Char Development and Settlement Project Phase IV
Bangladesh

Climate change aspects of CDSP IV

Mission Report No. 4

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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

Content

List of Abbreviations

ASPS	Agricultural Sector Programme Support
BARI	Bangladesh Agricultural Research Institute
BCAS	Bangladesh Centre for Advanced Studies
BDRCS	Bangladesh Red Crescent Society
BRRI	Bangladesh Rice Research Institute
BWDB	Bangladesh Water Development Board
CBACC-CF	Community Based Adaptation to Climate Change through Coastal Afforestation
CBDM	Community Based Disaster Management
CBDP	Community Based Disaster Preparedness
CDMC	Community Disaster Management Committee
CDMP	Comprehensive Disaster Risk Management Programme
CDSP	Char Development and Settlement Project
CEGIS	Centre for Environmental and Geographic Information Services
COP	Conference of Parties
CPP	Cyclone Preparedness Programme
DFID	Department for International Development
DPHE	Department of Public Health Engineering
DRR	Disaster Risk Reduction
FAO	Food and Agriculture Organisation of the United Nations
FFF	Forest Fruit Fish
FFS	Farmer Field School
FLI	Field Level Institution
GHG	Greenhouse Gas
GoB	Government of Bangladesh
HYV	High Yielding Variety
IFAD	International Fund for Agricultural Development
IIED	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
IUCN	World Conservation Union
IWM	Institute for Water Modelling
LCS	Labour Contracting Society
LGED	Local Government Engineering Department
LGI	Local Government Institution
LHR	Law and Human Rights
MoU	Memorandum of Understanding
NAPA	National Adaptation Programme of Action
NGO	Nongovernmental Organisation
PCD	Project Coordinating Director
REDD	Reducing Emissions through
RFLDC	Regional Fisheries & Livestock Development Component
SARCCAB	Support to Agricultural Research for Climate Change Adaptation in Bangladesh
SDC	Swiss Development Cooperation
SREX	Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organisation
WMA	Water Management Association
WMF	Water Management Federation
WUR	Wageningen University and Research centre

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I am grateful for the discussions held with the staff from IUCN, UNDP, Oxfam, IWM, Alterra/WUR and CEGIS. They provided important insights in expected climate change impacts in the coastal zone of Bangladesh, adaptation to climate change, and on CDSP-IV related programmes and projects.

Finally, I would like to thank Mr. Martin Bos of the Royal Netherlands Embassy for the time given to discuss the major findings of the mission.

Summary

The mission was carried out from 12 November – 12 December. The objective of the mission was to study and critically review the climate change aspects of the project and to provide recommendations for further specifying/strengthening the CDSP IV approach to climate change, in view of the latest developments in this field.

The mission studied the latest scientific publications on climate change adaptation and mitigation, Bangladesh's climate change and disaster risk management policies, CDSP-IV reports, and reports/websites from related projects and studies in Bangladesh. Furthermore, discussions were held with CDSP and partner NGO staff, representatives of local organisations from all CDSP phases (mainly Water Management Groups, Social Forestry Groups and Farmer Forums), and experts from different institutions and organisations working on climate change in Bangladesh.

Drawing on CDSP reports, field visits and (group) discussions with project beneficiaries and CDSP staff, a description of the current climate risks and conditions in the char areas is provided. This includes an assessment of the vulnerability, exposure and ability of the population to cope with current climate risks and conditions. It can be concluded that natural conditions (such as flooding, cyclones and a lack of fresh water) and anthropogenic factors (i.e. lack of a secure land title, poor communication infrastructure, a lack of institutions and governance) mutually reinforce chronic vulnerability to climate conditions and natural disasters. As a result of this, without CDSP interventions the people's capacity to deal with climate conditions is very low (even without considering climate change impacts). This very low coping capacity of the char population is illustrated by the significant damage and the number of casualties related to the relative 'weak' tropical storm of October 10, 2012.

On the basis of an extensive literature study and discussions with climate change experts from international and national organisations, an overview of the predicted climate change risks and impacts for Bangladesh in general, and the CDSP project area in particular, is provided. It is shown that although the coastal region in general is very vulnerable to climate change, the chars are by far the most vulnerable areas. The already existing uncertainties and hazards in the CDSP-IV chars will be exacerbated by the impacts of climate change, which will bring a greater intensity of cyclones and storm surges, more erratic rainfall (more during the monsoon season, less in winter), higher temperatures and sea level rise.

This is followed by an analysis of how the CDSP-IV interventions aim at reducing the vulnerability and exposure to current climate conditions and increase the adaptive capacity of the population to future climate change impacts. It also considers the contribution of CDSP-IV to the growing knowledge on climate change adaptation in coastal zones. It can be concluded that in the next two or three decades, climate change impacts will probably be relatively small compared to the current year-to year climate variations. However, as climate change impacts become more dramatic over the years, its effect will become increasingly important and will play a more significant role in the lives of the char population.

As it is impossible to anticipate exact future impacts of climate change – particularly at local scale – climate change adaptation should have an intermediate goal of empowering communities to adapt to the impacts in a broader development perspective, which is exactly what CDSP-IV is doing. CDSP-IV includes both community based and engineering interventions, which has proven to be very effective approach as it does not only address climate change adaptation but also increases the resilience of communities to current climate conditions while simultaneously improving the socio-economic situation in the chars.

Part of the above analysis is a review of the set of Bangladesh's climate change strategy and action plans, which shows that CDSP-IV interventions fit well in this. Next to that, similar projects / programmes with a climate change focus in Bangladesh were studied and discussed, thereby identifying lessons learned. Other projects show that climate change adaptation efforts should be launched with a focus on current

variability while factoring in climate change, and that multiple and integrated adaptation measures across sectors are essential. Next to that, some innovative practices such as crop insurance, the FFF model, and REDD+ could provide interesting ways to further strengthen the CDSP-IV approach to climate change adaptation.

On the basis of the current situation, the climate change impact assessment, the comparison with similar projects & programmes, and the review of CDSP-IV climate change interventions, recommendations for further specifying and strengthening the CDSP-IV interventions and approach to climate change are:

- ***Mainstream climate change adaptation in CDSP-IV:*** It is recommended to continue with the current approach of both community based and engineering interventions. However, this approach has not been developed deliberately. There is no coherent climate change strategy at the moment. Climate change adaptation work is dispersed over all the CDSP-IV components, and there is no overarching approach that binds these components. It is therefore recommended to develop a comprehensive strategy – on the basis of this mission – which combines all relevant work on climate change adaptation for CDSP-IV. This could be done through development of a 'CDSP climate adaptation methodology' or a short strategy on how CDSP-IV is addressing climate change in coastal chars. Ideally, a methodology for climate change adaptation developed by CDSP-IV would then be replicated in other areas or projects, or even internalised by the Government of Bangladesh.

- ***Explore new interventions:*** Some activities that are being implemented elsewhere have been identified that could be piloted to strengthen CDSP-IV's community based interventions. A few of the most promising include the practice of crop insurance, the 'Forest Fruit Fish' (FFF) model from UNDP, and linking up with the REDD+ (Reducing Emissions from Deforestation & Forest Degradation) process.

- ***Improve contribution to knowledge on climate change adaptation in coastal zones:*** CDSP-IV's approach to climate change adaptation, combining community based and engineering interventions, is a very effective one. This integrated approach, combined with the fact that six government agencies are working together to implement the project, makes the CDSP-IV approach to climate change adaptation fairly unique. Both the national and international development community is still learning about adaptation, so documenting and sharing lessons learned is essential. Although the project is disseminating this knowledge, experiences and lessons learned to a certain extent, given the unique approach to climate change adaptation these efforts should ideally be strengthened. This can include (further) development of the website through which information such as technical reports, background information, progress, lessons learned and news can be shared. Next to that the project brochure should be further developed[1], and conferences, workshops and seminars could be used more for outreach activities.

[1] On the basis of the findings of this mission, the project brochure was updated to include climate change aspects of CDSP-IV, which is included in Annex V.

“Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level”
(IPCC, 2007)

1. Objectives of the Assignment

1.1 Introduction

The objective of CDSP-IV is to reduce poverty and hunger for people living on newly accreted coastal chars. Security for people and livelihoods is provided through the six components of the project:

1. protection from climate change;
2. climate change resilient infrastructure and water supply and sanitation;
3. land settlement and titling;
4. livelihood support;
5. institutional development;
6. studies and surveys.

Climate change aspects are important considerations for CDSP interventions, obviously for the components 'protection from climate change' and 'climate resilient infrastructure', but also for one of the sub components of the social and livelihood support program, 'disaster management and climate change', implemented jointly with the four partner NGOs of the project, and for the 'agricultural support program', where climate smart agriculture is an important aspect.

However, it is not entirely clear what the climate change impacts in the CDSP-IV areas will be, how CDSP-IV is (already) contributing to increasing adaptive capacity to climate change, and how the climate change components of the project could be strengthened.

1.2 Objectives and Tasks Performed

The objective of the mission was to study and critically review the climate change aspects of the project and to provide recommendations for further specifying / strengthening the CDSP-IV approach to climate change, in view of the latest developments in the field of climate change.

This includes, but is not limited to issues like reviewing the links and relationships between climate change, rural development, agriculture and food security in the CDSP-IV area; governance issues like role of LGIs and FLIs in addressing Climate Change problems; innovative approaches to helping smallholder producers build their resilience to climate change.

Therefore, the following tasks were performed:

1) Assessment of the actual risks and underlying assumptions of climate change for Bangladesh in general and for the CDSP project areas in particular, including a review of CDSP-IV climate change interventions and scope in the light of Bangladesh's climate change policies;
2) Studying the climate change aspects of all components of CDSP-IV, including the effect of climate change on the different CDSP components;
3) Studying and providing an overview of similar projects with a climate change focus in Bangladesh, and identify lessons learned;
4) Providing recommendations for further specifying / strengthening CDSP-IV climate change interventions and scope;
5) Evaluating the experience of the climate change scheme implemented during CDSP-III in cooperation with IUCN (Education materials and video documentary / drama);[2]
6) Updating the project brochure to include climate change aspects of CDSP IV.[2]

[2] These tasks are less related to the overall objective of the mission, therefore their results are included as Annex IV and V

The mission spent 22 days in the CDSP-IV area, and during this period met with CDSP and partner NGO staff, representatives of local organisations (mainly Water Management Groups, Social Forestry Groups and Farmer Forums), and experts from different institutions and organisations working on climate change in Bangladesh. Several meetings also took place in Dhaka.

The assignment was performed by Mr. Koen Joosten, climate change expert of Euroconsult Mott MacDonald.

1.3 Report Structure

After this description of the purpose of the mission, *Chapter 2* describes the methodology and approach of this assignment, followed by *Chapter 3* which describes the current climate risks and conditions in the char areas. This includes an assessment of the vulnerability, exposure and ability of the population to cope with current climate risks and conditions. The findings of this chapter are illustrated by an example of a recent disaster, a tropical storm which occurred on October 10, 2012.

On the basis of an extensive literature study (using the most recent scientific publications and reports) and discussions with climate change experts from international and national organisations, *Chapter 4* provides an overview of the predicted climate change risks and impacts for Bangladesh in general, and the CDSP project area in particular.

This is followed by an analysis of how the CDSP-IV interventions aim at reducing vulnerability and exposure and increasing the adaptive capacity of the population to current climate conditions *and* future climate change impacts (*Chapter 5*). It also considers the contribution of CDSP-IV to the knowledge base on (community based) climate change adaptation in coastal zones.

Chapter 6 reviews the set of Bangladesh's climate change policies & strategies, and examines how CDSP-IV interventions fit within this. Similar projects and programmes with a climate change focus in Bangladesh are briefly discussed in *Chapter 7*, including their lessons learned.

Chapter 8 and 9 are the most important ones, as they provide the conclusions of this mission and the recommendations for further specifying and strengthening the CDSP-IV interventions and general approach to climate change, on the basis of the previous chapters.

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2. Methodology & Approach

This Chapter briefly describes the methodology used by the mission to collect data and information, and the key definitions used in this report.

2.1 Briefing, fact finding & debriefing meetings

The mission started with a meeting with the Project Coordinating Director (PCD), Mr. Md. Mahfuzur Rahman, in which the general context of the CDSP-IV project and the expectations for this mission were discussed. After arrival in Noakhali, an introductory meeting was held with all professional staff from the CDSP-IV team. During this meeting the tasks and terms of reference were briefly discussed, and initial logistical arrangements were made. Furthermore, the team produced several related reports and documents to the mission.

During the first week of the assignment, discussions were held with CDSP and partner NGO staff, and representatives of local organisations (mainly Water Management Groups, Social Forestry Groups and Farmer Forums). During the second week, meetings were organised in Dhaka with experts from different institutions and organisations working on climate change in Bangladesh. Experts consulted were from IWM, UNDP, IUCN, Oxfam, Alterra/WUR, and CEGIS. See Annex II for a full list of experts consulted. In the third and fourth week more field visits were conducted, including to polders from previous CDSP phases and with beneficiaries of the Cyclone Preparedness Programme implemented by the Red Crescent.

Before leaving for Dhaka a meeting was organised with several of the professional staff from the CDSP-IV team in which the major findings were presented and their feedback was received. This has been taken into consideration while preparing this report. In Dhaka a debriefing meeting was held with the First Secretary Water Sector, Mr. Martin Bos and the CDSP-IV Team Leader, Mr. Jan van der Wal, at the Royal Netherlands Embassy on December 11, 2012.

2.2 Review of reports, policies & scientific publications

CDSP has produced a large number of documents and reports during the previous and present phases of the project. Several of them have been reviewed and these are listed in Annex III. An extensive literature review was undertaken using the most recent scientific publications and reports. In general this mission tried avoid publications older than 3 years. The bibliography can be found in Annex III, and among others includes publications by the IPCC, WHO, World Bank, IWM, CEGIS, and FAO, but also articles published in scientific journals such as *Nature*.

Next to that, Bangladesh's national policies and strategies on climate change adaptation & mitigation and disaster risk management were studied. References can be found in Annex III.

2.3 Field visits

From 18 November to 5 December several visits were made to the field, in which the mission interacted with the representatives of various local organisations established under the project, such as the Water Management Groups, Social Forestry Groups, Farmer Forums, Tubewell User Groups and Local Area Development Committees. At various places discussions were also held with staff of CDSP-IV (both from the Noakhali office and in the field) and partner NGOs. An overview of groups interacted with is provided in Annex II.

Furthermore, several sites were visited, including (proposed locations of) embankments, sluices, foreshore and mangrove plantations, crop demonstration plots, and cyclone shelters. Next to that, several activities were attended, such as an orientation meeting for Disaster Risk Managers from NGOs, a demonstration / training activity on a high yielding rice variety and a law and human rights (LHR) training.

These visits provided an overview of the overall project, its interventions, the socio-economic conditions in the Chars, and the level of vulnerability and exposure to (extreme) climate conditions.

2.4 Key Definitions

Before diving in to the findings of the mission, a short overview of the definitions used throughout the document is appropriate. These definitions are based on the most renown scientific literature (Easterling et al., 2007; IPCC, 2007; Stern et al., 2007, UNFCCC, 2012).

Adaptive capacity: the "ability to design and implement effective adaptation strategies, or to react to evolving hazards and stresses so as to reduce the likelihood of the occurrence and/or the magnitude of harmful outcomes resulting from climate-related hazards" (Brooks, Adger, and Kelly, 2005).

Climate change: a change in the statistical properties of the climate system when considered over long periods of time, regardless of cause. However, climate change is often used to refer specifically to climate change caused by human activity.

Climate change adaptation: the actions of adjusting practices, processes and capital in response to the actuality or threat of climate change as well as changes in the decision environment, such as social and institutional structures, and altered technical options that can affect the potential or capacity for these actions to be realized"

Climate resilience: Where adaptive capacity relates to the ability to influence and respond directly to the processes of change (to shape, create or respond to change), resilience is the ability to absorb shocks or ride out changes.

Climate variability: Natural variations in the climate that are not caused by greenhouse gas emissions (e.g. it rains more in some years and less in others).

***Disaster risk reduction (DRR)*:** a systematic approach to identifying, assessing and reducing the risks of disaster. It aims to reduce socio-economic vulnerabilities to disaster as well as dealing with the environmental and other hazards that trigger them. It is therefore much more that emergency management.

Mitigation: the actions taken by individuals or institutions to reduce greenhouse gas emissions in order to minimize their effects on global climate change.

Vulnerability: the extent to which climate change may damage or harm a (socio-economic) system. It depends not only on a system's sensitivity, but also on its ability to adapt to new climatic conditions.

2.5 Checklist used to obtain relevant information in the field

Part of the tasks of the Terms of Reference was addressed through discussions and interviews with the various stakeholders. For this purpose a number of specific checklists were developed for each category of stakeholders (local organisations, NGO workers, and climate change specialists). Topics on these checklists included:

- current exposure / vulnerability to climatic events
- capacity to cope with these conditions (without CDSP Interventions)
- changing climatic conditions over time
- the tropical storm of 10 October
- disaster risk management and early warning
- possible adaptation measures (independently of CDSP)
- prioritisation of adaptation measures

See Annex VII for the complete list of topics.

3. Current vulnerability, exposure and coping capacity

This chapter provides an overview of the exposure and vulnerability of the char communities to climate conditions, without the impacts of CDSP-IV interventions and of climate change. Based on this, the capacity of the population to cope with these conditions is determined.

3.1.1 Introduction

The Meghna Estuary forms the central and most dynamic part of the coastal zone of Bangladesh. It is being shaped by a very complex set of interactions between physical processes. These processes result in the erosion and accretion of land. Surveys, based on satellite pictures, have shown that each year there is a net accretion of around 20 km.

Chars are newly emerged lands as a result of accretion. These lands are often occupied by people who have become landless due to the erosion of their land in other parts of the country. After settling, these people face many challenges inherent to the natural conditions of these new lands – which are described in more detail in the next section, such as:

- unfavourable conditions for agriculture due to salinity levels, flooding, and drainage problems;
- extreme weather events, including cyclones and storms (bringing very strong winds and heavy rainfall;
- lack of fresh water.

In addition, socio-economic factors make life on new chars very challenging, including a very poor communication infrastructure (i.e. roads, ghats, bridges, etc.), a lack of institutions and governance, and lack of a secure land title.

Poor communication infrastructure

With a very limited number of roads, bridges and ferries connecting the chars to the 'mainland', char dwellers have limited access to markets, cyclone shelters, schools, etc. and are virtually 'cut off' from the rest of the country. For the people living in the chars it is difficult to obtain modern inputs, and linkages with the private sector are weak. There is a lack of access to markets, so farmers need to transport products themselves and may need to go some distance by land and boat to get to a market. And if a local market exists, prices can be very low.

This lack of communication infrastructure was very obvious during field visits to the CDSP-IV areas. It takes almost 2 hours to reach Caring Char, with car and speedboat – imagine if one has to do this with local bus, CNG, rickshaw and ferry. Discussions with people from a village in Boyer Char (CDSP-III area) which is now intertwined with several roads showed that farmers and fishermen can now easily access markets. Their transport costs are much lower, resulting in a significantly higher income.

Lack of institutions and governance

The newly developed chars are largely out of reach of the state and this, combined with the illegal nature of land occupation, results in a high degree of lawlessness and consequent risk of loss and physical harm for char settlers, especially women.

Furthermore, government services are (almost) absent, especially in the newer areas such Caring and Urir Char. Fore example, police presence and healthcare facilities are very limited or nonexistent, and there are no schools. And because of the harsh conditions in the chars, institutions such as BWDB, Department of

Agricultural Extension and the Forest Department – and to a lesser extent also NGOs – have difficulties in establishing a presence, as few people are willing to work in these areas.

Lack of a secure land title

Land on newly emerged chars is often grabbed by criminal gangs who allow poor people to occupy plots in return for illegal rents and other obligations. Without a secure title, settlers are often unwilling or hesitating to invest in improving their land or houses. This also further discourages investments in agriculture. During discussions with local organisations, issues with landless people settling on the land of a landlord or other land titling issues were often brought up, which shows that the lack of a land title is of great importance to the local communities. Not having a land title significantly increases insecurity.

Resulting in extreme poverty…..

The people migrating to new chars have often lost many of their possessions, or are very poor already; combined with the harsh natural and unfavourable socio-economic conditions in the chars, resulting in extreme poverty. A baseline survey conducted during CDSP-IV appraisal of Noler, Caring and Nangulia chars (see Annex VI for a map of the project area), estimated average household income to be Tk3,103 per month – or Tk18.80 per head per day. Although this may have increased a little over the last years since the survey, the char dwellers still are among the poorest of the poor in Bangladesh.

According to the Design Completion Report – Appraisal, "*This falls within the poorest 10% of the rural population. The same survey found that 87% of households report a food shortage, with 72% having a shortage for at least 3 months and 46% for at least 5 months. Over half (52%) of children under five years of age were stunted, suffering from chronic malnutrition, 18% of under-five children were wasted, showing acute malnutrition, and 57% of children were underweight for their age. The rates of wasting and stunting are significantly higher than for rural Bangladesh as a whole."*

3.1.2 Vulnerability and Exposure to Climatic Conditions

Bangladesh is often quoted as the most disaster prone of the least developed countries. Between 1970 and 1998, 171 large-scale water-related hazards such as cyclones, storm-surges, droughts, floods, and river erosion disasters killed an estimated half million people and affected more than 400 million. The poor are hit hardest because they live at greater density in the most poorly constructed housing in settlements on lands prone to hazards - particularly along the coast which is most affected by storm surges[3].

CDSP-IV communities face multiple challenges related to the environment in which they live, often exacerbated by their socio-economic conditions. Based on a review of CDSP reports, scientific literature and (especially) discussions with representatives of local organisations (Water Management Groups, Social Forestry Groups, Farmer Forums, and Local Area Development Committees) and staff of partner NGOs, the current vulnerability and exposure to climatic conditions is described. This relates to the climate variability in the coastal regions of Bangladesh, and does not include climate change (long term) effects and does not incorporate CDSP-IV interventions.

Cyclones and storm surges

Bangladesh is a global hotspot for tropical cyclones[4]. On average, Bangladesh is hit by a major cyclone every 3 years. These cyclones are often accompanied by a storm surge, which is an abnormal rise of water generated by a storm, over and above the predicted astronomical tide and is caused primarily by the strong winds in a hurricane or tropical storm. Several natural conditions explain the relative high intensity of cyclones and storm surges in the coastal areas of Bangladesh (Dasgupta et al, 2011):

- the wide, shallow continental shelf;
- the high tidal range (up to 7-8 meters at Sandwip channel);
- the shape at the head of the Bay of Bengal, which acts as a 'funnel' resulting in sea water being pushed by the wind toward the coast;
- the low elevation of the coastal land;

[3] Coastal Embankment Rehabilitation Project, Project Performance Assessment Report, World Bank 2005

[4] UNDP has ranked Bangladesh as the world's most vulnerable country to tropical cyclones (UNDP 2004)

Most surge amplifications occur in the Meghna estuarine region (Dasgupta et al, 2011), which is the region where CDSP-IV is located. Coupled with the high-density population, unfavourable socio-economic conditions and a lack of – or not yet established – coastal embankments and mature trees that reduce wind speeds, char dwellers are very vulnerable and exposed to cyclones and storm surges.

Recent research work has demonstrated that the mortality risk from tropical cyclones depends on such factors as tropical cyclone intensity, exposure, levels of poverty, and governance structures (Peduzzi et al. 2012). As governance structures in the chars are almost non-existent, areas are not (yet) protected by embankments nor shielded by forest, people are extremely poor and cyclones in this area can be very intense with very high wind speeds (see below), char dwellers are extremely vulnerable and mortality risk from cyclones is high.

In the last few years, several cyclones hit Bangladesh, including Sidr (2007) and Aila (2009).

Box 1: Climate Extremes in Bangladesh - Sidr & Aila

Sidr

Sidr was a 10-year return period cyclone with an average wind speed of 223 km per hour, and resulted into one of the worst natural disasters in Bangladesh. The fourth named storm of the 2007 North Indian Ocean cyclone season, Sidr formed in the central Bay of Bengal, and quickly strengthened to reach peak 1.00-minute sustained winds of 260 km/h. The storm eventually made landfall in Bangladesh on November 15, 2007. It resulted in 4,234 casualties and 55,282 injuries. Livelihoods of 8.9 million people were affected and damages and losses from Cyclone Sidr totaled US$1.67 billion (Dasgupta et al, 2011; GoB 2008). In the aftermath of Sidr, people in the affected area experienced severe health problems such as diseases like diarrhoea, which spread due to shortage of drinking water.

Aila

Aila was the second tropical cyclone of the 2009 North Indian Ocean cyclone season. Heavy rains from Aila resulted in 190 deaths, 7,103 injuries and affected 3.9 million people. More than 400,000 people were reportedly isolated by severe flooding in coastal regions of Bangladesh. Numerous villages were either completely submerged in floodwaters or destroyed. Dozens of people are reportedly missing throughout the country. A storm surge of 3 meter impacted western regions of Bangladesh, submerging numerous villages. Several rivers broke through embankments, causing widespread inland flooding. Damage to embankments throughout the country was estimated at Tk. 1 billion (US$14.4 million). Overall estimated damage of assets from Aila is US$270 million (Dasgupta et al, 2011; GoB, 2008)

The examples of Sidr and Aila – and the below described storm of 10 October 2012 – show that the coastal regions of Bangladesh, including the CDSP-IV areas are extremely vulnerable and exposed to cyclones and storms. Observations from field visits and discussions with representatives of local organisations confirm this. Several chars are not yet protected by embankments, or will not be protected by CDSP-IV at all since they are still growing in size. Foreshore plantations are not yet developed, and there are hardly any (mature) trees that can give some protection from strong winds.

After a cyclone or storm has passed, the effects are immediately visible. Houses often (partially) collapse, trees fall down, crops are damaged, and livestock has died[5]. In very intense storms human casualties are often the result as well. See below for a more detailed description of the effects of a recent storm in the CDSP-IV area.

[5] Chickens are the most vulnerable, followed by goats and sheep, whereas cattle is often the least affected by cyclones/storms and related flooding & wind (according to Mr. Harvey Demaine, Team Leader of the Danida-funded Regional Fisheries and Livestock Component Project)

A recent disaster

On October 10, 2012, a tropical storm hit south eastern Bangladesh, including the chars of CDSP-IV. Two days later, CNN reported that the storm killed "at least 23 people, police and local administrators said. More than 1,000 fishermen who were fishing in the deep sea were still missing, the officials said. […] Small islands of southeast Noakhali district, some 200 kilometres from capital, Dhaka, were the worst affected areas, and at least 16 people were killed there".

What happened?

The weather office had forecasted heavy rain in the coastal areas and advised the fishermen to stay close to safety, but there was no warning for a major storm. Around 2 am on October 10, a heavy storm broke loose bringing heavy rains and strong winds and continued for 6-7 hours non-stop. Where cyclone shelters were nearby, (homeless) people took refuge at schools and cyclone shelters. However, in many of the CDSP-IV areas cyclone shelters had not yet been built or were too far away. These people stayed in their own houses, "waiting and praying", according to several villagers. In Caring char, some people gathered at higher grounds (mainly around the market). In Noler char, people thought of using the newly built CDSP-IV office as a shelter, although this would have flooded as well.

Many people in Nangulia, Caring and Noler Chars considered themselves even 'lucky' with this storm, as the wind did not come from the seaside and the tide was low. The storm's impact could have been much worse had this not been the case.

What was the damage?

One child (in Caring Char) and a couple (in Char Nangulia) died because their houses collapsed. There were no casualties in the other CDSP-IV chars. After it subsided, the storm had (partially) destroyed hundreds of houses; most of them made of very basic materials such as wood and tin, and numerous households had lost smaller items, such as cooking utensils. The storm furthermore uprooted thousands of trees and banana plants. It also devastated crops, mostly rice and country bean (the latter being in the flowering stage and therefore vulnerable). Uprooted trees along roadside plantations led to disruption of road traffic. Hours of continuous and intense rainfall inundated many low-lying areas. In Noler char, ponds overtopped and as a result many fish escaped. In Caring char and char Nangulia, however, no problems with flooding were reported.

Part of a mosque in Caring char collapsed – which they just had rebuilt after cyclone Aila – and the Hindu temple was damaged as well.

Uprooted trees on the way to Char Nangulia (taken on 19-11-2012) and a collapsed house in Noler Char (taken on 20-11-2012).

In the CDSP I, II and III areas the storm caused less problems. There was less damage to houses, and more people gathered in cyclone shelters during the storm. There were also fewer uprooted trees, although the ones that were uprooted were much larger.

Why so much damage?

There was no warning of an incoming storm at all, so no one saw this storm coming. But even if there would have been a warning, many people in the CDSP-IV areas could not have protected themselves as cyclone shelters were too far away. Houses in the chars are made of very basic materials, and are not strong enough to withstand strong winds. Although people plant trees around their houses, these could not provide enough protection from the wind because they are not mature yet. Many of the houses were simply not strong enough, and crops and cattle could simply not be protected.

In the process of planting the trees along the roadsides, the core root – which is growing downwards – was cut to make their transportation and handling easier. The result is that many trees have only horizontal growing roots, and are therefore much more susceptible to strong winds. Next to that, commercially interesting tree species were chosen by the forest department. However, these species have a lot of foliage, also making them more susceptible to wind. Lastly, trees were planted on too steep slopes, making it harder to 'hold on' during storms.

Collapsed house (in front) and partially destroyed mosque (in the back) due to the 10 October storm (Photo taken on 20-11-2012)

What does it show about current vulnerability and adaptive capacity?

This most recent storm shows that char dwellers in the CDSP-IV areas are extremely exposed and vulnerable to extreme weather events. Even with the 'mild' conditions of this storm (low tide, wind from the north), three people died and material damage was large. Many people lost their houses, and crops were heavily damaged. With already limited resources, people had to rebuild their houses, and will have a lower yield. This even reduces their adaptive capacity further.

As there was no warning for this storm, not all people were able to take shelter in time, if shelters were available at all, since in most of the CDSP-IV areas cyclone shelters are not yet built. The distance to cyclone shelters in other areas was often too long.

Furthermore, people are not able to effectively protect themselves. Asked about the measures they take to cope with heavy storms, people indicated that it is too expensive to sufficiently strengthen their houses. Some households use bamboo, as concrete is too expensive. However, for many people even bamboo is too expensive, as it is not available locally. As there are no mature trees in the area, they often use immature trees for house strengthening. These trees are not strong enough to withstand a large storm. Other measures include building their houses on raised platforms and planting of trees around the house. No other adaptation activities were identified. This shows that the population is largely dependent on external interventions.

If people are not able to cope with a relatively 'small' storm, how can they withstand a major disaster? The consequences of a very big storm, including a storm surge, are therefore incalculable. However, looking at the areas of CDSP III one can see a big difference. Boyer Char was much less affected by the tropical storm than all of the CDSP-IV chars.

Within the CDSP-IV project area the chars were not all affected in the same way. Whereas Caring and Nangulia Char were affected most by the strong winds, people in Noler Char reported that the very intense rainfall (and lack of enough drainage capacity) did most of the damage. In Char Ziauddin some houses and crops were damaged, but overall this area was much less affected than the others[6]. This may be explained by the fact that this area is surrounded by chars that were part of previous CDSP phases, and therefore it already has embankments and a good drainage system. Compared to Caring Char, Char Ziauddin has also been inhabited longer, trees are fully grown and houses seem stronger.

This shows that the development of good drainage systems, cyclone shelters, house strengthening activities and general socio-economic development of char areas increases the capacity to cope with these kinds of extreme events.

[6] Unfortunately it was not possible to visit Urir Char, due to the difficulties of reaching this area.

Flooding, drainage congestion and salinity intrusion

The project area is at or just above sea level and many parts are not (yet) protected by embankments. During storms or cyclones, but in some areas also during high tide, significant areas are flooded with saline water. Discussions with experts from IWM and CEGIS revealed that the tidal amplitude in this part of the coastal zone is extremely high, reaching up to 8 metres, whereas the amplitude in the Sundarbans area is usually not more than 1.5-2 metres.

In Caring, Noler and Nangulia chars, floods damage houses and crops every year. This especially goes for low laying areas, which are regularly flooded by saline water during high tide, severely damaging crops. Villagers from Noler char indicated that there are no high(er) grounds in their area, so they have nowhere to go to protect themselves during high tide and storms.

Intense rainfall can also lead to flooding, as happened during the storm of 10 October 2012. As a drainage system is not yet in place or canals have not enough drainage capacity, several areas become waterlogged after heavy rain or floods. Discussions with villagers shows that this is mainly a problem in char Nangulia and parts of Noler Char, where the current canals do not have enough capacity to drain off the excess water, and are in need of re-excavation. As Caring char is very close to the sea and still has a lot of natural canals formed during accretion, the drainage problem is not that big.

The lack of a good drainage system also results in damage to crops, roads, houses, etc. The fact that an earthen road constructed by CDSP-IV in Caring char in the last dry season is (after one rainy season!) already eroded to an extent that it is even difficult to walk on shows the force of floods and rainfall. Char Ziauddin faces fewer problems with flooding and drainage congestions, as it is protected by embankments from previous phases of CDSP, and the drainage capacity is higher than in the other areas.

Lack of freshwater

During periods of drought crops are often damaged by lack of fresh water. Irrigation is not possible in this part of the country, as ponds fall dry during the dry season, river water is too saline to use for irrigation, and shallow groundwater becomes increasingly saline towards the end of the dry season[7].

In some areas this means that agriculture is not possible during the dry season, which lasts from November/ December – April. Saline soils, tidal flooding, drainage congestion and lack of fresh water limit agricultural production on coastal chars. In Caring char, already at the start of the dry season the soil becomes more saline, making agriculture (almost) impossible during this season. In char Nangulia, people indicate that crop yields have been declining over the last ten years. They attribute this to a combination of regular saltwater intrusion, saline groundwater, and reduced soil fertility[8].

Next to agriculture, people themselves also face a lack of fresh water. As there are not many tubewells yet – except for Char Ziauddin – people have to walk long distances to get their drinking water. In some areas, people used to drink the water from the ponds before there was access to tubewells. These ponds were also used by their cattle. Unsurprisingly, a lot of waterborne diseases were the result. Although this is not the case anymore, many people identified closer access to drinking water as a priority for their area.

In Nangulia, villagers indicated that they often have shortage of safe drinking water. Currently 250 households share 2 tubewells, which means that in the dry season people sometimes drink water from the pond, or have to walk at least 1 km to fetch drinking water. In Caring char there used to be a lot of problems with safe drinking water, but since CDSP-III placed some tubewells these problems have become less urgent. At present there is sometimes queuing at tubewells.

Temperature

[7] Heavy rains during the monsoon season temporarily reduce soil salinity levels, as the excess water washes the saline water to deeper groundwater levels.

[8] According to the farmers, the yields were quite good when they settled in Nangulia 10-12 years ago, because the forest provided fertile soil. After the trees were cut down, the nutrient content of the soil reduced.

No significant problems related to high or low temperatures are reported by the population. However, being extremely poor, char dwellers have very limited capacity to deal with lower temperatures in the winter season. Although temperatures in Bangladesh never drop to freezing conditions, winter temperatures do have an impact on people living in the chars.

This year, the early arrival of winter put char dwellers in an even more vulnerable position. Usually the winter comes at the end of November or early December, which is also the time when local and international NGOs often distribute (second hand) warm clothes. However, this year low temperatures engulfed parts of Bangladesh in the first week of November. As the very poor people in the chars are not able to purchase warm clothes and NGOs did not start the distribution yet, they suffered from the unusually low temperatures during the nights and mornings. According to some farmers, "*labourers could not join their work before 10:00 am and they went back home before 5:00 pm due to the cold as many of them had no warm cloths"*[9]. This slight deviation from 'normal' weather again shows the vulnerability of the char communities.

3.1.3 Coping Capacity

Societies have a long record of adapting to impacts of climate and weather, and adapting to environmental conditions has always been part of agriculture. It is the pace and magnitude of climate change that causes problems. In its fourth assessment report the IPCC stated that adaptation to climate change is already taking place, but on a limited basis and seldom in response to climate change alone. Furthermore, adaptive capacity is unevenly distributed across and within societies, and substantial limits and barriers to adaptation exist (Adger et al., 2007).

Coping capacity is the *"ability to design and implement effective strategies or activities to hazards and stresses so as to reduce the likelihood of the occurrence and/or the magnitude of harmful outcomes resulting from climate-related hazards"*. Being able to do so depends on *social capital at the household level* (education and other factors), *presence of local enabling institutions* (cooperatives, banks, self-help groups), and *physical and social infrastructure* (embankments, roads, institutional capacity).

One of the ways to assess coping capacity is to analyse the current (exposure to) hazards – which was done in the previous section – and how these are being dealt with. The section below provides an overview of what measures are taken by people themselves (not including CDSP interventions!), and the limitations they face in taking effective measures. It is divided in:

- Reducing risk
- Transferring risk
- Preparedness and management of risks.

Reducing risk

Char dwellers have very limited means of reducing weather and climate risks themselves. Although building of embankments, cyclone shelters and drainage infrastructure is an effective way to reduce the risk and exposure to tidal flooding and salinity intrusion, storm surges, and drainage congestion, they cannot do this without external help.

The measures they do take themselves are limited to constructing their houses on raised platforms to avoid their house being flooded. Although this is usually enough to protect from tidal flooding and flooding due to heavy rainfall in the monsoon, it is not sufficient for the more serious floods that come with storm surges. Other practices include the planting of trees around the homestead to protect from strong winds and to get some income from their products. However, these trees are not yet mature, giving limited protection from strong winds.

Although people try to strengthen their houses, it is often too expensive to sufficiently strengthen them to withstand major storms. Some households use bamboo, as concrete is too expensive. However, for many people bamboo is even too expensive, as it is not grown locally. As there are no mature trees in the area,

[9] "*Early winter adds to woes of char people".* The Daily Star, Wednesday November 14.

people often use immature trees for house strengthening. These trees are not strong enough to withstand a large storm.

As irrigation is not possible, agricultural inputs are very limited or too expensive, saltwater intrusion regularly occurs and soils are often saline, farmers have difficulties in getting high good harvests, especially during the dry season. Although they are interested in the possibilities of High Yielding Varieties (mainly salt tolerant), knowledge of and access to these varieties is very limited. Without a guarantee that new varieties are just as good as their traditional varieties, farmers are often resistant to trying something unknown. This means that there is limited use of High Yielding Varieties.

The only possibility to get drinking water is through either rainwater harvesting – often in ponds – or through groundwater pumping. During the dry season many ponds fall dry. Being in a coastal area the shallow groundwater is too saline. For sufficient quality drinking water, groundwater has to be pumped from at least 700 feet. Obviously, constructing enough tubewells this deep without external help is too expensive for the char communities. They have therefore limited means of ensuring sufficient quality drinking water year round.

Basically, the conditions in the CDSP-IV chars are such that without external help, communities can hardly reduce the risk of weather and climate events themselves. Their natural environment is very harsh, and they have limited means to deal with this.

Transferring risk

Obviously, reducing the risk of weather and climate related impacts often has first priority. However, in this part of Bangladesh weather events can be very extreme. It is (almost) impossible to prepare for cyclones with wind speeds of over 250 km/h, and storm surges of up to 3-4 meters. No embankment will protect from this kind of surges, and even salt tolerant rice varieties will be severely damaged by such strong winds.

Knowing that disasters can not always be avoided or their impact reduced, risk transferring mechanisms – such as insurance schemes – can provide char dwellers with more security. Farmers who can (partially) insure themselves against crop failure are less likely to lose everything every time in case of a cyclone or major flood. This means that they do not have to start all over again, roughly every three years: Bangladesh is hit by a major cyclone once every three years. Without a doubt this would help farmers in further securing their livelihoods, thereby increasing their capacity to cope with weather and climate related events.

No such transferring mechanisms are practised in the CDSP-IV areas. The government and private sector, which could provide these services, are (almost) absent, especially in the newer chars. NGOs are not providing risk transferring mechanisms, but may be able to do so.

Preparedness and management of risks

Being well prepared for the extreme climate variability that comes with living in an exposed and vulnerable area, and being able to manage an extreme event can save lives and secure livelihoods. Related to disasters such as cyclones and storm surges it was noticed that at the moment not all chars have a well-functioning signalling system that can warn the entire population for extreme weather. BRAC and the Red Crescent try to warn people for incoming cyclones, but not everyone is reached through this. If possible, mosque speakers are used to warn people. There is no clear or institutionalised communication infrastructure. Government institutions responsible for disaster risk management and early warning are absent, and the well developed Bangladesh disaster risk strategy and its associated mechanisms (see chapter 6) are not yet fully established in the chars.

Furthermore, as the current infrastructure (such as roads, bridges, and ferry services) is very limited, the mobility of the population before and during extreme events is limited. This is often exacerbated by flooding of low laying areas.

As a consequence, even when people would know in advance that a major storm is coming and they can quickly move around, they have nowhere to go as the nearest shelters are often too far away. In many of

the discussions with representatives from local organisations, the building of (nearby) cyclone shelters was given the highest priority for better coping with their environment. A member of a Water Management Group remarked: *"First we have to survive and then we can further develop"*.

Preparedness for other possible weather and climate related events such as droughts or low winter temperatures is very limited. Households have few resources to be adequately prepared, like enough food and drinking water in stock for post disaster times. The same applies for having enough warm clothes to cope with low winter temperatures.

Shop damaged by the tropical storm of 10 October in Caring Char (photo taken on 20-11-2010)

Looking at the socio-economic situation and natural conditions in the CDSP-IV chars, one can clearly see that the capacity to cope with climate variability is very low, in particular with more extreme events. There is hardly any physical and social infrastructure (yet), no presence of local enabling institutions (although local organisations are currently being formed) and social capital at the household level is very limited. The fact that after a relatively 'mild' storm there are several casualties, many families lose their house, crops are damaged and cattle is lost, shows that they can hardly cope with the current conditions.

The very low coping capacity of the people in the coastal chars of Bangladesh is further evidenced by the fact that many Sidr victims are still without proper housing, five years after the disaster struck[10]. Of the 54,006 families who lost their homes in the event, only 23,639 have got new houses from government and different donor agencies. Unable to build new houses, the other 30,367 families are living in shabby huts, according to the Patuakhali District Relief and Rehabilitation Office. This shows that without external help, people do not have the means to rebuild their houses. As a consequence, these people are more vulnerable for future extreme events than before. Resilience and adaptive capacity are therefore very low. Although Sidr mainly hit the south western part of the coastal area, char dwellers in CDSP-IV have comparable – if not less[11] – coping capacity related to extreme weather events.

[10] "*Sidr victims still cry for help*". The Daily Star, Friday November 16, 2012.

[11] Due to the fact that some of the CDSP-IV areas have very recently formed and are poorly connected to the mainland.

4. Climate Change in the CDSP-IV Chars

4.1 Introduction

The global climate is changing, and a large part of that can be attributed to anthropogenic activity. While that was a very controversial statement twenty years ago, today it is widely accepted that changes are happening and human emissions of greenhouse gasses (GHGs) are a cause. As the Intergovernmental Panel on Climate Change (IPCC) stated in its Fourth Assessment Report:

> ***"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level"***
>
> - IPPC (2007)

Nowadays, many agree that the scientific evidence clearly indicates that climate change presents very serious global risks, and that it demands an urgent response. This response includes actions on *mitigation* (reducing greenhouse gas emissions in order to minimize their effects on global climate change) and *adaptation* (responding to the actuality or threat of climate change).

Bangladesh's contribution to global warming is minimal. The country emitted between 0.045 and 0.053 billion tonnes of carbon in 2005 - less than 0.2% of world total - reflecting its extremely low consumption of energy (GoB, 2008). Being also one of the Least Developing Countries and having (had) a very small contribution to the global warming problem, mitigation is not Bangladesh first priority. Predicted impacts of climate change on Bangladesh – and the coastal chars in particular – are significant. Given the slow progress on mitigation coupled with evidence of greater and more rapid impacts of climate change than those previously expected, adaptation is firmly on the agenda as a crucial supplement to mitigation. As the emission of GHGs in the chars is very minimal while the impacts of climate change will be large, the mission focused on adaptation to climate change, but where possible links with climate change mitigation have been explored.

A warming world…

Overall, in 2007 the Fourth Assessment Report of the IPCC predicted that global temperatures will rise between 1.8 ^{o}C and 4.0 ^{o}C by the last decade of the 21st century. In a recent report for the World Bank, the Potsdam Institute for Climate Impact Research and Climate Analytics warned that without further commitments and action to reduce greenhouse gas emissions, the world is likely to warm by more than 3°C above the preindustrial climate. Even with the current mitigation commitments and pledges fully implemented, there is roughly a 20 percent likelihood of exceeding 4°C by 2100. If they are not met, a warming of 4°C could occur as early as the 2060s (World Bank, 2012). Needless to say, this will have large impacts all over the world. However, the impacts of climate change, such as sea level rise, weather patterns, cyclone activity, and temperature changes, will vary significantly between regions.

Current climate change impact predictions on (the coastal zone of) Bangladesh are all based on secondary data. To date, for climate impact projections the country is dependent on Global and Regional Circulation Models. These have a resolution too large to give detailed estimates on sea level rise, temperature, and rainfall patterns, for example. No detailed climate model runs have been completed for Bangladesh specifically, although some institutions are in the process of doing so. Coupled with the scientific uncertainties that still exist, the complexity of and linkages between climate impacts, and the natural variability of climate from region to region, it is difficult to determine the exact impact of climate change on the chars.

This chapter therefore provides an overview of the likely impacts with a high probability, but will not go into much detail on the extent of these impacts as there is still no agreement (i.e. on the extent of sea level rise, for example). In general, there seems to be scientific consensus that sea level will rise, cyclonic activity will be more intense (but increased frequency is hotly debated), temperatures will overall rise, rainfall patterns will change and the Himalayan glaciers are melting.

The below figure gives an overview of the predicted climate change impacts for Bangladesh, and this chapter is structured accordingly. It is based on a literature review, but also discussions with climate change experts from national and international research institutes. This chapter aims to provide a general overview of the climate change impacts for the CDSP-IV chars.

4.2 Sea Level Rise

Projections

Global warming has already raised[12] and will continue to raise sea level due to thermal expansion (warmer water takes up more space) of the oceans and the melting of ice stored in glaciers or ice sheets. The principle of sea level rise is quite well understood, as its effects, although the estimations are the topic of much debate.

According to the IPCC's Fourth Assessment Report global sea levels will rise by at least 18 cm, but in the worst case scenario as much as 59 cm by the year 2100 (Alley et al, 2007). However, these predictions from the IPCC excluded the melting of ice caps as scientists have been finding it difficult to assess their impact on sea levels (Hodson & Hodson, 2008). As studies have since been carried out on the input from melting ice sheets in Antarctica and Greenland, especially the loss of sea ice in summer months, it has been found that without sea ice to prop up land ice, the land ice sheets tip into the seawater and disintegrate faster. As a result, those land ice sheets are breaking up much more quickly and far more melt water is being added to the oceans than was expected. This has led to recent revisions on predicted global sea level rise by 2100. Several researchers – most recently during the COP18 negotiations in Doha, Qatar – published estimations of sea level rise up to 1 meter in 2100.

Land subsidence in the coastal zone is further increasing the impact of sea level rise. Although the experts disagree on the extent of land subsidence – mentioning between 1 and 9 mm subsidence per year! –, it should be incorporated in thinking about sea level rise. Preliminary research of IWM shows the following results for the relative mean sea level rise (sea level rise + land subsidence):

Year	Local Effect including subsidence (mm/yr)	Relative Mean Sea Level Rise above 2011 Water Level Including Local Effects (cm)		
		A1FI	A1B	B1
2030	2	18	16	14
	5	24	22	20
2050	2	45	40	35
	5	57	52	46

This table draws on the IPCC projections including the melting of ice sheets and land subsidence based on different IPCC scenarios. This shows that the predicted sea level rise in the coastal region of Bangladesh will probably be between 14 and 24 cm in 2030.

[12] Over the last 35 years, sea levels have risen between 4 and 8 mm/y, according to different researchers (IWM, Karim et al, 2006)

Impacts

Of all climate change impacts, sea level rise may have the largest consequences for the chars. Sea level rise in conjunction with increased intensity of storms and cyclones has severe implications for coastal inundation in the region (CDKN, 2012). Without additional protection measures its direct effect will be an increased risk of flooding (and salinity intrusion). Obviously this applies to both tidal and storm surge flooding.

It is expected that sea level rise will increase water logging as it will be more difficult to drain excess water to the sea. Next to that, a higher sea level might lead to the raising of riverbeds further upstream as more sediment is deposited further upwards due to lower river flow velocity[13]. This will further reduce the (natural) drainage capacity of polders, as the difference between polder and river levels will be less. Land subsidence will increase the relative mean sea level rise, and exacerbate the impacts of floods (as flood depth will be higher) and worsen the water logging conditions as it will be more difficult to drain the excess water to the sea.

Overall, increased periods of inundation will hamper agricultural productivity, damage infrastructure such as roads and houses, and will also threaten human health by increasing the potential for water borne diseases. In combination with more intense storms (see next section), sea level rise might also lead to more deaths due to floods. The effect of saline water intrusion in the estuaries and into groundwater would be enhanced by low river flow, sea level rise and subsidence. The adverse effects of saline water intrusion will be significant on coastal agriculture and the availability of fresh water for public may diminish. Sea level rise contributes to salinity intrusion to the land area causing saline water contamination of surface water as well as groundwater.

4.3 Changing intensity/frequency of cyclones and storms

Projections

According to the IPCC future tropical cyclones will become stronger, with higher wind speeds (Alley et al, 2007). The scientific evidence indicates that increased sea surface temperature with climate change will intensify cyclone activity and heighten storm surges. Surges will be further elevated by a rising sea level as thermal expansion and ice cap(s) continue to melt (Nicholls et al. 2007; Dasgupta et al. 2011). According to Stern (2007), even small increases in sea temperatures will lead to more damage, as peak wind speeds of tropical storms are a strongly exponential function of temperature, increasing by about 15-20% for a 3°C increase in tropical sea surface temperatures.

The IPCC´s Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (CDKN, 2012) reports that the average maximum cyclone intensity (defined by maximum speed) is likely to increase in the future (Field et al. 2012). An increased frequency of cyclones – often related to climate change – is not yet observed in Bangladesh, and there is no scientific consensus on this.

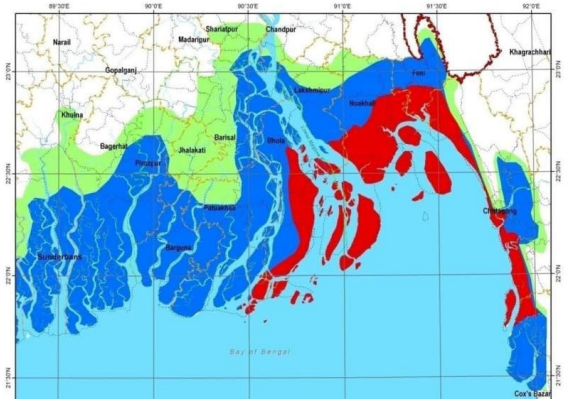


Figure 1: High risk area (cyclones and flooding) by 2050 in a changing climate

Dasgupta et al. (2011) estimated that a 27-centimeter sea-level rise and 10 percent intensification of wind speed from global warming is likely to increase the storm surge-induced inundation area in size by 69 percent given a +3-meter inundation depth and by 14 percent given a +1-meter inundation depth by 2050.

[13] The process of sedimentation may rise as water level gradients due to higher downstream water levels at sea result in lower flow velocities. The morphologically highly dynamic rivers in Bangladesh are expected to adapt to such changes in water levels over a period of several decades. The changes in bed levels in turn will cause additional changes in river levels (NAPA, 2009).

At present, a 10-year return period cyclone with an average wind speed of 223 km/ hour, as recorded during the Cyclone Sidr, 2007, covers 26% of the vulnerable zone; estimates of this study indicate that a similar cyclone will be more intense with global warming and is likely to cover 43% of the vulnerable zone by 2050 - exposing an additional 9.1 million inhabitants to risk of inundation. (Dasgupta et al, 2011)

Impacts

In the next two or three decades, the expected increase in climate extremes will be probably small compared to the normal year-to-year variations. However, as climate change impacts become more and more dramatic, its effect on a range of climate extremes will become increasingly important and will play a more significant role in disaster impacts.

"It should be considered that today's climate extremes will be tomorrow's 'normal' weather. Tomorrow's climate extremes may therefore stretch our imagination and challenge our capacity to manage change as never before"

- Managing Climate Extremes and Disasters in Asia (CDKN, 2012)

More intense cyclones will bring larger storm surges and – if not better protected - greater future destruction, because they will increase the depth of inundation and will move further inland - threatening larger areas than in the past. The destructive impact of storm surges will generally be greater when the surges are accompanied by strong winds and large onshore waves (Dasgupta et al., 2011).

The effects of more often and more powerful storms and cyclones will include:

- damage to crops and infrastructure,
- uprooting of trees,
- increased risk of deaths and injuries,
- loss of property,
- damage to mangrove forests, and
- coastal erosion (Adger et al, 2007).

4.4 Temperature rise

Projections

The global temperature has been rising, and is currently 0.8 ^{o}C above pre-industrial levels (World Bank, 2012). Even with appropriate GHG emission reductions, warming will continue for the coming century. In 2007 the IPCC predicted that global temperatures will rise between 1.8 ^{o}C and 4.0 ^{o}C by the last decade of the 21st century.

In Bangladesh, both average minimum and maximum have been rising over the last 35 years. Observed data indicate that average monsoon maximum and minimum temperatures show an increasing trend annually at the rate of 0.05 ^{o}C and 0.03 ^{o}C, respectively (NAPA, 2009). Winter temperatures are rising as well, albeit at slightly lower rates.

Impacts

Such a temperature rise is expected to have significant results. A thorough assessment of extreme events by Field et al. (2012) concluded that it is very likely that the length, frequency, and intensity of heat waves will increase over most land areas, with more warming resulting in more extremes. Agriculture, for example, might be severely affected by higher temperatures. Rice production is and will be affected by changes in climate. Peng et al. (2004) have analyzed 6 years of data from 227 irrigated rice farms in six major rice-growing countries in Asia, which produce more than 90 percent of the world's rice. They found that rising temperatures, especially night temperatures, have had a severe effect on yields causing losses of 10 -20 percent of harvests in some locations. Higher temperatures can also lead to a higher likelihood of outbreaks of pests and diseases, with large losses of crops and harvested products. Together with other estimated climate change impacts such as more irregular rainfall, drought and floods this can have a significant an effect on yields in the chars.

Next to agriculture, human health is also expected to suffer from higher temperatures. According to (McMichael and Lindgren, 2011), a temperature increase affects the rates of spread and multiplication of pathogens and changes the ranges and survival of non-human host species. Changes in temperature (next to changes in precipitation and humidity) influence vector-borne diseases (for example, malaria and dengue fever), as well as hanta viruses, leishmaniasis, Lyme disease and schistosomiasis (World Health Organization, 2009). Naturally, this will be a problem for livestock as well.

As temperature rise is a very gradual process, it is not expected to have very large impacts on the CDSP-IV areas in the short to medium term. As the temperature does not yet cause many problems at the moment, there should be sufficient time to adapt to higher temperatures (e.g. through new crop varieties, or through improved sanitation).

4.5 Changing rainfall patterns

Projections

Although there is not much evidence up to date in e.g. the rainfall annual and three-monthly data in Bangladesh to suggest a trend, climate scientists predict that heavy rainfall will become more common, and periods of drought may increase.

As with sea level rise, detailed projections on rainfall patterns are not yet available. The current projections are based on Global and Regional Circulation models (e.g. Indian subcontinent), which cannot give very detailed information on future rainfall patterns in Bangladesh. Observed rainfall data revealed that there is no significant change in annual rainfall. However, analysis shows an increasing trend in the number of days without rainfall, for example at Bogra and Rangpur.

Impacts

More intense rainfall is likely to damage farm incomes through increased soil erosion, and an inability to cultivate land due to the water logging of soils. Increased drought periods will probably reduce crop yields, as there are no possibilities for irrigation in the chars.

In general, unreliable weather patterns lead to a larger insecurity for farmers. During discussions with representatives from local CDSP organisations, people indicated that the weather is not how it was and can no longer be relied on. They reported that the rains are more unpredictable than before, weather is becoming hotter, and the winter season has shortened. All in all, the seasons seem no longer as distinct as they used to be. Farmers now find it more difficult to decide when to plant their crops, and perceive a higher risk of climate related events.

4.6 Melting of Himalayan Glaciers

Projections

The melting of Himalayan glaciers and loss of mountain snow will for Bangladesh result in an increased flood risk during the wet season (short to medium term) and threaten dry-season water supplies (long term, when all snow has melted). Climate change will have serious consequences for people who depend heavily on glacier melt water to maintain supplies during the dry season.

Impacts

For the coastal chars, however, the melting of Himalayan glaciers will probably not have that much impact. The char communities do not depend on water supply from the rivers, as they are too saline, and the sea level has more effect than the river discharges. Next to that, it is virtually impossible to attribute (increased) river flooding to climate change, since anthropogenic factors – such as the (in-) appropriate planning and operation & maintenance of infrastructure, or the building of dams upstream – might have a similar or larger influence. It can be concluded that the melting of Himalayan glaciers will not have a very large impact on the chars of CDSP-IV.

4.7 Consequences for Char communities

Even without the predicted climate change impacts, char dwellers already face numerous challenges. The socio-economic situation in the chars of CDSP-IV combined with a high exposure to tidal flooding, storm surges, cyclones, salinity intrusion, intense rainfall, drought periods, water shortages and a lack of options

to deal with saline soils, drainage congestion, a weak early warning system for major storms and few opportunities to take shelter from them make the char communities extremely vulnerable. People can easily lose everything in any disaster, whether a major storm, excessive rainfall or a very long drought period. Being extremely poor with very limited means, their capacity to deal with their harsh natural environment is very low. They have virtually no possibilities to reduce, transfer, prepare for, and manage the risks related to climate variability in the area they live in.

As a result of both the challenges imposed by their natural environment as well as the socio-economic situation, char dwellers belong to the poorest of the poor and face much insecurity. If not properly dealt with, climate change will further exacerbate the already difficult conditions in the chars. To be able to develop – or even survive – char communities need to better cope with climate variability and learn to adapt to a changing climate.

4.8 Community Based Adaptation

The expected climate change impacts in the CDSP-IV areas, as identified in previous sections, make clear that in the medium to long term there is a clear need to adapt to climate change. The capacity of the population to deal with current climate variability (coping capacity) *and* the capacity to deal with predicted climate change impacts (adaptive capacity) should be increased. Literature suggests that this can be (at least partially) achieved by community based adaptation.

Community based adaptation operates at the local level in communities that are vulnerable to the impacts of climate change. *It identifies, assists, and implements community based development activities that strengthen the capacity of local people to adapt to living in a riskier and less predictable climate*. Moreover, community based adaptation generates adaptation strategies through participatory processes, involving local stakeholders and development and disaster risk reduction practitioners (Ayers and Forsyth, 2009). By addressing local development concerns that make people vulnerable to the impacts of climate change in the first place, community based adaptation helps communities to deal with (future) climate change impacts.

However, risks from disasters and natural hazards are often more linked to social, economic, and even political factors in different contexts than simply to the size of physical events such as storms and floods (Smit and Wandel, 2006). In this sense, the socio-economic situation of communities and related social vulnerability to climate change is inseparable from the development context (Wisner et al, 2004). Accordingly, measures based on technology alone (such as embankments) can only be partially effective if they do not also address non-climatic factors that are the underlying drivers of vulnerability (Ayers and Forsyth, 2009). In the case of CDSP, for example, the implementation and effectiveness of high yielding rice varieties is limited by their acceptance in a community. As previously mentioned, this in turn depends on other factors such as costs and availability of the seeds, access to required agricultural inputs, ease of use, and perceived risk of using a new variety.

In response to these kinds of issues a new, more development oriented perspective to climate change adaptation formed. This perspective considers development and climate change adaptation as strongly complementary. In this approach, adaptation is not only focused on anticipating higher physical risks related to climate change, but rather addresses developmental needs such as improving livelihoods and access to productive assets to increase the adaptive capacity of poorer, more vulnerable people (Ayers and Forsyth, 2009).

This means that climate change adaptation interventions cannot stand alone, but must go hand in hand with development. Community-based adaptation takes the approach of adaptation as development.

> ***Adaptation as development in effect implies that overall development is an effective contribution to withstanding future climate change.***
>
> - Ayers and Forsyth (2009)

Community based adaptation has the following characteristics:

- It is local and place based; addressing the locally and contextually specified nature of climate change vulnerability.
- It must be generated through participatory processes, rather than being restricted to impacts-based scientific inputs alone.
- Expertise in vulnerability reduction must come from local community-based case studies and indigenous knowledge of locally appropriate solutions to climatic variability and extremes.

For example, house design in CDSP chars is based on traditional cultural preferences but incorporates modest technological innovations that help strengthen the house against strong winds and (limited) flooding. This might include raised foundations, strengthened house structures with bamboo or other materials, and creating raised platforms for the entire house or within homes where people can take shelter during floods. The planting of trees around the homestead is another example of local expertise to reduce vulnerability from strong winds.

By empowering households to intensify agriculture outputs and diversify economic activities, communities can also become more resilient to climate shocks. Addressing climate risk sometimes can mean reducing the dependency of income on one activity, such as agricultural or fishing-based activities.

Limitations of community based adaptation

Of course, community based adaptation is not the solution to all climate change impacts. It may not be sufficient in preventing some of the most extreme impacts of climate change. If current climate change policies fail to halt global warming at just 2 degrees, and if warming approaches 4 degrees or more – as feared by many, including the World Bank in its latest report 'Turn down the heat' – then it is likely that especially the coastal chars of Bangladesh will face challenges that can not be met with community based adaptation alone. A sea level rise of 1 meter will probably inundate the whole CDSP-IV area. Technological or engineering based approaches to adaptation are therefore necessary and will supplement the community based approach.

Sunset over a fishing boat from Char Nangulia

5. CDSP-IV interventions and climate change

CDSP-IV activities target the development of five new chars: Char Nangulia, Noler Char and Caring Char (contiguous to each other); Urir Char and Char Ziauddin. The total extent of these chars is around 30,000 ha, with an estimated population of 155,000 in 28,000 households.

The six components of the project are:

1) protection from climate change;
2) climate resilient infrastructure and water supply & sanitation;
3) land settlement and titling;
4) livelihood support;
5) institutional development;
6) knowledge management.

Looking at the current vulnerability to climatic conditions and the predicted climate change impacts for the project areas, this chapter first provides an analysis of how the CDSP-IV interventions reduce vulnerability & exposure to climate variability and climate change, and increase the adaptive capacity of the population to current climate conditions and future climate change impacts. It furthermore considers the contribution of CDSP-IV to the growing knowledge on climate change adaptation in coastal zones.

5.1 Protection from climate change

This component consists of two sub-components, 'water management' and 'social forestry'. The first is implemented by BWDB, while the latter is implemented by the Forest Department.

5.1.1 Water Management

CDSP-IV interventions

During CDSP-III, feasibility studies and surveys were carried out to establish the location, type and design of infrastructures required to protect the CDSP-IV polders from tidal and storm surges and drainage congestion. This protects the communities living within the polders from (most of the) tidal and storm surges, and will improve agricultural production. Based on the findings from the feasibility studies, CDSP-IV will protect land on three of the five chars (Nangulia, Noler and Ziauddin[14]) from tidal and storm surges, and improve drainage. This involves the establishment of 18 km of coastal dykes, 23 km of interior and 13 km of dwarf embankments, six sets of sluice gates, and 148 km of khals (drainage channels).

This sub-component will also focus on improved O&M via formation of about 30 Water Management Groups and apex organisations, and funding of maintenance costs (using government funds). Much khal excavation and maintenance work would be done by LCS, and it is estimated that this could create employment for over 3000 poor people, especially women, who have few other opportunities for work in the chars.

Predicted benefits

The water management component is predicted to reduce tidal and storm surge flooding as well as drainage problems in Nangulia, Noler and Zia chars. Embankments, sluices and drainage channels have proven effective measures in previous CDSP phases. An impact evaluation of CDSP I, II and III in 2010

[14] As the other two chars (Caring and Urir) are not yet mature or stable enough, they will not be protected by embankments during CDSP-IV. However, limited work to improve drainage will be carried out.

showed that flooding is no longer a concern in CDSP I an II areas. In CDSP III areas, cyclone Aila caused much damage in 2009 as the embankments were not yet completed at that time.

With the reduced flooding, salinity of soils will also reduce, improving the conditions for agricultural production. This can be seen in previous phases of CDSP, where more than 90-95% reduction in salinity has been observed compared to the pre-project situation.

Impact of climate change

Through sea level rise and changing weather and rainfall patterns, climate change will have an impact on this sub-component.

- *Sea level rise* will increase the likelihood of overtopping of embankments. It will also lead to higher storm surges, and will make drainage of polders more difficult as water levels outside the polder will be higher. If sea level rise results in the further raising of riverbeds because silt is deposited more quickly due to lower flow velocities, the drainage problem will even be further exacerbated.
- *Increasing intensity of cyclones* will also have an impact, as higher wind speeds will further increase the height of storm surges.
- *Changing rainfall patterns*, in this case more intense rainfall events, might lead to drainage congestion. Together with a decreased drainage capacity due to sea level rise, this may cause water logging.

However, mainly the long term (from 2050 – 2100) climate change impacts are predicted to have the largest consequences. Sea level rise, for example, will not increase linearly over time but will rather show a more exponential growth (the warmer the earth becomes the faster ice melts). This means that on the short to medium term (up to 2050), impacts will be relatively 'mild'.

What does this mean?

For embankments, the following design conditions were set by BWDB:

- For cyclonic conditions the return period has been set to 20 years[15], where flooding due to wave overtopping of the sea/major river facing embankment should not result in average depth in the polder exceeding 1.0m, and crest should not be lower than the still water level of cyclonic storm surge.
- Climate induced sea level rise has been estimated at 5 – 10 mm rise per year for the next 5-30 years.

The embankments that are now being built have been designed to last a maximum of 20 years. This means that a sea level rise of 20 cm within the 'life' of the embankments can be handled without compromising the protection level. After 20 years the embankments will either be re-sectioned or re-built in a different location to take account of movement in the coastline as well as rising sea levels. Depending on the actual sea level rise in the coastal zone of Bangladesh – which is currently estimated by IWM to be somewhere between 14 – 24 cm in 2030 – the design of the embankments for the coming 20 years can be considered as rather sea level rise 'proof'.

However, if cyclones are indeed becoming more intense within the coming twenty years, the protection level of the embankments will be compromised. A storm surge of 4.8m may have a return period of 20 years in 2012, but in 2025 a storm surge with a return period of 20 years may reach a height of 5.0m.

For drainage infrastructure (sluices and channels), the following design conditions were set:

- A five day duration rainfall with 10 years recurrence interval is taken as the design rainfall.
- Drainage routing is carried out 1 in 10 years 5 days rainfall amounts for the period of June - July following the criteria of 5% inundation of the incremental area, that in addition can not be drained by gravity to greater depth than 0.30m for a period of 3 days[16]
- The design drainage discharge through the sluice is calculated at average tide condition of the river water.

[15] This translates into a surge height of 4.8 m (± 1.0) with 90% confidence limits

[16] Rice can be inundated for three days to a depth of 0.30m without a reduction in yield.

If rainfall is becoming more intense, water logging will occur more than once in 10 years, resulting in more damage to crops, houses and other infrastructure. Coupled with a reduced drainage capacity due to sea level rise and the raising of riverbeds, this might become a more significant problem. Canal re-excavation and proper O&M will therefore be necessary to maintain drainage capacity.

However, one has to keep in mind the uncertainty of current projections of climate change impacts, the very dynamic character of the land and fact that the design life of embankments and drainage infrastructure is being set at 20 years. A sea-facing embankment built in 2013 might lose its protection function in 2025 if there is a lot of accretion in front of it. This could easily happen to the embankments of Noler and Nangulia chars.

Up to 2030, the CDSP-IV polders should be pretty safe from climate change impacts[17]. For the coming twenty years climate change impacts are not considered to be that large. It is the long term climate change impacts that will be difficult to adapt to. Drainage congestion, however, could become a problem on the shorter term, but many uncertainties still exist. Large additional investments in infrastructure are therefore not necessary. Current climate variability will have probably more impact on the areas than long term climate change. Furthermore, by the time the current infrastructure has to be replaced there will be much more knowledge on the effects of climate change, making it easier to adjust to.

5.1.2 Social Forestry

CDSP-IV interventions

To complement the protection provided by embankments, CDSP IV will establish on all chars protective plantations of trees on mud flats, foreshores and embankments using a social forestry approach. It has been shown that such a protective “green belt” can significantly reduce damage from cyclones – both to the embankment itself and to the surrounding area. In addition planting mangroves on mudflats accelerates accretion of new land. In general, trees provide effective protection from strong winds, whether planted on roadsides or around homesteads. To establish and maintain plantations, CDSP-IV uses Social Forestry Groups (SFG). In total over 300 km of strip plantation, almost 1000 ha of block and foreshore plantation, and 1,800 ha of mangrove plantation will be established by CDSP-IV, involving nearly 500 SFGs.

Predicted benefits

Especially for the (unprotected) Caring and Urir chars, foreshore and mangrove plantations are very important, as they will provide the only protection from rising sea levels and more intense storm surges. Given the current vulnerability of their population, these plantations will provide benefits from the short to the long term. The result of the research done by UNDP (see chapter 7) on the best composition of mangrove plantations for protection against tidal and storm flooding could be taken into account when planting (future) mangrove forests.

Next to protection from tidal flooding and storm surges, forestry activities – including roadside plantations and social forest block plantation – provide income earning opportunities through the use of SFGs. See the ‘institutional development’ component for more information on these groups.

Visits to the area showed the large differences between CDSP-IV chars and the polders of previous phases. There are virtually no mature trees in CDSP-IV areas, while the other areas are much more forested. In CDSP-I in particular, trees are now well grown and the timber trade and furniture making are flourishing. The impacts from the strong winds during the October 10 storm were much more severe in the CDSP-IV areas than in the more forested, older CDSP chars. This again shows the importance of protection from wind by trees.

[17] Protection levels are not comparable to Western standards. In the Netherlands, for example, some areas are protected from floods with a return period of 10,000 years.

Impact of climate change

Climate change is not expected to have very significant impacts on the forestry component. More intense cyclones and higher storm surges may lead to more uprooting of trees. The risk of this can be minimised by appropriately planting trees, ensuring maximum root stability and avoiding planting on too steep slopes.

5.2 Climate Change resilient infrastructure

5.2.1 Internal infrastructure

CDSP-IV interventions

CDSP-IV will build infrastructure for communications, market access and cyclone protection on all five chars. This includes over 150 km of roads, 25 bridges, 72 culverts, 48 multi-purpose cyclone shelters, 16 killas (cyclone refuges for livestock), 6 markets, one bus stand, 9 boat landing ghats and one Union Parishad complex.

In addition some basic development (cyclone shelters, killas, earth roads) will also take place in other newer chars where settlers are extremely vulnerable, but which are not yet sufficiently mature for a comprehensive development programme. Where possible, work will be undertaken by LCSs which channels income directly to some of the poorest women. There is also support for road maintenance in the CDSP I, II, III and IV areas.

Predicted benefits

A better communication infrastructure will increase access to markets (on the “mainland”). This ensures that farmers and fishermen can more easily sell their products and face less transportation costs. It will also improve access to agricultural inputs, such as HYV and fertilizer, and reduces travel time. The 2010 impact assessment of CDSP I, II and III showed that there have been remarkable improvements in market access since the start of CDSP. In CDSP-III only, 23 markets have been developed in Boyer Char, all connected by good roads. Large numbers of traders/middlemen, who are linked with Dhaka and other important markets now buy directly at the farm-gate or in the markets. Previously they never bothered to come to Boyer char due to its remoteness and inaccessibility. The physical access to outside markets has made a tremendous impact on farm prices. For instance country beans now sell for 50% of the price in the Dhaka market, which is the same as in other rural areas. The cost of processed good from outside is now almost the same as in other parts of the country (Technical Report no. 7 – CDSP-III). This shows the potential of improving internal char infrastructure for development of the area. This in turn leads to an increased capacity to adapt to climate change, and makes transportation during and after a disaster easier.

Cyclone shelters provide effective protection against strong winds and storm surges. Together with the establishment of embankments and the provision of a land title, cyclone shelters are given the highest priority of all CDSP interventions by char dwellers. In CDSP-IV, cyclone shelters are designed to withstand a cyclone with a 50 years return period (which means winds up to 260 km/h). They should be constructed near to a village and preferably near a safe place for cattle (a killa, for example), as people are often hesitant to leave their home and cattle until the last moment. The bad law and order situation makes leaving house and cattle unattended risky. This means that if people decide to go to the cyclone shelter they often do so during the most intense period of the cyclone, leading to more casualties. After cyclone Sidr, it became clear that there were many deaths under the people heading for a cyclone shelter. This also shows that cyclone shelters should be easily accessible.

Impact of climate change

The impact of climate change on the internal infrastructure component is not so clear and obviously depends on the timeframe one looks at. It can be expected that especially on the long term more intense rainfall and consequent water logging, as well as an increased risk of flooding due to sea level rise and higher storm surges might increase the risk of damage to roads and other infrastructure. However, with appropriate O&M this should not be such a significant issue. In addition, roads are often constructed on top of embankments and are therefore quite well protected against flooding.

5.2.2 Water and Sanitation

CDSP-IV interventions

The CDSP-IV feasibility studies and other sources of information show that supply of drinking water in the project areas was extremely limited. Although a number of NGOs and projects have installed about 200 deep tube wells, around 1,900 are needed. The sanitation situation was even worse: less than 4% of households had some sort of sanitary latrines.

As the shallow groundwater in the chars is too saline, there is a need for deep tube wells to tap fresh water at a greater depth, which will be provided by CDSP-IV. Each tube well is to be shared between 15 to 20 households. CDSP-IV also provides a hygienic latrine for all households in the project area. In addition 150 DTWs will be installed on newer chars where settlers have no water supplies. Manufacture of concrete rings and slabs for latrines will be partly undertaken by LCSs.

Predicted benefits

Improved water supply and sanitation situation provides one of the quickest and most observable benefits for communities. Safe drinking water and basic sanitation is of crucial importance to the preservation of human health, especially among children. Water-related diseases are the most common cause of illness and death among the poor of developing countries, and this is no different in Bangladesh. Households with improved services suffer less morbidity and mortality from water-related diseases. Tube wells and latrines closer to home yield significant time savings, and significant productivity gains can be achieved with improved water and sanitation facilities. Girls and women have better educational and productive opportunities when they have water and sanitation facilities nearby, because they can safeguard their privacy in school and save time fetching water.

In CDSP I, II and III areas tube wells are now used by almost all households. In CDSP-III areas almost 50% of households used water from ponds for drinking water in 2004, while in 2009 this dropped to around 3%. In the same time the distance between a household and its water source has also become shorter with the increased availability of tube wells. This means that less time is needed to fetch water, especially in the dry season (Technical Report no. 7 – CDSP-III). The same improvements have been made for sanitation facilities in CDSP-III, as the percentage of households with ring/slab latrines increased from under 2% to over 70% from 2004 to 2009. In the CDSP-II area an increase in 42% to 55% over the same period was observed, even though there has been no funding by CDSP. This shows that households invested in sanitation facilities themselves.

Impact of climate change

As a result of climate change, even groundwater from deep aquifers might become more saline. This would have significant consequences on the supply of safe drinking water. However, it is impossible to anticipate the exact future impacts of climate change on water supply from groundwater, particularly at local scale. Next to that, if groundwater becomes more saline in the future, this will be on such a timescale that the currently installed – or soon to be built – tube wells will need replacement or relocation anyway.

Another impact of climate change on the water and sanitation component might be that increased flooding (due to sea level rise, higher storm surges or more intense rainfall) submerges the facilities, with consequences for water availability and public health. However, tube wells and latrines are built on raised platforms. Inquiries during discussions with villagers show that these haven't been flooded since they were built during CDSP-II (and thus withstood both Sidr and Aila). The impact of climate change on the short term (up to 20 years) is not expected to be very large anyway, so the water and sanitation facilities seem to be well enough protected.

The situation in the unprotected areas of Caring and Urir char will be different, as they will continue to be regularly flooded. Although the impact of climate change on the short term will not be that significant, to be on the safe side it is worthwhile to look into the possibilities of building the water and sanitation facilities on higher platforms than in the other chars. Given that sea level is expected to be between 14 and 24 cm higher in 2030, raising the platforms just 10 cm will already provide more security.

5.3 Land settlement and titling

CDSP-IV interventions

CDSP IV aims to get secure land titles granted to 20,000 households. This involves a plot-to-plot survey to identify parcels of land and their current occupiers, followed by a six step process for registration of title which is carried out by the land staff of the local administration. CDSP IV will also support improvements to the land record system involving computerisation of records. This will aim to make records less vulnerable to improper alteration and should make them more accessible to the public.

Predicted benefits

A secure land title will provide a much more secure livelihood to char dwellers, as they don't have to fear loosing their land anymore. Discussions with villagers show that a secure land title is often given the highest priority, together with access to cyclone shelters and establishment of embankments. Several times during field visits issues with land grabbers and occupation of lands came up, showing the urgency of land settlement and titling.

Climate change impacts & adaptation

Although climate change has no direct link to land settlement and titling, increased security through land titling is expected to result in increased investment of households in agricultural production, housing, cattle and other assets. This increases the adaptive capacity of the population. An IFAD impact evaluation of CDSP I, II and III showed that related to the security of land tenure and higher incomes, people have invested in better housing. In the CDSP I and II areas, over 60% of houses now have tin roofs compared to just 15% at the start of the project. Next to that, families have invested in household assets, and the number of families owning cattle has increased substantially. This all contributes to the adaptive capacity of households.

5.4 Livelihood support

5.4.1 Agricultural Support

CDSP-IV interventions

Agriculture (field and homestead crops) is the main source of livelihoods for char dwellers. DAE is implementing a component aimed at developing field crops, the partner NGOs focus on homestead agriculture (see next section).

DAE demonstration activity on a high yielding rice variety, Caring Char (20-11-2012)

This sub-component enables farmers to make better use of land resources through the forming of farmer groups by DAE, and through these groups promoting agricultural technologies that are adapted to saline conditions and resilient to climate change. This involves technology identification and farm level testing, demonstrations, training of staff and farmers, and follow-up through DAE field staff and with publicity material.

During a field visit to the CDSP-IV area, a demonstration activity on a new high yielding rice variety was attended. During trialling this new variety yields three times as high as the traditional variety were reported. Farmers were therefore very eager to try this new variety next year themselves. Technical report 6 (CDSP-III, 2010) estimated that since the start of the project, in the CDSP-I area cropping intensity had increased from 138% to 200%, in CDSP-II from 138% to 220% and in CDSP-III from 131% to 185%. This shows the significant uptake of HYV by farmers.

Climate change impacts & adaptation

Climate change will change the conditions for agricultural production. Sea level rise and an increased intensity of cyclones and rainfall will result in more flooding or water logging. Higher temperatures and carbon fertilization[18] might bring some benefits for crop production, but an increased risk of outbreaks of pests and diseases. A temperature rise might also damage rice production, as discussed in chapter 4.

[18] Carbon fertilization is a theory that states increased CO_2 resulted by global warming would cause a positive agricultural productivity in certain geographical locations

Having access to and knowledge of crop varieties that can tolerate higher salinity levels, longer inundation periods or prolonged droughts is therefore essential when adapting to the (long term) impacts of climate change. Diversification of agricultural production is another measure to deal with more erratic and extreme climatic conditions, as it reduces the risk of loosing everything at once. Through this sub-component, CDSP-IV is transforming agriculture from fairly marginal to more diverse and resilient to the conditions in the chars.

5.4.2 Social and livelihood support

CDSP-IV interventions

The Social and Livelihood Support sub-component is implemented by NGOs, and has the following objectives:

- Providing essential services to support poverty reduction, such as health, disaster management and household-level climate change adaptation that cannot be provided by government agencies at this early stage of development of CDSP chars.
- Enabling micro-finance services, which enable poor people to take advantage of the improved environment and infrastructure.
- Supporting the activities of government implementing agencies for CDSP IV, such as for water and sanitation – where NGOs form tube well user groups and organise the installation of latrines.
- Promoting human rights and legal awareness – especially for women

The Social and Livelihood Support component has been divided into the following sub-components:

a) Group Formation, Micro-finance and Capacity Building
b) Health and Family Planning
c) Water and Sanitation
d) Homestead Agriculture and Value Chain Development
e) Legal and Human Rights
f) Disaster Management and Climate Change.

Obviously, the last sub-component is most relevant for climate change adaptation. Within this component, the focus of the NGO activities is on awareness on climate change issues, and disaster preparedness. A number of pilot activities has started to introduce improved technologies such as improved stoves (to prevent fires), and wave/ flood protection measures such as house-plinth-raising. Under this NGO sub-component, the following activities are taking place:

1) Training of selected group members/family members on disaster preparedness and mitigation to develop cadres of skilled people and teach the community about disaster preparedness, and mitigation options. This is a day long local training that focuses on possible disasters (cyclone, floods, damage of embankment etc) in the chars, possible preparedness measures, community mobilisation, post-disaster mitigation etc. Next to that, a refresher course will be organised on the same issues every year.
2) Organising meetings with other stakeholders and work with local (UP) disaster management committee and Red Crescent.
3) Observing Environment and Disaster Management Day ensuring maximum participation of all stakeholders in the community.
4) Organising training on production of improved cooking stove so that the trained persons promote and make ICS as a business. Similarly, experienced masons will be trained on construction of bio-digesters.
5) A special initiative is undertaken to raise the plinths of 100 very poor households in Caring char to protect homesteads from rising waves and floods. The selected households are provided with an equivalent of 10 days of labour cost to raise their own house-plinth and homestead. In addition 100 houses will be further strengthened against storms.
6) Project staffs are trained on climate change and disaster management issues. The TA team organised a two-week training course for 13 persons (one person per NGO branch) on climate change and disaster prepared issues including the above mentioned project activities, management of the project activities, monitoring and reporting.

Predicted benefits

Next to the clear benefits of this component for improved livelihoods, which on the longer term will increase the capacity to deal with climate change, the Disaster Management and Climate Change sub-component specifically aims at adaptation to climate change *and* current climate variability. Through awareness raising and pilot activities, the necessity of disaster preparedness and mitigation as well as the effectiveness of these technologies and practices are made clear.

Awareness raising is very important, as people are often hesitant to leave their house and cattle unattended given the bad law and order situation. And if they leave, they often wait until the last moment. After cyclone Sidr it became clear that there were many casualties on the way to the cyclone shelter. Furthermore, discussions with villagers in a CDSP-II area trained by the Red Crescent Society on disaster preparedness and management revealed that young women are often not allowed to go to a cyclone shelter during a storm, as their relatives fear that it is not safe. In Char Majid of CDSP-II, volunteers trained by the Red Crescent take responsibility for these women so they can go to a cyclone shelter. This shows that awareness raising and training activities are extremely important.

For measures such as plinth raising and house strengthening, it is expected, together with the overall improvement of socio-economic conditions, to lead to replication through private initiatives. This is confirmed by findings from CDSP I and II, where related to the security of land tenure and higher incomes, people have invested in better housing. Over 60% of houses now have tin roofs, and houses are visibly stronger (unlike in CDSP-IV areas where virtually all houses are made of basic materials, in houses in CDSP I and II areas significantly more use is made of concrete, metal and timber).

The example of the 10 October storm shows that building of cyclone shelters should go hand in hand with improvement of early warning & signalling systems. One can have a lot of cyclone shelters, but these are useless when people are not aware that a large storm is coming. On the other hand, if there is a very good early warning & signalling system but nowhere to take shelter, people end up in the same situation. This is also true when cyclone shelters are not easily accessible (see section 5.2.1).

In general, the institutional capacity to deal with extreme climate events is quite well developed in Bangladesh. The Red Crescent, together with government bodies such as the Disaster Management Bureau and the Meteorological Office have a fairly effective early warning and disaster risk management system in place[19]. However, regarding disaster management the general consensus is that further improvements are needed. These include the need for greater precision in forecasting, especially with regard to landfall location and location-specific inundation depth; broadcasting of warnings in local dialects; and raising awareness to promote timely and appropriate evacuation (Dasgupta et al, 2011).

It is not the task of CDSP-IV to implement a comprehensive early warning and disaster management system. The CDSP-IV chars are new lands in the early stages of development, and natural conditions, low institutional capacity and unfavourable socio-economic economic conditions hinder effective implementation of a disaster management system. As a vehicle for awareness raising and the general development of the chars, CDSP-IV is an appropriate mechanism to lay the foundations for implementing a disaster management system by the government and/or the Red Crescent Society in the coming years.

[19] Nonetheless, no warning was given prior to the tropical storm of 10 October 2012.

Cyclone Preparedness & Disaster Risk Management – The work of the Red Crescent Society

As an auxiliary to the GoB, the Bangladesh Red Crescent Society (BDRCS) has been working with vulnerable communities since the early 1970s through its Cyclone Preparedness Programme (CPP). In 1997, the BDRCS launched a comprehensive Community Based Disaster Preparedness (CBDP) Programme designed to reduce the vulnerabilities of communities living in high risk areas of disaster prone districts. Since its inception, the programme has been implemented in 34 disaster prone districts and 142 cyclone shelters were built, benefiting about 450,000 vulnerable people directly.

Building on the success of the CBDP Programme, the Community Based Disaster Management (CBDM) programme was launched in 2005. This programme aims to adopt a more holistic approach towards disaster risk management and is being implemented in 80 flood prone communities in 10 districts. Focusing particularly on women, it continues to increase community consciousness about risk and how they collectively act to reduce their exposure to hazards. It fosters community participation and unity to coordinate with the local government in fulfilling their responsibilities to save lives and property in the event of disasters.

Features of BDRCS projects

Early Warning System

The Cyclone Preparedness Programme operates an extensive telecommunication network with 130 HF and VHF radio stations that directly link the headquarters of CPP with the coastal areas of Bangladesh. To receive the meteorological storm warning signals, each Unit Team Leader is provided with a transistor radio. To disseminate warning signals among the community, megaphones, bicycles, hand sirens and signal flags are provided to each team of volunteers.

Community-led approach

To guarantee a community-led approach and to reach the most vulnerable, the CBDM programme is implemented by the communities with support from the Red Crescent. The programme assists the communities to organise themselves in Micro Groups with 30 to 40 members each. These Micro Groups (MGs) act as target group for household-level disaster risk reduction interventions. Each MG selects two representatives who become members of the Community Disaster Management Committee (CDMC). The CDMC is a community level organization responsible for leading programme activities to reduce long-term community risks from floods and for facilitating the contingency planning process. It consists of 16 members, 50 per cent of whom are women. Next to that, a team of physically and mentally fit community volunteers is trained to assist vulnerable community members during severe floods.

5.5 Institutional Development (Field Level Institutions)

CDSP-IV interventions

Institutional development is an important element in a number of components. CDSP-IV is instigating the formation of community based groups that will closely be involved in planning and implementation of project interventions and in operation and maintenance after the project is completed. These groups give shape to the concept of people's participation, an important element in the project's approach.

- CDSP-IV is establishing Water Management Organisations (WMOs) to manage water control infrastructure. These WMOs operate at three levels: Water Management Groups (WMG) represent farmers within a geographically defined water management area. At polder level (i.e. one char with a surrounding embankment) a number of WMGs will form into a Water Management Association (WMA), with a Water Management Federation (WMF) at the district level. WMGs are registered as cooperatives.
- NGOs are establishing groups to receive micro-credit and other services from NGOs, as well as Tubewell User Groups (see section 5.2.2).
- DAE is establishing Farmer's Forums as the focal point for the agricultural development activities, see section 5.4.1.
- Social Forestry Groups are formed by the Forest Department to carry out tree planting, look after the trees, and share in the ensuing benefits of firewood, fruit and timber (see section 5.1.2)
- BWDB, LGED and DPHE form Labour Contracting Societies to undertake labour-intensive construction and maintenance works.

Predicted benefits

Over the past two decades, many governments, development agencies and non-governmental organizations have recognized that the "top-down" approach characteristic of traditional development strategies has largely failed to reach and benefit the rural poor. Instead, participation of beneficiaries was identified as of paramount importance to promote rural development. It implies the active involvement of the rural people in development, particularly disadvantaged groups that form the mass of the rural population and have previously often been excluded from the development process.

Through the establishment of local organisations CDSP-IV is empowering the char communities to continue the development of their area after the project has ended. Among others, these groups will become responsible for operation and maintenance (O&M) of part of the infrastructure and tree plantations. Habibullah et al. (2009) state *"A participatory approach to Integrated Water Resource Management can very substantially improve Operation and Maintenance of water management infrastructure and make a major contribution to long-term sustainability".*

By ensuring that they have their own sources of income and possibilities to create additional income through new activities, CDSP-IV is making sure that the groups that have been established will not fall apart after closure of the project.

That the approach of CDSP to building resilience to climate conditions and the capacity of the local population to adapt to changing conditions is working is evidenced by the fact that Water Management Groups from earlier phases are still functioning. They meet every month to discuss problems and possible solutions, and are taking care of the operation and maintenance of (part of) the infrastructure built by CDSP. A striking example is a WMG in Char Majid (CDSP-II), which by themselves constructed *and* funded a new cross dam to prevent salinity intrusion. Next to that, discussions with representatives of WMGs revealed that especially the older organisations have broadened their activities to providing other services to their communities. This included a vaccination programme for cattle, value chain development, and transportation services to markets.

5.6 Knowledge management

The practice of (community based) adaptation to climate change in coastal zones is a relatively new one to Bangladesh. Both the national and international development community is still learning about adaptation, so documenting and sharing lessons learned is essential. This should include not only what is being done, but also how it is being done, including the process of working with communities – which is essential for effective climate change adaptation – and other stakeholders. Furthermore, lessons learned from successes and challenges should be shared, to be able to learn from what is working and what is not (the latter often being equally – if not more – important!).

CDSP-IV has a number of innovative features, with opportunities of learning by the implementing agencies, the government, the donors, and the international development community in general. The project collects and analyses information on results & outcomes. As CDSP is a long-running, rather unique projects with a very integrated approach to coastal development and climate change adaptation, there is a wealth of information, knowledge and experience within the project – in all its phases – on integrated coastal zone development and for planning the climate resilient development of new chars.

Although the project is disseminating this knowledge, experiences and lessons learned to a certain extent, given the unique approach to climate change adaptation these efforts should ideally be strengthened. For outsiders, information (such as technical reports, surveys, general background information, progress and lessons learned) is difficult to find. The CDSP-IV website has been developed but is not functioning optimally, and the information that is online is very limited[20]. A project brochure is not yet developed. As part of this mission, a first set of information leaflets was developed that could develop into an information package on the work of CDSP-IV. These leaflets can provide information on the different components of

[20] In fact, the CDSP-IV website itself is not easy to find. When searching for "Char Development and Settlement Project IV" on Google, the CDSP-IV website turns up as the fourth result, but with a very confusing description.

the project, but also on cross-cutting issue such as (community based) climate adaptation, gender, and law & human rights. This material can be used to show the unique approach of CDSP to other projects, donors, research institutions, government and other actors active in sustainable coastal development and climate change adaptation. See Annex V for a draft leaflet on Climate Change in CDSP IV.

Next to limited outreach, participation and input of CDSP-IV in (inter)national knowledge platforms is limited. There are numerous opportunities for CDSP-IV to disseminate its knowledge and experience both nationally and internationally. For example, the online platform weAdapt (www.weadapt.org) is a way to publish, share and discover new work around climate change adaptation. It is an online 'open space' on climate adaptation issues which allows practitioners, researchers and policy makers to access credible, high quality information and to share experiences and lessons learnt with the weADAPT community. It is designed to facilitate learning, exchange, collaboration and knowledge integration to build a professional community of research and practice on adaptation issues while developing policy-relevant tools and guidance for adaptation planning and decision-making. weADAPT is furthermore collaborating with Google to explore ways of improving access to information on climate adaptation using Google Earth. Based on input from users weADAPT has created a quick and easy way to find out who is working on what and where.

Regional knowledge platforms include the 'Adaptation Knowledge Platform for Asia', 'Climate Change Adaptation in Asia and the Pacific' and the 'Asia Pacific Climate Change Adaptation Network'.

Next to online knowledge platforms, there are numerous other possibilities to contribute to and benefit from the growing knowledge base on sustainable coastal development and (community based) climate adaptation. This includes national and international conferences, workshops and seminars, but also the dissemination of (hardcopy) brochures and project briefs.

CBA7: Seventh International Conference on Community-based Adaptation
From 18 - 25 April 2013, the Bangladesh Centre for Advanced Studies (BCAS) and the International Institute for Environment and Development (IIED) will organise the Seventh International Conference on Community-based Adaptation in Dhaka. The conference aims to provide the latest thinking from climate scientists, policy makers and practitioners on the latest approaches for mainstreaming community-based adaptation into international, national and local planning and processes, and to provide lessons learned.

The conference includes three days of field visits to projects in Bangladesh to see how communities living in different ecosystems have adapted to climate change, and three days of plenary sessions and interactive sessions at the conference in Dhaka. Topics that will be discussed include:

- *Community Based Adaptation in practice in sectors and regions*: water, agriculture and food security, ecosystem-based approaches, disaster risk reduction, economics, human health, urban areas, children, gender, migration and population
- *Knowledge, education and awareness on Community Based Adaptation*: challenges and opportunities for mainstreaming adaptation
- *Monitoring and evaluation of Community Based Adaptation*

This event provides an excellent opportunity for CDSP-IV to show its integrated approach to sustainable development of coastal char areas, including community based adaptation. Next to that, links can be established with other projects, donors and research institutes, and lessons learned in other projects or programmes can be explored for the benefit of CDSP-IV. Participants can apply for the possibility to make a presentation at the conference, but it might even be possible to include a field visit to the CDSP-IV project areas. This is an excellent way to disseminate the knowledge and experiences of the project.

Community based adaption has received more and more attention over the last years, including from donor agencies, recognizing that it is a valid approach to building adaptive capacity in vulnerable communities. At the Third International Community-Based Adaptation Workshop in Dhaka in February 2009, FAO announced the possibility of providing funding for small scale community-based adaptation projects, while other donors – including the World Bank, UNDP, DFID and SDC – have been actively engaged in discussions on the best way to achieve donor support for community based adaptation.

Furthermore, benefits of linking up – or at least interacting – with other donors and projects are not yet fully exploited. UNDP, for example, is currently implementing a very similar project in four coastal chars. As described in the next chapter, CDSP could learn from the pilot activities of this project, while the integrated approach of CDSP towards sustainable coastal zone management is something that could strengthen the activities of UNDP.

In the coming months a knowledge management expert from IFAD may be temporarily added to the CDSP IV TA team, which provides opportunities for strengthening knowledge management.

5.7 Adaptation as Development

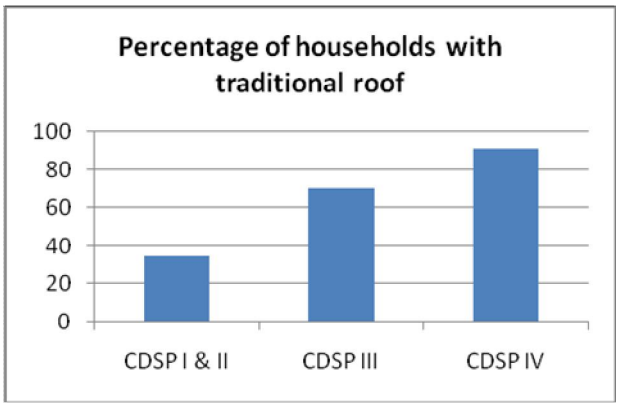
By taking an integrated approach to development, CDSP-IV increases the adaptive capacity of the char communities, and as a result they will be better positioned to adapt to future climate change. The combination of 'community based' and 'engineering / technology' based approaches provides very good results for adapting to climatic conditions. This is confirmed by looking at previous phases of CDSP.

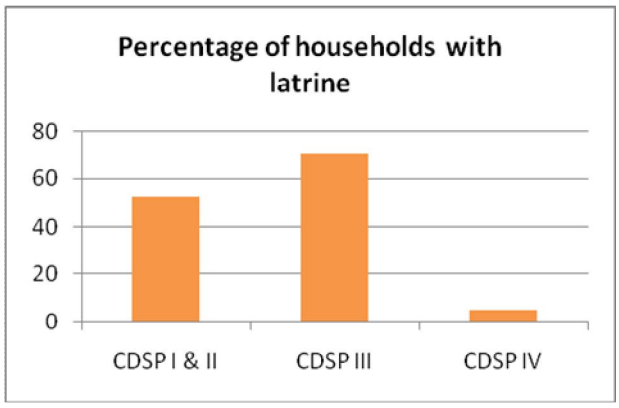
A 2010 report on the '*Impact of the Char Development and Settlement Projects I, II, and III*' shows that CDSP has had substantial impacts in terms of reducing flooding and salinity and increasing agricultural production, which in turn has resulted in better livelihoods and increased employment, leading to reduced poverty, increased income and a degree of empowerment for women. Some more detailed findings include:

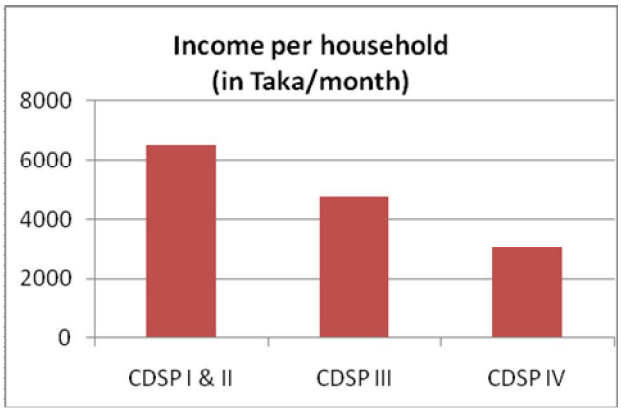
- In the CDSP I and II areas, soil salinity is no longer considered to be a problem, although saline groundwater limits irrigation.
- Access to markets is now good in the CDSP I and II areas. This is the major driver behind the spread of high value cash crops.
- Agriculture is still the main source of livelihoods in all three areas, but has lost some of its dominance in CDSP-I (and to a lesser extent in CDSP-II) with the growth of the non farm sector.
- Growth in the agricultural sector has led to reduced poverty. The proportion of households in the two poorest categories fell from over 90% to between 39%-56%.
- The distance between a household and its water source has become shorter with the increased availability of tube wells. Sanitation facilities have improved enormously, with percentage of households with ring/slab latrines increasing from under 2% to over 70%.

The 2010 impact evaluation has also shown that related to the security of land tenure and higher incomes, people have invested in better housing. In the CDSP I and II areas, over 60% of houses now have tin roofs. This is an excellent example of *adaptation as development*.

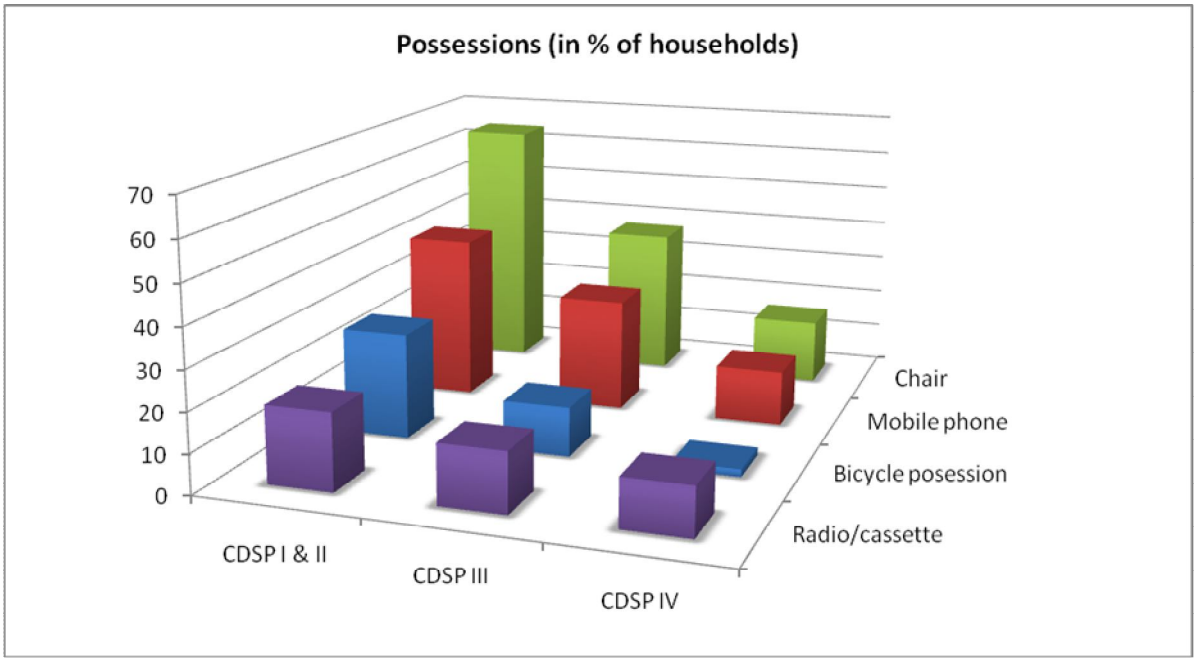
Possibly the most convincing evidence of the impact of CDSP is provided by comparing 2009 data for the CDSP I, II, III and IV areas. In these 2009 data CDSP I and II represent the more or less fully developed char and, with 13 and 8 years since the end of these projects, also takes account of the degree to which the changes brought about have been sustainable. In 2009, CDSP III represented the situation just before project completion, where many benefits had been realised, but improved flood control and drainage were not yet fully in place so land productivity was only starting to improve. The data from 2009 show the situation prior to any development for CDSP IV, and can thus be treated as a 'without project' control group. Of course, the situation in the CDSP IV areas has already improved a little, with the first project interventions already implemented. However, the graphs below provide an interesting picture of how CDSP increases the coping capacity of the char population, which translates into an increased capacity to adapt to climate change.







Looking at household assets – which is a good indicator for overall development and as a consequence adaptive capacity – there is a similar trend between the different phases of CDSP.



Looking at the impact of the previous phases of CDSP, the assumption that by the time of closure CDSP-IV will have increased the capacity the communities to adapt to climate change is realistic. Related to the security of land tenure and higher incomes, people will among others invest in better housing, more resilient agriculture and effective local institutions capable of dealing with changing conditions.

6. National Climate Change Strategies & Action Plans

This chapter reviews two of the most important documents on which the current response to climate change by the Government of Bangladesh is based, the "*Climate change strategy and action plan",* and the "*National Adaptation Programme of Action".* It also looks at how CDSP-IV interventions fit in this approach.

6.1 Climate Change Strategy and Action Plan

In the "*Climate Change Strategy and Action Plan 2008*" (GoB, 2008), Bangladesh is identified as one of the most climate vulnerable countries in the world and will become even more so as a result of climate change. It assumes that floods, tropical cyclones, storm surges and droughts are likely to become more frequent and severe in the coming years.

The Climate Change Action Plan is a 10-year programme (2009-2018) to build the capacity and resilience of the country to meet the challenge of climate change. The needs of the poor and vulnerable, including women and children, are to be mainstreamed in all activities under the Action Plan. In the first five year period (2009-13), this programme comprises six pillars:

1. **Food security, social protection and health**
   To ensure that the poorest and most vulnerable in society, including women and children, are protected from climate change and that all programmes focus on the needs of this group for food security, safe housing, employment and access to basic services, including health.
2. **Comprehensive Disaster Management**
   To further strengthen the country's already proven disaster management systems to deal with increasingly frequent and severe natural calamities.
3. **Infrastructure**
   To ensure that existing assets (e.g., coastal and river embankments) are well-maintained and fit-for-purpose and that urgently needed infrastructure (e.g. cyclone shelters and urban drainage) is put in place to deal with the likely impacts of climate change.
4. **Research and knowledge management**
   To predict the likely scale and timing of climate change impacts on different sectors of the economy and socioeconomic groups; to underpin future investment strategies; and to ensure that Bangladesh is networked into the latest global thinking on climate change.
5. **Mitigation and low carbon development**
   Evolving low carbon development options and implement these as the country's economy grows over the coming decades.
6. **Capacity building and institutional strengthening**
   Strengthening to enhance the capacity of government ministries and agencies, civil society and the private sector to meet the challenge of climate change.

6.2 National Adaptation Programme of Action

Next to a review of the current and future impacts of climate variability and climate change on Bangladesh, the NAPA identifies key adaptation needs (GoB, 2009a). It underlines that coping with extreme climatic events like floods, drought, cyclone and storm surges is not new to the people of Bangladesh, and that adaptation activities should build on existing knowledge on coping strategies. Particularly in other

geographic areas which may face problems at present similar to those expected elsewhere with climate change, transferring knowledge and experiences from one area or ecosystem to another are considered to be a key priority.

The NAPA identified 45 important adaptation measures, grouped under the same six themes as the 2008 Climate Change Strategy and Action Plan. However, it also acknowledges that no adaptation measure can entirely eradicate the adverse impacts of climate change and climatic variability. This means that part of the cost of climate change impacts will be borne by the society. To strengthen the capacity to withstand such losses, the NAPA proposes to develop and strengthen insurance mechanisms for future climate impacts. Such insurance schemes may include crop failures, losses due to cyclones and storm surges and other natural hazards.

The responsibility of the Government of Bangladesh

Just as all other governments, the Government of Bangladesh also has an obligation to protect its citizens from climate (change) impacts to the best extent possible. After CDSP-IV has closed, the interventions that have been implemented have to be sustained and maintained by the government agencies. For example, field level institutions are expected to do a part of the O&M of the infrastructure after CDSP-IV has ended, but the GoB will be responsible for the larger infrastructures. The experience of erosion at the Gabtoli sluice – which threatens the future operation – shows that the government agencies have a responsibility to ensure the long term sustainability of CDSP interventions. The same goes for adaptation to future climate change impacts. If necessary, additional interventions (such as strengthening of embankments to protect from sea level rise) will have to be implemented by the GoB. Although it makes perfect sense to increase the capacity of the population to cope with climate change impacts, the state should always take responsibility for the interventions that cannot be done by communities themselves.

The Bangladesh is actively (and effectively) conveying the message that climate change is threatening the country, and that Bangladesh might be the most vulnerable country in the world. As a result of this, it is already receiving significant external funding for climate change adaptation activities. The GoB therefore also has the responsibility to effectively implement its own climate change strategy and action plans.

6.3 CDSP-IV Interventions in the light of national policies & strategies

Looking at CDSP-IV interventions (see previous chapter) and the priority activities and main 'pillars' identified in the NAPA and Climate Change Strategy and Action Plan, it is obvious that CDSP-IV fits very well in the national climate change plans.

CDSP will ensure that existing assets (e.g. coastal and river embankments) are well-maintained and fit-for-purpose and that urgently needed infrastructure (e.g. cyclone shelters and urban drainage) is put in place. The project will furthermore ensure that the poorest and most vulnerable in society, including women and children, are protected from climate variability and climate change. CDSP-IV focuses on the needs of this group for food security, safe housing, employment (mainly agriculture) and access to services, including markets, agriculture extension, health, etc. CDSP-IV is also strengthening the capacity of government agencies, civil society and (maybe most important) the local communities to meet the challenge of climate change. Through the formation of local organisations – such as Water Management Groups – char people will be better equipped to deal with changing conditions.

Through the CDSP-IV interventions, the national disaster management system is (slowly) making its way into the chars. In general, the institutional capacity to deal with extreme climate events is well developed in Bangladesh. However, as the chars are new lands in the early stages of development, natural conditions, low institutional capacity and socio-economic economic conditions hinder effective responses to climate change. By developing the chars, CDSP-IV is laying the foundations for implementing a more comprehensive disaster management system in the future.

Although not a focus area, CDSP-IV is contributing to climate change mitigation through the planting of significant patches of mangrove forests, foreshore and roadside plantations and homestead forestry.

However, there is one ‘pillar’ of the Bangladesh climate change strategy that is not yet covered very well. As CDSP-IV has a rather unique and effective approach to climate change adaptation – a combination of the ‘community based’ and ‘engineering / technology’ approaches - transferring knowledge and experiences gained in CDSP-IV and previous phases can provide a wealth of knowledge and expertise to other projects, programmes and even policy-making.

Next to that, insurance mechanisms, identified in the NAPA to strengthen the capacity to withstand losses due to climate impacts, might provide an interesting new activity through which CDSP-IV could improve its approach to climate change adaptation.

People waiting for a ferry at Caring Char

7. Lessons from other projects

7.1 Similar projects and programmes and their lessons learned

This section provides an overview of some similar projects / programmes with a climate change component and their lessons learned. It is based on a literature & internet review, as well as on discussions with climate change experts from international and national organisations and institutions. It does not aim to provide a full overview of all related projects, but rather a snapshot of what is currently being done in relation to climate change adaptation in (the coastal zones of) Bangladesh.

Community based adaptation to climate change through coastal afforestation (CBACC-CF) project

This UNDP, SDC and GEF[21] funded project aims to reduce the vulnerability of coastal communities to the impact of climate change by expanding the livelihood options in a way that supports the conservation of coastal resources. This is expected to increase the ability of the coastal communities to adapt to climate change, while at the same time the project contributes to climate change mitigation. It is being implemented in Sukhchar (Noakhali), Raipur (Chittagong), Char Kukri-Mukri (Bhola) and Naltuna (Borguna).

The project has two components:

- Establishment of over 6100 ha of mangrove plantations on 14 kilometres of newly accredited land, protecting the land and its people from storms and cyclones
- Piloting the 'Forest, Fruit, and Fish' (FFF) model on lands protected by mangrove plantations – but not by embankments.

Box 2: The FFF model

The FFF model developed by the CBACC-CF project[22] provides a new way to make barren, unprotected coastal land productive. By building mounds and ditches, fruit and timber trees can be grown, and fish can be cultivated. In between the fruit and timber trees and on top of the mounds and along the banks of the ditches high yielding vegetables can be grown.

The model can be created in areas that are protected by coastal mangrove forests, but that are outside of embankments. Because the entire model is raised, it is protected from tidal surges and storms. The ditches are filled with freshwater during the monsoon, which is the time when fish can be grown. These are then harvested before the ditch becomes dry in the dry season. As the trees and vegetables are planted on top of the mounds they are protected from saline groundwater (salinity washes out after the first rains).

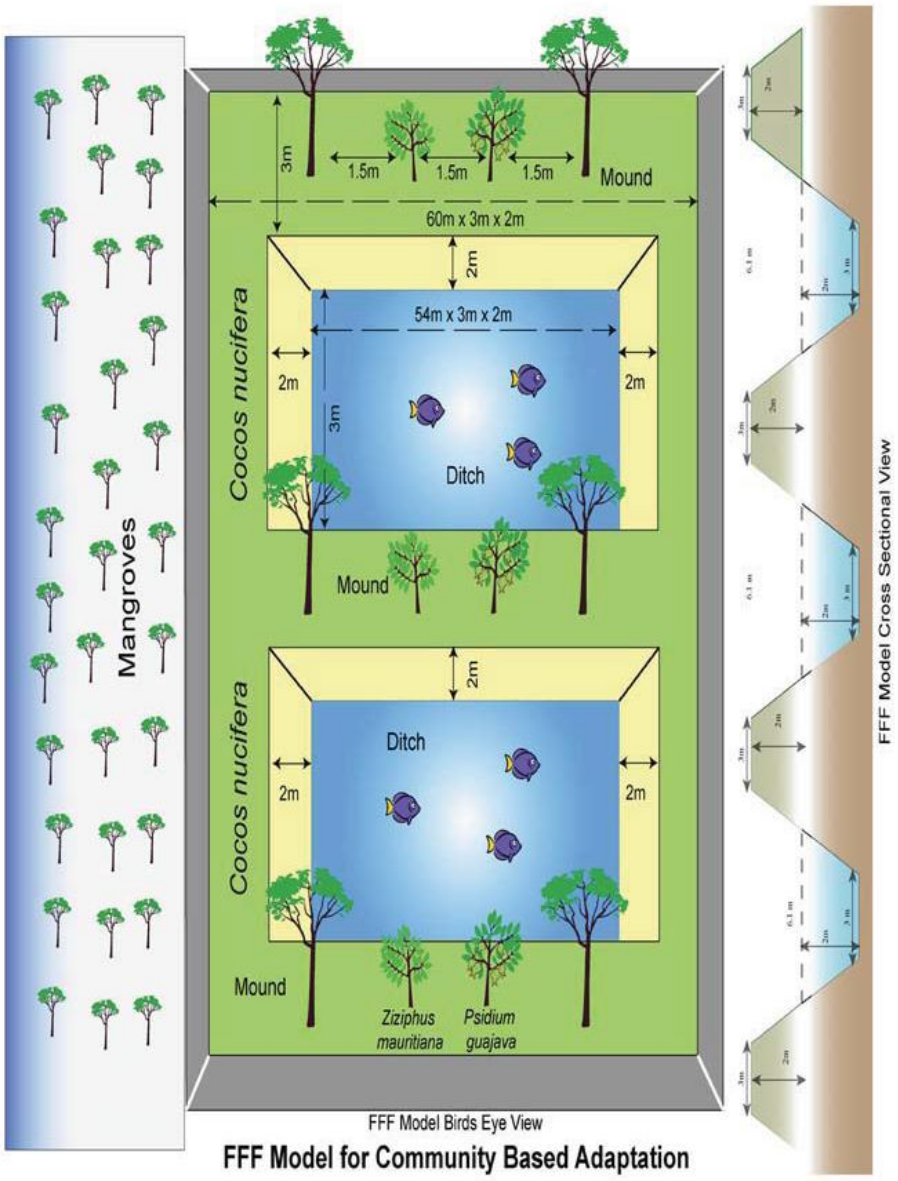
According to UNDP, the FFF model can produce enough fruit, vegetables and fish to supplement nutrition in the family diet and generate regular extra income from the sale of what is left over. In addition, the protective mangrove forests and fruit and timber trees can be pruned regularly for fuel needs. In the long term timber trees provide a good earning once they have matured and been cut down. According to the CBACC-CF project, the FFF model can provide:

- A lot of vegetables within half a year
- 140 kg fish within one year
- 10-20 kg fruit per tree within 1-2 years

[21] CBACC-CF is the first GEF funded project in Bangladesh, and the first project implemented under Bangladesh's NAPA

[22] See fore more information: http://www.undp.org.bd/projects/proj_detail.php?pid=71

The FFF model is currently being used by local communities in three districts along Bangladesh's coastline.



The project is collecting, sharing and disseminating lessons and knowledge across the region and beyond, as well as with other coastal afforestation and livelihood programmes in Bangladesh[23].

Lessons learned

- Mangrove forest act as effective carbon sinks, being able to absorb three times more carbon than non-mangrove forests. Per hectare, 97.6 tons of carbon is stored. By its completion, the project will have resulted in over 7,000 hectares of mangrove and non-mangrove plantations - absorbing an estimated 610,000 tonnes of carbon. The CBACC-CF has established connections with the REDD+.
- Next to their large carbon storage capacity, mangrove forests trap sediments at a high rate. The CBACC-CF project has piloted a range of mangrove species to test which combination trap the largest amount of sediment. Through this pilot, more disaster resistant species have been identified, that have more regeneration capacity that the species that is currently mostly used[24]

[23] No links established with CDSP-IV, yet.

[24] This species has a very low regeneration, and only 25% of new trees survive the first three years.

throughout Bangladesh. This provides better protection from storm surges, cyclones and sea level rise, as well as creating greater areas of land for the long run.

- Furthermore, mangrove forests can protect the FFF model piloted by the project. The FFF model showed high potential for livelihood diversification, reducing poverty and increasing food security. By carving ditches and dykes out of the land, fruit trees, vegetables and fish can be cultivated. On 1 hectare of (barren) land, 8 mounds and 8 ditches can be built, which can provide 8 families with multiple sources of income by generating short (vegetables), medium (fish) and long-term (fruit) resources. And since this model cannot be sustained without the protection of mangrove forests, it ensures that these forests are preserved.

Oxfam - 'Sea Vessel Tracking System'

Over the last years, many fishermen have lost their lives on the open sea during extreme weather events. Often they are not warned of incoming storms or cyclones, like in the tropical storm of October 10, 2012. Even if they receive a warning, this is sometimes too late to safely return to the mainland.

Oxfam, along with CARE, CGC and Mobile Phone operator company Airtel singed a MoU on the 'Sea Vessel Tracking System' project in January 2011. This was a pilot project for 1 year. In the project, 50 fishing boats received a GPS tracking unit, able to determine the precise location of the vessel and to record the position at regular intervals. Using cellular (GPRS/EDGE) technology, this system can also communicate with fishermen while they are in the open sea.

One of the advantages of this system is that it allows early warning for extreme events, but it also aids in search & rescue missions in case a vessel gets into trouble. According to Oxfam, the Bangladesh Disaster Management Bureau was highly impressed with the initiative and has agreed to promote this technology through all the mobile operator companies.

This initiative shows that through mobile technology early warning systems can be improved. It also shows the willingness of the private sector to contribute to improving disaster risk management, and the willingness of the government to provide an enabling environment.

Regional Fisheries and Livestock Development Project (RFLDC) - Danida

The Regional Fisheries and Livestock Development Component (RFLDC) of Danida's Agricultural Sector Programme Support, Phase II (ASPS II), is implemented by the Department of Fisheries and the Department of Livestock Services of the Ministry of Fisheries and Livestock. Its focus is the coastal zone of southeast Bangladesh in Barisal Division and the Greater Noakhali region of Chittagong Division. RFLDC's Immediate Objective is *Improved Productivity of and Returns from Fisheries and Livestock Systems of Resource Poor Farmers*.

To achieve this objective, RFLDC has five outputs:

1) Effective support to resource-poor households through decentralized, integrated, demand-driven and participatory fisheries and livestock extension provision.
2) Community Based Organisations and farmers associations formed and enabled to successfully articulate their demands to local private and public service providers.
3) Linkages with the private sector improved to enable farmers to access quality inputs and markets.
4) Local government institutions in component areas enabled to address the expressed demands of the local community in relation to the areas of fisheries and livestock development.
5) The capacity of the relevant departments to deliver public goods enhanced.

One can clearly see the similarities with CDSP-IV (community organisations, integrated approach, involvement of local government), thereby also improving resilience of farmers (and communities in general) to climate variability and climate change. Unlike CDSP-IV, RFLDC focuses solely on the livestock and fisheries sector, and is thus complementary to CDSP. Two aspects of RFLDC's work were found to be very interesting for CDSP-IV work on climate change adaptation.

Farmer Field Schools (FFS)

RFLDC seeks to address the problems of resource-poor farmers in the coastal region mainly through its Farmer Field Schools, a highly participatory form of farmer training which lays emphasis on what is

normally termed an 'experiential learning approach'. As of May 2011, through 61 community based organisations RFLDC has established 2325 FFS in Noakhali District.

Throughout the world there is widespread enthusiasm for FFS among farmers and development practitioners. Participation in FFS has always been voluntary, and none of the FFS provide financial incentives to participants. On the contrary, participation in FFS has always involved a considerable cost in terms of time and effort. Despite these costs, since the FFS concept was developed, two million farmers decided to participate. In most countries, the demand for places on a field school has been ahead of supply, and drop-out rates have been very low.

Development of Killa's

RFLDC has developed sites in which a water point (mainly for cattle) and a killa were brought together in the same location, along with a small Livestock Service Centre for veterinary services. The management of the Livestock Service Centres is passed to local Community-based Organizations. Next to that, installation of solar panels ensures the cold chain, and killa's are planted with fodder crops and tree legumes to ensure enough food for livestock during floods.

Improved Adaptive Capacity to Climate Change for Sustainable Livelihoods in the Agriculture Sector – FAO

In 2005, the Food and Agriculture Organization of the United Nations (FAO) initiated a project at the request of the Bangladesh government that was designed to improve the adaptive capacities of rural populations and their resilience to drought and other climate change impacts.

The project has been implemented under the Comprehensive Disaster Risk Management Programme (CDMP), by the Department of Agricultural Extension, and in collaboration with the Departments of Fisheries, Livestock and Forestry, BRRI and BARI.

The project has developed a menu of diversified good practice adaptation options, which guides field testing of locally prioritized adaptation practices. It included field demonstrations and awareness raising (Baas and Ramasamy, 2008).

Lessons learned

- *Launch adaptation with a focus on current variability and factors in climate change*. The experiences of the recent past, current living conditions and natural hazard threats prevails in peoples' memory, making them the best entry points for community level interventions, awareness raising and advocacy towards climate change issues.
- *Climate adaptation is a social learning process that creates the capacity to cope with climate change-related impacts.* Since it is impossible to anticipate exact future impacts of climate change, particularly at local scale, the project suggests that climate change adaptation programmes should have an intermediate goal of empowering communities to adapt to the impacts in a broader perspective.
- *Multiple and integrated adaptation measures across sectors are essential.* The project showed that climatic conditions and anthropogenic factors reinforce each other, thereby often increasing vulnerability to climate and natural disasters. Technology is only a partial solution to climate change, and should be embedded in the relevant social and environmental contexts. The project confirms the need for multiple but integrated pathways across sectors to improve adaptive responses of local communities, especially the poorest sectors of the community. Neither an agricultural nor any other single sectoral intervention alone can provide sufficient scope to manage the future climate change risks (Baas and Ramasamy, 2008).

7.2 Other Concepts / practices relevant to CDSP-IV

This part provides some concepts and practices used in other projects that may be relevant to the climate change aspects of CDSP-IV.

Crop Insurance

Natural disasters hit hard. They may cause heavy losses to farmers and forest owners. Insurance can assist in managing these losses, and crop insurance is the branch of this financial mechanism that is especially geared to covering losses from adverse weather and similar events beyond the control of growers.

Like all entrepreneurs, smallholder farmers make decisions in risky and uncertain environments. However, in contrast to most entrepreneurs, smallholders are vulnerable to significant systemic price and weather risks, which will be exacerbated (in the future) by the effects of climate change, with no safety net to protect their livelihoods. Smallholders are further exposed due to their limited asset base and small margins.

Index-based Insurance Products

In a classic crop insurance policy, evidence of damage to the actual crop on the farm, or in the area of the farm, is needed before an indemnity is paid. But verifying that such damage has occurred is expensive, and making an accurate measurement of the loss on each individual insured farm is even more costly (Gloy and Staehr, 2009).

An index (also known as 'coupon') policy operates differently. With an index policy a meteorological measurement is used as the trigger for indemnity payments. These damaging weather events might be:

- a certain amount of rainfall in a certain time period – this can be used for
- excess rain and also for drought cover;
- attainment of a certain wind speed – for cyclone insurance.

The classic insurance policy is replaced with a simple coupon. Instead of the usual policy wording, which would give the indemnity, or range of indemnity levels, on say a per hectare basis for a given crop, for losses from specific causes, the coupon merely gives a monetary sum which becomes payable on certification that the named weather event, of specified severity, has occurred. The face value of the coupon may be standard, to be triggered once the weather event has taken place for the area covered. Alternatively it could be graduated, with the value of the coupon then being proportional to the severity of the event (Gloy and Staehr, 2009).

Introducing crop insurance in the chars of CDSP-IV might offer the means of transferring the risk of losses from extreme weather events from small farmers to the government or private sector (depending on whether it is possible to implement commercially attractive crop insurance schemes). A well designed crop insurance scheme removes most of the uncertainty and risk related to farming in the chars, thereby improving livelihoods and increasing resilience to current climate events and future climate change.

Covering local risks: index-based micro insurance for crop risks in India

An innovative insurance program set up in India in 2003 covers non-irrigated crops in the state of Andhra Pradesh against the risk of insufficient rainfall during key times of the cropping season. The index-based policies are offered by a commercial insurer and marketed to growers through microfinance banks. In contrast to conventional insurance, which is written against actual losses, this index-based (parametric) insurance is written against a physical or economic trigger, in this case rainfall. Schemes replicating this approach are currently targeting more than a million exposed farmers in India. One advantage of index-based insurance is the substantial decrease in transaction costs due to eliminating the need for expensive post-event claims handling, which has impeded the development of insurance mechanisms in developing countries. A disadvantage is basis risk, which is the lack of correlation of the trigger with the loss incurred (CDKN, 2012)

Reducing Emissions from Deforestation & Forest Degradation (REDD)

REDD is a mechanism that aims to reduce carbon emissions from deforestation by providing financial incentives to conserve rather than exploit forests[25]. Deforestation and forest degradation, through agricultural expansion, conversion to pastureland, infrastructure development, destructive logging, fires etc., account for nearly 20% of global greenhouse gas emissions. Basically, the idea behind REDD is that industrialized countries compensate developing countries for lost income associated with reducing deforestation rates relative to a historical baseline. The carbon credits thus generated from emissions savings in developing nations could be purchased and used by developed nations to meet their emissions reduction targets (Ghazoul et al., 2010).

The contribution of greenhouse gas emissions from deforestation in developing countries to climate change and the need to take action to reduce such emissions was recognized internationally. At COP13 in Bali, Indonesia, countries adopted a decision on "Reducing emissions from deforestation in developing countries: approaches to stimulate action" (Decision 2/CP.13). This decision provided a mandate to further strengthen and support on-going efforts, explore the possibilities for new actions and to mobilize resources (UNFCCC, 2012).

Maintaining forest ecosystems can contribute to increased resilience to climate change. To achieve these multiple benefits, REDD+ will require the full engagement and respect for the rights of Indigenous Peoples and other forest-dependent communities.

Although it is too early to judge the effectiveness of the UN-REDD programme, it is considered by many to be rather successful. It is seen as one of the most cost-effective ways to combat climate change, while supporting the livelihoods of a large number of indigenous peoples and forest-dependent communities as well providing essential ecosystem services such as habitat for biodiversity and provisioning clean water supplies. Furthermore, it makes the private sector part of the solution by providing the kinds of market signals, mechanisms and incentives to encourage investments that conserve recourses instead of mining them. But above all, it is recognized within the UNFCCC that forestry is a sector of (key) importance in combating climate change. Jordan (2010) states that "*REDD is an unmistakably reasonable solution to global climate change on paper*".

On 17 January, 2012, the Bangladesh Forest Department, with the support of UNDP and FAO country offices, held a consultation workshop to share and discuss progress on the national REDD+ Readiness Roadmap. As a partner to UN-REDD Global Programme the country is moving closer towards a comprehensive REDD+ Readiness Roadmap, and thus fully realizing the potential role of the country's forest sector in tackling climate change. Bangladesh. Being a partner country means that the country may be invited to submit a request to receive funding for a National Programme in the future.

It is predicted that worldwide financial flows for greenhouse gas emission reductions from REDD+ could reach up to US$30 billion a year. This significant North-South flow of funds could reward a meaningful reduction of carbon emissions and could also support new, pro-poor development, help conserve biodiversity and secure vital ecosystem services.

With 4000 hectares to be planted with mangrove forests, CDSP-IV forestation activities offer large potential for carbon sequestration. Linking up with REDD+, possibly through UNDP Bangladesh, might provide some opportunities for additional funding; if not for CDSP-IV then possibly for a successor project.

Early disaster warning through mobile technology

Several countries have implemented early warning or emergency alert systems using voice messages to landlines and text messages to mobile phones within a defined area, about likely or actual emergencies. In the case of an emergency, people living in the affected area the may receive a text message on their mobile phone. Such a system allows customers who own an enabled mobile device to receive

[25] The UN-REDD Programme is not the only initiative assisting countries that wish to engage in REDD+ activities. Other initiatives include the World Bank's Forest Carbon Partnership Facility, Norway's International Climate and Forest Initiative, the Global Environment Facility, Australia's International Forest Carbon Initiative and the Collaborative Partnership on Forests.

geographically-targeted messages alerting them of imminent threats to safety in their area. It enables government officials or other authorized personnel to target emergency alerts to specific geographic areas through cell towers (e.g. the coastal areas where a cyclone is about to hit), which pushes the information to mobile devices.

Alerts are geographically targeted, so a customer living in Chittagong would not receive a threat if they happen to be in Dhaka when the alert is sent. Similarly, someone visiting Chittagong from Dhaka on that same day would receive the alert. Usually, the last known location of a mobile phone is updated when the handset makes a call, receives a call, sends an SMS, receives an SMS, or has moved across a number of network cells (has travelled a long distance). If none of the above occurred the mobile phone's location is updated by the network every 60 minutes.

Looking at the coverage of mobile telephony in Bangladesh among all layers of the population – field visits showed that many char dwellers are using mobile phones – and the possibility to geographically target a specific group, this could be a very quick and effective way to warn for incoming storms or other natural disasters. However, it requires participation by the wireless provider. Given the interest in Corporate Social Responsibility activities by the private sector in Bangladesh[26] it should not be too difficult to persuade providers to cooperate. This is however not something that can be done by CDSP-IV itself, but requires a joint approach with similar projects and the Bangladesh government.

Box 3: NL-Alert

NL-Alert is a new supplementary emergency system of the Netherlands government using mobile phones. With NL-Alert, the government can inform people in the immediate vicinity of an emergency with a text message. The message specifically states what the problem is and what you should do in this situation. Using this technology, more people can be reached and people are better informed.

How it works: The government sends a text message to the mobile phones in the vicinity of a (potential) emergency. NL-Alert works on the basis of cell broadcast and not with SMS. Therefore it works even when the network is overloaded. NL-Alert is free and anonymous. The messages are transmitted in the area where the emergency arises.

[26] Discussions with several Bangladeshi people working in the private sector confirm that there is a lot of interest in CSR activities related to improving the socio-economic and environmental conditions for fellow citizens.

8. Conclusions

Coping capacity

Char dwellers face numerous challenges after settling on newly emerged lands. This includes unfavourable conditions for agriculture due to salinity levels, flooding, and drainage problems; extreme weather events, including cyclones and storms; and a lack of fresh water. In addition, socio-economic factors make life on new chars very challenging, including a very poor communication infrastructure, a lack of institutions and governance, and lack of a secure land title. Climatic conditions and anthropogenic factors mutually reinforce chronic vulnerability to climate variability and natural disasters. As a result of both the challenges imposed by their natural environment as well as the socio-economic situation, char dwellers belong to the poorest of the poor and face much insecurity.

The socio-economic situation in the chars of CDSP-IV combined with a high exposure to tidal flooding, storm surges, cyclones, salinity intrusion, intense rainfall, drought periods, water shortages and a lack of options to deal with saline soils, drainage congestion, a weak early warning system and shelter possibilities for major storms make the char communities extremely vulnerable. People can easily lose everything in any disaster, whether a major storm, excessive rainfall or a very long drought period. Being extremely poor with very limited means, their capacity to deal with their harsh natural environment is very low. They have virtually no possibilities to reduce, transfer, prepare for, and manage the risks related to the climate conditions they face. The very low coping capacity of the char population is illustrated by the significant damage and the number of casualties related to the relative 'weak' tropical storm of October 10, 2012.

Climate change in the coastal chars

Although people have always adapted to the climate, the current speed of change coupled with extreme vulnerability and exposure – related to geographic, but certainly also socio-economic conditions – makes increasing the adaptive capacity of the char population paramount, especially for the medium and long term. The coastal region in general is very vulnerable to climate change, but the chars are by far the most vulnerable areas. The already existing uncertainties and hazards in the CDSP-IV chars will be exacerbated by the impacts of climate change, with a greater probability of cyclones and storm surges, changing rainfall patterns, higher temperatures and sea level rise.

The general impacts of climate change on Bangladesh are generally quite well understood, although the exact impacts remain uncertain and obviously depend on the timeframe one looks at. Without more detailed climate change assessments for Bangladesh specifically – and not based on secondary data, which is now the case – it remains difficult to determine the exact impacts on the chars. However, sea level rise, increased intensity of cyclones, changing rainfall patterns and an increased temperature are most likely to have a significant impact on the medium term (20-50 years from now). This should be taken into account into planning of (climate change) interventions.

Most of the future vulnerability to climate change will not necessarily add any new climate related hazards to the already well known ones such as floods, droughts and cyclones. But it will enhance both the frequency as well as intensity of such climatic events in future. For the short term, current climate variability and its extreme events are a more important than climate change (which has a more long term impact). As the char communities cannot even cope with the current climate variability, the need for addressing future climate change should not be overemphasized. An approach where the current problems are addressed while keeping in mind the possibilities for the climate of the future is therefore the most appropriate.

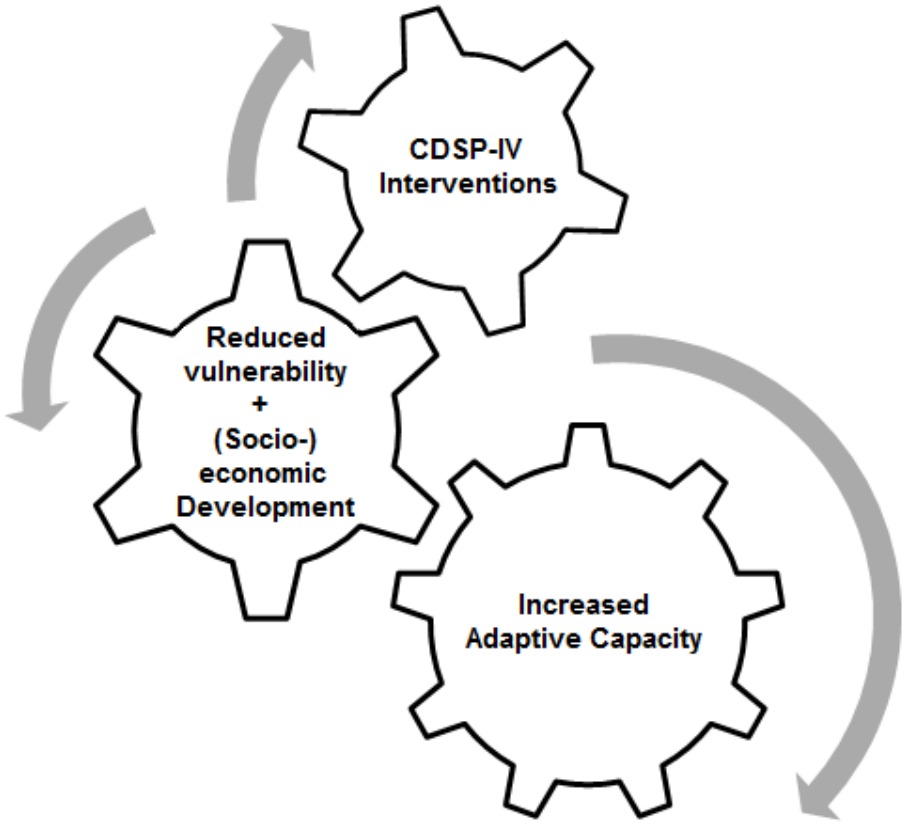
Community based adaptation in combination with technological / engineering based interventions for the most extreme impacts (such as sea level rise) seems the most suitable approach to climate change adaptation in the CDSP-IV chars. This ensures that current vulnerability is reduced, which – coupled with general (socio-) economic development –results in increased capacity to deal with climate change impact.

CDSP-IV interventions related to climate (change)

For the next two or three decades the expected climate change impacts in Bangladesh will be relatively small compared to the normal year-to year variations. Infrastructure built by CDSP-IV has a design life of 20 years and is situated in a very dynamic environment (which for example means that the protection function of an embankment might be lost after 10 years due to the accretion of new land). For the infrastructure components of CDSP-IV additional measures are therefore not necessary. Current interventions such as embankments, tube wells and drainage canals do not have to be reconsidered or redesigned. It is better to periodically reconsider the need for higher or stronger embankments using the knowledge that is available at that time than to try to plan ahead and build embankments that can withstand sea levels currently predicted for 2050.

As it is impossible to anticipate exact future impacts of climate change, particularly at local scale, climate change adaptation should have an intermediate goal of empowering communities to adapt to the impacts in a broader development perspective, which is exactly what CDSP-IV is doing. This community based adaptation helps people cope with current climatic risks, which will in turn assist in building (or limit the loss of) assets and entitlements that can contribute to adaptive capacity over a longer time scale. CDSP interventions are designed to have a sustainable impact, by ensuring involvement, ownership, and buy-in of local communities, so that after the project ends char dwellers will be able to – independently of CDSP – keep adapting to future climate change. Adaptive capacity is directly related to economic, social, demographic, cultural, institutional and governance factors. As poverty and vulnerability to climate change feed each other, addressing social welfare, quality of life, infrastructure, and livelihoods, and incorporating a multi-hazards approach into planning and action for disasters in the short term facilitates adaptation to climate extremes in the long term.

Although just one component of CDSP-IV is explicitly mentioning climate change ("*Protection from climate change"*), all components increase the char communities' adaptive capacity. While most CDSP-IV interventions are aimed at reducing vulnerability and exposure to climate variability, improving the coping capacity together with (socio-) economic development will lead to increased capacity to adapt to climate change (see figure below).



All in all, CDSP-IV's approach to climate change adaptation combining community based and engineering interventions is a very effective one. The 'protection from climate change' and 'climate resilient infrastructure and water supply & sanitation' components of CDSP-IV can be regarded as the 'engineering / technological' approach to climate change adaptation, while the 'land settlement and titling', 'livelihood support' and 'institutional development' components are typical community based climate adaptation approaches. This integrated approach, combined with the fact that six government agencies are working together to implement the project, makes the CDSP-IV approach to climate change adaptation fairly unique. Unfortunately, the contribution of CDSP-IV to the existing (international and national) knowledge on (community based) adaptation to climate change in coastal zones is still limited.

Looking at the impact of the previous phases of CDSP[27], the assumption that by the time of closure CDSP-IV will have increased the capacity of the communities to adapt to climate change is realistic. Related to the reduced vulnerability by the infrastructure provided, coupled with the security of land tenure, higher incomes, and other socio-economic improvements, people have invested in better housing, more resilient agriculture and effective local institutions capable of dealing with changing conditions.

Alignment with National Climate Change Strategy and Action Plans

CDSP-IV fits very well within the national climate change strategy and action plans, as it will ensure that existing assets (e.g., coastal and river embankments) are well-maintained and fit-for-purpose and that urgently needed infrastructure (e.g. cyclone shelters) is put in place. The project will furthermore ensure that the poorest and most vulnerable in society, including women and children, are better protected from climate variability and climate change. CDSP-IV focuses on the needs of this group for food security, safe housing, employment (mainly agriculture) and access to services, including markets, agriculture extension, health, etc. CDSP-IV is also strengthening the capacity of government agencies, civil society and (maybe most important) the local communities to meet the challenge of climate change. Through the formation of local organisations – such as Water Management Groups – char people will be better equipped to deal with changing conditions.

Although it makes perfect sense to increase the capacity of the population to cope with climate change impacts through CDSP-IV, the state should always take responsibility for the interventions that cannot be done by communities themselves. As the Government of Bangladesh is already receiving significant external funding for climate change adaptation activities, it has the responsibility to effectively implement its own climate change strategy and action plans.

Lessons that can be learned from other projects and practices

Other projects show that climate change adaptation efforts should be launched with a focus on current variability while factoring in climate change, and that multiple and integrated adaptation measures across sectors are essential. Next to that, some innovative practices such as crop insurance, the FFF model, and REDD+ could provide interesting ways to further strengthen the CDSP-IV approach to climate change adaptation.

Looking at disaster management, the institutional capacity to deal with extreme climate events is well developed in Bangladesh. The Red Crescent, together with government bodies such as the Disaster Management Bureau and the Meteorological Office have a fairly effective warning system in place. However, as the chars are new lands in the early stages of development, natural conditions, low institutional capacity and unfavourable socio-economic economic conditions hinder effective implementation of a disaster management system. Although it is not the task of CDSP-IV to implement a comprehensive early warning and disaster management system, as a vehicle for the development of the chars, CDSP-IV is an appropriate mechanism to lay the foundations for implementation of a disaster management system by the government and/or the Red Crescent Society in the coming years.

[27] A 2010 report on the '*Impact of the Char Development and Settlement Projects I, II, and III*' shows that CDSP has had substantial impacts in terms of reducing flooding and salinity and increasing agricultural production, which in turn has resulted in better livelihoods and increased employment, leading to reduced poverty, increased income and a degree of empowerment for women.

9. Recommendations

1. Mainstream climate change adaptation in CDSP-IV

It is recommended to continue with the current approach of both, community based and engineering interventions. This has proven to be a very effective approach that does not only address climate change adaptation but also increases the resilience of communities to current climate conditions while simultaneously improving the socio-economic situation in the chars.

The findings of this mission show that the current climate change adaptation approach has not been developed deliberately. There is no coherent strategy on this at the moment. Climate change adaptation work is dispersed over all of the components, and there is no overarching approach that binds these components. It is therefore recommended to develop a comprehensive strategy, which combines all relevant work on climate change adaptation for CDSP-IV. This could be done on the basis of the findings of this mission, possibly through development a 'CDSP climate adaptation methodology' or a short strategy on how CDSP-IV is addressing climate change in coastal chars. Such a strategy or methodology can also be used to link certain results of the current M&E activities to the adaptive capacity of the char communities, and can be used to determine the need and appropriateness of new activities / pilots.

The result of mainstreaming climate change adaptation will be that the CDSP team itself, implementing agencies, beneficiaries, donors and other development actors in Bangladesh and beyond will become more aware of how CDSP-IV works on helping communities adapt to climate change. Ideally, a methodology for climate change adaptation developed by CDSP-IV would then be replicated in other areas or projects, or even internalised by the Government of Bangladesh.

Whatever way of mainstreaming climate change adaptation, it should be kept in mind that in the next two or three decades, climate change impacts will probably be relatively small compared to the current year-to year variations in climate. However, as climate change impacts become more dramatic over the years, its effect on a range of impacts will become increasingly important and will play a more significant role in the lives of the char population. The CDSP-IV approach facilitates adaptation to climate change in the longer term by addressing social welfare, quality of life, infrastructure, and livelihoods,

2. Explore new interventions and establish links with other projects / initiatives

Next to the mainstreaming of climate change adaptation some additional activities have been identified that might be piloted to strengthen the community based interventions. A few of the most promising are listed below:

Crop insurance

Although related to a different kind of disaster, crop insurance schemes in India are already targeting more than one million farmers. Piloting crop insurance in the chars of CDSP-IV might offer the means of transferring the risk of losses from extreme weather events – such as cyclones and floods – from small farmers to the government or private sector. A well designed crop insurance scheme removes most of the uncertainty and risk related to farming in the chars, thereby improving livelihoods and increasing resilience to current climate events and future climate change.

Forest Fruit Fish (FFF)

The FFF model developed by UNDP might be a new way to make barren, unprotected coastal lands of Urir and Caring char more productive. By building mounds and ditches, fruit and timber trees can be grown, and fish can be cultivated. In between the fruit and timber trees and on top of the mounds and along the banks of the ditches high yielding vegetables can be grown. The project areas where this model was

piloted by UNDP (including on Hatiya island) are protected by coastal mangrove forests, but outside embankments. This looks promising for the unprotected chars of CDSP-IV, and it is therefore recommended to pilot this model in these areas in collaboration with UNDP.

REDD (Reducing Emissions from Deforestation & Forest Degradation)
As a partner to UN-REDD Global Programme the country is moving closer towards a comprehensive REDD+ Readiness Roadmap, and thus fully realizing the potential role of the country's forest sector in tackling climate change. It is predicted that world wide financial flows for greenhouse gas emission reductions from REDD+ could reach up to US$30 billion a year. This significant flow of funds could reward a meaningful reduction of carbon emissions and could also support new, pro-poor development, help conserve biodiversity and secure vital ecosystem services.

With thousands of hectares to be planted with mangrove forests and foreshore plantations, CDSP-IV activities offer a significant potential for carbon sequestration. Linking up with REDD+, possibly through UNDP Bangladesh, might provide some opportunities for additional funding. Even if this cannot be realised for CDSP-IV this option could be explored for a successor project.

3. Improve contribution to knowledge on climate change adaptation in coastal zones

The CDSP-IV approach to climate change adaptation combining community based and engineering interventions is a very effective one. This integrated approach, combined with the fact that six government agencies are working together to implement the project, makes the CDSP-IV approach to climate change adaptation fairly unique. Both the national and international development community is still learning about adaptation, so documenting and sharing lessons learned is essential. This should include not only what is being done, but also how it is being done, including the process of working with communities – which is essential for effective climate change adaptation – and other stakeholders. Furthermore, lessons learned from successes and challenges should be shared, to be able to learn from what is working and what is not (the latter often being equally – if not more – important).

The CDSP-IV approach therefore provides opportunities of learning by the implementing agencies, the government, the donors, and the international development community in general. As CDSP is a long-running project there is a wealth of information, knowledge and experience on integrated coastal zone development and for planning the climate resilient development of new chars. Although the project is disseminating this knowledge, experiences and lessons learned to a certain extent, given the unique approach to climate change adaptation these efforts should ideally be strengthened. In the coming months a knowledge management expert from IFAD may be temporarily added to the TA team, which already provides an opportunity for strengthening knowledge management in the project.

As part of this mission, a proposal was made for a set of information leaflets or project briefs that could together form an information package on the work of CDSP-IV, including climate change adaptation. It is recommended that this set should be further developed and fine-tuned, including a complete revision of the CDSP-IV website to match the set-up and layout of the information package. As there is limited capacity to do so within the TA team it is recommended that a short term consultant with knowledge of both the project and the international and national issues in coastal zone development and climate change be deployed. Together with a website developer, the CDSP-IV website can then also be revised, after which the responsibility of updating and maintaining can be transferred to the Computer/MIS specialist and the senior specialists of the TA team.

It is recommended that CDSP-IV be represented during the Seventh International Conference on Community-based Adaptation in Dhaka, from 18-25 April 2013. Given the rather unique integrated approach to coastal zone development, including community based climate change adaptation, CDSP-IV should attend this event, especially since it is held in Dhaka. It provides a platform to show the CDSP approach to international and national experts working in this field, and gives the opportunity to link up with similar projects, programmes and initiatives. It should be noted, however, that information materials as discussed above should be finished by then.

Annexes

Annex I – Terms of Reference

For a short term mission on
Climate change aspects of CDSP IV

1. Introduction

The objective of CDSP IV is to reduce poverty and hunger for people living on newly accreted coastal chars. Security for people and livelihoods is provided through the six components of the project: protection from climate change; climate change resilient infrastructure and water supply and sanitation; land settlement and titling; livelihood support; institutional development; studies and surveys.
Climate change aspects are important considerations for CDSP interventions, obviously for the components protection from climate change and climate resilient infrastructure, but also for one of the sub components of the social and livelihood support program, disaster management and climate change, implemented jointly with the four partner NGOs of the project. And for the agricultural support program, where climate smart agriculture is an important requirement.
Examples of typical aspects of these components where climate change is an important factor are:
For protection from climate change: Crest level of embankments; capacity and dimensions of drainage infrastructure like canals and structures, in particular sluices; interventions by the forest department like foreshore and mangrove plantations, and embankment and village plantation.
For climate resilient infrastructure: Designs and capacity of communication infrastructure and of cyclone shelters and other structures.
For the agricultural and social and livelihood support program: Agricultural zoning; disaster preparedness; disaster risk management.

2. Objectives of the mission

Study and critical review of the climate change aspects of the project and providing recommendations for further specifying/strengthening CDSP IV approach to climate change, in view of the latest developments in the field of climate change. Next to above mentioned aspects this will include, but not be limited to issues like reviewing the links and relationships between climate change, rural development, agriculture and food security in the CDSP IV area; governance issues like role of LGIs and FLIs in addressing CC problems; innovative approaches to helping smallholder producers build their resilience to climate change.

3. Tasks to be performed

During the assignment, the adviser will implement the following tasks:
- Assess the actual risks and underlying assumptions of climate change for Bangladesh in general and for the CDSP project areas in particular, including a review of CDSP IV climate change interventions and scope in the light of Bangladesh's climate change policies
- Study the climate change aspects of all components of CDSP IV, including the effect of CC on the different CDSP components
- Evaluate the experience of the CC scheme implemented during CDSP III in cooperation with IUCN: Education materials and video documentary/ drama.
- Study and provide an overview of similar projects with a climate change focus in Bangladesh, and identify lessons learned
- Provide recommendations for further specifying/ strengthening CDSP IV climate change interventions and scope
- Update the project brochure to include climate change aspects of CDSP IV.

4. Organisation, timing, reporting

The assignment will be performed by Mr. Koen Joosten of Euroconsult Mott MacDonald, who achieved his MSc on Climate Studies, at Wageningen University in 2011. He will report to the Project Coordinating Director and Team Leader, CDSP-IV. The assignment will take one month from early November to early December 2012. The mission report will be submitted before the end of the mission. Mr. Joosten will debrief at PCD and EKN at the end of his assignment.

Annex II – Itinerary & meeting schedule

Date	Activities	Consultations with
12 November	Departure from The Netherlands	
13 November	Arrival in Dhaka	
14 November	Meeting with Project Coordinating Director. Travel to Noakhali	Mr. Md. Mahfuzur Rahman
15 November	Meeting with TL and DTL Introductory meeting with TA team	
16 November	Study relevant documents and reports	
17 November	Study relevant documents and reports	
18 November	Meeting partner NGO Disaster Management & CC Coordinators Visit to Boyer char (including discussion with WMG, visit to cyclone shelter, embankment, sluice, foreshore plantation and shortcut canal)	WMG, villagers
19 November	Visit to Char Nangulia (including discussions with WMG, SFG, and chairman of union parishad, and visits to cyclone shelter, embankment, sluice, foreshore plantation)	WMG, SFG, NGO staff
20 November	Visit to Caring and Noler Chars (including discussions with representatives from WMGs, FFs, LADCs and NGO staff). Attending a LHR training and a HYV introduction/demonstration session	WMG, FF, LADC, NGO staff
21 November	Study relevant documents and reports. Report writing	
22 November	Meeting with staff from partner NGO SSUS on Disaster Risk Management and Climate Change. Report writing	NGO staff (Sagorika)
23 November	Reviewing CDSP-III brochure and development of a CDSP-IV brochure	
24 November	Travel to Dhaka	
25 November	Meeting with UNDP climate change expert Meeting with IUCN country representative Study relevant documents and reports	Dr. Paramesh Nandy (UNDP) Mr. Istiaq Uddin Ahmad (IUCN)
26 November	Meeting with Oxfam humanitarian coordinator. Report writing	Mr. Kaiser Rejve (Oxfam)
27 November	Meeting with IWM climate change expert Meeting with Director, Wageningen UR Project Office Dhaka Meeting with CEGIS climate change expert. Report writing	Mr Jahirul Haque Khan (IWM) Ms. Catharina Terwisscha Scheltinga (Alterra/WUR) Mr. Fida M Kamal (CEGIS)
28 November	Introduction meeting at the Netherlands Embassy. Travel to Noakhali	Mr. Martin Bos (EKN)
29 November	Study relevant documents and reports, report writing	
30 November	Visit to Char Ziauddin (including discussions with representatives from WMG and TUG), and visit to shortcut channel	WMG, TUG
1 December	Report writing	
2 December	Consultation meetings with CDSP-IV TA staff Report writing, study relevant documents and reports	
3 December	Visit to Char Nangulia, Polder 59/3B (CDSP-II area). Meetings with WMG Visit to Char Nangulia. Meetings with WMG and FF Visit to Char Majid (CDSP-I area). Meeting with WMG	WMG, FF
4 December	Report writing. Work from guesthouse (hartal).	
5 December	Meeting with beneficiaries of Cyclone Preparedness Programme implemented by the Red Crescent in Char Majid Discussion on findings with DTL. Report writing	Disaster Management volunteers (Red Crescent)
6 December	Discussion on findings with TL. Report writing	
7 December	Report writing	
8 December	Report writing	
9 December	Debriefing with CDSP-IV TA team to discuss findings of mission Report writing	
10 December	Travel to Dhaka	
11 December	Debriefing at the Netherlands Embassy. Finalising report	Mr. Martin Bos (EKN)
12 December	Departure to the Netherlands	

Annex III - Bibliography

- **Adger, W.N., S. Agrawala, M.M.Q. Mirza, C. Conde, K. O'Brien, J. Pulhin, R. Pulwarty, B. Smit and K. Takahashi** (2007) *Assessment of adaptation practices, options, constraints and capacity. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 717-743.
- **Ayers, J. and Forsyth, T.** (2009): Community-Based Adaptation to Climate Change. *Environment: Science and Policy for Sustainable Development*, 51:4, 22-31
- **Baas, S., and Ramasamy, S.** (2008) *Community Based Adaptation in Action. A case study from Bangladesh.* Food and Agriculture Organisation of the United Nations, Rome, Italy.
- **Brooks, N., Adger, W.N., Kelly, P.M.** (2005) The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Global Environmental Change* 15 (2005) 151–163
- **Climate and Development Knowledge Network** (2012) *Managing climate extremes and disasters in Asia: Lessons from the SREX report*. CDKN, available online at www.cdkn.org/srex.
- **Dasgupta, S., Huq, M., Khan, Z.H., Ahmed, M.M.Z., Mukherjee, N., Khan, M.F., Pandey, K.** (2011). *Cyclones in a Changing Climate: The Case of Bangladesh*. World Bank, Washington DC, USA
- **Easterling, W.E., P.K. Aggarwal, P. Batima, K.M. Brander, L. Erda, S.M. Howden, A. Kirilenko, J. Morton, J.-F. Soussana, J. Schmidhuber and F.N. Tubiello** (2007) *Food, fibre and forest products. Climate Change 2007: Impacts, Adaptation and Vulnerability.* Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds.), Cambridge University Press, Cambridge, UK, 273-313.
- **FAO** (2010) *"Climate-Smart" Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation*. Food and Agriculture Organisation of the United Nations, Rome, Italy.
- **Ghazoul, J., Butler, R.A., Mateo-Vega, J., and Koh, L.P** (2010) REDD: a reckoning of environment and development implications. *Trends in Ecology & Evolution* (25), pp. 396-402
- **Gloy, B.A. and Staehr, A.E.** (2009) *Case Studies on the Use of Crop Insurance in Managing Risk.* College of Agriculture and Life Sciences Cornell University, Ithaca, New York
- **Government of the People's Republic of Bangladesh** (2008): *Cyclone Sidr in Bangladesh: Damage, Loss, and Needs Assessment for Disaster Recovery and Reconstruction*.
- **Government of the People's Republic of Bangladesh** (2009a). *National Adaptation Programme of Action.*
- **Government of the People's Republic of Bangladesh** (2009b): *Bangladesh Climate Change Strategy and Action Plan 2009*.
- **Habibullah, A.T.M., Jenkins, A., Iqbal, Z., Chowdhury, A.** (2009) *Participatory Water Management: A Strategy for Climate Change Adaptation in Coastal Bangladesh.* 2nd International Conference on Water & Flood Management (ICWFM-2009).
- **IPCC** (2007) Summary for Policymakers. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- **Jordan, B.** (2010) *Environmental Justice and REDD: Impacts for indigenous populations in Latin America. World Forestry* (FOR 595), North Carolina State University.
- **Karim, M.F. and Mimura, N. (2006)** *Sea Level Rise In The Bay Of Bengal: Its Impacts And Adaptations In Bangladesh*. Center for Water Environment Studies, Ibaraki University, Hitachi, Ibaraki 316-8511, Japan

- **McMichael, A. J., & Lindgren, E.** (2011). Climate change: present and future risks to health, and necessary responses. *Journal of Internal Medicine*, 270(5), 401–413.
- **Peduzzi, P., Chatenoux, B., Dao, H., Bono, A. D., Herold, C., Kossin, J., Mouton, F., et al.** (2012). Global trends in tropical cyclone risk. *Nature Climate Change*, 2(4), 289–294.
- **Smit, B. and Wandel, J.** (2006). Adaptation, Adaptive Capacity and Vulnerability. Global Environmental Change 16, no. 3, 282–92
- **Stern, N.** (2006) What is the Economics of Climate Change? *World Economics*, Vol. 7, No. 2. pp. 1-10
- **UNDP** (2004). A Global Report: Reducing Disaster Risk: A Challenge for Development. http://www.undp.org/bcpr
- **UNFCCC** (2012) Website of the United Nations Framework Convention on Climate Change, United Nations, Bonn. URL: www.unfccc.org (Accessed: 08/12/2012)
- **Vermeer, M. and Rahmstorf, S.** (2009) Global sea level linked to global temperature. *Proceedings of the National Academy of Sciences of the United States of America*. Edited by William C. Clark, Harvard University, Cambridge, MA, and approved October 26, 2009 (received for review July 15, 2009)
- **Wisner, B., Blakie, Cannon, P.M.T. and Davis, I.** (2004). At Risk: Natural Hazards, People's Vulnerability and Disasters, 2nd ed. (London and New York: Routledge, 2004)
- **World Bank** (2012). *Turn down the heat. Why a 4 ^{o}C warmer world should be avoided.* The World Bank, Washington DC
- **World Health Organization** (2009). *Protecting health from climate change: connecting science, policy and people.* Geneva: WHO.

Annex IV – Review of IUCN-CDSP-III climate change scheme

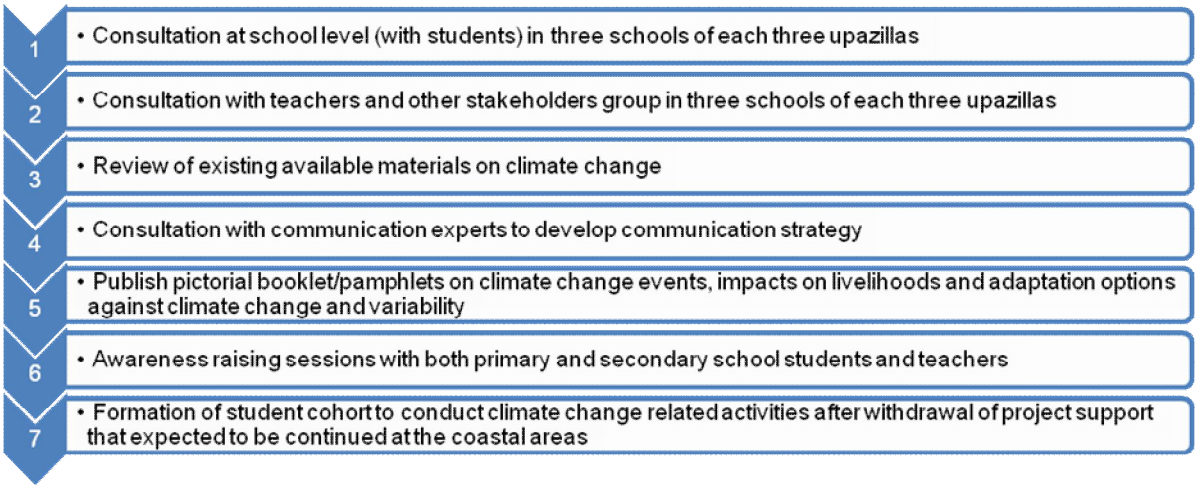
In 2008 - 2009, the World Conservation Union (IUCN) Bangladesh and CDSP-III jointly developed and implemented the *"Awareness and education on the impacts of climate change and climate variability for central coastal char communities in Bangladesh"*. Goal of this project was to raise awareness of CDSP communities on climate variability and its impacts at an effective level so that vulnerable people in the coastal areas can be able to adapt and face the challenges of climatic vulnerabilities. The objective of this project was threefold:

1. To identify issues/topics and to develop awareness raising tools for education and awareness raising of school students and teachers.
2. To implement innovative ideas, techniques, events and programme for awareness raising of school students and teachers with the help of materials to be developed herein under objective 1.
3. To train and establish student cohort to carry over awareness activities as a self-sustaining process.

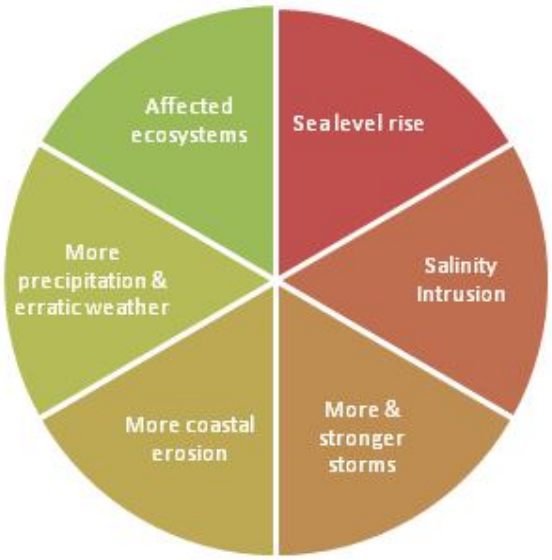
The project was based on the following assumptions:

- The vulnerability of coastal people can be reduced by reducing vulnerability factors such as sensitivity, exposure and increasing adaptive capacity.
- In the context of Bangladesh, vulnerability of livelihoods would be reduced through disaster preparedness, adaptation and by reducing intensity of looming events of climate variability.
- There is a need to alert the people about the future scenario of climate change & climate variability
- It is anticipated that the well-informed coastal population would prepare themselves for combating future climate change impacts.
- Educated people will successfully disseminate their knowledge to the remnant coastal population to reduce their vulnerability through adaptive measures and preparedness process.

Project activities included:



The project identified six climate change impacts for the area, which are summarised in the picture to the right.



Findings of the review

The project rightly assumed that vulnerability to climate events can be reduced through better disaster preparedness and management. A well-informed coastal population will be able to better prepare itself for combating future climate change impacts. Awareness raising initiatives are therefore important. The decision to focus this on children is a very sensible one, as normally this group is not specifically targeted. Most initiatives tend to focus their attention on adults. Children, if well informed, can play an important role in disaster preparedness and during crises. Fore example: as adults are often hesitant to leave their cattle and house during storms / cyclones, children might be able to convince their parents to take shelter. Next to that, children usually interact more with each other and could therefore spread the message faster.

A review of the booklets for teachers and students shows that considerable attention was paid to the science behind climate change. This includes the greenhouse effect, radiative forcing, and even El Niño and La Niña effects. Feedback on these materials showed that this information was too detailed and difficult to grasp for both teachers and students. Any successor initiative should review this material and make it easier. For CDSP-IV areas specifically this should be not too difficult, as education levels are extremely low. Next to that, attention should be paid to the approach of organising activities, as no government schools are present in the CDSP-IV areas. One could think of dissemination through madrasah's or other informal schools.

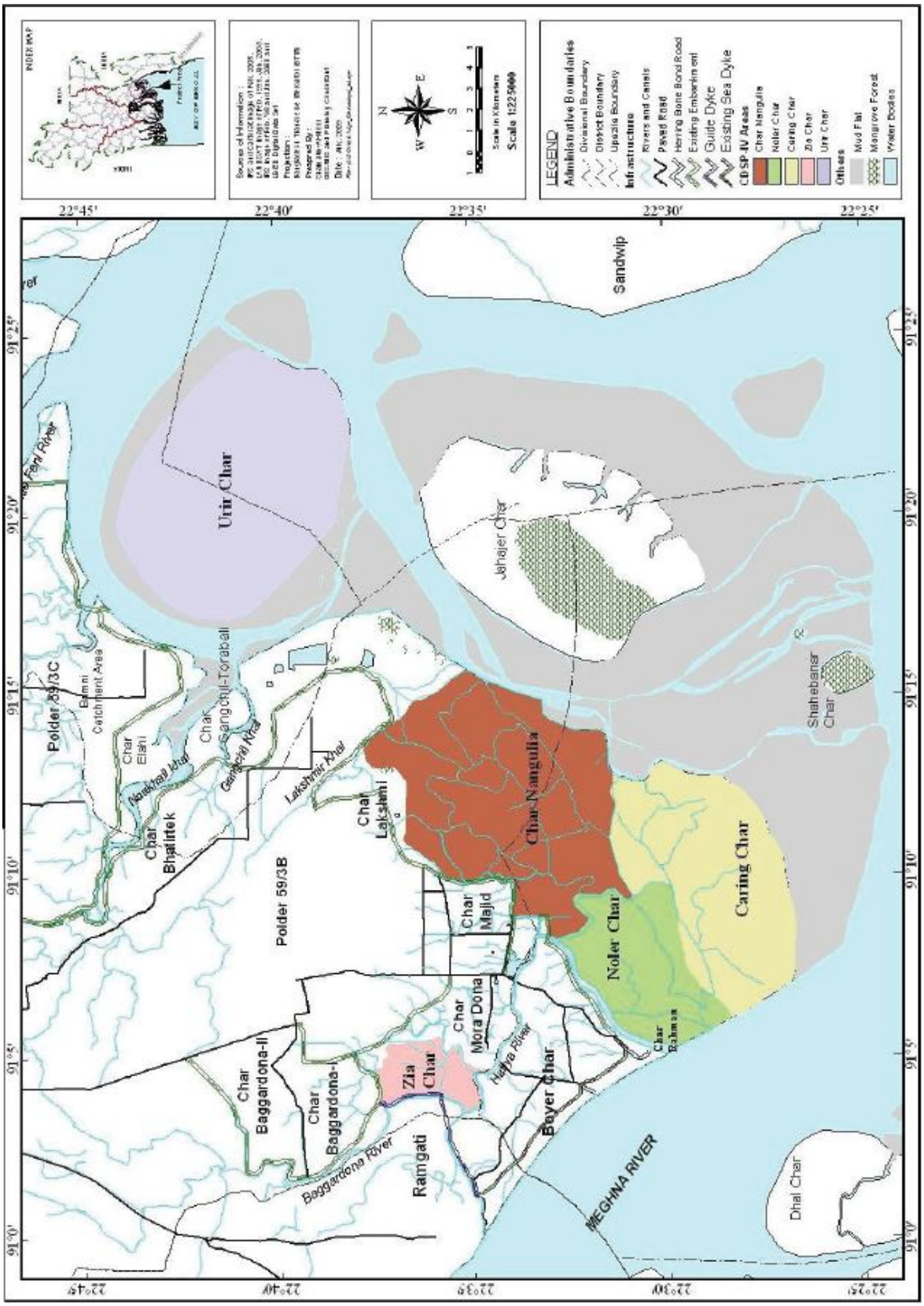
The different ways of dissemination (a drama, booklets, posters, group activities) seem to be very well suited for the purpose of the project, and using the character of "Rana the frog" makes it easier and more interesting for children to grasp the material. It is recommended that any successor project would therefore continue with this approach.

Most of the future vulnerability due to climate change will not necessarily add any new climate related hazards to the already well known ones such as floods, droughts and cyclones. But it will enhance both the frequency as well as intensity of such climatic events in future. For the short term, current climate variability and its extreme events will be a bigger factor for the chars than climate change which is more significant for the long term. As the char communities cannot even cope well with the current climate variability, the need for addressing future climate change should not be overemphasized. There is no real need for people to be urgently alerted about the future scenario of climate change. Efforts should be rather aimed at preparedness for / management of current climate variability.

It is therefore recommended that any similar future project should focus on current vulnerability to climatic conditions. A population well prepared for current disasters will more easily adapt to future climate change impacts, since climate change will hardly add new climate related hazards.

Annex V – Proposed text for CDSP-IV brochure

Annex VI – Map of CDSP-IV project area



Annex VII – Checklist for Discussions in the Field

For (representatives of) local organisations and NGO staff[28]:

Current exposure / vulnerability to climate events:

- Have you experienced cyclones / heavy storms since you settled here? If so, how often?
- Do you experience flooding? If so, how often and what is the cause (rain / river flooding, storm surge)?
- Do you experience drought problems? If so, what are the consequences?
- Do you experience river erosion?
- Do you experience drainage problems?
- Do you experience problems with high or low temperatures? If so, what is the result?

Capacity to cope with these conditions (without CDSP interventions)

- Do you take any measures against cyclones / flooding / drought / drainage / erosion / temperature?

Are the conditions in the Chars changing, compared to the time when you settled?

- Regarding temperature / weather patterns / droughts / flooding / cyclonic activity (both intensity and frequency)?
- Regarding the overall development of the char?
- Regarding crop yields?

On disaster risk management

- Do you prepare for storms / cyclones? If so, how? If not, why not?
- Is there a warning system? If so, does it reach everyone in time? How does it reach people?

On the storm of October 10, 2012

- Were there any casualties you know of? If so, how did these people die?
- Was there any warning for a storm beforehand?
- Did you receive help afterwards?
- What could have been done to prevent damage / casualties?

For the development of your Char, what activity should be given highest priority?
Have you ever heard of climate change?

For climate change experts:

These meetings were deliberately designed to be more like discussions on the impacts of climate change, vulnerability and exposure of the people in the coastal areas of Bangladesh, lessons learned and potential (innovative) adaptation practices.

[28] For NGO staff, these questions were related to the work of their organisation