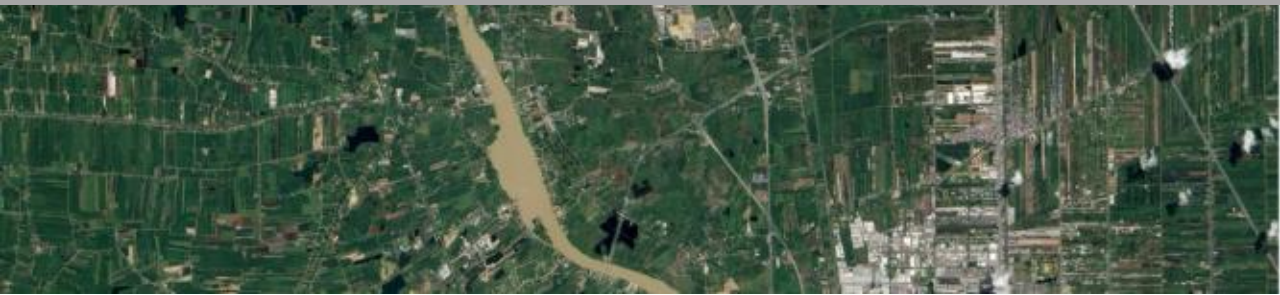


City Vulnerability Assessment

Elena Marie Enseñado, Institute for Housing and Urban Development Studies



Session Outline

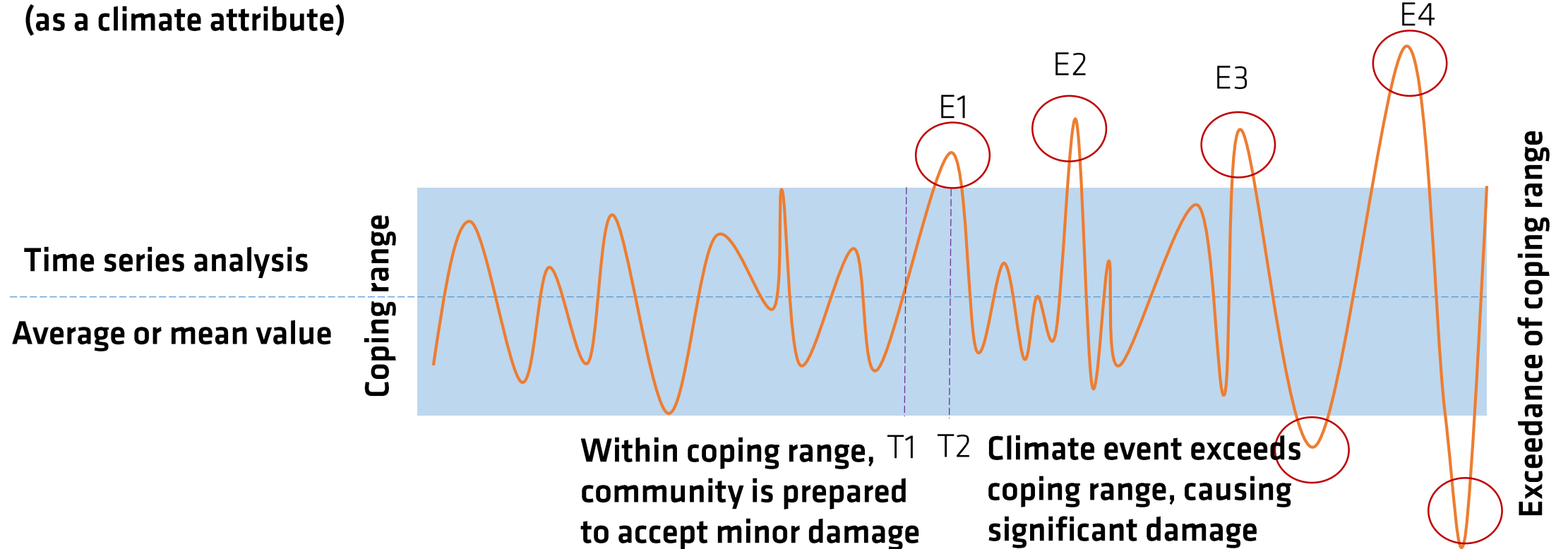
- What is **vulnerability**?
- What are the **factors affecting vulnerability**?
- What is **vulnerability assessment**?
- **Case study examples** of city vulnerability assessments
- Let's try a simple **sectoral vulnerability assessment** tool!
- **Individual assignment**: Read the case study assigned to your group.
- **Group assignment**: Discuss the vulnerable sectors/assets on June 19.

Vulnerability

*Vulnerability is the degree to which a system is **susceptible to**, or unable to cope with, **adverse effects of climate change**.*

Example: Rate of precipitation
(as a climate attribute)

“Previously **unusual** would become **normal**”



Vulnerability

*Vulnerability is a function of three factors: **exposure**, **sensitivity**, and **adaptive capacity**.*

$$\text{Vulnerability} = F(\text{Exposure} \times \text{Sensitivity} \times \text{Adaptive capacity})$$

Exposure

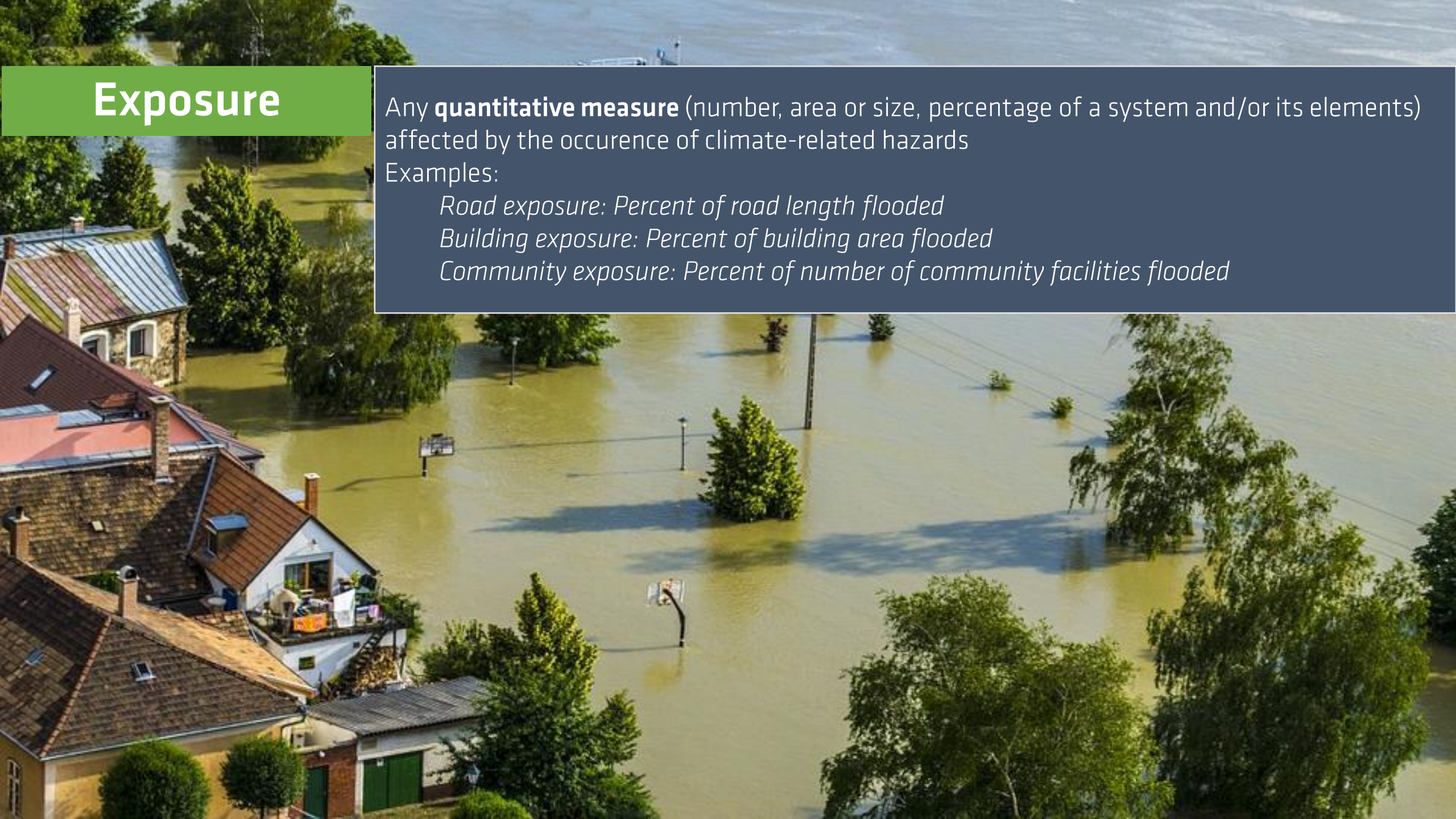
Any **quantitative measure** (number, area or size, percentage of a system and/or its elements) affected by the occurrence of climate-related hazards

Examples:

Road exposure: Percent of road length flooded

Building exposure: Percent of building area flooded

Community exposure: Percent of number of community facilities flooded





Sensitivity

Characteristics of the system affected by a hazard that describe the level of susceptibility

Examples:

Livelihood dependence on marine goods and services: Dependence on fisheries for jobs (percent of workforce in fisheries)

Dependent demographic groups: Percent of the population without access to emergency information

Access to critical infrastructure and facilities: Access to emergency response (emergency response options per 100 people: fire, police, medical, hurricane shelters)

Adaptive Capacity

Capacity of the system, both natural and social, to absorb, cope up, and rebound

Examples:

Health population: Percent of people with health insurance

Economic resources: Percent of people with property insurance

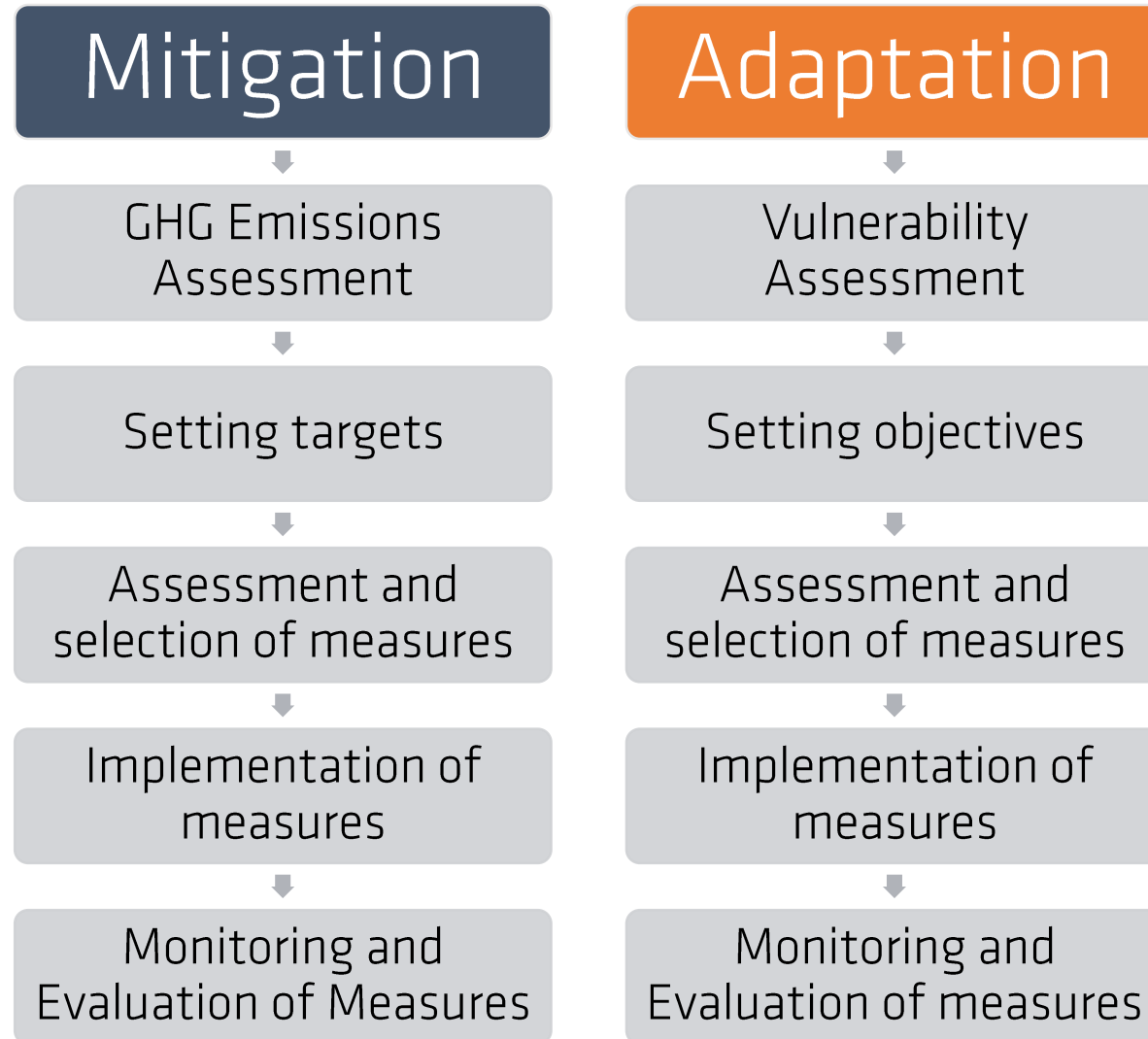


Vulnerability Assessment

Vulnerability assessment is a process of estimating the extent to which a sector is susceptible to the risks due to climate change and its impacts.

*By **sector**, this includes human population, ecosystem and its elements, land area, land use and its elements, forestry and biodiversity, fishing areas, agriculture, water system, cities, residential and settlement areas, coastal communities, health, and environment.*

Climate Change Planning Process



Mitigation



GHG Emissions
Assessment

Adaptation



Vulnerability
Assessment

Key Questions

Which sectors are the
largest emitters of GHGs?

How is your city exposed to
climate change today and in
the future?

How sensitive are your
city's people, places and
institutions to this
exposure?

Who is most vulnerable at
least able to adapt?

What sectors are most
important?

Key Methodologies

Many approaches, many methods!

The level of sophistication depend on the resources and capacity available

However, every approach consider the basic issues: exposure, sensitivity, and adaptive capacity

Local circumstances will dictate the scale and scope of the final methodology

Follow the national guidelines, if possible!

Different Methods

- Science based
 - *All impact indicators are established through science-based research*
- Experts' judgment
 - *All impact indicators are estimated by experts familiar with the area*
- Social survey
 - *All impact indicators are estimated through interviews of people affected by climate change*
- Combination of different methods

Additional Tools and Methods

Focus groups

Structured Interviews

Scientific Hazard
assessment

Field Mapping GPS/GIS

Hot spot mapping

GIS / Visualizations

Disaster risk mapping

Surveys

Community perception
elicitation

Climate change
observation template

Impact rating matrices

Influence diagrams

And many more!

Vulnerability Assessments: Importance

- Identify magnitude of threats, such as climate change
- Guide decision making on planning and investment
- Identify measures to reduce vulnerability
- Prioritize measures for climate change adaptation

Case Study 1: Sorsogon City, the Philippines



Exposure

Changes in Extremes

- *Tropical cyclones / storm surges*: Passing of more typhoons, more rain volume, stronger winds, occurrence of storm surge, increasing incidence of evacuation of families from urban coastal areas especially those living in informal settlements
- *Extreme rainfall and riverine floods*: Flash flood events, riverbank erosion
- *Eli Nino / Southern oscillation*

Changes in Means

- *Increased precipitation*: more than the average 200 days of rainfall per year
- *Increase in temperature*: 2-3 degrees change in temperature
- *Sea level rise*: Inundation of land in coastal barangays, changes in tides in Sorsogon Bay

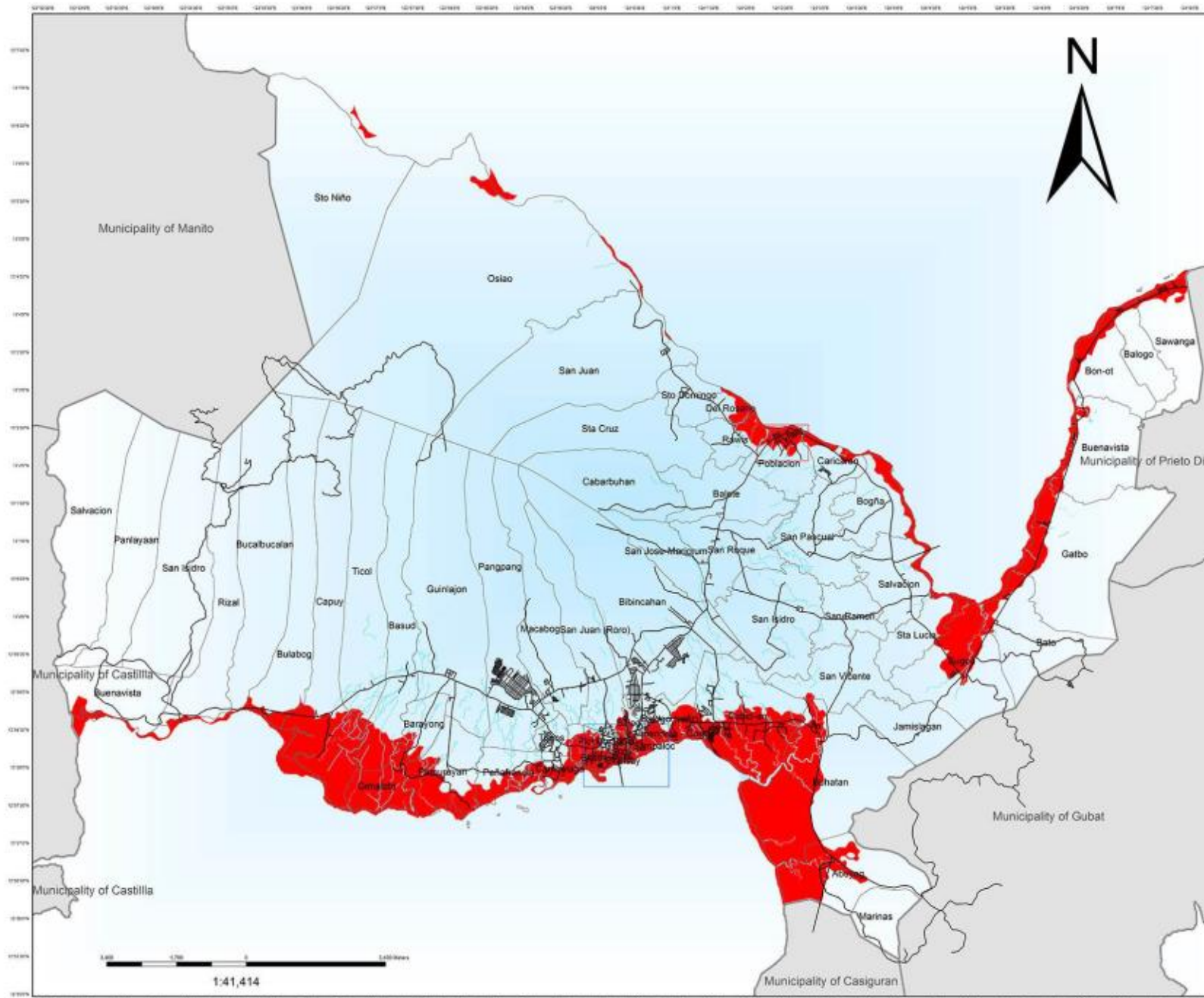
The map shows the geographical context of the study area within Zamboanga City. Key features include:

- Compass Rose:** Located in the upper right corner, indicating North (N), South (S), East (E), and West (W).
- Scale Bar:** Located in the lower left corner, with a scale of 1:41,000.
- Municipalities:** Labeled areas include Municipality of Manito, Municipality of Prieto Diaz, Municipality of Gubat, and Municipality of Casiguran.
- Barangays:** Numerous barangays are labeled, including Sta. Niño, Osiao, San Juan, Sta. Cruz, Sto. Domingo, Del Rosario, Balite, Potacion, Carichan, Bogha, San Pascual, San Jose Medcun, San Roque, Cabarbuhan, Balite, San Isidro, San Ramon, Sta. Lucia, Sugod, Sulu, Jamalagan, Suhatan, Aburos, Marinas, Gimaloto, Patuyan, Penablanca, Cullaga, Macabog, San Juan (Roa), Sibinhahan, Pangpang, Guinajan, Basud, Bulabog, Capuy, Rizal, San Hidro, Bucabucalan, Parlayaan, Salvacion, and Buenavista.
- Study Area:** A red box highlights the study area in the northern part of the city, near the coast, specifically around the barangays of Potacion and Carichan.

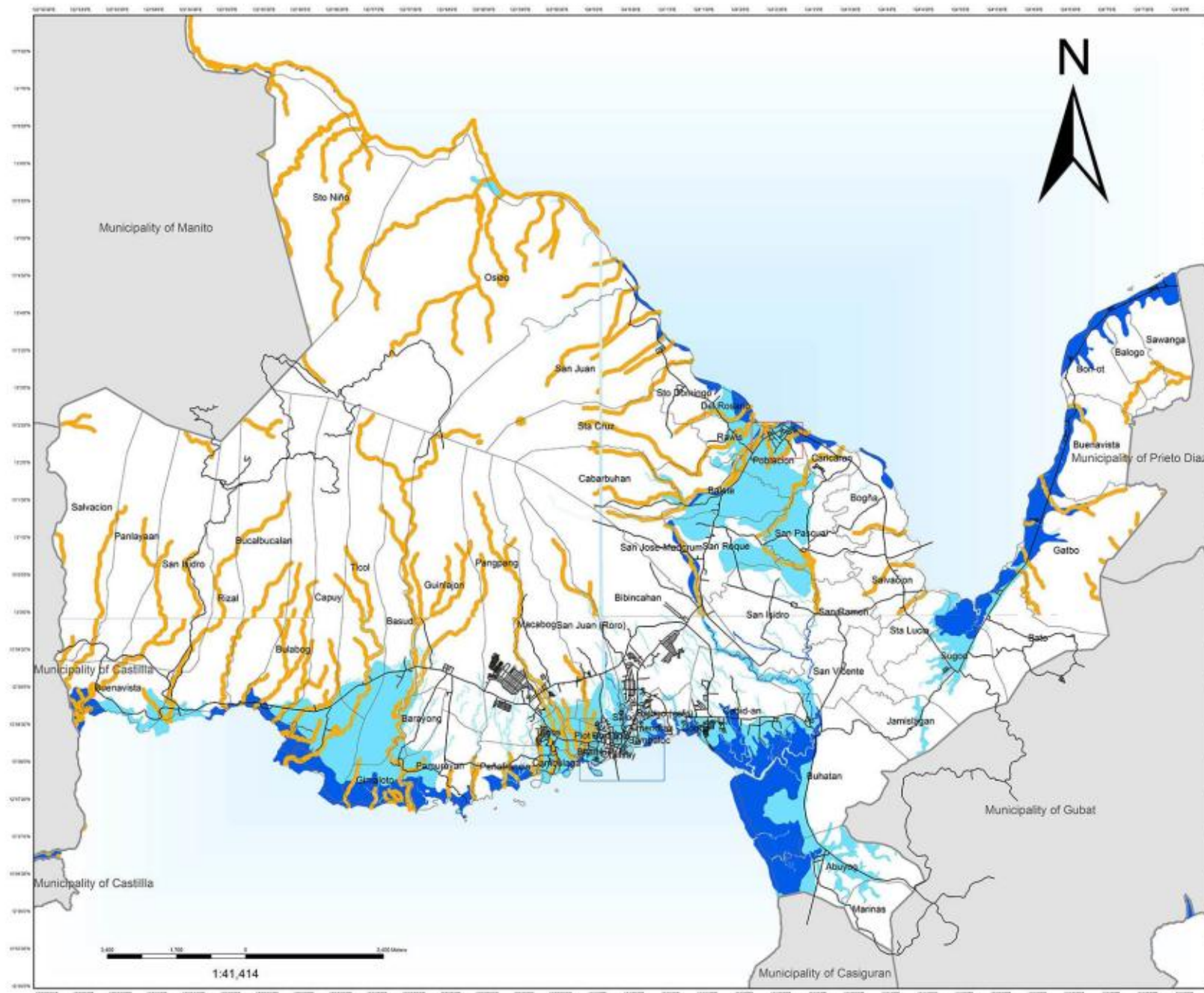
Sea Level Rise

- SLR 2 meters
- SLR half meter
- SLR 1 meter

Made by: CPDO GIS office
email: giacpdosercity@gmail.com



Data sources: Brangay City CLUP
MSB GeoHash and Image, MGRS Topographic Map,
V 5 AA Image
Brangay boundaries are indicative not authoritative
Road network from Satellite Imagery
Coordinate System: WGS 1984 UTM Zone 51N
Datum: D NGB 1984
Unit: Degree
Made by: CPDGIS office
email: cpdgisoffice@gmail.com

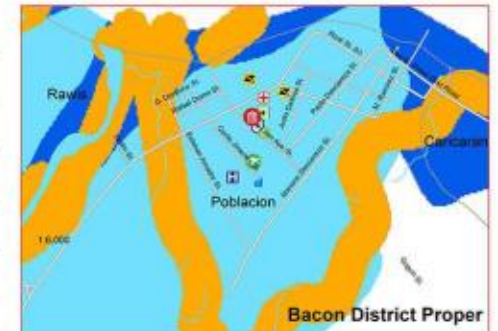


Sorsogon City Flood Hazard Map

Legend:

Flood Hazard

- Administrative
 Areas Prone to Riverbank Erosion
 Regularly to Frequently Flooded Areas
- Rivers
 Occasionally to Rarely Flooded Areas
- Creeks
 Non Flood Prone Areas



Data sources: Sorongon City CLUP,
MOB Geospatial Maps, NAMRIA Topographic Map,
V & AA Maps

Energy boundaries are indicative not authoritative.
Road network from Satellite imagery

Coordinate System: WGS 1984 UTM Zone 51N
Datum: WGS 1984
Units: Meters

Made by: CPDO CIB office
email: goodsoncib@gmail.com

Sensitivity

Who/What will be affected:

- *People:* population
- *Places:* built up area, agricultural zone, forest/watershed area

Sectors:

- *Trading, tourism, agriculture, service oriented livelihoods, infrastructure systems*

Sea Level Rise Exposure & Sensitivity Analysis from Sorsogon City

CC Risk Indicator: Sea Level Rise													
RISK EFFECTS	Permanent Flooding						Salinization						Risk Rating (total score over count of risk effects)
Who/What will be affected?	Exposure			Sensitivity			Exposure			Sensitivity			
	Probability or Likelihood of impact			Possible Adverse Consequence/s (expected losses)			Probability or Likelihood of impact			Possible Adverse Consequence/s (expected losses)			
	2010	2020	2050	2010	2020	2050	2010	2020	2050	2010	2020	2050	
People													
- Population	1	1	1	1	1	1	1	1	1	1	1	1	1
													0
Places													0
- Built-up Area	1	1	1	1	1	1	1	1	1	1	1	1	1
- Agricultural Zone	1	1	1	1	1	1	1	1	1	1	1	1	1
- Forest/Watershed Area	1	1	1	1	1	1	1	1	1	0	0	0	0.75
- Others...													0
													0
Activity Sector (Local Economy and lifelines)													0
- Trading	1	1	1	1	1	1	1	1	1	1	1	1	1
- Tourism	1	1	1	1	1	1	1	1	1	1	1	1	1
- Agriculture (Fishing /Farming)	1	1	1	1	1	1	1	1	1	1	1	1	1
- Service Oriented livelihoods	1	1	1	1	1	1	1	1	1	1	1	1	1
- Infrastructure Systems	1	1	1	1	1	1	0	0	0	0	0	0	0.5
- bridges	1	1	1	1	1	1	0	0	0	0	0	0	0.5
- communications /power	1	1	1	1	1	1	0	0	0	0	0	0	0.5
- Public School Bldg.	1	1	1	1	1	1	0	0	0	0	0	0	0.5
- Roads/ seawall/river control	1	1	1	1	1	1	0	0	0	0	0	0	0.5

Exposure Rating Probability/Likelihood: 1=Frequent or Very Likely; .75=Likely; .50=Moderately Likely; .25=Low probability

Suggested Rating for Possible Adverse Effect:

1= Very Severe Consequence; .75= Severe Consequence; .50=Moderate Consequence; .25= Low Consequence (previous experience as basis)

Adaptive Capacity

DIMENSIONS, INDICATORS AND RATINGS TO BE USED				CITY ADAPTIVE CAPACITY ASSESSMENT			
				Score		Wtd Score	Total Score
Socio-economic		0.50					0.25
Poverty Incidence	0.40			0.57	0.23		
Informality (Tenure)	0.20			0.46	0.09		
Literacy Rate	0.20			0.17	0.03		
PO/CBO/MFI membership	0.20			0.7	0.14		
					0.49		
			0.25				0.06
Technology				0.1	0.03		
Access to telecommunications	0.30			0.06	0.02		
Access to electricity	0.30			0.5	0.20		
Functional DRR Plan	0.40				0.25		
Infrastructure		0.25					0.07
HH with safe water access	0.25			0.28	0.07		
Paved Road	0.25			0.4	0.10		
Protective Infra	0.50			0.22	0.11		
-Sea Wall	0.5		0.7	0.35	0.28		
-Unsafe Housing Unit	0.5		0.16	0.08			
				0.43			
			1.00				0.38





- More **exposure and sensitivity** increase **vulnerability**
- More **adaptive capacity** decreases **vulnerability**
- An assessment of vulnerability should consider all three factors

In **Sorsogon City**:

- Climate change responses would focus on hotspots (**exposure**) which overlap with urban poor communities (high level of climate change **sensitivity** and limited **adaptive capacity**)

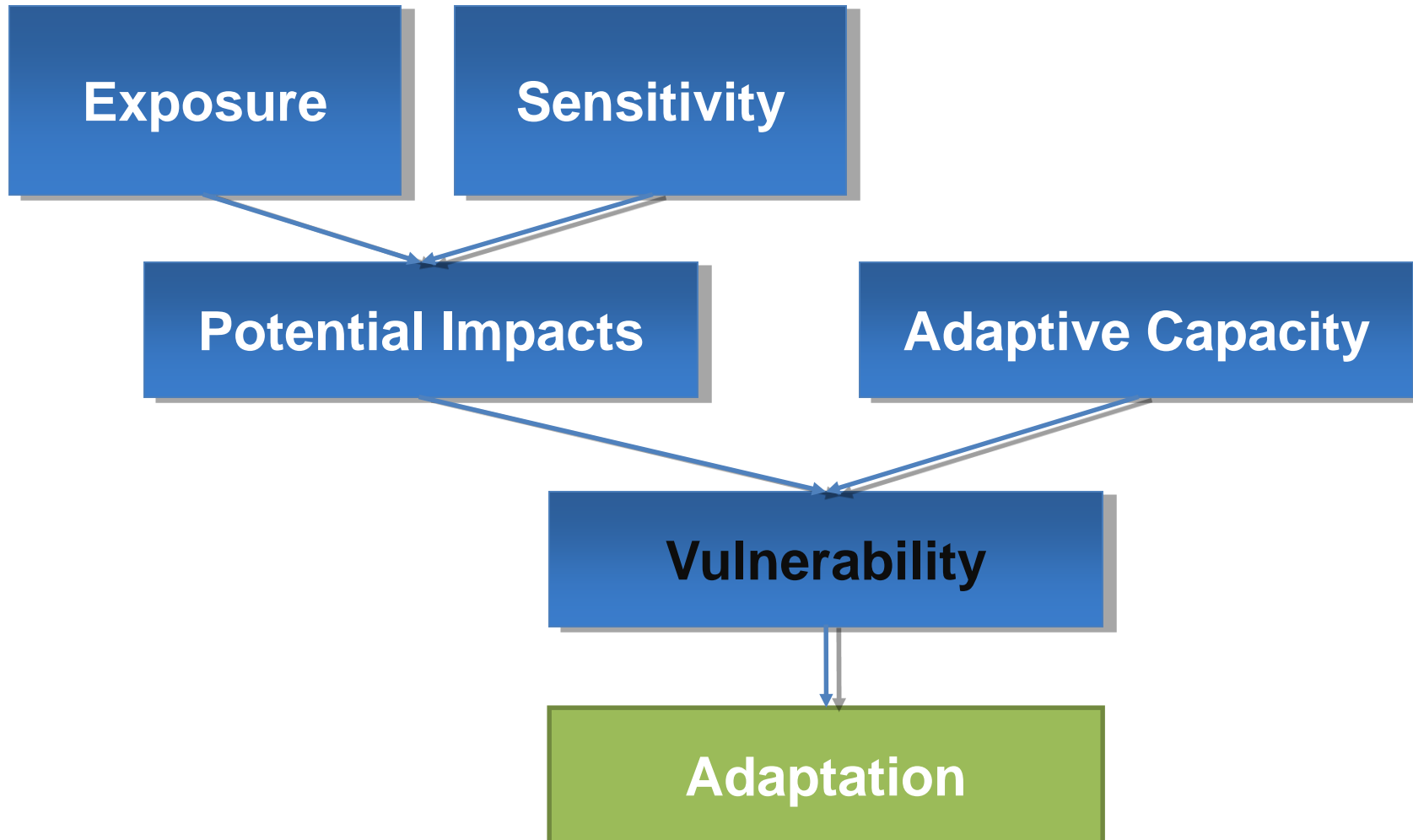
Table 1. Sorsogon City Climate Change Action Plan priorities and quick-win demonstration projects.

Theme	Broad content	“Quick wins”		Long-term measures
		Adaptation demonstration projects	Mitigation demonstration projects	
Housing and basic services	Improving housing structures of the poor; water and sanitation; climate change responsive shelter plan development	<ul style="list-style-type: none"> • Development of local minimum standards for climate change resilient house structures for the socialised housing sector • Development of community-based structural assessment template using local minimum standards • Retrofitting vulnerable structures of poor 	<ul style="list-style-type: none"> • Public buildings conversion to efficient lighting fixtures and systems 	<ul style="list-style-type: none"> • Enhancement of CLUP and Comprehensive Development Plan (CDP) with considerations of risk areas and safe development zones • Revision of local zoning ordinance • Issuance of City Policy on minimum housing standards for low-income household • Water and sanitation • Enhancement of CLUP and CDP looking at sustainable farming and trades in view of the climate change projections • Revised training curricula for construction trades for implementation of the national training institute (TESDA)
Livelihoods and economic development	Livelihood baseline development; skills development for non-climate-sensitive livelihoods; local economic development in the context of climate change	<ul style="list-style-type: none"> • Profiling baseline of community livelihoods <i>vis-a-vis</i> climate change impacts to seasonal production/productivity • Construction trades and livelihood skills training (non-climate-sensitive livelihood support) 		
Environmental management	Forest and mangrove rehabilitation and afforestation; lowering of green house gas emissions (transport and energy)		<ul style="list-style-type: none"> • Public buildings conversion to efficient lighting fixtures and systems • Tricycle conversion to four-stroke motors and electric motors 	<ul style="list-style-type: none"> • Enhancement of CLUP and CDP incorporating climate change adaptation within coastal/forest management • Issuance of local policy on “green tricycle” operation
Mainstreaming climate risk reduction/ disaster risk reduction (DRR)	Development of local policies; CLUP and CDP (sectoral); community-based disaster risk reduction and management (CBDRRM) strengthening towards adaptation	<ul style="list-style-type: none"> • Strengthening of city’s CBDRRM • Retrofitting of a school used as evacuation centre considering climate change resilient-building technologies • Art programmes at the community level for CBDRRM and climate change adaptation 		<ul style="list-style-type: none"> • Enhancement of CLUP and CDP with considerations of risk areas and safe development zones • Revision of City Disaster Risk Reduction and Management Plan and Regular Budget allocation for common country assessment/DRR preparedness projects • Improved coastal zone management, incorporating infrastructure measures and eco-systems-based adaptation

Case Study 2: San Vicente, Palawan, the Philippines



VA Framework and Concept



San Vicente and Climate Change

Flood & Landslides

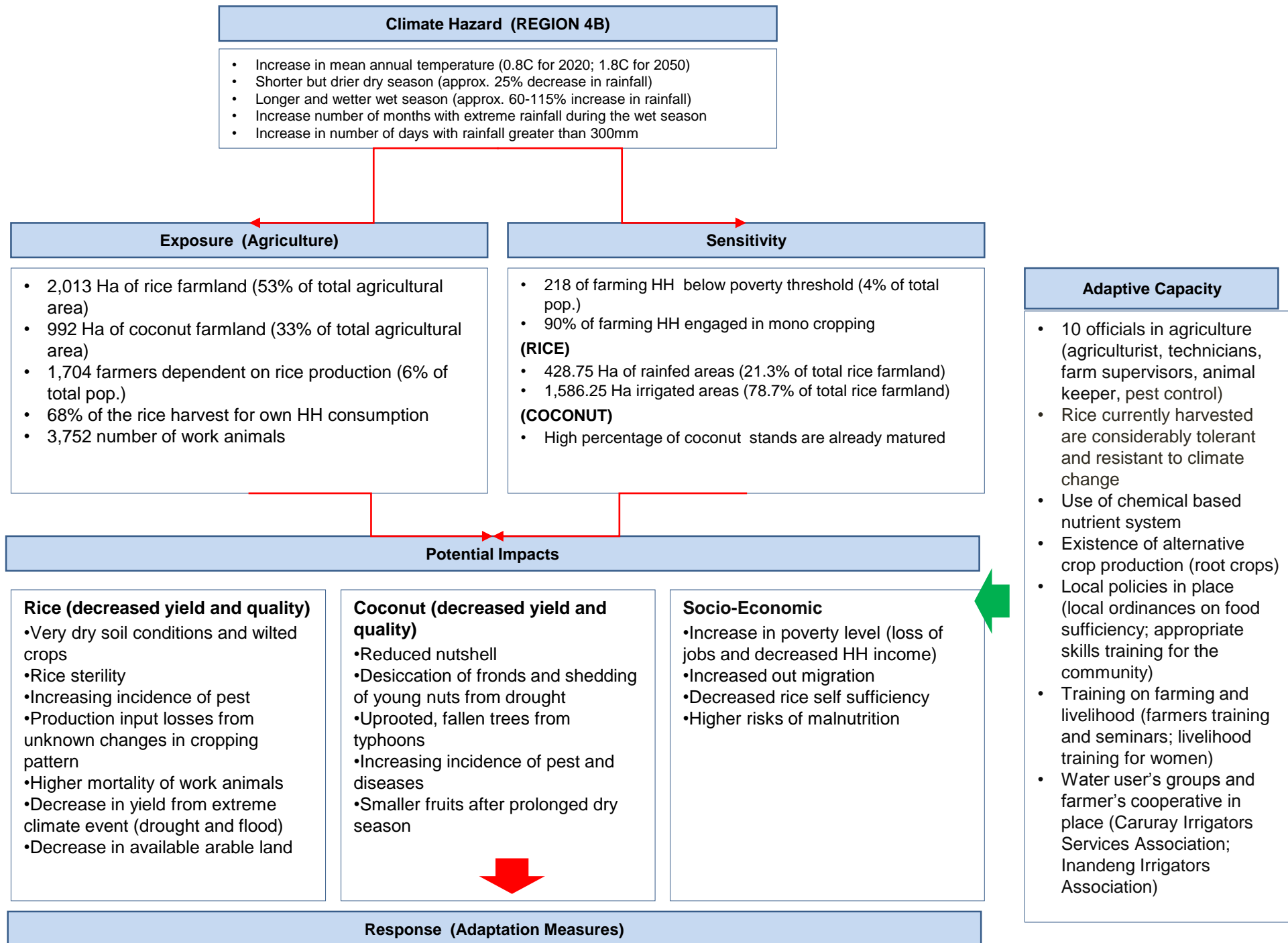
- Strong typhoons felt the last 30 years, projections indicate it will intensify.
- Annual rainfall has significantly increased (13.39%) in the total annual rainfall in 2011 and 2012

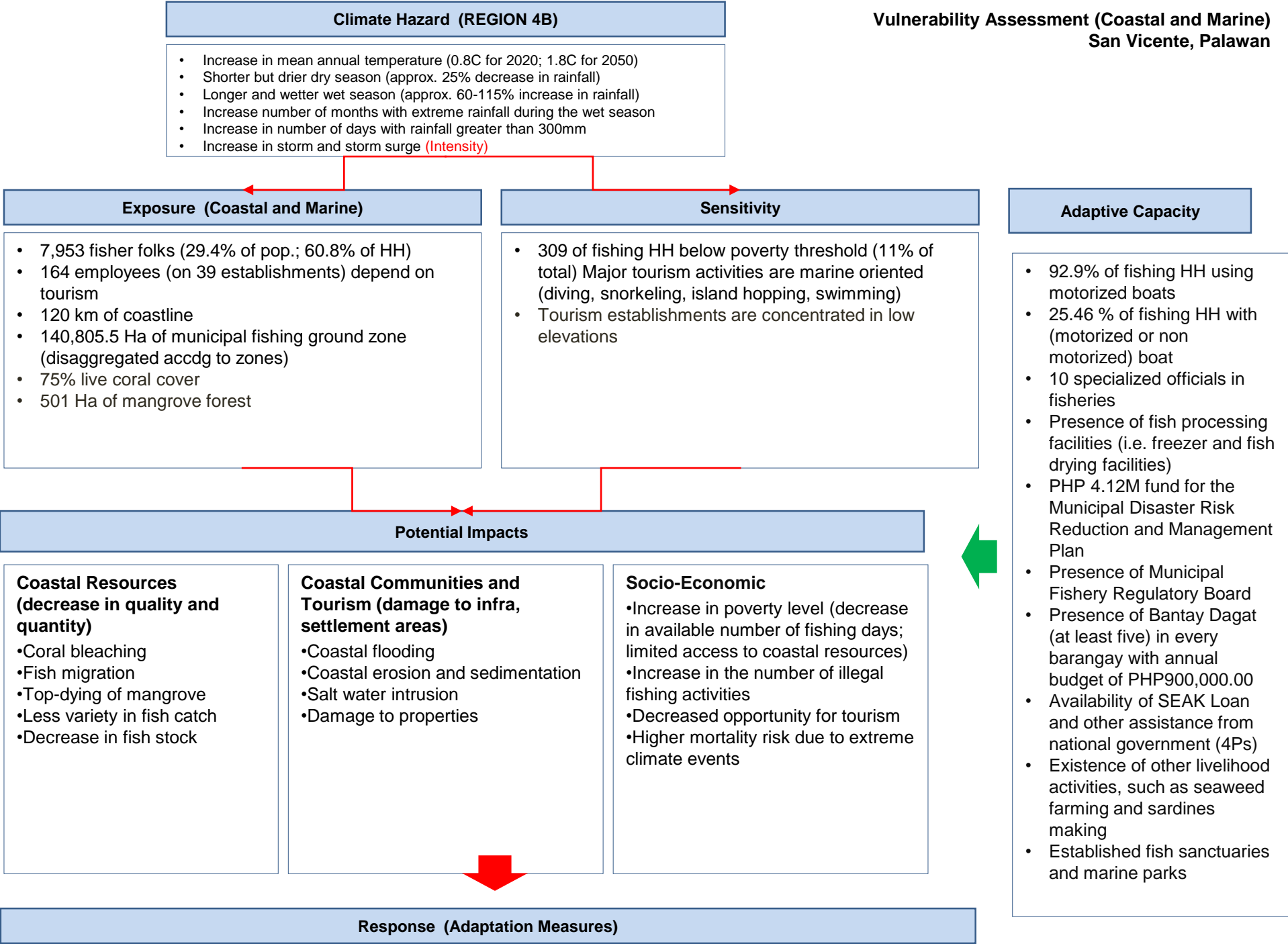
Coastal inundation

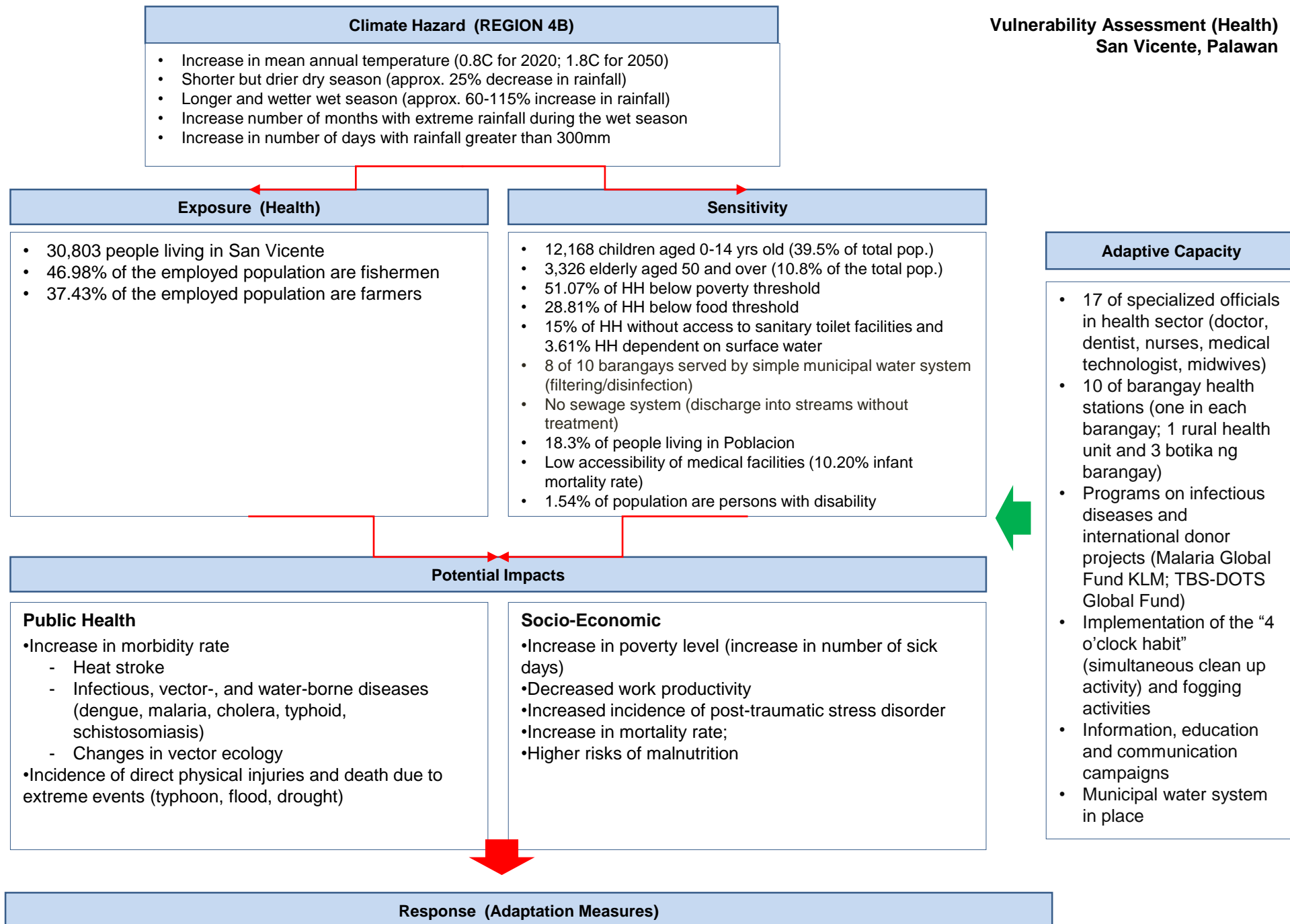
- Extreme coastal flooding threatens resorts and restaurants (Port Barton).
- Coastal flooding can also inflict damage to agriculture. High salt concentration can adversely affect vegetation.

Drought

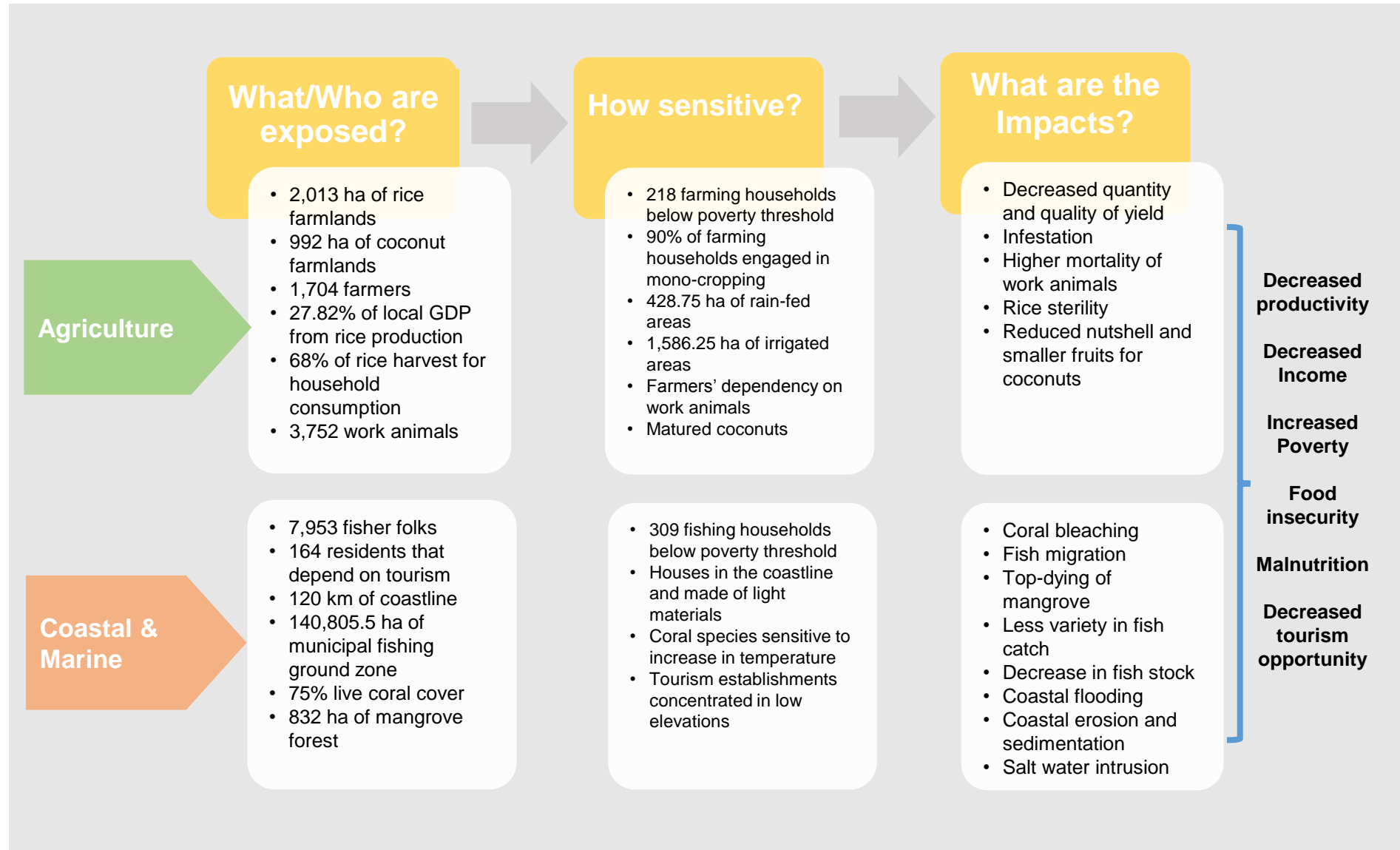
- Damaged more than 10% of our live coral cover due to coral bleaching during El Niño (1998 and 2010)







Summary: What are San Vicente's foremost vulnerabilities especially in its most important sectors?

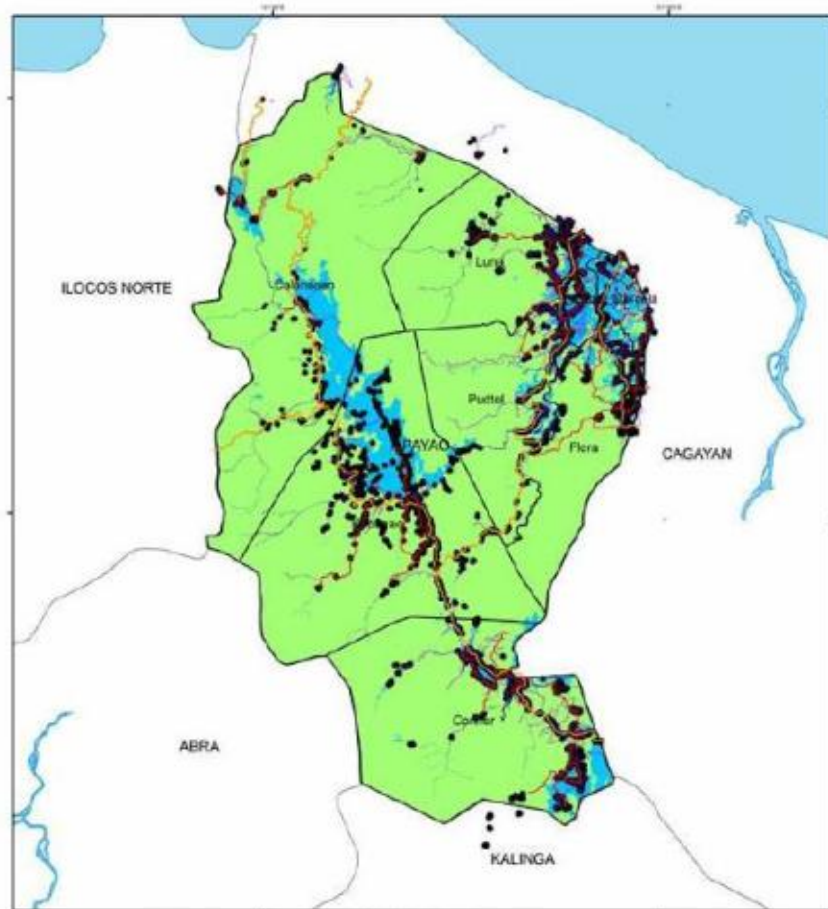


Based on San Vicente's vulnerabilities, what are the viable adaptation measures to climate change?

	AGRICULTURE	COASTAL & MARINE
Technical/ Infrastructure	<ul style="list-style-type: none"> • Construction of additional automatic weather stations • Construction of small scale irrigation facilities 	<ul style="list-style-type: none"> • Establishment of sea walls and dikes in Port Barton • Setting up of early warning system • Mangrove deforestation
Governance & Policies	<ul style="list-style-type: none"> • Training to introduce alternative livelihood (non-timber forest product) • Establishment of farmers' field schools and programs 	<ul style="list-style-type: none"> • Total fish-catch monitoring • Monitoring of illegal fish catch practices • Organizing and strengthening fisherfolk organizations • Coral rehabilitation (i.e., undertake herbivore seeding, establish the necessary mix of marine habitat types to enhance coral resiliency)
Practices	<ul style="list-style-type: none"> • Introduction of new crop varieties, including hybrids • Alteration of cropping pattern/calendar and practices 	<ul style="list-style-type: none"> • Training for alternative livelihood • Promotion of private sector involvement in coastal planning and management • Trainings and orientation on disaster risk reduction and management • Enhanced public information campaign • Policy for water resource use conflict resolution

Through multi-criteria analysis, several options were prioritized based on the following criteria: effectiveness, cost, technical feasibility, social/cultural feasibility, required time, and sustainability and overall impact.

Case Study 3: Apayao, the Philippines



LEGEND: (Agriculture and Fisheries, Forest and Biodiversity, Housing and Settlements)

- Agriculture and Fisheries Areas
- Forest and Biodiversity Areas
- Housing and Settlements Areas
- Inland Water
- National Road
- Provincial Road
- Municipal Road
- Barangay Road

Prepared by:
PPDO - Apayao 2018



Map Source:

Department of Environment and Natural Resources Civil
Natural Ecosystems and Development Authority - CEN
Administrative Boundary, National Road, River and Spot
Elevation, NAMRIA Topographic Map 1:750,000 scale

VULNERABILITY ASSESSMENT (LAND USE)

Step 1: Participatory Mapping of Spatial Context

Using standard color codes, map the coverage of the sectors or the physical planning areas and impact domains for analysis in our vulnerability assessment.

No.	Name of Sector and Standard Color	Description
1	Agriculture and Fisheries	Agricultural production areas including fish production as well as settlement areas
2	Coastal and marine habitat	Bay or coastal areas including freshwater habitats e.g. lakes or rivers as well as settlement areas
3	Forestry & Biodiversity	Production and protection of forests; Declared protected areas (strict protection and multiple use zones) and key biodiversity areas; including settlement areas
7	Housing and Infrastructure	Residential, commercial, and industrial areas, and locations of basic services and infrastructure e.g. hospitals, schools

Step 2: Identification of climate change impacts or disaster risks

Indicate whether each climate change impact or disaster risk is presently being experienced or would likely be experienced in the future by each sector. Write down either 'yes', 'no', or 'maybe' for each cell.

No.	List of climate change impacts or disaster risks	Agriculture and Fisheries	Coastal and marine habitat	Forestry and Biodiversity	Housing and Infrastrcuture
1	Drought / heat stress	YES	No	NO	MAYBE
2	Erosion	MAYBE	No	YES	MAYBE
3	Flooding	YES	No	NO	YES
4	Land slide	MAYBE	No	YES	YES
5	Sea level rise or fall	NO	No	NO	NO
6	Tropical cyclones / typhoon	YES	No	MAYBE	YES
7	Pest/ disease occurrence	YES	No	NO	MAYBE

Step 3: Assessing sensitivity, exposure, and adaptive capacity indicators

For each sector (e.g. agriculture, coastal marine habitat), assess the vulnerability against each climate change impact or disaster risk (e.g. drought, flooding). You can do so by scoring each sensitivity, exposure, and adaptive capacity indicator according to the following numerical rating:

Numerical Rating	Explanation
1	Very High
0.8	High
0.6	Moderate
0.4	Low
0.2	Very Low

Click the drop-down menu list to select your rating.

Sector	Climate Change Impacts or disaster risks	Sensitivity Indicators	Sensitivity Rating	Exposure Indicators	Exposure Rating	Adaptive Capacity Indicators	Adaptive Capacity Rating
Agriculture	Drought	Duration of drought	0.4	Number of agriculture dependent families affected	0.8	Use of drought resistant crop varieties	0.4
	Flooding	Proximity of farmlands to river/stream banks	1	Percentage of agricultural production areas flooded	1	facilities in agricultural areas	0.2
	Typhoons	at maturity stage during typhoon	1	Percentage of yield losses due to typhoons	1	Accesss to crop insurance, loans, or subsidies	0.4
	Sea level rise	Proximity of coastal farmlands to sea		Number of agriculture dependent families affected		Planting of saline tolerant crops	
	Pest occurrence	Percentage of low resistant crop variety	0.4	Percentage of yield losses due to pests	0.6	Presence of integrated pest management program	0.6
Coastal and marine habitat	Sea level rise	Percentage of coastal wetlands inundated		assets and infrastructure affected		Presence of wetland protection programs	
	Tropical cyclone	Percentage of beaches and coastal shores with settlements		Percentage of beaches and coastal shores frequently affected by typhoones		Presence of early warning system and disaster preparedness prorgame	
	Flooding	settlements not protected by mangroves or natural barriers		Percentage of coastal settlements and families affected		Relocation of coastal settelements at high risk areas	
Forestry and biodiversity	Erosion	Percent of forest cover	1	Percentage of cultivated areas of the forest area	0.4	Presence of reforestation efforts	0.6
	Landslides	Average daily rainfall volume	0.6	Settlements within and below landslide prone areas	0.6	Relocation efforts by local government units	0.2
	Flooding	Proximity to river and other water bodies	0.4	Percentage of riverine communities at risk	0.6	system and evacuation routes	0.8
	Drought	Upland areas used for agriculture	0.2	Percentage of upland areas with settlements	0.2	Presence of water conservation practices	0.4
	Pest occurrence	Percentage of wildlife species and human population residing inside	1	Percentage of wildlife species susceptible to or affected by pests and	0.2	Monitoring and protection of critically endangered species	0.2
Housing and Basic Infrastructure	Disease occurrence	History of disease outbreak in the last five years	0.4	without access to sanitary toilets and clean water	0.6	access to health service and facilities	0.8
	Drought	surface water during summer months	0.6	without access to alternative water sources	0.6	government units with water conservation programs	0.2
	Typhoons / Storms	infrastructure e.g. schools, hospitals	0.6	infrastructure in need of repair / rehabilitation	0.4	government units with repair / rehabilitation	0.4
	Sea level rise	basic infrastructure to sea level rise or flood impacts areas	0.6	Percentage of housng and basic infrastructure inundated by sea level rise	0.6	government units with early warning system and evacuation routes	0.4

Step 4: Calculating (automatically) the weights for each sensitivity, exposure, and adaptive capacity indicator and for the vulnerability index for each impact.								
Check the results of the (automatic) calculation. Note: the rating of 1 (or red color) means high level of vulnerability. The lower the rating the better!								
Sector	Climate Change Impacts or disaster risks	Sensitivity Rating	Weight	Exposure Rating	Weight	Adaptive Capacity Rating	Weight	Vulnerability Index for each impact per sector
			35%		35%		30%	
Agriculture	Drought	0.4	0.14	0.8	0.28	0.4	0.12	0.5
	Flooding	1	0.35	1	0.35	0.2	0.06	0.8
	Typhoons	1	0.35	1	0.35	0.4	0.12	0.8
	Sea level rise	0	0	0	0	0	0	0.0
	Pest occurrence	0.4	0.14	0.6	0.21	0.6	0.18	0.5
Coastal and marine habitat	Sea level rise	0	0	0	0	0	0	0.0
	Tropical cyclone	0	0	0	0	0	0	0.0
	Flooding	0	0	0	0	0	0	0.0
Forestry and biodiversity	Erosion	1	0.35	0.4	0.14	0.6	0.18	0.7
	Landslides	0.6	0.21	0.6	0.21	0.2	0.06	0.5
	Flooding	0.4	0.14	0.6	0.21	0.8	0.24	0.6
	Drought	0.2	0.07	0.2	0.07	0.4	0.12	0.3
	Pest occurrence	1	0.35	0.2	0.07	0.2	0.06	0.5
Housing and Basic Infrastructure	Disease occurrence	0.4	0.14	0.6	0.21	0.8	0.24	0.6
	Drought	0.6	0.21	0.6	0.21	0.2	0.06	0.5
	Typhoons / Storms	0.6	0.21	0.4	0.14	0.4	0.12	0.5
	Sea level rise	0.6	0.21	0.6	0.21	0.4	0.12	0.5

VULNERABILITY ASSESSMENT (HAZARDS MAP)

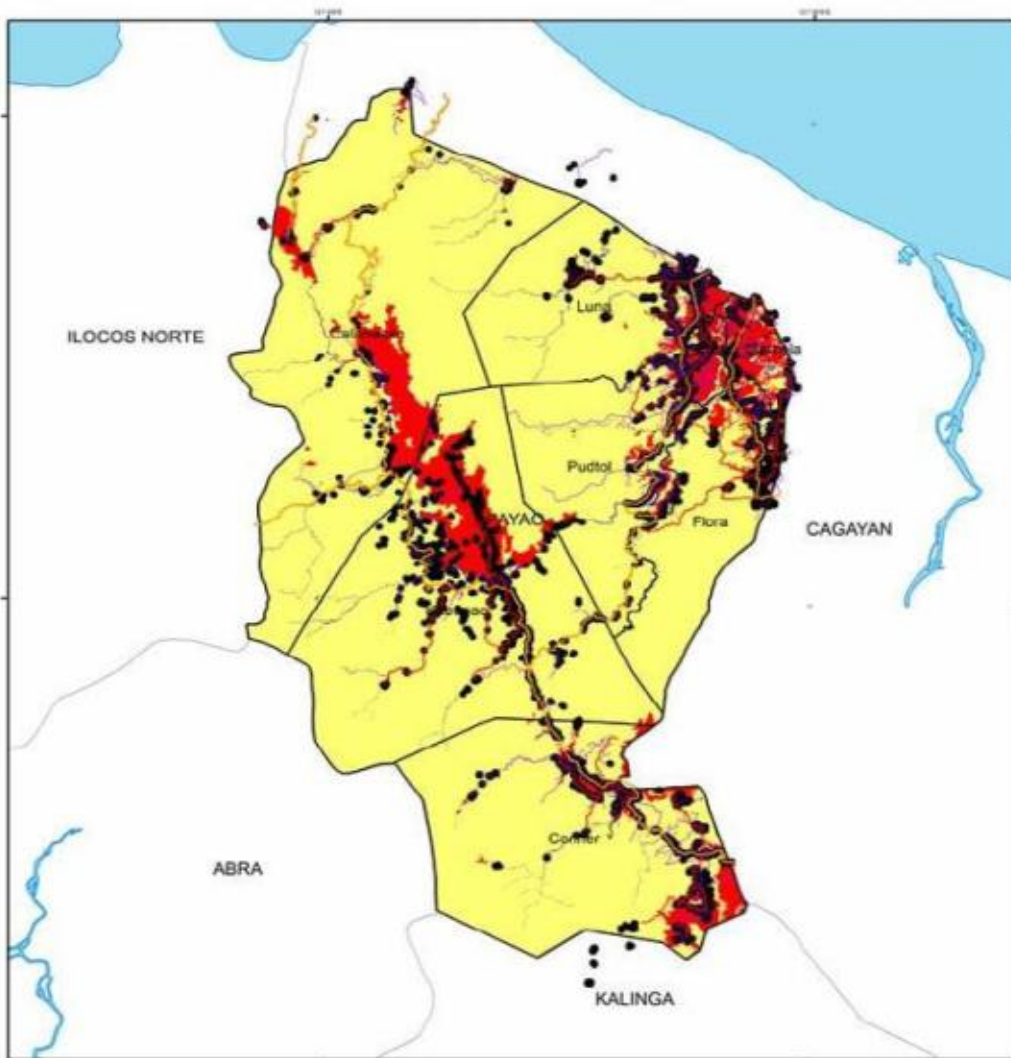
Step 5: Mapping the level of vulnerability for each sector.

Refer to the following color codes denoting level of vulnerability in the final mapping process:

Red	Very high level of vulnerability
Orange	High vulnerability
Yellow	Moderate vulnerability
Light green	Low vulnerability
Dark green	Very low vulnerability

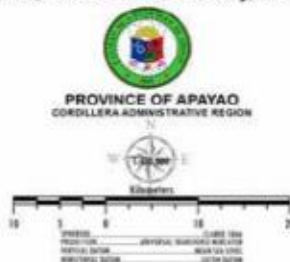
Here is the final index based on the average vulnerability indices for each sector.

Sector	Final Index
Agriculture	0.53
Coastal and Marine Habitat	0.00
Forestry & Biodiversity	0.50
Housing and Infrastructure	0.52



LEGEND: (Agriculture and Fisheries, Forest and Biodiversity, Housing and Settlement)

- Agriculture and Fisheries Areas
- Forest and Biodiversity Areas
- Housing and Settlements Areas
- Inland Water
- National Road
- Provincial Road
- Municipal Road
- Barangay Road



Map Sources:

Department of Environment and Natural Resources (DENR)
National Economic and Development Authority (NEDA)

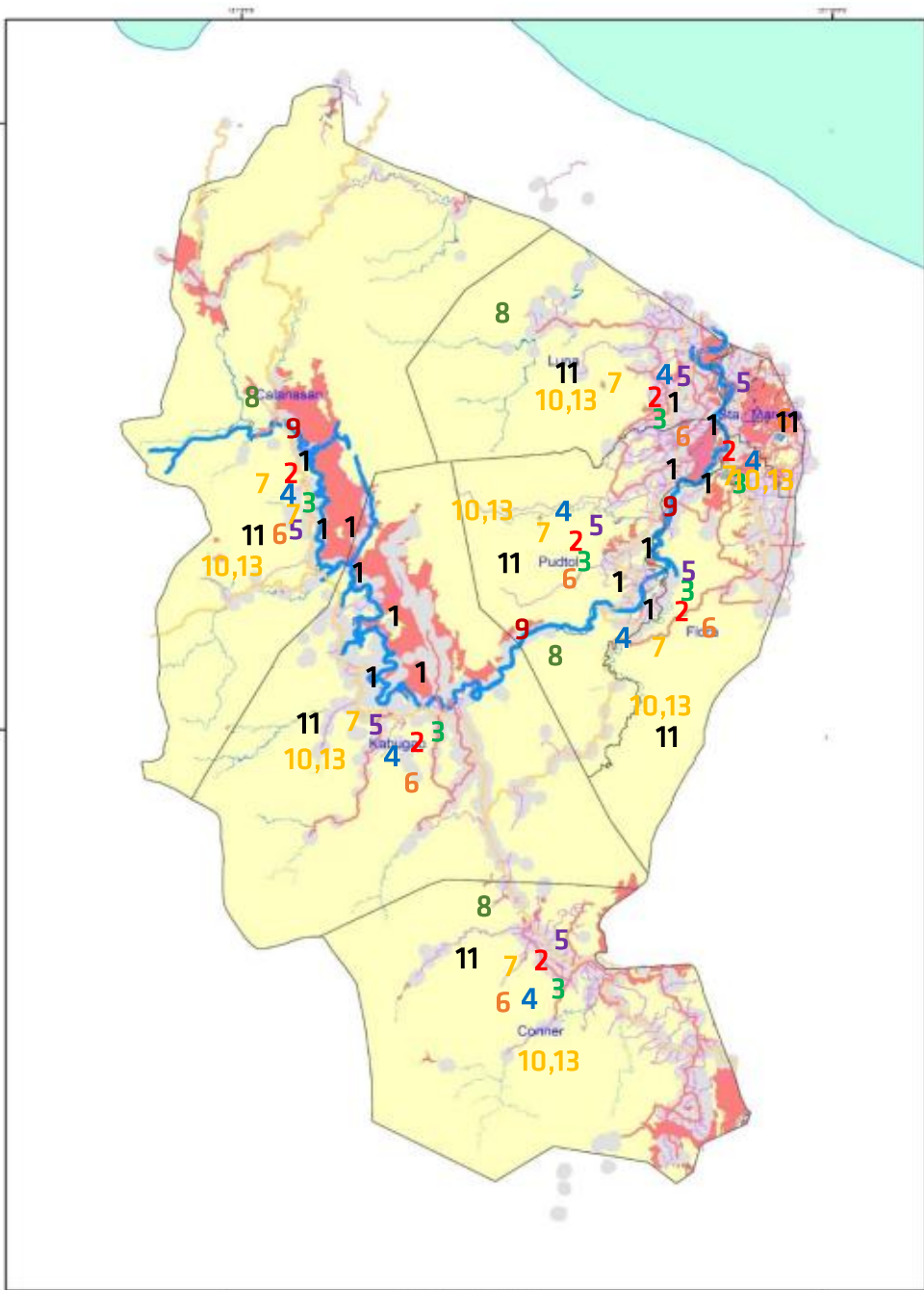
Administrative Boundaries, National Roads, Rivers and Spot Elevation, APAYAO Inventory Map 1:750,000 scale

HAZARDS

1. TYPHOON
2. FLOODING
3. LANDSLIDES/EROSION

VULNERABLE SECTORS

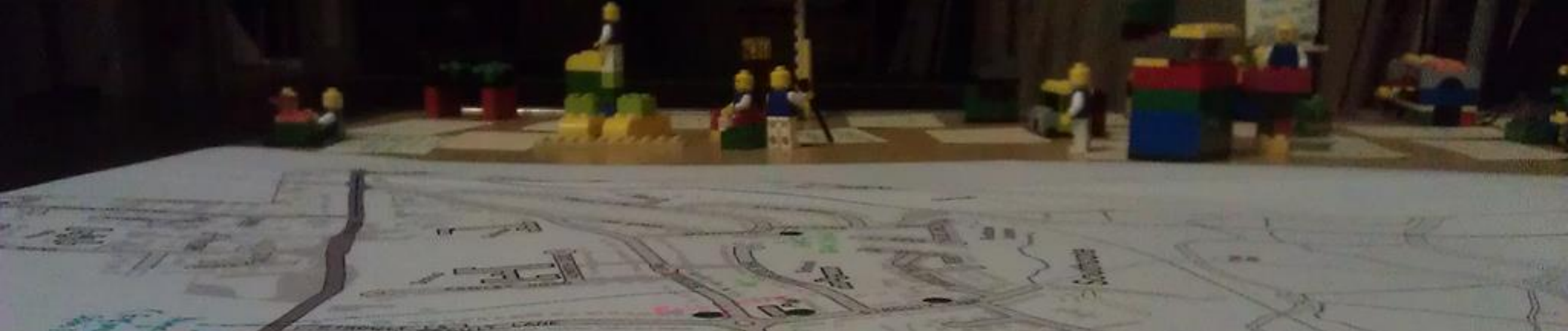
HIGH LEVEL OF VULNERABILITY - AGRICULTURE
MODERATELY VULNERABLE. - HOUSING/SETTLEMENTS/BUILT-UP AREAS
LOW LEVEL OF VULNERABILITY - FORESTRY & BIODIVERSITY



SECTORAL MAP
(Agriculture and Fisheries, Forest and Biodiversity, Housing and Settlements)

SPATIAL LOCATION OF ACTIONS

No	Adaptation actions	Sector	Groups of People
1	Construction of Flood Control	Infrastructure	
2	Relocation of Vulnerable Households	Social	FARMERS
3	Const'n./Improvement of Resilient Evacuation Centers	Infrastructure	INDIGENOUS PEOPLE
4	Provision of Alternative Livelihood Opportunities	Agriculture	VULNERABLE SECTORS
5	Installation of early warning systems	Disaster management	- Women
6	Provision Emergency Social Services	Social	- Children
7	Construction of Food Storage Facility	Infrastructure	- PWD
8	Agro-Forestry Program	Ecological	- Senior Citizens
9	River Dredging	Flood management	- Fisherfolks
10	Establishment of Data-Based Information System	Disaster management	
11	Construction of Access Road (Social Services Fac)	Infrastructure	
12	Information Campaign	Disaster management	



Sectoral Vulnerability Assessment Tool



Image Source: Laura Billings

Key Questions:

- Which sectors and physical planning areas are most at risk in your provinces?
- Which people, housing and infrastructure would be most at risk?

Step 1: Mapping the Spatial Context

- Individually, trace the outlines or the boundaries of your city using the printed Google maps (e.g. map and satellite views) and other materials provided.

- Using standard colour codes (*or any colour as long as you provide a legend!*), map the coverage of the sectors or the physical planning areas and impact domains for analysis in our sectoral vulnerability assessment.

No.	Name of Sector and Standard Color	Description
1	Agriculture and Fisheries	Agricultural production areas including fish production as well as settlement areas
2	Coastal and marine habitat	Bay or coastal areas including freshwater habitats e.g. lakes or rivers
3	Forestry & Biodiversity	Production and protection of forests; Declared protected areas (strict protection and multiple use zones) and key biodiversity areas
7	Housing and Infrastructure	Residential, commercial, and industrial areas, and locations of basic services and infrastructure e.g. hospitals, schools

- Specify where the housing (settlements) and basic infrastructure are located in the map.
- You can also map settlement areas on top of other sectors, such as agriculture and fisheries, coastal and marine habitat, forestry and biodiversity!
- Feel free to use texts, signs, or other forms of visual communication in mapping the spatial context of your province.

Step 2: Identify Climate Change Impacts or Disaster Risks (5 minutes)

- Once the map is produced, identify which climate change impacts or disaster risks are presently being experienced or would likely be experienced in the future by each sector.
- Refer to the most common impacts or risks, namely, drought / heat stress; erosion, flooding, land slide, sea level rise (or fall), tropical cyclones/typhoon, and pests or disease occurrence.
- **Note:** There are other impacts or risks, such as watershed run off, ocean acidification, nutrient and sediment loading, and sea surface temperature change. Due to time constraints, we will focus on the pre-selected impacts and risks.

- Using the sectoral vulnerability assessment matrix (**Tab: Climate Change Impacts**), write down either 'yes', 'no', or 'maybe' for each cell.

No.	List of climate change impacts or disaster risks	Agriculture and Fisheries	Coastal and marine habitat	Forestry and Biodiversity	Housing and Infrastructure
1	Drought / heat stress	Yes	No	Maybe	Maybe
2	Erosion	Yes	No	Maybe	Maybe
3	Flooding	Yes	No	Maybe	Maybe
4	Land slide	Yes	No	Maybe	Maybe
5	Sea level rise or fall	Yes	No	Maybe	Maybe
6	Tropical cyclones / typhoon	Yes	No	Maybe	Maybe
7	Pest/ disease occurrence	Yes	No	Maybe	Maybe

- Considering the geographical location of your province and the climate change impacts or disaster risks that are being experienced or will likely be experienced in the future, **which sector(s) will be likely to be significantly affected?**
- Select the most affected sectors, including housing and infrastructure, for assessing vulnerability in the next step.

Step 3: Assessing Sensitivity, Exposure, and Adaptive Capacity Indicators

- In the vulnerability assessment matrix (Tab-Assessing Indicators), you will find pre-selected climate change impacts or disaster risks for each sector and their corresponding indicators for sensitivity, exposure, and adaptive capacity.
- Think of climate change impacts or disaster risks that affect housing and settlements. Add specific indicators for sensitivity, exposure, and adaptive capacity, if necessary.
- For each sector (e.g. agriculture, coastal marine habitat) you have selected from the previous step, assess the vulnerability against each climate change impact or disaster risk (e.g. drought, flooding).

- You can do so by scoring each sensitivity, exposure, and adaptive capacity indicator (for each climate change impact or disaster risk) according to the following numerical rating:

Numerical Rating	Explanation
1	Very High
0,8	High
0,6	Moderate
0,4	Low
0,2	Very Low

- Click the drop-down menu list to select your rating.

- To give an example, under agriculture sector for City X, drought is a major climate change impact or disaster risk. It scored very high in terms of sensitivity (duration of drought), exposure (number of agriculture dependent families affected), and adaptive capacity (use of drought resistant crop varieties) indicators.

Climate Change Impacts or disaster risks	Exposure Indicators	Sensitivity Rating	Sensitivity Indicators	Exposure Rating	Adaptive Capacity Indicators	Adaptive Capacity Rating
Drought	Duration of drought ($\geq H$)	1	Number of agriculture dependent families affected ($\geq H$)	1	Use of drought resistant crop varieties ($\leq H$)	1

- Try to finish rating the indicators for the sectors that are most affected by climate change impacts or disaster risks!
- **Note:** If the impacts do not apply, remove the pre-provided answers.

Step 4: Calculating the Weights and the Vulnerability Index (5 minutes)

- In the vulnerability assessment matrix (Tab – Calculating Vulnerability), you will find the assessment results from Step 3: Assessing sensitivity, exposure, and adaptive capacity indicators.
- In addition, you will see the pre-determined corresponding weights (35% for sensitivity, 35% for exposure, and 30% for adaptive capacity) which are calculated automatically. You can adjust the weights (or the degree importance for sensitivity, exposure, and adaptive capacity) if necessary. Usually, exposure is provided with a higher weight. Remember: The total weight should not exceed 100%.

Sensitivity Rating	Weight	Exposure Rating	Weight	Adaptive Capacity Rating	Weight
	35%		35%		30%

- To give an example, drought has a sensitivity rating of 1 (very high), an exposure rating of 1 (very high), and an adaptive capacity of 1 (very high). Each rating (for sensitivity, exposure, and adaptive capacity) is multiplied by the corresponding weight (35% for sensitivity, 35% for exposure, and 30% for adaptive capacity). As such the weighted results are as follows: 0.35 for sensitivity, 0.35 for exposure, and 0.30 for adaptive capacity.

Climate Change Impacts or disaster risks	Exposure Rating	Weight	Sensitivity Rating	Weight	Adaptive Capacity Rating	Weight	Vulnerability Index for each impact per sector
		35%		35%		30%	
Drought	1	0,35	1	0,35	1	0,3	1,0

- Lastly, vulnerability index is the sum of the calculated weights for sensitivity, exposure, and adaptive capacity. Drought has a vulnerability index of 1.0 from the combined weighting results of 0.35 (for sensitivity), 0.35 (for exposure), and 0.30 (for adaptive capacity). The vulnerability index for drought shows a very high level of vulnerability.

Notes:

- The calculations are done automatically!
- Check the weights and adjust, if necessary.
- Examine the vulnerability index for each impact per sector.
- Do you agree with the results?

Step 5: Mapping the Level of Vulnerability (10 minutes)

- For the last step of the exercise, using the map prepared in Step 1: Mapping the Spatial Context, the participants can use the following color codes in showing the level of vulnerability for each sector.

Red	Very high level of vulnerability
Orange	High vulnerability
Yellow	Moderate vulnerability
Light green	Low vulnerability
Dark green	Very low vulnerability

- Here's an example of the final index results with the agriculture sector having a high level of vulnerability. The final index is the average vulnerability index for each sector.

Sector	Final Index
Agriculture	1,00
Coastal and Marine Habitat	0,80
Forestry & Biodiversity	0,60
Housing and Infrastructure	0,30

- In the map, the participants can shade the areas allotted for agriculture in red (high level of vulnerability), while coastal and marine habitat in orange (high vulnerability), and so on.
- For housing and infrastructure, which settlements are more vulnerable based on their physical and socio-economic conditions? You can use different color gradient to show differences in level of vulnerability.

Individual Assignment

- Your class will be divided into four sub-groups
- Each sub-group will be assigned with a case study
- Individual members should read the assigned case study
- On June 19, 2018 (Tuesday), 15:30 – 17:00, there will be a group discussion

Key Questions:

- Which are the most vulnerable sectors/assets in the city assigned to you?
- Which people, housing and infrastructure would be most at risk?

**Note: The sub-groups will be the same for the next workshop:
Prioritization of climate change actions on Week 3.**

Assignment

Kampala	Da Nang	Negombo	Copenhagen
Ronard Mukuye (Uganda)	Piyapong Janmaimool (Thailand)	Larytha Kayrona, Fletcher (Jamaica)	Osama Mohamed Elsaid Omar (Egypt)
Roland Nassour (Lebanon)	Illuminado Quinto Jr. (Philippines)	Alvin Penaranda Principe (Philippines)	Armand Nicod-am Camhol (Philippines)
Janet Lumayag (Philippines)	Frances Ifeoma Ukonze (Nigeria)	Bashir Olufemi Odufuwa (Nigeria)	Hadiza Kabiru (Nigeria)
Yukubu Bununu (Nigeria)		Chikaodili Arinze Orakwue (Nigeria)	