Development of coastal chars in Bangladesh

Are the adaptation policies in coastal Bangladesh sustainable?

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Abstract

In response to land grabbing, overpopulation and riverbank erosion, displaced farmers in Bangladesh, have moved to coastal islands in search for newly accreted, unclaimed land. The Char Development and Settlement Project (CDSP) aims to improve the lives of these families by protecting them from current and possible future climate hazards, connecting them to mainland by investing in infrastructure and by enabling the communities to adapt to the always changing circumstances. This thesis aims to evaluate the efforts of CDSP, establishing whether investing in the area would result in maladaptation – making the community or other communities less resistant to climate hazards. Existing literature is used to create a set of guidelines within four themes; (1) global and local sustainable environment, (2) sustainable investments, (3) critical solutions and (4) community empowerment. The guidelines are then compared to CDSP policy through interviews with local experts on the project and two main points of critique are found; (1) the pressure that population increase on the islands puts on natural resources in the area and (2) the unclear life-span of investments leading to design being based on deterministic decision making. In general, however, it is concluded that the CDSP has managed to improve the lives of the Island dwellers greatly.

Picture on front cover by Carel de Groot (2014) of Boyer char (CDSP IV area) on the Meghna River

Contents

List of Abbreviations

BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CDSP (IV)	Char Development Settlement Project (Phase 4)
GHG	Greenhouse Gas
GoB	Government of Bangladesh
IDP	Internally Displaced Person
IFAD	International Fund for Agricultural Development
IPCC	International Panel on Climate Change
NGO	Non-Governmental Organization
SLR	Sea Level Rise
SST	Sea Surface Temperature
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations High Commissioner for Refugees
WMO	Water Management Organization

1. Introduction and Motivation for Research

1.1. Context

Natural hazards are a large problem in Bangladesh and cause an average of 722 fatalities every year (CRED EM-DAT, 2015). The country is mostly a deltaic floodplain, greatly under the influence of the Brahmaputra, Ganges and Meghna, all braided rivers that constantly change course and reshape the land. This movement constantly erodes the river banks displacing about 26,000 people yearly (CDSP, 2014), but the estimated land that will be lost to sea level rise – 11% of the country by 2050 – could displace another *15 million* Bangladeshis (Feldman & Geisler, 2012).

Many displaced farmers search for new land elsewhere. Bangladesh is the most densely-populated non-island state in the world (Feldman & Geisler, 2012), meaning accommodating these farmers is problematic. Some move to *chars*, riverine or coastal sandbanks that are formed from sedimentation. These are officially government owned and people live here illegally. Because of the high demand for land, the landless take the risk and move to the islands (CDSP, 2014). These new inhabitants live disconnected from basic needs such as schools, roads and markets, and often have no access to potable water. They are vulnerable to natural hazards in an unstable, unprotected environment and are unsure of their future because of their illegal status. The *Char Development and Settlement Project* (CDSP) aims to "reduce poverty and hunger among poor people living on the newly accreted chars." The first two goals in the project areas are (1) to protect from climate change and (2) to build climate resilient infrastructure (CDSP, 2014). These goals will ideally create a resilient community that can cope with the climate hazards they are faced with but the project could be part of the problem by attracting more landless to hazard prone areas.

1.2. Aim

This research aims to analyse and evaluate the development on newly formed islands and settlements (chars) in the coastal area of Bangladesh. It specifically aims to determine whether the adaptation methods used by Char Development and Settlement Project are the best possible solutions or whether there is a chance that the measures taken will lead to larger problems in the future, making them *maladaptive*. This research focuses on the following key question:

Does the process of development on the coast of Bangladesh prevent the future possibility of maladaptation?
In order to answer this question, it is necessary to answer a few sub-questions;

1. What are the guiding principles of adaptation and when can we speak of maladaptation according to literature?
2. What is the process of adaptation in the Char Development and Settlement Project area?
3. Has the CDSP made sure to avoid issues that could lead to maladaptation?

1.3. Social and Scientific Justification

Maladaptation in terms of climate change planning is a new concept. There is a lot of literature on the subject, but these papers mostly focus on developed countries or are very general. By specifically looking at coastal planning in a developing country, this paper fills a gap in existing literature. The conclusions made in this research could benefit other development projects in defining pitfalls in adaptation planning, hopefully creating a safer living environment for coastal communities.

1.4. Structure of the research

The next chapter will provide context for the research question by elaborating on the themes and theories involved in the research. In chapter 3 a literature review will try to establish guidelines that need to be followed in adaptation policy to avoid maladaptation. Chapter 4 will discuss these guidelines in the context of CDSP in Bangladesh based on interviews with experts on natural hazard- and coastal management in Bangladesh and on the project more specifically.

2. Theoretical Framework

2.1. Climate-induced natural hazards

As mentioned in the introduction natural hazards cause 722 fatalities a year in Bangladesh. The natural hazards that largely cause the displacement of the char people or are a danger to their current living environments are sea level rise, tropical storms, saline intrusion and river bank erosion. To appreciate the dangers of living in the char areas and the necessity for adaptation, it is important to understand these hazards and their influence on the lives of char dwellers.

Sea level rise

Sea level rise (SLR) is caused by a combination of thermal expansion of seawater and the melting of the Arctic Ice sheets (Gornitz, 1995; Church et al., 2001). The relative SLR in Bangladesh (4.0mm to 7.8mm a year) is much higher than the global average estimate (1.0mm to 2.0 mm a year). This is due to the subsidence of the Ganges-Brahmaputra delta, causing a relatively higher rise in sea level (Karim & Mimura, 2008). A 1 meter rise in sea level will inundate 15 to 20% of Bangladesh (IPCC, 1992; Salauddin & Ashikuzzaman, 2011) but will also cause saline intrusion into aquifers (see saline intrusion). 46% of the country's population lives at risk in this Low Elevation Coastal Zone (Anderson et al., 2007).

Tropical storms and storm surges

95% of fatalities related to natural hazards in Bangladesh are caused by tropical storms (named cyclones in the Indian Ocean). They are common to Bangladesh because the warm Sea Surface Temperature (SST) and the funnel-like shape of the Bay of Bengal and several studies have suggested a link between the rising SST and an increase in frequency of cyclones (Salauddin & Ashikuzzaman, 2011; Karim & Mimura, 2008). Although studies also dispute the relationship, the present frequency of cyclones is already at a dangerous level for the inhabitants of the coastal regions of Bangladesh.

Saline intrusion

Saline intrusion is the intrusion of salt water into the ground water aquifers – used for drinking water or irrigation of agriculture. Certain types of agriculture cannot be sustained in a brackish environment and it is therefore a risk to the livelihoods of farmers living in coastal areas (Salauddin & Ashikuzzaman, 2011).

Riverbank and coastal erosion

Riverbank- or coastal erosion is caused by moving water, which dissolves or displaces sediment and is likely to get worse due to climate change (Gilvear & Jefferies, 2005). This is a major threat to settlements near riverbanks or coasts and in Bangladesh is an important cause for displacement of people. According to satellite images 32km^2 of land is eroded every year, and although more is accreted, these people still lose their livelihoods and homes (CDSP, 2014). Estimates of how many people affected range from 26 000 displaced every year (CDSP, 2014) to 1 million (Zaman, 1991). It is unclear why these estimates are so different but riverine erosion is very variable and a possibility is that in 1991 more land was eroded. What is sure is that the families affected have little to no hope for immediate recovery, because the force of the rivers is too large to withstand (Feldman & Geisler, 2012). The solution for most farmers is to move to Dhaka or search for new land elsewhere (see landlessness and land grabbing in §2.2).

2.2. Social/Institutional Hazards

Landlessness and Land-grabbing

Bangladesh is extremely densely-populated. The country hosts 155 million people of which 62% work in agriculture, but only 3.7% of the country is permanent cropland (Rahman & Salim, 2013; Feldman & Geisler, 2012; CDSP, 2014). These odds in addition to the aforementioned natural hazards have created a high demand for land in a country where over half of the rural population is landless. This high demand has in turn led to land-grabbing. The elite, politicians or military use loopholes in the law, corruption or violence to claim more land (Feldman & Geisler, 2012; Islam et al., 2010).

Internally displaced persons

These landless flee to illegal slums in the large cities or government owned land like the chars. The char dwellers have mostly lost their land to the rivers and find themselves in dangerous living conditions on the new chars. This group is very vulnerable

Internally displaced persons (IDPs) are defined by the United Nations High Commissioner for Refugees (UNHCR) as people that have fled their homes due to "armed conflict, generalized violence, or human rights violations." Unlike refugees, IDPs have not crossed a state border. Scholars often expand the definition to include the group displaced through development "most often in reference to mega-projects and infrastructure growth" (Feldman & Geisler, 2012) but this has not been accepted officially by the UNHCR.

2.3. Adaptation

Adaptation is the adjustment made to "natural or human systems in response to actual or expected climatic stimuli or their effects" (IPCC, 2014). This adjustment should reduce the vulnerability of the 'system' to the risks of climate change in a sustainable way, taking into account both the natural and social factors that could have an effect (Eriksen et al., 2011; Barnett & O'Neill, 2010).

Adaptive strategies

An adaptive measure can be characterised as a physical or institutional measure. Physical adaptations include *soft engineering* (maintaining or supporting existing natural buffers) or *hard engineering* (building of cross dams or cyclone shelters). Institutional measures aim to improve the socio-economic situation of inhabitants by engaging and empowering them through community level institutions, enabling local skills and creating an economically diverse community.

The International Panel on Climate Change (IPCC) proposes three types of adaptation: protection, accommodation and retreat (IPCC, 1996).These are clarified below.

Protection is a defence strategy that uses *hard* and *soft* measures to prevent a hazardous event (like erosion or saline intrusion) from happening. Examples of hard measures are seawalls, dykes or saltwater intrusion barriers. Examples of *soft* measures are beach nourishment, maintaining or building dunes and planting or maintaining mangrove forests.

Accommodation is the act of making a community *resilient* – increasing the ability to cope with – to the effects of climate caused disasters. Possible examples of accommodations to an area are well installed storm warning systems and evacuation plans or regulations on pumping groundwater.

Retreat is the act of reducing risk by minimizing presence of the community in the hazardous area. This can be realized by preventing development through laws, buying up land and/or withdrawing subsidies from the area (Macintosh, 2012).

Adaptive Capacity

Adaptive capacity refers to the ability of a system to plan and implement adaptation measures effectively so as to minimize the damage to the system or even to seize "climate opportunities" (Brown et al., 2010). Adaptive capacity is created by socio-economic "assets" like capital, information, technology, social capital, and equity (Smith and Pilifosova, 2003).

Risk perception

Risk perception plays a key role in adaptive planning as the perceived level of risk will influence the public or expert opinion on how necessary certain forms of adaptation are. *Affect heuristic* is a form of decision making that relies on the emotion of the person, which is mostly influenced by previous experiences. This means that if a farmer has experienced floods or a hurricane, they will estimate it as a more serious risk than another probable hazard that they have not personally experienced. The problem with *affect heuristic* in decisions regarding climate change is that the change is gradual and people often perceive it as a risk of the future and not one that needs immediate attention (Slovic et al., 2007).

Considerations for Adaptation

The decision on how to adapt an area to climate change risks is complicated because of four aspects of the adaptive planning process. These are (1) time, (2) space, (3) multiple-drivers and (4) variability.

Firstly, time is important because a measure can seem like an appropriate solution for an existing or imminent hazard to a certain system, but could lead to new problems for the system in the future. The spatial aspect adds that a valuable solution for one area (or social group) could have negative consequences for another area (Bharwani et al., 2015). These time- and spatial-scales create extra dimensions that adaptive planning needs to account for.

Aside from these two dimensions, adaptive planning is made more complex due to the multiple-drivers that define the system. The vulnerability of a system is dependent on many different natural and social drivers. The population density, land use, economic activity, political stability and socio-economic situation of inhabitants can all lead to a change in vulnerability of the system and all need to be taken into account when trying to adapt. With this in mind, sustainable forms of adaptation are inherently complicated because it has to assess so many different influences.

Lastly, these influences also change the variability of the system. Climate change planners often discuss the unpredictability of climate change but it should not be forgotten that the system that needs protection can also change, due to an economic or political instability, for example (Bharwani et al., 2015).

Maladaptation

Adaptation is meant to reduce vulnerability of a socio-ecological system to climatic events or changes. When an adaptive measure aims to do this, but has adverse effects on the system or other "systems, sectors or social groups" it is defined as maladaptation (Barnett & O'Neill, 2010). Maladaptation increases vulnerability to changes in the natural environment (Heyd & Brooks, 2009) but in practice it is not always clear when this is the case because of the same temporal and spatial scales mentioned above. Adaptive measures that end up postponing the problem – increasing vulnerability in the future (Anderson, 2011) – or displacing it – increasing vulnerability in another system – can be viewed as maladaptive (Barnett & O'Neill, 2010).

2.4. Conceptual model

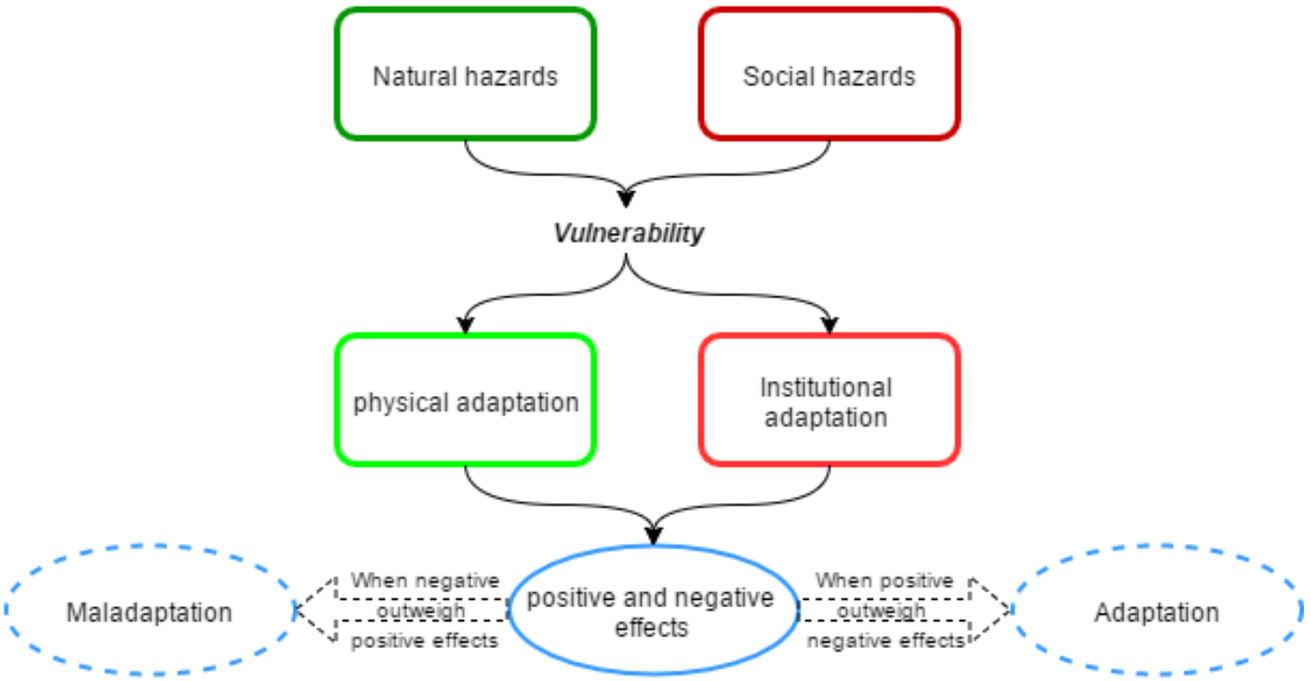

Figure 1 Conceptual framework

This thesis will evaluate the process conceptualized in the above model, figure 1. A set of natural and social hazards lead to *vulnerability* of a system. Examples of natural hazards that are a risk to the research area are rising sea level, cyclones, storm surge, saline intrusion and erosion. Possible social hazards include population increase, landlessness, corruption or isolation, which can lead to insecurities in the system. The vulnerability caused by a combination of these types of hazards leads to physical and institutional adaptation that *should* result in the system becoming less vulnerable.

3. Literature review of adaptation

3.1. Common limitations to adaptive measures

As discussed in the previous chapter, adaptation methods need to decrease the vulnerability of the system as a whole, on the long term without creating disproportionate adverse effects for other systems in the process. There are certain consequences of adaptation that could lead to the measures being deemed unsuccessful – and therefore defined as maladaptive – these are summarised below.

1. **The measure leads to an increase in Greenhouse Gas (GHG) emissions.**
   If a measure causes a significant increase in GHG emissions, it is probable further adaptive measures will be necessary in the future (Barnett & O'Neill, 2010). Air-conditioning as adaptation to a heat wave is an example of how an energy intensive measure and the related GHGs lead to the planet warming further and a greater need for air-conditioning.

2. **The development causes environmental degradation *in situ* or displaces the pressures to other environments.**
   Certain measures can lead to the area in question to degrade causing an escalation in required protection (Magnan, 2014). An example of this could be the subsidence of land due to drainage of groundwater. The measure can also displace issues to another area. Although the possibility that displacing the problem to an area that is less vulnerable could be seen as beneficial, the interdependence between areas should not be underestimated (Magnan, 2014).

3. **If the naturally occurring protection is not used or limited in the development.**
   Natural buffers (mangrove forests, dunes) create the first line of defence against natural hazards and are often more flexible than man-made barriers (Magnan, 2014). Limiting these buffer-zones or removing them completely is taking away a cheap, adaptable protection (Hallegatte, 2009).

4. **It is "disproportionately burdening the most vulnerable"** (Barnett & O'Neill, 2010).
   An example of a policy burdening the most vulnerable – often minorities or the poorest in the community (Anderson, 2011) – is increasing the price of water as solution to a water shortage. The policy treats water as a luxury item instead of a basic necessity due to its scarcity. Although this could reduce the amount of water wasted, it will burden the poor considerably more than the rich (Barnett & O'Neill, 2010).

5. **High opportunity costs**
   If the measure has high social or economic opportunity costs compared to alternative methods, it is wasting resources in an already vulnerable system (Barnett & O'Neill, 2010).

6. **The measure reduces incentives to adapt.**
   If the measure does not encourage incentives to change societal norms that are inherently unsustainable, it will be seen as maladaptation (Barnett & O'Neill, 2010). Promoting bottom up adaptation, like recycling waste, reusing rain water, or limiting energy consumption, by creating incentive to do so is important in changing norms and values.

7. **It creates a path-dependent system.**
   A measure that does not only commit large amounts of capital but also commits future generations to a path that was chosen when less information was available than is available to them, is maladaptive (Barnett & O'Neill, 2010). An example of this is large infrastructure investment.

8. **It is based on deterministic decision-making.**
   Deterministic decision making is when considering a proposed plan, certain predictions can be taken as a *known truth*. This leads to plans overlooking the deep-seated uncertainty that any climate change model carries with it. If deterministic decision making is used to create a policy, the policy could become an under- or over-reaction (Macintosh, 2012; Hallegatte 2009).

9. **It focuses solely on cost of inaction and maintaining the status quo.**
   The tunnel vision of "defending existing settlements and shorelines" (Macintosh, 2012) while ignoring other long-term possible solutions, like a variable shoreline or pulling away settlements, can be seen as maladaptive because resources are not used efficiently.

10. **It creates a false sense of security affecting risk perception.**
    If the measure taken only protects people against a specific risk, people will – without enough knowledge on other possible hazards – feel safe in general. This could encourage development in an area that is only partially protected (Slovic et al., 2007).

3.2. Guidelines for Adaptation

To avoid the consequences mentioned in §3.1, guidelines based on various reports have been summarised below, categorised into four sections. These reports were either based on theory of decision making in general (Slovic et al., 2007) or on theory of adaptive planning (Hallegatte, 2009; Magnan, 2014), specifically within the framework of a developed country (Macintosh, 2012; Barnett & O'Neill, 2010). A limitation to these reports is that they have not looked specifically at adaptation within developing countries and the limitations indigenous to a country with limited resources. This should be taken into account when applying the guidelines to Bangladesh. The numbers between brackets refer to the consequences that were discussed in the previous section.

Global and local sustainable environment (1 & 2)

To avoid energy intensive measures that increase the risk for future generations, GHG emissions should be minimal in adaptive measures (Barnett & O'Neill, 2010). To minimize the possibility that measures displace hazards or create new ones for other systems, assessments of the effects of an investment on the surroundings need to be made beforehand. To ensure both the increase in GHG emissions and the displacement of hazards do not take place, a level of centralisation is needed. Some scholars (Garnaut, 2008; Oates, 1972) assert that planning policy on adaptation should be decentralised because local government better understands the needs of the community, but adaptive measures focused on a small area or group have a risk of negatively influencing other areas and groups (Macintosh, 2012).

Sustainable investments (7 & 8)

Climate change is a variable risk and predictions made on this matter are subject to a large uncertainty at best and are completely wrong at worst (Macintosh, 2012). Therefore a robust approach that is insensitive to (1) possible changes in the system, (2) changes in how the system reacts to the environment and (3) changes in the environment, is favourable. Following the precautionary principle, an approach based on over-pessimistic data could be defined as robust (Hallegatte, 2009). More importantly, decision makers need to keep an open mind to the potential future hazards and use multiple prediction models in their planning (Macintosh, 2012).

It is important that the adaptations made to a system minimize the cost of inaccurate predictions. Hallegatte (2009) proposes that adaptive measures should be beneficial to the system even without the predicted hazards of climate change; "No-regret strategies". Another way to minimize risk in an adaptation is to choose measures that are flexible and can be altered if new information deems this necessary. Shortening decision-making time scales (Macintosh, 2012; Hallegatte, 2009) by avoiding long-term investments like major infrastructure networks or by shortening the life-span of the investments, creates this flexibility. Another possibility is to choose measures that are reversible like preventing urbanisation in certain at risk areas (this can be taken back when the areas turn out to be safe) or insurance policies (that can be adjusted when necessary) (Hallegatte, 2009).

Critical solutions (3, 5 & 9)

When looking at the challenge of adaptation it is important to critically look into existing methods and try to let go of accepted ideas of adaptation. The mind-set that coastal adaptation should accomplish "holding the line" needs to be let go (Macintosh, 2012). Also, effectively using the resources available to the system, like naturally occurring buffer zones as protection, is essential (Magnan, 2014). Accepting that future generations will know more, and leaving certain decisions to them is also a way of minimizing costs, as technology will improve and adapting will become easier and cheaper. Decision makers need to stop treating "potential future losses as the equivalent of certain present costs" (Macintosh, 2012). This also links back to flexible solutions that can be adapted later if necessary. Finally, a cost-benefit analysis is necessary with every measure to see if it is worth the costs (Barnett & O'Neill, 2010).

Community empowerment (4, 6 & 10)

The adaptive capacity of a community is key to future planning. If the community is able to adapt to unforeseen risks in the future, this will reduce the potential losses of the community. This is also why the poor are often hit the hardest by natural (or economic) disasters as their capacity to adapt to new circumstances is limited (Anderson et al, 2007). To improve adaptive capacity, the most vulnerable of the community need to be empowered by (1) increasing socioeconomic equality, (2) encouraging early actors within the community through knowledge and opportunity (Barnett & O'Neill, 2010), (3) by encouraging economic diversification and (4) involving the community in decision making. These measures that develop the community socially and economically, can also be seen as "no-regret strategies" because they are a good investment, even in the absence of climate change (Hallegatte, 2009).

Table 1: Summary of the established guidelines

Centralized rules	Follows centralized rules at a different scales	Global and local sustainable environment
Robust measures	Over-pessimistic measures that are based on multiple prediction models.	Sustainable investments
No-regret strategies	Beneficial strategies, even when predictions are incorrect.	
Flexible measures	Measures that are reversible or changeable so future decision makers can alter them.	
Existing resources	Uses all existing resources efficiently, including space elsewhere or natural buffers.	Critical solutions
Socioeconomic equality	Empowers the most vulnerable to create an adaptive capacity.	Community empowerment
Community action	Informs the community and creates opportunities for people to adapt.	
Economic diversity	Encourages economic diversity to	
Community cooperation	Encourages participation of community, to create an investment in projects	

4. Method

4.1. Data collection

As is explained in chapter 1, this research aims to answer the following key question: "*does the process of development on the coast of Bangladesh prevent the future possibility of maladaptation?"* In order to answer this question, three sub-questions were defined:

1. What are the guiding principles of adaptation and when can we speak of maladaptation according to literature?
2. What is the process of adaptation in the Char Development and Settlement Project area?
3. Has the CDSP made sure to avoid issues that could lead to maladaptation?

The first question has been addressed in the literature study in Chapter 3, but in order to answer the second and third question, a number of interviews with experts on adaptation policy, decision making in Bangladesh and the Char development and Settlement Project have been used (for a list of interviewed people and summaries of these interviews, see Appendix 1). Initially, to determine if these guidelines apply to Bangladesh and if not, why or how they should be adapted.

The first expert was Andrew Jenkins, a professor at Brac University who has 30+ years of experience working in delta planning in Bangladesh. Professor Ainun Nishat, a professor at BUET (Bangladesh University of Engineering and Technology) and Brac, and a Bangladeshi delegate at many UNFCCC Conferences of Parties, elaborated in his interview on how Bangladesh was formed and the hazards it faces. Amanat Ullah Khan, a professor at University of Dhaka and expert in planning and natural disaster management was on the subject of defining ideal solutions to the overpopulation and land scarcity in Bangladesh.

An interview with Mahfuz Rahman, the chief of planning of the Bangladesh Water Development Board (BWDB), the lead government agency that also works within the project on water management, shed light on the decision making process and the roles of donors and government in the project. The same topics were discussed in a short interview with Mr. Khaleduzzaman, a senior advisor at the Embassy of the Netherlands (a donor).

Technical reports, cost-benefit analyses, and feasibility studies published by BRAC and CDSP on the project were referenced to back the above interviews and get the clearest possible picture on how CDSP dealt with adaptation on the chars. Finally Jan van der Wal, the team leader of CDSP IV, explained the policies of CDSP and the reasoning behind possible maladaptive measures.

Semi-structured interviews were held with the respondents because it was unclear beforehand how extensive their knowledge of each issue within adaptation and the project would be. This way the respondents could give open answers (Longhurst, 2010) and I could expand on certain topics that were also new to me as interviewer. A flexible and informal conversation as opposed to fixed questions was favourable because it permitted the questions to vary between questions that were fact based and those that were more emotional or opinion based (Longhurst, 2010). I also think that the semi-structured interviews created a conversation in which I could ask critical questions and not expect a short or defensive answer, but a more varying conversation in which respondents could feel free to explain their opinions and choices.

4.2. Research Area

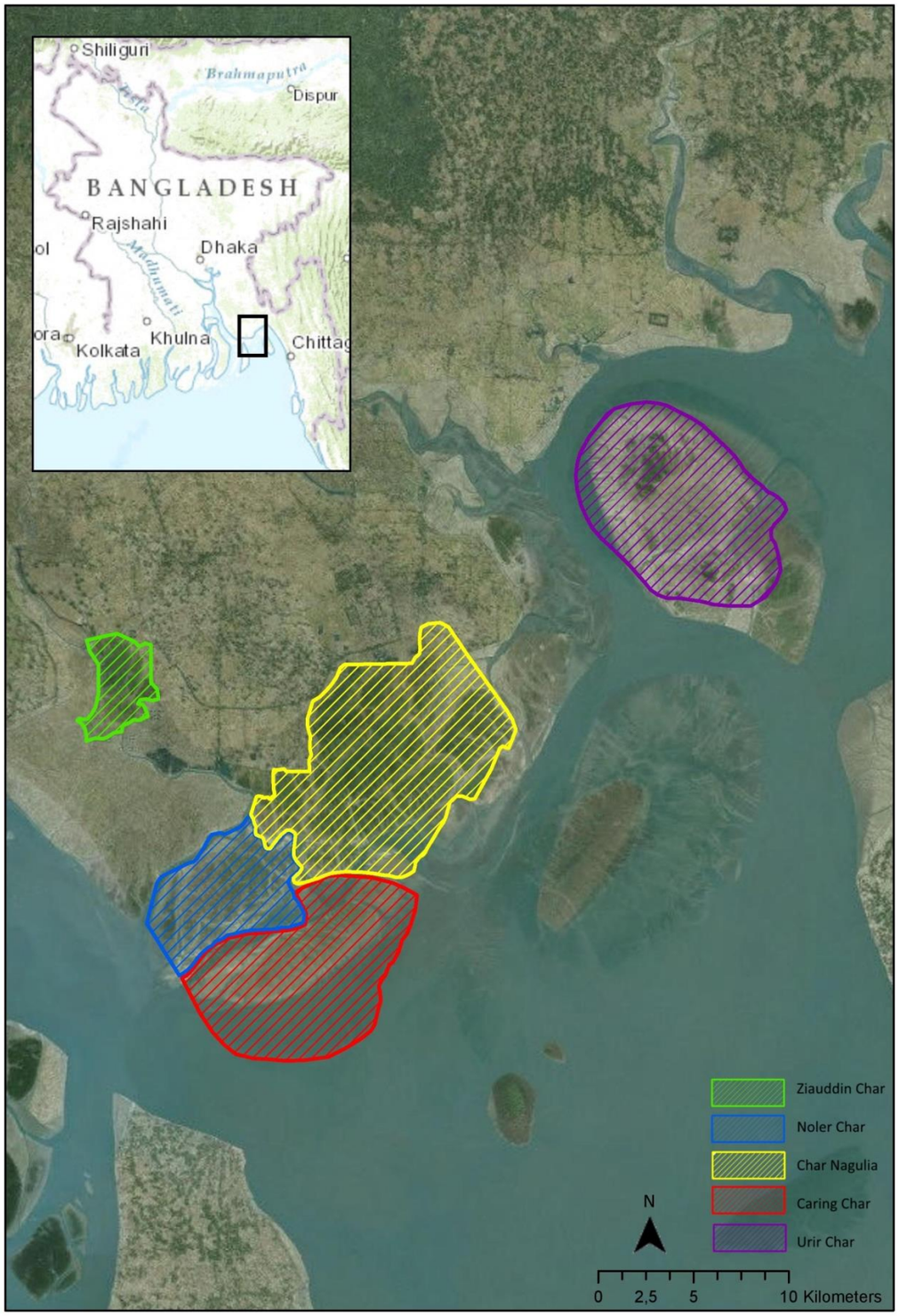

Figure 2: Map of the chars included in CDSP IV

The areas highlighted on the map above (figure 2) are the included chars in Char Settlement and Development Project phase 4. Due to security reasons (see reflection in chapter 6) inhabitants of the chars or NGO employees could not be interviewed or surveyed for this thesis.

5. Assessment of CDSP

Using the guidelines established in §3.2, an analysis of the Char Development and Settlement Project can be made based on the interviews and documents mentioned in Chapter 4. A complete depiction of the adaptive process of the CDSP and a following analysis would be beyond the scope of this thesis. Therefore the sub-questions (2) '*what is the process of adaptation in the CDSP area'* and (3) '*has the CDSP made sure to avoid issues that could lead to maladaptation'* have been combined in the following chapter. The analysis is presented in the same four themes: (1) global and local sustainable environment, (2) sustainable investments, (3) critical solutions and (4) community empowerment.

Global and local sustainable environment

As mentioned in Chapter 3, maladaptive measures could degrade the area or displace a hazard to another area. Pumping out ground water to keep a polder dry is a present example of degradation as it will lead to subsidence of the polder and subsequent sinking in relation to sea level (Ainun Nishat, 2015 interview). The Char Development and Settlement Project avoids this by only investing in chars that are "mature" (remaining above water, at high tide, during the monsoon) before development begins (Rahman, 2015 interview). Drainage can then occur naturally instead of ground water needing to be pumped out.

An example of a displaced hazard that is mentioned in multiple interviews is the Farakka barrage, a dam in India that was designed to divert part of the Ganges to Calcutta, to prevent the shallowing of the harbour. It greatly restricted the amount of water reaching the coast in Bangladesh, resulting in saline intrusion in the south west of the country (Khan, 2015; Rahman, 2015 - interviews). The government of Bangladesh tries to prevent these kinds of conflicts *within* the country through centralized regulation[1]. The CDSP follows these policies and tests the effects of the projects through different assessments[2].

The above solutions do have their limitations. The impoldering, even when the ground has naturally matured, will lead to increased siltation outside the embankment, according to an environmental guidelines report (2002) by the CDSP. The sluices also prevent the tide from traveling up rivers increasing siltation further (Nishat, 2015 – interview). In addition, the CDSP environmental guidelines report mentions the possibility that the project *will* lead to indirect degradation of the natural systems in the area. As more people move to the polders, more natural resources will be depleted. The chars are also home to many animals and the development of the chars could make this area unsuitable for the indigenous species (Keukelaar, 2012).

There are no clear indications that the CDSP leads to a significant increase in greenhouse gas emissions, but Jan van der Wal (2015, interview) does mention that the access to mainland (discussed later in '*community empowerment')* and raise in income lead to an increase in use of vehicles. Although the connection between prosperity and carbon footprint is strong it is the question if keeping a group poor to minimize emissions is desirable. This question is far too complex for the scope of this research, but it is worth mentioning as it is a negative 'side-effect' of adaptation.

Finally, the project was implemented with the idea that the farmers have no-where else to go, giving the government of Bangladesh no choice but to help them (Rahman, 2015; van der Wal, 2014; Heering, 2015 - interviews). The Chittagong hill tracts and Dhaka have been (and still are) destinations for landless but in both cases the new stresses are created in the host community. In the Chittagong hills ethnic tensions between the migrants and the natives led to violent protests to the relocation of landless (Khan, 2015 – interview). The farmers from the coastal belt also would not know how to farm in the hills leaving them without an income (Rahman, 2015- interview). Dhaka, on the other hand, cannot handle the rapid growth of the urban population and newcomers often end up in low end jobs or homeless (Khan, 2015 interview).

[1] The *Water Pollution Control Ordinance* of 1970 – later expanded to include air and soil pollution in the *Environmental Pollution Control Ordinance* of 1977 –, the *National Environmental Policy* and the *Environmental Conservation Act* (1995).
[2] The CDSP is required to perform a feasibility report, Initial Environmental Examination and an Environmental Impact Assessment. These reports then need to be accepted by the Department of Environment.

Sustainable investments

As mentioned in chapter 3.2., robust measures that are insensitive to the variables associated with climate change are favourable, but in practice an approach can hardly be defined as 'robust' beforehand due to those same, sometimes unknown, variables. Ainun Nishat (2015, interview) explains however, that in most cases protection from, for example, sea level rise (SLR), has a large buffer; say the IPCC predicts an 80cm SLR, the dikes will still be 6 meters. But Nishat goes on to explain that *saline intrusion,* on the other hand – due to SLR, but also less regular rainfall and more draining of the key rivers upstream in India – cannot be stopped by 6 meter dikes. Within the CDSP, sluices are an example of an investment that needs to be robust because they are too expensive to replace or alter and have a long life-span. The project is over-pessimistic in the design of sluices by taking into account less regular and more intensive rainfall (Van der Wal, 2015 interview).

In terms of a solution to lack of fresh water and saline intrusion, *ponds* that catch and hold rainwater, have been proposed as a flexible and renewable source of fresh water. The ponds have also created a new opportunity: fish-farming (Van der Wal, 2015 interview).

The CDSP also invests in numerous 'no-regret' measures. An example is the early warning system, that lets fishermen and inhabitants on the chars know when a storm is coming, so that they can take cover in a cyclone shelter. The combination of an early warning system and cyclone shelters is a clear no-regret measure because they are already valuable in the present climate and have saved thousands of lives (Mahmut, 2015 interview). Cyclone shelters are also mostly used as school or office buildings so are also useful in years with fewer storms.

Aside from the key guidelines mentioned in the literature review, the interviews with experts on coastal management in Bangladesh shed light on another important pitfall for adaptive measures: maintenance and corruption. Firstly, the maintenance of existing investments, be it infrastructure, mangrove forests or machinery, is hardly ever followed through. This is because of a glitch in how the government of Bangladesh organizes its budget (Khaleduzzaman, 2015 interview) which, while this is a complex issue, boils down to maintenance not being treated as a priority. Corruption is also a major frustration within development in general in Bangladesh (Khan, 2015 interview). The CDSP does have policies to prevent this from happening within the projects. Prices of every investment that is outsourced are calculated beforehand and the project scrutinizes every step in the process to prevent that money is made by saving on quality of the construction of cyclone shelters, roads and even mangrove forests (Van der Wal, 2015 interview).

Critical solutions

Examples that have been found in literature that could be defined as critical solutions were often no goes in Bangladesh and the CDSP areas. Although a varying coastline is inevitable – the rivers are too strong to control (Khan, 2015 interview) – retreating is not seen as an option. The government has already made it illegal to live on the newly accreted lands, but people still move there because of the high demand for land (Van der Wal, 2015 interview). It is "a question of humanity" if the government can then chose to turn its back on these 'illegal' inhabitants (Rahman, 2015 interview). Another guideline that was not followed within the CDSP is efficiently planning for the lifespans of investments. The CDSP based plans on the IPCC estimated sea level rise of 100 years, regardless of the life-span of the sluice, dike or shelter (Van der Wal, 2015 interview).

Natural buffers have been enforced in the CDSP area; a kilometre of mangrove forest is planted along the coast and rivers outside of the dikes as first line of defence in a storm (Van der Wal, 2015 interview). In addition, there have been innovative solutions to natural hazards on the coast, like shrimp cultivation in saline water ponds. This cultivation could be seen as a solution to the saline intrusion, however, shrimp cultivation takes very little labour and this development has led to many land workers to lose their jobs (Nishat, 2015 interview). In the CDSP area, though, there are no large landowners and every farmer works their own land (Heering, 2015 interview), making a less labour intensive option favourable.

Community empowerment

Monitoring and maintenance would improve if locals were more involved in general adaptive policies (Nishat, 2015 interview). Van der Wal (2015, interview) explains that CDSP maximises local bottom up investment in policies through field level institutions like water management groups (WMGs). WMGs are local representatives of the char dwellers and the CDSP ensures that at least 40% are women. The WMG also spreads information on imminent hazards. An NGO within CDSP also advocates women rights on the chars and grants microcredit to create opportunity for the families to invest in their own farm or another small venture like livestock or a homestead garden.

6. Conclusion

Natural hazards and the policies created to protect the people against them are complex issues in Bangladesh. Not only does climate change threaten a large portion of the country, land grabbing and over population have led to a high demand for land and desperate farmers therefore take great risks to claim newly accreted chars. The Char Development and Settlement Project aims to limit the poverty in the lives of these farmers and to protect them from the natural and institutional hazards in Bangladesh. This thesis aims to find if "*the process of development on the coast of Bangladesh prevent[s] the future possibility of maladaptation.*"

The CDSP can be evaluated based on guidelines for adaptation within four themes; (1) global and local sustainable environment, (2) sustainable investments, (3) critical solutions and (4) community empowerment. Based on the information available, the policies of the CDSP are *not* maladaptive. The policies follow most guidelines and in cases where they do not, suitable alternatives were found. The main issues in the project according to the guidelines are the pressure that population increase puts on natural resources in the area and the unclear life-span of investments leading to designs based on deterministic decision making. For the first, it would be valuable to conduct further research to see if natural systems in the area are in fact, being depleted due to the population increase. In the case that there is a significant impact on the natural resources, it could also be asserted that as long as the resources are used sustainably, the welfare of the inhabitants is a priority. For the second critique an analysis of the life-span of investments would be necessary, to create a clearer timeframe in which the investments need to meet expectations. At the moment it is uncertain how long a cyclone shelter or sluice will last, so the project uses IPCC predictions about sea level rise or salinity increase, for 2100, even if the investment only lasts 20 years. This is a waste of resources and limits the possibilities future generations have to adapt. It is, however, doubtful that infrastructure could assume smaller changes in climate because the costs of creating an over-pessimistic buffer is in many cases marginal compared to the costs of rebuilding the investment completely.

Finally I would like to add that a more complete analysis of the project would be possible with just more time and space. Surveying the change in perceived or actual standard of living amongst the inhabitants would have given a more complete picture of the effect of CDSP on a char. A comparison of the population densities and - structure, economic welfare and safety of inhabitants and the influence on natural resources in the direct surroundings, of two chars (one within the CDSP and one excluded from the project) would also have been an interesting way to analyse the possible effects of the project that they have not taken into account. Due to supposed attacks by Daesh (the Islamic State) on foreigners in Bangladesh in September and October 2015, it was not possible for me to travel to the coastal regions to do fieldwork. Surveying inhabitants was therefore not possible, but also speaking to the many representatives of the NGOs active within CDSP was difficult.

References

Anderson, S. (2011). *Assessing the effectiveness of climate adaptation*. Lessons from Adaptation in Practice. IIED.

Barnett, J., & O'Neill, S. (2010). Maladaptation. *Global Environmental Change*, *20*(2), pp. 211-213.

Bharwani, S., Burkett, M., Burton, I., Erikson, S., Gemenne, F., Magnan, A., Schaar, J., Schipper, E., and Ziervogel, G. (2015). Addressing the risk of maladaptation to climate change.

Brown, H. C. P., Nkem, J. N., Sonwa, D. J., & Bele, Y. (2010). Institutional adaptive capacity and climate change response in the Congo Basin forests of Cameroon. *Mitigation and Adaptation Strategies for Global Change*, *15*(3), pp. 263-282.

CDSP (2014), CDSP IV. Brochure. Bangladesh: Char Development and Settlement Project

Church, J. A., Gregory, J. M., Huybrechts, P., Kuhn, M., Lambeck, K., Nhuan, M. T., ... & Woodworth, P. L. (2001). Changes in sea level. *, in: JT Houghton, Y. Ding, DJ Griggs, M. Noguer, PJ Van der Linden, X. Dai, K. Maskell, and CA Johnson (eds.): Climate Change 2001: The Scientific Basis: Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel*, pp. 639-694.

CRED EM-DAT – Centre for Research on Epidemiology of Disasters, Emergency Events Data (2015) The International Disaster Database. Retrieved 07-10-15 from [www.emdat.be]

Eriksen, S., Aldunce, P., Bahinipati, C. S., Martins, R. D. A., Molefe, J. I., Nhemachena, C., O'Brien, K., Olorunfemi, F., Park, J., Sygna, L., & Ulsrud, K. (2011). When not every response to climate change is a good one: Identifying principles for sustainable adaptation. Climate and Development, 3(1), pp. 7-20.

Feldman, S.; Geisler, C. (2012). Land expropriation and displacement in Bangladesh. *Journal of Peasant Studies*, *39*(3-4), pp. 971-993.

Garnaut, R. (2008). *The Garnaut climate change review*. Cambridge: Cambridge University Press.

Gilbert, J. and Vellinga, P. (1990). *5: Coastal Zone Management*. IPCC Response: Strategies Working Group Reports. The Hague: IPCC, pp. 133-158.

Gilvear, D. J. & Jeffries, R. (2005) *Fluvial geomorphology and river management.* In: Holden, J. (2012). *An introduction to physical geography and the environment*. Pearson Education. Pp. 336-367

Gornitz, V. (1995). Sea-level rise: A review of recent past and near-future trends. *Earth Surface Processes and Landforms*, 20(1), pp. 7-20.

Hallegatte, S. (2009). Strategies to adapt to an uncertain climate change. *Global Environmental Change*, *19*(2), pp. 240-247

Heyd, T., Brooks, N. (2009) Exploring cultural dimensions of adaptation to climate change. In: Adger, WN., Lorenzoni, I., O'Brien, K. (Eds.). Adapting to Climate Change: Thresholds, Values, Governance. Cambridge University Press: pp. 269-282

IPCC (1992) *Climate Change: The 1990 and 1992 IPCC Assessments.* Assessment Reports: International Panel on Climate Change.

IPCC (1996) *Climate Change 1995*. Assessment Reports: International Panel on Climate Change.

IPCC (2014). *Working Group II: Impacts, Adaptation and Vulnerability*. Assessment Reports: International Panel on Climate Change.

Islam, S. N., Singh, S., Shaheed, H. & Wei, S. (2010). Settlement relocations in the char-lands of Padma River basin in Ganges delta, Bangladesh. *Frontiers of Earth Science in China*, *4*(4), pp. 393-402.

Karim, M. F.; Mimura, N (2008). Impacts of climate change and sea-level rise on cyclonic storm surge floods in Bangladesh. *Global Environmental Change* 18(3): pp. 490-500.

Keukelaar, F. (2002) *Environmental Guidelines and Application of GIS.* Char Development and Settlement Project Phase II.

Longhurst, R. (2010) *Semi structured interviews and focus groups*. In: Clifford, N., French, S., & Valentine, G. (2010). *Key methods in geography*. Sage: Pp. 103-115

Macintosh, A. (2012). Coastal climate hazards and urban planning: how planning responses can lead to maladaptation. *Mitigation and Adaptation Strategies for Global Change*, *18*(7), pp. 1035-1055.

Magnan, A. (2014). Avoiding maladaptation to climate change: towards guiding principles. *SAPI EN. S. Surveys and Perspectives Integrating Environment and Society*, (7.1).

Anderson, B. Balk, D., & McGranahan, G., (2007). The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones. *Environment and urbanization*, *19*(1), pp. 17-37.

Oates, W. (1972). *Fiscal federalism*. New York: Harcourt Brace Jovanovich.

Rahman, S.; Salim, R. (2013). Six decades of total factor productivity change and sources of growth in Bangladesh agriculture (1948–2008). *Journal of Agricultural Economics* 64(2): pp. 275-294.

Salauddin, M., & Ashikuzzaman, M. (2011). Nature and extent of population displacement due to climate change-triggered disasters in the south-western coastal region of Bangladesh. *Management of Environmental Quality: An International Journal*, *22*(5), pp. 620-631.

Slovic, P., Finucane, M., Peters, E. and MacGregor, D. (2006). The affect heuristic. *European Journal of Operational Research*, 177(2007), pp. 1333-1352.

Smith, B., & Pilifosova, O. (2003). From adaptation to adaptive capacity and vulnerability reduction. *Climate change, adaptive capacity and development*, pp. 9-28.

Zaman, M. Q. (1991). The displaced poor and resettlement policies in Bangladesh. *Disasters*, *15*(2), pp. 117-125.

Appendix 1: Interviews

1.1. List of Experts

Hero Heering	Interviewed on 14 October 2015	Appendix 1.2
Mr. A. T. M. Khaleduzzaman	Interviewed on 14 October 2015	Appendix 1.3
Mahfuz Rahman	Interviewed on 19 October 2015	Appendix 1.4
Professor Ainun Nishat	Interviewed on 21 October 2015	Appendix 1.5
Professor Amanat Ullah Khan	Interviewed on 26 October 2015	Appendix 1.6
Jan van der Wal	Interviewed on 13 November 2015	Appendix 1.7

1.2. Hero Heering 14 October 2015

Hero Heering is project director of Blue Gold and CDSP IV. The following is a summary of a short interview with him about the Char Development and Settlement Project (CDSP).

Climate change has been on the agenda of CDSP since IFAD became a part of the project. This is because IFAD imposes certain requirements to projects that they fund, including preparing for climate change. An issue with climate change adaptation in Bangladesh is that climate is already and has always had a great impact on the coastal communities. Therefore, a lot of the so called changes to infrastructure or policies are just changes in naming. A road that needs to be built can be labelled as just new infrastructure investment or climate resilient infrastructure and it will not matter that the road in both cases is designed the same way – resilient to the local environment. The use of 'fashionable vocabulary' will pull more investors and funds. Another example is "climate resilient crops", these often already exist because these areas are already saline but seem to be innovative because of the phrasing.

In the case of CDSP, certain steps have been taken to adapt the chars but because of the current situation mentioned above, it is not clear which ones are really taken to adapt to climate change and which are just to protect people from current hazards. Another thing is that dykes, for example, might need to be raised 1.5 m throughout Bangladesh because of specific measurements. But these estimates are based on 25 to 50 years while the dykes are already showing problems and need fixing after 10 years. So it is not logical to look ahead that far when steps can also be taken in multiple stages, which is cheaper.

CDSP is now also looking at "flow-studies" to see where the rivers will move the coming years and if development is sustainable in certain areas. Aside from that the project installs WMOs [Water Management groups], in which inhabitants of the chars are represented and can actively participate in the decision making process.

Retreat is not an option in the case of the CDSP areas because the demand for land is too high and the displaced farmers are desperate, they will move there anyway. So retreat would mean to ignore the living standards of the char inhabitants and not invest in the area to avoid a situation where people are encouraged to move to the chars. But those people do not have a choice, they have nowhere else to go, the government cannot let them 'drown'.

1.3. Mr A. T. M. Khaleduzzaman 14 October 2015

Mr. Khaleduzzaman is a senior advisor for water management at the embassy of the kingdom of the Netherlands (a donor of the CDSP). The following is a summary of a short interview with Khaled.

People in Bangladesh are constantly adapting to the climate, sometimes every month or year. They plan within their capabilities and knowledge and do what they can to ensure their own sustainable livelihoods. They do not wait around idle for someone else to fix it. There are simple examples of adaptive measures taken by farmers in Bangladesh. A bundh is like a small dike that farmers build around their land to keep high water levels out. Another measure is fisheries, when water levels are high a fishery is a good alternative to crop and by setting up nets around there land, fish cannot escape even when the water level is higher than the surrounding bundhs.

WMOs [Water management organizations] are used by projects to keep the locals invested in the project. A WMO is a group of inhabitants of an area that represent their community and participate in the planning of the chars. They need to be at least 30% women and not only farmers because interaction between non-farmers and farmers in these new communities is important in order to improve the co-operation and harmony in these communities. A farmer-only society is not sustainable and people representing transport, energy, security, etc. are also necessary in the WMOs.

By interacting with the local population and organizing periodic meetings, projects keep the community keen to improve the char's safety and living standards. Sometimes there are issues with trust on the chars compared to other older areas where delta projects are active. This is because the community is new and inhabitants do not easily entrust their savings, for example, to a WMO. There is also less of a societal structure that is capable of pressuring peers to fulfil certain agreements.

Focus on the chars has also changed. In the 60s development was focused on tidal movements and building dykes so that forestry or fisheries could be possible in the area. Because of the coastal development adaptation has changed; there is now also infrastructure that needs to be protected, school, roads, colleges, industry. "Some investments will always be lost" but because of the high population pressure and economic demand you have to develop the area. The challenge is to rationalize investments; a low investment can lead to high results.

CDSP focuses on already reclaimed land. The chars grow naturally and are sometimes encouraged by mangroves and cross-dams but there is no dredging involved.

1.4. Mahfuz Rahman 19 October 2015

Md. Rahman is Chief of Planning at the Bangladesh Water Development Board. The following is a short summary of his interview.

The main cause for displacement is the coastal or river bank erosion. Stopping erosion can sometimes be done for a while but for now it is impossible to protect land from the rivers, on the long term. It is difficult to say if the movement to the chars is sustainable because net land is gained every year, especially in Noakhali, but in other areas it is eroding. The allocation of displaced people can only start when the land is mature [higher then high tide] and so this is a slow process, but seeing as displaced families have nowhere to go, they move to the new chars before it is mature.

The CDSP protects families from the unfavourable environment and this encourages farmers to move to the CDSP areas, because they are safe. People often lobby for their islands to be included in the project because they know it will improve their living standards. The CDSP has successfully done this in previous projects and in the current phase 4. Many landless have gotten land rights in a safe and accessible environment. The project cannot retreat out of the coastal environment because these people will move there either way; they were displaced from a char and will move to new chars. The government cannot expect them to suddenly move to the city or the hills, because they will not have an income. They know how to farm the land in this environment and not how to get by in the city or the hill tracts.

The problem with early inhabitants of the chars is that the land first needs to 'grow' through afforestation and constant flooding during high tide. These 'illegal' inhabitants are not actually stopped from living here though, because they have nowhere to go, so the government does not have a choice.

Climate change is a new issue, also to the BWDB. Now for most projects, it is taken into account and investments are developed with a 50 year period in mind. But in the case of CDSP current climate hazards are mostly a bigger issue, so climate resilience is important but it is not always taken into consideration. This is also because certain embankments will only last 20 years, so planning ahead 50 years is not necessary. The intention is to be flexible; the costs will be too high if we need to take into account everything now. Protection from regular flooding and cyclones is the priority at the moment.

Every project in Bangladesh is subject to a cost-benefit analysis, and with CDSP it has always been positive. The difficulty with these analyses is that often benefit is intangible, it depends on how bad the climate gets, how much the sea level rises, and it depends on social factors like liveability of the inhabitants. It is difficult to quantify this.

Water is limited in the CDSP area. One reason is that India and China are diverting water from the main rivers into Bangladesh. The water challenge will only become bigger because while Bangladesh needs more water, it will receive less due to India and China using more and due to irregular supply from the monsoons and Himalayas. The country needs to learn to survive on less water; water security and water efficiency have to be secured in the future.

1.5. Professor Ainun Nishat 21 October 2015

Ainun Nishat is a professor at BUET (Bangladesh university of Engineering and technology) and Brac Universities and was a Bangladeshi delegate at many UNFCCC Conference of parties. The following is summary of his interview.

Bangladesh was born out of a sedimentation process of two major rivers, the Ganges and the Brahmaputra which carry about 1 to 2 billion tons [1200 billion m^3/year]. People started living in Bangladesh in *beri bundhs* – small polders – building their houses on raised mounds. The people of Bangladesh have always had to adapt, they have always had their own water management practices, but in 1965 local inhabitants of the coastal belt demanded formal polders. This was the start of government involvement in planning of the coast and by 1970 the coastal belt was polderised. This led to a population increase in the area because people felt safe; there are about 5 storm surges a year, but below 3 meters and the dykes are about 5 meters. In 1970, however, a cyclone and its storm surge killed half a million people, because the polders were not protected against storm surge that high [9 meters]. In 1991 130 000 people died because of a storm and since then there have been 8 or 10 peak events, but due to cyclone shelters and warning systems the death toll has gone down. But the main threat to the coast is still the storm surge and another 5000 cyclone shelters are still necessary to cover the whole coast.

Sluices have started to cause other problems in the area. The tide cannot travel up the river anymore so the volume of water in the rivers has gone down leading to the rivers becoming shallow. Because the river bed has gone up, water cannot easily drain out of the polders leading to water clogging. River tidal management has been proposed as solution to this.

The artificial encouragement of siltation like cross-dams is a measure that has been used in the past to create more land, but it can change the path of the rivers and could lead to erosion in other areas. “If nature is doing something and you find that this is wat nature is going to do then accelerate that process.”

The Ganges is also drying up because India is draining it and the sea level rises 5.5 mm/year in the South West and 12 to 15 mm/year in the South East. These two issues lead to the sea water moving further inland and so to an increase in salinity along the coast. Farmers cannot irrigate with saline rivers, so this will influence production. A solution to this has been shrimp cultivation, which is possible in saline water, but the production of shrimp takes less labour, so many lose their job when fewer workers are needed.

The amount of labour needed on the farms is any case an issue because of overpopulation. Even though a smaller percentage of Bangladeshis work in agriculture than in the 70s, in absolute numbers the rural population is still growing. Aside from this the maintenance of the polders is also inadequate. Locals are not involved enough, they need to be empowered and responsible for maintenance of the dykes, sluices or natural buffer zones.

In IPCC 1 they had estimated that the SLR would be 4m and said that 1/3 of Bangladesh would go underwater but they ignored the dikes, the polders. The polders in those days were 5 m but they are now being raised to 6.5 m. So aside from the salinity caused by it, SLR is not a problem. Some western papers on Bangladesh propose people should retreat because the land will be inundated. But this is based on those IPCC reports that ignore the polders, or that land grows with the sea level due to new sedimentation. Aside from the fact that a third of the country will not be inundated by 2040, where are the people supposed to move to? Many landless move to Dhaka and officially and unofficially many move to India, Malaysia, the Middle East; anywhere in search for jobs. Based on these papers, however, 40 million people need to move out, and as population increases this number will increase.

Similarly to the overreactions of western research, climatologists or geologists will look ahead 500 years and expect people to act now. Politicians think ahead 5 years and engineers for 30 years, but the trick is to constantly monitor changes so that we can adapt when necessary.

1.6. Professor Amanat Ullah Khan 26 October 2015

Amanat Ullah Khan is professor at the University of Dhaka and expert in planning and natural disaster management in Bangladesh. The following is a summary of an interview with him.

Bangladesh is one of the most hazard prone countries in the world. Cyclones, storm surges, floods, north-western tornados, tectonic and hydro-meteorological hazards are al common in the country, but the largest problems are the periodic cyclones and the constant riverbank erosion. Now climate change is a 'popular' problem in the world and so Bangladesh goes along with the trend and blames these hazards on climate change, which helps with getting funding for projects. The rivers have, for example, become more saline, and it is easy to blame sea level rise but up until the climate change rage, everyone blamed the Farakka barrage [dam in India that limits the flow of the Ganges to Bangladesh]. Even though it is just a trend and climate change is not always the cause of the hazards, the hazards still exist and threaten inhabitants of Bangladesh. The measures that are taken in the name of 'climate change protection' are therefore almost always a good development.

The Bangladeshi terrain is sandy or clay, there are no rocks and it is very easy for the rivers to move around. People try to stabilize the rivers and in some places it has been successful for some time but the river will always win on the long term. Ideally the rivers should be given more space to move. This means the population needs to retreat from the first few kilometres and create a buffer, but Bangladesh is too densely populated with people and rivers. Although it is land of contrasts and in the hill tracts you could walk for miles without seeing anyone. People have been relocated to these areas, but this has caused ethnic tensions with native people as there are now more 'outsiders' in the region then natives. Bangladeshis that have lost their land to the rivers have also moved to Dhaka but the capital is becoming too big, it cannot handle the growth. Another option for many landless is leaving Bangladesh officially or unofficially; a lot of movement goes unrecorded, like to Thailand, India, Malaysia or Indonesia.

Farmers have also adjusted to Natural hazards in other ways. They build their houses weakly so that it is easy to rebuild when destroyed by a cyclone. The roads also never last longer than two years.

A solution to the growing population density would be choosing growth centres, places that can handle a larger population. By creating (economic, educational, health) incentives in a few cities, not everyone will move to Dhaka, making the cities more liveable. Aside from this the government will need to stop people from moving to the coast by enforcing the law. The Delta plan is important tool to create a general plan for the country and for example choose these growth centres, but it is not innovative. Research has been done, reports made, media will write about it and it will be archived and nothing will become of the plans. It has happened before and nothing proves that it will not happen again to the Delta plan. Corruption often plays a role in the failure of both enforcing the law and actually carrying out plans. People make money on the projects in name of climate change; crores [a crore is 10 000 000 taka] are invested in infrastructure but then there is no-one there to manage it.

1.7. Jan van der Wal 13 November 2015

Jan van der Wal is project manager of the Char Development and Settlement Project phase 4 (CDSP IV). The following is a summary of an interview with him.

The CDSP is actually a combination project of 6 government agencies, 5 ministries ad 4 NGOs [non-governmental organizations] and they work very well together. Central to the CDSP is poverty reduction and a key measure in this is access to main land; roads and bridges are essential. People can import goods, but also reach markets easier, to sell their own product. Aside from this gender roles play an important part in CDSP as the project is active in the most conservative areas in Bangladesh and equality is not yet the norm. One of the NGOs is completely focused on women. There is a microcredit program that helps women start their own homestead garden, the field level institutions have quota for women and the new land title is given half to the husband and half to the wife. All this empowers the women in the communities and it is often visible meetings, where women start to speak up. The communities have changed completely in that sense in the 6 years the project is active there [CDSP IV].

Water is a complicated problem on the chars. There is a shortage of fresh water the project tries to remedy this through tube-wells and ponds. Tube-wells are narrow wells that pump fresh water from very deep ground water and are shared by 25 to 30 people. They can only be used for drinking water and are maintained by tube-well groups. Agriculture is rain fed and sometimes farmers use ponds to supply extra water, but the ponds are also used for fish farming.

IFAD [International Fund for Agriculture Development] has become a donor the fourth phase of CDSP [CDSP IV] and their midterm review in 2014 showed that family incomes had increased 3 fold already. This is due to the width of the program, it develops the market, the role of women, the co-operation between farmers and between farmers and other groups. The villages expand quickly as business, small shop owners move in. This does mean that the project draws more people to the area, but CDSP does not see this as irresponsible because the area is protected. What is important is that people understand the risks of the area, the dikes cannot stop high storm surges, like of 1970 and it has happened that people fled to the dike in a storm. To prevent this from happening in a more serious event we spread information about escape routes and the warning system on billboards and through field level institutions. This communication and improved weather forecasts have led to a much safer environment to live in.

There are chars where people live, outside the CDSP area, that do not have cyclone shelters yet. These people live with a great risk of storms and storm surges, but these islands are often not stable enough to start investing in large infrastructure (like a cyclone shelter). People still live here because, like in the CDSP areas, they have nowhere else to go; they have mostly been displaced due to erosion somewhere else. Every year 20 km^2 of land is eroded in Bangladesh and 50km^2 accretes somewhere else. This means that although Bangladesh is growing, countless families lose land every year. Often groups of families make the choice together to move to a new char, these areas are extremely unsafe, so for one family to go alone is unwise. This is why the CDSP also tries to get government and police to move into the area, because pirates and bandits often extort new inhabitants.

A group of farmers moving together is rational but it does mean an existing hierarchy comes along with the group, and often a political preference exists within the community. This has to be kept completely separate from the project because political influence is often a small step away from corruption in the area. CDSP tries to prevent this from keeping the WMO [water management group] meetings politics-free. Corruption is also present in contractors and the development of infrastructure, for example. By setting fixed prices for products and cautiously checking the quality of every project.

CDSP lasts 20 years but the maintenance after completion is still done through the project but with Bangladeshi money. This is due to how the government of Bangladesh assigns money to development. The project uses IPCC predictions for sea level rise, for example, to design dikes and cyclone shelters, but a large buffer is always used and even if a dike only lasts 20 years, the

design is based on a longer period. The areas taken into CDSP are believed to be growing, and never eroding, and the char needs to be above sea level at high tide in the monsoon before development begins, even if people have been living there for years before. Even then dikes are built 1 km inland and sluices 1.5 km, because the rivers can always change direction and erode part of the char. Foreshore plantation tries to limit this by absorbing the energy of the waves and limiting the damage to the land.