Livestock Resources

Livestock and poultry, being an essential element of integrated farming system, play an important role in the economy of the Polder area. Livestock provides significant draft power for cultivation, threshing and crushing of oil seeds; cow dung as a source of manure and fuel; a ready source of funds; and meat, milk and eggs for human consumption. Most of the households raise poultry and livestock, a practice that significantly reduce poverty through generating income and employment. Total numbers of Cattles, Buffaloes, Goats, Sheep, Ducks and Chicken are presented in **Table 6.21**.

Table 6.21: Number of livestock and poultry of the Polder area

Category of livestock	Nos. of livestock/poultry
Cow/Bullock	9,872
Buffalo	29
Goat	5,060
Sheep	270
Duck	3,520
Chicken	50,540
Total	69,291

Source: Feasibility report (agriculture) of CEIP, 2012

The owners of the livestock population are facing problems in respect of availability of fodder and feeds during the month of July to December due to standing crops in the field. Rice straw is the main fodder. Oil cake and Bushi are the other common fodders in this study area. Shortage of grazing areas throughout the year aggravates the feed problem to the animal population. Poultry population at family level survives by scavenging and generally no feed supplements are provided. However, at times kitchen waste becomes feed for the poultry.


Figure 6.28: Livestock and poultry of the Polder area

Productions of livestock and poultry are mainly constrained due to diseases and death of the population. Outbreak of disease is causing a considerable economic loss in livestock farming. Every year livestock population is affected by different diseases. Major poultry diseases are Ranikhet, Fowl Pox, and Cholera. The vulnerable period is around year for spreading diseases to livestock and poultry populations.

6.7 Socio-economic Resources

6.7.1 Area and Location

The Polder 32 covers part of Dacope upazila of Khulna district. The Polder area falls in two unions namely Kamarkhola and Sutarkhalias shown in **Table 6.22.**

Table 6.22: Unions and Upazilas in Polder 32

Name of district	Name of Upazila	Name of Unions	Percentage of Union within polder
Khulna	Dacope	Kamarkhola	85
		Sutarkhali	72

Source: Spatial GIS Analysis, CEGIS, 2012

6.7.2 Demography

Based on the Census Report of Bangladesh Bureau of Statistics (BBS) for 2011, the population in the Polder 32 is 33,456. This includes 16, 985 males and 16,471 females. A total of 8,399 households exist in the polder with average size of 3.98 persons per household. The density of population is about 980 persons per square kilometer. The key demographic data of the Polder is presented in **Table 6.23**.

Table 6.23: Demographic Data of Polder

Households	Population			Size of House Hold
	Total	Male	Female	
8,399	33,456	16,985	16,471	3.98
		50.8%	49.2%	

Source: Population Census 2011, BBS

Figure 6.29: Trend of population in the study area.

Population trend is shown in thousands in the above figure (**Figure: 6.29**). It is found that total number of population remain same in 2011 as found in 2001. But, it increases three thousands than in 1991. It is also noticeable that the number of male and female remains same both in 2011 and 2001.

Table 6.24 shows the age group composition of the people of the polder area. About 31 percent of the population is less than 15 years, 61 percent in between 15 to 59 years and 8 percent are over 60 years of age. The data shows that around 39 percent of the population depends on the 61 percent of the earning members of their households. Hence the dependency ratio is 64.

Table 6.24: Age Distribution in Polder

Age Range (Years)	0-4	5-9	10-14	15-19	20-24	25-29	30-49	50-59	60-64	65+
Percent of Population	8	11	12	8	9	9	27	7	3	6

Source: Population Census 2011, BBS

6.7.3 Livelihood

Occupation

According to the census report 2011, around 76 percent households report agriculture as their main occupation. About 23 percent population is engaged in service sector and only 1 percent is engaged in industrial sector. Most of the population is engaged in agriculture and service sector. (**Figure: 6.30 and Table: 6.25)**

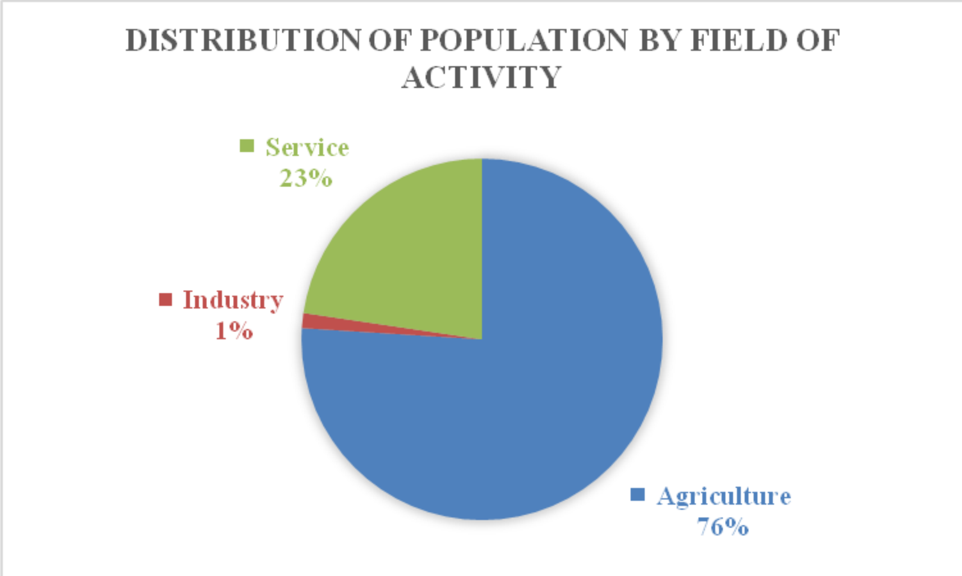

Figure 6.30: Distribution of population by field of activity

Source: Population Census 2011, BBS

Table 6.25: Main Occupation in Polder

Union	Agriculture (%)		Industry (%)		Service (%)	
	Male	Female	Male	Female	Male	Female
Kamarkhola	79.5	2.5	1.3	0.8	12.8	3.1
Sutarkhali	67.2	6.2	0.8	0.3	16.6	9.0

Source: Population Census 2011, BBS

Male and female are equally engaged in livelihood activities. However, participation of female member is nominal in comparison to male participation. In the polder area only 13 percent female members are working whereas 87 male members are engaged in income generating activities.

Employment

In the Polder, about 35 percent of total population is employed, 43 percent is engaged in household work, only one percent is looking for work and about 21 percent of total population is not working (it includes children and physically challenged population). Figure 6.30 shows the employment status of the people in the Polder area.

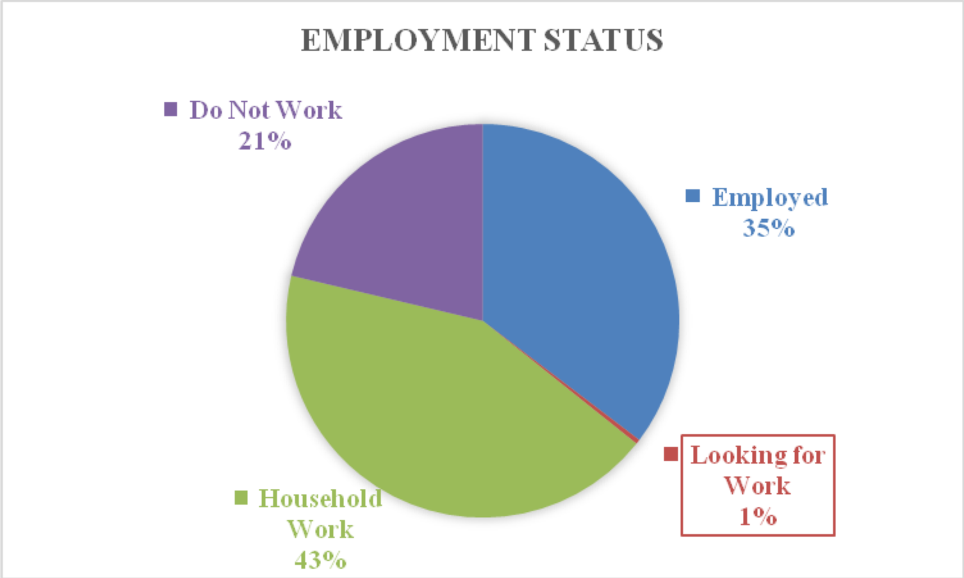

Figure 6.31: Employment status in the polder area.

Source: Population Census 2011, BBS

The following table (Table 6.26) shows the distribution of employment status by male and female in the polder area. It is found that only four percent female members are employing whereas 31 percent male members are employing in the study area.

Table 6.26: Employment status in Polder

Union	Employed (%)		Looking for Work (%)		Household Work (%)		Do Not Work (%)	
	Male	Female	Male	Female	Male	Female	Male	Female
Kamarkhola	29.5	2.0	0.1	0.1	0.2	45.2	7.0	15.8
Sutarkhali	31.5	5.8	0.3	0.2	0.8	41.0	7.2	13.3

Source: Population Census 2011, BBS

6.7.4 Quality of Life

Housing Condition

In the Project area, overall housing condition is not satisfactory. On an average only one percent houses are pucka (made of bricks and mortar) whereas 85 percent are kutcha (made of wood/bamboo, and other local materials. Statistics show that Sutarkhali union comprises the highest kutcha household (95.4%) whereas Kamarkhali union comprises the highest Jhupri households (20.3%). It can be concluded that the people living in the study area belong to extremely poor category in term of housing type.[9]

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

Table 6.27: Housing condition in the study area

Union	**Type of Structure (%)**			
	Pucka	**Semi-pucka**	**Kutcha**	**Jhupri**
Kamarkhali	**1.7**	**4.4**	**73.6**	**20.3**
Sutarkhali	**1.2**	**1**	**95.4**	**2.4**

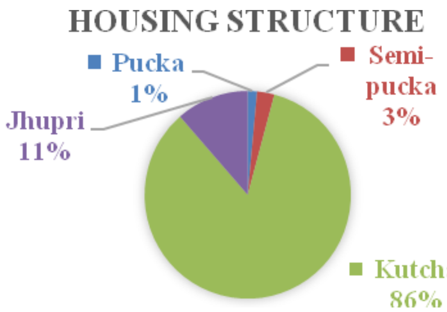

Figure 6.32: Housing Types in Polder Area

Source: Population Census 2011, BBS

Drinking Water

Overall status of drinking water in the area is not satisfactory. Most of the people can collect drinking water from other sources such as ponds, PSF, rain water etc. salinity is the main problems in the polder area. The detail is presented in **Table 6.28**, which shows that percentage of tube-well coverage is insignificant. People are to collect drinking water from different source.

Table 6.28: Source of Drinking Water in Polder

Union	**Sources of Drinking Water (%)**		
	Tap	Tube-well	Other
Kamarkhola	0.1	22.6	77.3
Sutarkhali	1.6	13.7	84.7

Source: Population Census 2011, BBS; and Baseline Survey, 2012.

Figure 6.33: Domestic level rain water harvesting

Figure 6.33: Domestic level PSF

The water quality analysis result for drinking water i.e. arsenics or coliforms already has mentioned in baseline chapter of water resources.

Sanitation

The sanitation facilities[10] adopted by households of the Project area are presented in Table 6.29 and Figure 6.35. It shows that about 30 percent households have hygienic sanitation facility (water-sealed), 22 percent have not water-sealed sanitation facility, 30 percent have non-sanitary sanitation facility and 18 percent have no sanitation facility. Local people face the worst situation regarding the sanitation facility.

Table 6.29: Sanitation Facilities in the Polder

Union	Type of Structure		
	Sanitary (water-sealed)	Sanitary (not water-sealed)	Non-sanitary
Kamarkhola	54.6	27.3	6.1
Sutarkhali	5.3	16.2	53.6

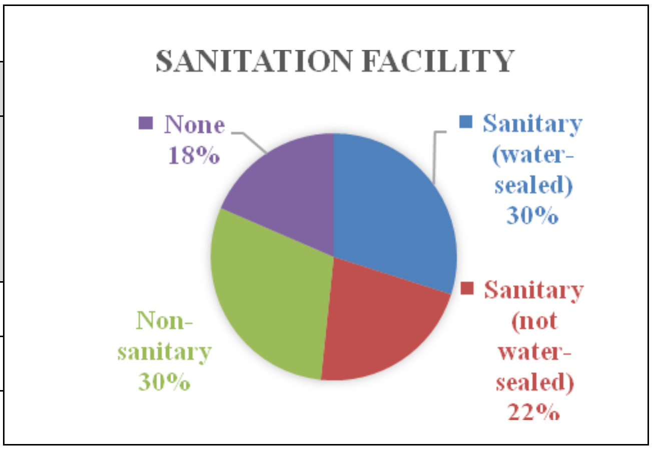

Figure 6.35: Sanitation facility in study area

Source: BBS and Baseline Survey, 2012.

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

Sanitation facility is quite satisfactory in Kamarkhali union (55% eater-sealed sanitary) whereas it covers only five percent in Sutarkhali union. This union is located nearby the Sundarban and experiences the worst effects of salinity. Most of the people use hanging latrine or defecate in open spaces.


Figure 6.36: Sanitation facility in the polder area

Health Profile of Polder People

The health profile of the local people living in the Polder is presented in the Table 6.30. According to the ranking, the incidence of gastric is the most prevalent ailment in the area. Cough/cold, skin diseases are also common in the Polder area.

Table 6.30: Disease Profile in the Polder

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

Source: CEGIS fieldwork, 2012

Health Services and Facilities

Field findings show that there is no hospital/community clinic in the polder area. However, there isone upazila health and five community clinics in peripheral area (Dacope upazila). The local people are to receive health service and facility from these peripheral hospitals (Table 6.31). It is observed that communication between polder area and upazila is so poor that patients cannot go to these peripheral hospitals easily. As a result, they show carelessness to receive treatment facility.

Table 6.31: Health service facilities in the study area

Sl. No.	Union Name	No of upazila health complex	No of Community Clinic	Outside of Polder health facilities
1	Kamarkhola UP	-	1	Dacop, Khulna
2	Sutarkhali UP	1	4	Dacop, Khulna
Total		1	5	

Source: RRA, CEGIS, 2012

It is found that about 40 percent people tend to receive health service from quack and 35 percent from paramedic/diploma physicians and only 10 percent from trained physicians. But it is noteworthy that about 15 percent cannot receive treatment facility due to their impoverishment and communication problems (**Figure 6.37**).

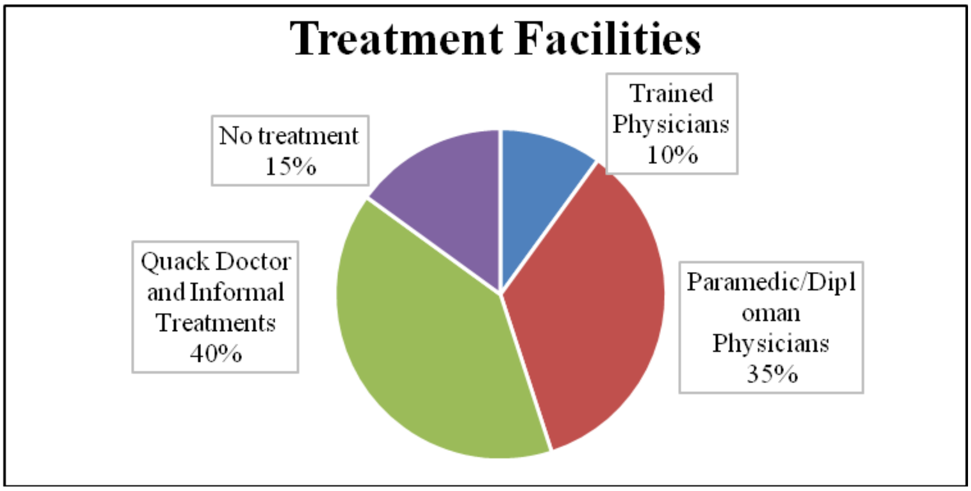

Figure 6.37: Health Service Providers in Polder

However, quality of health services and facilities is quite poor as reported by the local people. People responded that they are not satisfied in health services and facilities at all.

Education

In the study area literacy rate not satisfactory in terms of national average. It comprises 58 percent in Kamarkhali union and 50 percent in Sutarkhali union (Table 6.32). Local people are to think about livelihood earning all the time. However, the tendency to be educated in growing. They perceived that they have no way to overcome this worse situation but only education can lead them towards emancipation.

Table 6.32: Literacy Rate at Polder 32 Area

Union	Literacy Rate (%)		
	Total/Both	Male	Female
Kamarkhola	58.1	65.9	50.1
Sutarkhali	49.5	56.3	42.6

Source: Population Census 2011, BBS

The following figure (**Figure 6.38**) shows the trend of literate rate. It shows that overall literacy rate is increasing gradually. The tendency of being educated is growing among men and women.

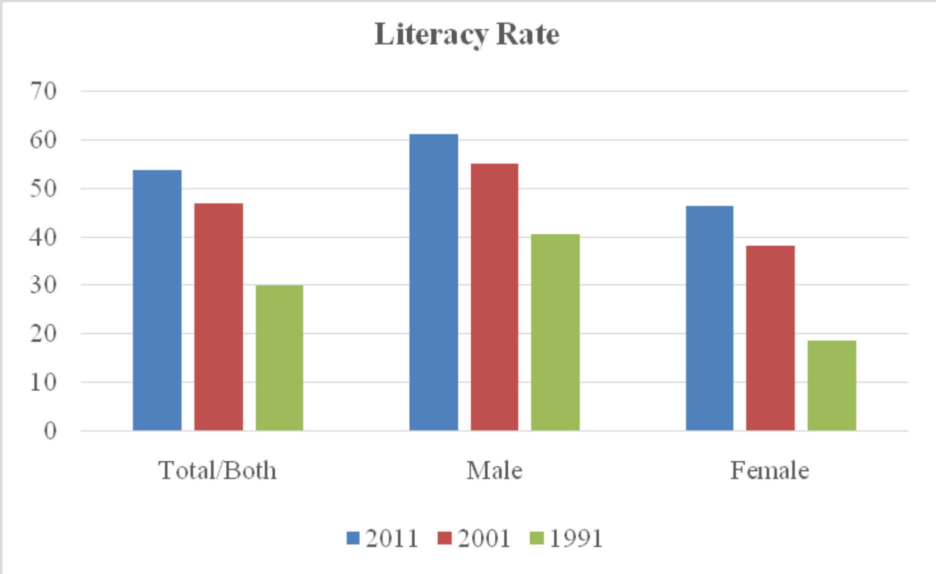

Figure 6.38: Trend of literacy rate in the polder 32 area

Electricity

Electrification as reported in the Population Census is not satisfactory in the Project area. On an average, only 19 percent households are under electricity coverage. Very few households use solar electricity in the Project area. **Figure 6.39** shows the percentage of electricity connection in different unions of the Polder areas (69%).

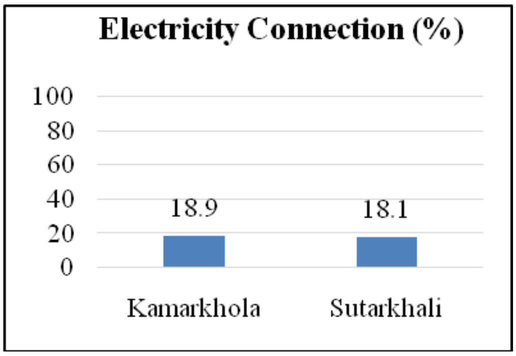

Figure 6.39: Trend of electricity facility

6.7.5 Poverty and Safety Nets

Landownership Pattern

Landownership pattern can be an indicator to understand the poverty incidence in a given area. Statistics shows that there are 75 percent smallholders, 20 percent medium and only 5 percent large landholders (**Table 6.33**).

Table 6.33: Landownership Pattern in Polder

Land Ownership Classes	Households (%)
Small (0.05 to 2.49 acres)	75
Medium (2.5 to 7.49 acres)	20
Large (7.5 acres and above)	5

Source: BBS, Agriculture Census, 2008

The following figure (**Figure 6.40**) shows the ownership pattern in the polder area in a comparative manner. It is found that smallholders are the dominant owner groups both in Kamarkhali and Sutarkhali unions.

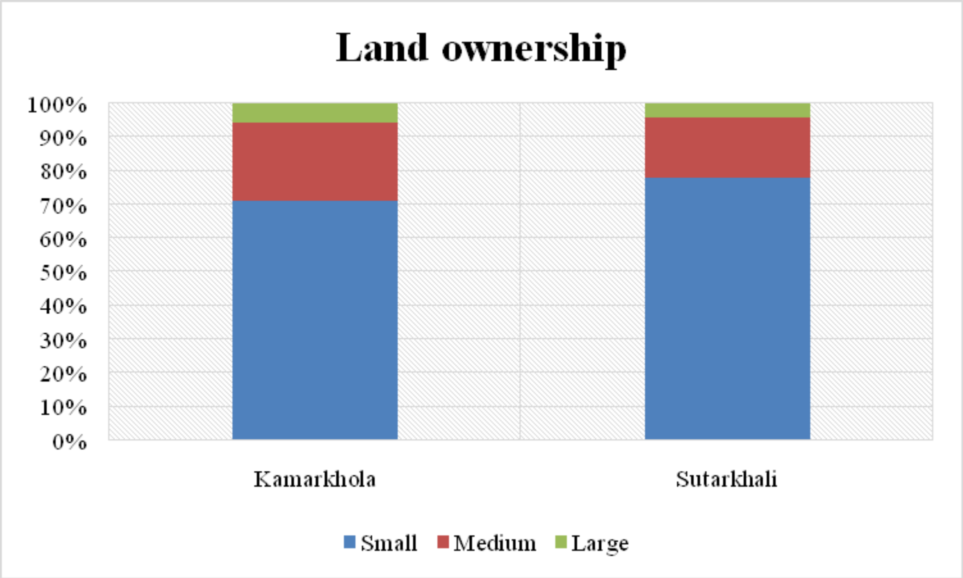

Figure 6.40: Land holding categories in project area

Source: BBS, Agriculture Census, 2008

Income Poverty

Income poverty profile has been prepared by the participants of the RRA themselves through a self-assessment exercise. The assessment is based on the year-round income along with the food consumption of the inhabitants within three different categories (**Figure 6.41**). It is observed that about 54 percent of the households in average are in the 'deficit' category. These households have been identified in the RRA as the poor households of the Polder area. Considering the standard consumption of food (three meals in a day), the deficit group was usually taking two meals in a day in the lean period since they could not afford three full meals.

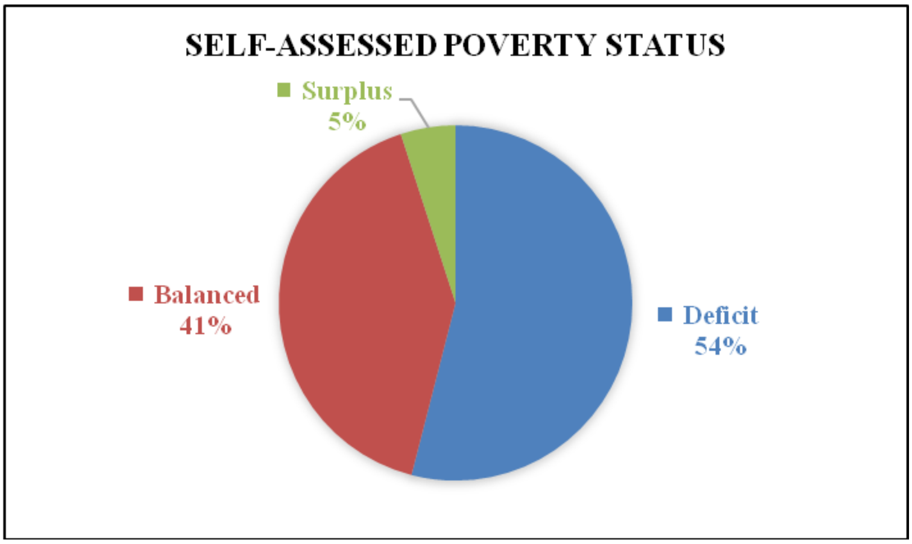

Figure 6.41: Self-Assessment of Poverty Status

Income and Expenditure

The income and expenditure at the household level in the Polder area is shown in **Table 6.34**. It is found that most of the people belong to 12,001 taka to 108,000 taka income and expenditure category annually. Their monthly income varies from 1000 tk. to 9000 tk. per month.

Table 6.34: Annual Income and Expenditure Level

Range in Taka	Percentage (%) of Households	
	Income	Expenditure
Up to 12,000	8	5
12,001to 24,000	25	20
24,001to 60,000	30	52
60,001to 108,000	28	20
108,001 to 240,000	9	3
More than 240,000	-	-

Source: CEGIS fieldwork, 2012

Natural Disasters

The local inhabitants of Polder 32 have identified tidal flooding, salinity intrusion and cyclones as the major hazards in the area. Details about the disasters and their affects in the area are presented in **Table 6.35**.

Table 6.35: Effects of Recent Natural Disaster in Project Area

Disaster		Affected Area (%)	Affected House Holds (%)	Crop Damaged (%)	Major Damaged Crop
Tidal Flood	2007	80	50	90	Rice
Salinity	2007, 2009, 2011	90	90	98	Rice
Cyclone	2007 (Sidr), 2009 (Aila)	100	100	98	Rice

Source: CEGIS fieldwork, 2012

Social Safety Nets and Poverty Reduction Measures

The major social safety nets and poverty reduction programs initiated in the area include the Vulnerable Group Development (VGD), Food/Taka for Work (F/TFW), Food for Education/Cash for Education, Rural Maintenance Program (RMP), Old Age Allowance, Freedom Fighter Allowance and Integrated Poverty Reduction Program. These programs have created food security as well as social safety nets among the targeted poor households and vulnerable communities (**Table 6.36**).

Table 6.36: Households Served by Different Social Safety Nets Programs

Social Safety Net Programs	Households/Communities Served (%)
Vulnerable Group Development (VGD)	6
Food/Taka For Work (F/TFW) of PIO	4
Food for Education/Cash for Education	10
Rural Maintenance Programme (RMP)	6
Old Age Allowance	5
Freedom Fighter Allowance	3
Integrated Poverty Reduction Program of BRDB	6

Source: CEGIS fieldwork, 2012

A number of local, national and international NGOs are working in the Project area. The main activities of these NGOs are operating micro credit programs among the rural poor and landless women/men. The major NGOs working in the area include BRAC (Bangladesh Rural Advancement Centre), ASA (Association for Social Advancement), World Vision and Karitas (Table 6.37). These NGOs are serving with micro credit while BRAC, ASA, World Vision and JJS are working for non-formal education, Health, human rights, water and sanitation, gender and children development programs. On the other hand Karitas is working to build awareness for natural disaster. About 45 percent of households are found to benefit from the NGOs interventions. After disasters (Sidr and Aila) the JJS was appeared the most important NGO for the local people.

Table 6.37: NGOs and their Programs in Project Area

NGOs	Type of Programs						
	Credit	Education	Water and Sanitation	Health	Disaster	Gender	Children
BRAC	✓	✓	✓	✓	-	✓	✓
ASA	✓	✓	-	-	-	-	-
World Vision	-	✓	✓	-	-	-	-
Karitas	-	-	-	-	✓	-	-
JJS	✓	-	-	✓	-	-	-

Source: CEGIS fieldwork, 2012

6.7.6 Social Capital

Roads

Road networks and communication system is so far poorest in the polder area. Local people communicate through both roadways and waterways. It is found that there are three connecting roads in the across the polder area (Table 6.38). Most of the roads are earthen and undeveloped. There is no single roadway connecting directly to the upazila rather they are to cross the dissecting khals and rivers.

Table 6.38: Road Network in Polder

Sl. No	Description	Type of Road	Length (Km)
1	Jaliakhali to Kamarkhola	Earthen road	3 km
2	Kamarkhola Uttar para (Care road)	Earthen road	1.5Km
3	WAPDA Colony KhayGhat to Kalinagar	Herringbone/Brick soling	10Km

Source: CEGIS fieldwork, 2012

Figure 6.42: Muddy and soling roads in the Polder area

The following table shows the traffic entry and exit in the polder area. It appears that motor bike is the dominant mode of communication since the road networks and condition appears poorest.

Table 6.39: Traffic entry and exit in the polder area.

Type of vehicles	Entry	Exit
Motorbike	48	52
Van	2	2
Nosiman	2	2
Trawler	9	22
Kheya	8	8

Waterways

Waterway is one of the most important modes of communication. There are twelve boat ghats those are used by the local people as the main mode of communication.

Figure 6.43: Navigation in the polder area

Local people are to communicate through waterways due to poor road networks. Most of the goods and commodities are carried by this mode.

Table 6.40: Major Navigation Routes in the Area

Sl No	Union Name	Name of boat ghat	No of boat ghat
1	Kamarkhola UP	Kalinagar,WPDA colony, Rakhamari, Joynagar, KamarkholaPoshim para, Jaliakhali,Sreenagar, VhitaBhanga	8
2	Sutarkhali UP	Kalibary, Gunary, Nolian, Sutarkhali Forest Ghat	4
Total			12

Educational Institutions

According to the field findings there are 30 primary schools, 10 secondary schools and 2Madrashas in the study area (Table 6.41) There is no college seen in the study area.

Table 6.41: Academic Institutions

Sl. No	Union Name	No of Primary School	No of Madrasha	No of High School	No of Collage
1	Kamarkhola UP	13	-	5	-
2	Sutarkhali UP	17	2	5	-
Total		30	2	10	-

Source: CEGIS field work, 2012

Markets

There are 4 markets/bazaars in the study area, among them two in Kamarkhali union and another two in Sutarkhali union (Table 6.42). These are serving better for the local people.

Table 6.42: Markets in Project Area

Sl. No	Union Name	No of Market Facilities:
1	Kamarkhola UP	Kalinagar Bazar, Joynagar Bazar
2	Sutarkhali UP	Gunary Bazar, Talirkona Bazar.
Total		4

Source: CEGIS database, 2012

6.7.7 Gender and Women

Like other part of the country women in the polder area are also restricted to household works. Most of the decision making power goes to family maintenance. They have limited access to social sphere (Figure: 6.44). Women mobility in the area is mostly localized except when going for medical treatment, fetching water, farming activities, and visiting relatives.

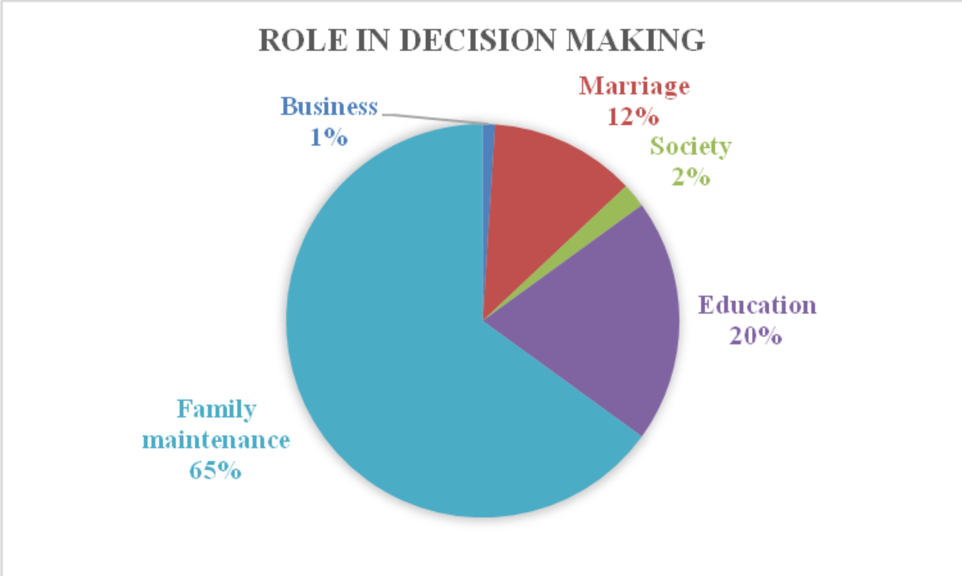

Figure 6.44: Scope of Decision Making by Women

In some cases women can play role in livelihood earning, education of their children. The traditional scenario is changing nowadays. Mortality rate of the pregnant mother during delivery period has reduced in the area. The growing consciousness among the local people as well as the health services provided by the public and other health centers including the programs of NGOs have contributed to the decrease of the mortality rate. About 20 percent women are living with good health condition and the rest are suffering from various diseases such as low blood pressure and premature delivery. About 15 percent women are getting proper nutrition and about 10 percent have access to the health centers, which are around 15 km away on average from their residence.

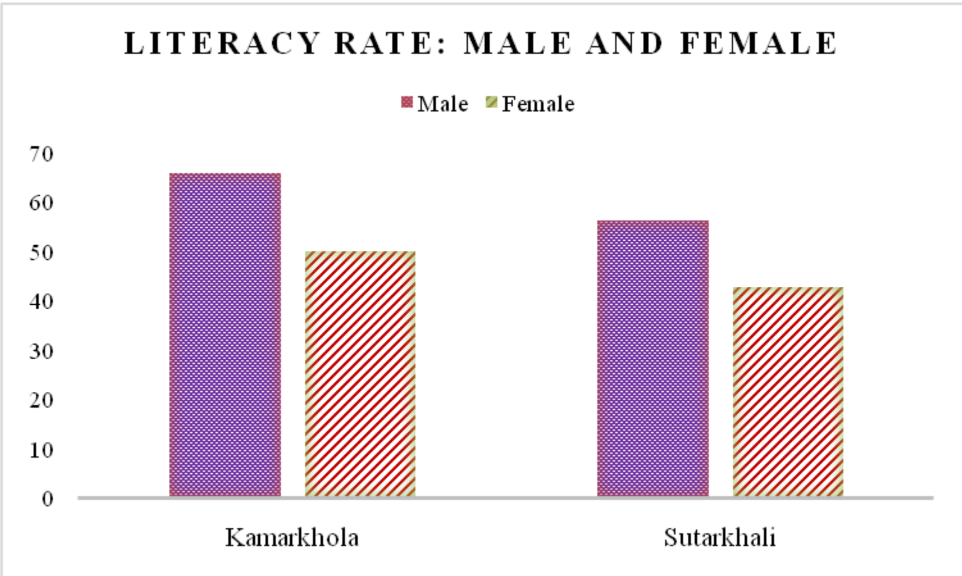

Figure 6.45: School Enrolment

Literacy rate of both male and female is ever increasing than the privous year. The worst natural situation and associated plight stimulated the spirit of education.

6.7.8 Vulnerable Communities

Fishes community is the most vulnerable community in the polder area. The fishing area was owned by them was captured by the large gher owners. Thus, there exists severe conflict between gher owner and fishermen.

6.7.9 Common Property Resources

The common property places/resources of the area are different social amenities e.g. mosques, graveyards, temples, cremation grounds, playgrounds and Eidgahs (place for offering Eid prayers). These are used frequently by the local people for the purposes of religious, social and cultural gathering. Besides these, the BWDB embankment is also used very commonly for different livelihood purposes of the local inhabitants.

There are 46 mosques, 48 temple, 65 graveyards and 26 crematoriums in the polder area. Besides there are 19 cyclone shelters among them two are under construction. However, there are no known historical and archeological sites declared by government in the Polder area (Table 6.43).

Table 6.43: Common Property Places/Resources in Polder 32

Sl.No	Union Name	No of Mosque	No of Temple	No of Graveyard	No of Cremation	No of Cyclone Salter	
						Functional	Under construction
1	Kamarkhola UP	17	22	15	15	11	1
2	Sutarkhali UP	29	26	50	11	6	1
Total		46	48	65	26	17	2

Source: CEGIS fieldwork, 2012

7. Climate Change

7.1 Overview

Climate change refers to a change in the state of the climate parameters that can be identified by changes in the mean and the variability of it properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of anthropogenic activity. This definition differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (Forth Intergovernmental Panel on Climate Change - IPCC Synthesis Report, 2007).

7.2 Regional Context

Asia is very likely to be warm during this century; the warming is likely to be well above the global mean in central Asia, the Tibetan Plateau and northern Asia, above the global mean in East and South Asia, and similar to the global mean in Southeast Asia. It is very likely that summer heat waves/hot spells in East Asia will be of longer duration, more intense, and more frequent. It is very likely that there will be fewer very cold days in East Asia and South Asia.

Boreal winter precipitation is very likely to increase in northern Asia and the Tibetan Plateau, and likely to increase in eastern Asia and the southern parts of Southeast Asia. Summer precipitation is likely to increase in northern Asia, East and South Asia and most of Southeast Asia, but it is likely to decrease in central Asia. An increase in the frequency of intense precipitation events in parts of South Asia, and in East Asia, is very likely.

Extreme rainfall and winds associated with tropical cyclones are likely to increase in East, Southeast and South Asia. Monsoonal flows and the tropical large-scale circulation are likely to be weakened.

The above mentioned regional level climate change impacts were assessed in the second national communication report of Bangladesh.

7.3 Local Context

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). 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 likely implications due to climate change considered in this study for the coastal areas of Bangladesh:

7.3.1 Sea Level Rise and Coastal Inundation

Bangladesh is vulnerable to current coastal hazards and anticipated Sea Level Rise (SLR) because of its low elevation. Drainage congestion and water logging are already an alarming problem in Bangladesh specifically in polder area and likely to be exacerbated by SLR and increased river flooding. It is reported that inundated areas might increase up to 3 percent (2030s) and 6 percent (2050s) primarily in coastal low lying areas (0 – 30 cm, Khan et al., 2006, using upper estimates of SLR). Large uncertainties are associated with regional to district level estimates of inundation which is due to the compounding effects of the variable rates of uplift and sedimentation, river flooding and erosion. Siltation is gradually increasing in the project area due to SLR. As a result of reduced upstream flow, the silt flocculate/deposit in the riverbed which restricts removal of excess water from the countryside and causes drainage congestion.

7.3.2 Tidal Flooding

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 climate change impact (sea level rise).

A recent study entitled 'Climate Change Impacts on Food Security in Bangladesh' assessed future flooding scenarios for Bangladesh (Yu et al., 2010). In this study, MIKE 11 and MIKE BASIN models were used for generating river flow, discharge and finally flooding. In this study Bangladesh has been divided into 16 sub regions for incorporating the spatial and temporal variation in flooding in different parts of the country. In defining the sub regions the MPO/NWMP Plan Unit and district boundaries are considered to be whole. These sub regions are classified based on various climatic, agricultural and flooding characteristics. In the classification process of sub regions similar topography, flooding characteristics etc. have been considered with great importance. The results of the flooding analysis have been presented utilizing the MPO flood depth classification. This classification includes five flood phases/land type, based on a three-day maximum flood depth, theoretically with an exceedence return probability of 1 in 2 years (MPO, 1987). In this classification F0 is 0-30 cm; F1 is 30-90 cm; F2 is 90-180 cm; F3 is 180-300 cm and F4 is over 300 cm. Figure 7.1 illustrates the percentage changes in flooded area in each sub region due to climate change in the 2030s and 2050s. The results show an increase in flooded area in the coastal region of Bangladesh.

7.3.3 Salinity Intrusion

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. In 2007, Institute of Water Modelling (IWM) and CEGIS jointly carried out a study on "Investigating the Impact of Relative Sea-Level Rise on Coastal Communities and their Livelihoods in Bangladesh" and assessed that in base condition about 10 percent of coastal area is under 1 part per thousand (ppt) salinity and 16 percent area is under 5 ppt salinity and this area will increase to 17.5 percent (1 ppt) and 24 percent (5 ppt) by 2050 considering 88 cm sea level rise. So, there will be an increase of around 8 percent in the area under 5 ppt salinity levels due to sea level rise. The area of influence of 5 ppt salinity line under different sea level rise scenarios are show in Figure 7.2. The intrusion of salinity will increase soil salinity and surface water salinity and might affect agriculture crop production.

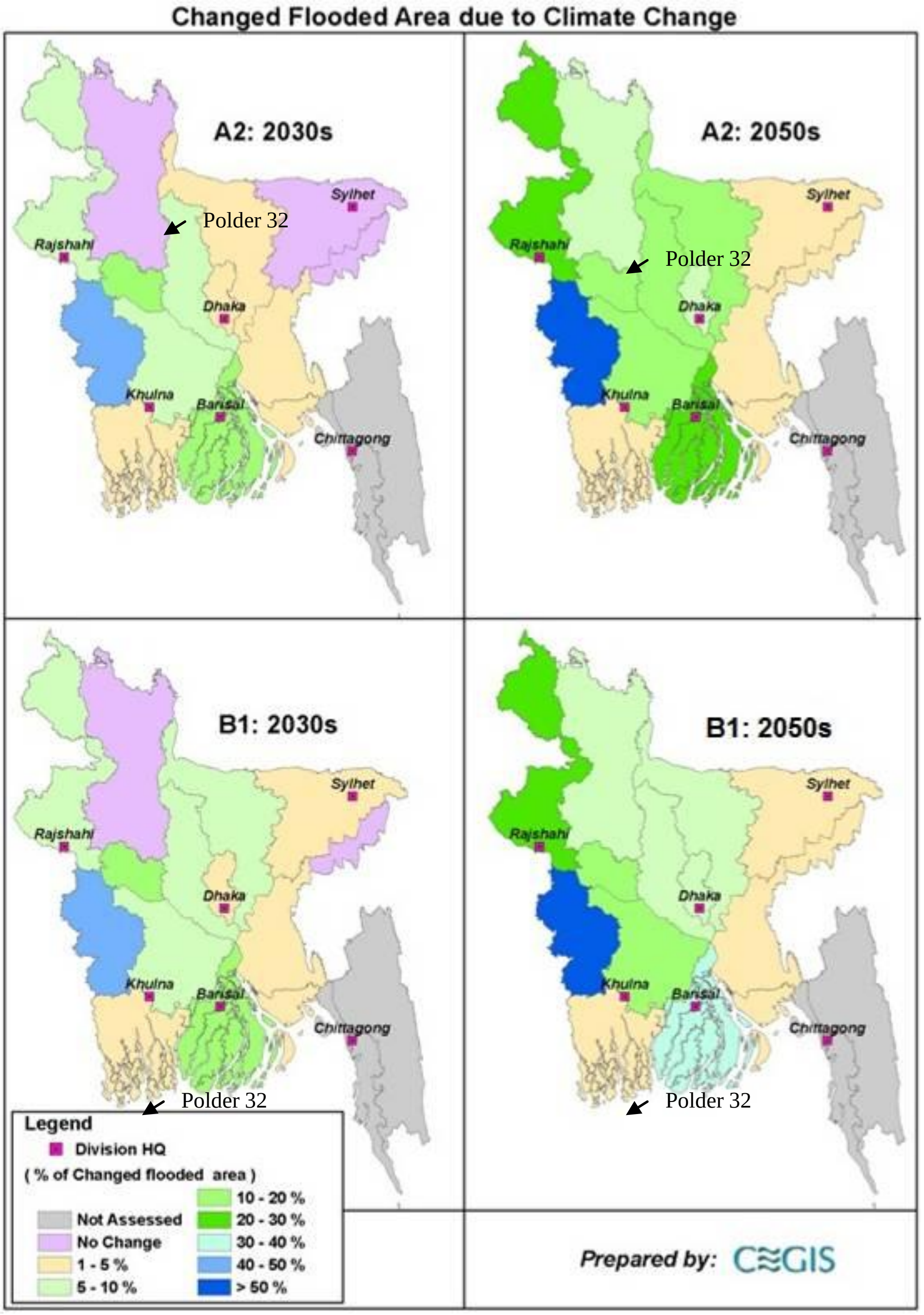

Figure 7.1: Changes in flooded area in Bangladesh in the 2030s and 2050s

(Source: Hassan et. al., 2010)

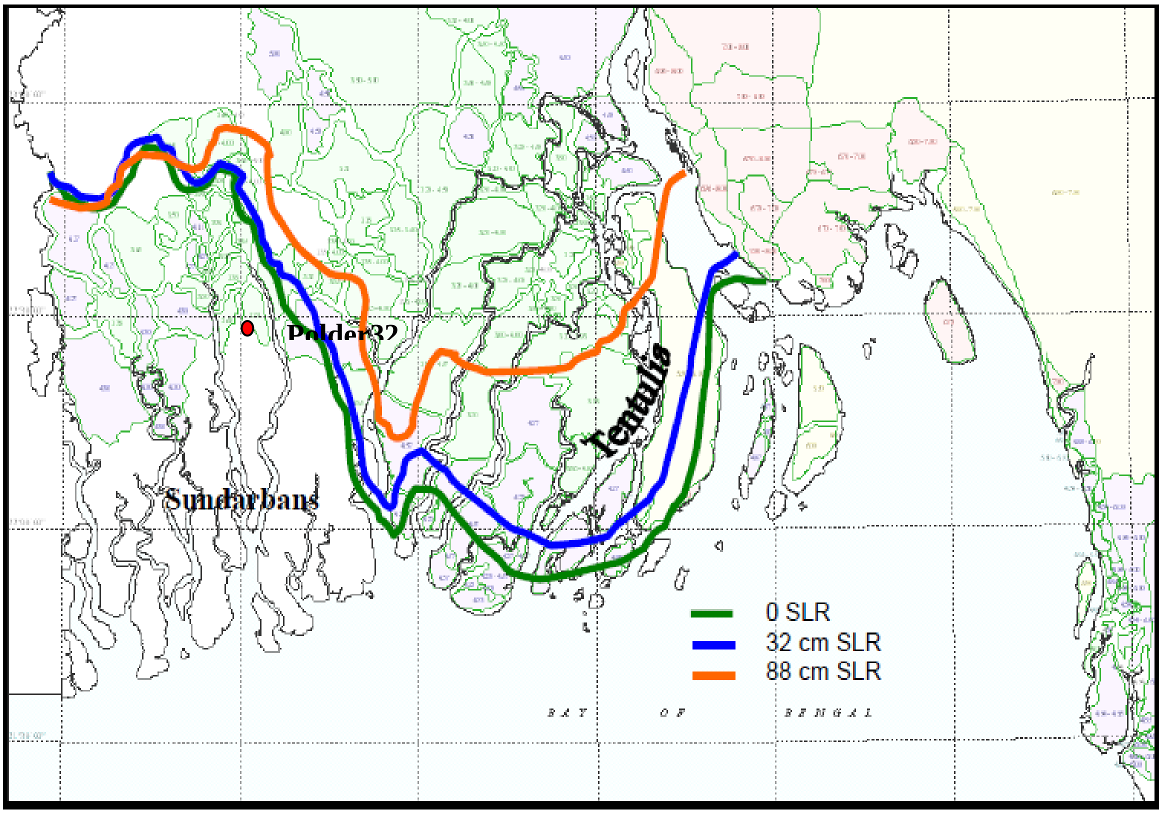

Figure 7.2: Five ppt isohaline line for different sea level rise in dry season

(IWM and CEGIS, 2007)

7.3.4 Cyclones and Storm Surges

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

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 (Figure 7.3) and 16 cyclones (Table 7.1) have occurred in the last 25 years. The following table represents the occurrence of cyclone is more frequent due to climate change (T. Islam, 2009). Last devastating cyclone (SIDR) hit the study area and project site on 2007. The project area (Polder32) is located in the wind risk zone of Bangladesh.

The area is vulnerable to cyclone and storm surge. During SIDR, surge water entered the polder area by overtopping the right bank of the Bhairab (Daratana) River. As per local community perception, the site has experienced the maximum surge height during cyclone SIDR. As per local perception, the area was inundated by the surge of 4.42 m during Aila.

Table 7.1: Major Cyclones Hitting the Bangladesh Coast

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

7.3.5 Rainfall, Drainage, and Water logging

The rainfall is likely to increase by about 26 percent in the month of March - May; and 13 percent in the month of June- August (4th IPCC). As a consequence, flooding inundation will change demanding efficient drainage for crops.

The drainage of coastal polders mainly depends on the tidal characteristics of the surrounding rivers and degree of siltation of these rivers. In 2008, Institute of Water Modeling (IWM) carried out a study on “Impact of Sea level rise in coastal river of Bangladesh” and assessed that present study mainly focused the change in the tidal characteristics of the surrounding rivers due to sea level rise and its impact on inundation area of the polder.

The result shows that high water level at the surrounding rivers of polders increases in the range of 30-80 cm for sea level rise of 32 cm and 88 cm respectively. This rise will eventually hamper the smooth drainage of a number of polders. Inundation area in few polders causing drainage congestion due to sea level rise is presented in Figure 7.4.

Sea level rise will deteriorate drainage conditions to a large extent. 17 polders (light green in Figure 7.4) out of 35 will be facing acute drainage congestion where present performance of this polder 32 is unsatisfactory.

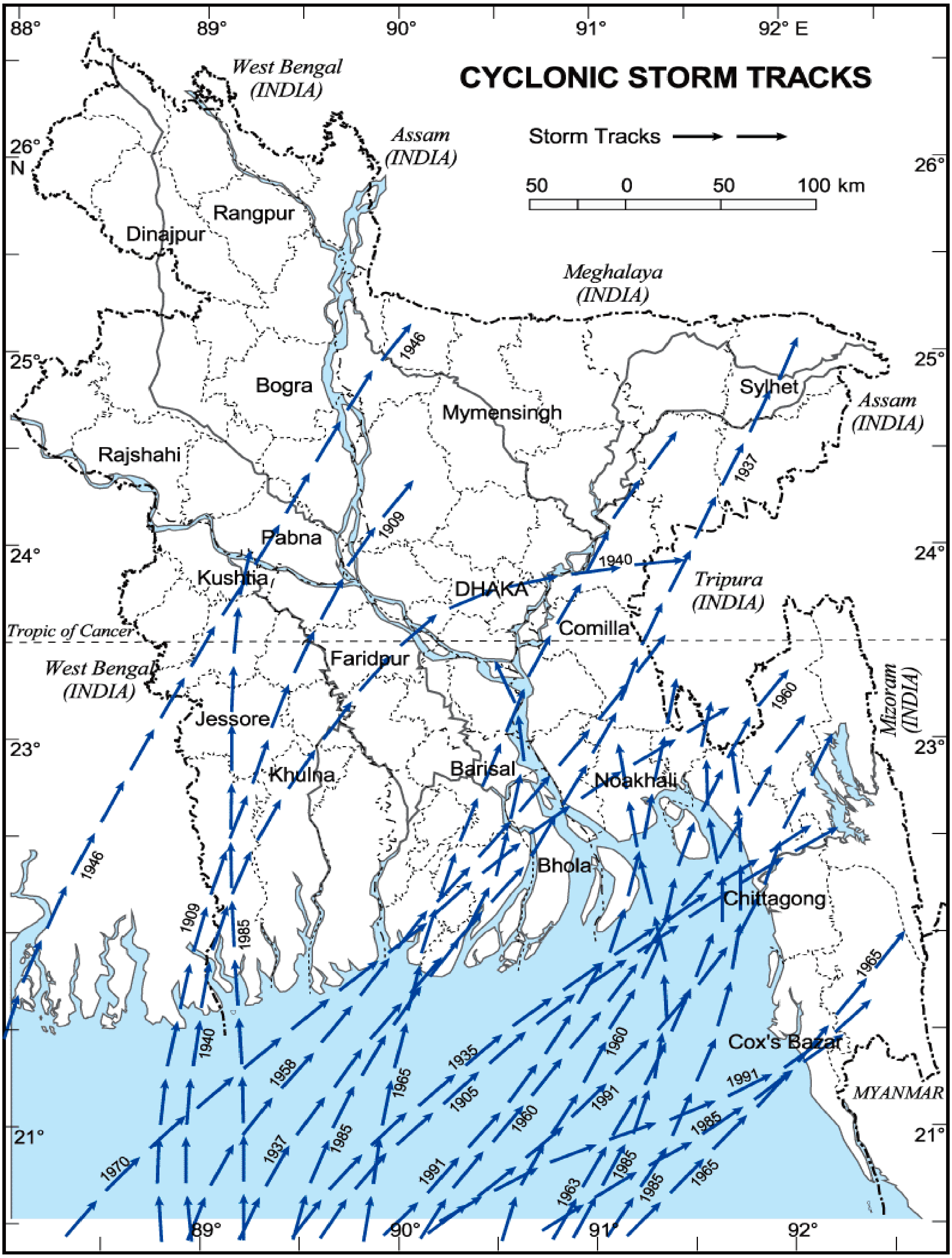

Figure 7.3: Previous Cyclonic Storm Tracks

(Source: MCSP, 1993)

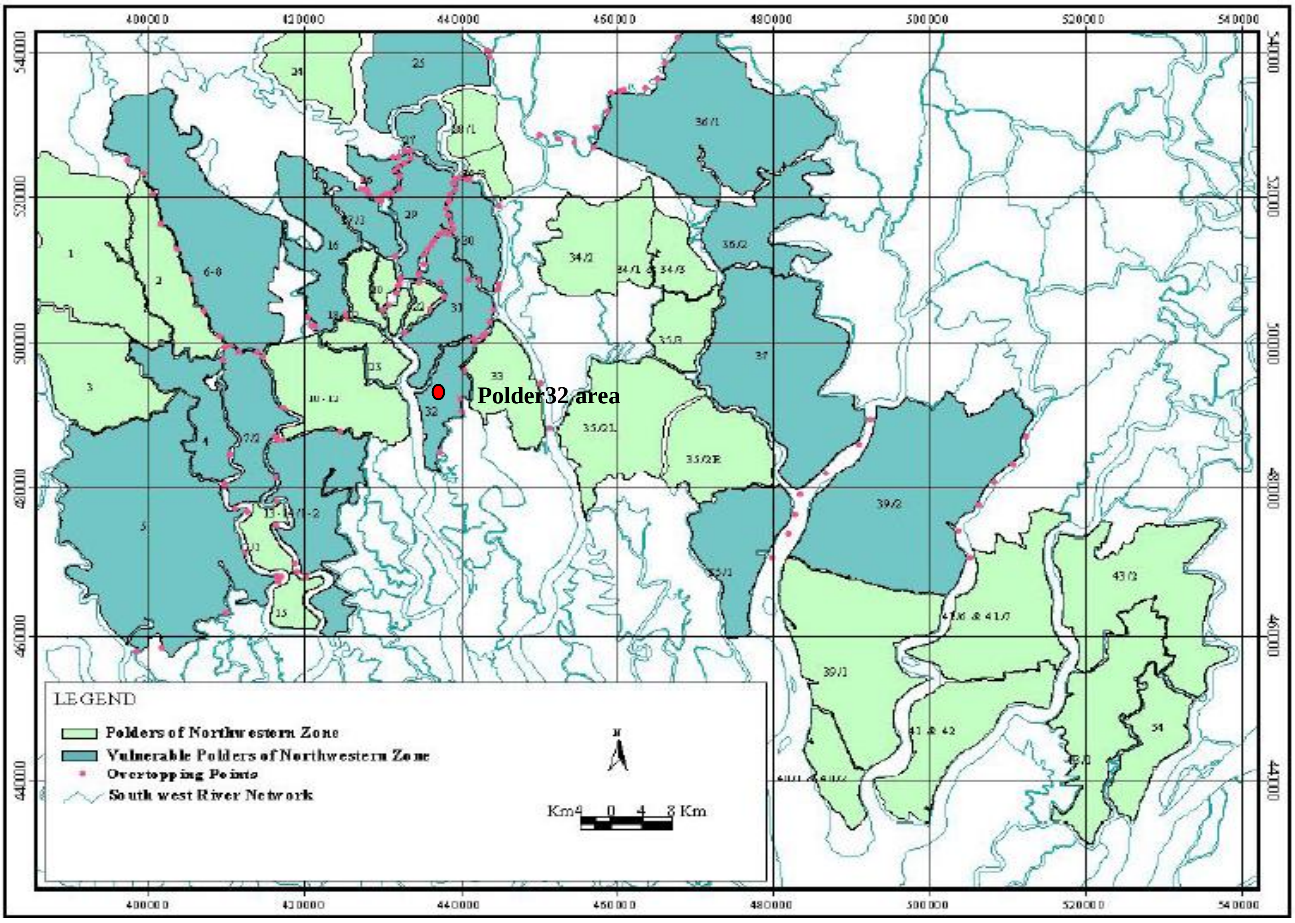

Figure 7.4: Drainage Congestion in Affected Polders due to Sea Level Rise

7.3.6 River Erosion and Accretion

Bangladesh is a riverine country and morphology of the rivers is highly dynamic. Disastrous riverbank erosion is mainly associated with the major river systems of the country. The main rivers are braided and form islands or chars between the braiding channels. These chars (many of which are inhabited) move with the flows and are extremely sensitive to bring changes in the river conditions (CEGIS, 2009). River erosion not only causes people's displacement but also leads to massive financial loss. River erosion is commonly observed in the entire coastal area specifically in Meghna estuary region.

The magnitude of erosion and accretion in the Meghna estuary (Figure 7.5) for the period of 2008-2010 is represented in the following figure. During this period the extent of accretion was 250 km^2 while that of erosion was 153 km^2 with a corresponding net accretion of 97 km^2. Extension of mainland of Noakhali towards the sea continued like the previous period with a net accretion rate of 4.3 km^2/yr. Significant amount of accretion occurred in Bhola Island with a net accretion rate of 27.6 km^2/yr. Both erosion and accretion process occurred along shoreline in Chittagong district with a net accretion rate of 8.5 km^2/yr. Erosion was observed in Patuakhali and Lakshmipur district with a net erosion rate of 3.2 and 2.8 km^2/yr respectively.

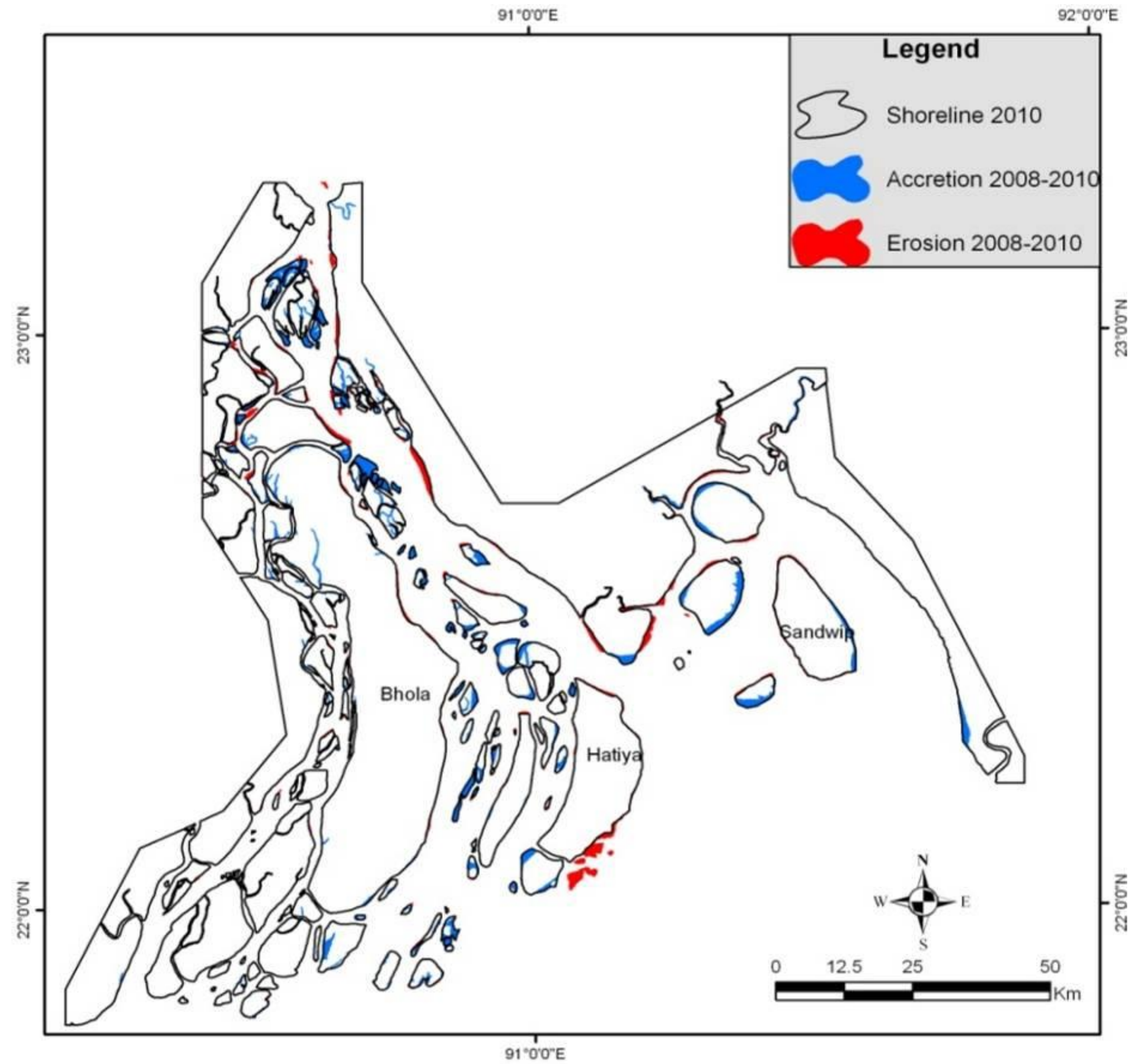

Figure 7.5: Erosion and Accretion of Land in the Meghna Estuary from 2008 to 2010

7.4 Adaptation Strategy for Climate Change Impacts in the Project Area

7.4.1 Adaption at Local level

Local people of the project area are already facing different natural problems due to climate change. Specifically drainage congestion, tidal flooding, water logging, storm surges and salinity intrusion are the major natural hazards in the project area, some of which can be linked with the climate change phenomenon. People have reported that the occurrences of the natural hazards are more frequent than before in the project area. Locally the following adaptation measures have been practiced in different physical, environmental and social sectors in coastal belt of Bangladesh for adapting climatic hazards.

- People switching their livelihood from agriculture to shrimp culture.
- High yielding and salinity tolerance verities of paddy are being introduced in the project area.

- Social and homestead forestry is being increased due to protect their life and properties from the strong wind velocity during cyclone.
- People raise the plinth level of their houses due to adapt water logging and flooding.
- Peoples introduce floating vegetable gardening system and case culture in the water logging area.
- Rain water harvesting system is being adopted to mitigate their drinking water problem during dry season.

7.4.2 Adaptation at Rehabilitation and Improvement planning

The IPCC projections have been considered in the hydrologic and hydro-dynamic modeling of the feasibility study of the CEIP-I. The climate change projections have been considered to determine the design criteria and finally these outcomes have been adopted in the planning and design of rehabilitation and improvement plan. The following criteria and the projected climate change information have been used in the design and planning of the interventions for taking care of climate change scenario in 2050.

- Sea level rise of 50 cm;
- 10 percent increase in maximum wind speed of cyclones; and
- Rainfall increase by 26 percent from March through May; and 13 percent increase from June through August.

These considerations have ultimately led to determine new height of the embankment of polder 32 and improved drainage system to cope with the impact of climate change. Design crest level of embankment: 4.50 m (From km 5.50 to km 44.00) and 5.0m (From km 0.00 to 5.50 & km 44.00 to 49.50).

8. Stakeholder Consultations and Disclosure

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. Also included in the Chapter are the disclosure requirements for the EIA.

8.1 Overview

The GoB as well as international donors (e.g. the World Bank) place great importance on involving primary and secondary stakeholders for determining the environmental and social impacts associated with project implementation. In order to gather local knowledge for baseline conditions, understand perceptions of the community regarding impact significance, and propose meaningful mitigation measures, participation of stakeholders is an integral part of the EIA process. During the present EIA, an attempt has been made to consult with a full range of stakeholders to obtain their views on Project interventions.

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.

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.

8.2 Objectives of Stakeholder Consultations

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.

8.3 Identification of Stakeholders

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.

8.3.1 Primary Stakeholders

Primary stakeholders are people who would be directly benefited or impacted by a certain project intervention. In case of the proposed Project in Polder 32, 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.

8.3.2 Secondary Stakeholders

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

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.

8.4 Approach and Methodology

Participatory approach was followed in conducting the public consultation meetings in the Polder 32. 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-I. 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 contacted over telephone and informed about the specific consultation meetings and requested them to be present in the meeting. In this way, the venue, date and time of the consultation meetings were fixed. Later, the consultant team organized the meetings at the local level. The participants provided their names, occupations and addresses in each meeting.

Focus group discussions (FGD) were carried out during in the public consultation process. In order to conduct the FGD and consultation meetings, two checklists were prepared covering the aspects including an overview of the proposed CEIP-I, 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, socio-economic resources, and disaster aspects were discussed in detail.

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 32 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.

8.5 Public Consultation Meetings and FDGs

8.5.1 Consultation Process

A number of consultation meetings and FGDs were conducted at different locations of the Polder 32. The details of these meetings and FDGs are presented in **Table 8.1** and some photographs of these meetings are given in **Figures 8.1 to 8.6**.

Table 8.1: Consultation Details

Sl No.	District	Upazila	Union	Meeting venue	Type of consultation	Meeting date	Time
1	Khulna	Dacope	Kamarkhola	Kamarkhola UP	PCM	03/06/2012	10:00
2	"	"	Sutarkhali	Kalabegi village	FGD	07/03/2012	15:00
3	"	"	Kamarkhola	Parjoynagar	"	06/03/2012	10:00
4	"	"	Kamarkhola	Kamarkhola UP	"	14/02/2012	10:00
5	"	"	Kamarkhola	WAPDA Colony Khaya Ghat	"	15/12/2013	09:30
6	"	"	Kamarkhola	Kamarkhola UP	"	15/12/2013	02:30
7	"	"	Kamarkhola	Sreenagar – Kalinagar	"	15/12/2013	05:00
8	"	"	Sutarkhali	Nalian Bazar	"	16/12/2013	11:30
9	"	"	Sutarkhali	Gunary Closer	"	16/12/2013	03:30

Figure 8.1:PCM at Kamarkhola UP

Figure 8.2: PCM at Kamarkhola UP

Figure 8.3: Discussion with local people

Figure 8.4: Discussion with female participants

Figure 8.5: Discussion with local people

Figure 8.6: A view of open discussion of PCM

8.5.2 Consultation Participants

The main participants of the consultation meetings included public representative, farmer, trader and daily-wage laborers of the Polder 32 and nearby areas. A total of 119 participants attended these consultations. The participant details are provided in **Table 8.2** below.

Table 8.2: Participant Details

Sl No.	Meeting venue	Type of consultation	Type of Participants	No. of participants
1	Kamarkhola UP	PCM	Primary and secondary stakeholders	38
2	Kalabegi village	FGD	Primary stakeholders	10
3	Parjoynagar	"	"	05
4	Kamarkhola UP	"	"	10
5	Kamarkhola	"	"	12
6	Kamarkhola	"	"	13

Sl No.	Meeting venue	Type of consultation	Type of Participants	No. of participants
7	Kamarkhola	"	"	11
8	Sutarkhali	"	"	10
9	Sutarkhali	"	"	10

Figure 8.7: FGD at WAPDA Colony Khay Ghat and Kamarkhola UP

Figure 8.8: FGD at Sreenagar – Kalinagar and Gunary Closure

8.6 Issues discussed in FGDs and Meetings

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

- Water resources:
- Surface water (tidal flooding, drainage, salinity, siltation)
- Water management (flood control, drainage, irrigation)
- Land resources:
- cropping practice,
- production and yield,
- water logging and drainage congestion

- crop damage.
- Socio-economic aspects:
- Occupation and Employment (unemployment/joblessness)
- Migration (temporary/permanent out-migration)
- Poverty (food and income poverty)
- Education (poor literacy rate, non-schooling, less female education, drop out etc)
- Health and nutrition (ilMNess, diseases, poor nutrition)
- Quality of life (poor housing and sanitation facilities, scarcity of drinking water, fuel and fodder)
- Disasters:
- Cyclones
- River erosion
- Associated damages
- The sustainable and integrated solutions of the main problems being faced in the Polder:
- Water resource management
- Agriculture and fisheries management
- Land resource management
- Disaster management.

8.7 Community Concerns and Suggested Solutions

The outcomes of the FGDs and consultation meetings in terms of concerns and the suggested solutions were noted and organized by themes are presented in the Table 8.3 below.

Table 8.3: Community Concerns and Suggested Solutions

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
Overall	Water logging, tidal flooding, salinity intrusion and cyclone are the main community concerns in the polder 32 area.	Comprehensive rehabilitation of the polder should be taken up at the earliest with the active involvement of the local community.
Water Resources	The polder was damaged due to cyclone and storm surge in 2007 (Sidr) and 2009 (Aila). Surface water related problems like saline intrusion, drainage congestion, sedimentation and shortage of irrigation water and tidal flooding increased severely in this area. Life and livelihood of polder area have been disrupted severely. Several segments of embankment have been damaged due to erosion by the Sibsa River during Sidr and Aila.	The damaged segment of embankment is to be considered for retirement under CEIP I as soon as possible. Salinity intrusion could be controlled by construction of embankment. Introduce re-excavation program in internal canals, increase height of the embankment and improvement of sluice gates are very essential; Re-excavation of rivers and khals are urgently needed for improvement of the irrigation facilities and removal of

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
	These segments of the embankment need to be retired. Erosion engulfed local people's land, homesteads and have created environmental and social hazards. Tidal flooding is very common in the project area especially in the proposed project sites. Floodwater enters the project area by overtopping the embankment during the wet season. Extreme tidal floods inundate roughly 35-40% of area while 20-25% area is inundated during normal floods. Salinity reaches highest level during mid March to mid June in the River. Saline water inundates significantly breached areas causing damage to agricultural crops and increasing food deficit of the polder. Drainage congestion as a common issue has been defined for the total project area though intensity varies from place to place. The drainage performance through linked canals has been gradually decreasing in existing sub-project sites due to sedimentation. The dry season water logging is around 40-45% in the low lying areas. Significant number of farm laborers including the landless/marginal farmers of the Polder tends to migrate outside from their village in search of livelihood. Here, almost 50% of households are shifting to other parts of the polder. Scarcity of fresh water is one of the main problems in the Polder area during dry season. There is lack of reserve sweet fresh water in khals for irrigation during dry season due to malfunctioning of water control structures. Absence of embankment along the rivers also makes the surface water non-available to the users. They collect drinking water from others. The typical conflict among different type of users, e.g. bagda gher owner, open water fisher (fishing at sluice gates) and farmer are observed in	drainage congestion/stagnant water from Polder 32 ; Need for formation of Water Management Organizations (WMOs) to properly manage the water control structures, i.e. embankment, sluice gate, regulator, inlets, culverts etc and growing of consciousness among the community in the Polder; All khals should be kept free from illegal occupier; Replace the damaged/non-functional sluices and construct new ones where required. Salt tolerant varieties of rice need to be introduced and in this regard necessary extension works need to be organized by the respective departments; Ensure water distribution by compartmentalization/zoning system for shrimp cultivation, white fish and agriculture practice through WMOs; The embankment needs to be strengthened for prevention of tidal flood in wet season and intrusion of saline water in dry season.

Themes/Topics	Concerns/Issues/Problems	Suggested Solution/Remedies
	maximum part of project area. It is due to the existence of non-functional structures and absence of adequate water management infrastructures in appropriate places. The level of conflict is presently low in the Polder area. Local powerful persons, including the political leaders, often illegally interfere in the water control/ management infrastructure.	

8.8 Consultations during RAP Preparation

A number of stakeholder consultations were conducted in the Project area while preparing the resettlement action plan (RAP) for the proposed Project in the Polder 32. These are discussed below.

The local persons who could potentially be affected by the Project along with local community leaders and other stakeholders were consulted through group meetings and personal contacts. The opinion of different stakeholders regarding the Project was sought and considered in preparation of the RAP. A total of four formal stakeholder meetings were held with different communities in the Polder 32. Different types of stakeholders including concerned UP chairmen/members, teachers, Imams (prayer leaders), local community leaders, political leaders, farmers, shopkeepers, and other people to be affected by the Project attended these sessions. The salient details of these consultations carried out in Polder 32 are presented in Table 8.4; some photographs of these meetings are presented in Figures 8.7 and 8.8.

Table 8.4: Consultation Meetings Held in Polder 32

Location, Date and Time	Category of Participants
WAPDA Colony Khay Ghat December 15, 2013 at 9.30 am	Service, Social Worker, farmers, fishermen, UP members, and Driver.
Kamarkhola UP December 15, 2013 at 02.30 pm	UP Chairman, UP members, UP Sectary, Village Doctor and Businessmen.
Sreenagar – Kalinagar December 15, 2013 at 05.0 pm	Farmers, businessmen and fishermen.
Nalian Bazar December 16, 2013 at 11.30 am	UP Chairman, farmers and Service.
Gunary Closer December 16, 2013 at 03.30 am	Service, farmers, businessmen and fishermen.

Figure 8.9: Meeting at Par Joynagar

Figure 8.10: Meeting at Nalian Bazar

During these meetings, the key features of the proposed interventions in Polder 32 under CEIP-I, its key benefits, its potential impacts particularly relating to resettlement and displacement, the process for determining people to be affected, compensation payment procedure, GoB's laws and World Bank's policy on involuntary resettlement, and cut-off-date for listing assets to be affected were discussed. The relocation requirements and availability of alternative lands in the surrounded area suitable for relocation were disclosed to the communities to be affected. Views of the stakeholders were obtained on the Project and its potential impacts, encroaching government land, relocation requirements, compensation process, and alternative options. Consultations were also conducted with women and other vulnerable groups and their views obtained on their livelihood aspects, Projects impacts, and compensation options.

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. The inputs from the stakeholder meetings have been used to develop measures and principles to address the resettlement impacts.

8.9 EIA Disclosure

Regional Workshop

The EIA report and Bengali translation of its executive summary was disclosed to the public on13th January, 2013 in Dacope, Khulna. The main aim of the meetings was to present the findings of the final draft report on FS and EIA and having feedback from the local stakeholders attended. The report was also finalized through incorporation of comments and suggestions got from the meetings. The communities including the persons to be affected of polder 32 by the Project expressed their views in favor of the Project and wanted early implementation to protect them from natural disasters. They demanded following actions to be taken immediately. These are:

- The intrusion of saline water might be controlled by the improvement of embankment.
- Need awareness building among the communities about water management;
- Ensure proper compensation for affected people
- O & M for embankments and sluice gates in the polder area
- Need formation of Water Management Organizations (MWOs) to manage properly water control structures

- New embankment is required to be constructed by developing village road.

National Workshop

Coastal Embankment Improvement Project (CEIP) organized a national workshop on the "Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA)" studies under CEIP at Spectra Convention Centre, Gulshan 1, Dhaka on 28 February 2013. Mr. Md Shaikh Altaf Ali Senior Secretary, Ministry of Water Resources, Government of the People's Republic of Bangladesh was the chief guest of the Workshop, while Mr. Mohammad Azizul Haque, Director General, Bangladesh Water Development Board (BWDB) and Dr. Sultan Ahmed, Director, Natural Resource Management, Department of Environment (DoE) were the special guests. The meeting was chaired by Mr. Salim Bhuiyan, Chief Planning, BWDB.

The program started with registration of the participants at 9:30 am. The main program then started at 10:00 am through recitation from the holy Quran. Mr. Sarafat Hossain Khan, Project Coordinator, CEIP, BWDB made the introductory speech. After that Mr. Md. Waji Ullah, Deputy Executive Director (Operations) and Team Leader of Environmental Studies of CEIP presented the findings of the Environmental study and EA findings of five polders. Mr. Kh Khairul Matin presented the Social Impact Assessment (SIA).

Figure 8.11: Welcome Speech by the Project Coordinator of CEIP

Figure 8.12: Presentation of EIA findings by Team Leader of Environmental Study

Figure 8.13: Participants of the Workshop

Figure 8.14:Chief Guest delivering his speech

National experts from multi disciplinary fields such as engineers, agriculturists, economists, sociologists as well as local stakeholders were present in that workshop.

Finishing the presentation, the floor was opened for all to take part in discussion on the presentation. The participants attended and exchanged their views on different issues which were noted by the professionals of CEGIS with a view to furnishing the final report.

Findings of the National Workshop

The comments and Suggestions from participants are as follows:

(i) Impacts on health and hygienic need to be considered in the study

(ii) Subsidence due to climate change needs to be included in the study

(iii) The cumulative impacts of five polders are assessed in the study why not for the other polders to be constructed in future?

(iv) The cumulative impacts have used "may increase/decrease". This should be more specific.

(v) As fisheries sector specially Shrimp Gher plays vital role in economy of coastal region, a Fisheries Specialist is to be included in the proposed Institutional Framework of the EMP of CEIP

(vi) Mal-functioning of structures to be defined in the report

(vii) Net value of fisheries impact to be provided

(viii) Fish-friendly structure should be constructed. The location of these structures is important.

(ix) Involvement of DoE during implementation of project activities should be ensured.

8.10 Framework for Consultations during Project Implementation

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 8.5 charts out the proposed participation framework during different project Phases.

Table 8.5: Participation Framework

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
Project Design Phase	Meetings with institutional stakeholders (carried out during the present EIA and RAP preparation); meetings with grass root stakeholders (carried out during the present EIA and RAP preparation)	Institutional stakeholders; Grass root stakeholders, including the communities to be affected by the Project.	EIA consultant.
Project Construction Phase	Information disclosure (sharing of the project objectives, project components, major benefits, potential impacts, mitigation measures and Resettlement Plan with the affected communities and other stakeholders).	Institutional stakeholders; Grass root stakeholders, including the communities to be affected during the project implementation.	BWDB; Supervision Consultants; Contractors

Project Stage	Proposed Tool	Stakeholders to be Consulted	Responsibility
	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

9. Assessment of Environmental Impacts

9.1 Preamble

This Chapter identifies the environmental and social impacts that may potentially be caused by various Project phases, and also proposes appropriate mitigation measures to avoid, offset, reduce, or compensate these impacts. Potential Intervention which may cause potential environmental impacts during pre-construction, construction, and O/M stages have been identified in Chapter 4. The project influence area has been identified in Article 2.2.1 of Chapter 2. The following detailed investigations are being carried out or proposed to assess the magnitude of these prioritized impacts:

- Census survey to assess the extent of land acquisition and resettlement, loss of vegetation, occupation, income and poverty levels of the affected households, etc.
- Polder drainage model developed using the existing calibrated and validated Southwest Regional Model as base model has been used to understand the impact of project intervention to improve the existing drainage system and impact of climate change with the existing drainage system and with modified drainage system.
- Environmental quality baseline monitoring of air, noise, surface water, groundwater and soil,
- Ecological surveys comprising vegetation, wildlife and fisheries covering both mainland and Charland,
- Charland surveys comprising socioeconomic status and environmental settings,
- Expert consultations, focus group discussions, and public consultations.

It is to be mentioned here that some of the studies are in progress, the results of the selected investigations completed to date are discussed in this chapter. Most of the project activities are yet to be finalized (for example locations for afforestation component, locations of construction yards, operational arrangement of the sluices during the operation period). Similarly the detailed bills of quantities and equipment usage are yet to be ascertained. Therefore, this report has to be further improved as per suggestions and future need.

Table 9-1: List of Environmental Components and Updating of EIA report by BWDB

Environmental Component	Present Gap/Pending Issue in the EIA	Information in the pipeline to finalize the EIA report	Tentative date of finalization
Natural Environment			
graphy	Topography analysis for the afforestation component of the project	Sites for the location of the afforestation component are underway. The possible locations have been identified. However, the team is now out for field checking.	End of August, 2013

Environmental Component	Present Gap/Pending Issue in the EIA	Information in the pipeline to finalize the EIA report	Tentative date of finalization
	Topography analysis for construction camp.	Sites for construction camp will be decided by the contractors	End of December, 2013
oil	Total Loss of Top Soil	Will be finalized once the information regarding the construction yards and exact locations of borrow pits are obtained	End of December 2013
scape	Landscaping to the side slopes of the embankment and surrounding areas to tree plantation	Location, length and geometry of the afforestation area are yet to be finalized	End of August, 2013
Ecological Environment			
Endangered Species	None	None	None
Vegetation	Change in vegetation from the project	Require additional information for area of construction yards and afforestation	End of December 2013
Wetlands	Total Impact on the wetlands	Require additional information for area of wetland coverage (if any) for the construction yards	End of December 2013
Environment Quality			
Noise Quality	Noise quality impact around all facilities during construction	Type and number of equipment, vehicles, dredger etc to be used by the contractors, Their locations, time and extent of works etc.	End of December 2013
Air Quality	Air quality impact around all facilities during construction	Type and number of equipment, vehicles, dredger etc to be used by the contractors, Their locations, time and extent of works etc.	End of December 2013

Environmental Component	Present Gap/Pending Issue in the EIA	Information in the pipeline to finalize the EIA report	Tentative date of finalization
Soil Quality	Total amount of lands adjacent to proposed facilities including construction yard, borrow and dredged material	Requires final location and amounts of lands for construction yards and stacking of construction material and dredged spoil.	End of December 2013
Wastes	Total wastes likely to be generated at different proposed facilities during construction works. Total population to be occupied at the construction camps	Input requires form the contractors about the required number of skilled and unskilled labors.	End of December 2013
Spoils	Dredged Spoil amount and how it will be managed. Preliminary finding say that it will be kept on the two sides of the dredged canal	The contractor needs to come up with the dredged spoil management plan	End of December 2013
Socio Economic Environment			
Agriculture	Land needed for the construction camp set up, widening of embankment base, afforestation	Pending on finalization of design, plan for land acquisition	End of December 2013
Health and Hygiene	Analysis on the total workers likely to take part in the construction	Pending on the output of the contractors plan	End of December 2013
Transport	Number and type of construction equipment, vehicles, their possible routes which will conflict with the existing transport	Pending on the outcome from contract units	End of December 2013
Road Accidents	Number and type of	Pending on the outcome	End of December 2013

Environmental Component	Present Gap/Pending Issue in the EIA	Information in the pipeline to finalize the EIA report	Tentative date of finalization
	construction equipment, vehicles, their possible routes which will conflict with the existing transport	from contract units	
Water Transport Accidents	Number, type of water transport for carrying equipment and their possible access routes	Pending on the outcome from contract units	End of December 2013
Irrigation	Irrigation affected by the construction	Pending work-plan from the contractors for rehabilitation of the hydraulic structures	End of December 2013

9.2 Impact Screening

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

- High negative (adverse) impact;
- Low negative impact;
- Insignificant impact;
- High positive (beneficial) impact;
- Low positive impact; and
- No impact.

The matrix of polder 32 is provided in **Table 9.1**. The negative impacts predicted in this manner were the 'unmitigated' impacts. Appropriate mitigation measures were recommended as part of this EIA, thus reducing the occurrence possibility and severity of the potentially adverse impacts. The potentially negative impacts identified through this process are discussed in the subsequent sections.

Table 9.1: Environmental and Social Screening Matrix (Unmitigated)

	Physical					***Biological***		***Social and Socioeconomic***												
Project Phases and Activities	Soil Erosion/ Contamination	Air Quality	Surface Water Quality	Groundwater Quality	Water Availability and Consumption	Natural Vegetation	Wildlife/Aquatic Fauna	Settlement	Blocked Access Routes	Noise and Vibration	Impacts on Agriculture and grazing	Flooding	Vehicular Traffic	Safety Hazard	Damage to Infrastructure	Public Health	Aesthetic Value	Cultural Issues	Gender Issues	Employment Opportunities
Pre-construction Phase																				
Land Acquisition	0	0	MN	MN	0	0	0	HN	0	0	MN	MN	0	0	MN	MN	MN	MN	MN	0
Construction Camp Establishment	MN	0	MN	MN	0	MN	MN	0	MN	MN	0	MN	MN	MN	0	0	0	MN	MN	MP
Construction Phase																				
Contractor Mobilization	0	0	0	MN	0	MN	MN	MN	0	MN	MN	MN	HN	MN	0	0	0	MN	MN	MP
Equipment / Material Transportation	0	MN	MN	MN	0	0	MN	MN	0	HN	0	MN	HN	MN	0	0	0	0	0	MP
Operation of Construction Camp	MN	0	MN	MN	0	0	0	0	MN	0	0	MN	HN	HN	0	0	0	HN	0	MP
Site Clearance	MN	MN	MN	MN	MN	MN	MN	0	0	0	0	MN	0	0	0	0	MN	0	MN	HP
Borrow and disposal area management	0	0	HN	MN	0	MN	0	MN	0	0	MN	0	MN	0	0	0	0	0	0	HP
Excavations of water channels	0	0	HN	MN	0	MN	MN	MN	0	0	0	0	MN	MN	0	MN	0	0	0	HP
Re-sectioning of Embankments	MN	0	MN	0	0	MN	0	HN	0	0	MN	MN	0	MN	0	MN	MN	0	HN	HP
Retired of embankment	MN	MN	0	MN	0	MN	MN	HN	MN	0	0	MN	0	MN	MN	MN	0	0	MN	HP
Slope protection of embankment	MN	MN	0	MN	0	MN	0	MN	MN	MN	MN	MN	0	MN	MN	MN	0	0	0	HP
Installation/replacement/repair	MN	0	0	MN	MN	MN	MN	MN	0	MN	MN	HN	0	MN	0	0	MN	0	0	MP

	Physical					***Biological***		***Social and Socioeconomic***												
of Regulators																				
Bank protection works	MN	MN	0	MN	0	MN	0	MN	MN	MN	MN	MN	0	MN	MN	MN	0	0	0	MP
Demobilization	MN	0	0	MN	MN	0	0	0	0	0	MN	MN	HN	HN	0	0	0	MN	MN	MP
Post-project/Operation Phase																				
Operation of Regulators	MN	MN	0	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	0	MN	MN	0	MP
Repair and Maintenance	MN	0	0	MN	MN	MN	MN	MN	0	0	0	0	0	0	MN	0	MN	0	0	MP
Monitoring	MN	0	0	MN	MN	MN	MN	MN	0	0	0	0	0	0	MN	0	MN	0	0	MP

Key: HN: High negative impact; MN: Moderate negative impact; 0: Insignificant/negligible impact; HP: High positive impact; MP: Moderate positive impact

9.3 Impacts during pre-construction Phase

Site development involves the following activity:

- Mobilization of equipment, construction material/vehicles
- Clearing of sites
- Collection of earth materials from borrow pits and Shibsha, Bhodra and Dhaki river bed Construction of civil amenities and development and
- Establishment of temporary construction yards

The activities will cause the following environmental impacts

9.3.1 Damages due to Project Intervention and Land Acquisition

Impact

Land will need to be acquired to construct the retirement embankments (Ch. Km 0.5 to 3.5 km and Ch. Km 24.2 to 24.7 km) and water control structures. It is estimated that 67 ha of land would be acquired resulting in displacement of about 56 households having land within project area. Out of total acquisition land the highest quantity is single cropped (64 ha) followed by double cropped (2.41 ha) and Homestead (0.54 ha). The details of these damages in Polder 32 are presented in **Tables 9.3** to **9.5**, whereas the resettlement cost estimates are provided in **Table 9.6.**

Table 9.3: Land to be Acquired in Polder 32

Description	Area (ha)
Houses	0.59
Single cropped fields	64.00
Double cropped fields	2.41
Total	67.00

Source: Socioeconomic survey conducted by KMC in Dec 2011-Feb 2012

Table 9.4: Primary Structures to be Affected in Polder 32

Description	Quantity	Covered Area (square feet)
Pucca (made of bricks and mortar)	3	823
Semi pucca	268	84204
Katcha	1890	340546
Total	2261	425573

Source: Socioeconomic survey conducted by KMC in Dec 2011-Feb 2012

Table 9.5: Secondary Structures to be Affected in Polder 32

Description	Quantity
Pucca latrine (numbers)	9
Slab latrine (numbers)	201
Katcha latrine (numbers)	3
Tube well (numbers)	7
Boundary wall (running feet)	402
Gates (numbers)	529
Water tanks (cubic feet)	180

Source: Socioeconomic survey conducted by KMC in Dec 2011-Feb 2012

Table 9.6: Common Properties to be Affected in Polder 32

Description	Quantity
Mosque	9
Mandir	5
Club House	6
School/Pathshala	13
Government Office	1
Madrasa (religious school)	1
Latrine	1
Miscellaneous	2
Total	44

Source: Socioeconomic survey conducted by KMC in Dec 2011-Feb 2012

Table 9.7: Resettlement Budget for Polder 32

Description	Amount (BDT)
Compensation for land acquisition	48,563,288
Compensation for structures	101,371,395
Compensation for Trees	245,000
Other Resettlement Benefits	42,448,825
Capacity building training for EA	1,000,000
Development of Resettlement sites	5,000,000
Operation cost for RAP Implementing Agency/ INGO	10,000,000
Operation cost for External Monitoring Agency	2,000,000
Contingency @ 10% of the above	21,062,851
Total Estimate Budget (in BDT)	231,691,358
Total budget in USD (1 USD=82 BDT)	2,825,504

Source: Socioeconomic survey conducted by KMC in Dec 2011-Feb 2012

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

Mitigation

The following measures will be undertaken to address the above concerns:

- A Resettlement Action Plan (RAP) will be prepared in accordance with the national laws and WB OP 4.12. Salient features of RAP would include: the affected households to be compensated for their loss of land, structures, trees, ponds and others; squatters and tenants to be paid compensation for the loss of their structures and livelihood
- Compensation will be paid prior to construction in accordance with RAP
- Contractor will maintain liaison with communities.
- Grievance redress mechanism (GRM) will be established properly.

Residual Impacts

Despite implementing the above mitigation measures, the impacts associated with the involuntary resettlement are not likely to be fully eliminated, essentially because of the severity and extent of the involuntary resettlement. The significance of residual impact will therefore be **Moderate**, and regular monitoring will be essential to ensure that RAP is effectively implemented and the community grievances related to resettlement are promptly addressed.

9.3.2 Loss of Agricultural Land

Impact

The project will involve 3.5 km of construction of retired embankment, widening base of 44.8 km of embankment and 0.5 km of forwarding of embankment, establishment of 47 construction camps, dredged soil disposal on the two sides of the 17.5 km of dredged channel, construction of cross dam and repairing of flushing inlets (**Table 4.2**). The activities will acquire 64 ha of single cropped field and 2.41 ha of double cropped field.

Mitigation

Since the estimated loss of agriculture land has already be determined based on the current alignment, the contractor will ensure construction work or establishment of construction camp will not further cause loss of agriculture land. The contractor will set up the plan for location of construction camp, stock piling of construction material and dredged spoil to cause minimum disturbance to agriculture land. The contractor needs to reflect the above planning in the Environmental Action Plan. The following steps will be followed to cause minimum disturbance to agriculture land:

- The contractor will identify the potential sites for establishing the temporary facilities in consultation with the BWDB, DCSC (Design Consultant and Supervision Consultant), and local communities. The sites will be finalized after obtaining approval from DCSC.
- All temporary facilities will preferably be located within the area owned by BWDB
- If the BWDB-owned land is not sufficient, contractor will consider floating camps outside the Polder. Such camps will be equipped with all necessary facilities to avoid river water pollution, and safeguard measures to protect labor from health and safety hazards.
- Ensure that no private structure or property is affected by the temporary facilities.
- Pay compensation/rent if private property is acquired on temporary basis.
- Consult and maintain liaison with the communities.

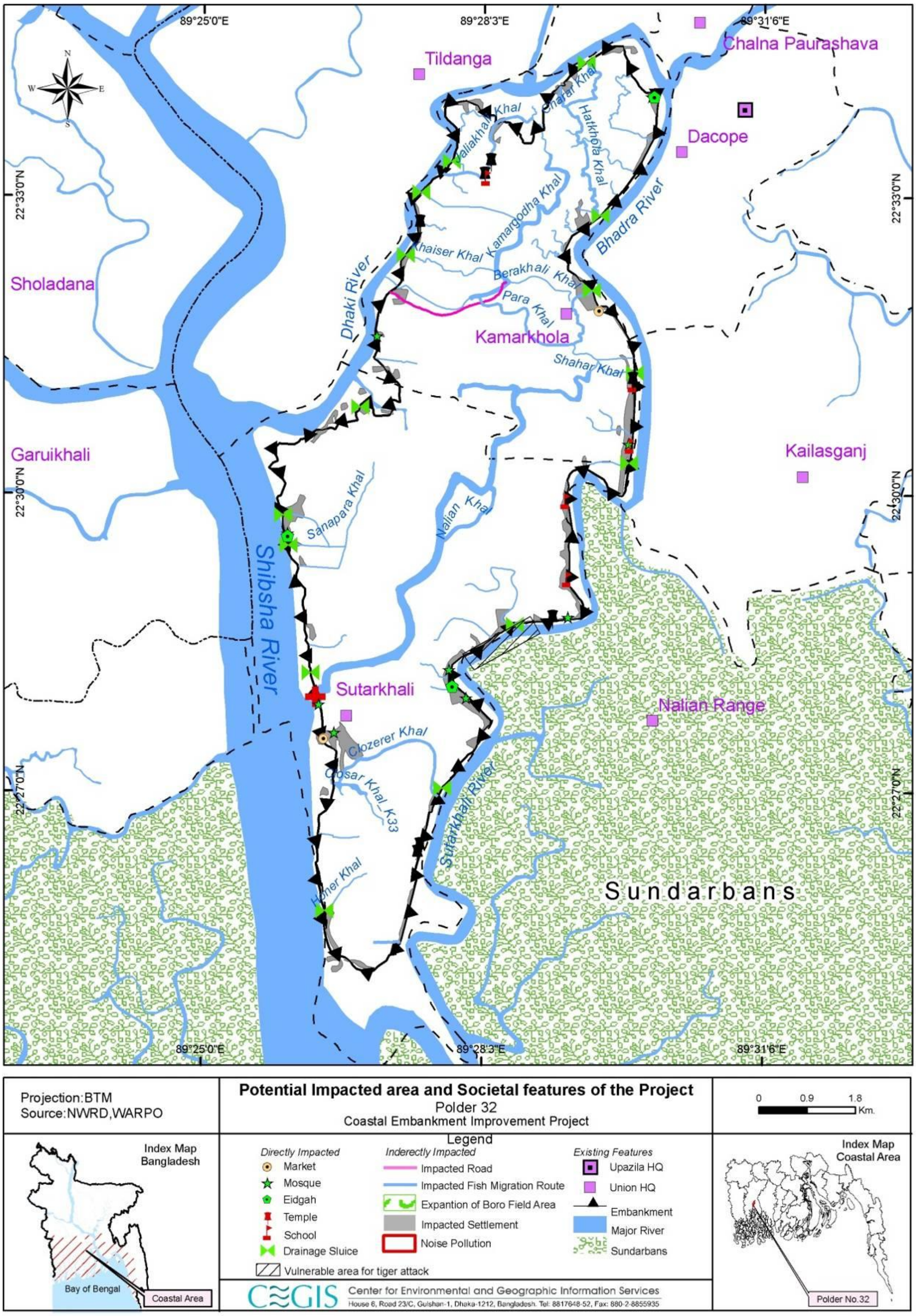

Figure 9.1: Key Potential Impacts in Polder 32

9.3.3 Clearing of Trees

Impact

A total of 47 labour sheds will be constructed near the embankment and interventions sites. The detail of which is provided in the **section 4.6.5** in the project description chapter. The feasibility team has not provided the spatial location of the labour sheds. Due to cyclone Aila and Sidr, polder 32 is almost like a desert and a few trees are found beside the embankment. According to field visit, around 265 trees exist on both side of the embankment which are like to be felled down during construction of retired embankment, re-sectioning of embankment and regulators structures.

Table 9.8: Trees to be Affected in Polder 32

Types	Big	Medium	Small	Plant	Total
Fruit trees	16	19	83	25	143
Timbers trees	0	18	83	9	110
Banana	6	6	0	0	12
Bamboo	0	0	0	0	0
Totals	22	43	166	34	265

Source: Socioeconomic survey conducted by KMC in Dec 2011-Feb 2012

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

Mitigation

- Thick and dense vegetated area will be avoided to prepare the labour shed as far as possible;
- Contractor will prepare a tree plantation plan will be prepared for compensation of loss of trees. Trees will be planted at the end of the construction period during wet season. It is recommended to establish a nursery with selected tree species (Geoa, Kewra and Babla) in the beginning of the project in order to reduce the purchasing cost of saplings. All saplings will be planted and monitored according to section 4.5.6 under project description chapter;
- Contractor will avoid dumping of spoil earth in and material borrowing from vegetated areas.
- The project has an afforestation component. The Senior Environment Specialist of PMU and Design Consultant (DC) will ensure the afforestation plan is prepared based on the number and species of trees to be cut. The ration of number of trees to be cut to trees to be planted will be 1:4 (as per DoE guideline). Moreover, the species willbe chosen according to the species are cut. Vegetation coverage will also be introduced for slope protection of polders. The mitigation measure will reduce the negative impact substantially in the long run. The overall impact will be negative to positive in the long run. However, there will be transition phase of impact between immature tree at early stage and mature tree at later stage.

Residual Impacts

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

9.3.4 Fisheries

Impact

The construction of embankments and dredging of canals and rivers have important consequences on flood plain ecology. The fish spawning will be impacted if canal excavation and collection of earth from Dhaki, Shibsha and Bhadra rivers happens during spawning period. Open water fish habitat of the study includes khal, such as *Nalian River, Kamargoda khal, Golbunia khal, Jalia khal, Pacherdoani khal, Katakhali khal, Uluruar khal, Nadaken khal, Goler khal, Thakuronbari khal, Kashiar khal, Parar khal, Chotkatola khal, Hatkhola khal, etc* are acting as major arteries of fish migration into the study area. Table 4.4 shows Hatkhola, Parar, jaliakhali will be reexcavated. A closure dam/canal closure regualator will be constructed to reopen the drainage paths from the lands to Nalian khal. Construction of 11 new drainage sluices, 2 flushing inlets and repairement of 21 flushing inlet will hamper fish migration and availability if propoer planning for civil work and design is not done. The spawning time for open water fish is late June to August. Re-excavation of the canals and collection of earth from river bed will increase the turbidity of water which will cause a suspension of sediments, and thus, an increase in turbidity for the affected water column. Increased turbidity along with the suspended sediments can affect fish behavior such as feeding, avoidance, territoriality, and homing behavior.

Mitigation

The contractor will prepare the work plan for re-excavation of canals, collection of earth from Dhaki, Shibsha and Bhadra river and construction of sluices avoiding late June to August, during reexcavation of canals (Table 4.4) and placement of drainage sluice (Table 4.1).

9.3.5 Increased Traffic during mobilization

Impact

Mobilization of contractor, equipment, machinery, material and manpower will be transported to the Polder resulting additional traffic on roads and in water ways. This traffic may potentially cause traffic congestion particularly in water ways. Figure 9.1 shows the key locations of the project area where this impact is likely to take place.

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

Mitigation

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

- Contractor to prepare and implement mobilization plan considering water vessels and launch movement in the external rivers. And, avoid the launch movement time.
- Proper traffic management plan should be adopted by the contractor during construction works to solve the problem.
- All the construction materials will be distributed to the intervention sites during high tide to overcome the low water level of the Bhadra river.
- Ensure minimal hindrance to local communities and commuters,
- Liaise with local communities and concerned authorities. Specifically union parishad members of the polder. The details of communication address of union parishad chairman and members have been got in the public consultation chapter.

Residual Impacts

With the help of above mitigation, the impacts associated with the increased traffic are likely to be adequately addressed and the significance of residual impact will be Low.

9.3.6 Increased Water Way Traffic

Impact

Polder 32 is surrounded by Shibsa (west),Dhaki (North-west), Dhara and Sutarkhali rivers (east). All the construction materials are to be transported through the river by Cargo, Burge, Troller and Engine Boats. The road way conditions inside the polder are not suitable for transportation of larger vehicles i.e. dump truck, trolley, excavator etc. Therefore, carrying of earth and other construction materials from the stock yard, a temporary jetty will be constructed in Dhaki River near Dacope BWDB colony. During carrying and unloading of construction materials through this jetty, waterway traffic may create significant problem in Dhaki River because the river is relatively shallow but remains navigable throughout year.

Mitigation

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

- Contractor to prepare and implement traffic management plan.
- River crossing for material transportation during nighttime where possible and appropriate.
- Material transportation through rivers during high tide where needed.
- Liaison to be maintained with community and BIWTA.
-

Residual Impacts

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

9.3.7 Preparation of Facilities for Contractor and Labour force

Impact

Establishing and constructing site facilities in the Polder may potentially cause air and water contamination, noise generation, hindrance to local communities, and other similar impacts. Figure 9.1 shows the key locations in the Project area where these impacts are likely to take place because of 4 schools are located near the embankment, where as all the labour force facilities will be implemented near the embankment.

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

Mitigation

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

- Contractor will prepare site establishment plan and obtain approval from the DCSC
- Approval from DC & SC will be obtained for the location of temporary facilities.
- Tree felling and vegetation clearing will be minimized to establish site facilities
- Photographic record will be maintained to record pre-construction condition of the area
- Site facilities will be established at a safe distance from communities
- Contractor will prepare and implement pollution control and waste management plans
- No untreated wastes will be released on ground or in water

- Exhaust emissions from vehicles and equipment will comply with standards
- Vehicles, generators, and equipment will be properly tuned.
- Water will be sprinkled where needed to suppress dust emissions
- Speed limits will be enforced for vehicles on earthen tracks
- Vehicles and machinery will have proper mufflers and silencers
- Liaison will be maintained with the communities.

Residual Impacts

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

9.3.8 Issues Addressed during Design Phase for Polder 32to Avoid Environmental Impact

The following tasks have been taken into account during design phase to avoid the negative environmental impact:

- To reduce the drainage and water logging and promoting fish migration canals need to be re-excavated have already been identified. The list of khals (canals) to be considered for re-excavation are presented in Table 4.4
- The locations for borrow pit is identified and presented in Table 4.8. However the soil quality to meet the requirement of earth volume needs to be addressed. If the currently chosen borrow pits does not satisfy the soil quality criteria, the Senior Environment Specialist of the PMU will update the information.
- The list of sluices requires reconstruction and repairement have already been listed in Table 4.1.
- Table 4.5, Colum II states that the dredged material will be put on two sides of the canals which is a usual practice by BWDB. It is recommended to keep the dredged spoil 15 m away from the canal side. The contractor will ensure sufficient fencing has been provided to avoid any possible accidents
- Tidal River Management will not be followed in any place of polder 32.
- Closure Canal/Cross Dam near Nalian Khal will be closely monitored during construction and operationa phase.

9.4 Impacts during Construction Phase

Reconstruction and rehabilitation of embankment and polder area will involve the following tasks during construction phase:

- Mobilization of equipment, construction material/vehicle
- Placement and compaction of earth
- Re-excavation of canals
- Demolition of non-repairable hydraulic structures
- Disposal of canal excavated wastes

9.4.1 Loss of Agriculture

Impact

About 66.41 ha of agricultural land would be lost due to construction of retired embankment (Ch. Km 0.5 to 3.5 km and Ch. Km 24.2 to 24.7 km). The present cropping patterns in the scheme area is presented in **Table 9.9**. The area of single and double cropped area are 64 ha and 2.41 ha respectively over total net cultivable area. A total of 172.2 metric ton of rice and non-rice crop production loss is expected due to construction of retired embankment (**Table 9.10**).

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

Table 9.9: Existing cropping pattern in the study area

Kharif-I	Kharif-II	Rabi	Area(ha)	% NCA
Fallow	T.Aman (HYV)	Fallow	20.0	30.1
Fallow	T.Aman (Local)	Fallow	44.0	66.3
Fallow	T.Aman (HYV)	Vegetables	1.41	2.1
Fallow	T.Aman(local)	Chilli	1.0	1.5
	Total		66.41	100.0

Table 9.10: Loss of Production under the acquired land

Name of Crops	Area(ha)	Yield(T/ha)	Production loss (m.ton)
T. Aman(HYV)	21.41	3	64.2
T.Aman(Local)	45	2	90.0
Vegetables	1.41	12	16.9
Chilli	1	1	1.0
Total	68.82		172.2

Mitigation

The following measures will be under taken to address the above concerns:

- Contractor will avoid cultivation fields during construction
- Contractor will avoid agricultural land for material borrowing, material stockpiling, and labor camps
- Contractor will ensure that no vehicular movements will take place inside the cultivation fields
- Contractor will ensure that no material is dumped inside the cultivation fields
- Compensation will be paid for any crop damage
- Contractor will maintain liaison with communities.

Residual Impacts

For the help of above mitigation measures, the impacts associated with loss of agriculture are likely to be addressed adequately and the significance of residual impact will be Low.

9.4.2 Drainage congestion during replacement of drainage regulators

Impact

During construction phase, some existing localized natural drainage system near construction sites may be disrupted during dewatering, which are reversible. The specific name of the drainage congestion khals are Charar Khal, Hatkhola Khal, Para Khal, Kayratoli Khal, Clozarer Khal and Jaliakhali Khal. If the replacement of regulators is not properly dewatered during initiation of construction works then the upstream area of the regulators will face major drainage congestion problem and create water logging. Additionally, dewatering and spoil earth from the six khals would create disturbance to the natural drainage system during earthwork.

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

Mitigation

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

- Contractor will constructing bypass canal before replacement of regulators
- Sequence of work at the regulators and in the water channels will be carefully planned to avoid drainage congestion.
- Contractor will ensure that drainage channels are not obstructed or clogged by the construction activities
- Contractor will ensure that construction activities do not cause any water ponding near cultivation fields.

Residual Impacts

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

9.4.3 Seasonal Impacts due to natural hazards

Impact

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

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

Mitigation

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

Residual Impacts

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

9.4.4 Air Quality

Impact

Generally, construction machinery and Project vehicles will release exhaust emissions, containing carbon monoxide (CO), sulfur dioxide (SO_2), oxides of nitrogen (NO_X), and particulate matter (PM). These emissions can deteriorate the ambient air quality in the immediate vicinity of the Project sites (particularly along the embankment, and around the channel excavation sites and borrow areas (see **Figure 4.1)** for the Project interventions in Polder 32). Furthermore, construction activities such as excavation, leveling, filling and vehicular movement on unpaved tracks may also cause fugitive dust emissions. These emissions pose health hazards for the nearby communities as well as for the construction workers. In particular, the settlements near the work areas will be exposed to air contamination caused by the Project activities (Figure 9.1). Six schools (Ch 25.00 km, Ch 27.00 km, Ch 29.00 km, Ch 31.00 km, Ch 35.00 km, and Ch 49.00 km) are located near the embankment, which students is under threat for fugitive dust emissions. This sound is also harmful for the people of the thirteen settlements (Ch 0.5 km, Ch 3.00 km, Ch 4.0 km, Ch 7.2 km, Ch 11.37 km, Ch 12.60 km, Ch 13.50km,Ch 8.9 km, Ch19.9 km, Ch 23.4 km, Ch25.0 km, Ch 28.78 km, Ch 35.0 km and Ch 39.28 km), which are near to the construction site. The spatial location of the schools with chainage is shown in figure 4.1.

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

Mitigation

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

- Exhaust emissions from vehicles and equipment will comply with standards
- Proper tuning of vehicles, generators, and equipment will be carried out, to minimize exhaust emissions.
- Construction material (sand/soil) will be kept covered while transporting and stock piled.
- Water sprinkling will be carried out where needed, particularly on the earthen tracks near communities.
- Vehicle speed will be on low (15 km per hour) on earthen tracks particularly near communities.
- Vehicles and other machinery will be turned off when idle
- Good quality fuel will be used, minimizing exhaust emissions.
- Camps will be located at a safe distance from communities.
- Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.

Residual Impacts

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

9.4.5 Noise and Vibration

Impact

The construction activities particularly demolition of existing structures, excavation, compaction, operation of construction machinery, and vehicular traffic will generate noise and vibration which are likely to affect the nearby communities. In addition, camp sites may also generate noise.

Increased noise levels may cause disturbance, nuisance and even health hazards for the nearby communities as well as for the construction workers. In particular, the settlements near the work areas will be exposed to noise and vibration generated by the Project activities; in addition sensitive receptors such as schools (Ch 25.00 km, Ch 27.00 km, Ch 29.00 km, Ch 31.00 km, Ch 35.00 km, and Ch 49.00 km) are likely to be more severely affected by noise (Figure 9.1).

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

Mitigation

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

- Restricting/limiting construction activities during the day time.
- Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards.
- Vehicles and machinery will have proper mufflers and silencers
- Provision of noise barriers at schools and other sensitive receptors, as needed.
- Provision of PPE (ear muffs and plugs) to labor
- The construction crew will be instructed to proper use the equipment, to minimize noise levels
- Camps will be located at a safe distance from communities.
- Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.

Residual Impacts

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

9.4.6 Sedimentation

Impact

Borrowing material from the river banks may potentially cause increased sediments in the rivers. Similarly, re-excavation of water channels (see **Table 4.4** for the list of channels to be re-excavated) 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, demolition debris, and other materials may enter the river or other water bodies causing increased sediments in them. Run off from construction sites, material yards, camps, and other temporary facilities may enter water bodies increasing their sediment load (see **Figure 9.1** for the potential locations of sedimentation). Unless mitigated the impact of sedimentation due to project activities will be major.

Mitigation

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

- Contractor will protect untreated embankment slopes
- Contractor will excavate channels after dewatering them.
- Contractor will not leave excavated earth and silt on channel banks
- Contractor will implement measures to protect channels from run-off from work areas and camps
- Contractor will obtain borrow material from river banks in a manner not to increase siltation in rivers, and will not leave loose soil after excavation.

Residual Impacts

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

9.4.7 Fish habitat and migration

Impact

About 30 existing water control structures will be replaced by new structures. All structures are connected with the khals of the polder. These khals lost their natural fish migration system during construction of polders under the Coastal Embankment Project (CEP) in the sixties. Brackish fish migration has also been disrupted due to the lack of proper and timely operation and maintenance of sluices. The names of species are Paisa, Betki, Horina Chingri, Khorsula, and Chatka Chingri. Some of these brackish fish species are still found to move in the internal khals and beel during breeding season. During construction period, this fish migration will be partially obstructed by the new sluices, but the problems are reversible.

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

Mitigation

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

- Contractor will constructing bypass canal before construction of each regulator
- Sequence of work at the regulators and in the water channels will be carefully planned to minimize impacts on fish and their migration.
- Contractor will maintain liaison with communities.

Residual Impacts

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

9.4.8 Benthic Fauna

Impact

Benthic communities play important role in food chain not only for lentic but also for lotic water bodies. Multiple activities like re-excavation of 6 khals (17.50 km of khal), dredging of Shibsha, Bhadra and Chunkuri rivers and discharge of solid wastes (Construction activities and labour shed) may have an important impact on the benthic communities of the water bodies. This impact is quite local which will be revived within 1-2 years.

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

Mitigation

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

- Contractor will not release untreated wastes on soil or in water.
- Contractor will carry out *khal* excavation in segment thus minimizing impacts on benthic fauna.

Residual Impacts

Implementation of the above mitigation measures, the Project's impacts on benthic fauna will be somewhat reduced. After the construction phase, these resources are likely to fully recover gradually. The significance of the residual impacts has therefore been assessed as Low.

9.4.9 Disturbance of Flora and Fauna

Impact

About 265 number of tree will be cut down during rehabilitation of embankment. These clearances of plant will have temporary impact on landscape or scenic beauty around the project areas. Loss of plants will indirectly affect the fauna habitats. As such, this floral and faunal composition may be affected locally during construction phase.

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

Mitigation

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

- No material will be borrowed from and no waste will be disposed in Sundarban.
- Liaison with the Forest Department will be maintained to forestall any negative impacts on Sundarbans.
- Contractor will not release untreated wastes on soil or in water
- Labor will not indulge in hunting, trapping, or shooting wild animals.

Residual Impacts

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

9.4.10 Disturbance of water way navigation

Impact

Chunkuri-Passur with connection of Mongla-Ghasiakhali navigation route (Figure 9.2) along the northern and western periphery of the Polder 32 is very important route which connects the Mongla sea port. Also, this route is the part of Indian Protocol Route which is important for cargo transportation generated from India. The least available depth (LAD) of the navigation channel (Chunkuri River) has been increased upto 2 meter during the last decade. The river traffic is also increasing through this route.

During the last couple of decades, many of the tidal rivers in the southwest were found to be silted up rapidly and as a result they were unable to drain the tidal plains surrounded by the embankments (polder). Due to the reduction of tidal volume resulting from empoldering, the tidal rivers do not have its pre-polder flow area. As the tidal pumping process is able to bring huge sediment in this area, rivers can adjust its dimension (width and depth) very rapidly. A chain of such feed-back process has been initiated in this area in the late 1980s, effects of which are still continuing.

The cut-down of the tidal prism due to the construction of Polder 32 has already occurred. Strengthening of this polder may not have any significant irreversible effects on the surrounding rivers or Chunkuri-Passur route.

All the above mentioned localized problems may have short term effects on communication system of the area, which are reversible.

Mitigation

Contractors will be instructed and monitored by the environmental monitoring specialist to use traffic management plan. Movement of vessels or engine boat during fog and bad weather situation will be avoided. Additional temporary jetties where needed will be established for materials distribution. Liaison will be maintained with community and BIWTA.

Residual Impact

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

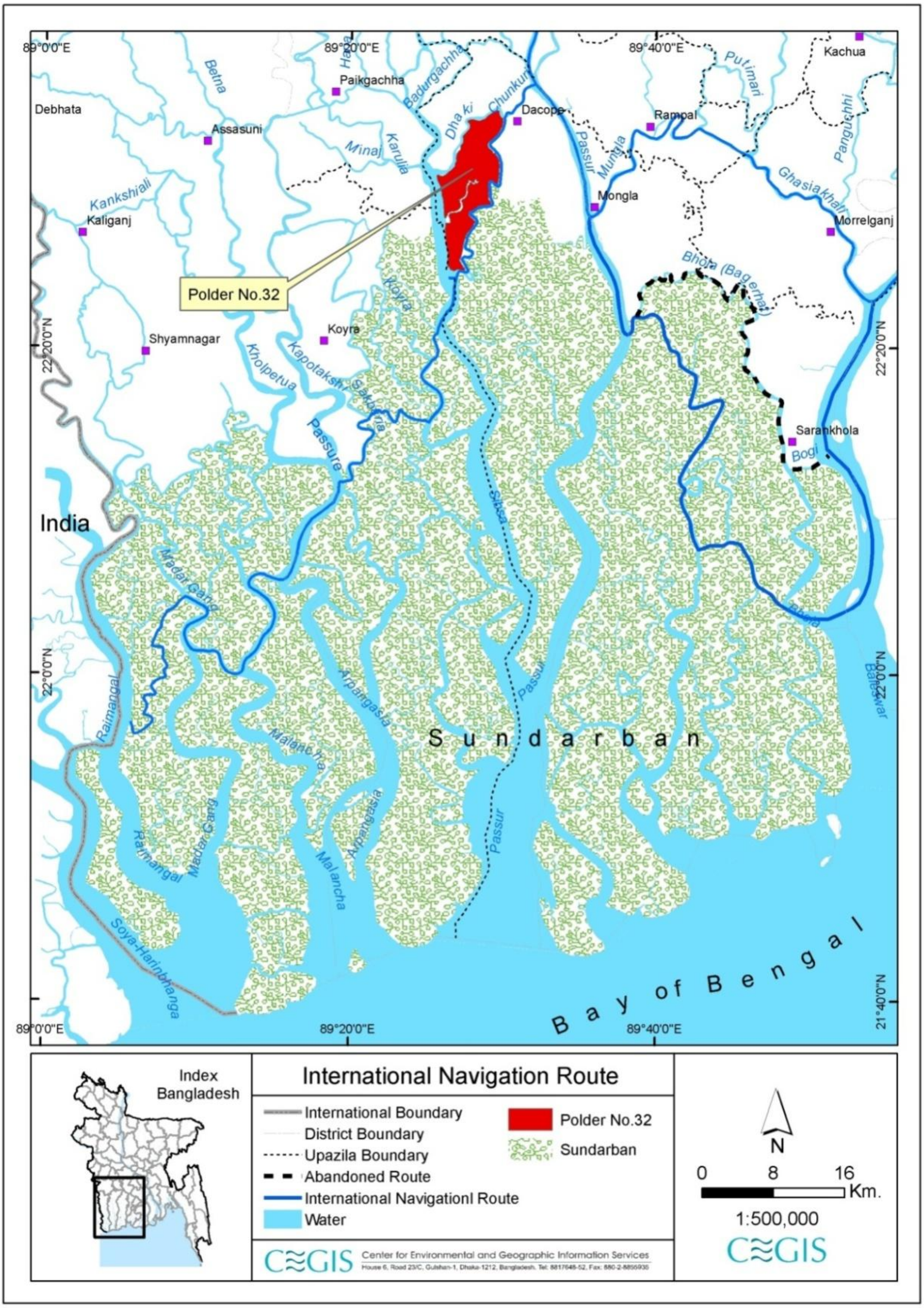

Figure 9.2: International Navigation route surrounding the polder 32

9.4.11 Affects on Irrigation

Impact

Irrigation is vitally important for the agricultural activities in the Kamarkhola, Nothbox, Kalabogi, Gonari, Sutarkhali, Nalian and Joynagar village of the Polder. Construction activities particularly on regulators and in water channels can potentially disrupt the crop irrigation during wet season thus negatively affecting cultivation. The works on sluices can cut off the incoming water from the river, while the excavation works in water channels can affect water conveyance through them.

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

Mitigation

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

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

Residual Impacts

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

9.4.12 Hindrance for Pedestrian and Vehicle Movement

Impact

A total number of four of markets are located near the embankment. The name of the markets are Kalinagar (Ch 26.00 km) Gunary (Ch 8.00 km), Joynagar (Ch. 10.00 km), and Talirkona bazaar. Embankment is the main road for communication of the local people. There is no alternative road for transportation of vehicles. Most of the internal roads in the polder area have been damaged by Aila (2009) which are not suitable for movement of vehicle. However, during hut and marketing time, all the stakeholders use this embankment as road for carrying their goods for buying and selling and other purposes. Earth work for re-sectioning of embankment and vehicles movement may create short term disturbances to the polder inhabitants.

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

Mitigation

The following measures will be under taken to address the above concerns:

- The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes.

- The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track.
- 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.
- Local routes will not be blocked as much as possible. If unavoidable, alternative routes will be identified in consultation with local community.
- Water way can be used during re-sectioning of embankment

Residual Impacts

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

9.4.13 Safety and Public Health Hazards

Impact

The area is prone to cyclones and storm surges. Although the works will be carried out during dry season, a certain level of safety hazards still exists for the 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 people as well as for the construction workers. The fuel storage at the camp sites may also pose safety hazards to them.

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

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

Mitigation

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

- All temporary facilities including labor camps will meet minimum safety, hygine and sanitation requirements (safe drinking water, proper sewage disposal, solid waste management, general cleanliness, protection against disease vectors, protection against weather elements, fire fighting, and other similar essential services)
- All workers must be provided with and use appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities;
- The construction sites will have protective fencing to avoid any unauthorized entry, where appropriate and possible
- Health screening of employees would be a Contractor obligation prior to laborers working on site and living in the temporary accommodation facilities. The health screening would entail normal review of physical fitness and also include a review of appropriate vaccinations. Workers would be given vaccinations as when and where required;
- All site staff will undergo screening against communicable diseases. Communicable disease careers will not be employed at the site.
- All employees need to carry out induction health and safety training prior to commencement of works. OHS issues would be a 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;
- 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;
- Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in employment and training;

- Report regularly on the labor force profile, including gender, and location source of workers;
- Report regularly on labor and working condition key performance indicators, for instance hours worked (regular and overtime) during period and cumulatively, hours lost, number and type of accidents, near misses, site audits and meetings; trainings, and use of labor grievance mechanism;
- Hold toolbox talks on workers' rights and the labor grievance mechanisms during the construction phase;
- Organize a training program and keep training registers for construction workers;
- Establish Occupational Health and Safety (OHS) procedures in the overall environmental management system which provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project.
- Availability of safe drinking water will be ensured for the construction staff.
- First aid boxes will be made available at each construction site. Emergency phone numbers (including hospitals, Fire Department, and Police) will be displayed at key locations within the site. Each site will have an ambulance available.
- Firefighting equipment will be made available at the camps and worksites.
- The camp staff will be provided safety including fire fighting training.
- All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel.
- Waste management plan to be prepared and implemented in accordance with international best practice.
- Liaison with the community will be maintained.

Residual Impacts

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

9.4.14 Local worker vs outside worker conflict

Impact

Around 51,553 numbers of skilled and unskilled labours will be required for construction activities. Most of the labour will be needed for re-sectioning of embankment and retired embankment. It is envisaged that about 60 percent construction workers will be recruited from within the Polder while the remaining will come from other areas. The presence of outside laborers in the area may create friction and conflict between the local labor and outside labor, and between local community and outside labor.

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

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

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

Mitigation

The following measures will be undertaken 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;
- 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

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

9.4.15 Wastes from Labour shed and construction sites

Impact

Sanitary wastewater generated from various facilities such as worker's shed units will be discharged in the project area. This sanitary wastewater, if discharged without proper treatment, will have adverse impact on both the surface and ground water quality and could lead to water borne diseases.

Water discharged from the construction sites during dewatering generally contains objectionable odor and colour. It may also be acidic, toxic and highly turbid. Such water is unfit for drinking or any other use. In some cases these may also contain pathogenic microorganisms, which posses potential health hazard. The polluted water may not be useful for re-vegetation and human or animal consumption; and high turbidity and oils on water may not allow proper oxygenation of the surface water. Further, high turbidity may prevent sunlight to enter into the water body necessary for promoting photosynthesis of aquatic plants. So, polluted water may affect the aquatic life.

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

Mitigation

- Contractor will prepare and implement pollution control plan considering the following aspects and issues:
- Workshops will have oil separators/sumps to avoid release of oily water.
- Avoid repairing 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
- 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 borrowing from the river banks will be carried out sufficiently away from the water line, minimizing the possibility of loose soil to wash away in the river
- Location of camps away from communities and drinking water sources
- Prepare and implement camp waste management plan (septic tanks, proper solid waste disposal);
- Untreated wastes will not be released on ground or in water
- Spoil and excavated material will be re-used where possible
- Community consent will be considered during dispose spoil
- Construction material, demolition debris, and excavated soil/silt will not be allowed to enter water bodies.
-

Residual Impacts

For the help of mitigation measures, the impacts on the water resources are likely to be addressesed adequately and the significance of residual impact will be **Low**.

9.4.16 Damage to Local Infrastructure

Impact

There could be some inadvertent damage to the roads, electricity lines, water channels, jetties, and other structures during the construction activities, transportation of equipment and material, and associated vehicular traffic (see **Figure 9.1**).

Mitigation

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

- The condition of the infrastructure being used for the construction and transportation activities will be regularly monitored.
- All damaged infrastructure will be restored to original or better condition.
-

Residual Impacts

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

9.4.17 Damage to Local Infrastructure

Impact

There could be some inadvertent damage to the roads, electricity lines, water channels, jetties, and other structures during the construction activities, transportation of equipment and material, and associated vehicular traffic (see **Figure 9.1**).

Mitigation

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

- The condition of the infrastructure being used for the construction and transportation activities will be regularly monitored.
- All damaged infrastructure will be restored to original or better condition.
-

Residual Impacts

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

9.5 Impacts during Post-construction Phase

9.5.1 Water Contamination and Reduced Soil Fertility

Impact

At present, about 300 ha of land are under boro (rice) cultivation. According to the initial estimates, about 1.50 Mm^3 of water will be available from the internal canal system, after the completion of the proposed Project. This will allow expansion of area under irrigated cultivation of boro and aus varieties of rice to about 670 ha. Specifically, boro cultivation will be expanded in the medium high land and medium low land areas (Figure 6.8 under Chapter 6). This expansion of irrigation is likely to result in decrease of soil fertility and increase use of chemicals including fertilizers and pesticides. Runoff from such cultivation fields may pollute the water bodies and even drinking water sources thus causing health hazards to the communities. This runoff may also lead to eutrophication of the water bodies, a phenomenon which would decrease the dissolved oxygen in the water and thus negatively affecting the aquatic fauna.

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

Mitigation

The following measures will be undertaken to address the above concerns:

- Capacity building and awareness building of the farmers will be carried out to practice Integrated Pest Management (IPM) and Integrated Crop Management (ICM) – in order to minimize usage of chemical inputs.
- Farmers group will have close contact with DAE for adoption of various measures of IPM/ICM.
- Farmers will be encouraged to use organic manure to increase soil fertility while avoiding water contamination
- Farmers will be encouraged to cultivate leguminous crops to enhance the soil quality

Residual Impacts

Implementation of above mitigation measures, the impacts associated with usage of increased level of chemical inputs are likely to be somewhat addressed and the significance of residual impact will be Moderate.

9.5.2 Risk of Embankment Failure

Impact

Rain cuts and public cuts due to farming of shrimp fish are the major causes of embankment breaching of the Polder 32. Lack of regular maintenance has created weak point at the sensitive locations of the embankment. Mal-maintenance and increasing intensity and magnitude of the cyclone and storm surge simultaneously have accelerated the risk of embankment failure. Counter clockwise circulation of the cyclone of the Bay of Bengal will make the eastern embankment more susceptible to breaches.

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

Mitigation

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

- Regular monitoring and careful maintenance of the embankment and existing water control structures especially along the eastern side of the Polder will be ensured. This monitoring will particularly be carried out before and after monsoon season.
- Available cyclone and flood shelter will be prepared as a contingency measure during emergency situation.
- WMG will develop a fund for this kind of emergency situation.
- Structural measures like geo bag and sand bag will be kept in stock yard of local BWBD colony.

Residual Impacts

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

9.5.3 Drainage Congestion and Increased Sedimentation in Water Channels and Rivers

Impact

Drainage congestion is a key issue in southwest zone of Bangladesh, and Polder 32 is facing this problem due to siltation of khals and external rivers, as discussed in Section 4.5.4. Specifically, external River and khal is silted up due to reduced flow from the upstream. This problem is localized and reversible by proper re-excavation of khals, which has been considered in Feasibility Study. However, it is a recurring problem and silt deposition in the rivers outside and water channels inside the Polder is likely to continue. Particularly, the low lying areas of the polder (Figure 6.8) may face severe drainage congestion in the future.

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

Mitigation

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

- An ongoing program of de-silting of water channels will be considered with full community involvement and participation.
- Proper land zoning plan will be prepared in the Polder for controlling unplanned development works. For this purpose further research should be taken by the SRDI or Agriculture Extension Office of Bangladesh.
- The local government (union parishad) will be authorized to monitor the development activities.
- Proper training program in connection with land zoning and monitoring system will be undertaken by the development authorities of Bangladesh.
- A research program will be carried out for polder-wise land zoning plan preparation in future.
- Prepare Bangla manual for sluice gate operation and provide training to WMOs; and
- Reduce conflicts between farmers and fishermen.

Residual Impacts

With the help of above mitigation measures, the impacts associated with drainage congestion are likely to be mostly addressed and the significance of residual impact will be Moderate.

9.5.4 Increased soil and water salinity due to Nalian cross dam

Impact

It is expected that implementation of interventions and their proper management would protect the area from undesirable entry of saline water and would allow draining out of the dissolved salts from agriculture land. The flood control and drainage structure will restrict the intrusion of saline surface water during high tide or tidal surge. Soil salinity will also be flushed out from the project area during monsoon with rainwater as drainage channels will be re-excavated.

On the other hand, construction of cross dam at the upstream of Nalian river system will result in trapping of saline water in Nalian River for a long time. Inundation by saline water may increase the persistence of salinity in both soil and water along Nalian River inside the polder. Soil and water salinity can potentially have negative impacts on the agriculture, and biological resources of the area including aquatic flora and fauna.

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

Mitigation

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

- Alternative channel with regulators' will be constructed near the cross dam
- Regulator should be operated properly.

Residual Impacts

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

9.5.5 Increase Salinity Intrusion Due to Leakage of Regulators

Impact

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 or poor upkeep and maintenance of these control structures will undermine the very objective of the Project.

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

Mitigation

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

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

Residual Impacts

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

9.5.6 Improvement of Fish Migration

Impact

Due to Aila most of the water regulator structures became malfunction and internal khal have been silted up due to breaching of embankment. Construction of new water control structures on water channels which would be directly connected with the outer rivers and will potentially result in improvement in fish migration (figure 6.18 under Chapter 6). This can potentially result in increase of fish population in the Polder thus positively impact for fish catch and fishermen.

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

Mitigation/enhancement

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

- Proper sluice gate operation allowing fish migration;
- Fish friendly structure should be constructed;
- Provide training to WMOs.

Residual Impacts

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

9.5.7 Impact on Shrimp farming and Livelihood

Impact

Shrimp farming is a common practice in the polder area. A significant number of farmers are involved in shrimp farming in this area. It is more profitable than paddy. Shrimp export contributes significantly to the local and national economic development, employment and income generation as well as livelihood improvement. Improved drainage system, or protection of saline water intrusion by embankment and water control structures, the salinity problem will be reduced within the project area. As a result, rice area would be increased compared to its base condition. On the other hand, shrimp farm area would be adversely impacted due to reduction in saline prone area and would be reduced to corresponding shrimp production. It is expected that the livelihood of the shrimp farmers will be impacted unfavorably no doubt. Many local labours who are exclusively engaged in shrimp farming will become jobless. The significance of this potential unmitigated impact has been assessed as **Moderte.**

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Mitigation

1. Prospective of golda farming should be encouraged through campaigning and by providing training on improved culture practices as well as rice-cum-golda farming within available sweet water;
2. Alternative income generation i.e. livestock rearing, poultry and integrated fish culture may create scope of alternative income for shrimp farm labour;
3. Shrimp farming is not environmentally sound practice. In shripmp farm area, there is no green environment due to salinity intrusion. But after completion of the CEIP project, people will be benefitted by different type of by-products like paddy straw, vegetable garden, yard garden, poultry and livestock and finally food security from their crop fields. So it may ensure the proper extension service as well as proper training for betterment of life and livelihood;
4. Shrimp farming is suitable and profitable for only rich farmer but not for landless people, marginal and small farmer. Considering poverty reduction the proposed CEIP project will be very helpful for landless people, marginal and small farmer as a whole.

9.5.8 Impacts on Sundarbans

Impact

Sundarbans is 35 km away in the south-eastern part of polder 32. Sutarkhali river is in between Sundarbans and Polder 32 from chainage 29500 to 42500. The main impact of the polder on the Sundarban ecosystem situated across the river is the intrusion of more water on the forest floor of Sundarban. This may enhance the height of the tidal inundation of the forest. This enhanced tidal inundation, may imbalance the natural tide inundation features of the given ecosystem. It is commonly observed that in areas that have higher tide inundations, the species composition is different than that is found in the areas that have lower tide inundations. It has been observed that the species such as Sundri (*Heritiera fomes*), Passur (*Xylocarpus moluccensis*), Kakra (*Bruguiera gymnorhiza*), etc. prefer lower tide inundation. As against this, species such as Jhana (*Rhizophora mucronata*), Goran (*Ceriops decandra*), etc. prefers higher inundation. Thus with the enhanced inundation the species composition may gradually change. Secondary information obtained from interviewing local forestry officer reveals that the proportion of Goran on the patch of forest north of “Dabrir Bhorani” across the Shoronkhola Range has increased tremendously and population of crabs have reduced significantly.

Again if the quantity of water entering the Sundarbans increases, consequently the speed at which the water enters the forest floor also increases, which in turn may cause two things, namely

- brings in more of coarser soil particles on the forest floor as it enters and majority of these get deposited on the river banks or nearby
- drains off more of the heavier detritus from the forest floor as it recede s, which otherwise would have got retained by the given ecosystem.This may ultimately cause the loss of soil fertility.

It is however very difficult to isolate what part or what quantum of these above said impacts are because of the polders alone. It needs to be mentioned herein that the quantum of these impacts will be lower if the width of the river between the Sundarban & Polder is more.

Mitigation

1. Although there is no definite study on how much width should be maintained between the river and polder to have no impact on Sundarbans, the study advised to avoid any kind of realignment for polder 32 from chainage 29550 to 42,500.

2. The long term monitoring study under the project will incorporate the study on the impact on the ecology of Sundarbans.

3. BWDB will continue to monitor the ecology on Sundarbans due to project intervention and will guide the design consultant for finalizing the design of other polders close to Sundarbans like Polder 15 under this project.

9.6 Positive Impact of the Project

9.6.1 Employment Generation

The construction work will generate a significant amount of employment over its construction period to local people and other associated professionals. People will also be involved to carry put operation and maintenance related jobs to operate the hydraulic structures. It is expected the agriculture production will be increased, water logging will be decreased due to the project which will create jobs indirectly from agriculture, business and commercial services.

9.6.2 Livelihood Development

Polder 32 was one of the worst affected polder during cyclone Aila. The project is expected to increase resilience of people within Polder 32. Agriculture production increase, reduction of drainage congestion, income generation is expected to improve the livelihood of the people.

9.6.3 Gender Promotion

Construction work requires various types of skilled and unskilled labors. It is found that in Bangladesh a portion of construction labors are female. These females are vulnerable to natural disaster and mostly distressed and widow who are dependent on others and do not have any definite source of income. Therefore, employment access to them in the construction works and during operation/maintenance phase is significantly positive.

9.6.4 Communication

Height of the embankment would be increased and re-sectioning work would be done which would improve road communication under the FWIP condition. People of the polder area would be able to use this embankment for communication purpose. The sufferings of local people will reduce as well as carrying costs of goods would be minimized. Over all road communication will be easier for local people permanenetly.

9.6.5 Afforestation

The project will promote afforestation which is expected to largely mitigate the negative impact associated with felling off the trees. However the impact is expected to be positive in the long run.

9.6.6 EMP Promotion

The project has in built component which will facilitate implantation of Environmental Management Plan. Under the project, the capacity building for environmental management of BWDB and WMO will be performed. The project is expected to have long term positive impact on institutional development of BWDB and WMO for ensuring environmental sustainability.

9.7 Summary of Assessed Impacts

A summary of these impacts and their significance discussed in the sections above is presented in **Table 9.11**.

Table 9.11: Significance of Environmental Impacts

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
A. Pre-construction Phase								
Involuntary resettlement	Long term	Local	Irreversible	Certain	High	Major	• RAP to be prepared • Compensation to be paid prior to construction in accordance with RAP • Maintain liaison with communities. • Grievance redress mechanism (GRM) in place	Moderate
Conflict for the absence of proper land ownership legal document	Long term	Local	Irreversible	Certain	High	Major	• This conflict could be reduced, if the compensation would be disbursed by the Local Government Authority in presence of Union	Moderate

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							Parishad Chairman and Upazila Nirbahi Officer (UNO) of the Upazila.	
Increased traffic for contractor mobilization	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Moderate	• Contractor to prepare and implement mobilization plan. • Liaise with local communities and concerned authorities • Ensure minimal hindrance to local communities and commuters	Low
Preparation of Facilities for Contractor and Labour force	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Major	• Contractor will prepare site establishment plan and obtain approval from the Construction Supervision	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							Consultants (CSC) • Approval from CSC will beobtained for the location of temporary facilities. • Tree felling and vegetation clearing will be minimized to establish site facilities • Photographic record will be maintained to record pre-construction condition of the area • Site facilities will be established at a safe distance from communities • Contractor will prepare and implement	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							pollution control and waste management plans • No untreated wastes will be released on ground or in water • Exhaust emissions from vehicles and equipment will comply with standards • Vehicles, generators, and equipment will be properly tuned. • Water will be sprinkled where needed to suppress dust emissions • Speed limits will be enforced for vehicles on	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							earthen tracks • Vehicles and machinery will have proper mufflers and silencers • Liaison will be maintained with the communities.	
Changes in Land Use	Short term	Local	Reversible (after construction phase)	Certain	low to medium		• Established all the construction camps within the area owned by BWDB • Pay compensation/rent if private property is acquired on temporary basis, which instructions will be specified in the tender document. • Consult local	Negligible

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							stakeholders in the polder area in presence of elected executive body of Union parishad. • Avoid impacts on local stakeholders.	
Tree cutting during embankment re-sectioning and labor shade preparation	Short term	Local	Reversible (after construction phase)	Certain	low		• Thick and dense vegetated area will be avoided to prepare the labour shed as far as possible; • Contractor will prepare a tree plantation plan will be prepared for compensation of loss of trees. Trees will be planted at the end of the construction period during wet season. It	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							is recommended to establish a nursery with selected tree species (Geoa, Kewra and Babla) in the beginning of the project in order to reduce the purchasing cost of saplings. All saplings will be planted and monitored • Contractor will avoid dumping of spoil earth in and material borrowing from vegetated areas.	
B. Construction Phase								
Loss of Agriculture	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Major	• Compensation will be provided for any crop	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							damage • Contractor will avoid cultivation fields during construction • Contractor will avoid agricultural land for material borrowing, material stockpiling, and labor camps • Contractor will ensure that no vehicular movements will take place inside the cultivation fields • Contractor will ensure that no material is dumped inside the cultivation fields	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							• Contractor will maintain liaison with communities.	
Hindrance for Pedestrian and Vehicle Movement	Short term	Local	Reversible	Likely	Medium	Major	• The works on embankment will be carefully scheduled to minimize impact on local markets and transportation routes. • The embankment works will be carried out in segments and soil will be placed linearly on half of the embankment, leaving the other half to be used as track. When the works are completed on the first half, it	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							will be opened for local traffic while works will be undertaken on the other half of the embankment. • Work schedule will be finalized in coordination and consultation with local representatives and communities. • Local routes will not be blocked as much as possible. If unavoidable, alternative routes will be identified in consultation with local community	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							• GRM will be put in place.	
Increased inland and waterway traffic	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Major	• Contractor to prepare and implement traffic management plan • Contractor to establish new, temporary jetties where needed • River crossing during nighttime where possible and appropriate • Material transportation through rivers during high tide where needed (eg, Chunchuri River) • Liaison with community	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							and BIWTA.	
Safety and Public Health Hazards	Short term	Local	Reversible	Likely	High	Major	• Liaison will be established with the Bangladesh Meteorological Department for early warning of storms and cyclones. Radio and television sets will be kept in all the labor camps for obtaining weather information. • Each contractor will establish a comprehensive Health and Safety Plan aimed at preventing accidents, injuries and work-related diseases. This	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							plan will be submitted to BWDB and World Bank for review and approval; • Each contractor will prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan will be submitted to BWDB and World Bank for review and approval; • All workers must be provided with and use appropriate Personal Protective Equipment	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							(PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities; • 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	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							review of appropriate vaccinations. Workers would be given vaccinations where required; • Hazards require staff training. All employees need to carry out induction health and safety training prior to commencement of work. OHS issues would be part of the employee training plan. Training would include the provision of appropriate written or visual materials to	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							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	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							for employment of children and meeting international standards of not employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activity. The construction contractor(s) would not hire people under the age of 18 on permanent contracts but would include short training activities for youth to the extent possible;	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							• Ensuring acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work; • Ensuring no workers are charged fees to gain employment on the Project; • Ensuring rigorous standards for occupational health and safety are in place; • Contractor will establish a labor grievance mechanism	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							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	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							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	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							community employees that involves local authorities in clearly understood procedures; • Employ a community liaison officer (this could be full time or part of another post's responsibilities); • Raise awareness prior to recruitment, clarifying the local hire policy and procedures, including identification of opportunities for women to participate in	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							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	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							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	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							provide workers with a safe and healthy work environment taking into account the inherent risks for this type of project.	
Local worker vs outside worker conflict	Short term	Local	Reversible	Likely	High	Major	• 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)	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							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	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							of alcohol and drugs; • Safe driving practices; • Respect for the local community and its cultural norms in which laborers are working. • Avoiding construction activities during Prayer time.	
Seasonal Impacts due to natural hazards	Short term	Local	Reversible	Likely	High	Major	• Weather signals will be considered by the contractor during construction works. • Radio and television will be provided in all the labour sheds for receiving	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							weather information through these media. • Ensuring rigorous standards for occupational health and safety are in place.	
Air quality deterioration (dust, combustion gases)	Short term	Local	Reversible (after construction phase)	Certain	Medium to high	Moderate	• Exhaust emissions from vehicles and equipment to comply with standards • Proper tuning of vehicles, generators, and equipment • Covering construction material (sand/soil) while transporting and stock piled.	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							• Water sprinkling where needed • Speed limits for vehicles on earthen tracks • Turn off engine when idle • Use of good quality fuel • Locate camps at a safe distance from communities. • Liaison with the communities will be maintained and grievance redress mechanism will be established at the site.	
Noise and vibration	Short term	Local	Reversible (after construction	Certain	Medium to high	Moderate	• Restricting/limiting timing of construction	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
			phase)				activities • Noise levels from vehicles, equipment and machinery to comply with national and WB noise standards. • Vehicles and machinery to have proper mufflers and silencers • Provision of noise barriers at schools and other sensitive receptors • Provision of PPE (ear muffs and plugs) to labor • Instruction for proper use of equipment • Liaison with community • Locate camps	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							at a safe distance from communities.	
Water logging and drainage congestion	Short term	Local	Reversible	Occasional	Medium to high	Moderate	• Constructing bypass canal during construction of all regulators • Ensuring that drainage channels are not obstructed or clogged • No water ponding near cultivation fields	Low
Affects on irrigation	Short term	Local	Reversible	Likely	High	Moderate	• Constructing bypass canal during construction of all regulators • Proper sequencing of works on regulators and sluices • Ensuring no negative	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							impacts on crop irrigation • Maintain liaison with communities.	
Hindrance to fish migration	Short term	Local	Reversible	Likely	Medium to high	Moderate	• Constructing bypass canal during construction of all regulators • Proper sequencing of works on regulators and sluices; • During monsoon runoff will be diverted to adjacent depressions and from there to river after settling • Maintain liaison with communities.	Low
Affects on benthic	Short term	Local	Reversible (in medium to long	Likely	Medium	Moderate	• Do not release untreated	Low to medium

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
communities			term)				wastes on soil or in water. • Carry out *khal* excavation in segment thus minimizing impacts on benthic fauna.	
Damage / disturbance to faunal resources	Short term	Local	Reversible	Likely	Medium	Moderate	• No material to be borrowed from and no waste to be disposed in Sundarban. • Do not release untreated wastes on soil or in water • Labor not to indulge in hunting, trapping, or shooting wild animals.	Negligible
Damage to floral resources	Short term	Local	Reversible (in medium to long term)	Likely	Medium	Moderate	• Carry out compensatory tree plantation for tree felling • Avoid	Negligible

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							dumping of spoil earth in vegetated areas; • Enhance flora environment by planting fruit trees and mangrove plants; • Use grasses to assist slope and soil stability. • No material to be borrowed from and no waste to be disposed in Sundarban.	
								Low
Social Unrest	Short term	Local	Reversible	Likely	Medium	Moderate	• Proper awareness programs will be conducted through public consultation measures such as village	Low

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							scoping sessions, meetings, and placement of bill boards with assistance from the Union Parishad Chairman, Upazila Nirbahi Officer (UNO) and BWDB local officers. • Cultural norms of the local community will be respected and honored. • GRM will be established address the grievances of local as well as outside laborers. • Careful use of local natural resources and	

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							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.	
C. Post Construction Phase								
Soil and water contamination (increased use of chemical	Long term	Local	Reversible	Likely	High	Major	• Using IPM method for reducing pesticide use; • Awareness	Moderate

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
inputs) and reduced soil fertility							raising of communities	
Risk of embankment failure	Long term	Local	Reversible	unlikely	High	Major	• Regular repair and maintenance of embankment and regulators.	Low
Drainage congestion and increased sedimentation in *khals* and rivers	Long term	Local	Reversible	Likely	High	Major	• Provide water shed management training to WMOs • Prepare Bangla manual for sluice gate operation and provide training to WMOs; and • Reduce conflicts between farmers and fishermen. • Program for on-going de-silting of water channels.	Moderate

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							• Implement small scale tidal river management (TRM)	
Increase salinity intrusion due to leakage of regulators	Long term	Local	Reversible	Likely	High	Major	• Regular repair and maintenance of regulators • Prepare Bangla manual for sluice gate operation • provide training to WMOs; • Proper standard operating procedures (SOPs).	Low
Increased soil and water salinity due to Nalian cross dam	Long term	Local	Reversible	Likely	High	Major	• Alternative channel with regulators' will be constructed near the cross dam • Regulator will be operated	Moderate

Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Unmitigated)	Mitigation Measures	Residual Impact
	(See Table 2.1)				(Table 2.2)	(Table 2.3)		
							properly.	
Improvement of fish migration	Long term	Local	Reversible	Likely	Medium	Moderate	• Proper sluice gate operation allowing fish migration. • provide training to WMOs; • Transferring juvenile fish from rivers to Polder through artisanal fisher. • Construction of fish sanctuaries in the internal important khals	low

10. Cumulative and Induced Impacts

This Chapter attempts to present analysis of cumulative impacts of the proposed Project and other projects in the area. In addition, induced impacts are also covered in the chapter.

10.1 Cumulative Impacts of all CEIP Interventions

As shown in **Figure 4.1**, Polder 32 is surrounded by a number of rivers and lakes/ khals. There is Sibsa river along the western periphery, Dhaki river along the north-west periphery, Bhadra and Sutarkhali rivers along the eastern periphery of the polder. Figure 10.1 shows the location of the Polder along with the surrounding polders. Polder 31, 23 are located on the north direction of Polder 32. In the eastern direction, Polder 33 is located. In the west, Polder 23 and Polder 10-12 are located.

Of the aforementioned polders, Polder 33 is under CEIP-I whereas Polder 23, and Polder 18 are among the 12 polders of which the feasibility level studies have been completed and these polders are to be considered for detailed design in the later phases of CEIP.

Polder 33 is located in the opposite direction of Polder 32 (see **Figure 10.1**) with a design crest level of 4.5 m. The design crest level of Polder 32 is 5 m (above MSL) along the periphery of Sibsa river and 4.5 m in the remaining parts. The construction works in Polder 33 will have significant effects on Polder 32. The major impact would be the transferring of risk of inundation into Polder 32. The embankment constructed around Polder 33 would prevent the entry of cyclonic surge and hence there will be immense hydraulic pressure created on the eastern part of embankment around Polder 32. Also the embankment around Polder 33 would cause increased amount of siltation in the Bhadra river increasing overtopping chances of river water during monsoon for both polders. The development of livelihoods in Polder 33 would generate socio-economic impacts on Polder 32. There will be more employment opportunities created in Polder 33 during the implementation of CEIP-I, creating labor scarcity to some extent in Polder 32. Also Polder 33 would provide food security, market options to Polder 32 at times. Polder 33 and Polder 32 will pollute the water of Bhadra river due to the overall developments. Such pollutions are likely to affect the flora-fauna of Polder 32 (Polder 33 as well), may result in migration of species as well in future.

Polder 23 is another polder under CEIP, but not considered under phase I. This polder has an existing crest level of 4.27 m and it has less chances of transferring the inundation risks into Polder 32. During the implementation of CEIP in Polder 23, there will be wastes created that may pollute the surface water further downstream (Sibsa river). Such pollution may hamper the surface water quality of the internal lakes/ khals of Polder 32 as well. However the pollution effect of Polder 23 on Polder 32 is marginal. The major impact that the implementation of Polder 23 is likely to cause on Polder 32 is the transfer of inundation risk. The embankments (after construction) around Polder 23 would divert river water further downstream and this may eventually lead to increase in surface water surge of Sibsa river. During monsoon or disaster events the increased surge of Sibsa river may inundate Polder 32. The other polders located upstream of the Sibsa river will generate similar impacts to polder 32 in future. These polders however generate no significant impact on Polder 32 at present.

The other polders under CEIP-I (Polder 35/1, 35/3 and 39/2C) are located far from Polder 32 and generate very negligible cumulative impacts if any. Therefore, from the context of Polder 32, discussions on such negligible cumulative impacts (if any) are avoided.

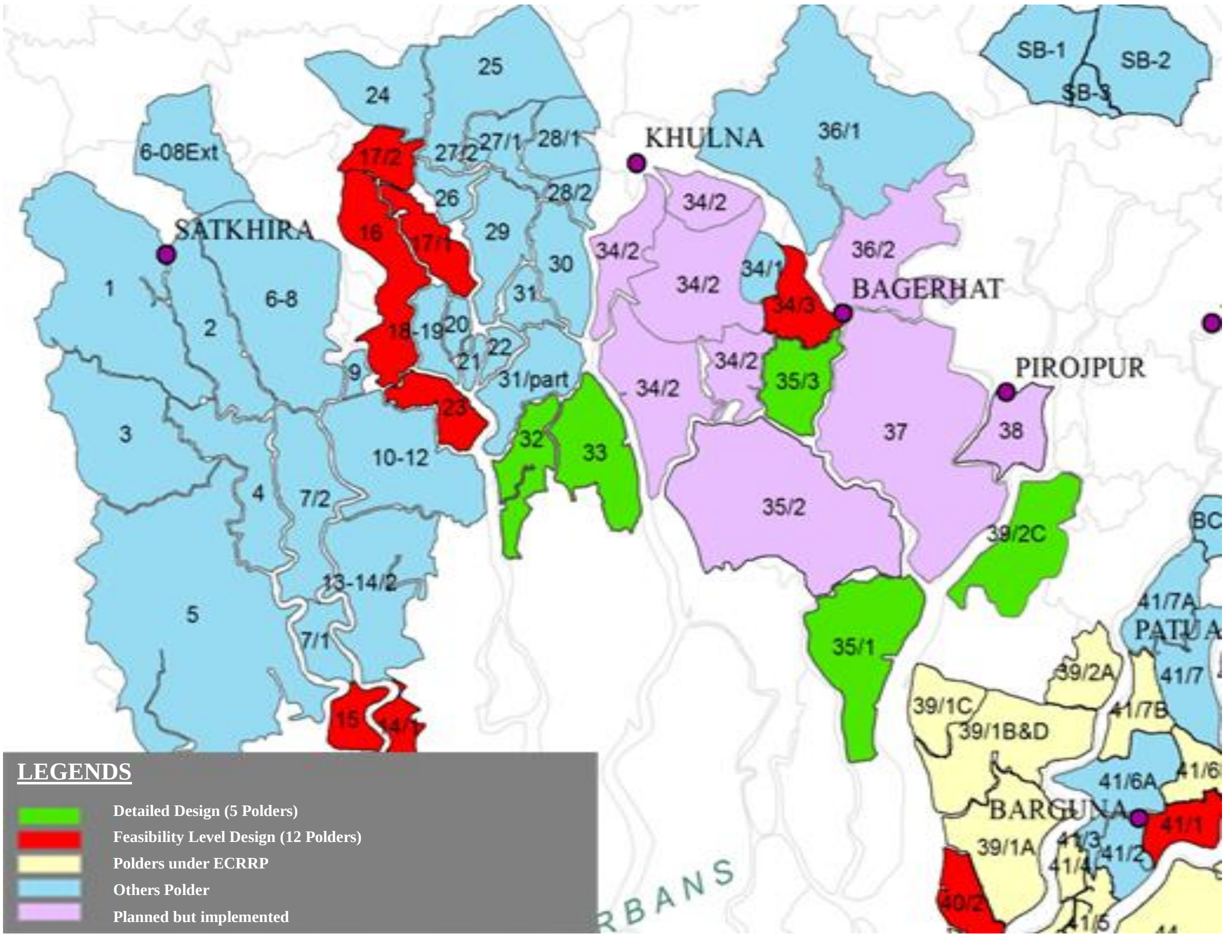

Figure 10.1: Locations of polders under CEIP-I

10.2 Other Projects around Polder 32

Apart from CEIP, there are some other development projects implemented by the Government of Bangladesh (GoB) and a number of Non Government Organizations (NGOs) at or near polder 32. The activities of these projects may generate cumulative impacts on the polder. Table 10.1 and Table 10.2 show lists of various projects undertaken by the GoB and NGOs frequently in the district of Khulna, where Polder 32 is situated.

Table 10.1: List of other projects implemented by the GoB

Agency	Project Name	Duration	Location
DMB, BWDB, FAO, LGED	Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)	2008-ongoing	Pirojpur, Barguna, Barisal, Bagerhat, Bhola, Khulna etc.
LGED	Flood Rehabilitation Project in the Area of Rural Development Project-18 (Greater Khulna, Jessore and Kushtia District)	2000-2003	Khulna, Satkhira, Bagerhat
	Greater Khulna District Infrastructure Development Project	2000-2004	Khulna, Satkhira, Bagerhat
	Biodiversity Conservation in Sundarban Reserve Forest.	1999-2005	Satkhira, Khulna, Bagerhat

Agency	Project Name	Duration	Location
DoF	Extension of Culture Technology of Marine Shrimp	1997-2004	Khulna, Bagerhat, Satkhira & Cox's Bazar
BEPZA	Mongla EPZ (Phase-1)	1998-2004	Khulna
KCC	Solid Waste Disposal and Environmental Improvement in Khulna City Corporation	1996-2004	Khulna

Table 10.2: List of projects implemented by the NGOs

Agency	Project Name	Duration	Location
CDP	CDP-CARE RVCC Partnership Project: Collection and Dissemination of Information on Climate Change in South West Bangladesh: Development of Central Information Centre (CIC)	2003-2005	Bagerhat, Khulna, Satkhira, Jessore, Narail and Gopalganj
CCEC	Sundarban Conservation through Crab Fattening	2002-2003	Khulna

10.3 Cumulative Impacts of Other Projects in the Area

Some cumulative impacts are also generated in polder 35/1, due to the implementation of various large or small scale projects. These impacts may be direct or indirect, major or minor in context of polder 35/1, but the consequences of such impacts need to be investigated. The cumulative impacts found in polder 35/1 for different projects are discussed below:

a) Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)

In order to facilitate recovery from damage to livelihoods and infrastructure caused by Cyclone Sidr and to build long-term preparedness through strengthened disaster risk management, the GoB implemented the "Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)" in a total number of 13 districts (Barguna, Bagerhat, Barisal, Khulna, Bhola, pirojpur, Jhalokati, Noakhali, Feni, Chittagong, potualkhali, Sathkhira, Laksmipur) of Bangladesh. A major component of the overall activities of this project is rehabilitation of coastal embankments in Five upazillas of Barguna district (Amtali, Bamna, Betagi, Barguna sadar, Patharghata), two upazillas of Pirojpur district (Bhandaria, Mathbaria), and three upazillas of Patuakhali district (Dashmina, Galachipa, Kalapara).

The Polders under ECRRP are located far from Polder 32 (see Figure 10.1). Therefore the cumulative impacts generated by such interventions into the polder are negligible and hence not considered here.

b) Other GoB projects

Apart from ECRRP and CEIP there are other projects undertaken by the GoB at or near the study area (see **Table 10.1**). The GoB projects listed in **Table 10.1** generate the following foreseeable impacts into Polder 32.

To provide protection from salinity intrusion in Nazirpur, BWDB implemented a project naming "Protection from Saline Water at Nazirpur and its Surrounding Areas" from 1994 to 2004. This project generates notable hydrological influence in the rivers surrounding Polder 32. Over the years, the flow of Sibsa river has seen marginal change in flow due to the project implemented in Nazirpur. Due to the upstream river dredging under the project, the flows in Sibsa and Dhaki rivers have increased in recent times.

There is a flood rehabilitation project implemented by Local Government Engineering Department (LGED), at local level in Khulna, Satkhira, Bagerhat districts. The project improved the status of local people living in Polder 32. Due to agricultural development caused by the flood rehabilitation project, food security has been developed for Polder 32. The effective implementation of the project ensured growth in development, and hence many people from polder 32 preferred such developed places of Khulna, Sathkhira, Bagerhat for employment. LGED also implemented an infrastructure development project during 2000-2004 which eventually improved the communication system, thus affecting the overall socio-economy. There had been biodiversity conservation plans on smaller scale in the districts of Bagerhat, Khulna and Sathkhira. Such biodiversity conservation plans in Sundarbans have eventually led to improvement of habitats, people, water quality etc. in Polder 32.

In the year 1998, Department of Forest (DoF) extended the culture technology of marine shrimp on macro scale in Khulna, Bagerhat, Sathkhira & Cox's bazaar. The project continued upto 2004, discovering the consequences of virus attacks (of white spot syndrome virus, taura syndrome virus, and infectious hypodermal and haematopoietic necrosis virus) on shrimps during the later stages of the project implementation. However, the popularity of shrimp culture spread in regional level and shrimp culture in Polder 32 during dry season is a very common practice. The culture of shrimp is not a labor intensive practice, thus shrimp culture in Polder 32 created more unemployment among the people. During the dry season, a number of places in the embankment are cut down to facilitate the entry of saline water; this practice creates weak points in the embankment and reduces the strength of the embankment. One notable positive impact of shrimp culture in Polder 32 is that it ensures overall socio-economic development of the area. Due to frequent shrimp culture practice in the polder area, agricultural practice is being hampered, which eventually is affecting the asset level of poor farmers in Polder 32.

The Mongla EPZ, Phase-1 project completed in 2004 and the cumulative impacts it presently generates are negligible. The Khulna City Corporation (KCC) implemented the "Solid waste disposal and environmental improvement" project in 1996-2004. This project improved the surrounding environment, as the disposal of waste does not affect Sundarbans as the way it used to do before. The quality and navigability of Sutarkhali river and Chunkuri river have further improved due to the implementation of the project by KCC. Therefore, the environment of Polder 32 is being improved.

c) NGO projects

In recent times, there are number of projects implemented in Khulna by several NGOs. Most of these projects are awareness building projects. CDP implemented an awareness building project to disseminate information on climate change in the southwest region of Bangladesh. Apart from that, a number of projects were implemented as a measure of climate change adaptation (crab fatting, floating garden etc.). These non structural projects have mostly been able to spread awareness against climate change, biodiversity conservation etc. Now a days, people in polder 32 consider floating garden as a very useful practice in response to climate change effects. Such adaptable measures adopted by the people of Polder 32 may help their economic status on crisis situations.

10.4 Induced impacts caused by CEIP

In Polder 32, implementation of interventions may cause some effects to a number of environmental and social components in a longer period. Impacts may also be found in different locations outside the Polder. The following sections provide detailed discussions on a number of spatially and temporally induced impacts of CEIP works in Polder 32.

a) Sedimentation

The proposed interventions will guard the Polder against direct intrusion of tidal water during high tides or cyclonic hazards. The water of the rivers (Sibsa, Dhaki, Bhadra) carrying huge amount of sediments will move further downstream or upstream and may cause sedimentation. Sedimentation would occur in the Sibsa river and new morphological changes may be established in course of time (i.e. new lands may be formed inside the rivers through accretion). There are areas outside the polder that may suffer the consequences of siltation in the big rivers. Garuikhali, Amirpur, Baniakhali, Dhapodini, Saheber Abad etc. unions (see **Figure 10.2)** will be subjected to the risk of being inundated due to tidal flooding and cyclonic events. This is because the increased amount of siltation would reduce the water carrying capacity of the surrounding rivers.

In future, the Sutarkhali river may be silted up due to sedimentation in the upstream and other factors caused by Polder 32 (i.e. waste generation, increased fertilizers etc.).

The effects of project implementation in Polder 32 will be significant in the nearby areas. The Polders situated farther beyond the discussed areas will bear negligible effects of the interventions in Polder 32. The following figure (**Figure 10.2)** is a satellite image that shows the names of the unions near Polder 32.

Figure 10.2: Satellite Image polder 32

b) Erosion

The blockage of tidal flow into the polder will result the flow of the peripheral rivers (Sibsa and Bhadra) to be diverted further downstream and upstream. This may lead to erosion on the river banks of the unprotected areas (including parts Sundarbans).

c) Drainage congestion

Siltation in the rivers or water bodies outside the polder would cause drainage congestion on a more frequent basis. The smaller lakes and rivers i.e. Bhadra river, Sutarkhali river etc. would undergo frequent congestion. Especially during low tides, Southkhali river in the south-east gradually becomes more shallow. In the next few years, there is possibility of the Sutarkhali river (on the south-east, connected to the Sundarbans) to be filled up permanently due to accumulation of silts, lower velocity of flow etc. The effects of congestion in the surrounding rivers would directly affect the nearby areas (sundarbans, Polder 33, 31 etc.). The polders beyond these locations may undergo some congestion affects but these are negligible in the context of Polder 32.

Due to the congestion in the rivers, the upstream areas would be subjected to greater surge heights. This may cause damage to embankments of the Polders located upstream of Sibsa river and Chunkuri river (Polders 23, 21, 22 and 31)

d) Flooding

Polder 31, 23, 33 and 10-12 are adjacent to the Polder 32 and located along the Sibsa river. The crest level of Polder 32 would be raised upto 4.5 - 5 m. If Polder 32 is raised according to the proposed design, the adjacent polders (31, 23 and 10-12) might be overtopped in the extreme cyclonic events or tidal flooding. Tidal water would not be able to enter polder 32 during monsoon, as a result water will be diverted elsewhere. This will surely increase the risk of flooding in the nearby polders.

Table 10.3 shows the crest levels of embankments in polder 32, 33, 31, 23 and 10-12. The existing crest levels of polder 23, 31 and 10-12 is relatively low compared with the crest levels of polder 32 and 33. This shows that polder 23, 31 and 10-12 will bear the chances of being flooded during storm surge or tidal activities of the surrounding rivers (of Polder 32) due to their lower elevation.

Table 10.3: Crest level of embankments

Polder Number	Design crest level (mPWD)
32	4.5-5 (design)
33	4.5 (design)
10-12	3.45 (existing)
23	3.45 (existing)
31	3.66 (existing)

Source: Data collected by CEIP

e) Water quality

The implementation of interventions would lead to infrastructural developments, increased labor sheds, increased residences and hence population would increase. This would generate increased amount of wastes. The disposal of wastes would deteriorate the quality of surface water in the nearby water bodies. Pollution will also increase in the downstream of Sibsa river and Sutarkhali river. Furthermore, due to increase in agricultural area, more agriculture practices and industrialisation are expected. Therefore, water pollution by chemical fertilizer, pesticides and industrial effluents may increase outside the polder as well.

The polders in the vicinity of polder 32 (Polders 23, 21, 22, 31 and 10-12) will be more exposed to saline water intrusion. Saline water may enter into the nearby areas from January to April. Due to salinity intrusion for a longer period, water quality and soil quality may further deteriorate.

f) Land use

The implementation of proposed interventions may indirectly affect the land use of nearby areas. Due to increased surge created in Sibsa river Polder 23, 10-12 would undergo flooding on a more frequent basis. Agricultural areas may be reduced in these polders. The increased salinity of surface water during dry season might encourage local people to culture shrimps. In future, the local residences of these polders would be affected due to flood and other disasters. More erosion may take place in the river banks causing significant reduction of lands. The rivers in the periphery of Polder 32 would cause erosion in the adjacent areas, but for areas beyond the adjacent polders such affects would be negligible.

g) Cropping pattern

The implementation of the proposed interventions would increase water availability in the polder during dry season Boro cropping practice. Therefore, stakeholders will be able to sell their products to other nearby districts (Khulna, Bagerhat etc.). Areas that would be subjected to the intrusion of saline water for a longer period will possess high soil salinity and therefore, such lands would not yield good production and be unsuitable for agricultural practice in future. There would be increased salinity intrusion on areas along of the Sibsa river. However in areas in the upstream of the river (Polder 31, 23), salinity intrusion would be limited and boro cropping may still be practiced during dry seasons.

h) Habitat of flora-fauna

Depth of smaller water bodies outside the polder i.e. Sutarkhali river, Bhadra river would be reduced due to increased sedimentation, as well as other factors. Due to reduced depth of surrounding water bodies, the fish habitat as well as fish production may decrease in future. The terrestrial flora i.e. mangrove flora may be increased where as the aquatic flora and fauna may be decreased significantly.

In the next few years, the fisheries of the areas near Polder 32 may eventually decrease while fish culture practices might increase. For improvement of the polder, the risk of inundation might be transferred to nearby areas of little protection. Therefore tidal flood plain for capture fisheries may increase in that area whereas overtopping chances for culture fisheries pond may be further aggravated.

i) Fish Migration and biodiversity

Due to protection of Polder 32 from flood water, water will move towards the upstream and downstream of Sibsa river during high tide. This increased volume of water may 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. Biodiversity of aquatic life may decrease in the Sibsa River.

j) Housing condition

The embankment giving protection around the polder area would prevent the intrusion of surface water during monsoon. As a result, the nearby areas with little protection (polder 23, 31 and 10-12) may be subjected to flooding at regular intervals. This may eventually deteriorate the housing conditions of the people in these areas.

k) Employment opportunities

The development of the polder would create better employment opportunities of local people. Employment will be properly distributed and in the nearby areas the employment opportunities would be enhanced as well. In a few years time, due to the development of Polder 32, new employment opportunities would be created. This will encourage people from outside the polder to visit the polder for work and improve their economic status.

l) Food security

The proposed interventions would drive economic development inside the polder. Thus, the polder area may provide food security to the surrounding areas. In future, Polder 32 would not only be able to resist the damage of cyclonic hazards or flooding; but may also provide safety against food crisis for the nearby areas undergoing probable damage (Polder 33 in particular).

10.5 Conclusion

Most of the cumulative and induced impacts discussed above are found to be marginal during the assessment made in the study. However, these impacts are important from the context of the project as implementation of the proposed interventions do not only depend on the scenario of the polder but also its surroundings. The changes that may be caused by the aforementioned induced and cumulative impacts need further assessments to be evaluated on a quantitative basis. A detailed study on such impacts would be needed to provide a more vivid perception.

The cumulative and induced impacts discussed in this chapter have covered the physical impacts causing infrastructural damage as well as those affecting the people and their property. Many of the impacts stated above have not been directly harming the interventions under different projects. But these impacts have caused significant changes either to the overall socio-economy or environment.

While assessing the cumulative impacts, the adjacent areas or Polders have been assessed. The minimal effects caused by the polders located beyond the adjacent ones could not be analyzed because of the constraints generated due to limited time frame, information unavailability etc. Therefore, further studies may be carried out in future on cumulative and induced impacts for the entire study area to quantify the cumulative and induced impacts if needed. Also for considering the polders outside the adjacent polders of 32, more detailed studies are recommended.

11. Environmental Management Plan

This Chapter presents the Environmental Management Plan (EMP) for the CEIP-I activities in the Polder 32. The EMP essentially provides the implementation mechanism for the environmental and social mitigation measures discussed in **Chapter 9**.

11.1 Objectives of EMP

The basic objective of the EMP is to manage, prevent, and mitigate potentially adverse impacts of Project interventions in the Polder 32. 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 9**.
- Assign responsibilities for project proponent, contractors, consultants, and other members of the Project team for the environmental and social management of the Project;
- Define a monitoring mechanism and identify monitoring parameters to ensure effective implementation of the mitigation measures.
- Assess environmental training requirements for different stakeholders at various levels.
- Describe communication and documentation requirements.

The EMP should be included in all the bid documents of Polder 32 and will become a part of the civil works contract. The strict implementation of the EMP and project management's strict enforcement of the adequate construction practices and standards will greatly reduce the negative impacts of the Project.

11.2 EMP Components

The EMP components are listed below:

- Institutional Arrangement
- Mitigation Measures and Plan
- Monitoring Plan
- Documentation and reporting
- Contractual arrangements for EMP implementation
- EMP implementation cost
- Capacity building
- Grievance redress mechanism
- These components are discussed in **Sections** below.

11.3 Institutional Arrangement

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. The institutional arrangements proposed to implement the EMP of Polder 35/1 are described below.

11.3.1 Overall Responsibility

The overall responsibility of EMP implementation and fulfilling other environmental obligations during the Project rests with the Project Director (PD). For this purpose, the PD will be supported by environmental and social staff of the PMU, Design and Construction Supervision Consultants (DCSC), and contractors.

11.3.2 Construction phase

Environment and Social Staff in PMU

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 (ESC)Unit .The Unit will supervise compliance with and 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 divisions. The ESC unit 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 Construction Supervision (CS) Consultants. In order to effectively manage the EA process and EMP implementation, the ESC will be established and made operational before awarding the contract to contractor. ESC will be responsible for updating the EIA after receiving the pending information.

Environment and Social Staff with Construction Supervision (CS) Consultants

The CS consultants will be responsible for overall supervision of polder rehabilitation related activities. The CS consultants will ensure quality control and report to PD. The CS will also assist the ESC for ensuring environmental compliance and monitoring of progress including EMP and/or ECP implementation. The CS will supervise the contractors, ensuring design compliance and quality of works. For supervising the EMP implementation, CS will have dedicated and adequately qualified and experienced environmental staff including field-based environmental monitors (EMs). The EMs will supervise and monitor contractors to ensure compliance with the EMP. The CS consultants' environmental staff will maintain coordination with the ESC unit for the effective implementation of EMP and other environmental commitments and obligations of the Project.

Contractor's Environment Supervisors

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

11.3.3 Post-construction Phase

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

11.3.4 Need of sound O&M regime

BWDB field offices have a little amount of fund for Operation and Maintenance (O&M) of large scale water resources projects which is not only inadequate to cover the exact requirement of major preventive maintenance works; but also in most cases it is so meagre compared to the total needs that even no minor maintenance work is possible to undertake. Thus for the years together vital works of preventive maintenance are deferred and eventually pushed down to expensive rehabilitation measures. The Coastal Embankment Improvement Program (CEIP) is one of the latest such interventions to address a systematic restoration and upgrading of polder systems in the coastal region. Under this long term phased program of polders improvement, Operation and Maintenance issues with special reference to Local Government Institutions (LGIs) as well as local stakeholders participation and need based budgeting is required which will continue to remain. BWDB should ensure preparation of ***Detail operation and Maintenance of polder*** which will include ***standing operation procedure for hydraulic structure***.

11.3.5 Need of Inter-agency coordination and MoUs

The proposed interventions of CEIP may affect many sectors in the coastal region, it is very much essential to maintain liaison and coordination with all stakeholders, especially with all institutions who are implementing their development projects in the coastal area. BWDB will need to coordinate with major stakeholders such as PAPs, BIWTA, WMOs, FD, DoF, DoE, DAE, BADC, SRDI, LGED, BRDB, DC, DLS, MoL, LGI (Upazila and Union Parishad) and NGOs. Coordination with all relevant stakeholders and agencies should be done by the Project Director, CEIP and particular member of the project implementation unit within BWDB. Inter-agency co-ordination mechanism can be institutionalized as follows:

- Forming coordination committee with the provision of regular review meeting with specific intervals
- Signing Memorandum of Understanding (MoU) or contract among stakeholders, if needed for particular information sharing or for implementing particular tasks specified in the EMP
- Involvement of stakeholders in the implementation and O &M of the sub-projects
- Regular capacity building programme for stakeholders through training/ seminar/ workshop

During implementation of the EMP, the institutional mechanism for inter-agency co-ordination can be assessed using the following:

a. Co-ordination committee formation
b. MoU or contract signed among stakeholder for involvement in CEIP
c. Stakeholders consultation workshops

11.4 Mitigation Measures& Plan

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.

Mitigation measures should be considered starting with Environmental Assessment process. It is important therefore, that there is good integration between the EIA team and project design engineers. Project specific environmental construction guidelines should be developed. These guidelines should specify precautions and mitigation measures for construction activities, and to be included with the EMP. Good Environmental Construction guidelines has been compiled in Appendix 10 of Environmental Management Framework.

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

Based on the past experience, a generic Mitigation Measures for EMP has been presented in Table 11.1below for reference. This can be used as a reference material for comprehending the scope of the EMP. Table 11.1 will be used in conjunction of the polder specific mitigation measure stated in Chapter 9. BWDB will be responsible for implementing the EMP with the help of Contractor and Construction Supervision Consultants.

Table 11.1: Generic Mitigation/Compensation Measures/Guideline

(ECoP: Environmental Code of Practice)

Parameter/Activities	Mitigation/Compensation Measure/Guideline
ECoP 1: Soil/ Land Management	
Sources of Material for Earthwork	• During design the segment wise soil requirement and location of the sources of soil for earthwork for each polder construction/rehabilitation will be identified. • Selection of Borrow Areas for earthen material collection. • No objection from land owner/Revenue authorities as applicable • Contractor shall ensure that borrow materials used for embankment filling is free of pollutants • Disposal of excess soil will be done at site with no objection from DoE and local authority

Parameter/Activities	Mitigation/Compensation Measure/Guideline
Borrowing of Earth	**Borrow Area Selection** Borrowing close to the toe line on any part of the embankment is prohibited. Earth available from dredging as per design, may be used as embankment material (if necessary and applicable), subject to approval of the Engineer, with respect to acceptability of material. Borrowing to be avoided on the following areas: • Lands close to toe line and within 0.5 km from toeline. • Irrigated agricultural lands (In case of necessity forborrowing 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. Also, a distance of 500 m will 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 borrow areas before commencing the borrowing activity that provide the basis of the redevelopment plan. • Chainage along with offset distance; • Area (Sq.m); • Photograph and plan of the borrow area from allsides; • Type of access/width/kutcha/pucca etc. from the roadway; • Soil type, Slope/drainage characteristics; • Water table of the area or identify from the nearest well, etc; • Existing land use, for example barren / agricultural /grazing land; • Location/name/population of the nearest settlement from borrow area; • Quantity excavated (likely and actual) and its use; • Copy of agreement with owner/government; and • Community facility in the vicinity of borrow pit. • Rehabilitation certificate from the land owner along with at least four photograph of the rehabilitated site from different angles.
Excavation operation and Management of Excavated Material	To minimize the adverse impact during excavation of material following measures are need to be undertaken: • Adequate drainage system shall be provided to the excavated area • At the stockpiling locations, the Contractor shall construct sediment barriers to prevent the erosion of excavated material due to runoff. The followings precautions shall be undertaken during quarry operations. • Overburden shall be removed. • During excavation slopes shall be flatter than 20 degrees to prevent their sliding. • In case of blasting, the procedure and safety measures shall be taken as per DOE guidelines. • The Contractor shall ensure that all workers related safety measures shall be taken. • 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 will be away from the channel edge to limit damage to streamside habitats. This also allows a degree of flooding to occur on the floodplain, thereby creating opportunities for wet grassland, scrub/wet woodland, wetlands and seasonally grazed rough grass. • Where possible biotechnical engineering, for example geo textiles, may be used to help stabilize the material and aid re-colonization. • Other possibilities include: drying and spreading the spoil over adjacent land, which can

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	improve soil fertility in some cases, but may also smother important flora and habitats; excavating a trench and infilling it with spoil, thus minimizing disturbance to agriculture and the local environment; dumping off-site is possible but expensive, using spoil to create artificial wetlands.
Contamination of soil by fuel and lubrication	
ECoP 2: Water Resource & Hydrology Management	
Hazardous Waste Management	The contractor will minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes).
Ponding of water/water logging	• Do not allow ponding of water especially near the waste storage areas and construction camps • Discard all the storage containers that are capable of storing of water, after use or store them in inverted position • Reinstate relief and landscape • Monitor drainage pattern after high down pouring and recession flood • Connect water pockets to the nearest drainage structures/canals
Soil Erosion and siltation	The Contractor shall • Water the material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds) • All the work sites (except permanently occupied by the road and supporting facilities) will be reinstated to its initial conditions (relief, topsoil, vegetation cover). • Ensure that roads used by construction vehicles are swept regularly to remove sediment
Dredging	• Disturbance can be minimized if mechanical excavators work from one 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 curing used for cement concrete directly into water courses and drainage inlets • Monitor the water quality in the runoff from the site or areas affected by dredge plumes, and improve work practices as necessary
ECoP 3: Air Management	
Construction vehicular traffic	The Contractor will • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner • Cover haul vehicles carrying dusty materials (cement, borrow and quarry) moving outside the construction site • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions • Control the movement of construction traffic • Water construction materials prior to loading and transport • Service all vehicles regularly to minimize emissions • Materials will be transported to site in off peak hours.
Construction activities	• Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. • Increase the watering frequency during periods of high risk (e.g. high winds). • Stored materials such as excavated earth, dredged soil, gravel and sand shall be covered and confined to avoid their being wind-drifted • Minimize the extent and period of exposure of the bare surfaces

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• 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 least500 m away from the nearest habitation. • The waste disposal and sewerage system for the camp shall be properly designed, built and operated so that no odor is generated.
ECoP 3: Agriculture Management	
Loss of Top Soil	• Soil from fallow lands/ non-agricultural lands will be used in earthwork in embankments • Collect/strip top soil before earth filling and store and reuse it for final surfacing of embankment top and tree plantation/afforestation. • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m • Remove unwanted materials from top soil like grass, roots of trees and similar others • The stockpiles will be done in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil • Locate topsoil stockpiles in areas outside drainage lines and protect from erosion • Spread the topsoil to maintain the physico-chemical and biological activity of the soil. • The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites • Topsoil stockpiles will be monitored and should any adverse conditions be identified corrective actions will include: o Anaerobic conditions-turning the stockpile or creating ventilation holes through the stockpile; o Erosion – temporary protective silt fencing will be erected;
Soil salinity	• Use of duckweed will remove soil salinity • Flushing with pre-monsoon rain water will reduce soil salinity. • Saline tolerant crops need to be cultivated. • Environmentally and socially responsive shrimp farming e.g. shrimp-rice farming system is encouraged. • Increasing upland discharge of fresh water will push back ingress of saline water from the sea • Green manure application is promoted • Ground water abstraction for shrimp farming will be avoided.
ECoP 4: Noise Management	
Construction vehicular traffic	• Maintain all vehicles in order to keep it in good working order in accordance with manufactures maintenance procedures • Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise at the work site.
Construction machinery	• Appropriately site all noise generating activities to avoid noise pollution to local residents • Maintain all equipment in order to keep it in good working order in accordance with manufactures maintenance procedures.
Construction activity	• Notify adjacent landholders/Schools prior any typical noise events outside of daylight hours • Employ best available work practices on-site to minimize occupational noise levels • Install temporary noise control barriers where appropriate • Plan activities on site and deliveries to and from site to minimize impact • Monitor and analyze noise and vibration results and adjust construction practices as required • Avoid working during 09:00pm to 06:00 am within 500m from residences.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
ECoP 5: Ecology Management	
Flora	
Vegetation Clearance	• Tree felling will be performed upon preliminary notification to the relevant authority (District Forest Office, DoE). • Preparation of maps in GIS format, cadastral description of trees to be felled, marking, and supervision of Forest Department are necessary elements of the procedure. • Provide adequate knowledge to the workers regarding nature protection and the need of avoid felling trees during construction • Fruit and timber trees owned by local population will be compensated at their replacement cost according to market prices
Plant Management	• Tree seedlings are planted in a way that minimizes damage to the soil, while facilitating seedling survival. Tree seedling species are selected appropriate for maintaining long-term productivity. • Focus on tree species suitable for site condition • Prevent unreasonable species resulting in slow growth, less water and soil conservation and pest or disease outbreaks • Local species as planting materials, since natural selection and succession are most suitable for local climates and natural conditions • Ensure avoid single species or clone monoculture • Choose suitable species for berm, turfing and side
Planting	• Leave set back requirements around streams, restricted areas e.g. native vegetation, protected riparian strips, historic and heritage sites, research areas. • For nursery raising, physical and biological controls are practiced to control the pests and diseases in the nurseries. • Do not plant spread-prone species on sites where there is a high risk of uncontrollable wilding spread beyond the boundaries of the plantation. • Consider appropriate species, patterns and layout when planting areas with high visual values and/or with important recreational values
Polypropylene Bags Handling	• Make a Borrow Pit at each site for collection of poly bags • Collect all bags at the pits after plantation • If feasible, inform private sector to collect those bag for recycling
Pest Management to Nursery	• During outbreak of any deadly plant disease develop a plan to manage pest in coordination with neighbors by identifying existing pests and diseases and the risks for the introduction of new pests and diseases. • Share the plan with Bank before application.
Water Management	• Install temporary sediment basins, where appropriate, to capture sediment-laden run-off from nursery • Divert runoff from undisturbed areas around the harvesting site • Stockpile of fertilizer or agrichemical away from drainage lines • Prevent all solid and liquid wastes entering waterways by collecting solid waste, oils, chemicals, fertilizer waste and transport to an approved waste disposal site
Fauna	
Construction works in the surrounding lands	• Pre-entry survey and prevention of damage to fauna prior to start up • Limit the construction works within the designated sites allocated to the contractors • Not be permitted to destruct active nests or eggs of migratory birds • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching.
ECoP 6: Fisheries Management	
Construction works in the rivers and on the surrounding lands	• Critical breeding areas of major fish species will be identified and declared as sanctuaries. • Creation of small lagoons and pools that may trap the fishes will be avoided. • Creation of artificial waterfalls and other barriers for migration will be avoided. • Natural river channel will be reinstated after completion of construction works
Hydraulic Structure	• Sufficient free flow will be guaranteed in the design and construction work to ensure free pass of migrating fishes.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Hydraulic structure will be operated considering fish migration and spawning time • A guideline for area specific hydraulic structure operation guideline will be developed
Dredging	• Ensure dredging activity will create minimum sediment load in the water • Avoid dredging during spawning period of fish
ECoP 7: Socio-Economic Management	
Construction Camp Management	
Siting and Location of construction Camps (MRDI, 2011)	• Locate the construction camps at areas 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 water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • BWDB will endorse detailed layout plan for the development of the construction camp submitted by the contractor. The plan will show the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters
Construction Camp Facilities	The following facilities will be provided by the contractor • Adequate housing for all workers • Safe and reliable water supply • Hygienic sanitary facilities and sewerage system. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities • Provide in-house community/common entertainment facilities, dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Solid Waste Management	• Ensure proper collection and disposal of solid wastes within the construction camps • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. • Establish waste collection, transportation and disposal systems with the manpower and equipment/vehicles needed. • Do not establish site specific landfill sites. All solid waste will be collected and removed from the work camps and disposed in approved disposal sites
Fuel supplies for cooking and heating purposes	• Provide fuel to the construction camps for their domestic purpose, in order to discourage them to use fuel wood or other biomass. • Conduct awareness campaigns to educate workers to protect the biodiversity and wildlife of the project area, and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	• Provide adequate health care facilities within construction sites • Provide first aid facility round the clock. Maintain stock of medicines in the facility • Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outside areas • Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work • Provide HIV awareness programming, including STI (sexually transmitted infections) • And HIV information, education and communication for all workers on regular basis • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Regular mosquito repellant sprays during monsoon. • Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers.

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	• Place display boards at strategic locations within the camps containing messages on best hygienic practices
Payment of Wages	• The payment of wages will be as per the Minimum Wages Act, Department of Labor, and Government of Bangladesh for both male and female workers. • Display of the minimum wages board at camps and major construction sites will be done in local languages at the construction and labor camp sites. • Wages will be paid to the laborers 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
Rehabilitation of Labor and Construction Camp	At the completion of construction, all construction camp facilities shall be dismantled and removed from the site. The site shall be restored to a condition in no way inferior to the condition prior to commencement of the works. Various activities to be carried out for site rehabilitation include: • Oil and fuel contaminated soil shall be removed and transported and buried in waste disposal areas. • Soak pits, septic tanks shall be covered and effectively sealed off. • Debris (rejected material) will be disposed of suitably. • Underground water tank in a barren/non-agricultural land can be covered. However, in an agricultural land, the tank shall be removed. • If the construction camp site is on an agricultural land, preserve top soil and good earth can be spread back for a minimum 30cm for faster rejuvenation of the land. • Proper documentation of rehabilitation site is necessary. This shall include the following: • Photograph of rehabilitated site; • Land owner consent letter for satisfaction in measures taken for rehabilitation of site; and • Undertaking from contractor; In cases, where the construction camps site is located on a private land holding, the contractor would still have to restore the campsite as per this guideline. The rehabilitation is mandatory and will be include in the agreement with the landowner by the contractor. Also, he would have to obtain a certificate for satisfaction from the landowner.
Damage and Loss of Cultural Properties	
Conservation of Religious Structures and Shrines	• All necessary and adequate care shall be taken to minimize impact on cultural properties which includes cultural sites and remains, places of worship including temples, mosques, churches and shrines, etc., graveyards, monuments and any other important structures as identified during design and all properties / sites / remains notified. No work shall spillover to these properties and premises. The design options for cultural property relocation and enhancement need to be prepared. • All conservation and protection measures will be taken up as per design. Access to such properties from the road shall be maintained clear and clean.
	• During earth excavation, if any property is unearthed and seems to be culturally significant or likely to have archaeological significance, the same shall be intimated to the Engineer. Work shall be suspended until further orders from the PD. The Archaeological Department shall be intimated of the chance find and the Engineer shall carry out a join inspection with the department. Actions as appropriate shall be intimated to the Contractor along with the probable date for resuming the work. • All fossils, coins, articles of value of antiquity and structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government, and shall be dealt with as per provisions of the relevant legislation.
Worker's Accident Risk	
Risk from Operations	• The Contractor is required to comply with all the precautions as required for the safety of the workmen as per the International Labor Organization (ILO) convention. The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, books, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells,

Parameter/Activities	Mitigation/Compensation Measure/Guideline
	excavations, trenches and safe means of entry and outlet.
Risk from Electrical Equipment	• Adequate precautions will be taken to prevent danger from electrical equipment. No materials on any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Bangladesh Standards (BS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per BS provisions and to the satisfaction of the Engineer.
Risk from Hazardous Activity	• All workers employed on mixing material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals.
Malarial Risk	• The Contractor shall, at his own expense, conform to all anti-malarial instructions given to him by the Engineer and the EMU, including filling up any borrow pits which may have been dug by him.
Disruption to Users	
Loss of Access	• At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock. Work that affects the use of existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the Engineer. • The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, and any other access footpaths to or of properties whether public or private.
Traffic Management	• Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night • The temporary traffic detours in settlement areas shall be kept free of dust by frequent application of water
Traffic Control and Safety	• The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the cross section.

11.5 Chance find Procedures for Physical Cultural

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).

11.6 Monitoring Plan

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

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' (Environmental Action Plan) references to environmental mitigation measures requirements have been incorporated as part of contractor's assignment and making sure that any advance works are carried out in good time.

Environmental monitoring during construction phase is a function of supervision, and the essential purpose is to ensure adherence to the EMP. The monitoring is a daily process, which ensures that departures from the EMP and RAP are avoided or quickly rectified, or that any unforeseen impacts are quickly discovered and remedied. This monitoring will be carried out by the Design and Supervision Consultants on a regular bassis. Additional monitoring will be carried out by the Environmental and Social Unit.

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 theproject during the construction and operation stage are presented in Table 11.2 and Table 11.3

Table 11.2: Environmental Monitoring Plan during Construction and Operation of Rehabilitation and Improvement of Polders System

(Source: MRDI, 2011, LGED, 2011)

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
During Construction					
Sources of Material	Work Site	Possession of official approval or valid operating license of suppliers materials (Cement, soil).	Before an agreement for the supply of material is finalized.	Contractor	CS, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
Operation of borrow site	Borrow pit/site	Visual inspection of borrow site and ensuring operational health and safety	monthly	Contractor	CS, M&E Consultant, BWDB
Top Soil	Storage area	Top soil of 0.15 m depth should be excavated and stored properly	Beginning of earthwork	Contractor	CS, BWDB
	do	The stored top soils should be used as cladding material over the filled lands	Immediately after filling and compaction of dredge materials	Contractor	CS, 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	CS, 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	CS, M&E Consultant, BWDB
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	CS, BWDB
Traffic safety	Construction area	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	CS, 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	CS, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	CS
Air Quality (PM_{10}, $PM_{2.5}$)	Close to School/ Madrasha, Hospital &Villages	Air quality monitoring	Half Yearly	Contractor through a nationally recognized laboratory	CS, M&E Consultant, BWDB
Noise	Construction sites	Visual inspection to ensure good standard equipment are in use	Weekly	Contractor	CS, M&E Consultant, BWDB
	Construction sites	Ensure work restriction between 09:00 pm-6:00 am close to School/ Madrasha, Hospital & Villages	Weekly	Contractor	CS, M&E Consultant, BWDB
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each polder	Sampling and analysis of surface water quality	Half Yearly	Contractor through a nationally recognized laboratory	CS, M&E Consultant, BWDB
Drinking Water Quality(TDS, Turbidity, pH, FC, as if groundwater etc)	Sources of drinking water at construction camp/site	Sampling and analysis of water quality	yearly	Contractor through a nationally recognized laboratory	CS, M&E Consultant, BWDB
Sanitation	Construction camp/site	Visual Inspection	Weekly	Contractor	CS, M&E Consultant, BWDB
Waste Management	Construction camp and construction site	Visual inspection of collection, transportation and disposal of solid waste and solid waste is deposited	Weekly	Contractor	CS, M&E Consultant, BWDB

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
		at designated site			
Flora and Fauna	Project area	Survey and comparison with baseline environment	Yearly	Contractor through nationally recognized institute	CS, M&E Consultant, BWDB
Cultural and archeological Sites	At all work sties	Visual observation for chance finding	Daily	Contractor	CS, M&E Consultant, BWDB
Reinstatement of Work Sites	All Work Sites	Visual Inspection	Aftercompletion of all works	Contractor	CS, M&E Consultant, BWDB
Safety of workers Monitoring and reporting accidents	At work sites	Usage of Personal Protective equipment	Monthly	Contractor	CS, M&E Consultant, BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	Water sample at each of river for each polder	Sampling and analysis of surface water quality	Yearly	BWDB through a nationally recognized laboratory	M&E Consultant
Air Quality (Dust PM_{10}, $PM_{2.5}$)	At the baseline monitoring site	24 hours Air quality monitoring	Yearly	BWDB through a nationally recognized laboratory	M&E Consultant
Flora and Fauna specially fisheries	In the project area	Detail species assessment and compare with baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant
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

Table 11.3: Environmental Monitoring Plan during Construction and Operation of Afforestation

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented by	Supervised by
During Implementation					
Plant Selection	Nursery	Visual inspection. Type and variety of plant species to be planted for turfing on the top of embankment and foreshore	Before plantation	Contractor	CS, BWDB, M&E Consultant
Water Quality	Water bodies near nursery	Odor and chemical testing	Half yearly	Contractor through nationally recognized laboratory	CS, BWDB, M&E Consultant
Waste Management	Work site and Nursery	Visual inspection of collection, transportation and disposal of grasses, debris and is deposited at designated site	Weekly	Contractor	CS, BWDB, M&E Consultant
	Work site and Nursery	Visual inspection of Water bars & cut-offs .sediment traps to prevent water pollution caused by run-off from harvesting areas	Beginning of work	Contractor	CS, BWDB, M&E Consultant
Nursery Embankment Management	Nursery	Visual inspection of height of embankment, possibility of water logging and connection to the water bodies	Beginning of each nursery	Contractor	CS, BWDB, M&E Consultant
During Operation and Management					
Multilevel belt of trees	Polder top and along the polder	Visual inspection	yearly	BWDB through nationally recognized institution	M&E Consultant
Flora and Fauna	In the project area	Detail species assessment and compare with baseline	Yearly	BWDB through a nationally recognized institution	M&E Consultant
Erosion	Along Alignment	Visual Inspection presence of gullies or erosion	Yearly	BWDB	M&E Consultant

11.6.1 Qualitative Spot Checking Indicators

Moreover a rapid environmental monitoring will be carried out according the following checklist in terms of visual judgment during field visit as an indirect control to implement Environmental Mitigation plan. Table 11.4 can be followed during project construction and operation process.

Table 11.4: Spot Checking Indicator

Parameter	Visual Judgment		
	Poor	Moderate	Satisfactory
Workers Safety			
Camp Site Management			
Plant Site Management			
Borrow Area Management			
Top Soil Prevention			
Waste Management			
Occupational Health and Safety			
Stockpiling of construction materials			
Reporting and Documentation			

Third Party Validation

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

11.7 Documentation, Record keeping and Reporting

11.7.1 Record Keeping

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

11.7.2 Monitoring Records

Quantitative Physical Monitoring

The objective of quantitative physical monitoring is to ensure that the mitigation measures designed to prevent, reduce and where possible offset any significant adverse impacts on the environment are being implemented throughout the Project lifecycle. CS will regularly monitor and provide information to ESC for updating the database. CS will provide the following information bi-weekly to ESC, 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.

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

General Site Inspections and Monitoring

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 9 and Section 11.4**, during the construction phase. The Site Inspection Checklist would be supported by sketches, as necessary.

11.7.3 Information Sources

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 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.

11.7.4 Non-Compliance Report

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

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

11.7.5 Monthly Internal Reports by CS

The CS will prepare a monthly report for issue to the ESC 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.

11.7.6 Half Early Progress Report by BWDB

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 11.6.5.

11.7.7 Environmental Audit Report & Third Party Monitoring Report

It is expected BWDB will conduct annual environmental audit. In addition, the environmental audit will be carried out before the mid-term evaluation and before project closing. All Environmental Audit Report will be shared with Bank. Environmental monitoring will be conducted during the project Third Party Monitoring. The Third Party Monitoring report will also be shared with Bank. The Bank would also supervise the environmental compliance as part of regular implementation support missions.

11.8 Contractual arrangements for EMP implementation

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

11.8.1 Guideline to Incorporate Environmental Management in Bid Document & Preparation of EAP

- Prepare cost estimates, to be incorporate in Bid Documents.
- Environmental Management Plan along with the good environmental construction guidelines to be incorporated in the bid document‘s work requirements.
- Preparation of work requirement (addendum/corrigendum to polder & hydraulic structure construction/afforestation) and
- Corrigendum / Addendum to polder/embankment specification, if any, as special provisions to be incorporated in bid document.
- Penalty clauses for not complying with EMP requirements to be incorporated. Indicative penalty clauses proposed in the CEIP are presented below (Addendum to Clause 17.2 Contractor‘s Care of the Works of FIDIC).

- The contractor has to follow all traffic safety measures as defined in the technical specification. Damage shall be levied at the rate Tk. 3000/- per day per location for non – conformity of traffic safety measures as per the decision of the engineer.
- The contractor has to follow all environmental mitigation measures as defined in the technical specification read along with the Environmental Management Plan for the specific CEIP activities. Damage shall be levied at the rate Tk. 3000/- per day per location for nonconformity of Environmental Management Plan measures as per the decision of the BWDB Engineer.
- The contractor has to ensure that prior to every monsoon season, during the construction period; all the temporary and permanent cross drainage structures are free from debris as defined in the Technical Specifications read along with the Environmental Management Plan. Damage shall be levied at the rate of Tk.3000/- per day per location for non-conformity as per the decision of the Engineer.
- The contractor has to ensure that sufficient numbers and good quality Personnel Protective Equipment (PPE), should be provide to staff and labor all time as defined in the labor codes read along with the EMP. Damage shall be levied at the rate of Tk. 1000/- per day for non-conformity as per the decision of the Engineer.

11.9 Guideline for Compensation and Contingency Plan during Project Period

Compensation becomes necessary when project impacts cannot be satisfactorily mitigated. 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 handles by the Grievance Redress Committee.

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

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

11.10 EMP Implementation Cost

The estimated costs for the environmental management and monitoring activities are set out in **Table 11.5** below.

Table 11.5: Tentative Cost Estimates for Environmental Management and Monitoring*

SL. No	Description of EMP activities	Cost Million BDT	Cost Million US$
1	Construction of alternative or bypass channels at each construction sites	3.0	0.037
2	Crop compensation to the direct loser land owner/ share croppers of construction sites /damage to dredge spoils	1.50	0.017
3	Installation of fugitive particulate matter system and Spraying water on embankment/road	Included in contractor budget	
5	Conservation and stocking of threatened fish species (4 spots of Nalian khal, Clozarer khal, Gonari khal and Joynagar khal)	1.5	0.005
6	Awareness program on plant and wild life conservation	.40	0.005
7	Campaigning and providing training on improved culture practices as well as the rice-cum-golda farming instead of bagdha	.50	0.006
8	Social forestry program along both sides of the embankment and other khas areas	Included in afforestation budget	
9	Emergency budget allocation for closing breach points of embankments and repairing the damage of structure	10.00	0.122
10	Monitoring cost to fish biodiversity, migration, fish production	1.0	0.012
11	Air and noise quality monitoring analysis cost	.50	0.006
12	Water quality monitoring cost	.40	0.005
13	Waste disposal arrangement	.50	0.006
14	Soil and water salinity monitoring cost	.50	0.006
15	Land acquisition and compensation cost	Budget included in RAP report	
16	Resettlement cost	Budget included in RAP report	
17	O &M cost during construction	Budget included in O & M report	
18	WMOs monitoring cost	1.00	0.012
19	Capacity building and training	4.00	0.049
20	Consultancy services cost for supervisions and monitoring	5.00	0.061

SL. No	Description of EMP activities	Cost Million BDT	Cost Million US$
Total Cost of EMP		29.80	0.349

11.11 Grievance Redress Mechanism

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

11.11.1 Grievance Redress Focal Points

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

Membership of GRC

1. Executive Engineer (BWDB Division Office)	:	Convener
2. Representative of the RP Implementing NGO	:	Member-Secretary
3. Local UP Chairman /Ward Councillor	:	Member
4. Teacher from Local Educational Institution (nominated by Upazila Administration)	:	Member
5. Representative from Local Women's Group	:	Member
6. Representative from the PAP Group	:	Member

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

11.11.2 Grievance Resolution Process

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.

If the resolution attempt at the local level fails, the GRC will refer the complaint with the minutes of the hearings to the Project Director at PMO for further review. The Project Director will assign the ESC at PMO for review the grievance cases and assist Project Director in making decision. The ESC will review the case records and pay field visits for cross examining and consult the GRC members and aggrieved persons, if required. If a decision at this level is again found unacceptable by the aggrieved person(s), BWDB can refer the case to the MoWR with the minutes of the hearings at local and headquarters levels. At the ministry level, decisions on unresolved cases, if any, will be made in no more than four weeks by an official designated by the Secretary, MoWR. A decision agreed with the aggrieved person(s) at any level of hearing will be binding upon BWDB.

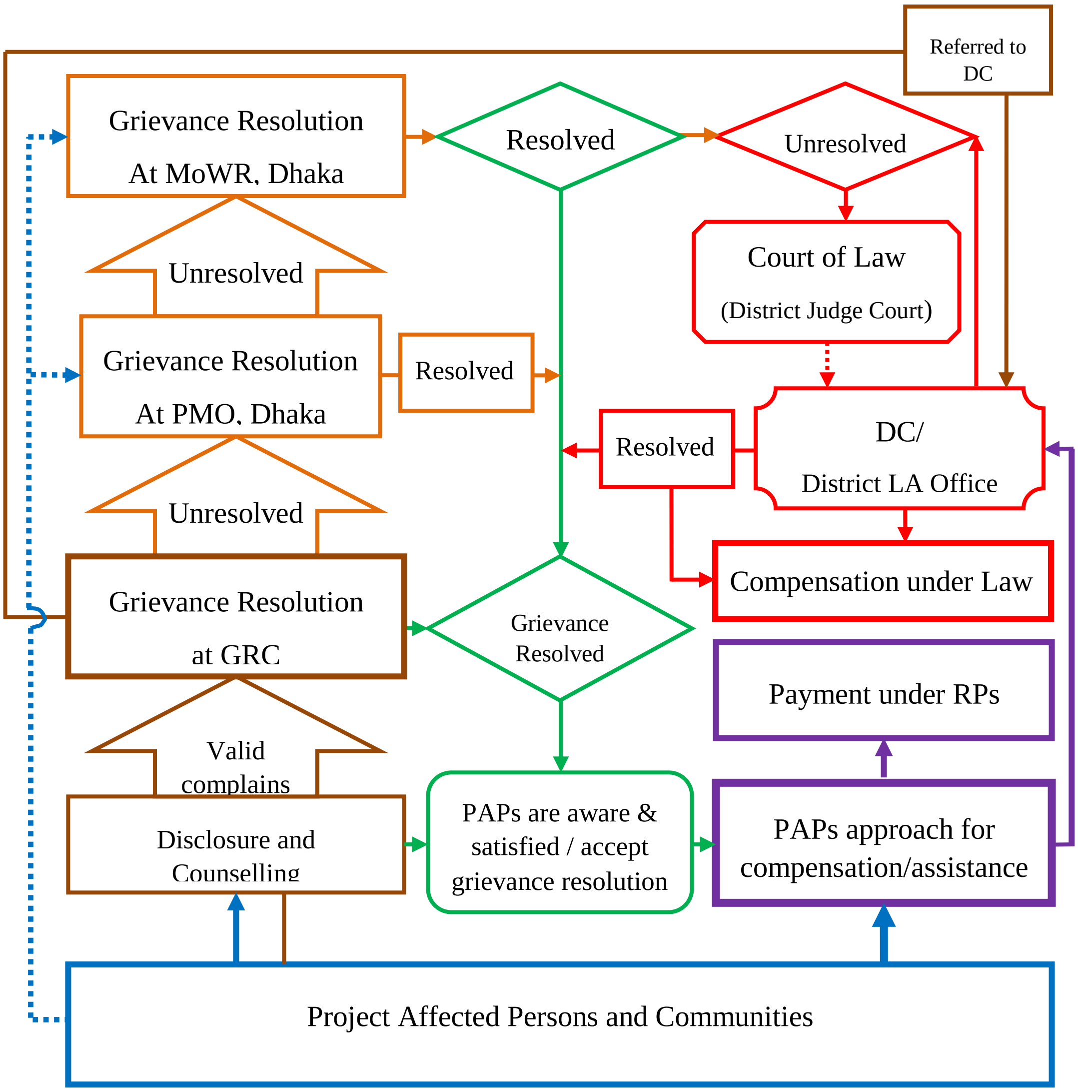

Figure 11.1: GRM Process Flow Chart

To ensure that grievance redress decisions are made in formal hearings and in a transparent manner, the Convener will apply the following guidelines:

- Reject a grievance redress application with any recommendations written on it by a GRC member or others such as politicians and other influential persons.
- Remove a recommendation by any person that may separately accompany the grievance redress application.

- Disqualify a GRC member who has made a recommendation on the application separately before the formal hearing:
  - o Where a GRC member is removed, appoint another person in consultation with the Project Director.
- The Convener will also ensure strict adherence to the impact mitigation policies and guidelines adopted in this SMRPF and the mitigation standards, such as compensation rates established through market price surveys.

11.11.3 GRM Disclosure, Documentation and Monitoring

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

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.

Grievance resolution will be a continuous process in RP implementation. The PMO and SMOs will keep records of all resolved and unresolved complaints and grievances (one file for each case record) and make them available for review as and when asked for by WB and any other interested persons/entities. The PMO will also prepare periodic reports on the grievance resolution process and publish these on the BWDB website. The format in Annex 3 of SMF may be used for periodic grievance reporting.

11.12 Capacity Building

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 ESC 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 11.6** 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.

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 11.1: Environmental Trainings

Contents	Participants	Responsibility	Schedule
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area.	Selected BWDB; PMU; DC & CS staff	DC & CS & ESC	Prior to the start of the Project activities. (To be repeated as needed.)
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Mitigation measures; Community issues; Awareness of transmissible diseases Social and cultural values.	PMU; DC & CS; selected contractors' crew	DC & CS & ESC	Prior to the start of the field activities. (To be repeated as needed.)
EMP; Waste disposal; HSE	Construction crew	Contractors	Prior to the start of the construction activities. (To be repeated as needed.)
Road/waterway safety; Defensive driving/sailing; Waste disposal; Cultural values and social sensitivity.	Drivers; boat/launch crew	Contractors	Before and during the field operations. (To be repeated as needed.)
Camp operation; Waste disposal; HSE Natural resource conservation; Housekeeping.	Camp staff	Contractors	Before and during the field operations. (To be repeated as needed.)
Restoration requirements; Waste disposal.	BWDB core unit , Restoration teams	Contractors	Before the start of the restoration activities.
Strengthening of water management organizations(i.e. WMGs, WMAs and WMF) and beneficiaries organizations	Member of water management organizations(i.e. WMGs, WMAs and WMF) and beneficiaries organizations	BWDB, ESC, Contractor	Before and during construction activities

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 workplan
- Training of the WMOs on successful operation of hydraulic structures
- Training on structured format in reporting for all stages of implementation and those of relevant agencies who are involved in EMP implementation.

The training programs should be arranged before implementation of the interventions in the polder area. Detail plan can be made by the proposed ESC Unit of BWDB.

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EIA Study Team

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

5. Water Resources Engineer/ Team Leader:	6. Md. Waji Ullah
7. Water Resource Expert:	8. Md. Sarfaraz Wahed
9. River Morphologist:	10. Nazneen Aktar
11. Socio-Economists:	12. Dr. Dilruba Ahmed 13. Subrata Kumar Mondal
14. Soil and Agriculture Specialist:	15. Mujibul Huq
16. Agronomist	17. Dr.Anil Chandra Aich
18. Fishery Specialists:	19. Mohammed Mukteruzzaman 20. Ashraful Alam
21. Ecologist/Junior Ecologists:	22. Ashoke Kumar Das 23. Mohammed Amanat Ullah 24. Mohammad Kamruzzaman
25. Environmentalist:	26. Dr. Ashraful Alam
27. Geographical Information System (GIS)/Remote sensing (RS) specialist:	28. Kazi Kamrull Hassan
29. GIS/RS Analysts:	30. Mohammed Saidur Rahman 31. Hasan Tawfique Imam
32. Junior Engineers/Junior environmental Engineers:	33. Syed Ahsanul Haque, 34. Mohammed Shibly Shadik 35. Mohammed Shakil Ahmed 36. Mohammed Jafrul Alom 37. Kanak Kanti Kar

The report has been reviewed by K.B. Sajjadur Rasheed, PhD, Environment Specialist, former Professor of Geography and Environment, University of Dhaka.. On behalf of BWDB, an Internation Independent Environment Specialist, Mr. Mohammad Omar Khalid reviewed the document.

Annex A: Checklist

EIA of Coastal Polders under CEIP

Checklist for Water Resources Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

A. Administrative Information

Name of Polder:	BWDB Zone:	Hydrological Zone:
BWDB Circle name:	BWDB O & M Division:	
District (s):	Upazila (s):	
Union (s):	Mouza (s):	

B. Project Description

General Information	
a. Type of project:	b. Area of polder (Ha):
c. Objectives of the scheme:	
d. New problems (if any) created by the project activities:	
e. Year of Starting:	f. Year of completion:
g. Name of surrounding polder	
h. Name of the projects hydro-morphologically dependent on the polder	
i. Cumulative hydraulic and morphological impacts as anticipated by local people	

Data Collected by:	Date:
Present Status/condition of Embankment	
Embankment length (……………….Km)	Embankment Type: Submergible / Full flood protection
Breaching: 1. Yes 2. No Breaching spot (If yes): (Please specify the spot names, length, GPS reading)	

Location of Breaching Points (Name of Place)	Reasons of breach	Good		Moderately affected		Badly affected/ Vulnerable		Completely damaged	
		GPS ID	Length	GPS ID	Length	GPS ID	Length	GPS ID	Length

Public Cuts: 1. Yes 2. No Public Cuts (If yes): (Please specify the spot names, length, GPS reading)

Location of Public Cuts	Reasons	Moderately affected		Badly affected/ Vulnerable		Completely damaged	
		GPS ID	Length	GPS ID	Length	GPS ID	Length

Re-sectioning: 1. Yes 2. No Re-sectioning (If yes): (Please specify the spot names, length)

From	To	Length	Height	Actual reasons

Location of Structure	GPS ID	Type	Vent Size	No of Vent	Service Condition (VG/G/M/B/VB)[11]	Present Condition (Partial/full damage/good)	Present Problems	Reasons for problem	Year of problem	Rehabilitable (Y/N)	Replaceable (Y/N)
Regulators											
Fish pass Structures											
Cross Drainage Structures (Syphon/Aqueduct)											
Barrage											
Pipe Sluices											

11 VG – Very Good, G – Good, M – Moderate, B – Bad, VB – Very Bad

Irrigation Inlets										
Bridge/Culverts										
Others										

Drainage Channels

Name	Length	Flow Direction	Flow (%)	Present Service Condition \Problems	Reasons of Problem	Re-excavation Need (Y/N)	Proposed Re-excavation Mode (Manual/ Mechanical)	From – To (Approx. length)	GPS ID (Structure)

Irrigation Canals

Name	Length	Problems	Reasons	Re-sectioning (Y/N)	From – To (Approx. length)

Protective Works

Location Name	Type (Temporary/Permanent)	Length	Present Condition (G/ MD/ CD)12	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

12 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			

<table>
<tr><th>Recent flood</th><th>Extent (Days)</th><th>Flood level (cm)</th><th colspan="2">Damage of resources</th></tr>
<tr><td>2004</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>2007</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td rowspan="2">Last five years</td><td colspan="2">Flood year</td><td></td><td rowspan="2">Flooding areas:</td></tr>
<tr><td colspan="2">Non flood year</td><td></td></tr>
</table>

I. Participatory Social Mapping by stakeholders (Name of regulators, name of public cuts points, Name of breaching points, location of water logged area, identification of encroached canal with name and their location on map)

J. Peoples opinion of the project

Pre-project condition:
Period of project benefits:
Present condition and Present problems:
Causes of problems:
Probable Solution/Improvement:

EIA of Coastal Polders under CEIP

Checklist for Land Resources, Agriculture and Livesock Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

Land Resources:

Land degradation

Factors	Year from starting LD	Result of LD
Soil erosion		
Sand carpeting		
Salinisation		
Acidification		
Nutrient deficiency		
Farming practices		
Water logging		
Others		

Agriculture Resources: (For small project information collection from filed. For large project both primary and secondary information collection from field and DAE office)

Cropping Pattern by land type

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	% of area

Crop calendar

Crop name	Seedling		Transplanting/Sowing		Harvesting	
	Start	End	Start	End	Start	End

Crop yield

Crop Name	Damage free Yield (ton/ha)	Damage area (%)	Damage Yield (ton/ha)

*Damage area and yield loss calculation: Last 3 years average value

Crop damage

Name of hazard	Ranked	Timing	Causes
Flood			
Drought			
Pest infestation*			
Others:			
*List name of pest and pesticide by crop			

Fertilizer and pesticide application

Crop Name	Seed (Kg/ha)	Fertilizer (Kg/ha)				Pesticide		
		Urea	TSP	MP	Other	No of Appli.	Liq. (ml/ha)	Gran. (Kg/ha

Irrigation, Land preparation and Labour

Crop Name	Irrigation			Land preparation			Labour	
	Mode	% of Area	Charge (Tk/ha)	Power (%of Area)	Animal (% of Area)	Tk/ha	Nos./ha	Tk/ labour

Note: Support Services of the project areas

Livestock Resources: Primary and Secondary Information collection from field and DLS offices

Livestock and poultry production

Name of Livestock/poultry	% of HH having Livestock/Poultry	No. of Livestock/poultry per HH
Cow/Bullock		
Buffalo		
Goat		
Sheep		
Duck		
Chicken		

Feed and Fodder

Name of Livestock/poultry	Feed/Fodder Scarcity (Timing)	Causes	Remarks
Cow/Bullock			
Buffalo			
Goat			
Sheep			
Duck			
Chicken			

Diseases

Name of Livestock/poultry	Name of Disease	Disease (Timing)	Causes	Remarks
Cow/Bullock				
Buffalo				
Goat				
Sheep				
Duck				
Chicken				
Note: Support Services-				

Where, when, how much and causes of Crop Damage.

Fisheries Baseline Checklist

EIA of Coastal Polders under CEIP

Village: Mouza: Union: Upazila: District: BWDB Circle: BWDB Division:

Background Water bodies: Name: Alphabetic, Area: in Ha/% of area/Ana, Length: in km, Depth/Inundation depth: in Meter, Flood Duration: in Months, Production: metric ton

<table>
<tr><th rowspan="2">Problem/Issue</th><th rowspan="2">Fishing Effort</th><th rowspan="2">Habitat Type</th><th rowspan="2">Water Quality</th><th rowspan="2">Avg. Production</th><th rowspan="2">Production Trend (+/-) and Reason</th><th rowspan="2">List of Gears</th><th rowspan="2">% of gears</th><th rowspan="2">List of Habitat Name</th><th colspan="5">Present</th><th colspan="5">Past (15-20 yrs back)</th></tr>
<tr><th>Area</th><th>Length</th><th>Width</th><th>Depth</th><th>Duration</th><th>Area</th><th>Length</th><th>Width</th><th>Depth</th><th>Duration</th></tr>
<tr><td rowspan="5">Capture Fisheries:

Culture Fisheries:

Indiscriminate Fishing Activities:</td><td rowspan="5">a. Total No. of fisher HHs:

b. %/No. of CFHHs:

c. %/No. of SFHHS:

d. No. of Days spend annually in fishing by CFHHs: SFHHs:

e. Hrs/Day spend in fishing by CFHHs:</td><td>River</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Beel (Leased/ non leased)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Khal</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Floodplain</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Swamp Forest</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

	SFHHs:	Fish pond																
		Baor																
		Other																

Fish Migration				Fish Biodiversity		Species List					Species Composition				
						River	Khal	Beel	Pond	Other	Group	River	Khal	Beel	Pond
Previous Migration Status				Fish diversity status (Poor/Moderate/Rich)/%							Major carp				
											Exotic carp				
											Other carp				
											Catfish				
											Snakehead				
Present Obstacle to fish migration:	1. 2. 3.			Reasons of increase or decrease	1. 2. 3. 4. 5.						Live fish				
											Other fish				
											Prawn				
											Hilsa				
Important breeding, feeding and over wintering ground															
											Rui				
											Catla				
Horizontal Migration pattern	Species: 1. 2. 3. 4. 5.	Season (Months):	Routes:	Significant areas	1. 2. 3.						Mrigel				
											Koi				
											Sarpunti				
											Large prawn				
											Small Pprawn				
Vertical Migration Pattern	Species: 1. 2. 3. 4. 5.	Season (Months):	Habitats:	Species of Conservation Significance	Rare:						Silver carp				
											Carpu				
											Grass carp				
											Tengra				
						Unavailable:					Chapila				
											Others				

Post Harvest Activities		Fishermen Lifestyle	
Fish edible quality:		Socio-economic Status of subsistence level fishermen:	
Source of pollution in each habitat:		Socio-economic Status of Commercial fishermen:	
Seasonal vulnerability:		Other conflict (with muscle men/ agriculture/ other sector/laws):	
Ice factory (Number, location and name):		Fishermen community structure (Traditional/Caste/Religion)	
Landing center, whole sale market, other district markets, etc.:		Traditional fishermen vulnerability (Occupation change/others):	
Storage facility (number, location and name):		Existing Fisheries Management	
Fish market (Number, location and name):		Fishermen Community Based Organizations (FCBOs):	
Marketing problems:		WMOs activity:	
Fish diseases (Name, Host species, Season, Syndrome, Reason, etc.):		Fishing right on existing fish habitats (Deprived/Ltd. access/Full access):	
Other backward and forward linkages (Number, location and name):		Leasing system:	
Transport facility (Mode of fish transportation, cost, other involvements)		Enforcement of fisheries regulation (Weak/strong):	
Dry fish industries (Number, location and name):		Department of Fisheries (DoF) activity:	
Others information:		NGOs activities:	

Note: 1. Major Carp - Rui, Catla, Mrigal, 2. Exotic Carp - Silver Carp, Common Carp, Mirror Carp, Grass Carp, 3. Other Carp - Ghania, Kalbasu, Kalia, 4. Cat Fish - Rita, Boal, Pangas, Silon, Aor, Bacha, 5. Snake Head - Shol, Gazar, Taki, 6. Live Fish - Koi, Singhi, Magur, 7. Other Fish - Includes all other fishes except those mentioned above.

Beels: Rui (Labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus mrigala), Kalbasu (Labeo calbasu), Gonia (Labeo gonius), Boal (Wallago attu), Air (Mystus aor / Mystus seenghala), Shol/Gazar (Channa spp.), Chital/Phali (Notopterus chitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustes fossilis /Clarias batrachus), Sarpunti (Puntius sarana), Large Shrimp (Macrobrachium rosenbergii /M. malcomsonii), Small Shrimp, Silver Carp (Hypophthalmichthys molitrix), Carpio (Cyprinus carpio), Grass Crap (Ctenopharyngodon idellus), Pabda (Ompok pabda), Punti (Puntius spp.), Tengra (Mystus spp.), Baim (Mastacembelus spp.), Chapila (Gudusia chapra), Others.

Pond: Rui (Labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus mrigala), Kalbasu (Labeo calbasu), Mixed Carp, Silver Carp (Hypophthalmichthys molotrix), Grass Carp(Ctenopharyngodon idellus), Mirror Carp (Cyprinus carpio var. specularis), Tilapia (Oreochromis mossambicus / O. niloticus), Shrimp, Aor (Mystus aor / Mystus seenghala), Boal (Wallago attu), Shol/Gazar & Taki (Channa spp.), Chital/Phali (Notopterus chitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustes fossilis / Clarias batrachus), Sarpunti (Puntius sarana), Thai Sarpunti (Puntius gonionotus), Punti (Puntius spp.), Others.

EIA of Coastal Polders under CEIP

Checklist for Ecological Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

Basic Information

Date		Prepared by	
Name of the Polder			
BWDB Circle Name			
District/s		Upazila/s	
Location of the FGD			

Habitat Information/Ecosystem Types (Please put tick where is applicable)

Agriculture land		Forest patches including social forestry	
Settlement/Homesteads		Canal and ponds	
Orchard		Grasslands	
Fallow		Reserve forest	
Ridges		Others	

Terrestrial Vegetation Checklist (List of Major Plant Species)

Species Name	Status	Utilization
Homestead Vegetation		

Mangrove Vegetation		
Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others		

Terrestrial Wildlife Check List

Species Name	Habitat	Status	Migration Status
Mammals			
Amphibians			

Reptiles			
Birds			

Habitat: 1= Homestead forest, 2= Floodplains, 3= Wetlands, 4= River, 5= Pond, 6=Forest

Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare

Migration Status: 1= Local, 2= Local Migratory, 3= Migratory

Aquatic Wildlife Checklist

Species Name	Habitat	Status	Migration Status
Mammals			
Amphibians			
Reptiles			
Birds			

Habitat: 1= Homestead forest, 2= Floodplains, 3= Wetlands, 4= River, 5= Pond, 6=Forest Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Migration Status: 1= Local, 2= Local Migratory, 3= Migratory			

Foreshore vegetation/Mangrove vegetation

Name of the forest patches location (s)	Species Name	Abundance	Utilization
Abundance1= High,2=Moderate,3=Low Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others			

Major Wetland information

Name of wetland	Type of Wetland	Area in Acre	Connectivity		Importance
			Khal	River	

Type 1= Beels, 2= Rivers, 3= Open water wetlands, 4= Floodplains, 5= Closed water wetlands, 6= Ponds, 7= Baors (oxbow lake).

1=Fish; 2= migratory bird; 3= other wildlife; 4=aquatic flora

Wetland vegetation Checklist

Species Name	Habit	Status	Utilization

Habit 1=Submerged, 2=Free floating, 3=Rooted floating, 4=Sedges, 5=Marginal

Status 1= High, 2= Moderate, 3= Low

Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others

Forest Information (Surrounding/nearer the polder)

Forest Name with Range/Beet office	Type	Location	Area in Acre	Major Plant Species
Type 1=Swamp Forest, 2=Reserve Forest, 3=Vested Forest, 4=Reed forest, 5=Other (specify)				

(9)Anticipated Impacts due to proposed interventions on particular Ecosystems

(Impact from changed land use, noise, human presence etc.)

Name of Intervention	Impacts
Embankment Re-sectioning	
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	

Main occupation by population	% of population
Household work	
Agriculture	
Industry	
Water, Electricity & Gas	
Construction	
Transport	
Hotel & Restaurant	
Business	
Service	
Others…..	

Source: BBS

Main occupation by households:

Main occupation by households	% of households
Agriculture/Forestry/Livestock	
Fishery	
Agriculture Laborer	
Non-agriculture Laborer	
Handloom	
Industry	
Business	
Hawker	
Construction	
Transport	
Religious	
Service	
Rent	
Remittance	
Others…..	

Source: BBS

2.5 Labor availability and wage

a. Labor (Male) for farming (High/Medium/Low), Av. Wage/Day (Tk.) Max:............Min: ....

b. Labor (M) for non-farming (High/ Medium/ Low), Av. Wage/Day (Tk.) Max:............Min: ....

c. Labor (Female) for farming (High/Medium/Low), Av. Wage/Day (Tk.) Max:............Min: ....

d. Labor (F) for non-farming (High/ Medium/ Low), Av. Wage/Day (Tk.) Max:............Min: ....

2.6 Migration (seasonal/permanent)

a. Seasonal out migration from study area (% per year with location):

b. Seasonal in migration to study area (% per year with location):

c. Permanent out migration from study area (Number per 1/2 years with location):

d. Permanent in migration to study area (Number per 1/2 years with location):

2.7 Annual Expenditure and Income by range

a. Expenditure

Expenditure group (in taka)	Percentage of households
<=12,000	
12,000-24,000	
24,000-60,000	
60,000-1,08,000	
1,08,000-2,40,000	
>=2,40,000	

Sources: RRA

b. Income

Expenditure group (in taka)	Percentage of households
<=12,000	
12,000-24,000	
24,000-60,000	
60,000-1,08,000	
1,08,000-2,40,000	
>=2,40,000	

Sources: RRA

Self assessed poverty for year round

Sl. No.	Poverty status	Percentage of households
1	Deficit	
2	Balance/Breakeven	
3	Surplus	

Sources: RRA

Housing (photographs)

Sl. No.	Housing status	% of hhs having
1	Jhupri	
2	Kutcha	
3	Semi Pucka	
4	Pucca	

Source: RRA

Drinking water (photographs)

Sl. No.	Drinking water sources	Percentage of households use
1	Tap	
2	Tube well	
3	Well	
4	Pond	
5	Other........................	

Source: BBS

Sanitation (photographs)

Sl. No.	Toilet types	Percentage of households under each type
1	Water Sealed	
2	Ring Slub	
3	Kacha	
4	No facilities	

Source: RRA

2.12 Diseases in polder area

a. Diseases in area

Sl. No.	Disease	Ranking by incidence	Sl. No.	Disease	Ranking by incidence
1	Influenza/ Common fever		9	Chicken pox	
2	Cough/cold		10	Skin disease	
3	Diarrhoea		11	Diabetes	
4	Dysentery		12	Hypertension	
5	Hepatitis		13	Asthma	
6	Malaria		14	T B	
7	Dengue fever		15	Gastric	
8	Typhoid		16	Arsenicosis	

Sources: RRA

b. Health facilities in study area (photographs)

Sl. No.	Type of facility	Number of facilities with name
1	Number of District level Hospitals	
2	Number of Upazila Health Complex	
3	Union Health Center	
4	Private Health Clinic/ Hospitals	

Sources: RRA

b.1 Status of peripheral health facilities used by the study area people:

____
____
____
____

Source of treatment facilities in study area

Sl. No.	Source of treatment facilities	% of hhs received
1	Trained Physician	
2	Paramedic/ Diploma Physician	
3	Quack Doctor and Informal Treatments	
4	No treatment facilities at all	

Sources: RRA

2.13 Electricity

Percentage of household having electricity facility: ....BBS

Percentage of household having electricity facility: ....(During Survey)

3. Social overhead capital (photographs)

3.1 Existing road networks in study area and it's level of benefit

a. National Road (km.) ....(GIS) Beneficial: Highly /Moderately / Poorly

b. Regional Road (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

c. Local Road Pucca (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

d. Local Road Kancha (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

3.1.1 Status of peripheral road networks (with name) used by the study area people:

____
____
____
____
____
____
____
____
____.

3.2 Existing railway network in study area and it's level of benefit

a. Railway (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

3.2.1 Status of peripheral railway service used by the study area people:

____
____
____
____
____
____

3.3 Existing waterways in study area and it's level of benefit

a. National Route (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

b. Local Route (km.) .... (GIS) Beneficial: Highly /Moderately / Poorly

3.3.1 Status of peripheral water ways (with name) used by the study area people:

____
____
____

3.4 Status of the navigation route by season

a. National Route: Served Seasonally/Through out the year

b. Local Route: Served Seasonally/ Through out the year

3.5 Major waterways handicapped

a. by structures.................................... location

b. by siltation................................. location

3.6 Nos. of major ghats/ports and name:

3.7 Academic Institution (school, colleges) (photographs)

Sl. No.	Type of facility	Nos. of Institution	Type of facility	Nos. of Institution
1	Primary School		Ebtedayee Madrasha	
2	High School		Dakhil Madrasha	
3	College		Alim/ Fazil Madrasha	

Sources: RRA

3.6.1 Status of peripheral academic institutions (with name) used by people of the study area:

____
____
____
____
____
____

3.8 Markets and GC (photographs)

Sl. No.	Type of facility	Nos. of markets	Comments with name
1	Major markets		
2	Minor markets		
3	Growth Centers		

Sources: RRA

3.8.1 Status of peripheral markets used by people of the study area:

____
____
____
____
____
____

4. Land holding categories

4.1 Percentage of HH who have owned agricultural land: ....(BBS)

Percentage of households with different land ownership category in the area:

Land ownership classes	Percentage of household
Land less/ No land (0 decimal)	
Land less (up to 49 decimal)	
Marginal (50-100 decimal)	
Small (101-249 decimal)	
Medium (250-749 decimal)	
Large (750 + decimal)	

Sources: RRA

5. Conflict between different land owner group and professional group

Reasons of Conflicts	Present status of problem	Solution they want with location
Water control infrastructures		
Land elevation		

Reasons of Conflicts	Present status of problem	Solution they want with location
Cross-interest		

6. Disaster related information: (photographs)

6.1 Type of major disaster and damage occurred in the area after completion of the Project

Sl. No.	Major Disaster	Severely affected year	% of area affected	% of hhs affected	% of crop damage	Major crop damaged
1	Flood					
2	Drought					
3	Tidal flood					
4	Storm					
5	Cyclone					
6	Hail storm					

Sl. No.	Major Disaster	Severely affected year	% of area affected	% of hhs affected	% of crop damage	Major crop damaged
7	Salinity intrusion					
8	Water logging					
9	Erosion					

Sources: RRA

7. Safety Nets and Poverty Reduction Measures in the area:

7.1 Name and activity of GO/ NGOs working in this area

Name	Activity (Credit, Education, Health, Forestry, Fishery, Livestock Rearing, Women Empowerment, Human Rights, VGF, Boyosko bhata, etc.)	% of HHs coverage

8. Information on Water Management Organizations (WMOs) (photographs of office building, committee members, resolution etc)

8.1 Do you know about the CEIP project? Y/N

8.2 Existence of WMOs: Yes/No

8.2.1 If WMO exists:

Sl	Issue/Question	Response/Suggestion		
a)	Year of formation (date if possible)			
b)	Registered by whom?			
c)	Number of members (male-female)	Male	Female	Comments
	Farmer			
	Trader			
	Labor			
	Landless			
	Fisher			
	Service holder			
	Others			
d)	No. of villages covered			
e)	Existence of fund			

Sl	Issue/Question	Response/Suggestion
f)	AGM	
g)	Election	
h)	EC meetings	
i)	Present water resources management activities	

8.2.2 Name of EC members with address/phone number:

Sl. No.	Name	Address	Phone Number
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

If WMO does not exist, please state the reasons for

____
____
____
____

8.3 Are people willing to form WMO? Y/N

(If yes, give demonstrative proof of their capacity if any)

8.4 Is WMO willing to take up management responsibilities? Y/N

8.4.1 If yes, please give some idea about what to do on management

9. Some other Issues

9.1 Any land acquisition to be needed for the rehabilitation of the polder ? Yes/No

9.1.1 If yes, size of the area? ________________________________(acre)

9.1.2 If yes, are they willing to provide land for acquisition? Yes/No

9.2 Any replacement of people to be needed for the rehabilitation of the scheme? Yes/No

9.2.1 If yes, how many? ___________________________ (number of household)

9.3 Have any cultural heritage /archeological sites in the polder? Yes/No

Give some description

9.4 Have any vulnerable communities (e.g. landless, fishermen, boatmen, destitute women without food and/or shelter) in the scheme area? Yes/No

a. Give some description

9.5 Have any common property resources (e.g. irrigation systems, fishing grounds (wetlands), pastures, forests, graveyard, cremation ground, mosque, temple, etc.) in the scheme area? Yes/No

a. Give some description

10. Comments of Facilitator:

Name of the RRA/FGD Participants:

Name	Age	Occupation	Address/Phone No.

Annex B: No Objection Certificates

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

৬নং কামারখোলা ইউনিয়ন পরিষদ

ডাকঘর- কালিনগর বাজার
দাকোপ, খুলনা।

পূর্ব সূত্র.......

তারিখ ০৩/০৬/২০১২

অনাপত্তি পত্র

এই মর্মে প্রত্যায়ন করা যাচ্ছে যে, বাংলাদেশ সরকার ও বিশ্ব ব্যাংক কর্তৃক গৃহীত উপকূলীয় বাঁধ উন্নয়ন কর্মসূচীর আওতায় (CEIP) বাংলাদেশ পানি উন্নয়ন বোর্ড এর অধীনে খুলনা জেলার দাকোপ উপজেলার অন্তর্গত পোল্ডার ৩২ প্রকল্পটির জরুরি ভিত্তিতে পুনর্বাসন ও উন্নয়নের কাজে আমার ও অত্র এলাকার জনগণের কোন আপত্তি নাই।

এখানে উল্লেখ্য যে, উক্ত প্রকল্পের কার্যক্রম জনগণের সক্রিয় অংশগ্রহনে পরিচালিত হবে। তাছাড়াও বাংলাদেশ পানি উন্নয়ন বোর্ড এর প্রকল্প বাস্তবায়নের সময় অত্র ইউনিয়নের জনগণ সার্বিকভাবে সহযোগিতা করবেন।

03.6.12
উমাশংকর রায়
চেয়ারম্যান
৬নং কামারখোলা ইউনিয়ন পরিষদ
দাকোপ, খুলনা।

জি, এম, আশরাফ হোসেন
চেয়ারম্যান
৫নং সুতারখালী ইউনিয়ন পরিষদ
নলিয়ান-৯২৭৩
দাকোপ, খুলনা।

G.M. Ashraf Hossain
Chairman
5 No. Sutarkhali Union Parishad
Dacupe, Khulna.

পূর্ব সূত্র ঃ ....

তারিখ	বাং								
	ইং	০	৬	০	৫	২	০	২	১

অনাপত্তি পত্র

এই মর্মে প্রত্যায়ন করা যাচ্ছে যে, বাংলাদেশ সরকার ও বিশ্ব ব্যাংক কর্তৃক গৃহীত উপকূলীয় বাঁধ উন্নয়ন কর্মসূচীর আওতায় (CEIP) বাংলাদেশ পানি উন্নয়ন বোর্ড এর অধীনে খুলনা জেলার দাকোপ উপজেলার অন্তর্গত পোল্ডার ৩২ প্রকল্পটির জরুরি ভিত্তিতে পূনর্বাসন ও উন্নয়নের কাজে আমার ও অত্র এলাকার জনগণের কোন আপত্তি নাই।

এখানে উল্লেখ্য যে, উক্ত প্রকল্পের কার্যক্রম জনগণের সক্রিয় অংশগ্রহনে পরিচালিত হবে। তাছাড়াও বাংলাদেশ পানি উন্নয়ন বোর্ড এর প্রকল্প বাস্তবায়নের সময় অত্র ইউনিয়নের জনগণ সার্বিকভাবে সহযোগিতা করবেন।

০৬/০৫/২১
জি,এম, আশরাফ হোসেন
চেয়ারম্যান
৫নং সুতারখালী ইউনিয়ন পরিষদ
দাকোপ, খুলনা।

যে আইনের মধ্যে বাস করে সমস্ত পৃথিবীটাই তার জন্য নিরাপদ।

Annex C: Tables

Table 1: Available Homestead plants in the polder area

Scientific Name	Family	Local Name	Habit	Usage	Local Status
Acacia moniliformis	Mimosaceae	Akashmoni	Tree	Timber and fuelwood	R
Acacia nilotica	Mimosaceae	Babla	Tree	Timber And fuelwood	C
Moringa dulcis	Mimosaceae	Sajna	Tree	Food, Timber and fuelwood	C
Achyranthes aspera	Amaranthaceae	Apang	Herb	Medicine	C
Adhatoda zeylanica	Acanthaceae	Bashok	Shrub	Medicine	C
Aegle marmelos	Rutaceae	Bel	Tree	Food and Medicine	R
Albizia lebbeck	Leguminosae	Sirish	Tree	Timber and fuelwood	VC
Albizia richardiana	Leguminosae	Gogon Sirish	Tree	Timber	C
Anthocephalus chinensis	Rubiaceae	Kadom	Tree	Timber and fuelwood	C
Areca catechu	Palmae	Supari	Monocot	Food and Timber	C
Artocarpus heterophyllus	Moraceae	Kathal	Tree	Food, Timber and fuelwood	R
Azadirachta indica	Meliaceae	Nim	Tree	Timber and medicine	C
Bambusa sp.	Gramineae	Bans	Bushes	Thaching	C
Borassus flabelifer	Palmae	Taal	Tall Monocot	Fruit, Fuelwood and Timber	C
Carica papaya	Caricaceae	Papay	Shrub	Fruit	C
Cassia fistula	Leguminosae	Badarlathi/Sonalu	Tree	Ornamental and Medicine	R
Centella asitica	Umbelliferae	Thankuni	Herb	Medicine and Vegetables	R
Citrus grandis	Rutaceae	Jambura	Tree	Fruits	C
Cleorodendrum viscosum	Verbenaceae	Bhat	Herb	Fuelwood	C
Cocos nucifera	Palmae	Narikel	Tall Monocot	Fruit and Fuelwood	VC
Dalbergia sissoo	Fabaceae	Sisso	Tree	Timber and fuelwood	C
Datura suaveolens	Solanaceae	Dutura	Herb	Medicine	C
Diospyros discolor	Ebanaceae	Bilatigab	Tree	Fruit	C
Diospyros perigrina	Ebenaceae	gab, deshigab		Fruit and Timber	R
Erythrina variegata	Leguminosae	Mandar	Tree	Fuelwood	R
Ficus benghalensis	Moraceae	Bot	Tree	Fuelwood	C
Ficus hispida	Moraceae	Dumur	Shrub	Fruit and Fuelwood	VC
Ficus religiosa	Moraceae	Assawath	Tree	Fuelwood	R
Glycosmis pentaphylla	Rutaceae	Daton	Shrub	Medicine	VC
Leucauna laucocephalata	Mimisaceae	Ipil ipil	Tree	Timber	R
Mangifera indica	Anacardiaceae	Aam	Tree	Fruit and Timber	C
Manilkara zapota	Zapotaceae	Chabeda	Tree	Fruit	C
Mikania scandens	Compositae	Assamlata	Herb	Medicine	VC

Scientific Name	Family	Local Name	Habit	Usage	Local Status
Moringa oleifera	Moringaceae	Sajna	Tree	Vegetable	C
Musa spp	Musaceae	Kala	Monocot	Fruit	C
Ocimum americanum	Labiatae	Tulshi	Herb	Medicine	C
Phoneix sylvestris	Palmae	Khejur	Monocot	Fruit and Fuelwood	C
Pithecolobium dulce	Mimosaceae	Khai Babla	Tree	Timber and Fruits	C
Ruellia tuberosa	Acanthaceae	Patpaty	Herb	-	VC
Spondias dulcis	Anacardiaceae	Amra	Tree	Fruit	C
Streblus asper	Urticaceae	Sheora	Tree	Fuelwood	C
Swietenia mahagoni	Meliaceae	Mahogoni	Tree	Timber and medicine	C
Syzygium cumini	Myrtaceae	Kalojam	Tree	Fruit	C
Tamarindus indica	Leguminosae	Tetul	Tree	Fruit	R
Terminalia arjuna	Combretaceae	Arjun	Tree	Timber and medicine	C
Terminalia catappa	Combretaceae	Katbadam	Tree	Fruit	R
Trewia nudiflora	Euphorbiaceae	Pitali/Latim	Tree	Timber and fuelwood	C
Zizyphus mauritiana	Rhamnaceae	Kul Baroi	Tree	Fruit	VC
Zizyphus rugosa	Rhamnaceae	Anai	Tree	Fruit	C

Local Status Code: C=Common, VC=Very Common, R=Rare

Source: Field Survey, 2012

Table 2: List of available Aquatic plant species and their status inside the polder area

Scientific Name	Family	Local Name	Local Status
Aponogeton natans	Aponogetonaceae	Ghechu	C
Arundo donax	Gramineae	Baranal	C
Azolla pinnata	Salviniaceae	Kutipana	C
Colocasia esculenta	Araceae	Kachu	C
Cyperus cephalotes	Cyperaceae	Mutha	VC
Eclipta alba	Compositae	Kalokeshi	C
Eichhornia crassipes	Pontaderiaceae	Kochuripana	C
Enhydra fluctuans	Cyperaceae	Helencha	VC
Fimbristylis squarrosa	Cyperaceae	Jumka chaise	C
Hydrilla verticillata	Hydrocharitaceae	Jhangi, kureli	C
Ipomoea aquatica	Convolvulaceae	Kalmi sak	C
Lemna perpusilla	Lemnaceae	Khudipana	C
Ludwigia repens	Onagraceae	Panidoga	C
Mersilea quadrifoliata	Mersileaceae	Susnisak	C
Monochoria hatata	Pontaderiaceae	Kechur	R
Nachamendra alternifolia	Hydrocharitaceae	Kaisa	C
Nymphaea nouchali	Nymphaeaceae	Shapla	C
Nymphaea stellata	Nymphaeaceae	Nilshapla	R
Nymphoides indicum	Menyanthaceae	Panchuli	C
Oryza rufipogon	Gramineae	Jhara dhan	R
Phragmites karka	Gramineae	Nol	R
Pistia stratiotes	Araceae	Topapana	VC
Polygonum barbatum	Polygonaceae	Bishkatali	C
Saccharum spontaneum	Gramineae	Khag	R
Sagittaria sagittifolia	Alismataceae	Chhotokul	C
Salvina natans	Salviniaceae	Tetulpana	C
Spirodela polyrhiza	Lemnaceae	Khudipana	C
Trapa natans	Trapaceae	Singra	R
Utricualria exoleata	Lentibulariaceae	Chotojhangi	C
Ludwigia abscendens	Onagraceae	Keshordam	C
Trapa bipinosa	Trapaceae	Singra	R
Typha sp.	Typhaceae	Hogla	R
Cyperus rotundus	Cyperaceae	Mutha	VC

Local Status Code: C=Common, VC=Very Common, R=Rare

Source: Field survey, 2012

Table 3 : Future cropping pattern in the project area

Land Type and Flood Depth	Future Cropping Pattern			FWIP	
	Kharif-I	Kharif-II	Rabi	Area (ha)	% of NCA
High Land, F0 (0-30 cm)	Sugarcane	Cont'd	Cont'd	5	0.07
	Orchard	Cont'd	Cont'd	5	0.07
	S. Vegetables	T. Aman (Local)	Fallow	330	5
	Fallow	T. Aman (Local)	W. Vegetables	200	3
	Fallow	T. Aman (HYV)	W. Vegetables	250	3.8
	T. Aus(Local)	T. Aman (HYV)	Watermelon	200	3
	Fallow	T. Aman (Local)	Oil seeds	100	1.5
	Fallow	T. Aman (HYV)	Fallow	1,757	27
			Sub Total	**2,847**	**43.8**
Medium High Land F1 (30-90 cm)	T. Aus (HYV)	T. Aman (HYV)	Pulses	200	3
	T. Aus (HYV)	T. Aman (HYV)	W. Vegetables	40	0.6
	T. Aus (HYV)	T. Aman (HYV)	Boro (HYV)	100	1.5
	Fallow	T. Aman (Local)	Pulses	310	4.8
	T. Aus (Local)	T. Aman (HYV)	Spices	200	3
	T. Aus (HYV)	T. Aman (HYV)	Boro (HYV)	300	4.6
	Fallow	T. Aman (HYV)	Chilli	50	0.7
	Fallow	T. Aman (HYV)	Fallow	2,332	35.8
	S. Vegetables	T. Aman (HYV)	Boro (HYV)	118	1.8
			Sub Total	**3,650**	**56.2**
			Grand Total	**6,497**	**100.0**

Source: Main consultant and field investigation, 2012

Table 4: Changes in land use in the polder area

Land use	Baseline situation		FWIP	
	Area (ha)	% of NCA	Area (ha)	% of NCA
Total area	8,097	100	8,097	100
Agriculture land	6,497	80	6,497	80
Single crop	5,358	82.5	4,099	63.06
Double crop	444	6.8	1,240	19.08
Triple crop	695	10.7	1,158	17.83
Total cropped area	8,331		10,053	

Source: Main consultant and field investigation, 2012

Table 5: Changes in crop production in the polder area

Sl No.	Crop Name	Production (metric ton)			
		Baseline	FWOP	FWIP	Impact (FWIP-FWOP)
1	B. Aus	144	144	-	-
2	T. Aus(Local)	497	497	515	18
3	T. Aus(HYV)	752	752	1,823	1071
4	T. Aman(HYV)	7,152	7,152	20,357	13205
5	T. Aman(Local)	3,459	3,459	2,726	-733
6	Boro (HYV)	1,500	1,500	2,072	572
Total Rice		**13,504**	**13,504**	**27,493**	**14,133**
7	Sugarcane	150	150	150	0
8	Orchards	53	53	53	0
9	Chilli	19	19	80	61
10	Pulses	1,883	1,883	1,020	-863
11	S. Vegetables	5,396	5,396	6,225	829
12	w. Vegetable	3,240	3,240	8,183	4943
13	Spices	35	35	900	865
14	Oil seeds	39	39	194	155
15	Watermelon	-	-	8,000	8,000
Total non-rice		**10,815**	**10,815**	**24,805**	**13,990**
Total crop production		**24,319**	**24,319**	**52,298**	**28,123**

Source: Feasibility report (Agriculture) of CEIP, 2012

Annex D: List of participants of PCM

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব প্রশমনের উপায় ও ব্যবস্থাপনা নিরূপণ বিষয়ক
মতবিনিময় সভা

স্থান: কামারখোলা ইউনিয়ন পরিষদ তারিখ: ০৬.০৬.২২

ক্রমিক নং	অংশগ্রহনকারীর নাম	পদবী ও ঠিকানা	মোবাইল নং	স্বাক্ষর
১	[illegible] রায়	চেয়ারম্যান কামারখোলা ইউ.পি.	01740596176	[illegible]
২	[illegible] আনোয়ার হোসেন	চেয়ারম্যান [illegible] ইউ.পি.	01755470267	[illegible]
৩	মো: আনোয়ার হোসেন	উপ-সহ: প্রকৌ. [illegible]	01711-309008	[illegible]
৪	দুর্গাপদ মন্ডল	ইউপি সদস্য ৭ নং ওয়ার্ড ২ নং দাকোপ	01940037624	দুর্গাপদমণ্ডল
৫	লক্ষ্মীকান্ত রায়	কৃষক, ৭নং ওয়ার্ড, কামারখোলা	০১৭২৬৫৫৭১০৭	লক্ষ্মীকান্ত রায়
৬	অমরেন্দু রায়	প্র: শি: কালিনগর মা: বি:	01720661972	[illegible]
৭	হিমাংশু সরকার	[illegible] কালিনগর	[illegible]	[illegible]
৮	মো: হাবিবুর রহমান	প্র: শি: পারজয়না সর: প্রা: বিদ্যা:	01717539529 01919539529	[illegible]
৯	ননীগোপাল [illegible]	ইউ.পি. সদস্য ৪ নং ওয়ার্ড কামারখোলা	01710121642	ননীগোপাল
১০	[illegible] বাছাড়	ইউপি সদস্য ৬নং ওয়ার্ড	01714-750925	[illegible] ৬/৬/২২
১১	মো: [illegible] রহমান	ইউ.পি. সদস্য ৮ নং ওয়ার্ড কামারখোলা	0192555468 04	[illegible]

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব প্রশমনের উপায় ও ব্যবস্থাপনা নিরূপণ বিষয়ক
মতবিনিময় সভা

স্থানঃ কামারখোলা ইউপি

তারিখঃ ০৬/০৬/১২ ইং

ক্রমিক নং	অংশগ্রহনকারীর নাম	পদবী ও ঠিকানা	মোবাইল নং	স্বাক্ষর
১২	[illegible]	কৃষি ৭নং ওয়ার্ড	৭ ওয়ার্ড ০১৯১২৪৭৬৮৬৩	[illegible]
১৩	প্রদীপ রায়	ব্যবসায়ী ৭নং ওয়ার্ড	০১৭১৩ ৭১৬৪৮০	[illegible]
১৪	কনিকা সরকার	ইউ, পি সদস্য ১,২,৩ সংরক্ষিত	01940094993	[illegible]
১৫	প্রমিলা বালা	সংরক্ষিত মহিলা ৭.৮.৯	0191318 7347	[illegible]
১৬	[illegible]	৭নং ওয়ার্ড		[illegible]
১৭	সন্ধ্যা সরকার	সংরক্ষিত সদস্য ৭.৮.৯ নং ওয়ার্ড	01745-703650	সন্ধ্যা
১৮	[illegible]	U.P সদস্য ওয়ার্ড নং-১,২,৩	01732-104038	[illegible]
১৯	[illegible]	৬ নং ওয়ার্ড ইউপি সদস্য	0175229 6040	[illegible]
২০	[illegible]	৭ নং ওয়ার্ড	01912957757	[illegible]
২১	বাসুদেব রায়	ইউ, পি সদস্য [illegible]	01740512952	[illegible]
২২	[illegible]	ইউ, পি, সদস্য ৬নং কামার খোলা ৫নং ওয়ার্ড	01725 436250	[illegible]

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব প্রশমনের উপায় ও ব্যবস্থাপনা নিরূপণ বিষয়ক
মতবিনিময় সভা

স্থান: কামারখোলা ইউপি

তারিখ: ৩/৬/১২ইং

ক্রমিক নং	অংশগ্রহনকারীর নাম	পদবী ও ঠিকানা	মোবাইল নং	স্বাক্ষর
২৩,	মো: ফজলুল হক মোল্লা	সদস্য ইউনিয়ন ৬ নং ওয়ার্ড	0193425353 54	[illegible]
২৪	আবু বক্কর সিদ্দিক	সিনিয়র শিক্ষক কামারখোলা [illegible] মাধ্যমিক বিদ্যালয়	01939648767	[illegible]
২৫	মো: আসাদুজ্জামান	ইউ.পি. সদস্য ৭নং ওয়ার্ড	01924833822	[illegible]
২৬.	বিকাশ চন্দ্র মন্ডল	ইউ. পি. সদস্য	01913729265 01768693370	বিকাশ চন্দ্র মন্ডল
২৭	গাজী [illegible]	ইউ.পি. সদস্য	0171[illegible]	[illegible]
২৮	মো: [illegible]	ইউ.পি. সদস্য [illegible]	01712969229	[illegible]
২৯	মো: মুজিবর রহমান	[illegible]		[illegible]
৩০	এস.এম. এরশাদ	ইউপি সচিব	01916-473888	[illegible] ৩.০৬.১২
৩১	মো: আবদুল্লাহ [illegible]	ইউপি উদ্যোক্তা কামারখোলা	01712708632	[illegible]
৩২	[illegible]	[illegible]	01710619080	[illegible]
৩৩	মো: [illegible]	[illegible]		

উপকূলীয় বাঁধ উন্নয়ন প্রকল্পের সম্ভাব্য পরিবেশগত ও সামাজিক প্রভাব প্রশমনের উপায় ও ব্যবস্থাপনা নিরূপণ বিষয়ক
মতবিনিময় সভা

স্থান: কামারখোলা ইউ.পি

তারিখ: ০৬/০৫/২০১৮

ক্রমিক নং	অংশগ্রহনকারীর নাম	পদবী ও ঠিকানা	মোবাইল নং	স্বাক্ষর
৩৪	[illegible]	কাউন্সিলর	০১৭২৪৩০৪১ ০৭৮	[illegible]
৩৫	বিশ্বজিৎ রায়	[illegible]	০১৭১১-২৯ ০৭৫৪	[illegible]
৩৬	অসীম কুমার রায়	তথ্য সেবক কামারখোলা	01740616673	অসীম রায়
৩৭	ভাস্কর রায়	তথ্য সেবক কামারখোলা ইউ.পি	01915576163	[illegible]
৩৮	সুপ্রভাত রায়	সমাজ কর্মী, ৭ নং ওয়ার্ড	01711-273457	[illegible]

Table: List of FGD participants

The list of FGD participants are given in Table 1- 5

Table1: WAPDA Colony Khaya Ghat, Kamarkhola, Dacope, Khulna (FGD-1)

Sl.No.	Name of the Participants	Age	Occupation	Address/Mobile Phone Number
1	Md. Anower Hosian	51	Service	01711309008
2	Bekish Chandra Mondol	46	Member	01913729265
3	Suprovat Roy	43	Social Worker	01711273457
4	Bot Krisno Roy	39	Farmer	01721046068
5	Md. Lutfor Rahman	53	Farmer	Kalinagar
6	Prokash Mondol	29	Fisherman	Kalinagar
7	Sonjoy Mondol	33	Fisherman	Par Joynagar
8	Md. Amzad Hosain	51	Member	01924333822
9	Himunshu Sorkar	48	Farmer	01721996242
10	Laxmi kanta Roy	61	Farmer	01726559107
11	Md. Eakrim Mia	29	Driver	01924807426
12	Md. Torikul	33	Driver	01720409428

Table2: Kumakhola UP, Kamarkhola, Dacope, Khulna. (FGD-2)

Sl.No.	Name of the Participants	Age	Occupation	Address/Mobile Phone Number
1	Uma Shankor Roy	41	UP Chairman	01740 596176
2	Imran Ali	31	UP Sectary	01725564835
3	S.M Ohiduzzaman	42	Member	01725436250
4	Amurondu Roy	51	Farmer	01720661972
5	Oshim Kumar Roy	39	Farmer	01740616673
6	Md.Abu Musa	48	Business	01714 919671
7	Abdus Batter Sana	50	UP Member	01717 708632
8	Jahidur Rahman Gazi	33	Farmer	Kamarkhula
9	Md. Nashir Uddin Sana	35	Farmer	01922145775
10	Bishowjit Biswas	49	Farmer	01758270129
11	Md. Omar Ali	51	Farmer	Kamarkhula
12	Goutom Mondol	40	Farmer	01917668103
13	Binoy Krishno Bashar	42	Village Doctor	01710619080

Table3: Sreenagar – Kalinagar, Kamarkhola, Dacope, Khulna (FGD-3)

Sl.No.	Name of the Participants	Age	Occupation	Address/Mobile Phone Number
1	Anup Roy	37	Business	01740596173
2	Md. Touyob Shak	41	Farmer	01947276652
3	Md. Liton Bashar	39	Farmer	01946512462
4	Md. Musa Shakh	29	Farmer	Sreenagar
5	Oashim Kumar Mondol	41	Business	01918603144
6	Bishowjit Mondol	37	Farmer	01947284287
7	Manush Mondol	36	Farmer	01731919687
8	Md. Hafijur Rahman	41	Farmer	01939648750
9	Md. Farukul Islam	29	Farmer	Shatghuria
10	Sosanko Kumar Mondol	42	Farmer	01914311344
11	Uzzal Kumar Mondol	31	Fisherman	Par Joynagar

Table4: Nalian Bazar, Dema, Sutarkhali, Dacope, Khulna (FGD-4)

Sl.No.	Name of the Participants	Age	Occupation	Address/Mobile Phone Number
1	Gazi Asraf ali	44	UP Chairman (Suterkhali)	01711470267
2	Md. Masum Hosain Gazi	48	Farmer	01745006346
3	Md. Faruk Hosain Gazi	51	Farmer	01911855713
4	Md. Shofikul Gazi	58	Farmer	01747109571
5	Md. Nobiruddin Shakh	41	Farmer	01721195568
6	Md. Afdar ali Fokir	38	Farmer	01734423265
7	Md. Toru Shakh	43	Farmer	01758339460
8	Md. Najrul Islam Shakri	38	Farmer	01735897108
9	Amorunda Roy	43	Service	01720661972
10	Aboni Kumar Boyda	39	Farmer	01712969229

Table5: Gunary Closer, Sutarkhali, Dacope, Khulna (FGD-5)

Sl.No.	Name of the Participants	Age	Occupation	Address/Mobile Phone Number
1	Babu Choudhory	44	Business	01718552818
2	Md. Nashir Uddin	35	Farmer	01922145775
3	Md. Rofiqul Gazi	35	Farmer	Per Joy Nagar
4	Rohim Mia	28	Farmer	Per Joy Nagar
5	Sonjoy Mondol	44	Fisherman	Gunary
6	Suprovat Ray	51	Business	01711273457
7	Ronjit Das	45	Farmer	Gunary
8	Krisno Mondol	31	Farmer	Gunary
9	Nurul Islam	37	Service	01720928601
10	Ballal Shakh	35	Farmer	01924916692

List of PDM participants

উপকূলীয় বাঁধ উন্নয়ন প্রকল্প-১ম পর্য্যায় এর
অনুকূলে প্রনয়নকৃত সমীক্ষা প্রতিবেদনের উপর কর্মশালা
দাকোপ, খুলনা

ক্রমিক নং	নাম/পদবী	ঠিকানা	মোবাইল নং	স্বাক্ষর
১	[illegible] উপজেলা নির্বাহী অফিসার	দাকোপ উপজেলা, দাকোপ, খুলনা	01712979053	[illegible]
২	[illegible]	[illegible]	01915579298	[illegible]
৩	মোঃ [illegible]	[illegible]	01712110091	[illegible]
৪	[illegible]	সাংবাদিক	01711323686	[illegible]
৫	[illegible]	সাংবাদিক	01922626100	[illegible]
৬	[illegible]	ইউ, পি, সদস্য [illegible]	01968688732	[illegible]
৭	[illegible]	ইউ, পি, সদস্য [illegible]	01913598889	[illegible]
৮	[illegible]	[illegible]	03928620878	[illegible]
৯	মো: [illegible]	[illegible]	01732435938	[illegible]
১০	[illegible]	ইউনিয়ন সদস্য [illegible]	01714-950925	[illegible]
১১	[illegible]	ইউনিয়ন সদস্য [illegible]	01712-708632	[illegible]
১২	[illegible]	ইউ পি সদস্য [illegible]	01728437366	[illegible]
১৩	[illegible]	ঐ ঐ	01936287425	[illegible]
১৪	[illegible]	[illegible]	01920545653	[illegible]
১৫	[illegible]	[illegible]	01913187347	[illegible]
১৬	[illegible]	[illegible]	01934-807778	[illegible]
১৭	মো: [illegible]	[illegible]	01711-762144	[illegible]
১৮	[illegible]	[illegible]	01725436250	[illegible]
১৯	[illegible]	U.P সদস্য [illegible]	01732104038	[illegible]

উপকূলীয় বাঁধ উন্নয়ন প্রকল্প-১ম পর্য্যায় এর
অনুকূলে প্রনয়নকৃত সমীক্ষা প্রতিবেদনের উপর কর্মশালা
দাকোপ, খুলনা

ক্রমিক নং	নাম/পদবী	ঠিকানা	মোবাইল নং	স্বাক্ষর
২০	আনোয়ারা বেগম	ইউ.পি. সদস্য সুতারখালী	01754-299015	আনোয়ারা
২১	হাবিবা ইয়াসমিন	ইউ.পি. সদস্য	01921-294111	সাবিনা
২২	বাসুদেব রায়	ইউ.পি. সদস্য	01740-512952	[illegible]
২৩	মো: [illegible]	ইউ পি [illegible]	01920526472	[illegible]
২৪	[illegible]	[illegible]	01740-58[illegible]77	[illegible]
২৫	[illegible]	[illegible]	01716-331983	[illegible]
২৬	[illegible]	[illegible]	01711-348512	[illegible]
২৭	[illegible]	ইউ.পি. সদস্য [illegible]	01712529 6090	
২৮	[illegible] সরদার	ইউ.পি. সদস্য সুতারখালী	01736-396229	[illegible]
২৯	[illegible]	ইউ.পি. সদস্য	01737167897	[illegible]
৩০	[illegible]	সদস্য সুতারখালী	01745-006346	[illegible]
৩১	বি. এম. [illegible]	[illegible]	01711-890259	[illegible]
৩২	[illegible]	ইউ.পি. সদস্য সুতারখালী	[illegible]	[illegible]
৩৩	[illegible]	[illegible] সুতারখালী	01340-912618	[illegible]
৩৪	রবিউল ইসলাম	সদস্য সুতারখালী	01921-947826	[illegible]
৩৫	[illegible] ইসলাম	সদস্য সুতারখালী ৪নং	01714-972179	[illegible]
৩৬	[illegible]	[illegible]	01717-256507	[illegible]
৩৭	[illegible]	[illegible] সুতারখালী	01927-684948	[illegible]
৩৮	Mihir mondal	Charman Kaligonj.	01716252213	[illegible]

উপকূলীয় বাঁধ উন্নয়ন প্রকল্প-১ম পর্য্যায় এর
অনুকূলে প্রনয়নকৃত সমীক্ষা প্রতিবেদনের উপর কর্মশালা
দাকোপ, খুলনা

ক্রমিক নং	নাম/পদবী	ঠিকানা	মোবাইল নং	স্বাক্ষর
৩৯	[illegible]	U.P সদস্য, [illegible]	01915193937	[illegible]
৪০	[illegible]	ইউপি, [illegible]	01924-333822	[illegible]
৪১	এস,এম, বজলুল আলী	সাংবাদিক, [illegible], দাকোপ	01711342720	[illegible]
৪২	মো: [illegible] আলী [illegible]	[illegible]	01716082278	[illegible]
৪৩	[illegible]	[illegible]	01730172576	[illegible]
৪৪	মো: [illegible]	[illegible]	[illegible]	[illegible]
৪৫	[illegible]	[illegible]	01922880188	[illegible]
৪৬	রবীন্দ্র নাথ মন্ডল	[illegible]	019240907[illegible]	[illegible]
৪৭	[illegible] নাথ মন্ডল	দাকোপ	01917763152	[illegible]
৪৮	[illegible]	[illegible]	01721-946153	[illegible]
৪৯	[illegible]	[illegible]	01912686149	[illegible]
৫০	[illegible]	[illegible]	01710618665	[illegible]
৫১	মো: [illegible] রহমান	[illegible]	01718347674	[illegible]
৫২	[illegible]	[illegible]	01711350408	[illegible]
৫৩	[illegible]	[illegible]	0183581[illegible]	[illegible]
৫৪	[illegible]	[illegible]	01711.713121	[illegible]
৫৫	মো: [illegible] আলী	[illegible], দাকোপ	01720-139937	[illegible]
৫৬	দেবপ্রসাদ [illegible]	[illegible] ইউ.পি	01712557555	[illegible]
৫৭	ডা: [illegible] চন্দ্র ঘোষ UHZ FPO	UHC, Dacope	01711-703844	[illegible]

উপকূলীয় বাঁধ উন্নয়ন প্রকল্প-১ম পর্য্যায় এর
অনুকূলে প্রনয়নকৃত সমীক্ষা প্রতিবেদনের উপর কর্মশালা
দাকোপ, খুলনা

ক্রমিক নং	নাম/পদবী	ঠিকানা	মোবাইল নং	স্বাক্ষর
৫৮	[illegible]	৩ নং, দাকোপ	01721853282	
৫৯	অনিতা রায়	কৈলাশগঞ্জ	01929651562	
৬০	[illegible]	দাকোপ	01926-636030	
৬১	দুর্গাপদ মন্ডল	দাকোপ	01940037624	
৬২	সুশীল [illegible]	দাকোপ	01722509642	
৬৩	সুব্রত মন্ডল	দাকোপ	01918320126	
৬৪	কনিকা সরকার	দাকোপ	01940094993	
৬৫	শ্রীকান্ত [illegible]	দাকোপ	01913049366	
৬৬	[illegible]	দাকোপ	01928224089	
৬৭	[illegible]	[illegible] ৫নং সুতারখালী [illegible]	01915828473	
৬৮	জয়ন্ত মন্ডল	সুতারখালী দাকোপ	01715182611	
৬৯	অমিত বরন সাহা	[illegible]	01711361190	
৭০	দেবব্রত মন্ডল	সুতার খালী	01715-858008	
৭১	[illegible]	কামারখোলা	[illegible]	
৭২	উজ্জল রায়	বাজুয়া	01935-164956	
৭৩	[illegible]	[illegible]	01710-121642	
৭৪	[illegible]	উপজেলা পরিষদ [illegible]	01731-141034	
৭৫	[illegible]	[illegible]	01716820654	
৭৬	দীপঙ্কর রায়	সাবেক চেয়ারম্যান [illegible] ইউ.পি.	01820-537347	

উপকূলীয় বাঁধ উন্নয়ন প্রকল্প-১ম পর্য্যায় এর অনুকূলে প্রনয়নকৃত সমীক্ষা প্রতিবেদনের উপর কর্মশালা

দাকোপ, খুলনা

ক্রমিক নং	নাম/পদবী	ঠিকানা	মোবাইল নং	স্বাক্ষর
৭৭	[illegible]	[illegible]	০১৭১২০৪১০৭২	[illegible]
৭৮	[illegible] (মেম্বার)	বাজুয়া	০১৯২২২৪৩৫৪	[illegible]
৭৯	সুনিল কুমার মন্ডল	লাউডোব	০১১৬৭২৮২৮৯০	[illegible]
৮০	[illegible] বিশ্বাস	লাউডোব	০১৯১৮৪৫৫৫২৬	[illegible]
৮১	[illegible] মন্ডল	[illegible]	01926312691	[illegible]
৮২	[illegible] মন্ডল	বাজুয়া	~~0193294938~~ 01932249257	[illegible]
৮৩	[illegible] মন্ডল	বাজুয়া	01923324614	[illegible]
৮৪	[illegible]	বাজুয়া	01728534713	[illegible]
৮৫	জীবনানন্দ মন্ডল	বাজুয়া	01930352127	[illegible]
৮৬	[illegible]	[illegible]	01712-141703	[illegible]
৮৭	[illegible]	[illegible]	0193680[illegible]	[illegible]
৮৮	[illegible]	[illegible]	01740596176	[illegible]
৮৯	[illegible]	USSO, দাকোপ	0711-477181	[illegible]
৯০	[illegible]	UEO, Dacope	01721-326232	[illegible]
৯১	বিপ্লব [illegible] ঘোষ	SUFO, দাকোপ	01717488378	[illegible]
৯২	[illegible]	U.P সদস্য [illegible]	01935645817	[illegible]
৯৩	[illegible]	U.P সদস্য	01923074191	[illegible]
৯৪	দুর্গাপদ [illegible]	"	01925325200	[illegible]
৯৫	দুর্গাপদ [illegible]	২নং [illegible]	01936636128	[illegible]

উপকূলীয় বাঁধ উন্নয়ন প্রকল্প-১ম পর্য্যায় এর অনুকূলে প্রনয়নকৃত সমীক্ষা প্রতিবেদনের উপর কর্মশালা

দাকোপ, খুলনা

ক্রমিক নং	নাম/পদবী	ঠিকানা	মোবাইল নং	স্বাক্ষর
৯৬	হিরন্ময় রায় ইউপি সদস্য	বানীশান্তা	01712632603	[illegible]
৯৭	বিকাশ চন্দ্র মন্ডল	[illegible]	01913729265	[illegible]
৯৮	বিকাশ চন্দ্র মন্ডল	ইউ,পি সদস্য বানীশান্তা	01918-484480	[illegible]
৯৯	[illegible]	ইউ, পি, সদস্য [illegible]	01925185720	[illegible]
১০০	[illegible]	[illegible]	01931675130	[illegible]
১০১	[illegible]	[illegible]		[illegible]
১০২	[illegible]	[illegible]	01922622698	[illegible]
১০৩	[illegible]	[illegible]		
১০৪	মো: [illegible]	[illegible] দাকোপ	01712-242775	[illegible]
১০৫	[illegible]	[illegible]	0171482107[illegible]	[illegible]
১০৬	[illegible]	[illegible]	[illegible]	[illegible]
১০৭	মো: [illegible]	[illegible] দাকোপ		[illegible]
১০৮	[illegible] মন্ডল	ইউ,পি, সদস্য বানীশান্তা	01711968919	[illegible]
১০৯	মো: [illegible]	সভাপতি - দাকোপ প্রেসক্লাব [illegible]	01716-297079	[illegible]
১১০	[illegible]			[illegible]
১১১	" [illegible]			[illegible]
১১২	[illegible] হোসেন	[illegible] দাকোপ	01711-309008	
১১৩	[illegible]	[illegible]	01711-065400	[illegible]
১১৪	[illegible]	[illegible]		[illegible]

Annex E: ToR for Environmental Impact Assessment of Polder 32

*Backg*round

Bangladesh Water Development Board (BWDB) requires to conduct Environmental Impact Assessment (EIA) study for Polder 33 under CEIP, as per the findings of IEE study as well as the guidelines of DOE and World Bank. The EIA reports will be submitted to DOE for obtaining environmental clearance. The EIA study should be conducted according to following scope of works.

Objective

The objective of the EIA study is assessment of environmental impacts and preparation of environmental management plan for implementing the sub-projects without harming the environment.

Scope of works

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

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

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

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

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

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

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

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

ix) Describe alternatives that were examined in the course of developing the proposed project and identify other alternatives that would 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 and 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 Plans along with the 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;

xiv) Prepare the EIA report

Structure of the EIA report

EIA report should be prepared as per following key contents, but not limited to:

1. Executive Summary
2. Introduction: *This section will include (i) purpose of the report and (ii) extent of the IEE study.*
3. Methodology of EIA
4. Policy, Legal and Administrative Framework: *This section will describe relevant environmental policies, rules and administrative procedures that need to be followed for the proposed project.*
5. Project Description: *This section will provide a brief but clear picture about (i) type of project; (ii) category of Project; (iii) need for project; (iv) location (use maps showing general location, specific location, and project site); (v) size or magnitude of operation;(vi) proposed schedule for implementation)*
6. Analysis of Alternatives: *This section will describe analysis of alternatives in terms of project location and technical designs and associated environmental impacts.*
7. Environmental and Social Baseline: *This section will provide sufficient information on the existing environmental and social baseline resources in the area affected by the project, including the following:*

(i) Physical Resources: (e.g. atmosphere, topography, air quality etc.)

(ii) Water Resources: (e.g. hydrology, surface water and groundwater system, sedimentation, tidal influence, etc.)

(iii) Land and Agriculture resources: (e.g. land type, landuse, cropping pattern, crop production, etc.)

(iv) Fisheries resources: (e.g. fisheries diversity, fish production, etc.)

(v) Ecology: (e.g. ecosystems, wildlife, forests, rare or endangered species, protected areas, coastal resources, etc.)

(vi) Socio-economic condition: (e.g. population and communities (e.g. numbers, locations, composition, employment), health facilities, education facilities, socio-economic conditions (e.g. community structure, family structure, social well being), physical or cultural heritage, current use of lands and resources for traditional purposes by Indigenous Peoples, structures or sites that are of historical, archaeological, paleontological, or architectural significance, economic development (e.g. industries, infrastructure facilities, transportation, power sources and transmission, mineral development, and tourism facilities, etc.)).

8. Climate Change: *Climate change aspects in global, regional and local perspectives and the likely impacts on the Project area and its surroundings should briefly discus in this section.*
9. Stakeholder Consultation and Disclosure: *This section will describe the process undertaken to involve the public in project design and recommended measures for continuing public participation; summarize major comments received from beneficiaries.*
10. Significant Environmental and Social Impacts: *Significant environmental and social impacts due to project location, and related to project design, construction, and operations phase should discus detail in this section.*
11. Cumulative and Induced Impacts: *Cumulative impacts of the proposed Project and other projects as well as induced impacts should provide in this section.*
12. Environmental Management Plan: *The environmental management plan (EMP) will include institutional arrangement for EM, mitigation and enhancement plan, compensation and contingency plan as well as monitoring plan. The EMP should also include tentative cost of implementation of the plan.*
13. List of References
14. Annexes:

    Checklist for Environmental and Social Survey

    Records of Consultations (list of participants and photographs)

    Data and Unpublished Reference Documents

Annex F: Photo Album

Photo Album Polder-32

	
Figure 1: FFDFK1 at 0.74 km near Nalian Bazar	**Figure 2: FFDFM1 at Sutarkhali**
	
Figure 3: F8 at 13.40 km at Jaliakhali village	**Figure 4: F10 at Joynagar**
	
Figure 5: FFDFK 3 at Banmuk chak khal	**Figure 6: Anuar Khal near Nalian Bazar**

Figure 7: Sand carpeting near Jaliakhali closure

Figure 8:Water logging Near Nalian Bazar

Figure 9: EC measurement in the polder

Figure 10: EC measurement in the polder

Figure 11: Navigation Dhaki River

Figure 12: Navigation Signal Dhaki River

	
Figure 13: Navigation Dhaki River	**Figure 14: Navigation Dhaki River**
	
Figure 15: Embankment of the Polder	**Figure 16: Embankment erosion the Dhaki River**
	
Figure 17: Shifting of house due to repaire embankment	**Figure 18: Jupre house alone the embankment**

Figure 19: Shifting of house due to repaire embankment

Figure 20: Juprrrrre house alone the embankment

Figure 21: Pucka Road in the polder area

Figure 22: Herringbone Road Network in the Polder

Figure 23: Internal Katcha Road Network in the Polder

Figure 24: Bridge in the Polder

Figure 25: Crop collect to field in the polder area

Figure 26: Rice cum fish culture in the polder

Figure 27: Soil sample collection in the polder

Figure 28: Potato cultivation

Figure 29: Fishing boat

Figure 30: Fishing by khepla jal

Figure 31: Shrimp Collect

Figure 32: Crab collection from gher

Figure 33: PL collect in Dhaki River

Figure 34: PL harvesting

Figure 35: Mixt fish

Figure 36: Hilsha fish

Figure 37: KamarKhola Bazar in the Polder

Figure 38: Nalian weekly market in the Polder

Figure 39: School cum Cyclone shelter

Figure 40: Cyclone shelter in the polder

Figure 41: Joynagor jame Mosque

Figure 42: Temple in the polder

Figure 43: Sutarkhali Govt. Primary School

Figure 44: Jibonnagor High School

Figure 45: Ring slave Toilet in the Polder

Figure 46: Ring slave Toilet in the Polder

Figure 47: Katche house in the polder

Figure 48: Jupre house on the Embankment

	
Figure 49: Katcha house in the polder area	**Figure 50: Katcha house beside the embankment**
	
Figure 51: Rain Water Collect	**Figure 52: Pond Sand Filter(PSF)**
	
Figure 53: Drinking water collect from Tube well	**Figure 54: Drinking water collect from supply**

FGD (Focus Group Discussion)

Figure 55: FGD at WAPDA Colony Khay Ghat

Figure 56: FGD at Nalian Bazar

Figure 57: FGD at Sreenagar

Figure 58: FGD at Gunary Closure

Figure 59: FGD at Kalabegi village

Figure 60: FGD at Parjoynagar Village

Figure 61:FGD in presence of Omar khalid at WAPDA Colony Khay Ghat

Figure 62: FGD in presence of Omar khalid at WAPDA Colony Khay Ghat

PCM (Public Consultation Meeting)

Figure 63: PCM at Kamarkhola UP

Figure 64: PCM at Kamarkhola UP

Figure 65: Discussion with local people

Figure 66: Discussion with female participants

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<tr><td></td><td></td></tr>
<tr><td>Figure 67: Discussion with local people</td><td>Figure 68: A view of open discussion of PCM</td></tr>
<tr><td colspan="2">Public Disclosure Meeting (PDM)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Figure 69: Presentation of EIA report by TL of EA of CEIP</td><td>Figure 70: : Presentation of Feasibility report by DTL CEIP</td></tr>
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