

Deltas in Times of Climate Change II
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Global delta vulnerability indicator development

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DELTA S Project

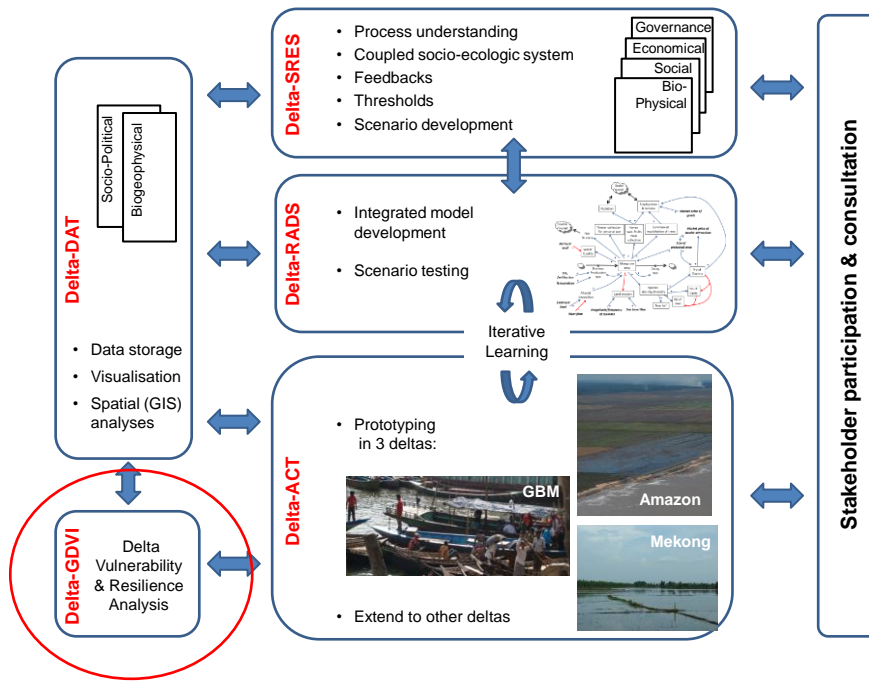


Belmont Forum DELTA S Project: 2013-2016

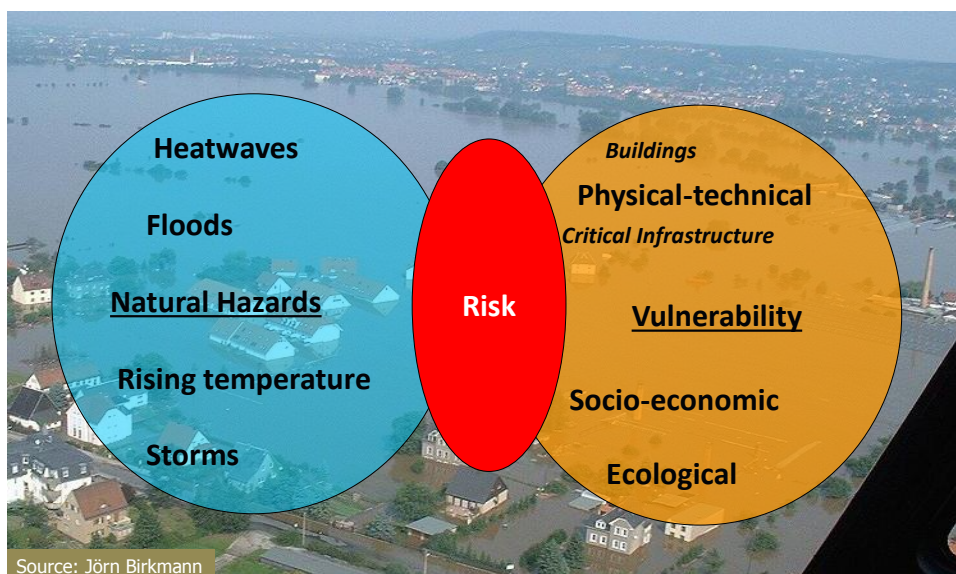


G8MUREFU3FP-2201-037:

“DELTA S: Catalyzing action towards sustainability of deltaic systems with an integrated modelling framework for risk assessment”



Risk = f (Hazard and Vulnerability)



Existing delta vulnerability assessments



- Standardized comparison of delta vulnerability (e.g. for 10 deltas, Bucx et al 2010)
 - High impact study, sub-delta level and spatial aspects missing
- Comparison of deltas based on one aspect of vulnerability (e.g. Flooding, 33 deltas, Syvitski et. al 2009)
- Detailed analysis of vulnerability for one delta and one sector (e.g. Vulnerability of agricultural systems in the Nile delta, Attaher et al. 2009)
- Detailed analysis of social vulnerability at the sub-delta level, for selected localities (e.g. various publications for the Mekong by Birkmann, Garschagen; IMHEN, 2011)

Vulnerability Assessment in DELTAS



- **Overall goal:**
To understand the **vulnerability** of delta systems to global environmental change at **the sub-delta scale** to support **planning** and the implementation of **adaptation options** to transform deltas to “seedbeds of sustainability and resilience”
- Jointly with other DELTAS workpackages, **develop an unified framework** for assessing resilience and vulnerability that can be adapted locally
- Apply a **flexible indicator development** process that combines scientific and local stakeholder-based approaches
- **Define indicators** that are quantifiable at the sub-delta scale and transferable in different delta contexts capable to capture the spatial variability of vulnerability
- Conduct an assessment in the three **demonstration deltas at the sub-delta scale**
- Draw **lessons** for application in other delta environments

How do we proceed?



Comprehensive **review** of vulnerability assessment frameworks and indicators in delta context (ongoing)

Local consultations in the three demonstration deltas at the sub-delta scale (Mekong: April 2014, Ganges: September 2014, Amazon: March 2015)

Identification of a **set of indicators as a joint outcome** of the desk-based studies and the 3 local consultations

Collection of secondary and spatial data following the identification of indicators, model assessments

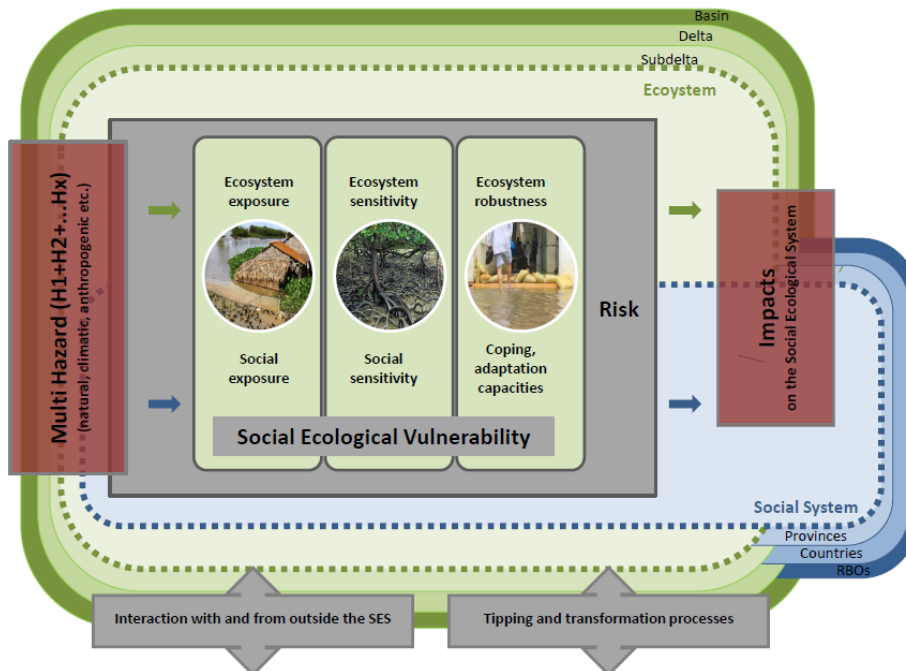


Feedback to the model deltas

Literature review: Examples of frameworks used



- Dynamic Interactive Vulnerability Assessment (DIVA)
- Driver, Pressures, State, Impact, Response (DPSIR)
- Coastal Vulnerability System (CVS)
- Composite Vulnerability Index (CVI)
 - Coastal Economic Vulnerability Index (CEVI)
- Multi-Criteria Decision Analysis (MCDA)
- Coastal adaptation framework
- Modified frameworks
- (...)



Sebesvari & Renaud 2014, after Turner et al. 2009, Garschagen 2014, Kloos et al. forthcoming

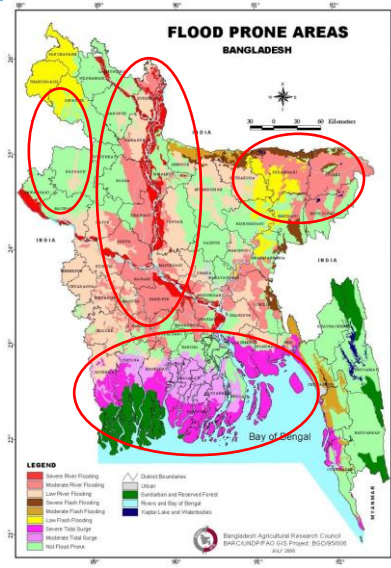
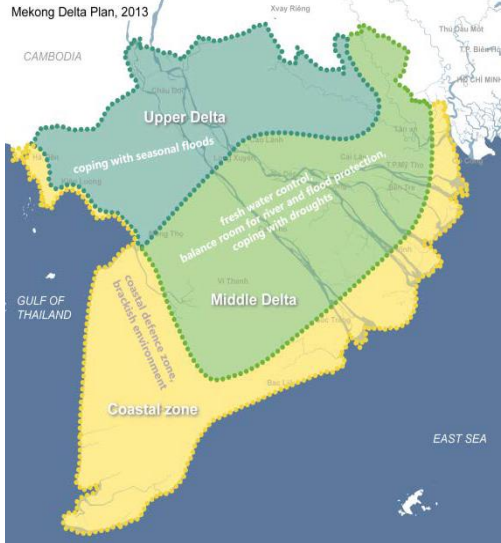
Local consultations

- Remote sensing, physical measurements and data mining can provide **datasets** and the a **bird's eye view** perspective and can lead to **large scale assessments and comparisons** -> good choice to understand the vulnerability of the physical sphere, can also provide useful info on e.g. population density, location of exposed population
- At the subdelta level, in-depth **process understanding** needed
- **Selection of participants:** inclusive approach, invite representatives from provincial level authorities, scientific organizations, NGOs, independent consultants, project partners
- Steps:
 - Identification of hazards at the sub-delta level
 - Impact chains
 - Indicator selection

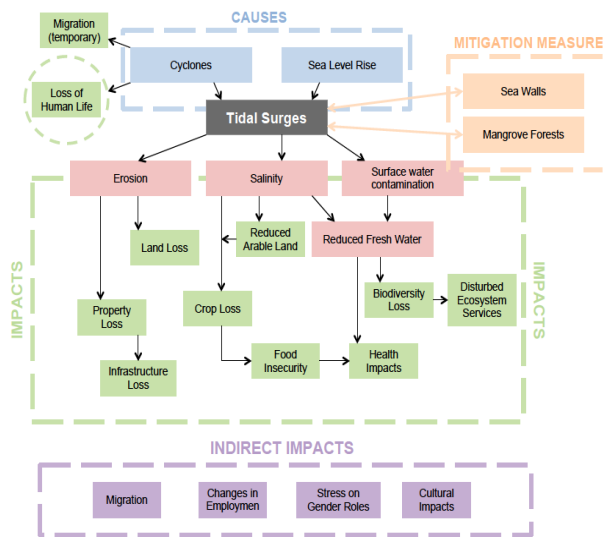
Subdelta regions

Regional divisions

Mekong Delta Plan, 2013



Impact chains



Data for indicators



- Some data for vulnerability assessments are more readily available in national or international databases.
- Many DRR related vulnerability assessments use the same data source for indicators. Examples include:
 - PREVIEW Global Risk Data Platform for hazard exposure
 - WHO/UNICEF Joint Monitoring Programme statistical data
 - GDP, GINI index for social sensitivity
 - Environmental Performance Index (EPI, Yale University)
 - Human Development Index (HDI, UNDP)
 - Global Environment Outlook Data Portal (UNEP, data from FAO, WRI, World Bank etc.)
 - World Development Indicators (World Bank)
 - Corruption Index (Transparency International)

Different indicators within deltas (Mekong example)



Dimensions	Coastal Processes (mainly salinity intrusion)	Upper delta (mainly "high floods")
Exposure (S)	Value of damage of infrastructure by erosion; % population; % rice land; % land lost to coastal erosion	% population in the flood zone; % critical infrastructure in the flood zone
Exposure (E)	Distance of 4 ppt salinity line from river mouth; Duration of 4ppt salinity level; rate of forest degradation;	% production land in the flood zone; % animal in the flood zone;
Sensitivity (S)	% household access to tap water; Income gap between rich and poor; Average income per capita; Price of freshwater in the dry season	% poor household; % landless household; % agricultural household/aquaculture household; % illiteracy; gender ratio; % poorly constructed house; % land area with triple crop; % household having access to freshwater; % rural road; % poorly constructed bridge; % pop under 6
Sensitivity (E)	Ratio of fallow land/total area of production land; % of mangrove area damaged	% severe acid sulfate soil
Ecosystem robustness	% area of mangrove planted when compared to total area land suitable for forestry	% agricultural land with farming system adapted to flood; % floating rice area
Coping/adaptive capacities	Freshwater mixing; Rate of migration; legal documents on salinity regulation; \$ value of salinity control projects; Capacity of freshwater supply stations; Number of salinity monitoring stations; knowledge on CC	Income per capita; % labor force; % household owning boat; % pop with access to mobile medical services; % pop having access to child care facilities; % pop having access to public media; % well constructed dike system; % pop living in the flood protection land

Different indicators between deltas for a same coastal hazard (Mekong vs. GBM example)



Dimensions	Mekong	GBM
Exposure (S)	Value of damage of infrastructure by erosion; % population; % rice land; % land lost to coastal erosion	Population density; Density of buildings; % pop living 5 km from the coastline; % pop of rice/aquaculture/monoculture farmers; % area protected by polders....
Exposure (E)	Distance of 4 ppt salinity line from river mouth; Duration of 4ppt salinity level; rate of forest degradation;	Contiguity of the forest; Biodiversity index; Tree density; area covered by fresh water bodies
Sensitivity (S)	% household access to tap water; income gap between rich and poor; Average income per capita; Price of freshwater in the dry season	% malnourished persons; % people below the poverty line; Per capita GDP; % dependents; % of pop not dependent on agriculture or fisheries systems; % families with access to clean water supplies; % people who receive remittances; Nature and duration of migration
Sensitivity (E)	Ratio of fallow land/total area of production land; % of mangrove area damaged	Rate of biodiversity decline; Rate of deforestation; Per capita production of mangrove products
Ecosystem robustness	% area of mangrove planted when compared to total area land suitable for forestry	% coastline protected by sea walls or sand dunes; Rate of biodiversity change
Coping/adaptive capacities	Freshwater mixing; Rate of migration; legal documents on salinity regulation; \$ value of salinity control projects; Capacity of freshwater supply stations; Number of salinity monitoring stations; knowledge on CC	% outward migration; % pop with access to EWS; % pop with access to rehabilitation programmes; % pop with access to evacuation services; % pop with food reserves; % homes at safe height from storm surge; % of people with access to roads; Level of investment in biodiversity conservation; % pop with insurance; % with immediate family living in nearby city/Dhaka/abroad; % pop with savings

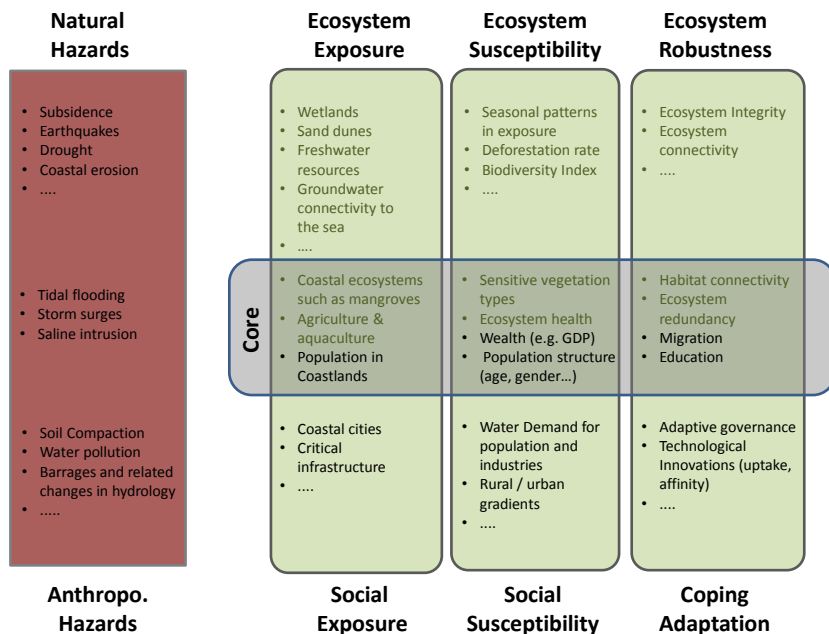
Main indicators from the literature review



- Partial review so far:
 - Split into 5 categories (socio-economic; technological development; network/infrastructure; natural resources/land and water; governance)
 - Ca. 136 different indicators (some could be grouped further)

F	Natural resources
F1	number of drought days per year
F2	% of delta with salinity problems
F3	% of polluted areas (water, soil, air)
F4	frequency of storms (storm surge)
F5	flood hazard level (high-medium-low)
F6	annual loss of land (Km2/ year)
F7	average erosion rate(m/year)
F8	% area of wetlands
F9	% of wetlands protected by treaties
F10	biodiversity index
F11	soil erosion rate in catchment
F12	fluvial sediment transport
F13	river discharge
F14	% of sediment trapped in reservoirs

Global Delta Vulnerability Index – (modular system, work in progress)



Conclusions

- Participatory process has indicated that (for the most part) different indicators are selected depending on:
 - Geographical location within a delta/type of hazard considered
 - Country where the delta is located (for same hazard)
- Limitations:
 - Composition of the groups of stakeholders and the way they interact in a group
 - Capturing the essential elements of a (complex) vulnerability framework
- Next steps:
 - Continue the exchange with stakeholders to refine results
 - Integrate the results with literature review and consolidate the core list of indicators
 - Develop a list of secondary indicators that can be used in delta-specific environments
 - Quantify the vulnerability of deltas with a sub-delta resolution

Thank you!



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