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Assessments for Investments

Dutch Business Case for Adaptation with focus on the case of Bangladesh

Results from the sessions at the Amsterdam IWW/ Aquaterra conference 2011

2012

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Introduction

Chapter 1

Background and objectives

The current report has been prepared in the framework of developing an 'Assessments for Investments' Business Case for Adaptation the IWW/Aquaterra conference (1-3 November 2011 in Amsterdam) with a focus on the case of Bangladesh. It essentially comprises a generic approach towards risk assessment and risk management capacity as a universally applicable methodology for climate proofing, and to seek the interest and clientele for this unique capability among the IFIs and other parties as to engage the Dutch expertise in their activities. In section 5.1 and 5.2 experiences from recent projects in Bangladesh are being used, for instance the study for the ADB 7276-REG project on a review of investments in flood early warning systems in Bangladesh, and the preparation of a ToR for the development of a Delta Plan 2100 in Bangladesh.

Objectives

- The intention is to show case the Dutch approach for adaptation to interested parties including Governments, NGOs, private sector and International Financing Organizations overseas in order to build and foster relations for cooperation and to market the Dutch approach. Furthermore, the business case is to enhance the visibility and marketing competence of the NL knowledge institutions.
- The longer term objective is that the project contributes to the strengthening of the "Dutch Enabling Delta Life" or "Delta Assessment" approach as a universally effective methodology for risk management of Delta's around the world, including for World Bank, Asian Development and African Development Bank initiatives, the Water Mondiaal countries (Vietnam, Bangladesh, Mozambique, Indonesia and Egypt), the DGIS focus countries (Benin, Ethiopia, Ghana, Kenya, Mali, South Sudan) and global Water for Development reports and studies (WB, ADB, UN agencies).

Particular attention is given to Bangladesh as a case study delta. Bangladesh is a focus country under the Dutch 'Water Mondiaal' Program, while the issues to be discussed may be worthwhile to consider for the other Water Mondiaal focus countries[1] as well.

The IWW/Aquaterra conference provided a good opportunity to bring interested parties and potential clients together for further discussions and follow up on the approach taken.
Having Bangladesh as a case study country, there were 3 sessions at the AquaTerra conference where this approach was presented in a coherent fashion with a focus on 'making the business case' work for the Dutch water sector: the Bangladesh Delta session, the Water and Climate Services session, and the Assessments for Investments session. The current report summarizes the sound discussions, reporting and further outreach on the Dutch business case approach during the 3 sessions of the Aquaterra conference and beyond.

In this framework, reference is made to relevant programs and projects, such as Water Mondiaal, WB and ADB projects, CIWK, UN WWAP and the Alliance for Global Water Adaptation.

Aquaterra 2011 conference

Aquaterra is an international conference and exhibition on development in coastal and delta regions. It focuses on managing risks and creating opportunities to meet the challenges of deltaic and coastal development at all levels, from economic and financial to safety and planning issues. Exhibitors include consulting engineers, dredging and other contractors, equipment and materials suppliers, and companies from the service sector including finance and insurance.

Aquaterra is intended for advisors, consultants, contractors, project developers, civil and other engineers, water companies, research institutes, financial and insurance institutions, governments (international, national, regional and municipal), NGOs and port authorities. The event brings together government specialists, advisors, consultants, contractors, knowledge institutions and companies from all over the world.

The Aquaterra conference is held every second year. In 2011 was the third edition (see Annex 1 and 2 for brief descriptions of respectively Aquaterra 2007 and 2009).
In response to the on-going activities in Bangladesh three related sessions were scheduled in the Aquaterra 2011 program. In the next chapters the outline of these sessions are briefly described and reflections and observations are summarized. Full program of key notes and presentations are available on the following website:
http://www.aquaterraconference.com/nl/en/pages/presentations.aspx

1 *Water Mondiaal Countries: Indonesia, Vietnam, Bangladesh, Egypt and Mozambique*

Brief outline of the Bangladesh sessions at Aquaterra 2011

Chapter 2

The sessions were convened by the Delta Alliance, jointly with PBL, NWP and the Water Mondiaal Programme. They also build upon the information acquired in the Delta Alliance report "Comparative assessment of the vulnerability and resilience of 10 deltas" [2]. See Annex 3 for brief outline description of the three sessions.

Session on Water and Climate Services

The world's climate is changing into more extreme events of rainfall and temperature resulting in floods, draughts, and typhoons. Many meteorological stations collect the actual weather conditions. In fact due to the changing weather conditions these historical data are not very reliable for future projections to be used in the design of water infrastructure. Water resources are shrinking and there will be more claims for access to water. More effective water management is becoming more and more urgent.

In many regions only very few monitoring infrastructure is available. There is a need for advanced technologies in the water sector where space-borne imagery and state of the art water-models support in predicting future behaviour of water resources. This is key for governments to adequately manage (plan, invest, store, distribute) their water resources, and design, build and operate infrastructure for water storage (dams, basins, etc.), agriculture (food security, increased yields) and safety (levees, barriers etc.).

The World Meteorological Organisation uses the phrase 'Water & Climate Services' to describe the interaction between climate (-change) and water resources management. The Netherlands has excellent experience in this field. Therefore 40+ Dutch organisations have signed in 2011 a cooperation agreement to jointly support further development of Water & Climate Services, as to bring science and market closer to each other (NL Cooperation on Water and Climate Services – CIWK, see also paragraph 3.2).

Objective of the session: Sharing the opportunities of Water & Climate Services to assist the world's deltas in coping with the increasing needs for spatial information supporting water management, food security, climate change adaptation and disaster risk reduction.

Session on the Ganges-Brahmaputra-Meghna Basin

As the challenges Bangladesh is facing are enormous and complex, an integrated interdisciplinary approach (a "Delta Vision") will often be needed to find solutions.
With 1226 inhabitants per km² Bangladesh is amongst the countries with the highest population density worldwide. It is also one of the world's poorest countries with a predominantly labour-intensive agricultural economy. Currently the country is already vulnerable to water extremes. Additional climate change will result in more cyclones and storm surges, sea level rise, salinity intrusion and water logging. With a sea level rise of 1.5m 16% of the country will be permanently flooded, affecting a population of 22 million. Increasing salinity will reduce agricultural production and affect drinking water production. The north east and central region will have to cope with river floods, the north-west region with increased drought.

Especially coastal inhabitants and the agricultural sector will be affected. Future food production (2 million more mouths to feed every year) will be very dependent on improved integrated water resources management and on developing adequate adaptation strategies for climate change. The fact that such approaches have not been very successful in the water management sector until now, a new approach using climate change adaptation and food security as drivers could be proposed.

Objective of the session: Sharing major challenges of Bangladesh in coping with the envisaged impacts of Climate Change.

Session on Assessments for Investments

Water related decision processes and operations require optimal understanding of the impacts of proposed measures and investments on related sectors such as food production, energy supply, spatial planning, climate adaptation, etc. Assessments that not only address vulnerability and resilience, but also socio-economic dimensions and trade-offs between sectors under different scenario's, are key to underpin sound decision making for investments in the water sector. This session will elaborate on down-scaling global integral assessments as a framework for decision support at national and programmatic levels, and on how to calibrate the output with a more locally based understanding of vulnerability and investment needs for e.g. adaptation to climate change. Presentations of joint case studies on the Bangladesh and Vietnam deltas by Dutch and local institutes will provide input to discuss the relevance of such assessments for IFI-based and national programming of investments.

Objective of the session: To present a methodology for assessments for investments, with Bangladesh and Vietnam as example case studies, and to discuss its relevance for IFI's and national programming in the region.

Reflections and observations from the Aquaterra sessions

Chapter 3

Session on Climate services

This session comprised a general introduction on climate information services and a comparison between three Water Mondiaal countries: Vietnam, Bangladesh and Mozambique. In all cases the discussion was focussing on the issue how to connect different scale levels and how to incorporate local information in the whole system. Reference was made to the Global Framework for Climate Services (GFCS). The objective of the GFCS is to make climate related data and information available for all countries. The main rationale for this is reflected in the following sequence:

Without good data → no information
Without information → no knowledge
Without knowledge → no decision
Without decisions → no (economic) development

In Vietnam standardization of data and models is very much needed. Plus better exchange of knowledge and information. Information from satellites is nice but field data from neighbour countries are also still needed

In Mozambique there is increase in information needs because of large scale new projects and their impact on the people and the environment. Secondly the hydraulic regime of the rivers is changing due to climate change. This needs to be better understood.

Bangladesh is facing many challenges related to impacts of climate change. In this respect information services will become crucial. Holistic master plans (like the Haor[2] masterplan) are needed. Many different types of data and information are collected and processed.

Main remarks and issues raised during the discussion:

- Consider the complete information chain including the connection to local knowledge.
- Local end users can nowadays be reached better due to new IT techniques
- There is a clear need for comprehensive and reliable information
- Communication and dissemination and transformation of information to end users is crucial
- There is a growing awareness for the need of (trans boundary) data sharing
- Where to focus?
- Quality of information
- Level of required detail for IPCC (regional) models
- Harmonisation of data and (climate) models is needed
- Early warning is a major issue but how to include basin wide cooperation
- More detailed modelling requires more detailed data and validation of models

Session on Ganges – Brahmaputra - Meghna Basin

In this session the emphasis was put upon the geographical context of Bangladesh in relation to the river basins of the large rivers and the proximity of the Himalaya mountains. The solution for the many challenges lies in transboundary river basin management. The session comprised presentations at different scale levels (Southern Delta Master Plan and Khulna City) plus a presentation of the contours of a possible Delta Plan 2100 for Bangladesh (Water Mondiaal program).

Survival strategy

- Strengthening existing and developing appropriate physical infrastructure: embankment, shelters, road networks, disaster warning systems, etc
- Promoting climate resilient farming techniques
- Capacity building of all stakeholders
- Save our mother earth
- Drastic reduction of GHG emission
- Change of lifestyle in industrialized nations and support to dignified life for 1 billion hungry people
- Ensuring equitable access of climate victim nations to global natural resources for Sustainable development

Challenges

- Inter-ministerial cooperation, national level planning, complex setting, intrinsic uncertainty, need for new knowledge
- Climate change is adding to the level of uncertainty
- Integration of future scenario's for driving forces is not a straight forward exercise

Specific remarks from the Khulna city case study

- huge investment for climate proofing is needed
- focus on fresh water supply (move intake upstream or create reservoirs)
- structured approach (FFA) sketch future scenario's, impacts and adaptation measures with involvement of stakeholders

2 *Haor areas are low lying depressions in Bangladesh with sensitive ecology*

Concluding remarks and reflections:

- In Bangladesh the tools and skills to carry climate adaptation studies are available (CEGIS and IWM)
- Climate proofing can also be very old techniques and traditions
- More close study of robustness and vulnerability is needed in relation to future uncertainty
- Think at different geographical scales (zie mijn memo met 4 punten voor spatial planning)
- Private sector needs to be involved
- Private sector is not well organised (accessible)
- Try to connect Dutch – Bangladesh private sector
- In 50 – 100 years from now the private sector may very well be in the driver seat for delta developments
- Already now (5 year plan 2011 – 2015) more than 77% of the overall country investments originates from private sector (Shamsul Alam)
- However without (government) investment the National Water Management Plan will never be implemented
- PPP is already existing in Bangladesh but with large emphasis on private interests (due to corruption) and not on public services
- Bangladesh is home for the largest concentration of NGO's in the world

Way forward:

- Equitable access to resources: between nations in the basin and within nations
- Pro-active investments for basin development including dredging, river training, livelihood support, trans boundary disaster preparedness
- Addressing second generation problems within polders in the basin and developing protective structures with a return period of >100 years in the backdrop…?
- Accelerated access to climate funds (REDD)
- Bangladesh could become a net exporter of agriculture crops and products
- Bangladesh could become the world leader in adaptive delta techniques
- Prepare Bangladesh Delta Plan 2100 based on water and food security in a delta approach
- Delta approach comprises:
  - Participatory approach
  - No-regret measures
  - Long term holistic vision
  - Roadmap for actions
  - Clever Institutional arrangements
  - Utilize funding

Session on Assessments for Investments

The third session focused on the identification of possible solutions for the mentioned (long term) challenges and the assessment of the trade-offs in comparing these solutions. As introduction a quick scan simulation of several driving forces related to flooding in Bangladesh was presented. In Annex 4 the summarized approach is presented as a brochure. In this study the vulnerability of Bangladesh to future flood risks is investigated with the rapid global assessment instrument "Global Flood Risks with IMAGE Scenarios" (GLOFRIS). GLOFRIS was recently developed in collaboration with the Netherlands Environmental Assessment Agency (PBL) and Utrecht University. With this instrument worldwide flood risk can be assessed for the current and future climate, considering both socio-economic and environmental changes. A flood hazard downscaling algorithm makes the model output suitable for local scale applications so that it may be applied in any delta area in the world.

First findings reveal that this rapid assessment method for flood risk changes is very useful for a first screening to assess:

- which regions / countries are most vulnerable to global change
- which changes are to be expected
- where investments are required within a region
- which investments are most promising

To this end, the demonstrated rapid assessment can be employed in any delta region in the world. In the near future, the method will be extended with a larger ensemble of IPCC GCM scenario computations to provide a broad view of climate change impacts on flood risks (see also Annex 4 for more information).

Next, several presentations were given on the socio-economical situation in Bangladesh and the long term effects on the water- and food sector issues. During the discussion the question was raised at which level of an investment strategy, local information becomes a pre-requisite. In other words, for large scale planning of investments, knowledge on possible local damage and casualties is needed.

Concluding remarks and reflections:

- At which level local knowledge becomes a pre-requisite for further development (for example flood hazard)
- There is a large need for (local) damage functions related to the risks
- Which trade-offs exist between risks and investment in adaptation measures?
- Trade-off for investment will depend on optimization of the geographical scale of the adaptation measures (cost-benefit ratio's for different types of risks)
- The Ministry of Environment and Forestry already conducted an assessment for investment (Mr. Quamrul Chowdhury - Journalist)
- The private sector is not interested to invest in the water sector (Nandan Mukherjee – BRAC). How to bridge the gap and make them more interested?
- The private sector will only bring in what the market is prepared to pay for
- Many PPP's fail because of poor institutional arrangements
- What exactly do you want to support? Private interests? Or Public goods and services?
- Private sector needs to be involved in (delta) planning as early as possible
- Where will the money come from? (tax payers, IFI's, private?) under what terms and conditions?
- Private financing (involvement) depends on rate of return of investment
- Risk zoning and spatial planning will be crucial for investment in high risk areas with high investment potential
- Focus on the win-win's or trade-offs and create investment packages (for instance large cross dams with tidal energy installations)

Relevant programs and projects

Chapter 4

NL Water Mondiaal Program

The Dutch National Water Plan (NWP) was adopted in December 2009 by the Dutch Government [9]. This plan outlines the water policy the Dutch Government will implement in the period from 2009 to 2015 in order to achieve sustainable water management. The NWP focuses on protecting against flooding and providing sufficient clean water. At the same time, the plan pays attention to various types of water use.

In the NWP a special paragraph, the 'Water Mondiaal' program, is dedicated to international cooperation. One of the main objectives is to enter into long term collaborative partnerships with a limited number of delta areas. In these areas (water management, climate change and spatial planning) collaboration with stakeholders and authorities and the exchange of high-quality knowledge takes place. There is a joint search for effective adaptation strategies in the light of climate change. Specific knowledge and experience is exchanged and innovations are implemented to achieve sustainable development objectives (including the Millennium Development Goals).

In 2011 the Dutch Water Mondiaal Preparatory Team started their activities in Bangladesh. End of July a Bangla-Dutch Core team was installed with the objective to find policy drivers on water topics actual for the Delta in Bangladesh. Their mission focuses on the feasibility

of a Bangladesh Delta plan 2100 and seeking commitment for such an approach with the Government of Bangladesh and the private sector stakeholders in Bangladesh and the Netherlands.

Recently the Government of Bangladesh, through the Prime Minister's office, has requested the Government of the Netherlands to provide advice and recommendations for the formulation of a Bangladesh Delta Plan 2100, inspired by the Dutch Delta Plan [5]. Early August 2011 the Government of the Netherlands has fielded a Delta Plan Preparatory Team (DPT) with a mission to prepare and advice regarding the need for and wish of the GoB to develop its Delta Plan for the country with a 50 – 100 year timeframe.

NL Cooperation on Water and Climate Services – mission Bangladesh

The timely availability of accurate meteorological and hydrological data plays a key-role in optimizing food production and minimizing flood and drought consequences. Around the world, and particular in developing countries, such data are often not available leading to unnecessary economic and human losses.

A recent Dutch initiative, the Dutch declaration "Information Chain for Water, Food and Climate Services (CIWK)" aims to contribute to this world wide problem by providing information chains and required tools or services. Therefore in February 2011, over 40 Dutch organizations (combination of consultancy firms, knowledge institutes and governmental organizations) specialized in space, Earth Observation, hydrology, food security, geomatics and climate signed the declaration.

These organizations share knowledge and work together to effectively address climate change challenges. The unique added value of the Dutch cooperation is that the organizations together can provide the whole information chain for water, food and climate related problems: from data acquisition through sensors and satellites, data infrastructures, models, decision support services, capacity building to implementation and support. Examples of services that the Dutch organizations can offer are: flood and drought forecasting systems, crop monitoring and forecast systems, dike inspection systems, climate scans and crisis management systems.

In August 2011 a mission to Bangladesh has been organized to find out the opportunities of the declaration for this country and for the participating Dutch organizations. The objectives of this mission were closely related to the main intentions of the Water Mondiaal Program (see paragraph 3.1).

Conclusions and recommendations of the Bangladesh mission [10]

Despite the short preparation time, the mission has been successful in contacting relevant stakeholders in Bangladesh. The active role of institutes like IWM and CEGIS, in the field of water and climate studies, is important for further development of business opportunities. The interaction between NGOs, knowledge and research centers and governmental organizations is well developed. The position of the private sector in water and climate studies is less pronounced.

It is widely acknowledged that further development of large scale climate adaptation measures in Bangladesh will only be possible in a cooperation arrangement between public and private sector. Through this mission we only 'scratched the surface' of private sector investment and their information requirements. However there are large opportunities for the Dutch partners of the CIWK. The opportunities with currently the highest potential are:

- Crisis management support in Bangladesh using a comprehensive operational framework (proven concept in the Netherlands) with the identified stakeholder DMB (Disaster Management Buro).
- Dredging business partnership with local Bangladesh large construction and dredging group Bashundhara Group and an identified Dutch partner (HEM or other) and potential win-win on land development. (reclamation/building with nature concept/building with spoil)
- Food security early warning system improvement of BRAC using complementary expertise and proven concepts on large (river basin & regional) and small (community base) scale level.
- (Transnational) Flood Early Warning Systems (BWDB-FFWC) with emphasize on increasing lead time for end users.

Furthermore, the following opportunities exist:

- Dhaka town central registration and information support using (Public infrastructure on: drinking water, electricity, sewerage and drainage (town storm drains)
- Southern Delta river information system (WM project BRIC)
- Monitoring system for small scale river management, improving and maintenance river water levels
- Further development of specialized agricultural services (seed, fertilizer, irrigation systems) in combination with micro-credit facilities and crop-insurances (BRAC).

The Bangladesh mission has been a valuable experience for the Dutch partnership on Water and Climate Information Services (CIWK). For the Dutch partners of the CIWK, the mission has opened interesting doors to over 50 interesting stakeholders and potential business cases.

During the mission the strength and added value of linking the CIWK initiative with the Water Mondiaal Program became clear. In particular, without proper information, major Water, Food and Climate issues cannot be solved sustainably. Therefore this topic and the CIWK initiative should be included in the Multi-Annual Strategic Plans of the Dutch embassies.
The International donors in Bangladesh showed keen interest in the approach and possible outcome. The availability of trust worthy data in the field of water and climate change is crucial for the planning and implementation of sustainable adaptation measures.

International programs

WB Climate resilience program

In 2008, the SCF Trust Fund Committee approved the Pilot Program for Climate Resilience (PPCR) as a target program of the Strategic Climate Fund (SCF).
The objective of the PPCR is to pilot and demonstrate ways to integrate climate risk and resilience into core development planning, whiles complementing other ongoing activities. The pilot programs implemented under the PPCR are to be country led, build on National Adaptation Programs of Action and other relevant country studies and strategies, and be strategically aligned with the Adaptation Fund and other donor funded activities to provide pilot finance in the short term so as to learn lessons that will be useful in designing scaled up adaptation financing.
The PPCR aims to contribute to achieving the objectives of the SCF by seeking to provide incentives for scaled-up action in integrating consideration of climate resilience in national development planning consistent with poverty reduction and sustainable development goals. Various projects have been initiated under this programme, including in Bangladesh.

One specific study for the PPCR Programme contributed to developing the Dutch Business on Assessments for Investments: “Water and Climate Change: Modeling the impact of climate change on hydrology and water availability”, by Kenneth M. Strzepek and Charles W. Fant, Colorado University (2011).
This report builds on work completed by the World Bank Water Anchor Energy, Transportation, and Water Department: “Water and Climate Change: Understanding the Risks and Making Climate Smart Investment Decisions” (Alavian et. al., 2009). The previous work aimed to gain insights into potential future hydrology and to establish a common platform of information on the behaviour of key hydrologic drivers across World Bank regions at a scale appropriate for policy and investment decisions. These results have since formed the basis of much work on water and climate change in the World Bank,

The overall objective of the Colorado University study was to contribute to enhanced planning of climate change adaptation in World Bank client countries, in particular as this relates to water infrastructure and water resources management and related services, and to contribute to an enhanced representation of climate change data and of hydrologic indicators.

The consortium of Dutch institutes of the present Bangladesh case study intended to present themselves as capable and well positioned to execute such assessments for investments related to the World Bank programme of work under the PPCR Programme.

ADB Cimate proof urban areas

Through an ADB-World Bank-Japan Bank for International Cooperation Initiative on Climate Impact and Adaptation in Asian Coastal Cities, ADB is supporting the analysis of future climate conditions, assisting local governments to adapt their investment plans to those future conditions. Several coastal mega cities have been identified for analysis, including Bangkok, Ho Chi Minh, Jakarta, Karachi, Kolkata, and Manila.
Together, these urban areas are home to more than 50 million residents, and all face increasing risks from flooding, heat waves, water shortages, and other adverse impacts of climate change. The study will include economic analysis to determine the likely costs associated with these phenomena as a means for prioritizing adaptation measures.

UN World Water Assessment Programme (UN WWAP)

The UN-WATER World Water Assessment Programme is starting a project on Scenario's to updat its last assessment report. This is the second time that a global scenario project will be done. In March 2000, at the World Water Forum 2 held in The Hague, the first ever scenario based World Water Development Report has been presented. This report was the result of a 3 year project (1997-2000) that involved many organizations including science, government, private sector and NGOs. The Dutch Government (DGIS) and Dutch institutions played a key role in the project. The outcomes of the first World Water Development Report include the acceptance at the World Summit on Sustainable Development (2002, Johannesburg) of the global targets for water supply and sanitation as well as the goals for Integgrated Water Resources Management - IWRM. More than 15.000 professionals and over 20 organizations were involved in the process. The project costs were some U$11 million.
The UN World Water Assessment Programme has initiated a process to update the work done under the scenario's. Reasons include the need to deepen the insights in the increased complexities of water and development that include climate change, paucity of information,

political developments, economic realities and environmental concerns all bearing down on the need to address water beyond even the "box" of a linear IWRM approach. Also the technical capacities to deal with the increasing complexities have improved over the last decade, in combination with a more solution oriented development of scenarios and modelling for national and local level applications.

The WWAP has active interest to closely cooperate again with Dutch institutions on the second scenario project. And, vice versa, Dutch institutions (research as well as private sector) have an active interest to contribute. This cooperation is considered to benefit the Dutch water knowledge development because the WWAP is a global report that will showcase Duch expertise.

WB Alliance for Global Water Adaptation (WB AGWA)

The Alliance for Global Water Adaptation represents a coordinated effort among several institutions and organizations to jointly work towards improved and wider-spread practices on adaptation to climate change in the water sector. This Alliance provides a vehicle for reflection, discussion and action in adaptation, and to share - with policy and decision makers and other stakeholders in the water and other relevant water related sectors - information that can be used to develop informed public policies and serve as a framework to take Climate Change adaptation actions in the water sector. Members of this Alliance bring the complementary skills and institutional reach needed to close these multiple gaps through coordinated and joint actions, and by catalyzing others to do the same.

The Objective of AGWA is to assist countries to build resilience for adapting to climate change impacts by closing the gap between existing knowledge and its practical application in the water related sectors. Specifically:

- To make operational contributions that will strengthen the global water and climate adaptation agenda in the UNFCCC and other global-level policy processes and institutions.
- To serve as a network/channel for sharing knowledge and practical and operational experiences and for coordinated and joint actions to assist countries, communities and utilities in coping with water related climate change though applying knowledge, principles, tools and methodologies for adaptation.

The Dutch Business case on Assessments for Investments contributes to the objectives of these international programmes.

Making the Dutch business case work for Bangladesh

Chapter 5

Drivers and trends of physical and socio-economic development in Bangladesh

In the coming decades, Bangladesh will be confronted with increasing flood risks, challenges regarding water quality, droughts and salinization due to main driving forces such as: population growth, economic development, political development and climate change. These drivers pose huge effects on the available natural resources and severity of natural and man-made disasters. Technological development may provide opportunities for more cost effective infrastructure, exploitation of previously untapped natural resources and for improving resource productivity and increase the resilience of agriculture and aquaculture systems. Climate change will act as an 'amplifier' of the already existing challenges. Proper future development and management of natural resources including spatial planning is essential for the future development of Bangladesh. Hereafter the main drivers are briefly discussed in their Bangladesh context.

Climate change

One of the important drivers is climate change, which is expected to have severe impacts on infrastructure, food and livelihood security of the country. On average every five years, up to two-thirds of Bangladesh is inundated by floods that cause substantial damage to infrastructure, housing, agriculture, and livelihoods. Low-lying coastal areas and costal polders are also at risk from tidal floods, water-logging and severe cyclone induced storm surges. Severe cyclones make landfall on the Bangladesh coastline, either before or after the monsoon, causing storm surges that are sometimes in excess of 7 meters. Crops and the livelihoods of the rural poor in low-lying coastal areas are also devastated by saline water intrusion. All these climate related risks will be exacerbated due to a warmer and wetter future climate that goes beyond historical variations.

Population growth

Rising population is causing pressure on land and water use, livelihood and economic development. Bangladesh is one of the most densely populated countries of the world. The projected population in the year 2025 is about 180 million and about 220 million in the year 2050. Currently 40 percent of the population is living in poverty and are vulnerable to natural hazards. Absolute numbers will increase over time. The growing population increases pressure on use and consumption of resources and sustainable environment that need to be addressed d in managing resources under efficiency and equity principles.

Economic development

Bangladesh wishes to achieve Middle Income status by 2021. This will mean a sustained economic growth of some 8 percent. The country is already undergoing an unprecedented urban and economic transformation and the growth will surely alter the landscape. Corridors and connectivity will be significant in providing economic efficiency and agglomerations with increasing economic density concentrated around greater Dhaka. Achieving Middle Income status will mean more resource use and consumption for a larger population with increased standard of living as well as increased need for infrastructure and municipal services. There is a need also to provide protection and safety to areas of economic density and growth poles that in many areas of Bangladesh are increasingly threatened by natural disasters and risks. It needs to be acknowledged that economic growth is the engine to drive the change and transformation of the country and without appropriate planning and programming of that change/transformation chaos and disasters will continue to exist, and under a more increasingly difficult climatic conditions.

Technological development

Technological development may provide opportunities for more cost effective infrastructure, exploitation of previously untapped natural resources and for improving resource productivity and increase the resilience of agriculture and aquaculture systems. Technology innovations may open opportunities to enhance the functionality of infrastructure solutions, to extend the life-time of infrastructure and/or to develop more cost effective designs. Unless technological developments and related governance aspects do not significantly improve, the overall resilience and sustainability will significantly decrease in the future.

Sediment Balance

It is important to focus the sediment dynamics between Bay of Bengal, river and hinterland. Coastal polders suffer from a sediment deficit because embankment prevents tidal flooding and results in siltation of river. There is enormous opportunity of land reclamation in the Bay of Bengal for agricultural production and enhanced livelihood. The potential of land reclamation under the changing climate needs to be assessed and materialized.

Subsidence

The lower deltaic area of Bangladesh is located on two active troughs, Faridpur Trough and Hatiya Trough. Although most of the Bengal Basin is slowly subsiding, the troughs are subsiding more rapidly. The area shows evidence of three different types of subsidence: tectonic, anthropogenic, and that resulting from the compaction of peat layer. GPS data were processed with Gamit_Globk software developed by MIT, USA. Geodetic GPS observation in Bangladesh shows that the north-eastern part of Indian plate covering Bangladesh is moving 4 to 5 cm per year with respect to International Terrestrial Reference Frame (ITRF). The vertical component of the GPS time series plots demonstrate that the Bengal Basin as a whole is subsiding, including Dhaka, Sylhet, Patuakhali and Khulna areas. the result from collected data shows Khulna is going down by 9.55 mm/year. Prolonged water logging may be experienced in the coastal polders because of combined effect of subsidence and sea level rise. The subsidence inside the polder can be minimized if sedimentation is allowed though tidal flooding in a planned way, currently tidal river management is practiced.

Political development

Political stability and focus towards more international cooperation will have major impacts on an effective adaptation measures. Regional cooperation and sharing water between lower and upper riparian countries is a crucial issue for water resources development and management in Bangladesh. This issue needs to be addressed in the Delta Plan.

To enhance resilience and sustainable development of Bangladesh a clear vision has to be developed on how to respond to the various drivers of change as well as on how to play along with the trends in society. The development and adaptation of land and water use, the extension and revitalization of infrastructure, and the management and reduction of disaster risk as well as restoration of natural systems are the major issues to be addressed for the management of Bangladesh Delta.

Major issues, themes and Interventions

During the presentations in the sessions as well as from existing planning policy in Bangladesh and new approaches such as the Bangaldesh Delta Plan 2100 many issues and possible interventions may be identified. In the section hereafter a few main issues or interventions are elaborated. Each of these issues may form the base for the Dutch Business case in Bangladesh.

Integrated Delta approach

Enabling Delta Life needs an integrated approach including institutional arrangements, information services, (spatial) planning and structural measures such as physical infrastructure. This will be elaborated in a Delta plan with focus on the following items:

- Prepare a Bangladesh Delta Plan 2100 based on water and food security in a holistic delta approach
- Private sector needs to be involved in (delta) planning as early as possible
- Delta approach comprises:
  - Participatory approach
  - No-regret measures
  - Long term holistic vision
  - Roadmap for actions
  - Clever Institutional arrangements
  - Utilize funding

Climate services and monitoring

Bangladesh is facing many challenges related to impacts of climate change. In this respect information services will become crucial. Holistic master plans (like the Haor masterplan) are needed. Many different types of data and information are collected and processed. Without proper information, major Water, Food and Climate issues can not be solved sustainably. In the 'water & climate information sector' the added value of the NL Cooperation on Water,and Climate Services comprises the following points:

- Consider the complete information chain including the connection to local knowledge.
- Communication, dissemination, transformation and harmonization of information to end users is crucial
- More close study of robustness and vulnerability is needed in relation to future uncertainty
- Monitoring system for small scale river management, improving and maintenance river water levels

Physical infrastructure

The physical infrastructure in Bangladesh is very important for safety and economic reasons. However the current infrastructure needs more maintenance and further development. Main elements to address are:

- Strengthening existing and developing appropriate physical infrastructure: embankment, shelters, road networks
- Addressing second generation problems within polders in the basin and developing protective structures with a return period of >100 years in the backdrop…?
- Dredging business partnership with local Bangladesh large construction and dredging group Bashundhara Group and an identified Dutch partner (HEM or other) and potential win-win on land development. (reclamation/building with nature concept/building with spoil)
- Ample attention for operation and maintenance of existing infrastructure

Disaster risk management – crisis management

In Bangladesh the society has learned to cope with (natural) disasters. In a way Bangladesh can be considered as one of the most climate resilient countries in the world. However, due to the increasing pressure by the driving forces disasters will continue to happen. For this reason disaster risk reduction and management is a major issue in Bangladesh. Main points to be considered are:

- Crisis management support in Bangladesh using a comprehensive operational framework (proven concept in the Netherlands) with the identified stakeholder DMB (Disaster Management Bureau).
- Food security early warning system improvement of BRAC using complementary expertise and proven concepts on large (river basin & regional) and small (community base) scale level.
- (Transnational) Flood Early Warning Systems (BWDB-FFWC) with emphasize on increasing lead time for end users.

Institutional strengthening and arrangements

The (inter)national institutional and political setting in Bangladesh is extremely complex. To solve the main issues transboundary river basin management will be a major challenge. Moreover the quest for sustainable and so feasible solutions will also have to comprise the interaction between government and private sector.

In Bangladesh the interaction between NGOs, knowledge and research centers and governmental organizations is well developed. The position of the private sector in water and climate studies is less pronounced. It is widely acknowledged that further development of large scale climate adaptation measures in Bangladesh will only be possible in a cooperation arrangement between public and private sector. Through the mission of CIWK (see chapter 4)

only some possibilities of private sector investment and their information requirements emerged. However there are large opportunities for the Dutch Water sector.

- Governance challenges: Inter-ministerial cooperation, national level planning, complex setting, intrinsic uncertainty, need for new knowledge
- Private sector needs to be involved by seeking PPP constructions. N.B. PPP is already existing in Bangladesh but with large emphasis on private interests (due to corruption) and not on public services
- Private sector is not well organised (accessible)
- Try to connect Dutch – Bangladesh private sector
- In 50 – 100 years from now the private sector may very well be in the driver seat for delta developments

Towards assessment for investments

Although the three sessions during the Aquaterra conference delivered valuable results, time was too limited to further discuss and elaborate an assessment approach for selection and prioritization of specific investments. In order to feed and inspire a possible follow-up on this in the following three paragraphs some other examples of useful appraoches are briefly illustrated.

Guidance for selection and preparation of action plans for further investments (ICHARM project) [7]

In the ICHARM project (Title funded by ADB) a generic approach is elaborated for the "Development of a National Road map for Early Warning System Development (EWS)."
Such a roadmap is expected to be useful to guide the preparation of long term national planning and can be used by the government agencies and donor agencies for screening and ranking of investments on EWS development projects.

Main Steps towards formulation of a national road map for investment in EWS:

- Review by technical assessment, institutional assessment, impact assessment and need assessment at grass-root communities.
- Identify key issues: the review summarizes the key findings that can be translated into key issues based on expert knowledge.
- Dependency test and Project Identification: All prioritized issues were classified.
- Short listing of issues: The screening and validation of issues from the long list for priority ranking is done through stakeholders' involvement.
- Priority ranking and selection of interventions
- National Road Map Outline: the ranking of proposed interventions led to the identification of most essential projects to fulfill the current gaps

The priority ranking was carried out on the list of clustered interventions:

- One for a Multi Criteria Analysis (MCA) approach to compare all different interventions
- A second for a Strength – Weakness – Opportunity – Threat (SWOT) approach to compare the interventions one by one.

The final step towards a Roadmap for flood EWSD is a (qualitative) feasibility analysis of the priority interventions by classification of the interventions in terms of:

- technical aspects
- social – cultural aspects
- institutional aspects
- financial aspects

Next, each intervention was scored using the following criteria:

- Technology (availability of data, equipment, software)
- Socio-Cultural (acceptance of warning info, response capacity, level of awareness)
- Institutional including (mandate, user demands, legal feasibility, existing laws and regulations, enforcement, organization capacity)
- Financial (availability of budget for: purchase, O&M, capacity development)

The final results of the pre-feasibility analysis are presented in table 1.

Cascade	First Priority intervention	Technical	Socio-cultural	Institutional	Financial
1 Risk knowledge development	Formal and informal education	++	++	+++	+
2 Monitoring and data acquisition	Operation & maintenance of the monitoring network	++	++	+	+
3 Forecasting and warning	Model accuracy and upgrade software	+++	++	+++	++
4 Dissemination and communication	More precise and user friendly warning	+++	+++	++	++
5 Information type and reliability	More precise and location specific information	+++	++	++	++
6 Response capability	Capacity development of community	+++	++	+	++
7 Cross cutting issues	FFWC capacity building	+++	+++	+++	++

Cascade	Second Priority intervention	Technical	Socio-cultural	Institutional	Financial
1 Risk knowledge development	National and local level risk assessment	+++	++	++	+++
2 Monitoring and data acquisition	Expanding the range of data acquisition	++	++	+++	++
3 Forecasting and warning	Flood forecast model development	++	++	+	++
4 Dissemination and communication	Capacity building for dissemination	+++	+++	++	++
5 Information type and reliability	Update warning information timely manner	+++	++	++	++
6 Response capability	Community preparedness	++	+++	+	++
7 Cross cutting issues	International cooperation	+++	+	+	+++

Table 1. Pre-Feasibility Analysis with main priority interventions

Range of Symbol	Descriptions (based on expert judgment)
+++	Very High - High feasibility which means that the priority interventions is very likely to be implemented
++	Medium
+	Medium - Low which means that the priority interventions will not be implemented easily

Score range low, medium, high feasibility	
Technical	• Low if the technology is not ready, not available, large capacity building and training needed • Medium • High if technology is already available in the organization and if well trained staff is available
Socio-cultural	• intervention or the local end-users do not see the benefit or the solution is to high end or technical/expensive for end-users
Institutional	• Low if there is no acceptance and no ownership, or cooperation and involvement of institutes. Also low if there are no existing laws and regulations or that the enforcement is not in place
Financial	• Low if the funding is not available, if the intervention is expensive and not cost-effective, the intervention needs large O&M cost in the future • Medium High if (own) funding is available, if the intervention is cost-effective and if a clear O&M planning is available

Risk assessment related to hazards and scenarios

In the SUBCOAST project (funded by EU FP7) a risk assessment approach is elaborated for subsidence harzard [3]. A risk analysis is very important to assess the possible impacts of subsidence and subsequently to select and prioritize most appropriate strategies and measures. Risk can be defined as: (risk of hazard) = (probability of hazard) x (impacts of hazard)

Relevant stakeholders and experts should estimate the risk level for several themes related to the impacts of subsidence. This involves estimation of the hazard by the driver(s) of change and the related direct or indirect impacts. A high probability of the hazard will increase the risk level. On the other hand if the area is very vulnerable for direct or indirect impacts, the risk level will be increased as well, especially for areas with high density of population and assets.

In other words the combination of level of probability and vulnerability will determine the total risk level, as illustrated with an example in figure 1. A high risk level asks for urgency in taking measures, medium risk gives some time for mitigation plans, and low risk is associated with ample time and no-regret measures. The measures can be focused on reducing the probability of the hazard or reducing the direct or indirect impacts.

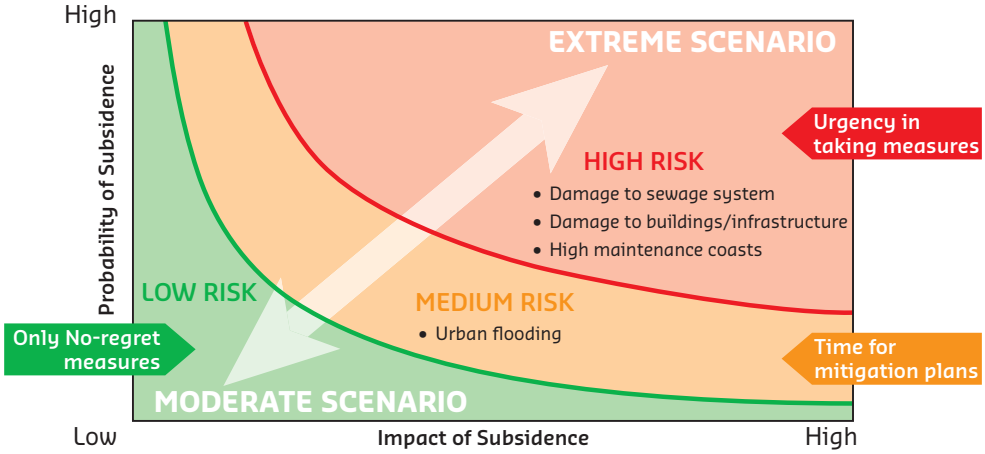

Figure 1. Example of a risk assessment for several themes in a case study area

In the risk assessment, besides land subsidence preferable also other hazards should be taken into account, including their interaction (for example socio-economic growth combined with climate change sea level rise will further increase risk levels). Moreover the impact of different scenarios for the drivers of change should be considered in order to deal with uncertainties in the future, and to execute some kind of sensitivity analysis for impacts and risks. A more extreme scenario will increase the impact and risk levels, while a moderate scenario will decrease these levels.

Adaptation Tipping Point (ATP) approach regarding climate change

The rate of climate change and its consequences in the 21st century are very uncertain, and our insights are still developing. These large uncertainties might require adaptive strategies which can be accelerated when climate change speeds up and can be delayed when climate change develops slower as expected. In other words to take the right decisions in time while not overinvesting or taking measures that block future strategies.

To assess the durability of current or planned water management strategies Kwadijk et al. [4] and Te Linde and Jeuken [8] propose the methodology of adaptation tipping points (ATP's). ATP's are defined as points where the magnitude of change due to climate change or sea level rise is such that a strategy will no longer be able to meet its objectives.
It will address the following strategic questions of the policymaker: How long will the strategy be efficient after the time horizon (robustness), and how easy is it to change in time to an alternative strategy (flexibility/no regret)? The possible succession of alternative strategies/ measures into the future are called 'adaptation pathways' (see figure 2).

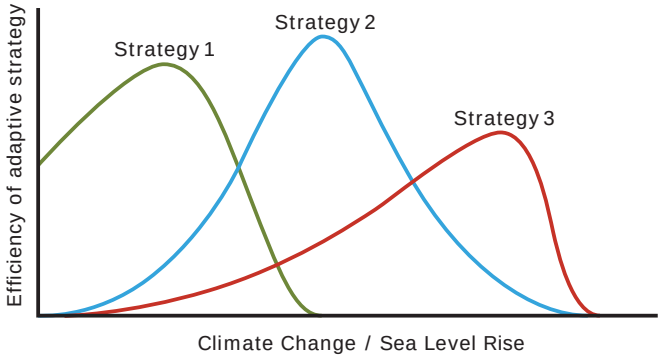

Figure 2. Succession of alternative strategies

Usually climate change scenarios are taken as a starting point to assess the impact on functions and define strategies to adapt to the consequences of climate change.
In subsequent steps a projection of climate change and sea level rise is made (driving forces), the effect of these changes on water quantity and quality of a system is quantified, and the way the latter changes affect the objectives for functions such as safety, nature and agriculture is estimated (impacts). Based on these impacts one decides whether policy objectives are (still) met or an alternative strategy is needed (response).

The adaptation tipping point approach starts where the classical top-down approach ends, and follows steps in reverse order: determine the objectives for the functions at stake (impacts), quantify the relevant boundary conditions under which these objectives can still be met, quantify the corresponding climate characteristics and sea level (driving forces) and compare these with climate change projections to estimate when these tipping points may be reached. Reaching ATPs might have physical and ecological, technical, economic, societal or political causes.
The classical top-down approach addresses the question: "What if the climate changes or sea level rises to a particular scenario?" The adaptation tipping point approach addresses the question: "How much climate change can we cope with?"

Conclusions and recommendations

Chapter 6

During the Aquaterra Conference, the Dutch Business Case "Assessments for Investments" as they relate to adaptation measures under the uncertainty of climate change, has been well presented in a number of sessions related to case studies in Bangladesh. The Dutch consortium of institutes that presented their method of downscaling global climate change scenarios to the appropriate level for the purpose of future decision making is well positioned to apply their approach world wide.

Such "top-down" assessments should always be accompanied with local information at the level of actual measures and alternatives to be considered. Green adaptation, for example, may comprise cost-effective infrastructure alternatives. The NL Cooperation on Water and Climate Services provides an entry point towards implementing techniques to assist in acquiring accurate data.

Furthermore, several approaches – road maping, risk based management, tipping point analyses - have been high lighted which may be helpful in further prioritization for decision making processes. An integrative and holistic, cross-sectoral vision – such as layed down in a Delta programme approach - is key to develop sustainable alternatives.

Economic analyses, in combination with innovative financial engineering, are essential elements buiding the enabling environment for applying good governance principles.

However - in view of the discussions held during the AquaTerra sessions - when aiming at really assessing the trade-offs of possible investment alternatives, a more clear overview of the actual interventions is needed. The discussions with different stakeholders clearly indicated the awareness of the main issues, themes and interventions. For review, short listing and ranking of priority interventions based on trade-offs more interaction with the stakeholders is needed.

The main issues identified are:

- Integrated Delta approach
- Climate services and monitoring
- Physical infrastructure
- Disaster risk management – crisis management
- Institutional strengthening and arrangements

Some points to consider are:

- There is a large need for (local) damage functions related to the risks
- Which trade-offs exist between risks and investment in adaptation measures?
- Trade-off for investment will depend on optimization of the geographical scale of the adaptation measures (cost-benefit ratio's for different types of risks)

- Risk zoning and spatial planning will be crucial for investment in high risk areas with high investment potential
- Focus on the win-win's and create investment packages (for instance large cross dams with tidal energy installations)

Further elaboration is needed, especially regarding costs/benefits (in time!), in order to be able to make appropriate decisions on selection and implementation of the Dutch business case. The available examples of assessment approaches as illustrated in paragraph 3.3 and 5.3 may give good guidance on what to address and how. This should involve prioritisation and interaction between technical, social–cultural, institutional and financial aspects. Moreover the following items should be addressed:

- which regions / countries are most vulnerable to global change
- which changes are to be expected
- where investments are proposed or required within a region
- which investments are most promising with reference to costs/benefits and intersectoral trade-offs

The way forward

The project team recommends to elaborate the possibility for trade-offs further by making use of several already existing projects, platforms and related policy processes such as:

- Water Mondiaal Bangladesh
- CIWK Bangladesh
- WWF6 Marseille
- The National Roadmap of the ADB-ICHARM project RETA - 7276
- Delta Alliance – Bangladesh wing

The 6th World Water Forum in Marseille will provide a next opportunity to explore a next step in the preparation of the (Dutch) sector business cases. The Water Mondiaal program is currently preparing a ToR and MoU for the start of a Bangladesh Delta Plan 2100. A contour document with main interventions will form part of that approach.

Funding for the implementation of the Dutch business case "Assessments for Investments" may be found at different levels. The International donors in Bangladesh showed keen interest in the work of the 'water & climate information' sector. Availability of trust worthy data in the field of water and climate change is crucial for the planning and implementation of sustainable adaptation measures. Some possible sources of funding to be explored include:

- WB Climate resilience program
- ADB Cimate proof urban areas
- UN WWAP
- Multi-Annual Strategic Plans of the Dutch embassies
- Accelerated access to climate funds (REDD)
- In the current 5 year plan 2011–2015 of Bangladesh already more than 77% of the overall country investments originates from private sector (Shamsul Alam); however without (government) investment the National Water Management Plan will never be implemented.

The next table gives an additional overview of multilateral and bilateral adaptation financing sources [6].

Table 2. Overview of multilateral and bilateral adaptation sources [6]

	Global Environment Facility	Global Environment Facility Small Grants Programme	Pilot Programme for Climate Resilience	Least Developed Countries Fund
Focus Area				
Mitigation	•	•		
Adaptation	•	•	•	•
Sustainable Development	•			
Disaster Risk Reduction				
Type of Activity Funded (Restrictions, if any)				
Capacity Building	•	•	•	
Technical Assistance	•	•	•	•
Investment	•	•(Pilots)	•	•
Type of Funding				
Grant	•	•	•	•
Loant			•	
Guarantee				
Funding Amount per Project				
	Up to several million	Up to $50,000	Up to $1.5 million for preparation. In the range of $100 million for program.	Average $3.6 million
Eligible Institutions (Eligible Countries)				
Community-based Organizations	All eligible; national government approval required.	•		
Nongovernmental Organizations		•		
Private Sector				
Local Government				
National Government			•	• (LDCs)

Sources: GEF 2011; UNDP 2011; CIF 2011; UNFCCC 2011; Adaptation Fund 2011; GFDRR 2011; World Bank 2010b; MDG 2011.

Special Climate Change Fund	Adaptation Fund	Global Facility for Disaster Risk Reduction (Track 2)	Multilateral Development Banks	Private Sector Arms of Multilateral Development Banks	Millennium Development Goal Achievement Fund
•			•	•	•
•	•	•	•	•	•
			•	•	•
		•	•	•	
	•	•	•	•	•
•	•	•	•	•	•
•(Institutional)	•	•(Post- disaster)	•	•	•
•	•	•	•	•	•
			•	•	
			•		
Average $4.2 million	Several million	Several hundred thousand in Track 2.	Very broad range of millions to billions.	Very broad range, up to several hundred million.	Several million; in the range of $4-8 million.

	All eligible with emphasis on most vulnerable developing countries; national government approval required.				All eligible in the 57 MDG countries; national government approval required.
				•	
				•	
•(Most vulnerable DCs)		•(Most vulnerable DCs)	•		

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2 **Comparative assessment of the vulnerability and resilience of 10 deltas** – *synthesis report. T. Bucx, M. Marchand, A. Makaske, C. van de Guchte, 2010, Delta Alliance report number 1. Delta Alliance International, Delft-Wageningen, The Netherlands*

3 **SUBCOAST** – *Report D1.3 User requirements, T. Bucx, K. van Ruiten, D.van den Bergh, P.Kruiver (Deltares), www.subcoast.eu, final draft version December 2011*

4 **Using adaptation tipping points to prepare for climate change and sea level rise, a case study for in the Netherlands,** *J. Kwadijk et al., 2010, Wiley Interdisciplinary Reviews: Climate Change, Volume 1, Issue 5*

5 **Working on the delta. Investing in a safe and attractive Netherlands, now and tomorrow**, *2010, Ministry of Transport, Public Works and Water Management, Ministry of Agriculture, Nature and Food Quality, and Ministry of Housing, Spatial Planning and the Environment*

6 **Guide to climate change adaptation in cities**, *2011, World Bank*

7 **National Roadmap for Floods Early Warning System Development in Bangladesh, ADB-ICHARM Technical Assistance TA 7276-REG** *"Supporting Investments in Water Related Disaster Management, Dhaka, October 2011, International Center for Water Hazard and Risk Management (ICHARM), Japan, Deltares, The Netherlands, Center for Environmental and Geographic Information Services (CEGIS), Bangladesh*

8 **On the use of water scenarios in the Dutch Delta Programme**, *Ad Jeuken, Aline te Linde, Lineke Woelders, Jaap Kwadijk (Deltares), 2010, Bundesanstalt für Gewässerkunde, Veranstaltungen*

9 **Dutch National Water Plan (NWP)**, *2009, Ministry of Water Management, Ministry of Spatial Planning and the Environment, Ministry of Agriculture*

10 **Mission report Bangladesh**, *Dhaka, 29th July – 4th August 2011, Hans van Leeuwen, Dick van den Bergh, Leanne Reichard, ICHARM*

Annex

1. Aquaterra 2007

Aquaterra 2007 was opened by Prince Willem-Alexander of the Netherlands, chair of the UN Secretary-General's Advisory Board on Water and Sanitation. Taking the recent climate developments into account, the organisers created a programme intended to bring practical solutions a step closer. This included case studies on cities such as Shanghai, New Orleans, Singapore and the Californian delta, plus presentations on policy-sensitive environments such as Hamburg , London and Dordrecht.
The forum attracted a practical and consultancy oriented audience, keen to examine ways of managing and tackling climate in delta and coastal areas within the constraints of modern society. Key aspects herein were flexible and timely responses to developments and the development of innovative solutions.

According to Gaele Rodenhuis, Chairman of the International Advisory Committee of Aquaterra, the event clarified approaches to adapting to climate change. "The clear message was that people are not going to move from threatened areas, whether that be in the Netherlands or New Orleans. Ongoing development is important for a healthy economy, without which living conditions would deteriorate and nature conservation efforts would dry up."
Another conclusion was that the costs of land reclamation are more than compensated for by the results. "As the volume of dredged material increases thanks to new equipment, the price per cubic metre is reduced at the same time as the cost per square metre of reclaimed ground rises," Rodenhuis continues. "The Aquaterra case studies on cities such as Singapore, Shanghai and Rotterdam show that reclamation pays."
Other Aquaterra presentations looked at how technological advances are facilitating the struggle against climate change effects, including the creation of islands in front of the coast and the development of rivers and lakes. "Such solutions are not only economically viable but can also be carried out in an ecologically responsible way," Rodenhuis says. "The dredging industry is making great strides, and the Maasvlakte II development in Rotterdam proves how reclamation can go hand-in-hand with major nature conservation schemes."

Aquaterra 2007 was supported by a wide range of industry leaders and organisations, including Netherlands Water Partnership (NWP), COST 22, American Society of Civil Engineers (ASCE), Environmental & Water Resources Institute (EWRI), International Water Association (IWA), Partners for Water, European Water Association (EWA), International Association of Hydraulic Engineering & Research (IAHR) and The Oceans, Ports and Rivers Institute (COPRI). The next edition of Aquaterra is scheduled for February 2009.

2. Aquaterra 2009 and Aquaterra Statement

The mission of the Aquaterra Conference is to bring together professionals from around the world to share insights and experiences in the sustainable development of deltas, estuaries and coastal zones. Aquaterra aims to provide an international platform for a continuing dialogue on sustainable delta development. This ***Aquaterra Statement*** *is an expression of this intention; it is the outcome of moderated discussions among the delegates of the Aquaterra Second World Forum on Delta & Coastal Development, held in Amsterdam from February 10 to 12, 2009. These discussions took as their starting point the inventory of trends and responses for 8 deltas[3], specially prepared for Aquaterra by the Dutch institute Deltares, and experiences presented during the conference. Delegates agreed that the delta dialogue started at Aquaterra should continue.*

3 *Towards sustainable development of deltas, estuaries and coastal zones. Trends and responses, January 2009, Deltares, Delft, The Netherlands.*

Deltas: economic power house and food basket of nations

Deltas are economic and environmental hot spots. Because of their strategic location linking the interior of nations to seas and the world through inland waterways they provide tremendous opportunities. Deltas and estuaries are often the economic power house of a nation. In many cases they are also the food basket of the nation; deltas provide some of the world's most fertile lands and rich fisheries. Attracted by these potentials, some 50% of the world's population presently live and work in coastal deltas and we have seen the rapid growth of coastal mega-cities. The rivers that flow through deltas are an important source of fresh water and nutrients, critical for sustaining life in the delta and the ocean beyond. The mixing of salt and fresh water in the estuarine part of the deltas creates conditions for a unique flora and fauna. Deltas and estuaries are among the most productive ecosystems on earth and precious to life.

But they are vulnerable and there are huge challenges ahead

The characteristics which make deltas attractive to live and work are being threatened. The threat is acute; action is urgently needed. Flood risks are huge, critical infrastructure is under threat, available space is getting scarce, fresh water resources are over-exploited and environmental quality is deteriorating. Population growth, economic development and climate change are aggravating current stress. We need to be prepared for the huge challenges in deltas which we are facing here and now, and over the next 50 years; yet we are not. A pro-active, integrated approach is urgently required for each delta to assess and monitor its vulnerability and to determine adaptation paths to make the delta more resilient.

There are viable solutions to be grasped[4]

A changing climate and environmental degradation makes it clear beyond doubt that nature poses limits. These limits may be stretched but only at increasing cost. Despite these limits, there are in fact good prospects to harmonize economic and environmental interests in a sustainable manner. The challenge is to make better use of the inherent adaptive capacities of nature and to make use of natural processes. It reflects the understanding that nature is not a problem, but can be part of the solution. Building with nature, restoring natural dynamics, is already practiced successfully, for example in the form of beach nourishments as opposed to hard structures to control erosion and in 'room for the river' programs. Multifunctional use of infrastructure is being implemented in densely populated deltas to provide protection, save space and money. The natural purification capacity of wetlands and estuaries can be restored, even in highly modified deltas. Waves, tides and salinity gradients can provide renewable energy. Adoption and implementation of such solutions, however, requires a shift in paradigm. As was stated at the Conference: 'Nature where possible, technology when required'.

Supported by advances in science and technology

Solutions must be supported by science and technology. 'We cannot manage what we do not understand'. The natural systems supporting deltas are very complex. While significant advances in understanding these systems have been made, more is needed. Advances in sensor and simulation technologies help us to map and monitor the systems' state, and make it possible to play out scenarios under various assumptions of climate change. These technologies also allow for adaptive management strategies where continuous feedback of the delta system ensures that societal objectives are achieved, enhancing public understanding and involvement. Pro-active community programs – 'meet the experts' – have shown to be successful in achieving public acceptance and support of major measures.

4 *Aquaterra: Key factors for the successful management and development of deltas and estuaries, Editor Dr. Gaele Rodenhuis, Chairman International Advisory Committee, Committee members, moderators and speakers.*

Knowledge and experience on 'delta technology' should be shared

The science and technology needed for the sustainable development of delta areas – collectively called 'delta technology' - is a vast field of science. Furthermore, it should be embedded in the socio-economic dynamics and cultural diversity characteristic of the many different deltas around the world. It is only by experience, experimentation and learning that we can succeed in coping with the impacts that climate change will pose. Therefore, co-creation and exchange of knowledge and experience should be stimulated to develop successful strategies and best practices, and to build adequate capacities and capabilities in dealing with delta issues world wide.

Technological fixes alone cannot resolve the problem – governance and public awareness are also essential.

The development and management of deltas has become increasingly complex and often an issue of societal debate. A number of trends have added to this complexity, including decentralization of government and larger involvement of the private sector. Deltas are mostly governed by multiple layers, e.g. international, national, regional and local; often the governance of deltas is fragmented. The fact that there is no legal entity for governance of deltas adds to the complexity. But the water in deltas flows. It flows across political and institutional boundaries; it links the river basin and the coastal zone. 'Delta governance' is needed. Good delta governance promotes the development of a collective vision for the future. It proactively communicates and engages with stakeholders and the general public. It works together with nature conservancy organisations (remember: nature can be part of the solution). It advances the implementation of the vision by stimulating development projects and experimental pilots. It secures adequate and timely maintenance and adaptation.

Deltas urgently need political recognition at the global level

Deltas are economic and environmental hot spots. The threats due to the impacts of climate change, population growth and economic development are imminent. Remarkably, their critical functions in the economy and food supplies of nations, is not reflected in political recognition on the global level under the various policy debates such as the World Water Forum and the UN Climate negotiations. The UN Convention recognizes, for example, the Small Island Developing States (SIDS) as a vulnerable category. Deltas and estuaries are just as vulnerable; given their critical socio-economic importance and geopolitical importance they deserve prime recognition.

Therefore, in recognition of the essential functions and vulnerable state of deltas, the participants of the Aquaterra Conference, including representatives from government, science, private sector and NGO's from some 10 key deltas around the world, call upon all national delegations to:

recognize deltas as a special category of vulnerability,
stimulate the sharing of knowledge and experience,
promote education in delta science and technology,
facilitate a continuing global delta dialogue,

and call upon the Dutch Government to bring this message to international forums such as the Fifth World Water Forum in Istanbul, 2009 and the Conference of Parties (COP15) under the UNFCC in Copenhagen in December 2009. Amsterdam, February, 2009.

3. Brief outline descriptions of the three sessions at Aquaterra 2011

Water & Climate Services Session

Wednesday 2 November 2011
11:30 – 13:00 hrs, Room D202, RAI Congress Centre, Amsterdam

Conveners:	NL Covenant WCS & Delta Alliance
AquaTerra Adv.Cie:	Henk van Schaik (PBL)
Covenant WCS:	Ruud Grim, Leanne Reichard, Hans van Leeuwen, Dick van den Bergh
Delta Alliance:	Cees van de Guchte, Wim van Driel
NWP:	Martijn van Staveren
Water Mondiaal:	Raimond Hafkenscheid

Session Outline
The world's climate is changing into more extreme events of rainfall and temperature resulting in floods, draughts, and typhoons. Many meteorological stations collect the actual weather conditions. In fact due to the changing weather conditions these historical data are not very reliable for future projections to be used in the design of water infrastructure. Water resources are shrinking and there will be more claims for access to water. More effective water management is becoming more and more urgent.

In many regions only very few monitoring infrastructure is available. There is a need for advanced technologies in the water sector where space-borne imagery and state of the art water-models support in predicting future behaviour of water resources. This is key for governments to adequately manage (plan, invest, store, distribute) their water resources, and design, build and operate infrastructure for water storage (dams, basins, etc.), agriculture (food security, increased yields) and safety (levees, barriers etc.).

The World Meteorological Organisation uses the phrase 'Climate Services' to describe the interaction between climate (-change) and water resources management. The Netherlands has excellent experience in this field. Therefore 40+ Dutch organisations have signed in 2011 a cooperation agreement to jointly support further development of Water & Climate Services, as to bring science and government closer to each other.

Session Goal

Sharing the opportunities of Water & Climate Services to assist the world's deltas in coping with the increasing needs for spatial information supporting water management, food security, climate change adaptation and disaster risk reduction.

Chair	**Dr. Raimond Hafkenscheid**, Ministry of Foreign Affairs / DGIS, the Netherlands
Guest of Honour	**HE Muhamma Ali Sorcar**, Ambassador for Bangladesh in the Netherlands
Opening	**Dr. Raimond Hafkenscheid**, Chair of the Session
Key Note 1	Global Framework for Climate Services Remark to G20 Declaration on Food Security, ref. Global Monitoring Mechanism for Food – Group on Earth Observation **Dr. Piet de Wildt**, KNMI for WMO, the Netherlands
Key Note 2	Dutch Cooperation on Water & Climate Services and its needs analysis in Bangladesh, Vietnam and Mozambique **Dr. Ruud Grim**, Netherlands Space Office, the Netherlands
Statements	• **Dr. Thai**, Vice Director IMHEN, Vietnam, on weather information for water management, floods, drought in Vietnam • **Mr. Rosaque João Guale**, Director Hydropower Cahorra Bassa, Ms Cacilda Machava, Director, ARA Zambeze, Mr. Roberto Mito, Mozambique Zambeze Valey Development Agency,, on the information needs for operational water management in the Zambezi (Zambezi Environmental Flows Project) • **Dr. Choudhury**, Director CEGIS, Bangladesh, on information needs for long term climate adaptation and spatial planning in Bangladesh
Panel Discussion	*Panellists:* **Dr. Piet de Wildt, Dr. Thai, Mr. Rosaque João Guale, Ms Cacilda Machava, Mr. Roberto Mito, Dr. Choudbury; Dr. Grim** *Chair:* **Dr. Raimond Hafkenscheid** 1 Perspectives from Dutch Water & Climate Services: Response on WMO key note and country statements by **Dr. Ruud Grim**, Netherlands Space Office 2 Reflection on country statements and on Dutch approach as a possible contribution to the Global Framework for Climate Services by **Dr. Piet de Wildt**, KNMI/WMO representative, the Netherlands 3 Discussion on promising next steps and business cases to be developed.
Closing remarks	• **Dr. Piet de Wildt**, KNMI/WMO representative, the Netherlands HE Muhammad Ali Sorcar, Ambassador for Bangladesh in the Netherlands • **Dr. Raimond Hafkenscheid**, Chair of the Session

Ganges/Brahmaputra/Meghna Delta Session
Bangladesh

Wednesday 2 November 2011
14:15 – 15:45 hrs, Room D202, RAI Congress Centre, Amsterdam

Conveners:	Delta Alliance & Alterra/WUR & Deltares
AquaTerra Adv.Cie:	Wim Cofino (>Wim van Driel (DA), Fulco Ludwig), Ron Thiemann (>Cees van de Guchte (DA), Dick van den Bergh), Henk van Schaik
NWP:	Martijn van Staveren
Water Mondiaal:	Raimond Hafkenschei

Session Outline
With 1226 inhabitants per km² Bangladesh is amongst the countries with the highest population density worldwide. It is also one of the world's poorest countries with a predominantly labour-intensive agricultural economy.
Currently the country is already vulnerable to water extremes. Additional climate change will result in more cyclones and storm surges, sea level rise, salinity intrusion and water logging. With a sea level rise of 1.5m 16% of the country will be permanently flooded, affecting a population of 22 million. Increasing salinity will reduce agricultural production and affect drinking water production. The north east and central region will have to cope with river floods, the north-west region with increased drought.
Especially coastal inhabitants and the agricultural sector will be affected. Future food production (2 million more mouths to feed every year) will be very dependent on improved integrated water resources management and on developing adequate adaptation strategies for climate change.
As the challenges Bangladesh is facing are enormous and complex, an integrated interdisciplinary approach (a "Delta Vision") will often be needed to find solutions.
In view of the fact that such approaches have not been very successful in the water management sector until now, a new approach using climate change adaptation and food security as drivers could be proposed.

Session Goal	Sharing the challenges of Bangladesh in coping with the envisaged impacts of Climate Change

Chair	**Dr. Sjef IJzermans**, former Dutch Ambassador in Bangladesh
Guests of Honour	• **Dr. Shamsul Alam**, National Planning Committee Bangladesh • **HE Muhamma Ali Sorcar**, Ambassador for Bangladesh in the Netherlands
Opening	**Dr. Sjef IJzermans**, Chair of the Session
Key Note 1	Bangladesh Vulnerability to Climate Change **Prof Dr Zahurul Karim**, FAO, Bangladesh
Key Note 2	Road Map towards a Delta Vision in Bangladesh **Dr. Raimond Hafkenscheid**, Ministry of Foreign Affairs / DGIS, the Netherlands
Key Note 3	Water resources management for the city of Khulna **Prof. Dr. Eelco van Beek**, Deltares, the Netherlands
Panel Discussion	1 Responses on key notes by • **Dr. Bastiaan Mohrmann**, IFC, India (5 min) • **Dr. Khawaja M Minnatullah**, WB, Bangladesh (5 min) • **Prof. Dr. Monowar Hossain**, IWM, Bangladesh (5 min) 2 *Discussion:* from parallel activities to cooperation between programmes in Bangladesh *Facilitators:* **Raimond Hafkenscheid** & **Sjef IJzermans**
Closing remarks	• **HE Muhamma Ali Sorcar**, Ambassador for Bangladesh in the Netherlands • **Dr. Sjef IJzermans**, Chair of the Session

Assessments for Investments Session

Wednesday 2 November 2011
16:15 – 18:00 hrs, Room D202, RAI Congress Centre, Amsterdam

Conveners:	Delta Alliance & CPWC
AquaTerra Adv.Cie:	Henk van Schaik (PBL)
Delta Alliance:	Cees van de Guchte, Dick van den Bergh, Hessel Winsemius, Frederiek Sperna Weiland (Deltares), Willem Ligtvoet, Arno Bouwman (PBL), Wim van Driel, Fulco Ludwig (Alterra)
NWP:	Martijn van Staveren
Water Mondiaal:	Raimond Hafkenscheid

Session Outline
Water related decision processes and operations require optimal understanding of the impacts of proposed measures and investments on related sectors such as food production, energy supply, spatial planning, climate adaptation, etc. Assessments that not only address vulnerability and resilience, but also socio-economic dimensions and trade-offs between sectors under different scenario's, are key to underpin sound decision making for investments in the water sector. This session will elaborate on down-scaling global integral assessments as a framework for decision support at national and programmatic levels, and on how to calibrate the output with a more locally based understanding of vulnerability and investment needs for e.g. adaptation to climate change. Presentations of joint case studies on the Bangladesh and Vietnam deltas by Dutch and local institutes will provide input to discuss the relevance of such assessments for IFI-based and national programming of investments.

Session Goal	To present a methodology for assessments for investments, with Bangladesh and Vietnam as example case studies, and to discuss its relevance for IFI's and national programming in the region

Chair	**Dr. Henk van Schaik**, PBL, the Netherlands
Guests of Honour	**Dr. Henk van Schaik**, Chair of the Session
Opening	Assessment of environmental, socio-economic and climate resilience trade offs for alternative investment decisions - Framework and results of the Bangladesh case study **Dr. Hessel Winsemius**, Deltares/PBL/Alterra, the Netherlands
Key Note 1	Vulnerability assessment and envisaged resilience improving investments in the delta of Bangladesh **Dr. Shamsul Alam**, National Planning Committee, Bangladesh
Key Note 2	Overview of vulnerability assessment for envisaged resilience improving investments in the Mekong delta (Vietnam). **Martijn van de Groep**, Technical Advisor Mekong Delta Plan and Ho Chi Minh Master Plan, the Netherlands
Key Note 3	Water resources management for the city of Khulna **Prof. Dr. Eelco van Beek**, Deltares, the Netherlands
Panel Discussion	*Panellists:* • **Dr. Khawaja M Minnatullah**, World Bank, Bangladesh • **Dr. Giasuddin Ahmed Choudhury CEGIS**, Bangladesh • **Dr. Bastiaan Mohrmann**, IFC, India • **Dr. Arthur Gleijm**, REBEL, the Netherlands • **Dr. Nandan Muhkerjee**, BRAC, Bangladesh 1 Chairs' short reflection on the key notes, ref. applicability in DGIS focus countries and positioning of the Dutch water sector 2 Panellists' short statements, ref. interest in cooperation with NL-sector in this field. 3 Discussion on promising joint approaches in assessments for investments Facilitated by the chair
Closing remarks	**Dr. Henk van Schaik**, PBL Chair of the session

4. Rapid assessment instrument for global flood risk changes

A Bangladesh case-study

Socio-economic and climate changes may have devastating impacts worldwide. This is particularly the case for low lying Delta areas, such as Bangladesh. Rapid global future change assessments of hazards and risks may provide cost-effective first screening information of the major problems in delta regions across the world, and the required adaptation measures in such areas. After the identification of the most relevant problems, these may be studied in more detailed with local assessments (see figure 3).

In this study, we investigated the vulnerability of Bangladesh to future flood risks with our rapid global assessment instrument "Global Flood Risks with IMAGE Scenarios" (GLOFRIS). GLOFRIS was recently developed in collaboration with the Netherlands Environmental Assessment Agency (PBL) and Utrecht University. With this instrument worldwide flood risk can be assessed for the current and future climate, considering both socio-economic and environmental changes. A flood hazard downscaling algorithm makes the model output suitable for local scale applications so that it may be applied in any delta area in the world.

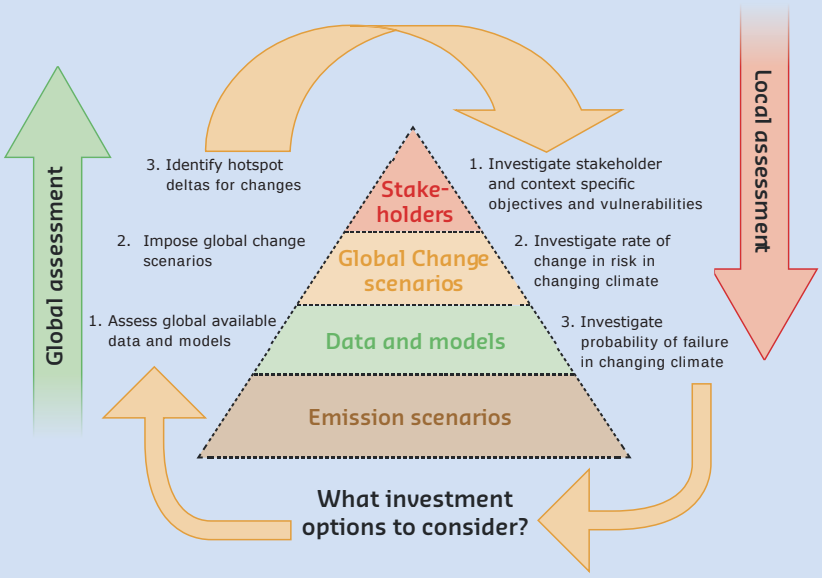

Figure 3: Framework global assessments for local investments

The global modeling instrument

The core of the modeling instrument are the global hydrological model PCRGLOB-WB developed at Utrecht University and the global assessment model IMAGE, developed at PBL. PCRGLOB-WB requires meteorological input (precipitation, temperature and evaporation), calculates the global water balance on a global 0.5 degrees model grid and simulates river discharges, flood genesis and inundation for the major rivers in the world using a sub-grid variable flood routing model. To assess changes in the probability of floods in this demonstration study, the model has been forced with bias-corrected meteorological data from the global climate models (GCMs) ECHAM5 and HadGEM2 for the current climate and the future IPCC scenario A1B for the year 2050. IMAGE assesses socio-economic changes as a function of global changes in land use, land cover and climate change. The combination of the two models provides estimations of flood risk.

Downscaling floods

A demonstration case study has been performed for Bangladesh. In this analysis the 0.5 degree maps have been downscaled to a 1 by 1 km resolution, by combining the flood water volumes in each 0.5 degree cell with high resolution elevation and river network data. This resulted in high resolution estimates of inundation depths with different return periods, which show reasonable resemblance with local hydrological model results and satellite data (see fig.4-7).

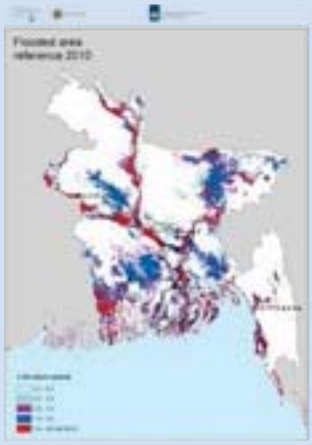

Fig.4: Global model 1/30 year

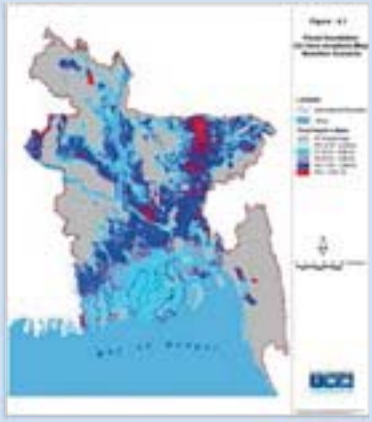

Fig.5: Local model Bangladesh 1/90 year

Fig.6: Dartmouth satellite max flood extent

Combining flood risk with socio-economic changes

The high resolution flood maps are combined with data on current and future population densities and GDP from IMAGE. Not only is the population of Bangladesh projected to increase over the next decades, there is also a strong urbanization trend. By 2030 about 40 % of the Bangladesh population will be living in cities, of which most are located close to the river flood plains. By 2050 the affected GDP is likely to increase from 7% to about 11% of the countries total GDP and the average number of affected people per year may increase with a factor 1.5 to 1.7 (see fig. 8 and 9). The main causes are urbanization, increasing river flood frequencies and to a lesser extent increase in hazards from storm surges. In particular the fast growth of urban areas suggests that adaptation efforts should focus on urban areas, which show a rapid increase in flood hazard. Further local assessments are required to investigate the trade-off between risk and investments.

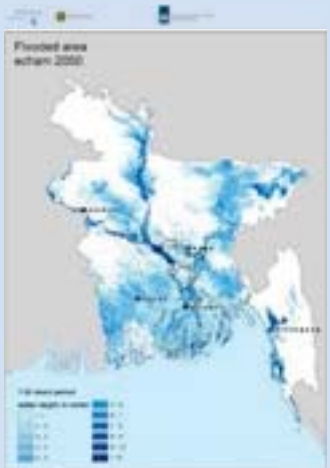

Fig.7: Once in 30-year flood

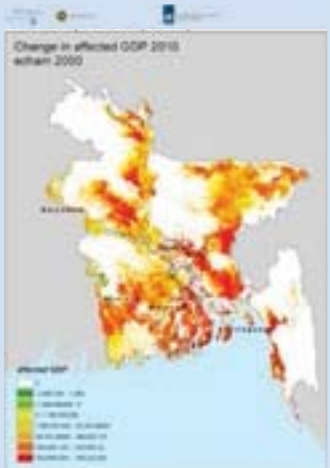

Fig.8: Change in affected GDP per year

Fig.9: Change in affected people per year

Global to local scale

In this study we have piloted a rapid assessment method for flood risk changes with the GLOFRIS instrument. The method is very useful for a first screening to assess:

- which regions / countries are most vulnerable to global change
- which changes are to be expected
- where investments are required within a region
- which investments are most promising

To this end, the demonstrated rapid assessment can be employed in any delta region in the world. In the near future, the method will be extended with a larger ensemble of IPCC GCM scenario computations to provide a broad view of climate change impacts on flood risks.

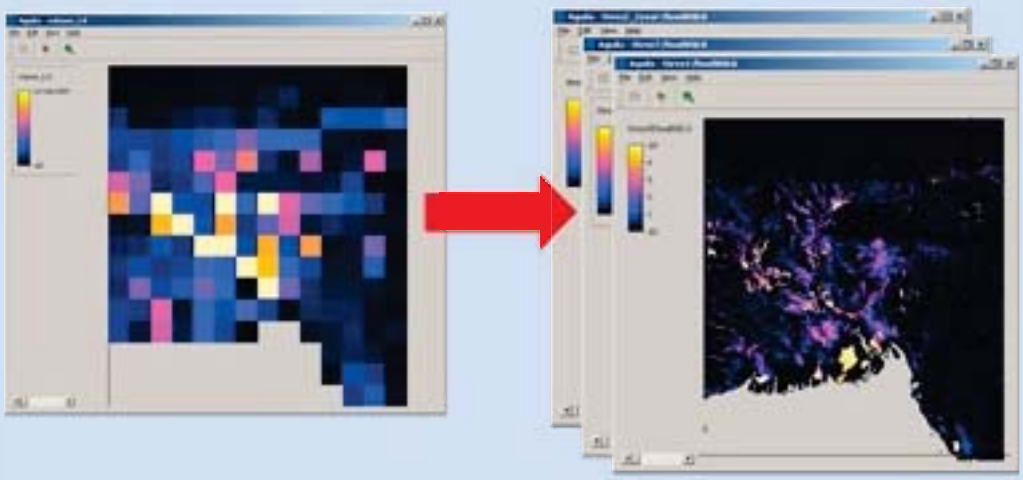

Fig.10: Example of downscaling global climate scenarios in Bangladesh regarding floods: