

Climate Risks and Adaptation in Asian Coastal Megacities

Asia Pacific Adaptation Forum Oct 21, 2010

Poonam Pillai

Sr. Environmental Specialist

World Bank

Presentation based on joint WB, ADB and JICA Study



Outline of the presentation

- Context and objective of joint ADB, JICA and World Bank study
- Overview of the methodology
- Highlight main findings and messages

Context

- Cities are centers of local and regional economic growth....
- Those located in coastal areas, particularly in the mega-deltas of East and South Asia are highly vulnerable to climate related risks (IPCC AR4, Nicholls et al, 2008)
- While there is a growing literature on cities and climate change, limited research that systematically assesses risks and damage costs at the city level
- This study aims to fill this gap

Objective and Process

- ADB, JICA and the World Bank agreed to collaborate and prepare several case studies and prepare a synthesis report
- Objective
 - Assess the scale of climate related impacts and vulnerabilities at the city level
 - Estimate associated damage costs
 - Identify /prioritize adaptation options
- Selected cities

Manila (JICA)	Kolkata (WB, South Asia region)
Ho Chi Minh city (ADB)	Bangkok (WB, East Asia region)
- Process
 - Common terms of reference, extensive collaboration over the past year and half ; extensive engagement by each team with local government counterparts and stakeholders

Methodology Step 1: Modeling future temperature and precipitation

- Time horizon: 2050
- IPCC Scenarios used—A1FI and B1 (a high and a low emissions scenario) were used as inputs to GCMs
- GCMs can help predict temperature and precipitation at the global level
- To make city level predictions, used 2 approaches
 - Pattern scaling: Based on 16 GCMs –to make predictions for the 4 cities (Univ. of Tokyo and JICA)
 - HCMC: Regional climate model (PRECIS)
- Finding: For all cities, there is an increase in temperature and precipitation under different scenarios by 2050
 - 2-10% increase in precipitation depending upon city and emissions scenario

Step 2: Hydrological analysis

- Each team undertook hydrological analysis to estimate flooding in each metropolitan area in 2050 under different scenarios
- Events of different return periods (1/10, 1/30 and 1/100 years) considered
- Parameters included in hydrological mapping
 - temperature
 - precipitation
 - Sea level rise
 - Storm surge
 - Land subsidence (in Bangkok)
 - Different infrastructure scenarios
- Combinations gave 16-27 scenarios for different cities
- Vulnerability Analysis: Allowed teams to estimate areas in the city more or less likely to be flooded, information about the area, depth and duration of floods and present them in GIS maps

Step 3:Socio-economic analysis

- ▶ Methodology based on ECLAC approach for damage cost assessment
- Estimation of direct and indirect costs (HCMC exception)
- Cities in 2050: Assumptions based on available data and official figures and projections
- Important assumption—Climate in each city in 2050 without climate change will be similar to 2008 climate
Simplifying but useful to separate impact of climate change
- Cost-Benefit analysis of adaptation options (Bangkok, Manila)
- Variations in how each team pursued the downscaling, hydrological and socio-economic analyses, availability of data--thus clear cut comparisons difficult
 - Numerous uncertainties at every step

Selected Megacities—Main features

	Economy	Pop.	Climate	Topography	Factors- flooding
HCMC	Key economic center; city accounted for 23% of national GDP in 2006; Poverty rate: .5% of population (2006)	7-8 million	90% rain falls between May to Nov Vulnerable to drought	Located in delta of Dong Nai river Low lying	Seasonal monsoon rainfall, tides, extreme conditions when this combines with tropical storms and storm surges
Metro Manila	Major economic center; Ranked 40 th richest urban conglomeration in the world (2008) 35% residing in slum settlements	11 million (2007)	Frequent history of typhoons Wet season between May and October	Low lying, bisected by Pasig river and its tributaries Located on swampy isthmus	Typhoons, SLR, high tide, non-climate factors (e.g. land subsidence, loss of natural retention areas)
Bangkok Met. Region (BMR)	Capital city area; GDP of BMR was 43% of national GDP (2006) Poverty rate: .6% of BMR population (2007)	10 million (2007)	Tropical monsoon climate; 85% of rain between May and Oct	Located in delta of Chao Phraya river basin; Basin area is flat; avg. elevation is 1-2m from sea level	Heavy seasonal precipitation over 3 months Cyclones not very common
Kolkata Municipal Authority (KMA)	Key regional economic center A third of the population lives in slums	KMA 14.7 Million KMC (4.6 million) (2001)	Tropical Monsoon climate; wet season between June and Sept.	Flat topography and low relief Once a wetland area; a number of natural depressions remain	Intense precipitation during monsoon, tides, cyclonic storms and storm surges, Hooghly Riverine flooding

Bangkok: Selected Findings

- 30% increase in annual inundated area in 2050 under AIFI scenario compared to situation without climate change for a 1/30 year event
- About 1 million people affected in the case of 1/30 year flood in 2050 under high emission scenario (compared to approximately half a million) in 2008
- Damage costs (for 30 year flood) increase from \$1 billion (2008) to \$4.6 (2050) due to climate change and land subsidence
- Additional damage costs due to climate change: 2% of regional GDP (2008)
- By 2050 13% of affected inhabitants in condensed housing compared to 5% in 2008
- Almost 70% of the increase in flooding costs in Bangkok is due to land subsidence—highlights the importance of addressing urban environmental issues

Manila—Selected findings

- Area flooded will increase by 42% for a 1-100 year flood under the AIFI scenario.
- Increase in population exposed to flooding in 2050 under both high and low emissions scenarios---
 - For instance, for a 1/100 year flood, 2.5 million people are likely to be affected in 2050 (assuming infrastructure is same as in base year); 1.3 million if planned flood protection infrastructure is implemented
- Additional Damage cost due to climate change is 6% of regional GDP (2008) for 1-30 year flood/high emission scenario
- As in other cities, current flood protection plans will reduce but not sufficiently protect the population

Kolkata—selected findings

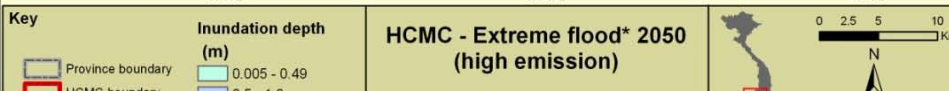
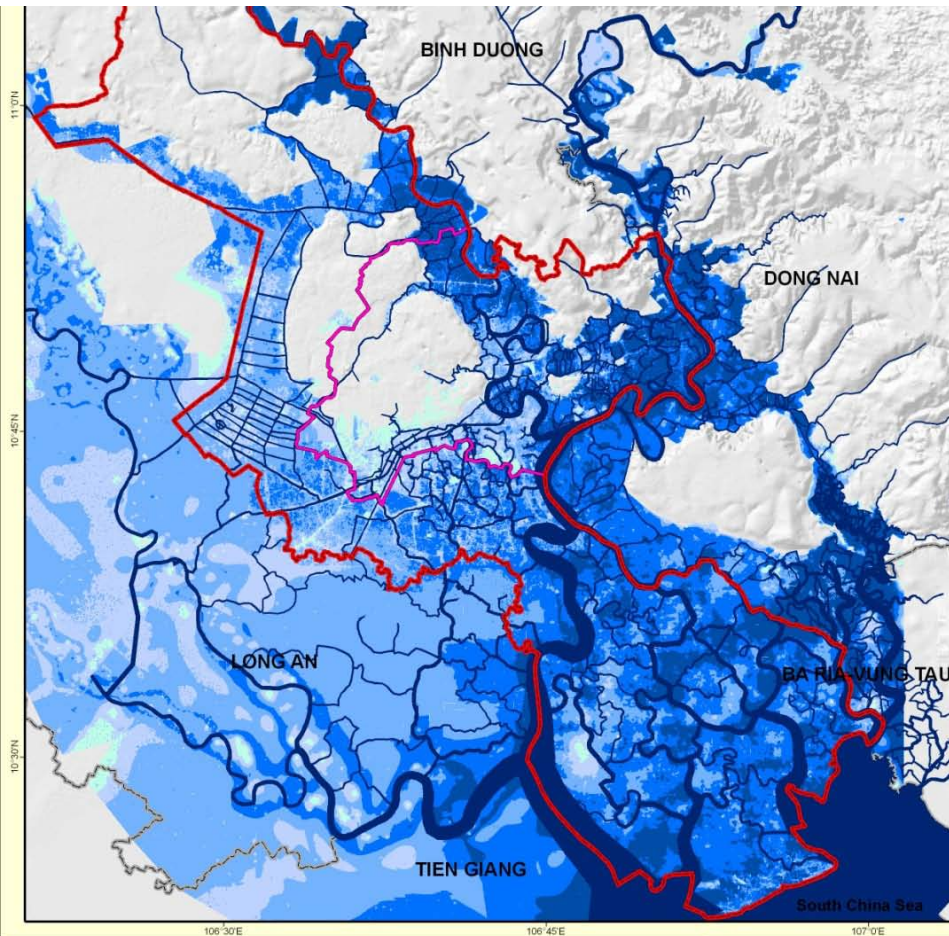
- 9% increase in flood prone area in KMA in 2050 under A1FI scenario compared to a situation without climate change for a 1/100 year event
- Additional 6% of population of KMA will be affected by 2050 for high emission scenario
- Damage from a 1/100 year flood will increase by US\$800 million due to climate change under A1F1 scenario for KMC alone
- Residential buildings & property damage and health care account for largest component of damage
- Study considered several adaptation options: De-siltation of sewers can help reduce area affected by flooding by 4 percent and population affected by floods by 5% (2009)

HCMC: Selected findings

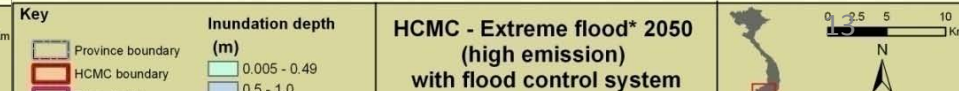
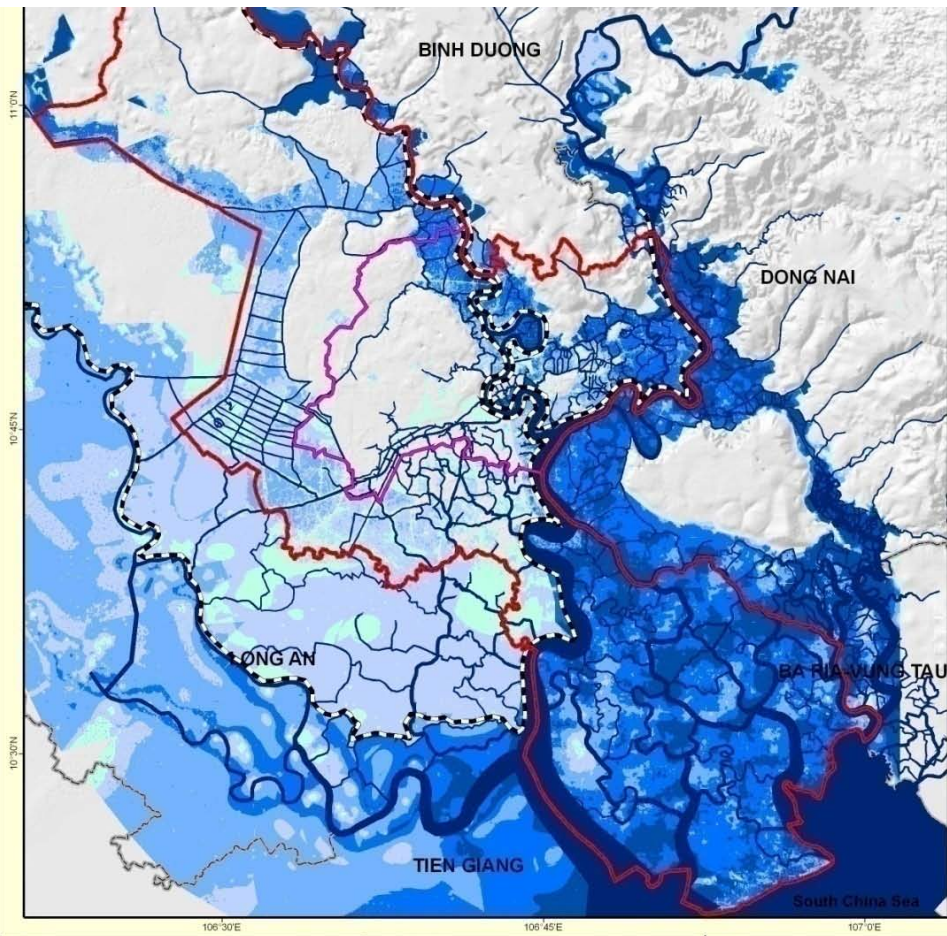
- Increase in area exposed to flooding (compared to situation without climate change) by 7% for regular floods for a 1/30 year flood
- Increase in population at risk from flooding: (e.g. currently 26% of population is affected by extreme event. In 2050, this will increase to 62%)
- Some areas more at risk of flooding (e.g. Central Urban districts and Can Gio)
- Non-climate factors (silting of canals, poor drainage, land subsidence contribute to urban flooding)
- Institutional capacity, coordination between sector agencies and plans needs to be strengthened

In HCMC, planned flood protection system will reduce but not adequately protect urban areas from flooding: (2050, A2, 1/30)

Without Dyke

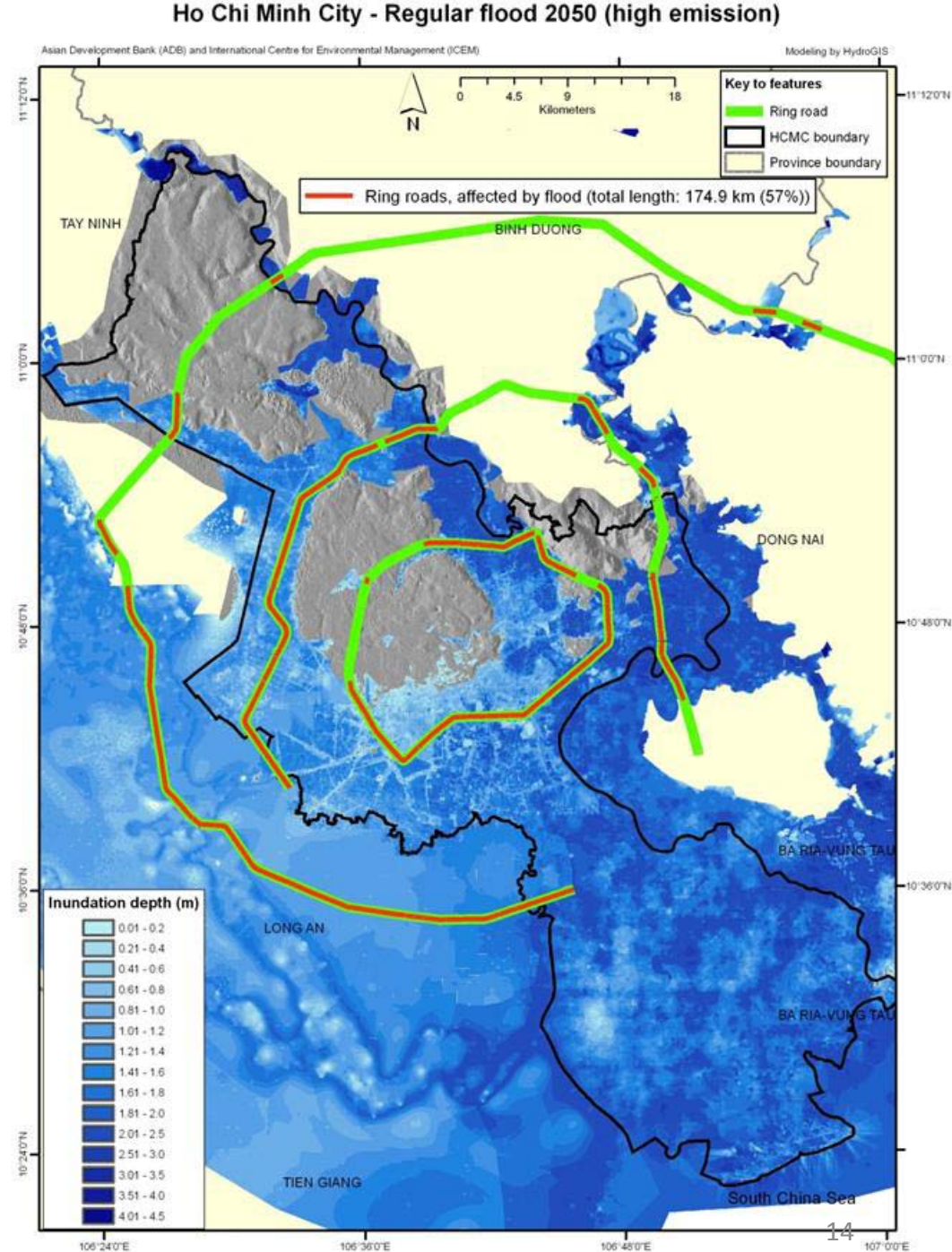


With Dyke

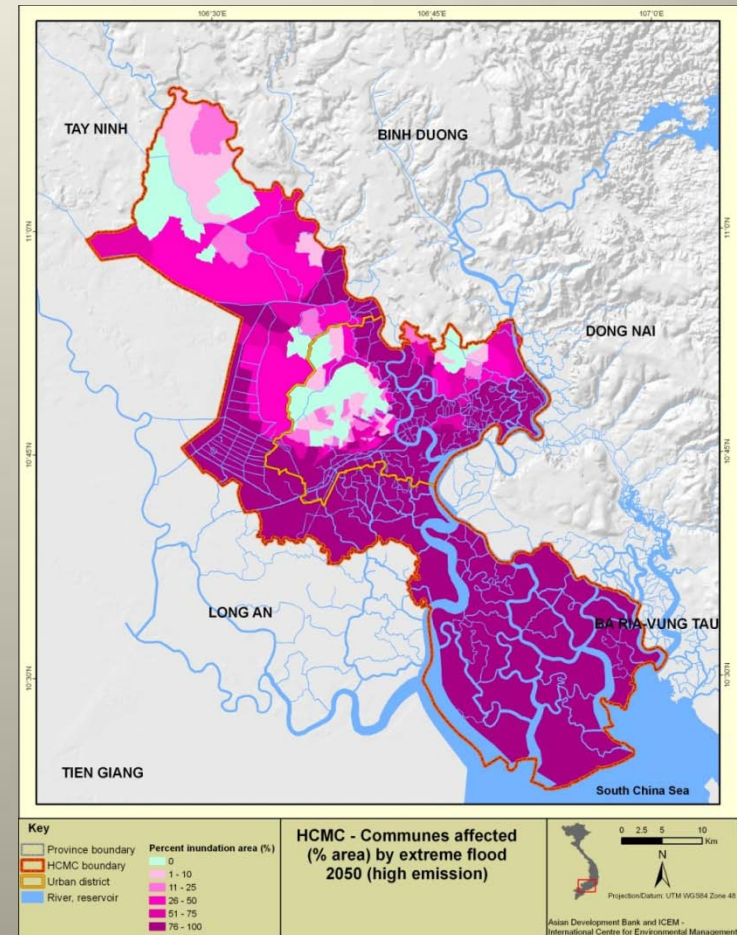
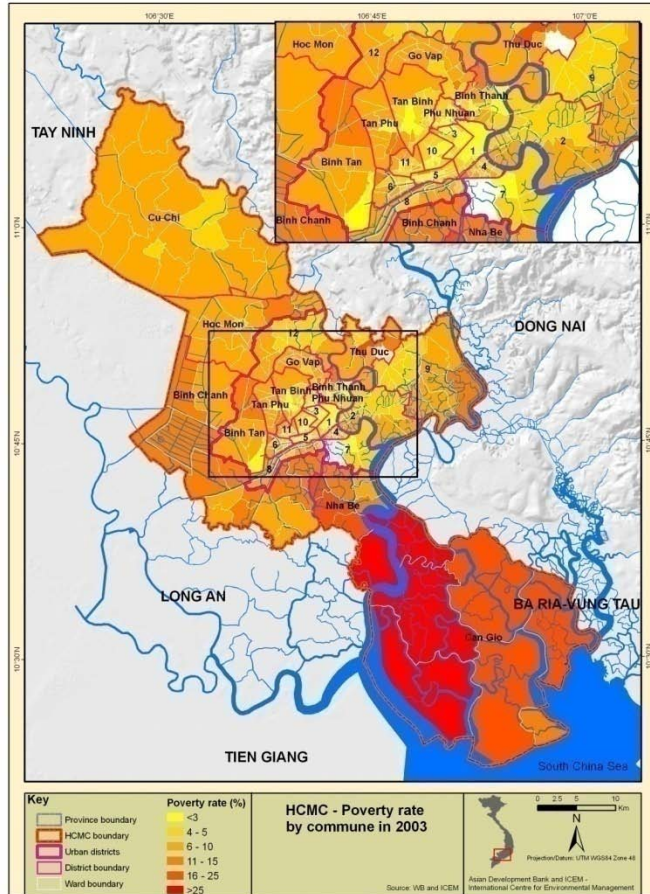


Sector implications (HCMC) Impact on existing and planned sections of ring road

(Scenario: A2, 1 in 10 year flood, no
additional dykes)



Poor more likely to be affected by extreme events (HCMC)



Cross cutting findings

- Increase in area and populations exposed to flooding
- Damage to buildings is the largest component of damage costs (Manila, Kolkata and Bangkok)
- Additional damage costs from climate change is in the range of 2-6% of regional GDP
- Existing and planned flood protection infrastructure will reduce but not adequately address potential climate related risks
- Urban environmental issues—an important contributing factor to flooding
- Impact on poor communities will be significant; better off communities also affected

Take home messages

- Sound urban environmental management is crucial for climate adaptation
(e.g. Addressing land subsidence, investing in basic infrastructure and drainage)
--However, this is not sufficient
- Given the added damage costs due to climate change, proactive efforts are needed to integrate climate adaptation into city planning
 - Developing city wide approach to climate adaptation
 - Strengthening links between planning departments and research institutions
 - Strengthening institutional capacity
- Adaptation measures need to be tailored to each city through
 - targeting vulnerable areas
 - combining infrastructure and ecosystems based approaches
 - land use planning and zoning

Acknowledgements & Thanks

Colleagues at ADB, JICA, in the Environment Department and in the East and South Asia regions of the World Bank and various consultant teams that have worked on the city level reports and the synthesis report

