





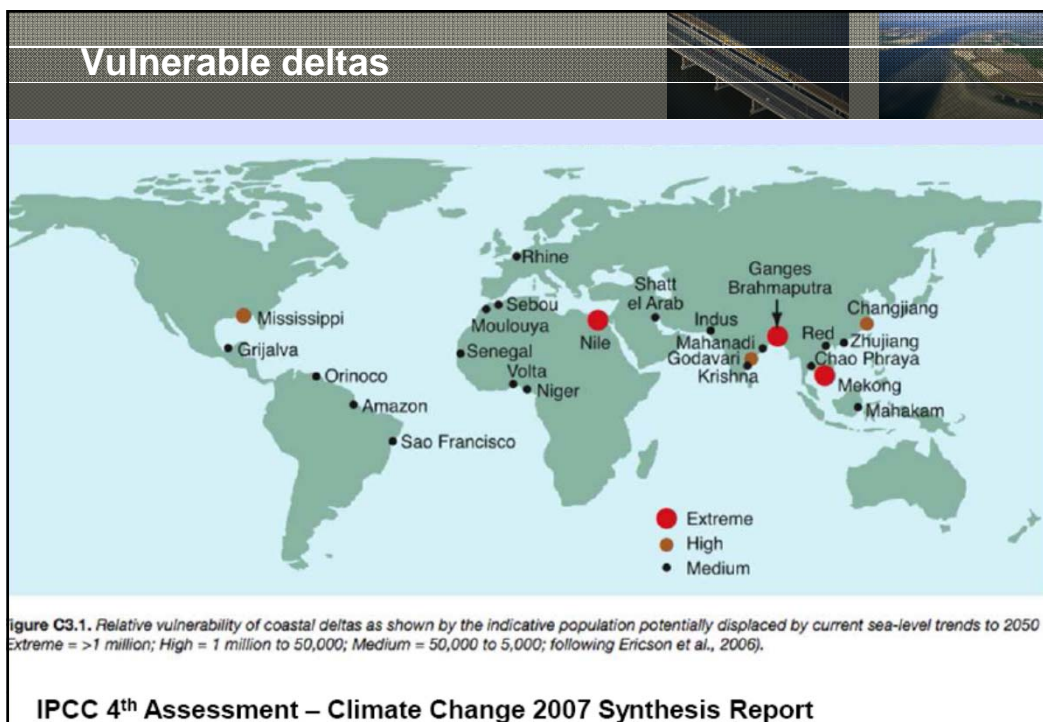
for the resilience of deltas worldwide

Comparative assessment of the vulnerability and resilience of 10 deltas :

Research Gaps in Bangladesh

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 C. van de Guchte, W. van Driel & C. Terwisscha
 GWP-DA Stakeholder Workshop
 Dhaka, 27 Februari 2013



What is the Delta Alliance?

- International network between deltas
- Knowledge driven
- Multi-sector, interdisciplinary
- Framework and support for successful international cooperation

Mission: improve the resilience of deltas worldwide

Through:

- Generating jointly more integrated and effective knowledge
- Sharing knowledge
- Reduce unnecessary overlap
- Identifying knowledge gaps.

NL-KvK Project, Program Manager: Wim van Driel (Alterra-Wageningen UR)
jointly with Cees van de Guchte (Deltares), coordinator NL Wing



Which countries and deltas are already connected?

Existing Wings

- Netherlands: Rhine-Meuse
- Indonesia: Ciliwung (and Mahakam)
- Vietnam: Mekong
- USA: California - California Bay-Delta
- USA: Louisiana – Mississippi River
- Bangladesh: Ganges-Brahmaputra-Meghna

Candidate Wings

- Brazil: Pantanal inner-delta
- Argentina: Parana
- Kenia: Tana

Potential candidate Wings

Danube, EU DeltaNet, Nile, Taiwan, Mozambique,
other USA deltas, Indian deltas

Comparative assessment of the vulnerability and resilience of 10 deltas

- Provide a first step towards a comprehensive overview of the current and future state of deltas
- Integrate scientific, social and management knowledge
- Provide framework for future data collection



Project team

Lead authors

Tom Bucx (Deltares)
 Marcel Marchand (Deltares)
 Bart Makaske (Alterra-Wageningen UR)
 Cees van de Guchte (Deltares)

Main authors of delta descriptions

Nile: Shaden Abdel-Gawad, National Water Research Center, Egypt

Incomati: Antonio Hoguane, Eduardo Mondlane University, Mozambique
 Frank van der Meulen, Deltares, the Netherlands

Ganges-Brahmaputra-Meghna: Emaduddin Ahmad, Asif Mohammed Zaman, Zahir Haque Khan, S.M. Mahbubur Rahman, Institute of Water Modelling, Bangladesh

Yangtze: Wenwei Ren, Yi Yong, Xinghua Fu, World Wide Fund for Nature, China

Ciliwung: Jan Sopaheluwakan, Heru Santoso, Indonesian Institute of Sciences, Indonesia

Mekong: Le Quang Minh, Vietnam National University Ho Chi Minh City, Vietnam

Rhine Meuse: Bart Makaske, Alterra-Wageningen UR, the Netherlands
 Arjan Berkhuisen, World Wide Fund for Nature, the Netherlands

Danube: Adrian Stanica, Nicolae Panin, National Institute for Research and Development of Marine Geology and Geoecology, Romania

California Bay-Delta: Peter Wijsman, Arcadis, USA

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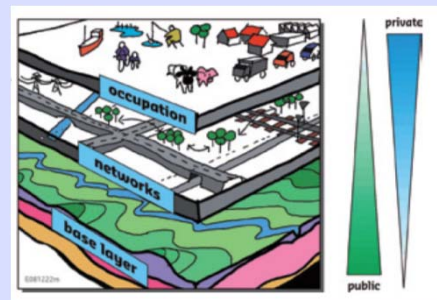
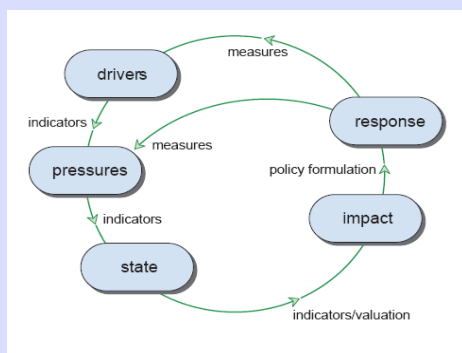
In addition the World Wide Fund for Nature contributed to the delta descriptions of the Ganges-Brahmaputra-Meghna, Ciliwung and Mekong

Deltares

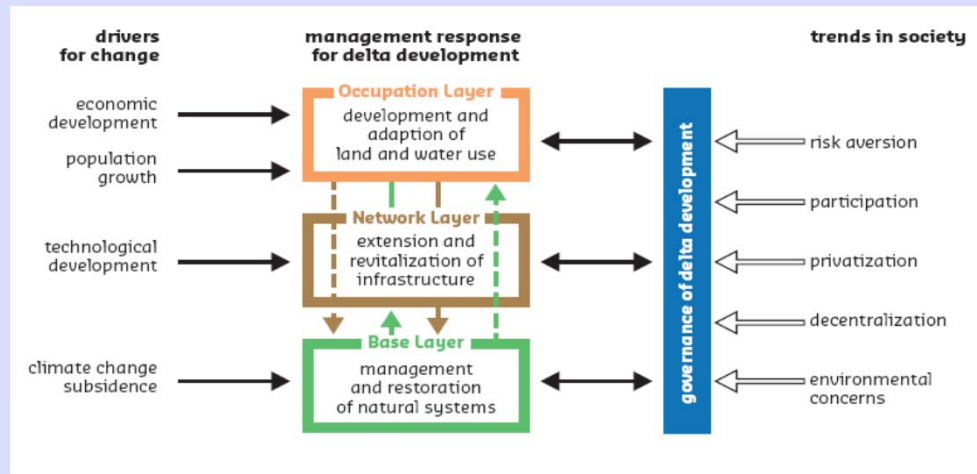
Deltas studied



DPSIR + Spatial layers approach



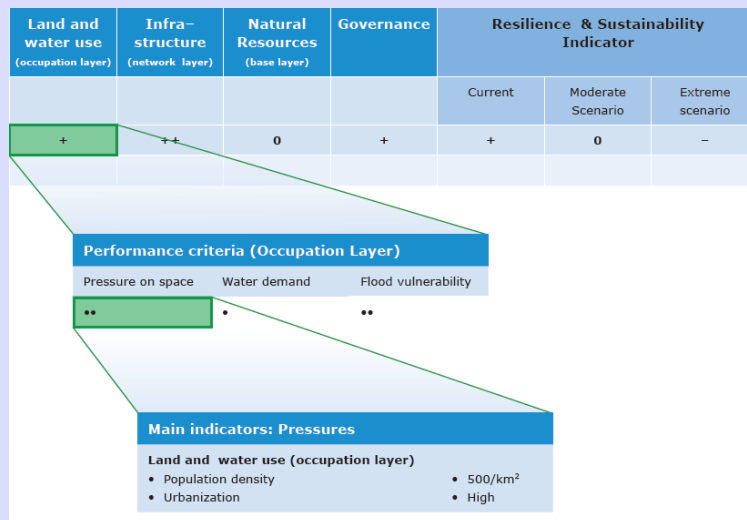
Framework for assessment



Towards indicators of change

DRIVERS	PRESSURES/IMPACTS	GOVERNANCE	RESPONSES
Demographic trends <ul style="list-style-type: none"> • population in delta • migration 	Land and water use (Occupation layer) <ul style="list-style-type: none"> • pressure on space • shift in land use/urbanization • water demand • flood vulnerability 		Development and adaptation of land and water use <ul style="list-style-type: none"> • multifunctional land use • land use zoning • water saving • flood preparedness
Economic developments <ul style="list-style-type: none"> • status of economy • sectoral developments • upstream development 	Infrastructure (network layer) <ul style="list-style-type: none"> • flood protection system • irrigation and drainage • water supply & sanitation • roads, railways & ports 	Multi-level and multi-sectoral cooperation	Extension/revitalization of infrastructure <ul style="list-style-type: none"> • land reclamation • multifunctional use of infrastructure • building with nature
Technological developments <ul style="list-style-type: none"> • food / agricultural • civil engineering • ICT • energy generation 	Natural resources (Base layer) <ul style="list-style-type: none"> • freshwater shortage • salinity intrusion • water pollution • flood hazard • coastal/fluvial erosion • loss of biodiversity and wetlands • sediment supply • mobility of delta distributaries 	Public-private partnerships	Management and restoration of ecosystems <ul style="list-style-type: none"> • protected areas management • habitat restoration • ecological engineering • environmental flows • multiple use of wetlands • ecosystem approach
Climate change <ul style="list-style-type: none"> • temp./evaporation • sea level rise • precipit./discharge 		Involvement of stakeholders and citizens	
Subsidence <ul style="list-style-type: none"> • natural and human induced subsidence 		Approaches for dealing with risks and uncertainties	

Scorecard and related indicators



Scorecard

Assessment of the current and future state of the delta

Delta	Land and water use (occupation layer)	Infrastructure (network layer)	Natural resources (base layer)	Governance	Overall Resilience & Sustainability index
Current situation 2010	+	++	+	+	+
Scenario 1 moderate 2050	0	++	0	+	0
Scenario 2 extreme 2050	-	++	-	+	0

resilience/sustainability: ++(very good), +(good), 0 (medium), -(low), -- (very low)

Comparative overview of delta score cards

	Land and water use (occupation layer)	Infra-structure (network layer)	Natural Resources (base layer)	Governance	Resilience & Sustainability Indicator		
					Current	Moderate Scenario	Extreme scenario
Nile delta	--	0	-	0	-	-	--
Incomati delta	0	-	-	-	-	-	--
Ganges-Brahmaputra-Meghna delta	--	--	--	0	--	-	--
Yangtze delta	-	+	-	0	0	0	--
Ciliwung delta	--	--	--	-	--	--	-
Mekong delta	0	0	-	0	0	+	0
Rhine-Meuse delta	+	++	0	+	+	0	-
Danube delta	+	+	+	0	+	0	0
California Bay-Delta	0	-	-	0	-	0	-
Mississippi River Delta	0	0	-	0	-	0	-

resilience/sustainability: ++ (very good), + (good), 0 (medium), - (low), -- (very low)

Comparative overview of delta score cards - Conclusions

For most of the deltas current resilience and sustainability is not satisfactory

Reasons differ per delta but some general mechanisms:

- An imbalance between demands and supply with regard to land and water use;
- An inadequate or ageing infrastructure in the delta;
- Disruption of the natural delta processes;
- Inadequate governance to address problems and implement solutions.

For a number of deltas the challenge is defining a comprehensive (multi-sectoral) delta plan

The combined DPSIR-layer approach has proven to be useful

Delta description - format

- Drivers of change
- Pressures / potential problems
 - Land and water use (occupation layer)
 - Infrastructure (network layer)
 - Natural resources (base layer)
- Governance (institutional and organisation aspects)
- Adaptive measures
- Technical methods and tools
- Needs for knowledge exchange and research gaps
- Lessons learned

Score card

Comparative overview of research gaps

	Nile	Irrawaddy	Ganges-Brahmaputra-Meghna delta	Yangtze	Changjiang	Mekong	Indo-mekong	Donbas	Cal. Bay-delta	Mississippi river delta
Occupation layer										
Socio-economic scenarios (6)	*	*		*	*			*		*
Water use and treatment (5)	*	*	*		*		*			
Integrated spatial planning (5)	*	*	*		*		*			
Ecosystem services (5)	*			*	*		*	*		
Land-use change modelling (4)	*		*		*				*	
Adaptation to salinisation (2)	*		*							
Network layer										
Freshwater management (7)	*	*	*		*	*	*	*	*	*
Dikes and dams (5)	*		*		*		*	*	*	*
Transport (3)	*	*			*					
Flood forecasting/early warning systems (1)			*							
Base layer										
Effects of changes/ eco-system functioning (9)	*	*	*	*	*		*	*	*	*
Building with nature and natural safety (6)	*		*	*	*	*	*	*	*	*
Monitoring changes (7)	*		*	*	*	*	*	*	*	*
Predicting changes (7)	*		*	*	*	*	*	*	*	*
Base-layer data management (3)			*		*					*
Governance										
Governmental roles and arrangements (6)	*				*	*	*	*	*	*
Integrated delta management (6)	*	*	*	*	*			*		
Communication/capacity building (4)	*	*	*		*					
Financial arrangements (4)			*		*		*	*	*	
River basin cooperation (2)		*	*							
Policy impact studies (1)					*					

Comparative overview of adaptive measures

	Technical	Ecological	Economic	Institutional
Nile	**	*	*	*
Incomati	*	**	*	**
Ganges-Brahmaputra-Meghna delta	***	*	*	*
Yangtze	*	***	*	*
Ciliwung	**	**	*	**
Mekong	**	**	*	**
Rhine-Meuse	***	**	**	**
Danube	*	*	*	*
California Bay-Delta	*	***	*	*
Mississippi River Delta	**	**	*	*

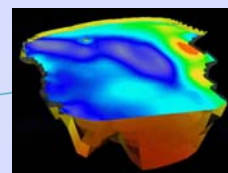


Comparative overview of tools and methods

- Many advanced delta process models, decision support systems and integrated assessment and management tools
- Especially for base layer
- Rather generic

Recommendations:

- Adapt existing tools for new situations rather than develop completely new ones for each delta
- Working with common tools will facilitate research collaboration and inter-delta data exchange



The Ganges-Brahmaputra-Meghna delta

Main authors of the delta description for Delta Alliance 10-Delta study;

Institute of Water Modelling, Bangladesh

- Emaduddin Ahmad
- Asif Mohammed Zaman
- Zahir Haque Khan
- S.M. Mahbubur Rahman

➤ Assessment AND Identification of Knowledge Gaps

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The Ganges-Brahmaputra-Meghna delta

Delta plain area: 100.000 km²

Mean annual discharge: 30.000 m³/s

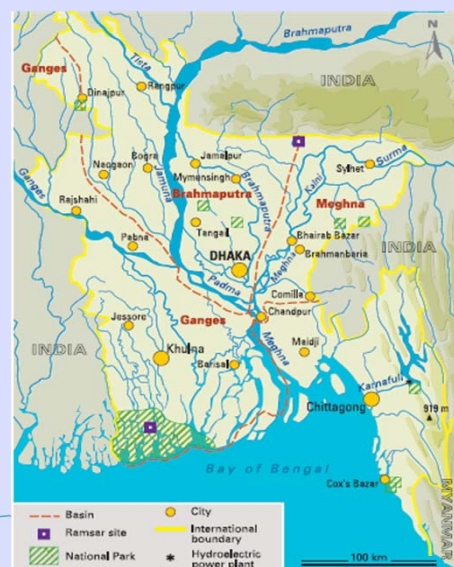
Catchment area: 1.720.000 km² (93% of the area outside Bangladesh)

Holocene delta deposits: >15 m thick

Flood protection: embankments, dikes

Population: 156-200 million

Infrastructure: rather poorly developed

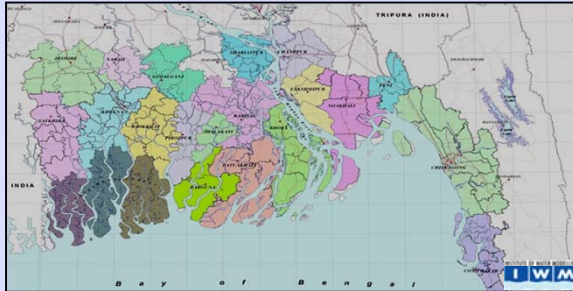


GBM delta: drivers of change (1)

Demographic trends – 1.3% growth of population

Economic developments – GDP/capita US\$ ~400; predominantly labour-intensive agricultural economy and weak industrial base

Technological developments – need for faster technology development; development plans for science and technology research (a.o. crop varieties, irrigation, ICT); suite of tools (process models) for predication of the impacts of climate change have been developed



19 districts
Area: 47,201 km²
125 polders, 5107km embankment
Total population: 35.1million (2001)

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GBM delta: drivers of change (2)

Climate change – already vulnerable to water extremes; increase in cyclones and storm surges, sea level rise, salinity intrusion, water logging; in the north-west increased drought

Subsidence – tectonic subsidence, compaction of peat layers and human induced disturbance of sedimentation up to ~7.8 mm/year (eastern coast)

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GBM delta: pressures (occupation layer)

- Demographic trends** – population density ~1200 people/km²; high pressure on space
- Vulnerability to flooding** – permanent threat because of still active and unstable river branches; delta is prone to cyclones, storm surges
- Freshwater shortage** – critical low flow conditions of rivers are likely to increase due to upstream developments and climate change; increase of salinity intrusion

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GBM delta: pressures (network/base layers)

- Flood protection infrastructure** – management of embankments and irrigation system is a recurrent problem
- Coastal erosion** – riverbank and island erosion is one of the major issues
- Biodiversity** – especially the mangrove forests (Sundarbans) are highly valuable but also under high pressure from encroachment and exploitation
- Salinity Intrusion** – Salinity and its (highly) seasonal variation are dominant factor for coastal eco-system, fisheries and agriculture
- Cyclonic storm surge** – Due to its geophysical setting Bangladesh is frequently visited by cyclone-induced storm surges

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GBM delta: governance issues

Governmental cooperation – highly centralized government with a strong administrative culture; efforts to improve governance systems

Cooperation between government and private sector – the privatization of public sector industries has proceeded at a moderate pace

Involvement of stakeholders and citizens – stakeholder consultation at planning and implementation phase of a project in different parts of the country is already practiced

Approaches for dealing with risks and uncertainties – focus on the development of flood forecasting and warning systems; operational early warning system for cyclonic storm surge

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Scorecard for the GBM delta

Scorecard

Ganges-Brahmaputra-Meghna delta	Land and water use (occupation layer)	Infrastructure (network layer)	Natural resources (base layer)	Governance	Overall resilience & sustainability indicator
Current situation 2010	--	--	--	0	--
Scenario 1 moderate 2050	--	--	--	--	--
Scenario 2 extreme 2050	--	--	--	--	--

resilience/sustainability: ++ (very good), + (good), 0 (medium), - (low), -- (very low)

- Current situation is unsustainable and this will be worse in the future
- Pressures on the occupation layer and the base layer will increase due to population growth and economic development
- Climate change and sea level rise will make the situation worse
- Most critical issues will be related to increased river and coastal flooding, salinisation in coastal areas, and droughts in northwest region

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What's next?

■ What are the main research gaps?

- Drivers of change
- Occupation layer
- Network layer
- Base layer
- Governance

>> What are realistic opportunities for knowledge exchange and developing bankable collaborative projects?



Knowledge Gaps Identified

Examples from Delta Alliance Bdsh Wing

Occupation layer: - Improved 7-10 day flood forecasting

Network layer: - river bed level management in embanked rivers
- improved Polder Management

Base layer: - improved morphological model of river, estuary and sea to calculate bank erosion and land reclamation more accurately under present and future conditions
- an ecological model to observe the changes in biodiversity due to human intervention, and to quantify ecosystem services
- a well calibrated and validated salinity model of river, estuary and sea to understand and analyze the impact of climate change and sea level rise

Governance: - Adaptive Delta Management & capacity building

To be prioritised for further development of a bankable proposal

See Delta Alliance documents for more details, note running initiatives of NL, WB, ADB, ao.

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Website - downloads

- www.delta-alliance.org
- Delta Alliance Background information
- Documents to download:
 - 10-Delta Synthesis report, incl. Knowledge Gaps identified
 - Working document (with full delta descriptions)

THANK YOU !

