Government of the People's Republic of Bangladesh

Ministry of Water Resources

Bangladesh Water Development Board

Final Report on
Environmental and Social Impact Assessment
of
Rehabilitation of Polder 36/1 in Bagerhat District

January 19, 2015

Submitted by

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Abbreviations and Acronym

ADB	Asian Development Bank
ADG	Additional Director General
AEZ	Agro Ecological Zone
ASA	Association for Social Advancement
B. Aus	Broadcast Aus
BADC	Bangladesh Agriculture Development Corporation
BARC	Bangladesh Agriculture Research council
BBS	Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BCSAP	Biodiversity Conservation Strategy and Action Plan
BMD	Bangladesh Meteorological Department
BOD	Biological Oxygen Demand
BRAC	Bangladesh Rural Advancement Committee
BRRI	Bangladesh Rice Research Institute
BWDB	Bangladesh Water Development Board
CAS	Catch Assessment Survey
^{0}C	Degree Centigrade
CBOs	Community Based Organizations
CE	Chief Engineer
CEGIS	Center for Environmental and Geographic Information Services
CEP	Coastal Embankment Project
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
Cm	Centimeter
Cm^3	Cubic Centimeter
CZPo	Coastal Zone Policy
DAE	Department of Agriculture Extension
dBA	Decibel = International scale of noise level
DC	Deputy Commissioner
DG	Director General
DO	Dissolve Oxygen
DoE	Department of Environment

DoF	Department of Fisheries
DPHE	Department of Public Health and Engineering
DPP	Development Project Proposal
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EC	Electro-conductivity
ECA	Environmental Conservation Act
ECA	Ecologically Critical Area
EMP	Environmental Management Plan
EMP	Environmental Monitoring Plan
ESIA	Environmental and Social Impact Assessment
Ex EN	Executive Engineer
FAO	Food and Agriculture Organization
FCBO	Fisheries Community Based Organization
FCD/I	Flood Control Drainage/ Irrigation
FD	Forest Department
FES	Fishing Effort Survey
FGD	Focus Group Discussion
E.P.	East Pakistan
FRSS	Fisheries Resources Survey System
FS	Frame Survey
FWIP	Future With Project
FWOP	Future Without Project
GDP	Gross Domestic Product
GIS	Geographic Information System
GL	Ground Level
GO	Government Organization
GoB	Government of Bangladesh
GPA	Guidelines for Project Assessment
GPP	Guidelines for Peoples Participation
GPWM	Guidelines for Participation of Water Management
GSB	Geological Survey of Bangladesh
GWT	Ground Water Table
Ha	Hectare
HH	Household

HYV	High Yielding Variety
ICM	Integrated Crop Management
ICZM	Integrated Coastal Zone Management
IEE	Initial Environmental Evaluation
IESC	Important Environmental and Social Component
IPM	Integrated Pest Management
IS	Institutional Survey
ISC	Important Social Component
IUCN	International Union for Conservation of Nature
IWM	Institute of Water Modeling
KII	Key Informant Interview
Kg	Kilogram
Km	Kilometer
Km2	Square Kilometer
LGED	Local Government Engineering Department
m^3	Cubic Meter
Mg/l	Milligram per liter
mm	Millimeter
MPO	Master Plan Organization
MoEF	Ministry of Environment and Forest
MoWR	Ministry of Water Resources
MP	Murate of Potash
MT	Metric Ton
MW	Mega Watt
NEMAP	National Environmental Management Action Plan
NCA	Net Cultivable Area
NCS	National Conservation Strategy
NEMAP	National Environmental Management Action Plan
NGO	Non-Governmental Organization
NO_x	Oxides Nitrogen
NTU	Nephelometric Turbidity Unit
NWRD	National Water Resources Database
O&M	Operation and Maintenance
PCM	Public Consultation Meeting
PD	Project Director

PL	Post Larvae
PP	Project Proforma
PPM	Parts Per Million
PWD	Public Work Department
RRA	Rapid Rural Appraisal
RS	Remote Sensing
SAAO	Sub Assistant Agriculture Officer
SE	Superintending Engineer
SDE	Sub-Divisional Engineer
SIA	Social Impact Assessment
SIS	Small Indigenous Fish
SO	Section Officer
SO_2	Sulfur Dioxide
SPARRSO	Space Research and Remote Sensing Organization
SPM	Suspended Particulate Matter
SRDI	Soil Resources Development Institute
STW	Shallow Tube Well
SS	Suspended Solid
T. Aman	Transplanted Aman
TDS	Total Dissolve Solid
ToR	Terms of Reference
TRM	Tidal River Management
TSP	Triple Super Phosphate
UAO	Upazila Agriculture Officer
UFO	Upazila Fisheries Officer
UNDP	United Nation Development Program
WARPO	Water Resources Planning Organization
WMOs	Water Management Organizations

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-December. 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.
Aman:	Rice generally transplanted at the beginning of monsoon from July-August and harvested in November-Dec.
B:	When preceding a crop means broadcast (B. Aus)
Bagda:	Shrimp (Penaeus monodon), brackish/slightly saline water species.
Baor**:**	A perennial water body formed in an abandoned part of a river course, and in some cases seasonally connected with river system.
Bazar:	Market
Beel:	A saucer-shaped natural depression, which generally retains water throughout the year and in some cases seasonally connected to the river system.
Bepari:	Middleman in the marketing chain who transports the products to the other places, use of term depends on the location, sometimes also used synonymously with retailer.
Boro:	A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January and harvested before the onset of monsoon in April- May.
Faria:	Local trader/agent/intermediary.
Flood plains**:**	A nearly flat plain along the course of a stream or river that is naturally subject to seasonal/periodical tidal flooding.
Gher	Farm lands converted into ponds with low dykes and used for cultivation of shrimp/prawn/fish.
Golda	Prawn (Macrobrachium rosenbergii), non-saline/ slight saline water species

Hat: 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/prawn /shrimp from the water bodies.

Jolmohol: Section of river, individual or group of beels (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. Type of house use by very poor community peoples.

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

Khal: A drainage channel usually small, sometimes man-made. The water flows through the channel. These may be perennial or seasonal.

Khas land: Public lands and water bodies not registered in the name of any individual or corporate body, regarded by land administration officials as belonging to the state.

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 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.

Kum Deep pool in the river where water retain around the year. These are sites for the shelter place for fishes and the natural spawning ground of riverine fishes.

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

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

Monsoon: Period of rains starting in June and ending in October

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

Pacca: Well constructed building using modern masonry materials

Polder: An area of low-lying land, generally in a tidal floodplain, encircled by embankment with provisions for control of drainage & irrigation/flushing.

Rabi: Agricultural crop growing in dry 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.

Slum The area where the poor people lives together in very un-hygienically

Sluice: A structure for draining water in tidal area fitted with flap gate (s) on the river side, which automatically opens at low tide and closes with high tide. It is usually made of bricks, concrete and pipes.

T. Aman: When preceding a crop means transplanted (T. Aman).

Trap: Bamboo made instrument use to catch fish

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.

WCS**:** Water Control Structure – a broad name for all structures (like regulators, sluice) with control devices like gates or flaps for irrigation-drainage system.

Executive Summary

Background

Polder 36/1 is located in Bagerhat district in the southwest region of Bangladesh which used to experience flood and ebb tides in a day through intricate tidal rivers. Coastal Embankment Project (CEP) was implemented in the 1960s to protect the area from tidal flooding, storm surge and salinity intrusion by construction of flood protection embankment along the river banks and construction of drainage sluices at the out fall of internal khals. During implementation of CEP, environmental impact was not taken for considerations. After implementation of the CEP, the unproductive vast land was brought under agricultural production which changed the land into double or triples cropping and eventually changed the socio-economic condition of the local people.

The polder 36/1 was very good for agricultural production up to early 90s. But with the introduction of saline water for shrimp culture in ghers, saline water intrusion had started in this area after 1990's and the agricultural production started decreasing due to the saline water intrusion inside the polder area. Besides these the connecting khals and the water regulatory structures are not functioning due to improper maintenance. In fact, the BWDB has insufficient fund to maintain the activities of the said polder. Then the people in the polder area started shrimp culture activities for their livelihood as a way of adaptation with salinity from the adjacent area namely Rampal and Fakirhat upazilas.

From the beginning of gher culture the gher owners got good profit and simultaneously most of the people of this polder area were engaged in gher culture activities. The saline water intrusion in the polder area is decreasing from the 2011 and the bagda gher owners are now facing problem for bagda gher culture.

The drainage system of the polder area is composed of Chitra, Bhairab, Modhumoti, Atharobanki, Baleswar River and along with internal drainage khals. At present, due to high siltation, the Atharobanki, Bhairab and Chitra River lost their conveyance capacity significantly. In addition, siltation of the peripheral rivers created water logging in the polder.

Study Area

The polder 36/1 is located broadly in Fakirhat upazila, Mollahhat upazila, Chitalmari upazila in Bagerhat district.

Objectives of the Study

The objective of ESIA Study of the Rehabilitation of Polder 36/1 is to ensure sustainable development involving the beneficiaries in project conceptualization, planning and implementation properly.

Approach and Methodology

In the absence of DOE guidelines for water sector projects, Environmental impact assessment guideline of water sector projects, developed by the Flood Plan Co-ordination Organization (FPCO) in 1992 and updated by the Water Resources Planning Organization

(WARPO) in 2002 was followed for conducting the Environmental Impact Assessment (EIA) study.

Environmental and Social Baseline

Meteorological information on different parameters i.e. rainfall, temperature, relative humidity, wind speed, evaporation and sunshine hours have been collected from National Water Resources Database (NWRD) for the Bangladesh Meteorological Department (BMD) station at Khulna. The values of monthly maximum, average and minimum rainfalls are collected from the BMD station of Khulna (1948-2014) and analyzed. Temperature data Humidity, Evaporation, Wind speed, Sun shine, Seismicity and climate change data have been collected and analyzed.

Water quality in the polder area like pH, TDS, DO, EC of water in the field is satisfactory as DoE standard for surface water in the polder area. . No Saliniity was found during in situ test as the test was conducted immediately after monsoon. Sound level and air quality is within the range of DoE standard.

The average surface water levels are 2.9 m+ PWD and 2.8 + PWD in upstream and downstream respectively.

The major drainage routes of polder 36/1 are the Athharobanki river, Bhairab river, Chitra-Karamara river and Old Madhumoti river which are now facing huge sedimentation problem.

Drainage Congestion is a crucial problem in Polder 36/1. Sedimentation in the rivers and khals within and around the polder is the main cause for the drainage congestion. Another major reason of drainage congestion is the encroachment of the rivers and khals for fish culture and agriculture. Total drainage congestion area is 1842 ha.

Two locations namely Paranpur and Saildah are identified by BWDB which are vulnerable to erosion. The approximate length is 1000m and 800m in Paranpur and Saildah simultaneously.

The polder area comprises of four Agro-ecological regions. (i) High Ganges River Floodplain (ii) Low Ganges River Floodplain (iii) Ganges Tidal Floodplain and (iv) Gopalganj - Khulna Bils.

The gross area is 39,130 hectors. Of which net cultivable area (NCA) is 25,043 ha The coverage of settlement 7,305 ha beels/ water congestion area 1,842 ha, ghers 4,539 ha, khals 204 ha and roads 197 ha. About 10% of NCA is affected by salinity in the polder area. Farmers reported that the soil salinity of the area is reducing day by day.

The most common cropping pattern in the study area is Fallow- Fallow- Boro (Hybrid) covers about 30.67% of Net Cultivable Area (NCA). The cropping intensity of the study area is about 117.55%. In the polder area, the annual total crop production is 142,828 tons of which rice is 51,310 tons (36%) and non-rice is 91,518 tons (64%).

Total loss of rice production is about 2,621 tons in 1,479 ha and loss of non-rice production is 172 tons in 199 ha due to drainage congestion, siltation of khals and drainage channels, effect of salinity, natural calamities etc. Surface water is the major source of irrigation water in the polder area.

About 40% of household in the polder area are rearing Cattle/cow/bullock, 15% of household are rearing goat, 5% of household are rearing sheep, 20% of household are rearing duck and 60% of household are rearing chicken

Capture fish habitat area is 2046 ha and culture area is 17,516 ha, Total production e.g. shrimp and prawn is 1326 MT and 12190 Mt.

The polder area is moderate in fish biodiversity though the biodiversity of fishes has the declining trend over the years. Both sweet water and brackish water species are grown. Golda is comparatively more compared to Bagda. About 80 fish species are present in the polder area.

The rivers and khal in polder areas comprises of different landforms like beels, canals, ditches and having varied vegetation patterns which create diverse habitats for different wild life. The project area encompasses two bio-ecological zones, namely the Ganges Floodplain and Gopalgonj / Khulna peat land.

The study area of Polder 36/1 has 75,529 households (HHs) consisting of 337,232 people. The average size of households in this polder is 4.3 where male and female are almost equally distributed. At present, the area represents moderate employment status considering the involvement in earning sources.

Public Consultation

Several numbers of consultation meetings with the mixed group of different occupational people were conducted by the EIA study team. Immediately starting of the rehabilitation work in polder 36/1 is the foremost demand of the local people to mitigate the existing irrigation and drainage problem. They also opined that protective work and dredging of major rivers should be started on priority basis so that people can be relieved from the loss of their assets and can execute a sustainable source of income.

Impact Assessment

Implementation of proposed interventions will improve the water logging situation and erosion problems which will improve the damage situation. Significant amount of household, homestead garden, school, mosque, temple, agricultural land, Saildah bazar and road will be saved from further erosion.

The irrigated area would be increased to 123 ha. Additional 11,165 tons of rice and 18,824 tons of non-rice per year would be produced after successful implementation of proposed interventions.

Increased production in agriculture would lead to increased availability of food. The project will also play significant role in employment and income of the stakeholders by protecting the vulnerable area from river erosion. This will directly impact on livelihood options by making diversified opportunity of occupation. The improved livelihood options will ultimately minimize deficit level with high income, which will be positive impact on poverty in the area.

Fish habitat quality will improve simultaneously. But beel area will decrease 149 ha, Gher area will increase by 149 ha and pond area will increase by 50 ha. Fish production will increase in Gher by 90 MT and pond by 370 MT per year, beel production will be 104 MT.

Embankments vegetation will be enriched due to fresh water in the khals and rivers after re-excavation and dredging work. Improvement of vegetation and fruit trees will support resident wildlife throughout the year. Aquatic wildlife and vegetation will be enriched by enhanced water flow, volume and depth of khals and rivers after re-excavation and dredging work. Improvement of vegetations will happen in the khals by holding more water throughout the year.

The overall socio-economic condition of the project site will improve significantly as employment opportunity will be created during pre-construction and construction phases. Land price of the project area will increase and overall common property resources would be saved from further erosion.

The following EMP measures will minimize the negative impacts and enhance the positive impacts which will be generated by the proposed interventions:

- The construction activities should be implemented in dry season.
- Construction material (sand, coarse aggregates etc.) should be covered during movement as well as storage. Water should be sprinkled as and where needed.
- The constructing materials like sand, cement, construction of labor sheds and stockyard should be placed in non-agricultural land as far as possible.
- Noise levels from vehicles, equipment and machinery should comply with national noise standards.
- Exhaust emissions from heavy vehicles should comply with standards.
- Cross bundh should be constructed immediately after connecting the diversion channel.
- Earthwork for re-excavation should be carried out in such a way (creating chamber in the khals) so that it causes minimum hindrance to natural flow.
- Waste materials from labor shed should be buried under soil far from water bodies.
- Dredging work should be performed in such way so that oil will not spill into water.
- Dredged spoil should be dumped very carefully so that further siltation cannot occur.
- Irrigation should be provided in optimum level with minimum conveyance loss.
- Organic manure should be applied for the restoration of soil fertility.
- Use barren land or low vegetated land for placing of construction materials, stockyard and labor shed preparation.
- Avoid the re-excavation and other intervention work during fish migration and breeding period.
- TRM activity should be implemented with proper care. Guidance on effective implementation of TRM may be taken from the EIA study report of KJDRP.
- Plantation of local timber/ fruit plants on embankment area after completion of earthwork activities Re-excavation work should be done from extreme downstream point to the upstream gradually.
- Committee consisting of local people should be formed to ensure active participation in spoil management in a disciplined way.

There could be some minor temporary impact at the construction phase, but there will be no significant negative or irreversible impact of the project. As such, the EIA report may be cleared so that the implementation of the project interventions may be taken up.

1 Introduction

1.1 Background

1. The southwest region of Bangladesh used to experience flood and ebb tides in a day through intricate tidal rivers. This tidal flooding in the vast lands and beels prevented production of agricultural crops. On the other hand most of the areas were inundated with silt and saline water during high tide in the dry season. Due to increasing demand of population, Coastal Embankment Project (CEP) was implemented in the early 60s to protect the area from tidal flooding, storm surge and salinity intrusion by construction of flood protection embankment along the river banks and construction of drainage sluices at the out fall of internal khals. By implementation of the CEP, the unproductive vast land was brought under agricultural production which changed land into double or triple cropping and eventually changed the socio-economic condition of the local people. During implementation of CEP in the 60s, environmental impact was not taken into considerations. As because environmental awareness was not build up at that time, the possible negative impacts could not be assessed. The negative impacts of CEP have been prominently visible since 1984. The silt leaden water coming up during flood tide and spreading over the vast low lying area during dry season was prevented by construction of embankment, as a result siltation in the river bed started at the beginning of ebb tide when velocity become zero. In course of time, the accumulated silt made the river bed higher than that of the beel area to obstruct natural drainage. Moreover the upland flow of the rivers in the southwest region reduced drastically after operation of Farakka Barrage which accelerated the sedimentation process due to increased salinity concentration in the downstream rivers.

2. Thus water logging started in the southwest region from the early 80s and became acute within early 90s. The Polder 36/1 is one of the polders of the CEP constructed at early 70s which is suffering from acute water logging problems. After implementation of Coastal Embankment Project, it has been playing vital role in increasing agricultural production, improving livelihoods of the people and environment in the study area for many years. But in the recent years, the Polder is experiencing water logging problem due to high rate of siltation in the peripheral rivers and internal drainage khals. This affected the normal social and economic activities of the people of the Polder area severely.

3. The drainage system of the project area is composed of Chitra, Bhairab, Modhumoti, Atharobanki, Baleswar River and Nalua Khal along with internal drainage khals. At present, due to high siltation, the Atharobanki, Bhairab and Chitra River lost their conveyance capacity significantly and consequently about 1842 ha land remained water logged out of total gross area 39,130 ha. As a result agricultural production mainly Boro cultivation has been totally stopped for last 6-7 years in this water logged area.

4. In this regard, a feasibility study for Rehabilitation of Polder 36/1 by Model Technique (Mathematical Modeling) was done by the Institute of Water Modeling (IWM) in December, 2013. In this study IWM recommended to implement the selected final option of the study. In final option they suggested some interventions. But they did not study the Environmental and Social Impact of the suggested interventions. For successfully implementation of the project Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) are essential to investigate effects of water management improvement plan. Reports on EIA and SIA study is essential to obtain environmental clearance from DoE, which will eventually allow

implementing the proposed interventions in an environmentally sound manner suggested by the technical study team.

1.2 Study area

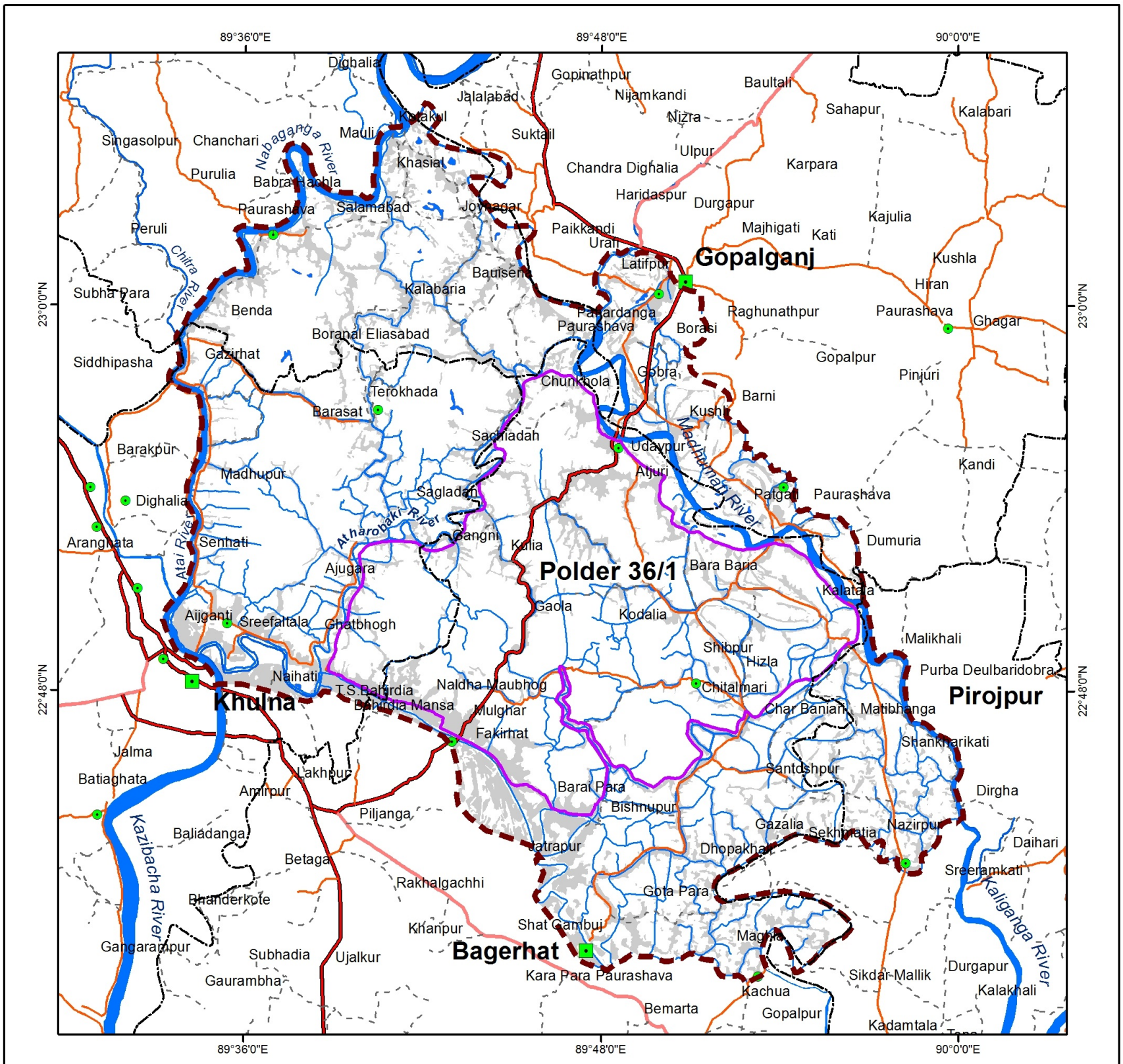
5. The Environmental and Social Impact Assessment (ESIA) study area of Polder 36/1 encompasses five upazila of Bagerhat and Khulna districts. The polder area encompasses a certain proportions of the upazila namely Bagerhat Sadar, Chitalmari, Fakirhat, Mollahat and Rupsa (which are likely to be directly impacted) due to the implementation of the rehabilitation plan. The administrative units within the polder area and percentages are stated in **Table 1.1.**

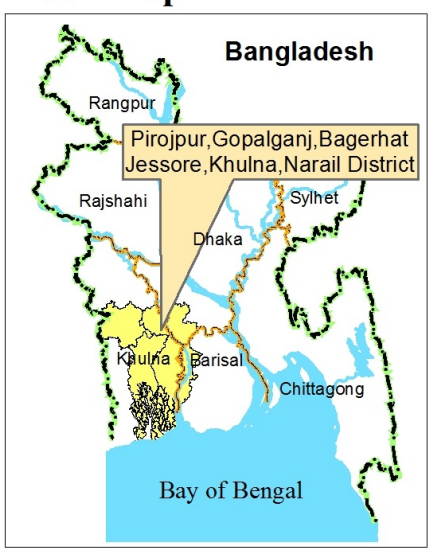
Table 1.1: Administrative units of Polder 36/1

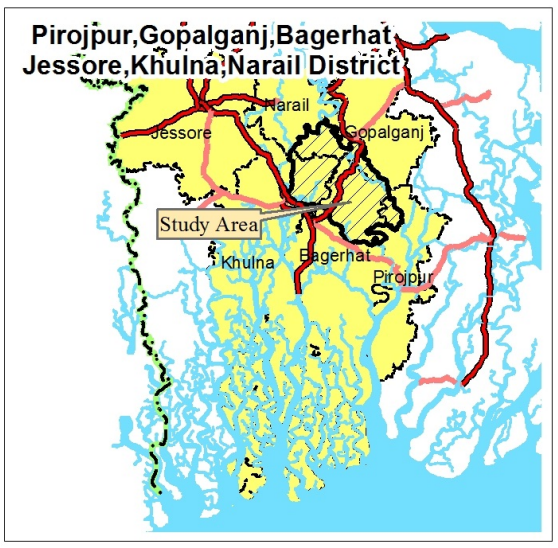
District	Upazilas	% of upazilas covered polder area
Bagerhat	Bagerhat Sadar	8
	Chitalmari	68
	Fakirhat	18
	Mollahat	93
Khulna	Rupsa	34

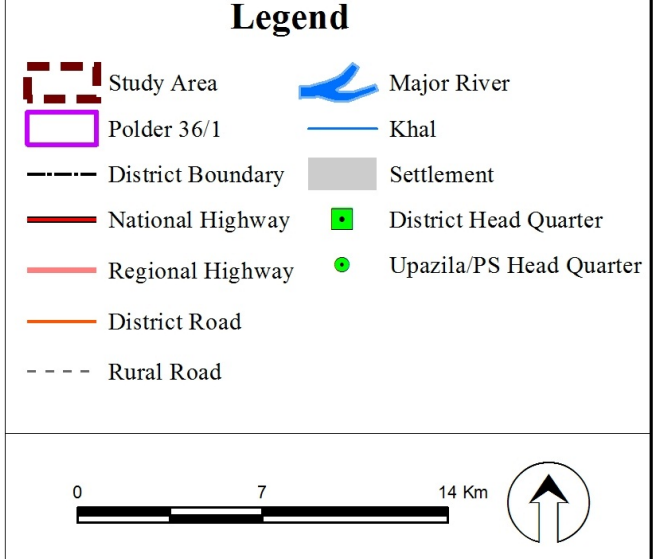
Source: GIS by CEGIS, 2014

Polder 36/1: Location Map









Data sources:
National Water Resources Database (NWRD)
CEGIS Archive

Projection:
Bangladesh Transverse Mercator (BTM)
Datum - Gulshan 303

CEGIS Center for Environmental and Geographic Information Services

December 2014

Map 1.1: Location Map of Polder 36/1

1.3 Study Objectives

6. The objectives of ESIA Study of the Rehabilitation of Polder 36/1 are to ensure sustainable development involving the beneficiaries in project conceptualization, planning and implementation. Specific objectives of the ESIA study are:

- To provide a consistent and common basis for the application of EIA and SIA to protect environment by ensuring that the project is environmentally sound.
- To assist EIA practitioners in identifying, quantifying and evaluating potential environmental consequences of flood control, drainage and irrigation (FCD/I) so that the impact of the project are highlighted and the project design can be altered or management measure can be developed to enhance positive impacts and lessen or alleviate negative impacts.
- Reduce the environmental degradation as well as deleterious socio-economic impacts in the project area and save the valuable lands and establishments located in the vicinity of the vulnerable eroding area.
- Provide stable and reliable agricultural growth in order to alleviate poverty and improve human welfare and generate employment opportunities.
- To ensure all development with full consideration for economic and environmental optimization, and for long-term sustainability and equitability of the environmental resource conservation.

1.4 Scope of Work

7. The intervention, proposed by the feasibility study team, may have impacts on the environmental and social components that are needed to be assessed at the planning stage for preparing an Environmental Management Plan (EMP). Implementation of EMP during project implementation cycle would contribute towards the sustainability of the Project. Environmental and Social Impact Assessments (ESIA) study would, therefore, be carried out of the Polder 36/1 area. The ESIA study will specifically include the following:

i. Establish the environmental and social baseline condition of the project;

ii. Obtain information on the proposed interventions from the previous study;

iii. Assess environmental and social impacts of the proposed project interventions;

iv. Prepare an Environmental Management Plan (EMP), which would include mitigation measures, enhancement measures, compensation measures, and an environmental monitoring plan including agencies responsible; and

v. Produce ESIA reports with approved format of DoE.

1.5 Output of the Study

8. The study would produce an Environmental and Social Impact Assessment (ESIA) study report on the Rehabilitation of Polder 36/1 in Bagerhat district area containing the following:

- Project description containing the proposed interventions;
- Environmental and social baseline condition of Polder 36/1 area;
- Environmental and social impacts of the proposed interventions;
- Environmental Management Plan (EMP) which would include:

- ❖ Mitigation plan;
- ❖ Enhancement plan;
- ❖ Compensation plan;
- ❖ Monitoring plan including agencies responsible.

1.6 ESIA study team

9. The ESIA study of rehabilitation of Polder 36/1 has been conducted by a multi-disciplinary team comprising of the following professionals.

Sl No	Professional	Position
1	Mr. Malik Fida Abdullah Khan	Team Leader/Water Resource Engineer
2	Mr. Md. Sarfaraz Wahed	Deputy Team Leader/ Environmentalist
3	Mr. Subrata Kumar Mondal	Socio-Economist
4	Mr. Mohammad Abdur Rashid	Soil and Agriculture Specialist
5	Mr. Mohammad Saidur Rahman	GIS/RS Specialist
6	Mr. Md. Ebrahim Akanda	Senior Agriculture Specialist
7	Mr. Ashoke Kumar Das	Fisheries Specialist
8	Mr. Md. Mizanur Rahman	Senior Ecologist
9	Mr. Md. Mokammel Hossain	Junior Engineer
10	Ms. Masuda Parvin	Junior Ecologist
11	Mr. Hifzur Rahman	Junior Sociologist
12	Mr. Md. Mosleh Uddin	Junior Agriculturist

1.7 Report format

10. The EIA report consists of the following 9 (nine) chapters:

Chapter 1: Background, study area, objectives, scope of work in addition to present the list of the multi-disciplinary EIA study team members.

Chapter 2: The Policy, Legal and Administrative framework.

Chapter 3: Approach and Methodology followed for conducting the EIA study.

Chapter 4: Description of the project including the present status of the infrastructure and the proposed interventions.

Chapter 5: Environmental and Social Baseline condition in respect of meteorology, seismicity, water resources, land resources, agriculture, livestock, ecological resources and socio-economic condition.

Chapter 6: Public Consultation Meeting.

Chapter 7: Important environmental and social components likely to be impacted by the proposed interventions; Assessment of the impacts on the environmental and social components pertaining to water resources, land resources, agriculture, livestock, fisheries, ecological resources and socio-economic condition are described in this chapter.

Chapter 8: Environmental Management Plan.

Chapter 9: Conclusion and Recommendations.

2 Policy, Legal and Administrative Framework

11. Development projects are governed by some legal and/or institutional requirements. Thus, review of relevant policy, strategy and regulatory issues are very important for any project proponent before actual execution of a program or plan. The proponent has to be well aware of these requirements and comply with the provisions as applicable and necessary. The following sections review the relevant national legislative, regulatory and policy requirements. The key pieces of policy and legislation which apply to such project execution program are described in this chapter.

2.1 National Policies and Legislations

2.1.1 National Conservation Strategy (NCS) 1992

12. National Conservation Strategy was drafted in late 1991 and submitted to the Government in early 1992. This was approved in principle. However, the final approval of the document is yet to be made by the government.

2.1.2 The National Environment Policy, 1992

13. The National Environment Policy was adopted by the Government of Bangladesh in 1992, with the aim to maintain ecological balance and overall development through protection and improvement of environment and to protect the country against any natural disaster. The Policy provides the broader framework of sustainable development in the country. It also stated all major undertakings, which will have a bearing on the environment and need an initial environmental examination (IEE) and environmental impact assessment (EIA) before initiation of the project. The Policy delineates the Department of Environment (DoE), as the approving agency for all such IEE/EIAs to be undertaken in the country.

14. The policy guidelines of fifteen sectors are stated in the Policy. Under the 'Water Development, flood Control and Irrigation' sector (Section 3.5), it states that it is required to conduct EIA before undertaking projects for water resource development and management (Section 3.5.7).

15. Section 3.5.2 states that it is required to ensure water development activities and irrigation networks should not create adverse environmental impacts and the Section 3.5.3 provides, 'ensure that all steps taken for flood control, including construction of embankments,.... be environmentally sound at the local, zonal and national level'. According to the Section 3.5.5 of the Policy the rivers and all water bodies are to be free from pollution. The Environment Policy sets out the basic framework for environmental action, together with a set of broad sectoral action and guidelines.

2.1.3 National Environmental Management Action Plan (NEMAP) 1995

16. The National Environmental Management Action Plan (NEMAP) is a wide ranging and multi-faceted plan, which builds on and extends the statements set out in the National Environmental Policy. NEMAP was developed to address issues and management requirements for the period 1995 to 2005 and set out the framework within which the recommendations of the National Conservation Strategy are to be implemented.

NEMAP has the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;

- Identification of actions necessary to halt or reduce rate of environmental degradation;
- Improvement of the natural and built environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development; and
- Improvement in the quality of life of the people.

2.1.4 Proposed National Wetland Policy (draft 1998)

17. The Wetland Policy is dated April 1998 but refers to documents dated December 1998, and appears to be in an early draft stage. The draft policy defines wetlands as areas of land surface which are seasonally flooded or remain under water permanently, either naturally or artificially, that may perform some known functions such as water reservoir, groundwater recharge, capture fishery area, aquaculture fish sanctuary, wild life sanctuary, navigation channel, cultivated area, etc. Such a broad definition effectively encompasses most of the country

2.1.5 The National Water Policy, 1999

18. The National Water Policy of 1999 was adopted to ensure efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned and institutional capacity building for water resource management. The policy considers water as being essential for human development, socio-economic development, poverty alleviation and preservation of the natural environment.

19. Sub-clause (b) of Section 4.5 states that planning and feasibility studies of all projects (relevant to water resources management or development or have interference on water sector) will follow the Guidelines for the Project Assessment (GPA), the Guidelines for Peoples Participation (GPP), the Guidelines for Environmental Impact Assessment (EIA), and all other instructions that may be issued from time to time by the Government. Giving importance on the navigation sector, sub-clause (a) of section 4.10 states that if a project may cause disruption to navigation, adequate mitigation measures should be taken. The stated objectives of the draft policy are:

- Establish the key principles by which wetland resource can be used in a sustainable manner;
- End existing unsustainable practices in wetlands, so as to stop and reverse the decline in their productivity;
- Ensure that measures are taken to maintain existing levels of biological diversity in wetlands;
- Maintain the functions and values derived from wetlands throughout Bangladesh;
- Actively promote the recognition and integration of wetland functions in resource management and economic development decision-making, with particular regard to sectoral policies and programs in the water, fisheries, agriculture, industries and infrastructure sectors.

20. The draft describes the importance of wetlands to the environment of Bangladesh and makes cross-references to the various recent government policy issues that relate to

wetland management. In its draft form, it provides a series of recommendations as found in other policies.

2.1.6 Coastal Zone Policy 2005

21. Realizing the multiple vulnerabilities and development potentials, the Government of Bangladesh gave special attention towards the development of the Coastal Zone of Bangladesh and with these notions adopted the Integrated Coastal Zone Management (ICZM). One of the key outcomes of the ICZM process was the Coastal Zone Policy (CZPo) which was finalized and approved by the Government of Bangladesh on 17 January, 2005. For coastal zone management the CZPo delineated the area of management which includes 48 upazillas under 19 districts of the country which are being affected directly or indirectly by affected by tidal waters, salinity intrusion and cyclone/storm surges (section 3.1). The CZPo formulated the goal of integrated coastal zone management to create such conditions, in which the reduction of poverty, development of sustainable livelihoods and the integration of the coastal zone into national processes can take place (section 3.3). Section 4 of the policy states the legal framework of the Policy as the Government made the coastal zone policy statements in relation to development objectives which provide general guidance so that the coastal people can pursue their livelihoods under secured conditions in a sustainable manner without impairing the integrity of the natural environment. More specifically, the following development objectives are identified in the CZPo: (1) to enhance economic growth in the coastal zone with the objective of poverty reduction; (2) to meet basic needs of the coastal people and enhance livelihood opportunities for coastal communities; (3) to reduce vulnerabilities and enhance coping capacities; (4) to ensure sustainable management of coastal resources (i.e. land, water, capture fisheries, aquaculture, agriculture, livestock, forests and energy); (5) to enhance an equitable distribution of resources and economic benefits across social strata and ensure the rights of the neglected and disadvantaged groups; (6) to enhance empowerment of coastal communities; (7) to enhance women's advancement and promote gender equity; and (8) to preserve and enhance the conditions of critical ecosystems (Section 4.1-4.8). Moreover, in order to enable institutional environment for mainstreaming Coastal Zone Management along with development of strategic planning and programs have been vested in section 5 of the Policy.

2.1.7 National Forestry Policy 1994

22. The National Forestry Policy of Bangladesh was enacted in 1994. The policy focused on the rights and participation of people taking departure from commercialization. Scrutiny of the policy statements can reveal the following main features:

- Horizontal expansion of forest to bring 20 percent of the land area under forest by 2015 (Statement 1);
- Emphasis for afforestation in rural areas, in the newly accreted char in the coastal areas and in the denuded Unclassed State Forest areas of Chittagong Hill Tract and northern zone of the country including the Barind tract (Statement 2);
- Public and NGO participation in forest expansion and management to achieve self reliance in forest products and maintenance of ecological balance (Statement 1). The government will undertake afforestation/tree plantation program with people's participation and with the assistance of NGOs in different areas like on either side of land surrounding road, rail, dam, khas tank etc. (Statement 1, 3, 5 and 12);

- Emphasis on urban forestry through promoting special afforestation activities in municipal areas taking assistance from relevant authorities (Statement 6);
- Special attention to the Chittagong Hill tracts by undertaking massive afforestation programs in the denuded hilly areas of Unclassed State Forests areas of Rangamati, Khagrachari and Bandarban by public and private agencies(Statement 7).
- Acknowledgements of the importance of biological diversity and protected areas. Attempts will be made to increase the amount of this protected area by 10% of the reserved forest land by the year 2015 (Statement 8).
- Multiple use of forest, water and fish of Sundarbans through sustained management ensuring the bio-environment of the area intact (Statement 9)
- Identification, protection and afforestation of inaccessible, denunded and encroached areas encouraging the agro-forestry in this regard (Statement 11 and 12)
- Sustainable use of Forest resources/products and promotion and development of forest-based small-scale enterprises (Statement 13-18)

2.1.8 The Social Forestry Rule 2004

23. The Social Forestry Rule was first adopted in December, 2004 by the Government of Bangladesh with a view to meet the forest product requirements of local population and to reverse the process of ecological and climatic degradation through proper soil and water conservation and to improve the socio economic condition of the rural people through Social Forestry Program. The Rule amended on January, 2010. The latest version of the Rule available contains the modifications made upto May, 2011 and therefore, the key issues of the Social Forestry Rule discussed below has been derived from this version of the Rule.

24. The Rule has provided guideline for delineating area for social forestry in section 3 and defined the terms, condition, selection criteria, duties and responsibilities of the parties to be involved (i.e. Department of Forest, Land owner, beneficiary and private organizations) in legal agreement to achieve the objectives of the Rule (Section 4-8 and 16-19) . However, as per the section 6.2, landless people, poor women, undeveloped communities, tribal communities, poor forest villagers and insolvent freedom fighters would get preference during selection of beneficiaries of the program. The duration of the legal contracts ranges from 10 to 40 years depending on the type of forestry and plantation (Section 5). For efficient functioning of the Social Forestry Program, the Rule has also prescribed the guidelines for formation of a Management Committee a, its role and mode of functioning (Section 9-13). The mode of sharing profit earned from the social forestry programs for different types of forestry has been precribed in section 20. According to the section 20.1, in case of agricultural products and products of orchards; the beneficiaries would get the whole profit during the first thinning and for other cases the profit would be distributed among the parties as described in sections 20.2.

2.1.9 The National Biodiversity Strategy and Action Plan for Bangladesh 2004

25. The Biodiversity Conservation Strategy and Action Plan 2004 (BCSAP) is a wide ranging and multi-faceted plan, which is also closely related to the statements set out in the National Environment Policy. The BCSAP has the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;

- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural and built environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development;
- Improvement in the quality of life of the people.

2.1.10 Bangladesh Climate Change Strategy and Action Plan (BCCSAP)

26. The Bangladesh Climate Change Strategy and Action Plan 2009 is built on the following 6 pillars:

i. Food security, social protection and health to ensure that the poorest and most vulnerable in society, including women and children, are protected from climate change and that all programs focus on the needs of this group for food security, safe housing, employment and access to basic services including health;

ii. Comprehensive disaster management to further strengthen the country's already proven disaster management system to deal with increasingly frequent and severe natural calamities;

iii. Infrastructure to ensure that existing assets are well maintained and fit-for-purpose and that urgently needed infrastructure is put in place to deal with the likely impact of climate change;

iv. Research and knowledge management to predict the likely scale and timing of climate change impacts on different sectors of the economy and socio-economic groups, to underpin future investment strategies and to ensure that Bangladesh is networked with the latest global thinking on science and best practices of climate change management;

v. Mitigation and low carbon development to ensure low carbon development options and implement these as the country's economy grows over the coming decades and the demand for energy increases; and

vi. Capacity building and institutional strengthening to enhance the capacity of government ministries and agency, civil society and the private sector to meet the challenges of climate change and mainstream them as part of development action.

2.2 Legal Framework

2.2.1 Water Resource Management Legislation

The Irrigation Act, 1876 (Bengal Act Iii Of 1876)

27. This Act provides the government with the power to regulate the application or use of irrigation water in Bangladesh. It also provides the provision for compensation or disclaimer to the government with regard to irrigation project activities.

28. The Protection and Conservation of Fish Act, 1950 (Bengal Act Xviii Of 1950)

29. This Act provides power to the government to:

- Make and apply rules in any water or waters for the purposes of protection of fisheries.
- Prohibit or regulate the erection and use of fixed engines; and the construction, temporary or permanent, of weirs, dams, bunds, embankments and other structures.
- Prohibit the destruction of fish by explosives, guns, and bows in inland or coastal areas.
- Prohibit the destruction of fish by means of poisoning, pollution and effluents.
- Prescribe the seasons during which fishing is allowed.
- Prohibit fishing in all waters during spawning periods.
- Specify the officials with authority to detect breaches.

The Embankment and Drainage Act 1952

30. This is an Act to consolidate the laws relating to embankment and drainage and make better provisions for the construction, maintenance, management, removal and control of embankments and watercourses or the better drainage of lands and for their protection from floods, erosion or other damage by water.

31. According to the Section 4 (1) every embankment, watercourse and embanked tow-path maintained by the Government or the Authority, and all land, earth, pathways, gates, berms and hedges belonging to or forming part of, or standing on, any such embankment or water-course shall vest in the Government or the Authority, as the case may be.

32. The section 56 (1) states that, persons will be subject to penalty (500 taka or imprisonment… if he erects, or causes of willfully permits to be erected, any new embankment, or any existing embankment, or obstructs of diverts, or causes or willfully permits to be obstructed or diverted, any water course. This section could be applied to the person causing damage to the protective works.

The Inland Water Transport Authority Ordinance, 1958 (E.P. Ordinance No. Lxxv Of 1958)

33. This is an ordinance to set up an authority for the development, maintenance and control of inland water transport and certain inland navigable waterways in Bangladesh. The authority is mandated to perform any other function such as, carrying out river conservancy work, including river training for navigation purposes and aiding navigation; drawing up programs on dredging requirements and priorities for the efficient maintenance of existing navigable waterways; and reviving dead or dying rivers, channels, or canals, including developing new channels and canals for navigation.

The Government Fisheries (Protection) Ordinance, 1959 (Ordinance No. Xxiv Of 1959)

34. This ordinance provides power to the government to declare any area as "Khas managed fishery" to bring it under the management and control of the government. No person shall fish in such an area without a valid fishing license issued by such authority as may be prescribed under the Act.

The Bangladesh Irrigation Water Rate Ordinance, 1983 (Ordinance No. XXXI of 1983)

35. An Ordinance to consolidate and amend the law related to the imposition of a water rate for the supply, regulation or storage of water for irrigation or drainage purposes. Imposition of water rate - (I) Whenever the government is of the opinion that lands within any area is benefited or is likely to be benefited by water supplied or regulated by the

government or the Board or the Corporation through any canal during any financial year. The Government may, by notification, declare its intention to impose in such area, hereinafter referred to as the notified area, a water rate for such financial year provided that the water rate so specified for a crop season shall not exceed such rate as may be prescribed and provided further that the water rate intended to be imposed may vary from one notified area to another.

The Ground Water Management Ordinance, 1985 (Ordinance No. Xxvit Of 1985)

36. This is an Ordinance to manage ground water resources for agricultural production. This act authorizes the Thana Parishad to grant license for installing tube wells in their jurisdiction areas. It may grant the license if the Thana Parishad is satisfied that the installation of the tube well applied for

a) will be beneficial to the areas where it is to be installed, or

b) will not have any adverse affect upon the surrounding areas, or

c) is otherwise feasible.

The Protection and Conservation of Fish Rules (1985)

37. These are a set of rules in line with the overall objectives of the Fish Act. Section 5 of the Rules requires that “No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters”. Section 6 of the Rules states -“No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters”.

Panishampad Parikalpana Ain (Water Resource Planning Act, 1992)

38. Under this Act, the government is authorized to set up a Water Resource Planning Organization (WARPO), which would prepare a master plan for the development of water resources and through a technical committee, advice all other agencies related to the issue of water resource development use.

Bangladesh Water Act 2013

39. The Bangladesh Water Act 2013 was adopted by the Government of Bangladesh in May, 2013, with the aim of making provision for integrated development, management, abstraction, distribution, use, protection and conservation of water resources. The act has provided the legal framework for better management of all forms of water resources in the context of natural flow of surface water and recharging of groundwater. The National Water Resources Council (henceforth termed as the Council) with the Honorable Prime Minister as the head has been formulated as the highest decision making body (section 4 and 5). An Executive Committee of the Council for efficient performance of its functions will act as per the duties and responsibilities described in section 10 of the act.

40. As per this Act, all forms of water (e.g., surface water, ground water, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people (section 3). In order to impose control on water resources development and management the water resources Planning Organization has been suggested to prepare a National Water Resources Plan in accordance with the Water Resources planning Act , 1992 (Section 15.1) containing the matters as described in section 15.2. Section 16 of the Act provides direction regarding issuance of clearance certificate on Water Resources

Development Project. To obtain control on water use, protection and conservation of Water Resources, the Act has stated about declaration of Water Stressed Area (section 17) as well as preferential use of available water in the Water Stress Area (Section 18). Without prior permission issued by the Executive Committee, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor they will be allowed to build any structure that impede the natural flow of rivers and creeks (section 19, 20 and 22). The Act has also pointed towards the protection of flood control embankment in section 21. It has suggested demarcation and management of different Water Zones in section 23 along with declaration and management of flood control zone in section 25. The Act has outlined that the Bangladesh Environment Conservation Act, 1995 will be applied for the prevention of water pollution in section 28.

41. The Act also provides provisions for punishment and financial penalty for non-compliance with the Act, including negligence to abide by government policy, ordinance, non-cooperation with government officials, refusal to present necessary documents, providing false information, affiliation with perpetrators, and protection measures for water resources management (Section 29-36).

2.2.2 Environmental Legislation

Bangladesh Wild Life (Preservation) Order, 1973 (P. 0. No. 23 Of 1973) and Act, 1974

42. The Bangladesh Wild life Preservation (Amendment) Act 1974 provides for the following main effects:

- This Act provides power to the government to declare areas as game reserves, wild life sanctuaries and national parks to protect the country's wild life. This Act also provides legal definitions of the protected areas as follows:
    - "Game reserve" means an area declared by the government as such for the protection of wild life and increase in the population of important species wherein capturing of wild animals shall be unlawful;
    - "National park" means comparatively large areas of outstanding scenic and natural beauty with the primary objective of protection and preservation of scenery, flora and fauna in the natural state to which access for public recreation and education and research may be allowed;
    - "Wild life sanctuary" means an area closed to hunting, shooting or trapping of wild animals and declared as such under Article 23 by the government as undisturbed breeding ground primarily for the protection of wild life inclusive of all natural resources, such as vegetation, soil and water.
- Under this law hunting, killing, capture, trade and export of wild life and wild life products are regulated. The Act also designates a list of protected species and game animals.

43. Provided that the government may, for scientific purposes or for aesthetic enjoyment or betterment of scenery, relax all or any of the prohibitions specified.

Environment *Conservation Act (1995, Amended in 2000 & 2002)*

44. The Bangladesh Environment Conservation Act of 1995 (ECA '95) is currently the main legislation in relation to environment protection in Bangladesh. This Act is promulgated for environment conservation, environmental standards development and environment pollution control and abatement. It has repealed the Environment Pollution Control Ordinance of 1977.

45. The main objectives of ECA '95 are:

- Conservation and improvement of the environment; and
- Control and mitigation of pollution of the environment.

46. The main strategies of the Act can be summarized as:

- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried/initiated in the ecologically critical areas;
- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of the industries and other development activities' discharge permits;
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines.

47. Before any new project can go ahead, as stipulated under the rules, the project promoter must obtain Environmental Clearance from the Director General. An appeal procedure does exist for those promoters who fail to obtain clearance. Failure to comply with any part of this Act may result in punishment to a maximum of 3 years imprisonment or a maximum fine of Tk. 300,000 or both. The Department of Environment (DoE) executes the Act under the leadership of the Director General (DG).

The Environment* Conservation *Rules, 1997

48. These are the first set of rules, promulgated under the Environment Conservation Act of 1995 (so far there have been three amendments to this set of rules - February and August 2002 and April 2003).

49. The Environment Conservation Rules of 1997 has provided categorization of industries and projects and identified types of environmental assessments needed against respective categories of industries or projects.

50. Among other things, these rules set (i) the National Environmental Quality Standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc., (ii) the requirement for and procedures to obtain environmental clearance, and (iii) the requirement for IEE and EIA according to categories of industrial and other development interventions.

51. The Rules are not explicit for water development projects. Rather, this is covered under the broader heading of "exploration, extraction and distribution of mineral resources" under the 'Red' category projects.

52. The DoE has issued EIA Guidelines and addresses the IEE and EIA for several sectors and activities. Each Project Proponent shall conduct an IEE or EIA and is expected to consult and follow the DoE guidelines.

Bangladesh *Environment Conservation Act (Amendment 2000)*

53. This amendment of the Act focuses on: (1) ascertaining responsibility for compensation in cases of damage to ecosystems, (2) increased provision of punitive measures both for fines and imprisonment and (3) fixing authority on cognizance of offences.

Environment *Court Act, 2000*

54. The Environmental Court Act, 2000 provide for the establishment of environment courts and matters incidental thereto. This act also provides the jurisdictions of environment court, penalty for violating court's order, trial procedure in special magistrate's court, power of entry and search, procedure for investigation, procedure and power of environment court, authority of environment court to inspect, appeal procedure and formation of environment appeal court.

Bangladesh *Environment Conservation Act (Amendment 2002)*

55. This amendment of the Act elaborates on: (1) restriction on polluting automobiles, (2) restriction on the sale and production of environmentally harmful items like polythene bags, (3) assistance from law enforcement agencies for environmental actions, (4) break up of punitive measures and (5) authority to try environmental cases.

2.3 Procedure for environmental clearance

56. The DoE has issued EIA Guidelines for Industries (this document was released in December 1997) and addresses the IEE and EIA for several industrial sectors and activities. Each Project Proponent shall conduct an IEE or EIA and is expected to consult and follow the DoE guidelines. Figure 3.1 shows the application procedure for obtaining site/environmental clearance. Environmental clearance from the DoE is required under the Environment Conservation Act of 1995. Section 12 of the Act stipulates that 'no industrial unit or project shall be established or undertaken without obtaining Environmental Clearance from the Director General in the manner prescribed by the Rules.' The procedure for obtaining the Environmental Clearance from the DoE is set out in the Environment Conservation Rules 1997. The Rules divide projects into four categories, namely Green, Orange A, Orange B, and Red, depending upon their nature, and hence perceived environmental impacts. A schedule attached to the Rules defines the categories into which various types of projects fall. The Rules also set out differing requirements to be fulfilled in applying for an Environment Clearance under each of the four categories of project, identifying the level of environmental impact assessment required in each case. The process of obtaining clearance from the DoE is presented in Figure 2.1.

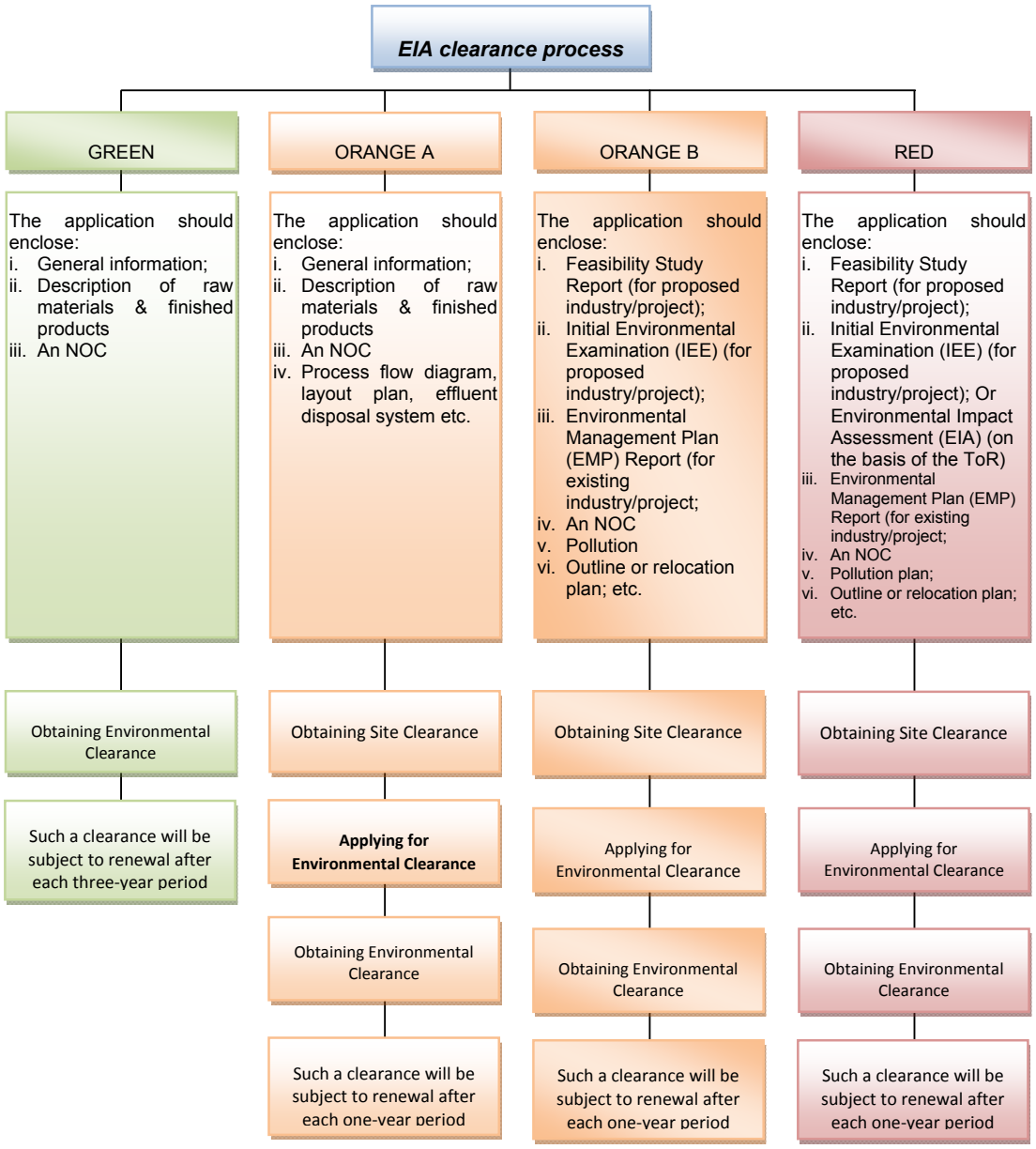


Figure 2.1: Steps Involved in Environmental Clearance following DoE Guidelines

57. The Environment Conservation Rules place construction/reconstruction/expansion of flood control embankments, polders, and dykes into the Red category. The proposed project, according to the DoE, is considered under the Red category of the Environmental Conservation Rules, 1997.

58. In order to obtain an Environmental Clearance Certificate for the project from the DoE, the following documents/ materials are to be submitted with the application:

- Feasibility Report for the Project (where applicable)
- Environmental Impact Assessment (EIA) Report
- Environmental Management Plan (EMP)
- No Objection Certificate from relevant Local Authority (where applicable)
- Other necessary information, (where applicable)

2.4 Environmental Quality Standards

59. Environmental quality standards for air quality, noise, odor, sewage discharge, industrial effluents, and industrial project emissions for Bangladesh are furnished in the following tables.

Table 2.1: Bangladesh Standards for Ambient Air Quality (All values in micrograms per cubic meters)

Sl. No.	Area	Suspended Particulate Matters (SPM)	Sulfur Dioxide (SO_2)	Carbon Monoxide (CO)	Oxides Nitrogen (NO_x)
1	Industrial and mixed	500	120	5000	100
2	Commercial and mixed	400	100	5000	100
3	Residential and rural	200	80	2000	80
4	Sensitive	100	30	1000	30

Source: Schedule-2, Rule 12, Environment Conservation Rules of 1997 (Page 3123. Bangladesh Gazette, 28 August 1997) (translated to English)

Note:

1. At national level, sensitive area includes monuments, health center, hospital, archeological site, educational institution, and government designated areas (if any).
2. Industrial units located in areas not designated as industrial areas shall not discharge pollutants which may contribute to exceeding the standard for air surrounding the areas specified at sl. no. c and d above.
3. Suspended Particulate Matter means airborne particles of a diameter of 10 micron or less.

Table 2.2: Bangladesh Standards for Noise

Sl. No.	Area Category	Standard Values (all values in dBA)	
		Day	Night
1	Silent Zone	45	35
2	Residential area	50	40
3	Mixed area (basically residential and together used for commercial and industrial purposes)	60	50
4	Commercial area	70	60
5	Industrial area	75	70

Source: Schedule 4, Rule-12, Environment Conservation Rules, 1997 (Page 3127, Bangladesh Gazette, 28 August 1997) (translated from Bengali to English)

Note:

1. The time from 6 a.m. to 9 p.m. is counted as daytime.

2. The time from 9 p.m. to 6 a.m. is counted as night time.

3. Area up to a radius of 100 meters around hospitals or educational institutions or special institutions/ establishments identified/to be identified by the Government is designated as Silent Zones where use of horns of vehicles or other audio signals, and loudspeakers are prohibited.

Table 2 3: Bangladesh Standards for Odor

Parameters	Unit	Values
Acetaldehyde	PPM	0.5-5.0
Ammonia	PPM	1.0-5.0
Hydrogen Sulfide	PPM	0.02-0.2
Methyl Disulfide	PPM	0.009-0.1
Methyl Mercaptan	PPM	0.02-0.2
Methyl Sulfide	PPM	0.01-0.2
Styrene	PPM	0.4-2.0
Trim ethylamine	PPM	0.005-0.07

Source: Schedule-8, Rule-12, Environment Conservation Rules, 1997. (Page 3130, Bangladesh Gazette, 28 August 1997) (Translated to English)

Note:

Following regulatory limit shall be generally applicable to emission/exhaust outlet pipe of above 5 meter height:

Q = 0.108 x He2Cm (Where Q = Gas Emission rate Nm3/hour)

He = Height of exhaust outlet pipe (m)

Cm = Above mentioned limit (ppm)

(2) In cases where a special parameter has been mentioned, the lower limit shall be applicable for warning purposes, and the higher limit shall be applicable for prosecution purpose or punitive measure.

Table 2.4: Bangladesh Standards for Sewage Discharge

Parameters	Unit	Values
BOD	mg/L	40
Nitrate	mg/L	250
Phosphate	mg/L	35
Suspended Solid (SS)	mg/L	100
Temperature	ºC	30
Coliforms	number/100ml	1000

Source: Schedule-8, Rule-I3, Environment Conservation Rules, 1997. (Page 3131, Bangladesh Gazette, 28 August 1997) (Translated to English)

Note:

This limit shall be applicable to discharges into surface and inland waters bodies.

Sewage shall be chlorinated before final discharge

Table 2.5: Bangladesh Standards for Industrial Project Effluent

Sl. No.	Parameters	Unit	Discharge To		
			Inland Surface Water	Public Sewer to Secondary Treatment Plant	Irrigable Land
1	Ammonical nitrogen (as elementary N)	mg/L	50	75	75
2	Ammonia (as free ammonia)	mg/L	5	5	15
3	Arsenic (as)	mg/L	0.2	0.05	0.2
4	BODs at 20°C	mg/L	50	250	100
5	Boron	mg/L	2	2	2
6	Cadmium (as Cd)	mg/L	0.05	0.5	0.5
7	Chloride	mg/L	600	600	600
8	Chromium (as total Cr)	mg/L	0.5	1.0	1.0
9	COD	mg/L	200	400	400
10	Chromium (as hexavalent Cr)	mg/L	0.1	1.0	1.0
11	Copper (as Cu)	mg/L	0.5	3.0	3.0
12	Dissolved oxygen (DO)	mg/L	4.5-8	4.5-8	4.5-8
13	Electro-conductivity (EC)	Mmho/cm	1200	1200	1200
14	Total dissolved solids	mg/L	2100	2100	2100
15	Fluoride (as F)	mg/L	2	15	10
16	Sulfide (as S)	mg/L	1	2	2
17	Iron (as Fe)	mg/L	2	2	2
18	Total kjeldahl nitrogen (as N)	mg/L	100	100	100
19	Lead (as Pb)	mg/L	0.1	1	0.1
20	Manganese (as Mn)	mg/L	5	5	5
21	Mercury (as Hg)	mg/L	0.01	0.01	0.01
22	Nickel (as Ni)	mg/L	1.0	2.0	1.0
23	Nitrate (as elementary N)	mg/L	10.0	Not yet set	10
24	Oil and grease	mg/L	10	20	10
25	Phenolic compounds (as C_6H_5OH)	mg/L	1.0	5	1
26	Dissolved phosphorus (as P)	mg/L	8	8	15
27	Radioactive substance	to be specified by Bangladesh Atomic Energy Commission			
28	pH		6-9	6-9	6-9
29	Selenium (as Se)	mg/L	005	0.05	0.05

Sl. No.	Parameters	Unit	Discharge To		
			Inland Surface Water	Public Sewer to Secondary Treatment Plant	Irrigable Land
30	Zinc (as Zn)	mg/L	5	10	10
31	Total dissolved solids	mg/L	2100	2100	2100
32	Temperature	^{0}C (summer) ^{0}C (winter)	40 45	40 45	40 45
33	Suspended solids	mg/L	150	500	200
34	Cyanide	mg/L	0.1	2.0	0.2

Source: Schedule-10, Rule-13, Environment Conservation Rules, 1997. (Page 3132-3134, Bangladesh Gazette, 28 August 1997) (translated to English)

Note:

(1) These standards shall be applicable to all industries or projects other than those specified under the heading "Standards for sector wise industrial effluent or emission."

(2) Compliance with these standards shall be ensured from the moment an industrial unit starts trial production, and in other cases, from the moment a project starts operation.

(3) These standards shall be inviolable even in case of any sample collected instantly at any point of time. These standards may be enforced in a more stringent manner if considered necessary in view of the environmental conditions of a particular situation.

(4) Inland Surface Water means drains/ponds/tanks/water bodies/ditches, canals, rivers, springs and estuaries.

(5) Public sewerage system means treatment facilities of the first and second stage and also the combined and complete treatment facilities.

(6) Irrigated land means such land area which is sufficiently irrigated by waste water taking into consideration the quantity and quality of such water for cultivation of selected crops on that land.

(7) Inland Surface Water Standards shall apply to any discharge to a public sewerage system or to land if the discharge does not meet the requirements of the definitions in notes 5 and 6 above.

Table 2.6: Bangladesh Standards for Industrial Project Emissions

Sl. No	Parameters	Values (in mg/Nm^3)
1	Particulates (ka) Power station of capacity of 200 MW or more (kha) Power station of capacity less than 200 MW	 150 350
2	Chlorine	150
3	Hydrochloric acid vapor and mist	350
4	Total fluoride (as F)	25
5	Sulfuric acid mist	50
6	Lead particulates	10
7	Mercury particulates	.2
8	Sulfur dioxide (ka) Sulfuric acid production (DCDA * process) (kha) Sulfuric acid production (SCSA * process)	kg/ton acid 4 10

Sl. No	Parameters	Values (in mg/Nm^3)
	(*DCDA: Double conversion, double absorption, SCSA; Single conversion single absorption)Lowest height of stack for sulfur dioxide dispersion: (ka) Coal based power plant 500 MW or more 200 MW - 500 MW Less than 200 MW (kha) Boiler Steam per hour- upto 15 tons Steam per hour - more than 15 tons (Q=$S0_2$ emission in kg/hour)	 275m 220m $14(Q)^{0.3}$ 11m $14(Q)^{0.3}$
9	Oxides of nitrogen (a) Nitric acid production (b) Gas based power stations 500 MW or more 200 - 500 MW Less than 200 MW (c) Metallurgical oven	3 kg/ton acid 50 ppm 50 ppm 40 ppm 30 ppm 200 ppm
10	Kiln soot and dust (a) Blast furnace (b) Brick kiln (c) Coke oven (d Lime kiln	Mg/Nm-1 500 1000 500 250

Source: Schedule-10, Rule-13, Environment Conservation Rules, 1997. (Page 3135-3136, Bangladesh Gazette, 28 August 1997) (Translated to English)

2.5 Administrative Framework

60. Bangladesh Water Development Board (BWDB) is responsible for implementing flood control/drainage improvement/irrigation/ river erosion related water development projects in Bangladesh. The organization has long experience in implementing such projects with its own institutional resources. There are planning, design, implementation and Operation & Maintenance (O&M) sections to implement this kind of projects. It has also project evaluation section, which monitors and evaluates the implementation status of projects.

61. Within organizational structure of BWDB, there is no position for taking care of environmental issues. Although BWDB has few positions of environment, forestry and fisheries professionals as “Research Officer” working in BWDB head office in Dhaka, there is no such professional position in Zone/Circle/Division office at local level, who can implement and monitor the ‘Environmental Management Plan (EMP)’ of any project. In current practice of BWDB, there is no provision for keeping such professional or forming any unit for implementing EMP while implementing any project. Nevertheless, there are many junior to senior level officers who have training on environmental management of water resources development projects. Those officers can contribute towards implementation of EMP and monitor the environmental concerns of the projects. Since BWDB has large institutional set up and human resources from national to local level, it will be very much convenient to mobilize required resources for implementing EMP.

3 Approach and Methodology

62. The ESIA study of the Rehabilitation of Polder 36/1 Project in Bagerhat District Area has been carried out following the GoB approved EIA Guidelines of Water Resources Planning Organization (WARPO).

3.1 EIA process

63. As suggested in the EIA Guidelines, the 9+1 step EIA process has been followed (Figure 1). Activities carried out at each step of the EIA process are presented in the following sections.

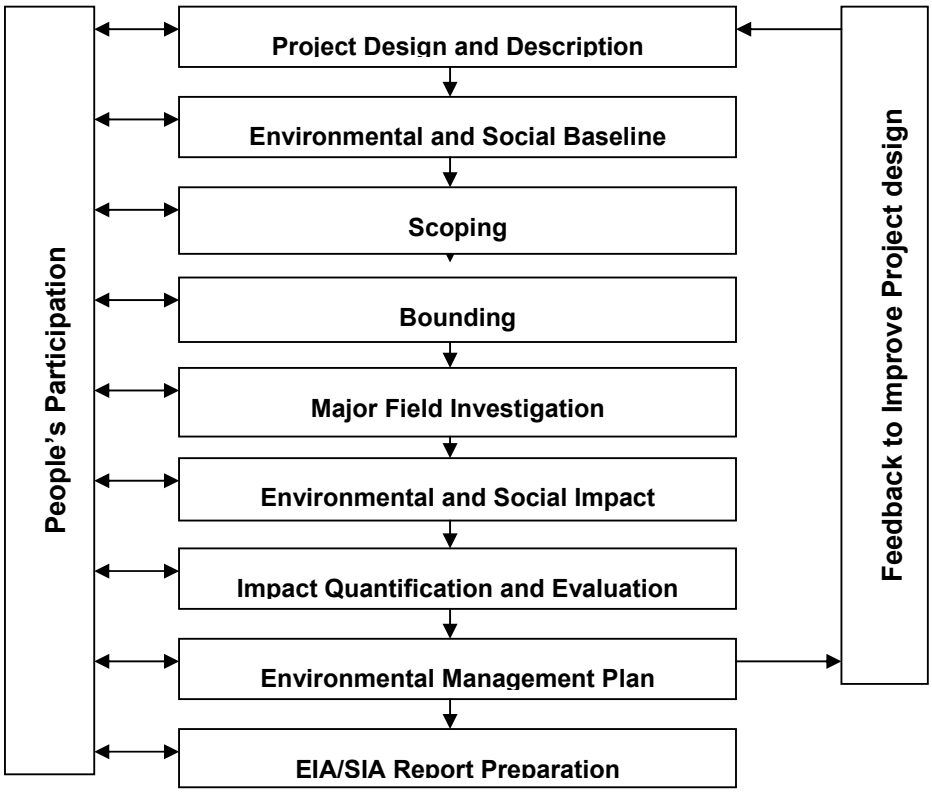


Figure 4.1: EIA Process

64. Activities carried out at each of the steps of the EIA process are discussed in the following sections.

3.2 Project Design and Description

65. Project description has been taken from "Feasibility Study report for Rehabilitation of Polder 36/1 using Model Technique (Mathematical Modelling)" which was submitted by Institute of Water Modelling (IWRM) to Bangladesh Water Development (BWDB) in December, 2013. Considering the acute problem of sedimentation of river, removal of drainage congestion and reduction of flood risk, 3 (three) options were devised in consultation with the local stakeholders and officials of Bangladesh Water Development Board. Among 3 (three) drainage improvement options (option-1, option-2 and option-3),

option-2 has been finally selected for the purpose of economically viable and environmentally sustainable project. The Details project description has been presented (chapter4) of this ESIA report.

The interventions of the proposed options are as follows:

SL	Proposed Interventions/Components	Option-1	Option-2	Option-3
1	Dredging/re-excavation of the Bhairab river, Mora Chitra river and Old Madhumoti river	✓	✓	✓
2	Re-excavation of selected 55 internal drainage khals	✓	✓	✓
3	Construction of nine new regulators	✓	✓	✓
4	Re-modeling of five existing regulators	✓	✓	✓
5	Bank protection works at two specific locations	✓	✓	✓
6	Sequential operations of TRM in selected beels	X	✓	✓
7	Construction of a regulator cum navigation lock gate at the upstream of Bhairab river (near Alaipur) to prevent tidal meeting point.	X	X	✓

3.3 Environmental and Social Baseline

66. The environmental and social baseline condition in Polder 36/1 Project area has been prepared based on literature review, reconnaissance field visits and consultation with local people. The baseline includes description of the meteorology, water resources, land resources, agriculture, livestock, fisheries, ecological resources and socio-economic condition including identification of problems in respect of these resources.

67. The environmental and social baseline study was initiated through literature review including collection of historical data from published reports. This was followed by collection of primary data from the field through field visits and different types of surveys. Most of the data has been collected through Focus Group Discussion (FGD), Rapid Rural Appraisal (RRA), Key Informant Interview (KII) and physical observation.

3.3.1 Baseline data collection and analysis

68. Baseline data collection was conducted as a pre-requisite for the EIA study of Rehabilitation of Polder 36/1. The baseline condition of the project area has been drawn according to information collected from secondary and primary data sources through literature review, field investigations and consultation with different stakeholders. The baseline condition has been established in respect of meteorology, water resources, land resources, agriculture, livestock, fisheries, ecological resources and socio-economic conditions including identification of problems in respect of the proposed project site and adjoining area.

a. Water resources

69. Water resource data under the heading of river hydrology, river morphology, ground water availability, drainage pattern, ground and surface water quality and water use has

been collected from secondary sources and primary observation by the professional of the multi-disciplinary team members. These were strengthened and backed up by feedback from the local people during field visit for baseline preparation and impact assessment in this study. Major river systems have been 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 events such as river-khal-beel network, water availability, drainage pattern, water quality (surface and ground water), flash flood, risk of erosion or sedimentation etc.

70. Field visits were made to the study area and primary data on water resources components has been collected through discussion with stakeholders. A checklist was used to obtain the information on different resources. Local knowledgeable persons and community representatives were also interviewed. During the field visits, the multidisciplinary EIA team members made professional observations pertaining to their individual areas of expertise.

71. The specific data on different events of water resources have been gathered and analyzed using the methodology presented in the following matrix.

Parameter	Data Source(s)	Methodology
Surface Water hydrology		
Dry and wet season water level and discharge	BWDB	Mean monthly water level has been collected from BWDB database
Drainage system	CEGIS	Data has been gathered through image analysis and physical observations was used for specification.
River hydro-morphology		
Sedimentation	CEGIS	Data has been collected through satellite image, secondary sources and physical observations.
Flooding	SRDI, CEGIS	Land type based on different inundation depth has been collected from SRDI and verified in field.
Ground water hydrology		
Water table	BWDB and field investigation	Data were collected from source organizations at different locations in the total study and project area.
Water quality and use		
Surface and ground water quality.	BWDB, DPHE and field investigation	Water quality has been analyzed on the basis of data from BWDB and verified at field level through physical observation as well as in consultation with local people.
Surface and ground water use (availability)	Local community and authority	Sources and different sector of water use was identified from field investigation and local authority

72. Meteorological data such as rainfall, evapo-transpiration, temperature, sunshine hours, humidity and wind speed were collected and analyzed for assessing local climate that are directly related to water resources of the study area and the project area. Meteorological data for selected stations weree collected from the National Water Resources Database (NWRD) of WARPO, which contains long time series of temporal data showing daily values

for meteorological stations maintained by the Bangladesh Meteorological Department (BMD).

73. The general geological features and the seismicity of the project and its surrounding areas were collected from available secondary literature and Geological Survey of Bangladesh (GSB). The topographical data was collected from GSB as well as from National Water Resources Database (NWRD) of Water Resources Planning organization (WARPO).

b. Land Resources

74. The Agro-ecological Region of the proposed project area were identified using secondary sources (FAO/UNDP). The land use, land type, soil texture data were collected from Upazila Land and Soil Resources Utilization Guide (Upazila Nirdeshika) of Soil Resources Development Institute (SRDI). The secondary data of these parameters were verified at field level through physical observations as well as in consultation with the local people and officials of the Department of Agriculture Extension (DAE) during field visit.

c. Agriculture Resources

75. Data on agricultural resources included farming practices, crop production constraints, existing cropping patterns, crop variety, crop yield, crop damage and agricultural inputs used. Agriculture data were collected from primary sources through extensive field survey by developing questionnaire and in consultation with local people and concerned agricultural officials. Agricultural resources data were also collected from secondary sources from Upazila Agriculture Extension office (DAE). Crop production has been estimated using the formula: Total crop production = damage free area × normal yield + damaged area × damaged yield. The crop damage (production loss) has been calculated using the formula: Crop production loss = Total cropped area ×normal yield-(damaged area ×damaged yield+ damage free area × normal yield). The crop damage data were collected from the field for last three years.

d. Livestock Resources

76. Present status of livestock (Cow/Bullock, Buffalo, Goat and Sheep and poultry (Duck and Chicken) in the study area has been evaluated at field level survey in consultation with the local people through FGD, RRA and KII. Livestock resources data were also collected from secondary sources from Upazila Livestock office.

e. Fisheries Resources

Data collection methods

77. The fisheries data were collected for the EIA study by considering the seasonal variance of dry and wet seasons. Prior to going for data collection, a checklist/ questionnaire was developed. The checklist included all kinds of information which should be looked into in the context of existing and potential structures of the project. A combination of survey techniques were used for data collection. The survey techniques included sampling site selection, data collection, data analysis and reporting. The sequential interpretations of the methodological approach were as follows:

Sampling Site Selection

78. Existing and proposed basin wise sites were selected for data collection. Sampling sites varied depending on the size of the basins. During site selection concentration was

given on the intervened area and non-intervened area to find the difference between them in terms of fisheries impact.

Data Collection

79. Data were collected in multiple ways which can be broadly classified into two classes, for instance, (i) primary data collection and (ii) secondary data collection. Primary data were collected from the fishermen community, fisher households and local key informants and secondary data were collected from Upazila Fisheries Offices during field visits.

Habitat Identification

80. Fish habitat classification was done based on physical existence and categorized into capture and culture fish habitats. The capture fish habitats included river, khal, floodplain, burrow pit and beel. The culture fish habitats included homestead culture fish pond, commercial fish farm, shrimp ghers etc.

Capture & Culture Fish habitats:

81. Capture fish habitat assessment was done through fishing Effort Survey (FES), Frame Survey (FS), micro scale Catch Assessment Survey (CAS), habitat based species diversity & 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 assessment was done through homestead culture fish pond survey and commercial fish farm/gher survey.

Associated Information

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

Secondary Data Collection

83. Relevant secondary data was collected from the Upazila Fisheries Office (UFO) from their annual report and from various literature/study.

Data Analysis and Output

84. Fish production for individual habitats was obtained through a series of calculation procedures using the collected information of FES, FS, CAS and Habitat area. Aggregating the fish production from all habitat types, total fish production of the study area has been estimated basin wise and then holistically. Secondary information was collected from the UFOs and literatures were blended with primary data in production estimation.

f. Ecological Resources

85. Information on bio-ecological zones and their characteristics was collected from the publication of International Union for Conservation of Nature (IUCN). The ecological component of the ESIA study focused on terrestrial and riverine ecology including flora, birds, reptiles, amphibians, mammals, and migratory birds. The field activities included collecting 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 the recent Satellite Image. Field investigation methods included physical observation, transect walk, habitat survey and consultation with local people. Field visits have been carried out in delineating the ecological baseline condition. Public consultation was carried out through FGD and KII methods. Inventory of common flora and fauna was developed based on field survey and data base of IUCN.

g. Socio-economic Resources

86. The socio-economic baseline information included the study area, demographic information, occupation and employment, literacy rate, drinking water, sanitation, electricity facilities etc. which were collected form secondary sources, i.e. BBS, 2011 and other relevant literatures including data from BWDB. The 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 NGOs, cultural and heritage features of the project area were collected mainly from primary sources through FGD, RRA and Public Consultation Meeting (PCM).

87. The steps taken for collecting socio-economic data were as follows:

I. Data was collected from Population and Housing Census, 2011 and relevant literatures from BWDB were reviewed;

II. Reconnaissance field visit and discussion with BWDB officials and local stakeholders for primary data collection;

III. RRA, FGDs, KII for primary data collection;

IV. Institutional Survey (IS) for primary data collection in district and Upazila level offices which included DC office, LGED office, Civil Surgeon office, Social Service office etc.

3.4 Scoping

88. During the process of environmental and social baseline data collection, important environmental and social components (IESCs) likely to be impacted by the proposed interventions in Polder 36/1 were selected through a scoping process. This included professional judgment of the multi-disciplinary team members including village scoping sessions where perception of the stakeholders have been utilized in the selecting the IESCs.

3.5 Bounding

89. Area likely to be impacted by the Polder 36/1 project has been delineated in consultation with the feasibility study team members in addition to feed back received from the local people during baseline consultation.

3.6 Major Field Investigation

90. Intensive data on the IESCs were collected from the field at the major field investigation stage. In this case also the major data collection tools included FGD, RRA and KII in addition to professional observations of the multi-disciplinary team members.

3.7 Environmental and Social Impact Assessment

91. Environmental and social impacts of the proposed interventions in Polder 36/1 on the IESCs have been assessed through several sets of activities. The future-without-project (FWOP) condition has been generated through trend analysis and consultation with the local people. This reflects conditions of IESCs in the absence of the proposed interventions in polder 36/1. Changes expected to be brought about due to proposed interventions in Polder 36/1 have been predicted to generate the future-with-project (FWIP) condition. The difference between the FWOP and FWIP condition has been considered as the environmental and social impacts of the project. This included both positive and negative

impacts which would be considered in the preparation of the environmental management plan.

3.8 Impact Quantification and Evaluation

92. At this stage, attempts were made to quantify the impacts of the proposed interventions on the IESCs. However, it was not always possible to quantify all impacts, especially the impacts on some of the environmental and social components. In those cases, qualitative impacts has been assessed and scores have been assigned with plus (+) sign for positive impacts and minus (-) sign for negative impacts. The magnitude of both positive and negative impacts have been indicated in a scale of 1 to 10 on extent, magnitude, reversibility, duration and sustainability considerations.

3.8.1 Assessment methodology

93. 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 is 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 has been applied to define both beneficial and adverse potential impacts.

94. 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.

3.8.2 Magnitude

95. The assessment of magnitude has been undertaken in two steps. Firstly the key issues associated with the project were categorized as beneficial or adverse. Secondly, potential impacts were 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.

96. The magnitude of potential impacts of the project has been identified according to the categories outlined in Table 3.1.

Table 3.1: 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 life span	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

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

3.8.3 Sensitivity

97. 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 3.2.

Table 3.2: 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

3.8.4 Assigning Significance

98. 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 3.3.

Table 3.3: 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

3.8.5 Mitigation measures

99. Subsequent to the impact assessment discussed above, appropriate mitigation measures has been proposed to avoid, offset, mitigate/reduce, or compensate for the identified impacts. Generally, impacts having moderate to critical consequence significance per the Table 4.3 require appropriate avoidance/mitigation/compensatory measures to reduce the significance. Impacts having low to negligible significance have been left alone without any mitigation measures.

100. Generally, preference is given to the avoidance of the impact with the help of options available for nature, sitting, 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.

3.8.6 Assessment of Residual Impacts

101. 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.

3.9 Environmental Management Plan

102. The environmental management plan (EMP) has been prepared suggesting mitigation measures for minimizing the effect of the negative impacts, enhancement measures for increasing the benefit of the positive impacts, compensation measures for compensating the negative impacts that cannot be mitigated and an environmental monitoring plan for monitoring changes taking place through implementation of the project. Cost estimate for implementing the EMP has also been suggested for inclusion in the project cost estimate.

3.9.1 Mitigation plan

103. The negative impacts of the proposed interventions, assessed at the environmental and social impact assessment stage, were picked up for inclusion in the mitigation plan. Measures aimed at minimizing the impact of the negative impacts has been suggested in the mitigation plan.

3.9.2 Enhancement plan

104. The positive impacts, assessed at the environmental and social impact assessment stage, were picked up for the enhancement plan. Measures aimed at increasing the benefit of the positive impacts of the proposed interventions have been suggested in the enhancement plan.

3.9.3 Compensation plan

105. Negative impacts for which mitigation measures cannot be suggested were picked up for the compensation plan that would indicate monetary compensation to be paid.

3.9.4 Monitoring Plan

106. Monitoring plan consider the important environmental and social components likely to be impacted by the project interventions. The monitoring plan include suggestions on data to be collected, processed, analyzed and interpreted to detect changes taking place in the impacted area. Location and frequency of data collection on each indicator along with institutional arrangement of environmental monitoring have been suggested in the monitoring plan.

3.10 Public Consultation and Disclosure

107. Public consultation and disclosure is an integral part of ESIA at all stages of the EIA process. This started from environmental and social baseline stage when data and information on problems were collected from the people. Their perception was considered in the selection of important environmental and social components through the scoping process. In the major field investigation stage, feedback from the local people were obtained for generating the future-with and future-without project conditions. Suggestion of the local people regarding possible mitigation measures for negative impacts were also collected. Finally, public disclosure meetings were organized where the findings of the ESIA study was shared with the local stakeholders. The feedback on the ESIA findings will be incorporated in the Final ESIA Report.

3.11 ESIA report preparation

108. Draft ESIA Report of Rehabilitation of Polder 36/1 Project has been prepared incorporating the findings of the ESIA study and the Final ESIA Report will be prepared by incorporating the feedback of the public disclosure meeting.

4 Project Description

4.1 Background

109. The project for rehabilitation of Polder 36/1 is located in the south-west region of Bangladesh and is characterized by numerous morphologically active tidal rivers and creeks. The study area is situated in Mollahat, Fakirhat, Chiltamari upazilas, Sadar of Bagerhat district and Rupsa upazila of Khulna district. It is bounded by the Atharobanki river to the north-west, the Bhairab river to the south-west, the Madhumoti river to the north-east and Mora Chitra river to the south-east. The project covers a gross area 39,130 hectares of which 25,043 hectares is the net cultivated area.

110. Polder 36/1 has been experiencing severe water-logging problem over the years because of high rate of siltation in the peripheral rivers and internal drainage khals. It severely affects the normal social and economic activities of the people of the project area. The Atharobanki river in the west side, Bhairab river in south side, Chitra river in the east side and middle of the project has already been silted up. Atharobanki, Bhairab and Chitra - these three rivers have lost their conveyance capacity considerably and as a result about 1842 hactares land remains water-logged. Consequently, agricultural production mainly Boro cultivation and livelihood opportunities have been significantly decreased. So, rehabilitation of this project is necessary for the survival as well as for the socio-economic development of the people living inside the polder, in the coming future.

4.2 Project Objectives

111. The objectives of the project are:

- to increase agricultural production through drainage management and protection of crops damaged by improving drainage facilities.
- To protect saline water intrusion for the improvement of overall socio-economic condition through poverty alleviation, social and economic development of the people in the proposed project area.
- River Bank Protection.
- Employment creation, income generation, development of living standard for the people in the project area.

4.3 Rationale

112. Bangladesh is a developing and densely populated country in the world. Additional people demand more food for their livelihood. Land is very limited compared to the large number of population. On the other hand, the overwhelming poverty problems, malnutrition, illiteracy, unemployment and under employment, particularly the vast rural population of Bangladesh persists on a challenge for overall development of Bangladesh.

113. The coastal polders are vulnerable to natural disaster. Frequent natural calamities cause damage to lives, crops and properties of the polder. The present Government is committed to take up a program for rehabilitation of Polder 36/1 specially for Kodalia, Aduadihi, Kendua and Nornia Beel development.

114. The objectives of the proposed project are in line with objectives of the NWMP. The overall objectives of the National Water Management Plan (NWMP) are to contribute in a

balanced fashion to the overall national goals of economic development, poverty alleviation, food security, public health and safety, decent standard of living for the people and protection of the natural environment.

115. It is therefore the proposed project is in line with the commitment and policy guidelines of the Government of Bangladesh.

4.4 Present Problems

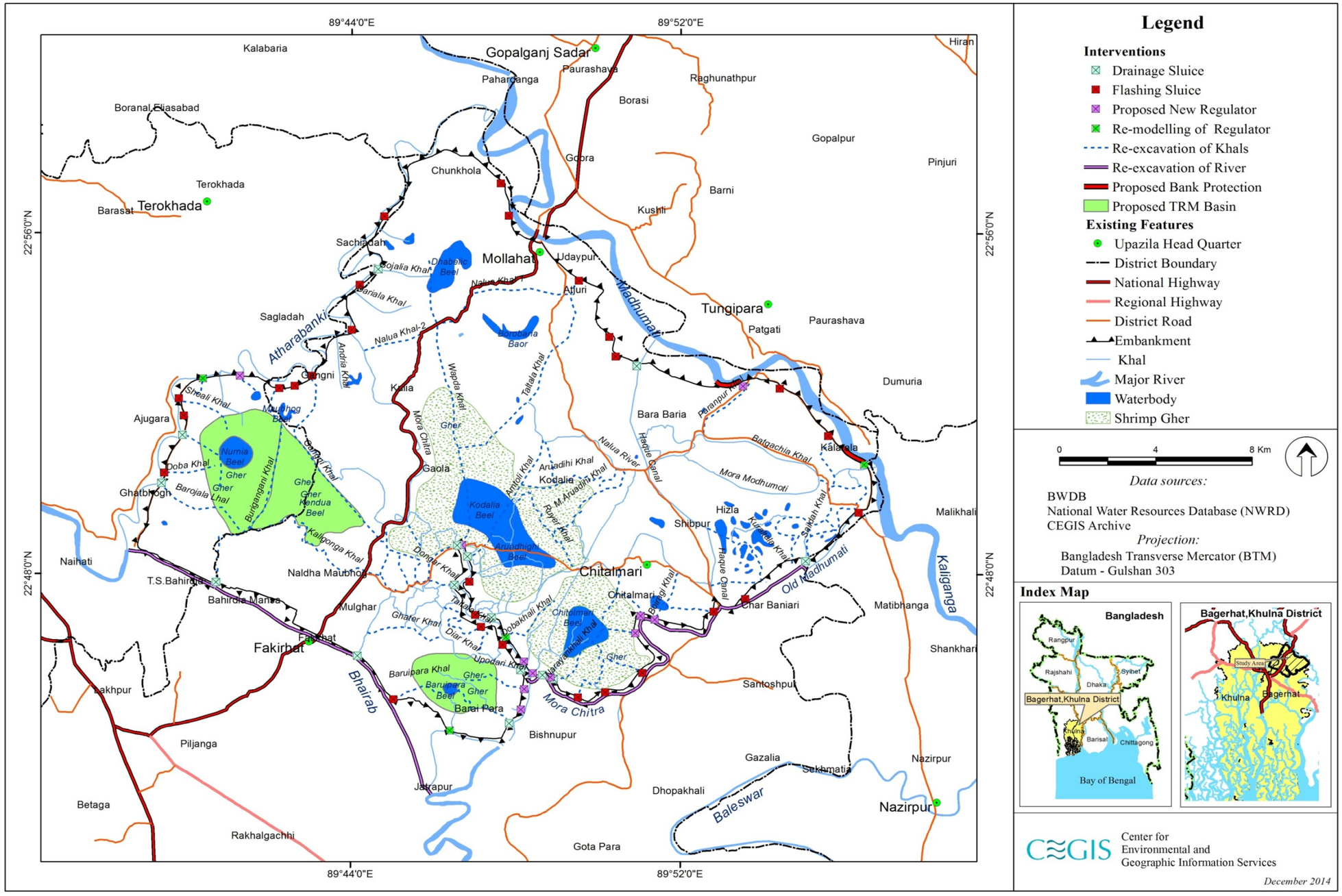
116. The existing problems in the polder area are given below:

- Water logging due to lack of inadequate drainage facilities;
- Salinity range is high in the down-stream of existing sluices along both banks of Chitra-Karamara river;
- High rate of siltation in the Atharobanki and Bhairab rivers;
- There is no drainage through the existing sluices along the left bank of Atharobanki river i.e., regulators are non-functioning due to lack of maintenance works;
- Lack of navigation facilities;
- Lack of availability of sweet-water for irrigation during dry season in the Madhumoti river in two specific locations;
- High rate of siltation at the downstream channels of almost all the sluices;
- Sedimentation in the internal khals within the polder due to long term functioning;
- Non-functioning of some drainage sluices;
- River bank erosion along the right bank of Modhumoti river;
- Lack of manpower for proper operation of the sluices/navigation lock gates; and
- Grabbing of land, adjacent to both banks of the rivers by the individual land owners.

4.5 Alternatives

117. There is no alternative other than the proposed interventions in Polder 36/1 at Mollahat, Fakirhat, Chiltamari, Sadar upazilas of Bagerhat district and Rupsa upazila of Khulna district as it is the rehabilitation of an existing project.

Polder 36-1: Location of Proposed Interventions



Map 4.1: Location of proposed interventions of Polder 36/1

4.6 Description of Interventions

118. The improvement of drainage congestion largely depends on the proper planning and implementation of best suited option. Considering the main objective and specific objectives, some critical problems are found and probable solutions are identified by Bangladesh Water Development Board (BWDB). Proposed interventions are given in the Table below:

Table 4.1: Location of proposed interventions in the polder

Proposed Intervention	Location Name/River Name/Khal Name/Beel Name	Remarks
a) Dredging/ re-excavation of peripheral rivers	Bhairab river	Length = 16 km
	Chitra River	Length = 7 km
	Mora Chitra river	Length = 13 km
	Old Madhumoti river	Length = 9 km
b) Re-excavation of internal drainage Khals	Total 55 numbers of internal drainage khals	Total Length = 185.362 km Total Estimated Volume =2759511 m^3
c) Construction of water control structures	Godara, New Link	New Structure
	Raigram, Katakhalir khal	New Structure
	Raigram, Simanar Khal	New Structure
	Karamara, Helajila khal	New Structure
	Paranpur, Paranpur khal	New Structure
	Naraynkhali, Naraynkhali khal	New Structure
	Chiltamari, Boiragi khal	New Structure
	Chiltamari, Shabukhali khal	New Structure
	Bamondanga,Bamondanga khal	New Structure
d) Replacement of existing drainage structures	Baruipara, Katakhali	Replacement
	Dobakhali, Dobakhali khal	Replacement
	Saildah, Saildah khal	Replacement
	Chandpur, Chandpur khal	Replacement
	Chiltamari, Dhanokhali khal	Replacement
e) River Bank Protective Work	Paranpur	From Chainage km 8.33 to km 9.33
	Saildah	From Chainage km 0.00 to km 0.80
f) Sequential Operation of TRM in selected Beels	Nurnia Beel	1315 ha
	Kendua Beel	990 ha
	Baruipara Beel	700 ha

4.6.1 Re-excavation of peripheral rivers

119. Detail information regarding re-excavation of peripheral rivers are given in the following Table 4.2.

Table 4.2: Details of re-excavation of peripheral rivers

River Name	Length (m)	Estimated Volume (m^3)	Outfall
Bhairab River	16,000	1,066,798	Karamara River
Chitra River	7,000	318,792	Karamara River
Old Madhumoti	9,000	318,792	Madhumoti River
Mora Chitra River	13,500	742,511	Karamara River
Haque Canal	12,500	208,019	Old Madhumoti

Source: Feasibility Report, IWM, Dec 2013

4.6.2 Re-excavation of internal drainage Khals

120. Details information regarding re-excavation of the 55 number of internal drainage khals are given in the following Table 4.3.

Table 4.3: Details of re-excavation of 55 Internal Drainage Khals

Khal Name	Length (m)	Estimated Volume (m^3)	Outfall
Amtoly Khal	5,000	73,928	Karamara River
Aruadihi Khal	4,100	88,522	Amtoly Khal
Banglabazar Khal	2,400	25,521	Old Madhumoti
Barojala Khal	4,770	40,493	Karamara River
Baruipara Khal	3,642	65,944	Bhairab
Bashtolier Khal	4,050	4,498	Old Chitra
Begamkhali Khal	2,130	69,756	Karamara River
Borshir Khal	1,200	26,310	Mamavagina Khal
Burigangni Khal	10,550	230,592	Bhairab
Chadur Khal	1,050	7,212	Atharobanki
Choddahazari Khal	1,600	12,445	Old Chitra
Doba Khal	2,205	22,664	Atharobanki
Dobakhali Khal	1,800	3,273	Karamara River
Dongar Khal	1,230	30,273	Karamara River
Fakirer Khal	1,600	22,219	Sader Ali Khal
Gangni Khal- 1	3,760	24,281	Atharobanki
Ghater Khal	3,400	74,205	Sader Ali Khal
Goara Khal	3,330	49,969	Atharobanki
Godarar Khal	1,300	5,337	Chitra River
Jalodanga-1 Khal	970	1,128	Karamara River
Kaligonga Khal	10,500	398,737	Chitra River
Kaligonj Khal	1,450	13,273	Kaligonga Khal
Kama Khal	2,800	79,972	Old Madhumoti
Kochuria Khal	1,800	32,884	Aruadihi Khal
Kodhalia Khal	1,150	9,542	Nalua River
Kuraltala Khal-1	1,500	47,274	Kuraltala Khal-2

Khal Name	Length (m)	Estimated Volume (m^3)	Outfall
Kuraltala Khal-2	4,000	89,781	Old Chitra
Kurmani Khal	3,700	64,552	Old Chitra
M. Aruadihi Khal	4,800	38,116	Ruyer Khal
Melarkul Khal	1,900	16,500	Madhumoti
Mundidari Khal	1,400	26,992	Taltala Khal
Nalua River	7,120	77,999	Amtoly Khal
Narynkhali Khal	6,500	32,343	Old Chitra
Pachkuli Khal	12,550	196,573	Karamara River
Pangasia Khal	3,500	82,193	Shantipur Khal
Petninar Khal	1,000	10,896	Karamara River
Ruyer Khal	4,550	27,124	Pachkuli Khal
Sader Ali Khal	3,400	67,998	Bhairab
Saildah Khal	4,000	23,298	Madhumoti
Saildah Khal-1	1,000	8,240	Saildah Khal
Saildah Khal-2	2,500	10,276	Banglabazar Khal
Shantipur Khal	2,100	24,541	Old Madhumoti
Sheali Khal	2,550	59,853	Atharobanki
Shibpur Khal	2,550	26,158	Wapdar Khal
Sonakhaly Khal	1,500	8,936	Pachkuli Khal
Surigati Khal	750	8,609	Old Chitra
Taltala Khal	1,150	7,451	Karamara River
Upodari Khal	2,855	40,369	Karamara River
Wapdar Khal	10,600	131,047	Naraynkhali
Paranpur Khal	3,000	57,000	Madhumoti River
Shabukhali Khal	1,600	22,158	Mora Chitra River
Dhanokhali Khal	1,800	30,884	Mora Chitra River
Boriragi Khal	1,200	13,936	Mora Chitra River
Bamondanga Khal	1,100	11,936	Atharobanki
Taltola Khal	11,400	83,500	Wapda Khal
Total	Total Excavated Length= 185362 m	Total Excavated Volume= 2759511m^3	

Source: Feasibility Report, IWM, Dec 2013

4.6.3 Disposal of Dredged Material

121. On average, Polder 36/1 is a low lying area. There is scarcity of high land required for construction of dwelling houses, garden, village markets (Huts), Roads and raising of play-grounds and cemeteries. According to local people, there is huge demand of loose soil for raising their homestead area and for filling and development of the adjacent low lying areas for future expansion. The local union parishad chairmen and members informed that earlier when they had re-excavated any Khal, the spoil earth was taken away by the local people with fast competition for use in multiple purposes; such as development of homestead areas, production of bricks and pottery-items. During field visit of the members of the study team, it was found that local people gave similar opinion as those given by public representatives. Specific locations for the priliminary dumping of dredged material are finalized by BWDB which are shown in Appendix-4.

4.6.4 Construction and Replacement of Water Control Structures

122. Details information regarding construction of nine new and replacement of five existing water control structures are Tabulated in Table 4.4 below:

Table 4.4: Details of fourteen proposed structures

Location Name	Chainage	Nos. of Vents & Size	Sill Level	Remarks
Godara, New Link	km 10.50	16 Vents (1.50mx1.80m)	-1.30	New Structure
Raigram, Katakhalir khal	km 17.60	2 Vents (1.50mx1.80m)	-0.80	New Structure
Raigram, Simanar Khal	km 18.40	1 Vent (1.50mx1.80m)	-0.80	New Structure
Karamara, Helajila khal	km 1.80	1 Vent (0.9mx1.20m)	-0.80	New Structure
Paranpur, Paranpur khal	km 48.20	2 Vents (1.50mx1.80m)	-0.90	New Structure
Naraynkhali, Naraynkhali khal	km 19.50	2 Vents (1.50mx1.80m)	-1.00	New Structure
Chiltamari, Boiragi khal	km 27.80	1 Vent (1.50mx1.80m)	-0.90	New Structure
Chiltamari, Shabukhali khal	Km 26.25	Boat Pass cum Regulator	-0.90	New Structure
Bamondanga,Bamondanga khal	km 84.10	1 Vent (1.50mx1.80m)	-0.60	New Structure
Baruipara, Katakhali	km 111.50	2 Vents (1.50mx1.80m)	-0.60	Replaced
Dobakhali, Dobakhali khal	km 16.50	2 Vents (1.50mx1.80m)	-0.80	Replaced
Saildah, Saildah khal	km 41.80	2 Vents (1.50mx1.80m)	-0.90	Replaced
Chandpur, Chandpur khal	km 85.80	1 Vent (1.50mx1.80m)	-0.60	Replaced
Chiltamari, Dhanokhali khal	km 27.14	2 Vents (1.50mx1.80m)	-0.90	Replaced

Source: Feasibility Report, IWM, Dec 2013

4.6.5 River Bank Protection Work

123. River bank protection works in the form of bank revetment will be undertaken at two locations of Madhumoti river as mentioned below:

Paranpur: a length of 1000 m; and
Saildah: a length of 800 m.

124. The following various components of revetment work have been selected based on the design of the protection work. Detail information regarding bank protection works are tabulated in Table 4.5 below.

Table 4.5: Details of Bank Revetment

Sl No.	Design Elements	Location	
		Paranpur	Saildah
1	Type of cover layer material	CC block	CC block
2	Size of cover layer material (mm)	400x400x200	400x400x200
3	Type of bedding material	Jhama Khoa	Jhama Khoa
4	Thickness of bedding material (mm)	100	100
5	Size of bedding material (mm)	5-40	5-40
6	Thickness of geotextile filter (mm)	3	3
7	Thickness of sand filter (mm)	75	75
8	F.M. of sand	1.5-2.0	1.5-2.0
9	Type of underwater materials	Block/Geobags	Block/Geobags
10	Size of cubical CC Block (mm)	350 & 400	350 & 400
11	Capacity of Geobag (kg)	175 & 125	175 & 125
12	Quantity of CC block in straight part of revetment (cum/m)	3.5	3.5
13	Quantity of CC block in apron part of terminations(cum/m)	40	45
14	Quantity of Geobag in straight part of revetment (cum/m)	35	43

Source: Feasibility Report, IWM, Dec 2013

4.6.6 Details for Conduction of TRM

125. The detailed list of works for conduction of TRM in Nurnia, Kendua and Baruipara beels is presented in Table 4.6 below:

Table 4.6: Detail Works for the Implementation of TRM

Item	Features	Quantity and Design Parameters		
		Nurnia Beel	Kendua Beel	Baruipara Beel
A	Effective area for TRM	1315 hectares	990 hactares	700 hactares
B	Peripheral Embankment	Total Length : 14190 m Design Section : Crest Level : 4.00 m PWD Top width : 3.0 m Side slopes : 1:2.5 R/S (Beel side)	Total Length : 17440 m Design Section : Crest Level : 4.00 m PWD Top width : 3.0 m Side Slopes : 1:2.5 R/S (Beel	Total Length : 10880 m (new) Design Section : Crest Level : 4.00 m PWD Top width : 3.0 m Side Slopes : 1:2.5 R/S (Beel

Item	Features	Quantity and Design Parameters		
		Nurnia Beel	**Kendua Beel**	**Baruipara Beel**
		1:2 C/S (Land side)	side) 1:2 C/S (Land side)	side) 1:2 C/S (Land side)
C	Link Canal	Design Section: Bottom width : 20 m Bottom level : -1.3 m PWD Side slope : 1:1.5	Design Section: Bottom width : 20 m Bottom level : -1.3 m PWD Side slope : 1:1.5	Design Section: Bottom width : 20 m Bottom level : -1.4 m PWD Side slope : 1:1.5
D	Drainage Outlet	Type : RCC Pipe Conduit No & Size : Total 6 Nos, each 1-Vent, 0.6 m dia RCC pipe	Type : RCC Pipe Conduit No & Size : Total 6 Nos, each 1-Vent, 0.6 m dia RCC pipe	Type : RCC Pipe Conduit No & Size : Total 5 Nos, each 1-Vent, 0.6 m dia RCC pipe
E	Baily Bridges	Two Locations : At Manasha Bazar across the link canal and Chandpur khal Length : 30.0 m each	One Location : At Manasha Bazar across the link canal Length : 30.0 m each	One Baily Bridge Length : 30.0 m each

Source: Feasibility Report, IWM, Dec 2013

4.6.7 Project schedule

126. Details of project schedule are given in Table 4.7 below :

Table 4.7: Phase and timing for development of the project

Item of construction works	2015-16	2016-17	2017-18	2018-19	2019-2036
Outlet Structure for TRM (8 Nos.)					
Construction/Re-construction of drainage/flushing sluice (14 Nos.)					
Repair of existing Regulators/Sluice (20 Nos.)					
Dredging/Excavation/Re-excavation of Major Rivers/Khals (54 km)					
Item of work for Tidal River Management (TRM)					
Construction of bank protective work (1.8 km)					

4.6.8 Requirement of Man powers and Materials

Man powers

127. For the implementation of the project following number of manpower will be required in different sectors.

Sl No.	Required Manpower	Number
1	Engineer	68
2	Machinery Operators	345
3	Mechanics	425
4	Surveyor	75

Construction Material

128. The construction materials required for re-excavation, water regulatory sluices and flushing inlets, and bank protection work which will includes cement, steel, and sand. Estimated quantities of these materials are presented in Table 4.8. The details of dumping soil reexcavation is presented in Appendix 4.

Table 4.8: Construction Materials

Sl No.	Description	Quantity	Remark
Re-excavation			
1	Earth work	7,678,503cum	The excavated earth will be dumped in selected place of Appendix 4
Construction of sluices and flushing inlets			
2	Cement	35,200 bags	To be procured from Bagerhat
3	Sand	3,800 cum	To be procured from Bagerhat
4	Stone	7,600 cum	To be procured from Khulna
5	Steel	910.50 MT	To be procured from Khulna
Bank protection			
6	Concrete Blocks	725,572 nos	To be made at construction site during construction
7	Stones	37,776 cum	To be collected from Khulna
8	Sand cement geo bag	640,500 nos	To be procured from Bagerhat

4.6.9 Expected Benefits

129. The implementation of the proposed works is expected to bring a number of significant benefits to the local people. Some of which are:

- Water-logging problem will be eliminated through the implementation of the project as Polder 36/1 has been experiencing severe water-logging problem over the years.

- Drainage system of the project area will be improved through re-excavation of rivers and khals, construction and replacement of water control structures.
- Project area will be protected from damages occurring from pre-monsoon or monsoon flooding.
- Crop production of the project area would be protected from flood, tidal water etc.
- Communication system will be improved through removal of water-logging.
- Navigation facility and transportation of agricultural products will be developed.
- Agricultural production will increase and food securities of the local people will be ensured by producing more crops in the protected agricultural lands.
- Livelihood, living condition and poverty status of the project area will be improved through increased agricultural and fisheries production.
- The proposed interventions will create employment opportunities for the local people during construction and post-construction periods.
- People will enjoy their normal social and economic activities through the removal of water-logging as it is hampering their day to day life severely.

4.6.10 Activities during Pre-construction, Construction and Post-construction Phase:

130. Certain activities are to be carried out during pre-construction, construction and post-construction phases which include both field and official works. A list of activities to be performed during these phases is given below:

Pre-construction	Construction	Post Construction
• Data collection for implementation of- the proposed intervention works; • Mobilization of construction materials and equipment through heavy vehicles; • Storage of construction materials near labour sheds/stockyard; • Selection and preparation of location for construction of labour shades with allied facilities; • Excavation equipment mobilization; and • Display of billboard at construction site for public awareness.	• Construction of nine new water control structures; • Replacement of five existing water control structures; • Bank Protective Works at two specific locations; • Dredging and re-excavation work by dredgers; • Mobilization of dredger machine; • Shore pipe line settings for dredging work; • Construction of Peripheral Embankment for TRM implementation; • Construction of Link Canal for TRM implementation; • Construction of Drainage Outlet for TRM implementation; • Construction of Baily Bridges for TRM implementation; and • Sequential operation of TRM in selected beels.	• Operation and Maintenance by BWDB; and • Formation of local committees (WMOs) by BWDB.

5 Environmental Baseline

131. Environmental and social baseline conditions have been established with the objective of using these data as a reference point in environmental and social impact assement. The baseline condition of water resources prevailing in the study area has been established by collecting data from secondary as well as primary sources. The secondary sources include Bangladesh Water Development Board (BWDB), National Water Resources Database (NWRD), Department of Public Health Engineering (DPHE), and Bangladesh Meteorological Department (BMD). Primary data are collected from the study area during field visits.

5.1 Physical Environment

5.1.1 Meteorology

132. Meteorological information on different parameters i.e. rainfall, temperature, relative humidity, wind speed, evaporation and sunshine hours have been collected from National Water Resources Database (NWRD) for the Bangladesh Meteorological Department (BMD) station at Khulna. The following sections will provide clear understandings on the meteorology of the study area.

(a) Rainfall

133. Rainy season is nominal in the study area in comparison to those of the other district of the country. November to February are the driest months of the year with negligible rainfall while June to September are the wettest months with highest rainfall intensity. The record of last 67 years (1948-2008) shows that, the study area received monthly maximum rainfall of 846 mm which was recorded in June 2002. Values of monthly maximum, average and minimum rainfalls are collected from the BMD station of Khulna (1948-2014). The collected data are shown in Figure 5.1. The figure indicates that significant rainfall occurs during the months of June to October while very insignificant during the months of November to January. The hydrograph shows that the highest and lowest values of maximum rainfall are observed during the months of June (846 mm) and December (65 mm) while the line graph illustrates that the highest and lowest values of average rainfall are observed during the months of July (342 mm) and December (4 mm) respectively.

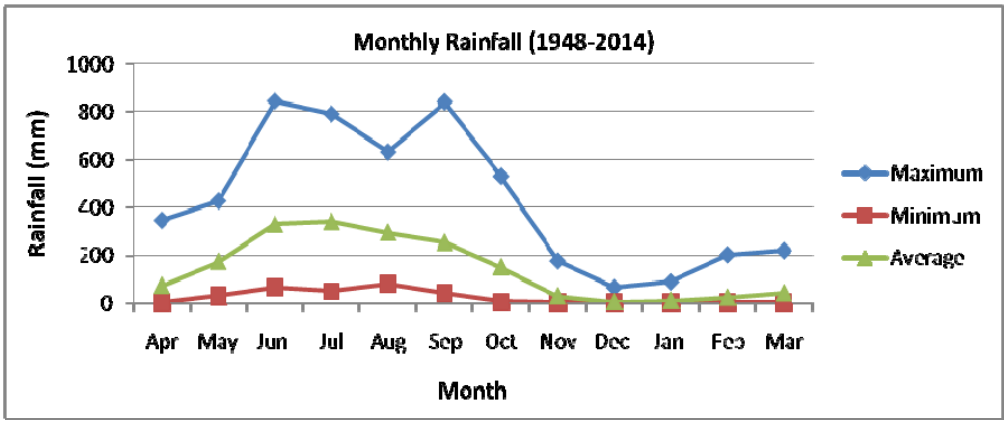


Figure 5.1: Monthly maximum, average and minimum rainfall at study area

(b) Temperature

134. Seasonal variation of temperature is distinct but does not vary widely. Temperature data of last 66 years (1948-2013) shows that the monthly maximum temperature varies from 29.5°C (December) to 37.0 °C (April) and April is the warmest month where as the monthly minimum temperature varies within the range of 10°C (January) to 25.2°C (June), and January is the coldest month of the study area. The highest maximum temperature ever recorded in the last 66 years is 37.0 °C which is found to occur in the month of April, 1954 while the lowest ever recorded minimum temperature is 10.0°C recorded in the month of January, 1989. The monthly maximum and minimum temperature of last 66 years (1948-2013) are shown in Figure 5.2 below:

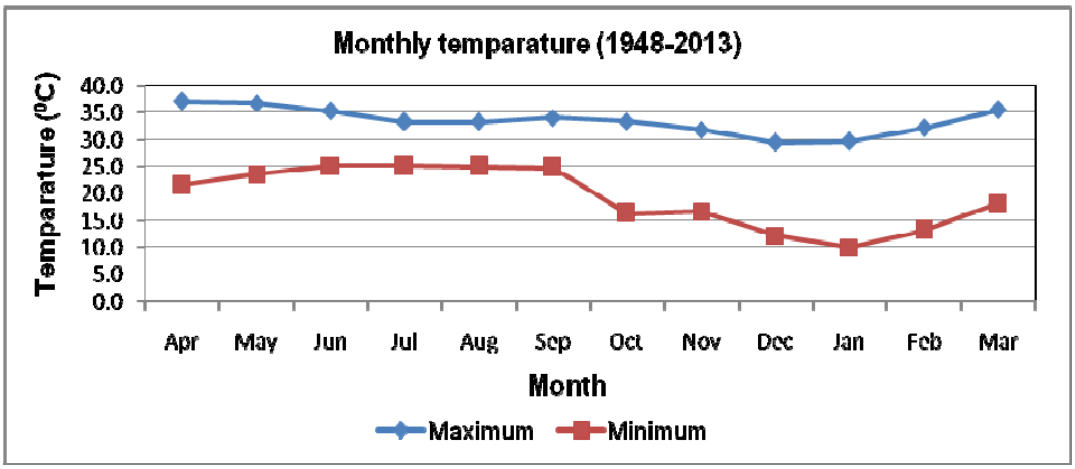


Figure 5.2: Monthly maximum and minimum temperature at study area

(c) Relative Humidity

135. Relative humidity is the ratio of the partial pressure of water vapor in an air-water mixture to the saturated vapor pressure of water at a prescribed temperature. The value depends on temperature and the pressure of the system of interest. As the temperature of the atmosphere increases, vapor carrying capacity in water increases, and thus the atmospheric vapor pressure also increases. Figure 5.3 below shows that monthly average relative humidity in the study area varies seasonally from 70.7% (March) to 88.6% (July).The most humid months are June, July, August September and October (relative humidity greater than 80%) and vary from 83 to 89 % while during January to March it remains lowest within a range from 11 to 16 %. The line graph of average relative humidity demonstrates a significant fluctuation as relative humidity values start to increase from April due to the increase in atmospheric water vapors coupled with temperature rise. Relative humidity rises above 85 % in monsoon (June to September) and starts decreasing from post monsoon season following the monsoon rainfall. The monthly maximum, average and minimum relative humidity for the last 66 years (1948-2013) is shown in Figure 5.3 below:

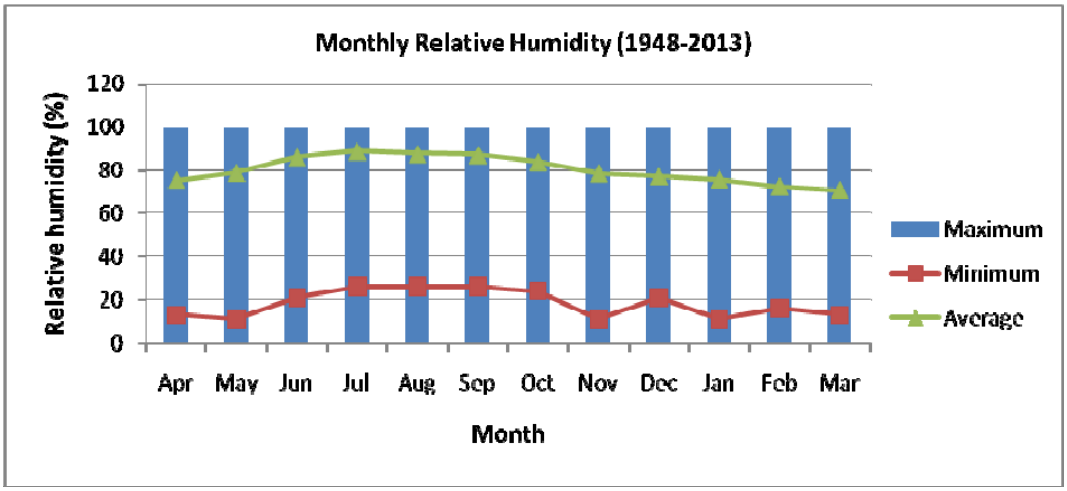


Figure 5.3: Monthly maximum, average and minimum humidity at study area

(d) Evaporation

136. Water is transformed from the surface to the atmosphere through a process of evaporation. Therefore, evaporation is another important component of the hydrological cycle which influences the overall water balance on the earth surface. Historical data on evaporation for the last 20 years (1992-2011) has been collected from the BMD station at Khulna which reveals that the average evaporation rate varies from 1.8 (January) to 3.9 (April) mm/day (Figure 5.4). The maximum evaporation rate is found as 9.9 mm/day which occurred in the month of April, in 1993. The minimum evaporation was recorded as 0.1 mm/day in the month of October, in 2004. The variation of maximum, average and minimum evaporation rate for the study area is shown in Figure 5.4.

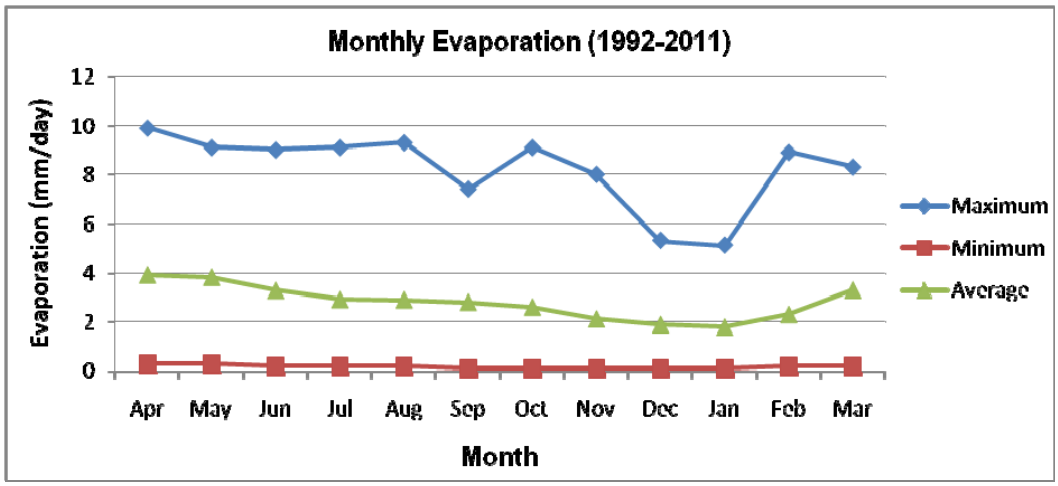


Figure 5.4: Monthly maximum, average and minimum evaporation rate at study area

(e) Wind Speed

137. The monthly average wind speed in study area varies from 35.1 to 146.8 km/day. The variation of monthly average wind speed is shown in Figure 5.5 below. The figure shows that the average speed of wind is highest in April (146.8 km/day) and lowest in November (35.1 Km/day). During cyclone Sidr (2007) and Aila (2009), one minute sustained wind speeds were recorded as 260 kph and 120 kph respectively, the former one created devastating impacts due to its high speed whereas the later one is more related to the increased storm surge.

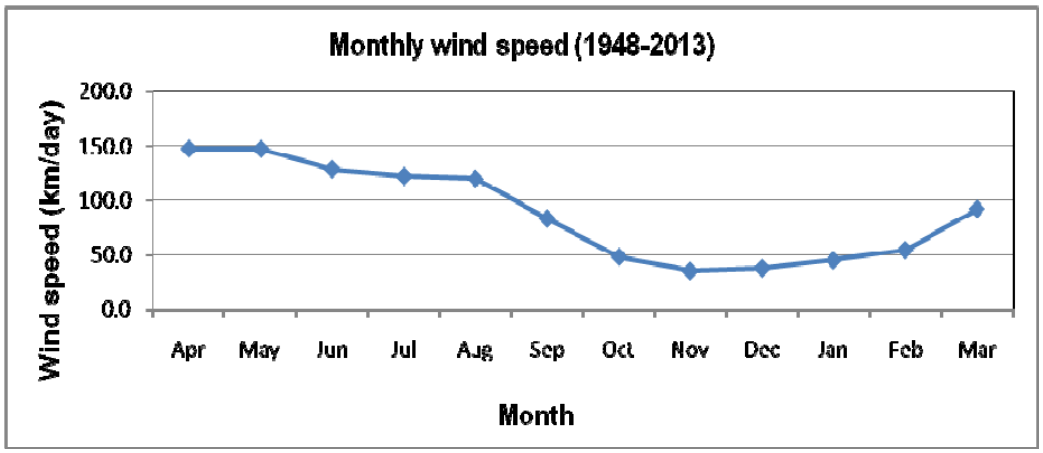


Figure 5.5: Monthly variation of average wind speed at study area

(f) Sunshine Hour

138. The data for sunshine hours for the last 30 years (1984-2013) has been collected from the BMD station at Khulna. The monthly average values of sunshine hours in Khulna vary from 3.8 to 8.5 hour/day. The average value of sunshine hours is highest in April (8.5hr/day) and lowest in July (3.8 hr/day). Figure 5.6 shows that the daily average sunshine hours are higher than 7 hours from November to May, but due to increased extent of cloud cover in monsoon (June to September) the values dropped below 5 hr/day.

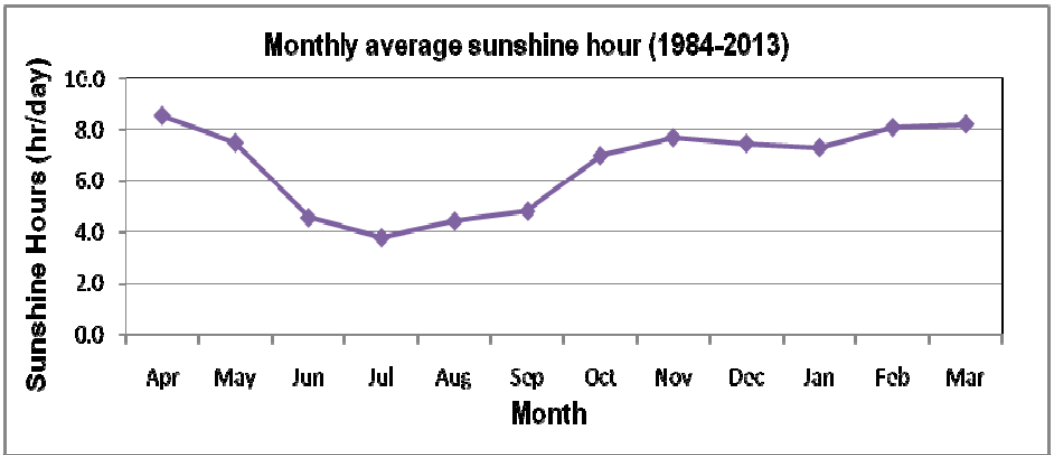


Figure 5.6: Monthly average sunshine hours per day at study area

5.1.2 Climate Trends

139. The climate of the area is tropical wet and dry, generally marked with monsoons, high temperature, considerable humidity and heavy rainfall. The hot season commences early in April and continues till August. The maximum temperature observed during March to

July and the minimum temperature recorded in January. The highest rainfall is observed during monsoon.

140. In order to assess the change in climatic factors, trend of annual variations of the aforementioned meteorological parameters were analyzed. Historically, the major impact caused for climate change is rise in temperature. From the analyses made for the study area, the average temperature is found gradually increasing in the area. In last 50 years, the mean annual temperature has experienced a rise of about 0.004°C per year (Figure 5.7). The variation of mean annual temperature recorded in Khulna station is shown in Figure 5.7.

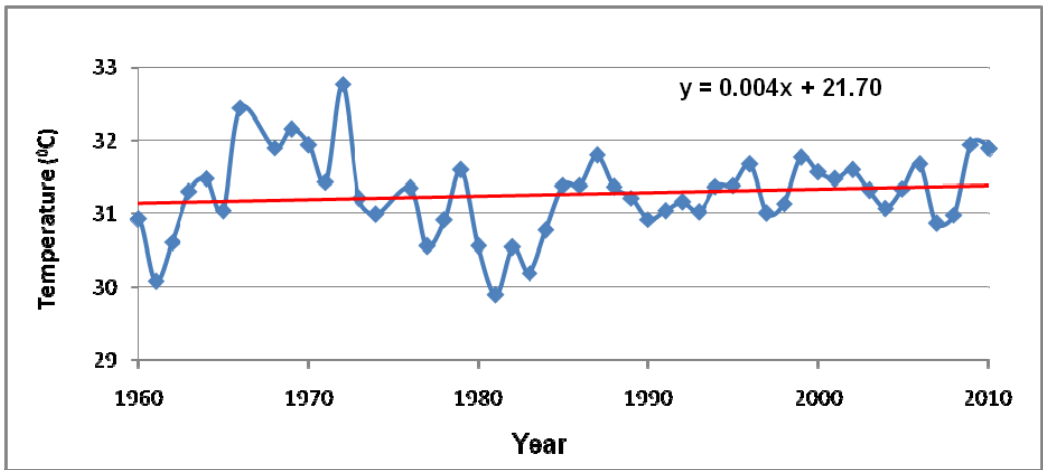


Figure 5.7: Annual Variation of Mean Temperature at the study area

141. The increase in mean annual temperature affects the rate of evaporation and thus rainfall intensities. The evaporation rates recorded in Khulna station shows an increasing trend (increasing by 0.038 mm/day each year in last 40 years). The following figure (Figure 5.8) shows the increasing trend of Evaporation rate. During this period, spring season has been shortened and monsoon has been shifting towards May. Now-a-days, monsoon starts from the month of May and lasts up to mid October. Due to such timing, water scarcity is often observed in the Boro season. This phenomenon affects the cropping patterns as well as the biodiversity and ecosystem of the study area. Farmers have presently initiated hybrid cropping, which eventually improved their socio-economic status.

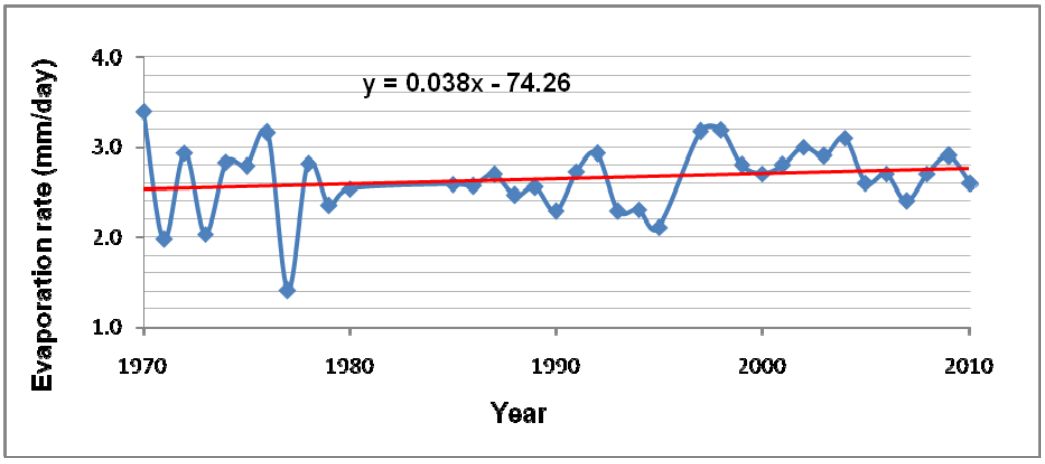


Figure 5.8: Annual Variation of Mean Evaporation at the study area

142. The rainfall intensities and patterns have also been changed and the extreme consequences of which have affected the study area. In the last 50 years (from 1960 to

2010), the annual variation of average rainfall has decreased by 0.192 mm per year (Figure 5.9). The annual variation of average rainfall recorded at Khulna station is shown in Figure 5.9.

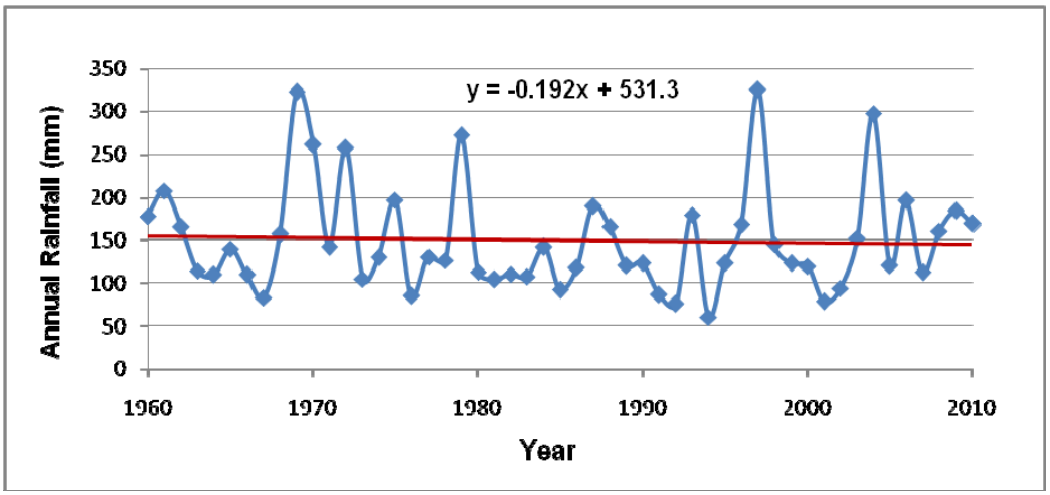


Figure 5.9: Annual Variation of average Rainfall at the study area

143. The average humidity has also experienced minor changes in the last two decades. The magnitude of average relative humidity has increased by 0.075% per year (Figure 5.10). The following figure shows the annual variation of average relative humidity of the study area.

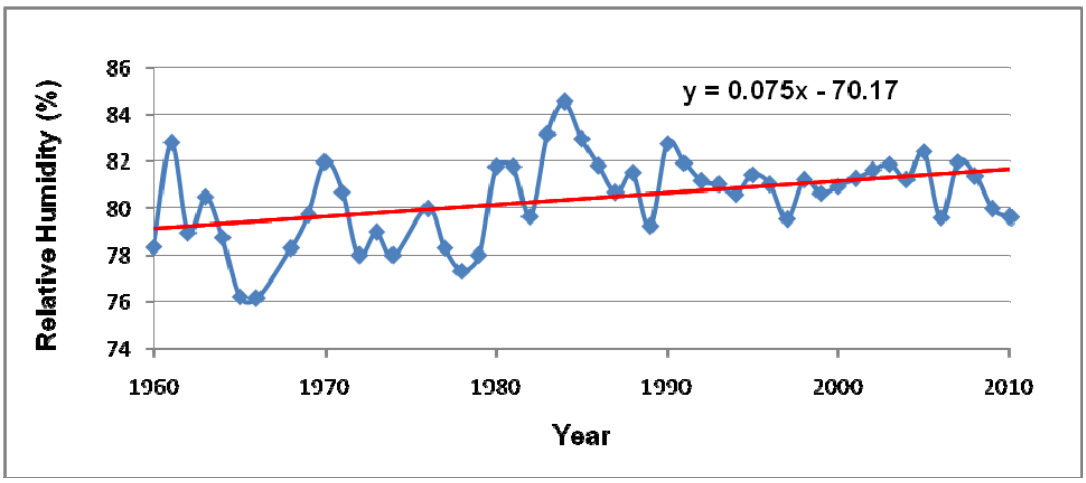


Figure 5.10: Annual Variation of Mean Relative Humidity at the study area

144. Apart from the meteorological changes discussed above, climate change also has important impacts on the frequency and intensity of natural disasters (Drought in particular) in the study area.

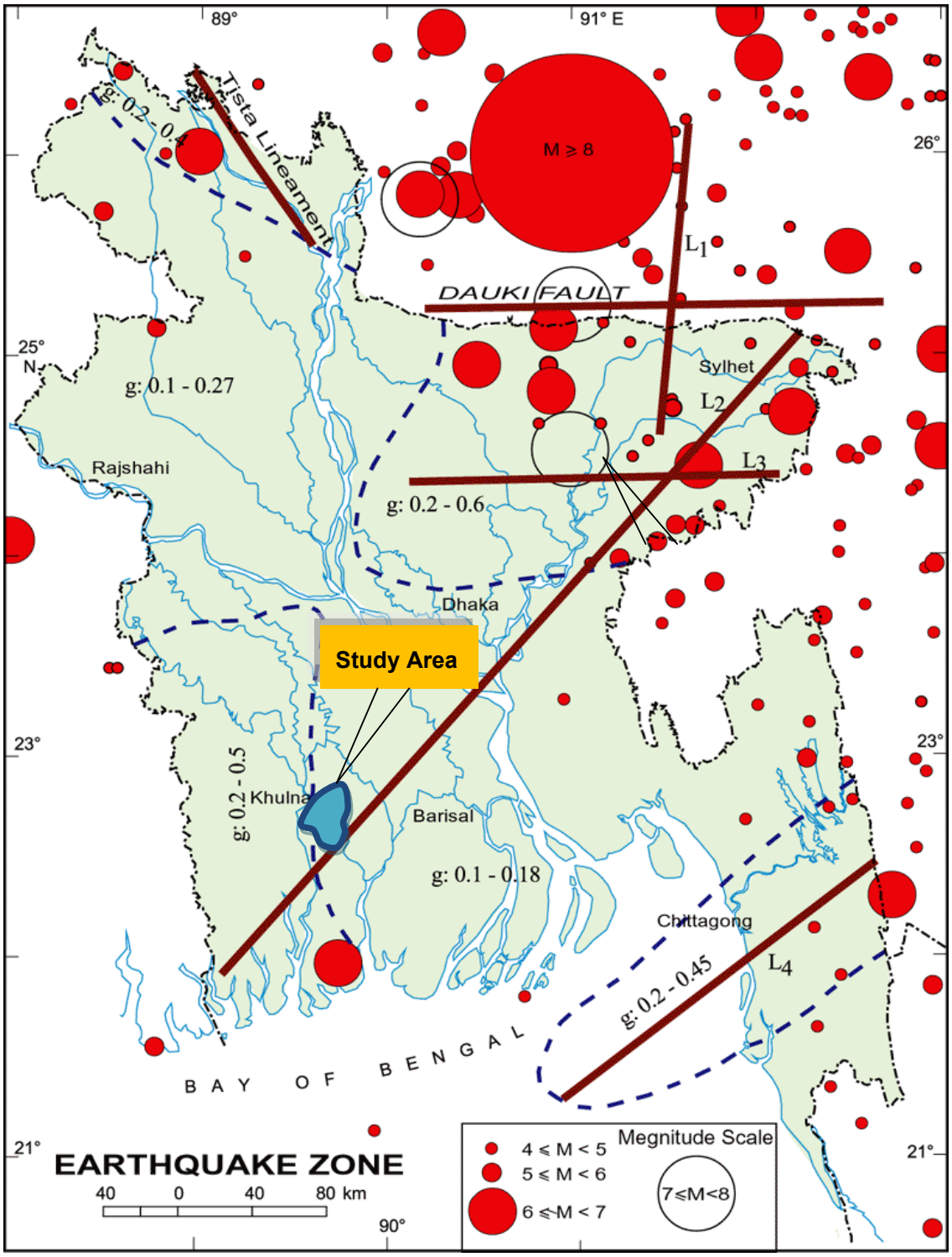
5.1.3 Seismicity

145. Geographical location of Bangladesh has made it ideally suited for natural disasters like earthquake. Tectonic framework of Bangladesh and adjoining areas indicate that Bangladesh is suited adjacent to the plate margins of India and Eurasia where devastating earthquakes have occurred in the past. Depending on the geological structure, Bangladesh has been divided into three generalized seismic zones: zone-I, zone-II and zone-III. According to it, the Polder area falls under Zone-I, which is characterized by low earthquake

prone site and has a basic seismic coefficient of 0.04g (Map 5.1). There are also different geological faults in and around the country, as shown in Map 5.2. According to it, the maximum magnitude of earthquake is within the range of 4≤M<5 on the Richter scale in and around of the polder area.

Polder 36/1: Earthquake Zone Map

Map 5.1: Earthquake zoning map with seismic coefficients



Map 5.2: Fault lines of Bangladesh (Source: GSB)

5.2 Environmental Quality

146. Environmental quality is assessed through analysis of sound, air and water quality of the study area. Several locations have been selected in discussions with BWDB officials for

noise and water quality measurements. Detail information including analysis are given below.

5.2.1 Sound Quality

147. A number of suitable sites have been selected within the study area for carrying out in-situ sound level measurements, considering some criterion in connection with sound generation (project interventions and other secondary activities) and places which are to be affected by any anomalies in sound level (settlements, schools). The Environmental Conservation Rules 1997, of Department of Environment (DoE), Bangladesh has defined standard noise levels as 50 dB during day time for residential zones.

148. During field inspection, sound levels were collected near the construction sites with 10 minute sampling periods. 'L50' values have been computed with the observed sound level variation during the sampling period. For a normal distribution of sound pressure level versus time, 'L50' is assumed to be equal to 'Leq', which is the Equivalent Noise Level. In our study area 'L50' value was found within the standard 'Leq' limit (for residential zone). As the project implementation works are to be carried out manually, i.e. without the use of any typical heavy loading vehicles, it can be assumed that the sound levels generated from the construction sites due to project implementation works would have very minor contributions in the equivalent noise levels.

Table 5.1: Sound Levels for Different Locations in the Study Area

Location Name	GPS	L50 Values (dB)	Standard Level (dB)	Deviations From Standard
Bhairab River	N 22º46'26.5'' E 89º43'12.1''	49	50 dB (Residential Zone)	Within limit
Baruipara Khal	N 22º45'5.2'' E 89º44'94''	48		Within limit
Baruipara Beel	N 22º46'20.1'' E 89º45'58.3''	49		Within limit
Dobakhali Khal	N 22º46'4.3" E 89º47'58.3''	50		Within limit
Mora Chitra River	N 22º45'34.9" E 89º48'9.7''	49		Within limit
Narayankhali Khal	N 22º45'36.1" E 89º48'45''	49		Within limit
Helajila Khal	N 22º44'56.2" E 89º47'55.5''	48		Within limit
Godara	N 22º48'41.9" E 89º46'25.3''	49		Within limit
Bamondanga Khal	N 22º52'42.2" E 89º41'10.2''	48		Within limit
Dhanokhali Khal	N 22º46'43.4" E 89º50'41.7''	48		Within limit
Boiragi Khal	N 22º47'3.8" E 89º51'9.7''	48		Within limit
Haque Canal	N 22º47'29.2" E 89º52'40.9''	50		Within limit

Source: CEGIS field survey, November 2014

Photo 5.1: CEGIS Professional recording sound level at Godara (proposed 16 vent regulator)

Photo 5.2: CEGIS Professional measuring Noise level during field investigation

5.2.2 Air Quality

149. The standards of air quality are given in **Table 5.2**. It is expected that standards should be maintained during the implementation of the interventions.

Table 5.2: Standards of ambient air quality

Areas	Concentration of micrograms per meter cube		
	SPM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)
Industry	500	120	100
Commercial	400	100	100
Residential and rural area	200	80	80
Sensitive	100	30	30

Source: Environment Conservation Rules, 1997

5.2.3 Water Quality

150. Five major water quality parameters have been measured in November 2014, from eight different locations within the study area by considering total water resources network prevailing in the Polder (**Table 5.3**).

Table 5.3: Values of Water Quality Parameters

Location	GPS Reading (Lat-Long)	pH	TDS (ppm)	Temp (ºC)	DO (mg/l)	EC (mS/cm)
Bhairab River	22º46'26.5''N 89º43'12.1''E	8.2	810	30	4.5	1.62
Chitra River	22º48'41.9''N 89º46'25.3''E	8.0	780	29	7.9	1.56
Old Madhumoti	22º47'17.2''N 89º52'49.7''E	7.9	390	30	6.8	.75
Mora Chitra River	22º45'34.9''N 89º48'9.7''E	8.2	690	31	6.8	1.37
Haque Canal	22°47'29.2"N 89°52'40.9"E	8.0	370	29	7.2	0.73
Baruipara Beel	22°46'20.1"N	7.9	920	32	6.9	1.77

Location	GPS Reading (Lat-Long)	pH	TDS (ppm)	Temp (ºC)	DO (mg/l)	EC (mS/cm)
	89°45'58.3"E					
Kendua Beel	22°50'34.4"N 89°45'13"E	8.0	860	31	6.5	1.5
Nurnia Beel	22°52'6.8"N 89°43'45.6"E	7.1	790	31	6.7	1.65

Source: CEGIS field survey, November 2014

Photo 5.3: CEGIS Professional collecting water sample from Mora Chitra River

Photo 5.4: Water quality test at Chitra River (Godara)

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

152. According to DoE, the highest range of Total Dissolved Solids (TDS) concentration for surface water is 2100 ppm. The values of TDS found during field investigation ranged between 370-810 ppm (Table 5.3), which completely satisfy the DoE standard.

153. Temperature of water bodies affects the fish habitats and their oxygen holding capacity. The temperature of the water bodies in the study area is found to vary from 29°C to 31°C, which complies with DoE standard (highest 45°C) for irrigation and fishing.

154. DO is an essential parameter for the metabolic process that produces energy for growth and reproduction of fishes and other aerobic aquatic habitats. Decrease in DO values below the critical level of 3 mg/l causes death of most of the fishes and other aerobic aquatic organisms. Generally DO remains relatively low in dry season than that of wet season. The values of DO found during field investigation range between 4.5 to 7.9 mg/L which are favorable for all aquatic organisms. DoE standard of Dissolved Oxygen (DO) for surface water is 4.5-8 mg/L. All of the values obtained during field investigation satisfy this standard.

155. Electric Conductivity (EC) is another useful water quality indicator for estimating the amount of minerals, assessing the effect of diverse ions on chemical equilibrium, physiological effects on plants or animals and corrosion rates. DoE standard of Electric Conductivity (EC) for drinking water is 1.2 mS/cm and for irrigation water is 0.20 – 0.7 mS/cm. The values of EC found during field investigation are ranges between 0.73 – 1.77 mS/cm. The higher values of EC indicate that the water bodies in the study area are more affected by saline water rather than fresh water.

5.3 Water Resources

156. The water resources system of the Polder area meets the demand of the surrounding ecosystem and provides livelihood for a significant amount of people. It is the source of water supply, and plays an indispensable role in assimilating and diluting wastes, attenuating and regulating drainage, recharge into the aquifer, and maintaining the environment for aquatic habitats.

5.3.1 Surface Water

157. To assess the surface water characteristics of the area, data on surface water levels have been collected from three stations of BWDB at Patgati, Manikdah and Offtake of Athar. The station at Patgati is located at the upstream of the Gorai-Madhumoti River whereas the Manikdah station is located at the downstream. From the analyses made, the water levels of the Gorai-Madhumoti River are higher in the upstream and lower in the downstream. This may be due to the increased velocity of river flow in the downstream, resulting in lower cross sections. The following sections provide a discussion on the scenario of surface water level and surface water salinity of the Polder area.

Water Level

158. Secondary information on water levels has been collected from the stations located at Patgati (from 1982 to 2009), Manikdah (from 1977 to 2009) and Offtake of Athar (from 1986 to 2009). The Table 5.4 shows that in monsoon, the average surface water levels are 2.9 m +PWD and 2.8 m +PWD in upstream and downstream respectively. In dry season, the river has moderate depths of 1.30 m +PWD at Patgati, 1.10 m +PWD at Manikdah and 1.00 m +PWD at Offtake of Athar. Table 5.4 shows the average values of water levels of the Gorai-Madhumoti River in different seasons.

Table 5.4: Average surface water levels of Gorai-Madhumoti River in different seasons

Season	Average RL of Water Surface (m)		
	Patgati (1982-2009)	Manikdah (1977-2009)	Offtake of Athar (1986-2009)
Dry (December-February)	1.3	1.1	1.0
Pre-Monsoon (March-May)	1.5	1.2	1.3
Monsoon (June-September)	2.9	2.8	2.6
Post-Monsoon (October-November)	2.4	2.2	2.1

Source: BWDB

159. Figure 5.11 presents a hydrograph showing monthly variation of water levels of Gorai-Madhumoti River. The crest portion of the hydrograph indicates the monsoon period whereas the rising and recessing limbs indicate the pre-monsoon and post-monsoon periods respectively. The average maximum water level at Patgati is 2.80 m +PWD (in August), at Manikdah is 3.50 m+ PWD (in September) and for Athar is 3.20 m +PWD (in September). The minimum water level at Patgati is found as 1.2 m+ PWD (in January), at Athar as 1.0 m+ PWD (in January and the same at Manikdah is found as 0.90 m +PWD (in February).

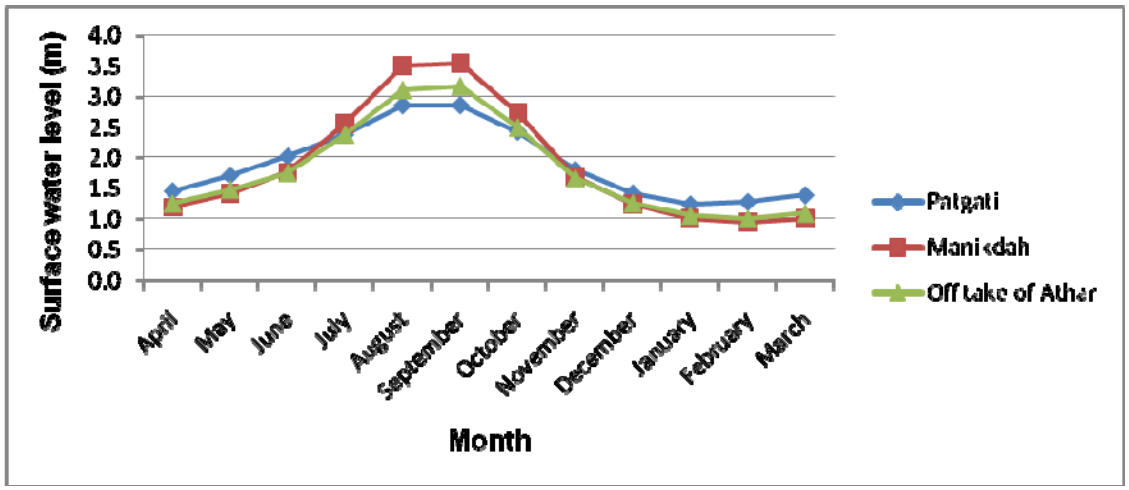


Figure 5.11: Water level of Gorai-Madhumoti River at different places

Water Salinity

160. For assessing the surface water salinity of the study area the monthly average salinity data of Bagerhat district have been collected from NWRD. A graph of surface water salinity (Figure 5.12) during high and low flow has been developed after analysis of the data. The graph shows that salinity is highest in April and zero in the month of October. The reason of being zero salinity is during October Monsoon season prevails usually in our country.

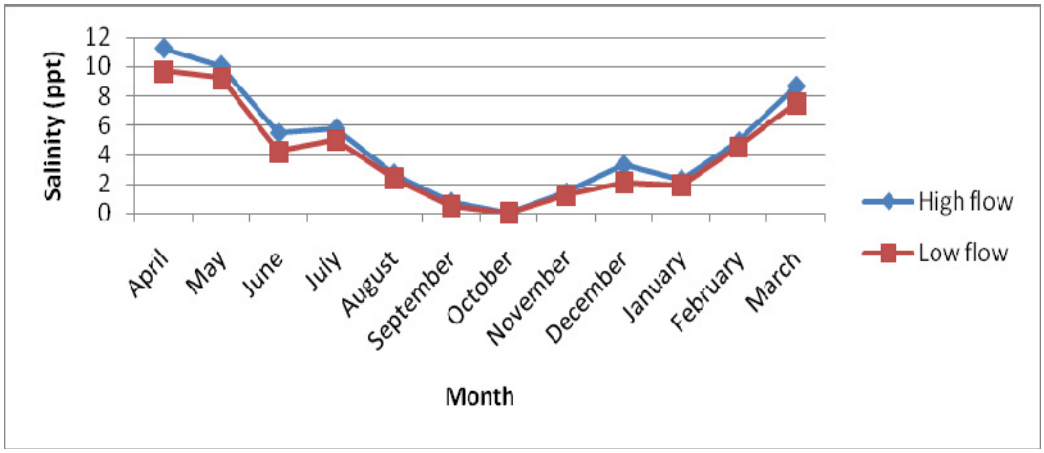


Figure 5.11: Surface water salinity in the study area (2000-2008)

5.3.2 Ground Water

161. Ground water level data are collected and analyzed from three different BWDB observation wells located at Singghathi, Garfa and Khanjahanpur. The monthly variation of mean ground water level at Singghathi (from 1966 to 2003), Garfa (from 1966 to 2003), and Khanjahanpur (from 1974 to 2003), are shown in Figure 5.12.

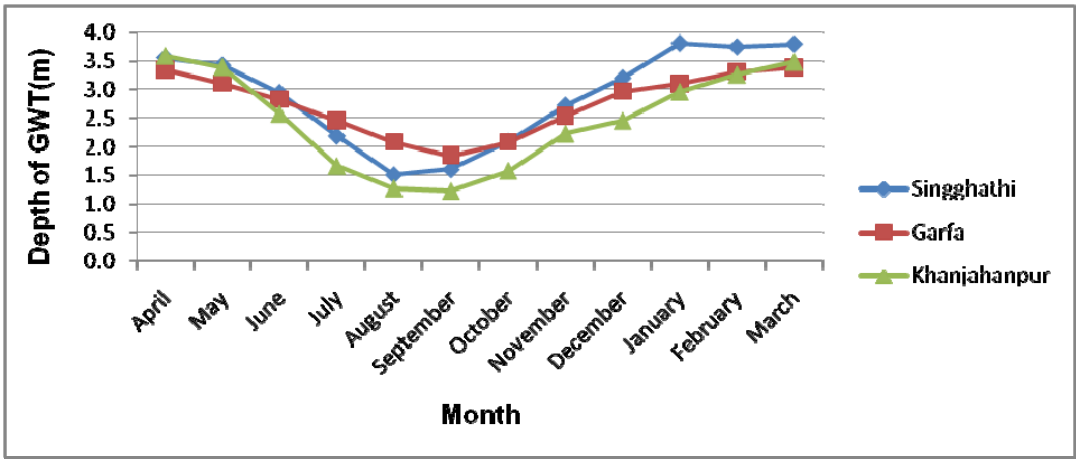


Figure 5.12: Ground Water Table (GWT) of the polder area

162. The depth of Ground Water Table (GWT) measured in the aforementioned locations at ten year intervals are shown in Table below. Values are analyzed for the months of April (Considered as dry period) and September (considered as wet period). In the dry season, increased dependency of the local people on ground water lowers the GWT. During monsoon, the higher availability of surface water leads to higher recharge of ground water sources. Table 5.5 shows that the GWT with respect to the G.L (Ground Level) in the dry period and wet period differ significantly over the years.

Table 5.5: Ground Water Tables (GWT) shown at ten year intervals

New ID	Location	1970		1980		1990		2000	
		Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep
BAH502	Singghathi	3.69	1.45	3.64	1.27	3.58	1.02	3.18	1.52
BAH004	Garfa	3.49	1.39	3.47	1.88	3.3	1.04	2.68	1.29
BAH003	Khanjahanpur	3.89	1.87	4.12	1.39	2.04	0.7	3.36	0.8

Source: NWRD

5.3.3 River and Khal System

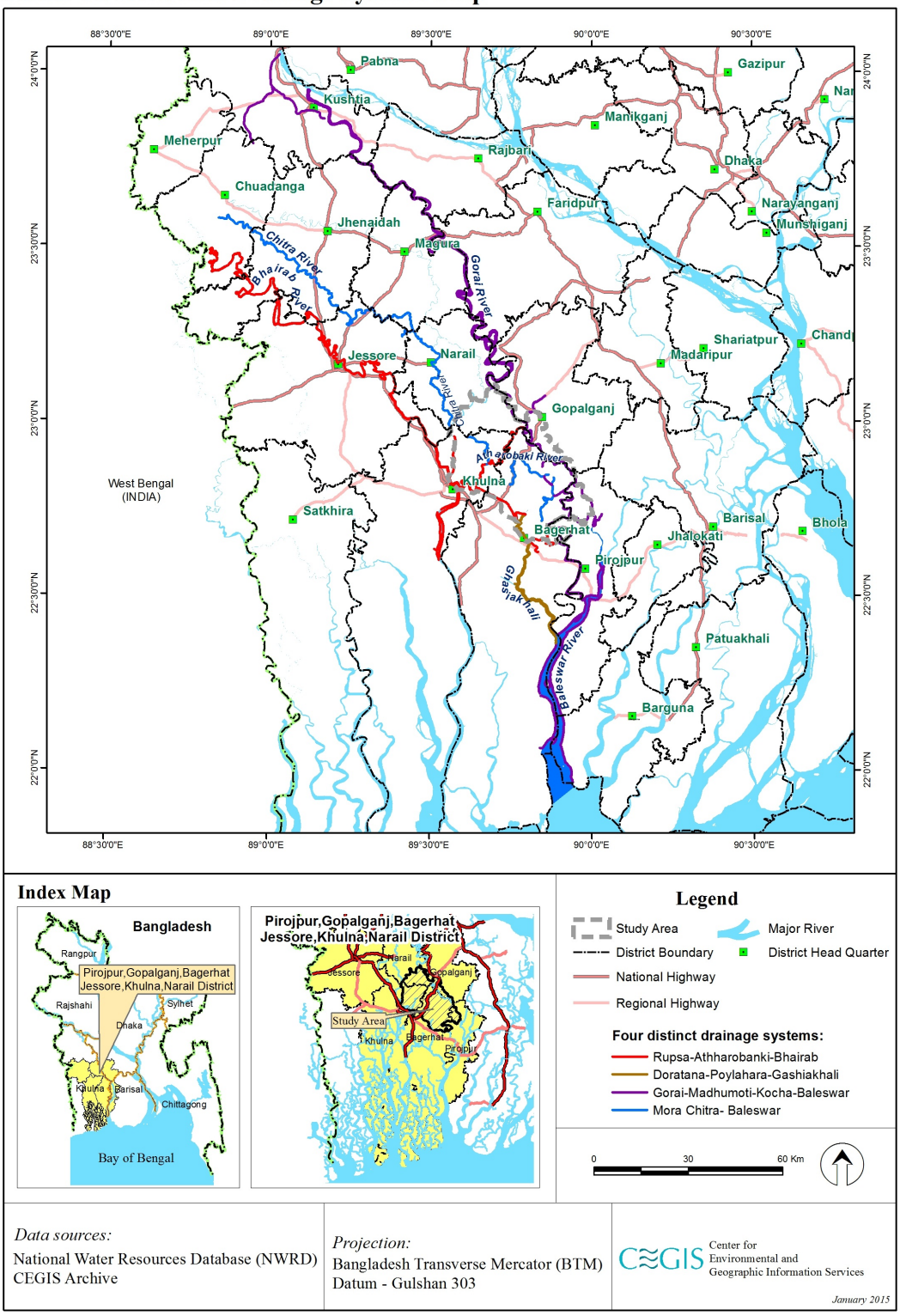
163. The study area is characterized by numerous morphologically active tidal rivers and khals (creeks), which provide drainage network for a system of embanked hydrological units. Rivers adjacent to the north-eastern boundary (eastern part of Chitalmari and Mollahat upazillas) of the study area receive upstream monsoon flows from the Ganges river through Gorai-Madhumoti and to the west are only rain-fed. There are number of beels (depressions) such as Kodalia Beel, Nurnia Beel, Baruipara Beel, Aruadihi Beel, Kendua Beel, Raigram Beel in the study area, which are connected to the drainage network, mostly through regulators. The river systems in the study area are comprised of four distinct drainage systems:

- The Rupsa- Atharobaki- Bhairab river system
- The Gorai- Madhumoti- Kocha- Baleswar river system
- The Karamara- Doratana- Poylahara-Gashiakhali river system
- The Mora Chitra- Baleswar river system

164. The Gorai river distributes its flow into Nabaganga and Madhumoti rivers near Bardia Bazar. The Athharobanki river is one of the most important rivers for the study area having about 55 km length which is mostly silted up. The upstream reach of Bhairab river is connected with the Athharobanki river at Alaipur of Rupsa upazila of Khulna district and the outfall of Bhairab river at the downstream is Doratana-Poylahara river near Jatrapur Bazar of Sadar upazilla of Bagerhat. The Chitra river is about 20 km long which drains out the rainfall runoff through the Karamara-Doratana-Poylahara river.

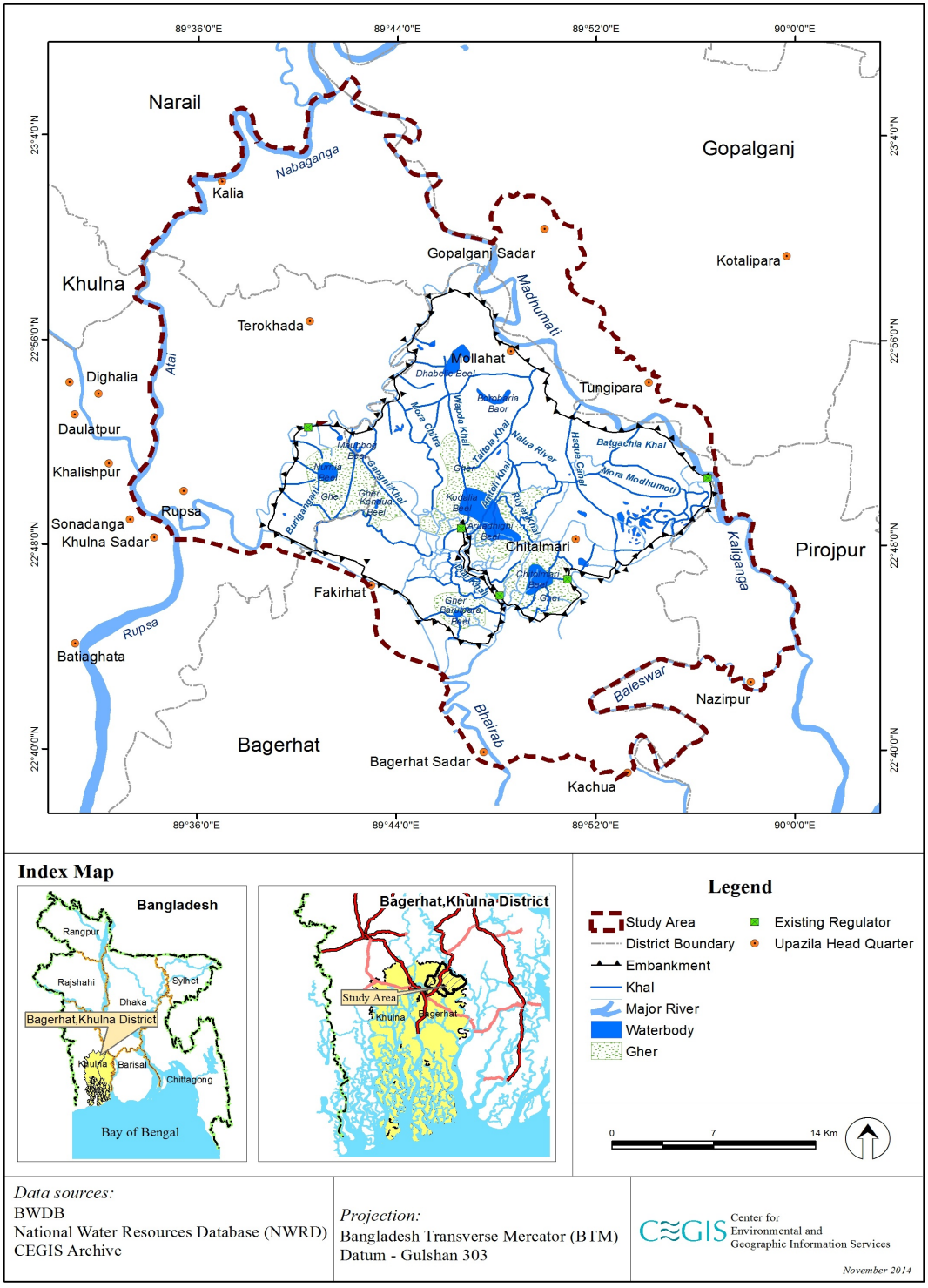
165. The major internal drainage khas are the Kaligonga, the Raigram, the Wapda khal, the Bashtoli, the Saildah, the Baruipara, the Narayankhali, the Dongar khal, the Haque canal, the Begumkhali, the Jolodanga,the Bangla Bazar khal, the Kuraltola khal, the amtolier khal, the Sonakhali, the Shabukhali, the Aruadihi, the Santipur, the Goara, the Doba khal, the Siali khal, the Barojala khal, the Bamondanga khal, the Taltola khal etc. The River and Khal system of the study area is shown in Map 5.3 and Map 5.4.

Polder 36/1: Distinct Drainage Systems Map



Map 5.3: Distinct drainage systems map of the polder area

Polder 36/1: Drainage Network Map



Map 5.4: Drainage network showing rivers and khals of Polder 36/1

5.3.4 Sedimentation Problem

166. Most of the rivers, khals are silted up and have lost their conveyance capacity significantly. The major drainage routes of polder 36/1 are the Athharobanki river, Bhairab

river, Chitra-Karamara river and Old Madhumoti river are now experiencing huge sedimentation problem.

167. Once the Bhairab river was a very large river and important route for navigation from Khulna to Bagerhat. But now-a-days it has become a very narrow one due to severe siltation in the river bed and has lost the navigation facility because of its reduced depth. The following Figure 5.17 shows the sedimentation problem of Bhairab river.

Photo 5.5: Critical stretch of the Bhairab river near Sonakhali

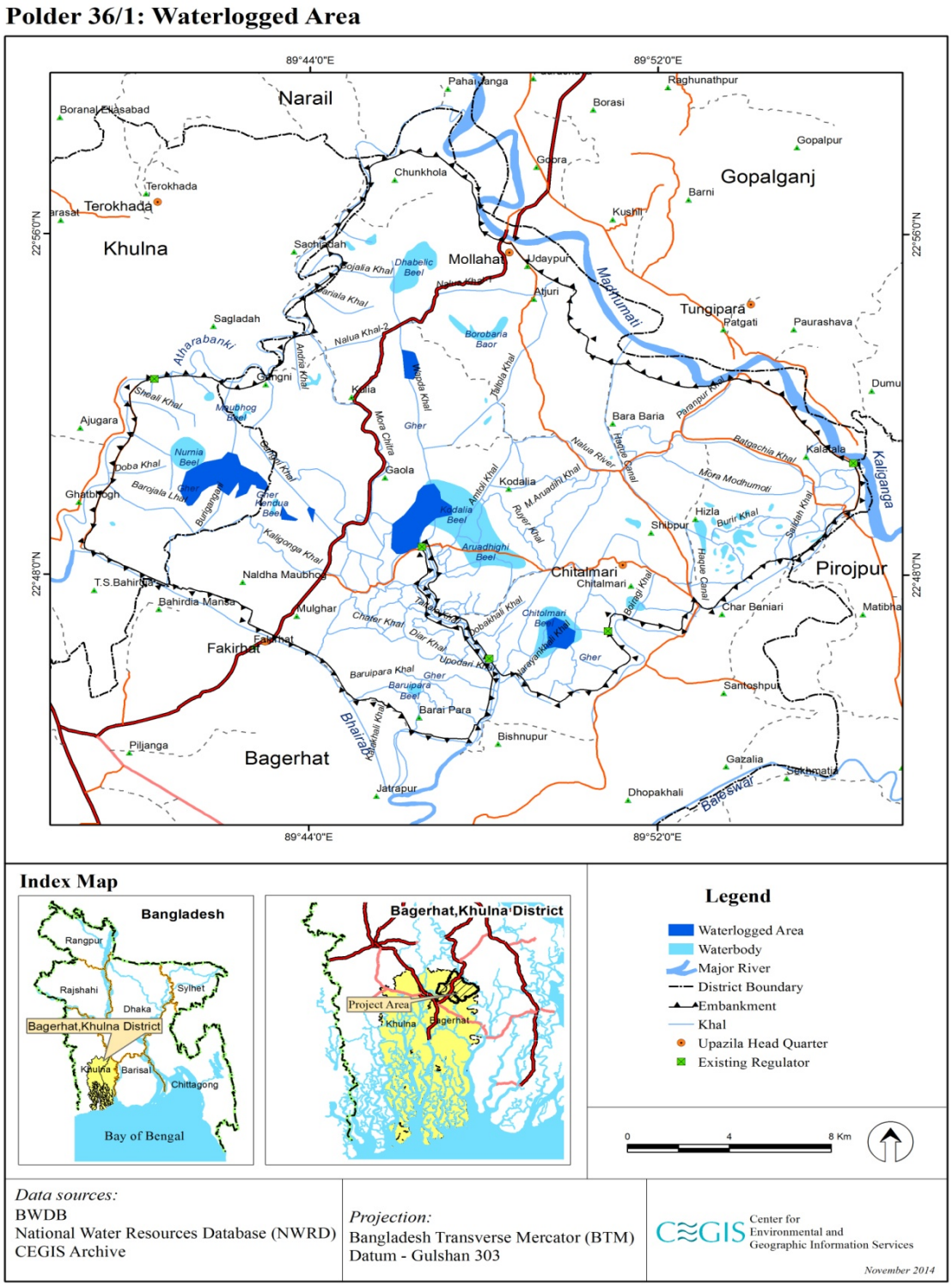
168. According to the local people, Haque canal controls the salinity concentration by allowing sweet water inside the polder from Madhumoti river and feeding the adjacent internal khals and low lying areas. But due to sedimentation in the canal bed it has lost its conveyance capacity drastically.

169. The Old Madhumoti river is an important drainage route as well as source of fresh water flow for the Chitalmari upazilla. But now-a-days it is also suffering from sedimentation problem like the other peripheral rivers of polder 36/1. All the drainage khals except the Kama khal are directly connected to the Old Madhumoti river to receive freshwater. But this river is reducing its conveyance capacity as well as navigability day by day due to lack of proper maintenance (dredging/ re-excavation).

5.3.5 Drainage Congestion and Water Logging

170. Drainage Congestion is a crucial problem in Polder 36/1. Sedimentation in the rivers and khals within and around the polder is the main cause for the drainage congestion. Another major reason of drainage congestion is the encroachment of the rivers and khals for pisiculture and agriculture.

171. The study team made several discussions with local people and BWDB officials to delineate the water logged area. There are some specific locations which remain inundated throughout the year. Approximately 1842 ha of beel area is permanently waterlogged round the year and even there is no human accessibility because of thick aquatic seeds in the water logged area. The Nurnia, Kendua, Kodalia beels are most water logged areas. Map 5.5 shows the permanent water logged area of polder 36/1.



Map 5.5: Water logged areas in Polder 36/1

5.3.6 Erosion prone areas

172. The Madhumoti is the major river which is located at the northeastern periphery of the study area, carrying huge monsoon flow during wet season and has the meandering

characteristics causing river bank erosion. Some specific locations are identified by BWDB which are vulnerable to erosion.

173. The vulnerable location of Paranpur is situated at Chitalmari upazilla. The approximate length is 1000m at the right bank of the Madhumoti river. According to local people about 200m bank is destroyed during every monsoon at Paranpur. Figure 5.18 shows some vulnerable locations for river bank Erosion at Paranpur.

Photo 5.6: Erosion prone areas at Paranpur

174. Another river bank erosion prone area is Saildah. About 800m stretch of the road cum embankment need protection by river bank protective works at the topmost priority before the road communication is disrupted. Figure 5.19 shows some vulnerable locations for river bank Erosion at Saildah.

Photo 5.7: Erosion prone areas at Saildah

5.4 Land Resources

5.4.1 Description of Agro-Ecological Zone

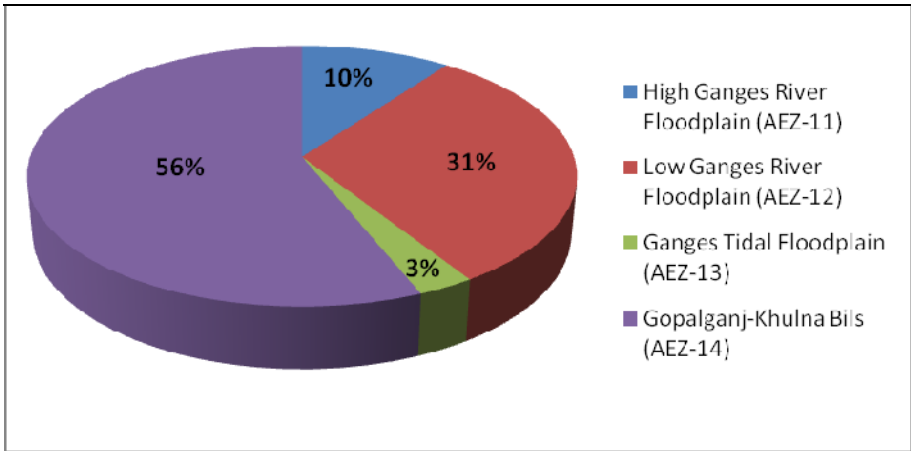
175. Thirty agro-ecological zones and 88 sub-zones have been identified by adding successive layers of information on the physical environment which are relevant for land use and assessing agricultural potential. These layers are:

- Physiography (land forms and parent materials)
- Soils

- Depth and duration of seasonal flooding and
- Agro-climatology [It comprises four elements: length of kharif and rabi growing seasons, length of pre-kharif transition period, number of days below certain winter critical temperatures (<15^{0}C) and number of days with extremely high summer temperature (>40^{0}C)](FA),1988).

176. Agro-ecological zones and sub-zones are very broad units. Fertility status of these zones varies greatly. Individual farmers have fragmented the land into small pieces causing wide variation in the management of each and every piece of land. This leads to the large variation in the fertility levels even between adjacent plots. Realizing the difficulties of agro - ecological zones is given here which serves as a ground for AEZs based fertilizer recommendations for cropping patterns (BARC, 2012). Realizing the difficulties of agro-ecological zones is given here which serves as a ground for patterns (FAO/UNDP, 1988). For detailed information about physical and chemical properties of soils, respective Upazila Nirdeshika may be consulted.

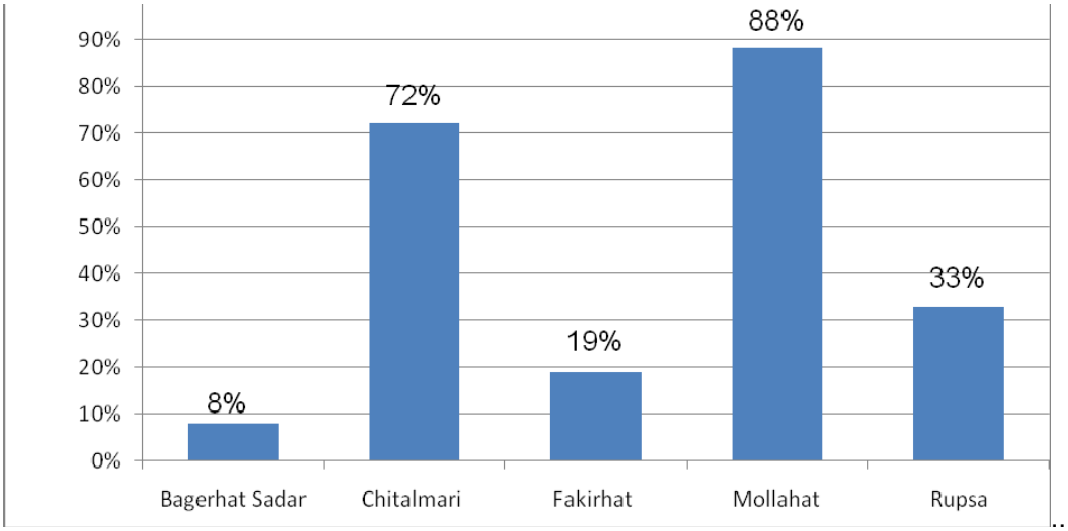
177. The polder area comprises of four Agro-ecological regions. (i) High Ganges River Floodplain (ii) Low Ganges River Floodplain (iii) Ganges Tidal Floodplain and (iv) Gopalganj-Khulna Bils. The description of AEZs with area and percentage are shown in Figure 5.13.



Source: Fertilizer Recommendation Guide, BARC, 2012

Figure 5.13: The area of Agro-Ecological Zone in percent of NCA

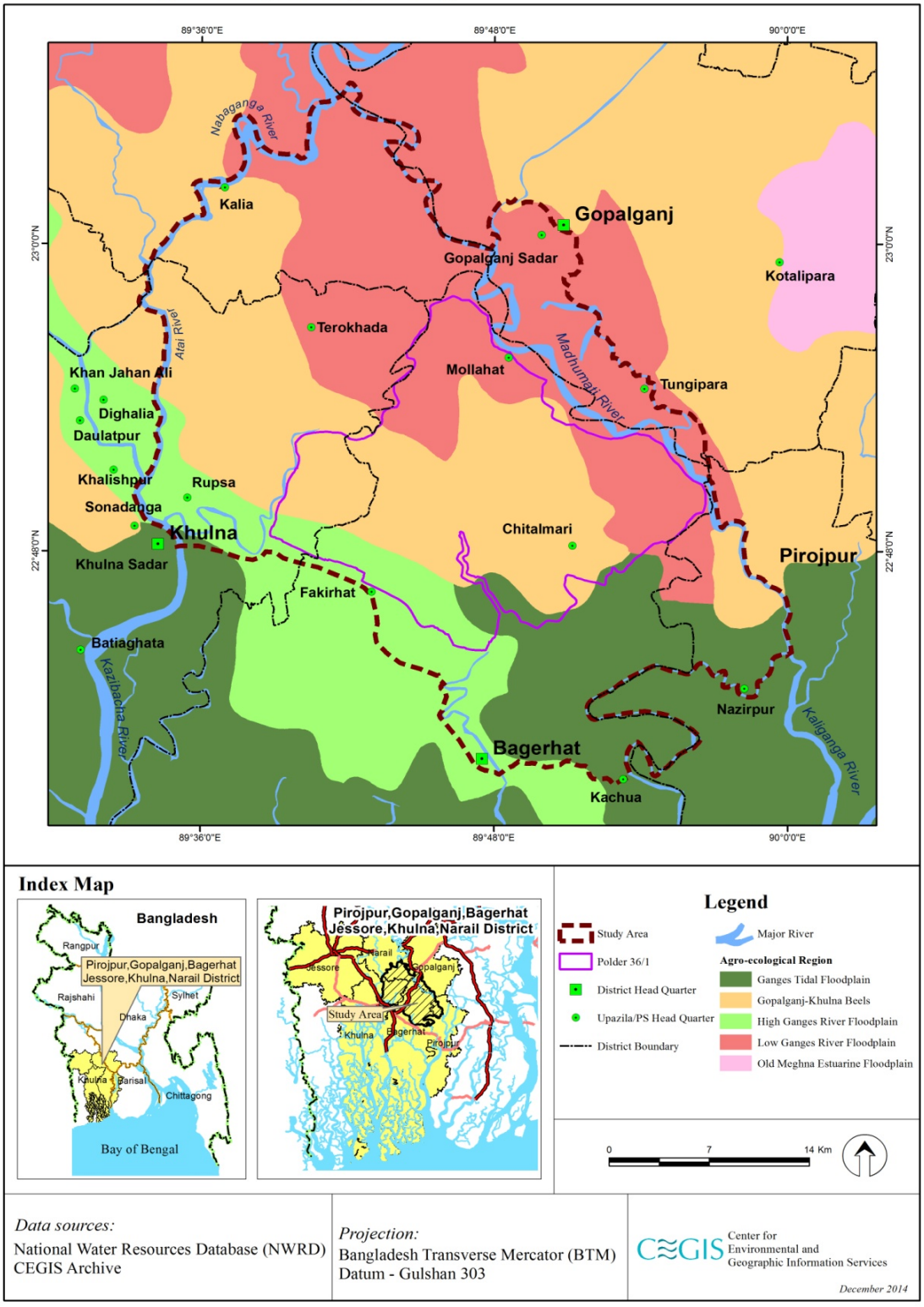
178. Bagerhat and Khulna Districts are in the polder area. Districts are subdivided into Upazilas. Bagerhat Sadar, Chitalmari, Fakirhat, Mollahat Upazilas are at Bagerhat district and Rupsa is in Khulna district. Under each Upazila there is Union Parishad, which is the lowest administrative unit in Bangladesh. There are 24 unions parished in the polder area. These union parisheds are Barai para, Bemarta, Bishnupur, Gota para, Jatra pur, Kara para, Bagerhat paurashava, union Parishads of Bagerhat sadar upazila, Char Baniari, Bara Baria, Chitalmari, Hizla, Santoshpur, Kalatala unions of Chitalmari upazila, Naldha maubhog, Mulghar, Fakirhat unions of Fakirhat upazila, Atjuri, Chunkhola, Ganjuri, Kulia, Udaypur unions of Mollahat upazila and Ghatbhogh, Sreefaltala, T.S. Bahirdia unions of Rupsha upazila. Percent of area coverage of each Upazila in the polder area Bagerhat Sadar (8%), Chitalmari (72%), Fakirhat (19%), Mollahat (88%) in Bagerhat, District and Rupsa (33%) in Khulna Districts Figure 5.14:



Source: Minor Irrigation Survey Report, BADC, 2009-2010

Figure 5.14: Percent of area in the upazilas

Polder 36/1:Agro-ecological Region Map



Map 5.6 :AEZ of the polder area

(a) AEZ 11: High Ganges River Floodplain

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

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

181. In general top soils are slightly acidic to slightly alkaline in reaction, but there is a significant lowering of soil pH in high land in the recent years and in some places top soils become strongly acidic. Sub-soils are slightly alkaline in reaction. General fertility level is low including N, P, S and B although CEC is medium. The K- bearing minerals are medium to high, but the Zn status is low to medium. Some physic-chemical properties of soils of AEZ-11 are presented in Table 5.6.

Table 5.6: Some physic-chemical properties of soils of AEZ-11

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
High land (43%)	4.5-7.9	L-M	VL-L	VL-L	L-M	VL-L	M-H	M-H	L-M	VL-L	M
Medium highland (32%)	5.6-7.1	L-M	VL-L	VL-L	L-M	VL-L	M-H	M-H	L-M	L-M	M
Medium lowland (12%)	6.5-8.3	L-M	VL-L	VL-L	L-M	VL-L	M-H	M-H	L-M	L-M	M

OM=Organic matter; VL=Very low; L=Low; M=Medium; H=High

Source: Fertilizer Recommendation Guide, BARC, 2012

(b) AEZ 12: Low Ganges River Floodplain

182. The region comprises the eastern half of the Ganges River Floodplain which is a low lying. The region has a typical meander floodplain landscape of broad ridges and basins.

183. Soils of the region are silt loams and silty clay loams on the ridges and silty clay loams to heavy clays on lower sites. General soil types predominately include Calcareous Dark Grey Soils and Calcareous Brown Floodplain soils. Organic matter content is low in ridges and medium in the basins. Soils are calcareous in nature having neutral to alkaline in reaction. General fertility level is low to medium, CEC and K status is medium to optimum and the Zn status is low to medium. Some physic-chemical properties of soils of AEZ-12 are presented in Table 5.7.

Table 5.7: Some physic-chemical properties of soils of AEZ-12

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
High land (13%)	6.6-8.2	L-M	VL-L	VL-L	L-M	VL-L	M-Opt	M-Opt	L-M	VL-L	Opt
Medium highland (29%)	6.1-8.2	L-M	VL-L	VL-L	M-Opt	VL-L	M-Opt	M-Opt	L-M	VL-L	Opt
Medium lowland (31%)	5.8-7.1	L-M	VL-L	VL-L	M-Opt	L-M	M-Opt	M-Opt	L-M	VL-L	Opt
Lowland (14%)	5.9-7.6	M	VL-L	VL-L	M-Opt	L-M	M-Opt	M-Opt	L-M	L-M	Opt

OM=Organic matter; VL=Very low; L-Low; M=Medium; Opt=Optimum

Source: Fertilizer Recommendation Guide, BARC, 2012

(c) AEZ 13: Ganges Tidal Floodplain

184. This region occupies an extensive area of tidal floodplain land in the south-west of the country. The greater part of this region has smooth relief having large area of salinity. There is general pattern of grey, slightly calcareous, heavy soils on river banks and grey to dark grey, non calcareous, heavy silty clays in the extensive basins. Non-calcareous Grey Floodplain soil is the major component of General Soil Types. Acid Sulphate soils also occupy significant part of the area where it is very strongly acidic during dry season. In general, most of the top soils are acidic and sub-soils are neutral to slightly alkaline. Soils of the Sundarban area are alkaline. General fertility level is high with low to medium organic matter content and very high CEC and K status. There are limitations of high exchangeable Na and low Ca/Mg ratio. The Zn status is low to medium and the B and S status is medium to optimum. Some physic-chemical properties of soils of AEZ-13 are presented in Table 5.8.

Table 5.8: Some physic-chemical properties of soils of AEZ-13

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Medium highland (78%)	4.5-8.4	L-M	L	VL-L	M-Opt	M-Opt	Opt-H	M-Opt	L-M	M-Opt	Opt

OM=Organic matter; VL=Very low; L=Low; M=Medium; Opt=Optimum.
Source: Fertilizer Recommendation Guide, BARC, 2012

(d) AEZ 14: Gopalganj-Khulna Beels

185. This region occupies extensive low lying area between the Ganges River Floodplain and the Ganges Tidal Floodplain. Almost level, low –flying basins occupy most of the region with low ridges along rivers and creeks. The region is seasonally moderately deep to deeply flood by clear water. Basin centers stay wet through the dry season.

186. Soils of the area are grey and dark grey acidic heavy clays, peat or muck overlie at 25-100cm. Soft peat and muck occupy perennially wet basin centers. General Soil Types include mainly Peat and Noncalcareous Dark Grey Floodplain soils. Organic matter content is high. They have low bearing capacity when wet, very strongly acidic to neutral in top soil

reaction and low in K, B and Zn status. The C: N ratio is very wide. Some physic-chemical properties of soils of AEZ-14 are presented in Table 5.9.

Table 5.9: Some physic-chemical properties of soils ofAEZ-14

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Medium High land (13%)	4.8-7.5	H	L	L-M	L	VL-L	Opt	Opt	VL-L	VL	Opt
Medium lowland (41%)	4.7-7.3	H	VL-L	L-M	L	L-M	Opt	Opt	VL-L	VL-L	Opt
Lowland 28%)	4.3-6.7	H	VL-L	L-M	L	L-M	Opt	Opt	VL-L	VL-L	Opt
Very Lowland (11%)	4.0-6.4	H	VL-L	L-M	L	VL-L	Opt	Opt	VL-L	VL-L	Opt

VL=Very low; L=Low; M=Medium; Opt=Optimum; H=High.

Source: Guide, Fertilizer Recommendation BARC, 2012

5.4.2 Fertility status of soils in the polder area

187. Soil fertility is an important factor for crop production. In general the coastal regions of Bangladesh, organic matter content of the soil is pretty low (Haque, 2006). Thus in addition to salinity, plant nutrients in soils affect plant growth. Farmers reported that the soils are in general poor in organic matter content. According to local farmers and SAAO of DAE about fifty percent on the polder area became saline in the dry season before 2-3 years back, now salinity is reducing day by day because saline water can't enter in the crop field due to silted of khals.

5.4.3 Land use

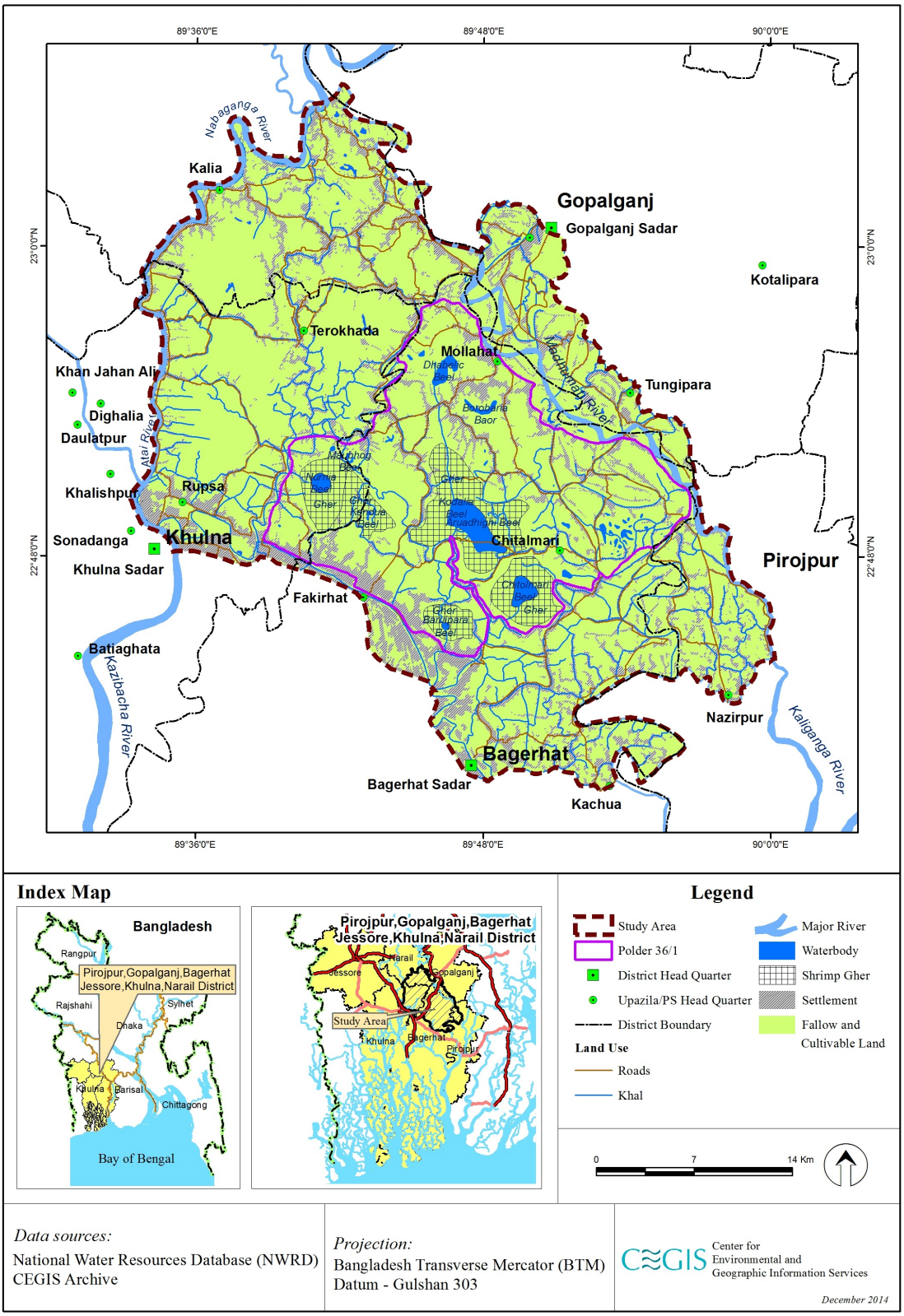
188. The agricultural production varies from one AEZ to another. Land use data has been analyzed using CEGIS-GIS analysis method. The gross area is 39,130 hectors. Of which net cultivable area (NCA) is 25,043 hectors. The coverage of settlement 7,305 hectares, beels 1,842, ghers 4,539, khals 204 hectors and roads 197 hectares. In the feasibility study final report, IWM, December 2013 said that about 6,257 hectares of the gross area is currently fallow. In the field visit it was observed that 4,539 hectors land became ghers and rest 1,718 hectares land are beels. Detailed of land use of the polder area is presented in Table 5.10. It is mention that the cultivable area of the polder is also using crop cultivation as well as gher culture activities.

Table 5.10: Detailed Land use in the polder area

Land use	Area (ha)	% of the total area
Net cultivable area	25,043	64
Settlements	7,305	18.7
Beels	1,842	4.7
Ghers	4,539	11.6
Khals	204	0.5
Roads	197	0.5
Gross area	**39,130**	**100**

Sources: CEGIS and Feasibility study Final Report, IWM, December 2013

Polder 36/1: Land Use Map



Map 5.7 :Land use Map of the study area

5.4.4 Land Form

189. The whole polder area is occupied by Basin and Ridge. The different types of landforms influence the land use related to agricultural crop production. Detailed of landform of the polder area is presented in Table 5.11

Table 5.11: Detailed distribution of major land form in the polder area

Land form	Area (ha)	% of the total area
Basin	20670	53
Ridge	18460	47
Total	**39,130**	**100**

Sources: CEGIS estimation from SOLARIS-SRDI, 2006

5.4.5 Land types

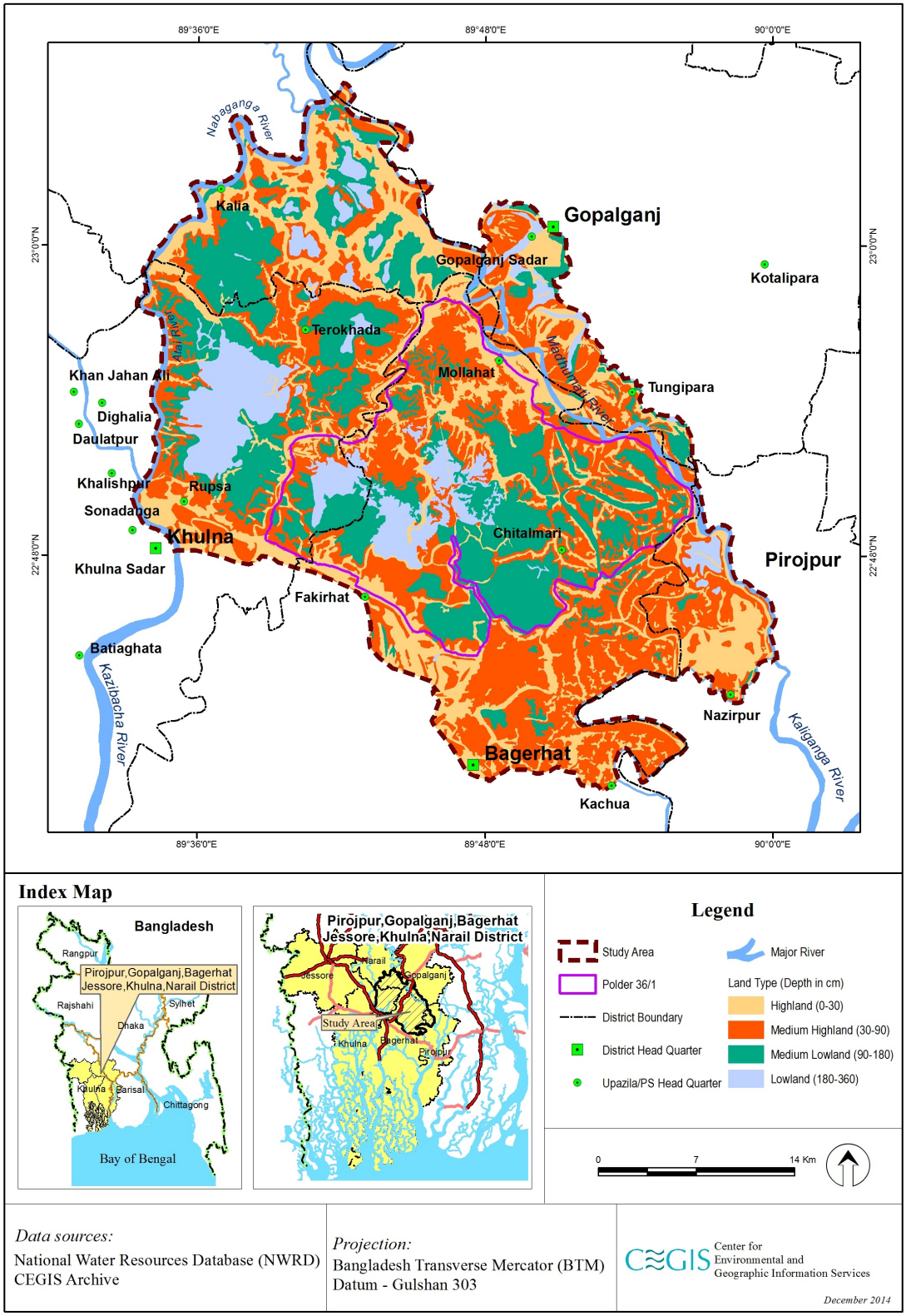
190. Land type is a system of classifying cultivated land based on the seasonal inundation depth in normal flooding year. According to Soil Resource Development Institute (SRDI, 1988), four land types have been classified in terms of depth of flooding on agriculture land. The entire polder area is four types of land were observed. In the feasibility study final report, December 2013 says low land is 72 ha. According to local farmers and local five SAAO's of DAE low land is about 5428 ha. The coverage of different land types of the polder area is presented in Table 5.12.

Table 5.12: Distribution of land type in the polder area

Land Type	Description	Flooding depth (cm)	Flooding characteristics	Area (ha)	% of NCA
FF	High land	Flood Free	Non-flooded	7,632	20
F_0	High land	0-30	Non-flooded	5,355	14
F_1	Medium High Land	30-90	Seasonal	14,495	37
F_2	Medium Low Land	90-180	Seasonal	6,220	16
F_3	Low land	180-360	Seasonal, but remains wet in early dry season	5,428	14
Total				**39,130**	**100**

Sources: CEGIS field visit and MPO and Institute of Water Modeling, Feasibility Study Final Report, December 2013.

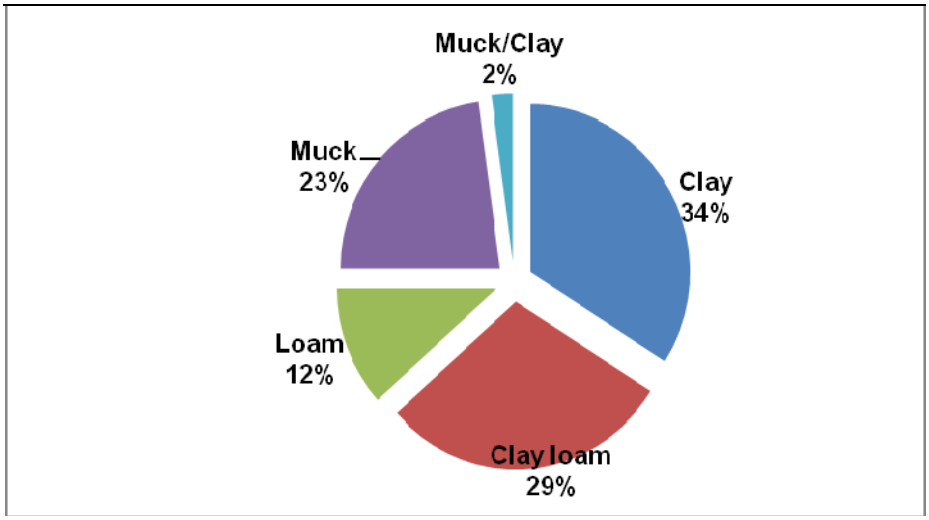
Polder 36/1: Land Type Map



Map 5.8 :Land Type Map of the study area

5.4.6 Soil Texture

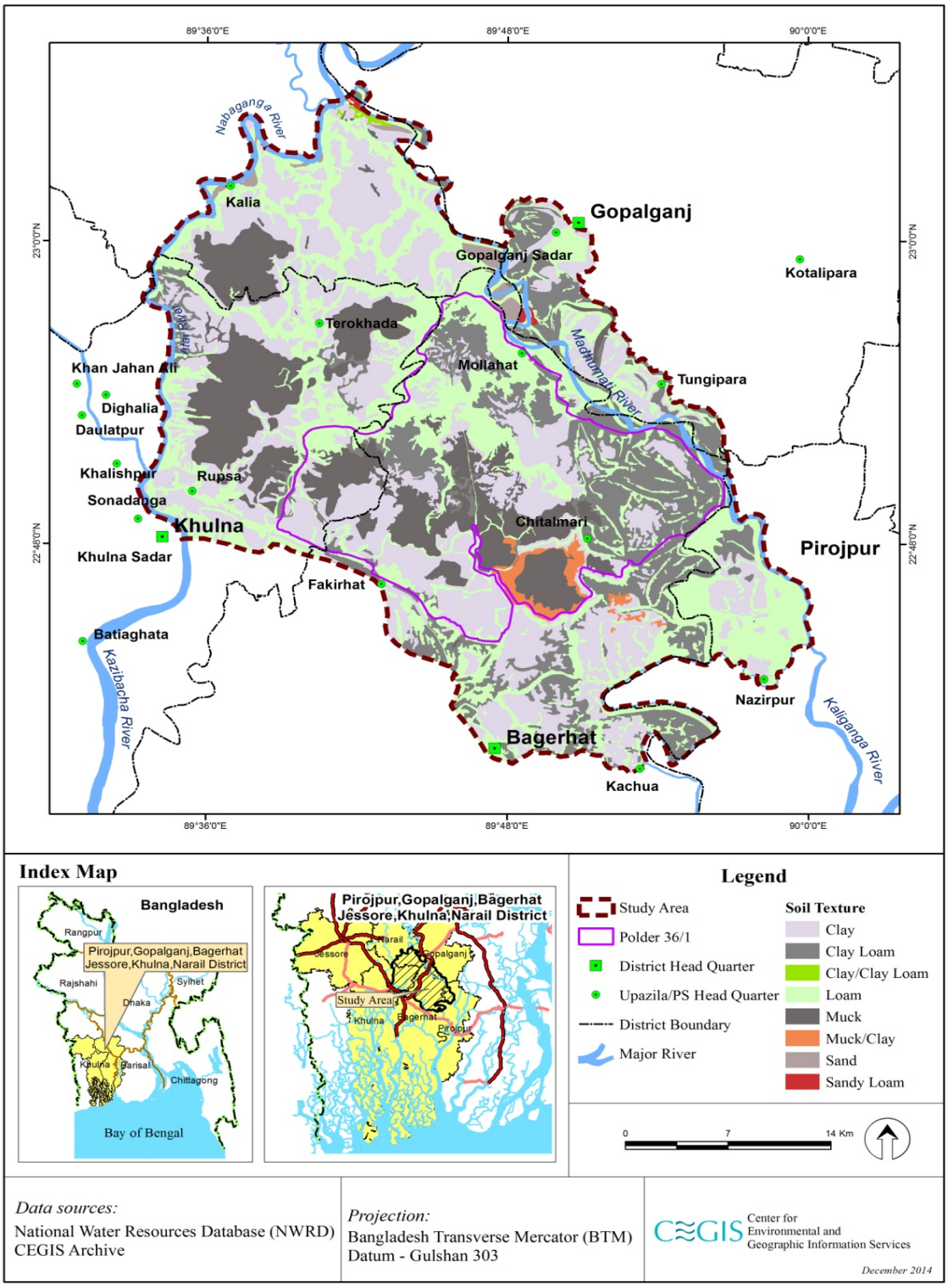
191. Soil texture is an important soil characteristic that says crop selection and crop production and also for field management. It influences many other properties of great significance to land use and management. Soil texture is the relative proportions of sand, silt and clay. Soil can be calcified as one of four major textural classes: a) sands b) silts c) loams and d) clays. It is very important for agriculture crop production. It influences many other properties of great significance to land use and management. The maximum soil texture is clay (34%) which is followed by clay loam (29%). The clay soils have a greater water holding capacity than sandy soils. Detailed soil texture is presented in Figure 5.15.



Source: Institute of Water Modeling, Feasibility Study Final Report, December 2013

Figure 5.15: Soil texture of the surface soil (0-15 cm) in the polder area

Polder 36/1: Soil Texture Map



Map 5.9 :Soil Texture Map of the study area

5.4.7 Soil Salinity

192. Saline soils are affected by salt at some time of the year. About 10% of NCA is affected by salinity in the polder area. Farmers reported that the soil salinity of the area reducing day by day. Some soils on tidal and estuarine floodplains are occasionally flooded by salt water during the monsoon season, which may not damage aus or transplanted aman. Local farmers reported that large farmers are entering saline water in the polder area for shrimp culture mainly in the low laying areas. The soils of the polder area became 40% non saline with some very slightly saline (2.0-4.0 dS/m) in 2009, whereas in 2000 it was 36% i e. 4% increased in top soil, 49% very slightly saline with some slightly saline (4.1-8.0dS/m) in 2009 whereas it was 60% in 2000 i.e 11% decries and 11% very slightly saline with some slightly saline (4.1-8.0dS/m) in 2009, where as it was 4% in 2000 i.e 7% increased in the months of March-May. According to SRDI, soil salinity mainly confined in the Low Ganges Floodplain and Gopalgonj-khulna Bils. In this polder, it is found that most of the water control structures are not functioning properly. As a result, this is unable to restrict the saline water to intrude inside the polder, thereby; this is reported as the major cause of the salinity increment inside the polder. Sometimes saline water is coming inside the polder but not creating problems for agricultural land. Detailed soil salinity status of the polder area is presented in Table 5.13.

Table 5.13: Detailed soil salinity status in the polder area

Salinity Class	2000		2009	
	Area (ha)	% of NCA	Area (ha)	% of NCA
Non saline with some very slightly saline (2.0-4.0 dS/m)	14,107	36	15,595	40
Very slightly saline with some slightly saline (4.1-8.0dS/m)	23,530	60	19,213	49
slightly saline with some moderately saline (7.1-12 dS/m)	1,493	4	4,321	11
Total	**39,130**	**100**	**39,130**	**100**

Sources: CEGIS estimation from SOLARIS-SRDI, 2006

5.4.8 Available soil moisture

193. The availability of soil moisture varies depending on the soil characteristics. The available soil moisture is very important for the cultivation of different crops. The soils having high levels of available soil moisture are highly suitable for cultivation of Rabi crops, (especially early rabi crops: pulses, mustard, wheat, onion, chilli, sesame, betel leaf, winter vegetables etc.) under rain fed and partial irrigated conditions. According to SRDI, the available soil moisture has been classified into four categories. Maximum area 46% is covered with low level of soil moisture and the second highest is 34%. Detailed distribution of available soil moisture of the polder area is presented in Table 5.14

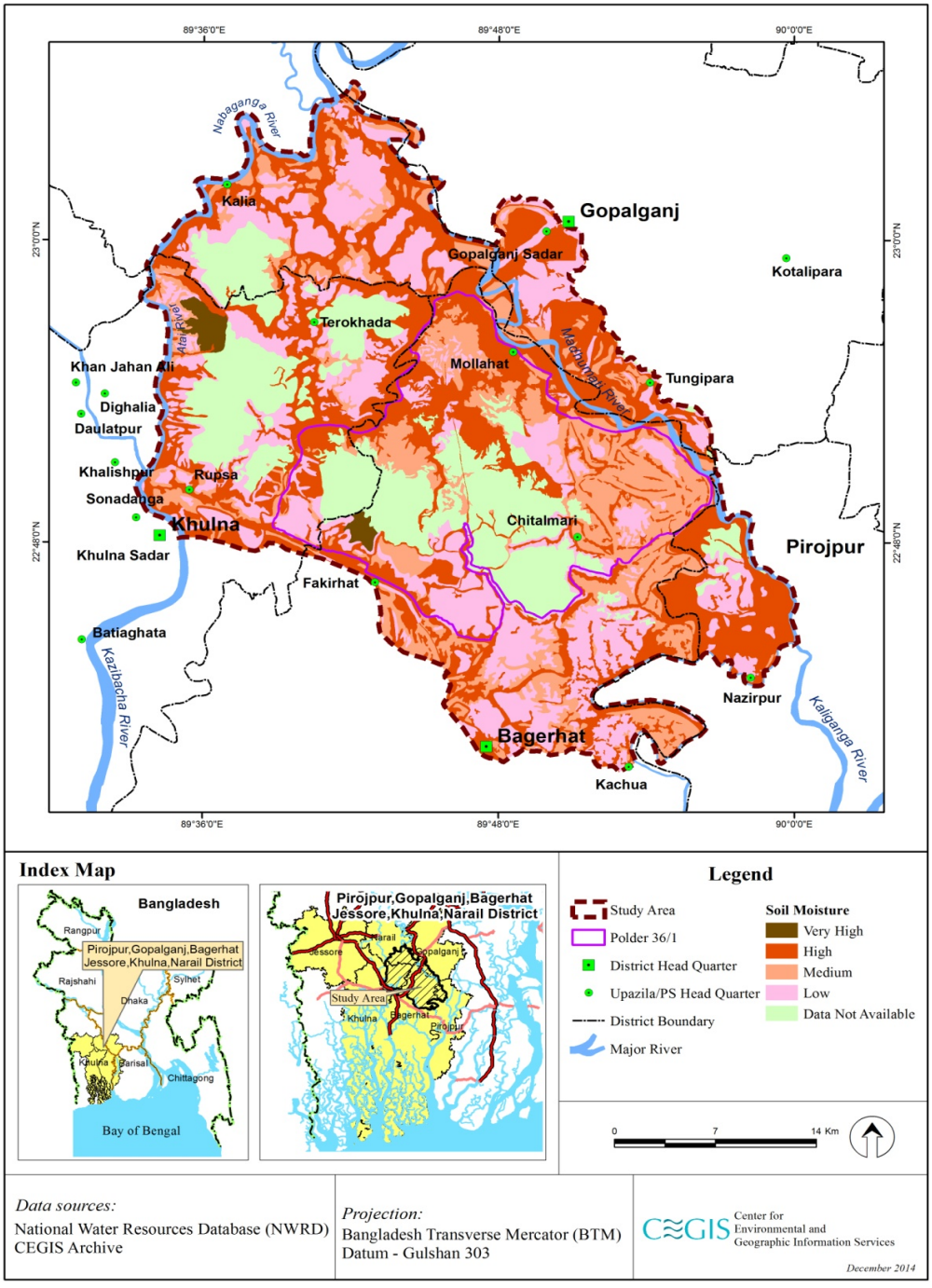
Table 5.14: Detailed distribution of available soil moisture in the polder area

Classification of soil based on available soil moisture	Characteristics	Area (ha)	% of polder area
Very High	Plant extractable moisture remained in field level from more than three months	382	1
High	Plant extractable soil moisture remained in field level from two to three months	7,361	19
Medium	Plant extractable soil moisture remained in field level for one to two months	13,394	34

Classification of soil based on available soil moisture	Characteristics	Area (ha)	% of polder area
Low	Plant extractable soil moisture remained in the field level less than one month	17,993	46
Total		**39,130**	**100**

Source: CEGIS estimation from SOLARIS, 2006

Polder 36/1: Soil Moisture Map



Map 5.10 :Soil Moisture Map of the study area

5.4.9 Drainage Characteristics

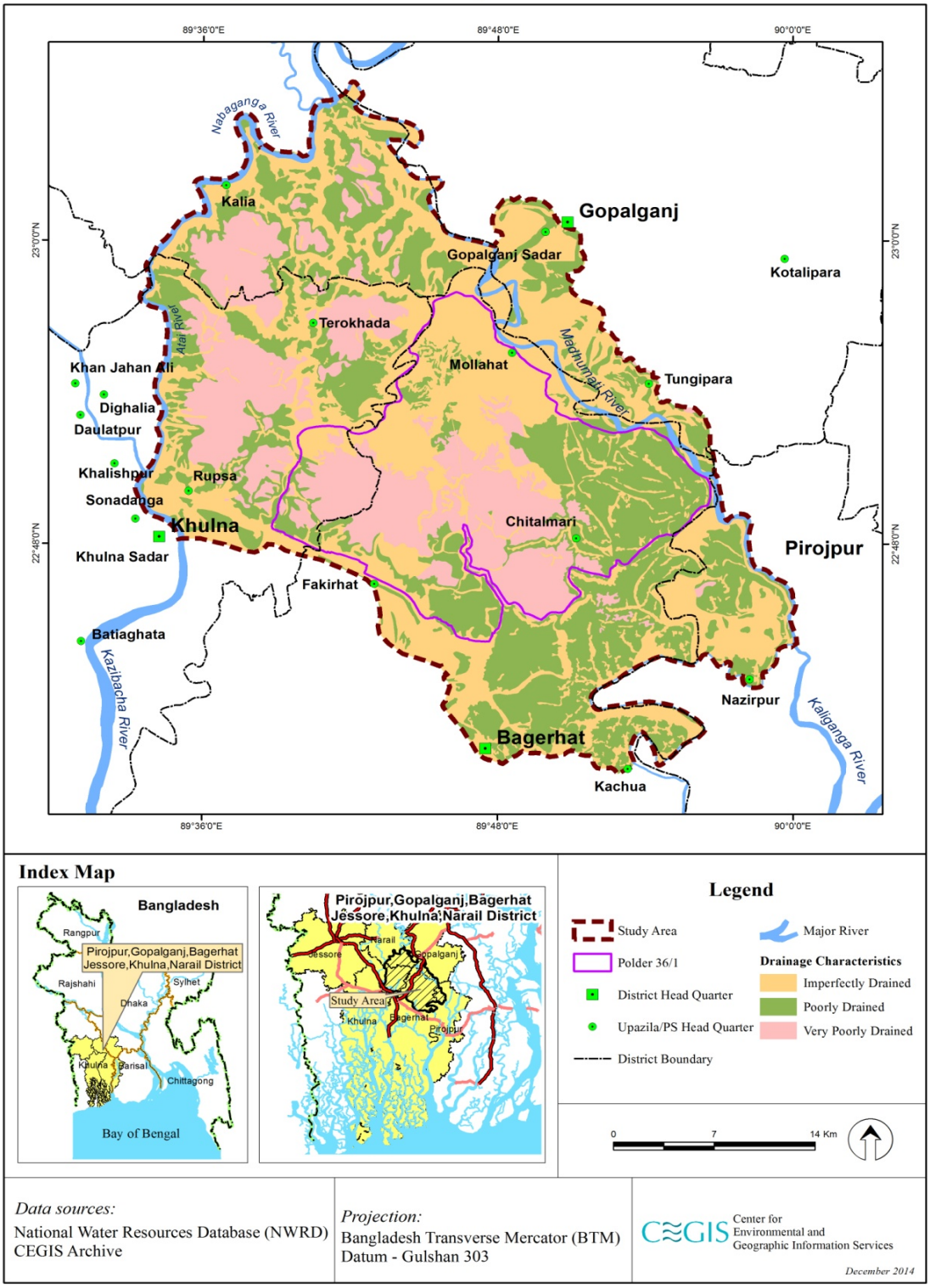
194. Drainage plays a vital role in the management of soil (salinity, soil health) in the polder area. As per the SRDI (1988), the drainage characteristics have been divided into six classes from the agriculture point of view. The most of the polder area (46%) of the NCA is covered under very poorly drained conditions and the rest are poorly drained 31% and imperfectly drained 23%. The dominance of very poorly drained soil of the polder area indicates that the removal of water in the rainy / monsoon season is the main constraint for growing dry land crops in the polder area. Detailed drainage characteristics along with area of the polder are presented in Table 5.15.

Table 5.15: Detailed drainage characteristics of the polder area

Drainage classes	Drainage characteristics	Area (ha)	(%) of total area
Imperfectly drained	Water drained from soil badly or slowly. This soil often remains wet in rainy season due to rainfall. In normal situation, water does not stand on land more than 15 days at a stretch. In rainy season, groundwater stands within 1 meter at least for some time.	9,058	23
Poorly drained	The soil remains under water from 15 days to 7/8 months. Water is drained from the soil slowly. In most cases, the land remains wet/water logged for a considerable period of time after the rainy season.	12,130	31
Very Poorly drained	The land remains submerged under water for more than 8 months and remains wet throughout the year.	17,942	46
Total		**39,130**	**100**

Source: CEGIS estimation from SOLARIS-SRDI, 2006

Polder 36/1: Drainage Characteristics Map



Map 5.11 :Drainage Charecteristics Map of the study area

5.5 Agriculture Resources

5.5.1 Farming practices

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

196. The Kharif-I season is characterized by high temperature, low humidity, high evaporation, high solar radiation and uncertainty of rainfall of low alternating dry and wet spells. In this season, a total of 3,315 hector land is cultivated (B Aus local, T Aus HYV, Turmeric, Betel leaf, Sugercan and S. vegetables) in the polder area and the remain lands are fallow.

197. The Kharif-II/monsoon cropping season is characterized by high rainfalls, lower temperatures, high humidity, and low solar radiation. This season has high probability of flooding that recedes at the end of the season. Rice is the predominant crop grown during this season due to the submergence of soil. Excessive soil moisture and higher temperature restricts other crops grow in that area. In this polder a total of 7073 hector land is cultivated HYV T. aman, Turmeric, Betel leaf, Sugercan and S. vegetables) in the polder area and the remain lands are fallow in this season.

198. The Rabi season, crops are favored with high solar radiation, low humidity, salinity and temperature but lack of adequate soil moisture depresses the crop yield because of very low or evens no rainfall throughout the season. Wide ranges of crops can be grown in this season. Major crops grown in this season of the polder area are Sesame Pulsed, Wheat, Mustard, Onion, Chilli, Turmeric, Betel leaf, Sugarcane, W. Vegetables, Boro Hybried and HYV Boro. Betel leaf and sugarcane are annual crops in the project area. However, there are occasional overlaps such that, Kharif-I season crops Aus (HYV) rice are harvested in Kharif-II seasons, Kharif-II season crops (Aman rice) are harvested in Rabi season and Rabi season crop (HYV Boro, Hybrid Boro, Chilli etc.) are harvested in Kharif-I season.

5.5.2 Crop production constraints

199. The following crop production constraints have been identified through field visit and group discussions with the local farmers:

- Drainage congestion during transplanting period in Aman season
- Most of the water control structures (Regulators) are not functioning properly.
- Due to impact of climate change the level of sea water increase which is caused to natural calamities such as tidal surge, cyclone and increase of water and soil salinity etc.
- Severe scarcity of irrigation water during dry season especially for rabi crops cultivation;
- The siltation caused raise of bed of different internal drainage khals and rivers.

200. Above situations are unfavorable for crop production.

5.5.3 Major Cropping pattern in the polder area

201. There are four land types are in the polder area. The most common cropping pattern in the study area is Fallow- Fallow- Boro (Hybrid) covers about 30.67% of Net Cultivable Area (NCA). The next popular cropping pattern is Fallow- Fallow- Boro (HYV) which is cover about 13.38% of NCA. About 19.99% area of NCA remains fallow through ought the year. In aus season farmers are growing rice local varieties (Nona kochi, Choto nona kochi, Baro nona kochi, Sada mota ,Lal mota, Kali jira and Cheni kanai) and HYV (BR24). In T. aman season farmers are growing BRRI dhan30, BRRI dhan32, BRRI dhan33, BRRI dhan34, BRRI dhan37, BRRI dhan 38 and in boro season farmers are growing (Shachal, Hera-1, 2 and 6, Ispahani-2, Rajkumar, Janak Raj, Rupali and Sathi Hybrid) and BRRI dhan 35, BRRI dhan 36. Among the other crops and varieties pulses, oilseed, spices, vegetables seeds were used local and HYVs. In addition the vegetables crops, red amaranth, indian spinach, all gourds (about 10% BARI, developed crop varieties) are popular among the farmers. Major cropping patterns of the study area are presented in Table 5.16.

Table 5.16: Existing cropping pattern of the polder area

Major Cropping Patterns			Area (ha.)	% of NCA	Cropped Area (ha.)
Kharif-1 (March-June)	Kharif-2 (July-October)	Rabi (Nov.-February)			
Fallow	Fallow	Boro (HYV)	4250	13.58%	4250
Jute	Fallow	Boro (HYV)	1250	3.99%	2500
Fallow	Fallow	Boro (Hybrid)	9600	30.67%	9600
Fallow	Fallow	Boro (Local)	450	1.44%	450
B. Aus (Local)	Fallow	Pulses	1030	3.29%	2060
T. Aus (HYV)	Fallow	Pulses	360	1.15%	720
Fallow	T. Aman (HYV)	Wheat	150	0.48%	300
Fallow	T. Aman (HYV)	Mustard	550	1.76%	1100
Fallow	T. Aman (HYV)	Onion	50	0.16%	100
Fallow	T. Aman (HYV)	Chillies	100	0.32%	200
Fallow	T. Aman (HYV)	Till	101	0.32%	202
Fallow	T. Aman (HYV)	Fallow	4197	13.41%	4197
Turmeric	Turmeric	Turmeric	80	0.26%	80
Betel leaf	Betel leaf	Betel leaf	350	1.12%	350
Sugarcane	Sugarcane	Sugarcane	690	2.20%	690
S. Vegetables	S. Vegetables	Fallow	805	2.57%	1610
Fallow	Fallow	W. Vegetables	1030	3.29%	1030
			25043		
Fallow	Fallow	Fallow	6257	19.99%	0
Total			**31300**	**100%**	**29439**
				Cropping Intensity=	**117.55%**

Source: Institute of Water Modeling, Feasibility Study Final Report, December 2013

Note:

A total of 6,257 ha land was shown as fallow-fallow-fallow in the feasibility study final report by IWM. In the field visit it was observed that about 4,539 hectors land became ghers and rest 1,718 hectors land are beels. The area 4539 ha is used for boro crop cultivation after completion of gher activities.

Photo 5.8: Discussion with the local community in the polder 36/1 area

Photo 5.9: View of betel leaf garden in the polder 36/1 area

Photo 5.10: View of rice field in the polder 36/1 area

Photo 5.11: View of T. aman crop damage in the polder 36/1 area

5.5.4 Cropped area and cropping intensity

202. Total cropped area is about 29,439 ha. The single cropped area is about 82% and double cropped area is about 18% and triple cropped area is 3.32% of the NCA respectively. The cropping intensity of the study area is about 117.55%. Major cropping pattern of the polder area is presented in above Table 5.16.

5.5.5 Crop Damage

203. Crop damage along with area was collected from the field in consultation with farmers, and officials of DAE. Generally crop damage occurs almost everywhere inside the polder area and the study area. Information on the table was sited only from inside the polder area. Inside the polder area crop damage by drainage congestion, heavy rainfall, partially salinity & drainage congestion etc. was reported by farmers and the local SAAO of DAE. Crop production loss has been calculated using the formula: - *Crop production loss = Total cropped area × damage free yield - (damaged area ×damaged yield + damaged free area × damage free yield).* Crop damage, percent of area and timing are presented in Table 5.17. Total loss of rice production is about 2,621 tons in 1,479 ha and loss of non-rice production is about 172 tons in 199 ha due to drainage congestion, siltation of khals and

drainage channels, effect of salinity, natural calamities etc. Details are presented in below Table 5.17.

Table 5.17 Crop damage in the polder area

Crop name	Location	% of damage area	Timing	Causes of damage
HYV Aus	Pocket area in the polder	10	May-Jun	Soil salinity, drought & drainage congestion
HYV Aman	Entire polder area	12	July-August	Heavy rainfall & drainage congestion
HYV Boro	Pocket area in the polder	15	April-May	Soil salinity, Heavy rainfall drought & drainage congestion
Pulses	Entire polder area	10	April-May	Heavy rainfall & drainage congestion
Oilseed	Pocket area in the polder	10	April-May	Heavy rainfall & drainage congestion
Spices	Pocket area in the polder	5	April-May	Heavy rainfall & drainage congestion

Source: Based on field information and local SAAO of DAE, 2014

Photo 5.12: View of HYV Boro damage in the polder 36/1

Photo 5.13: SAAO explaining present land and crops situation in the polder 36/1

5.5.6 Agriculture Inputs Use (seed, labor, fertilizers, pesticides and ICM)

204. Soil fertility is an important factor for crop production. Local people reported that in general the polder area is quite low in soil fertility. The organic matter content of the top soils ranges from less than 1% to 1.25%. The low organic content in soils indicates poor physical condition of the polder soils. Thus in addition to plant nutrients in soils affect plant growth. According to the local farmers last two years there are few area is soil salinity but soils are in general poor in organic matter content. Seed, labor, fertilizer, pesticide, ICM and irrigation are the major inputs for crop production.

a. Seed

205. The role of seeds is very important for growing crops. Selection of seeds should be considered on the basis of more than 85% germination rate, free from disease infestation, good shape and size and high yield potential. According to four land zone (AEZ 11, AEZ 12,

AEZ 13, AEZ 14) recommended seed rate presented in Table 5.18 (BARI 2011-2012 and BRRI 2011). The seed rate used by the farmers in the polder area is also presented in the below Table 5.18. In case of rice, farmers are using more seed than recommended as they normally use more seedlings per hill in case of local and HYV varieties but in case of hybrid farmers are growing one seedling per hill and using plant to plant distance more then 3-4 inches than recommendation. According to UAO's 18 seed dealers are in the polder area. In addition BRAC is camping in the market, for hybrid rice. Sometimes, they have to retrains plant due to damage caused by heavy rainfall during monsoon season. The seed rate of vegetables generally depends on the size and viability of the seed. The available seeds were in very good condition. Farmers reported that they prepared land very smoothly.

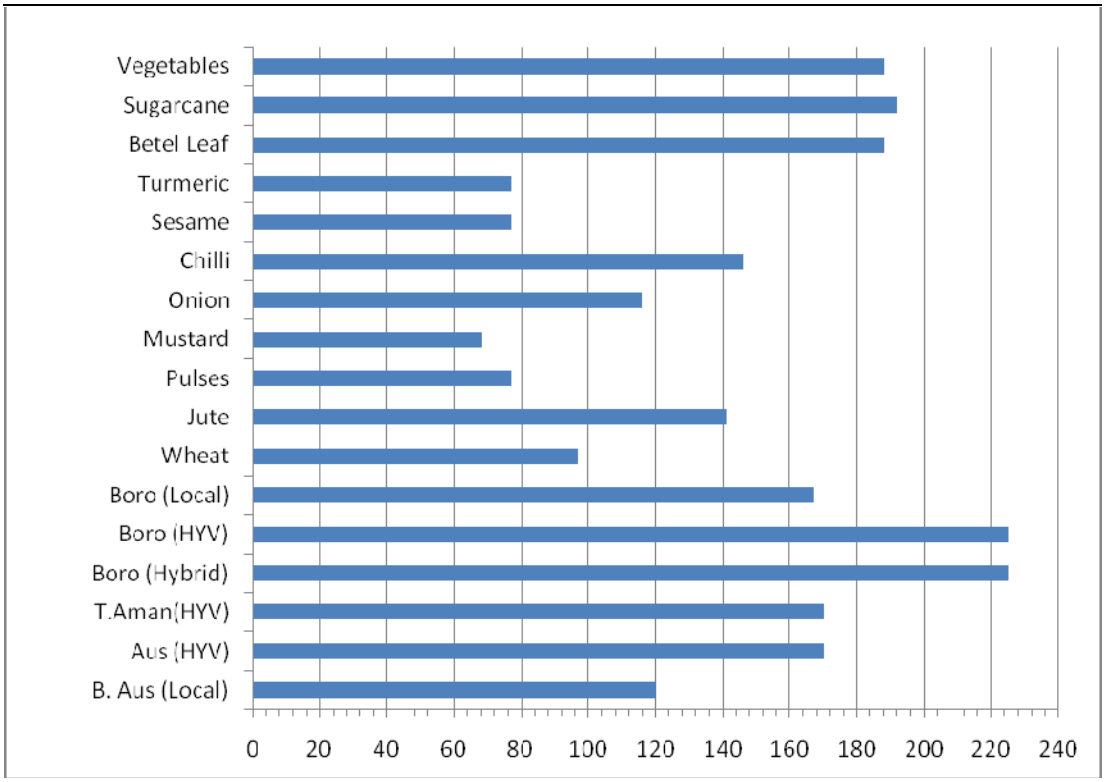
Table 5.18 Seed used by the farmers in the polder area

Name of crops	Farmers used (Kg/ha)	Recommended (kg/ha)
B. Aus (Local)	50-60	55
Aus (HYV)	45-50	40
T.Aman(HYV)	50-55	40
Boro (Hybrid)	10-12	8
Boro (HYV)	45-50	40
Boro (Local)	50-55	55
Wheat	120	120
Jute	8	8
Pulses	20-25	30
Mustard	15	7
Onion	5	4
Chilli	2	0.23
Sesame	9	7
Turmeric	200	250
Betel Leaf	1900 c	2000 c
Sugarcane	3,625 c	3,500 c
Vegetables	2	2

Source: BARI, Agriculture Technologies, 2012-2013 and Hand Book of Agricultural Technology, BARC 2012 and field information, November, 2014

b. Labor

206. In the polder area, almost 80% of the cultural practices for crop production are being done manually. So, agricultural labor is considered as one of the essential inputs for crop production. The labor requirement is not uniform throughout the year. The number of labor requirement varies from crop to crop and season to season. Local farmers reported that females are involved mainly for pulses, oilseed and spics crops harvest and post harvest technologies work. Crop wise average number of labor both male and female used per hectare in the polder area is presented in Figure 5.16.



Source: Local farmers interviewed, and SAAO of DAE, November, 2014

Figure 5.16: Crop wise average number of labor per hectare in the polder area

c. Fertilizer

207. The use of fertilizer in the project area is presented in Table 5.19. The rate of fertilizer use per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability etc. The major fertilizers used in this area are Urea, TSP, MP and Gypsum. Most of the cases (75%) farmers use fertilizers in unbalanced way. Organic manures are not used by the farmers in the field crops. Local farmers and SAAO of DAE reported that about 90% of cowdung used for fuel purpose. On the other hand they are using less chemical fertilizer than the recommended dozes in all most all crops. According to local farmers and UAO's, all most every local market there is about 30 fertilizer dealers inside the polder area. About 50% dealer shop there is chart for recommended dozes of fertilizers. Local farmers also reported that they don't have enough money to buy fertilizer. About 30-35% of the households have compost pit in there homestead area. Compost is mainly used in homestead area for pit crops. Recommended doses of fertilizer and presently what farmers are using are presented in the Table 5.19. Recommended rate was shown as per developed by BARC, 2012, on the basis of agro-ecological zone.

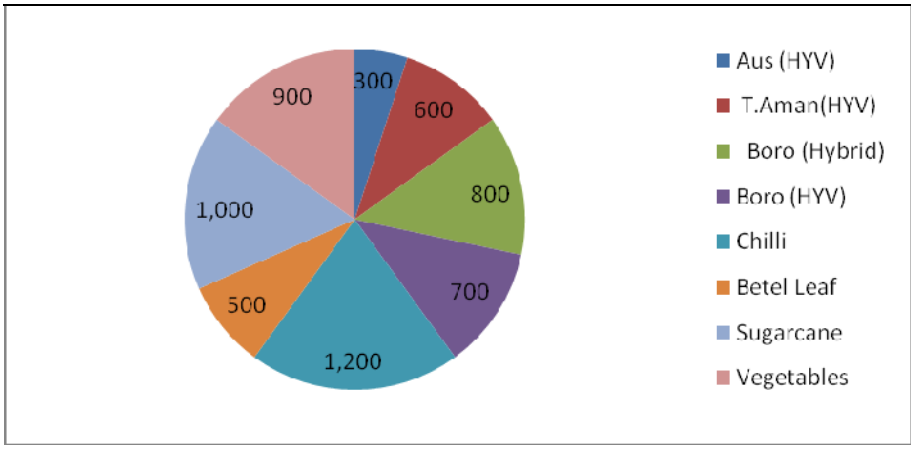
Table 5.19: Fertilizer application of the polder area

Crop name	Farmers using fertilizer (Kg/ha)						Recommended fertilizer (kg/ha)					
	Compost	Urea	TSP	MP	Gypsum	Zn	Compost	Urea	TSP	MP	Gypsum	Zn
B. Aus (Local)	0	30	10	5		0	0	85	10	15	0	0
Aus (HYV)	0	50	20	25		0	0	141	22	20	8	2
T.Aman(HYV)	0	60	20	10		0	0	163	35	30	0	0
Boro (Hybrid)	0	50	40	30	5	0	0	284	58	65	25	5
Boro (HYV)	0	60	20	5		0	0	272	44	58	17	4
Boro (Local)	0	60	25	10		0	0	150	24	12	0	0
Wheat	0	40	20	10	5	0	0	261	67	110	42	3
Jute	0	70	40	20		0	0	241	22	70	36	0
Pulses	0	40	10	5	0	0	45	67	20	0	0	0
Mustard	0	100	70	50		0	0	280	175	90	140	6
Onion	0	60	70	50		0	5,000	196	100	133	83	4
Chilli	0	90	48	38		0	1,000	70	42	53	14	1.3
Sesame	0	100	45	5	0	0	0	170	60	31	0	1.3
Turmeric	0	120	80	55		0	2,000	200	170	160	105	2
Betel Leaf	300-400	175	24	20	10	0	3,000 (oil cake)	65	27	25	17	0
Sugarcane	0	155	100	70	10	0	0	358	120	100	125	7
Vegetables	200-500	180	150	80	10	0	217	80	50	14	3	2

Sources: Institute of Water Modeling, Feasibility Final Report, December 2013, Hand Book of Agricultural Technology, BARC and local farmers interviewed, October, 2014; c= cutting, g = gram

d. Pesticides

208. The use of pesticides depends on the degree of pest infestation. The major insects as reported by the farmers are Stem borer, Ear cutting cater pillar, Green leaf hopper, Rice hispa, Brinjal fruit and shoot borer, diseases are Leaf and sheath blight, Root rot etc. Local farmers reported that they are using different types of pesticides such as Diazinon, Basudin, Cup, Karate, Sunfuran, Kuratap and Dimecron etc. to prevent pest infestation in rice, vegetables and cropland. Both liquid and granular pesticides are being used to prevent pest infestation in the rice, wheat spices and tuber crops cultivation pesticide is not required. Detailed information of pesticides used is presented in Figure 5.17. Melathion and BARI trap are used in bitter gourd and other gourd for prevention of pest infestation. Local farmers and SAAO of DAE reported that there are some crops like local rice, wheat, jute, pulses, mustard and onion where farmers are not using any pesticides.



Sources: Institute of Water Modeling, Feasibility Final Report, December 2013, Hand Book of Agricultural Technology, BARC and local farmers interviewed, October, 2014; c= cutting, g = gram

Figure 5.17: Crop wise pesticides application liq. approximately (ml/ha)

5.5.7 Integrated Crop Management (ICM)

209. The practices of Integrated Crop Management (ICM) are rarely found in the project area. DAE has taken active part on ICM mainly for rice field. In this system, insects are controlled biologically. Farmers of the ICM areas use branches of trees, bamboo sticks and jute sticks etc to make favorable perches for birds in fields with standing crops. The birds eat the insects which help control infestation. In this process, the crops are protected without applying pesticides. Trap is another technique for controlling pests under ICM. This system used in the agriculture fields especially on gourd family and vegetables for attracting insects. At the base of the trap, there is a sheet generally made of steel that slopes downward. Thus, it is possible to control the harmful insects without the application of pesticides. In the polder areas the ICM technique is mainly applied on rice crop. Field information (Farmers, SAAO of DAE) indicates that ICM is being practiced in the fields covering about 20 to 30% of the cultivated areas in the polder area and the impact has been found very encouraging.

5.5.8 Irrigated area by crops

210. Surface water is the major source of irrigation water. Surface water irrigation is extracted with the help of Low Lift Pumps (LLPs) from Internal river (Modhumoti) and internal khals which is covered 15,514 hectares and by Shallow Tube-Wells (STW) 5,978 hectares. According to local farmers total irrigation coverage of the polder area is about 60% of the

total NCA during the dry season mainly in boro, vegetables, wheat, chilli and partially in betel leaf crops. Local farmers reported that for irrigation per hectares of land it needs tk 5, 000 to 5,500. Detailed information's on irrigation are presented in Table 5.20.

Table 5.20: Irrigated area by crop in the polder area

Crop name	Irrigation by LLP	Irrigation by STW	Charge (tk/ha)
	NCA area in ha.	NCA area in ha.	
HYV Boro	13,100	2600	5,000-5,500
Wheat	150	0	5,000-5,500
Vegetables	1835	580	5,000-5,500
Chilli	100	0	5,000-5,500
Betel Leaf	750	350	5,000-5,500
Sugarcane	0	805	5,000-5,500
Turmeric	80	80	5,000-5,500

Source: CEGIS Estimation based on field information 2014 and SAAO of DAE

5.5.9 Crop yield level (Normal and damaged)

211. Farmers informed that drainage congestion and partial soil salinity is the constraint to crop production inside the polder area. Normally, crops are being damaged due to drainage congestion, for siltation of drainage channels, and natural calamities etc. In addition, early rain causes damage of some pulses and oilseed crops and Aman seedbed, Aman and vegetables crops at early growing stages. This causes reduction of average yields. However, the crop yield rate was estimated from the information collected from DAE office and in consultation with the local farmers at field level of the project area. The yield of rice is estimated as cleaned rice. All vegetables yield were calculated and average value was used. Demonstration yield of local DAE, farmers yield and damaged yield of crops are presented in Table 5.21. Local DAE demonstration yield proves that it is possible to increase crop production in the polder area.

Table 5.21: Crop Yield level by different crops in the polder area

Crop name	Yield(ton/ha)			
	Local demonstration results by DAE	Farmers (about)	Damage (about)	Damage free (about)
Aus (HYV)	3.1	2.3	0.5	1.8
B. Aus	0	1.28	-	1.28
Aman(HYV)	2.5	2.69	0.65	2.04
Boro(Local)	2	1.93	-	1.93
Boro (HYV)	3.4	3.78	0.85	2.93
Boro(Hybrid)	4.5	3.55	0	2.55
Wheat	3.5	2.76	0	2.76
Jute	Data was not available	7.93	0	7.93
Pulses	1	0.93	0.25	0.68
Mustard	1	0.87	-	0.87
Onion	7.1	6.25	-	6.25
Chillies	1.5	1.21	-	1.21
Sesame	1	0.88	0.35	0.53

Crop name	Yield(ton/ha)			
	Local demonstration results by DAE	Farmers (about)	Damage (about)	Damage free (about)
Turmeric	25	20	-	20
Betel Leaf	Data was not available	8.83	-	8.83
Sugarcane	Data was not available	42	-	42
Vegetables	16.7	15.23	-	15.23

*Sources: Institute of Water Modeling, Feasibility Final Report, December 2013 *Indicates cleaned rice*

5.5.10 Crop Production

212. In the polder area, the annual total crop production is about 142,828 tons of which rice is about 51,310 tons (36%) and 91,518 tons (64%) non-rice is produced. Among the rice crops, the contribution of Aus (HYV), B.Aus, Aman (HYV), Boro (Local), Boro (HYV) and Boro (Hybrid) are about 1%, 3%, 19%, 2%, 28% and 48% respectively. Detailed annual crop production and crop production loss is presented in the Table 5.22.

Table 5.22: Annual crop production and crop production loss of the polder area

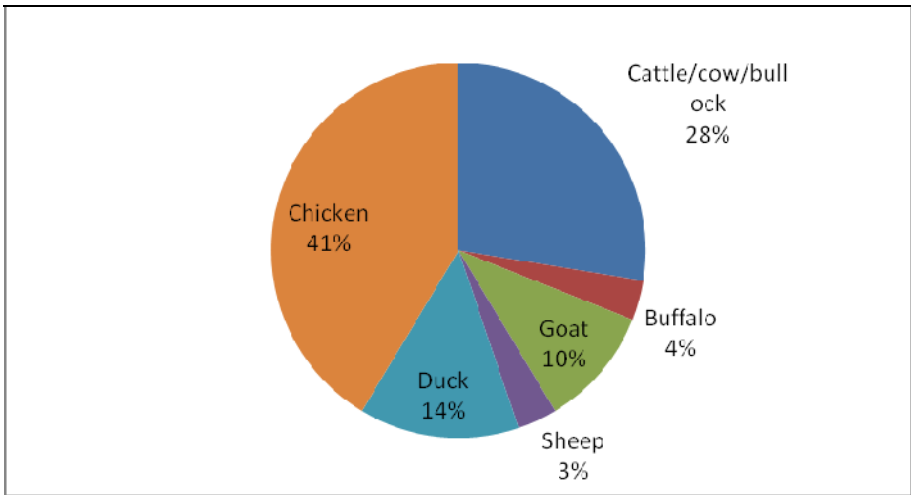
Crop Name	Crop Area (ha)	Damage Free		Damaged		Total Production (ton)	Production loss (ton)	Production (%)	Production loss (%)
		Area (ha)	Yield (ton/ha)	Area (ha)	Yield (ton/ha)				
Aus(HYV)	360	324	2	36	1	601	47	1	2
B. Aus	1,030	1,030	1	-	-	1,318	-	3	-
Aman(HYV)	5,148	4,530	2	618	1	9,643	859	19	33
Boro (Local)	450	450	2	-	-	869	-	2	-
Boro(HYV)	5,500	4,675	3	825	1	14,399	1,716	28	65
Boro (Hybrid)	9,600	9,600	3	-	-	24,480	-	48	-
Total Rice	**22,088**	**20,609**		**1,479**		**51,310**	**2,621**	**100**	**100**
Wheat	150	150	3	-	-	414	-	0	-
Jute	1,250	1,250	8	-	-	9,913	-	11	-
Pulses	1,390	1,251	1	139	0	885	60	1	53
Mustard	550	495	1	55	-	431	48	0	43
Onion	50	50	6	-	-	313	-	0	-
Chillies	100	95	1	5	0	97	4	0	4
Sesame	101	101	1	-	-	54	-	0	
Turmeric	80	80	20	-	-	1,600	-	2	
Betel Leaf	350	350	9	-	-	3,091	-	3	
Sugarcane	690	690	42	-	-	28,980	-	32	
Vegetables	2,640	2,640	15	-	-	40,207	-	44	
Total Non - Rice	**7,351**	**7,152**		**199**		**91,518**	**112**	**94**	**100**
Total	**29,439**	**27,761**		**1,678**		**1,42,828**	**2,733**	**-**	**-**

Source: CEGIS estimation from Institute of Water Modeling, Feasibility Study Final Report, December 2013

5.6 Livestock and poultry Resources

5.6.1 Status of livestock and poultry

213. Livestock provide significant draft power for crop cultivation and poultry being essential elements of integrated farming system, play an important role in the economy of the 36/1 polder area. A large number of populations of the polder area earn their livelihoods through work associated with raising livestock (Cow/Bullock, Buffalo, Goat and Sheep and poultry (Duck and Chicken). About 40% of household in the polder area are rearing Cattle/cow/bullock, 15% of household are rearing goat, 5% of household are rearing sheep, 20% of household are rearing duck and 60% of household are rearing chicken. Livestock resources data will also be collected from secondary sources from Upazila Livestock office and from local people through FGD, RRA. Detailed status of livestock and poultry are presented in Figure 5.18.



Source: Based on secondary information, 2014 and Upazila Livestock Office

Figure 5.18: Status of Livestock and Poultry in the polder area

Photo 5.14: View of duck in the polder 36/1 area

Photo 5.15 : View poultry farm in the polder 36/1 area

5.6.2 Feed and Fodder

214. The owners of the livestock population in the project area is facing severe problems in respect of non availability of fodder and feeds during the month of July to November due to water logging and non-availability of grazing land. During monsoon, aman rice crops remain in the field, when rice straw is the main sources of fodder for the cattle and buffalo. In addition, rice husk and oil cakes, etc. are other common fodders in this polder area. But, during the dry season (especially from December to April) there is grazing land but shortage of grass due to some area Aus rice crops are in the field and also for partial salinity. Poultry population at family level survives by scavenging and generally no feed supplements are provided. However, at times kitchen waste becomes feed to the poultry.

5.6.3 Livestock and poultry diseases

215. Productions of livestock and poultry are mainly constrained due to diseases and death of the population. According to local people every year livestock population is affected by different diseases like Tarka, Anthrax, Foot and Mouth Disease (FMD), Black Quarter (BQ) and Hemorrhagic Septicemia (HS). Diarrhoea, and Pest Des Petits Ruminants (PPR). Major poultry diseases are, Ranikhet (Newcastle), Fowl Pox, Fowl cholera and duck plague. During monsoon season, the soggy condition of the animal shelter promotes various kinds of diseases to the bullock and cows. Moreover the unhygienic condition of the courtyard during this season increases the diseases of poultry birds. However, there is vulnerable period in between July to October (rainy season) months for spreading diseases to livestock and poultry population. The duck plough generally occurs in March–April. Some other diseases are spreading round the year.

5.7 Fisheries Resources

216. The polder area is tidal in nature. 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 namely *Modhumoti River*, *Bhairab river, Chitra river and* the major beels are namely Kodalia beel, Aruadihi beel, Kendua beel and Nurnia Beel. The internal khals such as *Gurguria khal, Barobaria khal, Haque Channel, Dongar khal, Kaliganga khal,Burigangni khal, Wapder khal, Baruipara khal,Bagumkhali khal, Bastoli khal , Raigram Khal, Narayan khali khal, Saildah khal, Shantipur khal, Aruadhihi khal, Doba khal, Barojala khal, Nalua khal* etc which are acting as aquatic habitat and major arteries of fish migration into the polder area. These are playing a vital role to maintain the fisheries productivity in the internal water bodies of the polder. Bulk of the commercial fish production is coming from culture fish habitats especially from shrimp / prawn ghers. The productions from the capture fisheries come from the capture habitat e.g. Rivers, perennial and seasonal beels, seasonal and perennial khals and borrow pits etc.

217. All the rivers are perennial and tidal in nature and carries huge sediment during tidal period. Fish production trends are declining gradually from the open water sources because of sedimentation. The numbers of fishermen have decreased due to decrease of open water fish habitat, loss of khal – river- beel connectivity, water regulatory structures or sluice gate on the khals and improper operations of gates. Aquaculture is developing in suitable ponds of highland area in polder 36/1. The gher activities are also developing simultaneously in the polder area. Water body in the polder area is shown in the following photo 5.16.


Photo 5.16: Open water fish habitat of the polder area

218. The area is relatively moderate in fish biodiversity. But the fish biodiversity has the further decreasing trend because of morphological changes, obstruction to spawning migration, indiscriminate fishing and loss of river - khal connectivity and malfunctioning of water regulatory sluice/structures.

219. Once the polder area was very fertile and good agriculture practices was there up to 90s. Numbers of perennial beels was present. But after 90s the saline water started to intrusion in the polder area and damages the agriculture crop. Besides this the volume of water start to increase inside the polder area because of blocked of khal mouth by sedimentation. Long time no development activity has initiated by the water development board. After that the farmers in the polder area has started to gher culture both in shrimp and prawn by their own initiatives.

220. Aquatic environment is moderate though some pollutants are released from crop fields and are substantially causing damage or migrate to fish and other aquatic resources. On the other hand, water quality of internal khals degrades in some places during monsoon because of jute rotten and dry season due to connectivity loss. Moreover fish migrations from river to internal khals are mostly obstructed due to inactive or non-functioning of water regulator structure or natural sedimentation of khal off-take. Fisheries sector is contributing in good scale by gher culture and earning the foreign currency and increasing both local and national economy and improvement of livelihoods.

5.7.1 Fisheries Problems and Issues

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

- Indiscriminate fishing and overexploitation of fishes by using monofilament gill net and other gears in the beel area.
- Reduction of spawning and feeding grounds because of Gher culture;
- Fish habitat decreasing especially capture habitat because of gher culture and siltation is River and khals.
- Loss of connectivity due to siltation that hamper the fish migration and degrading the habitat quality.
- Sedimentation of internal khals loss the year round river-khal connectivity and loss of fish brood and decreasing fish biodiversity in the polder area.

- Besides these hindrances to fish migration and movement due to improper management and mal-functioning of the water regulatory structures along with encroachment and barriers in the khals;
- Over collection of snail from beels for prawn / shrimp feed that decrease the water quality.
- Less quality fish feeds are using in Gher culture and pond culture practices.
- Salinity adversely affect pond fish culture as well as Golda culture in polder areas
- Insufficient loan facilities for aquaculture practices.
- Gher farmers are not well trained for gher culture.

5.7.2 Fish Habitat Description

(a) Habitat Classification

222. Fish habitats of the study area are primarily classified in broad categories like Bagda gher with white fish (26%), Golda gher with white fish about (61%), River and khal (1%), pond and ditches (2%) and beel area is 10%.

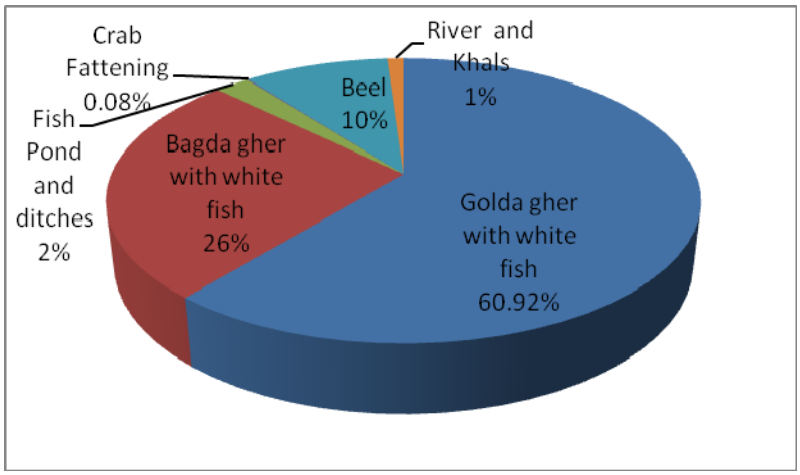
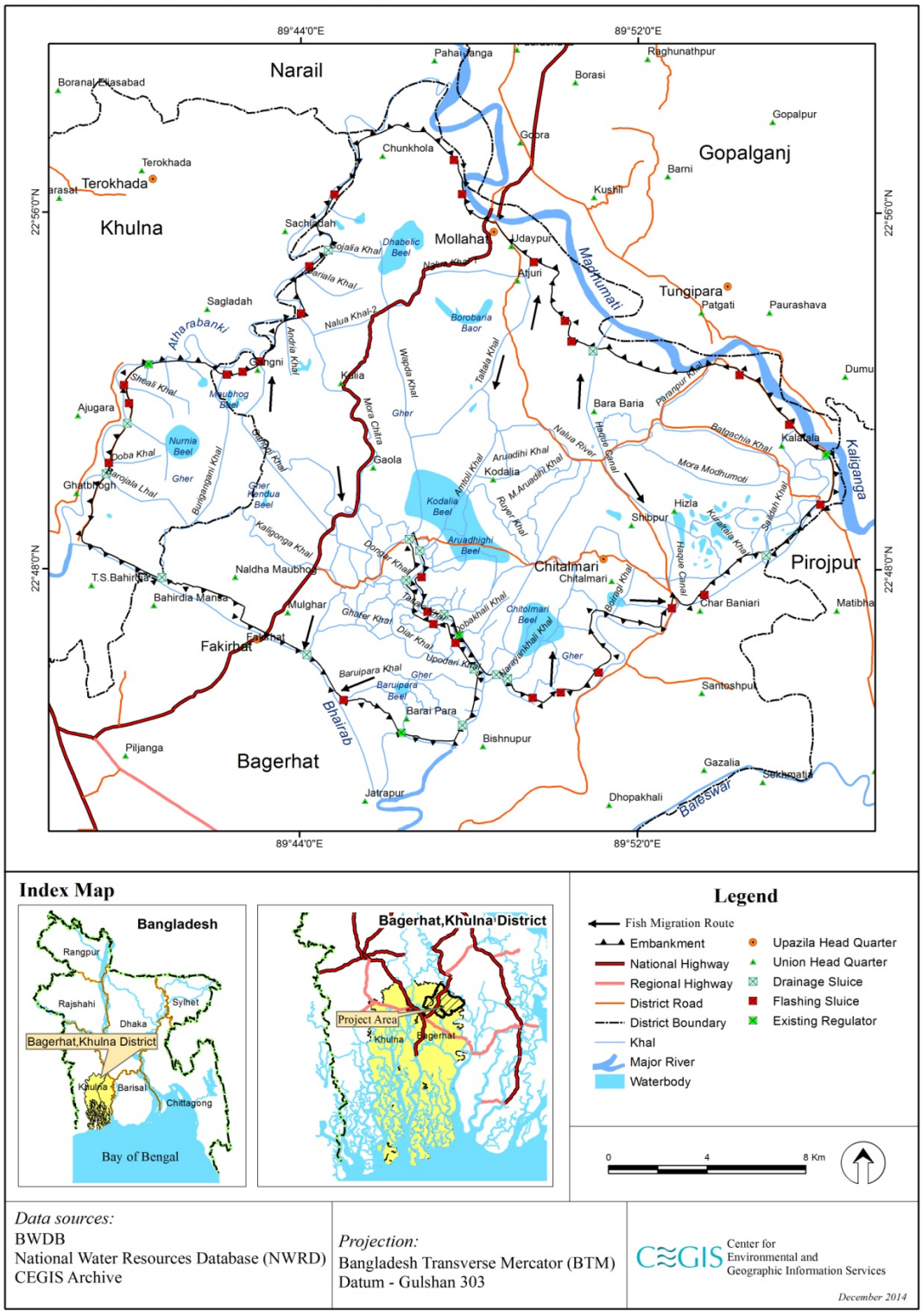


Figure 5.19: Fish Habitat Classification of the polder area

Polder 36/1: Fish Habitat and Migration Route



Map 5.12: Fish habitat and Migration route of Polder 36/1

(b) Habitat distribution

223. In the polder area fish habitats are situated in Mollahat upazila, Chitolmari Upazila, Fakirhat.

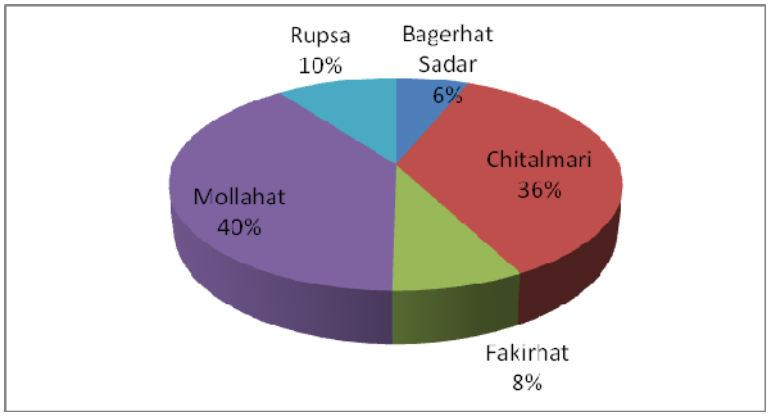


Figure 5.20: Fish Habitat distribution of the polder area

(c) Capture Fisheries

224. The total fish habitat in the polder area is 19562 ha. Out of this capture fish habitat of the polder area is 2046 ha which is distributed in river and khal, beel is shown in the following Table 5.23. The gher area are also using as shrimp /prawn culture as well as agriculture cultivation.

Table 5.23: Fish habitat status of the polder area

Sl.	Fisheries Category	Habitat Types	Area (Ha)
1	Capture	Beel	1842
		River and Khals	204
		Subtotal	**2046**
2	Culture	Golda gher with white fish	11941
		Bagda gher with white fish	5120
		Fish Pond and ditches	440
		Crab Fattening	15
		Subtotal	**17516**
		Grand Total	**19562**

Source: CEGIS estimation based on field findings

225. The polder area consist good number of perennial canals / khals, Rivers and ghers. Among those are Haque khal, Gurguria khal, Kaliganga khal, Buriganga khal, Gangni khal, Wapda khal, Narayan khali khal, Bastoli khal, Raigram khal, Baruipara khal, Begamkhali khal, Jalodanga khal, Dongar khal, Saildah khal, Santipur khal, Aruadhihi khal, Sialdah khal, Goara doba khal, Barobaria khal, Barojala khal, Taltola khal, Nalua khal, Batgachia khal etc are important in respect of fisheries habitat.

Photo 5.17: Natural fish habitat of the polder area

226. Average depth of internal khals is good for fish habitation. Some big khal where the tidal actions are there water depth in those khal is (1-1.5) m even in low tide situation. The small khals are seasonal or not active due to siltation or malfunctioning of gates / regulators. Local peoples reported that sedimentation rate in the khals off take is high and is (20-30) cm or more per year. Natural fish habitats in the polder area are shown in photo 5.17.

(d) Culture Fisheries

227. Pond and gher culture is ongoing in the polder area. Various types of fish culture systems are adopted by the local people including mono, poly and mix-culture in gher and ponds. Exclusively poly-culture practice is adopted by the local people in small ponds. Gher cultures are mainly shrimp /prawn with white fish like Rui, Catla, Thai Sarputi, Mrigal, silver carp etc. Estimated area under pond culture is 440 ha. Most of these ponds are culturing traditional in nature. Fish pond in the polder area is shown photo 5.18. Total culture fisheries area is 17516 ha.

Figure 5.18: Fish culture in different types of pond in the polder area

Gher Culture

228. The polder area is basically productive in respect of fisheries/ gher culture. Completion of polder activities that was in 70s and agriculture practices was started in full swim. After the completion of activities and more than twenty year agriculture production was very good. By this time the internal khals are silted up and disconnected from the main source of water. Water logged has started because of silt deposition in the mouth and

several parts of khal. No maintenance activities were conducted by that time. Beside these the rivers namely Bhairab, Chitra etc are losses its depth due to siltation.

Bagda with white fish culture

229. The suitability of Bagda culture depends on availability of saline water and some other important factors like soil pH and land types, connectivity etc. However, the availability of saline water depends on surface water salinity and the distance from the source of saline water. In the polder area the salinity intrusion has started in 90's and agriculture practices have stopped simultaneously because of less upstream flow of sweet water from River. Gher practices are mainly started in polder area in that time. This practice has continued up to 2011 -2012. During field visit the local people reported that last two year salinity intrusion is comparatively less than the previous few years. So the gher owners are fell less interest for Bagda culture. But some of the Bagda gher owners are culturing Bagda by using salt directly to increase salinity of water. Some agriculture practices are on growing and most of the dykes of the ghers are using for vegetable cultivation like cucumber, bitter gourd/, *dundhul*, Papaya etc and earning good amount of money. The gher area are also using as shrimp /prawn culture as well as agriculture cultivation. At present golda area is more in compare to Bagda area in the polder area. Total gher area is 17061 ha. Out of this Bagda area is 5120 ha. Gher in the study area is shown in photo 5.19.

Photo 5.19: Bagda Gher in the polder area

Golda Culture

230. Suitability of Golda depends mainly on the availability of fresh water, while the other vital factors are land types and soil like salinity. Golda shrimp farming mainly takes place in the monsoon and fresh water is almost available in good quantity.

Photo 5.20: Golda with white fish culture in the polder area

231. Salinity is the main limiting factor; land types also define the degree of suitability for Golda culture. In fact, Golda ghers are successful culturing within the non-saline and water logging zones of the polder area. The area of Golda is almost double in compare to Bagda area. About 25 years ago to till date gher culture is ongoing. Total Golda area is 11941 ha in the polder area. Both Bagda and Golda are practicing seasonally. Optimum temperature (24 – 30)^{0}C, p^H value is 7.5 to 8.5 and Dissolved Oxygen (DO) is (5-6) ppm. The range of water salinity considering the suitability of Bagda and Golda culture are given in table 5.24.

Table 5.24: Suitability of Bagda and Golda species considering salinity

Bagda		Golda	
Water Salinity (ppt)	**Suitability**	**Water Salinity (ppt)**	**Suitability**
0-5	1	0-5	1
5-10	2	5-7	2
10-15	3	7-12	3
15-25	4	>12	4
>25	5	-	-

Source: Prawn Culture and Management by Bishnu Das, Part 3
Suitability 1 = Highly Suitable 2 = Suitable 3 = Moderate Suitable 4 = Less suitable 5 = Not Suitable.

Crab Culture

232. In Bangladesh there are sixteen species of crabs reported so far. Of which the common crabs are Scylla serrata, Portunas pelagicus, Portunas sanguinolentus, Charybdis feriata, Charybdis rostrata, Matuta lunaris, M. planipes, Clappa lophos, Clappa pustulosa, Varuna litterata, Sartorina spinigera, Ocypoda cratopthalma, and Gelasimus annulipes. The six important food crabs are Scylla, Portunus, Charybdis, Matuta, Varuna and Sartorina. Most of these species are economically important but the serrated mud crab, also known as the mangrove crab or the Scylla serrata is the most commercially important species and culture in the area and is widely distributed in the Bay of Bengal. Some areas are practicing as a crab culture in this polder area.

233. At present crab culture is very prominent because of its market demand as well as good profit. Because worldwide crustaceans are mainly represents the culture of shrimp and lobsters. However, in recent decades crab culture, particularly the culture of mangrove mud crab, Scylla serrata, has received the most attention to the people because of its market demand and decreasing from the natural production. The stocking for monoculture at higher rates is 1-3 crabs/m^2 has been used with survival from 40-60 percent (Ref – FAO Technical Paper 567). Crab fattening is possible in pens and cages also. The minimum and maximum

temperature (25-35) °C and salinity ranges recommended in (10-25) ppt respectively. Crab fattening is now a very popular practice in Bangladesh, mainly in Paikgachha, Mongla, Satkhira, Kaliganj and Munshiganj areas of greater Khulna area. Suggested parameter for water quality is given below in Table 5.25.

Table 5.25: Suggested water quality parameters for mud crab pond management

Sl.	Parameter	Optimal Range
1	Dissolved Oxygen	> 5 ppm (mud crabs tolerant of low oxygen levels)
2	Temperature	$(25 – 35)^0$ C
3	Salinity	10 – 25 ppt for crab lets
4	p^H	7.5 – 9.0 (optimal approx.7.8*)

Photo 5.21:Crab in the basket

234. Seed scarcity is the main problem in polder area. The natural populations of mud crab are declining in Bangladesh and throughout Southeast Asia due to (i) over-exploitation, (ii) loss of natural mangrove habitat, and (iii) degradation of the coastal environments. In the polder area 15 ha of land is using in crab fettering.

235. Size of Harvest – The size of harvest actually depend on both the species being cultured and the needs of the markets. Most of the markets have good demand of good sizes and offer premium prices for particular types of mud crab. Premium prices can be obtained in most Asian mud crab markets for females carrying internal eggs, and for very large males with large claws. Market demandable size of mud crab is 200 gm to 300 gm of each crab. But other sizes are also selling in the market.

Table 5.26: Crab and Market price of crabs

Sl. No	Grade	Number /Kg	Price TK /kg
1	F1	5 nos.*	(1500 -1600)
2	F2	(10 -15) nos.	(1000 -1200)
3	F3	(15 – 20) nos.	(600 -800)

* Most demandable size, based on discussion with crab culturist in the field

5.7.3 Fish Production

236. Estimated total fish production of the polder area is about 13516 M. Ton. Bulk of the fish production (about 82%) is coming from Gher (culture fisheries) while the rest is coming from capture fisheries habitats. Fish production trend from capture fisheries is decline of the study area. The production is declining mostly due to obstacles to fish migration and decreasing of fish habitat. Aquaculture practices are almost as it is or partially increasing. Primary objective of this study is to increase the agriculture / crop production by using as much as land available and thus continues to decrease the open water fish habitats including ghers. Fish production status of the study area is shown in Table 5.27.

Table 5.27: Fish production from different habitats of the study area

Sl.	Fisheries Category	Habitat Types	Area (Ha)	Production rate Kg/Ha	Total Production (MT)
1	Capture	Beel	1842	700	1289
		River and Khal	204	180	37
		Total production	2046	-	1326
2	Culture	Golda gher with white fish	11941	650	7762
		Bagda gher with white fish	5120	650	3328
		Fish Pond and ditches	440	2500	1100
		Subtotal		-	12190
		Grand Total		-	13516

Source: FRSS 2011-2012 and estimation from field observation.

5.7.4 Fishing Effort

(a) Fishermen number

237. It was reported during the field investigation and consultations with Government officials and different types of local peoples that about 70% of households of the polder areas are involved with Gher culture. Gher Culturists are also involved with agriculture activities. Some of the commercial fishers are also involve with gher culture but they have no land. Part time fishers are also present in the polder area. The fishers are comes both from the Muslim and Hindu communities. The fishers usually catch fish in the nearby floodplain, beels, rivers and khals. The available fisheries occupations are mainly fishing, fish trading and gher farming, fry trading, fish labor etc.

(b) Fishing Season

238. Monofilament Gill net (Current jal) fishing is the major fishery of the study area. Seine net (Ber jal), drag net (net jal), cast net (Jhaki jal), push net (Thela Jal) and fish trap like Borshi, Aton / Charu) fishing are also prominent in the polder area fish habitats. Fishing in polder area as well as in peripheral rivers continues around the year. But in the month of April to December is comparatively fishing period. 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 5.28.

Table 5.28: Fishing seasonality of the polder area

Fishing Gears	Seasonality of Fishing																							
	Apr	May	Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan		Feb		Mar			Apr
	Boishak		Jaista		Ashar		Sraban		Bhadra		Ashin		Kartik		Agra		Poush		Magh		Fal		Chitra	
Current Jal																								
Ber Jal																								
Thela Jal																								
Jhaki Jal																								
Veshal																								
Lining(Borshi)																								
Charu/Aton																								
	High		Medium						Not use															

Source: Observation during Field visit - 2014

(c) Fishing Crafts and Location

239. The commercial fishermen of the polder area catch fish in the beels, floodplain, khals and peripheral rivers by using engine boat, Jala nauka and dingi fishing boats. Fishing boat of the study area is shown in photo 5.22.

Photo 5.22: Fishing boat of the study area

(d) Fishing Gears

240. Different types of nets/gears are used for fishing like (a) Mono filament net, locally known as Current jal, which is used to catch poa, chingri, tengra, golsha, along with other estuarine fish;.

Fishing by Jhaki Jal

Fishing by Trap

Photo 5.23: Fishing Boat and cast net using for fish catch

241. (b) Seine net, locally known as Berjal, which is used to catch all types of small and big fishes; (c) Cast net, locally known as Jhaki jal, which is used to catch rui, catla, puti, poa, bagda, golda, phasa, etc. (d) Push net, locally known as Thela jal, which is used to catch punti, tengra, chingri, etc. Traditional fishing gears of the polder area are current jal, cast net (Jhaki jal), push net (Thela jal/, lining (Borshi), fishing traps (Aton) etc.

5.7.5 Fish Migration

242. The Khals such as Haque khal, Gurguria khal, Kaliganga khal, Buriganga khal, Gangni khal, Wapda khal, Narayan khali khal, Bastoli khal, Raigram khal, Baruipara khal, Begamkhali khal, Jalodanga khal, Dongar khal, Saildah khal are most important for fish migration. Fish migration between river and khals are hampering because of silt deposition in khal mouth and malfunctioning of regulator and sluice gates. The internal khals are used as feeding and shelter ground of most of the fishes. Many fish species migrate horizontally to these water bodies as part of their life cycle. Peripheral rivers along with internal river and khals of the study area have silted up naturally and cause the reduction the length of successive migration routes. The fish migrate for breeding is the month of May to July. Overall fish migration status is poor to moderate in the study area.

5.7.6 Species Composition and Fish Biodiversity

243. The polder area is moderate in fish biodiversity though the biodiversity of fishes has the declining trend over the years. The species are both sweet water and brackish. Golda and Bagda are available. Golda is comparatively more in compare to Bagda. About 80 fish species are present in the polder area.

Photo 5.24: Major fishes occupying the catch composition of polder area

244. Pollutants (agrochemicals and pesticides) coming from paddy and vegetable fields, obstruction in fish migration routes, morphological changes of internal khals, siltation of fish habitats, squeezing of spawning and feeding grounds and further expansion of gher culture is responsible for gradual decline of fish abundance and biodiversity. The study area comprises of an assemblage of both fresh and brackish water fish species. Fish species in the study area are shown in the above photo 5.24.

245. Checklists of the fishes of different habitats reported by local fishermen have been analyzed and draw a tentative scenario of the local fish biodiversity of the polder area. List of the fishes of different habitats of the polder area is presented Table 5.29.

Table 5.29: Status of indicative fish species diversity of different fish habitats in the polder areas

Scientific Name	Local Name	Habitat Type		
		River and Khal	Gher	Fish pond
Labeo rohita	Rui	L	H	H
Catla catla	Catla	L	H	H
Cirrhinus mrigala	Mrigal	L	H	H
Oreochromis niloticus	Nilotica	A	L	M
Oreochromis mossambica	Tilapia	A	M	H
Aorichthyes aor	Ayre	L	A	A
Mystus vittatus	Tengra	L	A	A
Mystus cavasius	Kabasi Tengra	M	A	A
Gudusia chapra	Chapila	M	A	A
Ompok pabda	Pabda	A	A	A
Glossogobius giuris	Baila	M	A	A
Pama pama	Poa	L	A	A
Rhinomugil corsula	Khorsula	L	H	A
Macrobrachium rosenbergii	Bagda	L	H	A
Metapenaeaus monocerus	Harina chingri	L	H	A
Penaeus indicus	Chaka chingri	L	H	A
Leander styliferus	Gura chingri	M	A	A
Acentrogobius cyanomos	Nuna Baila	L	A	A
Lates calcarifer	Vetki	H	M	A
Channa straitus	Shol	L	A	A
Channa punctatus	Taki	L	A	A
Puntius titco	Tit punti	L	A	A
Mastacembelus armatus	Boro baim	L	A	A
Macrognathus pancalus	Guchi baim	L	A	A
Macrognathus aral	Tara Baim	M	A	A

Scientific Name	Local Name	Habitat Type		
		River and Khal	Gher	Fish pond
Liza parsia	Parsa	L	M	A
Lates calcarifer	Koral	H	L	A
Rhinomugil corsula	Khorsula	L	H	A
Setipinna phasa	Phesa	L	A	A
Puntius chola	Chola puti	L	M	A
Heteropneustes fossilis	Shing	A	A	A
Wallagu attu	Boal	L	A	A
Clupisoma gharua	Gharo	L	A	A
Eutropichthyes vacha	Bacha	L	A	A
Leander styliferus	Icha	M	L	A
Rita rita	Rita	L	A	A
Anabas testudineus	Koi	A	A	A
Colisa sota	Boicha	A	A	A
Chanda nama	Chanda	L	A	A
Chanda baculis	Chanda	L	A	A
Notopterus notoperus	Foli	L	A	A
Nandus nandus	Veda / Roina	A	A	A
Rasbora daniconius	Darkina	L	H	A
Lepidocephalus guntea	Gutum	L	A	A
Monopterus cuchia	Kuicha	A	A	A
Culture Fish Species				
Labeo rohita	Rui	L	H	M
Catla catla	Catla	L	H	M
Cirrhinus mrigala	Mrigal	L	H	M
Oreochromis niloticus	Nilotica	A	H	M
Telapia mossambica	Telapia	A	H	M
Ctenopharyng odonidellus	Grass carp	A	H	M
Hypophthalmichthys molitrix	Silver Carp	A	H	M
Cyprinus carpio	Carpio	A	H	M
Pungasius suchi	Thai Pungus	A	H	M
Puntius gonionotus	Thai Sarputi	A	H	M
Crab Species	Kakra	L	M	A

Here, H = High, M = Medium L = Low, A=Absent

5.7.7 Species of Conservation Significance

246. Fish species variety those are locally unavailable for last (10-15) years or have become rare as reported by the local fishermen and concerned elderly people are given in the following Table 5.30.

Table 5.30: Species list for conservation significance

Scientific Name	Local Name	Local Status	
		Rare	Unavailable
Nandus nandus	Veda	√	
Notopterus chitola	Chital	√	
Ompok pabda	Pabda	√	
Macrognathus aral	Tara Baim	√	
Aorichthyes aor	Ayre	√	
Clarius batrachus	Magur	√	
Channa striatus	Shol	√	
Channa marulius	Gojar		√
Rita rita	Rita		√
Heteropneustes fossilis	Shing		√

5.7.8 Area of Conservation Significance

247. Huge numbers of khals are present in the polder area. The important khals are Haque khal, Gurguria khal, Kaliganga khal, Wapda khal, Dongar khal (, Bastoli khal have the conservation significance (about 500m in each Khal) for next year fish propagation. There is no scope for fish sanctuary development in the existing khals in the study area due to huge sedimentation of tidal action.

5.7.9 Fish Marketing and Post Harvest Facilities

248. Shrimp and Prawn and white fish is the main product in the study area. The local people informed that they are fulfilling about 35% demand of shrimp and prawn of Bangladesh and 45% of total exported shrimp and prawn is supplied from their locality. Local fishermen/Gher owners are selling their catch (small or big) either directly to the local fish market or to fish arat. The major local markets are namely *Foltita Bazar, Daypara Bazar, Chingori Bazar, Garfa Bazar, Nagarkandi Bazar. Gangni Bazar, Patia Bazar, Sagladah Bazar, Nalua Bazar, Mansha Bazar* etc or to fish traders or buyers (*Bapari*) coming from Bagerhat or Khulna. Number of structured fish landing center are present in the area. Ice from ice plants is used for icing the harvested fish or prawn or shrimp. Good fish storage facilities are available in *Faltita bazar* within the polder area. Transportation facilities are good enough in compare to other areas of Bangladesh. The Khulna - Gopalgonj – Bhanga Highway passes through the study area. Besides this a navigation route is available through Madhumoti River almost around the year. Because of that the local markets are open every day especially for shrimp and prawn marketing. Rural people can sell their product to the local market. Private hatchery like BRAC Golda Hatchery is presented adjacent to the polder area. Availability of fish feeds for shrimp gher and ponds are sufficient. Fish seeds for gher/culture fishery are collected from the fish hatcheries and nurseries which are situated in Bagerhat, Khulna, or local Bapari or Forias.

5.7.10 Fish marketing chain in the polder area

249. Fish market chain of this region is well-developed due to good communication. There are some large fish markets in the study area. The major shrimp trading centers are Foltita Bazar, Fakirhat, Mollahat. Numbers of fish depots are situated in this area. The following marketing chains are mostly found in this area in Table 5.31.

Table 5.31: Marketing channel in the polder area is shown in the following

Post Larvae collectors ⇨	Faria ⇨	Aratdar ⇨	Gher Owner	-
Gher Owner (Bagda and Golda) ⇨	Faria / Bapari ⇨	Aratdar ⇨	Depot owner ⇨	Export
White Fish ⇨	Bapari / Consumer ⇨	Aratdar ⇨	Wholesaler ⇨	Export
Soto Mach / Beel Fish ⇨	Bapari/ Consumer ⇨	Aratdar ⇨	Wholesaler ⇨	Retailer

5.7.11 Problems in Fisheries Sector in the Polder Area

250. Natural environmental changes and several anthropological activities are responsible for the changing the river morphology by sedimentation. Besides this hydro-morphological alteration ultimately affect on fish migration and wetland habitat. The manmade activities include construction of cross fish *patta* in khals, katha in river/khals, shrimp ghers as well as the practice of making mud bunds on khals, housing and other civil construction by encroach the rivers and khals are most common. Fish migration is disturbing due to above mention activities.

251. Any types of construction in the water bodies, water current are discarding. Ultimately it leads towards in future when there will be no or very little fish in the rivers/water bodies. These types of phenomena are hampering the aquatic resources. Due to the increasing of gher culture day by day the open water habitat is decreasing in the study area. In a long run this is not good signal in respect of agriculture as well as hydrological consequences. Salinity in the area may replace the indigenous fish with brackish water fish species. Gher culture increases the shrimp production but disappearance of indigenous fresh water fish species in the polder area. In gher culture limited numbers of labor have the scope for work. Good numbers of labor losses the work opportunity.

5.7.12 Peoples employed and types of employment in fisheries sector

252. Numbers of professional fishers are reducing due to the changes in the surrounding ecological settings such as alteration of internal fish habitats and connectivity. Some of the professional fishers are engaging with fry trading, fish seller, fish labor in fish arat. On the other hand gher culture is increasing in the polder area and limited numbers of ponds are present only in high land. There is massive potentiality of shrimp and prawn and white fish culture in the polder areas. The gher owners in the polder area are habituated to practice the shrimp culture with good technological knowledge, financial support and sufficient marketing facilities.

253. Good numbers of households are involved in gher activities in the polder area. Beside this recently a good agricultural practice had started like vegetable culture in gher dyke. Numbers of peoples are getting scope to involve as a labor with these activities. The peoples in the polder area are involved with different types of activities in fisheries sector like Fish trader, Shrimp/Prawn Exporter, Fry traders, Fry collectors, Gher owners / farmer, Fish aratdar, Transport worker, Food supplier, Day laborer etc.

5.7.13 Fishermen Lifestyle

254. Comparatively Gher owner is more in compare to real fishers. Subsistence fishers are also present in the polder area. Average daily income of commercial fisher and part time fisher are Tk. (400 -500), Tk. (300-350) respectively. Numbers of commercial fishers are

decreasing day by day. The fishers are also vulnerable to the gher owners who are responsible to convert open water fish habitats into gher.

5.7.14 Fisheries Management

255. There is no community based fisherman association. Fishing right on existing fish habitats is particularly on common resources. Department of Fisheries (DoF) has limited activity for fisheries resource conservation and management in this area. Some NGOs are working, but they are very much limited in micro credit rather than extension services and aquaculture training. Enforcement of fisheries regulation is also weak.

5.8 Ecological resources

256. The Bagerhat Sadar, Mollahat, Fakirhat, Chithalmari upazila of Bagerhat district and Rupsha upazila of Khulna district (under the study area) occupied with different type of phyto-diversity and ecosystem. The rivers and khal in this areas are comprises with different landforms like beels, canals, ditches and having varied vegetation patterns which create diverse habitats for different wildlife. In physiographic and biodiversity points of view the area has already demarcated under certain bio-ecological zone described as below.

5.8.1 Bio-ecological zones

257. IUCN-The World Conservation Union has identified 25 bio-ecological zones (2002) in Bangladesh. The aspects of which these zones are primarily centered on physiographic, climate, soil type, flooding depth and biodiversities. These bio-ecological zones can be classified as major ecosystems of the country. The project area encompasses two of these bio-ecological zones, namely the Ganges Floodplain and Gopalgonj/Khulna peat lands. A brief ecological description of the bio-ecological zone is presented below.

Ganges Floodplain

258. Ganges Floodplain is the active meandering floodplain of the Ganges river. The floodplain mainly comprises a smooth landscape of ridges basins and old channels. The Ganges channel is constantly shifting within its active floodplain, and eroding depositing large areas of charlands in each flooding season. Both plants and animals move and adapt with the pattern of flooding (Brahmer, 1996). The floodplain is characterized by mixed vegetation and support a habitat of rich biodiversity to some extent for presence of a lot of stagnant water bodies and channels, rivers and tributaries. Beels and other water bodies support good amount of free floating aquatic vegetation.

259. Homesteads forest prominent with both cultivated and wild plant species. In this zone, the dominant floral types are the Panimorich (*Polygonum orientale*), Jhanji (*Hydrilla verticillata*), Topapana (*Pistia strateotes*), Chechra (*Schenoplectus articulatus*), Sada Sapla (*Nymphaea nouchali*), Keshordam (*Ludwigia adscendens*), Kolmi (*Ipomoea sp*), Tamarind (*Tamarindus indica*), Panibaj (*Salix tetrasperma*) etc. Moreover, Grasses are more abundant in Ganges floodplain and begin to grow as soon as the floodwater begins to recede. *Cyperus rotundus, Cyperus deformis, Eleocharis sp., Hemarthria sp.* etc are the notable grass species.

260. Major groups of oriental birds are presented in this zone by one or more species. In addition, a large number of migratory birds are found here during the winter. Beside this, different species of freshwater tortoise and turtles are found in the rivers and ponds. Among the amphibian species, the area found toads, frogs and tree frogs are well known. Foxes, Jackals, Rats, Mice, Squirrels, Bats etc are common mammals of this zone.

Gopalganj-Khulna Peat Lands

261. The Gopalganj/Khulna peat land occupies a number of low-lying areas between the Ganges river floodplains and the Ganges Tidal Floodplains in south of Faridpur region and the adjoining part of Khulna and Jessore districts. The basin are deeply are deeply flooded by rainwater during the monsoon. The zone is support limited floral diversity. Bakful (*Sesbania grandiflora*), Hijal (*Barringtonia acutangula*), Barun (*Crataeva nurvala*) are the remarkable floral species. Kaoatukri (*Sagittaria guayenensis*), Nil Komol (*Nymphaea stellata*), Kolmi (*Ipomoea aquatica*), Hogla (*Typha elephantina*) etc are the common aquatic species. The faunal species and their population size in this zone are low due to lack of diversity in vegetation.

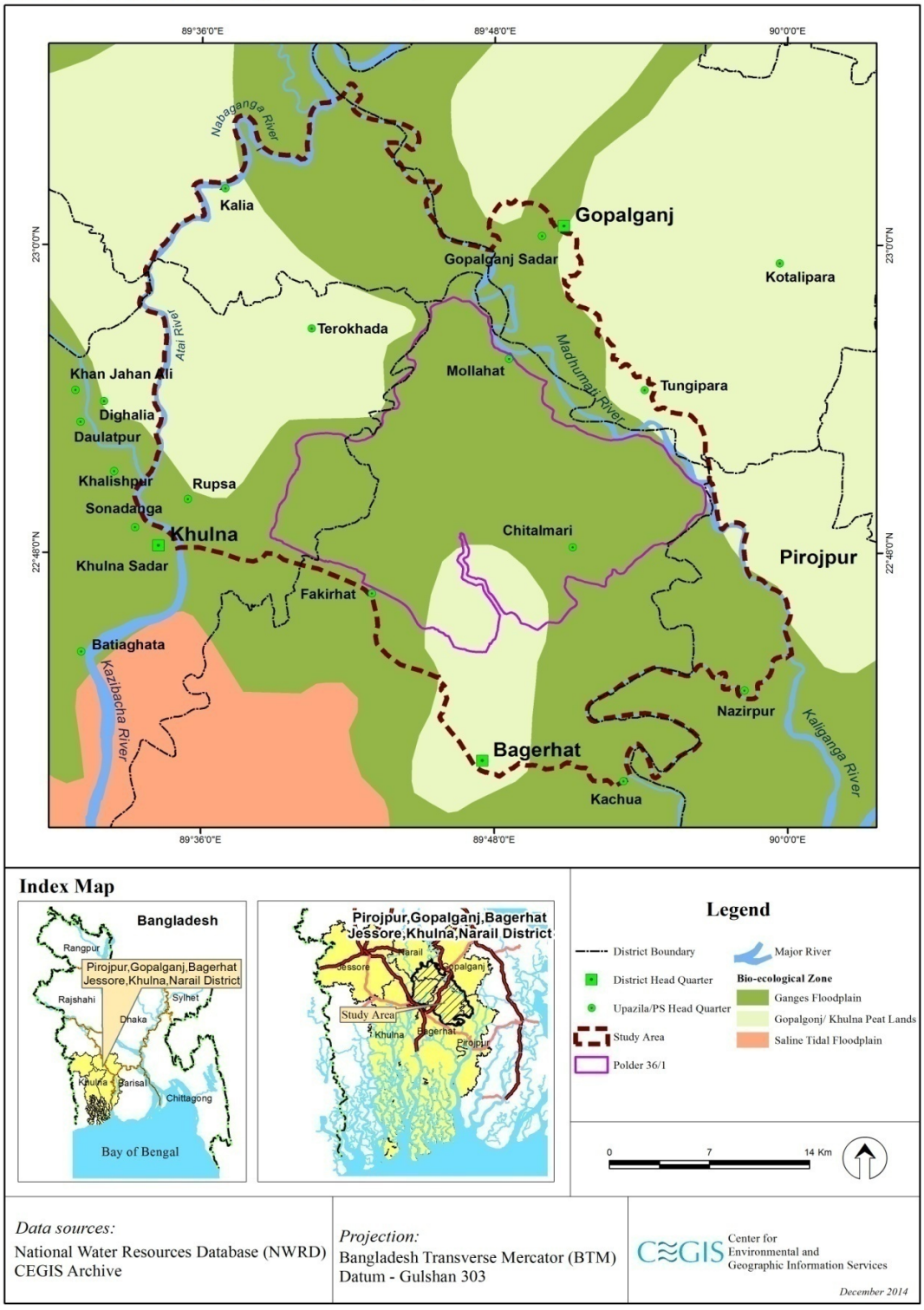
262. Among the faunal species, Five Stripped Palm Squirrel (*Funambulus pennanti*), Fishing Cat (*Perionailurus viverrinus*) etc are common mammals. Reptiles found in this zone are the common Krait (*Bungarus caeruleus*), Common Wolf Snake (*Lycodon aulicus)*, Copperhead trinket snake (*Elaphe radiata*) and Spotted Pond Turtle (*Geoclamys hamiltonii*). Only two species of amphibians are commonly found as Maculated Tree frog (*Polypedates maculatus*) and Cricket frog (*Limnonectes limnocharis*). The diversity of waterfowl species is relatively better in this zone.

Table 5.32: Area and location of Biological zones within the project area

Biological zone	Area (ha)	Percentage (%)	District
Gopalgonj /Khulna Peat Lands	4304	11	Bagerhat and Khulna
Ganges Floodplain	34826	89	
Total	39130	100	

Sources: GIS Division, CEGIS, 2014

Polder 36/1: Bio-ecological Zone Map



Map 5.13: Bio-ecological zones at the study area

5.8.2 Terrestrial Ecosystem

263. Terrestrial ecosystem denotes the ecosystem of agricultural crop land, homestead garden as well as the settlement and the adjoining fallow area. No Ecologically Critical Area (ECA) or designated protected area is located within or near the polder area.

(a) Terrestrial Flora

264. There are plenty of vegetation in terms of diversity and density, especially in the homestead area. The terrestrial vegetation is a home to many terrestrial fauna to mitigate their demand to survive and support ecosystem services. Findings on terrestrial flora are described below:

Homestead forest/vegetation

265. Homestead forest resources play an important role for the livelihoods of people living in the project area. Majority of the people of project area largely depend on homestead forest production as cash crop for their income and nutrition as well. Village or Homestead forest/vegetation is one of the most important natural resource bases of Bangladesh having huge number of diversified plant species within a specified area where herbs , shrubs, trees are present. Most of the homestead forest consists of fruit yielding plant, timber trees and medicinal plants. Diversity of trees as well as vegetation in homestead, river/khal peripheries and stagnant wetlands are sometimes fluctuated due to variation of soil salinity and low lying areas. The homestead forest/vegetation is the important place for wildlife as well as birds.

266. CEGIS vegetation survey remarked that, the trees which are successfully adapted in peripheral homesteads are Akashmoni *(Acacia auriculiformes*), Raintree (*Samanea saman*), Sada koroi *(Albizia procera)*, Raj koroi (*Albizia richardiana*), Babla *(Acacia Arabica),* Khoiya Babla *(Pithocelobium dulci),* Velveti/Bilati Gab *(Diospyros discolor),* Tentul *(Tamarindus indica),* Taal *(Borassus flabeliffer),* Narikel/Coconut (*Cocos nucifera*), Supari *(Areca catechu)*, Khejur *(Phoenix sylvestris),* Taal *(Borassus flabellifer)*, Aam *(Mangifera indica)*, Safeda *(achras sapota)*, Kul *(Ziziphus mauritiana)* and Bamboo/Bash *(Bambusa Spp.).* The homestead vegetation of this project area is exclusively dominated by the indigenous species namely which are representing the upper canopy layer of the homestead forest vegetation.

267. Shrubs and herbs occupy lower canopies in the homestead. Many species of undergrowth wild plants (herbs, shrubs, creepers) are found in homestead forest vegetation and also village groves. Among this type, Akand (*Calotropis procera*), Vaant/Bhat (*Clerodendron viscosum*), Hatisur (*Heliotropium indicum),* Dhol Kolmi (Ipomoea carnea), Jali Bet *(Calamus guruba)* are common species.

Table 5.33: List of plant species found in the homestead of the study area

Local/English Name	Scientific Name	Use	Abundance
Akasmoni	*Acacia auriculiformis*	Timber and Fuel wood	M
Safeda	*Achras sapota*	Fruit	M
Kalo Koroi	*Albizia lebbeck*	Timber and Fuel wood	H
Sada Koroi /Sil Koroi	*Albizia procera*	Timber and Fuel wood	H
Chambul/Raj Koroi	*Albizia richardiana*	Timber and Fuel wood	H
Supari	*Areca catechu*	Timber and Fuel wood	H
Kanthal	*Artocarpus heterophyllus*	Fruit and Timber	L

Local/English Name	Scientific Name	Use	Abundance
Bamboo/Bash	*Bamboosa spp.*	HH use and Fencing	M
Tal	*Boassus flabellifer*	Fruit	H
Shimul	*Bombax ceiba*	HH use	M
Sonalu	*Cassia fistula*	Timber and Fuel wood	L
Jambura	*Ciitrus grandis*	Fruit and Fuel wood	L
Narikel/Coconut	*Cocos nucifera*	Fruit and Fuel wood	H
Sisoo	*Dalbergia sissoo*	Timber and Fuel wood	M
Desi Gab	*Diospyros peregrina*	Fruit and Fuel wood	L
Mandar	*Erythrina orientalis*	HH use, Fencing	M
Eucalyptus	*Eucalyptus camaldulensis*	Timber and Fuel wood	L
Katbel	*Limonia acidissima*	Fruit and Fuel wood	H
Aam /Mango	*Mangifera indica*	Fruit and Timber and Fuel wood	L
Khejur /Date Palm	*Phoenix sylvestris*	Fruit and Fuel wood	M
Khoiya Babla	*Pithocelobium dulci*	Fruit and Fuel wood	M
Peyara/Guava	*Psitium guajava*	Fruit	M
Raintree	*Samanea saman*	Timber and Fuel wood	H
Amra	*Spondias dulcis*	Fruit	M
Mahogoni	*Swietenia macrophylla*	Timber and Fuel wood	H
Tetul	*Tamarindus indica*	Fruit, Timber and Fuel wood	M
Segun	*Tectona grandis*	Timber and Fuel wood	L
Katbadam	*Terminalia catappa*	Fruit and Fuel wood	M
Kul	*Ziziphus mauritiana*	Fruit and Fuel wood	L
Chatian	*Alstonia scholaris*	Soft Timber	L
Debdaru	*Polialthia longifolia*	Timber and Fuel wood	L
Kodom	*Anthocephalas chinensis*	Soft Timber and Fuel wood	M
Krisnachura	*Delonix regia*	Soft Timber and wood	L

Source: CEGIS field survey, 2014

Note: Abundance Code, H= High, M= Medium, L= Low

Photo 5.25: Forest vegetations profile in homestead

Photo 5.26: Forest vegetations profile in homestead

Crop field vegetation

268. Land is used mainly for shrimp, paddy, betel leaf and vegetables cultivation. Betel leaf gardens in the project area presents which mostly grown besides the homestead premises. Verities of field crops and their cropping patterns & production have been discussed in the agricultural section of this report.

269. The seasonal fallow lands have also important roles in ecosystem functioning as support grazing for cattle, feeding and breeding habitats of many arthropods, reptiles and avifauna. In cropland, some floras which are found along with crops and which are not cultivated, known as agricultural weeds. The weeds have important roles in terms of ecosystem those contribute to the ecosystem functionality.

270. The dominant cropland's wild species in this polder area are Dhol Kolmi (Ipomoea carnea), Hatisur (*Heliotropium indicum)*), Durba Gash (*Cynodon dactylon*), Thankuni (*Centella asiatica*), Akand (*Calotropis procera*), Vaant/Bhat (*Clerodendron viscosum*), Bondhone (*Scoparia dulcis*), Bagha Jongla (*Borreria articularis*), Telakhucha (*Coccinia grandis*), Jhunjhuni (*Crotalaria 113allid*), etc.

Photo 5.27: Betel leaf garden

Photo 5.28: Crop field vegetation

Embankment /Road side/Khal side vegetation

271. The study areas are low lying, so polder embankments are mainly using as rural road. Major tree species found along the village road/embankments are Akasmoni (*Acacia auriculiformis),* Kala Koroi (*Albizia lebbeck),* Sada Koroi /Sil Koroi (*Albizia procera),* Chambul/Raj Koroi (*Albizia richardiana),* Sisoo (*Dalbergia sissoo),* Khoiya Babla (*Pithocelobium dulci),* Raintree (*Samanea saman),* Mahogoni (*Swietenia macrophylla),* Tal *(Boassus flabellifer),* Khejur *(Phonix sylvestris),* Narikel (*Coccos nucifera*), Babla (*Acacia nilotica*) etc. which had been planted by Forest Department as per social forestry rules. Community people who are residing near the embankment are the beneficiary from this plantation along with Bangladesh Water Development Board and Forest Department.

272. Besides, Banana/Kola (Musa spp.), Pitali (Trewia nudiflora), Jiga (Lennea coromandelica), Akand (Calotropis procera), Vaant/Bhat (Clerodendron viscosum), Hatisur (Heliotropium indicum), Dhol Kolmi (Ipomoea carnea), Sojina (Moringa oleifera), Bashok (Adhatoda Vasica), Mutha gash (Cyperus rotundas), Mandar (Erythrina orientalis), Jhunjhuni (Crotalaria allid) are common shrubs and herbs sighted along most of the roadsides and polder embankment and Khal side. However embankment side and Khal side vegetation supports good habitats for numerous fishes, reptiles, insects and avifauna.

Photo 5.29: Vegetation along village road cum embankment side

Photo 5.30: Vegetation along village road cum embankment side

Photo 5.31: Khal side vegetation

Table 5.34: List of plant species found in the embankment/roadside of the study area

Local/English Name	Scientific Name	Use	Abundance
Akasmoni	*Acacia auriculiformis*	Timber and Fuel wood	M
Babla	*Acacia nilotica*	Timber and Fuel wood	H
Kala Koroi	*Albizia lebbeck*	Timber and Fuel wood	H
Sada Koroi /Sil Koroi	*Albizia procera*	Timber and Fuel wood	H
Chambul/Raj koroi	*Albizia richardiana*	Timber	H
Tal	*Boassus flabellifer*	Fruit and HH use	H
Sonalu	*Cassia fistula*	Timber and Fuel wood	L
Narikel/Coconut	*Cocos nucifera*	Fruit and Fuel wood	H
Sisoo	*Dalbergia sissoo*	Timber and Fuel wood	M
Mandar	*Erythrina orientalis*	HH use and Fencing	L
Jiga	*Lennea coromandelica*	Fencing	M
Ghora Neem	*Melia azedarach*	Timber and Fuel wood	M
Khejur /Date Palm	*Phoenix sylvestris*	Fruit and Fuel wood	M
Khoiya Babla	*Pithocelobium dulci*	Fruit and Fuel wood	M

Local/English Name	Scientific Name	Use	Abundance
Raintree	*Samanea saman*	Timber and Fuel wood	H
Mahogoni	*Swietenia macrophylla*	Timber and Fuel wood	M
Pitali	*Trewia nudiflora*	Fuel wood	L

Source: CEGIS field survey, 2014

Note: Abundance Code, H= High, M= Medium, L= Low

(b) Terrestrial Fauna

273. The fauna is environmentally interacted in the process of ecosystem. Findings on terrestrial fauna are described in accordance with their hierarchy as follows

Amphibians

274. Amphibian species favor by wetland areas and the marginal dried areas. The Spotted Tree Frog (*Polypedates maculates*) and Cricket frog *(Limnonectes limnocharis)* commonly found species in the homestead gardens of the current polder area. The Common Toad (*Bufo melanostictus*) frequent with various different habitats too, like under logs, brick piles, moist holes, crevices of tree trunks and dark corners of huts. The Indian Bullfrog (*Hoplobatrachus tigerinus*) is available in waterside bushes, homestead pond and khal sides.

Reptiles

275. The following species of reptile are found in the habitats of gher wetland, homestead, and cropland. Among the reptiles, Tokkhak/Gecko (*Gekko gecko*), House Lizard (*Hemidactylus brookii*), Common Garden Lizard (*Calotes versicolor*), Guisap/Monitor Lizard (*Varanus bengalensis*), Common Kukri Snake *(Oligodon arnenesis*), Buffstriped Keelback Snake (*Amphiasma stolata*), Rat Snake (*Ptyas mucosus*), Kal Keote Snake/King Kobra (*Naja naja*), Dhora Snake (*Xenochrophis piscator*), Common Vine Snake *(Athaetulla nasuta),* Monocellate Cobra (*Naja kaouthia*) and Spotted Pond Turtle (*Geoclamys hamiltonii*) have been seen within project area.

Mammals

276. Local people reported that Mammals' population is very low in the polder area due to human settlement, shrimp gher farming, development activities and anthropogenic disturbance. Big mammals have already been disappeared, because change of land uses system, jungle cutting and different human activities.

277. Common mammals are concentrated in village grooves (homestead forest), wetlands, road and embankment sides and crop fields. Small mammals, such as Pati Shial (Canis aureus), Grey Mask Shrew (Suncus murinus), Khatash/Bagdash/Small Indian Civet (Viverricula indica), Common Mongoose/Beji (Herpestes edwardsii), Dharia/Ud/Otter (Lutrogale perspicillata), Fish Cat/Mesho Bagh/Jungle Cat (Perionailurus viverrinus), Bengal Bandicot Rat (Bandicota bengalensis), Common House Rat (Rattus rattus), Five stripped palm Squirrel (Funambulus pennanti), and Short-nosed Bat (Cynopterus sphinx) are found in village grooves or crop fields of the project area.

Birds

278. The homestead garden ecosystem provides roosting and breeding sites for number of bird species that feed in adjacent wetland and crop cultivated area. Terrestrial birds can be divided into two major groups: birds observed in floodplains and wetland, and birds observed in dry habitat such as homestead, agricultural land, scrub and grass land.

279. Common bird species found in the project area are Bajpakhi/Brahmini Kite (*Haliastur indus*), Common Myna (*Acridotheres tristis*), Red-vented Bulbul (*Pycnonotus cafer*), Oriental Magpie Robin (*Copsychus saularis*), Spotted Dove (*Streptopelia chinensis*), Blue Rock Pigeon (*Columba livia*), Black Drongo (*Dicrurus macrocercus*), Asian Koel (*Eudynamys scolopacea*), Larged-billed Crow (*Corvus macrohynchos*), Asian Pied Starling (*Sturnus contra*), Barn Swallow (*Hirundo rustica)* and Tuntuni/Common tailor bird (*Orthotomus sutorius).* Several species are listed in the IUCN *Red Data Book* occurs within the polder area are given below.

Local/Common name	Scientific name	Local status	IUCN status	Cause of threat
Pati Shial/Golden Jackal	*Canis aureus*	Rare	Vulnerable	Hunt and habitat loss
Gui Sap/Bengal Monitor	*Varanus bengalensis*	Moderate	Vulnerable	Hunt and habitat loss
Khatash/Small Indian Civet	*Viverrricula indica*	Rare	Vulnerable	Habitat loss
Kal Keotey/ Common Krait	*Bungarus caeruleus*	Common	Endangered	Hunt and habitat loss
Dharia/Ud/Otter	*Lutrogale perspicillata*	Rare	Vulnerable	Hunt and habitat loss
Spotted Pond Turtle/Kalo Kachim	(*Geoclamys hamiltonii*)	Rare	Endangered	Hunt and habitat loss
Gangetic River Dolphin	(*Platanista gangetica*)	Rare	Endangered	Fishing and Habitat loss

Source: CEGIS Field survey, 204 and Red Data Book of IUCN Bangladesh

5.8.3 Aquatic ecosystem

280. An aquatic ecosystem is an ecosystem that found in the water body. Flora and fauna along with communities of organisms that are dependent on each other and on their environment live in aquatic environment. The study area is representing mainly fresh as well as brackish water ecosystems.

(c) Aquatic flora

281. The tidal inundation sweeps over entire study area twice a day and tidal current changing its direction after every six hours. The wetlands of the coastal area are influenced by high and low tidal water. The maximum rise and fall occurs during the spring tides in March and April. The effect of the tide is far into the interior and the rise and fall tends to be content throughout the year and varies only with the phases of the moon. Tidal inundation is only media to dispersal of plants seeds elsewhere in the study area which is relates with Sundarban mangrove vegetation.

282. The existing wetlands like canal systems (khal), shrimp ghers and ponds are using for fish culture. In general, the wetlands are classified into two categories on the basis of existence of water along with water depth around the year i.e. the seasonal wetland, and the perennial wetland.

- The seasonal wetlands inundate normally about 4-5 months in the monsoon. This type of seasonal wetlands is only upper canals those inundate during rainy days.

- The perennial wetlands inundate throughout the year due to using of water for fish culture. Hence, the fish-ponds and ghers have been considered as perennial wetlands for their characteristics having water in the year round.

283. Aquatic floras are mainly concentrating in the waterlogged areas in the field, internal khal and homesteads ponds. Due to having continuous tidal water flow in the channels of the river it does not support any aquatic macrophytes to grow and develop inside or along the bank line. That is why, little aquatic vegetation is observed in the river and river side canals. Within the polder area the ponds and khal contain different types of aquatic floras such as free floating, rooted floating, submerged and amphibian vegetations like sedges and meadows.

- Free floating plants are also common throughout the polder area. Kochuripana (*Eichhornia crassipes*), Kutipana (*Azolla pinnata*), Topapana *(Pistia stratiotes)*, Kuripana *(Salvina cucullata)*, Khudipana *(Lemna perpusilla)* are most dominant in this type of vegetation.
- Shapla/Poddo *(Nymphaea nouchali/Nymphaea stellata)*, Chandmala *(Nymphoides sp.*), Kaoatukri (*Sagittaria guayenensis*) are top frequent rooted floating plants available all the floodplains, homesteads ponds and ditches.
- Submerged plants exist in both perennial and seasonal wetland. Such as, Jhangi (*Hydrilla verticillata),* Ghechu (*Aponogeton natans),* Bicha (*Vallisneria spiralis)* etc are found.
- Sedges and meadows plants consist of amphibian plants. These types of plants also found moderately in the polder study area which is one of the most important wetland plant communities. They included Nil Kolmi (*Ipomoea aquatic),* Kochu *(Colocasia esculenta*) and Helencha *(Enhyra flactuans).*

List of plant species found in the wetlands of the study area

Local/English Name	Scientific Name	Use	Abundance
Ghechu	*Aponogeton natans*	Vegetable	M
Kutipana	*Azolla pinnata*	Compost	H
Kakra	*Bruguiera gymnorrhiza*	Timber and Fuel wood	L
Kochu	*Colocasia esculenta*		L
Kochuripana	*Eichhornia crassipes*	Compost	H
Helencha	*Enhyra flactuans*	Vegetable	L
Chaila gash	*Hemarthria protensa*	N/A	M
Jhangi	*Hydrilla verticillata*	N/A	M
Nil Kolmi	*Ipomoea aquatica*	Vegetable	M
Khudipana	*Lemna perpusilla*	Compost	H
Fern	*Lindsaea ensifolia*	N/A	M
Shapla/Poddo	*Nymphaea nouchali Nymphaea stellata*	Compost and Vegetable	M
Chandmala	*Nymphoides sp.*	Compost	M
Golpata	*Nypa fruticans*	Fruit and HH use	H
Topapana	*Pistia stratiotes*	Compost	H
Karanja/Chimti	*Pongamia pinnata*	Timber and Fuel wood	M
Kuripana	*Salvina cucullata*	Compost	H
Bakful	*Sesbania grandiflora*	Compost and Vegetable	L
Keora	*Sonneratia apetala*	Timber and Fuel wood	L
Choila/Ora	*Sonneratia caseolaris*	Fruit and Fuel wood	M
Hogla	*Typha elephantalis*	HH use	M
Bicha	*Vallisneria spiralis*	N/A	L

Sources: CEGIS Field Survey 2014

284. Throughout the intertidal plains and subsequent wetlands are dominated by Hogla/Patipata (*Typha elephantalis*) and local brackish grasses species like Chaila gash *(Hemarthria protensa)*. In addition, patches of Golpata (*Nypa fruticans*), Choila/Ora *(Sonneratia caseolaris)* trees are observed sporadically on the torus and along riverside toe of the embankment khal and rivers.

Photo 5.32: Choila/Ora found besides the tidal khal/rivers

Photo 5.33: Common scenario of wetland in the study area

Photo 5.34: Common scenario of Gher land in the study area

Photo 5.35 : Golpata, Choila/Ora and Kochuripana

Gher lands vegetation

285. In the existing land use system, a huge numbers of ghers are found in the study area which is also a part aquatic/wetland ecosystem. Hence, increase in salinity due to gher farming practices and reduction in freshwater flow due to river navigation loss would lead to disappearance of the low salinity tolerant species through gradual declining of plant resources. EIA survey tam observed that, the number of plant species in the gher areas is very less in comparison to homestead land species. The common flora in the gher areas (boundaries raise land) are listed below:

List of major plant species found in the Gher lands of the study area

Local/English Name	Scientific Name	Use	Abundance
Narikel/Coconut	*Cocos nucifera*	Fruit and Fuel wood	H
Khejur /Date Palm	*Phoenix sylvestris*	Fruit and Fuel wood	H
Tal	*Boassus flabellifer*	Fruit and HH use	H
Sonalu	*Cassia fistula*	Timber and Fuel wood	M

Local/English Name	Scientific Name	Use	Abundance
Mandar	*Erythrina orientalis*	HH use and Fencing	M
Chitka	*Phyllanthus reticulata*	Fuel wood	M

Sources: CEGIS Field Survey 2014, Note: Abundance Code, H= High, M= Medium, L= Low

(a) Aquatic fauna

286. The life cycle of aquatic fauna is dependent on seasonal variation as well as inundation depth and availability of water in all types of wetlands. Naturally, wetlands provide food and shelter to the aquatic fauna. EIA survey tam observed that, the number of wildlife species in the Gher areas is very less in comparison to homestead land species. The beel area (low lying area) was harbor of huge Mollusk (shamuk).

Amphibians

287. Among amphibians, the skipper frog *(Euphlyctis cyanophlyctis)* is common and found in all wetland and has been the most successful in adapting to the existing habitats. Bullfrogs *(Hoplobactruchus tigerinus)* are also found frequently during monsoon.

Reptiles

288. Discussion with local people at the time of field visit it is reveals that various types of wildlife including snakes are commonly found in the wetlands aquatic ecosystems. The population of Bengal grey monitor (*Varanus bengalensis*) is moderate but the number of snake in the polder area is high. Spotted Pond Turtle (*Geoclamys hamiltonii*) species are rare and maximum abundance occurred during monsoon. Among them checkered keel back snake (*Xenocrophis piscator*), smooth water snake (*Enhydris enhydris*).), Glossy marsh snake (*Gerardia prevostiana*), Common wolf snake (*Lycodon aulicus*) are commonly found in the study area.

Mammals

289. Local people reported that Mammals' population is very low in the polder area due to anthropogenic disturbance. Big mammals have already been disappeared from this area because of land uses change into Gher and jungle cutting. Small mammals, such as *Dharia/Ud/Otter (Lutrogale perspicillata),* Fish Cat/Mesho Bagh/Jungle Cat (*Perionailurus viverrinus*) are found in the wetland of the project area. Besides, Gangetic River Dolphin (*Platanista gangetica*) was sighted in Madhumati and Chitra river while field survey ongoing in the field.

Birds

290. Availabilities of small fishes in all types of shallow wetlands support feeding habitats to the aquatic birds but shrimp gher lands are not so supporting the bird population as well as we expected due to hunting and lack of food and roosting place in the gher land. The aquatic bird like Little Egret *(Egretta garzetta),* Great Egret *(Casmerodious albus),* Common Kingfisher *(Alcedo atthis),* Little Cormorant *(Phalacrocorax niger*), Grey Heron *(Ardea cinerea)* are found on limited basis along canal/khal systems and seasonal wetlands throughout of the year. Local people reported that, a few number of migratory birds namely Curlew Sandpiper, Common Sandpiper, Common Coot, Common Snipe are also found during the winter season.

5.8.4 Ecosystem goods and services

291. UNEP defines an ecosystem is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment, interacting as a functional unit.

Humans are an integral part of ecosystems. Ecosystem services are the tangible and intangible benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on earth.

292. Healthy ecosystems provide both goods (tangible benefits) and services (intangible benefits) to humanity. Here, goods refer to items given monetary value, whereas the services from ecosystems are valued, but are rarely bought or sold. Ecosystem "goods" includes foods, construction materials, medicinal plants and tourism.

293. On the other hand, ecosystem "services" includes maintaining hydrological cycles, regulating climate, shelterbelt, cleansing water and air, maintaining the gaseous composition of the atmosphere, pollinating crops and other important plants, generating and maintaining soils, storing and cycling essential nutrients, absorbing and detoxifying pollutants; providing aesthetic beauty and recreation.

294. The table below represents few tangible ecosystem goods (but not limited to) from different common plants of the polder areas.

Goods/Services/ Purpose	Name of Plants	Plants Parts used
Food	Supari *(Areca catechu),* Narikel *(Cocos nucifera),* Aam *(Mangifera indica),* Jam *(Syzygium sp),* Kola (*Musa sp),* Safeda *(Manilkara zapota),* Payara (*Psidium guajava*), Tal *(Boassus flabellifer),* Amra *(Spondias pinnata),* Katbadam *(Terminalia catappa),* Boroi *(Ziziphus jujuba),*	Fruit
	Ghechu (*Aponogeton spp*.)	Rootstock
	Helencha (*Enhydra fluctuans)* and Kolmishak (*Ipomoea aquatica*)	Leaf and stem
Fodder	Kochuripana, (*Eichhornia crassipe*), Ipil Ipil (*Leucaena leucocephala*)	Leaf and stem
Timber	Aam *(Mangifera indica),* Jam *(Syzygium sp),* Babla *(Acacia nilotica),* Mahogany (*Swietenia mahagoni),* Neem *(Azadirachta indica),* Akashmoni *(Acacia auriculiformis),* SadaKoroi /SilKoroi *(Albizia procera),* Chambul/Rajkoroi *(Albizia richardiana),* Sisoo *(Dalbergia sissoo),* Raintree *(Samanea saman),*	Tree Trunk, Bole
Medicine	Tetul (*Tamarindus indica),* Tulshi *(Ocimum americanum),* Sezi/Dudhiya *(Euphorbia antiquoram),* Bel *(Aglemarmelos),* Jat Neem *(Azadirachta indica),* Arjun *(Terminalia arjuna),* Gab *(Diospyros perigrina),*	Roots, Leaf, Bark, fruit
Thatching and mat making	Supari *(Areca catechu),* Narikel *(Cocos nucifera),* Tal *(Boassus flabellifer),* Hogla/Patipata (*Typha elephantalis*), Golpata (*Nypa fruticans*), Bamboo (*Bambusa spp.)*	leave
Fuel	Babla *(Acacia nilotica)*, Raintree *(Samanea saman),* Akashmoni *(Acacia auriculiformis),* Boroi *(Ziziphus jujuba),* Aam *(Mangifera indica),* Khoiya Babla *(Pithocelobium dulci),*	Branches, Leaf
Organic Fertilizer (compost)	Kochuripana (*Eichhornia crassipes*), Topapana (Pistia stratiotes), Khudipana (*Lemna perpusilla*) and other aquatic plants.	All parts of the pant

Sources: CEGIS Field Survey 2014

Note: Abundance Code, H= High, M= Medium, L= Low

Photo 5.36 : Furniture

Photo 5.37: Tree log from homestead forest and roadside plantation

5.8.5 Present threats on ecosystem

295. The ecology of the wetland areas are influenced by a number of macro-level physical factors. Among them, the quantity and periodicity of freshwater flow plays a significant role in determining the floral and faunal species diversity and richness. This is especially important for river-dominated wetlands since the flora of these wetlands is more susceptible to reduction in freshwater. Against the backdrop, the major problems identified in the polder area are improper maintenance of embankment and sluice gates, saline water intrusion and increased soil salinity, intensity and frequency of natural disasters (super cyclone like *Sidr*), khals siltation and water logging. Modhumoti river bank erosion (Paranpur and saidah villege) is also another problem in the study area which is destroying the homestead forest. Pests and diseases attack, improper homestead space utilization planning is also a problem. The knowledge derived from the field survey is Gher shrimp farming activities ultimately resulting increased salinity and successively creating continuous pressure to floral and faunal biodiversity as well as ecosystem and goods and services.

296. Local people reported that, 20-30 year back Lesser Adjutant/Modontak (*Leptoptilos javanicus*), Porcupine (*Hystricomorph Hystricidae*), White Ramped Vulture (*Gyps bengalensis*) were extinct from this area. The beels area (low lying area) is harbor of huge Mollusk (Shamuk) but they are under serious threats due to collection by local people for the purpose of shrimp feeding in the Gher. Mollusk (Shamuk) has important role in wetland ecosystem as it is a part of web chain. Nevertheless, hunting of birds and resident wildlife is also a threat and resulting disappearance of wildlife day by day. Consequently, faunal population and diversity is also decreasing due to flood, cyclone, salinity intrusion and various human activities

6 Socio-Economic Condition

6.1 Socio-economic Condition

297. The socio-economic baseline condition of five (5) upazilas under Bagerhat and Khulna districts was drawn for obtaining the current socio-economic status of the study area with a view to rehabilitate Polder 36/1 aiming to remove the existing problems e.g. drainage congestion, salinity intrusion etc. The socio-economic baseline condition within the 'ESIA Study of Rehabilitation of Polder 36/1' is presented in the following section. In coastal areas, fisheries sector plays an important role in leading of livelihood therefore fishery has been considered as different resource in ESIA study. The base condition of fishery resources has been described in sub-section 5.7 of chapter 5.

6.1.1 Location

298. The study area encompasses a certain percentages of the upazilas namely Bagerhat Sadar, Chitalmari, Fakirhat, Mollahat and Rupsa which are likely to be impacted directly by the Project. About 39,130 hector of land from five upazilas has been considered for the baseline study. The administrative units within the polder area and percentages are stated in **Table 5.35.**

Table 5.35: Administrative units of Polder 36/1

District	Upazilas	% of upazilas covered polder area
Bagerhat	Bagerhat Sadar	8
	Chitalmari	68
	Fakirhat	18
	Mollahat	93
Khulna	Rupsa	34

Source: GIS estimation by CEGIS, 2014

6.1.2 Demography

299. The study area of Polder 36/1 is taken an account of 75,529 households (HHs) consisting of 3,37,232 populations (PPs). The average size of households in this polder is 4.3 where male and female are almost equally distributed. Demographic information of polder area is presented in **Table 5.36.**

Table 5.36: Basic Demography of Polder 36/1

Union	HHs	PPs	HH size	Sex Ratio
Bagerhat sadar	5111	20956	4.1	101
Chitalmari	21525	99017	4.6	100
Fakirhat	6405	26262	4.1	101
Mollahat	27679	127322	4.6	99
Rupsa	14808	63675	4.3	101
Total/Avg	**75,529**	**3,37,232**	**4.3**	**100**

Source: BBS 2011, estimated by CEGIS, 2014

6.1.3 Employment opportunity and occupation

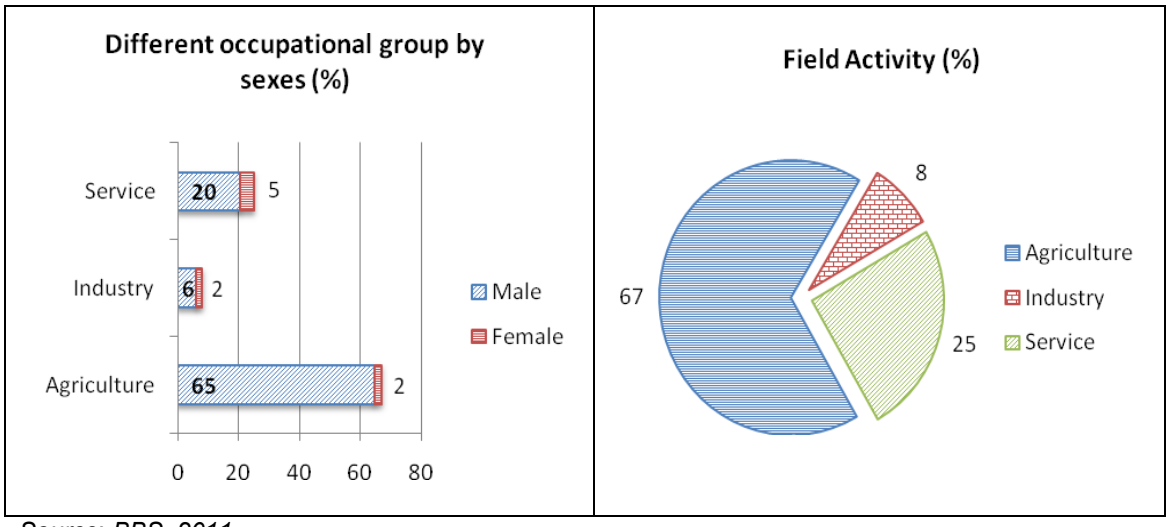
300. In Polder 36/1, about 40% of total populations are employed and 22% are not working (including children below 14 years and physically challenged people). About 38% of total populations are engaged in household work (all are female except some retired male). At present, the area represents moderate employment status considering the involvement in earning sources.

Table 5.37: Employment status of polder area

Union	Employment status					
	Employed		Household work		Do not work	
	Male	Female	Male	Female	Male	Female
Bagerhat sadar	36	4	1	36	9	14
Chitalmari	36	1	1	39	10	13
Fakirhat	36	3	1	38	8	14
Mollahat	38	2	1	39	9	11
Rupsa	35	8	1	34	8	14
Average	**36**	**4**	**1**	**37**	**9**	**13**
Total	**40**		**38**		**22**	

Source: BBS, 2011

301. Farming, as per the Census Data of BBS, is the foundation of people's mode of livelihood. The figure shows that on an average 67% of populations are involved in farming activities where a significant number of them are mainly engaged in shrimp/prawn/fish culture. Moreover, 25% of people are service holders and 8% are industrial workers in the polder area. The Figure 5.21 also represents the distribution of different occupational groups by sex, where the highest percentages of the male are farmer (65%) and the female are service holder (20%).



Source: *BBS, 2011*

Figure 5.21: Distribution of different occupational groups and field of activities

6.1.4 Availability of work force and wage rate

302. Data from Population Census of BBS, 2011 shows that about 58% of total population (aged 15 to 59 years) contribute in income generating activities who are the main working force of Polder 36/1, while 33% are children and 9% are aged, those are depending on the 15-59 years age group (**Table 5.38**). As stated by the local stakeholders, the socio-economic condition of gher owners who cultivate shrimp on their land is quite better compared to other agriculture based occupants in the polder area.

Table 5.38: Distribution population by potential workforce at polder area

Union	Population in all Ages	% of population in the age group		
		0-14 yrs.	15-59 yrs.	60+yrs.
Bagerhat sadar	20956	29	61	9
Chitalmari	99017	37	54	10
Fakirhat	26262	29	61	9
Mollahat	127322	38	54	9
Rupsa	63675	31	61	8
Total/Average	**3,37,232**	**33**	**58**	**9**

Source: BBS, 2011

303. Field finding shows that the area is suitable for fish culture and crop farming. Number of males are engaged as the wage laborers of different farming activities. Wage rate of male laborers are about Tk.350 to Tk.450 per day excluding lunch in farming activities. Both male and female are engaged in earth work and the wage rate varies for this activity from Tk.200 to Tk.250 for female labors and Tk.400 to Tk.500 for male labors including lunch. The female of the project area mainly involve in snails breaking activity, which is used as the fish meal in shrimp and crab culture and earn Tk.50 for breaking a sack of snails. Hence, the wage rate for both sexes is comparatively higher in non-farming activity.

6.1.5 Land price of polder area

304. The sale value of land in polder 36/1 varies by land categories those are presented in **Table 5.39**. Commercial and Homestead land, as reported by local stakeholders, are most preferable for business and residence purposes. Most of the agricultural land and medium low land is used for fish as well as crop culture, so that the sale value of per acre agriculture land is comparatively higher than that of the other saline prone areas.

Table 5.39: Land price of the polder area

Land classes	Minimum-Maximum land price(taka/acre)
Agricultural land	7,00,000Tk to 14,00,000Tk
Homesteads	10,00,000Tk to 20,00,000Tk
Commercial Land	10,00,000Tk to 24,00,000Tk

Sources: RRA, 2014 Note: 1 acre = 100 decimal

6.1.6 Population Migration

305. Migration is an important indicator to identify the working opportunity of the project area. Seasonal migration is reasonably found but permanent migration is negligibly found in

the project area for both in/out migration situations. In terms of seasonal in-migration, people mostly came from different upazilas of Polder 36/1 and adjacent districts as well; especially for harvesting and cultivating of paddy as well as fish capturing and related day laboring activities. The seasonal out-migration is comparatively low than the in-migration, where labors used to go to the surrounding upazilas of Bagerhat as well as Khulna and Dhaka districts for better employment. The detail migration feature of polder 36/1 is presented in **Table 5.40**.

Table 5.40: Trend of migration at polder area

Types of Migration	Out Migration		In Migration	
	Place of destination	% of PPs	Place of origin	% of PPs
Seasonal migration	Different upazilas of study area and Dhaka, Khulna, Bagerhat districts.	10	Different upazilas of study area and Pirojpur, Gopalganj, Faridpur etc. districts	15
Permanent migration	Jessore, Khulna, Dhaka etc.	5	-	-

Source: RRA, 2014

6.1.7 Household income and expenditure

306. Household income and expenditure is an important indicator to measure socio-economic condition of a household. In Polder 36/1, it is found that most of the people's income and expenditure are varying from 5,001 Tk. – 9,000 Tk./month, which indicate a low level of socio-economic status in the area. However, the income and expenditure group of over Taka 20,000+ is found for the businessman class who has some big shrimp ghers in the project area (**Table 5.41**).

Table 5.41: Distribution of household income and expenditure at polder area

Range (Tk./month)	Percentage of Households	
	Income	Expenditure
< 1,000	-	-
1,001 - 2,000	-	-
2,001 – 5,000	20	20
5,001 - 9,000	60	55
9,001 - 20,000	15	20
> 20,000	5	5

Source: RRA, 2014

6.1.8 Poverty

307. According to the HIES 2010, the household whose monthly income is below to the upper poverty is considered as poor. The per capita income has been adjusted considering the successive monthly average rate of inflation from 2011 to 2014 by the source of Bangladesh Bank. In accordance with household's monthly income (**Figure 5.22**) in the project area, approximately 30% of total households (estimated 22658 HHs) live below the upper poverty line. This percentage increases about 2% in terms of national (BDT.1717.68) per capita estimated income than that of to divisional level (BDT.1657.24).

308. Poverty is also measured through self assessment of the local people in Polder 36/1. This measurement is mainly based on fiscal value. In this process the respondents were

asked to evaluate the overall condition of people living in the project area. Their responses are assembled into three categories such as deficit, balance and surplus.

309. Local people of Polder 36/1 assumed that on an average 50% of total households are in balance or breakeven category, i.e. their economic activities are subsistence oriented. People also reported that 20% of households belong to deficit category since they have to borrow money round of the year to functioning their living. However, 40% of total households are in surplus category in the polder area which shows good features in terms of poverty status.

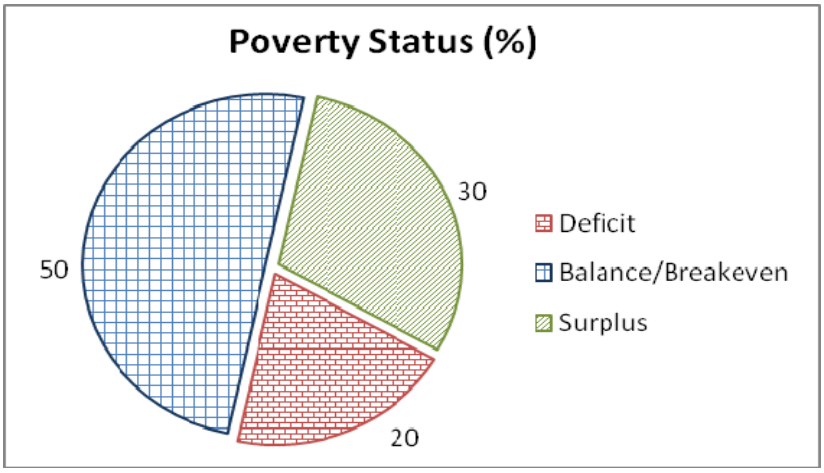


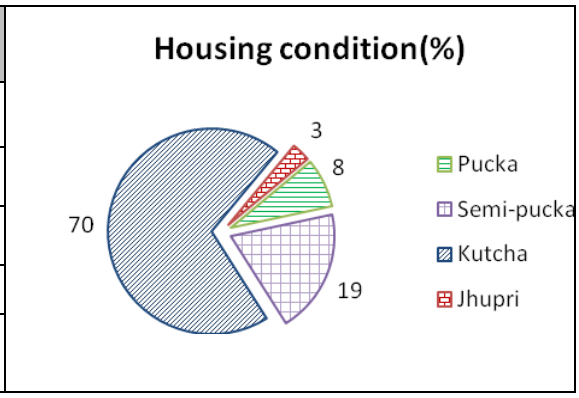
Figure 5.22: Poverty Status in polder 36/1

6.1.9 Housing condition

310. According to BBS housing conditions of the polder area is moderate to poor. On an average 73% of housing structures (70% kutcha and 3% Jhupri) are made by CI Sheet/bamboo/wooden/earth materials whereas only 8% of housing structures are pucka which are made in concrete frame (**Table 5.42**). Therefore, it can be summarized that in terms of housing structure, the polder area belongs to moderate to poor category.

Table 5.42: Housing structures of the polder area

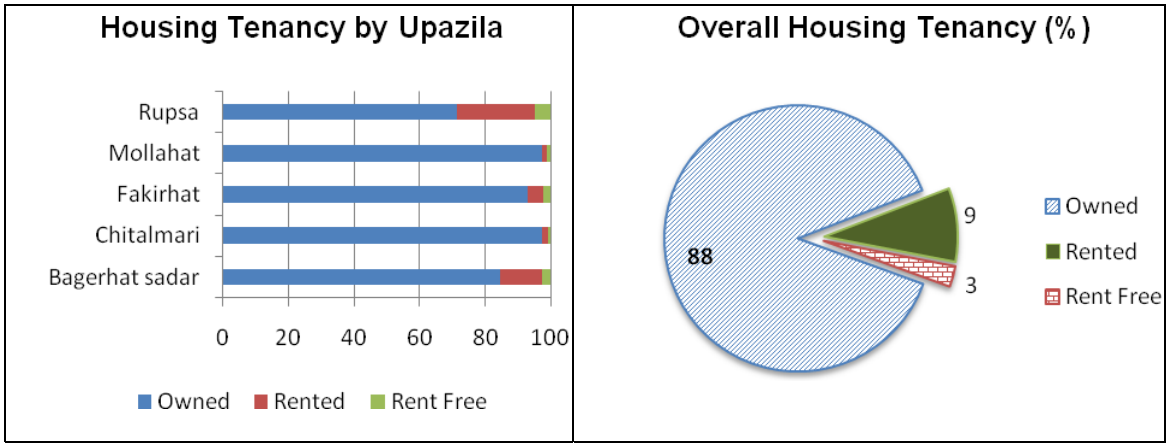
Upazila	Pucka	Semi-pucka	Kutcha	Jhupri
Bagerhat sadar	12	23	61	4
Chitalmari	4	6	89	1
Fakirhat	7	29	60	4
Mollahat	4	10	85	1
Rupsa	13	28	54	5



Source: BBS, 2011

311. In the polder area 88% of households live in their own house/land and 9% of households live in rental basis, however only 3% of households live in rent free habitat (**Figure 5.23**). The upazilas are adjacent to the Bagerhat sadar and Khulna city therefore

after implementing the project; in-migration rate could be increased proportionately to the infrastructural development. As a result, in near future the number of rented households may be increased which can be an additional source of income for the locals. Detail of housing tenancy is presented the following figures.



Source: BBS, 2011

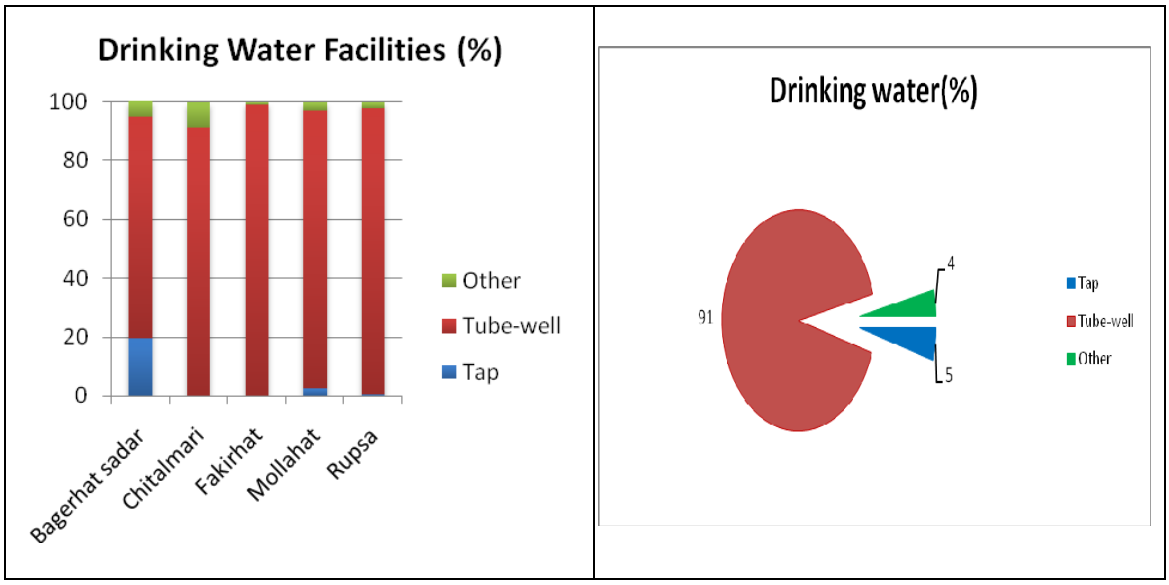
Figure 5.23: Housing tenancy of polder area

Photo 5.38:Kutcha house in Polder 36/1

Photo 5.39:Sanitation system in Polder 36/1

6.1.10 Sources of drinking water

312. The BBS reported that overall 91% of households use tube well water for drinking purposes (**Figure 5.24)**. Due to high expense of installing deep tube well, people in somewhere use some other sources i.e. supply water, surface water etc. for meeting up the need of drinking water.



Source: BBS, 2011

Figure 5.24: Drinking water source at polder area

6.1.11 Health

313. As per the local people, the overall health facilities are moderate in polder area but there are some variations on the perception of choosing service centers. The unions of the project area are away from the urban area; therefore the local people of the polder area preferably go to the union health complex. However, due to having good communication facilities the critical patients have taken to the district level and divisional level health complexes. People prefer to go to the local pharmacy cum physician for getting treatment of general ailments **Table 5.43.**

Table 5.43: Proportion health facilities system at polder area

Sl. No.	Type of Facility	Number of Facilities
1	District/Sadar Hospital	-
2	Upazila Health Complex	2
3	Union Sub-Center	10
4	Union Family Welfare Center	-
5	Community Clinic	17
6	Private Health Clinics/hospitals	2
7	Other (if any)	-

Source: RRA, 2014

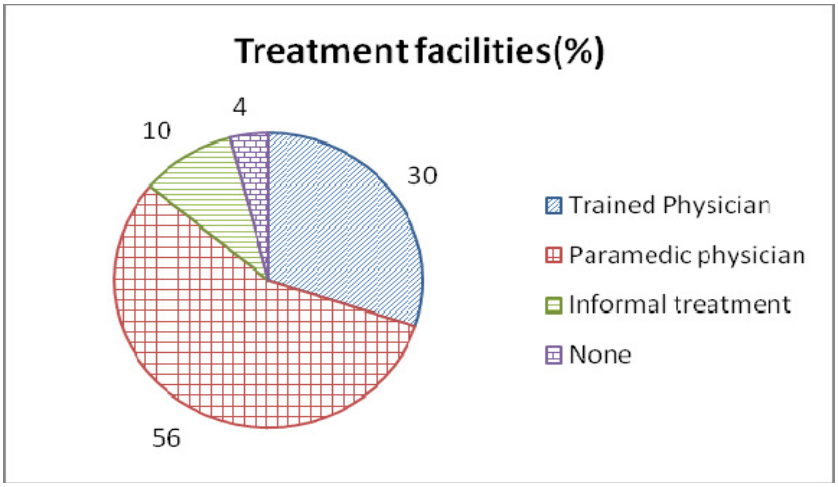
314. The disease profile of the local people living in the project area is presented in **Table 5.44**. According to the observation, cold/cough is observed as top in rank following the chronic fever in the project area. Besides, other diseases such as gastric, diabetes, hypertension, skin diseases, asthma, diarrhea, etc. are also appeared moderately in the area. Mostly affected cold/cough and chronic fever diseases are seasonal ailments. The national diseases profile is given with the percentages of suffering people to compare and contrast the diseases status of polder area.

Table 5.44: Common diseases in the polder area

Disease	Ranking by incidence of diseases in the polder area*	Ranking by incidence of diseases in the country**	Percentages of population suffered in the country**
Gastric	3	1	24
Rheumatic fever	6	2	14
Hypertension	4	3	11
Asthma	10	4	9
Heart diseases	7	5	7
Diabetes	5	6	5
Chronic fever	2	7	3
Skin disease (eczema)	8	8	2
Diarrhea	9	9	1
Cough/cold	1	-	-

*Source: *RRA by CEGIS, 2014;** Household income and expenditure survey in 2010*

315. In polder 36/1, most of the people (56%) receive treatment from the paramedic physician. Moreover, a significant numbers of people (30%) are willing to receive treatment from trained physician but 4% of people not able to receive any type of medical support yet. In addition, 10% of people receive informal treatment (**Figure 5.25**). So, it can be considered as moderate treatment facilities in polder area.

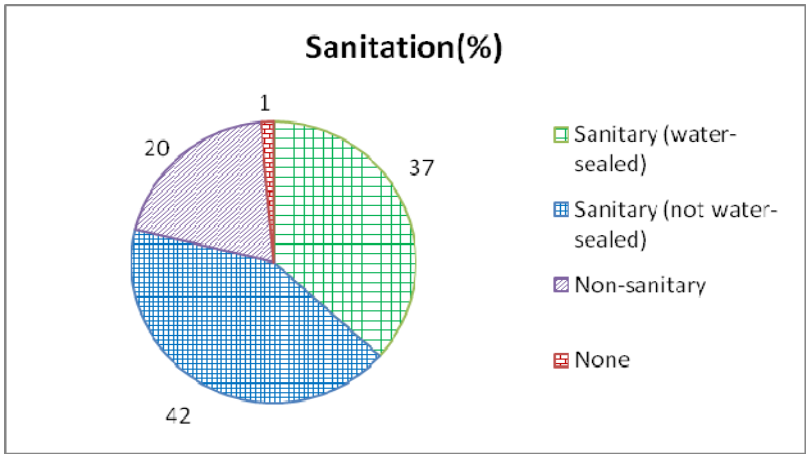


Source: RRA, 2014

Figure 5.25: Health treatment facilities at polder area

6.1.12 Sanitation

316. Sanitation facility is moderate in the polder area. About 37% of households get facilities of water-sealed sanitary latrine whereas 20% households still use non-sanitary latrine. Overall 79% of households are with sanitation facilities in the project area; however 1% of households have met up their toiletry needs by using open latrines (Figure 5.26).



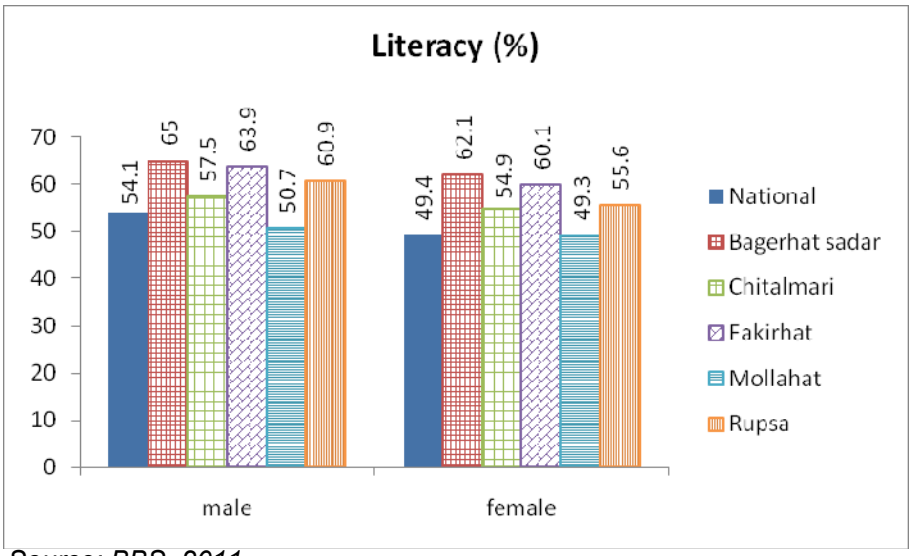
Source: BBS, 2011

Figure 5.26: Sanitation facility in polder area

Education

317. In most of the upazila of polder 36/1, male and female literacy rate is higher compared to the national level except in Mollahat upazila where the literacy shows alternative feature. In comparison of literacy rate by sex, male are always shows the higher proportion than the female in all the upazilas of polder.

318. The highest literacy rate for both sexes (male 65% and female 62.1%) shows in Bagerhat sadar upazila (**Figure 5.27)**. During FGD, people stated that from last few years girls performing better in education sector than that of boys.



Source: BBS, 2011

Figure 5.27: Percentages of literate people in upazilas

319. In the polder area, there are number of educational institutions, among those the existing number of institutes of some most comprising unions (Gangni, Kodalia, Kulia, Gaola, Mulghar, Baruipara and Chitalmari) within Polder 36/1 is shown in **Table 5.45**. There are 85 primary schools, 29 high schools and 3 colleges found in addition to, 7 dakhil madrasas and 1 fazil madrasa. Local people opined that children's schooling rate is increasing day by day.

Table 5.45: Number of govt. educational institution at seven unions of polder 36/1

SL. No.	Type of facility	Nos. of Institution	Type of facility	Nos. of Institution
1	Primary School	85	Ebtedayee Madrasha	-
2	High School	29	Dakhil Madrasha	7
3	College	3	Alim/Fazil Madrasha	1

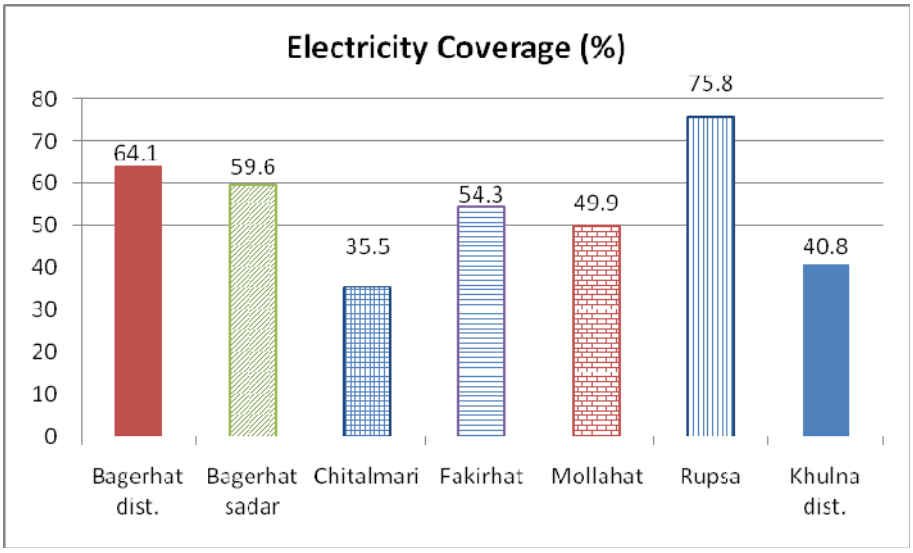
Source: RRA, 2014

Photo 5.40: College in polder 36/1

Photo 5.41: Primary School in polder 36/1

6.1.13 Electricity connections

320. Electricity facility of the polder upazilas is found as dissatisfactory level compared to the district level except in Rupsa upazila. In Rupsa upazila, the percentages of household having highest (about 76%) electricity coverage compared to other upazilas under Polder 36/1 as well as the district level (about 64% & 40.8%). The overall electricity coverage of five upazila with respect to the district level electricity coverage is reflected in the diagram below (**Figure 5.28**).



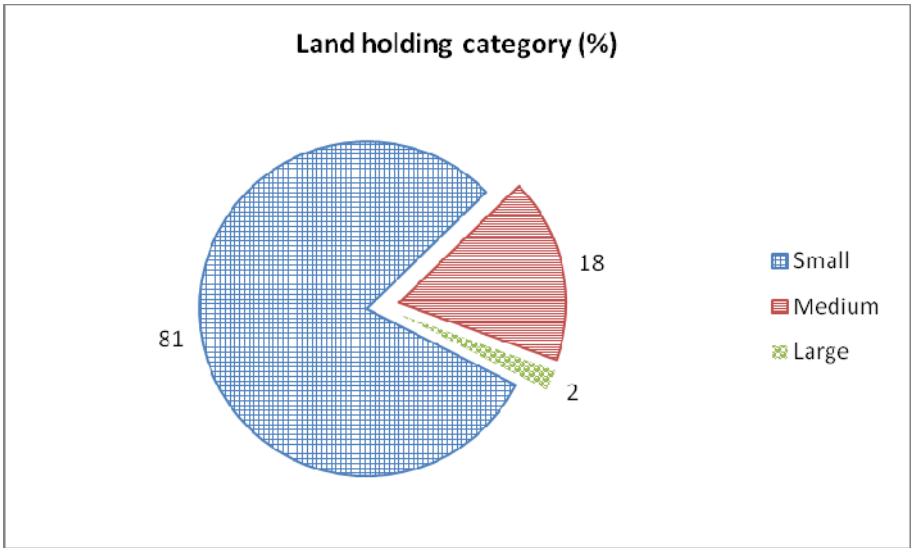
Source: BBS, 2011

Figure 5.28: Coverage of electricity facility in polder area

6.1.14 Land holding categories

321. In the polder area, it is found that most of the farming families holding small land. Small land holder comprises almost 81%, and medium holder comprises 18% whereas negligible 2% of households are in large land holdings category.

322. In polder 36/1, arable land is highly used for shrimp/prawn culture as well as crop production, because of being adjacent to Gopalganj, Bagerhat and Khulna district most of the land owners desire to found this polder as a commercial zone. The biggest fish stockyard (Faltita Bazaar) is situated in this polder. People opined that the commercialization of this area may change the land holding category of the land owners.



Source: Agricultural censes, 2008

Figure 5.29: Percentage of land holding category in polder area

6.1.15 Communication Status

323. Communication system reflects the connectivity with internal and external areas including districts and divisional level communication system from the polder area. All the upazila connecting roads are almost concrete but in some places it founds damaged road. It is observed that a huge area especially in village level, the connecting roads are kutcha or brick soling where in rainy season it is tough to move. However, comparing the feature of road communication facilities of general polder areas, Polder 36/1 reflects better facilities than the others. The navigational route is insignificantly found in the polder area because of silting up the internal khals and rivers.

Photo 5.42: Navigation facilities in Polder 36/1

Photo 5.43: Road communication in Polder 36/1

6.1.16 Social conflicts

324. The area is prominent by the name of *Bahanno Gram* where 52 villages comprising with full of hindu community lived in those villages. However with the time beings Muslim community resides in those villages and some of them have holding an important position in those villages in terms of administrative and social aspects. By residing side by side of two different communities no major conflict found in the polder area except some political violence. Both the communities try to attend the religious and cultural festivals of different communities if they have invited.

6.1.17 Safety nets

325. In present days, social safety nets of rural area depend on the NGO interventions. Most of the people living in the project area are satisfied by the activity of NGOs though the NGOs do not have significant impact to their livelihood. NGOs have small contribution upon them to borrow money/credit but have strong contribution in providing solar energy systems. ASA, Proshikha, Grameen Shakti, Uddipan, Badhon, Codac, SDO, BRAC, World Vision and Grameen Bank have major coverage for last few years. These NGOs mostly work on credit, health, sanitation, drinking water, disasters, solar energy and livestock rearing sectors.

6.1.18 Natural disaster and its aftermath

326. The local inhabitants of Polder 36/1 have identified water logging/ drainage congestion, cyclones and erosion as the major hazards in the polder area. Salinity intrusion was also being the problem in the polder area but from last few decades the local people coped with the salinity intrusion by changing the cropping pattern from rice to shrimp culture. However, from last two or three years the saline water intrusion have been reduced due to silting up of most of the connecting khals from Chitra River to the project areas.

6.1.19 Gender concerns

327. Gender issue holds as most important issue in present development aspect. In the polder area, females are moderately engaged in wage earning and snail breaking activities; however it found discrimination on gender in the payment of wage laborers.

328. Most of the female of Polder 36/1 are willing to involve in household works i.e. livestock rearing, vegetation, making rice from paddy etc. Apart from that a considerable number of female involve in snail breaking activity for contributing in family income. For

doing so they get support by their family. The females who are engaged in earth work are mostly belonging from the female headed households. Because they can earn a considerable amount of money by doing this activity so that they can somehow support their family. Moreover, the female of the study area are very much interested to involve themselves in small business entrepreneurs i.e. handicraft, livestock rearing etc.

329. Female of the polder area are also doing well in academic activities and in present days the literacy rate of female is almost equal to their male counterparts which was much lower in few years back. This sort of women development inspires the girls for enlightening them in creating their own future and the society as well.

6.1.20 Culture and heritage

330. There is no different culture and exclusive heritage found in the polder area.

7 Identification, Prediction and Evaluation of Potential Impacts

331. This chapter describes the Important Environmental and social components (IESCs) which are likely to be impacted by the project interventions. The evaluation of potential impacts have also been discussed in this chapter.

7.1 Identification of IESCs and Rationale

332. All environmental and social components are not impacted by project interventions. Some components may be impacted while others are independent of the interventions. Environmental and social components which are likely to be impacted by project interventions are termed as Important Environmental and Social Components (IESCs). Important Environmental and Social Components (IESCs), likely to be impacted by proposed interventions have been selected based on the rationale against each IESC are presented in the following table below 7.1

Table 7.1: Identified IESCs and Rationale

IESCs	Rationale
Physical Resources	
Noise	During pre construction and construction phases, noise will be generated temporarily in different locations of the study area for mobilization of construction materials and equipments, operation of equipment and machineries. There will be no such noise after implementation of the interventions. As such, noise has been considered as an IEC.
Air Quality	During pre-construction and construction activities, material carrying vehicles and construction machineries will exhaust emissions, containing carbon di-oxide (CO_2), sulfur dioxide (SO_2), oxides of nitrogen (NO_X), and particulate matters (PM). These emissions may temporarily deteriorate the ambient air quality in the immediate vicinity of the construction sites of the study area. As such, air quality is considered as an IEC.
Water Resources	
Drainage congestion	Study area is facing severe drainage congestion problem. Sedimentation in the rivers and khals within and around the polder is the main cause for the drainage congestion. After successful implementation of the proposed interventions, present situation of drainage congestion will be improved. As such, drainage congestion has been considered as an IEC.
Water logging	In the study area there are some specific locations which remain inundated throughout the year. After successful implementation of the proposed interventions, present situation of water logging will be improved. As such, water logging has been considered as an IEC.
Water quality	Water quality is very important for all living organism, aquatic ecosystem and livelihoods of the local fishing community. Dredging

IESCs	Rationale
	works will improve the quality of water. At the same time, Waste materials from labor shed or other sources may deteriorate the quality of water. So, water quality has been considered gjs as an IEC.
Siltation	Most of the rivers (especially Bhairab and Atharobanki) and khals are silted up and have lost their conveyance capacity significantly. Proposed interventions will reduce the siltation problem and will make the internal drainage system more dynamic. As such, siltation has been considered as an IEC.
Erosion	At present the erosion problem is very crucial at Paranpur and Saildah. After successful implementation of the proposed interventions, present circumstances of erosion will be improved. As such, erosion has been considered as an IEC.
Navigation	Facilitating of smooth navigation is one of the main objectives of dredging. After dredging and re-excavation navigation facilities will be improved. As such, navigation has been considered as an IEC.
Land Resources	
Land use	Land loss/land use change through river bank erosion is a major problem in the polder area. The proposed retired embankment is expected to check such change of agricultural land. Temporary change of agricultural land is likely to take place during the pre-construction and construction phase if labor sheds are constructed and/or construction materials are stored on agricultural land. Agricultural land use may also be changed if dredged spoil/re-excavated soils are disposed on agricultural land. Considering such permanent as well as temporary loss of agricultural land, land loss has been selected as an IEC.
Agricultural Resources	
Cropping intensity	The Polder interventions may change the hydrologic regime inside the polder area, which may encourage the farmers to change their cropping patterns. This may increase the cropping intensity in consideration of which cropping pattern has been selected as an IEC.
Crop production	Increasing agricultural crop production is one of the major objectives of the proposed interventions. This is expected to be achieved through reduction of crop damage, increased area under high yielding varieties/hybrid of rice with increased provision of overall adoption of improved crop management practices. As such crop production has been selected as an IEC.
Crop damage	Crops are presently damaged in the polder area due to flood, drainage congestion, partial salinity and drought, etc. which are expected to be checked through the proposed interventions. Reduction in crop damage would be reflected in aerial extent as well as increased yield per hectare contributing to increase in crop production in consideration of which crop damage has been selected as an IEC.
Irrigated area	Surface water from khals is more preferable over ground water for irrigation both primary and supplemental irrigation use because of its low cost and sediment content contributing towards maintaining the soil nutrient status. The proposed interventions are expected to

IESCs	Rationale
	increase the availability of surface water for irrigation use in consideration of which this has been selected as an IEC.
Fisheries Resources	
Fish habitat and quality	Rehabilitation of any types of interventions might modify the quality and quantity of fish habitat. The project till possess different water bodies like khal, beel, gher, floodplain, ponds etc that contribute towards the development of fisheries and other aquatic resources in the polder area. The proposed interventions will change the fish habitat and habitat quality in the polder area. In this context, fish habitat is considered as an IEC in this study.
Fish migration and grazing area	The adjacent Rivers namely Madhumoti, Bhairab, Chitra are tidal in nature and the internal khal are connected with the river. The entries of fish from such rivers are controlled by naturally by siltation and various water regulating structures. But internal fish movements and migration are still the driving force for capture fisheries within the polder area. Proposed intervention in the polder areas is expected to improve water flow, river-khal connectivity and to maintain the year round certain depth of water that will help to facilitate the fish migration and grazing. Thus, fish migration and grazing area has considered as an IEC.
Fish biodiversity and species richness	The polder area comprises both of fresh and brackish water fish species. About 80 fish species are present in the polder area. The brackish and fresh water fish species are reducing due to habitat losses, obstruction of migration routes, degradation of fish habitat quality because of siltation etc. The proposed intervention would facilitate the fish migration, restored fish habitats that change of fish species diversity and richness in the polder area. So, fish diversity and species richness is considered IECs of this study.
Fish Production	Fish productions, that comes from different water bodies like khal, ghers, pond and floodplain in the polder area. The fish habitat is declining over the years due to siltation and disruption of migratory routes. Fish production from these habitats might become change due to proposed interventions. Hence, fish production is considered as an IEC.
Ecological Resources	
Terrestrial Vegetation	Terrestrial vegetation is an important component of the existing ecosystem. This type of vegetation provides habitat for wildlife and also providence of various elements to human. Any change of physical environment causes different intensity of vegetation damage and creates threats to wildlife. The proposed interventions especially the new water controller structure (regulator) and rivers protection works may cause impacts to vegetation during construction as well as post construction phases. Therefore, Terrestrial vegetation has been identified as an IEC.
Aquatic Flora and Fauna	Aquatic flora and faunal status relies on wetland water salinity, quality, depth which plays an important role in the existing wetland ecosystem. Poor drainage capacity of internal silted khals/river and non-functionality of water control structures also creates drainage congestion. TRM and Khal/river re-excavation is expecting to change water quality as well as fresh water flow which may impact on aquatic flora and fauna. Impacts can be positive and/or negative in long run. Hence, aquatic flora and fauna is considering as an IEC.

IESCs	Rationale
Socio-econimic Condition	
Employment opportunities	The employment opportunities represent the way of livelihood by which people can generate their income and improve their living of standard. The proposed interventions will help in combined practice both agriculture and fishery in all over the polder area which is limited in present days. Developed irrigation facilities by opening all the water connectivity around the peripheral of polder 36/1 will help to restrict saline intrusion. As a result, a huge amount of land will be revived for agriculture as well as fishery activity which may increase the employment opportunity of polder 36/1. That is why, employment opportunity is considered as an ISC.
Income generation	An activity, which influences to generate additional income with basic income, is called income generation activity and the process is called income generation process. Participation in intervention works will temporarily help to generate the income local labors. Additionally the intervention works will help to generate the income of local people in long run by practicing agriculture and fishery activities substantially. Therefore, Income generation is selected as an ISC.
Safety/security of assets and resources	Paranpur and Saildah mouzas of Mollahat upazila is badly affected by Modhumoti River erosion. Moreover, a huge area of polder 36/1 has been inundated due to water logging. The proposed interventions will shield a huge amount of agriculture land, homestead and important structures as well. That is why safety/security of assets and resources is chosen as an ISC.
Migration	Migration represents the status of working scope and potential work force of the study area. A considerable number of labors involved in farming activities are come from outside of the polder. The proposed interventions will increase the area of agricultural practice therefore, the labors demand will be increased which may increase the in-migration rate in future. So that, migration is consider as an ISCs.
Public Health	Some labors will be in-migrated in intervention works and there will have some labor sheds for their living where it is essential to have sanitation and drinking water facilities, otherwise it may create environmental unrest by using unhygienic public health. Moreover, labors may little bit injure during construction works therefore fast-aid treatment facilities must be needed. That is why, Public health is been chosen as an ISC.

7.2 Eavaluation of Potential Impacts

333. This section identified the potential environmental and social impacts that may caused by various project activities during pre-construction, construction, and post-construction stages on already identified IESCs. Potential proposed intervention which may cause potential environmental impacts during pre-construction, construction, and post-construction stages have been identified in Chapter 4 four (4). The following detailed investigations have been carried out to assess the magnitude of these prioritized impacts:

- RRA survey to assess the loss of vegetation, occupation, income and poverty levels of the affected households, etc.

- Environmental quality baseline monitoring of noise, surface water, groundwater and soil,
- Ecological surveys comprising vegetation, wildlife and fisheries covering both terrestrial and aquatic ecosystem,
- Land surveys in the Polder area comprising socio-economic status and environmental settings,
- Expert consultations focus group discussions, and public consultation.

7.3 Impact on Physical Resources

334. Impact on physical resources (noise and air quality) for all the three phase's i.e. pre-construction phase, construction phase and post-construction phase are discussed in the following sub-sections.

7.3.1 Pre-Construction Phase

335. Impacts during pre-construction phase are discussed below:

(a) Activity: *Mobilization of construction materials and equipment*

IEC	Location	Baseline condition	Impact	Impact (+/-)/ Magnitude (1-10)*
Noise	Godara, Katakhalir khal, Simanar Khal, Helajila khal, Paranpur khal, Naraynkhali khal, Boiragi khal, Shabukhali khal, Bamondanga khal, Katakhali Khal, Dobakhali khal, Saildah khal, Chandpur khal, Dhanokhali khal, rivers and khals listed in Table 4.2 and 4.3 respectively	Sound is within tolerable limit, no significant source of noise found	Noise will be generated temporarily due to mobilization of vehicles and construction materials	-1
Air quality		Air quality is good	Dust generation during vehicle and construction materials movement will temporarily degrade the air quality	-1

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

7.3.2 Construction Phase

336. Impacts during construction phase are discussed below:

(a) Activity: *Construction of nine new regulators and replacement of five existing regulators*

IEC	Location	Baseline condition	Impact	Impact (+/-)/ Magnitude (1-10)*
Noise	Godara, Katakhalir khal, Simanar Khal, Helajila khal, Paranpur khal, Naraynkhali khal, Boiragi khal, Shabukhali khal, Bamondanga khal, Katakhali Khal, Dobakhali khal, Saildah khal, Chandpur khal, Dhanokhali khal	Sound is within tolerable limit, no significant source of noise found	Noise will be generated temporarily during construction of new regulators and replacement of existing regulators	-1
Air Quality	Godara, Katakhalir khal, Simanar Khal, Helajila khal, Paranpur khal, Naraynkhali khal, Boiragi khal, Shabukhali khal, Bamondanga khal, Katakhali Khal, Dobakhali khal, Saildah khal, Chandpur khal, Dhanokhali khal	Air quality is good	Dust generation during construction and repair work will temporarily degrade the air quality	-1

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

(b) Activity: *Dredging and re-excavation work by dredger*

IEC	Location	Baseline condition	Impact	Impact (+/-)/ Magnitude (1-10)*
Noise	Rivers and khals listed in Table 4.2 and 4.3 respectively	Sound is within tolerable limit, no significant source of noise found	Noise will be generated temporarily during dredging work	-1
Air Quality	Rivers and khals listed in Table 4.2 and 4.3 respectively	Air quality is good	Dust generation during re-excavation work will temporarily degrade the air quality	-1

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

(c) Activity: *Disposal of the dredged spoil on dumping locations through pipeline*

IEC	Location	Baseline condition	Impact	Impact (+/-)/ Magnitude (1-10)*
Air quality	As suggested in Feasibility report	Air quality is quite good	Dust will be generated while carrying and depositing dredged spoil in the selected locations which may temporarily degrade the air quality.	-1

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

(d) Activity: *Protective works to prevent erosion*

IEC	Location	Baseline condition	Impact	Impact (+/-)/ Magnitude (1-10)*
Noise	Paranpur, Saildah (along the bank of Modhumati river)	Sound is within tolerable limit, no significant source of noise found	Placing and dumping of CC blocks are likely to create noise temporarily which will affect the people	-1
Air Quality	Paranpur, Saildah (along the bank of Modhumati river)	Air quality is good	Dust generation Placing and dumping of CC blocks will temporarily degrade the air quality	-1

7.3.3 Post-Construction Phase

337. There will be no impact during post-construction phase.

7.4 Impact on Water Resources

338. Impact on water resources for all the three phases such as pre-construction phase, construction phase and post-construction phase are discussed briefly in the following sub-sections:

7.4.1 Pre-Construction Phase

339. There will be no impact during pre-construction phase.

7.4.2 Construction Phase

340. Impacts during construction phase are discussed below:

(a) Activity: *Construction of Labor Shed and Stockyard*

IEC	Location	Baseline condition	Impact	Impact (+/-)/ Magnitude (1-10)*
Water Quality	Godara, Paranpur, Saidah	Water Quality is quite good	Waste materials from labor shed may temporarily deteriorate the quality of water	-1

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

(b) Activity: *Dredging and re-excavation work by Dredger*

IEC	Location	Baseline condition	Impact	Impact (+/-)/ Magnitude (1-10)*
Water Quality	Rivers and khals listed in Table 4.2 and 4.3 respectively	Water Quality is quite good	Oil may spill from dredger to the water during dredging which may temporarily deteriorate the quality of water	-3
Drainage Congestion	All the existing khals	Severe drainage congestion	Earthwork in the khals while re-excavation may hinder the natural drainage	-2

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

(c) Activity: *Disposal of the dredged spoil on the dumping locations through pipeline*

IEC	Location	Baseline condition	Impact	Impact (+/-)/ Magnitude (1-10)*
Siltation	As suggested in Feasibility report	Siltation rate is high	Further siltation may occur if dredged spoil is not managed properly	-2

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

7.4.3 Post-Construction Phase

341. During post-construction phase, possible impacts of the proposed interventions on the selected IESCs have been assessed comparing the future-without-project (FWOP) condition with the future-with-project (FWIP) condition. Impacts during post-construction phase are discussed below:

a. Drainage Congestion

Future without Project

342. Drainage Congestion is a crucial problem in polder 36/1. Sedimentation in the rivers and khals within and around the polder is the main cause for the drainage congestion. Another major cause of drainage congestion is encroachment of the rivers and khals for

pisiculture and agriculture. If the project is not implemented the drainage congestion problem will increase with time.

Future with Project

343. If the project is implemented conveyance capacity of the rivers and khals will increase. New regulators will facilitate to drain out water smoothly. In addition, replaced regulators will work more dynamically. As a result, drainage congestion of the study area will be eliminated.

Impacts

344. After successful implementation of the proposed interventions, existing problems of drainage congestion will be removed.

b. Water logging

Future without Project

345. There are some specific locations in the study area which remain inundated throughout the year. Approximately 1500 ha of beel area are permanently waterlogged round the year and there is no human accessibility in that area. If the project is not implemented the problem of water logging will not be solved.

Future with Project

346. After successful implementation of the proposed works as per plan, the water logging problem will be eliminated.

Impacts

347. If the project is implemented the water logging will be removed. Around 1500 ha of agricultural land will increase and it will contribute to the total socio-economic development of the study area.

c. Siltation

Future without Project

348. Most of the rivers and khals are silted up and have lost their conveyance capacity significantly. The major drainage routes of polder 36/1 are Athharobanki river, Bhairab river, Chitra-Karamara river and Old Madhumoti river are now experiencing huge sedimentation problem. Siltation will increase more in the near future by reducing the section of the river. Thus, the conveyance capacity of the rivers and khals will be decreased and surface water availability will be reduced.

Future with Project

349. After successful implementation of the proposed works as per plan, the siltation or sedimentation problem will be decreased.

Impacts

350. If the project is implemented cross-section of the rivers as well as the water depths will be significantly increased and the conveyance capacity of the river will increase.

d. Erosion

Future without Project

351. The Madhumoti is the major river which is located at the northeastern periphery of the study area, carrying huge monsoon flow during wet season and it has the meandering characteristics causing river bank erosion. Erosion will cause severe damage in near future at Paranpur and Saildah which are the most vulnerable location to erosion.

Future with Project

352. After successful implementation of the proposed works as per plan, a huge portion of Chitalmari upazilla (Paranpur and Saildah) will be protected from erosion.

Impacts

353. After implementation of the project all possible damages due to erosion will be reduced. Significant amount of households, schools, mosques, temples, agricultural lands and roads will be saved from being washed away. People will feel secure and get relief from mental torment of losing their homestead, household and valuable properties.

e. Navigation

Future without Project

354. Consequential siltation will reduce the depth of the rivers. As a result, people will face problem to use the rivers as a mode of transportation and carrying goods to various locations due to insufficient section of the channel and navigational activities will further decrease in the study area.

Future with Project

355. Navigational activities will increase and people will regularly use the rivers as a mode of transportation and carrying goods to various locations.

Impacts

356. Considering the 'future without project' and the 'future with project' scenarios, it can be said that major navigational activities will resume and other navigational activities will also increase.

357. Impacts during post construction phase due to the implementation of proposed interventions are given below:

IEC	Baseline condition	FWOP	FWIP	Impact (+/-)/ Magnitude (1-10)*
Drainage congestion	Severe drainage congestion exists in the study area	Drainage congestion problem will increase in future	New regulators will facilitate to drain out water more smoothly. Present problem of drainage congestion will be removed.	+4

IEC	Baseline condition	FWOP	FWIP	Impact (+/-)/ Magnitude (1-10)*
Water logging	Around 1500ha of beel area remain inundated throughout the year	Problem of water logging will not be solved and people will suffer more and more	Around 1500ha of agricultural land will be increased and will contribute to the total socio-economic development of the study area	+4
Siltation	Most of the rivers and khals are silted up and have lost their conveyance capacity significantly	The conveyance capacity of the river and khals will further decrease and surface water availability will be reduced	Siltation rate will decrease, significant water depths will be achieved and conveyance capacity of the river will increase	+5
Erosion	Severe erosion at Paranpur and Saildah	Erosion will cause severe damage in near future at Paranpur and Saildah which are most vulnerable to erosion	Significant amount of households, schools, mosques, temples, agricultural lands and roads will be saved from being washed away	+6
Navigation	Consequential siltation reduces the depth of the rivers which decreases the navigation facilities	Navigational activities will decrease and extinct in upcoming days	Major navigational activities will resume and other navigational activities will be also increased	+4

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

7.5 Impact on Land Resources

7.5.1 Pre Construction Phase

358. There would be no impact during pre-construction phase Labor who would be involved in dredging period house or houseboat will be rented (if necessary) for temporary residence purpose. So, there would be no requirement of land for construction of labor shed. However, construction of labor shed in the existing embankment is not required because local labor will be involved.

7.5.2 Construction Phase

359. There would be no impact during construction phase.

7.5.3 Post-Construction Phase

(a) Land type

Future without project

360. Presently, about 20 %, 14%, 37%, 16% and 14% of the cultivable lands of the polder area are under FF, F_0, F_1, F_2 and F_3 land type respectively. If the project would not implemented in future it create aggravated situation in future. The land type of the polder area might be deteriorating in future without project (FWOP). The FF land type is remains same as baseline situation. The , F_0 and F_1 might be decreased about 1%, 2% respectively where as F_2 and F_3 land type might increased about 1% and 1% respectively. Detailed land type of the polder area is presented in Table 7.3.

Table 7.2: Detailed land type of the polder area

Land Type	Baseline	FWOP	FWIP	Imact (FWIP-FWOP)
	% of NCA	% of NCA	% of NCA	
FF	20	20	20	0
F_0	14	13	15	2
F_1	37	35	36	1
F_2	16	17	15	-2
F_3	14	15	14	-1
Total	**100**	**100**	**100**	0

Source: CEGIS estimation from field information, 2014

Future with project

361. The project interventions would improve the hydrological regime inside the polder area. That might change the present land type. The percentage of FF land remains same in future with project. F_0 and F_1 land type would be increased by about 2% and1% while the F_2 and F_3 land type would be decreased about 1% and 2% respectively. Detailed land type under FWOP and FWIP is presented in upper Table 7.3.

Impact

362. The overall impact would occur on land type pattern. The percentage of FF land remains same in future with project. F_0 and F_1 land type would be increased by 2% and1% while the F_2 and F_3 land type would be decreased about 1% and 2% respectively. Detailed land type of the polder area is presented in Table 7.3 and Table 7.4

(b) Agriculture land use

Future without project

363. Presently, NCA is about 64% of the gross area. Of this net cultivable area single and double cropped area is about 82% and 18% respectively. If the project could not be implemented in future, utilization of land for single and double crop would be about 83 % and 17% of the NCA respectively under FWOP condition.

Table 7.3: Detailed agriculture land use of the study area

Agriculture land use	Baseline	FWOP	FWIP	Impact (FWIP-FWOP)
	% of NCA	% of NCA	% of NCA	
Single crop	82	83	82	-1
Double crop	18	17	18	+1
Total	**100**	**100**	**100**	**0**

Source: CEGIS estimation from field information, 2014

Future with project

364. The interventions would increase land use in the polder areas. It is expected that dredging of rivers and re-excavations of khlas, protection of river bank, construction and repairing of regulator and TRM etc. would change the hydrologic regime of the study area. This situation would enhance land use. However, the land utilization for single and double cropped area would be around 82% and 18% of NCA respectively in future with project condition.

Impact

365. The overall impact of different options on land use would be very positive. Single cropped area would decrease about 1% and double cropped area would increase about 1% respectively. Detailed land use has been presented in Table 7.5.

Table 7.4: Impact matrix on agriculture land use of the polder area

IEC	Baseline	FWOP	FWIP	Impact (+/-)/ Magnitude 1-10
Activity: *Dumping the dredged and re-excavated spoil materials at the selected locations through pipeline and on both side of embankment of khals/channels*				

IEC	Baseline	FWOP	FWIP	Impact (+/-)/ Magnitude 1-10
Land type	Presently, about 20 %, 14%, 37%,16% and 14% of the cultivable lands of the polder area are under FF, F_0, F_1, F_2 and F_3 land type respectively	The FF land type is remains same as baseline situation. The F_0 and F_1 might be decreased about 1%, 2% respectively where as F_2 and F_3 land type might increased about 1% and 1% respectively.	The percentage of FF land remains same in future with project. F_0 and F_1 land type would be increased by about 2% and1% while the F_2 and F_3 land type would be decreased about 1% and 2% respectively.	+1
Agriculture and use	Presently, NCA is about 64% of the gross area. Of this net cultivable area single and double cropped area is about 82% and 18% respectively.	Utilization of land for single and double crop would be about 83 % and 17% of the NCA respectively under FWOP condition	Utilization of land for single and double crop would be about 82 % and 18% of the NCA respectively under FWOP condition	+2

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

7.6 Impact on Agricultural Resources

7.6.1 Pre-Construction Phase

366. There would be no impact during pre- construction phase.

7.6.2 Construction Phase

367. There would be no impact during pre- construction phase due to soil dumping place has already been selected where crop land will not hampered.

7.6.3 Post-Construction Phase

(a) Cropping pattern and intensity

Future without project

368. Presently, cropping intensity of the polder area is about 117%. If the project is not implemented, the land type as well as land use would be degraded in absence of embankments, structures and siltation of river and drainage channels. Under this condition, there would be negative impact. The cropping intensity is expected to change about 116% (Table 7.5).

Table 7.5: Major cropping patterns under FWOP and FWIP condition in ploder area

Major Cropping Patterns			Baseline	FWOP	FWIP	Impact
Kharif-1 (March-June)	**Kharif-2 (July-October)**	**Rabi (Nov.-February)**	**% of NCA**	**% of NCA**	**% of NCA**	**(FWIP-FWOP)**
Fallow	Fallow	Boro (HYV)	13.58	15.58	13.58	-2.00
Jute	Fallow	Boro (HYV)	3.99	2.99	3.99	1.00
Fallow	Fallow	Boro (Hybrid)	30.67	31.26	31.68	0.42
Fallow	Fallow	Boro (Local)	1.44	1.85	0.44	-1.41
B. Aus (Local)	Fallow	Pulses	3.29	3.3	1.27	-2.03
T. Aus (HYV)	Fallow	Pulses	1.15	1.29	3.16	1.87
Fallow	T. Aman (HYV)	Wheat	0.48	0.45	0.48	0.03
Fallow	T. Aman (HYV)	Mustard	1.76	1.26	1.76	0.50
Fallow	T. Aman (HYV)	Onion	0.16	0.36	0.26	-0.10
Fallow	T. Aman (HYV)	Chillies	0.32	0.32	0.32	0.00
Fallow	T. Aman (HYV)	Till	0.32	0.71	0.32	-0.39
Fallow	T. Aman (HYV)	Fallow	13.41	12.24	13.41	1.17
Turmeric	Turmeric	Turmeric	0.26	0.36	0.26	-0.10
Betel leaf	Betel leaf	Betel leaf	1.12	0.98	1.12	0.14
Sugarcane	Sugarcane	Sugarcane	2.2	2.2	2.1	-0.10
S. Vegetables	S. Vegetables	Fallow	2.57	2.57	2.57	0.00
Fallow	Fallow	W. Vegetables	3.29	2.29	3.29	1.00
			80.01	80.01%	80.01%	5.13
Fallow	Fallow	Fallow	19.99%	19.99%	19.99%	
Total			**100%**	**100%**	**100%**	
Cropping intensity (%)			117%	116%	118%	

Source: CEGIS estimation based on field information, 2014

Future with project

369. The implementation of the interventions would increase cropping intensity due to improvement of land type in the catchments areas of the project. The future with project condition would help to protect the area from submergence by flood water from river and would change the hydrologic regime inside the polder area, which might encourage the farmers to change their cropping patterns (Table 7.6). Under FWIP condition, the structures would function well and would influence to drain the excess water during rainy season from the cultivable land as a result land type might be improved. The improved land type would influence the farmers to practices multiple cropping in the polder area. After completion of the interventions, the cropping intensity is expected to increase to around 118%.

Impact

370. After completion of the interventions, the cropping intensity is expected to increase to around 118%.

(b) Crop production

Future without project

371. Presently, total crop production is 142,828 tons of which rice is about 51,310 tons (36%) and non rice is about 91,518 tons (74%). Adverse impact might occur due to siltation of river and drainage channels. The production would be decrease from the baseline situation. The farmers would be desperate to produce more crops for their increased demand under FWOP condition. A total of 51,011 tons rice is expected to be produced and a total of 71,160 tons non-rice would also be produced in the polder areas.

Table 7.6: Impact on crop production in the polder area

Crop name	Baseline	FWOP	FWIP	Impact (FWIP-FWOP)	% of Impact
Aus(HYV)	601	550	2,028	1,477	269
B. Aus	1,318	1,040	438	-602	-58
Aman(HYV)	9,643	6,879	11,137	4,259	62
Boro (Local)	869	1,127	290	-837	-74
Boro(HYV)	14,399	13,950	16,553	2,603	19
Boro (Hybrid)	24,480	27,466	31,731	4,265	16
Total rice	**51,310**	**51,011**	**62,177**	**11,165**	**22**
Wheat	414	353	481	128	36
Jute	9,913	5,616	10,116	4,500	80
Pulses	885	1,208	1,366	158	13
Mustard	431	348	653	304	87
Onion	313	565	529	-36	-6
Chillies	97	90	116	27	30
Sesame	54	211	454	244	115
Turmeric	1,600	4,842	1,790	-3,052	-63
Betel Leaf	3,091	2,456	3,330	874	36
Sugarcane	28,980	27,560	28,921	1,361	5
Vegetables	40,207	27,912	42,227	14,315	51
Total non-rice	**91,518**	**71,160**	**89,984**	**18,824**	**26**
Total	**142,828**	**122,171**	**152,161**	**29,989**	**25**

Source: CEGIS estimation from field information, 2014

Future with project

372. The crop production would be boosted up significantly under the FWIP condition. The total crop production would be about 152,161 tons of which rice would be about 62,177 tons and non-rice would be about 89,984 tons respectively. The rice and non-rice production would be about 22% and 26% higher respectively in FWIP than that of FWOP. Rice production would be increased due to expansion of HYV Aus, HYV Aman and Hybrid Boro area. Additional 11,165 tons of rice and 18,824 tons non-rice would be produced in the polder area Table 7.7.

Impact

373. Additional 11,165 tons (22%higher) of rice and 18,824 tons (26% higher) of non-rice would be produced in FWIP over FWOP Table 7.7.

(c) Crop damage

Future without project

374. Presently, total crop production loss is about 2,734 tons of which rice is about 2,622 tons and non-rice is about 112 tons due to drainage congestion, salinity, scarcity of irrigation water etc. The situation would be aggravated under FWOP condition. Total 3,615 tons of crops would be lost. Among the crops about 3,346 tons of rice and 269 tons of non-rice crops production would be lost under FWOP situation (Table 7.8).

Table 7.7: Impact on crop production loss in the polder area

Crop name	Baseline	FWOP	FWIP	Impact(FWIP-FWOP)	% of Impact
Aus(HYV)	47	217	49	-168	-77
Aman(HYV)	859	804	259	-545	-68
Boro(HYV)	1,716	2,325	495	-1,830	-79
Total rice	**2,622**	**3,346**	**803**	**-2,543**	**-76**
Pulses	60	233	21	-212	-91
Chillies	4	6	4	-2	-37
Mustard	48	30	8	-22	-73
Total non-rice	**112**	**269**	**33**	**-236**	**-88**
Total	**2,734**	**3,615**	**836**	**-2,779**	**-77**

Source: CEGIS estimation from field information, 2014

Future with project

375. In FWIP condition, crop damage would be reduced 77% due to implementation of interventions and its proper management. The interventions would have positive impact in reducing crop damage area as well as crop production loss. The total rice production and non rice loss would be about 803 and 33 tons respectively.

Impact

376. It is expected that loss of crop production would be reduced 2,779 tons which would be about 77% less in FWIP over FWOP Table 7.9.

(d) Irrigated area

Future without project

377. Presently, irrigated area is about 21,492 ha. If the interventions would not be implemented, the soil salinity would increase beyond critical limit (<4.0 dS/m) and the

availability of surface water in the river would decrease due to siltation of river and khals in area. The irrigated area would decrease about 19,271 ha in FWIP.

Future with project

378. After implementation of the project available reserve water will be in the rivers and khals. Irrigation will be provided from different rivers and khals in Boro and other rabi crops by using LLPs up to February if the water salinity remained within the tolerant limit. When the water salinity level exceed the tolerant limit (<2.5 d S/m), then ground water will be used for irrigation by using STWs. The irrigated area would increase about 19,394 ha in FWIP. The irrigated area would be increased about 123 ha in FWIP over FWOP.

Impact

379. The irrigated area would be increased about 123 ha in FWIP over FWOP Table 7.10.

Table 7.8: Impact matrix on crop production, crop damage and irrigated area in the polder area

IESC	Baseline	FWOP	FWIP	Impact (+/-)/ Magnitude 1-10
Activity: Dumping the dredged and re-excavated spoil materials at the selected locations through pipeline and on both side of embankment of khals/channels and sediment deposited by TRM				
Cropping pattern and intensity	Presently, cropping intensity of the project area is about 117%.	Cropping intensity would be reduced about 116%.	Expected to cropping intensity would increased about 118%.	+1
Crop production	Total crop production is 142,828 tons of which rice is about 51,310 tons and non rice is about 91,518 tons.	The total production is expected to decrease about 122,171 tons of which rice would be about 51,011 tons and non-rice would be about 71,160 tons.	The total production is expected to increase about 152,161 tons of which rice would be about 62,177 tons and non-rice would be about 89,984 tons.	+3
Crop damage	Total crop production loss is about 2,734 tons of which rice is about 2,622 tons and non-rice is about 112 tons.	Total crop production loss is expected to increase about 3,615 tons of which rice is about 3,346 tons and non-rice is about 269 tons.	Reduction of loss of rice and non-rice production would be about 803 and 33 tons respectively.	+2
Irrigated area	Irrigated area is about 21,492 ha.	Irrigated area is expected to decrease about 19,271 ha.	The irrigated area would be increased about 123ha in FWIP over FWOP	+1

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

7.7 Impact on Fisheries Resources

7.7.1 Pre Construction Phase

380. There will be no impact in the pre construction phase.

7.7.2 Construction Phase

IEC	Location	Baseline Condition	Impact	Impact (+/-) Magnitude (1-10)
Activity: Dredging and re-excavation of river and internal khals				
• Fish Habitat and quality.	• The Rivers are namely Old Madhumoti, Bhairab and Mora Chitra River. • Total 55 nos. of khals out of these Haque khal, Ghurguria khal, Kaliganga khal, Buriganga khal, Gangni khal, Wapda khal, Narayan khali khal, Bastoli khal, Raigram khal, Baruipara khal, Bagum khali khal, Jalodanga khal, Dongar khal, Saildah khal etc are most	• The area is tidal in nature and the most of the khals are connected with the tidal River. But Fish migrations from river to beels through khals are disrupted. • Water logged situation present because of siltation and risen of khal bed and mul-functioning of water regulatory structure. • Huge number of shrimp ghers both Golda and Bagda are present in the polder area. • At present northern part of the polder is sweet water and south- west part of the polder is saline water in nature. But salinity is decreasing day by day. • Fish diversity and species richness is moderate. About 80 fish species are present in the polder area. • Fish production in the polder area is coming from all the water bodies including Gher, beels, Khals and ponds.	• Decreasing of fish habitat and potential loss of feeding and breeding ground of beel fishes. • Unavailability of fish feed for beel fishes and bottom dweller fishes. • Migration of small fishes will be disturbed during construction period. • Destroying of fish habitat of some fish species particularly guchi baim, baila, gutum, tengra, kuicha and some other small fishes. • Damage of fish habitat temporarily in all re-excavated khals and loss of fish production for 1 year.	-2
• Fish Migration and grazing area.				-2
• Fish biodiversity and species richness.				-1
• Fish Production.				-1

IEC	Location	Baseline Condition	Impact	Impact (+/-) Magnitude (1-10)
	important khal and play a vital role for fish migration.		But after 1 year the habitat quality of fish will improve.	
Activity: Bank Protection Work at two specific locations				
• Fish Habitat and quality.	• Paranpur 1000 m • Saildah 800 m. Both are located in Madhumoti River which is adjacent of polder area.	• Both these two erosion points are located in Madhumoti River bank. • The river Madhumoti is tidal in nature and saline free water around the year. • Most of the khals are connected with the tidal River. • Fish migrations from river to beels and floodplain through khals. • Fish diversity and species richness is moderate. About 80 fish species are present in the polder area. • Fish production is coming from all the wetland including Ghers, beels, Khals and ponds.	• Damage of fish habitat temporarily especially several species of Baim, Ayre, Boal, Rita, Kakra/ crab, Kuchia atleast 1 year for block setting. But after 1 year the habitat will be suitable because of some dislocation of blocks for water current and tidal action.	-1
• Fish Migration and grazing area.			• Fish migration will hamper for time being.	-1
• Fish biodiversity and species richness.			• Richness of fishes will decrease partially for time being.	-1
• Fish Production			• Fish production will be same as base condition.	-1
Activity: Construction of Nine new regulators and re-modeling of Five existing regulators				
• Fish Habitat and	• Nine new regulators and	• Not working properly because of mul-functioning or	• Fish habitat quality will decrease	-1

IEC	Location	Baseline Condition	Impact	Impact (+/-) Magnitude (1-10)
quality.	Remodeling of five existing regulators in selected khals in the polder area.	deposition of sediment both side of regulators/sluice gates.	and unsuitable for time being.	
• Fish Migration and grazing area.		• The area is tidal in nature and the khals are connected with the tidal River. But Fish migrate from river to beels through khals are disrupted.	• Fish migration will hampered during construction period.	-1
• Fish biodiversity and species richness.		• Huge number of shrimp ghers both Golda and Bagda are present in the polder area.	• Richness of fishes will decrease (insignificant).	-1
• Fish Production		• Water logged situation present because of siltation and risen of khal bed and mul - functioning of water regulatory structure.	• Fish production will decrease slightly in compare to base condition.	-1
Activity: Sequential Operation of TRM in selected beels				
• Fish Habitat and quality.	• Operation of TRM in selected beels namely Nurnia Beel Kendua beel and Baruipara Beel.	• Water is still present of these beel and these areas are not using either gher or agriculture land.	• Gher culture will reduce in TRM beel area during implementation period.	-1
• Fish Migration and grazing area.		• Water logged situation present in some area in the polder because of siltation and risen of khal bed and mul - functioning of water regulatory structure.	• Fish migration will smooth during TRM operational period.	+1
• Fish biodiversity and species richness.		• The area is tidal in nature and the khals are connected with the tidal River. But Fish migrate from river to beels through khals are disrupted.	• Richness of fishes will increase.	+1
• Fish Production		• Huge number of shrimp ghers both Golda and Bagda are present in the polder area.	• Capture fish production will increase partially and gher production will decrease slightly in	• Capture +1 • Shrimp gher -1
		• At present northern		

IEC	Location	Baseline Condition	Impact	Impact (+/-) Magnitude (1-10)
		part of the polder is sweet water and south -western part of the polder is saline in nature. • Fish diversity and species richness is moderate. About 80 nos. of fish species are present in the polder area. • Fish production is coming from all the wetland including Gher, beel, Khals and ponds.	compare to base condition.	

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

7.7.3 Post Construction Phase

(a) Fish Habitat and quality

381. The proposed intervention like dredging and re-excavation of river and internal khals, construction of nine new regulators, Re-modeling of five existing regulators, Bank Protection work at two specific locations and Sequential Operation of TRM in selected beels will have the impact on fish habitat. The activities will change the habitat quality and quantity where interventions are implemented. But after 1year fish habitat suitability in the area will improve that will impact positively on fishes and other aquatic fauna and flora in the project area.

Future without Project

382. The polder area is located in tidal area and the overall habitat of river in the study area is good for its location and connectivity. But sedimentation rate is comparatively high and raise the River and khal bed simultaneously. More area will be inundated in compare to base line condition in FWOP. Good numbers of gher present in the project area. Number of golda gher will increase in FWOP.

Future with Project

383. Proposed interventions will decrease the fish habitat due to decrease of water logged area. Breeding ground of fishes will decrease for long time in the polder area. The riverien fish habitat quality will improve Number of shrimp gher will increase slightly and more area will go under agriculture cultivation especially area developed by TRM. Beel area wills decrease. Fish pond will slightly increase in FWIP.

Impacts

384. Good area of capture fish habitat will reduce due to implementation of proposed interventions. But fish habitat quality will improve simultaneously. Beel area will decrease and pond area will increase slightly.

(b) Fish Migration and grazing area

Future without Project

385. There will be no change in the status of fish migration under the FWOP condition in compare to base situation.

Future with Project

386. Grazing area will decrease and fish migration will smooth/undisturbed under FWIP condition.

Impacts

387. Grazing area will decrease and fish migration will smooth /undisturbed because of proposed intervention in the polder area.

(c) Fish Biodiversity

Future without Project

388. No impact on species richness especially floodplain fishes like tengra, puti darkina, kholisha, taki, koi etc in future without project condition (FWOP) in compare to base situation in the polder area. But same as base condition of gher fishes.

Future with Project

389. The richness of small fish species (capture) like tengra, puti darkina, kholisha, taki, koi etc will decrease partially. But riverien fish species will increase. But partial change of culture fishes will occur as compare with base condition.

Impacts

390. Some indigenous beel species will decrease partially due to implementation of different type of interventions. But after 1 year richness of riverien fish species will increase in the polder area. Culture fish species will be same as base condition.

(d) Fish Production

Future without Project

391. No change of fish production both in capture and culture fisheries in FWOP condition in the study area as compare to base condition.

Future with Project

392. Fish production in the polder area will decrease **in** capture fisheries and gher culture will increase in FWIP. Slight change will happen in river fish production. Pond culture fish production will increase partially.

Impacts

393. Capture fish production will decrease in the polder area and no change in river fish production. Pond culture and gher production will increase partially in the polder area. Impact matrix in respect in fisheries is shown in the following;

Impact Matrix of Fisheries

IEC	Baseline	FWOP	FWIP	Impact (+/-) / Magnitude 1-10
Fish Habitat and quality	**Capture Habitat** • Beel 1842 ha • River and Khal 240 ha. **Culture Habitat** • Golda gher with white fish 11941 ha • Bagda gher with white fish 5120 ha • Fish Pond and ditches 440 ha • Crab Fattening 15 ha	**Capture Habitat** • Beel 1842 ha • River and Khal 204 ha **Culture Habitat** • Golda gher with white fish 11941 ha. • Bagda gher with white fish 5120 ha • Fish Pond and ditches 440 ha • Crab Fattening 15 ha.	• Beel 1693 ha (decrease due to TRM implementation). • River and Khal 240 ha • Golda gher with white fish 12041 ha. • Bagda gher with white fish 5169 ha. • Fish Pond and ditches 490 ha • Crab Fattening 15 ha • Good area of fish habitat will reduced due to implementation of proposed interventions. But fish habitat quality will improve simultaneously. • Pond area will increase slightly. • Habitat of some species like Ayre, Baim, Baila and some other small species will decrease due to loss of feeding area. • Setting of protective materials like gunny bags, CC blocks and Geo	Capture - 1 Culture +3

IEC	Baseline	FWOP	FWIP	Impact (+/-) / Magnitude 1-10
			bags the habitat quality will decrease for time being but improved after one year in bank protection area.	
Fish Migration and grazing area.	Entry of fish from rivers to beels are through khals are controlled by naturally by siltation and various water regulating structures and uncontrolled operation of the structure. Grazing area is comparatively good due to water logged situation in the polder area.	Same as base situation.	• Fish migration will smooth in the khals but Fish grazing area will decrease due to implementation of proposed interventions. • Shifting of Fish species like Ayre, baim, Baila, and other riverien species temporarily from the location of bank protection. But after 1 year richness of fish species will increase in that location.	+2
Fish biodiversity and species richness.	About 80 fish species are present in the polder area. The brackish and fresh water fish species are reducing due to habitat losses, obstruction of migration routes, degradation of fish habitat quality because of siltation etc.	Same as base situation	• Number of fish species will be same but richness of riverien fish species will increase because of proposed intervention.	+2
Fish Production	• Production is moderate. Fish productions come from different water bodies like	• Same as base situation **Capture** • Beel 1289 MT • River and	• Decrease in capture production but same as base condition of gher production as compare to base	+3

IEC	Baseline	FWOP	FWIP	Impact (+/-) / Magnitude 1-10
	khal, ghers, pond and floodplain. **Capture** • Beel 1289 MT • River and Khal 37 MT • **Culture** • Golda gher with white fish 7762 MT. • Bagda gher with white fish 3328 MT. • Fish Pond and ditches 1100 MT.	Khal 37 MT **Culture** • Golda gher with white fish 7762 MT • Bagda gher with white fish 3328 MT • Fish Pond and ditches 1100 MT	scenarios. • Beel 1185 MT (decree se due to TRM implementation) • River and Khal 41 MT • Golda gher with white fish 7827 MT • Bagda gher with white fish 3353 MT • Fish pond and ditches 1470 MT	

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10)*

7.8 Impact on Ecological Resources

7.8.1 Pre construction phase

394. There will be no impact in this phase.

7.8.2 Construction phase

Activity: Construction of nine new water control structures

IESC	Location	Baseline Condition	Impact	Impact (+/-)/ Magnitude (1-10)
Terrestrial Vegetation	Godara, New Link Raigram, Katakhalir khal Raigram, Simanar Khal Karamara, Helajila khal Paranpur, Paranpur khal Naraynkhali, Naraynkhali khal Chiltamari, Boiragi khal Chiltamari, Shabukhali	• Vegetation along internal khal side is moderate. • A good number of grasses, herbs, shrubs, trees are found along the proposed khals. • A few number of trees are permanently cut	• Permanently damaged of existing khal side vegetation. • Temporary relocation of khal side vegetation depended wildlife like snake and aquatic bird due	-3

IESC	Location	Baseline Condition	Impact	Impact (+/-)/ Magnitude (1-10)
	khal Bamondanga, Bamondanga khal	down for new water control structure (Godara)	to damage of vegetation.	
Aquatic Flora and Fauna	Do	• Aquatic flora like Kochuripana, Kutipana and Dhol Kolmi are mostly common vegetation. • Bull frog, Little Egret, Common Kingfisher and various type of snake are found in the proposed area	• Temporarily damaged of aquatic plants. • Temporarily relocates of water depended wildlife like snake and aquatic bird due to damage of vegetation.	-2

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

Activity: Bank Protective Works at two specific locations

IESC	Location	Baseline Condition	Impact	Impact (+/-)/ Magnitude (1-10)
Terrestrial Vegetation	Paranpur Saildah	• Riverside homestead vegetation and habitats are risky due to bank erosion. • Species diversity and density of vegetation are moderate in terrestrial part. Few trees, small herbs and shrubs have been found. • This existing vegetation is favor to mongooses, mice, birds, snakes and frogs.	• Temporary damages of river bank side trees, herbs and shrubs due to earthwork activities.	-3
Aquatic Flora and Fauna	Do	• Aquatic portions are dwelling by fishes, crabs and mudskippers.	• Deterioration and relocation of aquatic flora and fauna for placement of geo-bag.	-3

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

Activity: Dredging and re-excavation work by dredgers

IESC	Location	Baseline Condition	Impact	Impact (+/-)/ Magnitude (1-10)
Aquatic Flora and Fauna	• Fifty five internal drainage, khals • Bhairab, Chitra, Old Modhumoti, Mora Chitra and Haque Canal	• Most of the khals and rivers are shallow and silted up from a long time and being waterless in dry season. • Aquatic flora like Kochuripana, Kutipana are observed in the river and river side khals. • Vegetation along internal khal side is moderate, some grasses, herbs, trees and shrubs are found along the marshy parts of proposed khals and river.	• Fishes and water depended fauna like Skipper frog, Bullfrog, Kingfisher, Egret, common aquatic Snake, etc. will be temporary relocated due to habitat loss in the khal area. • Grasses, herbs and shrubs will be damaged due to storage of soil along the both side of the khal and river.	-2

Low impact (1-3); Medium impact (4-6); High impact (7-10)

Activity: Shore pipe line settings for dredging work

IESC	Location	Baseline Condition	Impact	Impact (+/-)/ Magnitude (1-10)
Terrestrial Vegetation	Bank side of the proposed khals and rivers	●Bank side vegetation are Akand, Vaant, Durba Ghash, Ban Okra, bushy area, etc is found in inner portion of the khals and rivers ●Different types of local avifauna roam here for their feeding	●Damages of bank side vegetation including marginal herbs, shrubs and small bushes for shore pipe line setting. ●Relocation of wildlife due to damage of vegetation.	-2

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

Activity: Construction of Peripheral Embankment for TRM implementation

IESC	Location	Baseline Condition	Impact	Impact (+/-)/ Magnitude (1-10)
Aquatic Flora and Fauna	Nurnia Beel, Kendua Beel	• Aquatic plants like Kochuripana, Kutipana, grasses are	Permanently demolish aquatic flora and fauna	-5

IESC	Location	Baseline Condition	Impact	Impact (+/-)/ Magnitude (1-10)
	and Baruipara Beel	observed in the beel area. • This existing vegetation is favor to water birds, snakes and frogs. • Aquatic portions are dwelling by shamuk, fishes, crabs and mudskippers.	due to TRM implementation.	

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

7.8.3 Post construction phase

(a) Terrestrial Vegetation

Future without Project

395. Terrestrial vegetation including climbers, herbs, shrubs, trees will be further deteriorated due to increase of soil salinity, drainage congestion and riverbank erosion. Currently, there is no high density settlement but moderate. And it is also observed that, settlement density is higher in line with the polder embankments and lower near the peripheral settlement of the polder.

396. In addition, yearly riverbank erosion, natural disaster is also another threat that destroys homestead as well as terrestrial vegetation. Malfunctioning of water control structures like regulators causes insufficient drainage and flashing capacity of the polder area, which causes vegetation damage. Intrusion of saline water will degraded habitat quality, and vegetation loss those disrupt in continuation of ecosystem services.

Future with Project

397. By controlling saline water inundation through repairing of regulators and khal re-excavation will reduce saline water intrusion and protect climatic effects through fresh water flow. It will enhance vegetation coverage that ultimately improves habitat suitability for dweller animals as well as species diversity for viable population to continue ecosystem services. Hence, improvement of vegetation including fruit trees will support resident wildlife throughout the year. Improvement of drainage system and water conveyance capacity through re-excavation of khals will positively impacted on aquatic habitat condition in terms of area as well as water quality.

Impacts

398. In future the terrestrial habitat quality as well as floristic composition will improve. The spatial distribution in terrestrial vegetation density will be high. Moreover after implementation of the interventions settlement areas soil and water salinity will be reduced due to fresh water flow from nearest khals and rivers.

(b) Aquatic Flora and Fauna

Future without Project

399. Aquatic habitat condition will also be degraded day by day due to continuous siltation of khals. Existing floral and faunal species composition will goes under further degradation due to in sufficient water in the khals and rivers especially in the dry season.

Future with Project

400. Aquatic vegetation and wildlife will be enriched by facilitating fresh water flow in khals and rivers after re-excavation and dredging work.

Impacts

401. In future the terrestrial and aquatic habitat quality will improve for sure. The spatial distribution of aquatic vegetation will be increased. Moreover after implementation of the interventions settlement areas soil and water salinity will be reduced salinity due to fresh water flow from nearest khals and rivers.

Impact Matrix on Ecological Resources

IESC	Baseline	FWOP	FWIP	Impact (+/-)/ Magnitude 1-10
Terrestrial Vegetation	Moderate	• Plant species composition besides the khals and rivers embankment will further deteriorate due to lack of fresh water and soil salinity water in the khals and rivers especially in the dry season.	• Embankments vegetation will be enriched due to fresh water in the khals and rivers after re-excavation and dredging work. • Improvement of vegetation and fruit tree will support resident wildlife throughout the year.	+3
Aquatic Flora and Fauna	Moderate	• Existing species composition both flora and fauna will further decrease/reduce due to in sufficient water in the khals and rivers especially in the dry season. • Aquatic habitat would deteriorate and species composition will be changed negatively for in sufficient water.	• Aquatic wildlife and vegetation will be enriched by enhancing water flow, volume and depth of khals and rivers after re-excavation and dredging work. • Improvement of vegetation in the khal by holding more water throughout the year.	+2

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

7.9 Impact on Socio Economic Condition

7.9.1 Pre Construction Phase

IEC	Location	Baseline condition	Impacts	Magnitude of impact*
Activity: Construction of Labor Shed and Stockyard				
Employment	labor shed areas: The labor shed area will be stipulated as per the availability of land in Common Property Resources (CPRs) or any other unused land in the polder area.	About 10% of labors as well as skilled workers are daily out-migrated from the project area for employment issues.	The project may create temporary employment opportunity for labors and skilled workers during construction of labor shed & stockyard.	+1
Income generation		Almost 20% of households earn below 5000tk per month and most of them lived to the side of river. Overall 30% of households are belonging to the income range of below Tk.7000 per month.	It may help to create some additional income of low earning households during Labor shed & stockyard construction.	+1
Public Health		There are number of pharmacies in the polder area. But in terms of sanitation facilities, it may create problem if the labor sheds are established in open places outside the CPRs.	Unhygienic environment could be created by using open latrines. Moreover, poor treatment facilities may turn minor injury as major at labor shed areas.	-2

7.9.2 Construction Phase

IEC	Location	Baseline condition	Impacts	Magnitude of impact*
Activity: Construction of nine new regulators and replacement of five existing regulators				
Employment	**Area of new structures:**	About 10% of labors as well as	The project may create	+2

IEC	Location	Baseline condition	Impacts	Magnitude of impact*
	Godara, Raigram Katakhalir khal, Raigram Simanar Khal, Karamara, Helajila khal, Paranpur khal, Naraynkhali khal, Chiltamari Boiragi khal, Chiltamari Shabukhali khal Bamondanga Bamondanga khal	skilled workers are daily out-migrated from the project area for employment issues.	temporary employment opportunity for labors and skilled workers during construction and replacement of the regulators.	
Income generation	**Area of replacement structures:** Baruipara Katakhal, Dobakhali khal, Saildah khal, Chandpur khal, Dhanokhali khal	Almost 20% of households earn below 5000tk per month and most of them lived to the side of river. Overall 30% of households are belonging to the income range of below Tk.7000 per month.	It may help to create some additional income of low earning households during construction and replacement of the regulators.	+2
Activity: Bank Protective Works at two specific locations				
Employment	Paranpur and Saildah mouza	About 10% of labors as well as skilled workers are daily out-migrated from the project area for employment issues.	The project may create temporary employment opportunity for labors and skilled workers during protective works.	+2
Income generation		Almost 20% of households earn below 5000tk per month and most of them lived to the side of river. Overall 30% of households are belonging to the income range of below Tk.7000 per month.	It may help to create some additional income of low earning households during protective works.	+2
Safety/security of assets and resources	Paranpur and Saildah mouza	There are number of houses, important structures,	The important structures, agricultural lands as well	+2

IEC	Location	Baseline condition	Impacts	Magnitude of impact*
		agriculture land and trees at the bank of Madhumoti River in Saildah and Paranpur mouza.	as trees will be saved from river bank erosion.	
Activity: Dredging and Re-excavation work by dredgers				
Employment	Adjacent of 55 Khals and major Rivers i.e. ➢ Bhairab river ➢ Chitra River ➢ Mora Chitra river ➢ Old Madhumoti river	About 10% of labors as well as skilled workers are daily out-migrated from the project area for employment issues.	The project may create temporary employment opportunity for labors and skilled workers during dredging and re-excavation works.	+3
Income generation		Almost 20% of households earn below 5000tk per month and most of them lived to the side of river. Overall 30% of households are belonging to the income range of below Tk.7000 per month.	It may help to create some additional income of low earning households during dredging and re-excavation works.	+3
Activity: Construction of Peripheral Embankment for TRM				
Employment	Nurnia, Kendua and Baruipara beels	About 10% of labors as well as skilled workers are daily out-migrated from the project area for employment issues.	The project may create temporary employment opportunity for labors and skilled workers during TRM.	+2
Income generation		Almost 20% of households earn below 5000tk per month and most of them lived to the side of river. Overall 30% of households are belonging to the income range of below Tk.7000 per month.	It may help to create some additional income of low earning households during TRM.	+2

IEC	Location	Baseline condition	Impacts	Magnitude of impact*
Safety/security of assets and resources	Nurnia, Kendua and Baruipara beels	There are a huge amount of inundated low land which are not used in agriculture and fishery activities in present days	After implementing the project, low/fallow land will be used under agriculture and fishery activities.	+2

** No impact (0); Positive impact (+); Negative impact (-); Low impact (1-3); Medium impact (4-6); High impact (7-8); Very high impact (9-10)*

7.9.3 Post Construction Phase

(a) Employment opportunities

Future without Project

402. In this case, we predict the situation of study area for at least 25 years if the project is not implemented. Through this conception, employment opportunities of agriculture and fishery related activists may be decreased due to unavailability of water and intrusion of saline water in each year in FWOP.

Future with Project

403. In FWIP, we predict the situation of study area for at least 25 years if the project is been implemented. The proposed project might create the employment opportunity for agriculture and fishery resources related activists in Future-with-Project (FWIP). Moreover, by the infrastructural development the commercial activity will be expanded in the study area because of having connectivity of three districts with the polder area.

Impact

404. Due to having well drainage facilities and availability of water, number of employment opportunities can be created in agriculture and fishery sectors which may reduce outmigration percentages in future.

(b) Income generation

Future without Project

405. In future without project, it has been projected that the employment opportunities of agriculture and fishery related activists may be deteriorated; as a result, income of those activists might fall down in FWOP.

Future with Project

406. The increasing employment opportunity of agriculture and fishery activists can increase the income of those households in Future-with-Project (FWIP). In addition people can supplement their income by involving in short-term laboring and skilled working activities during construction phase.

Impact

407. After the intervention, people's income may rise up in agriculture and fishery related activities. The area will be suitable for practicing both agricultural and fishery related farming activities.

(c) Safety/security of assets and resources

Future without Project

408. In future without project, it has been projected that an amount of arable land, important properties, concrete road and trees might be affected in regular river bank erosion. Moreover, due to deadlock in main water connectivity points water logging and drainage congestion area will also be increased in Future without Project (FWOP).

Future with Project

409. The proposed project may shield an amount of arable land, important properties, main concrete road and trees from river bank erosion as well as water logging and drainage congestion which is drastically occurring from last few years in the polder area.

Impact

410. With the implementation of project the under threatening properties can be protected from river bank erosion as well as water logging and drainage congestion.

(d) Migration

Future without Project

411. In Future without Project (FWOP), the physical condition of polder 36/1 will be deteriorated which may decreased the in-migration rate in the polder area.

Future with Project

412. The proposed project may improve the physical condition of the polder area which may create more employment opportunities in the polder area. Therefore in-migration rate may gradually increase in Future with Project situation.

Impact

413. With the increasing of arable land the demand of farming labors will be increased in the polder area.

IEC	Baseline	FWOP	FWIP	Magnitude of impact*
Employment opportunities	About 10% of labors as well as skilled workers are daily out-migrated from the project area for employment issues.	Employment opportunities will be decreased and out-migration will be increased.	Employment opportunities will be created in agriculture and fishery sector.	+4
Income generation	Almost 20% of households earn below 5000tk per month and most of them lived to the side of river. Overall 30%	People income will fall down which cause intense poverty in near future.	People income will increase more in future by creating more working options in	+4

IEC	Baseline	FWOP	FWIP	Magnitude of impact*
	of households are belonging to the income range of below Tk.7000 per month.		agriculture and fishery sectors.	
Safety/security of assets and resources	There are huge amounts of inundated low land which are not able to use in agriculture and fishery activities in present days. Moreover, the arable land and structures at the bank side of Modhumoti River are in vulnerable situation.	A huge amount of agricultural land will be turned as fallow land and important structures will be affected.	Agricultural production will be significantly increased and important structures will be protected.	+4
Migration	At present 15% of the labors are in-migrated to the project area.	The percentages of in-migrated labors may be gradually decreased and the amount of inundated land can also be decreased.	The arable land will be increased as well as sufficient irrigation facilities which may increased the demand of farming labors in the polder area.	+3

** No impact (0); Positive impact (+); Negative impact (-); Low impact (1-3); Medium impact (4-6); High impact (7-8); Very high impact (9-10)*

8 Environmental Management Plan

8.1 Physical Resources

414. Environmental Management Plan (EMP) for Rehabilitation of Polder 36/1 project comprises of mitigation plan for minimizing the effect of the negative impacts and enhancement plan for increasing the benefits of the positive impacts. All the measures under the EMP have been described in this chapter considering three phases. These phases are Pre-construction, Construction and Post-construction. EMP measures suggested for water resources, land resources, agriculture, fisheries, ecological resource and socio-economic resources are presented in the following sections.

8.1.1 Pre Construction Phase

415. EMPs for pre-construction phase are discussed below:

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
Activity: Mobilization of construction materials and equipment				
Noise will be generated temporarily due to mobilization of vehicles and construction materials	Noise levels from vehicle, equipment and machinery should comply with national noise standards	N/A	0	BWDB and Contractors
Dust generation during vehicle and construction materials movement will temporarily degrade the air quality	Water to be sprinkled as and where needed	N/A	0	BWDB and Contractors

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

8.1.2 Construction Phase

416. EMPs for construction phase are discussed below:

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
Activity: Construction of nine new regulators and replacement of five existing regulators				
Noise will be generated	Noise levels during	N/A	0	BWDB and Contractors

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
temporarily during construction of new regulators and replacement of existing regulators	construction and repair work should comply with national noise standards			
Dust generation during construction and repair work will temporarily degrade the air quality	Water to be sprinkled as and where needed	N/A	0	BWDB and Contractors
Activity: Dredging and re-excavation work by dredger				
Noise will be generated temporarily during dredging work	Noise levels during dredging work should comply with national noise standards	N/A	0	BWDB and Contractors
Dust generation during re-excavation work will temporarily degrade the air quality	Water to be sprinkled as and where needed	N/A	0	BWDB and Contractors
Activity: Disposal of the dredged spoil on dumping locations through pipeline				
Dust will be generated while carrying and depositing dredged spoil in the selected locations which may temporarily degrade the air quality.	Water to be sprinkled as and where needed	N/A	0	BWDB and Contractors
Activity: Protective works to prevent erosion				

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
Placing and dumping of CC blocks are likely to create noise temporarily which will affect the people	• Provision of noise barriers if necessary • Provision of ear muffs and plugs to labor	N/A	0	BWDB and Contractors
Dust generation during placing and dumping of CC blocks will temporarily degrade the air quality	Water to be sprinkled as and where needed	N/A	0	BWDB and Contractors

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

8.1.3 Post-Construction Phase

417. There is no EMP during post construction phase.

8.2 Water Resources

418. Environmental Mitigation Plan (EMP) for water resources for all the three phases i.e. pre-construction phase, construction phase and post-construction phase are discussed in the following sub-sections.

8.2.1 Pre Construction Phase

419. There is no EMP during pre construction phase.

8.2.2 Construction Phase

420. EMPs for construction phase are discussed below:

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
Activity: Construction of Labor Shed and Stockyard				
Waste materials from labor shed may temporarily deteriorate the quality of water s	Waste materials from labor shed should be disposed in separate places far from water bodies	N/A	0	BWDB and Contractors
Activity: Dredging and re-excavation work by dredger				

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
Oil may spill from dredger to the water during dredging which may temporarily deteriorate the quality of water	Dredging work should be performed in such way so that oil will not reach the water	N/A	0	BWDB and Contractors
Earthwork in the khals while re-excavation may temporarily hinder the natural drainage	Earthwork and re-excavation should be carried out in such way so that the natural drainage system will not be disturbed	N/A	0	BWDB and Contractors
Activity: Disposal of the dredged spoil on dumping locations through pipeline				
Siltation may occur again if dredged spoil is not managed properly	Dredged spoil should be dumped very carefully so that further siltation cannot be occurred	N/A	0	BWDB and Contractors

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

8.2.3 Post Construction Phase

421. EMPs for post construction phase are discussed below:

Impacts	Mitigation Measure	Enhancement/ Contingency/ Compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible Agency
New regulators will facilitate to drain out water more smoothly. Present problem of drainage congestion will be removed.	N/A	*Enhancement* Regular maintenance of all the regulators	+6	BWDB
Significant amount of households, schools, mosques, temples, agricultural lands and roads will be saved from being washed away	N/A	*Enhancement* Regular maintenance of the protective work	+7	BWDB

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

8.3 Land Resources

8.3.1 Pre Construction Phase

422. There would be no impact during pre construction phase. So, there would be no measures required in this phase.

8.3.2 Construction phase

423. There would be no impact during pre construction phase. So, there would be no measures required in this phase.

8.3.3 Post Construction Phase

424. After implementation of the project hydrological regime inside the project area will improve. This might change the agriculture land use of the project areas. So, necessary measures may be under taken in this phase.

Impact	Mitigation measure	Enhancement/ Contingency/ Compensation	Residual Impact (+/-) / Magnitude (1-10) with EMP	Responsible agency
Activity: *Dumping the dredged and re-excavated spoil materials at the selected locations through pipeline and on both side of embankment of khals/channels and sediment deposited by TRM*				
The percentage of FF land remains same in future with project. F_0 and F_1 land type would be increased by about 2% and1% while the F_2 and F_3 land type would be decreased about 1% and 2% respectively.		• Formation of WMOs (GPWM-2002). • Strengthening of WMOs through imparting training on loop-cut, dredged and proper management and utilization of spoil earth materials which will come up from re-excavation. Involvement of WMOs in different project activities.	+2	BWDB,DAE and WMOs
Single cropped area would decrease about 1% and double cropped area would increase about 1% respectively in FWIP over FWOP.	-	• Involvement of WMOs in different project activities.	+3	BWDB, DAE and WMOs

8.4 Agriculture Resources

8.4.1 Pre Construction Phase

425. There would be no impact during pre-construction phase. So, there would be no measures required in this phase.

8.4.2 Construction phase

426. .There would be no impact during construction phase. So, there would be no measures required in this phase.

8.4.3 Post Construction Phase

Impact	Mitigation measure	Enhancement/ Contingency/ Compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
Cropping intensity would increased about 118%.	N/A	• Involvement of WMOs in project activities would enhance crop production. • Introduction of HYV/Hybrid crop cultivars along with crop diversification need to be practiced.	+2	DAE and WMOs
Additional 11,165 tons (22%higher) of rice and 18,824 tons (26% higher) of non-rice would be produced in FWIP over FWOP.	N/A	• Organic manure should be applied for the restoration of soil fertility; • Farmers group should have close contact with DAE for adaptation of various measures on IPM/ICM; • Irrigation should be provided in optimum level with minimum conveyance loss; • Involvement of WMOs in project activities would enhance crop production. • Introduction of HYV/Hybrid crop cultivars along with crop diversification need to be practiced.	+4	BIWTA, DAE and WMOs
It is expected that loss of cleaned rice production would be reduced 2,779	N/A	• Due to dredging of rivers, re-excavation of khals/channels construction and repair of regulator, bank protection work and	+3	DAE and WMOs

Impact	Mitigation measure	Enhancement/ Contingency/ Compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
tons which would be about 77% less in FWIP over FWOP.		TRM the storage capacity of the river and khals would increase. The excess water would remove from country side and which would influence to improve land type. This situation would help to protect crop from damage. • The Water Management Organizations (WMOs) should be given orientation about protect and their standing crops from river dredging and re-excavation and TRM.		
The irrigated area would be increased about 123ha in FWIP over FWOP.	N/A	• Training may be provided to WMOs on "integrated water management" which will be stored in the khals/ channels for different use.	+2	DAE and WMOs

8.5 Fisheries Resources

8.5.1 Pre Construction Phase

427. There would be no impact during pre construction phase. So, there would be no measures required in this phase.

8.5.2 Construction Phase

Impacts	Mitigation Measure	Enhancement / Contingency / Compensation	Residual Impacts (+/-) Magnitude (1-10) with EMP	Responsible Agency
Activity: Dredging and re-excavation of river and internal khals				
• Water logged area will decrease in the polder area due to re-excavation work. • Habitat loss	The activities should be implemented in dry season.	• Gher culture and nursery development (shrimp and prawn) training should be provided to the Gher and nursery owner to enhance the nursery activities and gher culture	+3	Upazila Fisheries Office

Impacts	Mitigation Measure	Enhancement / Contingency / Compensation	Residual Impacts (+/-) Magnitude (1-10) with EMP	Responsible Agency
for bottom dueler fishes. • Fish migration, fully stopped during re-excavation period. • Fish species temporarily shift from the working location. Some indigenous riverien fish species will disappear in the area for a certain period e.g. Ayre, Baim, etc due to re-excavation. But after 1 year fish species in river will increase in the project area. • With these consequences, fish production would temporarily decline. But after one year the fish production will increase simultaneously in the area.		practice in the area to disseminate the latest technology for additional production. • In the month of May to August is fish migration and breeding period. So avoid the re-excavation and other intervention of those months to protect the beel and Riverien fish species and other aquatic creators. • Avoid the water bodies for spoil dumping • Suggest the agriculture farmer to abstain from using agro chemicals and using the organic manure through piloting by DAE. • Awareness development on natural resources, camping against indiscriminate fishing and reinforcement of fisheries laws and regulation. • Fish migration and breed in the month of May to July/August. Avoid the bank protection work of those months. • Monitoring activities should be provided and continue at least two year. • Re-excavation activities should be		

Impacts	Mitigation Measure	Enhancement / Contingency / Compensation	Residual Impacts (+/-) Magnitude (1-10) with EMP	Responsible Agency
		implemented segment wise like (200 m – 250 m) in each segment and implement one after another.		
Activity: Bank Protection Work at two specific locations				
• Setting of protective materials like CC blocks and Geo bags the habitat quality will decrease, but improve after one year after implementation. • Fish habitat (capture) area will decrease due to implementation of bank protection and re-excavation work. • Habitat of some species like Ayre, Rita, Baim, Baila will destroy and loss of feeding area due to protective work.	PPlacing and dumping of geo bags and C.C. blocks should be conducted during the dry season.	• Management committee /nature club should be formed by the local teacher, student and local elite person in the polder area to disseminate the knowledge to the community about the importance of natural resources in our daily life.	+3	Related Upazila Fisheries Office in collaboration with local management committee.
Activity: Construction of Nine new regulators and re-modeling of Five existing regulators				
• Fish migration will disturbed • Fish	The activities should be implemented in dry season for minimum	➢ Implementation work should be monitor properly by BWDB officials during implementation	+ 4	BWDB Officials

Impacts	Mitigation Measure	Enhancement / Contingency / Compensation	Residual Impacts (+/-) Magnitude (1-10) with EMP	Responsible Agency
migration will disturbed due to transportation of construction materials by mechanized boats.	loss.	period.		
Activity: Sequential Operation of TRM in selected beels				
• All beel area will convert agriculture land and that land should be used as agriculture as well as gher practices after completion of TRM operation.	TRM activity should be implemented with proper care	The developed land should be used both for agriculture and gher culture.	+3	Related Upazila Fisheries Office.

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

8.5.3 Post Construction Phase

Impacts	Mitigation Measure	Enhancement / Contingency / Compensation	Residual Impacts (+/-) Magnitude	Responsible Agency
Fish Habitat	Not applicable	• her and pond culture and nursery development training should be provided to the gher and nursery owner to enhance the nursery activities and gher and pond culture fisheries practices in the area	+3	Related upazila Fisheries Office in collaboration with gher and pond owners.
Fish Migration	Not applicable	• Avoid fish catch in the month of May to July in up and down stream of sluice gates / regulators. The	+4	

Impacts	Mitigation Measure	Enhancement / Contingency / Compensation	Residual Impacts (+/-) Magnitude	Responsible Agency
		operation of sluice gates and regulators should be carefully done in those months because of smoothly movement of fishes.		
Fish Biodiversity	Not applicable	• Awareness development through observation of different national and international days like Environment day, Fish week, Earth day, World water day etc in cooperation with the local community. • Suggest the agriculture farmer to abstain from using agro chemicals and using the organic manure through piloting by DAE.	+4	
Fish Production	Not applicable	• Training on gher and pond culture should be continuing at least for two years. Knowledge sharing on gher and pond culture to be disseminate on that training for incremental gher and pond production. • Monitoring activities should be continuing at least two year.	+3	

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

8.6 Ecological Resources

8.6.1 Pre Construction Phase

428. There will be no impacts in this phase.

8.6.2 Construction Phase

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
• Permanently damaged of existing khal side vegetation. • Permanently relocates of khal side vegetation depended wildlife like snake and aquatic bird due to damage of vegetation.	• Should be used low vegetative land or barren land for soil collection. • Avoid construction activities during favorable time of wild life movement (early morning and night		0	Contractor , BWDB
• Temporarily damaged of aquatic plants. • Temporarily relocates of water depended wildlife like snake and aquatic bird due to damage of vegetation	Avoid construction works in early monsoon when regenerate most of the aquatic plants.		0	Contractor , BWDB
• Temporary damages of river bank side herbs and shrubs due to earthwork activities.	Plantation of arjun, jam, jarul, amloki, babla, etc trees on affected embankment area after completion of earthwork activities.		0	Contractor , BWDB
• Deteriorate aquatic flora and fauna condition for placement of geo-bag.	Avoid construction works in early monsoon when regenerate most of the aquatic plants.		-1	Contractor , BWDB
• Fish and water depended fauna as Skipper frog, Bullfrog, Kingfisher, Egret, common aquatic Snake, etc. will be temporary re-	• Keep intact the deepest points of the khal as much as possible • Avoid loss of aquatic biota during re-		-1	Contractor , BWDB

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
located due to habitat loss in the khal area. • Grasses, herbs and shrubs will be damaged due to storage of soil along the both side of the khal and river.	excavation activities • The works must be complete within the timeframe			
• Damages of bank side vegetation including Marginal herbs, small bushes for shore pipe line setting. • Relocation of wildlife due to damage of vegetation	• Choose barren land for spoil dumping as much as possible Implement • Plantation along the degraded land after completing the re-excavation activities.		-1	Contractor, BWDB
• Permanently demolish aquatic flora and fauna due to TRM implementation.	• Plantation along with fruit trees in raised land in and around the area		-1	Contractor, BWDB

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

8.6.3 Post Construction Phase

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
• Terrestrial floristic composition will improve.	N/A	• Planting of Timber/Fruit plant along the both side of the proposed construction sites. • Aware local people on plantation protection.	+6	Contractor, BWDB
• Aquatic vegetation will be enriched by enhancing water volume and depth of Khal and river after re-excavation	N/A	• Aware local people for restore wetlands. • Do not disturb and kill wildlife in their aquatic habitat.	+3	Contractor, BWDB

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
and dredging work				

** Low impact (1-3); Medium impact (4-6); High impact (7-10)*

8.7 Socio Economic Condition

8.7.1 Pre Construction Phase

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
The project may create temporary employment opportunity for labors and skilled workers during construction of labor shed & stockyard.	N/A	Ensuring more involvement (at least 60%) of local labors may improve the employment opportunities of polder area.	+2	BWDB/ Contractor
It may help to create some additional income of low earning households during Labor shed & stockyard construction.	NA	The wage rate of labors should be determined by the maximum present wage rates of the study area.	+2	BWDB/ Contractor
Unhygienic environment could be created by using open latrines. Moreover, poor treatment facilities may turn minor injury as major at labor shed areas.	At least two ring slab water-sealed sanitary latrines should be established in the each labor shed areas. In addition, the fast-aid medical facility should be established in labor shed areas which will be situated in highly remote area.	NA	-1	BWDB/ Contractor

8.7.2 Construction Phase

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
Activity: Construction of nine new regulators and replacement of five existing regulators				
The project may create temporary employment opportunity for labors and skilled workers during construction works.	NA	Ensuring more involvement (at least 60%) of local labors in construction and replacement of regulators.	+3	BWDB/ Contractor
It may help to create some additional income of low earning households during construction works.	NA	The wage rate of labors should be determined by the highest present wage rates of the study area in construction and replacement of regulators.	+3	BWDB/Contractor
Activity:Bank Protective Works at two specific locations				
The project may create short-term employment opportunity for labors and skilled workers during construction works.	NA	Sufficient numbers (at least 60%) of local labors should be involved in bank protective works.	+3	BWDB/ Contractor
It may help to create additional income of low earning households during construction works.	NA	Labors should be given highest wage rate for respective works in the polder area for bank protective works.	+3	BWDB/Contractor
Dwelling houses, important structures, agricultural lands as well as trees will be saved from river bank erosion.	NA	Implementation of the protective works should consider in priority basis so that more houses, structures and trees can be saved.	+3	BWDB/ Contractor
Activity: Dredging and Re-excavation work by dredgers				
The project may create temporary employment opportunity for a number of labors and skilled workers during construction works.	NA	Sufficient numbers (at least 60%) of local labors should be involved in earth works of dredging and re-excavation.	+4	BWDB/Contractor
It may help to create	NA	In terms of earth work,	+4	BWDB/Contr

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
some additional income of low earning households during construction works.		labors should be given additional money for lunch with their basic wage rate.		actor
Activity: Construction of Peripheral Embankment for TRM				
The project may create temporary employment opportunity for labors and skilled workers during construction works.	NA	Ensuring more involvement (at least 60%) of local labors in earth works of TRM basins.	+3	BWDB/Contractor
It may help to create some additional income of low earning households during construction works.	NA	Labors should be given highest wage rate for respective works in the polder area for earth works in TRM basins	+3	BWDB/Contractor
After implementing TRM, low/fallow land will be used under agriculture and fishery activities.	NA	The awareness program should execute to the threatening area of implementing basin before staring the implement works; so that people can harvest their crops or fishes from those threatening area.	+3	BWDB/ Contractor

8.7.3 Post Construction Phase

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
In future, a numbers of employment will generate in agriculture and fishery sectors.	NA	Training from DAE and DoF should be needed for the farming related activists.	+5	DoF and DAE
Income may be increased for all classes from labors to businessmen	NA	Training from Consultant should be needed for generating additional/new	+5	BWDB/Consultant

Impact	Mitigation measure	Enhancement/ Contingency/ compensation	Residual Impact (+/-)/ Magnitude (1-10) with EMP	Responsible agency
		income options and sustaining on it.		
Intervention works will shield a huge amount of cultivable land as well as important structures and houses as well. Moreover the TRM process will shield a huge amount of inundated land.	NA	Operation and Maintenance (O & M) works should be properly functioned after construction phases	+5	BWDB
The arable land will be increased as well as sufficient irrigation facilities which may increased the demand of farming labors in the polder area.	NA	Ensuring better occupational facilities may increase the in-migration rate in polder area.	+4	Local Government

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

8.8 Environmental Monitoring Plan

8.8.1 EMP Implementation Monitoring Schedule for Pre Construction Phase

In this phase, no implementation monitoring plan is needed for checking EMP implementation works.

8.8.2 EMP Implementation Monitoring Schedule for Construction Phase

Bangladesh Water Development Board

EMP IMPLEMENTATION

Book No. _____ Monitoring Report No._____

Date:_____ Time:_____

Contract:_____

Contractor:_____

Work Sites (s):_____

A	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5	A	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5
1	Correct Disposal of Construction Solid Waste				12	Health precautions taken			
2	Correct Disposal of Liquid Waste				13	Dispensary working, Doctor present			
3	Vehicles with no smoke or noise				14	Keep first aid box for labour camp			
4	Vehicles within speed limit				15	No loss to flora or fauna (Specially tree)			
5	No pollution from construction site				16	Obstruction to navigation			
6	No oil/diesel				17	Presence of			

A	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5	A	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5
	spills on land or water					child labour			
7	No social issue created				18	Labour camp location & management in order			
8	Any threat caused to river bank area				19	Drinking water and sanitation facilities for labour			
9	Water sprinkled on road				20	No burning of wood in camp			
10	No soil erosion				21	Women wage			
11	Safety dress, helmet and field boots used				22	Social conflict between local and outside labour			

B. EXPLANATION (of any of above points) **Total Scores = _____%**

C.NON COMPLIANCE:

Non Compliance # Description	**Period**	**Class**
		1. Minor: Under One Month (Contractor alerted)
		2. Moderate: Over One Month but under Two Months (Contractor warned)

3. Major: About Two Months (Contractor's local bill withheld by RE* till compliance)

4. Critical: Over Three Months (Contractor's overall bill withheld by RE and PM* till compliance)

D.CIRCULATION

1) **MD,** CCTF 2) **DG**, DoE 3) **DG**, BWDB 4) **EE**, Local BWDB Office

Field EHS* Monitor of Consultant

(Full Name & Signature)

*EHS- Environment Health & Safety

*RE – Resident Engineer

***ES – Environmental Supervisor of Consultants.**

Field EHS Expert of Contractor

(Full Name & Signature)

8.8.3 EMP Implementation Monitoring Plan for Post Construction Phase

(a) Water Resources

Indicator	Method	Location	Frequency	Monitoring Cost (Lac Tk)*	Responsible Agency
Physical condition of the protected bank	To check whether any rain cut, breaching, manmade cut exists	Paranpur, Saildah	Pre monsoon, monsoon and post monsoon period	5.00	BWDB
Proper maintenance of the water control structures	N/A	Godara, Raigram, Karamara, Paranpur, Naraynkhali, Chiltamari, Bamondanga, Chandpur	Twice in a year	1.00	BWDB
Siltation of the khals	Rate of siltation of khals should be measured by measuring the rise of bed levels	At the outfall and other locations of the khals	4 times (at every three months interval)	2.00	BWDB

(b) Fisheries Resources

Indicator	Method	Location	Frequency	Responsible Agency
Richness of fish species	Fish catch monitoring	1 Km upstream and 1 km downstream of each location of bank protection area of Modhumoti River namely Paranpur and Saildah area.	Twice per month in each location and will continue 2 year.	Related upazila Fisheries Office
Prawn and Shrimp production from Gher	Data collection from the Fish arat.	Foltita Bazar and other arat located within the polder area.	Once in a month	Upazila Fisheries Office
Training on gher culture	As per training module	Within the polder area	Need base	Upazila Fisheries Office
Awareness Development	Observation of wetland/ natural resource base national and international days.	In the polder area	Different national and international days like Fish Week, World Environment Day and Earth Day etc (according to date) and continue at least 2 year.	Upazila Fisheries Office,

(c) Ecology Resources

Indicator	Method	Location	Frequency	Responsible agency
Vegetation clearance	Direct observation	at proposed construction sites	Once before earthworks and once after earthworks	BWDB, and local stakeholders
Aquatic flora and fauna khal area	Direct observation		Twice in a year (January and June)	BWDB and EMP Monitor

(d) Socio Economic Resources

Indicator	Method	Location	Frequency	Monitoring Cost (Lac Tk)	Responsible Agency
Households development by expanding income	RRA	Five upazilas of interventi	Twice in a year	Professional cost: 0.80 Refreshment:	DAE. DoF and consultants

Indicator	Method	Location	Frequency	Monitoring Cost (Lac Tk)	Responsible Agency
generation opportunities		on places		0.90	
Training for eradicating poverty by creating more employment options.	RRA	Five upazilas of interventi on places	Twice in a year	Local travel cost: 0.70 Logistics for consultation-.30 Questionnaire preparation cost: 0.20 Report preparation cost: 0.30 **Sub total Cost : 3.20**	
Monitoring the socio-economic improvement of the households adjacent to the TRM basins.	HH survey of sampled household	Adjacent to The Nurnia, Kendua and Baruipara beels	Once in a year	Monitoring study cost per year: **15.0**	BWDB/Consultant

8.9 EMP Cost Estimate

Sl. No	EMP Measure	Cost (Lakh Tk.)	Sl. No	Monitoring Item	Cost (Lakh Tk.)
1	• Organic manure should be applied for the restoration of soil fertility; • Farmers group should have close contact with DAE for adaptation of various measures on IPM/ICM; • Irrigation should be provided in optimum level with minimum conveyance loss; • Introduction of HYV/Hybrid crop cultivars along with crop diversification need to be practiced.	3.5.0	1	Collection and disposal of earth materials for spoil management, sediment deposited by TRM etc.	2.50
2	WMOs should be involved in the post construction phase which might reduce crop damage.	1.50	2	Crop production	1.50

Sl. No	EMP Measure	Cost (Lakh Tk.)	Sl. No	Monitoring Item	Cost (Lakh Tk.)
3	N/A	N/A	3	Crop damage	1.00
4	N/A	N/A	4	Irrigated area	0.50
5	Planting of Timber/Fruit plant along the both side of the proposed sites	0.50	5	Terrestrial vegetation	0.20
6	N/A	N/A	6	Aquatic flora and fauna) in khal area	0.15
7	Training Program	2.0	7	Fish catch monitoring of selected location.	2.0
8	Awareness Development Program (Upazila wise).	2.0	8	Monitoring and data collection from the fish arat (Foltita and other Arat in the polder area for 1 year) for estimation of production of fish and prawn.	1.0
9	Operation and Maintenance (O & M) works	1.20	9	Households development by expanding income generation opportunities	2.4
10	N/A	N/A	10	Training for eradicating poverty by creating more employment options.	0.8
11	N/A	N/A	11	Monitoring the socio-economic improvement of the households adjacent to the TRM basins.	15.0
12	N/A	N/A	12	Physical condition of the protected bank	5.00
13	N/A	N/A	13	Proper maintenance of the water control structures	1.00
14	N/A	N/A	14	Siltation of the khals	2.00
Total EMP Measures Cost		**10.7**	**Total Monitoring Cost**		**35.05**
				Total Cost	**45.75**

9 Public Consultation

9.1 Introduction

429. Public Consultation meeting is mandatory for conducting any Environmental Impact Assessment (EIA) study in accordance with DoE guideline. The aim of Public consultation in EIA process is to ensure the involvement of project stakeholders into the project development and implementation process. During the consultation process the proposed project interventions were discussed while the tentative impact of project implementation was assessed from the discussion with local stakeholders. In the consultation process, the stakeholders are directly involved in the study with consultants for reforming/ developing the project interventions and considering the local needs and aspirations in line with the problems and solutions suggested by them. The proposed interventions, process of EIA and the EMP were briefly shared with the project stakeholders for getting their perceptions, views and feedback on the probable changes likely to be happened within the project area.

9.2 Objectives

430. The overall objective of the PCM is to explore the viewpoint of rehabilitation of Polder 36/1 to the local people and collect their suggestions to strengthening or sustaining the project as well as to mitigate the identified problem. Environmental and socio-economic benefits will be flashed out by the implementation of proposed interventions. The specific objective of the project is as follows:

- To increase the agricultural production in the polder area
- To protect the crop damage in the polder area
- To protect salinity intrusion in the polder area
- To protect important structures, homestead, arable land and tress from River bank erosion
- To improve employment opportunities, income generation and living of standard of the polder area

9.3 Approaches and methodology

9.3.1 Approach

431. Participatory approach was applied for identifying the problem and solution across the intervention in public consultation meeting. Initially, the consultants discussed with the BWDB authority of the respective areas in order to obtain their views and suggestions on the project. Key stakeholders were identified through consultation with local people and local government officials. The venue, date and time of those meetings were fixed in consultation with the key persons. The consultant used convenient and necessary checklists for facilitating the public consultation meetings, which helped to reflect uniformity and relevancy of the opinions and views of participants.

9.3.2 Methodology

432. The important issues like overall briefing of the project including problem of the area with the potential solutions, proposed interventions, probable impacts of selected interventions etc. were incorporated in the checklist. During public consultation meeting

(PCM), all relevant issues within socio-economic, agricultural, hydrological, fisheries, ecological aspects were discussed in detail. A Socio-economist along with the multi-disciplinary consultant team facilitated the consultation meeting. The consultants displayed maps of the polder area and explained the initial baseline condition and proposed interventions. The facilitators explained all relevant points and issues in order to enable the participants to comprehend the proposed interventions/activities properly and to respond, accordingly. The stakeholders' perceived views over the impacts on Important Environmental and Social Components (IESCs) along with perceived benefits, risks, threats and demand from the project were identified. The consultants paid the utmost care in recording opinions and views of the participants relevant to the EIA Report. The EIA team may also conduct the informal meetings with stakeholders as per the quires of the consultants. In the informal meeting, the meeting place will not be fixed in previous.

9.4 Public consultation meetings

9.4.1 Location of public consultation meeting

433. Several numbers of consultation meetings with the mixed group of different occupational people were conducted by the EIA study team. The meeting details are presented in the following table:

Table 6.1: Location of public consultation meetings

District	Upazila	Union/Mouza	Meeting place	Date
Bagerhat	Fakirhat	Mulghar	Goalbari Primary school	10.11.2014
	Mollahat	Gangni	Gangni Union Parishad	12.11.2014

434. During field visit, the EIA study team informally discussed with the local stake holders in different parts of the polder area. The details of the stakeholders meeting is given in the following table:

Table 6.2: Location of informal stakeholders meetings

District	Upazila	Union/Mouza	Meeting place	Date
Bagerhat	Fakirhat	Sadar	Bhairab bridge	09.11.2014
		Mulghar	Sonakhali Sluice gate	09.11.2014
	Bagerhat	Baruipara	Baruipara beel	09.11.2014
	Chitalmari	Khiligati	Katakhal	09.11.2014
		Raigram	Siminar Khal	09.11.2014
		Narayankhali	Narayankhali gate	09.11.2014
		Bashtolli	Bashtolli sluice gate	10.11.2014
	Sadar	Bishnupur	Helagila Khal	10.11.2014
	Chitalmari	Kolatoli	Saildah	11.11.2014
		Chitalmari	Bridgeside bazaar	11.11.2014
		Kolatoli	Paranpur	11.11.2014
Khulna	Rupsha	Ghat Bogh	Bamondanga Khal	11.11.2014

Photo 6.1: Informal Discussion with local stakeholders

9.4.2 Participants list

435. A list of participants attended in different meetings is featured in the following Table 6.3 with their ages, occupations and addresses including cell phone numbers (if any).

Table 6.3: Name of the BWDB officials participating in discussion

Sl	Name	Age	Occupation	Address	Mobile no
1	Mr. Md. Abdul Latif Miah	59	Chief Engineer	BWDB, Khulna	-
2	Mr. Md. Mainuddin	55	Executive Engineer	BWDB, Bagerhat	01717878481
3	Mr. Prabir Kumar Gaushami	32	Sub-Divisional Eng.	,,	01716055974
4	Mr. Abdus Sukkar Miah	52	Section Officer	,,	01721452511
5	Mr. Bajlur Rahman	53	Section Officer	,,	-

Photo 6.2: Consultation meeting with Executive Engineer and other officials of BWDB, Bagerhat

436. The list of participants attending in PCMs is enclosed in Appendix 3.

9.4.3 Issues discussed, problems and suggested measures

437. Issue problems and suggested measures of five different disciplines of EIA study are given in the following table (Table 6.4).

Table 6.4: Issues, problems and suggested measures

Sl	Issues	Problems	Suggested measures
1	Water resource	Water logging and drainage congestion in TRM basins (Nurnia, Kendua and Baruipara beel) Inactive/dilapidated sluice gates Siltation in major rivers and internal connecting khals River bank erosion at Paranpur and Saildah	• Re-excavation of major river and internal khals • Construction and repairing of regulators for managing irrigation water and halting the saline water intrusion • River bank protection work and regular maintenance • Sequentially implement TRM in selected basins to remove water logging, drainage congestion and convert the fallow land as arable
2	Agricultural Resource	Drainage congestion during transplanting period in Aman season. Severe scarcity of irrigation water during dry season especially for rabi crops cultivation. Most of the water control structures (Regulators) are not functioning properly. The siltation caused raise of river bed and different internal drainage khals. River bank erosion (Madhumoti) is also threat for agricultural land.	• River Bank protection. • Re-excavation khals and dredging of Rivers. • Construction and repair of sluice gates. • Training for WMAs.
3	Fisheries Resource	Habitat quality is degrading due to siltation. Disturbance of fish migration. Decreases the richness of Riverien fish species in the polder area. Good numbers of shrimp gher is present in the project area and water is available around the year but scientific culture is not practicing.	• Spoil should be dumped as suggested location according to the selected sites of the feasibility study. • Avoid the water bodies for spoil dumping. • The proposed interventions will facilitate the fish migration between river and khal in the polder area. • Avoid re-excavation and dredging activities in fish migration period (especially migration for breeding) in the month of May to July. • The proposed interventions (re-excavation and dredging activities and new regulators) should be immediately started. • Training will be needed for gher and fish capture related occupants. • Maintenance committee should be formed for regular

Sl	Issues	Problems	Suggested measures
			monitoring the act of interventions.
4	Ecology	The major problems identified in the study area are: Improper maintenance of water control structure, khals siltation, water logging and river bank erosion. Which are effecting, aquatic species, khals side, home stead and crop land vegetation. Consequently, faunal population and diversity is also decreasing due to natural disaster and various human activities.	• Construction of water control structure and river bank protection to protect settlement, road, and crop fields from existing problem. • Re-excavation of khal to remove drainage congestion and water logging.
		Gher shrimp farming activities ultimately increased salinity and creating continuous pressure and reduce to fresh water ecosystem. These is the also another problem in the study area.	
5	Socio-economic	Lack of irrigation facilities	• Open-up the water connectivity by excavating and dredging of major river and connecting khals • Protecting the bank of Modhumoti River • Construction and repairing of structures for saving saline intrusion and tidal surges. • TRM should be implemented for eradicating water logging; and created a successive possibility to increase a huge amount of arable land.
		Salinity intrusion	
		Loss of important structures and arable land with standing crops and trees	
		A huge amount of unproductive low land	
		Poor living of standard	

9.4.4 Findings

438. Immediately starting the rehabilitation work in polder 36/1 is the foremost demand of the local people to mitigate the existing irrigation and drainage problem. They also opined that protective work and dredging of major rivers should be started in priority basis so that people can relief from the loss of their assets and can execute a sustainable source of income.

Photo 6.3: Public Consultation Meeting at Goalbari Primary School near Godara Sluice Gate

Photo 6.4: Public Consultation Meeting at Gangni Union Parishad near TRM basins

10 Conclusion and Recommendations

10.1 Conclusion

439. The proposed dredging of peripheral rivers, re-excavation of khals, construction of water control structures, replacement of existing drainage structures, river bank protective work and TRM in selected Beels will be at Polder 36/1 which is surrounded by the Atharobanki River to the north-west, the Bhairab River to the south-west, the Madhumoti River to the north-east and Mora Chitra River to the south-east. The administrative and management control lies with Bagerhat O & M Division of BWDB. The study area is situated in Mollahat, Fakirhat, Chiltamari upazilas, Sadar of Bagerhat district and Rupsa upazila of Khulna district. The project covers a gross area 39,130 hectares of which 25,043 hectares is the net cultivated area.

440. After implementation of proposed works, drainage congestion, water logging, high rate of siltation and erosion would reduce and all the possible damages inside the polder area will minimize to a significant amount. Agricultural activities will increase which will ensure food security in the polder area. Total crop production would be about 152,161 tons of which rice would be about 62,177 tons and non- rice would be about 89,984 tons. The production of rice would be increased due to increase in area of HYV Aus, HYV Aman and Hybrid Boro under future with project situation. Capture fish production will decrease in the polder area and no change in river fish production. Pond culture and gher production will increase partially in the polder area. At present estimated fish production of the polder area is approximately 13,516 ton, which will increase partially (13,876 ton) after the completion of project.

441. Terrestrial vegetation, species diversity, floristic composition and over all ecosystem will be improved. The spatial distribution in terrestrial vegetation density will be high. Embankments vegetation will be enriched due to fresh water in the khals and rivers after re-excavation and dredging work. Improvement of vegetation and fruit tree will support resident wildlife throughout the year. Aquatic wildlife and vegetation will be enriched by enhancing water flow, volume and depth of khals and rivers after re-excavation and dredging work.

442. The overall socio-economic condition of the polder area will improve significantly as employment opportunity will create during pre-construction and construction phase. Thus, poverty will be reduced remarkably and more income generation opportunity would be produced in post-construction phase. Land price of the polder area will also increase and overall common property resources would be saved from further destruction. With the implementation of project the under threatening properties will be protected from river bank erosion as well as water logging and drainage congestion.

10.2 Recommendations

443. The following EMP measures will minimize the negative impacts and enhance the positive impacts which will be generated by the proposed interventions:

- Construction activities should be carried out as per design.
- Exhaust emissions from heavy vehicles should comply with standards.
- Construction material (sand, coarse aggregates etc.) should be covered during movement as well as storage.

- Water to be sprinkled as and where needed.
- Noise levels from vehicles, equipment and machinery to comply with national noise standards.
- Restricting/limiting timing of construction activities should follow.
- Cross bundh / ring bundh have to be constructed immediately after connecting the diversion channel.
- Earthwork for re-excavation should be carried out in such a way (creating chamber in the khals) so that it causes minimum hindrance to natural flow.
- Waste materials from labor shed should be disposed in separate places far from water bodies
- Dredging work should be performed in such way so that oil will not reach the water
- Dredged spoil should be dumped very carefully so that further siltation cannot occur.
- The constructing materials like sand, cement, construction of labor sheds and stockyard should be placed in non-agricultural land as far as possible.
- Irrigation should be provided in optimum level with minimum conveyance loss.
- Organic manure should be applied for the restoration of soil fertility.
- The construction activities should be implemented in dry season.
- Use barren land or low vegetated land for placing of construction materials, stockyard and labor shed preparation.
- Avoid the re-excavation and other intervention work during fish migration and breeding period.
- TRM activity should be implemented with proper care. Guidance on effective implementation of TRM may be taken from the EIA study report of KJDRP.
- Plantation of local timber/ fruit plants on embankment area after completion of earthwork activities
- Social consciousness and gender training should be conducted.
- Committee consisting of local people should be formed to ensure active participation in spoil management in a disciplined way.

444. Finally, having reviewed all the potential environmental impacts and following the recommended mitigation measures as per this EIA, this project is expected to proceed without having any unacceptable environmental effects.

References

FRSS, 2012. *Fisheries Statistical Yearbook of Bangladesh*. Fisheries Resources Survey System, Department of Fisheries, Bangladesh, No. 29.

FAO. 2011, Mud crab aquaculture – A practical manual by Colin Shelly, FAO consultant, Australia and Alessandro Lovatelli, Aquaculture Officer, Aquaculture Service, FAO Fisheries and Aquaculture Department, Rome, Italy.

B Das ,Prawn Culture and Management, Part 3, Published by -Bangla Academy, Dhaka 1000, Bangladesh. First Edition, June 1999.

FAO/UNDP, 1988. *Land Resources Appraisal of Bangladesh for Agricultural Development (Report-2), "Agro-ecological Regions of Bangladesh"*, Prepared by Food and Agricultural Organization (FAO), United Nations.

Soil Resource and Development Institute, 1988, Guideline for land and soil resources, Thana Nirdashika, Farmgate Dhaka.

S. A. HAQUE, Review article, salinity problems and crop production in coastal regions of Bangladesh. Department of Soil Science, Bangladesh Agricultural University, Mymensingh, Bangladesh. Pak. J. Bot., 38(5): 1359-1365, 2006.

SOLARIS (Soil and Land Resources Information System), 2006. SOLARIS Model developed by Center for Environmental and Geographic Information Services (CEGIS) for Soil Resource and Development Institute (SRDI).

BRRI (Bangladesh Rice Research Institute), 2011, Adhunik Dhaner Chash, Joydevpur, Gazipir, Gazipur

Fertilizer Recommendation Guide, 2012, Bangladesh Agricultural Research Council, Farmgate, Dhaka.

Hand Book of Agricultural Technologies, 2011-2012, Bangladesh Agricultural Research Institute Joydevpur, Gazipur, Gazipur.

Appendix-1: Data Collection Checklist

Water Resources

Baseline Data Collection Form

Environmental Studies for Polder 36/1

Name of Data Collector: Date:

Project Name:

A. Administrative Information

BWDB Division:	BWDB Circle:
BWDB Zone:	Hydrological Zone:
District(s):	Upazila(s):
Union(s):	Mouza(s):

B. Secondary data (to be obtained before going to the field)

Field	Source	Station(s)	Year(s)	Analysis		
				Max.	Min.	Avg.
Rainfall						
Temperature						
Humidity						
Evaporation						
Wind speed						
Sunshine hours						
Climate change						

C. Primary data (To be collected during field visit)

1. River system & flow direction (inside and outside the project)	
2. Name and location of beels and connectivity with rivers and khals	
3. Name of canals/khals and connectivity with rivers and beels	
4.Topography and Drainage pattern	
5. Location specific drainage congestion (% of extent, and delineate boundary in field map)	
6. Location specific water logging (% of extent, and delineate boundary in field map) in the month of February	
7. Flooding (depth, % of extent, onset, pick and recession)	

7. Flooding (depth, % of extent, onset, pick and recession)				
8. River/ khal erosion	River/khal	Area (ha) eroded	Length (m)	Reason
9. Accretion	River/khal	Area (ha) accreted	Reason	

D. Water Quality (people's perception/measurement)		
	People's Perception	Measurement
1. Ground water: (Arsenic/Iron/Salinity)		Arsenic: Iron: Salinity:
2. *Surface water: (Salinity, pH, DO, TDS, BOD, COD)		Salinity: pH: DO: TDS: BOD: COD:
*Note: It can be extended according to Client demands		
E. Pollution status (people's perception)		
1. Source of pollution		
2. Type of effluent		

F. Water Use

Sources	Domestic	Agriculture	Fisheries	Others (industry…)
Surface water				
Ground water				

G. Historical severe flood:

Year of recent severe flood	**Flood damage**			
	Extent (Days)	**Flood level (cm)**	**Damage of resources**	
1988				
1994				
1998				
2004				
2007				
Last 5 years	Flood year			Flooding areas:
	Non-flood year			

H. People's opinion about the project

Present problems:
Causes of problems:
Probable Solution/Improvement:
Natural disasters:

I. Collect Project description related information from field office:
Name of re-excavation Khals with length
Catchment area of the Khals
Outfall information of Khals
Drainage network of Khals
Drainage pattern of Khals
Cross section of Khals with other design information
Re-excavation length of individual Khal and volume of earth spoil
Location specific Spoil management plan for individual khal

Sl	Name of Khal	Location-dumping of spoil earth	Volume	Number of unskilled/skilled labor	Use of machineries with number	Remarks
1						
2						
3						
4						
5						
10						
..						
..						

Location of labor shed with their water and sanitation facilities system
Number of labor (foreign labor or local labor)
Area of land acquisition and requisition with name of place, if necessary
Carrying system of spoil earth
Time period of construction/earth works
Activities involved in re-excavation

Phase	Name of activities	Remarks
Pre-construction phase		
During construction		
Post-construction		

Stockyard information during construction time:

Baseline data collection for EIA study: Land, Agriculture and Livestock Resources

Land Resources: Secondary information: SRDI/SOLARIS/NWRD/GIS database

Agro-ecological regions

Name of AEZ	Area (ha)	%	Soil characteristics

Land use

Land use	Area (ha)	Percent of gross area
Gross area		
Net Cultivated Area (NCA)		
Settlements		
Water bodies		
Rivers/ Khals		
Forest		
Others		

Land type

Land Type	Flooding depth	Area (ha)	Percentage
F0	0 to 30 cm		
F1	30 to 90 cm		
F2	90 to 180 cm		
F3	180 to 300 cm		
F4	More than 300 cm		
	Total:		

Soil Texture

Texture name	Top-soil		Sub-soil		Sub-stratum	
	Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)

Soil Salinity

Agriculture Resources: (Primary information to be collected from the field)
Location:
Farming practices

Collect information on adjustment of crop production practices with agro-climatic condition, crops grown in different cropping seasons, flooding, drainage, drought, marketing facilities, availability of agricultural labor etc.

Major Cropping Pattern by land type

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	% of area

Crop Damage

Name of Crop	Location	% damaged	Timing	Cause of damage

Crop yield rate and market price

Crop Name	Yield (ton/ha)		Price (Tk/ton)	By-product (Tk/ha)
	Normal	Damaged		

Inputs Used

Crop Name	Urea (Kg/ha)	TSP (Kg/ha)	MP (Kg/ha)	Others (Kg/ha)	Seed (Kg/ha)	Labour (No/ha)	Pesticide (No. of spray)	Land preparation (Tk/ha)
Note: Name of pests and pesticides:								

Irrigation

Crop Name	Irrigation (Surface water)			Irrigation (Ground water)		
	Area irrigated	% of Area	Charge (Tk/ha)	Area irrigated	% of Area	Charge (Tk/ha)

Crop production constraints (including land degradation)

Factors	Year of starting LD	Location	Result of LD
Soil erosion			
Sand carpeting			
Salinisation			
Acidification			
Nutrient deficiency			
Pesticide use			
Water logging			
Others			

Livestock Resources: Primary and Secondary Information

Livestock and poultry production

Name of Livestock/poultry	% of HH having Livestock/Poultry	No. of Livestock/poultry per HH
Cow/bull		
Buffalo		
Goat		
Sheep		
Chicken		
Duck		

Feed and Fodder

Name of Livestock/poultry	Feed/Fodder Scarcity (Timing)	Causes	Remarks
Cow/bull			
Buffalo			
Goat			
Sheep			
Chicken			
Duck			

Diseases

Name of Livestock/poultry	Name of Disease	Disease (Timing)	Causes	Remarks
Cow/bull				
Buffalo				
Goat				
Sheep				
Chicken				
Duck				
Note: Support Services-				

Fisheries Baseline Checklist

Environmental Studies for Polder 36/1

Vill: Mouza: Union: Upazila: District: BWDB Circle: BWDB Division:

Background Water bodies: Name: Alphabetic, Area: in Ha/% of area/Ana, Length: in km, Depth/Inundation depth: in Meter, Flood Duration: in Months, Production: metric ton

Problem/ Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-)	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
Capture Fisheries: Culture Fisheries: Indiscriminate Fishing Activities:	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: SFHHs:	River																
		Beel (Leased/non leased)																
		Khal																

Problem/ Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-)	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
		Floodplain																
		Mangrove area																
		Fish pond																
		Baor																
		Ghers																

Fish Migration				**Fish Biodiversity**		**Species List**					**Species Composition**				
						River	**Khal**	**Beel**	**Pond**	**Other**	**Group**	**River**	**Khal**	**Beel**	**Pond**
Previous Migration Status			Fish diversity status (Poor/Moderate/Rich)/%								Major carp				
											Exotic carp				
											Other carp				
											Catfish				
											Snakehead				
Present Obstacle to fish migration:	1. 2. 3.		Reasons of increase or decrease		1. 2. 3. 4.						Live fish				
											Other fish				
											Shrimp/prawn				
											Hilsa/Bombay duck/Indian salmon				
											Pomfret				
Important breeding, feeding and over wintering ground					5.						Jew fish				
											Sea cat fish				
											Shark/Skates/ Rays				
											Rui				
											Catla				
Horizontal Migration pattern	Species: 1. 2. 3. 4. 5.	Season (Months):	Routes:	Significant areas	1. 2. 3.						Mrigal				
											Koi				
											Sarputi				
											Large shrimp				
											Small shrimp				
Vertical Migration	Species: 1.	Season (Months):	Habitats:	Species of Conservation	Rare:						Silver carp				
											Carpio				

Fish Migration				Fish Biodiversity		Species List					Species Composition				
						River	Khal	Beel	Pond	Other	Group	River	Khal	Beel	Pond
Pattern	2.			Significance							Grass carp				
	3.										Tengera				
	4.				Unavailable:						Chapila				
	5.										Others				

Post Harvest Activities		Fishermen Lifestyle	
Fish edible quality:		Socio-economic Status of subsistence level fishermen:	
Source of pollution in each habitat:		Socio-economic Status of Commercial fishermen:	
Seasonal vulnerability:		Other conflict (with muscle men/ agriculture/ other sector/laws):	
Ice factory (Number, location and name):		Fishermen community structure (Traditional/Caste/Religion)	
Landing center, whole sale market, other district markets, etc.:		Traditional fishermen vulnerability (Occupation change/others):	
Storage facility (number, location and name):		Existing Fisheries Management	
Fish market (Number, location and name):		Fishermen Community Based Organizations (FCBOs):	
Marketing problems:		WMOs activity:	

Post Harvest Activities		Fishermen Lifestyle	
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.

Marine: Hilsa/Illish, Bombay Duck (Harpondon nehereus), Indian Salmon (Polydactylus indicus), Pomfret (Rup_Hail_Foli Chanda), Jew Fish (Poa, Lambu, Kaladatina etc.), Sea Cat Fish (Tachysurus spp.), Sharks, Skates & Rays, Other Marine Fish.

Beels: Rui (Labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus mrigala), Kalbasu (Labeo calbasu), Ghonia (Labeo gonius), Boal (Wallago attu), Air (Mystus aor / Mystus seenghala), Shol/Gazar (Channa spp.), Chital/Phali (Notopterus chitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustes fossilis /Clarias batrachus), Sarpunti (Puntius sarana), Large Shrimp (Macrobrachium rosenbergii /M. malcomsonii), Small Shrimp, Silver Carp (Hypophthalmichthys molitrix), Carpio (Cyprinus carpio), Grass Crap (Ctenopharyngodon idellus), Pabda (Ompok pabda), Punti (Puntius spp.), Tengra (Mystus spp.), Baim (Mastacembelus spp.), Chapila (Gudusia chapra), Others.

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/Foli (Notopterus chitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustes fossilis / Clarias batrachus), Sarpunti (Puntius sarana), Thai Sarpunti (Puntius gonionotus), Punti (Puntius spp.), Others.

Ecological Data Collection Form

Environmental Studies for Polder 36/1

EDate		Name of the interviewer	
Name of the Project			
District/s		Upazila/s	
Location of the FGD			
Latitude		Longitude	
Gross area:		Net Area:	

Bio-ecological Zone(s):

Terrestrial Ecosystem

Major land use types of terrestrial habitat of the study area (please put Tick where applicable)

Agriculture land		Forest patches including social forestry	
Settlement/Homesteads		Canal and ponds	
Orchard		Grasslands	
Fallow		Reserve forest	
Embankment and roadside vegetation		Others	

Terrestrial Biodiversity

Major Terrestrial Flora

Common Species	Rare Species	Extinct Species	Exotic Species

Major Terrestrial fauna

Species Name	Habitat1	Food Habit2	Breeding Time	Status3	Migration Status4

1 Habitat: 1= Homestead forest, 2= floodplains, 3= wetlands, 4= river 2 Habit: 1=Herbivore, 2= Carnivore, 3= Both	3Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare 4 Migration Status: 1= Local, 2= Local Migratory, 3= Migratory

Aquatic Ecosystem

Wetlands and types of aquatic habitat (specify, area per type, flooding depth etc)

Name of wetland	Type of Wetland1	Area in ha		Flooding depth (m)	Connectivity with river		Importance2
		Seasonal	Perennial		from	to	

1= Open water wetlands, 2= Rivers, 3= Estuarine and mangrove forest, 4= Beels and haors, 5= Floodplains, 6= Closed water wetlands,
7= Ponds, 8= Baors (oxbow lake), 9= Brackish water farms
2 1=Fish; 2= migratory bird; 3= other wildlife; 4=aquatic flora;

Aquatic flora

Ecology and plant community (depending on water depth and flooding)

Species name	Type1	Abundance2	Growing period	Utilization3

1 1=Submerged, 2=Free floating, 3=Rooted floating, 4=Sedges, 5=Marginal
2 1= High, 2= Moderate, 3= Low
31=food; 2=fuel; 3=medicinal; 4=fiber/thatching; 5=Bio-fertilizer 6=others (specify if any)

Aquatic Fauna

Species name	Status1	Species name	Status1
Amphibians			
Reptiles			
Birds			

[1] 1= Open water wetlands, 2= Rivers, 3= Estuarine and mangrove forest, 4= Beels and haors, 5= Floodplains, 6= Closed water wetlands, 7= Ponds, 8= Baors (oxbow lake), 9= Brackish water farms
[2] 1=Fish; 2= migratory bird; 3= other wildlife; 4=aquatic flora;
[3] 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others

Species name	Status1	Species name	Status1
Mammals			
1=Very common, 2=Common, 3=Occasional, 4=Rare			

Present status and negative impacts on flora & fauna

Impacted Species	Existing Status	Cause of impact

Anticipated impacts on flora and fauna due to project activity (according to people opinion)

Victim Species	Anticipated Impact	Cause of impacts

Necessity of wildlife management practices (According to people's opinion):

☐ Yes ☐ No

How	

Ecosystem Services

Type of Service	Estimated Cost/House	Total Cost in project Area	Grand Total Cost
Fuelwood			
Timber			
Fruit production			
Thatching			
Fodder			
Bio-fertilizer			
Other			

Presence of Important Ecosystem (If any)

Important Ecosystem	Name	GPS Coordinate/waypoint
Ecologically Critical Area		
Important Bird Area		
Reserve Forest		
Natural Forest		
National Park		
RAMSAR Site		
Wildlife Sanctuary		
Game Reserve		
Eco-park		

Note (If any):

SOCIO-ECONOMIC BASELINE DATA COLLECTION

Checklist for Rapid Rural Appraisal (RRA)

Environmental Studies for Polder 36/1

Facilitation Information

Name of Facilitator	
Date of Facilitation	

Project Information

Name of Project	
Gross Area (ha.)	
Net Area (ha.)	

Study Area

Mauza	
Union/Ward	
Municipality (if any)	
Upazila/Thana	
District	

Educational Institution

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	

Note: The category "Primary School" includes only Government Primary School (GPS) and Registered Non-government Primary School (RNGPS)

Disease Prevalence

Ranking by Incidence	Name of Disease	Ranking by Incidence	Name of Disease
1		6	
2		7	
3		8	
4		9	
5		10	

Note: If the facilitator can collect disease profile from the Upazila Health Complex then this question could be skipped

Health Facilities

Sl. No.	Type of Facility	Number of Facilities
1	District/Sadar Hospital	
2	Upazila Health Complex	
3	Union Sub-Center	
4	Union Family Welfare Center	
5	Community Clinic	
6	Private Health Clinics/hospitals	
7	Other (if any)	

Peripheral Health Facilities (if any)

Number	

Name	
Description/status	

Sources of Treatment Facilities

Sl. No.	Source of treatment facilities	Percentage of Households Received
1	Trained physician	
2	Paramedic/diploma physician	
3	Quack doctor & informal treatments	
4	No treatment facilities at all	

Electricity Coverage

Sl. No.	Type of facility	Percentage of Households
1	Grid	
2	Solar	
3	Biogas	
4	Other (if any)	

Note: Percentage of households covered by grid electricity will be cross-checked with the data given in the Population and Housing Census 2011 of Bangladesh Bureau of Statistics

Income and Expenditure

Range (Tk./month)	Percentage of Households	
	Expenditure	Income
Less than 1,000		
1,000 - 2,000		
2,000 – 5,000		
5,000 - 9,000		
9,000 - 20,000		
More than 20,000		

Labor and Wage

Type of Activity	Male Labor		Female Labor	
	Availability (put √)	Daily Wage (Tk.)	Availability (put √)	Daily Wage (Tk.)
Farming	H M L		H M L	
Non-Farming	H M L		H M L	

Note: H=High; M=Medium; L=Low. Farming activities include agricultural activity and Non-farming activities include earthwork, brickfield work, construction work etc)

Self Assessed Subsistence Poverty

Sl. No.	Poverty Status	Percentage of Households
1	Deficit	
2	Balance/Breakeven	
3	Surplus	

GO/NGO Safety Net Programs

Name of GO/ NGO Department	Activity	% of HHs Coverage

Name of GO/ NGO Department	Activity	% of HHs Coverage

Land Price

Sl. No.	Lands Type	Sale Value (Tk./per acre)
1	Homesteads land	
2	Agricultural land	
3	Commercial Land	
4	Others (if any)	

Disaster and Damage (in last five years)

Most Prevalent Disasters	
Ranking by Incidence	1) 2) 3) 4) 5)
Tangible loss due to Disasters	
Intangible loss due to Disasters	
Impacts on Households	
Impacts on Livelihood	
Proposed Mitigation	

Note: These data will be cross-checked with the multidisciplinary information

Migration Trend

Type of Migration	Out Migration		In Migration	
	Place of destination	Number/ Percentage*	Place of origin	Number/ Percentage*
Seasonal Labor migration				
Permanent Household migration				

*Percentage of migration will be applicable in case of seasonal labor migration; whereas number will be applicable in case of permanent migration of households

Professional/occupational Conflict

Type of Conflict	
Reasons of Conflict	
Area	
Groups engaged in conflict	
Proposed solutions	

Miscellaneous

Particulars	Number	Name	Brief Description
Ethnic Community			
Vulnerable Community			
Cultural Heritage Site			
Common Property Resources			

Profile of RRA Participants

Name	Age	Occupation	Address/ Mobile no.

Required Photographs: Educational Institutions, Housing Pattern, Water-Sanitation Facilities, Solar/Biogas Plant, Health Facilities, Transportation/Communication Network, Markets, Adverse Affects of Disasters etc

Appendix-2: Checklist of PCM

Environmental and Social Impact Assessment (ESIA)

Rehabilitation of Polder 36/1, Bagerhat

Checklist for Public Consultation Meeting (PCM)

- Brief introduction about the project (by facilitator)
- Outlining the general problems of the studied area
- Knowledge about the project
- Knowledge about the location of the project
- Attitude to the project
- Project induced problems (each sector)
- Project induced opportunities (each sector)
- Suggestions for mitigation
- Suggestions for enhancement
- Suggestions to project implementers and planners

Outline of PCM

Expected location:

Nos. of participants:

Potential stakeholders:

Appendix-3: List of PCM participants

Rehabilitation of Polder 36/1

Attendance Sheet

Public Consultation Meeting (PCM)

Location : গোপালবাড়ী মঃ প্রাঃ বিদ্যালয় Date : ২০/১১/২০১৪

SL No	Name	Address	Mobile	Signature
১.	সৈয়দ তৌহিদুল ইসলাম	চেয়ারম্যান, [illegible]	01714828967	[signature]
২	[illegible] বিশ্বাস	মেম্বার, [illegible]	0173091000?	[signature]
৩.	ফিরোজ আলম	BWDB	[illegible]	[signature]
৪.	তাপস হালদার	গ্রাম্য ডাক্তার	[illegible]	[signature]
৫.	[illegible] সরকার	পুলিশ	[illegible]	[signature]
৬.	[illegible] বিশ্বাস	গোপালবাড়ী	[illegible]	[signature]
৭.	অমৃত রায়	ব্যবসা, গোপালবাড়ী	[illegible]	[signature]
৮.	শেখ বেল্লাল হোসেন	উপজেলা কৃষি অফিস	[illegible]	[signature]
৯.	জ্ঞান দাস রায়	গোপালবাড়ী	01718100937	[signature]
১০.	[illegible] রায়	কৃষিকাজ, গোপালবাড়ী		[signature]
১১.	সঞ্জীব হীরা	মৎস্যচাষ, গোপালবাড়ী	[illegible]	[signature]
১২.	ভবানী ভূঁইয়া	ব্যবসা, গোপালবাড়ী	[illegible]	[signature]
১৩.	বিদ্যুৎ রায়	ব্যবসা, গোপালবাড়ী	[illegible]	[signature]
১৪.	[illegible] রায়	মৎস্য, গোপালবাড়ী		[signature]
১৫.	সুবীরেন্দু মালাকার	মৎস্য, গোপালবাড়ী		[signature]
১৬.	বাবুল রায়	মৎস্য, "	01914194287	[signature]
১৭	অমিত রায়	মৎস্য "	01956460431	[signature]
১৮	সোহাগ মন্ডল	মৎস্য "	01720457537	[signature]
১৯	[illegible] মন্ডল	ছাত্র "	01858667540	[signature]
২০	কিশোর মন্ডল	ছাত্র "	01941383544	[signature]
২১.	সঞ্জীব বিশ্বাস	গ্রা: ডা: "	01859719987	[signature]
২২.	[illegible]	কৃষি "	01720460439	[signature]
২৩.	নিতীশ চন্দ্র হীরা	কৃষি	01720289212	[signature]
২৪	উত্তম কুমার রায়	কৃষি	01863701348	[signature]
২৫	এস. এম. [illegible] ইসলাম	[illegible]	[illegible]	[signature]
২৬	সাধন চন্দ্র রায়	কৃষি গোপালবাড়ী	=	[signature]
২৭	[illegible]	কৃষি গোপালবাড়ী	[illegible]	[signature]
২৮.	[illegible] রায়	কৃষি, "	017390048407	[signature]
২৯	[illegible] রায়	SAAO	01714847210	[signature]
৩০	গোবিন্দ রায়	কৃষিকাজ		[signature]
৩১	প্রকাশ কুমার	কৃষিকাজ		[signature]
৩২	লিয়াকত বিশ্বাস	মৎস্যজীবী		[signature]

৩৩, মো: [illegible], [illegible] [signature]

Rehabilitation of Polder 36/1

Attendance Sheet

Public Consultation Meeting (PCM)

Location ভেলাখালীবাড়ী নং ফ্লাড রিট্রেনচড্, Date: ২০/১২/২০১৪

SL. No	Name	Address	Mobile	Signature
৩৩	সুকান্ত হিরা	খেত, তিলমারী	01723194650	সুকান্ত
৩৪	তাজুল ইসলাম	পুর্বাচল, তিলমারী	—	তাজুল
৩৫	আবির হিরা	পুর্বাচল, তিলমারী	—	আবির
৩৬	হাজেরা বেগম	Correctional, তিলমারী	01828 743362	হাজেরা
৩৭	নিখিলেশ সিংহদার	মধ্যচরাচল, তিলমারী		নিখিলেশ
৩৮	মুজাদ মন্ডল	কুমিল্লা খেত, তিলমারী		Chuhad
৩৯	শ্রীমুক্ত মন্ডল	কুমিল্লা খেত, "		শ্রীমুক্ত
৪০	নাজমুন নাহার কনা	" , "		Kona.
৪১	কিশোর মন্ডল	" , "		—
৪২	প্রসান্ত মন্ডল	" , "	01742288688	Prasanta
৪৩	সাহিত্যিক মন্ডল	" , "	01924430776	—
৪৪	হেলাল উদ্দিন সরদার	খেত / তেলাখালী	—	হেলাল
৪৫	অমিত	টেকনিকেল Assistant BWDB	01913304190	
৪৬	মিজানুর রহমান	Asst. Chief, BWDB, DHAKA	01911164112	
৪৭	আব্দুর রহমান	SO, BWDB, Bagerhat		

Rehabilitation of Polder No- 36/1

Attendance Sheet

Public Consultation Meeting (PCM)

Location : [illegible] Date : 22/12/2018

Sl. No	Name	Add & Occupation	Mobile No	Signature
১	[illegible]	[illegible]	01724-308786	[illegible]
২	মো: নুর ইসলাম	[illegible]	01730-684084	[illegible]
৩	[illegible]	[illegible]	01712-278525	[illegible]
৪	[illegible]	[illegible]	01722164211	[illegible]
৫	[illegible]	[illegible]	01737868231	[illegible]
৬	[illegible]	[illegible]	[illegible]	[illegible]
৭	নুর মোহাম্মদ	[illegible]	—	[illegible]
৮	[illegible]	কৃষক	01911-222424	[illegible]
৯	এফ. এম. ইদ্রিস আলী	সমবায় সদস্য	01912806 86069	[illegible]
১০	আব্দুল খালেক মোল্লা	কৃষক	—	
১১	বি. এম. তাহাফীর	ব্যবসায়ী	01916 809424	[illegible]
১২	মোহাম্মদ আলাউদ্দিন	কৃষক	01863 424260	[illegible]
১৩	ওবায়দুর রহমান	ছাত্র (ভিশুর্ণ)(BBS)	01986 [illegible] 260	[illegible]
১৪	আবির শেখ	কৃষক	01962038[illegible]-89	[illegible]
১৫	রাব্বুল খাঁ	কৃষক	0189 6200 06248	[illegible]
১৬	[illegible]	[illegible]	0198 8699842	[illegible]
১৭	মো: মিঠান শেখ	কৃষক	01748 [illegible] 48922	
১৮	মোস্তফা কবির	কৃষক	01728 713592	[illegible]
১৯	আলমগীর সরদার	কৃষক	01733 948861	[illegible]
২০	কবির মোল্লা	কৃষক	01717811286	[illegible]
২১	আলীম ফকির	,,	01845048303	[illegible]
২২	শহীদ খাঁ	,,	[illegible]	[illegible]
২৩	এস. কে. ফেরদৌস আলী	,,	01775115759	[illegible]
২৪	আবুল শেখ	,,		
২৫	[illegible]	,,		[illegible]
২৬	[illegible]	,,	01835 18 2867	[illegible]
২৭	মোহাম্মদ আলী মোল্লা	,,	x	[illegible]
২৮	শেখ মোস্তাফিজুর রহমান	ঢাকরিবিবি	01820 53510	[illegible]

Rehabilitation of Polder No- 36/1

Attendance Sheet

Public Consultation Meeting (PCM)

Location : গাইনী ইউনিয়ন পরিষদ Date : 22/2/2028

Sl. No	Name	Add & Occupation	Mobile No	Signature
২৯	রফিদ মিয়া	কৃষক	01825733214	রফিদ
৩০	কালীদাস	কৃষক	—	কালীদাস
৩১	মিনতি বেপারী	ব্যবসায়ী	01727243468	মিনতি
৩২	হেলাল মিয়া	কৃষক		হেলাল মিয়া
৩৩	মো: মিলু মিয়া	,,	01839263388	মো: মিলু
৩৪	জোবেদ সরদার	চাকুরিজীবী	01 748079668	জোবেদ
৩৫	হেমায়েত মোল্লা	ব্যবসায়ী	—	হেমায়েত
৩৬	বাবু রঞ্জন বেপারী	কৃষক		বাবু রঞ্জন
৩৭	ফেরদৌস মোল্লা	কৃষক	01789939376	ফেরদৌস
৩৮	মোস্তফা হাওলাদার	,,	01735807123	মোস্তফা
৩৯	রাবু ঠাকুর	,,	01833410205	রাবু
৪০	মো: বাবুল মিয়া	,,	01825755686	বাবুল
৪১	নূর মোহাম্মদ সিকদার	,,		
৪২	হুমায়ুন মোল্লা	,,		হুমায়ুন
৪৩	বেপারী কামরুল আহমেদ	,,	01723003826	কামরুল
৪৪	মো: বাদশাহ বেপারী	,,	01836724293	বাদশাহ
৪৫	মো: কহিনুল ইসলাম	,,	01849340475	কহিনুল
৪৬	মো: ইকবাল কাজী	,,	×	ইকবাল
৪৭	মাসুদ বেপারী	,,	01739481611	
৪৮	আল আমিন শিকদার	ছাত্র (মেসার্স)	01829707944	আল আমিন
৪৯	হাসমত আলী	ব্যবসায়ী/কৃষক	—	মো: হাসমত
৫০	হুমায়ুন বেপারী	কৃষক	01812785399	হুমায়ুন
৫১	কাদির কুল খুশ লাল	,,	01873716617	কাদির
৫২	মো: রহমত	,,	—	রহমত
৫৩	[illegible]	Professional, Leads	01717653395	
৫৪	[illegible]	~		
৫৫	[illegible]	~		

Rehabilitation of Polder No- 36/1

Attendance Sheet

Public Consultation Meeting (PCM)

Location : গাছতলী ইউনিয়ন পরিষদ Date : ২৫/১২/২০২৪

Sl. No	Name	Add & Occupation	Mobile No	Signature
৫৩	Belayet Hossain	Matabbar	01727739548	
৫৭	Sobur Sheikh	"		
৫৮	Keramot Sarder	Ganyan	0	
৫৯	Robbel Khan	"	01751033164	
৬০	Mostafa Fakir	"	01728713592	
৬১	S.M. Sampul Alom	"	01732033001	
৬২	Sheikh Ainul Ali	" 7no ward Ex. Member	01735372174	
৬৩	Babul Sikder	Ganyan	0189707925	
৬৪	Abdul Malek Mollah	Bonisangha		
৬৫	Masud Rana	Ganyan 8no ward Member	01816397993	
৬৬	Gopal Bowmik	Ganyan	01860220919	
৬৭	Sheikh Feroz Ahmed	Nasan Kanyan 2no Ward Member	01716002224	
৬৮	[illegible]	SO, BWDB, Bagerhat		২৫/১২/২৪

Appendix-4: Map for dumping locations of spoil earth

Appendix-5: No Objection Certificates (NOCs)

Appendix-6: Terms of References (ToR)

Appendix-7: Comments and Responses