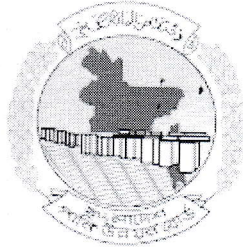


GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

**Ministry of Water Resources**

**Bangladesh Water Development Board (BWDB)**



**Terms of Reference**

**For**

**Detailed Feasibility Study for Integrated  
Development of Selected Stable Chars in the  
Meghna Estuary for Implementation under CDSP V  
and Erosion Management Plan at Boyer Char, Char  
Nangulia and Noler Char**

October 2023

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## Contents

1. Background .....	2
1.1 STUDY AREA .....	2
2. Objective .....	6
3. Methodology .....	7
4. Scope of Works .....	8
5. Detailed Activities .....	10
6. Expected Outputs .....	21
7. Duration of the study and milestone reports .....	22
8. Workshop .....	22
9. Staffing and organization .....	24
9.1 Guidance and monitoring of the feasibility study team .....	24
9.2 Staffing the Team .....	24
10. Key Personnel and Qualifications .....	24
10.1 Key Personnel .....	24
10.2 Experience and Qualification of Key Personnel .....	25
11. Work Plan .....	37
12. Duties and Responsibilities .....	38
12.1 BWDB's Responsibilities .....	38
12.1.1. Guidance and monitoring of the feasibility study team .....	39
12.2 Consultant's Responsibilities .....	39
12.3 Responsibilities of the CDSP IV Technical Assistance Team .....	39
13. Cost Estimation .....	39



## **1. Background**

### **Integrated Development Program in Stable Chars in the Meghna Estuary**

The estuary is a part of coastal zone of Bangladesh and is being shaped by a very complex set of interactions between physical processes. Sediment load deposited around the estuary forms the material for land accretion which is termed as 'Char' in Bengali. These areas are low lying and consequently vulnerable to flooding and cyclones from the Bay of Bengal. The youngest chars are mud flats supporting little vegetation, dissected by tidal creeks, subject to frequent flooding during high tides. The oldest chars are already consolidated lands, supporting annual cropping and there are some permanent homesteads. There are opportunities of culture and capture fisheries, social forestry and generation of wind, solar and tidal energy in the char area. However, Chars are vulnerable to erosion, tidal flooding and cyclonic storm surges and salinity intrusion.

The Government of Bangladesh intends to bring coastal chars under productive human settlement with the goal of a better economic situation for the char dwellers. To reduce the social, institutional, and environmental vulnerabilities that have been facing char dwellers in the char areas, development interventions are necessary to provide a sense of security at different levels and to unleash the development potential that the chars offer. Over the past two decades, the 'Char Development and Settlement Project (CDSP)' has been implemented in four Southern coastal areas, in four phases (CDSP I, II, III and IV), cumulatively benefitting over 90000 ultra-poor and despite households, or 500000 people, across the Noakhali, Laxmipur, Feni, Chattogram and part of Bhola District of the south-eastern coastal areas of Bangladesh.

A hydro-morphological model study was conducted under the CDSP-IV Bridging project (Additional Financing) (BWDB part), and a Strategic Plan was prepared based on the findings to facilitate sustainable land development and settlement in the dynamic region. The hydro-morphological model study identified twelve (12) stable char areas for integrated development under CDSP. The proposed feasibility study aims at planning and design the integrated program for char development focusing on stabilization, land reclamation, and afforestation for selected Chars in the Meghna Estuary. This study is designed to implement integrated program in the next phase of CDSP (CDSP-V). It is believed that implementation of interventions enhances economic situation of char dwellers and reduce their vulnerability to environmental hazards like flooding and cyclones. By leveraging the potential of the estuary's sediment load to create new land and developing sustainable settlements on existing char lands, the government aims to facilitate the growth and prosperity of the region.

### **1.1 STUDY AREA**

Based on the National Vision, Mission, Hotspot based Strategy and Delta Goals as defined BDP2100, satellite images analysis, hydro morphological model results, expert judgement and stakeholder consultations a few developments programme for Potential stable char have been formulated in the Meghna Estuary. The primary selection (on study results) of twelve potential chars for future development are shown in Table 1. Of them Six chars (Sl. 1-4, 6 and 8) and a prospective Ghasier Char (already existing settlements) has been chosen for comprehensive



integrated development and safe settlement under CDSP V, accordingly these are selected for the proposed Feasibility Study.

Table 1: List of Chars for Future Development in Meghna Estuary

SL No.	Char Name	2020 (Area, sq.km.)	Year of Existence	Remarks
1	Char Maksumul Hakim	36.67	2000-2020	CDSP-V
2	Char Kolatoli	36.68	2005-2020	CDSP-V
3	Char Mozzammel	26.56	2005-2020	CDSP-V
4	Dhal Char (CDSP-V)	19.55	2005-2020	CDSP-V
5	Domer Char	19.11	2005-2020	
6	Nijhuim Dwip	46.29	2005-2020	CDSP-V
7	Andhar Char	7.65	2005-2020	
8	Char Kukri Mukri	51.72	2005-2020	CDSP-V
9	Char Lakshmi	19.05	2005-2020	
10	Char Nizam	21.92	2005-2020	
11	Char Sakuchi	11.37	2005-2020	
12	Dhal Char	13.72	2005-2020	

Table 2: Other Chars include

1	Urir Char	127.69 Km2	1970-2020	
2	Ghasier Char	35.00 Km2	2005-2020	CDSP V

The Current study will include:

1. Char Maksumul Hakim
2. Char Kolatoli
3. Char Mozzammel
4. Dhal Char
5. Nijhuim Dwip
6. Char Kukri Mukri
7. Ghasier char

For the interest of the project CDSP-V, from above 'Table 1: List of Chars for Future Development in Meghna Estuary' SI No. 1,2,3,4,6 and 8 and from above 'Table 2: Other Chars include' SI No. 2 have been selected for current feasibility study for Integrated Development Programme.

If any remaining Chars from 'Table 1' (SI No. 5,7,9,10,11 & 12) and 'Table 2' (SI No. 1) needs to be included based on proper data for the interest of the project CDSP-V in the current study replacing any char/chars from the selected 7 chars, it will be decided during acceptance of 'Inception Report' by the competent authority.

For integrated drainage and erosion management

8. Boyer Char
9. Noler Char
10. Char Nangulia

The Study areas (Islands) at large located within the overall study area, essentially the central, dynamic part of the coastal zone of Bangladesh. This area is bordered in the east by the outfall of the Muhuri River and the Chittagong coastline. In the west the border is formed by the Tetulia River. In the north, the coastline of Feni, Noakhali and Lakshmipur Districts is followed, finally in the South, the Bay of Bengal.



### (A) Feasibility Study for Integrated Development of Selected Stable Chars in the Meghna Estuary for Implementation under CDSP V

Among the selected Chars for CDSP V: Dhal Char, Char Kola Toli, Char Mozammel, Nijhum Dwip and Char Kukri-mukri are distinctly different areas, separated by rivers. The larger part of Dhal Char is located in Hatiya Upazila, Noakhali District, Chittagong Division, while a small part of Dhal Char and the whole of Char Kola Toli forms part of Monpura Upazila, Bhola District, Barisal Division and Char Mozammel is under Upazila Tozimuddin, (Dolichadpur Union), Bhola District, Char Maksumul Hakim (Char Pollobi, Char Banani, Char Alaudiin, Char Khondakhar and Char Akram Uddin) under Char Clark Union of Subarnachar UZ under Noakhali District. Nijhum Dwip is a small island under Hatiya upazila under Noakhali and Char Kukri-mukri is situated between Char Montaz and Dhaler Char. It is situated at the west of West Shabazpur Channel. Ghasier char is situated in Horni Chanondi Union, Hatiya, Noakhali District. The chars have their own distinct physical characteristics and have different degrees of development. These Terms of Reference, and consequently the feasibility study reports themselves, will have clearly separate parts, devoted to individual Islands.

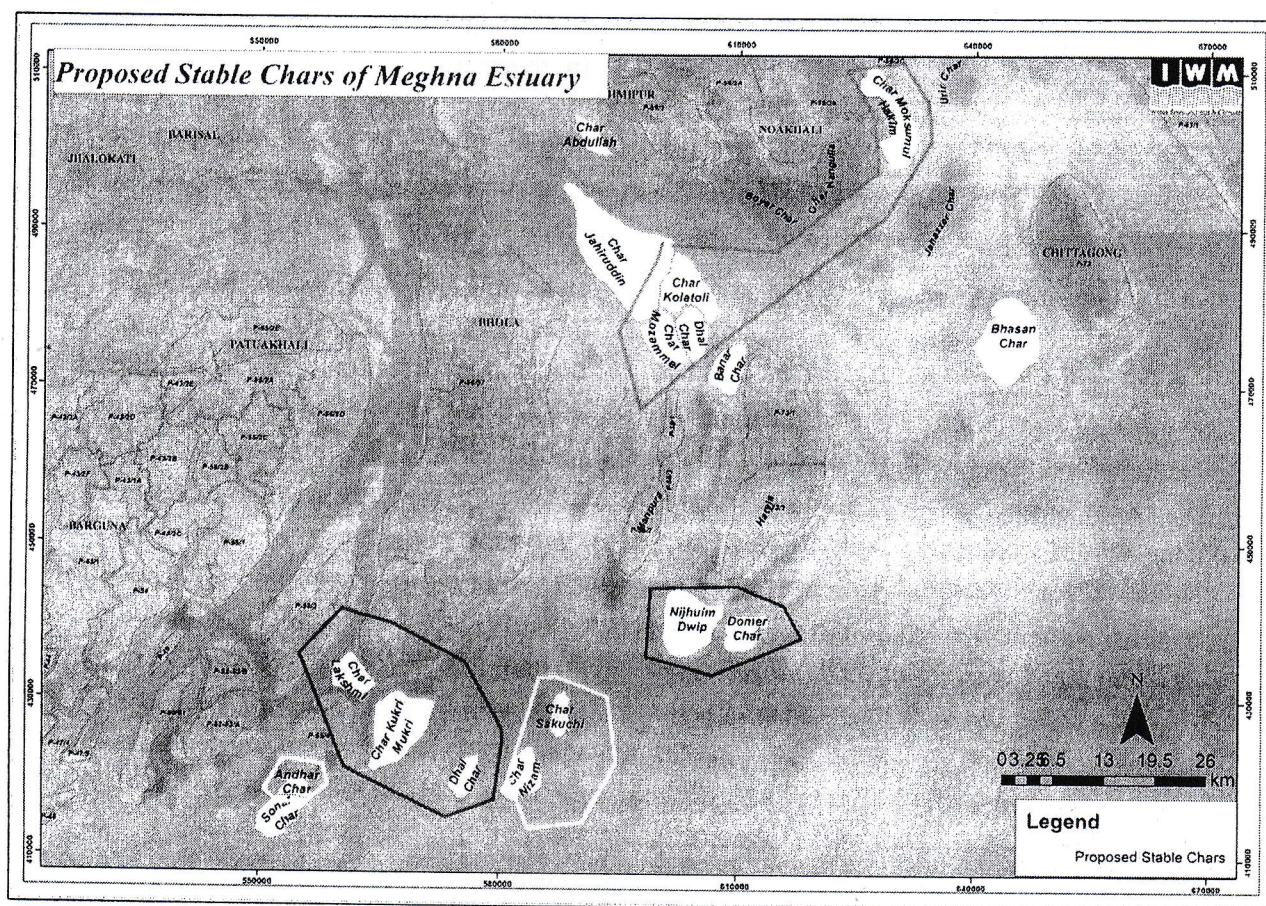


Figure 1.1: Map showing the Study Area with Proposed Selected Stable Chars

### (B) Erosion Risk Management at Boyer Char, Char Nangulia and Noler Char

The Meghna estuary is shaped by complex interactions between physical processes in Bangladesh's coastal zone. Factors affecting the estuary over time include river mouth shifts, base



level changes, natural hazards, and climate change. The yearly sediment discharge into the lower Meghna is around 1100 million tons, with around one fifth (1/5) remaining in the estuary. This is the material for land accretion in the coastal zone (Wilde, 2011)<sup>1</sup>. This estuary's net land accretion rate is roughly 25 km<sup>2</sup> each year, substantially higher than in the past. This stimulates engineering initiatives to get more land, which is desirable for a country like Bangladesh, given the population pressure. Land accumulation helps cope with natural disasters (cyclones, storm surges) and climate change consequences (sea level rise).

CDSP III and CDSP IV area are situated at Noakhali and Chittagong area. The aim of this CDSP project is to develop the different chars at different period. There are many well developed chars are in existence such as Boyer Char, Char Nangulia, Urir char, Jahaizzar char and Noler Char etc. These chars are also morphologically very dynamic and go through active erosion-accretion process. Over the past two decades, the '*Char Development and Settlement Project (CDSP)*' has been implemented in four Southern coastal areas, in four phases (CDSP- I, II, III and IV), cumulatively benefitting over 90,000 ultra-poor and destitute households, or 500,000 people, across the Noakhali, Laxmipur, Feni and Chattogram and part of Bhola Districts of the south-eastern coastal areas of Bangladesh. Noler char, Boyer char and Char Nangulia are the three (3) potential islands. Over the last few years, the bank erosion problem has worsened in the chars under CDSP III and CDSP IV project areas. In these areas, infrastructures like sluices and embankments either have already damaged/eroded or about to damage. Caring Char on the south corner of the CDSP has completely washed away. Sluice DS-2 in Char Nangulia had gone already by the end of 2016. It is observed that the Sluices DS-1 in Caring Char, DS-3 in Noler char were totally washed away. 35% of Boyer Char are already washed out.

Two other sluices in Boyer Char (Tankir Sluice and Gabtoli Sluice) are still doing well, but here the river is also coming close to the structures. In Boyer Char between Tankir Sluice and Chatla Sluice the embankment is washed away over a length of about 1km. Recently a retired embankment was built by BWDB, but this has been also breached already. Total 11.62 km embankment already diminished over the last three years. In the borrow pit channel near Janata Bazar one box culvert collapsed on 18 August 2019. In general, it can be concluded that Boyer Char, Noler Char and Char Nangulia are no longer fully protected from the erosion. The bank erosion does not only destroy the embankments and sluices at the riverbank, but it is also a threat to the infrastructure (embankments, roads and box culverts) in the polders. Thus, understanding, assessing, and predicting the hydro-morphological changes along the riverbanks of CDSP III and IV and a continuing hydro-morphological monitoring system are very important aspects for water resources planning, development and management. Based on the hydro-morphological understanding around the CDSP area, a development of sustainable infrastructure in Boyer char, Noler Char and Char Nangulia are urgently necessary for future sustainable land development and settlement, erosion and drainage management in this dynamic area. Figure 1.2 shows the proposed alignment for 10 years and regulators of Noler Char, Char Nangulia and Boyer Char.

In view of the above, Bangladesh Water Development Board (BWDB) has taken this endeavour to develop above mentioned islands considering the present hydro-morphological condition. As a result, a technical feasibility study is required to develop an integrated development of selected



stable chars and erosion risk management of Boyer Char, Noler Char and Char Nangulia for long-term sustainable improved development plan that is socially accepted and environmentally viable.

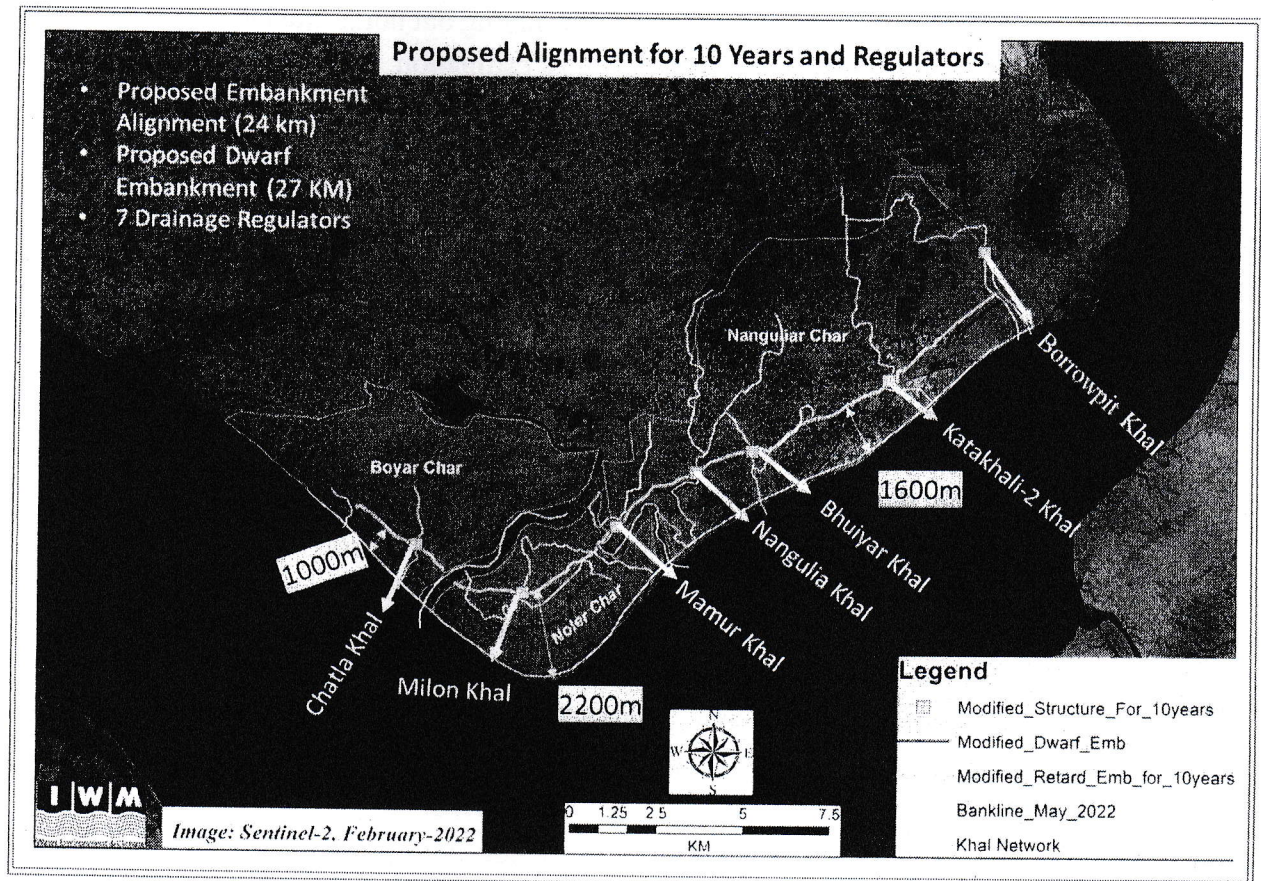


Figure 1.2: Study Area Map

## 2. Objective

The study aimed at planning and design of integrated development program for selected stable chars in the Meghna Estuary namely (i) Char Kolatoli(i/c Ghasier char) (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri & vii) Ghasier Char for integrated development under CDSP V and also to develop an integrated drainage and erosion management plan of Boyer Char, Noler Char and Char Nangulia for long-term sustainable improved development considering technical, social and environmental aspects.

The study therefore has to fulfil the standard rules and guidelines applied by the Bangladesh government in such cases. The study will develop a set of interventions that will contribute to the overall objective of CDSP: to reduce poverty and hunger for poor people living on newly accreted coastal chars, which would be achieved via improved and more secure livelihoods. The specific objectives are as follows:

- To understand prevailing scenario/situation of the Island (and surrounding) area.
- To enlist the development of the char since its emergence (by GO/NGO)
- To understand the morpho-dynamics of the selected Seven (7) chars and surrounding area;
- To understand the Climatic, Hydrological and Hydraulic Characteristics of the selected Seven (7) chars using Numerical Models for existing and proposed scenarios;



- Storm surge and coastal hydrodynamic analysis of the selected Seven (7) chars and Boyer Char, Noler Char & Char Nangulia;
- To devise a drainage improvement plan including but not limited to excavation and design of natural channel, detailed design and cost estimation;
- Plan and design for hydraulic structures and regulators, embankments and khals, detail design and cost estimation;
- Plan and design of multipurpose cyclone shelters, pavement roads, HBB road, etc, detailed design and cost estimation.
- Plan for afforestation to enhance the land accretion;
- Plan for land settlement, homestead, landing ghat, renewal energy, multipurpose cyclone shelter and fish processing zone;
- Plan for dredging/excavated of internal khals;
- Enhance the agricultural productivity by prevent salinity;
- Water supply & sanitation plan, locations of DTW, detailed design and cost estimation;
- Environment and Social impact assessment (ESIA) for proposed interventions;
- Disaster impact assessment and management plan (DIA);
- To develop an Integrated, Comprehensive, Adaptive & Resilient Development Plan of selected STABLE char areas (i) Char Kolatoli(i/c Ghasier char) (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri (vii) Ghasier Char (viii) Boyer Char (ix) Noler Char & (X) Char Nangulia for Integrated Comprehensive Adaptive development under CDSP V
- Plan and detailed design of shoreline erosion management measures for protection of Boyer char, Noler char and Char Nangulia from severe bank erosion and cost estimation;
- Establishment of safe alignment of embankment applying multi-criteria analysis;
- Plan and design of proposed embankment considering climate change, sea level rise, subsidence and cyclonic storm surge event of 25- years; in both cases of existing phases of CDSP and new Polders (Islands) of CDSP V.
- Prepare a short term and long-term development plan including phase-wise implementation;
- Economic & Financial Analysis including estimation of BCR, EIRR, FIRR, NPV of each planning option based on the with and without project situation;

### **3. Methodology**

The preparation of the study should follow these general phases:

- establishing base-line conditions
- identification of possible interventions that will contribute to the abovementioned overall Objective
- analysis of impacts and costs of the interventions
- formulating the overall proposed plan, setting priorities with regard to activities and time tables. Formulation of the proposed Plan(s) should take into consideration of all Government Plans, Rules, Guidelines and The BDP2100 in all respect and follow Adaptive Approach. The

preparation should adapt as much as possible a participative approach, especially with regard to the identification and prioritization of activities. At different stages both the local population and the concerned institutions should be informed about the progress of the work. More methodological issues are included in chapter 2 on the detailed activities to be undertaken.

These Terms of Reference cover the overall feasibility study(s) & Study of Erosion Risk Management at Boyer Char, Char Nangulia and Noler Char. The study will be carried out by a Bangladeshi firm or institute as CONSULTANT, entrusted/ appointed by the Competent Authority to prepare a set of Reports and shall submit the same to the Appointing concerned Authority(s) for their consideration for acceptance whether the required means will be made available and sufficient to implement and facilitate the interventions recommended in the study. Based on these overall Terms of Reference, specific Terms of Reference for the contracted firm or institute and for the TA team are available. If required, the TA team can hire additional staff on a short-term basis to support the study activities.

#### **4. Scope of Works**

The main scope of services to be rendered by the consultant shall include the followings:

##### **4.1 Main features of study area and population:**

An overall picture of the present physical features of the area and the current population in the area should be presented, including the following elements.

- Review of the related reports and Documents especially recent ones on the CZ of Bangladesh, COP27 updates, Al Nino La Nina Scenarios in the Pacific & Indian Ocean
- short description of the development of the char since its emergence
- land levels and land use.
- total population, with number of households and average household size; this should be based on a sample survey of approximately 10%
- the sample survey should also contain questions on main occupations and sources of livelihood of the settlers, landholdings and land tenure system, law and order situation
- the survey should cover as well the status of food security in terms of the number of months that food is available for the different social strata.

##### **4.2 Water management**

The following tasks should be performed as far as water management (and related to that, land suitability) is concerned:

- Make a basic topographic and drainage map for the present situation, based on existing information available with CDSP IV and new topographic (land levels) and hydrographic (cross section khals) measurements. Observations during field visits and interviews will add understanding of the area. This map should clearly identify the drainage units in the considered area, the drainage network, the depth-duration characteristics of the drainage congested areas (if any) and the origin and destination of the drainage waters. Design drainage discharges for each of



the drainage units should be established. The scale of the map should be 1:15000, while the map should show contour-lines with contour-intervals of 10 cm.

- Map the present salinity situation: intrusion and duration of the presence of saline water for concentrations above a selected concentration for rice tolerance (e.g., 8 ds/m). Salinity intrusion is for local settlers a bigger problem than drainage congestion.
- Make flood maps: depth and duration of tidal flooding in critical periods for agricultural practices (for instance transplanting of T. Aman).
- In order to obtain a first impression of the groundwater situation, collect and analyze samples of water produced by the few existing tube wells.
- Based on the above maps and established drainage patterns and discharges: identify bottlenecks and develop interventions (such as, for instance, drainage works and possibly embankments), to overcome these bottlenecks. Give particular attention to the issue of salinity intrusion. Designing an optimal internal drainage system might include shifting the present boundaries with adjacent drainage units, shortening of drainage channels, and cutting across boundaries of drainage units (drainage from and towards other drainage units).
- Make an assessment of the stability of (i) Char Kolatoli (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri Ghasier Char (viii) Boyer Char (ix) Noler Char & (X) Char Nangulia (accretion and erosion patterns); this assessment should cover the development over the last 20 years and a projection for the next 20 years.
- In case any embankment is proposed, the issue has to be discussed with the Project Coordinating Director, CDSP IV and Team Leader of the Technical Assistance team. If they agree to continue with the idea of embankment construction, type and height of embankments have to be established taking into account BWDB practices and experiences. Also, the results of the latest relevant climate change studies have to be considered. If the impression obtained during a field visit is indeed correct, the main purpose of an embankment would be protection of life and property and combating salinity intrusion.
- Make a map clearly showing the location of the proposed interventions, including the drainage network
- Prepare drainage, salinity and flood maps for the situation with interventions.
- Based on the above information: make land suitability maps, indicating the potential for certain cropping patterns and corresponding yields. The practice of agricultural zoning maps applied in CDSP III and IV should be given attention.
- For each type of water management structure, a conceptual design and drawing should be produced.

A cost-estimate of all proposed water management interventions should be made (with reference to **section 20** on cost/benefit analysis); this cost-estimate should take into consideration the increase in rates that is likely to occur in the period till actual implementation of the study recommendations.

#### **4.3 Internal infrastructure**



Although there is not much significant internal infrastructure present in the char, the study team should start with making an inventory and continue with preparing a plan for the development of public infrastructure for the char. The most important type of internal infrastructure for char areas are:

- transport related infrastructure as roads, bridges, culvert and pipe outlet/inlet
- social and economic infrastructure such as multipurpose cyclone shelters, deep tube wells, sanitary facilities, community ponds, killas and clustered villages, fish processing zone/area, landing ghat and markets.
- The infrastructure should be planned for a population that can be expected in future. The size of the future population can be estimated by dividing the total area of khas land available for settlement of landless households by 1.5 acre, being the maximum allocation for each household.
- An estimate of the total numbers of each of the structures should be made. The location of all structures should be clearly identified on a map. The map should also show the proposed road network.
- For each type of infrastructure, a conceptual design and drawing has to be produced.
- The costs of the proposed infrastructure should be estimated (see 2.14), taking into account increase in rates in the period until implementation will take place.

## **5. Detailed Activities**

The main activities to be rendered by the consultant shall include the followings:

### **1. Data collection, survey, and investigation:**

- i) Collect and review of existing data, maps, information and relevant available study reports for understanding of the dynamic erosion/sedimentation phenomena in greater details;
- ii) Collection of secondary data on topography, bathymetry, tide water fluctuation during neap tide and spring tide, tidal parameters, current speed and direction, wind velocity and direction, sediment, discharge at observed stations, wave direction, precipitation, and satellite/sentinel imageries and finding data gaps;
- iii) Carry out topographic, features and bathymetric survey, measurement of water level, discharge, current speed, wave, sediment concentration etc. around the Islands as per standard specifications (ME Survey);
- iv) Perform shoreline characterization surveys for the Chars to assess present condition of the bank line and floodplain by identifying important hydraulic/hydraulic/coastal features, vegetation condition, types of erosion, presence of any previous protection structures and retired embankments, drainage issues and condition and etc.
- v) Analyse the dynamic erosion mechanism in details and demarcate the erosion prone areas along the bank of the selected stable chars;

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- vi) Geotechnical assessment of the existing soil conditions of the Chars.
- vii) Preparation of an inventory of hydraulic structures with the present condition;
- viii) Collect relevant data on available freshwater sources, water quality, salinity, aquifer facilities, etc.
- ix) Detailed analysis of the data to ascertain coastline movement (based on satellite imagery), profile of coast (based on bathymetric data), tidal characteristics, wave, and sediment transport characteristics.
- x) Analysis of time series bathymetric chart and satellite images.
- xi) Data collection from social survey and secondary data collection (Agriculture, Groundwater, Feature Survey etc.)

## **2. Acquisition of satellite image and their analysis:**

- i) Time series satellite images of the study area will be analysed in order to assess the planform changes, bank line shifting characteristics and char movement. Sequential time series of available satellite imageries will provide spatial and temporal changes of the river over the time, recent bank shifting pattern, severity of erosion vulnerability, land loss, bar/char movement, shifting of channels over the years and overall morphological changes;
- ii) Probable bank line shifting of river and char will be predicted based on previous image analysis result in short term, medium term and long term.

## **3. Hydraulic and Morphological analysis using numerical models:**

- i) Development of Hydrodynamic, sediment transport and morphological Model to investigate the tidal characteristics, flow distribution, char & bank erosion, development and variation of current speed & direction at the study area during dry and monsoon seasons; It will also be used to simulate storm surges and analyse probable effects of storm surge on the Char area;
- ii) Flexible grid with coarse grid in the open sea (grid size 2-5km) and fine grid in the selected char areas (grid size 50-100m);
- iii) Model with updated bathymetry online during the calculation to cope with the impact of gradually changing bathymetry on the currents;
- iv) Model will produce proven stable results for calculation periods of at least 20 years.
- v) Sediment transport based on characteristics of sand and mud, including sand-mud interaction;
- vi) Model will have possibility that land is being eroded in the model (no fixed model boundaries at present bank lines and no fixed position of chars)
- vii) Calibration and Validation of the 2-D FM general Hydrodynamic, sediment transport and Morphological Models;
- viii) Develop site specific zoomed hydrodynamic, sediment transport and morphological model of very concerned and intervention sites using 2m-5m grid



to simulate bank erosion and Char development for detailed design of hydraulic structures.

- ix) Simulation of model with different scenario such as considering climate change and interventions;
- x) Long-term forecast of the morphological development around the study area (both bank line and char movement) for 5,10,15 and 20 years;
- xi) Establishment of wave characteristics based on wave model;
- xii) Assessment of storm surge level using numerical models;
- xiii) Impact of future scenarios including Climate change, Sea level rise, future development in the study area including anthropogenic changes/activities.

#### **4. Planning for Char Stabilization**

- i) Identify erosion prone locations;
- ii) Study of selected chars especially around the selected chars for development and maintenance/safety measures of CDSP previous phases using the hydro-morphological model and also develop zoomed hydrodynamic, sediment transport and morphological model of very concerned and intervention sites using 2m-5m grid;
- iii) An assessment of the prevailing and predicted hydro morphology in and around the char(s);
- iv) Plan for mangrove afforestation to enhance land accretion;
- v) Assessment of the available freshwater facilities, water supply and sanitation system and establish a plan for safe water supply sources and sanitation system;
- vi) Design parameters for hydraulic structures and embankment alignments taking into account predicted changes in precipitation and mean sea level related to climate change;
- vii) Identification and assessment of the existing and future salinity condition due to Climate Change of throughout the Chars in order to analyze the agricultural possibilities and probable mitigation measures;
- viii) Assessment of environmental and social conditions in relation to settlement and development;
- ix) Review of existing policies, strategy and guidelines set by GoB related to water sector;
- x) To check the outcomes of this study with national planning and policy of water sector and related sectors.

#### **5. Planning and design of protection works at Boyer Char, Char Nangulia and Noler Char**

- i) Assessment of erosion vulnerability for present and future in times of climate change applying morphological modelling technology;
- ii) Perform necessary coastal analysis from the collected secondary data and/or the hydrodynamic model results (i.e., tidal range and wave uprush analysis);
- iii) Plan and Design of intelligent dredging and appropriate erosion mitigation measures that are needed for stabilization of chars;

- iv) Plan for dredging/ excavation of internal khals and dredged material management
- v) Assessment of impact of the proposed interventions on the surroundings areas including the existing projects adjacent to the project area;
- vi) Assessment of optimization of connectivity by simulating different options;
- vii) Assessment of effectiveness of different options and selection of the best-suited improvement options;

#### **6. Planning and design of protection works and Drainage Regulators:**

- i) Perform meteorological and hydrologic analysis combined with numerical modelling for existing internal drainage system of the Chars.
- ii) Perform hydraulic and hydrodynamic analysis combined with numerical modelling for the existing drainage system of the Chars.
- iii) Analysis of the hydrologic, hydraulic and hydrodynamic model results for designing an efficient and effective internal drainage system and stormwater management for each chars. The proposed drainage system needs to be simulated in the prementioned numerical models in order to evaluate its effectiveness.
- iv) Plan and Design of internal khals/ channel and other relevant structures;
- v) Assessment of the khals excavation volume;
- vi) Assessment of land acquisition for establishing/restoration of internal khals/ channel/river for proper drainage;
- vii) Prepare a plan for beneficiary use and disposal plan of the excavated earth volume;
- viii) Identification of location, dimension and invert level of regulator considering 30years flood return period;
- ix) Assessment of impact of the proposed interventions on the surroundings areas including the existing projects adjacent to the project area;
- x) Plan and design any relevant structures that are needed for stabilization of chars
- xi) Assessment of impact of the proposed interventions on the surroundings areas including the existing projects adjacent to the project area;
- xii) Assessment of effectiveness of drainage regulators
- xiii) Assessment of effectiveness of different options and selection of the best-suited improvement options;

#### **7. Land settlement**

The work on land settlement should focus on the issue of supply and demand: how much khas land is available for distribution among landless households, versus the demand for land from households that have already settled in the area, based on a maximum allotment of 1.5 acre per household.

The following activities have to be undertaken:

- i) Report on the present status of land settlement; provide mouza-wise information on the total area of the mouza, the area that has already been officially settled, the area that is in process of settlement, and the balance of land that is available for future settlement; please note that experience in previous CDSP-projects have



- indicated that around 20-25% of land is required for public infrastructure, and thus cannot be used for settlement of households
- ii) There is an acute border issue between Noakhali- and Bhola district with the area in the Upazila; assess the nature of this conflict and recommend ways to solve the issue, and report on the impact of a land settlement programme in case the issue is not resolved
  - iii) Determine the number of households already settled in the char that have as yet no official land title
  - iv) Determine the possibility of providing the already settled households that have no legal land title with a plot of 1.5 acre
  - v) Assess the possibility of settling additional households that are as yet not present in the area.
  - vi) In addition, a plan for future activities should be developed aimed at facilitating the settlement process. This plan will include an estimate of the involved costs

## **8. Agriculture**

For agriculture, the team is required to:

- i) map the existing cropping pattern, cropped area (cropping intensity) and yields for each of the crops grown in the field;
- ii) describe the present status of homestead gardening
- iii) Analyze the present methods of cultivation, including an assessment of the status of the practice and adoption of modern technologies
- iv) investigate salinity levels (ECE ds/m) of soil and water and their impact on crop production
- v) assess the status of present small scale (such as from ponds) irrigation practices and the future scope for irrigated agriculture
- vi) Analyze the support system, including the extension services currently provided and the supply of agricultural inputs
- vii) assess the current practice of selling agricultural produce
- viii) Analyze the main factors hampering agricultural production, including at homesteads
- ix) develop recommendations to make the cropping patterns more suitable to the char environment, and to increase the cropping intensity and yields; give attention to the possible impact of climate change on coastal agriculture; also formulate recommendations for homestead gardening
- x) make a projection of future cropping intensity and yields, taking into account the suggested interventions with regard to water management and the interventions recommended in this section; while making this projection, makes use of information on results in previous CDSP areas, these are well documented in a number of CDSP-Technical Reports
- xi) make an estimate of the costs of the recommendations for field agriculture and homestead gardening (with reference to the required cost/benefit analysis)

- xii) determine the difference in production and value of that production between the situation before and after the proposed interventions (including the ones related to water management, if any, for field agriculture and homestead gardening).

## **9. Livestock**

With regard to livestock activities in the area, the study will:

- i) review the present situation of the livestock sector (poultry, small ruminants, cattle), including the role of livestock in the household economy
- ii) analyze the production and marketing systems and identify the bottlenecks that impede further development of the sector
- iii) describe the present status of diseases and their treatment
- iv) prepare a plan with recommendations for measures to be taken in support of livestock activities in the char
- v) estimate the costs of the proposed measures regarding livestock development (cost benefit/analysis)
- vi) make an estimate of the increase in livestock production and its value after introduction of the proposed measures.

## **10. Fisheries and aquaculture**

This part of the study has to focus on:

- i) an assessment of the importance of fisheries and aquaculture for the livelihood of settlers in (i) Char Kolatoli (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri, (vii) Ghasier Char (viii) Boyer Char (ix) Noler Char & (x) Char Nangulia Char an analysis of the current production systems (inland fisheries, marine fisheries, aquaculture in ditches and ponds)
- ii) an analysis of the present marketing system (if applicable)
- iii) the development of possible interventions to develop the sector, including the provision of extension services
- iv) an assessment of the impact of the proposed water management interventions, if any on fisheries and aquaculture
- v) estimate the costs of the proposed interventions.
- vi) make an estimate of the difference in fish production and its value between the situation before and after the proposed interventions.

## **11. Social Forestry:**

Forestry has multiple functions in char development (stabilization of land, buffer against tidal surges and storms, promotion of bio-diversity, income creation through involvement of local population). The following tasks have to be undertaken in the framework of this study:



- i) Describe briefly the forestry situation since the emergence of the char area and elaborate upon the present status of forest in the char by making an inventory of the forestry coverage and the presence of any social forestry activities
- ii) Analyze the bottlenecks that have adversely influenced forestry development
- iii) Prepare a forestry development plan for the char area, including road plantation, plantation in homesteads, plantation on the grounds of public institutions, embankment- and foreshore plantation (if applicable); the plan should also assess the possibilities of mangrove plantations including selection of appropriate species on land emerging in areas adjacent to or close to (i) Char Kolatoli (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri (vii) Ghasier Char (viii) Boyer Char (ix) Noler Char & (x) Char Nangulia, make an estimate of the costs of the proposed development plan (see cost/benefit analysis in 2.14)
- iv) make an estimate of the additional production of forest products and its value due to the proposed development plan and of the extra stream of income for the local settlers from their involvement in social forestry activities (with reference to 2.14).
- v) Plan and implement/improve the existing forest belt around the Chars preferably a strip between MSL line up to 1.5 Km inward.

## **12. NGO Component**

The proposed interventions in the study area (all the Chars under the proposed Program) should contain a social- and livelihoods support component, to be implemented by NGO's. This NGO programme will cover the following fields:

- i) Group formation, micro-finance and capacity building
- ii) Health and family planning
- iii) Education
- iv) Water and sanitation
- v) Homestead agriculture and value chain development
- vi) Poultry and livestock
- vii) Fisheries and aquaculture
- viii) Legal and human rights
- ix) Disaster management and climate change (see also 2.13.)
- x) Climate change awareness.

The size of the programme should be based on the expected number of households that will be settled in the study area an estimate of the costs of the overall NGO component has to be made. The required overall cost/benefit analysis, has to include the estimated costs of the economic oriented activities (homestead agriculture, poultry and livestock, and fisheries and aquaculture).

## **13. Governance issues:**

Governance related issues can be seen at three levels

National government agencies: One of the striking features of CDSP is the fact that six governmental departments (BWDB, LGED, DPHE, Ministry of Land, DAE, Forestry



Department) share the objectives of CDSP and closely cooperate and coordinate in undertaking activities. A key coordinating mechanism is the Project Management Committee (in which all six departments are represented). It is the intention that, in case the recommended interventions for (i) Char Kolatoli (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri (vii) Ghasier Char (viii) Boyer Char (ix) Noler Char & (x) Char Nangulia are carried out, the implementation will follow the same arrangement. If proposed activities are beyond the purview of the six departments, the feasibility study team should suggest the modality of implementation recommending appropriate Agency. This will, for instance, be the case for the fisheries and livestock sectors.

Local government level: The study should describe the involvement of local government bodies in the proposed activities in (i) Char Kolatoli (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri (vii) Ghasier Char (viii) Boyer Char (ix) Noler Char & (x) Char Nangulia. More specifically, these bodies are the Upazila Parishads of Hatiya and Monpura and the Union Parishads of Sukhchar (Hatiya UZ) and Monpura (Monpura UZ). The support of all councils would be vital for successful implementation of project activities and should be ascertained. The role of the councils in the activities should be defined.

**Field level institutions:**

- i) An inventory should be made of the community-based organizations that are already present and active in (i) Char Kolatoli (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri (vii) Ghasier Char (viii) Boyer Char (ix) Noler Char & (x) Char Nangulia.
- ii) A plan should be prepared, with a view on the proposed interventions in sections 2.2 to 2.8, of either broadening and strengthening the existing institutions or forming new ones. For each of the types of the proposed institutions the number should be indicated, as well as the size in terms of specific number of members (gender specific)
- iii) Also, for each the role and responsibilities should be spelled out. Special attention should be given to the involvement of the population in mangrove plantation and maintenance through the social forestry approach.
- iv) Costs of all proposed interventions should be estimated

**14. Social impact and impact on livelihoods**

The feasibility study report will clearly indicate what the effect of the proposed intervention is on the social and livelihood situation of the char settlers. One of the main aims of undertaking project activities in (i) Char Kolatoli (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri (vii) Ghasier Char (viii) Boyer Char (ix) Noler Char & (x) Char Nangulia is to contribute to a socio-economic transformation similar to what can be observed in other CDSP areas. This change in livelihoods is well documented (see for instance Technical Report no. 7 of CDSP



III, December 2010, Impact of the Char Development and Settlement Projects I, II and III). In describing and analyzing the expected effects in the study area, the following elements have to be highlighted:

- i) the economic benefits, including access to markets
- ii) the diversification in income
- iii) the employment opportunities
- iv) the level of poverty and food security
- v) the access to social services
- vi) the change in security and vulnerability of the settlers
- vii) the position and status of women

#### **15. Environmental Investigations**

- i) Establishment of environmental baseline conditions: physical and biological;
- ii) Selection Valued Environmental Component (VEC);
- iii) Environmental and social impact assessments and mitigation measures;
- iv) Environmental Management Plan Environmental monitoring program;
- v) Disaster impact assessments and mitigation measures;

#### **16. Environmental Impact:**

A comprehensive Environmental Impact Assessment (EIA) is required for the development of (i) Char Kolatoli (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri (vii) Ghasier Char (viii) Boyer Char (ix) Noler Char & (x) Char Nangulia. This EIA shall be in accordance with the government guidelines, provided in the WARPO Guidelines of 2005. Technical Report no. 19 of CDSP II, Guidelines for Environmental Impact Assessment of CDSP activities, also gives valuable information. The scope of the work should include but not be limited to

- i) review of existing information and identification of environmental issues related to CDSP type of activities
- ii) description of the relevant institutional, legal and policy framework
- iii) collection of baseline data on the present environmental condition
- iv) analysis of the key environmental issues, with a view on the interventions proposed in this feasibility study
- v) analysis of possible, more environment-friendly alternatives
- vi) preparation of an Environment Management Plan, including a mitigation component
- vii) preparation of an Environmental Monitoring Plan
- viii) a cost-estimate of the Environmental Management Plan, of the mitigation measures and of the Environmental Monitoring Plan should be included.

In a concluding section, the EIA should clearly state

- i) the gains which justify implementation of the proposed interventions
- ii) an explanation of how the environmentally adverse effects could be minimized
- iii) provisions for proper follow-up surveillance and monitoring.

#### **17. Impact of climate change**

It is likely that climatic changes will have an impact on the situation on low-lying areas of



coastal Bangladesh. The feasibility study should make an effort to provide insight in what this impact would mean for the proposed development activities in (i) Char Kolatoli (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri (vii) Ghasier Char (viii) Boyer Char (ix) Noler Char & (x) Char Nangulia.

The study should endeavour to reflect on, in general, the influence of climate change on the situation in (i) Char Kolatoli (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri (vii) Ghasier Char (viii) Boyer Char (ix) Noler Char & (x) Char Nangulia. The latest widely accepted reports should be used for this assessment.

More specifically, this section of the feasibility study report should dwell on the impact of climate change on the sustainability (durability) of the proposed interventions (especially with regard to water management, if any, internal infrastructure, agriculture, livestock, aquaculture and forestry).

- i) In addition, concrete consequences for, for instance, design parameters for structures, selection of crop- and fish varieties and similar issues shall be described. On the subject of climate change, a time horizon of 50 years should be applied.
- ii) Recommendations will be formulated if any special measures should be taken to support the settlers in Dhal Char to cope with the consequences of climate change. This could be in the range of raising awareness, support for community-based adaptation to special institutional arrangements to deal with natural disasters.

## **18. Impact/Consequence of Al Nino and La Nina**

Interpretation of Al Nino and La Nina Scenarios in the Pacific and Indian Ocean which may influence Disaster probabilities in the Bay of Bengal, Bangladesh and the Sub-continent.

## **19. Social Investigations**

- i) Questionnaire Survey;
- ii) Focus Group Discussions (FGD);
- iii) Community/local stakeholder Consultations (CC);
- iv) Key Informant Interviews (KII);
- v) Social Impact Assessments and Mitigation Measures;

## **20. Costs and benefits: financial and economic analysis**

An analysis of costs and benefits should be made, paying attention to the following major issues.

- i) Cost estimate of improvement measures;
- ii) Yearly breakdown of cost for DPP;
- iii) Economic and financial analysis;
- iv) Estimation of BCR, EIRR, FIRR, NPV of each planning option based on the with and without project situation;

As far as the *cost* side is concerned, the major cost components in the proposed package of interventions are

- i) costs of water management related infrastructure as excavation/re-excavation of drainage channels and construction of embankments, dwarf embankments, inlet /outlet and sluices



- ii) cost of construction of economic activities related internal infrastructure as roads, bridges, culverts, killas and community ponds
- iii) cost of construction of social facilities (cyclone shelters, deep tube wells, sanitary facilities)
- iv) operation and maintenance (O&M) costs in the period after project completion
- v) costs of recommended interventions as far as agriculture, livestock, fisheries/aquaculture and social forestry are concerned
- vi) cost of land acquisition
- vii) costs of the land settlement plan and implementation
- viii) costs of institutional development measures including capacity building of Stakeholders.

As is normally the practice, the category of the abovementioned social infrastructure does not have to be taken into account in a cost-benefit analysis.

With regard to the benefits, a distinction can be made between social and economic benefits. For the social benefit. As economic benefits can be counted:

- i) an increase in the value of agricultural production through a higher cropping intensity and an increase in yields
- ii) an increase in production of homestead gardening
- iii) a higher production of livestock products
- iv) the creation of an additional stream of income through aquaculture in community ponds and possibly individual ponds
- v) the creation of income for the settlers as a result of the social forestry activities
- vi) a stimulation of general economic activities caused by the abovementioned production increases and supported by the improved transport network (an effort should be made to quantify this benefit).

These economic benefits should form a part of the cost-benefit analysis.

Specific tasks that have to be performed are:

- i) make a selection of the costs that can reasonably be related to the economic benefits
- ii) calculate the total of these economy related investment costs
- iii) calculate the expected economic benefits
- iv) make an estimate of the expected O&M costs
- v) make an estimate of O&M costs and of economic production in the present (without project) situation
- vi) on the basis of these data calculate the Net Present Value NPV, benefit-Cost Ratio, Financial Internal Rate of Return (FIRR) and the Economic Internal Rate of Return (EIRR)

Please note that the methodology applied should be acceptable for the Bangladesh authorities. In this respect the Guidelines prepared by WARPO should be followed and conversion factors to come to economic costs and benefits as approved by WARPO should be used. If any further Guidelines prepared or modified in the meantime by the appropriate Authority may be checked and used/ consulted. The economic life of the proposed project should be assumed to be



20 years.

In CDSP, valuable reports have been published on the subject of cost/benefit analysis. It is strongly recommended to consult these reports while implementing this part of the assignment. See for instance

- i) CDSP Technical Report No. 1
- ii) Technical Report no. 26 (CDSP I), June 1999, The Costs and Benefits of Char Development
- iii) Technical Report no. 18 (CDSP II), September 2005, Cost benefit analysis
- iv) Feasibility study under CDSP III, Economic Analysis of Char Nangulia, Noler Char and Caring Char, March 2008.

## **21. Workshops and Reports**

- i) Workshop and Consultation meeting for disseminating the study results to stakeholder at the study area;
- ii) Preparation of feasibility study report compiling the technical, social, environmental and economic aspects;
- iii) Inception, Interim, Draft Final and Final Report
- iv) ESIA Report
- v) DIA Report

## **6. Expected Outputs**

The study result shall provide the following outputs (a) Feasibility Report for Individual Stable Chars (i) Char Kolatoli (ii) Dal Char (iii) Char Muzammel (iv) Char Maksumul Hakim (v) Nijhum Dwip (vi) Char Kukri-Mukri & (vii) Ghasier Char and a Report on Erosion Risk Management ERM at Boyer Char, Char Nangulia and Noler Char

- Integrated program of interventions for individual new Islands and the ERM of previous phase;
- Spatial plan showing different features of development program for individual areas;
- Erosion vulnerability maps for the study area;
- Critical locations for devising necessary protective measures of the Study areas;
- Plan and design for hydraulic structures and regulators;
- Plan for afforestation to enhance the land accretion;
- Plan for land settlement, homestead, landing ghat, renewal energy, multipurpose cyclone shelter and fish processing zone;
- Design Parameters Hydraulic structures and embankment alignments on the basis of the developed, calibrated and validated recent model results;
- Assessment of concerned sites based on the zoomed hydrodynamic, sediment transport and morphological modeling and analysis
- Prediction of shoreline erosion around all study areas;
- Design of channel/khal for drainage purpose and estimated detail cost;



- Protection of future erosion and deposition zone and its long term consequences;
- Assessing and recommending probable consequences if the protective works fails;
- Long term morphological forecast considering climate change and sea level rise
- Selection of prospective areas for land acceleration;
- Afforestation plan for reduction of coastal erosion as Nature-based Solution;
- Water distribution and sanitation plan and estimated detail cost;
- Complete Implementation Plan of Individual Chars and Erosion Risk Management ERM at Boyer Char, Char Nangulia and Noler Char;
- Implementation Plan;
- Cost estimate of protective work;
- Environmental Impact Assessment (ESIA) and Disaster Impact Assessment; (DIA), Climate Change Impact Assessment CCIA, all together combinedly titled ESIA Report
- Financial and Economic analysis;
- Workshops and
- Reports.

## **7. Duration of the study and milestone reports**

Duration of the Study: The start of the study is 01-06-2023; the duration will be no more **than 10 months**.

**Reporting** Following reports shall be submitted during the study period;

- 15 Copies Inception Report (Char wise), shall be submitted after one month of signing of the contract not later than one month after start of the assignment; the report will elaborate on methodologies and activities and provide detailed man power deployed and working schedule
- 15 (Fifteen) copies of Interim Report (Char wise) shall be submitted reflecting on the progress. It will contain the description and analysis of the present situation regarding all the subjects (including all relevant maps) and, if any, preliminary conclusions and recommendations; the Interim Report has to be submitted not later than four months after start of the assignment. A Draft Final Report; to be submitted not later than ten months after the start of the assignment
- 20 (Twenty) copies Draft Final Report (Char wise), shall be submitted at the end in the 10th month after start of the assignment.
- 20 (Twenty) copies of Final Report (Char wise) shall be submitted at the end or before 12 months of study incorporating the comments and suggestions of BWDB and local stakeholders

All above mentioned reports should follow the structure of these Terms of Reference. The final reports shall be delivered digitally (2 copies) and as hard copies (50 copies).

## **8. Workshop**

Workshop/dissemination programmes shall be arranged in close cooperation with the field officials of BWDB to disseminate and share the study results.

- i) Workshop and consultation meeting for disseminating the study results to stakeholder at the study area and or at Dhaka office as decided by the competent Authority;



- ii) Preparation of feasibility study reports compiling the technical, social, environmental and economic aspects and disseminate in Workshop;
- iii) Dissemination of Inception, Interim, Draft final Report and ESIA Report through workshop in places (Noakhali/Dhaka) as desired by the competent Authority.

### **Relation with Bangladesh 8<sup>th</sup> 5-year plan**

The project is relevant with article 4.6 managing water resources management focusing on coastal zone protection and management and climate change.

Article 4.6.3 Strategies for Water Resource Management in 8th Plan focused on “Development and improvement of embankments, barriers and water control structures” and “Strengthening River and estuaries management in the newly accreted char areas”.

### **Relation with Perspective Plan of Bangladesh 2021-2041:**

Two principal visions underpin the Perspective Plan 2041: (a) Bangladesh will be a developed country by 2041 and (b) Poverty will become a thing of the past in Sonar Bangla. The main objectives of CDSP-V are to reduce poverty for poor people living on newly accreted coastal chars, which would be achieved via improved and more secured livelihood. Security for people and livelihood would be provided via climate resilient infrastructures and by providing poor households with legal title to land including women empowerment. So, the project objectives completely aligned with the 2<sup>nd</sup> vision of Perspective Plan of Bangladesh 2021-2041.

### **Relation with Bangladesh Delta Plan 2100**

Bangladesh Delta Plan 2100 (BDP 2100) has been formulated with a perspective of a holistic, integrated and inclusive development of the country. BDP 2100 emphasizes on land reclamation under its “Goal 3: Ensure Sustainable and Integrated River Systems and Estuaries Management”. According to the plan, land reclamation is vital for Bangladesh since land is scarce in Bangladesh and issues like food security, housing, infrastructure building, industrial development mostly depend on it. Moreover, BDP 2100 identified six hotspots and “River Systems and Estuaries” and “Coastal Zone” are two of them. The Project area covers these two major Strategies. It identified land reclamation as an important strategy for development of these two hotspots. According to “Strategy CZ 3: Reclaim New Land in the Coastal Zone” of BDP 2100 along with its sub-strategies: CZ' 3.1: Conduct research on morphological behaviour of the Meghna estuary to assess the effect and potential of land reclamation, CZ” 3.2 Accelerate land reclamation process in the Meghna estuary’ and CZ” 3.3 Protection, development and zoning of reclaimed land. Meghna Estuary has huge potential for reclamation of new land by sediment management and accelerating the pace of accretion by physical interventions. Onward these can be converted to safe settlement areas especially for erosion victim landless population.

Further the Strategic Plan prepared by CDSP IVB translated the Vision, Mission Goals and Strategies into action or activities to achieve the national level goals and micro-level or project level goals.



These actions will be presented in the project form to be implemented in and around the Meghna Estuary which will include:

- Multipurpose development of stable, publicly accessible and safe chars by impoldering.
- Acceleration of accretion processes in prospective areas for land reclamation.
- Protection of land and settlement at risk of erosion through appropriate measures
- Multipurpose development of stable, publicly accessible and safe chars by impoldering.

## **9. Staffing and organization**

### **9.1 Guidance and monitoring of the feasibility study team**

Supervision of the feasibility study and coordination with other government institutions and non-governmental organizations will be in the hands of the CDSP IV Project Coordinating Director (of BWDB) and the Team Leader of the Technical Assistance team. The study will be carried out in close consultation and with full cooperation of the CDSP IV project staff, both from the government implementing agencies and the Technical Assistance team. At least once a month meeting will be held to monitor progress and more often when deemed necessary. Monitoring Team(s)/Individual Professional(s) may visit/monitor/participate field/office activities as and when required or desired while the CONSULTANT shall cooperate them in all respect. Consulting Team members shall enjoy the opportunity to discuss over telephone/ by person / in pre fixed meetings as and when necessary for any decision making purpose or any issue arises during the Study period.

### **9.2 Staffing the Team**

The study will be carried out by a team of experienced professionals in the following areas showing maximum duration of their involvement, minimum educational requirement and reference to the description of their task

## **10.Key Personnel and Qualifications**

### **10.1 Key Personnel**

The proposed study may require **183 person-months** of local professional input. The estimated consultants staffing requirements are presented in the Table 10.1.

*Table 10.1: List of Key Professionals*

SI No.	Position	Nos.	Month	Man-month
1	Team leader	1	10	10
2	Deputy Team leader	1	7	7
3	Coastal and Estuarine Expert	1	8	8
4	Senior Water Management Specialist	1	6	6
5	Senior Design Specialist	1	8	8
6	Senior Hydro-morphologist	1	6	6
7	Hydrodynamic Modeller	1	6	6

8	Morphological Modeller	1	6	6
9	Drainage Management Specialist	1	8	8
10	Mid Level Design Specialist	1	7	7
11	Storm Surge Modelling Specialist	1	6	6
12	Survey Specialist	1	6	6
13	Resettlement Specialist	1	5	5
14	Land acquisition expert	1	6	6
15	Junior Design Engineer	2	7	14
16	GIS and RS Specialist	2	4	8
17	People Participation Expert	1	6	6
18	Disaster Risk Management Specialist	1	6	6
19	Fisheries Expert	1	4	4
20	Forest Expert	1	4	4
21	Environmental Specialist	1	6	6
22	Water Supply and Sanitation Specialist	1	3	3
23	Ecologist	1	4	4
24	Agronomist	1	3	3
25	Economist	1	6	6
26	Junior Engineer/Data Analyst	3	8	24
	Total (A)	30	156	183

## 10.2 Experience and Qualification of Key Personnel

In total **183 man-months** of professional inputs shall be estimated to carry out this study. The team leader can also take another key personnel role. The following table gives an estimate of man-month requirement for different professionals:

Discipline	Qualifications and Tasks
<b>(1) Team Leader</b>	<p>Master's degree in civil engineering/ Water Resources/ Hydraulic Engineering. He/she should have at least 20 years of work experience in the river, estuarine and coastal dynamics and working experience in the management and supervision of study, modelling and survey teams. He/she should have at least 15 years' experience in river and coastal modelling and leading a multi-disciplinary team as team leader.</p> <p><b>Tasks:</b></p> <p>His/her major responsibilities shall include but not necessarily be limited to the following:</p> <ul style="list-style-type: none"> <li>• Take full responsibility for all aspects of planning, liaison and reporting;</li> <li>• Guide and lead the modelling, survey and multi-disciplinary study teams;</li> <li>• Take necessary steps to collect existing data from external sources and surveyed data from BWDB;</li> <li>• Arrange interaction meeting with the BWDB personnel and the consultant to develop different option scenarios;</li> </ul>



Discipline	Qualifications and Tasks
	<ul style="list-style-type: none"> <li>• Attend meeting as and when required by the designated representative of BWDB;</li> <li>• Take responsibility for the quality of data monitoring;</li> <li>• Analyse and interpret the mathematical modelling results;</li> <li>• Contribute to all the reports; and</li> <li>• Finalise the study outputs incorporating the comments from different organization.</li> </ul>
<b>2) Deputy Team Leader</b>	<p>Masters' degree in Coastal/Civil/ Water Resources Engineering having a minimum of 20 years of professional experience with at least 15 years' experience on river morphology, coastal and estuarine morphology, tide, wave and storm surge modelling, climate change impact assessment. Polder water management, tidal river management, erosion protection, previous experience in similar working environment will be preferred</p> <p><b>Tasks:</b></p> <p>His/her major responsibilities shall include but not necessarily be limited to Support the Team Leader in the following and play role of Team Leader in his absence:</p> <ul style="list-style-type: none"> <li>• Review of past study reports</li> <li>• Assist the team to carry out morphological studies, prediction of estuarine and river morphology;</li> <li>• Supervise and guiding the team for morphological impact assessment of various future development strategies for CDSP area;</li> <li>• Guiding field data collection, quality assurance, database development</li> <li>• Guide and supervise the morphological modelling activities</li> <li>• Assist in formulate future monitoring plan</li> <li>• Assist team leader in preparation of different reports, organizing workshops and maintaining Liaison with client and different stakeholders</li> </ul>
<b>3) Coastal and Estuarine Expert</b>	<p>Master's degree in civil engineering/Water Resources/Hydraulic Engineering. He/she should have at least 15 years of work experience in the river, estuarine and coastal dynamics and working experience in the management and supervision of study and survey teams. He/she should have at least 10 years' experience in numerical modelling.</p> <p><b>Tasks:</b></p> <p>His/her major responsibilities shall include but not necessarily be limited to the following:</p> <ul style="list-style-type: none"> <li>• Take full responsibility for all aspects of planning, liaison and reporting;</li> <li>• Guide and lead the modelling study team;</li> <li>• Take necessary steps to collect existing data from external sources and surveyed data from BWDB;</li> <li>• Arrange interaction meeting with the BWDB personnel and the consultant to develop different option scenarios;</li> </ul>

Discipline	Qualifications and Tasks
	<ul style="list-style-type: none"> <li>• Attend meeting as and when required by the designated representative of BWDB;</li> <li>• Take responsibility for the quality of data monitoring;</li> <li>• Analyse and interpret the mathematical modelling results;</li> <li>• Contribute to all the reports; and</li> <li>• Finalise the study outputs incorporating the comments from different organization.</li> </ul>
<b>4) Senior Water management Specialist</b>	<p>Minimum Master degree in Civil Engineering/Water Resources/Hydraulic Engineering. He/she should have at least 15 years of work experience in the river, estuarine and coastal dynamics and working experience in the management and supervision of study and survey teams. He/she should have at least 10 years' experience in Planning integrated water resources management projects.</p> <p><b>Tasks:</b> His/her major responsibilities shall include but not necessarily be limited to the following:</p> <ul style="list-style-type: none"> <li>• Review of the river systems and available data;</li> <li>• Carry out Water Resources Baseline, Impact and EMP write-up;</li> <li>• Incorporating study results from component-1 of the project;</li> <li>• Contribute in preparing the reports of the study and workshop materials.</li> <li>• Comparison of the alternatives and find out the suitable solutions</li> <li>• Preparation of different reports as required for the proposed study</li> <li>• Maintain liaison with BWDB and other related agencies</li> <li>• Assist in preparation of Final report containing all the requirement of BWDB for the feasibility study.</li> </ul>
<b>5) Senior Design Specialist</b>	<p>Minimum Master degree in Civil Engineering/Water Resources/Hydraulic Engineering. He/she should have at least 15 years of work experience in the river, estuarine and coastal dynamics and working experience in the management and supervision of study and survey teams. He/she should have at least 10 years' experience in designing hydraulic structures, bridges, road, culverts, cyclone shelters etc.</p> <p><b>Tasks:</b> His/her major responsibilities shall include but not necessarily be limited to the following:</p> <ul style="list-style-type: none"> <li>• Design of the alternative structures recommended for the solutions to stabilize the chars.</li> <li>• Preparation of cost estimates of the structures on the basis of recent actual schedule of rates, including annual expenditure schedules</li> <li>• Comparison of the alternatives and find out the suitable solutions</li> <li>• Preparation of different reports as required for the proposed study</li> <li>• Maintain liaison with BWDB and other related agencies</li> </ul> <p>Assist in preparation of Final report containing all the requirement of BWDB for the feasibility study.</p>



Discipline	Qualifications and Tasks
<b>6) Senior Hydro-Morphologist</b>	<p>Minimum B.Sc. in Civil /Water Resources Engineering with 15 years' experience. Master's' Degree or Equivalent will be preferable with minimum 10 years professional Experience; in both cases, including Hydrology and Coastal Morphology with comprehensive intellectual and professional knowledge and skill. Experience in the Tidal River, Estuary and Coastal Morphology &amp; coastal Zone management.</p> <p>Tasks:</p> <p>His/her major responsibilities shall include but not necessarily, be limited to:</p> <ul style="list-style-type: none"> <li>• Identify the present morphological process in tidal environment</li> <li>• and erosion-deposition pattern of the project area.</li> <li>• Develop morphological/sediment transport/mud transport model</li> <li>• Establish baseline morphological behaviour based result and available data</li> <li>• Assess the movement of chars and bank line shifting</li> <li>• Assess the new, chars and forecast the morphological changes for 5, 10, 15 and 20 years;</li> <li>• Contribute in preparing the report of the study and workshop materials</li> <li>• Attend meeting as and when required</li> </ul>
<b>7) Hydrodynamic Modeller</b>	<p>Minimum Master degree in Civil Engineering/Water Resources/Hydraulic Engineering. He/she should have at least 15 years of work experience in the river, estuarine and coastal hydrodynamics modelling and working experience in the management and supervision of study and survey teams. He/she should have at least 10 years' experience in MIKE21/Delft3D Flexible Mesh Hydrodynamic modelling system.</p> <p>Tasks:</p> <p>His/her major responsibilities shall include but not necessarily be limited to the following: -</p> <p>Establish a baseline condition on tide, tidal current, Flow distribution, and other driving forces at area of interest;</p> <p>Develop and simulate different scenarios;</p> <p>Interpret hydrodynamic model results;</p> <p>Development of different options for erosion mitigation measures and development of new chars;</p> <p>Review of alignment of peripheral embankment around the chars in terms of wave action and storm surge;</p> <p>Attend interaction meeting with the officials of BWDB;</p> <p>Maintain liaison required with other agencies;</p> <p>Prepare reports to a standard format acceptable to Client;</p> <ul style="list-style-type: none"> <li>• Collect and incorporate comments on final reports.</li> </ul>

Discipline	Qualifications and Tasks
<b>8) Morphological Modeller</b>	<p>Minimum B.Sc. in Civil /Water Resources Engineering, Masters' degree is preferable with minimum 15 years' professional experience in hydraulics and Coastal morphology with comprehensive intellectual and professional knowledge and skill. Experience in the tidal river/coastal zone morphology is preferable. Must have experience in Morpho dynamic Modelling specially focused on Meghna Estuary.</p> <p><b>Tasks:</b> His/her major responsibilities shall include but not necessarily be limited to:</p> <ul style="list-style-type: none"> <li>• Must have experience in Morphodynamic Modelling specially focused on Meghna Estuary</li> <li>• Identify the present morphological process in tidal environment and erosion-deposition pattern of the project area</li> <li>• Develop morphological/sediment transport/mud transport model</li> <li>• Establish baseline morphological behaviour based on model result and available data</li> <li>• Assess the movement of chars and Bankline shifting</li> <li>• Assess the new chars and forecast the morphological changes for 5, 10, 15 and 20 years;</li> <li>• Contribute in preparing the report of the study and workshop materials</li> </ul> <p>Attend meeting as and when required</p>
<b>9) Drainage Management Specialist</b>	<p>He/she should have Master's Degree in Civil /Water Resources Engineering with minimum 12 years of work experience including at least 5 years' experience in drainage/polder modelling with Hydraulic modelling system and Management/Monitoring. His/ Her major responsibility shall include but not necessarily be limited to the following:</p> <p><b>Tasks:</b> His/her major responsibilities shall include but not necessarily be limited to:</p> <ul style="list-style-type: none"> <li>• Review of existing drainage condition of the chars;</li> <li>• Prepared the base condition with 1D modelling system;</li> <li>• Development of different options for proper drainage;</li> <li>• Analysis of rainfall-runoff using metrological data;</li> <li>• Establishment of design parameter for different sluices or hydraulic structures;</li> <li>• Contribute in report writing; and</li> <li>• Guide and assist the team members of the study team.</li> </ul>
<b>10) Mid-level Design Specialist</b>	<p>Master's degree in Civil Engineering/Water Resources Engineering, preferably a postgraduate degree in relevant field. He/she should have at least 12 years of experience in design, construction, supervision and O&amp;M of river and coastal protection, hydraulic structures, bridges, road, culverts, cyclone shelters etc.</p>



Discipline	Qualifications and Tasks
	<p><b>Tasks:</b> His/her major responsibilities shall include but not necessarily be limited to the following:</p> <ul style="list-style-type: none"> <li>• Establish design criteria using different design guidelines;</li> <li>• Designing of alternative protective measures;</li> <li>• Developed design specifications and drawing;</li> <li>• Cost estimate of different protective measures;</li> <li>• Contribute in report writing; and</li> <li>• Assist the Senior Design Specialist in coordinating the study</li> </ul>
<b>11) Storm Surge Modelling Specialist</b>	<p>Master Degree in, Civil Engineering/Water resource Engineering/Hydraulic Engineering. He/she should have 12 years of working experience in the field of river hydraulics with at least 5 years' experience in numerical modelling specially in Cyclone model. Previous experience in similar environment will be preferred.</p> <p><b>Tasks:</b> His/her major responsibilities shall include but not necessarily be limited to:</p> <ul style="list-style-type: none"> <li>• Review of available data and reports;</li> <li>• Analyse the cyclone data;</li> <li>• Interpret model results in accordance with the requirement of BWDB.</li> <li>• Assessment of storm surge level for different return period around the proposed area;</li> <li>• Assessment of embankment crest level for fifty/hundred-year return period considering storm surge level and cyclonic wave;</li> <li>• DIA for storm surge</li> </ul> <p>Contribute to report writing</p>
<b>12) Survey Specialist</b>	<p>B.Sc. Degree in Civil Engineering/ Water Resources Engineering/ Survey/ Geomatics Engineering or any other relevant field or equivalent experience in addition of 10 working experience in the related field. He/She should have knowledge in hydrographic survey in the river and estuary, on DGPS and or RTK positioning system, survey software (e.g. HYPACK) and discharge measurement using ADCP. Experience in similar environment will be preferred.</p> <p><b>Tasks:</b> His/her major responsibilities shall include but not necessarily be limited to:</p> <ul style="list-style-type: none"> <li>• Assist Team Leader in planning the hydrographic survey and hydrometric data collection;</li> <li>• Quality control of all hydrographic surveys, data collection &amp; processing, quantification of dredging volume;</li> </ul>

Discipline	Qualifications and Tasks
	<ul style="list-style-type: none"> <li>• Quality control of any other survey (water level, water flow, sediment concentration, land level survey, bank survey and so on) and data processing;</li> <li>• Planning, supervise and conduct hydrographic surveys and land level surveys required for the detailed design of bank protection works, water control structures etc.</li> <li>• Assist Team Leader to finalize survey reports;</li> <li>• Miscellaneous related task as and when required;</li> <li>• Attend meetings with the client, contractor and other stakeholders as and when required;</li> </ul>
<b>13) Resettlement Specialist</b>	<p>Master's Degree in Sociology/ Social Science or equivalent. S/He should have minimum 12 years of working experience with minimum 5 years' experience in the relevant field. The Resettlement Specialist will have to work with communities and stakeholders to plan and design programs to resettle people displaced by infrastructure projects such as sea dykes, and sluices in the project areas. Overall, the Land Resettlement Specialist will have to play a critical role in ensuring that displaced communities are resettled fairly, just, and equitably and that their rights and interests are protected throughout the process according to the country's law. His/her tasks include:</p> <p><i>Tasks:</i></p> <ul style="list-style-type: none"> <li>• Prepare Resettlement Action Plan and framework considering social safeguard, livelihood, peoples' participation etc.;</li> <li>• Intensive Field visit for collecting views of the local people, their present socio-economic activities and problems including present situation in the vicinity of Project Area;</li> <li>• Holding interaction meeting with the stakeholders at field level holding Focus Group Discussion (FGD), Target Group Discussion (TGD) and work-shops/seminars at field level to find out the desired goal of the study and to disseminate the results.</li> <li>• Conducting social and economic impact assessments to determine the potential impacts of the resettlement program on affected communities and developing strategies to mitigate negative impacts.</li> <li>• Developing resettlement plans and resettlement framework that meet international best practices and comply with applicable laws and regulations in the country.</li> <li>• Engaging with communities and stakeholders ensures their concerns are heard and addressed throughout the resettlement planning process.</li> <li>• Assessing budgets and resources allocated for the resettlement program and ensuring all activities are included in the Resettlement plan and Resettlement framework.</li> </ul>



Discipline	Qualifications and Tasks
	<ul style="list-style-type: none"> <li>• Ensuring the resettlement program complies with all applicable laws and regulations, including environmental and social safeguards.</li> <li>• Find-out the conflicting issues, conduct motivational works among the stakeholders against any negative issue and to suggest mitigation measures.</li> <li>• Assist the study team in holding seminars, work-shop and preparing reports.</li> </ul>
<b>14) Land Acquisition Specialist</b>	<p>Minimum Master's degree in Social Welfare/Sociology or equivalent with minimum 12 years' experience in relevant field. Higher degree and experience in relevant field will be preferred. The Land Acquisition Specialist must have excellent negotiation, communication, and organizational skills and a strong understanding of legal and regulatory requirements related to land acquisition. His/her major responsibilities shall include but not necessarily be limited to the following:</p> <p>Tasks:</p> <ul style="list-style-type: none"> <li>• Demarcation of the existing acquired land/disputed land (if any) on CS/RS map under the project area;</li> <li>• Identifying potential land areas/plots for acquisition based on project requirements and goals.</li> <li>• Conducting a preliminary survey to gather plot information/status about the land, including zoning regulations, environmental restrictions, and other legal requirements according to "The Acquisition &amp; Requisition of Immovable Property Act, 2017."</li> <li>• Negotiating with landowners, government agencies, and other stakeholders to acquire land.</li> <li>• Preparing the concept of the draft proposal for acquisition.</li> <li>• Coordinating with other departments and stakeholders, such as surveyors and engineers, to ensure that all necessary documents and approvals will be available.</li> <li>• Prepare budgets and timelines for land acquisition proposals.</li> <li>• Ensuring compliance with applicable laws and regulations under "The Acquisition &amp; Requisition of Immovable Property Act, 2017."</li> <li>• Participating in public meetings and hearings to address concerns and questions related to land acquisition proposals where necessary.</li> <li>• Analysing and interpreting the data on CS/RS map;</li> <li>• Formulate a Land Acquisition Plan (LAP) for project components using Mouja maps;</li> <li>• Attending meeting as and where required;</li> <li>• Maintain liaison with required other agencies;</li> <li>• Assisting team leader in co-ordinating the study</li> </ul>

Discipline	Qualifications and Tasks
<b>15) Junior Design Engineer</b>	<p>Bachelor's in Civil Engineering/Water Resource Engineering or relevant field. Candidate should have professional experience of 8 years preferably in the field of environmental studies. Major tasks are as follows:</p> <p><i>Tasks</i></p> <ul style="list-style-type: none"> <li>• Establish design criteria using different design guidelines;</li> <li>• Designing of embankments, regulators, different hydraulic structures, bridges, culverts, road, cyclone shelters, alternative protective measures, etc;</li> <li>• Developed design specifications and drawing;</li> <li>• Cost estimate of different protective measures;</li> <li>• Contribute in report writing; and</li> <li>• Assist the Senior Design Specialist in coordinating the study</li> </ul>
<b>16) GIS and RS Specialist</b>	<p>Master's degree in Civil Engineering/Urban and Rural Planning/Hydrology/Geography. He/she should have at least 8 years' experience in producing GIS coverage, Contour map, Digital Elevation Model.</p> <p><i>Tasks:</i></p> <ul style="list-style-type: none"> <li>• Prepare ArcView based maps for erosion and depositions and bank-line migration map from historical satellite imageries; and</li> <li>• Assist the study team in preparing maps, charts in connection with the reports.</li> </ul>
<b>17) People's Participation Expert</b>	<p>Masters in Sociology/Statistics from a recognised University of Bangladesh. He /She should have at least 12 years' experience in sociological activities &amp; field survey, i.e interaction with the stakeholders, holding Focus Group Discussion (FGD), Target Group Discussion (TGD) and work-shops/seminars at field level to find out the desired goal of the study and to disseminate the results of the study.</p> <p><i>Tasks:</i></p> <ul style="list-style-type: none"> <li>• Responsible for covering the socio-economic aspects of the baseline study and selection of important social components (IECs) which are likely to be impacted by the specified project</li> <li>• Design and plan need assessment and PRA surveys of communities in the project area</li> <li>• Study and field data collection for identification of disadvantaged group/ affected people</li> <li>• Identification of future probable social negative impacts and social imbalance in project area</li> <li>• Quantification of the area under territory now have been occupied by local people with nature of the land use by them. (i.e agriculture, fisheries, brick field, permanent structures etc.)</li> <li>• Mitigation measure of evicted people from land and professionally disturbed people.</li> </ul>



Discipline	Qualifications and Tasks
	<ul style="list-style-type: none"> <li>To assist the study team in preparation of maps for workshops and reports etc.</li> </ul>
<b>18) Disaster Risk Management Specialist</b>	<p>Master's degree in climate or environmental science and related field. At least 12 years of experience in undertaking climate and disaster risk assessment in Bangladesh, and in-depth familiarity with climate and geophysical hazard issues and assessments undertaken in Bangladesh.</p> <p><b>Tasks:</b></p> <ul style="list-style-type: none"> <li>supporting the team leader and deputy team leader</li> <li>working in close collaboration with GIS expert in undertaking climate risk and adaptation assessment for the CDSP study area through the collection of necessary information and data and undertaking analysis;</li> <li>leading the support to local governments in integrating climate risk considerations in Char development plans;</li> </ul> <p>undertake raising activities for stakeholder / governments to raise awareness on climate and disaster risk by developing area specific profiles.</p>
<b>19) Fisheries Expert</b>	<p>The consultant must have a Master's Degree in Fisheries/Zoology/Environmental Science or relevant natural sciences. He/She preferably has 12 years of or longer experience in professional work experience. The experience must include the preparation of EIA or IEE, preferably for water resources management projects.</p> <p><b>Tasks:</b></p> <p>His/her major responsibilities shall include but not necessarily be limited to:</p> <ul style="list-style-type: none"> <li>Collect the inventory of fish species and fish habitats found in the study area;</li> <li>Fishermen and fish market survey for establishing the baseline conditions;</li> <li>Detect adverse impacts of project intervention on fisheries resources;</li> <li>Suggest mitigation measures and monitoring plan for minimizing the negative impacts of the project activities on the fisheries resources;</li> <li>Assist the team leader in formation of reports and presentations.</li> </ul>
<b>20) Forest Expert</b>	<p>He/she will have a minimum Bachelor Degree in Forestry/Agriculture/Agronomy with minimum 12 years' experience including at least 5 years working experience in water sector/similar nature project including that of conducting EIA.</p> <p><b>Tasks:</b></p> <p>His/her major responsibilities shall include but not necessarily be limited to:</p> <ul style="list-style-type: none"> <li>Plan for social forest in the reclaim land</li> <li>for assessing impacts of reviving the rivers on land resources and agricultural</li> </ul>

Discipline	Qualifications and Tasks
	<ul style="list-style-type: none"> <li>practices including cropping pattern, agricultural input use and crop production</li> <li>Suggest measures for mitigation plan, enhancement plan and monitoring plan in respect of land resources and agricultural practices</li> </ul>
<b>21) Environmental Specialist</b>	<p>He/ she should have M.Sc in Civil/ Water Resources/ Environmental Engineering/Environmental science with Minimum 12 years working experience in Environmental Impact Assessment and reporting .</p> <p><b>Tasks:</b></p> <p>His/her major tasks include but not limited to the following:</p> <ul style="list-style-type: none"> <li>Interact with the environmental, water and GIS specialists for development of maps of the coastal and river systems and other features Interact with research institutes and extension officials regarding the model results and tuning of parameters.</li> <li>Establish baseline condition of physical environment.</li> <li>Assess the impacts on physical environment.</li> <li>Develop water and environment management plan to mitigate the potential impacts due to different interventions;</li> <li>Develop a plan of action for implementing pollution control measures;</li> <li>Involve in preparation of report.</li> </ul>
<b>22) Water Supply and Sanitation Specialist</b>	<p>Master's degree degree in Civil /Water Resources Engineering and preferably a post-graduate degree in relevant field. He/she should have 12 years of experience on hydro logical analysis and hydrological modelling. S/He will work with Morphological Expert, help him to give input of all necessary primary and secondary information and assist in evaluating expected outputs.</p> <p><b>Tasks:</b></p> <p>His/her major responsibilities shall include but not necessarily be limited to:</p> <ul style="list-style-type: none"> <li>Review of the river systems and available data;</li> <li>Development of hydrological and hydrodynamic model for khal, regulator and river systems;</li> <li>Simulate hydrological and hydrodynamic conditions of river, khal and regulators;</li> <li>Establish design parameters from simulation results</li> <li>Design and planning of DTW and requirement and distribution of sanitary facilities.</li> <li>Analysis simulation results;</li> <li>Contribute in preparing the reports of the study and workshop materials.</li> </ul>
<b>23) Ecologist</b>	<p>Master's in Fisheries / Agriculture / Environmental Science / Zoology / Ecology / other natural sciences. He/She preferably should have 12 years or longer experience in the related fields. The experience must include the preparation of EIA/IEE, preferably for dredging and water infrastructure development projects.</p>



Discipline	Qualifications and Tasks
	<p><b>Tasks:</b> Major tasks are as follows:</p> <ul style="list-style-type: none"> <li>• Identification of terrestrial flora/fauna.</li> <li>• Describe breeding/ spawning behaviors and migratory patterns of aquatic and terrestrial fauna.</li> <li>• Identification of aquatic and terrestrial habitat types.</li> <li>• Inventory of aquatic and terrestrial wildlife.</li> <li>• Conservation significance of species recorded.</li> <li>• Describe existing land use pattern, threats to wildlife.</li> <li>• Identify impacts on ecology and ecosystem and suggest appropriate mitigation measures.</li> </ul> <p>Report writing and preparation of EIA/EMF/EMP</p>
24) Agronomist	<p>He/she will have a minimum Bachelor Degree in Agriculture/Agronomy or Master's Degree in Soil Science with minimum 8 years' experience including at least 5 years working experience in water sector/similar nature project including that of conducting EIA.</p> <p><b>Tasks:</b> His/her major responsibilities shall include but not necessarily be limited to:</p> <ul style="list-style-type: none"> <li>• Establish baseline condition in respect of land resources and agricultural</li> <li>• Collection and analysis of existing agricultural data and information (Land ownership, irrigated area, cultivated area with crops and yields, crop damaged area etc.) from secondary sources</li> <li>• Carry out comparative study between present agriculture and level of production with the projected future to assess the financial and economic feasibility of the project</li> <li>• Assessment of present agricultural situation with areas and cropping patterns based on soil type and fertility status, farming practices those influences the present cropping patterns, present cost of cultivation, availability livestock, and draft power, present irrigation use and method of application, present availability of extension services, present average yield per hectare, present use of fertilizer and pesticides</li> </ul>
25) Economist	<p>He/she should have at least Masters' degree in economics with minimum 12 years' experience including at least 5 years' experience in economic appraisal of water resources and dredging projects. A significant portion of this experience may also include natural resources management, physical and monetary valuation of possible environmental impacts. Higher Degree &amp; experience in relevant field will be preferred.</p> <p><b>Tasks:</b> His/her major tasks include but not limited to the following:</p> <ul style="list-style-type: none"> <li>• Elaboration of the cost estimates; administration costs and tax and duties shown as separate line items and the method of calculation of these costs</li> </ul>

Discipline	Qualifications and Tasks
	<ul style="list-style-type: none"> <li>Estimates for BCR, EIRR and NPV; benefits and costs of each planning option will be estimated based on the with and without project situation</li> <li>Assessment of risk to the project's viability; this will include social risks as well as traditional benefits and implementation schedule assumptions</li> <li>Assessment of costs arising out of mitigation measures (or external dis-benefits)</li> <li>Conclusion of socio-economic viability of each planning option and the project as a whole</li> <li>Assist Team Leader in preparation of reports</li> </ul>
<b>26) Junior Engineer/Data Analyst</b>	<p>Minimum of Bachelor degree in Civil Engineering/Water Resources Engineering. He/she should have at least 5 years' experience of analysis of bathymetry, sediment and flow velocity data. He/she should have at least 1 year of experience in numerical modelling.</p> <p><b>Tasks:</b></p> <ul style="list-style-type: none"> <li>Responsible for the collection of field data and data from different organizations;</li> <li>Ensure data quality and prepare data needed for the hydrological and morphological modelling/analysis;</li> <li>Provide necessary support with data for other analysis required by the study team</li> <li>Assist the line modellers in developing hydrodynamic and morphological models</li> <li>Assist the study team in inventory preparation and other tasks what and when assigned.</li> </ul>

## 11. Work Plan

The study shall be carried out within a period of **10 months**. A work plan is needed to accomplish the different study activities included in the work plan in a specified time frame. Staffing schedules and Activity schedule are prepared for reference.



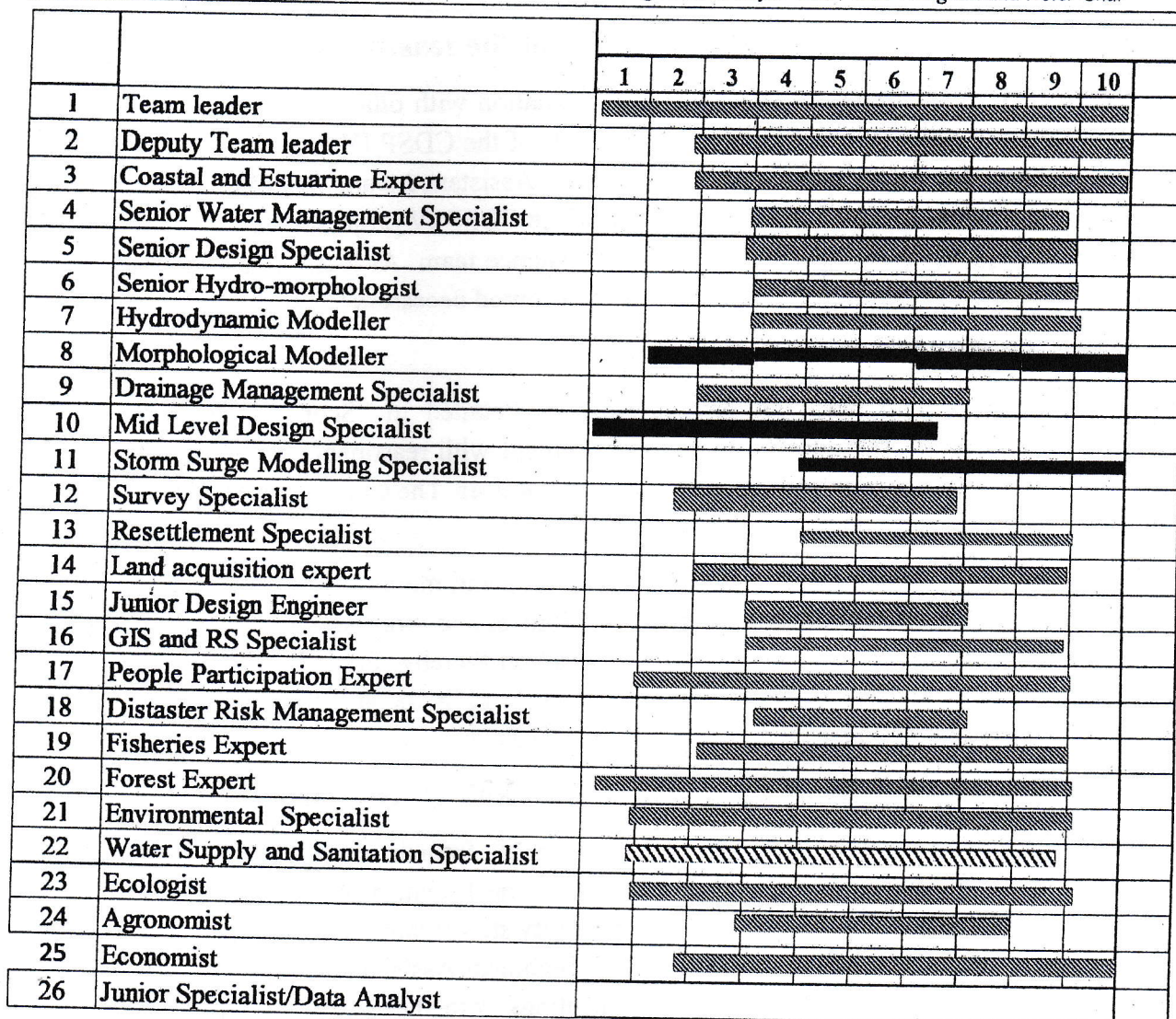


Chart 1: Manning Schedule

## 12. Duties and Responsibilities

### 12.1 BWDB's Responsibilities

Consultant shall work under the direct supervision of the Project Director. A team of client shall assist the study team as and when required. During field survey and data collection work, relevant engineers of the client shall accompany the study team for quality checking. The client shall or make available the existing data, services and facilities to consultant, if available. However, the duties of the Client can broadly be described as

- Services, facilities and property to be made available to Consultant by the Client.
- Professional and support counterpart personnel to be made available to Consultant by the Client.

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### **12.1.1. Guidance and monitoring of the feasibility study team**

Supervision of the feasibility study and coordination with other government institutions and non-governmental organizations will be in the hands of the CDSP IV Project Coordinating Director (of BWDB) and the Team Leader of the Technical Assistance team. The study will be carried out in close consultation and with full cooperation of the CDSP IV project staff, both from the government implementing agencies and the Technical Assistance team. At least once a month meeting will be held to monitor progress and more often when deemed necessary

### **12.2 Consultant's Responsibilities**

The consultant shall carry out the services as detailed in "Scope of Works" and "Tasks of Consultants" in the best interest of the Government with reasonable care, skill and diligence with sound engineering, administrative and financial practices. The Consultants shall be responsible to the client (BWDB) for discharge of responsibilities.

Consultant shall make available all the primary data and model results to BWDB. Make necessary arrangements for, site investigations and hydrological and morphological data collection as needed for performance of the assigned task and evaluation thereby. Provide all support for the effective delivery of the services as stipulated in the scope of work and the ToR. Work Plan can be altered/modified with the concurrence of both the parties.

### **12.3 Responsibilities of the CDSP IV Technical Assistance Team**

The Technical Assistance team of CDSP IV shall furnish all relevant data, maps and other information available to the feasibility study team. The Technical Assistance team will provide such assistance as is reasonably required by the feasibility study team for the purpose of implementing the activities under this Terms of Reference. The Technical Assistance Team will closely monitor the progress. To this effect monthly (at least) meetings with the feasibility study team will be held. Experts from the Technical Assistance team will join members of the study team during selected field visits

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