Tidal River Management

Temporary depoldering to mitigate drainage congestion in the southwest delta of Bangladesh

M.Sc. Minor Thesis by Leendert de Die

March 2013

Water Resources Management Group

WAGENINGEN UNIVERSITY
WAGENINGEN UR

Tidal River Management

Temporary depoldering to mitigate drainage congestion in the southwest delta of Bangladesh

Minor thesis Water Resources Management submitted in partial fulfillment of the degree of Master of Science in International Land and Water Management at Wageningen University, the Netherlands

Leendert de Die

March 2013

Supervisors:

Ir. Arjen Zegwaard, MSc
PhD candidate
Water Resources Management Group
Wageningen University
The Netherlands
www.iwe.wur.nl/uk

Dr.ir. Flip Wester
Chief Scientist Water
International Centre for Integrated Mountain Development (ICIMOD)
Kathmandu, Nepal
www.icimod.org

Dr. Shah Alam Khan
Professor
Institute for Water and Flood Management
Bangladesh University for Engineering and Technology
Dhaka, Bangladesh
www.buet.ac.bd

Leendert de Die

Lfdedie@gmail.com

+31-6-41472625

Registration number: 861203181020

Abstract

In the late 1980s, many tidal rivers in the Southwest delta of Bangladesh became filled up with sediment. This caused permanent waterlogging in areas around Khulna, Jessore and Satkhira, which had detrimental consequences for agriculture. In 1997, during the Khulna-Jessore Drainage Rehabilitation Project (KJDRP), the local population of Beel Bhaina created a tidal basin by cutting the embankment with the Hari river. This had two effects: 1) a gradual raise of land level in Beel Bhaina with sediment and 2) an increased cross section of the Hari river. Drainage of the entire KJDRP area improved after the cut. The strategy of creating temporary tidal basins was given the name "Tidal River Management".

This research describes the emergence of this water management practice over space and time. Current water management practices were mapped by conducting a Rapid Water Management Appraisal and drawing participatory maps. Accordingly, "Tidal River Management" is presented in 6 frames, which describe and explain the different perceptions of the concept among stakeholders.

Although 97% of all interviewees was found to be in favour in temporary inundation of Beels to prevent waterlogging, twelve government and Bangladesh Water Development Board cars were burned during a violent protest against "Tidal River Management" in June 2012. Among other factors, an ineffective compensation mechanism and the absence of accountable water management institutions were found to be the root causes of this conflict.

Based on the findings, I recommend the inclusion of informal water management entities in future river(basin) management plans and the start of independent campaigns to inform (local) stakeholders on the physical and political complexity of water management in the study area.

For Ami & Sebastiaan

Contents

List of figures

Acknowledgements

The strength and hospitality of the people of Bangladesh are engraved in my memory and deserve much more than my deepest respect. Besides all those I cannot thank by name, I am grateful to all the people that contributed to this research and – most importantly – to a safe stay in Bangladesh. Thank you Abdus Sattar, Ahmed Khaleduzzaman, Aminul Haque, Andrew Jenkins, Arjen Zegwaard, Carel de Groot, Carel Keuperie, Catharien Terwisscha van Scheltinga, Dilib Kumar, Dilib Kumar Datta, Fatima Halima Ahmed, Flip Wester, Gayanath Sarker, Gerben de Jong, Henrick van Asch van Wijk, Jan van Minnen, Lennart Pompe, Linden Vincent, Lisette Keuperie, Mahmuda Mutahara, Martijn van Staveren, Martin Bos, Nazrul, Nicole van Asch, Rob Nieuwenhuis, Russel vhai, Saskia Keesstra, Shah Alam Khan, Shahidul Islam, Shorab Hossain, Stéphanie Rousseault, Troy Anderson and Zahirul Haque Khan.

Think of the whole of existence, of which you are the tiniest part,

think of the whole of time, in which you have been assigned a brief and fleeting moment,

think of destiny – what fraction of that are you?

Marcus Aurelius: Meditations (book V, paragraph 24)

Chapter 1: introduction

"Rahman dreamed of the reclamation of kilometers of fertile land from the sea. He dreamed that the Ganges Delta would be never be struck by those terrible floods. That Bangladesh' golden people would forever be safe behind high dikes. Dikes, delta, land reclamation from sea: the Netherlands! It was a dream with a logical consequence. Only one country in the world was able to help Rahman with his vision: the Netherlands!"

Sheikh Mujibur Rahman, 1973. First president of Bangladesh

F. Springer: Bougainville (1987; pp. 63)

1.1 General introduction

The past decades, numerous projects have been implemented in Bangladesh aiming to mitigate the devastating floods that occur regularly in the country. These technocratic interventions, often sponsored by international donors like the Asian Development Bank and the World Bank, have had a profound impact on much of the country's environments. As Bangladesh's first president, Mujibur Rahman, mentioned in 1973, many consider(ed) the solutions to the country's problems as "engineering" problems. However, many interventions have had unforeseen effects on the natural environment, creating additional problems and uncovering the complexity of *managing water in Bangladesh*.

This thesis is about water management in Bangladesh. It is about the complexity of the ever-changing relationship between humans and their (natural) environment. It is about the confidence in technocratic solutions to so-called natural problems. It is about the failure of this confidence to result in solutions that are socially and environmentally viable, and about the necessity to think *with* instead of against the forces and spatial and historical scales of nature. It is about the neccesity to approach these immense forces with resignation and uncertainty.

The subject of this thesis is the emerging water management practice "Tidal River Management". In a nutshell, "TRM" or "Tidal River Management" is the name given to temporary depoldering in tidal rivers (rivers that do not receive upstream flow and are therefore under heavy influence of the tides), in order to prevent water logging caused by riverbed sedimentation.

By analyzing the historical and geomorphological context of "Tidal River Management" and by approaching the term as a boundary concept, this thesis aims to understand how and why stakeholders frame or perceive the concept of "Tidal River Management" in a particular way. Throughout this thesis, the question remains to what "Tidal River Management" entails. Though I will not attempt to define "Tidal River Management", I will describe it as complete as possible in a later stage.

This thesis has six chapters. Chapter 1 introduces the study area, states the research objective, provides a conceptual framework and presents the research questions and methodology. In chapter 2 the era preceding "Tidal River Management" is discussed. This is an essential part, as it sketches the historical and spatial context of the research area. Chapter 3 deals with the emergence of Tidal River Management: when, why and how did the term emerge? In a short interlude before chapter 4, a look will be taken at "Tidal River Management" in the Netherlands and Belgium. Chapter 4 lays out the results of a Rapid Water Management Appraisal (RWMA) of the study area, after which chapter 5 discusses the different perceptions of the term Tidal River Management among stakeholders. Accordingly, findings are discussed and concluded in chapter 6.

1.2.1 Daily life and politics in Bangladesh

The first thing that strikes one when arriving in Bangladesh are the sheer numbers of people. There are people everywhere and always, and everybody seems to be working on something, going somewhere or chatting with his (yes, male) neighbor about daily political affairs.

With a population of over 160 million on a surface area approximately 4 times that of the Netherlands (population 16.7 million), Bangladesh has a very high population density (1126 per square kilometer in 2009; UNdata, 2012). Bangladesh is one of the poorest countries of the world, with a GDP per capita of 549 US$ per annum in 2009 (UNdata, 2012). The high population density, the striking poverty and the natural environment makes life for many people harsh.

However, Bangladesh' economy is developing steadily over the past years. Based on life expectancy, "experienced wellbeing" and ecological footprint, Bangladesh is even proclaimed to be the 5th happiest country in the world (Happy Planet Index, 2012)!

Figure 1.1. Map of Bangladesh showing her 9 divisions

Source: ephotopix.com/image/asia/bangladesh_division_map.gif

Bangladesh is a religiously, culturally and linguistically diverse country[1]. The majority of the population is Muslim, after many Hindus left the country when it separated from India in 1948. Approximately 88% of the population in Bangladesh is Muslim, 11% is Hindu and the remaining 1% is Buddhist, Christian or animist (Discover Bangladesh, 2013). There are countless ethnic groups in Bangladesh, including the Munda (Perucca, 2010) and the Rohingya, who originate from Burma and can be found in the area around Chittagong (Refugees International, 2013). The predominant language of Bangladesh is Bengali, which is also spoken by Hindus in West-Bengal (India). There are numerous other languages spoken (UNESCO, 2010).

In 1947, predominantly Islamic East and West Pakistan (current Pakistan and Bangladesh), separated from primarily Hindu India. The distance between the two countries, and the marginalization of East Pakistan lead to Bangladesh' secession from West Pakistan in 1971, after a violent war in which Bangladesh was supported militarily by India (CIA World Factbook, 2012).

Bangladesh is subdivided into Divisions, Districts, Upazilas, Unions and villages (figure 1.1), with a central parliament in the country's capital Dhaka. The seven divisions of the country are Dhaka, Chittagong, Barisal, Khulna, Rajshahi, Rangpur and Sylhet. Divisions are subdivided into districts, which are subdivided into Upazilas and unions (Government of Bangladesh, 2012). Several villages compose a union, the head of a union is called a "up. chairman"[2], who should not be confused with a *Upazila* chairman.

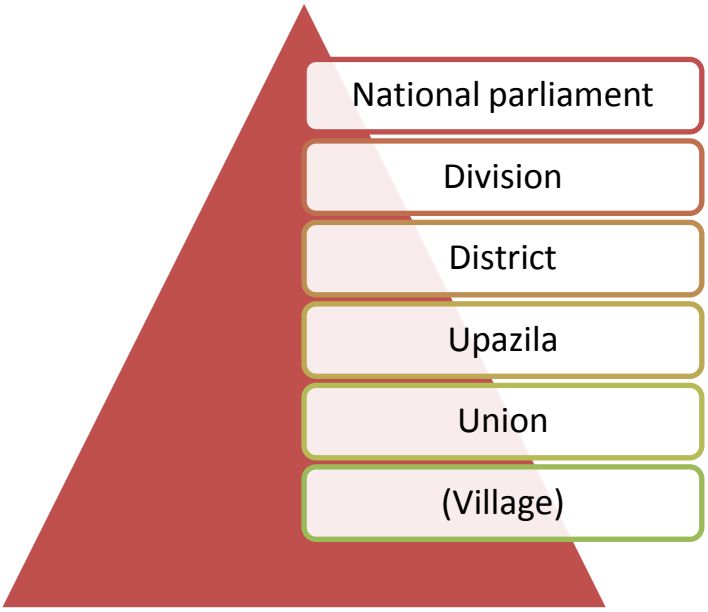


Figure 1.2. The structure of government in Bangladesh

Source: own design

[1] Not compared to India, but it still is ☺.
[2] Which stands for "union parishad"

Figure 1.3. An example of a peaceful protest during Hartal – it is often extremely violent

Source: www.thedailystar.net/photo/2010/06/04/2010-06-04__pcp02.jpg

The current political atmosphere in Bangladesh is tense. Elections are expected to be held in 2014, but the current government (the Bangladesh Awami League) and the main opposition party (the Bangladesh National Party) are in a continuous state of distrust. At the time of writing, the conservative Islamic party Jamaat-e-Islami demonstrates daily against the trial of some of its old members, who were allegedly responsible for war crimes during the war of independence (Al Jazeera, 2013). National strikes or Hartals (figure 1.3) are often declared by political parties, which paralyze the entire country (for example: BDnews24.com, 2012).

1.2.2 Water in Bangladesh and Tidal River Management (TRM)

Bangladesh is part of the world's largest delta. Besides people and politics (as described above), water can be regarded as a defining element of everyday life. The Meghna, Brahmaputra and Ganges rivers end up in the Bay of Bengal after joining in Bangladesh (figure 1.4).

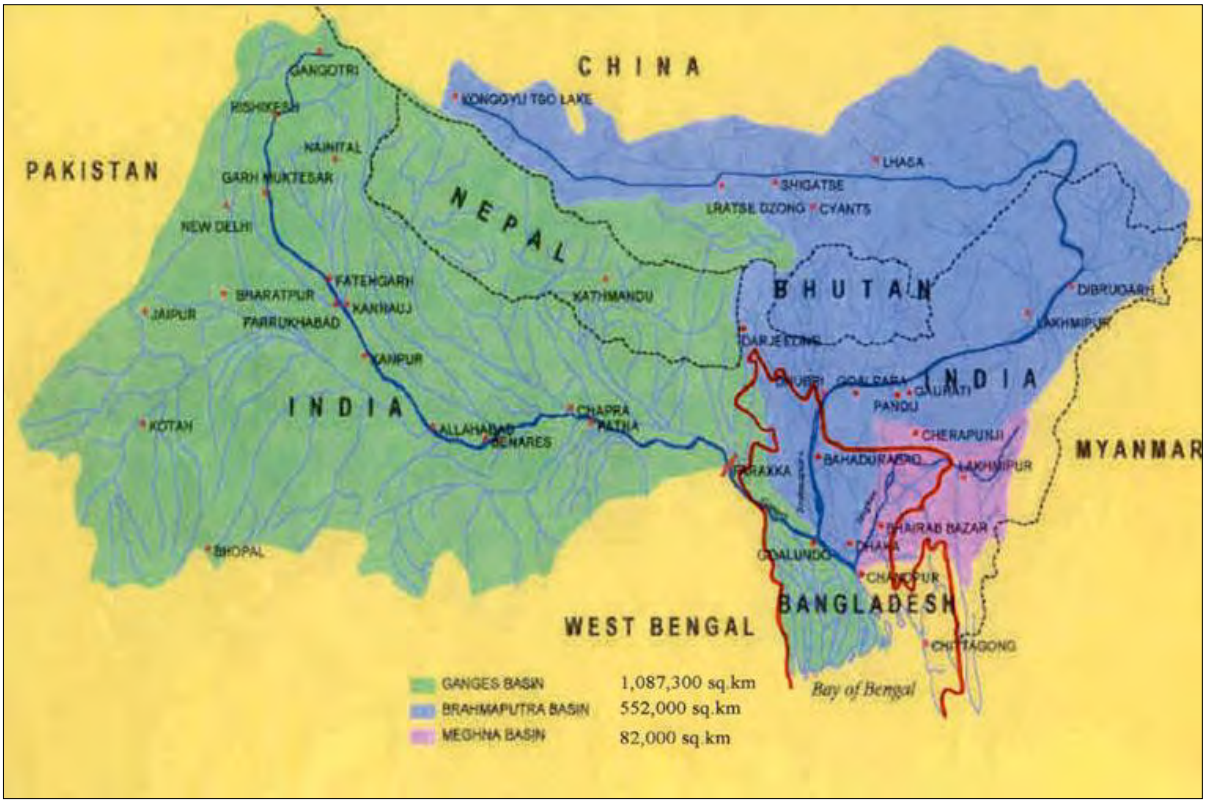


Figure 1.4. The catchments of the Ganges (green), Brahmaputra (blue) and Megna (pink)

Source: www.jrcb.gov.bd/image/Basin_map.jpg

Following severe floods in 1954, just 6 years after the country's independence from India, the United Nations Krug Mission led to the establishment of the East Pakistan Water and Power Development Authority (EPWAPDA) in 1959. After Bangladesh became independent from (contemporary) Pakistan in 1971, water and energy was dealt with separately which led to the creation of the present-day Bangladesh Water Development Board[3] (Hussain et al., 2004).

Under the Coastal Embankment Project (CEP), which started in the late 1950s and continued until the early 1980s, the USAID and the BWDB constructed polders in Bangladesh's south-west delta in order to decrease saline intrusion in the flood plains and to increase agricultural production (Dilib interview; Jenkins interview, 2012). Initially, the latter was achieved, as 3 harvests per year were possible instead of 1 (ibid, 2012). However, in the late 1980s, the south-west delta started to experience severe problems related to drainage congestion and water logging; agricultural production went down and some areas became permanently waterlogged, which led to increased poverty (ADB, 2007). Part of the cause of this rapid sedimentation is the lack of upsteam flow that flushes out sediment from these rivers.

[3] Strangely, people still call this organization *WAPDA*, even 40 years after the disintegration of the EPWAPDA and the establishment of the BWDB.

The construction of embankments decreased the tidal prism (the volume of water entering the river during high and low tide), and thereby the flow velocity of the water in these tidal rivers in the southwest delta. Consequently, sediment started settling down in rivers that were essential for draining the polders made under the CEP. Drainage congestion and water logging was detrimental for agricultural production and the local economy (Rahman, 1995; pp. 4). Chapter 2 describes the above process.

From 1994 to 2004, the Khulna Jessore Drainage Rehabilitation Project was implemented with financial support of the Asian Development Bank (ADB, 2007; Jenkins interview, 2012), aiming to decrease drainage congestion in the area to allow for agricultural production. Initially, the project proposed to close off the entire area of tidal influence by constructing a huge barrier in the Gengrail river. However, this was considered too risky as social and environmental consequences of this intervention could not be overseen (Jenkins interview, 2012).

During the course of the KJDRP, local inhabitants of Beel Bhaina cut an embankment in their polder which created a "tidal basin" (Jenkins interview, 2012). A Beel is "a low-lying depression in the floodplain that generally contains water throughout the year" (Wester and Bron, 1997). Upon return to the sea during low tide, the water stored in these tidal basins pushed its way through the narrow rivers with increased flow velocity[4], which caused erosion of the riverbed and increased the size of the rivers.

The process of temporarily inundating Beels in order to prevent drainage congestion is now often referred to as "*Tidal River Management"* or "TRM". Part of the objective of this thesis is to understand how and why different stakeholders frame the concept "Tidal River Management".

1.3.1 Relevance of this study

The Hari-Mukteswari river is not the only river that is heavily impacted by sedimentation of its riverbed. Numerous rivers in (the southwest delta of) Bangladesh suffer from the same problems as the river under study. Accordingly, hundreds of thousands of people are impacted by the sedimentation of these rivers, and are exposed to the problems drainage congestion creates. In this regard, one of this research' underlying aims is to understand what physical, social and political challenges lie ahead for the sustainable implementation of "Tidal River Management", not only in the Hari-Mukteswari river.

A strong underlying rationale to perform this research is its potential to contribute to creating a (more) sustainable relationship between the river and its users in the southwest delta. My personal idea of what "development" should be, is the creation of opportunity for people to decide

[4] As Q = V A, discharge = velocity x area

for themselves how to shape their (economic) lives. As we will see, past interventions altered the natural system in the southwest delta, which has caused people to be currently faced with worsening drainage. If one regards the high precipitation in Bangladesh, one also realizes how vital drainage is. Hopefully, the findings of this research contribute to putting the issue of (riverbed) sedimentation and its consequences in the southwest delta higher on the political agenda.

This research contributes to the WOTRO research project "Communities and institutions for flood resilience: enhancing knowledge and capacity to manage flood risk in the Bangladeshi and Dutch Deltas", led by Dr. Flip Wester (Wageningen Univesity / ICIMOD). This 5-year research project aims to compare the Dutch and Bangladeshi deltas, and see whether mutual lessons can be learned to increase flood resilience. This thesis can be regarded as an exploration of the research area and of water experts in Bangladesh, contributing in particular to the PhD thesis of Arjen Zegwaard and Mahmuda Mutahara.

As riverbed sedimentation does not only cause problems in Bangladesh, solutions that are implemented in the southwest delta in Bangladesh, might be advantageous in other deltas as well. The fourth reason to conduct this research is to see whether and how other deltas can learn from solutions implemented in Bangladesh. The text box between chapter 3 and 4 will shortly deal with *Tidal River Management* in the Netherlands and Belgium.

The fifth reason why this research focuses on Tidal River Management is because of the practice's potential to be an adaptive strategy for climate change[5]. Additionally, river management will be an important part of the Bangladesh Delta Plan that is currently being drafted. Findings of this research might contribute to this section of the plan (Planning commission et al., 2012).

1.3.2 Main objective of this research

"Tidal River Management"[6] is a new concept in water management in Bangladesh. One could also state that it is a new *water management practice*. Not much is known about its physical, social and political aspects, and what events and processes led up to the practice's emergence. It is the main objective of this research to find what physical and socio-political processes have led to the emergence of "Tidal River Management", and how the concept is perceived by stakeholders of the former KJDRP area. By regarding "Tidal River Management" as a boundary concept and analyzing it over different spatial and temporal scales, this thesis aims to understand whether and/or why different stakeholders *frame* the term differently.

[5] The outcomes from this study have been presented as part of Saskia Keesstra's and Catharien Terwisscha's course "Climate Change Adaptation in Developing Countries" in January 2013.
[6] As in the construction of tidal basins.

This yields the following main research objective:

To understand the role and perceptions of the emerging water management practice "Tidal River Management" in the former Khulna-Jessore Drainage Rehabilitation Project area by analyzing it using different spatial and temporal scales and by approaching the term as a boundary concept.

1.4.1 Conceptual framework

Water management can be regarded as a cross-disciplinary field of study (Bolding, 2012). Especially at the Water Resources Management Group at Wageningen University[7], the complexity of studying water (resources) management is stressed thoroughly. The purpose of this section is to shape a conceptual framework; a set of glasses to look at the study area and subject.

By scaling the concept "Tidal River Management" over time and space, I attempt to understand better how the study area has developed up to today. By approaching the concept "Tidal River Management" as a boundary concept, I acknowledge that the meaning of the term to a given stakeholders is determined by his/her disciplinary background and relation/interest to the term. Additionally, I try to understand different perceptions of "Tidal River Management" among stakeholders by means of their spatial and temporal relation to the concept.

1.4.2 Scaling "Tidal River Management"

In this research, I use Gibson's (2000) definition of *scale.* I specifically emphasize on its first two elements (space and time):

> *"A scale is the spatial, temporal, quantitative, or analytical dimension(s) used to measure and study any phenomenon."*
> (Source: Gibson, 2000; pp. 218)

The importance of scaling is emphasized by Cash (2006), who mentions that not carefully regarding scales in natural resource management can lead to misunderstanding of phenomena and the formulation of unfit solutions[8]. Additionally, Gibson and Olstrom (2000) emphasize that it is

[7] The former Irrigation and Water Engineering Group.
[8] Cash describes these flaws as challenges: 1) a **mismatch** between the chosen natural and human scale, 2) the **ignorance** of an entire scale (i.e. a timezone), or 3) the assumption that there is a single scale to understand a phenomenon best with. Cash calls this last challenge **plurality**.

especially in interdisciplinary[9] environmental science that issues of scaling are essential to successful research.

As the KJDRP area is physically part of an active delta, which has developed over millions of years, the current dynamic state of the system needs to be seen as the product of past (anthro-) (geo-) morphological and climatic processes. Similarly, today's events shape tomorrow's reality[10].

I regard "TRM" as a "boundary concept" to help understand how stakeholders perceive "TRM" in a particular way and why.

1.4.3 "Tidal River Management" as a boundary concept

By approaching the term "Tidal River Management" as a *boundary concept,* I try to understand the different dimensions or frames of the water management practice:

> *"Boundary concepts are words that operate as concepts in different disciplines or perspectives, refer to the same object, phenomenon, process or quality of these, but carry (sometimes very) different meanings in those different disciplines or perspectives. In other words, they are different abstractions from the same 'thing'"*
>
> (Source: Mollinga, 2008; pp. 24)

As described by Mollinga (2008) above, a boundary concept is perceived depending on the "relation" and interests that a stakeholder has with the concept or term under study[11]. For example, "Tidal River Management" means the transport of sediment for a river morphologist, whereas it means a great challenge for a sociologist working with people who have to abandon their land. A paddy farmer in a prospective tidal basin perceives the term as a mere catastrophe for his livelihood, whereas his neighbour - a fishermen – might celebrate the inundation of the polder. In contrast, some engineers within the BWDB simply want to construct regulators to manage the tidal river (see chapter 5).

---

[9] Although simplifying, I regard multidisciplinarity, interdisciplinarity and crossdisciplinarity as similar terms in this thesis, while acknowledging the importance of complexity in the interactions between human and natural systems (Dewulf et al., 2007; pp. 1)

[10] Throughout this thesis, dynamic spatial and temporal scales are applied. Please see 1.7.2 for an overview of time and space in this research.

[11] In literature, the word "boundary" is often used but hard to define. The term "boundary object" is introduced by Star and Griesemer (1989) and Mollinga introduce the term "boundary concept" in 2008. More recently, Warner (2010) pledges for "boundary spanning" as a process "to reduce uncertainty and deal with complexity in the organisational environment" (Warner, 2010; pp. 137). Boezeman (2012) applied the term "boundary organization" to the Dutch Delta committee, reflecting the boundary spanning nature of the committee.

By understanding "Tidal River Management" as a boundary concept, it is not possible to give *one definition* for the term, or to claim that the term reflects one true fixed reality[12]. One can merely describe it the best he/she can, according to his/her (disciplinary) background or, in this research, according to the relation a stakeholder has with the practice[13]. Additionally, the *perception* that a stakeholder has cannot be labelled as being *correct* or *false*. Instead, ones perception can only be described as being more or less "complete" than others[14], depending on the *boundaries* that define someone's (or a group/society's) perception[15].

In this thesis, I try to understand the perceptions of stakeholders according to their spatial and temporal boundaries that characterize their relation with the term "Tidal River Management".

1.4.4 Framing "Tidal River Management"

I believe that each persons' perception of "reality" is more than the sum of the accumulation of experiences and sensory input[16]. As these are different for every individual, everybody has their own unique perception of the outside world or what is objectively called reality. Additionally – although it is, in my opinion, our obligation to strive for it – it is impossible to "enter the mind of the speaker"; to completely understand how and why a person perceives, understands and explains reality[17].

Framing is the process of identifying different frames or perceptions of reality. In sociology and media studies, numerous definitions can be found of the concept "frames". For this research, I choose to adhere to the definition of Gitlin (1980), because it stresses the importance of *selection, emphasis and presentation* of aspects of reality with which a person explains it, which is also what characterizes the frames I identify in the field (chapter 5):

> *"Frames are principles of selection, emphasis and presentation composed of little tacit theories about what exists, what happens, and what matters."*
>
> (Source: Gitlin, 1980; pp. 6)

[12] A boundary concept fundamentally does not have set boundaries; they are defined by the relation of the person to the object or phenomenon.
[13] That is why I use quotation marks every time I use the term "Tidal River Management" in this thesis.
[14] although the term "complete" suggests that a full understanding of the concept of the phenomenon actually exists, whereas it does not. However, approaching the concept with dynamic spatial and temporal boundaries helps to acquire a more complete picture of the concept
[15] Ultimately, *all boundaries are conventions* that are (sub)consciously determined by an individual or a group.
[16] With sensory input I mean that what we have seen, heard and felt about the outside world.
[17] I owe this realization to conversations I had about the philosopher Emmanuel Lévinas on "the other", originating from Lévinas' work *Time and the Other* (1990).

By approaching "Tidal River Management" as a boundary concept, one thus acknowledges the inherent (social) construction of the reality. In other words, what different frames of "Tidal River Management" exist?

According to Dewulf, a frame can "add meaning to a previously confusing or less meaningful domain" (Dewulf, 2007; pp. 2) and "when people from different backgrounds work together, they tend to frame the issues at hand in very different ways by defining differently 'what this is all about'" (Dewulf, 2007; pp. 2). How a concept is framed is thus dependent on the boundaries that define an individual or (group of) stakeholder(s') relation to the concept under study; ones accumulated experience or knowledge pertaining to the concept.

The importance of framing is stressed by Schön and Rein (1994), who argue that "fragmentation of frames can form a barrier for mutual understanding and can evolve into protracted controversies about 'what the issue is really about', delaying or impeding effective decision making". In the study area, a difference (fragmentation) in perception of the concept "Tidal River Management" can form a barrier of understanding among stakeholders and fuels political and even violent conflict: *what is "Tidal River Management" really about?*

By approaching "Tidal River Management" as a boundary concept, I try to map and understand the different frames of the term not primarily across disciplines, but rather between different stakeholders. Thus, whereas Mollinga and Dewulf mention that the different perceptions of a term are mostly determined by *disciplinary* variation, I regard this variety as a consequence of scattered *spatial* and *temporal* relations of stakeholders with the water management practice "Tidal River Management"[18].

A stakeholder's spatial relation (the "where" question) with "Tidal River Management" is the extent of his/her knowledge on the emergence and physical aspects of "Tidal River Management" from a geographical point of view: *What does a stakeholder know about the down- and upstream effect of tidal basins on the Hari river? What does a stakeholder know about the relation between catchment-level (geo)morphological processes and the study area? What does a stakeholder know about the effects of "Tidal River Management" on the wider river context?*

A stakeholder's temporal relation (the "when" question) with "Tidal River Management" I regard the extent to which a stakeholder knows about the historical physical and political processes that have lead to the present situation: *What does a stakeholder know about processes that have led to the cutting of the embankment of Beel Bhaina in 1997? What does a stakeholders know about this first and earlier tidal basins in Beel Bhaina and Beel Dakatia, respectively?.*

[18] Although these relations are not sufficient to understand all the ways in which "Tidal River Management" is found framed. See chapter 5.

In order to understand how “Tidal River Management” emerged, I will look at the practice and its history from different spatial and temporal scales: I commence with describing the historical (geo)morphology of the Ganges-Brahmaputra-Meghna basin and gradually zoom in on the present condition of the KJDRP area. This background is essential to understand why and how stakeholders frame the concept “Tidal River Management”.

1.4.5 Boundaries in time and space

It follows from this conceptual framework that several key concepts shape the way with which this research aims to approach the concept “Tidal River Management”. By using dynamic spatial and temporal scales, the concept and context of “Tidal River Management” becomes more clear in a predominantly physical, but also in a socio-political sense. “Tidal River Management” is regarded as a boundary concept, which emphasizes the necessity of *framing*. Framing is essential to understand stakeholders’ perception of “Tidal River Management” and its context, and contributes to explaining why and how conflicts (of interest) between stakeholders evolve.

Spatial and temporal boundaries are used in this thesis (1) to understand the (mainly physical) geographical and historical context of the emergence of “Tidal River Management”; (2) to explain how and why stakeholders in the KJDRP area perceive the concept differently; and (3) to understand the implications of the existence of multiple frames of the concept “Tidal River Management” on the overall management of tidal rivers, in this case the Hari-Mukteswari river in the KJDRP area.

1.5.1 Problem statement

Water management in the southwest delta of Bangladesh has taken a considerable shift when, in the 1950s, the Coastal Embankment Project was implemented. Problems that the area faces today include but are not limited to sedimentation of rivers and its consequences, believed to be at least partially caused by these interventions. However, the Hari-Mukteswari river is strongly affected by the Bangladeshi delta at large and both have evolved over millions of years. The emerging water management practice “Tidal River Management” could therefore be regarded as a consequence of the river’s spatial and historical context. This brings us to the core problem this research addresses:

> *It is not known how and why the water management practice “Tidal River Management” has emerged in the Khulna-Jessore Drainage Rehabilitation Project area, how stakeholders perceive the concept, and why.*

1.5.2 Research questions

The central research question that will be answered in this thesis is the following:

> *How can the emerging water management practice "Tidal River Management" be understood using dynamic spatial and temporal scales, and how can approaching the term as a boundary concept help explain how and why stakeholders frame the concept differently?*

Subquestion 1: How did the study area evolve to its present state over time and space?
(chapter 2)

Subquestion 2: How did the water management practice "TRM" emerge in the study area?
(chapter 3)

Subquestion 3: What are current water management practices in the study area?
(chapter 4)

Subquestion 4: How do different stakeholders frame the concept "TRM"?
(chapter 5)

Subquestion 5: How can these perceptions be explained by regarding "TRM" as a boundary concept with spatial and temporal variation?
(chapter 5 & 6)

1.6.1 Research design and methodology

Figures 1.5 and 1.6 are maps of the study area (the former KJDRP area). Two catchments compose the study area: 1) the Hari-Mukteswari catchment and 2) the Solmari catchment. The relatively large Beel Dakatia drains in the latter; many Beels belong to the Hari-Mukteswari catchment. A Rapid Water Management Appraisal (RWMA) has been performed in this area, and participatory maps have been drawn with the help of local stakeholders (these maps are presented in chapter 4). Additionally, over 100 documents have been collected which help understand the history of the study area and the interventions that took place[19]. In this section, the RWMA and participatory map drawing methodologies are introduced, and an outline of the remainder of this thesis is presented.

[19] Many documents have been digitalized; some are only available in hard-copy. Contact Arjen Zegwaard (arjen.zegwaard@wur.nl) for more information.

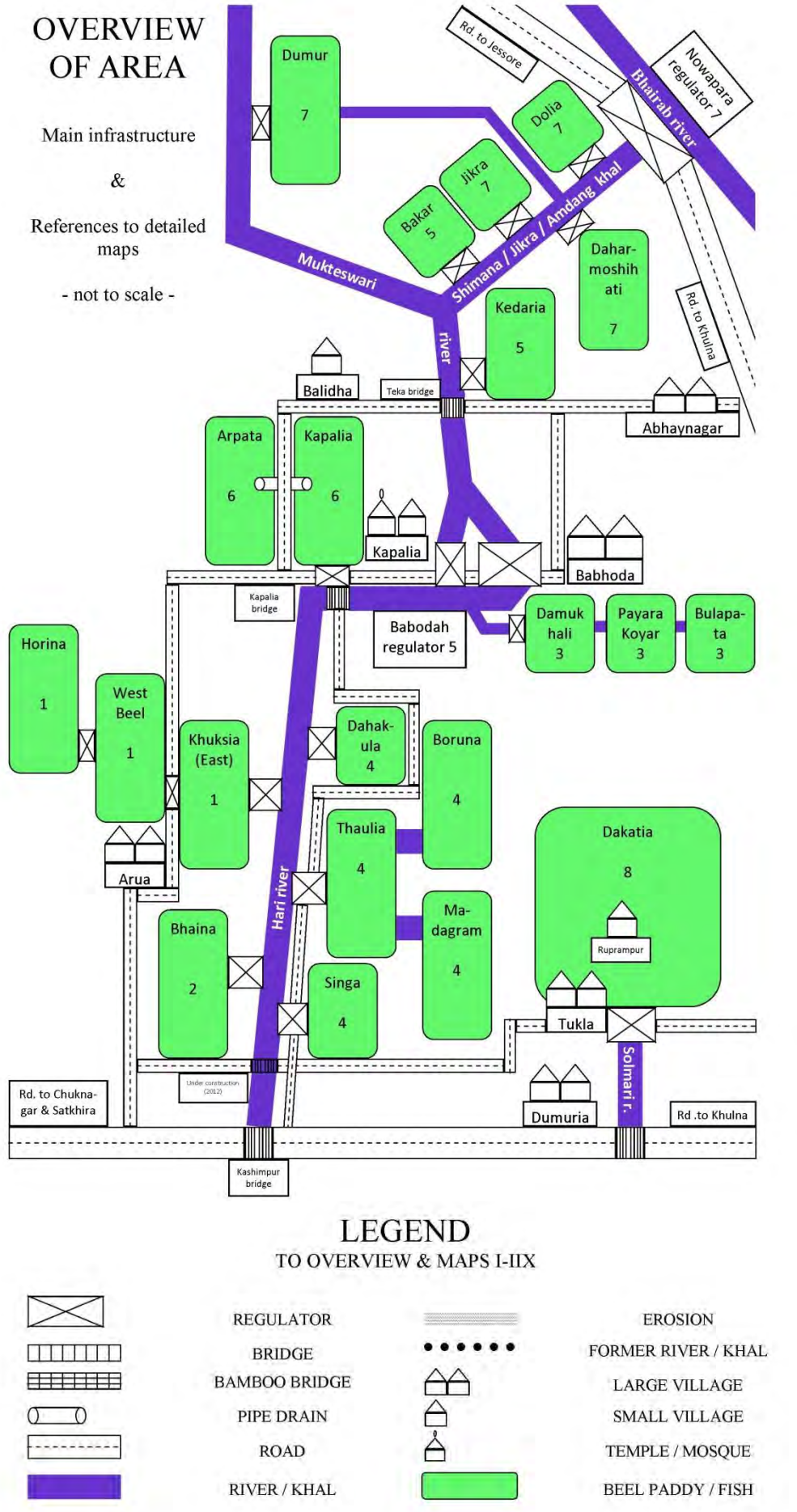


Figure 1.5. The Hari-Mukteswari and Solmari catchments: the main study areas in this research. Self-made map.

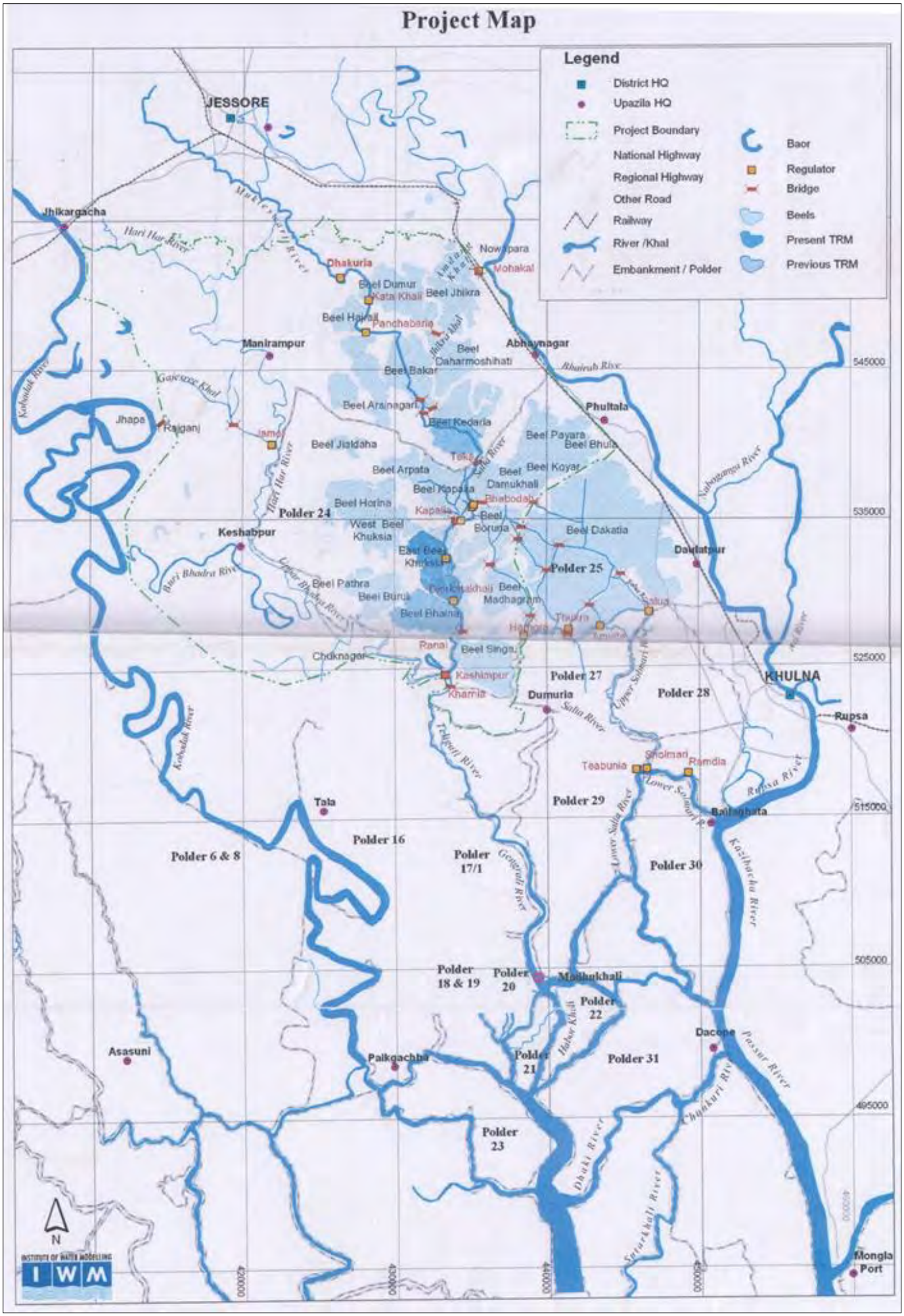


Figure 1.6. The Hari-Mukteswari and Solmari catchments: the main study areas in this research. Map of the Institute of Water Modelling, Dhaka, Bangladesh.

1.6.2 Conducting a Rapid Water Management Appraisal

The Rapid Water Management Appraisal (RWMA) methodology was developed by Wester and Bron (1996). The water management appraisal in this research is strongly inspired by this methodology, which was developed to answer the following questions:

1) Which water management practices and issues / conflicts exist in flood control and drainage (FCD) systems?
2) Which solutions or coping mechanisms have water management stakeholders devised to resolve or lessen these problems/conflicts/issues?
3) Which different forms of organisation (informal groups, committees, etc.) exist in FCD systems and how do they operate?
4) What is the perception of the inhabitants of FCD systems concerning the water management system in general and its management?
5) What is the opinion of BWDB staff concerning water management in FCD systems?

(Source: Wester & Bron, 1996; pp. 9)

In short, the goal of the RWMA is to gain – in a relatively short period of time – a basic understanding of the local reality in a water management system, including its practices, issues/problems and forms of governance *and* people's perception of this reality[20].

The RWMA conducted in this research is composed of 1) participatory map drawing and 2) participatory semi-structured interviews and 3) open interviews. Semi-structured interview locations were selected geographically. The persons with whom open interviews were conducted were selected with *snowball* sampling; each interviewee led to another person part of the knowledge network (Lach, 2005; pp. 3). In total, 42 semi-structured and 21 open interviews were conducted. See Annex I for an example of a semi-structured interview in the field. The question list is composed of two parts: part 1 (questions 1-8) to find the actual water management practices (presented in chapter 4), and part 2 (questions 9-19) to find how the stakeholder(s) frame the concept "Tidal River Management" (presented in chapter 5).

1.6.3 Participatory maps and interviews

As part of participatory rural appraisals and other participatory research methodologies, the use of participatory maps has been reviewed by Chambers (2007). Additionally, participatory

[20] Originally, it was designed to investigate the functioning of flood control and drainage systems in Bangladesh, but is adapted to suit the study of "Tidal River Management" in the KJDRP area.

mapping techniques using Geographic Information Systems (GIS) have been described by McKall and Minang (2007).

Twelve participatory maps have been produced together with local stakeholders in the Beels under study, which were all part of the former KJDRP area. The purpose of drawing these maps was to create a map of the physical reality of their Beel that helps understand the answers of the first part of the RWMA. Please see figure 1.7 for an example of a participatory map. All maps have been digitalized, an overview of which is presented in figure 1.5.

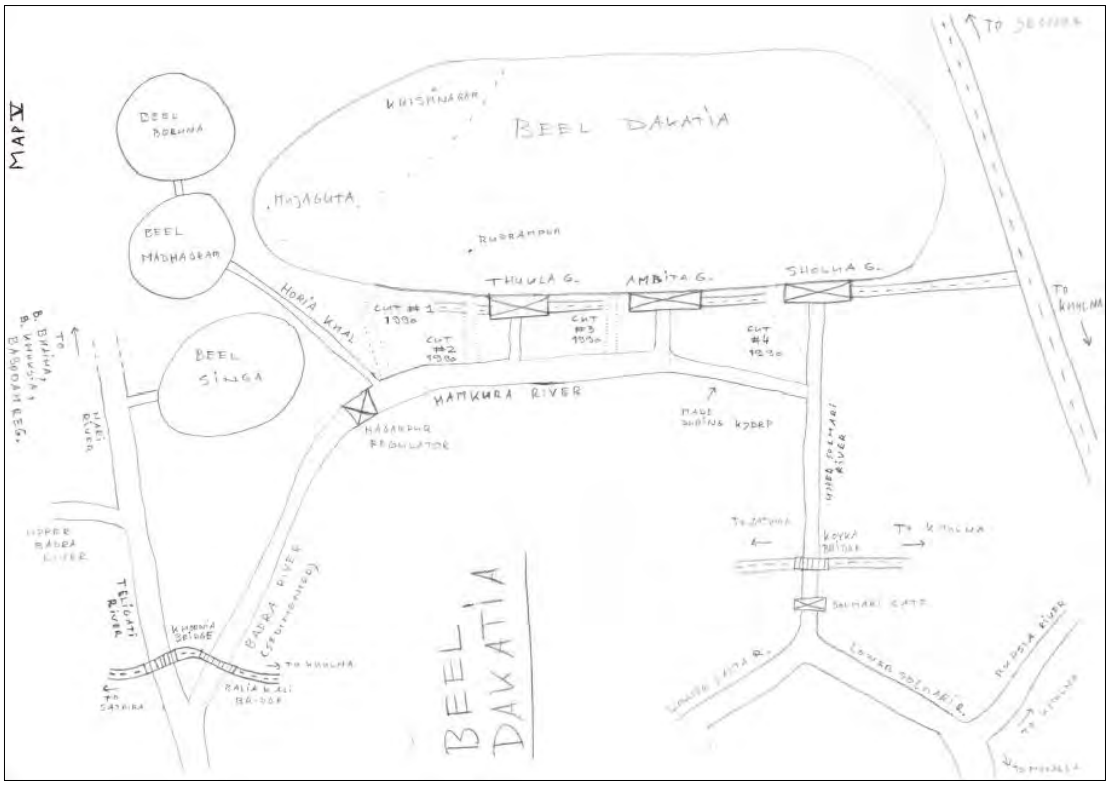


Figure 1.7. An example of a participatory map of Beel Dakatia

The participatory maps have been drawn and interviews conducted in tea stalls mainly, which are a very popular meeting place in Bangladesh. A benefit of using a tea stall as a meeting place and interview location is the presence of many people, which adds to the reliability of the data. However, under social pressure, some farmers might not express their critical opinion in this setting. Some interviews will therefore be conducted individually, for instance with women who are usually not welcome in tea stalls.

1.7 Thesis outline

The remainder of this thesis is composed of 5 chapters which are aligned with the five sub research questions. Every chapter has a different spatial boundary and temporal dimension, depending on the objective of the chapter. Chapter 2 provides accurate background information that is essential to understand the system of which the Hari-Mukteswari river is part of. Therefore, it takes a broad spatial boundary and temporal dimension. Chapter 3 discusses the emergence of "Tidal River Management" from 1997 onwards and is thereby bound to a much smaller hydrographical border and a shorter historical timescale. Accordingly, chapter 4 presents the results of a water management appraisal, which has the same spatial boundary, but reflects the "current" water management practices in the study area. Chapter 5 attempts to explain how and why people frame "Tidal River Management" differently. Last, chapter 6 discusses the results obtained, and attempts to conclude by answering the main research question. Please see figure 1.8 for a visual representation of this thesis' structure.

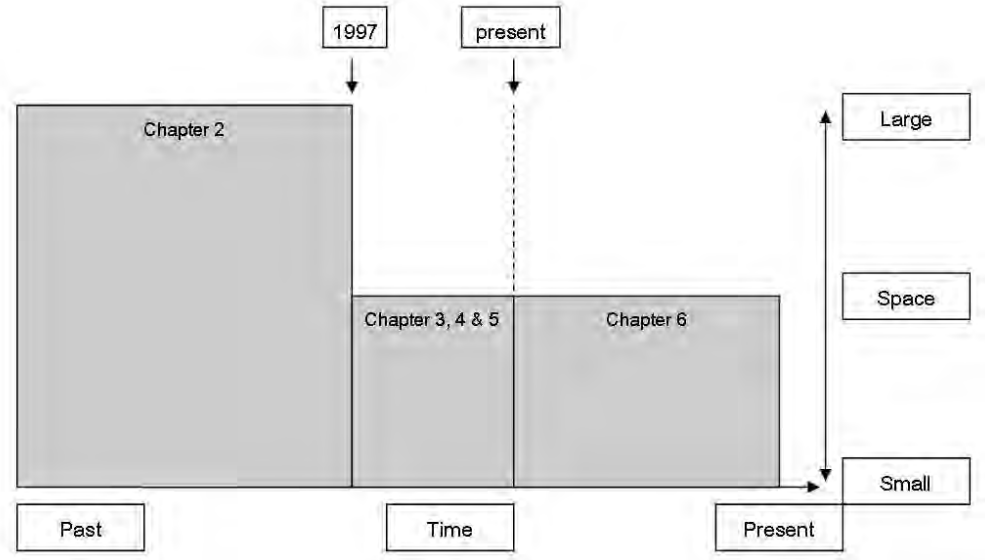


Figure 1.8. Time and space in this thesis.
Source: L. de Die

Chapter 2: the pre-Tidal River Management era

"Past. Present. Future. Everything is connected."

David Mitchell: Cloud Atlas (2004)

2.1 Introduction

This chapter will sketch a historical and spatial context of this research. It is essential to understand the processes that have shaped the present state of the southwest delta, as well as the rest of Bangladesh. The first section of this chapter will attempt to shortly sketch a geomorphological history of the Bengal delta with the aim of providing the reader a realization of the main factors that have shaped the delta of millennia. Second, the dying rivers in the southwest delta will be discussed, after which a leap in time is made to the first large-scale anthromorphologic intervention that commenced in the 1950s under the Coastal Embankment Project. Accordingly, the Flood Action Plan and the Khulna Jessore Drainage Rehabilitation Project are discussed. By this time, we have made a journey through the delta and history and have arrived to the present era and the first tidal basin in 1997 in Beel Bhaina (ADB, 2007; pp. 25). The last section of this chapter will reflect philosophically on the nature of the relationship between humans and their environment, with particular emphasis on Bangladesh. Chapter 3 will discuss the emergence of Tidal River Management in detail.

2.2 Bangladesh: a geographical introduction

Life in Bangladesh has been, is and will always be defined by the vast quantities of water and sediment that flow through the country. Eighty percent of the country is flat and is part of the Greater Bengal Plain, consisting of fertile alluvial deposits (Aquastat, 2010). Bangladesh is part of the delta of three of the largest rivers in the world (figure 1.4). Vast amounts of sediment are transported by the Ganges, Brahmaputra and Meghna rivers and settle down on flood plains or are transported to the Bay of Bengal. Thus, the sediment has two sources: 1) directly from the Himalayas (when rivers still receive upstream flow) or 2) from the Bay of Bengal (in the case of tidal rivers).

There are thousands of offtakes from and tributaries to these rivers. Peak discharges of the Brahmaputra, Ganges and Meghna are estimated around 100,000, 75,000 and 20,000 m^3 per second, respectively (Hughes et al., 1994; pp. 5), varying considerably throughout the seasons. Unlike the Netherlands, the land level in Bangladesh is not lower than the mean sea level (figure 2.1).

Hills can be found in the north and east of the country. Bangladesh' highest point is Keocradang in the Rangamati hill district, with an altitude of 1230 meter above sea level (Aquastat, 2010). One of the world's largest mangrove forests, the Sundarbans, is located in the southwest delta of the country (UNESCO, 2013).

Bangladesh has a tropical monsoon climate with 4 main seasons: the warm and cyclone-prone premonsoon (March-May), the rainy monsoon (June-September), the post-monsoon (October-

November) and the colder dry season (December-February). The temperature ranges from 4 degrees in winter to 43 degrees Celsius in summer (Aquastat, 2010). From the Bay of Bengal, cyclones and hurricanes can create massive infrastructural, ecological and agricultural damage (Hughes et al., 1994; pp. 6). A recent example of such a phenomenon is cyclone Sidr in 2007 (BBC, 2007).

Floods are fundamental to Bangladesh, and by definition not only destructive: floods are essential to land formation and loss in Bangladesh (Warner, 2010). In fact, the entire country is formed by the sediments from the Himalayas and the Bay of Bengal (Hughes et al, pp.1).

Floods create numerous *floodplain wetlands* throughout Bangladesh. Approximately 50% of the country can be labeled as a wetland[21]. The southwest Delta harbors many Beels (natural depressions, see text box page 29). Wetlands are essential to stabilize flood (peaks), as they can temporarily store water. Many wetlands in the northeast can be regarded to fulfill this function, as they absorb large quantities of pre-monsoonal floods. An additional function of floodplain wetlands is their capacity to recharge groundwater aquifers and support biodiversity (Hughes et al., 1994; pp. 15).

[21] if "rivers, permanent and seasonal lakes, agricultural areas, and beels and haors are included in this definition" (Hughes et al., pp. 14).

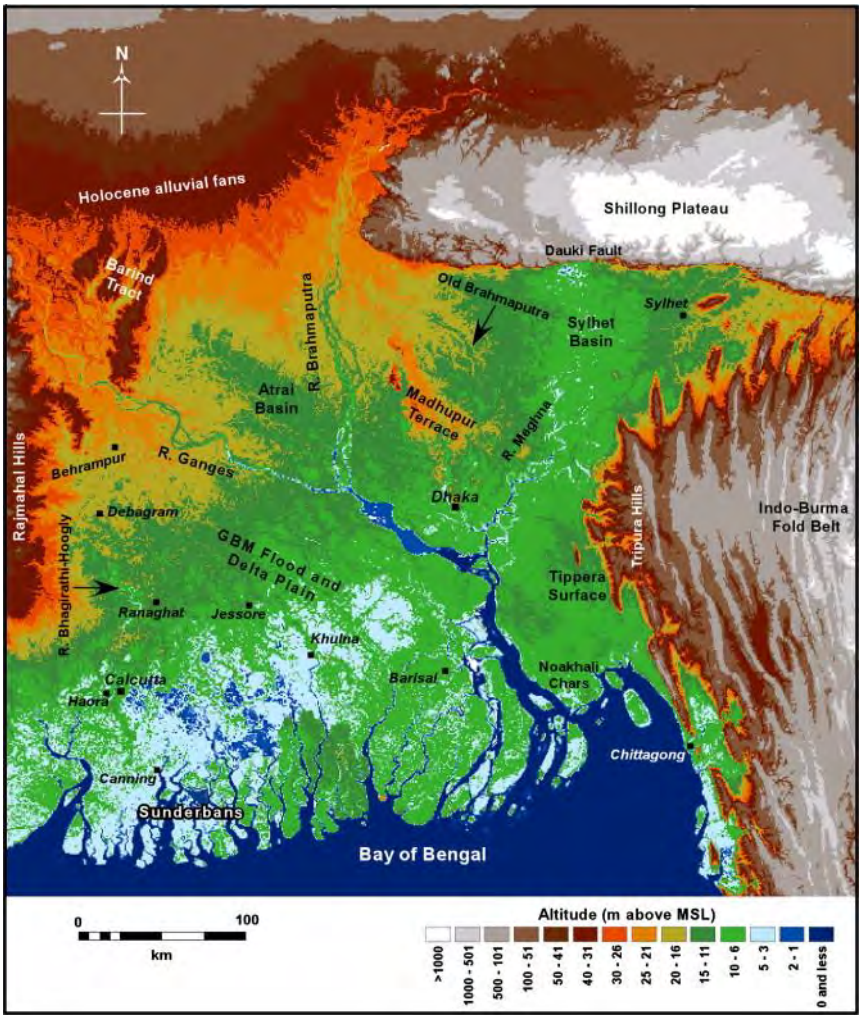


Figure 2.1. The altitude of Bangladesh in m above mean sea level

Source: Abhijit, M., Fryar, A.E., Thomas, W.A. (2009). Geologic, geomorphic and hydrologic framework of the Bengal basin, India and Bangladesh. Journal of Asian Earth Sciences, 34:3, pp. 227-244.

2.3 Delta dynamics over time and space

The Bengal delta has evolved over a period of millions of years. Gradually, the mouth of the Ganges has moved eastward towards Myanmar, due to tectonic (figure 2.2) and morphological (figure 2.3) processes (Jenkins interview, 2012; Abhijit, 2009; Goodbred, 2000). Morphological processes during the last 20,000 years have had a defining impact on the current physical reality in the delta. The rivers entering Bangladesh and the Bay of Bengal contains large amounts of sediment.

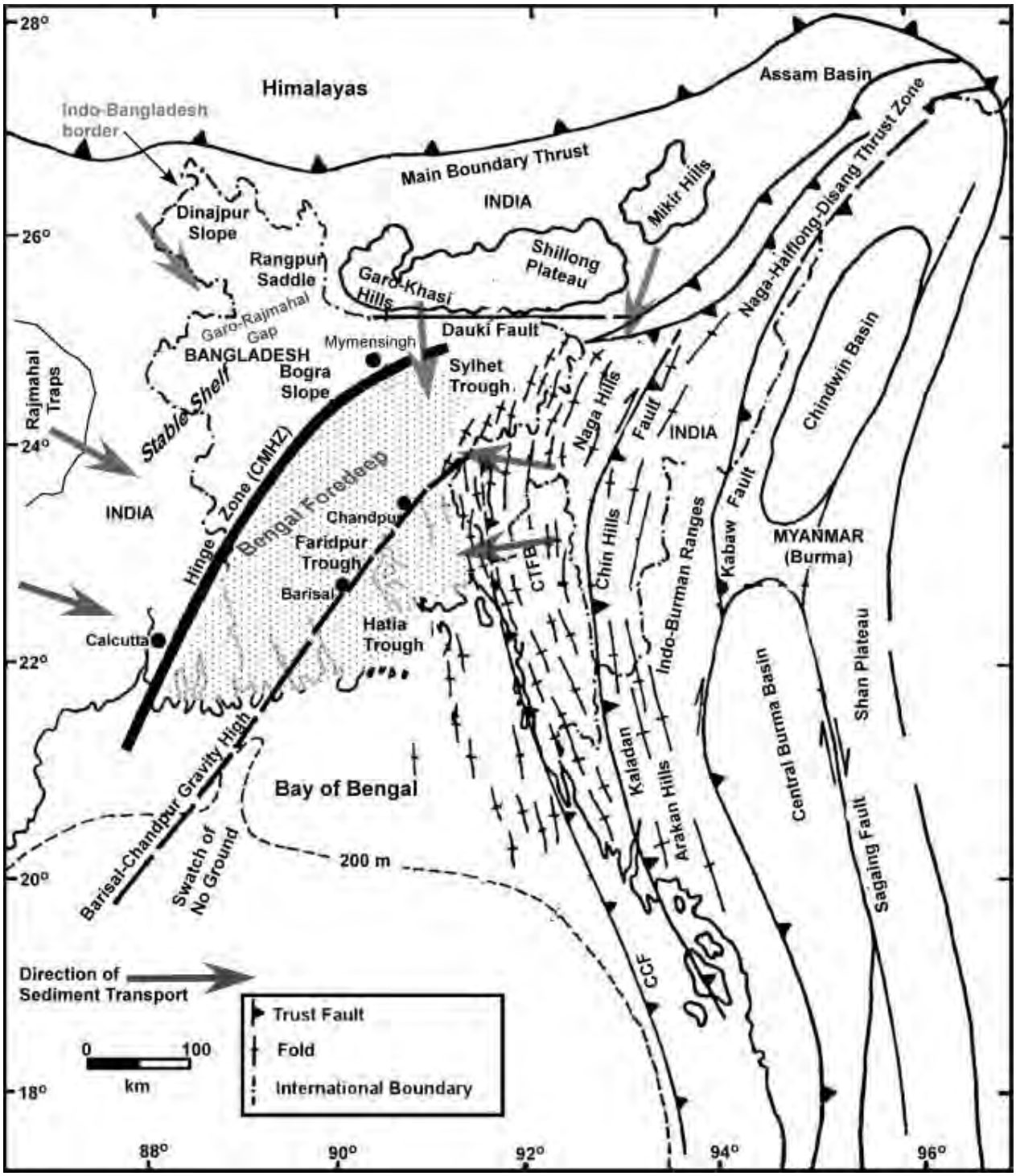


Figure 2.2 Tectonic activity in the Bengal delta, causing the entire mouth of the Ganges to move eastwards.

Source: Abhijit, M., Fryar, A.E., Thomas, W.A. (2009). Geologic, geomorphic and hydrologic framework of the Bengal basin, India and Bangladesh. Journal of Asian Earth Sciences, 34:3, pp. 227-244.

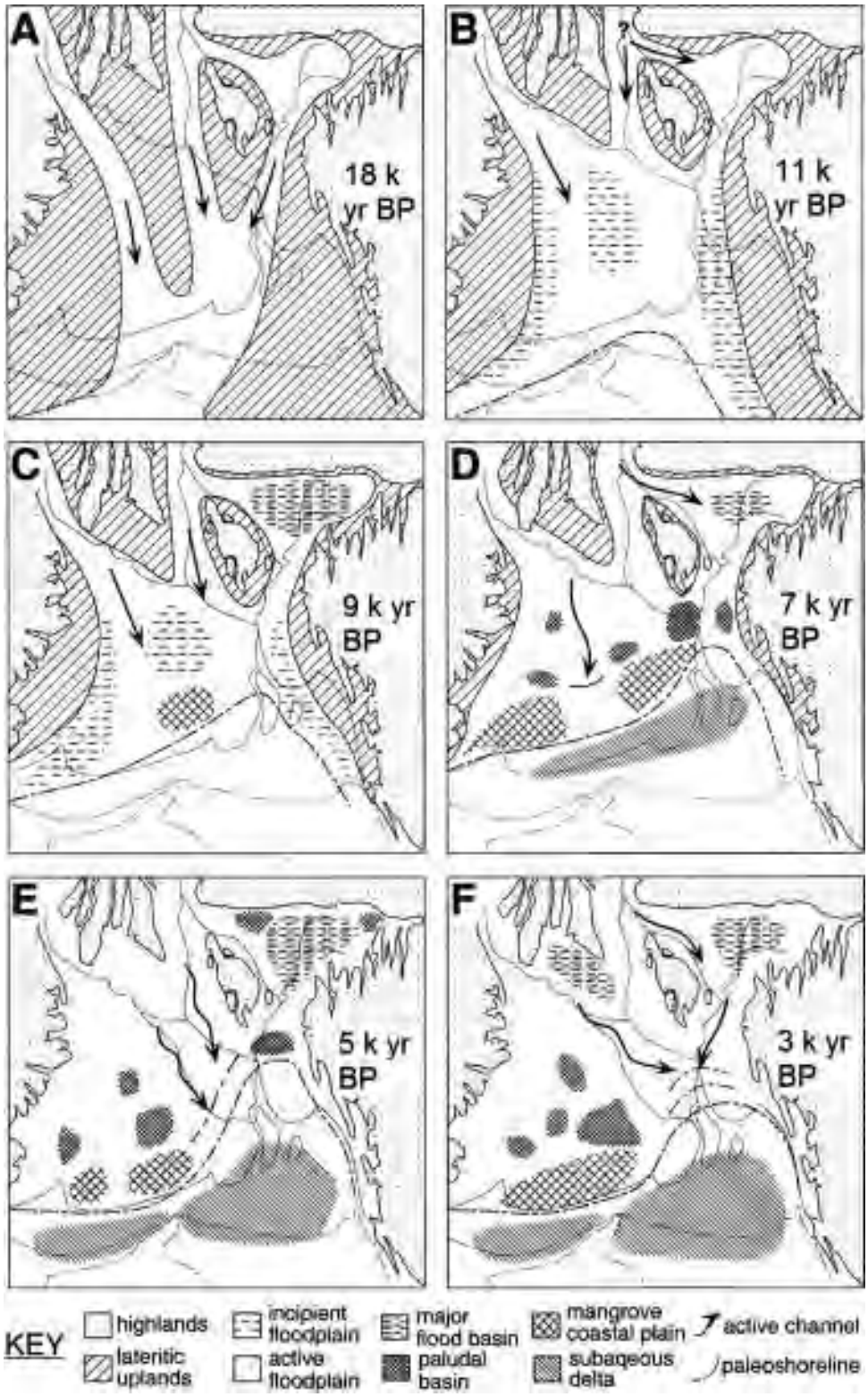


Figure 2.3. Stages of Holocene landform evolution of the Bengal basin.

Source: Goodbred Jr., S.L., Kuehl, S.A. (2000). The significance of large sediment supply, active tectonism, and eustasy on margin sequence development: Late Quaternary stratigraphy and evolution of the Ganges–Brahmaputra delta. Sedimentary Geology, 133:3-4, pp. 227-248.

The intertidal zone that evolved in the southwest of Bangladesh formed the perfect environment for mangrove forests to evolve. Mangrove forests need a very specific environment, characterized by strong tidal influence and an alternation of fresh and saline water. As will be presented in the next section, the eastward journey of the Ganges has profound consequences, which can explain the current state of the southwest delta in Bangladesh and the problems humans are faced with.

2.4 "Dying" rivers in the southwest delta

As the Ganges moves east, sediment deposition causes offtakes of rivers from the Ganges to the southwest delta to close; these rivers receive increasingly less upstream flow and, consequently, come under increasing tidal influence. See figure 2.4 for a map of the southwest delta. Without upstream flow that flushes out the dry-season sediment during the monsoon season, rivers quickly fill up with sediment. In these *tidal rivers*, floodplains developed which inundated twice daily by the high tide. As sediment build up continues, these rivers will disappear gradually.

Figure 2.4 shows the condition of many rivers in the southwest delta before the Coastal Embankment Project, which commenced in the 1950s. What can be noted is that the quantity of water flowing through the rivers during high and low tide is high; the volume available for the water to fill up (in the floodplains) is very large. In other words: the tidal prism of these rivers was very high, making the sedimentation process relatively slow.

Before the Coastal Embankment Project, sedimentation occurred mainly on the low-lying floodplains. As the water retreated through the river channel during ebb tide - causing relatively high flow velocity - sediment settled on the floodplains instead of the riverbed during dead tide. Because of the presence of the floodplains holding large quantities of water, rivers would drain a large quantity of water, which resulted in an low pace of overall sedimentation [22].

In this system, people constructed seasonal infrastructure (embankments) to be able to grow crops during the dry season. These "osthmeshe bundhs" or 8-month-embankments (BWDB, 2003) allowed for 1 harvest per year, usually rice, and allowed the floodplains to be under tidal influence the remainder of the year. During the period without these small embankments, the tidal prism was high which caused sedimentation of the rivers in the southwest delta to be very slow (see figure 2.5). Additionally, upstream flow was higher in the time before the Coastal Embankment Project, as the Farakka barrage was not yet constructed (see section 2.7).

[22] The higher the flow velocity of the river, the higher its capacity to hold sediment.

Figure 2.4. Map of the southwest delta.
The Farakka barrage (section 2.7) redirects water from the Ganges (light-blue) to the Hooghly river (green). The Gorgia river (red) is the most eastern river of the active southwest delta (blue). Note that the area between the active delta and the Hooghly river receives hardly any upstream flow, which increases tidal influence there.

Source: van Minnen, 2013

PRE - COASTAL EMBANKMENT PROJECT

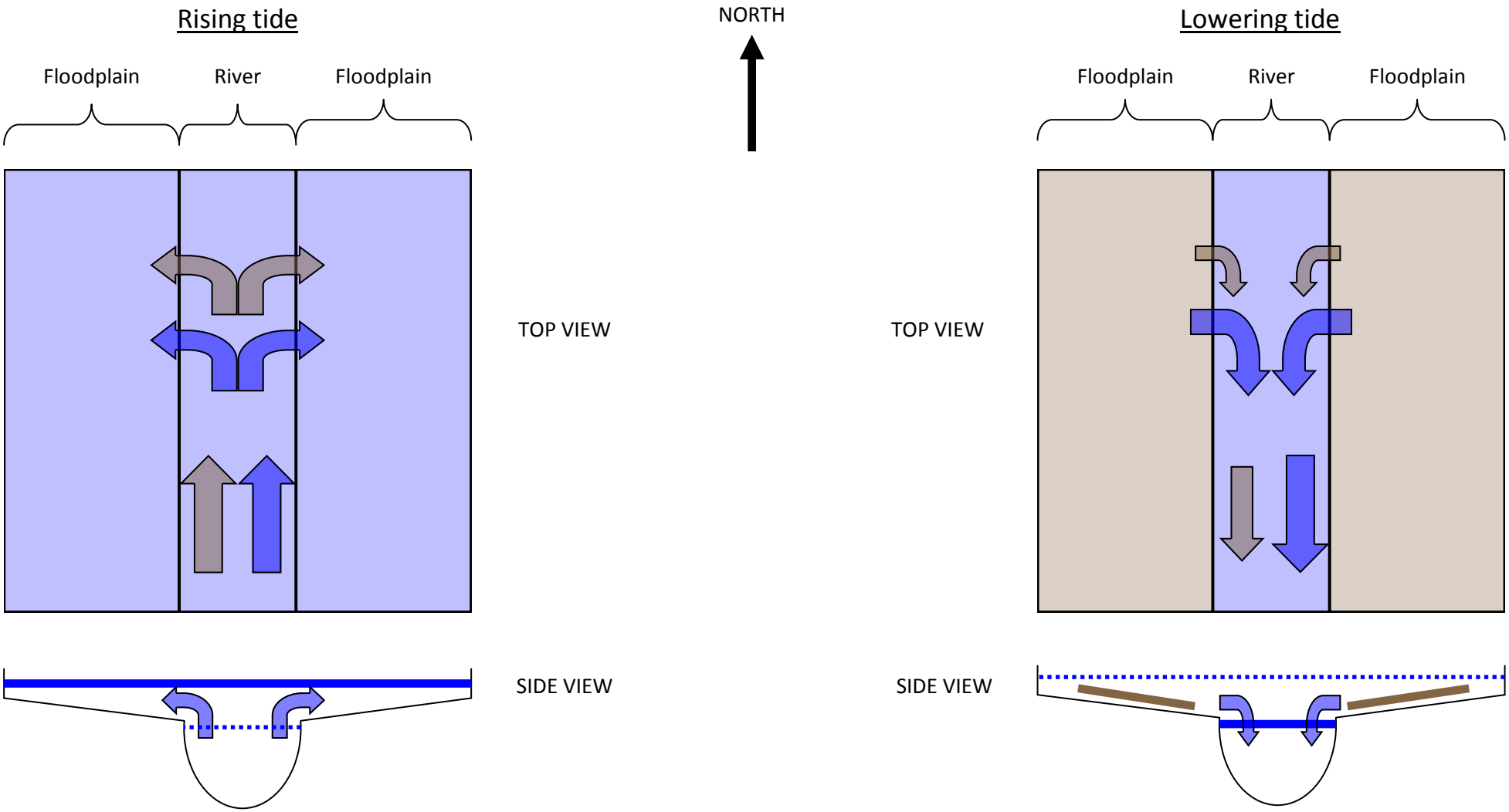


Figure 2.5. the morphological state of rivers in the southwest delta before the coastal embankment project

Source: own design

2.6 The Coastal Embankment Project (CEP)

The severe floods of 1954 resulted in the United Nations Krug mission to Bangladesh, which instigated the Coastal Embankment Project. Under this USAID funded project, 37 polders and 1566 kilometers of embankments were constructed in the southwest delta (Nishat, 1988 in BUET, 2010; pp. 6). The objective of the construction of this infrastructure was simple: to protect floodplains (and urban areas) against tidal flooding and salt intrusion (GoB, ADB & Haskoning, 1993), and thereby allow 3 harvests annually compared to 1 before the construction of the embankments. The CEP can be understood as a product of the *Green Revolution* movement (Rahman et al., 2010; pp. 1). Whereas polders were developed in the Netherlands to gain land, polders were constructed in Bangladesh to boost agricultural production. Please see text box 2.1 for further clarification on Beels and polders.

The polders were considered to be successful in their early years of operation, because they decreased floods and created stability in agricultural areas (Qaium, year unknown; Hughes et al., 1994; pp. 25). They allowed 3 harvests per year instead of 1 (Dilib interview, 2012).

The polders also dramatically decreased the volume of tidal water stored in the floodplains, because the embankments prevented water from entering them. O'Brien (1969; in SMEC, 2007) has shown that the cross-sectional area of a tidal channel is linearly linked to the tidal prism (Annex IV). Thus, when coastal embankments are placed and the cross-section of an area cannot increase (widen) during high-tide, the tidal prism or volume of water stored in the river/floodplain is

Text box 2.1: Beels & polders

A Beel is "a low-lying depression in the floodplain that generally contains water throughout the year, a small lake or backswamp" (Wester and Bron, 1997). A polder is a piece of land protected or reclaimed from a river, protected by embankments (Free Dictionary, 2013).

During the Coastal Embankment Project numerous polders were developed, delineated by river embankments. In the north of the CEP area, there are fewer rivers which made the polders developed there larger. Polder 24 is so large that it contains numerous Beels, which drain separately in the Hari river. Polder 25 contains only Beel Dakatia, which is one of the largest Beels in Bangladesh. It is thus not possible to speak of "temporary depoldering" as in the title. A better term would be "de-beeling".

Local water management mostly takes place on Beel level, as Beels usually drain separately in the Hari or Mukteswari river. Beels that are connected with each other require collective management. Water management thus depends greatly on the hydrological setting of a polder or Beel. Please see chapter 4 for more information on the current water management practices in the area.

Under tidal influence, the land level of several Beels has been raised up to 2 meters, for example in Beel Bhaina and Beel Khuksia.

What's in a name?

decreased. This is logical, because the height of the tide and the width of the water containing body (river/floodplain) are the two determinants of the volume stored in the basin (figure 2.5). A decrease in tidal prism, in the case of poldering, thus led to a decrease in river discharge and flow velocity, and thereby an increase in sedimentation.

Figure 2.6 shows the effect of the CEP embankments on the rivers in the southwest delta. The process of sedimentation was slow, but led to a gradual build-up of sediment in the rivers. In the early 1980s, riverbed sedimentation started to cause drainage congestion in the southwest delta. Paragraph 2.7 describes the major causes and consequences of the sedimentation in the study area.

POST - COASTAL EMBANKMENT PROJECT

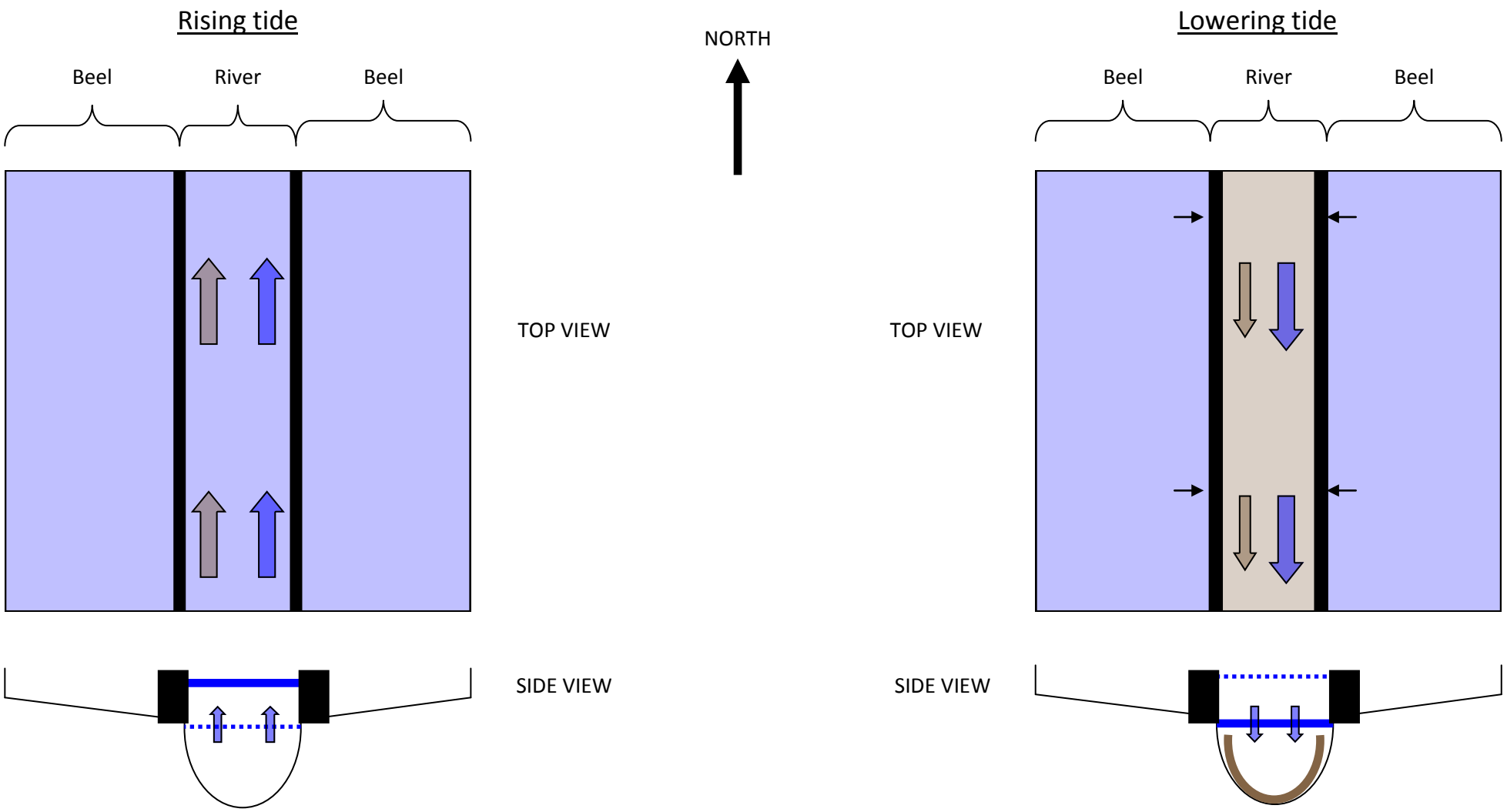


Figure 2.6. the morphological state of rivers in the southwest delta after the coastal embankment project

Source: own design

2.7 Factors that led to drainage congestion

"The effect of the embankments on sedimentation in the rivers and along the coastal areas will also be small. However, local erosion or deposition may take place at certain localities."

Source: United Nations Economic Commission for Asia and the Far East (1966). *Appraisal of some aspects of the Coastal Embankment Project of East Pakistan.* Report of the advisory group on development of deltaic areas.

As the drainage capacity of the rivers decreased gradually, waterlogging[23] started to occur in many areas in the southwest delta, particularly in Jessore, Khulna and Satkhira districts[24] (figure 2.7) (BUET, 2010; pp. 8; IWM, 2012), causing considerable problems in these areas. Damage to infrastructure was widespread, crops did not grow, and livestock breeding virtually ceased. Waterlogging caused considerable economic, social and environmental problems (ibid, pp. 9). Figure 2.9 explains the process of riverbed sedimentation and the development of drainage congestion. Figure 2.8 shows a photograph of riverbed sedimentation.

Figure 2.7. The districts of Jessore, Khulna and Satkhira.

Source: Google Maps

[23] The saturation of soil with water, impeding plant growth.

[24] The waterlogging occurred in Jessore, Jhikargacha, Abynagar, Monirampur and Keshabpur upazilas of Jessore district, Dumuria, Phultala, Batiaghata, Paikgacha & Koyra of Khulna district, and all upazilas of Satkhira district (IWM, 2012).

Besides tectonic and morphological processes (described in section 2.3) causing the entire mouth of the Ganges to move eastwards, and the construction of embankments under the CEP, the Farakka barrage in India can also be identified as a factor contributing to the developments in the southwest delta. As the barrage diverges water in the dry season through the Hooghly river to the port of Kolkata[25], the Padma (as the Ganges is named as soon as it crosses the Bangladesh border) receives less water and is left almost dry. This creates even less upstream flow in the rivers in the southwest delta, which on its turn allows tidal influence (and sedimentation) to move further and further north, thus *accelerating* the sedimentation of rivers. This effect, however, should not be overestimated: the main causes for river sedimentation are the movement of the mouth of the Ganges and the CEP (Jenkins interview 1, 2012)

Figure 2.8. In 2005, the Hari river was almost completely silted up.

Source: Amir, 2013

[25] Because the Hooghly River was also sedimenting up, causing problems for navigation in the port of Kolkata.

DRAINAGE CONGESTION LATE 1980s

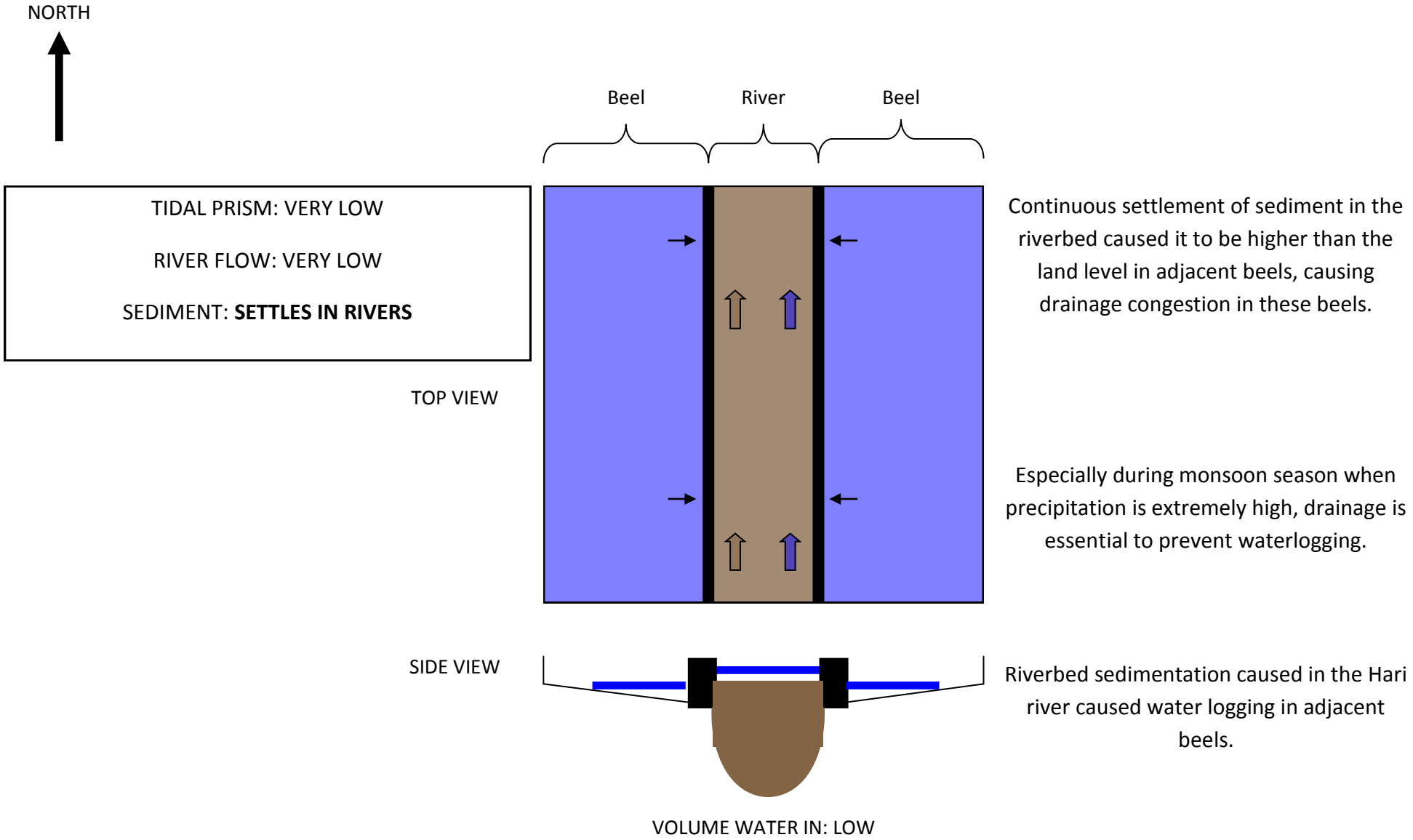


Figure 2.9. The development of waterlogging in beels adjacent to "dying" rivers in the southwest delta

Source: own design

2.8 The Khulna-Jessore Drainage Rehabilitation Project

Several projects were implemented to improve the drainage situation in the CEP area, including the Khulna Coastal Embankment Project from 1985 until 1990 and the Second Coastal Embankment Rehabilitation Project that started in 1990 and lasted until 1994 (GoB, ADB & Haskoning, 1993).

The latest project to improve the drainage in the area was the Asian Development Bank-funded Khulna-Jessore Drainage Rehabilitation Project (KJDRP). The KJDRP aimed to improve drainage in 100,000 hectares that were worst affected by the drainage congestion in the southwest delta, by improving infrastructure and community participation in water management (ADB, 2007; pp. 10). During the KJDRP, 106 formal Water Management Groups (WMG) and 9 Associations (WMA) were established and one overarching Water Management Federation (WMF) (interview Hossain 17-10-2012)[26] . The KJDRP covered approximately 25% of the CEP area with a population of 800,000 people, ran from 1994 to 2002 and was implemented by the Bangladesh Water Development Board.

The KJDRP is well-known in the study area, and its outcome is the topic of heated debate among locals, NGOs[27] and the government. Initially, there were 9 options considered to improve drainage of the study area, which included the construction of large-scale infrastructure and the development of tidal basins (SMEC, 2002). In contrast to the local population, the BWDB favoured the construction of large scale infrastructural solutions to counter drainage congestion in the area (Jenkins 2, 2012; ADB, 2007 pp. 33-34).

During the initial phase of the KJDRP, several regulators were constructed (i.e. at Sholmari and Ramdia), the Hari and the upper Sholmari river were dredged and a large embankment was built between Babodah and Teka (ADB, 2007; pp. 25). On October 29th, 1997, the local population at Beel Bhaina cut their embankment turning the 1000 hectare Beel into a tidal basin (ADB, 2007; pp. 25). The far-reaching consequences of this public action is the subject of the remainder of this thesis: *Tidal River Management*.

[26] Please see chapter 4 for more information on current water management practices in the study area. The WMGs, WMAs and WMF have lost considerably political power since the end of the KJDRP.
[27] Uttaran, a large NGO in the southwest delta, has called KJDRP "a project of mass destruction" (Islam, 2006)

2.9 Spatial and temporal reflection

In this chapter, we have made a journey through space and time. In order to grasp the complexity of the study area, one has to start examining the delta at large and its historical context. Gradually, this chapter zoomed in to the study area and has arrived to the end of the 2nd millennium, which is where chapter 3 picks up and will lead us to the present.

By now, the importance of approaching the term "Tidal River Management" as a boundary concept has been established. In the vast delta of the Ganges, Brahmaputra and Meghna, which developed over millions of years, it is essential to clearly delineate a spatial boundary and temporal margin of the system and/or phenomenon under study.

This chapter has shown that tectonic, geomorphological and anthromorphological processes have created a very dynamic delta in the southwest of Bangladesh. The eastward move of the Ganges and the construction of embankments under the CEP resulted in accelerated rates of sedimentation of rivers in the southwest delta, which caused water logging in the districts of Khulna, Jessore and Satkhira. The Khulna-Jessore Drainage Rehabilitation Project addressed the detrimental economic, environmental and social problems caused by waterlogging. The first tidal basin along the Hari-Mukteswari river was the result of a 1997 "public cut", and symbolizes the end of the pre-TRM era.

The next chapter starts in 1997, when the KJDRP was in full swing and people in Beel Bhaina cut their embankment, creating a large tidal basin that had far-reaching physical and political consequences.

Chapter 3: the emergence of “Tidal River Management”

“After three days, in the desert fun,
I was looking at a river bed.
And the story it told, of a river that flowed,
Made me sad to think it was dead.”

America: A Horse with no Name (1972)

3.1 Introduction

This chapter aims to sketch the emergence of the water management practice "Tidal River Management" (TRM). The Khulna-Jessore Drainage Rehabilitation Project was in full swing when people in Beel Bhaina cut their embankment in 1997. It is difficult to find out how exactly the term "Tidal River Management" evolved; many state that the tidal basin created in 1997 was the first example of "TRM" in the southwest delta, but others refer to the year 1989 when people cut embankments in Beel Dakatia with the purpose of improving drainage. Besides, how and when was the term "Tidal River Management" actually given to the practice of creating tidal basins? This chapter shows what the physical consequences of the embankment cuts were, and what the political circumstances were in which they occurred.

This chapter commences with sketching the political setting within the KJDRP when, on October 29th, 1997, people in Beel Bhaina cut their embankments. In the decade following Beel Bhaina, Beel Kedaria and Beel Khuksia were transformed into tidal basins. These cases will be discussed accordingly. The last section of this chapter will discuss the embankment cuts in Beel Dakatia in 1990, and attempt to explain how the term "Tidal River Management" evolved. This chapter deals with the period 1990-1994 for the Solmari catchment and 1997-2013 for the Hari-Mukteswari catchments. Chapter 4 discusses the *current* water management practices in the study area, which can be understood only after knowing the area's recent history.

3.2 The political setting within the KJDRP

As mentioned in chapter 2, the Khulna-Jessore Drainage Rehabilitation Project (KJDRP) was the last big project aiming to improve drainage in the study area. Initially, two technical options were considered to solve the drainage congestion in the Hari river: (1) a large regulator in the Gengrail river[28] and (2) a permanent tidal basin in Beel Kedaria which was regularly dredged. These options were designed by Snowy Mountains Engineering Cooperation (SMEC) and Royal Haskoning, respectively (Jenkins email 2, 2013; SMEC, 2003). The Bangladesh Water Development Board had a strong preference for the construction of a large (expensive) regulator in the Gengrail river[29].

Local consultation, performed by (among others) ADB consultants Andrew Jenkins and Shorab Hossain, made clear that the population neither supported a large regulator nor a *permanent*

[28] With the purpose of closing off the entire KJDRP area from tidal influence.
[29] As Jenkins (presentation embassy, 2012) and an anonymous source within the BWDB (interview, 2012) have mentioned, the BWDB prefers to implement infrastructural solutions. As these solutions are expensive, corrupt BWDB staff can put a lot of money "in their back pocket".

tidal basin (in Beel Kedaria) as a solution to the drainage problems. Instead, Jenkins, Hossain, Uttaran consultant "Tutu Bhai" and the local population developed the idea of *temporary rotating* tidal basins (Jenkins email 2, 2013). Consultation between the local population and the KJDRP management (Jenkins and Hossain) led to the creation of a political environment that allowed for a rigorous decision[30]...

3.3 Beel Bhaina tidal basin, October 1997 – December 2001

On October 29th 1997, people in Beel Bhaina – with the help of the Bangladesh Communist Party of Jessore (Jenkins email, 2013) - cut their embankment with the Hari river, as they hoped that the sediment-laden water would raise the land of their Beel and thereby improve drainage (SMEC, 2003 annex A). While the Bangladesh Water Development Board was implementing the Khulna-Jessore-Drainage Rehabilitation Project, Beel Bhaina was turned into a tidal basin which inundated the entire 900 hectare Beel. Initially, the BWDB's response was to take legal action against the people who cut the embankments, because the embankments - property of the BWDB - were destroyed. Under pressure from (among others) Shorab Hossain and Andrew Jenkins, ADB-consultants for the KJDRP, no legal action was taken.

After the cut, cross sections and sediment deposition in Beel Bhaina were monitored by the implementing authorities of the KJDRP; the BWDB, SMEC engineers (SMEC, 2007) and ADB consultants (Jenkins, 2013). As the tidal prism increased, the cross section of the Hari river downstream of Beel Bhaina increased considerably during the entire period the Beel functioned as a tidal basin. (see section 2.7; SMEC, 2002 annex A). Additionally, sediment was deposited in Beel Bhaina, raising its land level by an average of 78 centimeters (SMEC, 2007 annex A). Figure 3.1 shows the bed levels of the Hari river in the period before and after the public cut at Beel Bhaina.

As the tidal basin increased the cross section of the Hari river downstream of Beel Bhaina, drainage improved considerably. Beel Bhaina remained functioning as a tidal basin until December 8th, 2001. When the cut was closed, the bedlevel of the Hari river rose by more than 6 meters in the next 8 months (SMEC, 2007 section 4.7.2).

[30] Please see Jan van Minnen's thesis for a detailed account of the physical circumstances that preceded the public embankment cut in Beel Bhaina.

3.4 The cut's impact on KJDRP

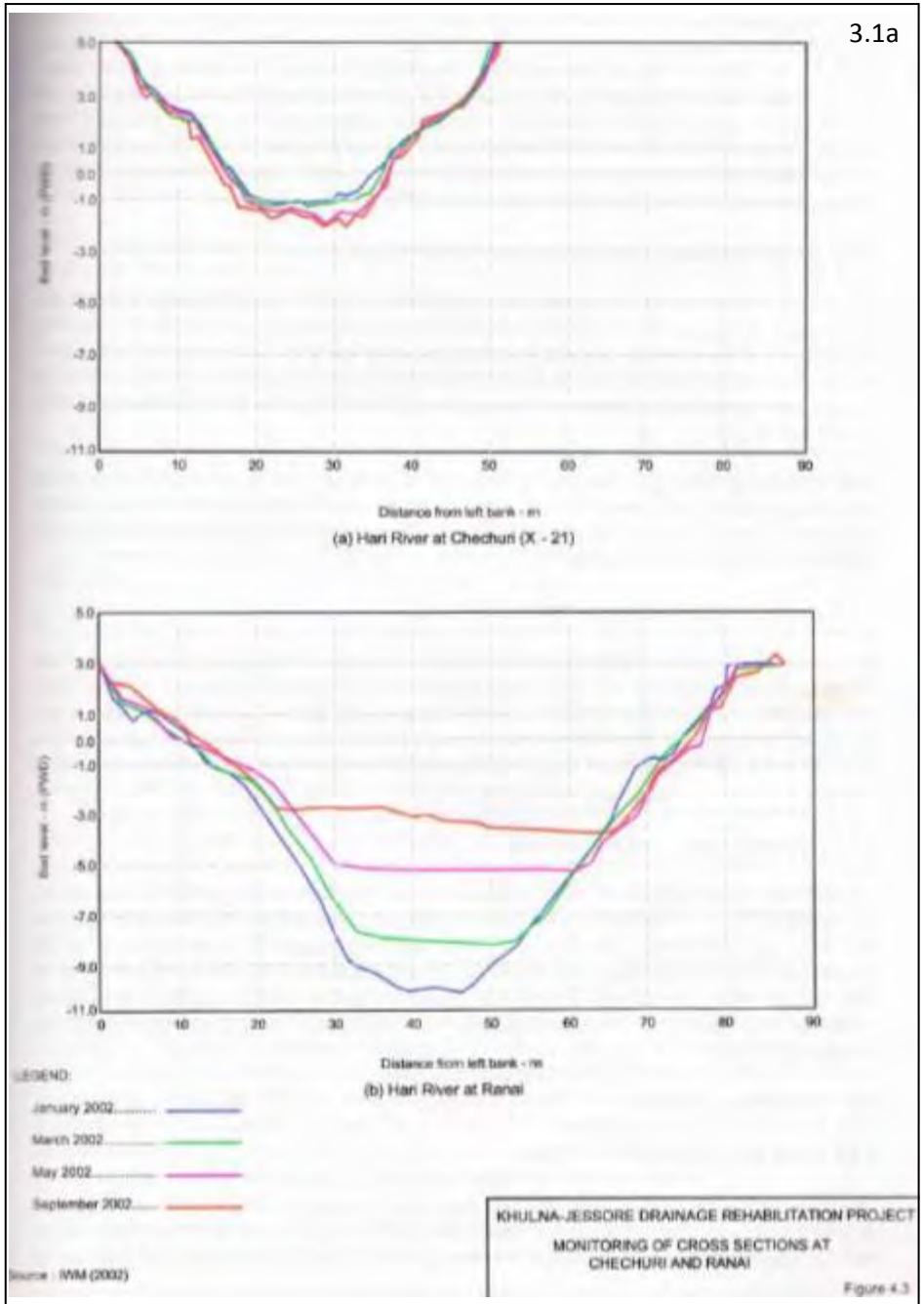
In the year preceding the embankment cut (from 1996), ADB consultants Jenkins and Hossain were in frequent contact with local stakeholders in the KJDRP area. After rigorous consultation, the people who cut the embankment might very well have had *political* rather than physical incentives for destroying the embankment. In other words: the embankment in Beel Bhaina might not only have been cut to raise the land in the Beel, but also to make a political statement to the KJDRP management and to the BWDB to reconsider their technocratic plans[31]. Having had considerably contact with Jenkins and Hossain, working for the KJDRP, people might have been confident that the cut would not be closed immediately and that their initiative would not just be discarded.

The public cut in Beel Bhaina was a milestone in the KJDRP. Not only was the cut a strong political message from local stakeholders to the project management to consider the opinion of the people better, it was also proof that (temporary) tidal basins could seriously benefit the Hari river and that expensive dredging and constructing a regulator in the Gengrail river would not be necessary (Jenkins email, 2013).

Accordingly, the ADB, the main funder of the KJDRP, requested the Center for Environmental Geographic Information Services (CEGIS) to perform an Environmental Impact Assessment (EIA) of all available options. This assessment was completed in 1998 (CEGIS, 1998), which concluded that the "rotating basin" option was the best from an environmental perspective[32] (Jenkins email, 2013). Additionally, modelling by the Institute for Water Moddeling (IWM) suggested that a potential tidal basin did not have to be very large in order to maintain drainage of the Hari river (Jenkins email, 2013).

[31] Which is not surprising if one considers the general mistrust people have in the BWDB (see chapter 5).
[32] The Dutch engineer Rob Koudstaal participated in this project (Development Associates, 2010).

3.1a



3.1b

3.1c

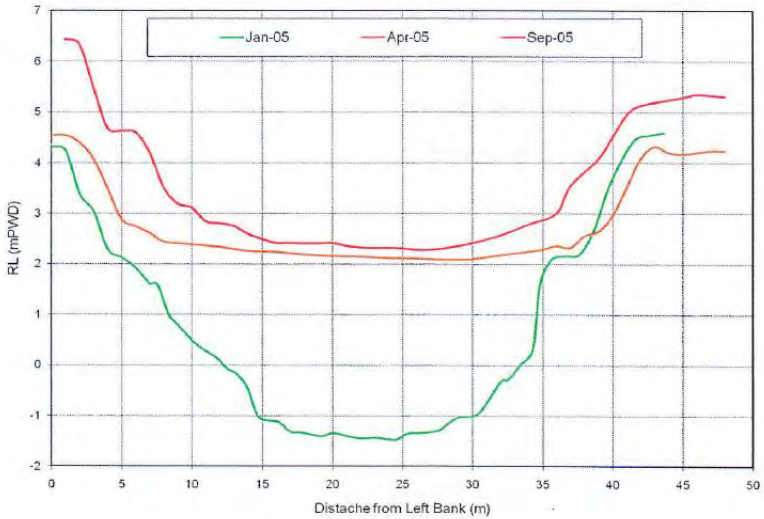


Figure 3.1a. Impact of Beel Bhaina and Beel Kedaria tidal basin
Figure 3.1b. part of the Hari-Mukteswari river displaying the two measuring points
Figure 3.1c. Impact of the closing of Beel Kedaria on Hari-Mukteswari river morphology at Ranai

Source: IWM, 2010

3.5 Beel Kedaria, January 2002 – January 2005

The tidal basin in Beel Kedaria was officially recognized by the KJDRP management. Initially, it was planned to be permanent, but after local stakeholders had expressed their concerns to the KJDRP management (Jenkins email, 2013), and violently resisted the construction of a peripheral embankment[33] (SMEC, 2003 annex B), it was decided that Beel Kedaria would also be a temporal tidal basin. The results of the EIA (1998) and the IWM modelling contributed to local stakeholders' acceptance of the rotating tidal basin plan (Jenkins email, 2013).

Beel Kedaria tidal basin was opened on January 31st, 2002, but its impact was not perceived as positive as Beel Bhaina by the local population. The river cross section at Chechuri (just downstream of Beel Kedaria) only barely changed during the year the basin was in operation (See figure 3.1a & 3.1b). However, no sedimentation took place in the river and there was no drainage congestion during the operation of Beel Kedaria tidal basin[34]. This might be caused by the fact that Beel Kedaria is positioned approximately 19 kilometers upstream from the confluence of the Hari and the upper Bhadra river, which makes tidal influence in Beel Kedaria less than Beel Bhaina (approximately 0.20m in contrast to approximately 2.00m in Beel Bhaina). The Babodah regulator located downstream of Beel Kedaria aggravates this effect (constructed under the CEP in 1962; interview 23-10-2012).

Beel Kedaria tidal basin remained active until January 2005 (IWM, 2007; pp.11). During February and November 2005, when Beel Kedaria was closed, severe sedimentation took place in the Hari river which raised the bed level up to 3.5 meters (figure 3.1c; IWM, 2010).

3.6 East Beel Khuksia, April 2006 –January 2013?

East Beel Khuksia tidal basin was officially opened by the BWDB on April 27th, 2006, but closed by the local population who opposed the cut on July 16th, 2006 (ADB, 2007; pp. 34). On November 30th, 2006, according to the Institute for Water Modelling (2012), the basin became active again, which greatly improved drainage in the area. Figure 3.2 shows the effect of the opening of East Beel Khuksia TRM on the morphology of the Hari-river.

[33] The reason of which is not entirely clear from the SMEC report.

[3434] The reason why Beel Kedaria is sometimes depicted as a "failure" is because no sedimentation took place in the Beel itself (interview 23-10-2012). Beel Kedaria was successful in the regard that there was no drainage congestion in the area during its operation. The explanation of this paradox can be found in the way people perceive and define "Tidal River Management" (as it is not yet named in 2000): the majority of the people define the term as the raising of land inside a Beel, and do not refer to the river as primary benefactor of the practice.

In addition to the positive effects of the tidal basin on the bed level of the Hari river, the ground level in East Beel Khuksia was raised significantly with sediment. Measurements in November 2012 show that the ground level was raised by approximately 2 meters near the beel cut, and 1.5 meters further away from the cut (Van Minnen, 2012). Opposition to the Beel Khuksia tidal basin mainly revolves around the absence of an effective mechanism to compensate local farmers. This, and the potential closing of the tidal basin in February 2013 will be dealt with in detail in chapter 4.

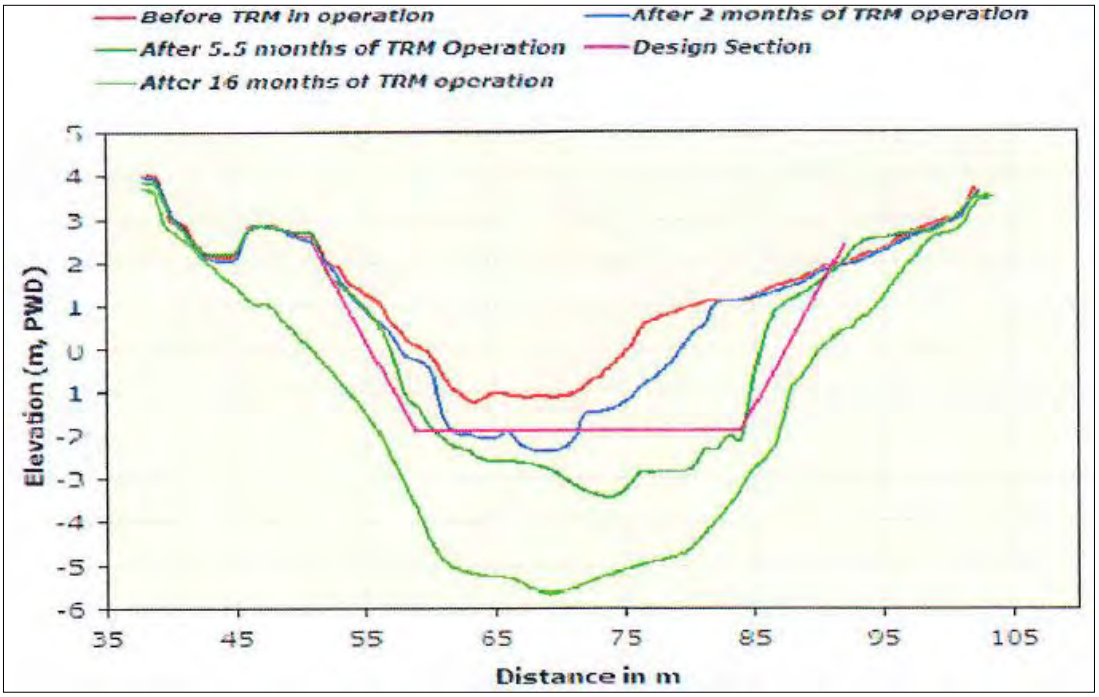


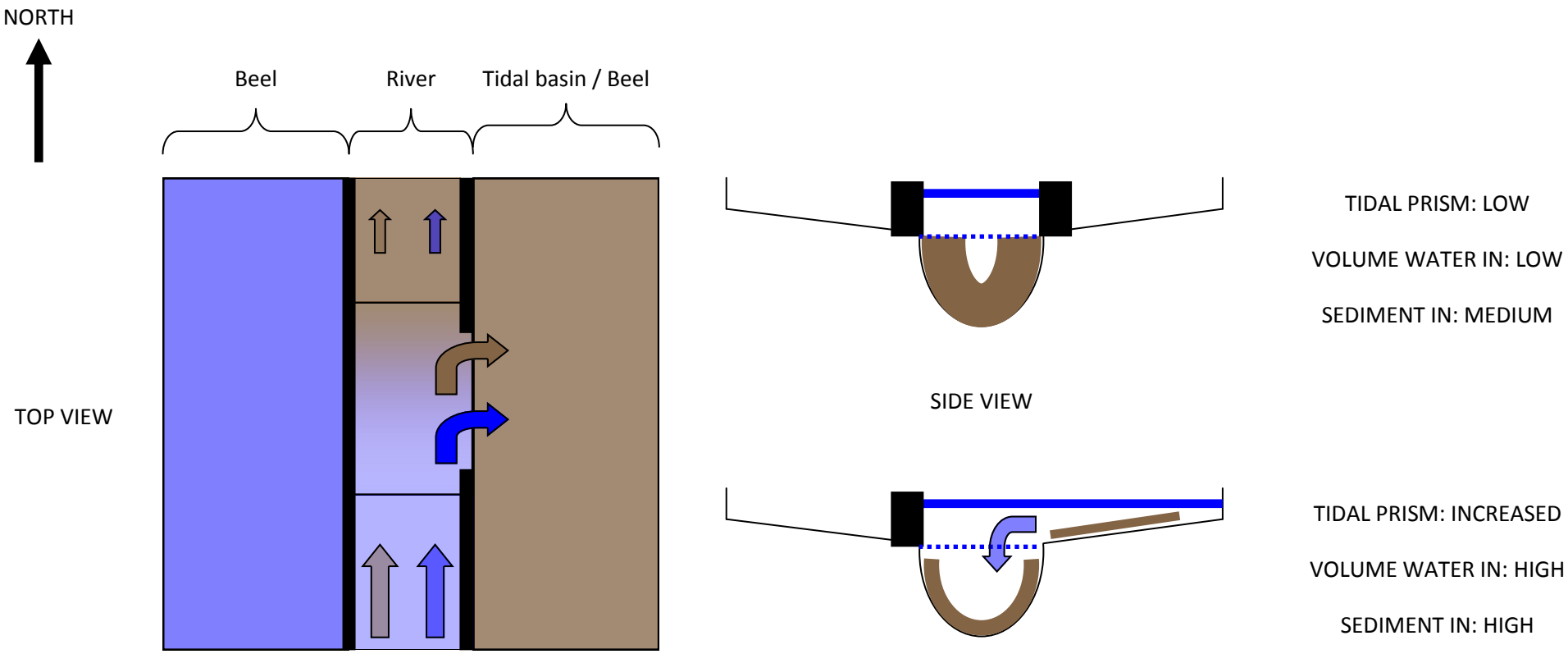
Figure 3.2. The impact of East Beel Khuksia tidal basin on Hari river morphology at Ranai. Source: IWM, 2010

3.7 How tidal basins work

From the data that is presented in the paragraphs above, it can be concluded that tidal basins are – under certain circumstances – able to drastically decrease riverbed levels in the study area, or at least stabilize them (in the case of Beel Kedaria). The Hari river enlarged considerably from the public cut in Beel Bhaina and the official cut of East Beel Khuksia. When Beel Kedaria was a tidal basin, the bed level of the Hari river did not decrease, but there seemed to be no netto sedimentation in the riverbed. This was the case from January to September 2005 when there was no active tidal basin along the Hari river (figure 3.1c). Additionally, the land level in Beel Bhaina and East Beel Khuksia were raised by approximately 80 centimeters and 1.5 meters, respectively, improving future drainage.

The relation between the cross-sectional area of the river and the tidal volume is first described by Williams (1919), who mentioned that “in dealing with these rivers [tidal rivers in the southwest delta] which are purely tidal creeks it may be noted that the section at any particular point bears a direct relationship to the tidal reservoir capacity above that point”. Later, the relation between the size of a tidal inlet and the available upstream volume (mean tidal volume) was expressed in a function by O’Brien (1969), which yields the figure in Annex IV (SMEC, 2003 annex A). Figure 3.3 summarizes the process of sediment and water movement in a tidal basin.

TIDAL RIVER MANAGEMENT



TIDAL PRISM: INCREASED

RIVER FLOW U/S OF BASIN: LOW

RIVER FLOW D/S OF BASIN: HIGH

SEDIMENT: **SETTLES IN BEEL**

Figure 3.3. River morphology under Tidal River Management.

Source: own design

3.8 Beel Dakatia, 1990

Eight years before people cut the embankment at Beel Bhaina, during the Khulna Coastal Embankment Rehabilitation Project, four embankment cuts were made in Beel Dakatia with the aim of 1) improving drainage, 2) improving water quality and of 3) raising land level through sedimentation (SMEC, 2003 annex A). In 1990, Beel Dakatia was suffering from severe waterlogging, as described in a famous book by Rahman[35] (1995). Beel Dakatia drained through the Hamkura river, which benefitted by the large quantity of water flowing through it during the embankment openings. The cuts in Beel Dakatia caused salinity intrusion and 10,000 to 12,500 hectares to be inundated (in the dry and wet season, respectively), which caused crop destruction and human suffering. In 1994 the cuts were closed by the BWDB, which caused the Hamkura river to sediment up rapidly[36].

The embankments around Beel Bhaina were cut to raise the land levels *inside* the Beel to improve future drainage by sedimentation, and possibly to make a statement to the KJDRP management (SMEC, 2003 annex A; Jenkins email, 2013). It was the Beel cut in Beel Bhaina that instigated a response of the organisations involved in the KJDRP and the BWDB. The option to transform some Beels into tidal basins to enlarge the cross-section of the river was only studied after the public cut in Beel Bhaina, not Beel Dakatia.

The embankment cut in Beel Bhaina on October 29th, 1997, can be regarded as the moment of birth for the then called "tidal basin option" for drainage of the Hari river. Not only its physical consequences, but also the political climate within the KJDRP contributed to the cut having such great impact.

3.9 The "discovery" of "Tidal River Management"

The Environmental Impact Assessment performed by CEGIS (1998) first literally mentioned the concept "Tidal River Management". Before this report, the term "TRM" was not used, but the actual idea was mentioned as early as 1993 in the final report of the Khulna Coastal Embankment Rehabilitation Program (1993). In hindsight, (evaluation) reports on the KJDRP talk extensively about (the) "Tidal River Management (option)", even when referring to the embankment cuts in the early 1990s in Beel Dakatia and Beel Bhaina.

[35] *Beel Dakatia: the Environmental Consequences of a Development Disaster*.
[36] The Hamkura river is now completely filled with sediment, it has died. During KJDRP, the Solmari river was dredged and the Solmari regulator was moved downstream. The drainage of Beel Dakatia is now (late 2012) good.

What is even more striking after having discussed the first cases of "Tidal River Management", is that the people who made the initial embankment cuts did not have the intention to create a tidal basin that would increase the cross-section of the river[37]. In contrast, the cuts in Beel Dakatia and Beel Bhaina were made to improve *future* drainage by raising land level *in* the Beels[38].

3.10 Conclusion

After having discussed the evolution of the Bengal delta at large and over many years in chapter 2, this chapter zoomed in on the Hari-Mukteswari and Solmari catchments during the period 1990-1994 and 1997-2013, respectively. Special attention was paid to the first tidal basins and their effect on river morphology, and how the implementing authorities of the KJDRP dealt with the unforeseen embankment cuts. In chapter 4 the results of a rapid water management appraisal will be presented, which makes clear how the current political and physical reality of the study area is composed.

It is now possible to answer the first sub research of this research: *How did the concept of TRM emerge in Bangladesh?* As the mouth of the Ganges is moving east, the river is losing its connection with many of its offtakes that lead through the southwest delta. These rivers transform into *tidal* rivers, which have totally different characteristics than normal rivers. The cross sections of these rivers are in relation with the tidal volume that passes through them (Annex IV). As the CEP embankments decreased both the cross sectional area and the tidal prism of (among many others) the Hari-Mukteswari river, much sediment was deposited in the river which created drainage congestion in adjacent Beels.

In 1997, during the KJDRP, people in Beel Bhaina cut their embankment with the aim to increase land levels in their Beel to improve *future* drainage. Both the local population and the KJDRP management did not expect the very positive effects of the creation of this tidal basin on the Hari river, although they could have known from the experience of Beel Dakatia[39]. In the Environmental Impact Assessment performed by CEGIS (1998), the creation of tidal basins as a practice to mitigate drainage congestion in the KJDRP area was given the name "Tidal River Management".

[37] Although it could have been expected, considering the large quantity of literature on the physical aspects of tidal rivers, and the relationship between river cross section and mean tidal volume as presented in Annex IV.
[38] As will be shown in chapter 5, people define the term "TRM" mostly as "a method to raise up the land inside the Beel by inundating it with sediment-laden water", without referring to the effect of tidal basins on the river.
[39] Even though there was no sedimentation in Beel Dakatia itself.

Text box: Tidal River Management outside Bangladesh

Tidal basins to control riverbed sedimentation are not only used in tidal rivers in the southwest delta of Bangladesh. In the Netherlands, the United States and Belgium, similar water management practices can be found in tidal rivers, forming – in some cases - an economically and environmentally sustainable alternative to dredging or (in the case of the Potomac river) pollution control.

In the tiny village of Paal (in Zeeuwsch-Vlaanderen), a small tidal basin is used to help keep sediment out of the harbour of the local yacht club. During high tide, the basin fills up with water. Two pipe gates are opened during low tide, which releases a large quantity of water that literally flushes the harbour. Dredging is still important to keep the harbour fully accessible, but only at a small scale and less often. Please see the picture hereunder.

The spuikom of Paal in action.

Source: own photograph

The Potomac tidal basin located in Washington D.C. was designed in the early 20th century to maintain the flow of the Potomac river to flush away pollution. It was successful in its early years of operation (Riverexplorer, 2013). The tidal basin in Oostende, in Dutch/Flemish called a “spuikom”, was also constructed in the early 20th century with the purpose of keeping the port of Oostende free of sediment. However, because of the poor engineering it has never functioned successfully (Vuurtorenwijk Oostende, 2013).

Not denying the fact that not all tidal basins work as they are designed to, further research to the reasons of failure or success of these basins is advisable, for example in the Eems/Dollard estuary. In an age where dredging is increasingly expensive, developing a more sustainable alternative to dredging might be very beneficial for delta communities.

Chapter 4: into the Beels

"He who sees the present has seen all things,
both all that has come to pass from everlasting
and all that will be for eternity:
all things are related and the same."

Marcus Aurelius: Meditations (book VI, paragraph 37)

4.1 Introduction

This chapter will present the result of the Rapid Water Management Appraisal (RWMA) that is conducted in the area of the Khulna-Jessore Drainage Rehabilitation Project in October and November 2012. Time and space are thus limited to the present and the KJDRP area, respectively. As the political atmosphere in the area is highly dynamic, much might have changed since the appraisal and the time of writing (February 2013).

As clear maps (both of road and water infrastructure) of the KJDRP area were not available, twelve participatory maps were drawn of different sections of the study area[40]. Out of these twelve maps, 9 digital maps have been composed that will be presented in this chapter, including 1 overview map (figure 4.1). The RWMA was conducted in October and November 2012[41] with two main purposes:

1. creating participatory maps of the KJDRP area, consisting of the Hari-Mukteswari river and the Solmari river catchments and
2. finding current water management practices in the entire area, and problems/issues

As the KJDRP area consists of numerous Beels that can be considered separate hydrological units that are part of the Hari-Mukteswari or Solmari catchment, the RWMA was performed on Beel level[42]. This chapter will proceed as follows. First, the results of the RWMA of the Hari-Mukteswari catchment will be presented (4.2), followed by the Solmari catchment (4.3). Second, the incident at Beel Kapalia in June 2012 and February 2013 will be discussed. Last, the findings will be examined. This chapter is entirely based on interviews that were conducted in the field. Annex III lists all the interview (locations) and the day reports they correspond to.

[40] Perhaps good maps of the area exist, but we did not find them. Yet another challenge in Bangladesh: where do roads lead you to? See chapter 1 for an example of a drawn participatory map.
[41] Please see chapter 1 for more information on the methodology of the RWMA.
[42] Performing the RWMA on political boundaries (i.e. district / upazilla / union) level would have been an alternative to performing them on hydrological boundaries. However, given the focus of this research on the actual water infrastructure in the area, this was not regarded a suitable method.

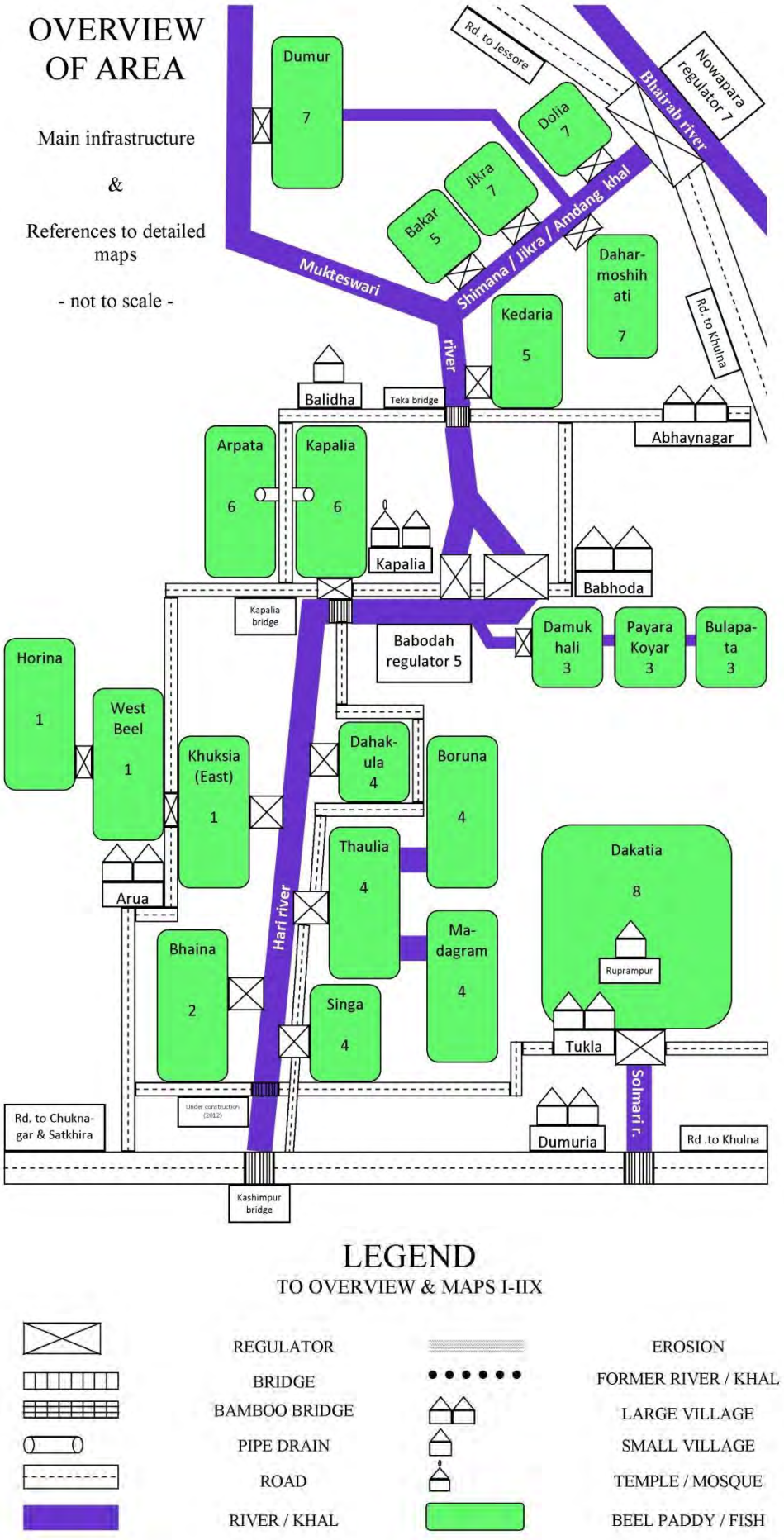
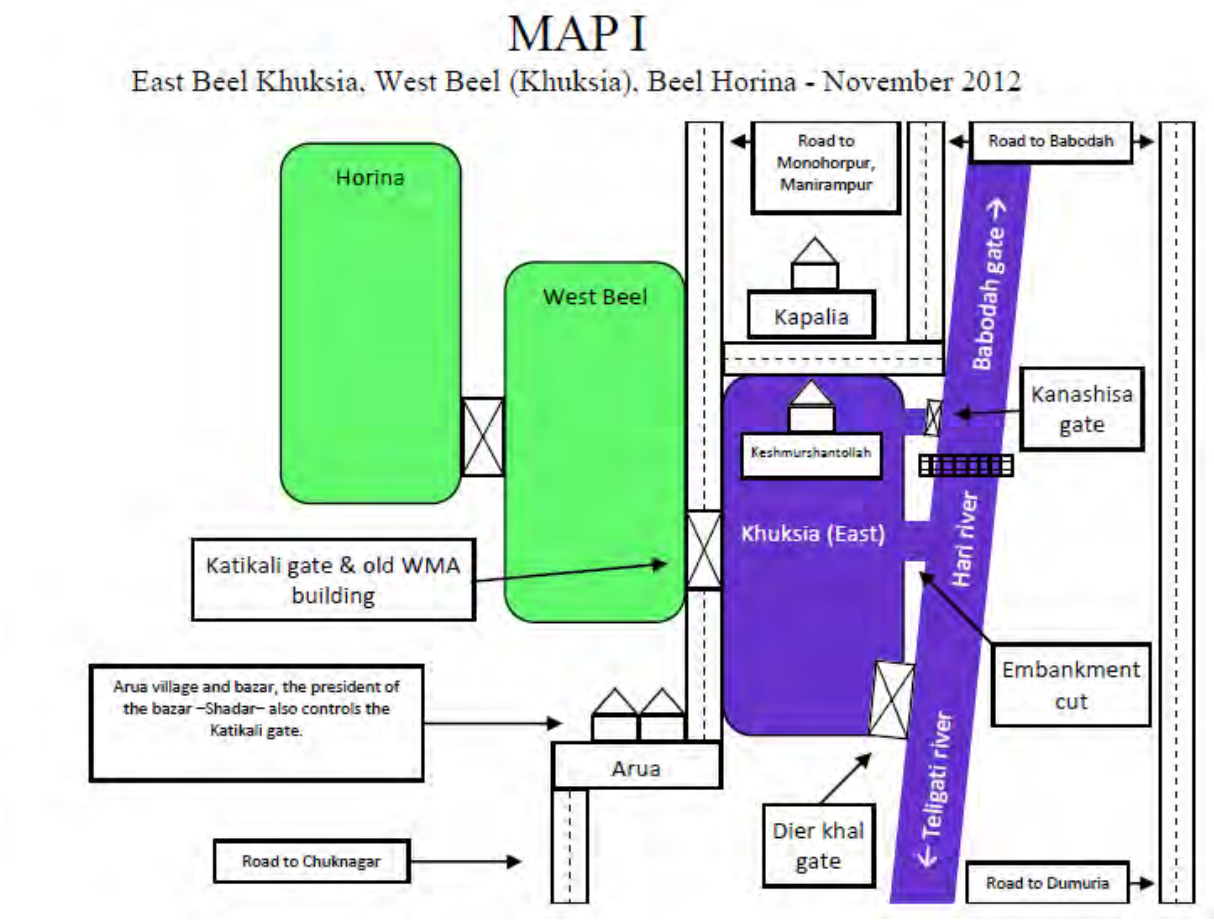


Figure 4.1. A systematic overview of the study area. Numbers in the Beels refer to detailed maps presented in this chapter.

4.2.1 Beel Khuksia, West Beel, Beel Horina



4.2. Digitalized participatory map of Beel Khuksia, West Beel (Khuksia) and Beel Horina.

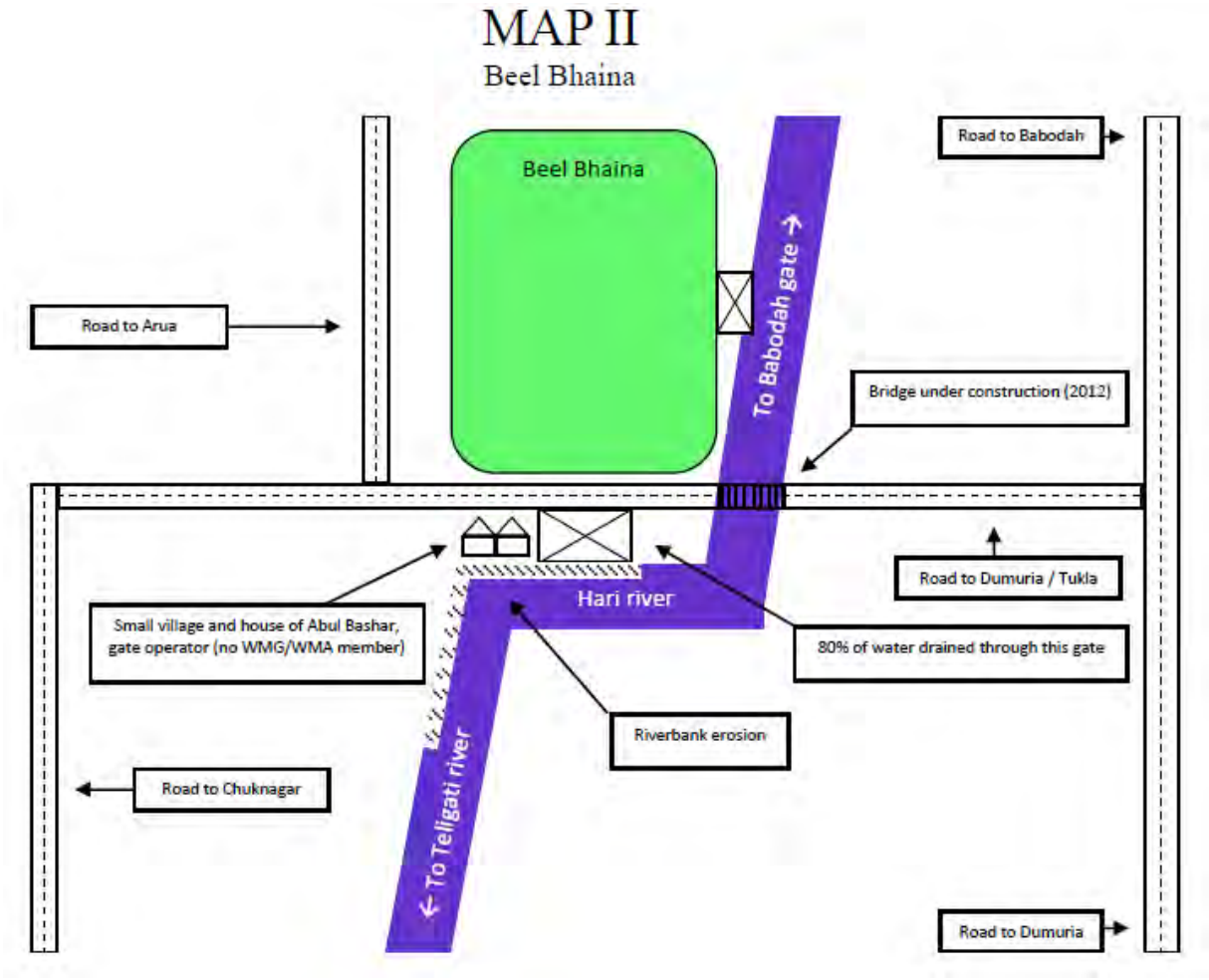
The villages of Arua and Kapalia are the largest villages adjacent to Beel Khuksia. Many farmers from these villages own land in Beel Khuksia, while others have land in West Beel and Beel Kapalia. There is a small settlement called Keshmurshantollah to the north of the Beel. The majority of the inhabitants here own land in Beel Khuksia only. To the south of the Beel, some farmers have constructed small embankments and made ghers (shrimp ponds).

Water in Beel Khuksia and West Beel is not managed by the official Water Management Group (WMG) or Association (WMA) as set up during KJDRP (interview 10-11-2012). The president of the bazar in Arua, Shadar, is in charge of the Katikali gate and thus the drainage of West Beel and Beel Horina. When the gate needs to be opened, Shadar calls Shamal who opens the gate. Shamal lives next to the Katikali gate. Shadar is a relatively wealthy person in Arua.

The main problem people in the adjacent villages of Beel Khuksia experience is the ongoing inundation of the Beel, which was turned into a tidal basin in 2006 (see chapter 2). In the past 6 years, 1.5 to 2 meters of sediment has been deposited on the bed of Beel Khuksia (Jan van Minnen's

research). People who own land in the Beel are not compensated for this – be it temporary – loss, which results in unemployment and increased poverty. There many fishermen in the Beel, but many people have sought employment somewhere else, for example in the Akij jute mill in Abhaynagar (interview 3-10-2012). At the time of writing (February 2013), there are strong, though unconfirmed, reports that the embankment cut of Beel Khuksia has been closed by the local population of the Beel (email Aminul Haque, 6-2-2013).

4.2.2 Beel Bhaina



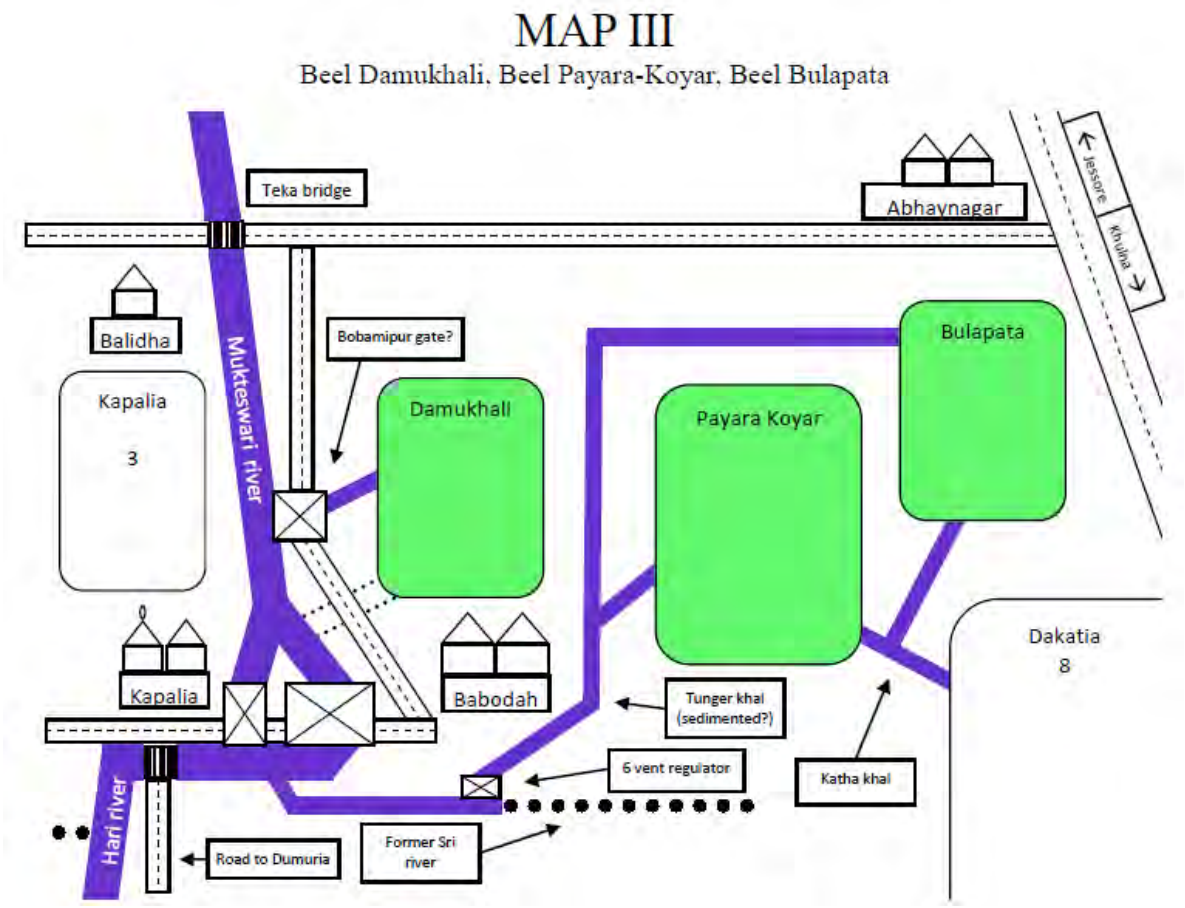
4.3 Digitalized participatory map of Beel Bhaina.

Beel Bhaina has benefitted considerably from the sediment deposition that occurred when the Beel was inundated during 1997-2001. As land has become much more productive and drainage is better, the value of land has gone up twenty times (interview VI, 18-10-2012). The main village and gate is located to the south of the Beel. Farming practices are diverse in Beel Bhaina: most farmers grow rice from February to April, cultivate salt water Bagda shrimp from May to July and sweet water Golda shrimp from August to December.

The control of the main drain of Beel Bhaina is in the hands of Abul Bashar, who owns about 60 biga land[43]. His house is located southeast of the main gate of Beel Bhaina. He does not belong to a formal water management group or association.

Because land in Beel Bhaina has been raised during the time it was a tidal basin, overall drainage is good and people are generally positive about the living conditions in the Beel. The main problem that the community faces, however, is riverbank erosion. Because of increased flow in the Hari river downstream of the main gate, houses are under threat of being destroyed[44].

4.2.3 Beel Damukhali, Payara-Koyar and Bulapata



4.4 Digitalized participatory map of Beel Damukhali, Payara-Koyar and Bulapatra

[43] 1 bigha is approximately 1340m² or 0.0134 hectare

[44] During the sedimentation of the Hari river in the 1980s and 1990s, people started building houses on the riverbed of the Hari river. Because of the operation of the tidal basins in Beel Bhaina (1997-2001) and Beel Khuksia (2006-now), the discharge in the Hari river has increased considerably, which causes riverbank erosion. In fact, the term "riverbank erosion" is not accurate, as it is houses that are build on the *sedimented riverbed* that are washed away.

Beel Damukhali, Payara-Koyar and Bulapata are located north of Beel Dakatia and east of Babodha village. There are numerous khals that link the Beels with eachother and with the main drains, the Hari and the Mukteswari river. There are numerous ghers and rice is also cultivated in the Beels.

The 6 vent regulator near the village of Babhoda is controlled by Abdul Malek, an employee of the BWDB and a former member of the official WMA/WMG. Currently, there is no active WMG or WMA in the Beels.

At the time of research there were some problems related to drainage, caused by shrimp farmers that blocked the drainage khals (canals) with their ghers (shrimp ponds). Drainage congestion occurred previously, for example in 1990 when the 6-vent regulator was broken (interview 2-11-2012)[45].

4.2.4 Beel Dahakhula, Boruna, Thaulia, Madagram and Singa

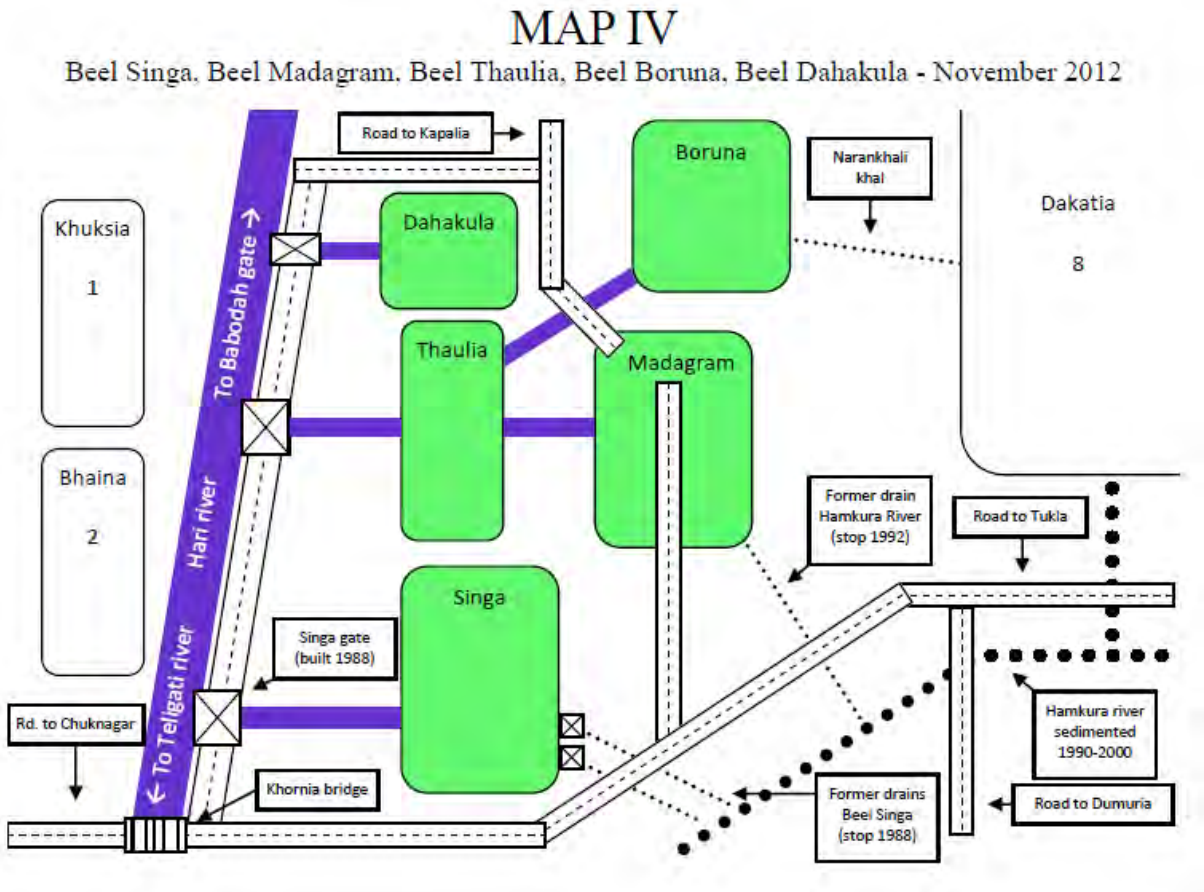


Figure 4.5. Digitalized participatory map of Beel Dahakula, Boruna, Thaulia, Medagram and Singa.

After the closure of the embankment cuts in Beel Dakatia in 1994, the Hamkura river rapidly silted up. For that reason, Beel Singha, Madagram and Boruna were connected to the Hari river to

[45] This section has been based on one interview only. There was not much activity in the Beels on the day that they were surveyed (Friday), which made it difficult to gather reliable data.

ensure better drainage. Beel Singa was directly linked to the Hari river, and Beel Boruna and Madagram both drain through Beel Thaulia. Beel Dahakula is a very small Beel and connected to the Hari river. In all Beels, there is a combination of paddy cultivation and shrimp farming (both sweet and salt water shrimp).

Singa gate is operated by Mr. Afsar, the only member of the local WMG. He has limited power, for the landowners of Beel Singa can also open and close the gate themselves. The official WMG and WMA has no more power in Beel Singa. The BWDB provides technical assistance in case there are problems with Singa gate. The main issue in Beel Singa is the lack of proper management of Singa gate.

Beel Madagram and Boruna drain through Beel Thaulia. The gate of Beel Thaulia is controlled by the chairman of Rodagara Union and the local WMG, Mr. G.M. Amanullah. Mr. Abas operates the gates of Beel Thaulia based on the orders of Mr. Amanullah. The local WMG consists of local government representatives from several villages in the area, including Mr. Abdul Sattar from Beel Boruna. The main problem in these three Beels concerns drainage: Beel Thaulia is several feet higher than Beel Madagram and Beel Boruna, which causes drainage problems in the monsoon season[46].

[46] The reason for the higher land level in Beel Thaulia relates – according to the local population - to the construction process of the CEP. As the CEP embankments around Beel Thaulia were constructed later than those around Beel Madagram and Beel Boruna, the sedimentation process could take place longer in Beel Thaulia than the latter Beels. This resulted in a difference in land level.

4.2.5 Beel Kedaria and Bakar

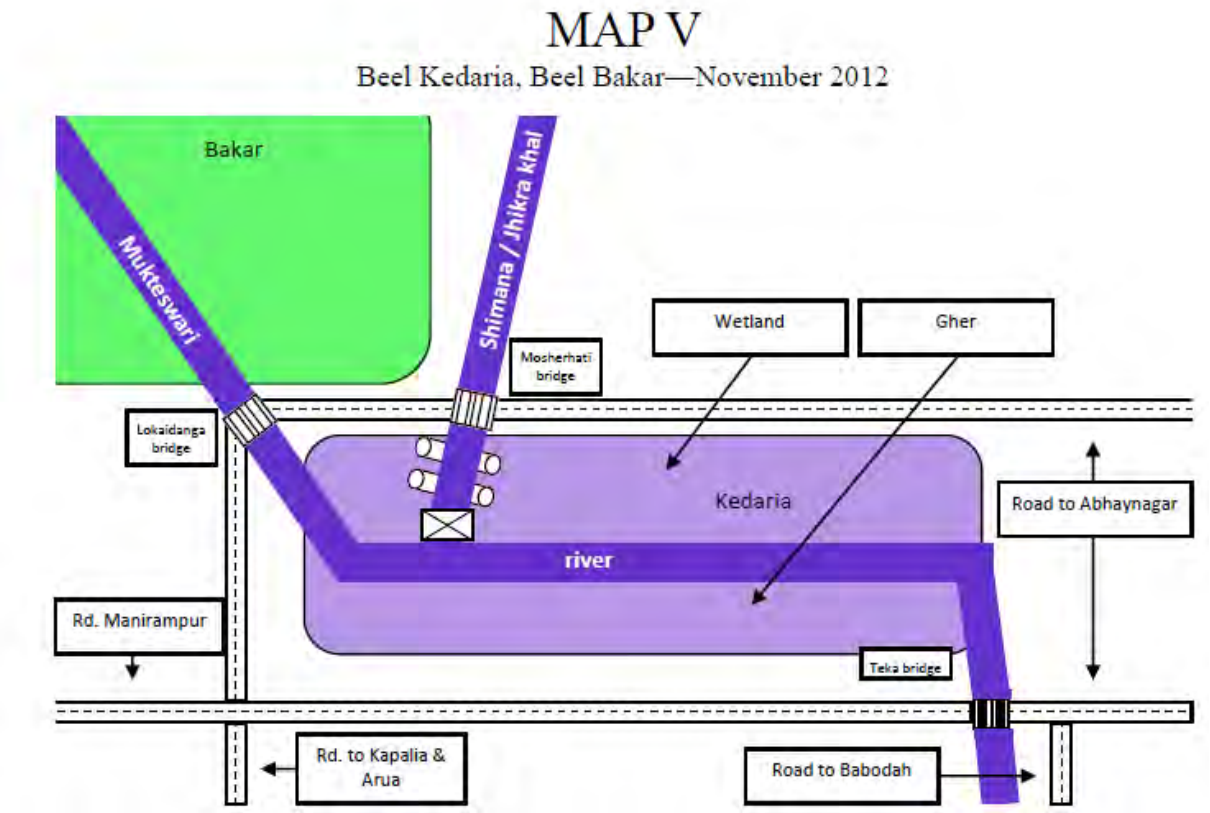


Figure 4.6. Digitalized participatory map of Beel Kedaria and Bakar.

Beel Kedaria was under tidal influence from January 2002 to January 2005. In contrast to Beel Bhaina and Beel Khuksia (now), no sedimentation took place during this period. This is clearly visible in the Beel nowadays: approximately half of the Beel is a wetland, while other parts are used as Ghers. Paddy cultivation is not possible due to permanent inundation of the land. Beel Bakar is higher and drains better, which makes it suitable for paddy cultivation.

The drainage of Beel Kedaria is complex. In the middle of the Beel, the Shimana khal seperates from the Mukteswari river. Pipe gates in the Shimana khal and a Bhalia khal in the Beel itself (not drawn on the map) contribute to drainage to the Mukteswari river[47]. The opening and closing of the pipe gates is under control of Naran Biswas. He is not part of an official WMG and has no relationship with the BWDB.

The main problem in Beel Kedaria is drainage. As the land level of the Beel is relatively low, it is permanently inundated. This allows for some shrimp farming and fishing, but no intensive agricultural production with 3 harvests per year, as in many better-drained areas.

[47] Drainage of Beel Bakar is unclear and has not been surveyed.

4.2.6 Beel Kapalia, Arpata and the Babodah gate

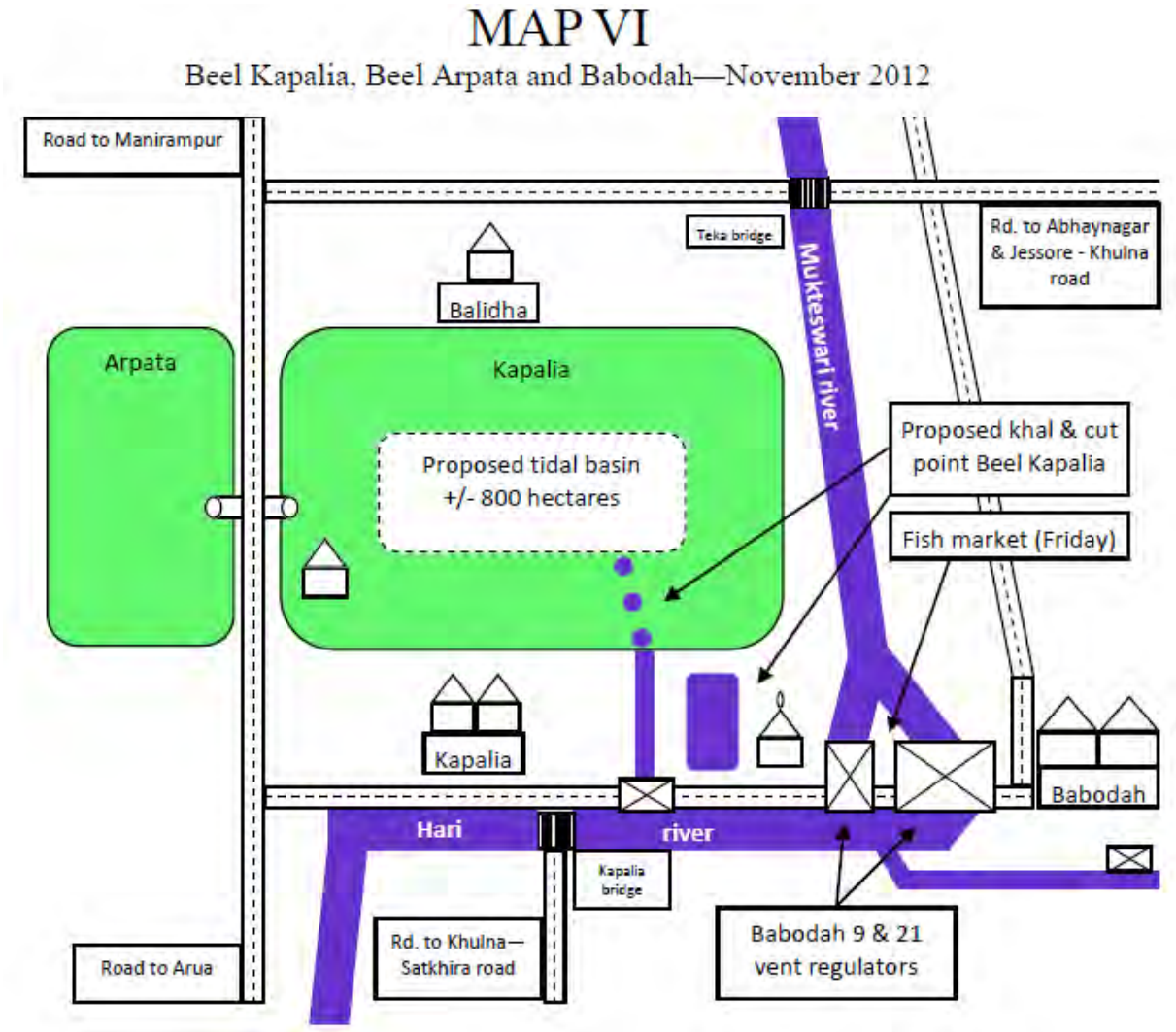


Figure 4.7. Digitalized participatory map of Beel Kapalia, Arpata and the Babodah gate

Beel Kapalia is foreseen to be the next tidal basin along the Hari river. Originally, the Beel was planned to be inundated from 2012 onwards, but violent protests on June 2nd prevented this (see section 4.4.2). The Beel is located next to the Babodah gate. To the south and southwest, one can find Kapalia village. North of the Beel, the village of Balidha is located. Rice is produced in Beel Kapalia, and there are also many ghers for shrimp cultivation.

Beel Arpata drains directly in Beel Kapalia through a pipe gate. Beel Kapalia drains into the Hari river through a big regulator east of Kapalia village. The water management system in Beel Kapalia is complicated, and the cause of widespread challenges to the successful development of a tidal basin in Beel Kapalia (see section 4.4.2).

It remained unknown who is responsible for the opening and closing of Kapalia gate. The official WMGs and WMAs are not in control. Powerful gher owners control much of what happens in the Beel, and have a defining impact on political processes regarding the development of a tidal basin in Beel Kapalia.

The problems in Beel Kapalia are political problems rather than related to drainage and agriculture. On February 4th, 2013, several people were hurt and one allegedly shot during a demonstration against the development of a tidal basin in Beel Kapalia (see section 4.4.2).

4.2.7 Beel Dumur, Jikra, Dolia and Daharmoshihati

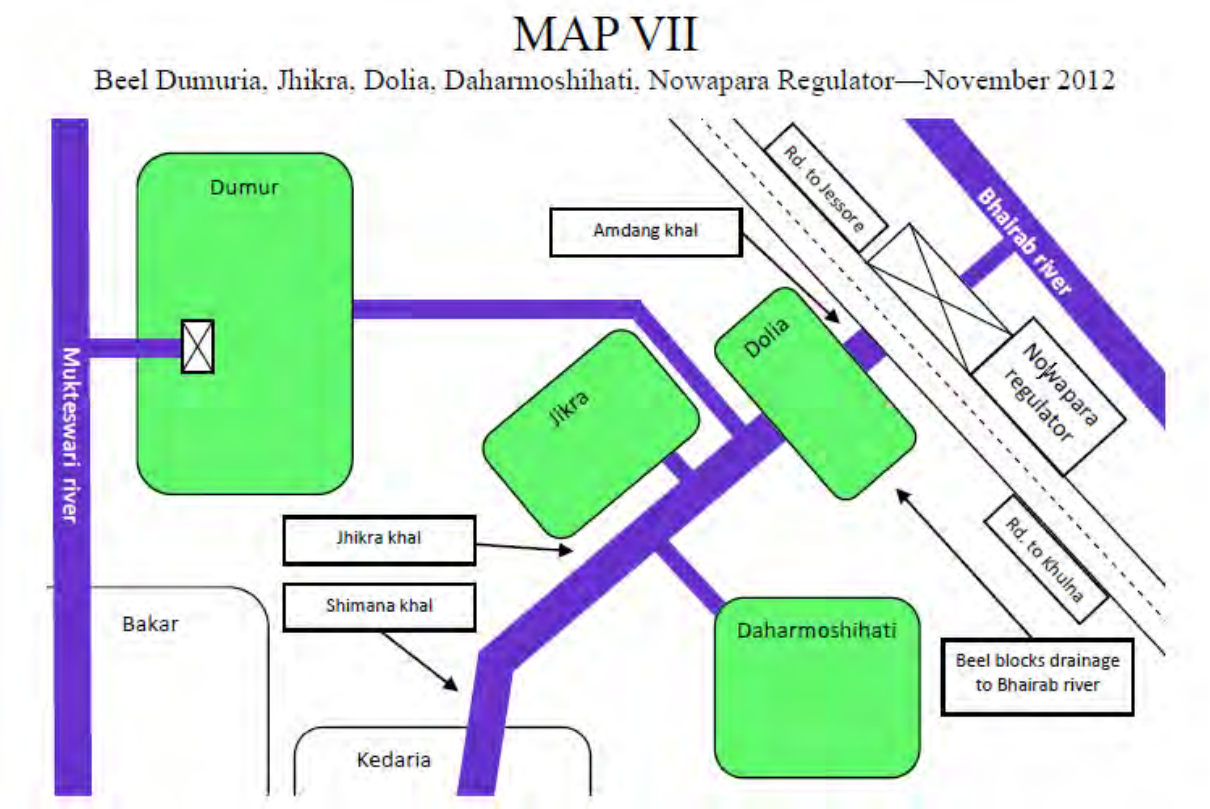


Figure 4.8. Digitalized participatory map of Beel Dumur, Jikra, Dolia, Daharmoshihati and the Nowapara regulator.

Beel Dumur, Jikra, Dolia and Daharmoshihato demarcate the upper boundary of the KJDRP area. Beel Dumur drains into the Mukteswari river, whereas Beel Jikra, Dolia and Daharmoshihati drain in the Jikra khal. The khal leading from Beel Kedaria to the Nowapara regulator has three names: Shimana khal, Jhikra khal and Amdang khal.

There are no active formal or informal WMGs or WMAs in these northern Beels. The gates that lead from Beel Dumur to the Mukteswari river and to Jhikra khal are always open.

All Beels in this area experience water logging problems in the monsoon season. For this reason, the Nowapara regulator was built in 2005. The local member of parliament, Mr Amin Uddin, ordered the BWDB to construct the regulator and drain in the Bhairab river. Today, most water still drains through Babodah regulator into the Hari river. The main reason for this is that the Amdang khal is blocked by ghers and is therefore not contributing to increased drainage of Beel Jhikra, Daharmoshihati and Dolia.

4.3 The Solmari catchment / Beel Dakatia

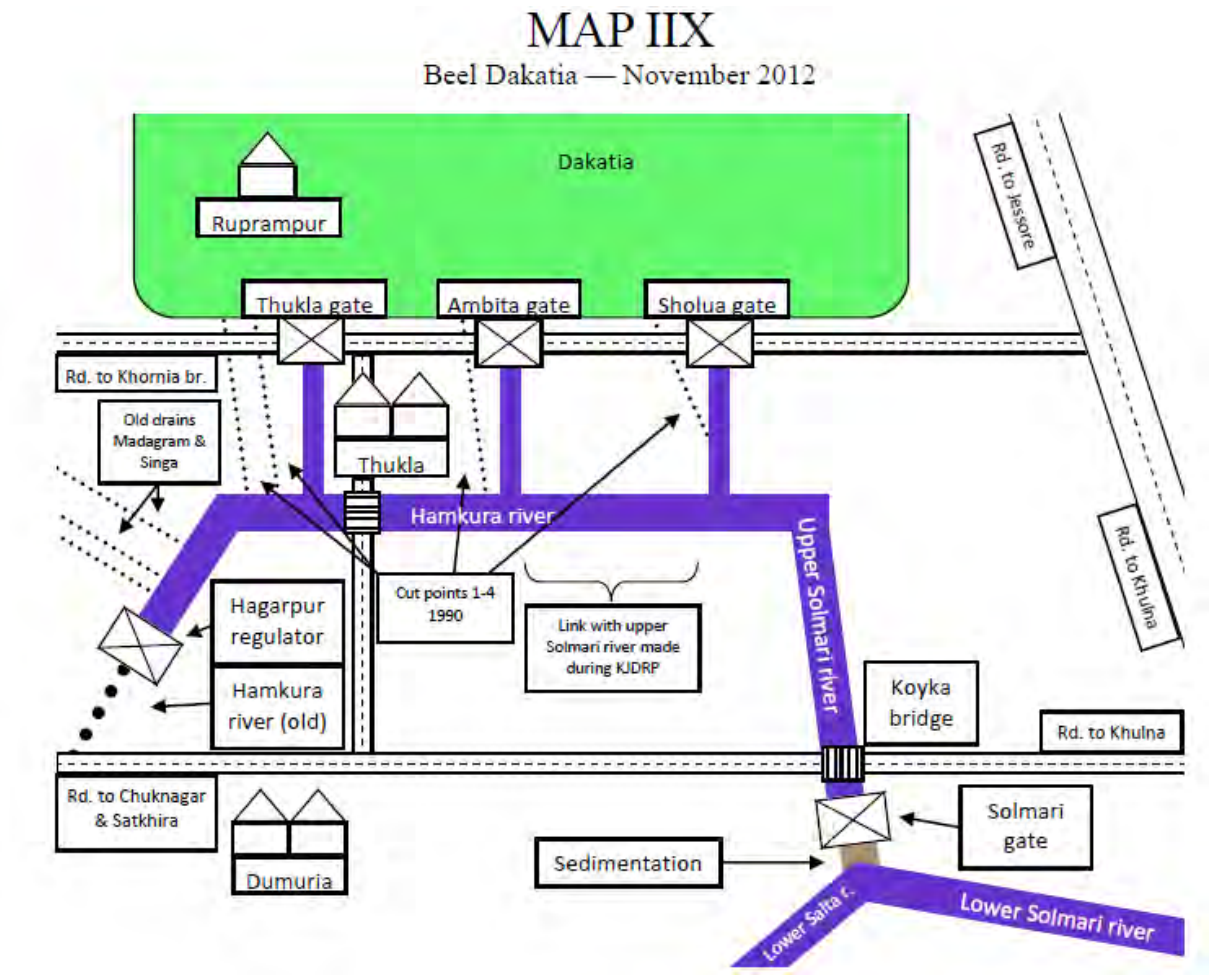


Figure 4.9. Digitalized participatory map of Beel Dakatia and Solmari gate

In the late 1980s and the early 1990s, Beel Dakatia suffered from severe drainage congestion. In his book "Beel Dakatia: the environmental consequences of a development disaster", Atiq Rahman (1995) describes the social, economic and environmental deterioration caused by water logging in Beel Dakatia.

Beel Dakatia is the largest Beel in the KJDRP area and – unlike all other Beels in the KJDRP area - drains into the Solmari river. The Beel drained in the Hamkura river up to 1998, when a connection between the Beel and the Lower Solmari river was established during the KJDRP. This involved dredging of the upper Solmari river and the excavation of a khal connecting it to the khals of the Tukla and Ambita gate, and placing the Solmari regulator closer to the Lower Salta river and Lower Solmari river. Drainage improved due to these measures; Beel Dakatia now knows many paddies and ghers.

The gates at Tukla, Ambita and Sholua gate drain water from Beel Dakatia and lead it to the Solmari gate through the Upper Solmari river. The BWDB opens and closes the gates. They have an office in Ambita and near Solmari gate.

The south part of the Beel is relatively well drained, but the north sometimes experiences drainage congestion in the monsoon season. Another problem is sedimentation of Solmari gate. As this gate is located approximately 100 meters above the confluence of the Lower Salta river and the Lower Solmari river, it is prone to sedimentation.

4.4.1 Political developments since the KJDRP

During the KJDRP, 9 Water Management Associations were established, and 68 Water Management Groups. The WMAs were established based on hydrological boundaries, and WMGs were established in villages or groups of villages[48]. The KJDRP management had not planned to set up a Water Management Federation, but the local people did so to support their common interests at the level of the two catchments (Interview Shorab Hossain, 17-10-2012). Representatives of the Water Management Groups formed the Water Management Associations.

From the short overview of the current state of the KJDRP area presented in the previous sections, it can be concluded that the role of the official Water Management Groups and Associations – as established during KJDRP – has been greatly diminished[49]. Since the end of the KJDRP in 2003, local water management has predominantly been taken over by informal water management organisations, or have lost their power altogether (for example in the northern Beels (section 4.2.7) (see figure 4.8). The Water Management Federation is not active anymore.

[48] See Annex VI for a map of WMAs established during the KJDRP.
[49] Hashim Ali Fakir, consultant at Uttaran, has called the role of officially established WMGs and WMAs "cosmetic" (interview 18-11-2012).

Figure 4.10. An abandoned WMA building in Arua, built during the KJDRP.

Source: own photograph

Since the end of the KJDRP, the BWDB and the Institute for Water Modelling (IWM)[50] have been conducting research in the area and have come up with a rotational tidal basin plan (figure 4.11), in order to maintain the tidal prism in the Hari river and prevent future drainage congestion[51] (IWM, 2010).

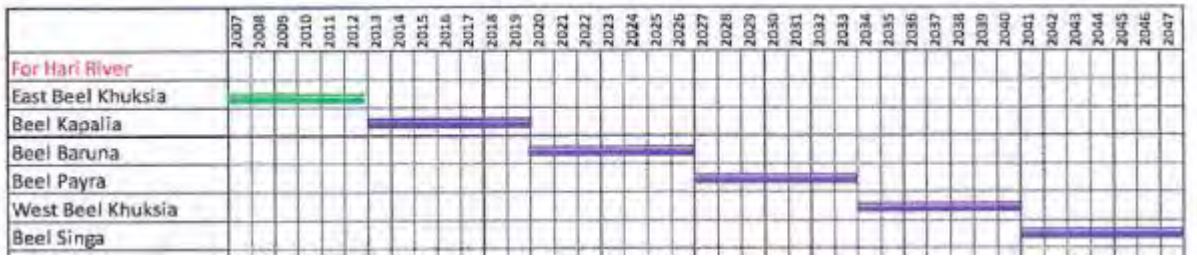


Figure 4.11. The IWM plan for rotational tidal basins in the Hari-Mukteswari river.

Source: IWM, 2010

The plan envisages the operation of successive tidal basins in the Hari river, with Beel Kapalia the first to open in 2012-2013. However, because of the diminished role and power of local WMGs and WMAs, local participation in the decision-making process of this plan has dropped considerably.

[50] And, on a small scale, the Center for Environmental and Geographic Information Services (CEGIS)
[51] The full IWM plan is available on request.

When the BWDB attempted to open Beel Kapalia tidal basin in June 2012, they encountered fierce local opposition.

4.4.2 Beel Kapalia, June 2012

On June 2nd, 2012, the government and the Bangladesh Water Development Board planned the opening of a tidal basin in Beel Kapalia for a period of 5 years[52]. At the proposed site of the embankment cut, near the temple in Kapalia village (figure 4.7), Sheikh Abdul Wohab (Member of Parliament), Deepok Kumar Shorkar (superintendent engineer BWDB Jessore), Mosjur Rahman (executive engineer BWDB Khulna) and several local government chairmen met an angry group of demonstrators, who were against the opening of Beel Kapalia[53].

As the protest turned violent, the demonstrators attacked the government and BWDB officials; their cars were burned and several members had to be treated in the hospital (figure 4.12). According to Deepok Kumar Shorkar (BWDB Jessure), the police did not do anything to prevent the violence[54] (interview 6-11-2012). The next section explains what had lead to this event.

Figure 4.12. Violent protest against the tidal basin in Beel Kapalia. June 2nd, 2012.

[52] How the decision-making process that led to the actual attempt to open Beel Kapalia had evolved has not become clear from interviews with various stakeholders. The Institute of Water Modelling (IWM) has laid out a detailed plan to open Beels along the Hari river rotationally, but the BWDB has not published an official project document. Nevertheless, it is clear that the decision-making process did not include local stakeholders; the decision to open up Beel Kapalia was top-down.

[53] The amount of demonstrators has not become clear. The local population told me that there were thousands (up to 5000) demonstrators, whereas the superintendent engineer of the BWDB in Jessore claimed that there were only 100-150 people resisting the Beel cut.

[54] When I found out about this incident during the RWMA, I went on a quest to find what had happened that day.

4.4.3 Causes for violence

The violence in Kapalia of June 2nd, 2012 had several causes. It must be noted that 95% of people who have land in Beel Kapalia are actually in favour of the development of a tidal basin in the Beel (see chapter 5 on perceptions of "TRM"). However, a small group of people fiercely resists the temporal inundation of the Beel. Four main reasons were found for the violent act that prevented the opening of Beel Kapalia in June 2012.

The compensation mechanism that is designed to financially support farmers whose land is inundated does not function effectively[55]. Currently, the District government in Jessore (approximately 40 km away from Beel Kapalia) is responsible for the processing of compensation requests[56]. The forms that need to be filled in are highly complex; they require several official documents land ownership documents, which many farmers do not possess (see annex VII for a copy and translation). Moreover, many farmers in the area cannot read and write.

Second, much land in Beel Kapalia is so-called "enemy land". This land was abandoned by Hindu inhabitants in 1948 when Bangladesh became independent, and taken by their former neighbours, Muslim farmers. This land was never officially registered with the government, which makes it (1) not possible for the current land users to demand compensation at all and (2) to receive the land back after the inundation of Beel Kapalia has finished. The group of farmers that uses enemy land thus risks losing their entire livelihood upon inundation of the Beel.

The third reason for the violence in Kapalia can be subscribed to a general lack of trust in the government. Beel Khuksia has been a tidal basin for 7 years already, but the initial plan was to only open it for 3 years only. Thus, people in Beel Kapalia do not believe that their Beel will only be inundated for 5 years; they fear to lose their land much longer.

Fourth, the people of Beel Kapalia believe that peripheral embankments should be constructed around their villagesto prevent flooding.

Swapan Batacharjee, the upazilla chairman of Manirampur, was one of the main organisers of the demonstration. He is against the transformation of Beel Kapalia into a tidal basin as long as the Bangladesh Water Development Board does not implement a proper compensation mechanism and listens to the demands of the local population of the Beel.

[55] Only very few farmers in Beel Khuksia were compensated for their loss. Farmers who receive compensation get 48000 taka / biga / year.

[56] The District government, NGOs and the people from Beel Kapalia proposed to make the union government responsible for the payment of compensation, as the union government knows the local reality better than the district government. Despite having written several letters to the Prime Minister's office requesting to change the compensation process, they have yet to receive a response.

4.4.4 The closure of Beel Khuksia and violence in February 2013

At the time of writing, there are unconfirmed reports that the cut in the embankment of Beel Khuksia has been closed during a popular action in late January – early February 2013. If this claim is correct, it has widespread consequences for the people living along the Hari river. Not only will the river be more subject to sedimentation and drainage congestion[57], it also puts pressure on the people of Beel Kapalia and the BWDB to implement an effective solution to the heated political debate around the development of Beel Kapalia into a tidal basin.

4.5.1 Conclusion

This chapter has shown that the current situation in the KJDRP area is highly dynamic. By conducting a Rapid Water Management Appraisal, the current water management practices are now mapped, and it is possible to answer subquestion 2[58].

Current water management practices consist of the control of regulators in the area to drain water from the Beels into the Hari-Mukteswari river or the Solmari river, which is defined by the area's dynamic political situation. Official water management entities established as part of the KJDRP (68 WMGs, 9 WMAs and 1 WMF) have lost much of their power since the end of the project (figure 4.9). Instead, on a local level, informal groups sometimes consisting out of a single powerful shrimp farmer control the gate or regulator that drains a Beel or set of Beels (i.e. Beel Thaulia). In Beel Dakatia the BWDB controls the drainage gates, and in the northern Beels there seems to be no water management organisation at all, be it formal or informal.

The Bangladesh Water Development Board is responsible for the management of the entire Hari-Mukteswari and Solmari rivers, and executes projects that require decisions taken above Beel level, for example the construction of tidal basins. The violent incident described in section 4.4.2 shows the large gap between the Bangladesh Water Development Board and local stakeholders. The lack of consultation of the latter in the decision-making process is only aggravated by the violence in June 2012.

[57] Most sedimentation occurs in the dry season from February to May, as there is less pressure from upstream fresh water.
[58] What are current water management practices in the study area?

4.5.2 What's next?

In contrast to chapters 2 and 3, this chapter has attempted to describe the current situation in the study area, and the developments since the end of the KJDRP in 2003. The term "tidal river management" has not been coined once in this chapter, for the mere reason that the following question remains unanswered: *what is Tidal River Management?*, and according to whom?

The conceptualization and definition of "Tidal River Management" is highly diverse among stakeholders. The term did not even exist before the 1998 CEGIS report (3.9). Yet, it is used by a wide variety of actors in many different ways. Chapter 5 will explore how the term "TRM" is perceived and defined by different stakeholders in the study area, by means of presenting 6 frames.

Chapter 5: what is “Tidal River Management”?

“The universe is change: life is judgement.”

Marcus Aurelius (Meditations, book IV, paragraph 3:4)

5.1 This chapter

The previous chapters have described how the study area has evolved physically and politically over space and time. Up to now, the question *"what is Tidal River Management?"* has been avoided, because the concept is framed differently by various stakeholders.

This chapter presents 6 frames of "Tidal River Management. An essential purpose of this chapter is to show similarities and differences between the different perceptions of "Tidal River Management".

5.1.1 Deconstructing "Tidal River Management"

What is "Tidal River Management"? The term is used by many, but seems to have different meanings in each context. In order to continue with this chapter, it is important to start with a tabula rasa; to set aside previous interpretations or ideas on how "Tidal River Management" is defined, described or what the term entails.

In chapter 1, "Tidal River Management" was introduced as "temporarily depoldering in tidal rivers" (page 1) with the purpose of mitigating drainage congestion in the Hari-Mukteswari river. In previous chapters, this has turned out to be a description of "Tidal River Management" that is suitable in most contexts.

What this chapter aims to do is to show how different stakeholders *frame* the concept "Tidal River Management". Important questions that will be answered are: *How do different stakeholders define the term? What is the purpose of "Tidal River Management"? How did the practice develop? How does "Tidal River Management" work? What makes "Tidal River Management successful or not?"* And, most importantly: *why does a (group of) stakeholder(s) perceive or frame "Tidal River Mangement" in their particular way?*

5.2 "Tidal River Management" in 6 frames

Six frames of "Tidal River Management" were identified during this research. The frames are not mutually exclusive; a stakeholder's perception of "Tidal River Management" can belong to more than one frame. The six frames show spatial and temporal variety, which reflects the relation that a given stakeholders has with "Tidal River Management". However, this spatial and temporal variety alone is not sufficient to explain the scattered perceptions of what "Tidal River Management" is or should be.

An overview of the six identified frames is shown in table 5.1. Those encountered most often are presented first. The ~~*TRM*~~ *Concrete!* frame was only indirectly identified and presented in section 5.2.6.

Table 5.1. Overview of TRM frames.

Section	Frame	Who?	Where?	When?	Why?
5.2.1	TRM = tee-r-am	local farmers / villagers	in area	short exposure	definition "TRM" is locally based
5.2.2	TRM = tidal prism	water experts	out area	long exposure	good physical knowledge of area
5.2.3	TRM = threat	locals	inundated areas / proposed basin	short exposure	TRM bad for economic interests
5.2.4	TRM = ind. WMP	NGOs	in and out area	med. exposure	financial / activist reasons
5.2.5	TRM = not enough	experts	Khulna / in area	long exposure	good knowl. area pre-interventions
5.2.6	~~TRM~~ concrete!	BWDB	out area	long exposure	financial reasons

5.2.1 "TRM raises the land level of our Beel / TEE-R-AM"

Where?: Beel Bhaina, Kapalia, Singha, Khuksia, Madagram, Boruna, Payara-Koyar
Who?: poor, uneducated, farmers or day labourers
Spatial relation to "TRM": perception "TRM" based on local observations – inundation of Beels
Temporal relation "TRM": little knowledge on history area
Refers to day reports: 18-10, 23-1-, 24-10, 1-11, 2-11, 5-11, 15-11, 19-11

The majority of the interviewed stakeholders in the study area perceives "Tidal River Management" as a water management practice that *raises the land of a Beel by means of temporarily inundating it with sediment-laden water*. Interviews in Beel Bhaina (18-10) and many in other Beels throughout the study area have shaped this frame.

"Tidal River Management" is, in the view of this large group of local farmers and villagers, a practice that redirects water and sediment into a given Beel, where the sediment settles and thereby gradually raises the land level of the low-lying Beel. Most people agree that "Tidal River Management" has positive effects on Beels located upstream and downstream of the tidal basin by improving the overall drainage in the river. The primary purpose of "TRM" is, however, to increase the land level in the Beel. Given the positive aspects of raising the land of the Beel on drainage, the majority of this group is in favour of what they perceive as "TRM". However, it is also the reason why this group perceived "Tidal River Management" in Beel Kedaria as a *failure*[59].

What characterizes most stakeholders who perceive "Tidal River Management" as a Beel-filling practice, is that their knowledge on the physical and political dynamics of the study area is limited. Most of these stakeholders are uneducated farmers with little specific knowledge on the study area or its history; few had knowledge on earlier embankment cuts and tidal basins, and the history of the KJDRP or CEP.

An interesting observation made during the interviewing of this group, was that the abbreviation of "Tidal River Management" – "TRM" – has gone to live its own life. Many people did not know the term "Tidal River Management"; rather, they knew the practice as the pronunciation of its abbreviation: "Tee-r-am" ("TRM"). This shows that the perception these stakeholders have of the concept "Tidal River Management" is very locally grounded and, in comparison to other frames, not based on a historical background/understanding of the major physical and political processes that shape the areas current reality.

[59] There was no sedimentation in Beel Kedaria.

5.2.2 "TRM is method of silt management in Hari-Mukteswari river"

Where?: Jessore, Khulna, Dhaka, Beel Kapalia, Bhaina,Singa, Payara, Kedaria, Jhikra, Dumur
Who?: DC Jessore, BWDB officials, local water management leaders, local pol. leaders
Spatial relation to "TRM": knowledge on entire Hari-Mukteswari river, hydrology of SW delta & BGD
Temporal relation "TRM": medium to long experience with water management in area
Refers to day reports: 30-9, 17-1-, 18-10, 1-11, 2-11, 3-11, 5-11, 7-11, 8-11, 10-11, 11-11, 15-11

A large group of stakeholders perceives "Tidal River Management" as a practice which has the primary objective of mitigating drainage congestion in the Hari-Mukteswari. People who frame "TRM" this way are mostly elderly locals and educated professionals in or outside of the KJDRP area.

As tidal basins increase the tidal prism of the Hari-Mukteswari river downstream of tidal basin, sedimentation is prevented and the cross section of the river is maintained. "Tidal River Management" thereby has a river-wide effect: it improves drainage in Beels upstream and downstream of the tidal basin considerably. A second advantage is that "Tidal River Management" raises the land level of a Beel, which improves drainage after closure of the tidal basin. However, this is not essential for successful "TRM"; these stakeholders regard the tidal basin in Beel Kedaria as a *success,* unlike the previously described "Tee-R-am" group.

Stakeholders framing "Tidal River Management" as a practice to maintain overall drainage in the KJDRP area are well informed about the historical physical and political processes in the study area. This group includes Zahirul Haque Khan (director Ports & Estuaries IWM), Andrew Jenkins (former consultant KJDRP), the DC of Jessore[60], several BWDB engineers (in Khulna and Jessore), Mohir Uddin Biswas[61], NGOs like Uttaran[62] and Ulashi Sreejoni in Jessore, local water managers (Abul Bashar in Beel Bhaina), and a large group of women interviewed in Kapalia village. Even Swapan Batacharjee[63] describes "Tidal River Management" as the only option to mitigate drainage congestion of the KJDRP area.

[60] The District Commissioner of Jessore – Mustaffazur Rahman - deals with the financial compensation of people in (prospective) tidal basins.
[61] President Water Management Association Zone F. Arguds for change of name to "Tidal River **Silt** Management" at IWMI / Shushilan workshop on November 3rd, 2012.
[62] Although Uttaran frames "Tidal River Management" predominantly as an indigenous water management practice (5.2.4)
[63] Upazila chairman of Manirampur, is believed to have organised the violent protests against the embankment cuts in June 2012 in Beel Kapalia.

5.2.3 "TRM is a livelihood threat"

Where?: Beel Khuksia, Kapalia, Khulna, Dhaka
Who?: Shrimp farmers, local politicians, landless people
Spatial relation to "TRM": local perception of "TRM", politicized opinion
Temporal relation "TRM": might be in area long time, politicized opinion
Refers to day reports: 17-10, 23-10, 3-11, 3-11, 5-11, 10-11

Only two out of 63 interviews turned out to be with stakeholders against "Tidal River Management"[64], which they see as a useless practice that takes away land from hard-working farmers. Those who perceive "Tidal River Management" as a livelihood threat do so primarily out of economic interests.

In the perception of this group of stakeholders, "Tidal River Management"'s potentially positive outcomes do not outweigh the negative consequences for the local population in current or prospective tidal basins. The reason why this group is against "Tidal River Management" is not so much based on their spatial and temporal relations with "Tidal River Management". As the compensation mechanism is very complex (see section 4.4.3), the economic prospects for this group when their Beel is inundated is very negative; they will most probably lose the majority of their income during the inundation of the Beel.

The largest group of people against "Tidal River Management" is located in Balidha village, north of Beel Kapalia. The group of (mostly) shrimp farmers that lives here has strong economic interests in Beel Kapalia, and do not want to give up the land they have leased for multiple years. In comparison to the first group of stakeholders, the anti-"TRM" group has more knowledge on the physical and political aspects of "Tidal River Management", and of the history of the area.

Two other groups that perceive Tidal River Management as a threat to their livelihood are landless people and people who cultivate so-called enemy land (4.4.3). These groups will lose their day job and have no right to compensation, respectively, and are believed to have fiercely protested the opening of Beel Kapalia in June 2012 (section 4.4.2).

[64] See annex IIX

5.2.4 "TRM is an indigenous water management practice"

Where?: Dhaka, Tala, Amsterdam
Who?: Uttaran, Both Ends
Spatial relation to "TRM": involvement in entire SW delta
Temporal relation "TRM": long involvement with water management in study area
Refers to day reports: 4-10, 6-12

Uttaran is one of the largest NGOs in the southwest delta of Bangladesh, and has a particular view on "Tidal River Management". In a joint 2011 publication, Uttaran and the Amsterdam-based NGO Both Ends portrayed "Tidal River Management" as an indigenous water management practice and an adaptation strategy to climate change (2011; pp. 1). Additionally, they describe "Tidal River Management" as "an age old practice in the region perfected by local communities over generations"[65].

The "age old practice" Uttaran and Both Ends refer to in their publication is locally called Jowaradhar (Datta, 2012). It entails the construction of small embankments during 6 or 8 months of the year, in order to protect rice against saline intrusion in the dry season[66]. Before the Coastal Embankment Project, the floodplains were used only part of the year to grow crops; the remainder of the year they were used for fishing purposes.

The involvement of Uttaran in the study area and the NGO's experience with "Tidal River Management" is strong and long. However, the framing of "Tidal River Management" by Uttaran does not seem to be so much based on this spatial and temporal experience. Rather, their perception might be determined by their economic interests. As the NGO depends on financial support from donors including UK's DFID and Japan's ODA, the use of popular terms like "indigenous and traditional knowledge" and "climate change adaptation" might help getting donations[67].

[65] "The estuarine rivers in the southwest coastal region witness two cycles of tides in every day. The high tides bring in muddy water flow with a think concentration of sediments. Local communities cut the embankment, in a appropriate point, to let the river flow enter a floodplain. The natural high tide of river enters the floodplain, leaves a part of the sediment to be deposited on the floodplain and goes back to the ocean. Over time, the deposition of sediments raise land level in the floodplain and enriches the soil. Since this process does not allow sediments to be deposited on riverbed, the depth of the riverbed also increases and makes the river congestion free." Source: Kibria, 2011

[66] In the dry season, salinity increases in the study area, as there is less fresh water stored in the river and soil.

[67] This is not confirmed in any interviews, but my own analysis of Uttaran's way of framing "Tidal River Management".

5.2.5 "TRM is not enough"

Where?: Khulna, Beel Kedaria
Who?: Dilib Kumar Datta (Khulna University), Rojib Bawani
Spatial relation to "TRM": knowledge on entire SW delta
Temporal relation "TRM": long involvement with water management in study area
Refers to day reports: 4-10, 24-10

In the eyes of Dilib Kumar Datta and Rojib Bawani, respectively professor of environmental science at Khulna University and a former local water manager in Beel Kedaria, "Tidal River Management" as the temporary inundation of Beels is not enough to prevent riverbed sedimentation and waterlogging in the southwest delta on the long term. Datta agrees with Uttaran that constructing 6- and 8-month embankments is the traditional method of water management, but that the current "Tidal River Management" should not be compared with the practice of Jowaradhar. The perception of Dilib Kumar Datta of "Tidal River Management" is normative; Datta argues for another way of looking at "Tidal River Management" than the majority of the people in the area do (as in 5.2.1, 5.2.2).

Dilib Kumar Datta and Rojib Bawani agree that if "Tidal River Management" is the controlling of sediment by the creation of tidal basins in the southwest delta (as in 5.2.2), the study area will be ultimately waterlogged again. The embankments built under the Coastal Embankment Project have such a strong impact on the physical environment of the study area, that the only sustainable solution would be to return to "the old system"; the removal of all embankments, the return of large floodplains, and the introduction of one harvest per year instead of the current 3.

Ideally, according to Datta, "Tidal River Management" would be based on the practice of Jowaradhar: the construction of small, easy-to-construct and remove hydromorphological segments or mini tidal basins in which controlled sedimentation takes place. The current large tidal basins are ultimately not able to keep the riverbed free of sediment, and provide no a long term-solution to the area's drainage challenge.

Dilib Kumar Datta's perception of "Tidal River Management" is based on a long involvement and study of not only the KJDRP area, but Bangladesh in total. His perception of the purpose of "Tidal River Management" would require a rigorous change of livelihoods in the entire CEP area.

5.2.6 *"~~TRM~~ we need concrete solutions!"*

Where?: Dhaka, Khulna (?), Jessore (?)
Who?: BWDB officials
Spatial relation to "TRM": knowledge on entire SW delta
Temporal relation "TRM": long involvement with water management in study area
Refers to day reports: 9-10, 10-12

The last frame on "Tidal River Management" has been mentioned in several interviews and is, like the frame presented in section 5.2.5, normative rather than applicable on the current physical reality in the KJDRP area. It portrays what this group of stakeholders think "Tidal River Management" *should* be, it does not relate to the current reality in the KJDRP area.

According to some engineers in the Bangladesh Water Development Board, the practice "Tidal River Management" should not be based on the construction of tidal basins to raise the land level in Beels, or to increase the tidal prism of the river (as in 5.2.1 and 5.2.2). Instead, some in the BWDB vouch for the construction of large regulators downstream of the KJDRP area, with the purpose of closing off the entire area of tidal influence.

This "concrete" frame is rooted in a technocratic and structural view on the practice of water management in (the southwest delta of) Bangladesh. During the design of the KJDRP project, the BWDB has already lobbied for a large multi-million dollar regulator in the Gengrail river south of the KJDRP area.

Even though the BWDB has the most and longest spanning experience with water management in the study area, the perception of what "Tidal River Management" should be is not entirely based on a well-balanced decision of *best practices*. Instead, the culture of corruption in Bangladesh can be ascribed to be the leading factor shaping this frame.

An anonymous source within the Bangladesh Water Development Board confirmed that money laundering occurs often during expensive projects implemented by the Bangladesh Water Development Board. As the cutting of embankments to create tidal basins is not expensive – in contrast to building large concrete regulators – this option is not favoured by BWDB officials who have the intention of putting some money of a large project in their own pocket...

5.3 Conclusion

Six different frames of “Tidal River Management” have been presented in this chapter. The majority of stakeholders in the study area itself, farmers and local villagers, perceive ”Tidal River Management” as a practice that heightens the land level of the Beel by temporarily inundating it, with the purpose of improving drainage after inundation. However, the group of stakeholders that has been around in the area for a longer period of time, views the practice as a means of increasing tidal prism in the Hari-Mukteswari river with the purpose of increasing river cross-sections and improving drainage.

By some, “Tidal River Management” is a direct threat to their livelihood; the concept means nothing more than the inundation of valuable cropland on which their living depends. Uttaran – the region’s largest non-governmental organisation – perceives “Tidal River Management” as an indigenous water management practice that has existed long before the Coastal Embankment Project.

Perceptions of what “Tidal River Management” *should* be are coined by Dilib Kumar Datta and the BWDB. They pledge for total removal of the embankments and the construction of large concrete regulators, respectively, and view the current overall view on “Tidal River Management” as unsustainable for the long-term drainage of the study area.

This chapter has shown that the two most common frames of “Tidal River Management” can be understood as being determined by the temporal and spatial relation the stakeholders have with the concept “Tidal River Management”. The group described first has a very local perception of the practice, and knows relatively little about the historical physical and political processes that have shaped the study area. The well-informed water expert group has long-term knowledge and experience with water management in the area, and has a good overview of the physical processes that have caused drainage congestion in the area, and the effect of tidal basins since the opening of Beel Bhaina in 1997. The much smaller groups’ perceptions on “Tidal River Management” can be understood by analyzing their political and economic interests regarding “Tidal River Management”.

Although the term “Tidal River Management” is used by many in- and outside of the study area, it has totally different meanings for many stakeholders. The frames presented in this chapter can contribute to mutual understanding and improved cooperation between different stakeholders.

Chapter 6: discussion & conclusion

"Drink before you are thirsty, eat before you are hungry"

Leendert de Die (2013)

6.1 Discussion

In this chapter, I will discuss research findings and present a conclusion. First, a short summary is given of the previous chapters, after which I reflect on these results and present several recommendations. Additionally, I elaborate on my own "frame"; the way I think "Tidal River Management" could best be understood and implemented.

6.1.1 Short summary

This thesis aimed to understand the role and perceptions of the water management practice "Tidal River Management" in the former Khulna-Jessore Drainage Rehabilitation Project area. This section will discuss how the findings in this research contribute to a better understanding of the complexity of the political and physical situation in the former KJDRP area. In other words: *How have dynamic spatial and temporal scales contributed to understanding "Tidal River Management"? And how has approaching the term as a boundary concept contributed to a better understanding of the term's scattered meanings among stakeholders?*

Chapter 2 has explained the historical and geographical context of the (southwest) delta. It showed that in understanding the study area it essential to regard its present state as the result of long (geo)morphological and tectonic processes. The eastward movement of the active delta of the Padma (the name of the Ganges in Bangladesh) has closed off many rivers in the southwest delta of upstream flow which made them tidal. The polders constructed under the Coastal Embankment Project in the 1960s aimed to improve agricultural production by closing off tidal floodplains from the rivers. This led to sedimentation of the rivers and water logging in the divisions of Khulna, Jessore and Satkhira. If the temporal and spatial context of the study area would not have been taken into consideration, the processes that have led to the current (physical) reality of the study area are not well understood.

Chapter 3 elaborated on the emergence of the term "Tidal River Management" in Bangladesh, and showed the impact of the embankment cut in Beel Bhaina, which created a tidal basin. This practice was named "Tidal River Management" by the Center for Environmental and Geographic Information Services (CEGIS) in 1998. Not only the physical state of the Hari-River – it was severely silted up -, but also the political setting during of the Khulna-Jessore Drainage Rehabilitation Project (KJDRP) led to the decision to cut the embankment of Beel Bhaina in 1997. Although there were earlier embankment cuts in Beel Dakatia in 1990, chapter 3 has shown that the timing of the

cut in Beel Bhaina contributed a lot to the actual inclusion of the "tidal basin option" (as it was named before 1998) in the KJDRP.

Chapter 4 presented the results of the Rapid Water Management Appraisal that was conducted in the study area. Its primary purpose was to sketch the study area's current water management practices, issues and problems. The chapter showed that official water management entities – the Water Management Associations and Water Management Groups established during the KJDRP – have lost almost all their power. Today, the vast majority of the gates in the study area are operated by large (rich) land owners, which makes the overall management of the study less effective, to say the least. The burning of twelve government and BWDB cars during violent protests against the development of a tidal basin in Beel Kapalia in June 2012 can be attributed to the lack of interaction between the BWDB and local informal water management entities.

Chapter 5 has presented six frames of "Tidal River Management that were identified during this research. In chapters 1 to 5, defining "Tidal River Management" has been carefully avoided, for the latter chapter has shown that the term has different connotations to various stakeholders.

6.2 Reflection

After having studied the current physical and political situation of the former KJDRP area thoroughly, the question *who controls the water?* remains. The myriad of informal water management actors and the lack of an accountable water management structure from the local up to the river basin level hampers the implementation of interventions that are supported by all people whose livelihood depends on the Hari river. Officially, the Bangladesh Water Development Board (BWDB) is in charge of the construction of physical infrastructure, and formal Water Management Associations and Groups established during the KJDRP represent groups of villages and villages, respectively.

A suitable example is the incident at Beel Kapalia in June 2012, when government and BWDB officials came together to cut the embankment of the Beel and turn it into a tidal basin. Although it can be regarded necessary to turn Beel Kapalia into a tidal basin to prevent long-term riverbed sedimentation, and as Beel Khuksia had been inundated since 2006, the decision-making process had been top-down with very little consideration of the interests of local stakeholders.

The intentions of the people that torched the twelve cars and left several officials with injuries were difficult to understand. After a long search for this group, I found that they were mainly

located in the village of Balidha in the north of Beel Kapalia. Why did this group resort to violence? Was it an act of despair or did this group want to force the implementing authorities to consider *their* interests better? In other words: was the act a means of negotiation?

Following interviews with farmers in Balidha village (day report 5-11) and with Swapan Batacharjee (day report 7-11), who is the most important official who supports the anti-"TRM" lobby in Balidha village, it became clear that even between these stakeholders the perception and goal of "Tidal River Management" is not streamlined. Swapan Batacharjee, the upazilla chairman of Monohorpur, can be regarded as an important organiser of the protests of June 2012. However, to me he stated: "I am in favour of TRM, it is the only option (to keep drainage of the Hari river ok). We need to manage it well." [68], thereby referring to the inefficient compensation mechanism and the lack of employment opportunities for the landless during inundation.

In contrast, the farmers interviewed in Balidha village, fervent supporters of Swapan Batacharjee, did not believe that the development of a tidal basin in Beel Kapalia would ever be successful, not even when an effective compensation mechanism would be implemented and employment for the landless would be managed by the government. This extreme standpoint can be partly attributed to the economic interests of the (shrimp) farmers in Balidha village, who do not want to lose their leased land under any circumstances. Additionally, they seem to have lost trust in government completely[69]. From this perspective, the violence can be regarded as a strong means of protest against the current political establishment.

Was the violence of June 2012 an act of despair or an act of negotiation of people whose livelihood was under threat? Different perceptions of reality exist among involved stakeholders. Part of the protesters were fundamentally against the inundation of land to benefit the Hari river (those in Balidha village), but their supported political leader Swapan Batacharjee *did* see the demonstration as a way of saying *"no"* against the process leading to and circumstances of the proposed cut in June 2002, lacking the regard of local stakeholders' interests, but saying "*yes*" to "Tidal River Management" in general.

[68] "TRM" as in a tidal basin to control riverbed sedimentation. It might be that he tells his supporters that he is against "Tidal River Management"
[69] Except for the trust in Swapan Batacharjee.

6.2.2 The boundary concept "Tidal River Management" in time and space

Approaching "Tidal River Management" as a boundary concept has helped to understand that the term has different meanings and connotations for different stakeholders, and paved the way to the identification of different frames as presented in chapter 5. It has helped to understand the situation on the ground as a complex mix of perceptions, storylines and interests, which all contribute to that we call "reality".

Using different spatial and temporal scales has helped to understand the emergence of the water management practice "Tidal River Management" better. It showed that the processes in the southwest delta are the result of (geo)(anthro) morphological and tectonic processes that occurred over thousands of years. It has also shown the dynamic nature of water management in the study area, with many factors contributing to the current physical state of the Hari river.

6.2.3 Compatible frames of reality?

What is reality? Who does reality belong to? Is the perception of the majority "reality"? Of the experts? Is there *one true reality*? This research has shown that many frames of reality exists besides each other. Depending on the perspective of a stakeholder, it being characterized by (spatial and temporal) knowledge of "Tidal River Management" or by the disciplinary background of the person, every stakeholder has a unique construction of reality of which "TRM" or "Tidal River Management" is part.

Is the presence of these diverging frames of "Tidal River Management" beneficial, or does it hamper effective decision-making? In the case of the Hari river, the combination of diverging frames and the absence of a government that fails to take into account these diverse frames and interests, can be regarded as hampering the development of long-term water management plan of the Hari river.

Most of the frames that I identified in this thesis do not fundamentally contradict each other; they are different distillations or understandings of the same perceived reality. This is especially true for 3 identified frames ("TEE-R-AM", "TRM keeps river OK", "TRM as an indigenous water management practice"), because they are all based on the current physical situation in the study area. The 3rd frame ("TRM as a livelihood threat"), 5th frame ("TRM is not enough") and the 6th frame ("~~TRM~~ concrete!") are normative and pledge for a completely different approach to the management of the Hari river and her sediment. The violence in June 2012 at Beel Kapalia shows the problematic aspects of the existence of these frames, especially when the stakeholders adhering these frames are not taken into consideration by the BWDB.

6.3 My frame

I identify myself mostly with the second identified frame. I am convinced that tidal basins can form an environmentally and economically viable alternative to dredging and large-scale concrete infrastructure as a means of controlling riverbed sedimentation, or the complete removal of all embankments. I think it is of prime importance, however, for implementing authorities to focus on participatory governance. This research has clearly shown that the current challenges in the research area pertain as much or even more to political and social aspects of water management rather than the physical dimensions.

I am quite certain that tidal basins can be constructed in other rivers in the southwest delta as well with positive results, whilst there is support by local stakeholders. This support needs to be gathered by creating effective compensation and adaptation mechanisms for those people who are impacted by the inundation.

During this research, I also thought about the option of creating numerous small tidal basins along the Hari river, instead of one large basin. Numerous small tidal basins can together increase the tidal prism of the Hari river as much as one large basins, but have potentially less intrusive physical, political and social side-effects.

6.4 Lessons and recommendations for the future

This research has shown that water management in the southwest delta of Bangladesh is a very complex challenge. The interaction between formal and informal water management entities (groups, associations and the BWDB), acting on different scales, makes it hard to gain an accurate overarching understanding of the study area. The highly dynamic physical conditions in the area add to this complexity.

There are numerous other tidal rivers rivers in the southwest delta, of which many suffer from similar symptoms as the Hari river. The riverbed of the Kobadak river near Tala, for example, has gradually sedimented up and many adjacent areas now have to cope with the detrimental effects of waterlogging (day report 19-11). This study has shown that tidal basins can contribute to controlling riverbed sedimentation and maintaining drainage in the tidal Hari river. Possibly, tidal basins might be able to mitigate riverbed sedimentation in other rivers in the southwest delta.

However, this research has also shown that the political dimension of water management in the southwest delta is highly important to consider in potential future interventions in the study area. Currently, informal water managers control almost all gates (and thus water levels). The official water management associations and groups established during the Khulna-Jessore Drainage Rehabilitation Projects have lost much of their power. Large and rich land owners control when gates are opened and closed, but do not represent local stakeholders at the Bangladesh Water Development Board and in official meetings with the different layers of government (district & upazilla).

For future projects, I recommend that informal local water management entities should be involved in basin-level water management, for example the construction of tidal basins in the Hari river[70]. These entities usually consist of very few but powerful people, which have a large influence on the local reality in the Beels. In contrast to the official WMGs and WMAs established during KJDRP, the informal entities are not composed of representatives of local communities (day report 17-10), but the (relatively wealthy) elite. Although this might be difficult for donor countries to support, it is the reality on the ground that one should not disregard.

Additionally, I recommend the BWDB, district and local governments in the former KJDRP area to swiftly and inclusively start sessions to inform all stakeholders on the current situation in the Hari-Mukteswari river. Many of the disagreements between stakeholders pertaining "Tidal River Management" are, in my view, the result of the lack of available and reliable information. To prevent a spiral of mistrust and – potentially - violence[71], inclusive measures should be taken to enhance dialogue between stakeholders, mostly those in the field.

The third recommendation I present regards the approach and design of future interventions. I think it is extremely valuable to start any field research with a *tabula rasa* – an open mind, without expectations[72]. Being objective and introducing oneself as being independent to stakeholders in the field can contribute considerably to gaining better understanding of the study area and its current reality. This recommendation is based on my own methodological reflection, especially on the initial field trip that was made in early October 2012 which had the prime purpose to getting a "feel" for the study area and its peoples.

[70] On November 3rd, a meeting in Khulna took place of members of the WMGs and WMAs in the study area. Many of the people present there we never found back in the field. Their role in the water management system in the study area seems to be more symbolic than practical, as in the control of water levels through the operation of gates.

[71] There are reports that several people were hurt and even killed during water management related violence in Beel Kapalia in February 2013.

[72] This would be possible in the perfect world, as every reseacher / consultant also perceives reality through the glasses of his or her (disciplinary) background.

6.5 Suggestions for further research

Although this research has attempted to provide an inclusive general overview of the past and the current physical and political situation in the study area, many questions remain unanswered and might form the subject of interesting (MSc?) research in the future. The role of the relation between shrimp and rice farmers in the study area, for example, would be very interesting to analyze. How do these two groups of stakeholders interact? And how does this relation differ (or not) from other areas in Bangladesh and why?

Taking a historical perspective on land ownership in the study area might also be the topic of future research. Much land in Beel Kapalia and possibly also in other Beels was abandoned by Hindus in 1948 when (East) Pakistan and India separated. This land was "taken" by Muslim settlers and never formally registered, which poses problems with the compensation process in Beel Kapalia today (see 4.4.3).

Another research topic would be to investigate the process of land redistribution after a Beel has served as a tidal basin. This process is highly interesting, as it might be based on age-old informal (water / land) management practices deeply rooted in the local communities.

6.6 Conclusion

In 1927, five years after Bengal was struck by severe floods, the Kolkata professor Prasanta C. Mahalanobis warned that building embankments as part of a flood control strategy would be ineffective because of the build-up of sediment on the riverbeds (Lewis, 2011). This research has shown that professor Mahalanobis' advice should have been taken into consideration by the USAID and the East Pakistan Water and Power Development Board in the 1960, when the Coastal Embankment Project was implemented in the southwest delta of then East Pakistan. Water logging due to drainage congestion had detrimental consequences for the lives of hundreds of thousands of people in the southwest delta from the late 1980s.

The water management practice "Tidal River Management" that emerged during the Khulna-Jessore Drainage Rehabilitation Project in 1997, showed that tidal basins can be an economically and environmentally friendly way of controlling sediment deposits in the Hari river by increasing the rivers tidal prism and cross section. The challenges that pertain to the practice today are, however, of social and political rather than physical nature. There is a large gap in the interaction between different levels of government and between water management entities on river basin level (BWDB)

and the field level (informal water management groups). It seems that, although polders were constructed nearly 50 years ago, a democratic polder-model has not evolved up to today.

This chapter has summarized and reflected upon this research' findings, and has attempted to answer the main research question:

> *How can the emerging water management practice "Tidal River Management" be understood using dynamic spatial and temporal scales, and how can approaching the term as a boundary concept help explain how and why stakeholders frame the concept differently?*

The analysis that was conducted in chapter 2 and 3 has led to an understanding of the spatial and temporal context of the emergence of "Tidal River Management" by describing the historical (geo)(anthro)morphological processes that led up to the embankment cut of Beel Bhaina in 1997. Accordingly, chapter 4 and 5 have attempted to answer the second part of the research question. The frames of the term "Tidal River Management" that were identified and presented in chapter 5 teach us that there are multiple perceptions and meanings of "Tidal River Management" in the former Khulna-Jessore Drainage Rehabilitation Project area. That some of these perceptions are in conflict with others, became clear in June 2012 when angry protesters burned 12 government and Bangladesh Water Development Board vehicles.

Unfortunately, flood management in Bangladesh is not as simple as building embankments to keep water out of places where it is not desired. More than any other place on Earth, Bangladesh shows that the only way to creating a sustainable relation between people and their environment is to work together instead of against each other. It is time for Bangladeshi to do the same. Not underestimating his good intentions, Sheikh Mujibur Rahmans unrealistic dream of an "embanked" Bangladesh has not come true. Fortunately.

References

Chapter 1

Asian Development Bank (ADB) (2007). *Performance Evaluation Report: Bangladesh, Khulna-Jessore Drainage Rehabilitation Project*. Operations Evaluation Department, Asian Development Bank.

BDnews (2012). *"More strikes if essentials become costlier"*. Retrieved on January 3rd, 2013 from bdnews24.com/details.php?cid=3&id=238854&hb=3

Benson, D., Jordan, A. (2010).*The scaling of water governance tasks: A comparative federal analysis of the European Union and Australia*. Environmental Management 46:1, page 7–16.

Bolding, A. (2012). *The Nuts and Bolts of Cross-disciplinarity*. Lecture at Wageningen University; March 19th, 2012.

Bron, J. (1997). *Water Management in the Bangladesh Context*. Reader of Workshop on Integrated Water Resources Management, BUET 1997.

BUET: Bangladesh University of Engineering and Technology, Bangladesh Centre for Advanced Studies (2010). *Interdisciplinary Research in Water Resources Management; Reader on Tidal River Management in Southwest Coastal Area*. Conference in Dhaka and Khulna, August-September 2010. Available on request.

CIA World Factbook (2012). *Bangladesh*. Retrieved on October 11th, 2012 from https://www.cia.gov /library/publications/the -world-factbook/geos/bg.html

Cash, D., Adger, W.N., Berkes, F., Garden, P., Lebel, L., Olsson, P., Pritchard, L., Young, O. (2006). *Scale and Cross-Scale Dynamics: Governance and Information in a Multilevel World*. Ecology and Society 11:2.

Chambers (1988) in Mollinga & Wester (1997; 2010). *Water control in sociotechnical systems: a conceptual framework for interdisciplinary irrigation studies*. Unp. lecture notes; pp.3.

Chambers, R. (2007). *Participatory mapping and Geographic Information Systems: Whose Map? Who is empowered and disempowered? Who gains and Who loses?* In: The electronic journal on information systems in developing countries, 25:2, pp. 1-11.

Dewulf, A., Mancero, M., Cárdenas, G., Sucozhanay, D. (2011). *Fragmentation and connection of frames in collaborative water governance: a case study of river catchment management in Southern Ecuador.* Ecology and Society 12:2.

Discover Bangladesh (2013). *Bangladesh: Religions*. Retrieved on January 2nd, 2013 from www.discoverybangladesh.com/meetbangladesh/religion.html

Free Dictionary (2013). *Definition of Polder*. Retrieved on March 20th, 2013 from www.thefreedictionary.com/polder

Gibson, C.C., Ostrom, E., Ahn, T.K. *The concept of scale and the human dimensions of global change: a survey*. Ecological Economics 32, pp. 217-239.

Gitlin, T. (1980). *The Whole World Is Watching: Mass Media in the Making and Unmaking of the New Left*. University of California Press.

Government of Bangladesh (2012). *All area*. Retrieved on October 11th, 2012 from www.cabinet.gov.bd/ view_area.php?page=all_area&lang=en

Happy Planet Index (2012). *Bangladesh*. Retrieved on February 16th, 2013 from happyplanetindex.org

Hughes, R., Adnan, S., Dalal-Clayton, B. (1994). *Floodplains or Flood Plans? A review of approaches to water management in Bangladesh*. Russell Press, Nottingham.

Hussain, I., Ahmad, Q.K., Karim, Z., Azharul Haq, K. and others (2004). *Pro-poor intervention strategies in irrigated agriculture in Asia*. Country report Bangladesh. International Water Management Institute, Bangladesh Unnayan Parishad, Asian Development Bank.

Institute of Water Modeling (2010). *Feasibility Study and Detailed Engineering Design for Long Term Solution of Drainage Problems in the Bhabodah Area. IWM and Development Design*

Consultant Limited, 2010. Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl)

IWM: Institute for Water Modelling, Development Design Consultant Ltd. (2010*). Feasibility Study and Detailed Engineering Design for Long Term Solution of Drainage Problems in the Bhabodah Area*. Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl)

Lach, D., Rayner, S., Ingram, H. (2005). *Taming the waters: strategies to domesticate the wicked problems of water resource management*. International Journal of Water 3:1.

McKall, M.K., Minang, P.A. (2005). *Assessing Participatory GIS for Community-Based Natural Resource Management: Claiming Community Forests in Cameroon*. The Geographial Journal 171:4, pp. 340-356.

Mollinga, P.P. (2008). *The Rational Organization of Dissent*. *Boundary concepts, boundary objects and boundary settings in the interdisciplinary study of natural resources management*. Working Paper Series 33. Center for Development Research, Bonn.

Mollinga, P. (1997; revised by Wester, 2010). *Water control in sociotechnical systems: a conceptual framework for interdisciplinary irrigation studies*. Unpublished lecture notes.

Mollinga, P. (2009). *Towards the transdisciplinary engineer: Incorporating ecology, equity and democracy concerns into water professionals' attitudes, skills and knowledge*. Irrigation and Drainage 55:2, pp. S195-S204

Mollinga, P., Jordans, E. (2003). *From Participation to Self-Governance: Changing approaches to Water Users Associations in Canal Irrigation.* Lecture notes Block 2: Local water management organisations. Wageningen University, IWE group, 2003.

Perucca, C., Munda, Krishnopodo (2010). *Social Water Management among Munda people in the Sundarban.* University of Liberal Arts, Bangladesh.

Planning commission, Bos, M., Terwisscha van Scheltinga, C. (2012). *Towards a Bangladesh Delta Plan*. Retrieved on January 9th, 2013 from www.bangladeshdeltaplan.org

Qaium, D.A. (year unknown). *Tidal River basin Management approach for Solving Water Logging Problem of Some areas of south-west region of Bangladesh*. Water Resources Planning Organization. Retrieved on May 29th, 2012 from cdc.fish.ku.ac.th/CZAP_website /abstracts /Qaium.pdf

Rahman, A. (1995). *Beel Dakatia: the Environmental Consequences of a Development Disaster*. The University Press limited. Dhaka, Bangladesh.

Rahman, S.M.A., Hasanuzzaman, MD., Azam, MN.R., Hossain, A.,Mazhabuddin, KH. (2010). *The past and present Fisheries situation in beel Dakatia area.* Marine Research and Aquaculture 1:1, pp. 1

Refugees International (2013). *Bangladesh*. Retrieved on January 2nd, 2013 from www.refugeesinternational.org/where-we-work/asia/bangladesh

Schön, D.A., Rein, M. (1994). *Frame Reflection: Toward a Resolution of Intractable Policy Controversies*. New York: Basic Books

Springer, F. (1987). *Bougainville, een gedenkschrift*. Grote letter Bibliotheek, Abcoude.

UNdata (2011). *Bangladesh*. Retrieved on August 22nd, 2012 from data.un.org/CountryProfile.aspx?crName=Bangladesh

UNESCO (2010). *Interactive Atlas of the World's languages in Danger*. Retrieved on January 2nd, 2013 from www.unesco.org/culture/languages-atlas/index.php

Uttaran, Center for Environmental and Geographic Information Services (2011). *Initial Environmental Examination. People's Plan of Action. Management of Rivers of South-West Coastal Region of Bangladesh*. CEGIS and Uttaran, 2011.

Warner, J. (2010). *Integration through Compartmentalization?" Pitfalls of "Poldering" in Bangladesh*. Nature and Culture 5:1, pp. 65-83

Wester, P., Bron, J. (year unknown). *Coping with water: Water Management in Flood Control and Drainage Systems in Bangladesh.* Retrieved on October 10th, 2012 from edepot.wur.nl/78392

Wester, P. (2008). *Shedding the Waters: institutional change and water control in the Lerma-Chapala basin, Mexico*. PhD thesis Irrigation and Water Engineering group, Wageningen University.
Wikipedia (2012). *Mind map*. Retrieved on October 12th, 2012 from nl.wikipedia.org/wiki/Mindmap
Wikipedia (2013). *Framing.* Retrieved on February 17th, 2013 from en.wikipedia.org /wiki/Framing_(social_sciences)
World Bank (2013). *Life expectancy at birth, total (years)*. Retrieved on January 2nd, 2013 from data.worldbank.org/indicator/SP.DYN.LE00.IN.

Interviews chapter 1

Andrew Jenkins. 9-10-2012. BRAC center, Dhaka, Bangladesh
Gayanath Sarker. 7-10-2012. Uttaran head office, Dhaka, Bangladesh
Dilib Kumar. 4-10-2012. Khulna University, Khulna, Bangladesh

Chapter 2

Government of Bangladesh, Asian Development Bank, Haskoning Engineers (1993). Second Coastal Embankment Rehabilitation Project: final report. Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl)
Asian Development Bank (2007). Bangladesh: Khulna-Jessore Drainage Rehabilitation Project. Project Evaluation Report. Retrieved on January 26th, 2013 from www.adb.org/documents/ khulnajessore- drainage-rehabilitation-project-loan-1289-bansf
Abhijit, M., Fryar, A.E., Thomas, W.A. (2009). Geologic, geomorphic and hydrologic framework of the Bengal basin, India and Bangladesh. Journal of Asian Earth Sciences, 34:3, pp. 227-244.
Aquastat (2010). Bangladesh. Retrieved on January 20th, 2013 from www.fao.org/nr/water /aquastat/countries_regions/bgd/index.stm
BBC (2007). *Bangladesh cyclone kills hundreds*. Retrieved on January 21st, 2013 from news.bbc.co.uk/2/hi/south_asia/7097678.stm
BWDB; Bangladesh Water Development Board (2003). *Monitoring and Integration of the Environmental and Socio-economic impacts of implementing the Tidal River Management option to solve the problem of drainage congestion in KJDRP area*. Final report part C: integrated water resource management plan. Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl)
Goodbred Jr., S.L., Kuehl, S.A. (2000). *The significance of large sediment supply, active tectonism, and eustasy on margin sequence development: Late Quaternary stratigraphy and evolution of the Ganges–Brahmaputra delta*. Sedimentary Geology, 133:3-4, pp. 227-248.
Hughes, R., Adnan, S., Dalal-Clayton, B. (1994). Floodplains or Flood Plans? A review of approaches to water management in Bangladesh. Russell Press, Nottingham.
Islam, S., Kibria, Z. (2006). *Unraveling KJDRP: ADB Financed Project of Mass Destruction in Southwest Coastal Region of Bangladesh*. Published by Uttaran, Tala, Bangladesh. Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl)
IWM; Institute for Water Modelling (2012). Monitoring and evaluation of the hydrological and conditions of rivers and drainage problems of beels in the KJDRP area for the planning of drainage improvement measures. Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl)
Rahman, S.M.A., Hasanuzzaman, MD., Azam, MN.R., Hossain, A.,Mazhabuddin, KH. (2010). *The past and present Fisheries situation in beel Dakatia area.* Marine Research and Aquaculture 1:1, pp. 1

SMEC; Snowy Mountain Engineering Corporation International (2002). *Khulna-Jessore Drainage Rehabilitation Project: Project Completion Report (FINAL)*. Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl)
UNESCO (2013). The Sundarbans. Retrieved on January 20th, 2013 from whc.unesco.org/en/list/798
United Nations Economic Commission for Asia and the Far East (1966). *Appraisal of some aspects of the Coastal Embankment Project of East Pakistan.* Report of the advisory group on development of deltaic areas.
Van Minnen, J. (2012). MSc thesis. Under construction at time of writing. Contact jan.vanminnen@wur.nl
Warner, J. (2010). *Integration through Compartmentalization?"Piotfalls of "Poldering" in Bangladesh*. Nature and Culture 5:1, pp. 65-83

Interviews chapter 2

Andrew Jenkins 1. 9-10-2012. BRAC center, Dhaka, Bangladesh
Andrew Jenkins 2. 10-12-2012. Comments on presentation at Netherlands Embassy, Dhaka.
Interview at Beel Kedaria, 23-10-2012.

Chapter 3

Amir, S.I.I. (2010). *Socio-technical Assessment of Sediment Management Options in Tidal Basins in Southwestern* Bangladesh. MSc thesis. Institute of Flood and Water Management, Bangladesh University of Engineering and Technology. Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl
Asian Development Bank (2007). Bangladesh: Khulna-Jessore Drainage Rehabilitation Project. Project Evaluation Report. Retrieved on January 26th, 2013 from www.adb.org/documents /khulna-jessore-drainage-rehabilitation-project-loan-1289-bansf
CEGIS: Center for Geographic Information Services (1998). *Environmental and Social Impact assessment of Khulna Jessore Drainage Rehabilitation Project (KJDRP)*. Report available through CEGIS.
Development Associates (2010). *Rob Koudstaal*. Retrieved on January 31st, 2013 from www.da-bd.org/associates/r-koudstaal
IWM; Institute for Water Modelling (2007). *Assessment of Dredging and Tidal Characteristics of Hari river.* Final report. Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl)
IWM: Institute for Water Modelling, Development Design Consultant Ltd. (2010*). Feasibility Study and Detailed Engineering Design for Long Term Solution of Drainage Problems in the Bhabodah Area*. Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl)
Rahman, A. (1995). *Beel Dakatia: the Environmental Consequences of a Development Disaster*. The University Press limited. Dhaka, Bangladesh.
SMEC; Snowy Mountain Engineering Corporation International (2002). *Khulna-Jessore Drainage Rehabilitation Project: Project Completion Report (FINAL)*. Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl)
Van Minnen, J. (2012). MSc thesis. Under construction at time of writing. Contact jan.vanminnen@wur.nl
Williams, C.A. (1919). *History of the rivers of the Gangetic Delta 1750-1918*. Bengal Secretariat Press, Calcutta. Available in Delft University library, the Netherlands.

Emails chapter 3

Andrew Jenkins, January 27th, 2013
Andrew Jenkins, January 31st, 2013

Interviews chapter 3

Andrew Jenkins 2. 10-12-2012. Netherlands Embassy, Dhaka, Bangladesh
Anonymous source BWDB. November 2012. Jessore, Bangladesh

Chapter 4

Please refer to Annex III for a full overview of interviewed people and locations. Chapter 4 is based on these interviews, which are worked out in day reports and available on request and the following other sources:

Institute of Water Modeling (2010). *Feasibility Study and Detailed Engineering Design for Long Term Solution of Drainage Problems in the Bhabodah Area. IWM and Development Design Consultant Limited, 2010.* Available in WOTRO library, Irrigation and Water Engineering group, Wageningen University (arjen.zegwaard@wur.nl)

Rahman, A. (1995). *Beel Dakatia: the Environmental Consequences of a Development Disaster*. The University Press limited. Dhaka, Bangladesh.

Emails chapter 3

Email Aminul Haque. 6-2-2013. Available in day reports folder.

Chapter 5

Please refer to III for a full overview of interviewed people and locations. Chapter 5 is based on these interviews of which day reports are available, and the following other sources:

Kibria, Z., Hirsch, D. (2011). *Tidal River Management: Climate Change Adaptation and Community based River Basin Management in Southwest Coastal Region of Bangladesh*. Published by Uttaran. Retrieved on February 20th, 2013 from uttaran.net/publications/ tidalrivermanagement(TRM).pdf

Interviews chapter 5

Dilib Kumar Datta. 4-10-2012. Khulna University, Bangladesh.

Chapter 6

Lewis, D. (2011). *Bangladesh: Politics, Economy and Civil Society*. Cambridge University Press.

Annexes

Annex I – example question list

Demographic information:
Name/age/:
Catchment: Hari-Mukteswari / Dakatia
Date: _____
Occupation: _____
Land status: _____
Cropping pattern _____
Monthly income _____

Information on water management in Beel:

1. *How many gates are there that drain Beel?*
2. *Who controls these gates?*
3. *Who maintains these structures?*
4. *What is the relation with the BWDB?*
5. *What is the role of the WMA and WMG?*
6. *What are problems in Beel Kedaria?*
7. *How is the drainage situation in Beel?*
8. *What is the function of the Babodah gate?*

Water management practices

Part of RWMA

Results discussed in chapter 4

Tidal River Management

9. *What is "Tidal River Management" in one sentence?*
10. *How does "Tidal River Management" work?*
11. *How and when did "Tidal River Management" start?*
12. *What are the upstream effects of TRM?*
13. *What are the downstream effects of TRM?*
14. *What will happen in Beel when Beel Kapalia is a tidal basin?*
15. *How are rice farmers affected by TRM?*
16. *How are shrimp farmers affected by TRM?*
17. *How are landless people affected by TRM?*
18. *Do you think TRM is a good way to decrease drainage congestion in the Hari and Mukteswari river?*
19. *Do you think TRM is a sustainable long term soluution to decrease drainage congestion in the Hari and Mukteswari river?*

Perceptions of "TRM"

Results discussed in chapter 5

Annex II - budget

Budget research Bangladesh September - December 2012

Costs		total costs in €
flight		800
accomodation		800
transport		900
translator (12€ / day)		150
food		500
visa		50
other costs		400
total costs		**3600**

Benefits	benefits / month	total benefits in €
study financing	500	1500
own resources		1000
WUR support	0	750
health care subsidy	70	210
total benefits	570	**3460**

Deficit	deficit / month in €	Todal deficit in €
total deficit	47	**140**

Annex III – detailed results overview

Overview of interview places, dates and type & participatory maps

refer to: day reports, TRM contact list, maps day reports

Place	# open interview (date)	# semi-structured interview / (date)	total interviews	map #
Beel Bhaina		7 (18-10)	7	2
Beel Boruna		1 (1-11)	1	4
Beel Dakatia	4 (2-10)		4	8
Beel Dumur		1 (11-11)	1	7
Beel Jhikra		3 (11-11)	3	7
Beel Kapalia	1 (3-10), 1 (23-10), 1 (2-11), 1 (5-11), 1 (10-11)	2 (23-10), 2 (15-11)	9	6
Beel Kedaria	2 (3-10)	2 (24-10)	4	5
Beel Khuksia	1 (3-10)	2 (10-11)	3	1
Beel Madhagram		1 (1-11)	1	7
Beel Payara / Koyar / Dahakhali		1 (2-11)	1	4
Beel Singa		1 (1-11)	1	4
West Beel Khuksia		2 (5-11)	2	1
Polder 29 - Latabunia	1 (8-11)		1	
Beel Pakhimara	1 (4-10), 3 (19-11)		4	
		Total field interviews	42	

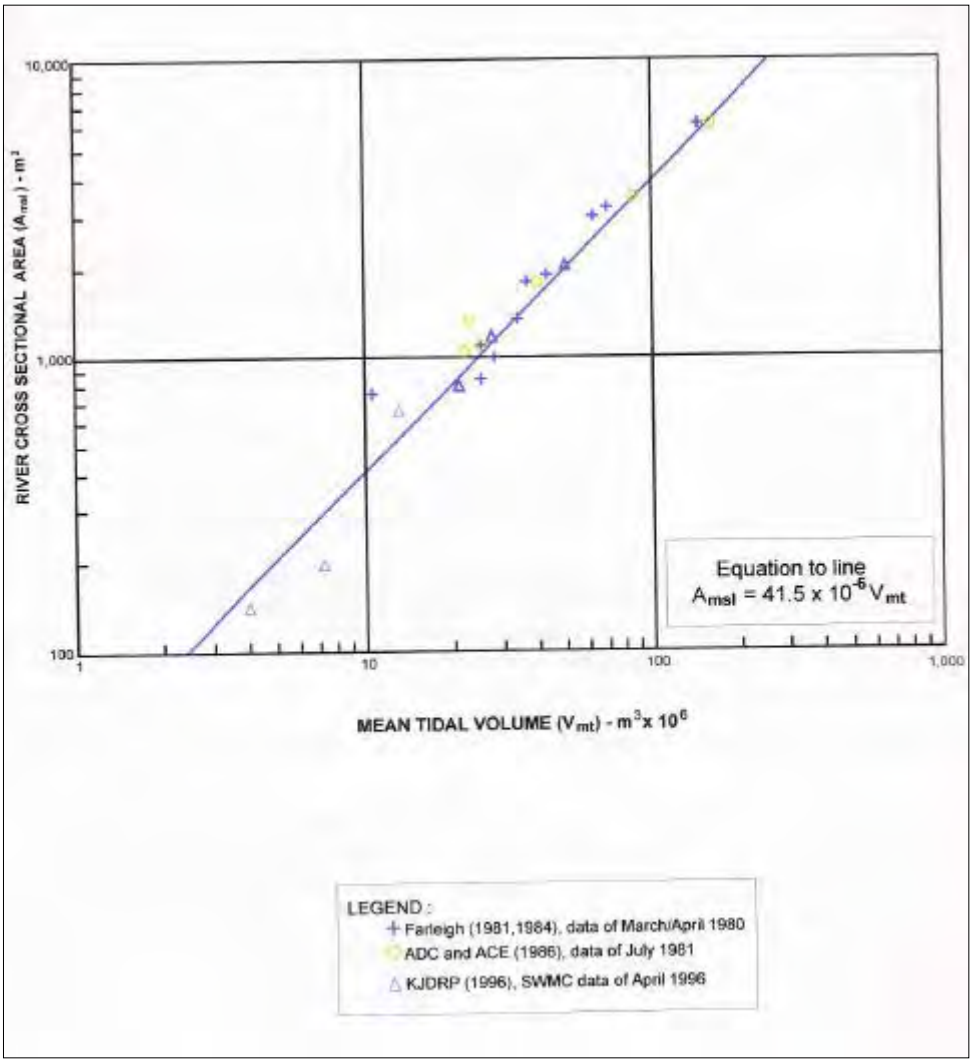
Person				
Abul Kamal Azad (BWDB Khulna)	1 (6-11)		1	
Andrew Jenkins (BRAC University)	1 (9-10)		1	
Conference IWMI & Shushilan	1 (3-11)		1	

Deepok Kumar Shorkar (BWDB Khulna)	1 (6-11)		1
Dilib Kumar (Uttaran)	1 (4-10)		1
Dilib Kumar Data (Khulna University)	1 (4-10)		1
Fatima Halima Ahmed	1 (26-9)		1
Gayanath Sarker (Uttaran)	1 (8-10)		1
Hashen Ali Fakir (Uttaran)	1 (18-11)		1
Khaled Khaleduzzaman (NL embassy)	1 (23-9)		1
Martin Bos (NL embassy)	1 (23-9)		1
Mashiur Rahman (BWDB Jessore)	1 (7-11)		1
Masud Korim (BWDB Jessore)	1 (21-11)		1
Md. Mustaffazur Rahman (DC Jessore)	1 (7-11)		1
Mohid Jamal (up. Chairman Monohorpur)	1 (5-11)		1
Mohir Biswas (president WMA zone F)	1 (17-10), 1 (21-11)		1
Shah Alam Khan (BUET)	1 (26-9)		1
Shahidul Islam (Uttaran)	1 (26-9)		1
Shorab Hossain (former BWDB - KJDRP)	1 (17-10)		1
Swapan Batachargee (Upazilla chairman Manirampur	1 (7-11)		1
Zahirul Haque Khan	1 (30-9)		1
		Total expert interviews	21,00
		Total interviews	63,00

X

Annex IV – tidal volume and river morphology

The theoretical and empirical relation between mean tidal volume and the cross sectional area of a river as described by O'Brien (1969, blue line) and several research teams (legend). Source: SMEC, 2007 annex A



Note:

What must be noted about this figure is that is does not show a cause-effect relation between the river cross sectional area and the tidal volume. In other words: correlation is *not* causation. In the case of the Hari river, it is possible to state that the interventions altered both the cross-sectional area *and* the mean tidal volume. In contrast, this figure shows that tidal rivers tend to seek a balance between its size and tidal volume. For example, when embankments were built during the Coastal Embankment Project, the cross sectional area and the tidal volume were reduced drastically, the river sought a new equilibrium and its cross section decreased (figure 3.4). When Beel Bhaina was opened, the tidal volume downstream of the Beel cut increased, which also enlarged the cross section of the river. The same holds true at the embankment cut of East Beel Khuksia: the river cross-section is considerably larger downstream of the cut than upstream.

Annex V – on methodology

Research design

This annex discusses the details of the design of this research. First, the selected research population, sample and area are legitimized. It is important to note that this research design evolved throughout the research process. Please see table 1 for a small overview of the planning of this study. It was chosen to include a short field visit in the preparatory period of this research, because it would help develop research ideas, design and methodology prior to the main field work conducted later.

Table A1. Overview of research planning

Section	Period
Research proposal	April – September 2012
Expert interviews & initial field visit	Late September 2012 – Early October 2012
Finalize research design	Early October 2012
Main fieldwork	October – December 2012
Analysis & writing	December 2012 – February 2013
Finalization of thesis & colloquium	Late February – March 2013

Selecting stakeholders

A stakeholder is "an individual whose livelihood is directly affected by a water management system, be it positively or negatively" (Wester and Bron, 1997). Stakeholders were found after asking the following question: *Who influences or is affected by the Tidal River Management?.* It was aimed to achieve a representative sample of the study area, composed of a variety of stakeholders. A full list of interviewing locations and interviewees can be found in Annex III.

Population and sample

The area this research focussed on is the former Khulna-Jessore Drainage Rehabilitation Project area. It is in this area that the first tidal basin in Beel Bhaina was established in 1997 and where Beel Khuksia is currently under tidal influence. By some, the area is called *Babhoda*. Water experts stationed in the area and in Dhaka and local stakeholders have been interviewed. These groups in Dhaka and former KJDRP area form the *population* of this study.

Water experts were selected by means of *snowball sampling* (as in Lach, 2005; pp. 3) and bottom up through interviews conducted in the field. As the main study area is large and its population huge and diverse, it was important to choose how to select a *sample* of local stakeholders that is representative for the study area. This was done by interviewing a group as diverse as possible, including different types of farmers (rice / shrimp) and even several groups of women (see picture). Bangladesh being a conservative country, it was quite hard to talk to women separately.

Two local NGOs - USS and Diphi Sikha – assisted in getting women's groups together (see picture; thank you!).

Data collection - Literature review

In order to sketch the (recent) past of the study area, documentation was collected while in Bangladesh. (Old) Project documents were vital to gain a better understanding of the history of study area and past interventions. Documents were collected from libraries at the BWDB in Khulna and Jessore, Uttaran in Tala, WARPO and the Institute for Water Modelling.

Data collection - open and semi-structured interviews

Open and semi-structured interviews were conducted with water experts, but also as part of the RWMA. The former interviews were open or semi-structured, depending on their objective. Interviews part of the Rapid Water Management Appraisal were semi-structured (Annex I).

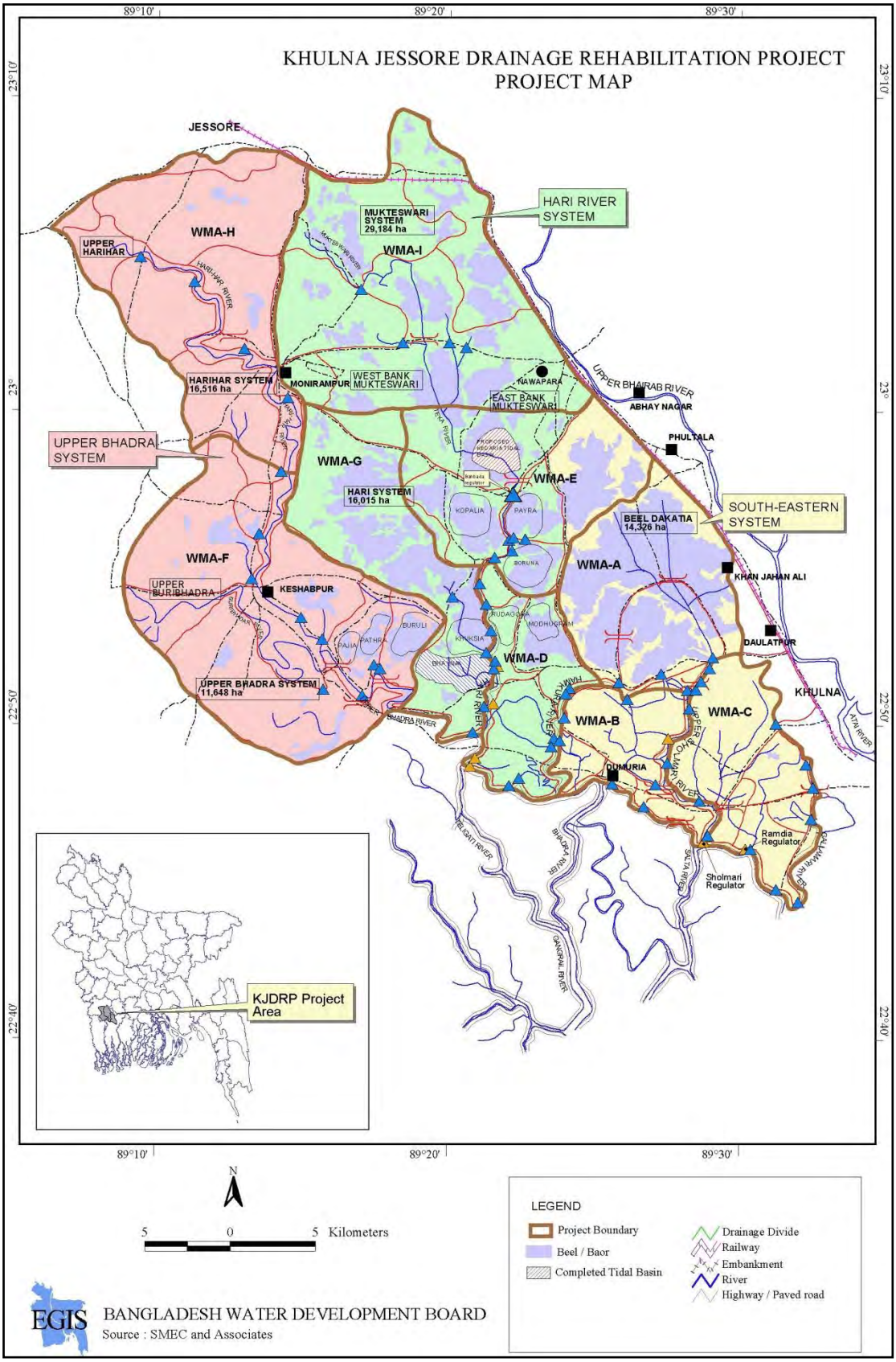
Methodological reflection

When we made field visits with Dr. Hamidul Huq, I noticed that his very appearance influenced greatly how and what information he received from local stakeholders. Whereas people

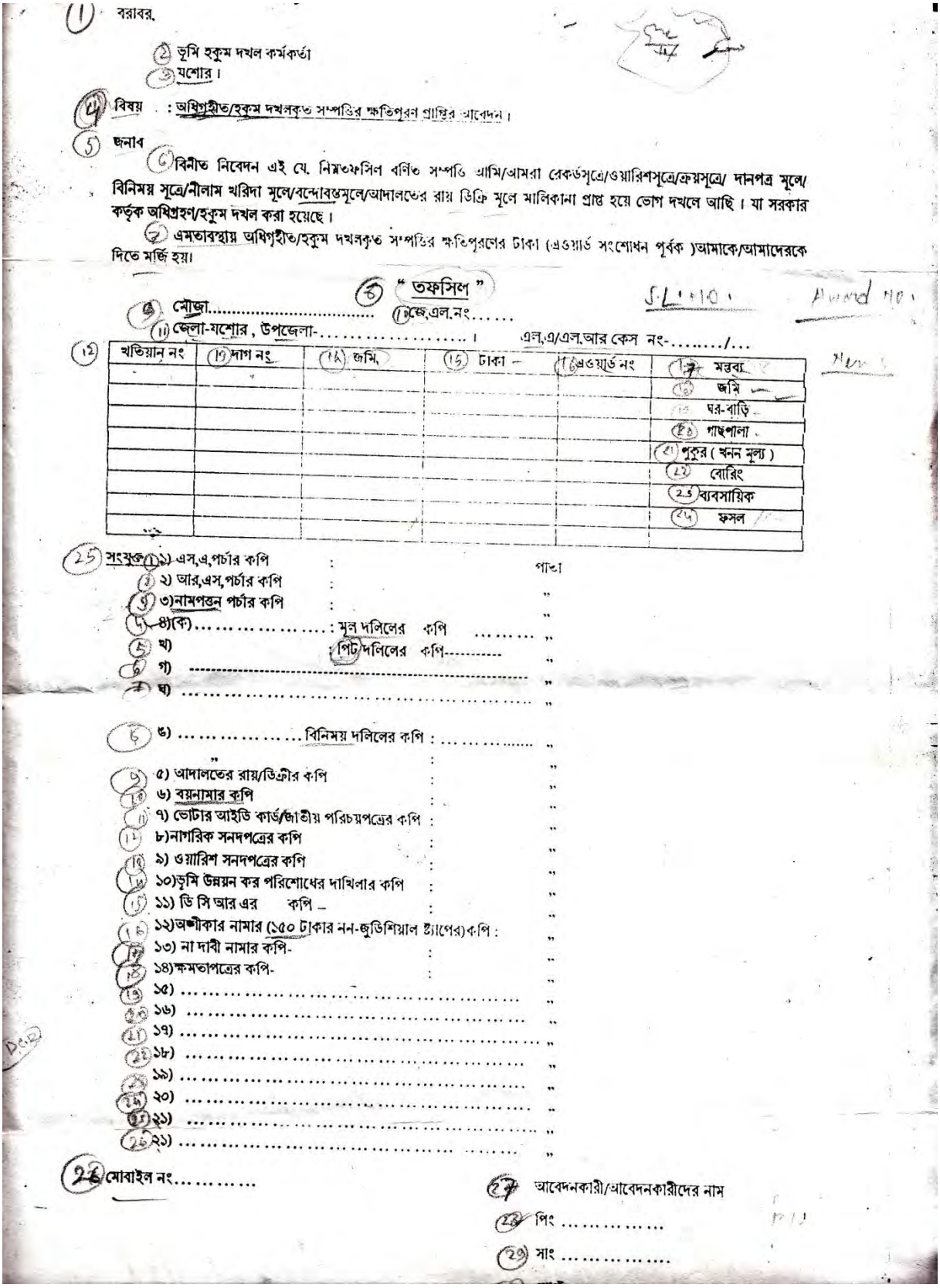
flocked around us when visiting a village (we are, after all, white men...), Dr. Huq was able to visit individual farmers without attracting much attention. Additionally, he was able to communicate in the farmers' own language.

It is important to keep in mind that our appearance (Caucasian men) had a big impact on the answers that were given by interviewees. This, and the fact that almost all data was collected during interviews in large crowds in tea stalls, probably made the fetched data (1) more superficial, as very controversial topics were not discussed but (2) more reliable, as all answers were checked by the whole group. Often, I checked with other people in the group whether they agreed with statements or not.

Annex VI – Water Management Associations established during the Khulna-Jessore Drainage Rehabilitation Project (KJDRP)



Annex VII – Beel Kapalia "TRM" compensation form & translation



(1) বরাবর,

(2) ভূমি হুকুম দখল কর্মকর্তা
(3) যশোর।

(4) বিষয় : অধিগৃহীত/হুকুম দখলকৃত সম্পত্তির ক্ষতিপূরণ প্রাপ্তির আবেদন।

(5) জনাব

(6) বিনীত নিবেদন এই যে, নিম্নতফসিল বর্ণিত সম্পত্তি আমি/আমরা রেকর্ডসূত্রে/ওয়ারিশসূত্রে/ক্রয়সূত্রে/ দানপত্র মূলে/ বিনিময় সূত্রে/নীলাম খরিদা মূলে/বন্দোবস্তমূলে/আদালতের রায় ডিক্রি মূলে মালিকানা প্রাপ্ত হয়ে ভোগ দখলে আছি। যা সরকার কর্তৃক অধিগ্রহণ/হুকুম দখল করা হয়েছে।

(7) এমতাবস্থায় অধিগৃহীত/হুকুম দখলকৃত সম্পত্তির ক্ষতিপূরণের টাকা (এওয়ার্ড সংশোধন পূর্বক)আমাকে/আমাদেরকে দিতে মর্জি হয়।

(8) "তফসিল"

(9) মৌজা..... (10) জে,এল,নং.....

(11) জেলা-যশোর , উপজেলা-.....। এল,এ/এল,আর কেস নং-...../...

(12) খতিয়ান নং	(13) দাগ নং	(14) জমি	(15) টাকা –	(16) এওয়ার্ড নং	(17) মন্তব্য
					(18) জমি
					(19) ঘর-বাড়ি
					(20) গাছপালা
					(21) পুকুর (খনন মূল্য)
					(22) বোরিং
					(23) ব্যবসায়িক
					(24) ফসল

(25) সংযুক্ত (১) ১) এস,এ,পর্চার কপি : পাতা
(2) ২) আর,এস,পর্চার কপি : "
(3) ৩)নামপত্তন পর্চার কপি : "
(4) ৪)(ক)..... : মূল দলিলের কপি ..... "
(5) খ) পিট দলিলের কপি---------- "
(6) গ) ---------- "
(7) ঘ) ..... "

(8) ৬) .....বিনিময় দলিলের কপি : ..... "
(9) ৫) আদালতের রায়/ডিক্রীর কপি : "
(10) ৬) বয়নামার কপি : "
(11) ৭) ভোটার আইডি কার্ড/জাতীয় পরিচয়পত্রের কপি : "
(12) ৮)নাগরিক সনদপত্রের কপি : "
(13) ৯) ওয়ারিশ সনদপত্রের কপি : "
(14) ১০)ভূমি উন্নয়ন কর পরিশোধের দাখিলার কপি : "
(15) ১১) ডি সি আর এর কপি – : "
(16) ১২)অঙ্গীকার নামার (১৫০ টাকার নন-জুডিশিয়াল ষ্ট্যাম্পের) কপি : "
(17) ১৩) না দাবী নামার কপি- : "
(18) ১৪)ক্ষমতাপত্রের কপি- : "
(19) ১৫) ..... "
(20) ১৬) ..... "
(21) ১৭) ..... "
(22) ১৮) ..... "
(23) ১৯) ..... "
(24) ২০) ..... "
(25) ২১) ..... "
(26) ২১) ..... "

(28) মোবাইল নং.....

(27) আবেদনকারী/আবেদনকারীদের নাম

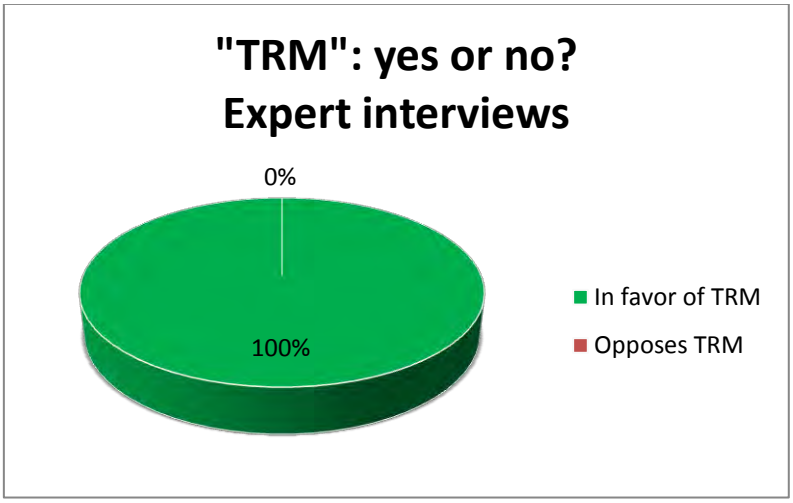
(28) পিং .....

(29) সাং .....

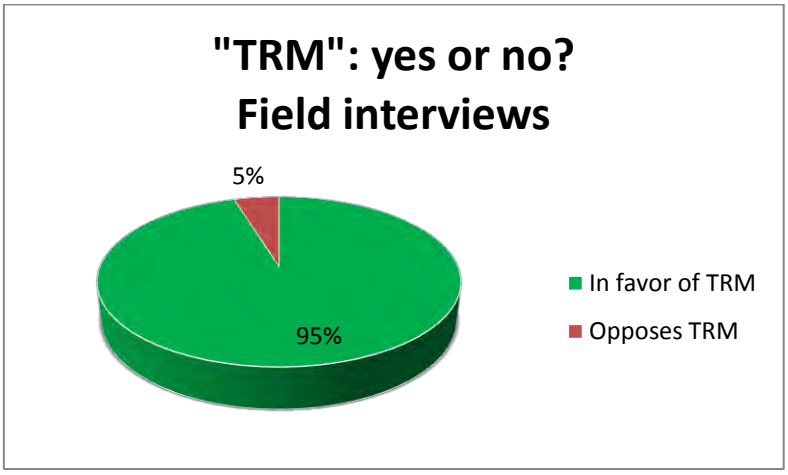
1) To
2) Land acquisation officer
3) Jessore
4) Subject: acquired land compensation form
5) Dear Sir,
6) With due respect I, undersigned, am the owner of this land which is acquired by the government.
7) In this condition, please give the compensation for the acquired land to me.
8) Unknown
9) Area: …..
10) Administrative number: ……
11) District: Jessore, Upazilla: ……., administrative number
12) Land registration number 1
13) Land registration number 2
14) Land size.
15) Taka
16) Award number
17) Recommendation
18) Land
19) Household
20) Trees
21) Ponds
22) Tubewell
23) Business
24) Production
25) Attachments:
    1. SA paper copy
    2. RS paper copy
    3. Family overview paper copy
    4. Main paper copy of land ownership
    5. Unknown form copy
    6. ….
    7. ….
    8. Unknown paper copy
    9. Copy from court decree
    10. ???
    11. Copy identity card
    12. National identity paper
    13. Copy of hereditary paper (from deceased parents etc.)
    14. Copy of land tax status
    15. DCR copy
    16. Non-judicial stamp copy (cost 150 taka)
    17. Agreement copy
    18. Attorney copy
    19. …
    |
    26. …
26) Mobile number
27) Name of applicant
28) Father’s name
29) Area
30) Post office
31) Upazilla
32) District

Annex IIX – "TRM": yes or no?

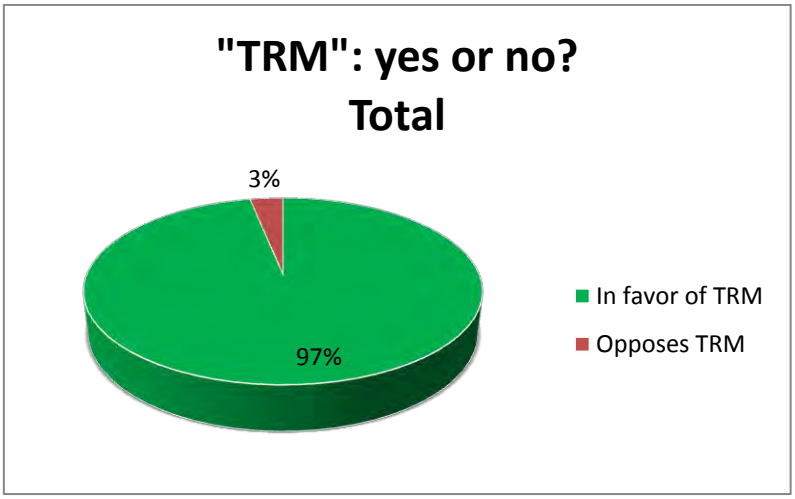
These graphs do not say anything about how a stakeholder frames "Tidal River Management"



Total amount of expert interviews: 21



Total amount of field interviews: 42



Total amount of interviews: 63