

Char Development and Settlement Project Phase IV Bangladesh

Feasibility study on the development of a cluster of island chars in the Lower Meghna in Bhola - and Noakhali Districts

Char Mozammel

Integrated Main Report

September 2016

Government of Bangladesh / IFAD / Government of the Netherlands

Implementing Government Agencies:

- Bangladesh Water Development Board (BWDB)
 - Ministry of Land (MoL)
 - Local Government Engineering Department (LGED)
 - Department of Public Health Engineering (DPHE)
 - Department of Agriculture Extension (DAE)
 - Forest Department (FD)
- and NGOs

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Appendices (separate documents)

Feasibility Study of Cluster of Chars (Char Mozammel), Development Design Consultants Ltd. (DDC)/ Institute of Water Modelling (IWM), September 2016.

CDSP IV Feasibility Study Cluster of Island Chars, Char Mozammel, TA-contribution, Euroconsult Mott MacDonald/ BETS/ Socioconsult, September 2016.

List of abbreviations

BDT	Bangladesh Taka
BWDB	Bangladesh Water Development Board
CBO	Community Based Organization
CDSP	Char Development and Settlement Project
cm	centimetre
DAE	Department of Agriculture Extension
DDC	Development Design Consultants Ltd.
DRLS	Directorate of Land Records and Surveys
DLS	Department of Livestock Services
DPHE	Department of Public Health Engineering
DoF	Department of Fisheries
DPP	Development Project Proforma
DTW	Deep Tube Well
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
FCDI	Flood Control Drainage Irrigation
FD	Forest Department
FF	Farmer Forum
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GOB	Government of Bangladesh
GPWM	Guidelines for Participatory Water Management
ha	hectare
HYV	High Yielding Variety
IEC	Important Environmental Components
IFAD	International Fund for Agricultural Development
IGA	Income Generating Activity
IMSC	Inter Ministerial Steering Committee
IWM	Institute of Water Modelling
IPCC	Intergovernmental Panel on Climate Change
kg	kilogram
km	kilometre
LCS	Labour Contracting Society
LGED	Local Government Engineering Department
m	meter
MFI	Micro Finance Institution
MHWL	Mean High Water Level
Mm	millimetre
MoL	Ministry of Land
MOWR	Ministry of Water Resources
MT	Metric Ton
NGO	Non Governmental Organization
NPV	Net Present Value
O&M	Operation and Maintenance
PCD	Project Coordinating Director
PKSF	Palli Karma-Sahayak Foundation
PMC	Project Management Committee
ppt	parts per thousand
PWD	Public Works Datum
RCP	Representative Concentration Pathway
RFLDC	Regional Fisheries and Livestock Development Component

SFG	Social Forestry Group
TA	Technical Assistance
TBA	Traditional Birth Attendant
Tk	Taka
TSP	Triple Super Phosphate
TUG	Tube well User Group
Unesco-IHE	Institute of Water Education
UP	Union Parishad
WARPO	Water Resources Planning Organization
WMG	Water Management Group
WMO	Water Management Organization
yr	year

Executive Summary

1. **Area:** Char Mozammel is located in Tazimuddin Upazila of Bhola District. The gross area of the char is 3,760 ha, with an average land level of 2 m PWD. Over 50% is still mudflat. About 1,600 ha are available for agriculture.
2. **Population:** Settlers started to migrate into the area about 15 years ago, with the majority in the period between 2005 and 2010, removing the trees planted by the Forest Department and occupying the land without a land title. Total population is nearly 15,600, settled in 3,195 households. Main occupation is farm daily labour, followed by farming, fisheries, business and small trading, and sharecropping. Of all households, 27% reported to have enough food for only three months and another 50% for six months, 15% for nine months and 8% for the whole year.
3. **Physical conditions:** About 1,600 ha can be considered as more or less mature, while 2,160 ha is still more part of the river as a char in development. Of the 1,600 ha, 83% is lower than 2.25 m PWD, and 96% is lower than 2.68 m, the mean high water level at monsoon time (see also 4 below). Only 2% is between 3 and 4.75 m PWD.
4. **Integrated program:** The study proposes to initiate a CDSP-type of project in the area. This means a multi-sectoral and multi-agency development program, with a distinct role for both government agencies and NGOs. The program should cover the following fields: water management (Chapter 2), internal infrastructure (Chapter 3), land settlement (Chapter 4), agriculture (Chapter 5), livestock (Chapter 6), fisheries (Chapter 7) and social forestry (Chapter 8). In addition it is advised to have a specific social- and livelihood component (Chapter 9). Such an approach requires specific governance related arrangements (Chapter 10). The integrated approach follows the principles of Integrated Coastal Zone Management, as reflected in the Coastal Zone Policy of Bangladesh.
5. **Water management:** The char is inundated twice a day during high tide, especially in monsoon time. Only less than 1% of the area stays flood free during monsoon time. The largest part (71%) has an inundation depth between 0.90 m and 1.80 m, and 26% between 1.80 m and 3.60 m. The water comes from all sides, but stays only for 2.5 to 3 hours. There is no stagnant water. In the dry season, the char is largely flood free during neap tide, but becomes flooded with spring tide. Mean high water level during monsoon time is 2.68 m. PWD in that part of the Lower Meghna. At that land level no further significant sedimentation of the land surface can be expected. Only at that level, the land would be high enough to consider construction of a polder. Sea level rise due climate change will not worsen the inundation situation, because natural sedimentation will counterbalance the impact of rise in sea level. Increased rainfall is not expected to substantially change this scenario.
6. **Water management, planning options:** There are two basic options for water management: leave the char unprotected and allow further natural sedimentation until land levels reach MHWL in monsoon time (estimated to happen only in 20 year time, beyond the period of a new project); or increase land levels mechanically by deposition of dredging spoils on the land (so construction of embankments could start within the presumed project period). A cost-benefit analysis has indicated that the latter option is financially and economically not feasible, mainly because of the additional dredging costs. It is recommended to leave the char unprotected. The proposed intervention is limited to re-excavation of channels with a total length of 18.3 km. The presentation of the future scenarios in the various sectors below (6 to 10) are based on the recommended option, which is to leave the char unprotected and allow further natural sedimentation. In the report itself consequences and costs of other options have been elaborated upon for each of the sectors.
7. **Internal infrastructure:** The area has presently hardly any infrastructure. The earthen roads (total length 8.4 km) are not well maintained and can actually only be used in winter time. There are 20 deep tube wells, no cyclone shelters, a few mosques and small bazaars and one Abashan (clustered village) complex. It is proposed to upgrade the existing rural, earthen roads and construct new ones (total 12.8 km.), including nine culverts, six cyclone shelters, 200 tube wells, 3,000 pit latrines, five rainwater harvesting schemes, five community ponds and one killa (raised land for cattle)..

8. **Land settlement:** Apart from nine clustered villages covering 54 acres, the whole char is khas land. Taking into account the land required for infrastructure, it is estimated that nearly 7,000 acres is available for allotment to land less households. Providing the families that are now living in Char Mozammel with 1.5 acres, would leave about 2,100 acres for distribution to about 1,400 households that are not yet living there. It is proposed to include Kazir Char, nearby Char Mozammel, in the land settlement program. On the area of nearly 4,000 acre, about 2,000 households could be settled; 600 are already living there and 1,400 could come from other areas.
9. **Agriculture:** About 36% of the settlers are directly involved with farming; 42% of the gross area is available for crop agriculture. Crop intensity stands at 142%, based on the cultivable area. The dominant crop is the monsoon rice, followed by the rabi crops. Reported yields of local variety rice ranges from 1.0 to 2.9 tons per ha, while the HYV rice (grown by only a few farmers). Average yield is 1.94 ton per ha. Homestead gardening is not well developed. The main constraints are tidal flooding and flash floods, high soil- and water salinity, high soil moisture in the pre-rabi period, lack of credit facilities and of extension services, non-availability of seeds. Main elements in the proposed development plan are improvement of water management, introduction of modern technologies (such as improved varieties and better cultivation methods), providing land titles (see 7 above), construction of community ponds to increase irrigation possibilities, and strengthening extension - and support services. The Department of Agriculture Extension has to expand their services to the area, while NGOs can support households in homestead agriculture. The plans for the road network will facilitate marketing of produce. The combination of these measures will significantly increase yields and overall production.
10. **Livestock:** In the vulnerable environment of char areas, livestock has a strong element of risk aversion. It is seen as a reliable source of income for small farmers and landless families. However, as in the case of agriculture, lack of support services and a poor marketing system are hampering livestock development, in addition to shortage of feed, animal diseases, theft, shortage of feed and poor genetic quality. It is recommended not to rely only on the services of the Department of Livestock Services, but to engage a NGO to develop semi-skilled manpower and employ a veterinary doctor. Training of farmers should follow the Livestock Farmer Field School methodology, supported by the NGO and livestock field workers, and with assistance from DLS. The Department should facilitate the supply of drugs and vaccines. The expected growth in agricultural production will improve the supply of fodder (crop residues); this can be further enhanced by including more leguminous crops in the farming system and by planting of trees with protein rich leaves. Simple collective rainwater harvesting devices could address the shortage of drinking water for buffaloes and cattle. It is critical that livestock rearing households organize themselves in order to make collective bargaining possible to reduce the risk of being exploited by the middlemen. The groups can establish direct contacts with sellers of inputs and with buyers of livestock products.
11. **Fisheries:** About 18% of households are directly depending on fisheries for their livelihood. They are involved in fishing in closed water bodies (ponds, ditches), in wild fisheries (khals and floodplains), or in fishing outside the area (Meghna estuary). The main constraints for fisheries are the limited number of ponds, tidal flooding, insufficient input supplies and extension services, and adverse marketing conditions. More intensive cultivation methods and improve extension services by engaging a NGO are essential components of the proposed development plan. Establishment of a fish hatchery in the area (adjacent char) would address the demand for fingerlings. Protection of the area by an embankment would change the situation dramatically. If the area is left unprotected, pond cultivation will still modestly improve (due to better extension services and input supplies). The same can be said of wild fisheries in open water bodies.
12. **Social forestry:** Forestry development started by the Forest Department in 1998, but immigration of settlers especially in the years between 2005 and 2010 led to complete deforestation. At present there is not much forest coverage in the study area. It is recommended that the Department renews its presence with a forestry program with mangrove plantations (around 1,500 ha) on the newly formed extensive mudflats of the Lower Meghna river and with strip plantation along all the roads (12.8 km). NGOs should be given the responsibility to promote and support agro-forestry on homesteads. It is standing policy in Bangladesh to apply the social forestry approach. Men and women from the area, organized in Social Forestry Groups, are involved in planning, implementation and maintenance of the forestry schemes and are rewarded through benefit sharing arrangements.
13. **Social and livelihood component:** Although many of the proposed activities have a distinct social impact and will favourably influence the livelihoods of the settled families, it is recommended to emphasize the importance of these aspects by a specific social and livelihood component, to be carried out by NGOs, as is the case in CDSP IV. The strategy is basically to render micro-finance services targeted at women (better credit facilities will stimulate productive pursuits) and to provide social and economic services that are not being delivered by the government at this early stage of development of the area. Subjects to be covered are: group

formation (exclusively women) and micro finance; health and family planning; education; water and sanitation; homestead agriculture and value chain development; livestock development; fisheries; legal and human rights; disaster management; and awareness on the environment and on climate change. It is foreseen, with a view on the size of the area and of the population, that establishment of three branch offices is required, by either one or two NGOs.

14. **Governance:** As indicated earlier, it is recommended to frame the multi-sector interventions in a multi-agency program. As in CDSP III and IV, it is recommended that the following six partner agencies participate: Bangladesh Water Development Board, Local Government Engineering Department, Department of Public Health Engineering, Ministry of Land, Department of Agriculture Extension and Forestry Department. An Inter-Ministerial Steering Committee and a Project Management Committee would function as coordination mechanisms. The Department of Livestock Services and the Department of Fisheries would support the program through training efforts and supply of inputs. The private sector would have also a role in input supply and in marketing of crops, fish and livestock products. The involvement of an NGO was explained in the previous section. Important is the support and active involvement of local government institutions, especially at the level of the Union Parishad. The significance of field level institutions for a successful char development program can hardly be underestimated. That is why much attention will be given to the formation of and support to Water Management Groups, Farmer Forums, Social Forestry Groups, Tube well User Groups and micro-finance groups. As much as practically possible, Labour Contracting Societies will be engaged for earth work.
15. **Environmental impact:** Leaving the char unprotected in the foreseeable future (water management option 1) will have a positive impact with regard to further sedimentation and thus higher land levels of parts the char. On the other hand, tidal flooding will continue and soil salinity will not be abated and quality of water, especially salinity, will not be improved either. Not protecting the char would be good for the status of flora, fauna and wildlife. But the environment for productive purposes, in particular agriculture and aquaculture, will not be enhanced, although wild fisheries will not be hampered and will continue to be a source of income. The conclusion is justified that this options has no significant negative impact on the environment. Mitigation measures and monitoring are however necessary.
16. **Social impact:** The social impact of the proposals would in general be favourable. Physical security for the settlers would improve a great deal (embankment, cyclone shelters, roads, skills in disaster management). Economic and food security would be much better. The upswing in local production and the economic development in general will increase and diversify the income streams and will open up employment opportunities. The higher production in agriculture, fisheries and livestock are bound to decrease the periods of food shortages of large sections of the population, as was proven in previous CDSP-project areas. It is expected that more service providers, both from the government and from the private sector, will be encouraged to come to the area because of the economic development and the better communication network. Health status will be improved by the improved food security, including a higher availability of high protein food, as well as by the targeted interventions of the social- and livelihood component. That component will increase the access for children to primary education. The cyclone shelters can serve as school buildings. The social position of settlers will be enhanced (land titles, participation in field level institutions), especially for women.
17. **Costs and benefits:** Comparing costs and benefits for the recommended option (leaving Char Mozammel unprotected) the economic internal rate of return (EIRR) would be 42.36% and the financial rate of return (FIRR) 18.81%. Both are above the opportunity costs of Bangladesh of 12%. This option is economically and financially sustainable. Other options (establishment of a polder by increasing levels through deposit of dredging spoils) score much lower internal rates, below the required standards. Total costs for the recommended option (option 1) are estimated to be Taka 6,842.04 lakh, which is equal to Euro 7,615,191 or US\$ 8,497,814 at the exchange rates of 19 September 2016.

1. Introduction

1.1 Background and objectives

The Inception Report of the Char Development and Settlement Project (CDSP) IV states that the project will undertake three feasibility studies in areas where in the future development programmes for chars might take place. It further states that these future areas have to be 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 which is on the west of Island of Bhola (Bhola District). In the north, the area follows the coastline of Feni, Noakhali and Lakshimpur Districts. After a rigorous process of selection, the BWDB and the Development Partners (Government of The Netherlands and IFAD) decided to take up Cluster of Chars (Char Pollabi, Char Banani, Char Akram Uddin, Char Alauddin, Char Khondakhar) in the district of Noakhali as the first of the series of anticipated three feasibility studies. The report on this cluster of chars was completed in January 2015. Subsequently, for the second series of feasibility studies three island chars in the Lower Meghna: Dhal Char, Char Kola Toli and Char Mozammel have been selected. The chars are located in Noakhali District and Bhola District. The present report represents the study on Char Mozammel. For an overview map of the three chars, see Fig. 1.1. The Terms of Reference can be found in Annex 1.

The main objective of the study is to assess the technical, economic, social and environmental feasibility of developing the chars in the study area. The aim is to present the feasibility study report to the Government of Bangladesh and to development partners (international donor agencies) in order to ascertain whether the proposed development plans are feasible out of a policy point of view and subsequently to secure funds and technical support necessary for the implementation of the proposed package of interventions.

1.2 Methodology

The overall coordination of the feasibility study was in the hands of the Technical Assistance (TA) team of CDSP IV, under responsibility of the Project Management Committee (PMC), chaired by the Project Coordinating Director (PCD) of the Bangladesh Water Development Board. The Terms of Reference for the study were drafted by the TA team and approved by the PCD and PMC. The study is financed by funds from the TA-budget.

The responsibility of actually undertaking the study has been split up. The major part has been sub-contracted to a consortium of a Bangladeshi firm and institute: Development Design Consultants Ltd. (DDC) and the Institute of Water Modelling (IWM). The DDC/IWM consortium covered water management, internal infrastructure, agriculture, livestock, fisheries, forestry, environmental impact and the cost-benefit analysis. The TA-team itself took up the task to prepare the parts of the study on the social- and livelihood/NGO component, and the parts on land settlement, governance and social impact. The report of DDC and IWM, and the reports of the TA-team form Appendices to this Main Report. This Main Report integrates all different sections and is a great deal shorter than the combined original reports. It provides a comprehensive presentation of the main findings.

The methodology of preparing the reports basically followed four phases: establishing base-line conditions and constraints; identification of interventions; analysis of impact; formulating the overall proposed plan. The information was obtained through both primary and secondary data collection. The DDC/ IWM report gives an overview of all field surveys that have been undertaken. The field work of the study was carried out in the period from mid-February to December 2015.

1.3 The study area

1.3.1. Main characteristics

Char Mozammel is located in Tazimuddin Upazila in Bhola District. The char covers an area of 3,760 ha. The char started emerging in the Lower Meghna during the 1990s. The average land level is currently 2 m

PWD. As far as land use is concerned, about 1,572 ha (41.8%) is available for agricultural production and another 2,000 ha (53.2%) area is mudflat and still in the accretion phase. Water bodies cover 2.2% area (83.4 ha) and forest 0.6% (24 ha.). Infrastructures, which include homesteads, roads and markets cover about 74 ha (2%) area. Fig 1.2 shows a map of Char Mozammel.

1.3.2. Population

At present (2015), 3,195 households are living in Char Mozammel. The average size of the household in Char Mozammel is 4.88 persons. The total population is estimated to be 15,592, of which 8,201 are males and 7,391 are females. The sex ratio M/F is 111:100. Nearly 42% of the population is younger than 15 years, while 28% is between the ages of 16 and 34; 24% is between 35 and 59 and 6% is over 60 years old. Around 35% of the population over 5 years is illiterate.

The first, very few, households settled in Char Mozammel in the period 2001-2005. The majority (60%) came between 2006 and 2010. All the other households (nearly 40%) migrated between 2011 and 2013. Most migrants came from Lalmohon Upazila and Monpura Upazila.

1.3.3. Occupational pattern, income and expenditures

The largest percentage (38%) of the household heads makes an income through non-farm daily labour. This group is followed by farmers (33%), fishermen (18%), small traders/businessmen (4%) and sharecroppers (3%). The remaining 4% are involved in a variety of occupations (as artisans, salaried service etc.).

Around 4% of the heads of households estimate the annual household income to be less than Taka 24,000 (from daily labour, fishing, farming, livestock); for 43% of the households this is between Taka 24,000 and Taka 60,000 (farming, petty trade and small business; 45% have an income between Taka 60,000 and 120,000 (small business and remittances from overseas); 8% earn more than Taka 120,000 (main source: remittances).

A considerable majority of households spent most of their income on food items (see also next section). This is followed by agricultural inputs, clothing and medical treatment.

1.3.4. Food security status

Of the households, 27% reported to have adequate food supply for only three months per year; 50% had food for six months, 15% for nine months, while 8% had enough food for the whole year. The 27% with the least food security had to buy 70% of their consumed food from the market; the group with the greatest security was only for 5% dependent on the market.

1.4 Time frame

1.4.1. Lead time to implementation

The current intention is that CDSP IV runs till September 2018. This would mean that the next phase, CDSP V, will not start before the end of 2018 with a duration of possibly six years, so roughly 2019-2025. The inception of the possible implementation of the package of interventions proposed in this study will be roughly two to two and a half years after the study has been completed. In this period a number of important variables might change. Factors that will have a significant effect are, for instance, the expected growth in the number of households and overall population and the extent of sedimentation. Also the inflation of in particular construction costs has to be taken into account.

1.4.2. Long term time frame

Due to the dynamic nature of the natural environment in coastal areas, in particular the central part formed by the Meghna estuary, the feasibility studies of CDSP have taken a time frame of 20 years, ten years shorter than the often used 30 years period. This basically means that the cost benefit analysis is based on the assumption that project interventions initiated by the project will be operational for 20 years (as for instance infrastructure) and that benefits accrued to project interventions are limited to the same 20 year period. For climate change however, a time horizon till 2050 was taken, 34 years from now. This was done out of caution. The longer period provides a hedge against developing insights in climatic changes.

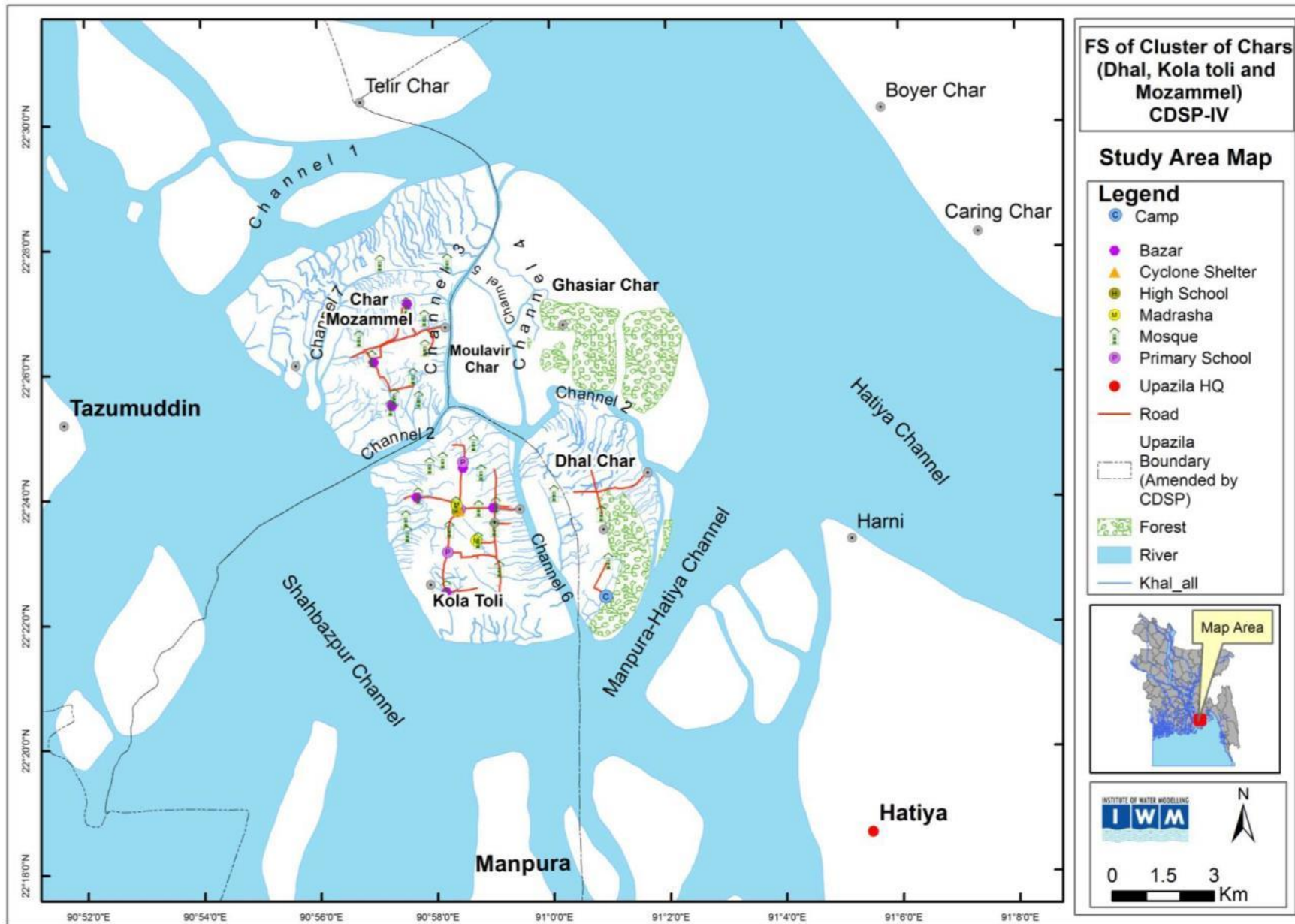


Figure 1.1 Overview of the study area of three chars: Char Kola Toli, Char Mozammel and Dhal Char

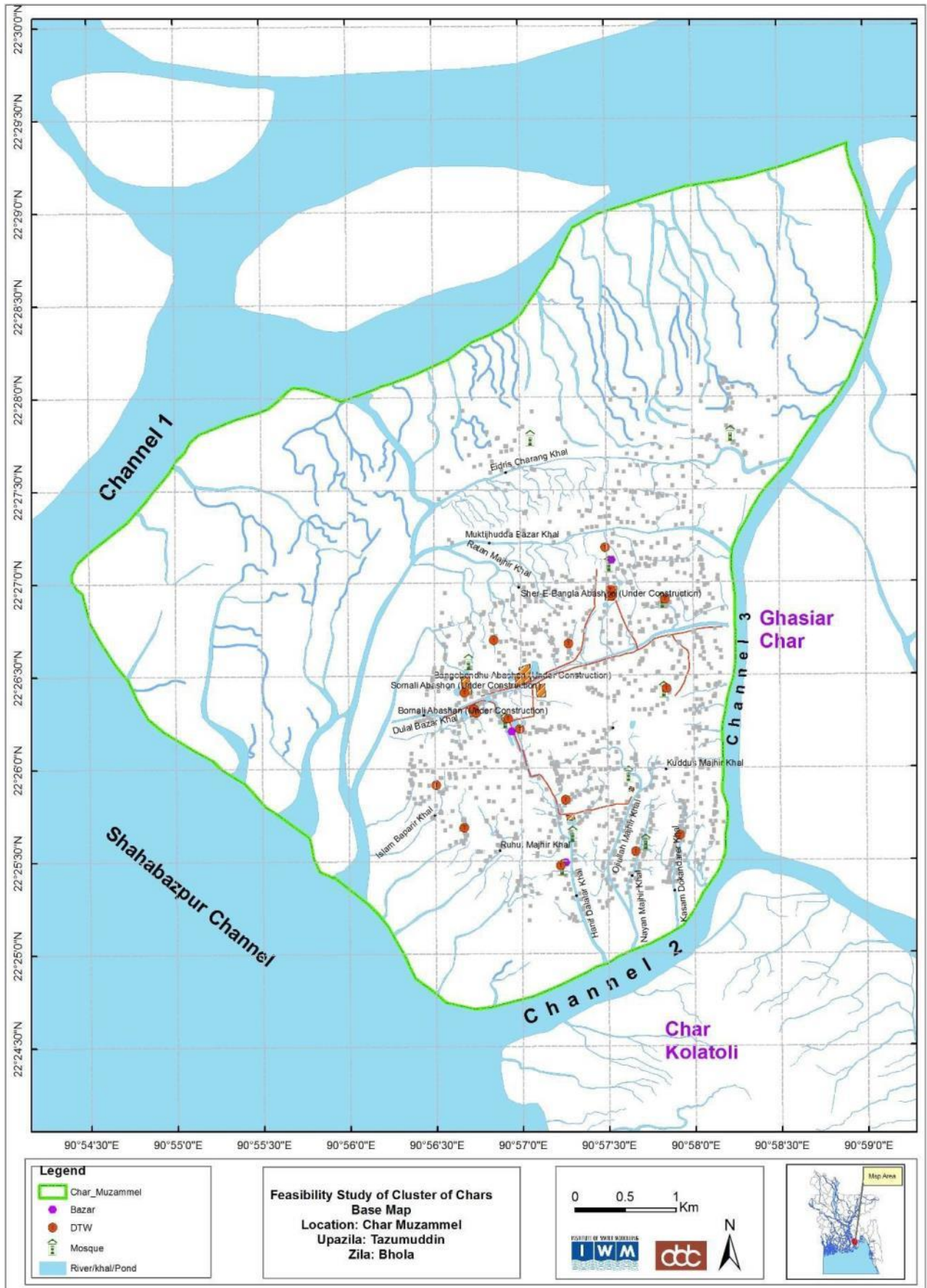


Figure 1.2 Map of Char Mozammel

2. Water management

2.1 Introduction

Water management is a crucial factor in CDSP projects because it is directly related to vital aspects of people's livelihoods as safety, food security and further economic development. This is certainly the case for Char Mozammel, with its vulnerable location in the Lower Meghna. That is why water management is dealt with so early in this feasibility study. It sets the stage for the possibilities for development in other fields such as agriculture, livestock, fisheries and forestry, all of great importance for livelihoods of char settlers.

This chapter starts with explaining the present situation (in 2.2) in terms of a number of essential variables. It continues with assessing the options for a future scenario in order to come to a water management plan (2.3), taking into account the consequences of climate change. The chapter closes with an overview of the costs of the proposed water management interventions and of the benefits they will generate (2.4).

2.2 Present situation and constraints

2.2.1. Main features of present situation

- Area and land levels: The gross area of Char Mozammel is 3,760 ha. Only 1,600 ha can be considered as more or less mature, with 2,760 ha still more a part of the river, as a char in the process of formation. Land levels in the 1,600 ha area vary from 0 to 4.75 m PWD. About 83% is lower than 2.25 m PWD, with less than 2% between 3 m and 4.75 m. About 96% of the char is between 0 and 2.68 m PWD (the mean high water level at monsoon time, the level that indicates the land is mature, in the sense that no further siltation will occur).

- Rainfall: The two nearest stations where rainfall is measured are at Hatiya (covering 65% of the study area) and at Ramgati. Average annual rainfall over the last 50 years for Hatiya station was 3,079 mm. The maximum daily rainfall (2.33 year return period) was 176 mm, with 3 days and 5 days consecutive rainfall of 309 mm and 392 mm respectively. For Ramgati average annual rainfall was 3,706 mm, maximum daily rainfall 140 mm, with consecutive 3 days and 5 days rainfall of 302 mm and 411 mm.

- Tidal characteristics: The tidal range during monsoon level varies from -0.80 m to 3.5 m, and during dry season from -0.50 to 2.75 m. The mean high water level (MHWL) during spring tide in monsoon time is 3.20 PWD and during neap tide about 2.20 m. MHWL during monsoon time can be taken as 2.68 m.

- Inundation: As table 2.1. shows, in the present condition, only 0.30 % of the area of Char Mozammel (the matured area of 1,600 ha) is flood free during the monsoon season. The largest part of the char (71 %) has an inundation between 0.90 m and 1.80 m, and 26% between 1.80 m and 3.60 m. In the dry season, the tidal range reduces to decreased upstream flow from the Meghna. The char is inundation free during neap tide, but low lying sections of the char become flooded at spring tide

- Drainage: The char is inundated twice per day during high tide, in particular in monsoon time. Average inundation depth is about 1.5 m. The water comes from all sides, but only stays for 2.5 to 3 hours. This quick run-off makes the char flood free during low tide. There is no particular problem of stagnant water.

- Salinity: Average water salinity levels are higher in the dry season than in monsoon time. Influence from sea salinity is highest during the period with low discharge from the Ganges-Meghna-Brahmaputra river system in winter, and drops when upstream flow increases in May. In January salinity varies from 8 to 10 ppt, with a peak of 14 ppt at spring tide. In the months of March and April, and the first part of May, salinity rises to 15-18 ppt, but then falls sharply to 4-7 ppt when the pre-monsoon rains set in. In June salinity drops to a concentration of below 1 ppt.

- **Stability:** Stability of the area is an essential variable for a decision to start a significant development program. Char Mozammel first appeared on a satellite image of 1999 as a char of about 350 ha, growing in one year to 520 ha. The land kept increasing day by day. As said earlier, still only about 1,600 ha is higher than 2 m PWD, and most of the char is under water during high tide in monsoon time. But the char has the potential to develop itself to a bigger and higher area, with especially the northern and north western part expanding by sedimentation.

- **Rate of sedimentation:** To come to an estimate of the rate of sedimentation, field tests were done (measuring cross sections of khals) and a desk study was undertaken. A 10 year model-study of IWM/ Unesco-IHE concluded that average annual sedimentation rate in the study area was 4 cm. The field tests indicated a rate of 3 cm at the raised are, and from 6-12 cm at the lower lying areas.

2.2.2. Major constraints

The major features of the area as summarized in 2.2.1 and views from the population point to the main water management related bottlenecks in Char Mozammel. Average land levels are still low. The char is very much in a development phase, with more than 98% of the gross area still with a land level lower than MHWL in monsoon time. Only a fraction of the area stays flood free in monsoon time. Salinity levels of water show a great range from less than 1 ppt in June to nearly 20 ppt in the beginning of May.

2.3 Impact of climate change

While assessing the impact of climate change on the physical conditions of the chars in the Lower Meghna, especially the Representative Concentration Pathways (RCP) of the IPCC have been used. Projections of precipitation for the year 2050 show dramatic increases in rainfall during the monsoon season, in particular in the months from July to October, ranging from nearly 17% more precipitation in July to nearly 27% in September. The increase in wind speed in 2050 is project to be 8%.

The feasibility study has assumed that global sea level rise will be 24 cm in 2050, relative to 2015, based on IPCC scenarios (RCP 8.5). The likely rate of land subsidence is taken as 10 mm a year (same assumption is used by the Coastal Embankment Improvement Project). The sedimentation rate for the study period is estimated to be 4 cm a year, based on field tests and a Unesco/ IHE model study. The relative mean sea level rise for 2050 (35 years from now, beyond the 20 year time horizon of this study) is estimated to be - 1 cm (or 0 cm). This is the product of global sea level rise of 24 cm, plus land subsidence of 35 cm, minus sedimentation of 60 cm (4 cm for a period of 15 years).

The abovementioned assumed changes in a number of essential variables have been an input in the drainage model applied for the study. This model supported the selection of planning options and the designs of the water management related structures.

2.4 Water management plan

2.4.1. Planning options

The study area is vulnerable to tidal inundation, storm surges, salinity, climate change, in particular sea level rise. After analysis of primary and secondary data and discussions with various stakeholders, four potential options were identified for addressing these vulnerabilities and for developing Char Mozammel. Essential criteria in the selection were the current land levels and the Mean High Water Level during monsoon time. Beyond MHWL in monsoon time no significant sedimentation of the area will take place. The four options are as follows:

- **Option 1: Leaving the char unprotected**

Allow natural sedimentation to raise the land levels up to the MHWL in monsoon time. No construction of embankment and water control structures. Development efforts will focus on limited growth of productive sectors as agriculture, fisheries and livestock, on social forestry, on development of internal infrastructure (road network, tube wells for drinking water and sanitary latrines, cyclone shelters) and on further enhancement of livelihoods with the assistance of NGOs.

- **Option 2: Construction of polder after maturing of char**

Construction of a polder if indeed the land levels have achieved MHWL in monsoon time through natural sedimentation. If this can be achieved within the project period, embankments and water management structures can form a part of the future project. In addition, same internal infrastructure and socio-economic interventions as in option 1.

- Option 3: Acceleration of land level increase through dredging
Raising of land levels to MHWL in monsoon time through mechanized sand deposition (dredging surrounding rivers and pumping fill material on the land). After MHWL is reached, construction of embankment with water control structures. Development of agriculture, fisheries and livestock and social forestry in a protected area. Other development activities as in options 1.

- Option 4: Make one polder of three island chars
Same approach as in option 3, but establishing one polder with two other study areas (Dhal Char and Char Kola Toli) by building cross dams between the chars and subsequently build an embankment around all three chars. Further development program as in option 3.

2.4.2. Selection of options

In view of the fact that the relative mean sea level rise is projected to be 0 cm (see 2.3 above), the inundation in case of option 1 (no embankments) is in future expected to be the same as the base condition. The change in rainfall due to climate change will not substantially change this expectation. Char Mozammel can be protected as soon as land levels reach MHWL in monsoon time (option 2). It is estimated that this process will in a natural way take about 20 years, which means that construction of a polder would be well beyond the timeframe of a new project (roughly 2019 to 2025). Option 2 is therefore not considered to be practical in terms of inclusion in a project that would succeed CDSP IV. Although option 3 (accelerating increase of land levels by deposition of dredging spoil) has practically a number of unresolved issues, it is most probably technically feasible. But it is doubtful whether the additional costs of dredging would make this option viable out of an economic and financial perspective. The same applies to option 4 (which is using dredging to help enhance land levels and construct one embankment around three chars (Char Kola Toli, Char Mozammel and Dhal Char), instead of establishing three separate polders.

Summarizing the assessment of the options: option 1 is obviously technically feasible and is not expected to worsen the water management situation; option 2 is technically, and probably financially and economically, feasible, but is not practical given the project time frame, and can thus be discarded; options 3 and 4 are probably technically feasible, but the additional costs of dredging makes the financial and economic feasibility doubtful. But these options cannot be discarded upfront.

2.4.3. Proposed interventions

- Option 1: No water management interventions are planned under this option. The char will stay unprotected to allow further sedimentation. It is proposed to re-excavate seven drainage channels with a total length of 18.3 km. There are no serious water logging issues at the moment.

- Option 2: This option has been discarded, because required land levels (2.68 m) would only be reached around 2035, far beyond the time frame of a new project.

- Option 3: Protection of Char Mozammel under this option would require a sea facing embankment of 6.66 km and internal embankments of in total 9.71 km. Ten one-vent water control structures have to be built and re-excavation of 7 khals with total length of around 18.3 km has to be carried out. Land levels have to be raised by filling with dredging spoil with an average of 47 cm; total quantity of dredging is estimated to be 7 million cubic meter.

- Option 4: Interventions under option 4 (one polder area encompassing three chars) are not benefitting Char Mozammel only, but also Char Kola Toli and Dhal Char. For this option around 11 million cubic meters of dredge filling is required (for Mozammel and Char Kola Toli). A sea facing embankment of 19.6 km and internal embankments of 29.73 km are required, plus two cross dams. Water control structures with in total 27 vents have to be constructed.

2.5 Cost estimates and benefits

2.5.1. Cost estimates

- Option 1: Costs of re-excavation of drainage channels will be Taka 195.9 lakh.

- Option 2: Option 2 is not applicable for Char Mozammel.

- Option 3: Total costs for option 3 would be Taka 27,796.90.1 lakh (see Table 2.1.)

- Option 4: Costs for option 4, for three chars, would be Taka 64,370.50 (see Table 2.1).

Table 2 - 1 Costs of water management infrastructure option 3 (only Char Mozammel) and option 4 (for three chars), in lakh Taka)

Infrastructure	Option 3	Option 3	Option 4	Option 4
Dredging	7 mln. M3	13,300.00	11 mln. M3	20,824.00
One vent sluices	10 nos.	1,634.00	27 nos.	34,320.00
Sea dyke	6.66 km	999.00	19.6 km	2,940.00
Interior dyke	9.71 km	1,1652.00	29.73 km	3,567.60.
Cross dams			2 nos.	2,100.00
Re-excavation of khals	18.3 km	195.90	52.5 km	570.90.
WMG building	1 nos.	16.00	3 nos.	48.00.
Total		27,796.90		.64,370.5

2.5.2. Benefits

- Option 1

The benefits under option 1 will be less than other options 2, 3 and 4, but will still be substantial. The environment for cultivation of crops will be slightly improved because of the decrease in water logging because of the re-excavation of khals. Productive sectors are expected to improve because of improved organization of producers and qualitative better and more accessible extension services. At the same time, inputs for production will become easier available and marketing is facilitated because of the improved road network. The NGO program will provide extension services for homestead cultivation.

- Options 3 and 4

There are many benefits of the water management plan under options 2,3 and 4 as presented above. The peripheral embankment provides a much safer environment for the people in the study area. The embankment means a huge step forward in their physical security. Economic prospects will be come much brighter because of the improved environment for productive activities as crop agriculture and cultured fisheries. The embankment, in combination with the regulators and the re-excavated drainage channels creates a fresh water environment in which water levels can be controlled and which will gradually lower soil salinity. This will boost the agriculture production, while settlers will be inclined to invest more in fish ponds. Although grazing facilities will be reduced, livestock is expected to benefit from the increased availability of fodder. Benefits mentioned above for option 1, will also apply for options 3 and 4. Economic benefits will be accrued in the productive sectors: field- and homestead agriculture, livestock, fisheries and social forestry and will be dealt with at the end of each of the respective chapters (Chapters 5 to 8).

3. Internal infrastructure

3.1 Existing infrastructure

3.1.1. Communication network

There is no well-developed road network within the char. There are 12 earthen roads, with a total length of 8.4 km (see table 3.1). These roads are however not of the required quality.

Table 3 - 1 Existing roads in Char Mozammel

Road ID	Road Type	Length (Km)	Remark
Abashan to Muktijhudda Bazar Road	Existing Kacha Road	1.150	Not in good condition
Dulal Bazar to Killa Road	Existing Kacha Road	0.445	Not in good condition
Dulal Bazar to Killa Road	Existing Kacha Road	0.275	Not in good condition
Dulal Bazar to Killa Road	Existing Kacha Road	0.158	Not in good condition
Dulal Bazar to Killa Road	Existing Kacha Road	0.944	Not in good condition
Dulal Bazar Road	Existing Kacha Road	0.472	Not in good condition
Dulal Bazar Road	Existing Kacha Road	2.906	Not in good condition
Sornali Abashon to Bangobondhu Abashan	Existing Kacha Road	0.517	Not in good condition
Abashan Road	Existing Kacha Road	0.539	Not in good condition
Abashan to Muktijhudda Bazar Road	Existing Kacha Road	0.280	Not in good condition
Rohijal Majhir Mosque Road	Existing Kacha Road	0.719	Not in good condition
Total Length of Char Mozammel's Road		8.405	

These roads are linked with households, mosques etc. and form the vital communication to the the boat/ ferry ghat. They are in bad condition. During the monsoon time they can hardly be used due to inundation by flood water at high tide, certainly not by motorcycles and bicycles.

3.1.2. Water supply and sanitary facilities

There are 20 deep tube wells in Char Mozammel. The tube wells are the main source of drinking water. Sanitary facilities in the char are almost nil. Most of the households are using kacha latrines. Only a few households are using single pit latrines.

3.1.3. Other infrastructure

Char Mozammel has a few mosques and bazaars. There is also an Abashan project.

3.2 Proposed internal infrastructure

3.2.1. Overview

The following internal infrastructure (Table 3.2) has been identified and assessed for Char Mozammel. Estimated number of household related infrastructure has been determined using the number of household obtained through survey of study area.

Table 3 - 2 Proposed internal infrastructure for Char Mozammel

SL No	Infrastructure	Option 1	Option 3,4	Unit
1.	Rural Road (Type R-2)	12.839	12.839	Km.
2.	Pacca Road		3	Km.
3.	Box Culvert	2	6	No.
4.	Pipe Culvert	3	3	No.

5.	Cyclone Shelter	6	9	No.
6.	Deep Tube well	200	322	No.
7.	Single Pit Latrine	3000	4835	No.
8.	Public Toilet		4	No.
9.	Community Pond	5	5	No.
10.	Rainw. Harvest. schemes	5	10	No.
11.	Market development		1	No.

3.2.2. Multi-purpose cyclone shelters

Cyclone shelters have more than one function. They provide safety for the char settlers during storms, cyclones and storm surges. But they can also be used as schools. In other chars they are also used as school building and as a place where the community can gather for meetings. The intention is to provide one cyclone shelter for each 500 households. Char Mozammel has currently 3,195 households. Taking into account an increase of 20%, over 3,800 households have to be accommodated. This would mean at least seven cyclone shelters. The plan has a provision for nine cyclone shelters. The location has to be discussed with the local population.

In option 1 six cyclone shelters would just be sufficient.

3.2.3. Water supply and sanitary facilities

One deep tube well for an average of 15 families is the standard in CDSP areas. Including the expected increase in households (in particular under options 3 and 4), this means 255. Because there are already 20 tube wells available, this would require 235 additional ones. But each cyclone shelter, mosque and public toilet should have a tube well too. This would bring the total of tube wells that are needed to around 250. Ten rainwater harvesting schemes for option 3 and 4, and five for option 1 are included in the package, to be located in places where deep tube well are not feasible.

One single pit latrine is provided for each present family and for increased families during project period. 20% increase considered (in total around 3,800). A provision of two public toilets to be built near markets has been included as well.

3.2.4. Rural roads and culverts

Rural roads will give the much needed improvement of the communication network within Char Mozammel. The proposed roads and to be developed existing roads are R-2 type LGED standard: crest width 3.7m; side slope 2:1; crest level 5.50 m PWD.

Table 3 - 3 Roads proposed for Char Mozammel (all options)

Existing Road's with Proposed development	Road Type (R-2)	Length (Km)
Abashan to Muktijhudha Bazar Road	Earthen Kacha Road	2.922
Dulal Bazar Road	Earthen Kacha Road	3.651
Sornali Abashon to Bangobondhu Abashan	Earthen Kacha Road	0.516
Abashan Road	Earthen Kacha Road	0.806
Rohijal Majhir Mosque Road	Earthen Kacha Road	1.812
Dulal Bazar to Killa Road	Earthen Kacha Road	3.129
Total length of Char Mozammel's Road		12.836

In case of options 3 and 4, a stretch of 3 km of pucca road will be added. The road alignment has to be set in such a way that the number of box -/ pipe culverts required is kept to a minimum. Provision of six box culverts and three pipe culverts have been taken up in the plan for cross drainage. The exact location will be determined after consultation with the settlers.

3.2.5. Ponds

There is currently no pond in the char with adequate dimensions. The plan is providing five community ponds.

3.2.6. Cluster village

During field visit and meetings with the local settlers, it became clear that the people preferred to live in independent houses instead of being housed in a cluster village. That is why the construction of cluster villages is not taken up in the proposed infrastructure package.

3.3 Costs and benefits

3.3.1. Cost estimate

Table 3 - 4 Cost estimate internal infrastructure, option 1

SL	Infrastructure	Quantity	Unit	Unit Cost (Lakh Tk.)	Total Cost (Lakh Tk.)
1.	Rural Road (Type R-2) with extension and development	12.839	Km	20.00	256.78
2.	Box Culverts	2	Each	35.00	70.00
3.	Pipe Culverts	3	Each	4.00	12.00
4.	Multi-purpose Cyclone Shelter	6	Each	200.00	1200.00
5.	Deep Tube well	200	Each	1.00	200.00
6.	Single pit latrine	3000	Each	0.05	150.00
7.	Rainwater harvesting scheme	5	Each	1.00	5.00
8.	Community ponds	5	Each	10.00	50.00
9.	Killa	1	Each	40.00	40.00
Total Cost					1,983.78

Table 3 - 5 Cost estimate internal infrastructure, options 3 and 4

SL	Infrastructure	Length	Unit	Cost (Lakh Tk.)	Total Cost (Lakh Tk.)
1.	Pucca road	3	Km	75.00	225.00
2.	Rural Road (Type R-2) with extension and development	12.839	Km	20.00	256.78
3.	Box Culverts	6	Each	35.0	210.00
4.	Pipe Culverts	3	Each	4.00	12.00
5.	Multi-purpose Cyclone Shelter	9	Each	200.00	1800.00
6.	Deep Tube well	322	Each	1.00	322.00
7.	Single pit Latrine	4835	Each	0.05	241.75
8.	Public Toilets	4	Each	13.00	52.00
9.	Rain Water Harvesting Schemes	10	Each	1.00	10.00
10.	Market development	1	No	75.00	75.00
11.	Community Pond	5	Each	10	50.00
Total Cost					3,254.53

3.2.2. Benefits

The upgraded and expanded road network will contribute to the greater safety of the char population by enhancing the possibilities for them to go to safer places. At the same time the roads will stimulate economic activities and thus promote the general economic uplift of the area. Markets, workshops and shops will emerge, providing employment opportunities and income for the settlers. The cyclone shelters obviously increase the security of the population, while the possibility of establishing schools in the buildings, increases the educational opportunities, especially for children. The deep tube wells will improve the health status of the population and will lessen the daily workload of the women. Sanitary facilities have a direct positive health impact. These benefits of the development of internal infrastructure have only an indirect economic impact and cannot be quantified in terms of money.

4. Land settlement

4.1 Introduction

Land settlement is an essential component of the CDSP-project, right from the start of CDSP I in 1994. The ultimate aim of this component is to provide hitherto landless households with a title on the land in newly developed chars. Since that first phase a total of 26,933 khatians (land title documents) have been distributed by the Ministry of Land in the framework of CDSP. Monitoring exercises indicate that over a period of on average 12 years, 80% of the original settlers still lived in the area and of the, 85% still had their original allocation of land.

Providing a title directly contributes to the main objective of CDSP: improving the livelihoods of settlers in coastal char areas. It considerably broadens the asset base of the households. The legal security that the document gives to the settlers will stimulate them to invest in their newly acquired land, which will have a positive effect on the agricultural production. Being landowners, the social status of the households is enhanced and the self-confidence of the settlers is increased.

Families in these new chars come from different areas, often from locations where erosion occurred and land was lost. Or they migrated because they had to sell their previously owned land due to their distressed circumstances. In many cases, the migration to new lands will mean they are being controlled by powerful jotdars, not seldom using or threatening with force by their bahinis.

According to Government regulations, newly emerged land has to be distributed to the landless (Policy for settlement of agricultural khas land of 1997), including a title on the land to a maximum of 1.5 acre per household. It is the task of the Government to apply the law and initiate and complete the process of land settlement (providing eligible households with a title). The Ministry of Land is one of the six partner implementing agencies of CDSP. In the project, innovative procedures are followed which brings the whole settlement process closer to the people, is more transparent, shorten the duration and make it far less costly for the settlers.

4.2 Present situation

The area of Char Mozammel is 9,287 acre (3,760 ha), inhabited by 3,195 households at the time of the study. During field visit it was observed that a char named 'Kazir char' is situated very near to Char Mozammel. Because Kazir Char is widely cultivated by the people of Char Mozammel, Kazir Char is included in this study (but in separate sections, see 4.4 and 4.5 below). The whole char area lies under Tazumuddin Upazilla, Bhola District.

There are several boundary disputes between Tazumuddin Upazilla and Monpura Upazillas, including the boundary lines in some adjacent chars like Kazir Char. A number of court cases are pending in the local courts to ascertain the actual location of the line. Though there is rivalry between the inhabitants of the two Upazillas, the local people are amicably maintaining the boundary. Therefore, most probably the local settlers will not hinder the land settlement process in Char Mozammel and Kazir Char. Nevertheless, before settlement works starts there, the boundary issue should be resolved through an initiative taken by the District administration of Bhola and the Ministry of Land.

The present status of the land is reflected in Table 4.1, giving char, Upazilla and District wise information. It shows that the overall, gross area of Char Mozammel is 9,287 acre (3,760 ha). At Char Mozammel no diara maps have been prepared and no mouza names have been given. No official settlement activities have yet been done here. Around 4,000 families are living here. Nine clustered villages have been constructed on 54 acres of land by government agencies. Excluding this clustered village land, status of the whole char (i.e. 9,233 acres) is khas.

Table 4 - 1 Status of land settlement in Char Mozammel

District	Upazilla	Mouza / Name of Chars	Area (in Acre)					
			Area under feasibility study	Diara Surveyed	Locally Surveyed (Charcha Map)	Un Surveyed	Clustered Village/ Asrayon	Available for Settlement
Bhola	Tazumuddin	Char Mozammel	9,287	0	3,325	7,624	54	9,233

4.3 Meeting supply and demand in Char Mozammel

The demand side for the available khas land essentially will consist of the demand for land by the households that are already settled in the area and have no khatian. In addition, there will be demand from government agencies for land needed for development of public infrastructure as embankments, roads, cyclone shelters etc. Experience has learned that about 25% of an area is needed for such collective investments.

The available supply consists of 9,233 acres, the size of the khas land at the moment. There are no claims from the Forest Department. Applying the rule of 25% requirement for infrastructure would leave 6,925 acres for allotment to landless households. If this land is indeed given to the households that have settled in the area and have no official land title (3,195), each household could receive 2.17 acres. But one family cannot receive more than 1.5 acres, according to the government khas land policy. So, if 1.5 acres land were provided per family, it will require (3,195 x 1.5) 4,792 acres. Rest (6,925 – 4,792) of 2,133 acres can be distributed to (2,133: 1.5) 1,422 landless families who are not living in the char. This would mean that a sizable land settlement program for (3,195 + 1,422) 4,617 landless families can be undertaken in Char Mozammel. It has to be mentioned that a considerable part of the available khas land is still char land in the process of further formation.

4.4 Present situation: Kazir Char

The size of Kazir Char is 3,942 acre (1,595 ha). It was seen that the char is matured enough to be settled, though it is a thinly populated area. The number of households in Kazir Char is estimated to be around 600. This figure is based on records of various Ministry of Land offices, Union Council offices and local representatives that were collected by an activity undertaken by the TA team. Total area of Kazir Char lies under Tazumuddin Upazilla, Bhola district. But some public representatives claimed that a part of this char is situated under Monpura Upazilla. However the actual location of the char can only be ascertained by a Diara survey which would be conducted by the concerned government department. Since the local people are amicably maintaining the boundary line, so there is no fear to be created any hindrance over land settlement process in the char. Nevertheless, before settlement works starts there, the jurisdiction and boundary issue should have to be resolved by the initiative taken from the district administrations of Bhola and Ministry of Land.

Table 4 - 2 Status of land in Kazir Char

District	Upazilla	Mouza /	Area (in Acre)
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		Name of Chars	Area under feasibility study	Di ara Surveyed	Local ly Surveyed (Char cha Map)	Un Surveyed	Alrea dy Settled	Un der Set tle ment proces s	Decl ared or illegal Shri mp Mah al	Clust ered Villa ge/ Asra yon	Ance stral land	For est Land	Misc. (Court case, etc)	Available for Settleme nt
Bhola	Tazumuddin	Kazir Char (Adjacent of Char Mozammel)	3,942	0	1,500	2,442	-	-	-	-	-	-	-	3,942

Kazir Char has 3,942 acres of land. No Diara survey has been conducted as yet. Consequently, no mouza or Upazilla boundaries have been determined. Out of this, 1,500 acres have been found only locally surveyed. In Kazir Char no official settlement has been done. So, around 600 families who are living in the char are illegally occupying the land. And the whole of the area of 3,942 acres can be considered khas land.

4.5 Meeting supply and demand in Kazir Char

The demand side for the available khas land essentially will consist of the demand for land by the households that are already settled in the area and have no khatian (around 600). In addition, there will be demand from government agencies for land needed for development of public infrastructure as embankments, roads, cyclone shelters etc. Experience has learned that about 25% of an area is needed for such collective investments.

The available supply consists of 3,942 acres, the size of the khas land at the moment. There are no claims from the Forest Department. Applying the rule of 25% requirement for infrastructure would leave 2,956 acres for allotment to landless households. If this land is indeed given to the households that have settled in the area and have no official land title (approx. 600), each household could receive 4.9 acres. But one family could not receive more than 1.5 acres, according to the government khas land policy. So, if 1.5 acres land were provided per family, it will require $(600 \times 1.5) = 900$ acres. The remaining part $(2,956 - 900)$ of 2,056 acres can be distributed to $(2,056: 1.5)$ 1,370 landless households that are presently not living in Kazir Char. This would mean that a sizable land settlement program for $(600 + 1,370)$ 1,970 landless families can be undertaken in the area.

4.6 Proposed interventions for Char Mozammel and Kazir Char

The following interventions are proposed as part of the land settlement programme in Char Mozammel under Tazumuddin Upazilla, Bhola district.

- Diara (newly accreted land) survey of Char Mozammel should be conducted immediately by the Directorate of Land Records and Survey (DLRS). District administration of Bhola should take immediate steps in this regard.
- Diara survey of Kazir Char should be conducted immediately by the Directorate of Land Records and Survey (DLRS). District administration of Bhola should take immediate steps in this regard.
- Before settlement works starts, the boundary issues of Char Kola Toli and Char Mozammel should have to be resolved by the initiative taken from the district administrations of Bhola under supervision of Ministry of Land.

- Court cases related to boundary disputes in Char Mozammel and Char Kola Toli have to be monitored closely. If there is any injunction or status quo imposed by the court in the settlement process that should be addressed and should be made vacant before settlement work starts.
- As it was done in previously CDSP-phases, a plot-to-plot survey should be undertaken in Char Mozammel and in Kazir Char in order to define the demand for land from the already present settlers. If available resources would allow it, it could be considered to start this survey in the CDSP IV period. That would give a clear overview of the situation before the proposed new project would start.
- It is important that the Ministry of Land takes the decision to apply the CDSP-procedure for the settlement process in the proposed project. This procedure contains fewer steps, is therefore shorter, and is more transparent, closer to the people and also less costly for them.

4.7 Costs and benefits for Char Mozammel and Kazir Char

4.7.1. Costs

Implementation of the land settlement component of the proposed project, will be the responsibility of the Ministry of Land. NGOs however could assist in informing the settlers about their land rights and about the settlement procedures. The Ministry of Land has to make staff available for the implementation, belonging to offices at different levels of the Ministry. The Ministry might appoint additional staff for the purpose, for the project period as it was done in CDSP III and CDSP IV. So extra costs would be involved, which can be covered under the GoB project budget of the Ministry of Land.

The plot-to-plot survey will bring extra costs as well. With a view on the size of the project area and the experiences to date, it can be estimated that about Taka 16 million is required for the surveys: Taka 11 million is required for the survey in Char Mozammel and Taka 5 million for Kazir Char. Under the responsibility of the Ministry of Land a number of households have to be resettled, because they have settled in areas where infrastructure will be built. Costs involved with the resettlement can roughly be estimated to be Taka 11 million: Taka 10 million for Char Mozammel and Taka 1 million for Kazir Char. Total costs of the land settlement program can therefore be estimated to be Taka 27 million or Taka 270 lakh.

4.7.2. Benefits

It is difficult to translate the benefits of the land settlement efforts into a particular amount in Taka. Experiences have shown that the provision of land titles contributes to an economic and social transformation of the communities concerned. The security that they indeed own the land, will lead to extra investments in the land and presumably to higher production levels. There will be less sharecropping arrangements in favor of more own cultivation. Immaterial benefits are the enhancement of the social status and increase in self-confidence. As can be witnessed in areas where CDSP has been operational, prices of land will considerably go up, further strengthening the asset-base and making it easier to obtain loans, if needed.

5. Agriculture

5.1 Introduction

Agriculture is an important source of livelihood in Char Mozammel. About 36% of the settlers is directly involved with farming. Of the area, 42% is available for agricultural production. Option 1 (leaving the char unprotected) of the proposed package of water management interventions is to have some influence on agriculture, but most of the improvements in the sector will have to come from introduction of modern cultivation technologies and improved crop varieties, facilitated by better extension services, training of farmers and improved input supplies. Under options 3 and 4 (creating a polder) agriculture would benefit because of the possibilities of controlled water levels and the gradual desalinization of the soils, leading to a higher cropping intensity and increased yields.

In this chapter the current situation is presented (5.2) and for both water management options a future scenario is described (5.3). The chapter ends with an assessment of the costs of the proposed actions as well as the benefits.

5.2 Present situation

5.2.1. Cropping pattern, cropping intensity and total production

Of the three cropping seasons (rabi -October to April, kharif I - March to June and kharif II - June to December), the winter (rabi) season and the monsoon (kharif II) season are of importance in Char Mozammel. In the char three cropping patterns can be observed: rabi alone, kharif II alone and rabi followed by kharif II. All cultivation is done under rain fed conditions.

The rabi crop alone pattern covers 14.5% of the cultivated area, followed by rabi and kharif II, with 32.5%. The dominant cropping pattern is kharif II (aman rice) alone, which is practiced on 67% of the area available for crop production (total area minus water bodies, homesteads, infrastructure, forest). The total area throughout all seasons used for crop agriculture is 146% of the available area (the sum of 14,5%, 65%, being twice 32.5%, and 67%), which constitutes the cropping intensity.

Less than 1% of farmers is growing modern rice varieties. Reported yields of local varieties varied from 1,0 to 2,9 tons per ha. The HYV crops brought 3.1 to 4.7 per ha. Total rice production presently amounts to 3,053 tons from 1,571 ha. This means an average yield of 1.94 tons per ha. Soil salinity, soil moisture, poor practices and low input use lead to relatively low yields of rabi crops. Main crops grown are sweet potatoes, tomatoes, egg plants and garlic. Total production stands at 2,469 tons, grown on 739 ha. This means an average yield of 3.34 tons per ha. Table 5.1 presents an overview of crop varieties and production.

5.2.2. Homestead gardening

Most homesteads of the char are not well developed. Area of the homesteads varies from 2 to 70 decimals, with an average of 9 decimals. About 40% of the families in Char Mozammel have a homestead garden. The size of the homesteads ranges from 0.25 to 0.48 decimals, with an average of 2.5 decimal. Crops that are grown are all kind of beans, egg plant, tomatoes, amaranths and other leafy vegetables. Some of the gardens are more developed and fruit – and timber trees, such as banana, custard apple, papaya and mahogany. About 19% of homesteads have a small ditch (borrow pit) that is the source of water for domestic usage and watering the garden.

Table 5 - 1 Yield and production of field crops in Char Mozammel

Crop	Rabi			Kharif-II			
	Area (ha)	Yld. ton/ha	Prod. ton	Variety	Area (ha)	Yield (t/ha)	Production (ton)
Grasspea	232	1.625	378	Rajssail	33	2.012	66
Chilli	156	6.840	1070	Kajolsail	184	2.158	398
Sweet Potato	76	2.496	189	Kalamota	764	1.930	1474
Soybean	51	2.567	131	Sadamota	141	2.006	283

Garlic	43	3.830	166	Kutisail	103	1.579	163
Potato	28	5.411	151	Pangas	112	1.611	181
Linseed	25	0.648	16	Monohar	139	2.398	334
Tomato	23	1.154	27	Lotermota	54	1.956	105
Mungbean	24	3.25	79	Lohachura	0.047	2.718	0.128
Wheat	15	1.322	60	Parbas	0.047	2.965	0.139
Felon	17	3.542	60	Agonsail	9	1.112	10
Groundnut	12	4.680	58	Lembu	0.047	1.236	0.058
Egg plant	12	7.213	89	Tepu	27	1.359	37
Sweet gourd	9	2.677	25	Katikota	0.047	0.741	0.035
Lentil	6	0.700	4	BR11	0.267	3.130	0.835
Mustard	2	0.145	0.290	BR40	0.047	3.707	0.174
Amaranth	2	0.581	1	BR44	0.094	4.448	0.418
Cucumber (Khira)	2	0.174	0.348	Bhajan irri	0.047	4.695	0.221
Okra	2	1.744	3				
Total	739		2,469		1,571		3,053

None of the households keep record of homestead production. The interviewers helped them to recall annual gross income. The average annual income from homestead of vegetables was around Taka 3,300, from fruits Taka 2,300 and from timber Taka 1,500.

5.2.3. Current status of extension services, input supply, credit supply and marketing

DAE staff once in a while visits the char to demonstrate new varieties of rice. The impact of those irregular visits on the technology adoption process is low, probably also due to the method of extension with low participation from the side of the farmers.

There is no registered dealer in agricultural inputs in the Char Mozammel. Some farmers act as representative of registered dealers located in Upazila headquarters. Most farmers use rice seeds from their own stock, and buy seeds for non-rice crops and fertilizer from local, non-registered dealers. The use of seeds is irregular: for some rabi crops less seeds are used than recommended and for others more. About 94% of rabi farmers and 90% of aman cultivators use urea. About 6 and 9% farmers use TSP in rabi vegetables and aman rice, respectively There is a shortage of organic manure. It is mainly used in homestead gardens or in the fields immediately surrounding the homestead.

Farmers borrow money for their investments. About 96% farmers reported to have received credit from one or more sources. Most of the borrowers from banks paid interest at rates between from 10 and 13%.

There is no storage facility in the char. Thos farmers that have a surplus sell their products, mainly rice, just after harvest to middlemen coming from Noakhali. Other products are sold in the markets for consumption by the local people.

5.2.4. Constraints

The five top constraints mentioned reported by farmers in the sample household survey and in group discussions are tidal flooding, high soil – and water salinity, flash floods, availability of credit and high soil moisture in the pre-rabi period. Other lower ranked impediments were not having a title on the land, lack of information and knowledge, availability of seeds, drought and lack of market demand.

5.3 Future scenario

5.3.1. Overview of recommended interventions

- Protection of the char by embankments: This would stop the tidal flooding, while soil salinity would decrease gradually over time; inside the polder fresh water would be available throughout the year. But this intervention is only a part of options 3 and 4. The below proposed interventions can be implemented under all options.

- Enhance drainage capacity: This is a part of the proposed water management intervention. Re-excavation of drainage khals would shorten the time of discharge of flood water after flash floods and tidal floods.

- Introduction of modern agricultural technologies: improved crop varieties suitable for coastal areas such as HYV rice, modern cultivation methods (land management geared toward reducing soil salinity, rice-fish culture, integrated crop-livestock system).

- Providing individual land titles: This forms part of the proposed package (see chapter 4). After receiving their land title, farmers are expected to be more inclined to invest in agriculture.

- Construction of community ponds: Well-located community ponds with proper dimensions could boost the rabi crop production significantly. This forms part of the proposed internal infrastructure (see chapter

3). Another option would be to design and construct control devices in internal khals, for storage of water. Using groundwater for irrigation is no option in coastal areas.

- Strengthening extension services: As mentioned earlier, DAE only provides extension services to a limited extent. The number of available staff, the difficult communication with isolated char islands, combined with inadequate logistical supplies are factors that influences DAEs capability to be effective. To overcome this problem it is proposed to engage suitable private sector organizations, in collaboration with DAE. These private institutions, possibly NGOs, should introduce adapted extension methods, for instance the methods applied by IRRI in chars of Noakhali mainland. This method, as with the Farmer Field School approach, is focused on self-motivation of farmers, with beneficial consequences for adoption of modern technologies.

5.4 Costs and benefits

5.4.1. Costs

The cost of the package of support services is estimated to be Taka 60 lakh (see Table 5.2.) for options 1 and 3. For option 4 (three chars) the estimate is Taka 160 lakh.

Table 5 - 2 Cost of agricultural support services

Item	Cost (Lakh Taka)
Demonstration Farm	20.00
Preservation of Seeds(Purchase of container & Training)	5.00
Training on Extension Activities	20.00
Establishment	10.00
Workshop /Seminar	5.00
Total	60.00

5.4.2. Benefits

The benefits for the agricultural sector will be more in case a polder will be established in Char Mozammel (options 3 and 4). Water levels can be controlled, which will facilitate introduction of HYV crops, while cropping intensity will increase because a larger area will be cultivable. Lower levels of soil salinity will result in higher yields, also for rabi crops. Table 5.2 reflects the expected future scenario under the different options.

Table 5 - 3 Future growth in area and production

Crop/cropping intensity	Time	Options 3,4		Option 1	
		Area (ha)	Production (ton)	Area (ha)	Production (ton)
Rabi	Present	739	2469	739	2469
	4 years after	923	5963	864	5611
	8 years after	1071	8061	943	7261
Rice	Present	1571	3059	1571	3059
	4 years after	1571	3889	1571	3770
	8 years after	1571	5807	1571	5624
All crops	Present	2310	5528	2310	5528
	4 years after	2494	9852	2435	9386
	8 years after	2642	13868	2564	12885
Cropping intensity (%)	Present	147			
	4 years after	159			
	8 years after	168			

The net incremental income per year for options 3 and 4 can be estimated to be Taka 661.45 lakh in the phase of full development, after about 7 years. For option 1 this would be considerably lower: Taka 265.58 lakh.

Also homestead cultivation will benefit from the improved support services. Homestead production could improve significantly. Total value of homestead production could rise from Taka 51.3 lakh now to nearly Taka 90 lakh in future, under all options. This would lead to an incremental annual income of Taka 38.47 lakh.

6. Livestock

6.1 Introduction

The livestock sector accounts for 1.78% of the national GDP, while the share of livestock to the agricultural GDP amounts to 14.08%. In unprotected chars these percentages are probably higher, given the relatively low agricultural yields and the ample availability of grazing land. Livestock products are an important protein source in the food diet. The importance of draught power is decreasing, but cattle is continued to be used for tillage, in char areas possibly more so than in well-developed agricultural settings. Large and small ruminants are considered as an important barrier against risk. Livestock, in particular poultry raising, provide a reliable source of income for landless - and small farmer households. In the estuarine context, in many areas large herds can be observed, owned by large and influential; farmers, using the graze land in unprotected char areas.

This chapter deals with the present situation first (6.2) and continues with possible future development of the sector in Char (6.3), indicating proposed measures. The chapter concludes with highlighting the costs and benefits of the suggested interventions (6.4).

6.2 Present situation

6.2.1. Livestock population

The sample household survey showed that a large majority (80%) of households in Char Mozammel rear cattle (cow or bullock), with an average of two animals per household. Only 3% possess buffaloes, with on average five buffaloes per family. Exactly half of households have goats and 5% has sheep. Goat owners have averagely three goats in their herd, sheep owners have six sheep. Nearly all (91%) households were found rearing chicken and 76% have ducks, with an average of 13 and seven birds per household respectively. A small fraction (3%) rears pigeons, with 11 pigeons per family. Most of the livestock is of local breed.

Table 6 - 1 Livestock population: numbers and value

Type of Livestock	Estimated total animal / bird in the village	Average Value per unit (Taka)	Value of animal/ bird (Taka)
Cow	2730	19,018	51,919,140
Bull/ Bullock	4056	11,502	46,652,112
Buffalo	478	31,735	15,169,330
Goat	5548	2,110	11,706,280
Sheep	868	1,677	1,455,636
Chicken	37372	133	4,970,476
Duck	17131	163	2,792,353
Pigeon	1043	132	137,676

Table 6.1 gives an overview of the current livestock population and its value, based on an extrapolation of the sample results to all 3,120 households.

Livestock owner obtain cash through selling products as milk and eggs, and through sale of live animals. They also save on expenditures by consuming own livestock products, using them as gifts, and by using dung for manure and fuel. On average, annual income of livestock holding household from milk is Taka 15,000, from eggs Taka 6,000 and from live cattle Taka 25,000, from live goat/ and sheep Taka 8,000 and from chicken and duck Taka 4,000.

6.2.2. Support services and marketing

Department of Livestock Services (DLS) provide country wide livestock extension services, but in Char Mozammel only to a very limited extent. Shortage of manpower, the difficulties in reaching the area, combined with lack of proper logistical support, all contribute to this unsatisfactory situation. Access to governmental services with regard to artificial insemination is almost unknown in the area, but private artificial insemination services through BRAC are available, but at a high cost. Due to high price (Tk. 500-600 per insemination) landless, marginal and small farmers cannot avail of the services.

There is no organized system for marketing of livestock products. Milk is sold to middlemen, mainly professional dairy vendors. Each day about 30 milkmen arrive in the char to visit the households and collect milk. For a liter of milk farmers are getting Taka 30 to 35. Milk men also render services for the households by bringing goods from outside the char in their empty cans when they come to collect milk. The raw milk is transported to the nearby bazaar on the main land; there the milk is processed to prepare curd, ghee, cheese etc.

Previously eggs were collected by the middlemen at the door steps of the farmers and subsequently brought to District headquarters like Noakhali and Bhola, and in some cases even to Dhaka and Chittagong. But due to the establishment of commercial poultry farms on the main land the urban demand for eggs is satisfied by these big farms.

Farmers sell live animals to the vendors at an average of Taka 25,000 for a bull or bullock, and Taka 4,000 for goat and sheep.

6.2.3. Constraints

The household survey indicated that major constraints as felt by the households are livestock diseases and lack of knowledge (reported by 30% and 29% of households respectively), followed by theft (14.9%), shortage of feed (13.6%), poor genetic quality (6.5%) and marketing (5.3%). In group discussions it became clear that also housing of animals, in particular cattle, is a problem, especially at night. Only about 10% of participants in the discussions were able to arrange adequate sheds.

6.3 Future livestock development

6.3.1 Measures addressing the constraints

- Extension services: As 30% of the households feel that lack of information and knowledge is a serious constraint in their livestock work, improvement of extension services and training of farmers would be significant steps forward. Instead of solely relying on the services of DLS, it is recommended to engage NGOs to develop semi-skilled manpower (Livestock Field Workers and Poultry Workers) within communities. After training, in which DLS could play a role, these workers can render extension services on husbandry practices, primary animal health care and immunization.

- Training of farmers: A Livestock Farmer Field School method of training of livestock owners should be introduced with the assistance from DLS. Such a system would create linkages between the settlers and DLS staff. The aim is to develop skills and to reduce the knowledge gap.

- Treatment of diseases: It is recommended to instruct the NGO to appoint a veterinary doctor who can organize weekly mobile clinics (also in the adjacent chars), assisted by the NGO workers. An arrangement with DLS should be entered into to channel the supply of drugs and vaccines through this veterinarian and these workers, and to establish a cool chain.

- Supply of fodder: In case the project area will become a polder (options 3 and 4), free grazing facilities will be reduced. On the other hand the cropping intensity will be increased and this will make available more crop residues for the cattle population. As a result the growth rate with project condition will be higher till the optimum herd size is stabilized. Availability of fodder can be stimulated by including more leguminous and salt tolerant fodder crops (such as cow peas and grass peas) in the farming system. Plantation of trees with protein rich leaves, promotion of urea treatment of straw and use of molasses blocks are additional measures to improve the nutrition of animals.

- Improved marketing: It is critical that livestock rearers organize themselves in order to make collective bargaining possible, to reduce the risk of being exploited by the middlemen. The groups can establish direct contacts with sellers of inputs and with buyers of livestock products. They could control the quality of the livestock workers and maintain contact with DLS. They also could introduce milk chilling vats (running on solar power or diesel), which would facilitate the sale of products to more distant markets.

- Shelter: A community livestock shelter and killas might be established

6.4 Costs and benefits

6.4.1. Expected costs

The core of the proposed development program is formed by an improvement of extension- and support services. NGOs are expected to take play a major role in these efforts. The costs of the involvement of NGOs are already included in the cost estimated of the social- and livelihood component (see Chapter 9). In the estimates for internal infrastructure (Chapter 3), a provision is made for a killa. An additional provision of

costs for livestock of Taka 45 lakh for options 1 and 3, and of Taka 130 lakh for option 4 (three chars) is taken up in the overall project cost estimate.

6.4.2. Benefits

The growth of the livestock sector in estuarine areas is expected to be higher than the national growth rate because of the specific environmental environment and the availability of natural resources as grazing grounds. The lack of a range of other employment opportunities is a factor as well. This growth can be stimulated further if the proposed measures (see 6.3.1) are indeed introduced, as is shown in Table 6.2 below for option 1 and in Table 6.3. for options 3 and 4.. The projected growth is expected to stabilize after about six years. Of course the projected growth rates are rough but at the same time reasoned estimates.

Table 6 - 2 Estimated livestock population growth (option 1)

Type of animal	Estimated Annual Growth Rate (%)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Cattle	1	6786	6854	6897	6940	6984	7028	7072	7117	7162	7207
Buffalo	1	478	483	487	491	494	498	502	506	510	515
Goat	2.5	5548	5687	5723	5760	5797	5834	5871	5909	5946	5984
Sheep	2.5	868	890	907	926	944	963	982	1002	1022	1042
Chicken	3	3737	38493	39467	40466	41489	42539	43615	44719	45850	47010
Duck	4	1713	17816	18422	19048	19696	20366	21058	21774	22514	23280

Table 6 - 3 Estimated livestock population growth (options 3 and 4)

Type of animal	Estimated Annual Growth Rate (%)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Cattle	2.5	6786	6956	7130	7308	7490	7678	7870	8066	8268	8475
Buffalo	2.5	478	483	488	492	497	502	507	512	518	523
Goat	3	5548	5714	5886	6062	6244	6432	6625	6823	7028	7239
Sheep	3	868	894	921	948	977	1006	1036	1068	1100	1133
Chicken	5	3737	39241	41203	43263	45426	47697	50082	52586	55215	57976
Duck	5	1713	17988	18887	19831	20823	21864	22957	24105	25310	26576

Net benefits at full development stage are estimated to be Taka 348.61 lakh per year in case a polder is built (options 3 and 4) and Taka 279.05 in case of option 1.

7. Fisheries

7.1 Introduction

Bangladesh wide the fish production is on the rise, currently representing 3.7% of GDP and 22.6% of the agricultural part in GDP. It gives employment to over 17 million people and has become a vital component of the country's export. Equally, aquaculture in ponds and fisheries in canals, rivers and in the Meghna estuary are important activities for the char population. These activities are a source of income and employment. Many of the settlers in the new chars were fishermen before and they like to work again in their old trade. Fish forms a welcome source of protein in the diet. Wild fisheries and aquaculture is essential in improving livelihoods in the context of coastal chars. In Char Mozammel about 18% of households are engaged in fisheries.

This chapter first looks into the present situation of fisheries in Char Mozammel (7.2.) and shifts then to possibilities for development, within the framework of the water management options presented in Chapter 2. The chapter concludes with the costs of the proposed development measures, and with the benefits (7.4.)

7.2 Present situation

7.2.1. Closed water fisheries

Closed water bodies are basically ponds and ditches. They can be considered a by-product of house building. They form the borrow pits of making raised homestead platforms for a house, courtyard and garden. Just over 5% of households reported that private ponds are a source of fishing for them; a low figure compared to adjacent chars. Total area of ponds and ditches in Char Mozammel is estimated to be nearly 7 ha. The ponds in the char produced about 3.5 ton in a year, which means around 500 kg of fish per hectare per year. As already mentioned, total catch in ponds and ditches is negatively influenced by tidal floods and storm surges.

7.2.2. Capture fisheries in khals, floodplains and outside the study area

Open, wild inland fisheries is practiced in khals (area of 79 ha) and on floodplains (0.5 ha). These khals and plains are stocked with wild sources during tides and floods. Wild fisheries in khals amounted to a production of about 39 tons of fish. This means that yield per ha is over 490 kg. Total catch from floodplains is not much, about 100 kg a year. More than half of households use khals and floodplains as their primary fishing ground. Another 36% of households said that the Meghna estuary was their most important fishing ground.

7.2.3. Total current fish production

The total annual marketable fish production of Char Mozammel, including catch from the estuary, is estimated to be 67 ton. The average price for big fish was Taka 248 per kilo and for small fish Taka 100 per kilo.

7.2.4. Constraints

Fisheries in Char Mozammel face a series of bottlenecks. The number of ponds is limited, which constraints the fish production through aquaculture. Ponds are damaged and fish gets lost by tidal surges, overtopping the little dykes protecting the ponds. Extension services are scarcely available. Staff of the Department of Fisheries hardly ever visit the char. Supply of inputs, such as fry and fingerlings, is highly inadequate. Most inputs carry a high price. There is a lack of credit facilities. Transport of fish for marketing is difficult due to lack of a proper road network and supply of ice. Fish from the area is sold to traders or on the wholesale market in Tazimuddin. Catch from the Meghna estuary is usually brought to Steamer ghat near Boyer Char.

7.3 Development plan

7.3.1. Consequences of water management interventions

The ultimate selection of water management option has obviously consequences for the possibilities of further development of the fisheries sector. In case a polder will be constructed in Char Mozammel (options 3 and 4) open fisheries in khals and on floodplains will be affected. On the one hand, fish can no longer enter freely into the khals and plains because of the embankment and regulators (which can be mitigated by making fish friendly structures). But on the other hand khals will be deepened by re-excavation, increasing the volume of water available for fish. Fish production through aquaculture will increase because the ponds will be flood free. The improved physical environment will encourage pond owners to adopt more intensive methods of culture. Fishing in the Meghna estuary will not so much be affected, although boats can no longer be taken inland for shelter and repairs. If the char will be left unprotected (under option 1), enhancement of fisheries has to be achieved through improved extension services, input supplies and marketing facilities. Inland fisheries will further benefit from re-excavation of khals.

7.3.2. Development of aquaculture based fisheries

- Option 1:

If the char is left unprotected to allow further siltation, pond cultivation will also become more productive due to the improved extension services and marketing system (see below). An increase from 10-20% is in that case possible, that is from the present 504 kg/ha per year to 550-600 kg/ha, or an increase of total annual production from 3.5 MT to about 4 MT.

- Options 3 and 4:

As just mentioned, protection of the area will stimulate further development of aquaculture. Introduction of improved methods of pond management will however require extension efforts and better input supplies. Semi-intensive or intensive models differ with traditional models in matters of stocking fingerlings and use of other inputs, such as fertilizers and feed. Prescribed number of fingerlings and quantities of inputs need to be applied. The distinguishing feature of the intensive method of production is the higher rate of stocking and the application of prepared feed. In a protected area, average annual production rate of household ponds can be increased to 2,000 kg/ha (from the present 504 kg/ha) using intensive methods of fish culture. In terms of overall production and taking the present number of ponds as basis, this would mean a growth from 3.5 MT to 13.7 MT a year. It is estimated that about 30% of ponds in Char Mozammel could be brought under prawn (golda) culture, a high value product.

7.3.3. Development of fisheries in open water bodies

- Option 1:

In case no embankment is constructed, wild fisheries will still be better off because of improved extension services and marketing possibilities, and because of the larger volume of khals as a result of re-excavation. An increase in yield with 10-20%, from 490 kg/ha per year to about 540-590 is possible. Floodplain fisheries would continue. This would represent an increase of annual production from open water bodies from 39 MT to nearly 45 MT a year.

- Options 3 and 4:

Khals will be re-excavated for improvement of drainage systems. If a polder is constructed, the re-excavated khals will retain water during the dry period covering December to April with the support of water control structures. This will create a better habitat for increasing natural fish production in the khals, provided no serious obstructions are made to movement of brood fish and shrimp species through the structures. Khals can even be used for aquaculture, if intelligent use is made of the water control structures and with support of rather simple devices as khattas from branches of trees to divide khals into sections. In such a way, khals can be stocked with fish and prawns. It is expected that khal fisheries production will increase from present level of 490 kg/ ha/ yr to 800 kg/ ha/ yr in case peripheral embankments are built. But floodplains would be lost as fishing ground. Annual production from open waters would grow from 39 MT to 63.5 MT. Option 4 would generate an additional 612 MT because of the huge lake that will be formed in between the three chars if they are all three included in one polder.

7.3.4. Extension services and marketing system.

As is proposed in the case of livestock, a NGO might be engaged to take care of extension services and training. This can be successfully done if a fruitful cooperation with the Department of Fisheries is established, for instance in the fields of training and input supplies. Demonstration ponds should be one of the methods of dissemination of good practices. Experiences in CDSP and the Greater Noakhali Aquaculture Extension Project should be utilized. The NGO should be asked also to assist households in organizing groups so collective bargaining with middle men can be initiated in the process of selling fish and procuring input supplies. It is proposed to erect a hatchery in nearby Char Kola Toli, so a sustained supply of good quality fish fry can be secured.

7.4 Costs and benefits

7.4.1. Costs

The additional costs of better extension services are in fact taken up in the budget for the social- and livelihood program, since the NGOs are expected to take the lead in this respect. For options 3 and 4 (three chars) a provision of Taka 35 lakh and Taka 105 lakh respectively for additional expenditures is included in the project cost estimate.

7.4.2. Benefits

The increased income from fisheries would come from aquaculture in individual ponds and community ponds if the char is protected by embankments, as well as from capture fisheries in the re-excavated *khals* and from the floodplain. Fisheries incremental annual net benefits from different production systems at full development level is expected to occur in the 8th year of project life. Under options 3 and 4, incremental benefits from fisheries in open water bodies are estimated to be Taka 56.50 lakh per year, and for closed water bodies Taka 12.24 lakh. If the char is not protected, the additional income will be very modest and is not reflected in the cost-benefit analysis.

8. Social forestry

8.1 Introduction

The benefits of forestry development can broadly be divided into three groups: greater safety, improved ecological conditions and a better economic situation for the char settlers. These beneficial functions of forestry make forestry development an essential element of any development package, especially for vulnerable areas as Char Mozammel, being an island char.

There is ample empirical evidence that plantations along the coast have enhanced the protection against storm surges and tidal bores. Devastation of infrastructure and loss of lives have been much smaller in areas with a forest belt. Houses on homesteads with trees suffer less damage from storms. Coastal forests, in particular mangroves, further stabilize the newly emerged areas. They stimulate biodiversity and conserve coastal ecosystems. Trees have a dampening impact on soil erosion, while organic matters are contributing to the fertility of coastal soils. Forests provide timber for building houses and fuel for cooking purposes. In addition, trees give fruits for human consumption, medicinal herbs, and fodder for animals. By participating in social forestry activities, settlers generate an extra stream of income.

8.2 Present situation and constraints

8.2.1. Present coverage of forest in the study area

In 1998 the Noakhali Coastal Division of the Forest Department started with a mangrove plantation of 250 ha, followed in the next year by a second one of 550 ha. Both were very successful. However, in 2007 illegal migration of settlers started, and gradually the mangrove coverage disappeared. The char is now not protected by any greenbelt around it, so is it very much open to natural hazards like cyclonic storms and water surges. Hardly any forest can be found in the Char Mozammel. The present coverage of vegetation can mainly be found in the homesteads and on public grounds. A survey showed that nearly all people are interested in further tree plantations.

8.2.2. Constraints for forestry development

Due to the encroachment of the mangrove forests the relation between the population and the Forest Department have often be tense. This has to change in order to implement a forest development program. The lack of a title on the land that people now occupy makes people reluctant to invest in more trees on their homesteads. Grazing of cattle is another impediment: more forests might imply loss of grazing grounds, while ruminants damage young trees. There is a huge demand for fuel wood (mainly cow dung and straw are sources of fuel). Shortage of seeds is a constraining factor. The char is not very old, so there is a dearth of mother trees as a source of seeds. Seeds are to be collected from nearby islands or from the main land.

8.3 Proposed interventions

8.3.1. Following the social forestry approach

The government has enacted specific Social Forestry Rules in 2004, amended in 2010. Essential elements in the social forestry approach are the participation of local people in planning and implementation of forestry development activities, the formation of Social Forestry Groups as institutions to make such participation happen and agreements between governmental agencies and the Social Forestry Groups on sharing of the benefits of forestry development. The social forestry approach adds a fourth benefit of forestry development to the three mentioned in the introduction. It provides employment to the people, and it enhances their self-confidence and self-esteem by acquiring skills and knowledge. Social forestry can contribute to the homogeneity of communities.

The Forest Department should apply the social forestry approach in Char Mozammel as well for all the below presented activities. Social Forestry Groups (SFG) have to be formed (see also Chapter 10). The Department is expected to enter into agreements with these SFGs determining the sharing of benefits. For different type of activities (as for example agro-forestry, road/embankment/khal plantations, and foreshore plantation) different sharing arrangements will be applicable. For strip plantations along roads etc. for

instance, the distribution of benefits would be Forest Department 10%, land owning government agencies 20%, SFG-members 55%, Union Parishad 5% and Tree Farming Fund 10%.

8.3.2. Embankment plantation

Only in options 3 and 4 plantation of embankments are applicable. Along the total length of the dykes (in option 3 6.66 km sea facing- and 9.71 km interior, in option 4 19.6 km sea facing and 29.73 km interior) planting of arhar, dhaincha and coconut seedlings is recommended.

8.3.2. Mangrove plantations

There are extensive mudflats adjacent to Char Mozammel. But these mudflats seem to be rather stable. They have a minimum of 15 cm of clay and are covered with uri grass. Regular tidal inundation takes place, with a depth between 75 and 90 cm. It is estimated that around 1,500 ha of mudflat is suitable for mangrove plantation. The species proposed are keora, baen, gewa and golpata. The seedlings are not available locally and the best solution seems to be to establish a nursery.

The mangrove plantation will be raised by the Forest Department with the involvement of Social Forestry Groups. On the one hand this will provide employment and income to local settlers, and on the other hand will prevent illegal encroachment. Mangrove plantations can be implemented under option 1, and under options 3 and 4.

8.3.3. Foreshore plantation on mounds

Between the land mass of Char Mozammel and the mudflats, non-mangrove species will be planted to further defend the coast line and at the same time create income for people living nearby. Trees will be planted on mounds, specially built for this purpose. There are eight non-mangrove species recommended for foreshore plantation: jhaw, kat badam, hybrid acacia, nishinda, babul, tetul, arjun and jarul. Estimated area to be planted is about 100 ha. Seedlings for foreshore plantation (and for other plantations, mentioned below, as well) can be procured from private and public nurseries in the adjacent areas. If settlers are interested to establish a local nursery, this should be encouraged by giving them training. Foreshore plantations can only be done in case an embankment is constructed, so only in options 3 and 4.

8.3.4. Roadside plantation

The proposed network of rural roads will have a total length of 12.84 km (see Chapter 3). It is recommended to have two rows of plantation at each side of the roads, one of them being arhar. There are many species suitable for roadside plantation, such as: jhaw, mahgani, gamar, neem, rajkoro, silkoro, raintree, sonalu, sissou and arjun. Road side plantations are possible in all options.

8.3.5. Plantation along khals

Total length of canals is 18.3 km. Each side of the canal will be brought under strip plantation, again with arhar as a fence for the other seedlings. Selection can be made from a wide assortment of species, among them pitali, raintree, gamar, sonalu, arjun, jam, kat badam, babul, khoye babul and kadam. Roadside plantation should only be considered in case the char is protected (options 3 and 4)

8.3.6. Agro-forestry on homesteads

The homesteads, including the banks of ponds and ditches, will have a combination of vegetables and fruit- and timber trees. A large number of species are suitable for the homestead, for instance am, jam, kanthal, kul, dewa, piara, lebu, coconut, mahgani, jhaw, raintree and bamboo. The Forest Department will support the NGO staff involved with homestead plantation with facilitating supply of seedlings and support to demonstration of plantation methods. Forestry development on homesteads is proposed for options 3 and 4.

8.4 Costs and benefits

8.4.1. Costs

Table 8 - 1 Plantation costs (in lakh Takas)

	Option 1	Option 3	Option 4
Mangrove plantation	330.0	348.0	417.6
Foreshore mound plantation		256.3	512.6
Embankment plantation		27.6	88.7
Roadside plantation	15.1	15.1	46.2
Canal bank plantation		20.2	57.9
Homestead plantation		6.0	11.8
Public/community Institutions plantation		0.1	0.3
Capacity building, mobilization		24.1	37.6
Total amount	345.1	697.4	1172.7

8.4.2. Benefits

Revenue will be generated by sale of wood and fruits of plantation trees. The program participants, members of SFGs, will provide labour in the nursery and during plantation on basis of benefit sharing arrangements. In addition to these financial benefits, the people and the area will benefit from the forestry development program as proposed here, because of the function of forests in char areas related to safety, social relations and the ecology, as described earlier in 8.1.1.

It is expected that most revenue can be obtained in the period from five years to 15 years after plantation. Estimated annual incremental income in that period amounts to Taka 620.06 lakh in case the char is left unprotected (option 1) and to Taka 1267.09 if a polder is established.

9. Social and livelihood component

9.1 Introduction

9.1.1. The need of a separate component

Many of the proposed interventions with regard to water management and productive sectors will have a significant impact on the social and livelihood situation of the char settlers,. Still it was felt that an additional component specially geared towards social needs not dealt with by the other components (such as health, education, disaster preparation) was warranted. This component could also support activities that have already been dealt with in other chapters (for instance livestock, fisheries, drinking water and sanitation). Following the practice in CDSP IV, it is proposed that this social and livelihood cluster is implemented by NGOs.

9.1.2. Present situation

In Char Mozammel only one NGO has been operational from outside the char (Muslim Aid), working on rural roads and distribution of sanitary latrines. Compared to the demand from the settlers for social services, this is quite insufficient. There is no Micro Finance Institution (MFI) working in the area.

There are no health care related government services. In terms of provision of health care, there are actually only the medicine shops. But the sellers have had no training in treatment of human diseases or family planning, immunization or nutrition. There are no government or NGO schools. There are a few madrassas with usually only students that live nearby. There is no organization involved with legal and human rights. The same can be said about disaster preparedness. As already indicated in other chapters there is only a marginal involvement from government institutions in productive sectors as agriculture, livestock, fisheries and forestry.

9.2 Strategy for NGO support

9.2.1. Objective

The social and livelihood component would have as main objective providing essential services to support poverty reduction, both in an economic (productive) and social sense (such as health, education, disaster management and household-level climate change adaptation), that cannot be provided by government agencies at this early stage of development of Char Mozammel. These essential services should include providing micro-finance services, which will enable poor people to take advantage of the improved environment and infrastructure; supporting the activities of government implementing agencies, such as for water and sanitation, where NGOs can form tube well user groups and organize the installation of latrines; promoting human rights and legal awareness, especially for women.

9.2.2. Subjects to be covered

The social and livelihood support program has been divided into the following sub-components:

- a) Group formation, micro-finance and capacity building
- b) Health and family planning
- c) Education
- d) Water and Sanitation
- e) Homestead agriculture and value chain development
- f) Poultry and Livestock
- g) Fisheries and aquaculture
- h) Legal and human rights
- i) Disaster management
- j) Awareness on environment and climate change

9.2.3. Number of NGOs

Based on the estimate of the current population and the expected migration of more settlers in the years to come, mainly because of the availability of khas land, planning has taken place on the basis of around 4,000 households in future. With a view on this number, it is the intention to support the establishment of

three branch offices in the area. These offices would be able to serve the whole population of Char Mozammel. It is proposed to engage one NGO for this char.

9.3 Proposed NGO services for the study area

As indicated under 9.2.2, the proposed program will have 10 components. Below, the intended activities will be dealt with component wise.

9.3.1. Group formation, micro-finance and capacity building

As well as paying for the cost for group formation, it is proposed to fund capacity building of group members/ clients and NGO micro-finance staff. Since the micro-finance in the project areas will be relatively new, it will be important for members to learn about micro-credit management, micro-credit discipline, rules and regulations, and to have a basic knowledge of Income Generating Activities (IGA) management. Organizing women char dwellers into NGO groups will be the main institutional platform for offering financial services (savings and credit) and for delivering other services. Micro-finance and other development services are expected to continue even after the end of the project. Projections for group formation are based on an estimated population of 4,000 households in the project. This is higher than the estimate of the present number of households, but it takes into account the expected increase in the period between the time of this study and actual implementation. Also during the project period itself a further increase can be expected. It is assumed one woman from each household will become a member of a group based around micro-finance. Assuming an average group has 25 members, a total of 160 groups will be needed.

As a regular activity the NGO will mobilize group member savings and use a part of this fund to lend out as micro-credit to the group members. The selected NGO must be able to mobilize resources from institutions like PKSF, the major institutional lender for micro-credit in the country. Capacity building will focus on both NGO staff as well as the members of the groups.

9.3.2. Health and family planning

The findings of review of the health and family planning aspects during the preparatory missions in area as well as experience of the on-going CDSP IV project, reveal critical health and family planning challenges and concerns of the char dwellers. Activities will focus on training, especially Health and Family Planning Facilitators (who will form the backbone of the component) and Traditional Birth Attendants (15 in each NGO branch); clinical services (each branch will have a clinic manned by a Medical Assistant); distribution of medicines, contraceptives and TBA-kits; awareness raising and linkages with other health programs, in particular the vaccination program.

9.3.3. Education

Human resource development is at the core of Bangladesh's development efforts and access to quality education is critical to poverty reduction and economic development. In the previous phases of CDSP there was no arrangement to implement an educational program. Children of school going age cannot go to school due to lack of available educational institutions and were deprived from at least primary education. A high rate of illiteracy is hindering development initiatives. In the study area there are no government or NGO schools. Among others, activities will include establishment of non-formal schools, supply of logistics (books, pencils etc.), advance-money for housing, one teacher for each school and training for NGO-staff. The aim is to establish 15 non formal primary schools under each of the three branches in Char Mozammel, so 45 in total.

9.3.4. Water and sanitation

It is proposed to install 200 DTWs under option 1 or 322 under options 3 and 4 (see Chapter 3). Also, every household will receive a latrine under the project; both interventions to be implemented by DPHE. The role of the NGO will be to assist DPHE to: (i) select sites for DTW installation, select and form water (tube-well) user groups, collect their contributions, train representatives of user-groups on repair and maintenance of tube-wells; (ii) facilitate distribution and installation of latrines; and (iii) provide training to NGO staff (the NGO staff will provide training to the members of the tube well user group on health and hygiene). With a view on the number of tube wells it is estimated that between 20 and 25 tube well user groups will be formed in case of options 3 and 4, and around 13 in case of option 1 (15 members, one each from 15 households using the tube well).

9.3.5. Homestead agriculture and value chain development

While DAE will implement a component aimed at developing field crops, the NGO will focus on homestead agriculture (fruits and vegetables). They will also promote tree (fruit and timber) nurseries operated by NGO group members and promote planting of trees around homesteads. The focus of the activities will be promotion of new and improved varieties and technologies through training and high value crop

demonstrations. An Agriculture Coordinator will be appointed in each NGO branch office. Training of farmers, demonstrations and dissemination will be the main activities. In respect of value chain development, crop and non-crop products will be identified through rapid assessment of their potential for creating employment, and increasing sales and income. The products could be high value new vegetables, fisheries and livestock, and any non-crop processed food and non-food items with good potential in the area. The intention is that each branch implements one value chain development activity each year for five years. A lump-sum amount of Tk100,000 is allocated for each value chain development effort.

9.3.6. Livestock

In previous CDSP phases, livestock development did not form a part of the project. The Danida supported Regional Fisheries and Livestock Development project (RFLDC) was operational at the same time in the same areas and took care of the livestock sector. Because the Danish program has ceased to exist, it is proposed to make the NGO responsible for livestock development, including poultry. Important activities will be conducting a baseline survey; the selection and training of Poultry Workers and Livestock Field Workers; training of farmers and extension services (on rearing of cattle, sheep goats and poultry, animal diseases, fodder cultivation etc.); supply and preservation of vaccines (to be collected from the Department of Livestock Services and other available sources) and medicines. See also Chapter 6 for more information on the livestock sector. The NGO will have one specialized staff member.

9.3.7. Fisheries

As in the case of livestock it is proposed to entertain fisheries activities, in particular aquaculture, through the NGO. Major activities will be making a baseline survey; selection and training of farmers; and distribution of inputs. The training will focus on selection of species and feed, pond management, raising and distribution of fingerlings and demonstration. The NGO will appoint a fisheries coordinator.

9.3.8. Legal and human rights

Experience in CDSP IV areas shows that settlers lack good knowledge about property rights, especially about land rights and about family laws (marriage law, registration etc). That places settlers in a vulnerable position regarding getting ownership of land, the most valued asset. Besides, women rights issues within the family and rights issues in the wider society need to be addressed. The objective of the sub-component is to inform the group members and community about several critical laws and human rights issues through training and other awareness raising activities. Apart from group members, male household members will be trained on legal and human rights. This activity will benefit from links to agencies that promote human and legal rights. With regard to the land rights and procedures to obtain a land title, close cooperation will be pursued with the Ministry of Land. Training of group members will be the most important intervention. In groups that have received training, a Law Implementation Committee will be formed. Two Legal and Human Rights promoters will be selected for each branch.

9.3.9. Disaster management

The remote coastal project area is specifically vulnerable to natural disasters as cyclones and storm surges. The emphasis will be on awareness with regard to preparedness, disaster management and mitigation issues. Training, followed-up by refresher courses, will be imparted to selected group members. NGO-staff will be trained as well. A relation will be developed with the Union Disaster Management Committee and the Red Crescent by having annual meetings. Each branch will have a coordinator for this sub-component.

9.3.10. Awareness on environment and climate change

Its location in the exposed coastal zone makes Char Mozammel especially vulnerable to climatic risk (see also Chapter 2). An essential strategy to mitigate the consequences of this global phenomenon is to assist local communities in adaptation to the gradually evolving changes circumstances. The situation fully justifies efforts to raise awareness about climate change and the environment. The focus will be on training of selected (about 10%) group members that can form a skilled cadre with the task of dissemination of knowledge and information to the community. Some rather basic measures will be promoted such as improved cooking stoves, raising of plinths, strengthening of houses and planting of protective trees on the homestead.

9.4 Costs and benefits

9.4.1. Costs

Table 9 - 1 Summary of budget for social and livelihood program, Char Mozammel

Sl No	Sub- components	Total
A	Supervision and management cost	
A.1	Supervision and management cost for coordination office	15,516,400
A.2	Supervision and management cost for branch office	28,129,922
A.3	Grand total -50% Char Mozammel	7,234,483
	Total A: Supervision and management cost	50,880,805
B	Group formation and microfinance	
B.1	Support for group formation	18,718,500
B.2	Beneficiary capacity building MF group members only	36,223,725
B.3.	Beneficiaries risk fund (credit insurance)	600,000
	Total B: Group formation and microfinance	55,542,225
C	Programme activities	
C.1	Health and family planning	42,581,047
C.2	Water and sanitation program	17,161,990
C.3	Disaster management program	15,147,196
C.4	Legal and human rights	12,171,622
C.5	Value chain development	1,650,000
C.6	Homestead agriculture	14,733,119
C.7	Education	93,719,448
C.8	Climate change and adaptation	33,410,010
C.9	Poultry and livestock program	22,090,947
C.10	Fisheries development	13,385,645
C	Total of programme activities (3to 11)	266,051,023
D	Grand Total (A+B+C)	372,474,052

9.4.2. Benefits

It is expected that the social- and livelihood component will lead to both social and economic beneficial results for the settlers in the study area. Because the groups to be formed by the NGO consist exclusively of women, the proposed activities will in particular support the improvement of the status of women. The training in legal and human rights can further strengthen their position. The health- and education sub-components will improve the health status and will increase the access for children to primary education. The support from the NGO for the formation of Tube well User Groups and the training in hygiene subjects will also contribute to better health conditions. The support in selection of sites will facilitate the installation of tube wells, which will lessen the burden of women in their daily task of collecting water. The attention for disaster management will enhance the physical security of the people in emergencies, and can be seen as complementary to other measures such as the establishment of cyclone shelters, improved road network and the protective embankment (in case of options 3 and 4).

The economic benefits are generated by the involvement of the NGO in homestead agriculture, fisheries and livestock, and in the income generating activities for women. Households will generate more income through these activities, and this will contribute to the general economic uplift of the chars.

10. Governance

10.1 Introduction

In the subsequent CDSP projects, it was recognized that improving livelihoods of households in vulnerable areas as the chars in the exposed coastal zone, cannot be achieved by one type of intervention undertaken by one institution. To be effective, it needs a multi-sectoral and multi-institutional approach. This is completely in line with the Coastal Zone Policy and the Coastal Development Strategy, adopted by the Bangladesh government.

This chapter will focus on the governance aspects of such an approach. It deals with the organizations that would be involved in the further planning and implementation of the package of activities as proposed in this study report. These organizations are positioned at different levels: national, local and field level. The next section dwells on the proposed future involvement of national stakeholders and the coordination among them. The local government bodies in can be found in 10.3 and the community based organizations in 10.4.

As in most of the coastal char areas, there are no institutions in Char Mozammel. The fact that the char is an island in the Lower Meghna, and thus rather remote, makes it cumbersome for national institutions to be effective. Actually, their presence is hardly felt. In 1998 the Forest Department started with afforestation of the char, but ultimately had to withdraw because the illegal encroachment of settlers. None of the other national technical oriented agencies important for CDSP, as BWDB, LGED, DPHE and DAE are active in the char. Also the Ministry of Land did not implement any activities. No diara map has been prepared, no land titles were distributed. Only one NGO, from another char, was involved in some road construction and installing of tube wells and latrines.

10.2 Future involvement of national government agencies

10.2.1. Bangladesh Water Development Board (BWDB)

BWDB will be entrusted to construct all water management related infrastructure, like drainage channels and information centres for WMOs. It will be the responsibility of BWDB to form, train, register and provide assistance to formation, training and support of WMOs. This has to be done in accordance with National Water Policy and the Guidelines for Participatory Water Management (GPWM), including the Participatory Water Management Rules of 2014. In order to establish the WMOs as leading CBOs, BWDB needs to make effective efforts to develop their capacities in discharging their due responsibilities as laid down in aforementioned government documents. There is no doubt this will be a challenging task for BWDB. Experience gained over the years in previous CDSP phases has learned that much of the work involved falls on the shoulders of the technical assistance team, not so much on those of the BWDB staff.

10.2.2. Local Government Engineering Department (LGED)

Like the current arrangement in CDSP, LGED has the mandate to construct much of the internal infrastructure such as the proposed rural roads, culverts, cyclone shelters and community ponds (see Chapter 3). LGED will extend their cooperation to water management organizations in developing relevant maintenance plans for the new infrastructure. LGED will be responsible for major maintenance works, also in older CDSP areas. For earth work, LGED will engage Labour Contracting Societies (LCS) as much as it is feasible under the local circumstances.

10.2.3. Department of Public Health Engineering (DPHE)

The responsibility of DPHE will be to construct the infrastructure related to water and sanitation, like deep tube wells, toilets, rain water harvesting schemes and public toilets (described in Chapter 3). DPHE will involve contractors as well as LCSs where feasible. DPHE will work closely with NGOs that are organizing and supporting tube well user groups.

DPHE will install tube wells in locations selected by the settlers with the assistance of NGOs. These NGOs will also collect contributions from households for the installation costs.

10.2.4. Ministry of Land (MoL)

The concerned District and Upazila administration will implement the land settlement program on behalf of the Ministry of Land. The process and procedures practiced in CDSP projects will be followed. Accordingly, information dissemination meetings will be organized in Char Mozammel and Kazir Char to inform the settlers about the steps to be taken in the settlement process. An NGO will be involved in providing information on the land rights of the population. The Ministry of Land will initiate a plot to plot survey to make an inventory of the actual situation and to identify the households that are landless and indeed qualify to participate in the official settlement. Those settlers will subsequently follow the other phases in the procedure that is ultimately aimed at distribution of titles on maximum 1.5 acres of land. More information on land settlement in Char Mozammel and Kazir Char is given in Chapter 4.

10.2.5. Department of Agricultural Extension (DAE)

Low productivity of crop land is typical for new char areas. Lack of information on suitable crop varieties and on modern cultivation technologies are factors that impede improvements in production. The task of DAE will be to provide extension services and training for farmers. In order to reach out to remote areas as the island chars in the Lower Meghna, DAE will have to make sufficient field staff available and provide its staff with the required logistical support. The Department will, with NGO assistance, form Farmers Forums (FF). Extension efforts will apply the Farmer Field School methodology, with a high degree of participation from the farmers. DAE can play a vital role in developing the capacities of FFs in developing backward and forward linkages with other market forces at local levels.

10.2.6. Department of Forest (FD)

The Forest Department will be responsible for all plantation activities, such as mangrove plantation on mudflats, plantation along roads and khals and on the terrain of public places as cyclone shelters, schools and mosques (see chapter 8). It will in a sense restart its presence in Char Mozammel by applying the social forestry approach. Social Forestry Groups will be formed. The Department will have the task to form, train and support these groups. The Department will work closely together with the NGO on homestead forestry.

10.2.7. Departments of Livestock (DLS) and Department of Fisheries (DoF)

The Department of Livestock and the Department of Fisheries will not belong to the group of abovementioned six implementing agencies of the proposed project. They will however provide assistance by providing support to the NGO working in Char Mozammel. This support will take place at Upazila- and Union level and will evolve around facilitating provision of input supplies and extension.

10.2.8. Coordination

Based on the experience of CDSP I, II, III and the on-going IV phase, a sort of “best practice” with regard to effective coordination and cooperation among the different implementing agencies has emerged over the years. Based on the principle of common planning and sectoral implementation, an integrated development model that has proven to be successful is to have one overall project concept paper as an umbrella, followed by individual development project proformas (DPPs) for each of the individual partner agencies. An Inter-Ministerial Steering Committee (IMSC) forms the policy level forum, while the Project Management Committee (PMC) forms the regular coordinating platform for implementation and review of all progress, problems and bottlenecks. Different phases of CDSP demonstrated the success of this coordination model particularly at national- and project level. There is scope of exploring ways to improve the coordination among different partner agencies at the level of the Union Parishad. Strengthening coordination with Union Parishad requires capacity development, which will form a part of the total proposed package of activities.

10.3 Local Government Institutions

10.3.1. Present situation

Char Mozammel is located in Bhola District. It is part of one Union, Dollichandpur, under Tazimuddin Upazila. The name of the mouza is Dollichandpur as well. CDSP has not yet been operational in Bhola District and consequently the administration of Bhola District and the Upazila and Union administrations are not familiar with the integrated development approach of CDSP. It is necessary that workshops are organized to inform administration staff members and elected Parishad members about the concept of integrated development and the way it is practiced in the context of CDSP. Also the history of CDSP and its achievements in other Districts should be on the agenda of these workshops.

10.3.2. Future scenario

In future char development programs, strengthening of the local government institutions, in particular the Union Parishads will need to be one of the core institutional development interventions. In case of Char Mozammel it is the UP of Dollichandpur. The UP is expected to provide and coordinate support to the

WMOs, and to be involved in the annual maintenance program for their area. The UP has an important role in developing the linkage between WMOs and other field level institutions (WMOs, FFs, SFGs, TUGs, microfinance groups etc.), government implementing agencies, NGOs and other service providers. UPs are indeed pivotal in assessing the local needs and planning of activities in consultation with other stakeholders, and in monitoring the progress.

10.4 Field level Institutions

10.4.1. Present situation

Apart from a number of mosque and market committees, there are no field level groups in Char Mozammel. So there is no institutional capacity at field level to plan for and participate in a multi-sectoral development effort as is proposed in this report. It is therefore absolutely vital that such capacity is established and fostered in order to make the program successful. The sections below describe which field level institutions should be formed. This is largely based on the experiences of CDSP's ongoing and previous phases.

10.4.2 Water Management Organizations (WMOs)

Participatory water management will be the focal feature for the proposed char development program. In turning this concept into practice, "Guidelines for Participatory Water Management (GPWM)" as approved by the Ministry of Water Resources (MOWR) in 2001 and the "Participatory Water Management Rules-2014" will be the guiding documents. . During the field level consultation with local people, they indeed expressed their interest on the formation of water management organizations. It is proposed to form eight Water Management Groups and one Water Management Association in Char Mozammel, based on a preliminary assessment of hydrological boundaries. This number can later be adjusted. Following the 2014 rules, 55% of all households have to be registered in the WMGs. It is the intention to have at least 50% female members in each WMG, and 30% in the management committees.

10.4.3. Tube Well Users Groups (TUG)

Tube Well Users Groups will be formed in collaboration with NGOs for all deep tube wells. The members of the TUG will be exclusively women, with an average of 15 in each group. It is earlier proposed (see Chapter 3) that around 330 deep tube wells will be required for Char Mozammel, which means that about the same number of TUGs will have to be formed.

10.4.4. Labour Contracting Societies (LCSs)

Labour Contracting Societies maybe engaged for earth works for construction of roads, markets etc., as an alternative to contractors. LCSs can also be involved all sorts of maintenance works and with the production of single pit latrines, as experienced in CDSP IV. The concept of LCS is to form a group of poor people from the operational area who are mainly dependent for livelihood on manual labour. If it is socially acceptable in Char Mozammel, then women LCSs can also be formed as was practiced in CDSP III and IV. According to the procedure, LCSs can be treated as D-class contractors by the public implementing agencies and the necessary work orders can be issued without inviting any tenders. The size of the LCS may vary based on the nature and volume of works to be implemented. It has been demonstrated in many government projects that a LCS can be an effective vehicle to provide project benefits directly to poor sections of the population by creating additional income and employment. In the GPWM and PWMR it is mentioned that at least 25% of earth works will have to be executed by engaging LCSs. In CDSP, LCSs are generally organized by the WMOs. LCSs will be engaged by the implementing agencies, in particular by BWDB and LGED, and to a lesser extent by DPHE and Forest Department.

10.4.5. Farmers Forum

The group approach will be followed in all agricultural extension activities in line with the DAE policy. A Farmer's Forum is a group of settlers whose main occupation is farming and who are interested in new technologies, and willing to participate in all agricultural activities (crop production, demonstration, field days and exposure visit/motivational tour). The size of each Farmer's Forum will be around 45 members on average, with at least 40% of women participation. It will be decided at a later stage exactly how many FFs will be formed in this char. But based on the current population of Char Mozammel, it can be estimated that about 15 FFs will be required.

10.4.6. Social Forestry Group (SFG)

In order to ensure the community participation in the afforestation activities, a social forestry approach will be followed through which the settlers will be involved in planning, implementation, monitoring, maintenance and management of the plantations. For this purpose, Social Forestry Groups will be formed for every 2 km of roadside plantation, 1.5 km of embankment plantation, 10-20 ha of foreshore plantation and 20-30 ha of mangrove plantation. Each group will have around 20-30 members with roughly 70% men and 30% women.

11. Environmental - and social impact

11.1 Introduction

In the previous chapters (2 to 10), an outline has been presented of the present situation and of the proposed measures on a range of subjects (with in principle two options: leaving the char area unprotected and protecting the area over time through a peripheral embankment). The chapters covered water management, internal infrastructure, land settlement, agriculture, fisheries, livestock, social forestry, institutions and NGO support. The present chapter dwells on the impact of the combined proposed interventions. In section 11.2 the impact on the environment is dealt with. In the last section (11.3) the influence of the proposed package of interventions on the social situation of the char dwellers is looked at.

11.2 Environmental impact

11.2.1. Methodology of assessment

Environmental assessment is a regulatory requirement (Environmental Conservation Policy, 1992, Environmental Conservation Rule, 1997). In carrying out the assessment, the standard code of practice was applied. The Guidelines of the Department of Environment and the Guidelines for Environmental Assessment of Water Management (FCDI) Projects of WARPO of 2005 were followed, while Technical Report no. 19 of CDSP-II was consulted.

The EIA started with review of available relevant literature, guidelines and other related studies and data sources. Field visits were undertaken by the study team to identify key environmental issues and to collect information on the Important Environmental Components (IECs). During field visits, consultations with different stakeholders such as governmental and non-governmental agencies as well as the char settlers were held to identify important issues and concerns. Impacts of proposed interventions formed a part of the discussions. Consultations were conducted through Focus Group Discussions and interviews with key informants.

After field data collection, scoping, bounding and environmental assessment were carried out. The impact assessment was done with the establishment of scenarios for the two basic options: leaving the char unprotected and construction of embankment and drainage works. The EIA led to the identification of potential environmental impacts due to proposed activities and suggested feasible remedial measures included in the Environmental Management Plan (EMP).

11.2.2. Summary of the assessment

The EIA led to the identification of potential environmental impacts and suggested feasible remedial measures included in the Environmental Management Plan (EMP).

Leaving the char unprotected in the foreseeable future (water management option 1) will have a positive impact with regard to further sedimentation and thus higher land levels of parts the char. On the other hand, tidal flooding will continue and soil salinity will not be abated. The quality of water, especially because of salinity, will not be improved either. Not protecting the char would be good for the status of flora, fauna and wildlife. But the environment for productive purposes, in particular agriculture and aquaculture, will not be enhanced, although wild fisheries will continue to be a source of income.

The EIA shows that the proposed options 3 and 4 (increasing land levels by dredging and subsequent construction of a polder) will have positive impacts on most of the important environmental components including prevention of flood and salinity. Soil salinity will be reduced over time, while tidal flooding will be prevented. This will result in an improvement in land types and land use. Drainage will be improved as well and availability of fresh water in type char will increase. However, embankments will prevent further sedimentation of the char, and thus a further increase in average land levels. It will have a beneficial effect on flora, but fauna and wildlife will suffer.

Possibilities for an increase of productivity in crop agriculture, homestead gardening, forestry and aquaculture will be significant. Wild fisheries will be negatively influenced.

The conclusion is justified that neither of the options has such significant negative impact on the environment, that the options should be discarded. Mitigation measures and monitoring are however necessary. But it has to be mentioned that the environmental impact of dredging has not been a part of the environmental assessment.

11.2.3. Mitigation measures and monitoring

An Environmental Management Plan (EMP) has been prepared with the following main elements (most of them meant for the event a polder is created): compensation for land acquisition; standard construction practices to keep adverse impacts of construction activities to a minimum; appropriate site selection of embankment and other public infrastructure to minimize loss of agricultural land; increased use of mulches and organic fertilizer; further promotion of integrated pest management; appropriate O&M measures to combat siltation of khals and rivers; construction of fish friendly regulators.

Regular monitoring of the following variables is proposed: breaches in embankment; flooding, erosion/sedimentation of channels; surface water quality incl. salinity; soil fertility and - salinity; quality; groundwater table; crop production and damage to crops; fish production.

An estimated cost of the environmental mitigation, enhancement and monitoring activities is estimated to be Taka 14.4 million per year.

11.3 Social impact

11.2.1 Introduction

Based on evidence in areas where CDSP has been operational in the past, there is a considerable impact of the combination of CDSP-type interventions as proposed in this document on the socio-economic situation of the people in the areas concerned. Data collected through monitoring and other survey methods in CDSP I, II, III and IV areas justify the conclusion that those interventions will lead to a transformation in the social and economic circumstances. This transformation can best be summarized as more security and less vulnerability. There is no reason to suppose that this will be much difference in the area of Char Mozammel.

11.2.2. Physical and legal security

Settlers will experience a greater physical security due to the construction of cyclone shelters and establishment of a protective belt of mangrove plantations. Roads will shorten the time to reach a cyclone shelter if a storm surge strikes the area. In case of options 3 and 4, it is obvious the embankment and foreshore plantation will have a tremendous positive influence on the physical security. Physical security is further enhanced by the improved law and order situation, as has been the case in earlier phases of CDSP.

The official titles on land possession, to be provided through the land settlement program will give security in a legal sense. At the same time this will encourage farmers to invest in their land, increasing the chances of higher production.

11.2.3. Economic and food security

The economic benefits, leading to more security in an economic sense, have been elaborated in other section of this document. It can be added here that access to markets to sell the produce that is not consumed inside the area will be improved and will probably lead to better prices. Previous CDSP areas also show a sharp increase in marketplaces in the area itself increasing the access to imported goods. This in many cases has also lead to lower prices of these goods because of lower transportation costs and competition. The upswing of local production and the greater accessibility will lead to an increase in employment opportunities.

A sample survey conducted among the households in CDSP I, II, III and IV areas shows that food security has improved significantly with an overall decline in the number of households that experience some periods of food shortage. Also the average number of months of food shortage has fallen. The most critical months are October/ November followed by July/ August. This development is largely due to the increase in agricultural production and the increased employment opportunities.

11.2.4. Delivery of services

The general development of char areas have led, as was demonstrated in previous CDSP phases, to establishment of service delivery mechanism, from the government, from NGOs and from the private commercial sector. The government has expanded its presence in those char areas by introducing educational, cluster villages as Asrayan and health services as well as by maintaining law and order to a higher degree. The impetus in economic development will stimulate banks to open branches, while shops will be established, for instance selling agricultural inputs.

11.2.5. Health and education

The CDSP type of package of interventions does not have a specific orientation towards health and education. Provision of health care and educational services is limited to parts of the proposed NGO-program. However, the health and education situation will indirectly be benefitted from many of the proposed interventions. The cyclone shelters that will be constructed are multifunctional and can be used as school as well. It is common practice in char areas that primary schools are established in these shelters. It takes usually sometime between completion of construction and completion of all the formalities to have a government school in the building. The proposed project could assist by facilitating this process.

Health of the settlers will be improved by the supply of safe drinking water through the provision of deep tube wells and by the provision of sanitary latrines. Also the greater variety in agricultural produce especially vegetables and the expected increased supply of fish and dairy products (mainly due to improved extension and other support services) will benefit the health situation. There are a few examples that cyclone shelters are used as health units.

11.2.6. Social position of settlers

The institutional development efforts of the project through the establishment of a series of field level community based organizations will lead to a greater cohesion among the households. Helped by the economic uplift this will lead to more vibrant and resilient char communities. The project will strengthen the position of the settlers in the struggle over control of natural resources. The provision of a title on land is of course a prime example. The formation of Water Management Organizations will enhance the fair and equitable way of using water resources. Social forestry activities promote equity in the sharing of benefits of public land. This will all lead to an increased self-confidence of the local people. This is further enhanced by the fact that settlers will no longer be controlled by jotdars or bahinis that were involved in the illegal settlement after migration into the newly emerged lands.

11.2.7. Gender issues

It is expected that the proposed project will have a positive impact on the lives of women in a practical sense, but at the same time will also enhance their social position and status. The increased employment opportunities within their own areas will reduce the relatively high number of female headed households. Seasonal outmigration will become less necessary, which means that men can stay more with their families. This should lessen the burden of work on the women. They will also benefit in a practical manner by the fact that the density of tube wells for safe drinking water will be dramatically increased, shortening the average time women have to spent on collecting safe water. Through the envisaged training and credit facilities supplied by NGOs combined with the general economic uplift, employment opportunities for women will be increased. Women will have more possibilities to create their own stream of income.

The proposed project will encourage an active and more equal participation of women in groups such as the Water Management Organizations (WMOs), Farmers Forum (FFs), Social Forestry Groups (SFGs) and Labour Contracting Societies (LCSs). The Tube well Users Groups (TUGs) and NGO microfinance groups will consist exclusively of women. The experience in other areas have learnt that such participation will increase the ability of the women to speak out, both in their own households as in the public arena. The khatians (land title document) will be signed by both the husband and wife (actually it is CDSP's policy to have the women signs first). This fully recognizes a women's right on land. It will considerably strengthen their asset base and economic security, and indeed increase their bargaining power within their households.

Considering all these developments, it is justified to expect that the social position and status of women will be strengthened in case the proposed project is implemented.

11.4 Conclusion

The environmental assessment has indicated that the implementation of the interventions as proposed in this report will not lead to a significant negative impact on the environment in the area. In order to mitigate any adverse influences, the Environmental Management Plan has to be made a fully integrated part of further project documents.

The proposed program would have an important and favourable impact on the social and economic situation of the char settlers. The assessment makes clear that on essential issues as physical and economic security, health and education, delivery of services, and gender, the proposed interventions will have a positive influence, often in a significant manner. Empirical evidence from areas where previous CDSP phases were operational, reinforce such expectations. In case the implementation itself has adverse consequences for families, for instance through loss of land and relocation because of infrastructure development, the compensation component of the EMP can provide support.

It is realistic to suppose that the proposed package of interventions can pass the clearance procedure successfully.

12. Costs and benefits

12.1 Overview of costs

Estimated financial costs have been mentioned at the end of the individual chapters on each of the components. Of the four originally considered options, one (option 2 has been discarded for Char Mozammel). Table 12.1 shows an overview of all the costs for options 1, 3 and 4. In option 1, the char would be left unprotected. Option 3 is on increasing the land levels in a mechanized manner, by depositing dredging spoils on the land. Option 4 also uses dredging to accelerate the increase of land levels and aims at making one polder of all the three study chars: Char Kola Toli, Dhal Char and Char Mozammel. This option consequently includes the costs of all three chars.

Option 1 would cost Taka 6,709.14 lakh, option 3 Taka 28,730.94 lakh and option 4 Taka 58,074.9 lakh (for three chars). As the table shows, costs of land settlement and of the social- and livelihood program are included.

Table 12 - 1 Comparison of costs of options 1, 3 and 4 (in Lakh Takas)

	Option 1	Option 3	Option 4
Dredging		13,300.0	20,824.0
Water management	195.9	4,010.1	13,546.5
Forestry	345.1	697.4	1,172.8
Agriculture	60.0	60.0	160.0
Livestock	45	45	130.0
Fisheries		35.0	105.0
Internal infrastruct.	1,983.8	3,254.6	2,022.4
O&M during constr.		39.8	126.4
Engin. and adm.	24.6	512.1	1078.6
Land settlement	270.0	270.0	500.0
NGO program	3,724.74	3,724.74	6,856.4
Contingencies	192.9	2,846.3	6,242.2
Total costs	6,842.04	28,795.04	52,764.3

12.2 Economic benefits

12.2.1. Overview of benefits

The benefits of the project interventions have been identified and quantified as far as possible for economic analysis.

Benefits differ for the different options. They have been reflected at the end of each of the Chapters 5 to 9 and are summarized below.

Option 1:

- an increase in the value of agricultural production through a increase in yields;
- an increase in production of homestead gardening;
- a higher production of livestock products;
- modest increase in fish production because of improved extension, input supplies and marketing
- the creation of income for the settlers as a result of the social forestry activities; and
- a stimulation of general economic activities caused by the above mentioned production increases and supported by the improved transport network.

For options 3 and 4:

- an increase in the value of agricultural production through a increase in yields and an increase in cropping intensity;

- a higher production of homestead gardening;
- a higher number of livestock and an increase in production of livestock products;
- significant increase in fish production because of much improved circumstances to develop aquaculture in individual and community ponds (protective embankments), better extension services and input supplies and marketing
- the creation of income for the settlers as a result of the social forestry activities; and
- a general economic uplift of the area, because of a multiplier effect of the abovementioned changes in economic production.

These economic benefits have been considered in the benefit stream of the project for the economic analysis.

In addition to the direct economic benefits, a number of interventions will lead to an indirect impact on the economic circumstances. These influences are hard to quantify. Potential benefits are envisaged from improved road communication within the project area and between the project area and the wider region, resulting in lower prices for agricultural inputs and higher farm gate prices. It will boost up economic activities, employment and services in the area. It is likely that obtaining land titles will make the settlers more inclined to invest in their own land. Production increases in different sectors, supported by the improved transport network, will stimulate general economic activities in the project area. This development process through forward and backward linkages will bring additional benefits. Such benefits are difficult to translate into monetary terms.

In the next section in Table 12.2, a summary is provided of the value of the benefits for each of the sectors. The incremental annualized benefits are given. As can be seen, an element of indirect benefits is reflected in the table, under the heading commercial gains.

12.2.2. Benefits per component

Table 12 - 2 Summary of Annual Net Benefits (Incremental), in Lakh Takas

Sectors/Sub sectors	At Full development Benefits	Benefit with limited Intervention	Remark
Agriculture	661.45	264.58a	Major benefits will start to accrue from 7 th year and full benefits at 10 th year.
Homestead Gardening	38.47	38.47	Through out the project life
Open Water Fisheries	56.50		Full benefits at 8 th year
Close Water Fisheries	12.24		Full benefits at 8 th year
Livestock	348.81	279.05b	Full benefits at 10 th year
Social Forestry	1267.09	620.06c	Annualized benefit. Benefits will accrue through year 5 to year 15 of rotation period.
Commercial Gains (3.7%)	76.54	38.10	Commercial gains due to multiplier effects
Total Benefits	2461.10	1240.26	

Note:

- 40% of benefits at full project development has been considered.
- 80% of benefits at full project development has been considered
- Only benefits of mangrove plantation and roadside plantation have been considered.

12.3 Comparison of costs and benefits

12.3.1. Economic and financial analysis

The economic indicators are computed to judge the economic viability of the proposed package of interventions. These indicators include Net Present Value (NPV), Benefit Cost Ratio (B/C Ratio) and Economic Internal Rate of Return (EIRR). Following the normal practice in CDSP projects, the costs of social infrastructure have not been taken into account in economic analysis. The analytical results of economic analysis are summarized in Table 12.3.

Table 12 - 3 Results of Economic Analysis

Option	EIRR (%)	NPV(Lakh Tk)	B/C Ratio
Option-1	42.36%	3,031.09	5.33
Option-2	Not considered	-	-
Option-3	7.36%	-3,253	0.69
Option-4	9.56%	-3,567.71	0.83

These results indicate that option 1 is the best option, as it secures the highest EIRR of 43.93%, clearly exceeding 12%, the opportunity cost of capital, presently used by all sectors of the economy in Bangladesh. NPV for option 1 is estimated as Taka 3,083 lakh. Options 3 and 4 do not meet the minimum requirements of economic indicators, applied to judge the economic viability of the project.

The economic analysis of projects is generally based on uncertain future events and imperfect data. Also certain risks are inherent in project planning and implementation. So a sensitivity analysis of the Base Case EIRR has been conducted, based on variations in the level of costs and benefits, implementation and gestation periods. The findings of the sensitivity analysis are summarized in Table 12.4.

Table 12 - 4 Results of Sensitivity Analysis for option 1

Variables	Variance	EIRR	NPV (Lakh Taka)
Base Case	-	42.36%	3,031
Costs Increase by +20%	20%	37.94%	2,891
Total Benefits decrease by 20%	-20%	37.00%	2,285
Costs +20% and Benefits - 20%	both	33.06%	2,145
Agriculture Benefit decreased by - 20%	-20%	41.70%	2,905
Forestry Benefit decreased by - 20%	-20%	39.64%	2,633

The results of sensitivity analysis presented show that in all cases, option 1 is not critically sensitive to any of the above assumptions, as the calculated EIRR is well above 12 percent. Based on the results of the sensitivity analysis, it can be concluded that option 1 is economically viable, therefore, recommended for implementation on economic grounds.

To assess whether the proposed investments are financially sustainable, a financial analysis have been carried out on the basis of market prices and interest rates (see Table 12.5).

Table 12 - 5 Results of Financial Analysis for option 1

Option	FIRR (%)	NPV (Lakh Tk.)	B/C Ratio
Option-1	18.81%	1,655.81	1.71
Option-2	Not considered		
Option-3	2.69%	-9397.60	0.45
Option-4	4.58%	-15939.45	0.54

This resulted in a Financial Internal Rate of Return (FIRR) of 19.25% for option 1, well above the opportunity costs for capital in Bangladesh of 12%. Options 3 and 4 score well below 12%. It has to be noted that the costs of the land settlement efforts and the social- and livelihood/NGO program were not taken into account in the FIRR calculation. But on the other hand, costs of support services for agriculture and livestock have been included.

12.3.3. Conclusion

Based on the results of the economic -, financial and sensitivity analysis, it can be concluded that for Char Mozammel option 1 is the recommended option for implementation. Leaving the char unprotected (until about 2035) and implementing a development package including land settlement, internal infrastructure, agriculture, livestock, fisheries, social forestry and a social and livelihood program (through NGOs) is economically viable and financially sustainable. A detailed cost estimate for the investments required for the recommended option can be found in Table 12.6 in the next section.

Comparing costs and benefits for the recommended option (leaving Char Mozammel unprotected) the economic internal rate of return (EIRR) would be 42.36% and the financial rate of return (FIRR) 18.81%. Both are above the opportunity costs of Bangladesh of 12%. This option is economically and financially sustainable. Other options (establishment of a polder by increasing levels through deposit of dredging spoils) score much lower internal rates, below the required standards. Total costs for the recommended option (option 1) are estimated to be Taka 6,842.04 lakh, which is equal to Euro 7,615,191 or US\$ 8,497,814 at the exchange rates of 19 September 2016.

Table 12 - 6 Detailed Project Cost (Financial) for Option 1

Expenditure Accounts by Years -- Base Costs (BDT Lakh)	Base Cost						Total
	1	2	3	4	5	6	
I. Investment Costs							
A. Dredging	-	-	-	-	-	-	-
B. Water Management Infrastructure							
1. Drainage Sluice							
1 vent Sluices	-	-	-	-	-	-	-
2 vent Sluices	-	-	-	-	-	-	-
3 vent Sluices	-	-	-	-	-	-	-
Subtotal Drainage Sluice	-	-	-	-	-	-	-
2. Embankment:							
Sea dyke	-	-	-	-	-	-	-
Internal dyke	-	-	-	-	-	-	-
Subtotal Embankment:	-	-	-	-	-	-	-
3. Re excavation of Channel	-	-	98.0	98.0	-	-	195.9
4. Construction of WMG Building	-	-	-	-	-	-	-
Subtotal Water Management Infrastructure	-	-	98.0	98.0	-	-	195.9
C. Forestry							
1. Mangrove Plantation	66.0	264.0	-	-	-	-	330.0
2. Foreshore Plantation	-	-	-	-	-	-	-
3. Embankment Plantation	-	-	-	-	-	-	-
4. Road side Plantation	-	-	-	4.5	6.0	4.5	15.1
5. Homestead Plantation	-	-	-	-	-	-	-
6. Public Institution	-	-	-	-	-	-	-
7. Canal Bank	-	-	-	-	-	-	-
8. Other Cost	-	-	-	-	-	-	-
Subtotal Forestry	66.0	264.0	-	4.5	6.0	4.5	345.1
D. Agriculture	-	-	15.0	15.0	15.0	15.0	60.0
E. Fisheries	-	-	-	-	-	-	-
F. Livestock	-	-	11.3	11.3	11.3	11.3	45.0
G. Internal Infrastructure							
1. Rural roads (Type R-2)							
Existing earthen road development	25.7	77.0	77.0	77.0	-	-	256.8
Pucca road	-	-	-	-	-	-	-
Subtotal Rural roads (Type R-2)	25.7	77.0	77.0	77.0	-	-	256.8
2. Bridge & Culvert							
Box Culverts	-	-	14.0	28.0	28.0	-	70.0
Pipe Culvert	-	-	2.4	4.8	4.8	-	12.0
Subtotal Bridge & Culvert	-	-	16.4	32.8	32.8	-	82.0
Subtotal Internal Infrastructure	25.7	77.0	93.4	109.8	32.8	-	338.8
H. Social Facilities							
1. Multipurpose Cyclone Shelter	360.0	600.0	240.0	-	-	-	1,200.0
2. Deep Tube well	30.0	60.0	80.0	30.0	-	-	200.0
3. Single pit latrine	30.0	45.0	37.5	37.5	-	-	150.0
4. Public Toilet	-	-	-	-	-	-	-
5. Rain Water Harvesting	-	-	2.5	2.5	-	-	5.0
6. Community Pond	-	-	25.0	25.0	-	-	50.0
7. Market development	-	-	-	-	-	-	-
8. Killa	40.0	-	-	-	-	-	40.0
Subtotal Social Facilities	460.0	705.0	385.0	95.0	-	-	1,645.0
I. O & M during Construction	-	-	-	-	-	-	-
J. Engineering & Administration	2.3	8.5	5.4	6.0	1.6	0.8	24.6
Total BASELINE COSTS	554.0	1,054.6	608.1	339.5	66.7	31.5	2,654.4
Physical Contingencies	11.1	21.1	12.2	6.8	1.3	0.6	53.1
Price Contingencies	-	26.9	47.3	45.0	12.7	7.9	139.8
Total PROJECT COSTS	565.0	1,102.5	667.5	391.4	80.7	40.1	2,847.3

Source: COSTAB generated table

Total project investments amount to Taka 2,847.3 lakh. To this amount, the costs of land settlement (Taka 270 lakh) and of the social- and livelihood component (Taka 3,724.74 lakh) have to be added. Overall project costs will thus be Taka 6,842.04. This equals Euro 7,615,191 or US\$ 8,497,814 at the exchange rates of 19 September 2016.

Annex 1. Terms of Reference

Char Mozammel

1. Introduction

1.1. Background

The Inception Report of CDSP IV states that the project will undertake feasibility studies in areas where in future char development programmes might take place. These future areas have to be 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. After a process of selection, the concerned authorities decided to take Dhal Char and Char Kola Toli as areas for the second in the series of feasibility studies. During preliminary visits to these chars it was discovered that Char Mozammel forms part of the same cluster of islands as Dhal Char and Kola Toli and has a similar pattern of habitation and activities, hence it was decided to include it in the study as well. Ghasiar Char and Moulovi Char are also in the same cluster, but the first one is protected forest area and the latter is under severe erosion. The assessment of the stability shall include the whole cluster of chars. Estimated total area of the 3 chars of the study area, i.e. Dhal, Kola Toli and Mozammel is about 5500 Ha, see attached map.

The three chars in question, Dhal Char, Char Kola Toli and Char Mozammel, 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. 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 three clearly separate parts, one devoted to Dhal Char, one to Char Kola Toli and another devoted to Char Mozammel.

1.2. Objectives

The objective of the feasibility study is to prepare a report which will be submitted to the concerned authorities for their consideration whether the required means will be made available to implement and facilitate the interventions recommended in the study. 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.

1.3. 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.

The preparation should adapt as much as possible a participative approach, especially with regard to the identification and prioritisation 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. However, a part of the study will be carried out by a Bangladeshi firm or institute, to be sub-contracted by the project, while another part will be done by the Technical Assistance team (TA team). Below, in the headings of the various sections on the subjects to be covered, it is indicated whether that section will be taken care of by the sub-contracted firm or institute, or by the TA team. Based on these overall Terms of Reference, specific Terms of Reference for the sub-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.

The duration of the study will be not more than 12 months.

2. Study area and activities

Char Mozammel

A.1 Study area

Char Mozammel is located in the lower Meghna, north west of Hatiya island. Char Mozammel is under Upazila Tozimuddin, (Dolichadpur Union), Bhola District. It is a char island, with an estimated size of the mature part of 1,500 ha. Encroachment started about 7 years ago and no forest was found at the char during the visit. Land levels vary from 2.7 meter to 3.9 meter, with an average of 3.45 meter (PWD). The char is thought to be stable, local people reported there is accretion at the southern and northern part of the char, and no erosion was found.

Approximately 3,500 households are present in the area with an estimated population of about 20,000. Preliminary investigations show that no official settlement was done in the whole char. The main sources of income are farming, fishing and livestock.

A.2 Activities

A.2.1. Main features of study area and population (sub-contracted firm)

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:

- short description of the development of the char since its emergence
- land levels and land use (see also under 2.2)
- 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

A.2.2. Water management (sub-contracted firm)

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 to the 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 analyse 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 Char Mozammel (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 2.14 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.

A.2.3. Internal infrastructure (sub-contracted firm)

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 and culverts
- social and economic infrastructure such as multipurpose cyclone shelters, deep tubewells, sanitary facilities, community ponds, killas and, if required, clustered villages 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.

A.2.4. Land settlement (TA team)

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. Initial information shows that in Char Mozammel no official land settlement has taken place, so all land is *khas* land.

The following activities have to be undertaken:

- 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
- determine the number of households already settled in the char that have as yet no official land title
- determine the possibility of providing the already settled households that have no legal land title with a plot of 1.5 acre
- assess the possibility of settling additional households that are as yet not present in the area.

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 (see 2.14).

A.2.5. Agriculture (sub-contracted firm)

For agriculture, the team is required to:

- map the existing cropping pattern, cropped area (cropping intensity) and yields for each of the crops grown in the field;
- describe the present status of homestead gardening
- analyse the present methods of cultivation, including an assessment of the status of the practice and adoption of modern technologies
- investigate salinity levels (ECE ds/m) of soil and water and their impact on crop production
- assess the status of present small scale (such as from ponds) irrigation practices and the future scope for irrigated agriculture
- analyse the support system, including the extension services currently provided and the supply of agricultural inputs
- assess the current practice of selling agricultural produce
- analyse the main factors hampering agricultural production, including at homesteads
- 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
- make a projection of future cropping intensity and yields, taking into account the suggested interventions with regard to water management (see 2.2) 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
- make an estimate of the costs of the recommendations for field agriculture and homestead gardening (with reference to the required cost/benefit analysis, see 2.14)
- 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, see 2.2) for field agriculture and homestead gardening (see 2.14).

A.2.6. Livestock (sub-contracted firm)

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

- review the present situation of the livestock sector (poultry, small ruminants, cattle), including the role of livestock in the household economy
- analyse the production and marketing systems and identify the bottlenecks that impede further development of the sector
- describe the present status of diseases and their treatment
- prepare a plan with recommendations for measures to be taken in support of livestock activities in the char
- estimate the costs of the proposed measures regarding livestock development (see cost benefit/analysis in 2.14)
- make an estimate of the increase in livestock production and its value after introduction of the proposed measures (see 2.14).

A.2.7. Fisheries and aquaculture (sub-contracted firm)

This part of the study has to focus on:

- an assessment of the importance of fisheries and aquaculture for the livelihood of settlers in Char Mozammel
- an analysis of the current production systems (inland fisheries, marine fisheries, aquaculture in ditches and ponds)
- an analysis of the present marketing system (if applicable)
- the development of possible interventions to develop the sector, including the provision of extension services
- an assessment of the impact of the proposed water management interventions, if any (see 2.2) on fisheries and aquaculture
- estimate the costs of the proposed interventions (see cost/benefit analysis 2.14).
- make an estimate of the difference in fish production and its value between the situation before and after the proposed interventions (see 2.14).

A.2.8. Social forestry (sub-contracted firm)

Forestry has multiple functions in char development (stabilisation 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:

- 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
- analyse the bottlenecks that have adversely influenced forestry development
- 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 on land emerging in areas adjacent to or close to Char Mozammel
- make an estimate of the costs of the proposed development plan (see cost/benefit analysis in 2.14)
- 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).

A.2.9. NGO component (TA team)

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

- Group formation, micro-finance and capacity building
- Health and family planning
- Education

- Water and sanitation
- Homestead agriculture and value chain development
- Poultry and livestock
- Fisheries and aquaculture
- Legal and human rights
- Disaster management and climate change (see also 2.13.)
- 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 (will be determined in section 2.4). An estimate of the costs of the overall NGO component has to be made. The required overall cost/benefit analysis (see 2.14), has to include the estimated costs of the economic oriented activities (homestead agriculture, poultry and livestock, and fisheries and aquaculture).

A.2.10. Governance issues (TA team)

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 Char Mozammel 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. 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 Char Mozammel. More specifically, these bodies are the Upazila Parishad of Tozimuddin and the Union Parishad of Dolichadpur. 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:

- *An inventory should be made of the community based organisations that are already present and active in Char Mozammel.*
- 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)
- 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.
- Costs of all proposed interventions should be estimated (see 2.14).

A.2.11. Social impact and impact on livelihoods (TA team)

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 Char Mozammel 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 analysing the expected effects in the study area, the following elements have to be highlighted:

- the economic benefits (see also section 2.14), including access to markets
- the diversification in income
- the employment opportunities
- the level of poverty and food security

- the access to social services
- the change in security and vulnerability of the settlers
- the position and status of women.

A.2.12. Environmental impact (sub-contracted firm)

A comprehensive Environmental Impact Assessment (EIA) is required for the development of Char Mozammel. 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:

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

In a concluding section, the EIA should clearly state

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

A.2.13. Impact of climate change (sub-contracted firm)

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 Char Mozammel.

- The study should endeavour to reflect on, in general, the influence of climate change on the situation in Char Mozammel. 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).
- 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.
- 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 (see also 2.9).

A.2.14. Costs and benefits: financial and economic analysis (sub-contracted firm)

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

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

- costs of water management related infrastructure as excavation of drainage channels and (possibly) construction of embankments and sluices
- cost of construction of economic activities related internal infrastructure as roads, bridges, culverts, killas and community ponds
- cost of construction of social facilities (cyclone shelters, deep tube wells, sanitary facilities)
- operation and maintenance (O&M) costs in the period after project completion

- costs of recommended interventions as far as agriculture, livestock, fisheries/aquaculture and social forestry are concerned
- costs of the land settlement plan
- costs of institutional development measures.

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 benefits* see 2.11.

As *economic benefits* can be counted:

- an increase in the value of agricultural production through a higher cropping intensity and an increase in yields (see 2.5)
- an increase in production of homestead gardening (see 2.5)
- a higher production of livestock products (see 2.6)
- the creation of an additional stream of income through aquaculture in community ponds and possibly individual ponds (see 2.7)
- the creation of income for the settlers as a result of the social forestry activities (see 2.8)
- 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:

- make a selection of the costs that can reasonably be related to the economic benefits
- calculate the total of these economy related investment costs
- calculate the expected economic benefits
- make an estimate of the expected O&M costs
- make an estimate of O&M costs and of economic production in the present (without project) situation
- on the basis of these data calculate the 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. 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

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

3. Staffing and organisation

3.1. Guidance and monitoring of the feasibility study team

Supervision of the feasibility study and coordination with other government institutions and non-governmental organisations 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 meetings will be held to monitor progress and more often when deemed necessary.

3.2. Staffing of the team

The study will be carried out by a team of experienced professionals in the following areas (between brackets: maximum duration of their involvement, minimum educational requirement and reference to the description of their tasks):

- civil engineering/ water management and team leader (6 months / graduate engineer / see sections 2.2. and 2.3)
- hydraulic engineering and deputy team leader (6 months / graduate civil engineer / see sections 2.2 and 2.3)
- agriculture (3 months / master's degree in agriculture / see section 2.4),
- livestock expert (2 months / master's degree in animal husbandry and veterinary science / see section 2.5)
- fisheries/aquaculture expert (2 months / master's degree in fisheries / see section 2.6)
- social forestry (2 months / master's degree in forestry / see section 2.7)
- environment (2 months / relevant master's degree / see section 2.8)
- climate change (1 month / relevant master's degree or graduate engineering degree / see 2.9)
- economic and financial issues and deputy team leader (4 months / master's degree in economics / see section 2.10).
- socio economist/ sociologist (1 month / relevant master's degree / see 2.1).

All experts should have at least 15 years of experience in their respective fields and at least 10 years of experience in the coastal zone.

In addition to the abovementioned 25 person months of professionals, technical assistants can be employed for the study to a maximum of 25 months.

3.3. Timing and reporting obligations of the study team

The start of the study is 1 December 2014; the duration will be not more than 12 months.

The following reports have to be prepared:

- Inception Report, not later than one month after start of the assignment; the report will elaborate on methodologies and activities and provide detailed working schedules
- Interim Report, 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
- Draft Final Report; to be submitted not later than ten months after the start of the assignment
- Final Report, in the 12th month after start of the assignment.

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

3.4. 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.

3.5. Responsibilities of the feasibility study team

The Water Management expert shall be appointed as Team Leader of the feasibility study team and the hydraulic engineer and the socio economist as Deputy team Leader for respectively the technical and socio economical parts of the study. He or she will be responsible to the Project Coordinating Director and the Team Leader of CDSP IV for the discharge of responsibilities of the feasibility study team. No changes can be made in the composition of the feasibility study team, after the contract has been awarded. In case, due to unforeseen circumstances, a team member has to be replaced, this can only be done with the approval of the Project Coordinating Director and the Team Leader of CDSP IV.

The feasibility study team will open an office in Noakhali. Staff will be employed at that office throughout the study period. The team will regularly consult with the Technical Assistance team. As mentioned earlier, regular meetings (at least once a month) and joint field visits will be held.

Accurate and systematic records and accounts will be kept in respect of the services in such form and detail as is customary in the profession and shall be sufficient to establish accurately the cost and expenditures incurred for the services. Except with the prior written approval of the Team Leader and Project Coordinating Director of CDSP IV the Consultant shall not assign or transfer the contract or any part thereof nor engage any independent consultant or sub-contractors to perform any part of the services other than the nominated personnel listed in the contract.

The feasibility study team will deliver all materials, including digital versions of all maps and reports, to CDSP IV upon completion of the assignment.