

APEC Climate Symposium 2011:

“Harnessing and Using Climate information for Decision Making”

19 October, Honolulu

ASSESSMENT OF VULNERABILITIES TO CLIMATE CHANGE FOR WATER AND WASTEWATER INFRASTRUCTURE MANAGEMENT IN VIETNAM: A CASE STUDY OF HO CHI MINH CITY

Lam Vu Thanh Noi and Vilas Nitivattananon

Urban Environmental Management
Asian Institute of Technology, Thailand

OUTLINE

1

Introduction

2

Research question and Objective

3

Methodology

4

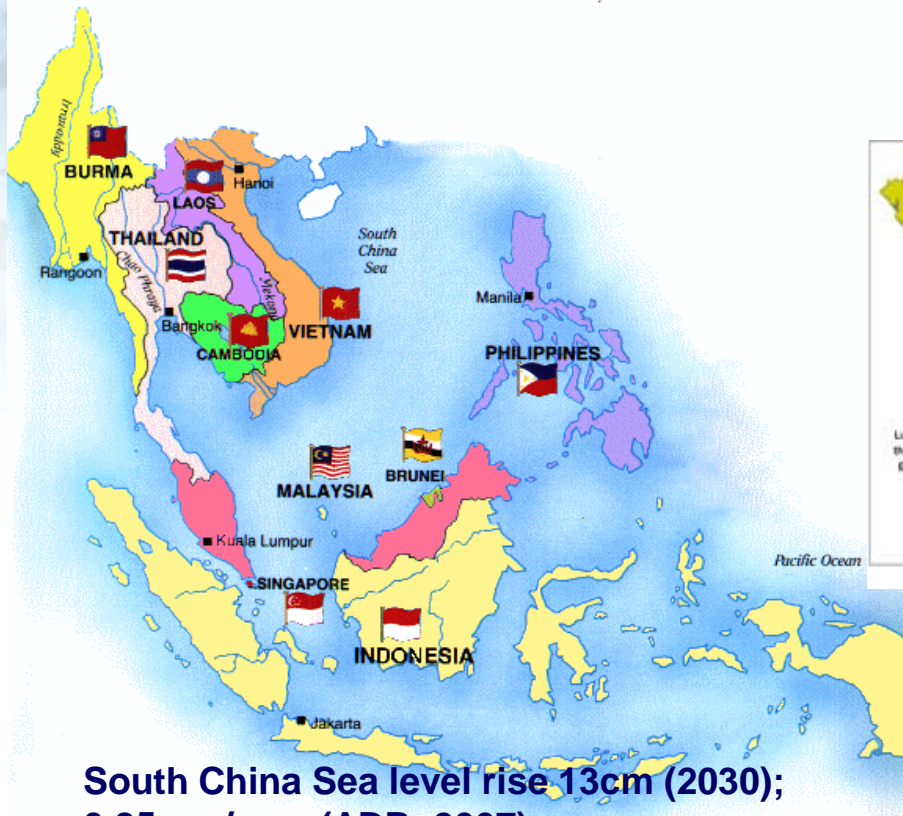
Results and Discussion

5

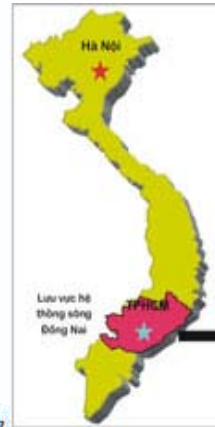
Conclusions and recommendations

Introduction

Climate change impacts in Costal cities



South China Sea level rise 13cm (2030);
0.85mm/year (ADB, 2007)



Introduction

Vietnam:

- Increased in floods, droughts, other hazards
- SLR would be 1.0m (2100) → impacts:
 - ⇒ 10% of pop.
 - ⇒ 10% of GDP
 - ⇒ Inundation of 40,000 km² of coastal areas (MONRE, 2008; ICEM,2009)
- Saltwater intrusion in the Mekong Deltal
- Vectors, water-borne disease & infectious diseases

Ho Chi Minh City:

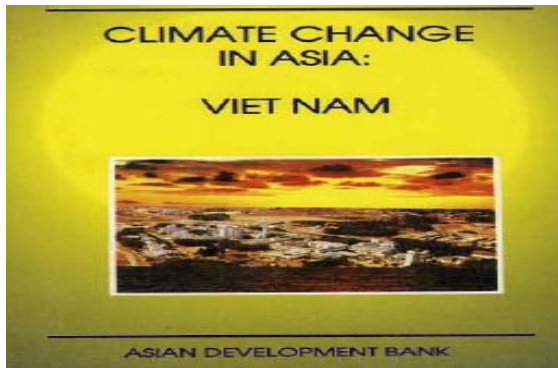
- Top 10 cities most affected by CC (WB, 2007, ADB/ICEM, 2009):
 - ⇒ 43% area
 - ⇒ 12% Citizen (~ 660,000)

Climate change impacts

Problem statements

Shortage in practical CC risk and vulnerability assessment

Knowledge gap in adaptation to climate change

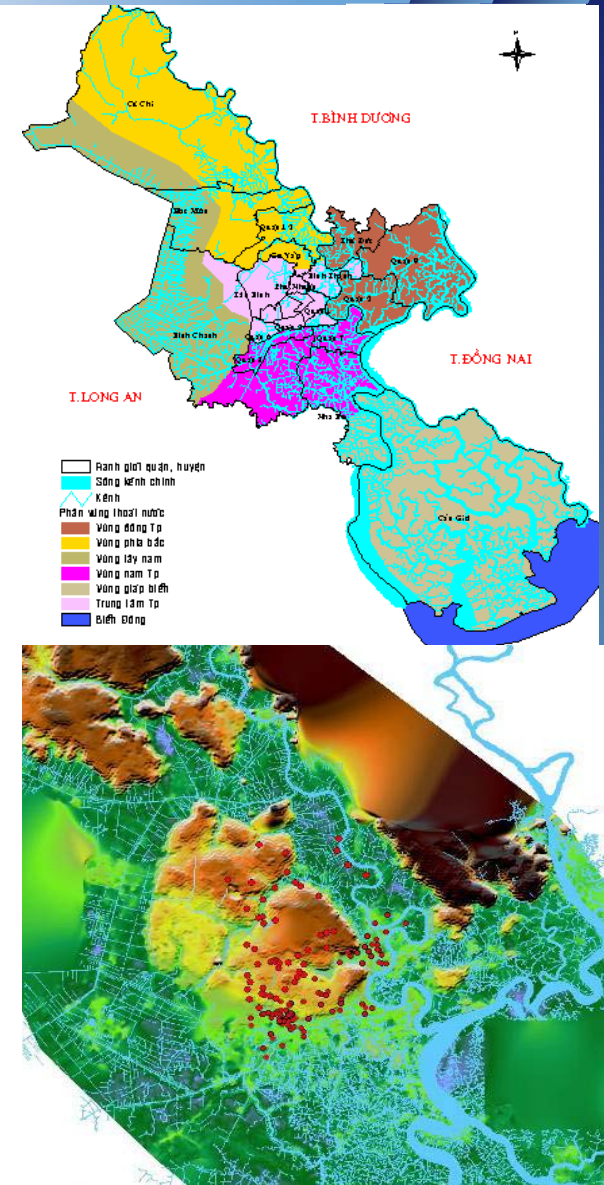


Research Question and Objective

- **Research Question**: How to conduct climate change vulnerability assessment for urban water and wastewater infrastructures at local level?
 - **Main objective**: To present a case of rapid vulnerability assessment (RVA) for urban water and WW infrastructures in HCMC and recommend next step for CC adaptation measures
-

Scope and limitation

- Water and WW infrastructures at communities
- Negative impacts
- Rapid assessment
- Perception of CC adaptation



Methodology

**Assessment
process**

Tools/Techniques

Identify CC related risk factors

Investigating
CC impacts on
coastal cities
and HCMC

Secondary data
analysis/Problem tree
analysis/ Participatory rural
appraisal (PRA)

- CC scenarios
- Social-
economic
change

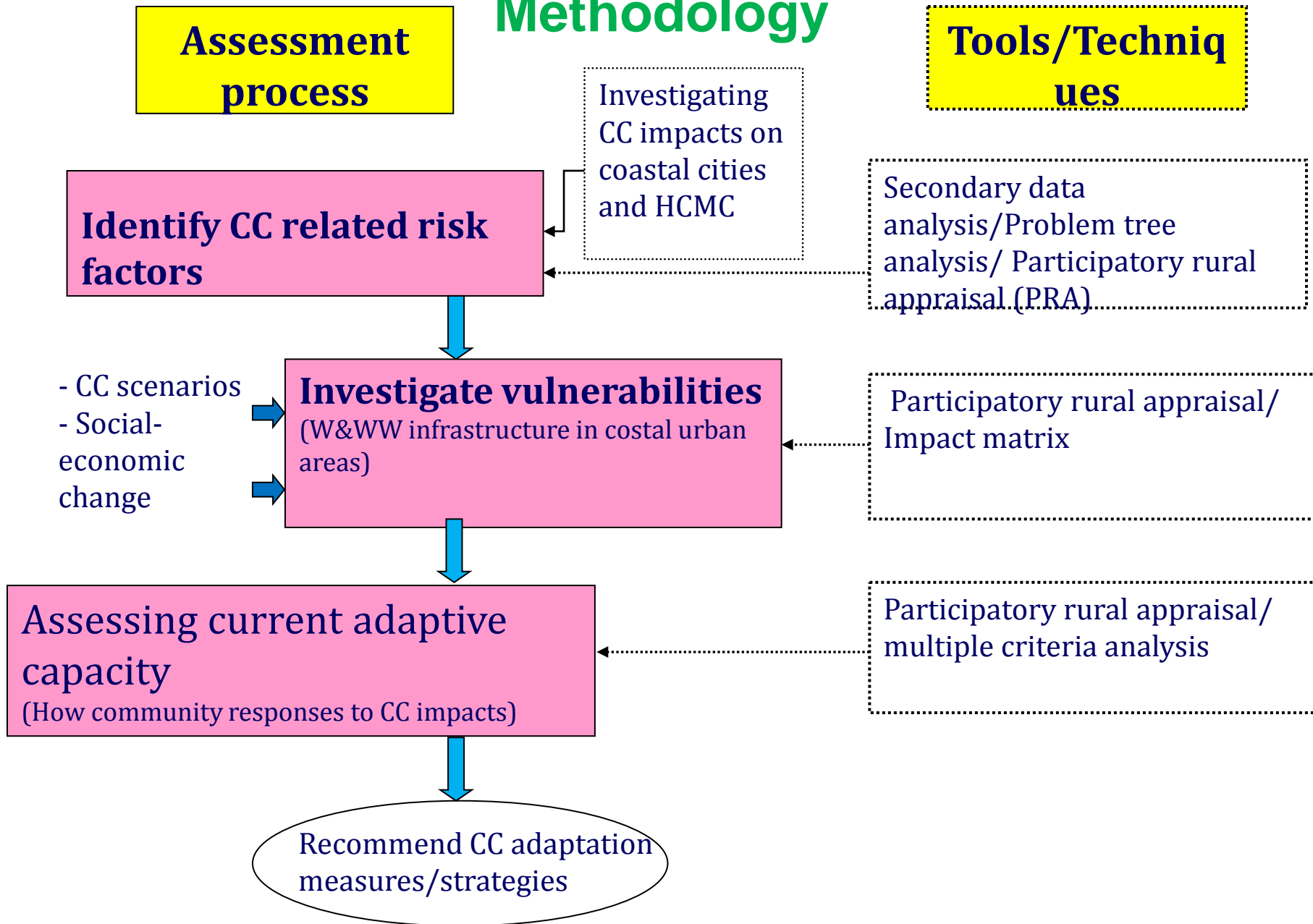
Investigate vulnerabilities
(W&WW infrastructure in costal urban
areas)

Participatory rural appraisal/
Impact matrix

**Assessing current adaptive
capacity**
(How community responses to CC impacts)

Participatory rural appraisal/
multiple criteria analysis

Recommend CC adaptation
measures/strategies



Main steps and tools/techniques undertaken in case study of HCMC

Steps	Main tools/techniques	Data collection and analysis
Identifying CC related risk factors in HCMC	Problem tree analysis	<ul style="list-style-type: none"> - Field observations, and analyses of causes and effects - Secondary data of SLR, flooding, salt intrusion, water and WW infrastructures
	PRA: interview key informants	<ul style="list-style-type: none"> - Interview researchers, experts
	Impact matrix	<ul style="list-style-type: none"> - Rank main flooding impacts on HCMC
Investigating vulnerabilities in Binh Thanh and Thu Duc districts	<ul style="list-style-type: none"> -PRA: group discussion, interview key informants, survey 	<ul style="list-style-type: none"> - Interview decision makers, researchers -Survey with 214 households -Statistics with Excel and SPSS software
	<ul style="list-style-type: none"> - MCA: rank level of CC related impacts 	<ul style="list-style-type: none"> - Statistics with Excel software
	<ul style="list-style-type: none"> - Impact matrix 	<ul style="list-style-type: none"> - Interview researchers/ decision makers -Statistics with Excel software
Assessing current adaptive capacity	PRA: group discussion, interview key informants, survey	<ul style="list-style-type: none"> - Interview, survey 242 households - Statistics with Excel, SPSS software
	MCA	<ul style="list-style-type: none"> - Rank current adaptation measures/activities

Research Area

The criteria for choosing research area:

(1) CC has been impacting on the city

(2) Rapid urbanization

(3) Long history of responding to climate change related natural disaster/Risks



HCMC become the most appropriate city for conducting CC Vulnerability assessment

Research Areas



1 Thu Duc District
(Semi-urban
coastal district)

2 Binh Thanh,
urban Coastal
District

Research Areas & respondents

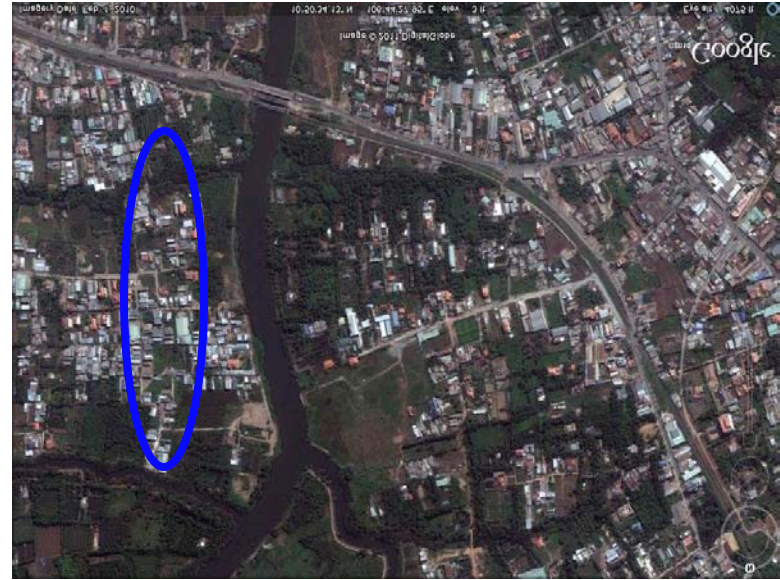
Respondents in two districts :

- Communities: vulnerability flooding, water pollution, inadequate water and others indirect vulnerabilities
- Key informants: Environmental/Water/Urban planning researchers



Selected communities in Binh Thanh District

Research Area



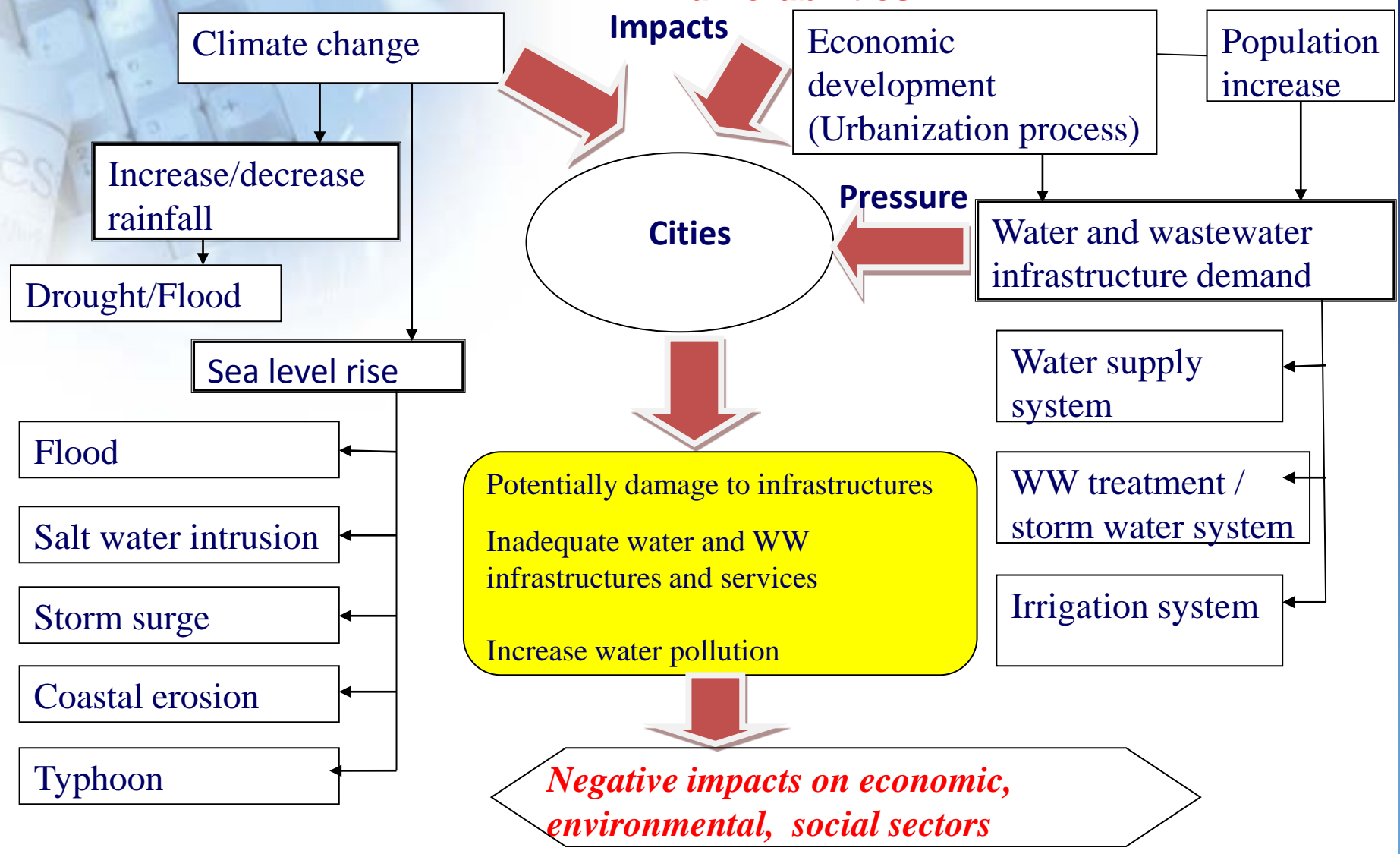
Selected communities in Thu Duc District

Shortage of policy and long-term strategies

Inadequate urban planning

Shortage of understanding of coastal cities' vulnerabilities

Knowledge gap in climate change adaptation



Climate change¹³ impacts on coastal cities

Results and discussion

Table : Key characteristics of the two study districts in HCMC

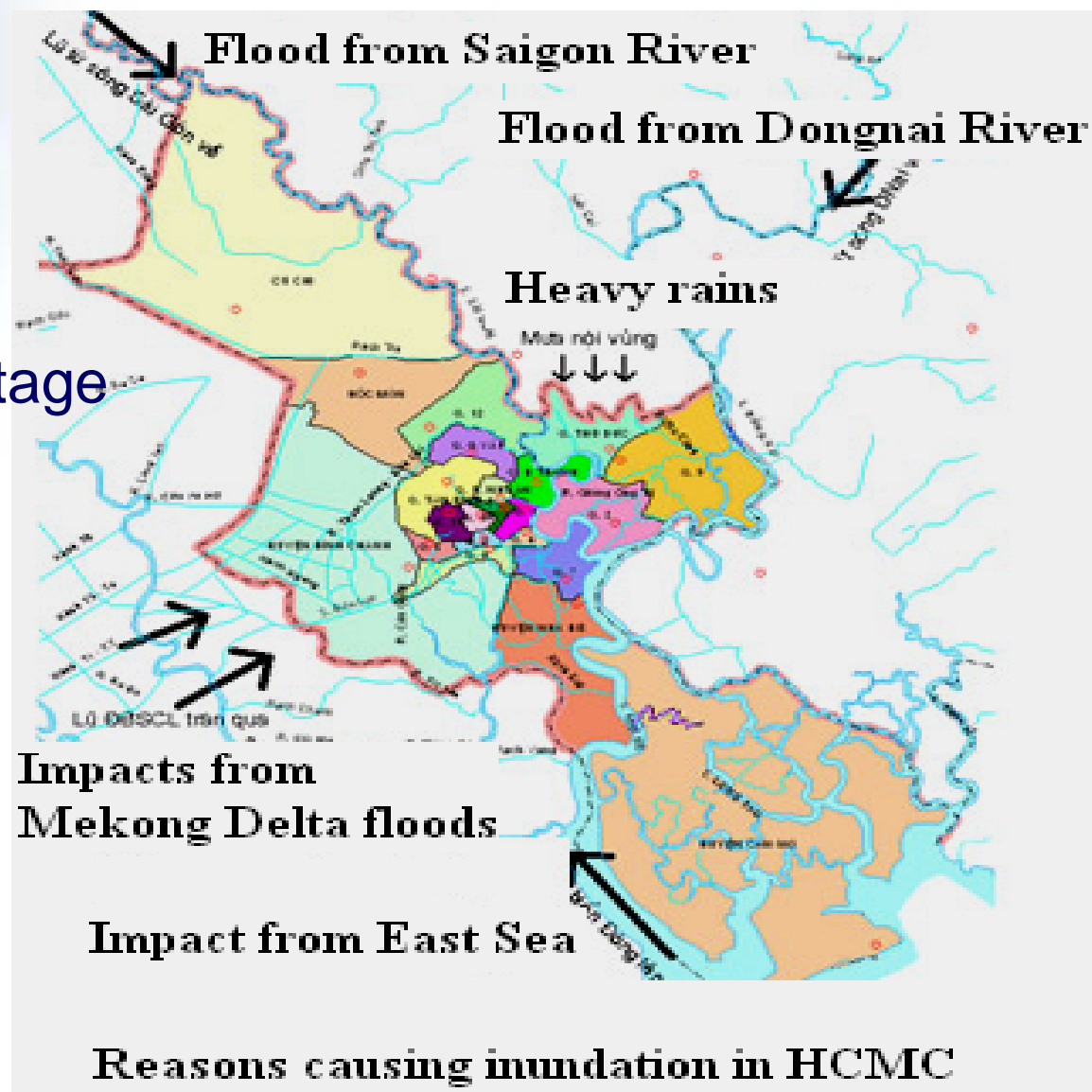
Characteristics	Units /location	Binh Thanh District	Thu Duc District
Total area	Km ²	20,76	47,76
Total number of wards	Ward	20	12
Total population (2009)	Person	451.526	442.110
Population density	Person/sq km	21750	9256
Target groups		Vulnerability to SLR, inadequate clean water, water pollution	
Total Length of drainage system	Meter	7070	25193
Occupation		Officers, commercial activities, domestic	Officers, commercial activities, domestic, farmers

Source: Data collection during filed survey in November 2009; HCMC's website; HCMC's Department of Transportation (2007).

Climate Change Impacts in HCMC

Main impacts:

- ▶ Droughts
- ▶ **Flood**
- ▶ Seasonal water shortage
- ▶ Land subsidence
- ▶ Saltwater intrusion



Vulnerability Assessment

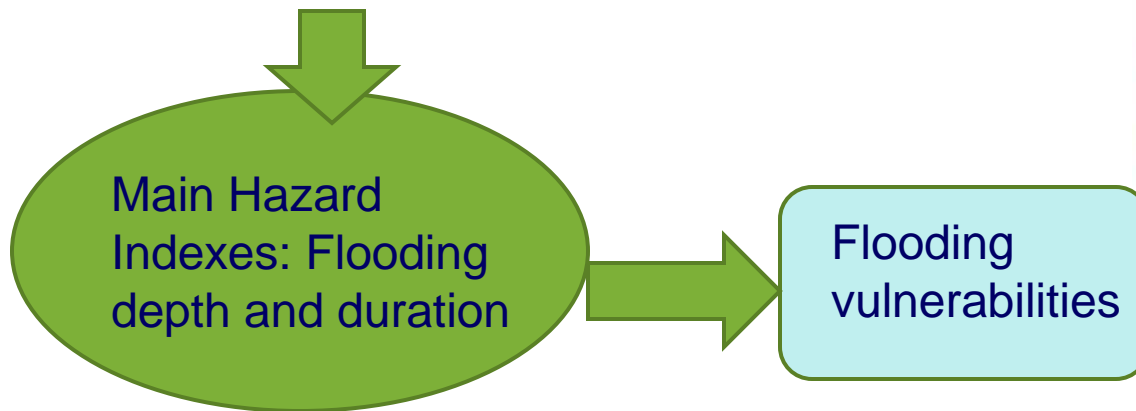
Identify risk factors

Hazards :

- Sea level rise
- High tide
- Heavy rain
- Flood
- Saltwater intrusion
- Topography

$$\text{Risk (R)} = \text{Hazard (H)} \times \frac{\text{Vulnerability (V)}}{\text{Capacity (C)}}$$

(ISDR, 2003 and ISDR, 2005)

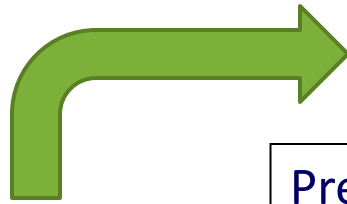


Source (Taylor, 2009)

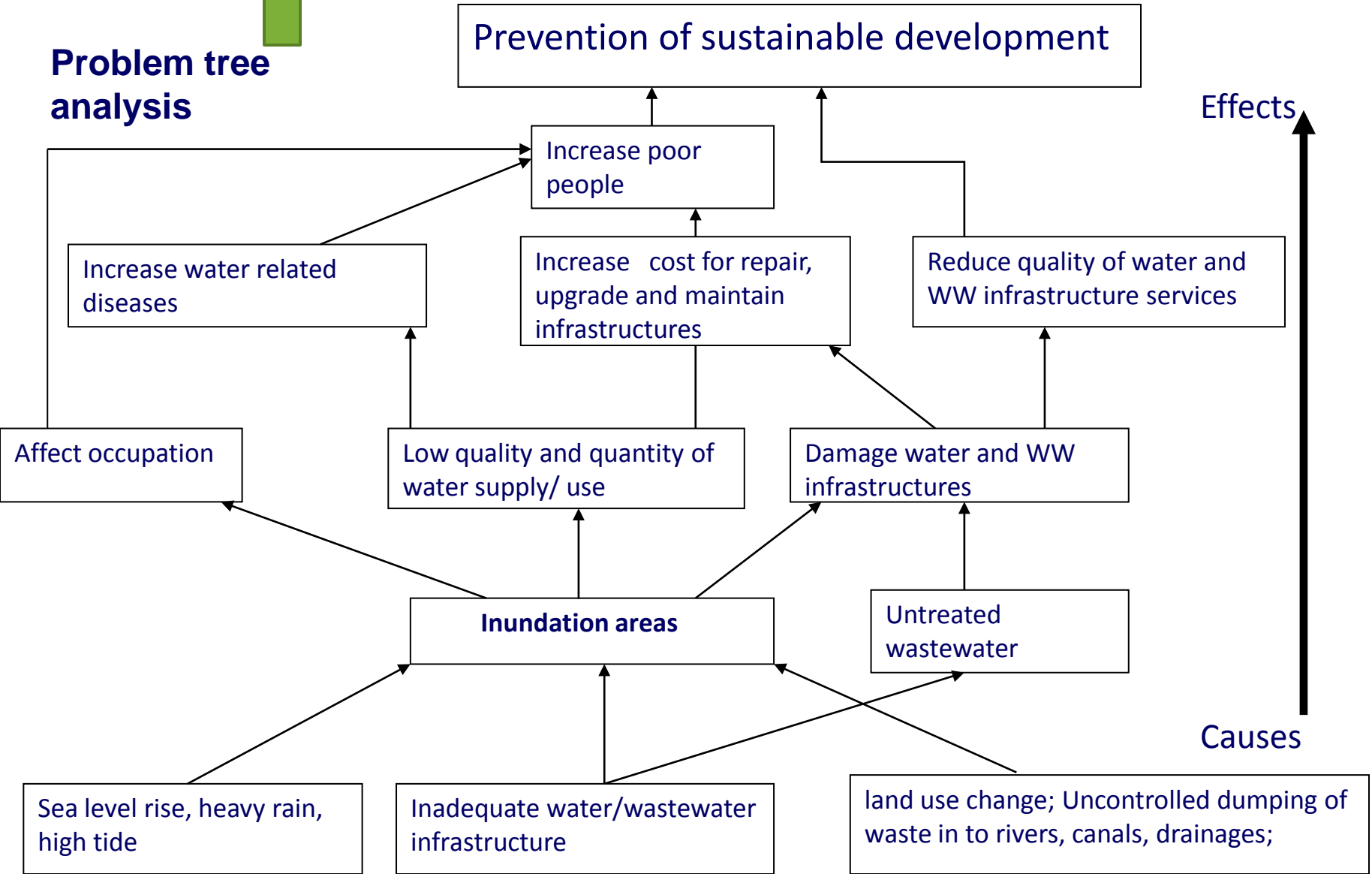
Binh Thanh and Thu Duc District

Identify risk factors




Flooding due to CC and urbanization is main cause of community vulnerabilities



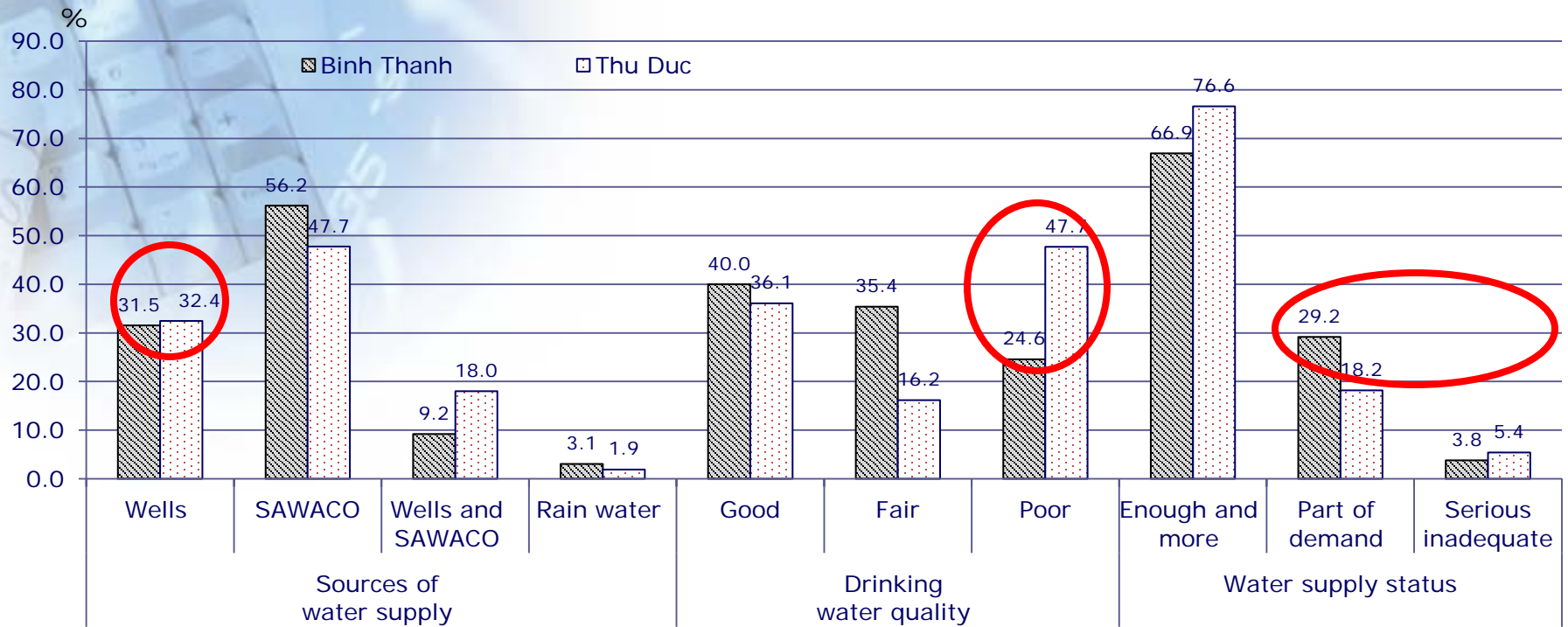
Problem tree analysis



Assessment of flooding impacts on water and wastewater infrastructures in study districts

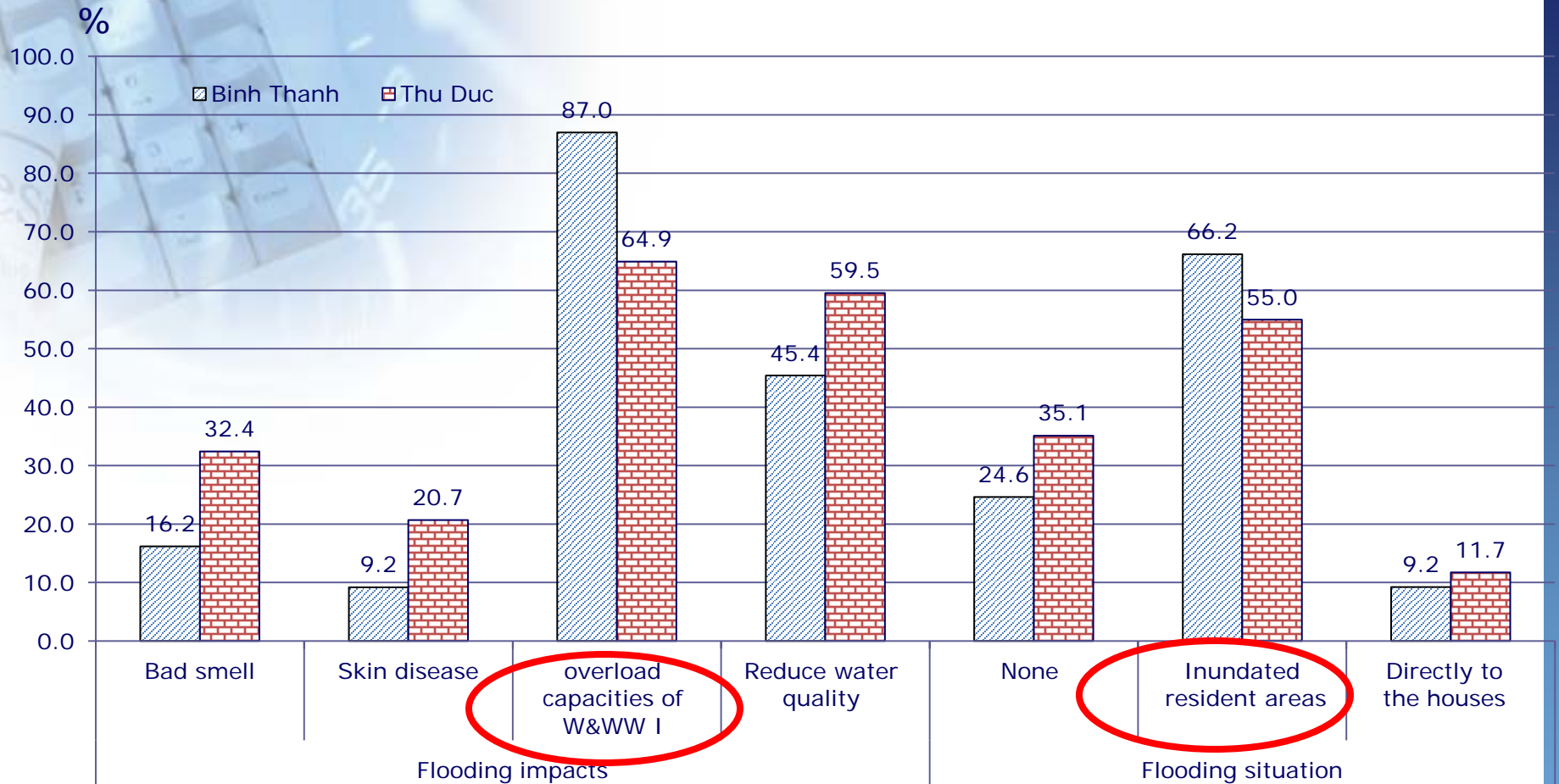
Key infrastructures	Direct impacts of CC to key water and WW infrastructures	Rank
Drinking water supply systems	Increase to water treatment costs	8 th
	Impact to water quality and quantity	6 th
	Degradation, failure and replacement due to increase in flooding events, change in groundwater	7 th
	Increase maintenance and replacement cost	7 th
Wastewater management systems	Overload the capacity of sewage network resulting in overflow to drainage network 	2 nd
	Pressure on drainage and sewerage systems, flooding of wastewater treatment sites 	1 st
	Environmental pollution in waterway and surface water	4 th
	Increase maintenance and replacement cost	6 th
	Drainages is inundated for longer, water logging due to flooding 	3 rd
Irrigation systems	Increase maintenance and replacement cost	6 th
	Situation of environmental pollution in waterway and surface water	5 th

Vulnerabilities assessment at community level



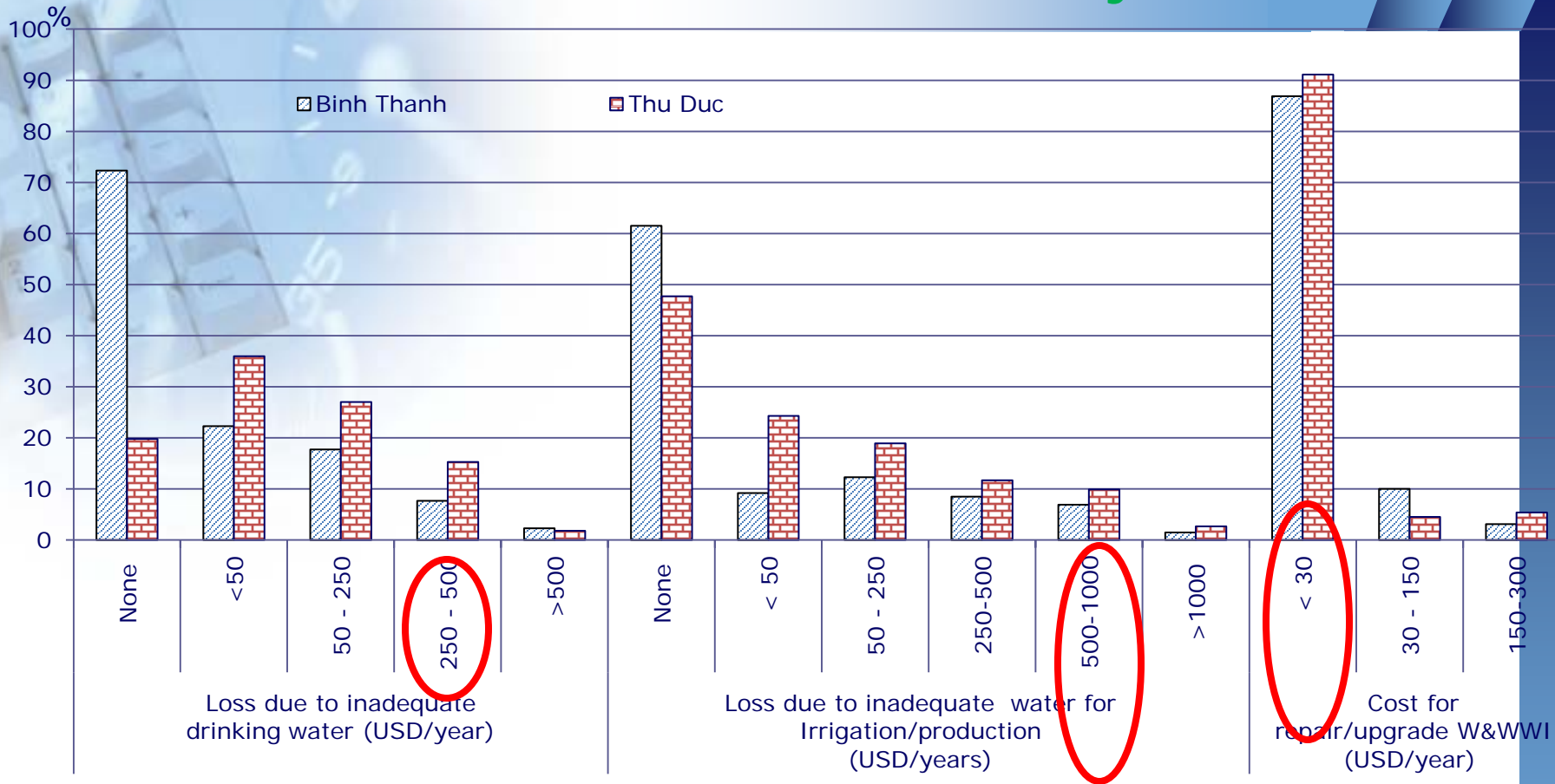
Status of water supply at simple sites

Vulnerabilities assessment at community level



Flooding situation and main flooding vulnerabilities

Vulnerabilities assessment at community level



Loss due to inadequate water and cost of repair and upgrade (USD/year) at simple sites

Perception of CC adaptation measures/activities

- (1) Clean and dredge drainage systems
- (2) Upgrade sewage, drainage, pipe networks
- (3) Increase public awareness
- (4) Upgrade/building dyke systems
- (5) Constructing more sewage & drainage systems
- (6) Increase rainy water store
- (7) Change the land use
- (8) No idea

Vulnerabilities assessment at community level



Perception concept of climate change adaptation measures

Conclusions

- This study contribution in presenting information of hazards, vulnerabilities, perception of CC adaptations at top-down scale level (promote CC risk assessment at local level)
- RVA framework can be applied for other coastal areas
- PRA, Impact matrix, problem analysis, multiple criteria analysis are simple and applicable tools and techniques in RVA
- PRA is more efficient in the step of identifying the risk factors and investigating vulnerabilities



Recommendations

- Continuing research activities on propose appropriate adaptation measures/strategies/policies
 - Further studies for developing CC risk assessment with applicable tools/techniques
 - Promote understanding on CC impacts, vulnerabilities, adaptation measures for both communities and governments
-

Acknowledgment

- Netherlands Ministry for Development Cooperation
- School of Environment, Resources and Development, AIT
- ICI_SEA Project, funding by Germany's Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)

THANK YOU

Contact email:

[First author: lamnoi2002@yahoo.com](mailto:lamnoi2002@yahoo.com); [Second author: Vilasn@ait.ac.th](mailto:Vilasn@ait.ac.th)