Urban Climate Resilience Master Class

Module 2

Understanding Climate Risks in Your City

GLOBAL CENTER ON ADAPTATION

Dhaka; Photo by Piyaset, Getty Images (licensed via Canva)

UCRMC Course Overview

Welcome to the Urban Climate Resilient Master Class! You are about to start **Module 2**.

Module 1

Introduction to Climate Change and Urban Resilience

Module 2

Understanding Climate Risks in Your City

Module 3

Locally Led Adaptation for Urban Resilience

Module 4

Ensuring Climate Resilience of Urban Infrastructure

Module 5

Step-by-Step Guidelines for Delivering Climate Resilient Infrastructure

Module 6

Financing Climate Resilient Urban Infrastructure

Acknowledgements

Welcome to the Urban Climate Resilience Masterclass!

This training has been developed by the Global Center on Adaptation (GCA) as a learning resource under Improving Urban Governance and Infrastructure Program (IUGIP) to strengthen the capacity of municipal officials to integrate climate adaptation and resilience into urban infrastructure and planning.

Thank You!

We would like to acknowledge the following partners and funders involved in designing and delivering this training:

Improving Urban Governance and Infrastructure Program (IUGIP)

ADB's Improving Urban Governance and Infrastructure Program (IUGIP) supports improving urban governance and services in 88 pourashavas (municipalities) of Bangladesh from 2024 to 2028, benefiting 7.6 million people.

The program aims to (1) strengthen institutional capacity for inclusive municipal governance and (2) improve municipal infrastructure regarding quality, access, resilience, and gender responsiveness.

Eligible infrastructure categories under IUGIP include:

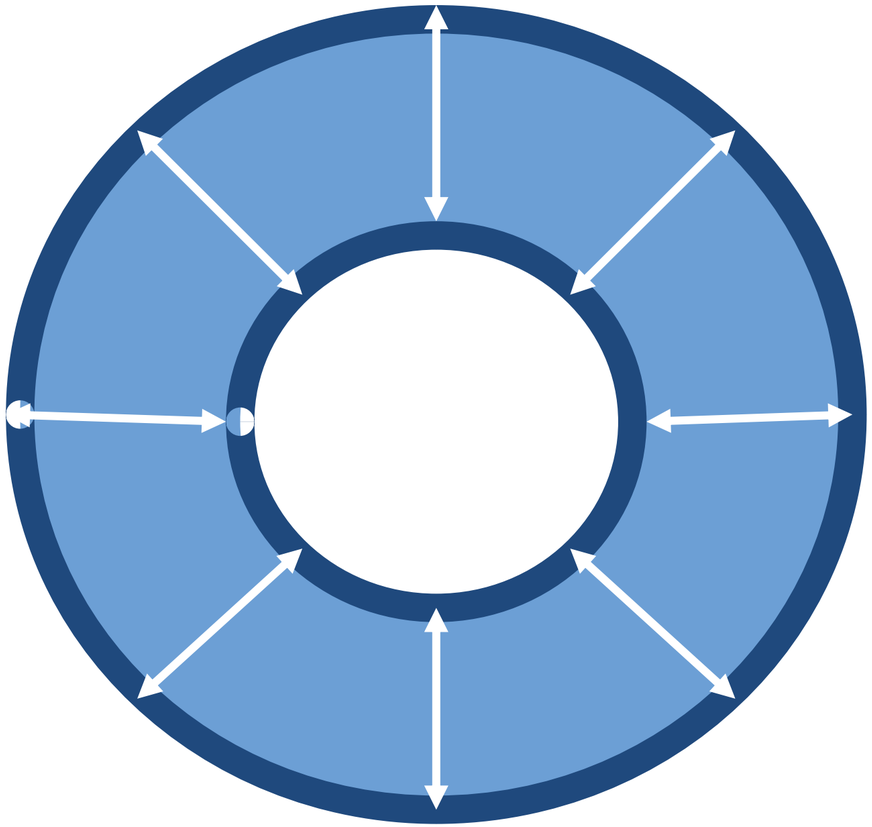
1. Drainage rehabilitation and construction .
2. Road rehabilitation and construction.
3. Climate resilient and socially inclusive public facility development and re-modelling.

Photo by ADB

Participant Introductions

Icebreaker Exercise:

1. Split the group in half.
2. Form two circles, one inside the other (Everybody in the outer circle should be facing a person in the inner circle).
3. Introduce yourselves.
4. Every minute the outer circle moves clockwise.
5. Keep moving round every minute.



Agenda

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02 Learning Objectives

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04 Understanding Climate Risks in Your City

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06 Climate Risk Assessments

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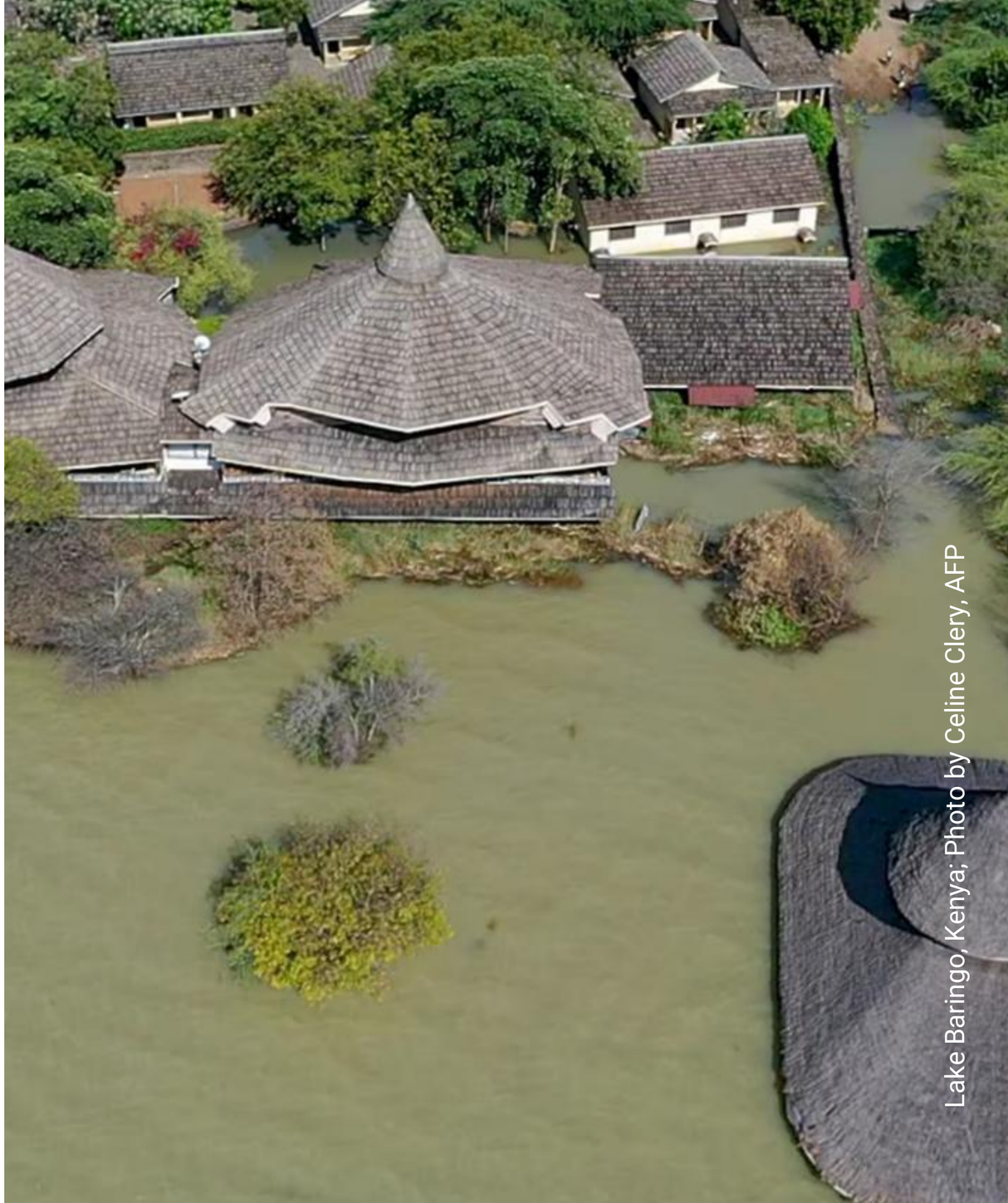


Lake Baringo, Kenya; Photo by Celine Clery, AFP

Housekeeping

Listen

Listen carefully, follow along and make your own notes.

Ask

Ask the trainers questions or clarifications at any time.

Share

Your own experience is valuable and we encourage you to share it.

Discuss

Share and discuss with others during exercises, breaks and reflections.

01 | Why This Topic Matters

Dhaka; Photo by Akhlas Rahman, Unsplash

Why This Module Topic Matters

Climate risk assessments (CRA) are the foundation of climate-informed planning and decision-making, enabling actors to identify and prioritise climate risks and opportunities, and implement corresponding resilience-building actions.

Understanding the process and components of a CRA enables city officials to effectively commission and supervise CRAs in their cities, and meaningfully engage with the results.

Understanding the climate risks in your city is an important first step in identifying the types of investments in infrastructure and services you can make to build resilience in your city.

This module also introduces the concept of climate resilient master planning – outlining ways in which cities can systematically integrate urban resilience into medium and long-term development planning.

It will also outline ways in which urban resilience initiatives and investments can support national and sub-national climate objectives in Bangladesh and Kenya.

02 | Learning Objectives

Dhaka; Photo by Ferdous Hasan, Pexels

Learning Objectives

By the end of Module 2 participants will be able to:

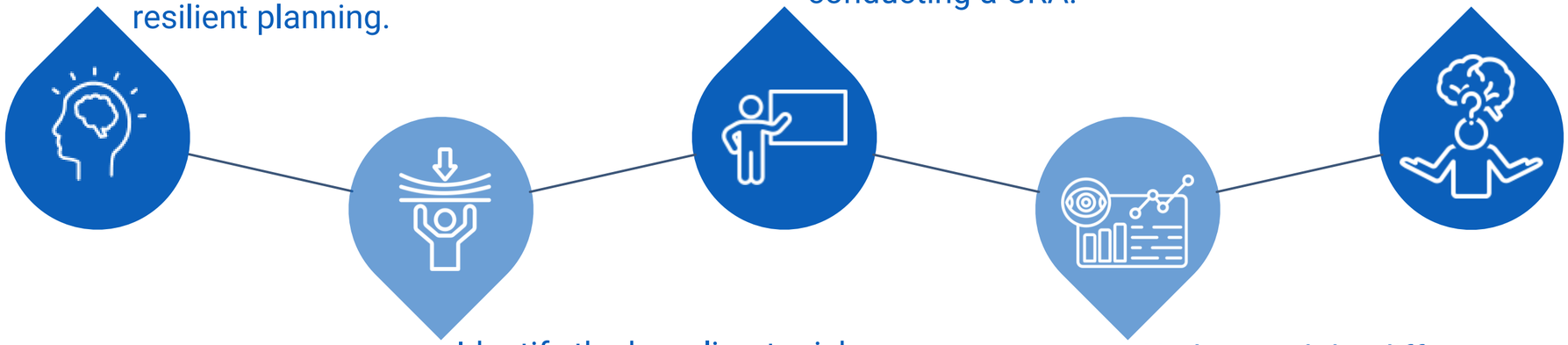
Understand the importance of climate risk assessments (CRA) as the foundation of climate-resilient planning.

Identify the key climate risks facing their cities and explain how these risks affect vulnerable and marginalized groups.

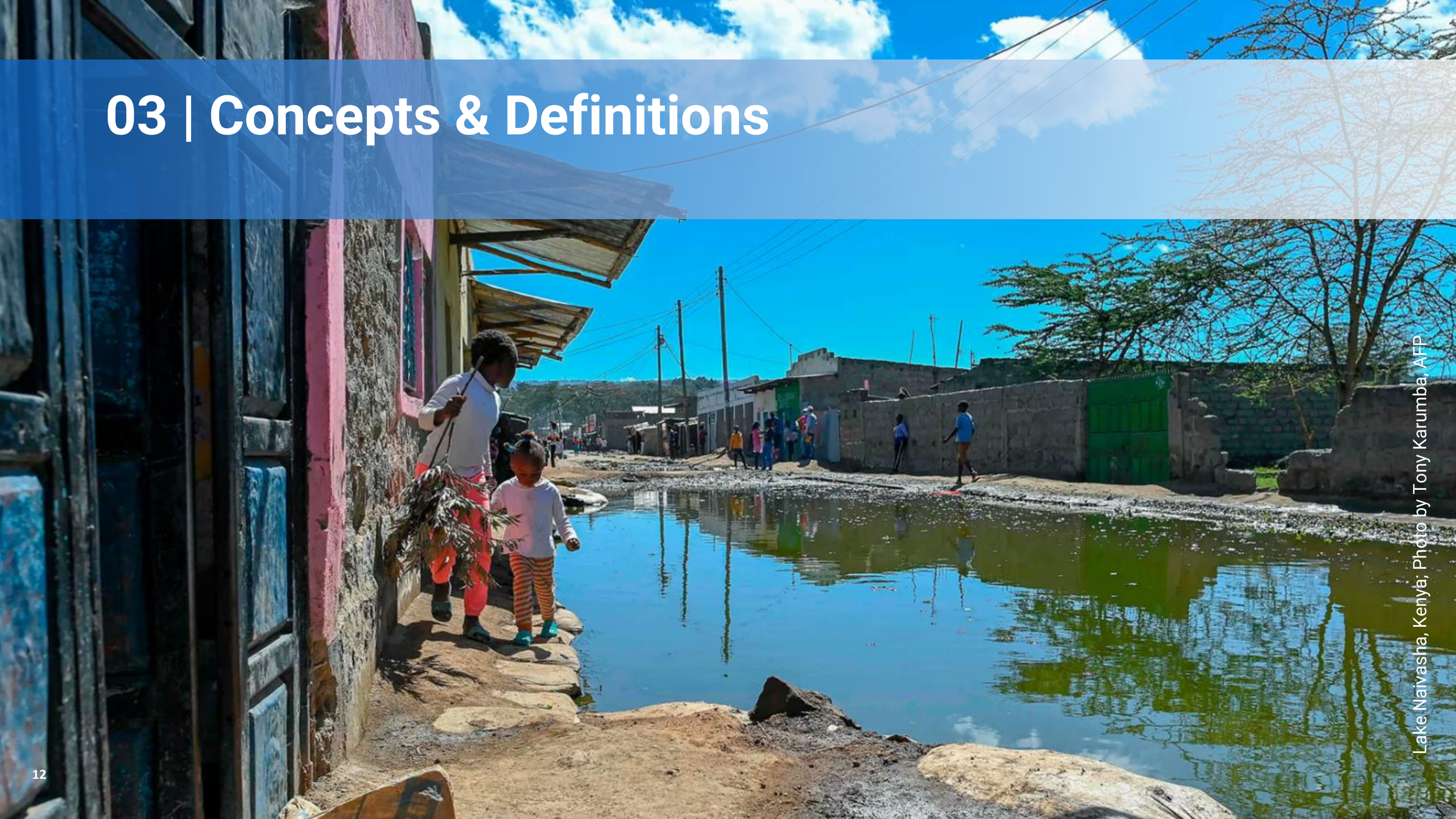
Outline the key steps involved in conducting a CRA.

Understand the different types and sources of data that can be used in a CRA (along with the limitations of the data).

Understand how to procure and supervise a CRA and interpret its results.



03 | Concepts & Definitions

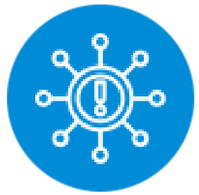


Lake Naivasha, Kenya; Photo by Tony Karumba, AFP

Concepts & Definitions

Climate Risk
The chance of negative consequences for people and nature because of climate change.

Hazard
A natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. Hazards include increased temperatures, flooding, and sea level rise.



Exposure
The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected – for example, on a flood plain, steep slope, or polluted land.

Vulnerability
The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Concepts & Definitions

Risk Assessment
The qualitative and/or quantitative scientific estimation of risks.

Master Plan
Planning instrument that provides a conceptual layout to guide future growth and development of a city.

Impacts
The consequences of realised risks (including extreme weather / climate events) on lives; livelihoods; health and wellbeing; ecosystems and species; economic, social and cultural assets; services and infrastructure. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial.

Climate Scenario
A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Scenarios are neither predictions nor forecasts but are used to provide a view of the implications of developments and actions.

Review Exercise

Definition Bingo

- Write down any three of the words on the screen.
- The definitions will be read out, if a definition matches your word then you can check it.
- The first person who has both of their words checked is the winner.

Climate Hazard

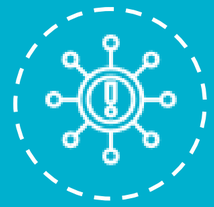
Risk Assessment

Climate Risk

Impacts

Vulnerability

Master Plan



Exposure

Climate Scenario

04 | Understanding Climate Risks in Your City

Dhaka; Photo by Simon Reza

Recap: What is Climate Risk?

Climate risk is the chance of negative consequences for people and nature because of climate change.

Risks happen when climate hazards affect exposed and vulnerable people, communities or systems.

Climate risk is therefore closely linked with issues of equity and inclusion – since risks are made worse by vulnerable and marginalized groups.

Climate risks occur as a results of three inter-linked elements:

- **Hazard:** climate event e.g., drought, flood, landslide
- **Exposure:** being in places that could be negatively affected
- **Vulnerability:** likelihood of being negatively affected. This is often made worse by inequality and social exclusion.

Risk = Hazard x Exposure x Vulnerability

Climate risks that might occur in your city

Disruptions to essential services
Increase in intensity of rainfall can cause surface flooding and waterlogging, obstructing transportation and economic activities.


Photo by Shantum Singh, Pexels

Physical damages to infrastructure
Frequent intense flooding and storms can inundate roads, vehicles, underground tunnels, cycle lanes, and pedestrian pathways.

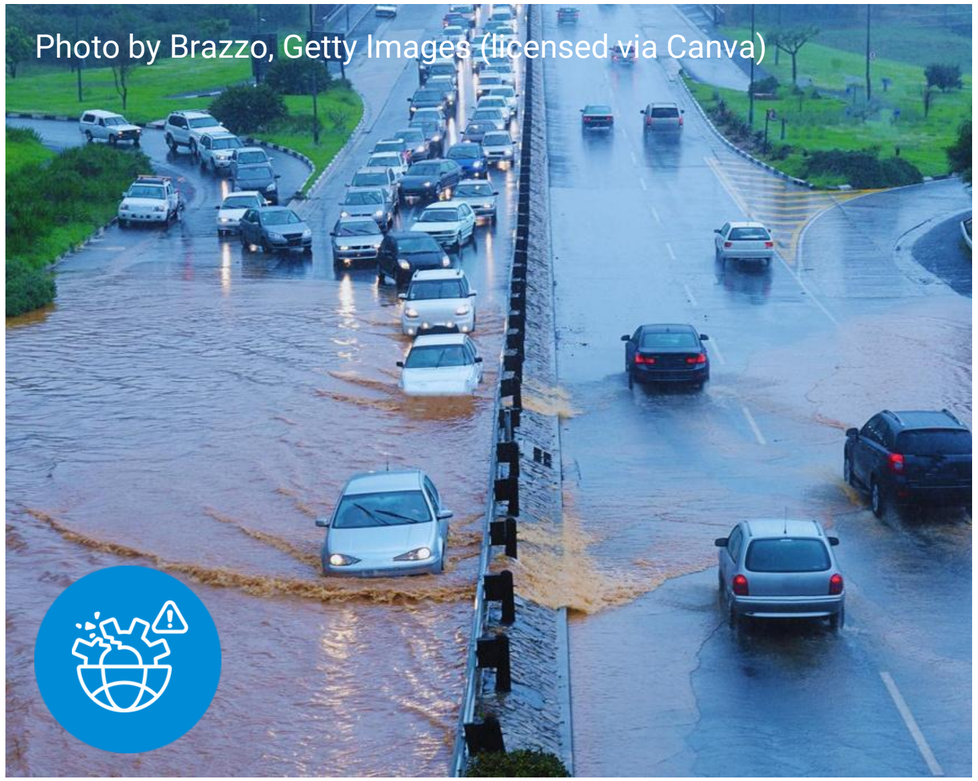


Photo by Brazzo, Getty Images (licensed via Canva)

Climate risks that might occur in your city

Food insecurity
Drought-related impacts on agriculture can lead to food shortages and increased prices, affecting urban food security.

Social and community stress
Climate-related disruptions to essential services contribute to social stress, impacting community well-being, mental health, and the social fabric of urban neighbourhoods.

Climate risks that might occur in your city

Degraded water & sanitation, water-borne diseases
Higher temperatures and increased rainfall, combined with a lack of adequate sanitation infrastructure can lead to higher incidence of water and vector borne diseases.


Bangladesh; Photo by Mushfiqul Alam, NurPhoto

Displacement and shelter needs
Storms, cyclones and typhoons can cause destruction of housing and public infrastructure, and loss of lives.


Photo by PTI

Climate risks that might occur in your city

Increased water stress & water scarcity
Increase in frequency of droughts can lead to acute shortage of safe and reliable water supply for drinking and industrial purposes.


Photo by Piyaset, Getty Images (licensed via Canva)


Photo by Alain Nkingi, Pexels

Discuss

What are the climate risks in your city?

- What risks does your city face?
- Who will they affect? Can you link any particular risks to particular groups?

Any questions or sharing to the room is welcome, please raise your hand.

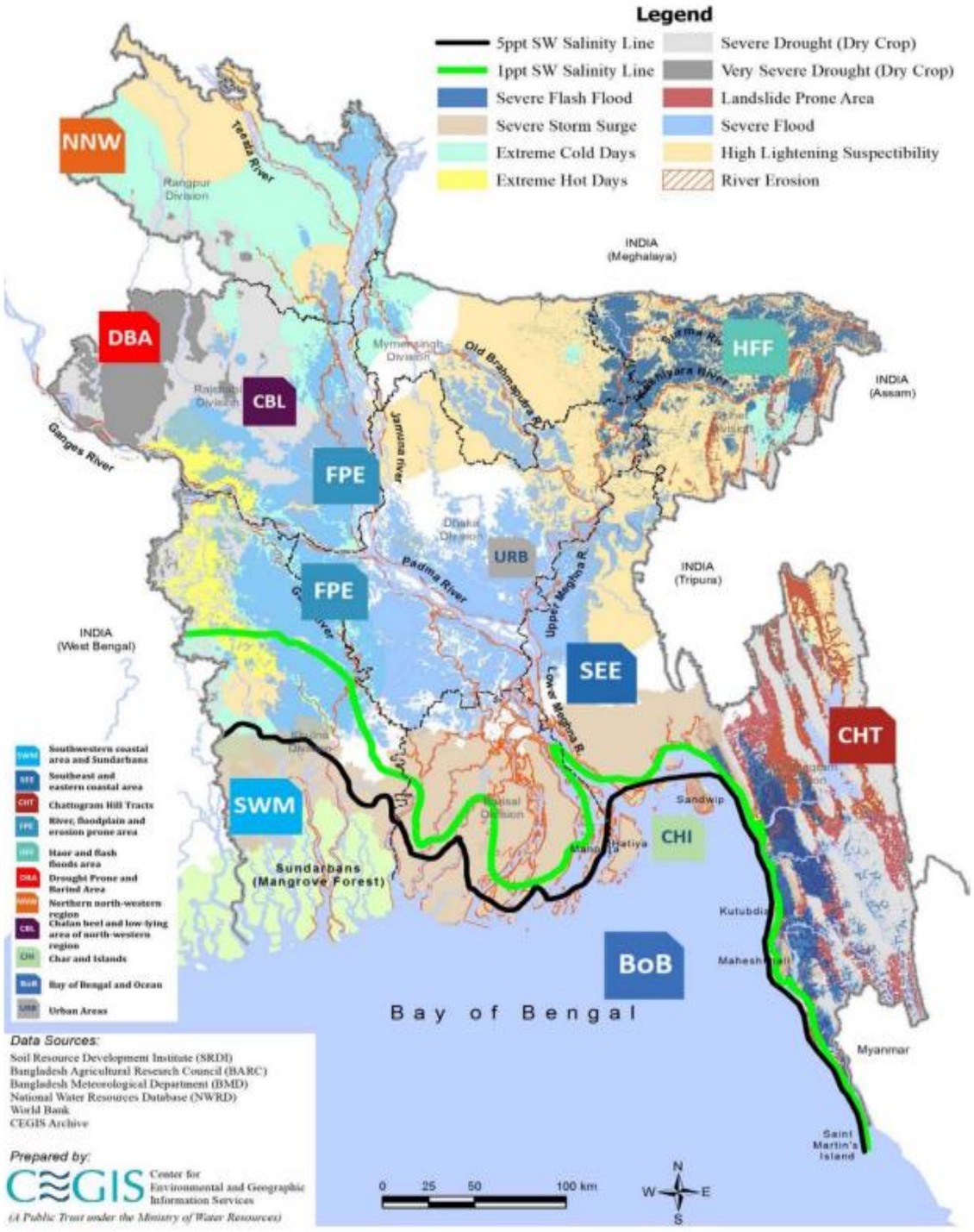
Multi-Sectoral Team Conducts Feasibility Study and Community Engagement; Photo by Mandera County Government

05 | Urban climate risks in Bangladesh

Photo by Joel Carillet, Canva

Urban climate risks in Bangladesh

- Bangladesh experiences a range of climate risks related to temperature increase, rainfall variability, tropical storms & cyclones, and sea level rise.
- When hazards create impacts on people who are exposed and vulnerable, this lead to climate risks.
- Climate hazards and risks in urban areas of Bangladesh vary between different regions, such as coastal and Barind regions.
- Bangladesh experiences both variability in temperature and rainfall that results in different types of climate hazards.



Urban climate hazards related to changes in rainfall

Hazards	Impacts
Increased (annual) rainfall **Extreme precipitation events** **Flood** **Drought**	• Failure of drainage systems causing waterlogging • Decreased water supply • Poor quality of supplied water • Disruption of sanitation system • Disruption of mobility • Loss of working hours and income • Disruption of waste management systems • Increased water-borne diseases • Landslide • Damage to buildings and infrastructure • Displacement of communities • Loss of life

Urban climate hazards related to temperature change

Hazards	Impacts
Increased (annual) temperature **Heat waves** **Cold waves** **Cyclones and Northwesters**	• Heat island • Heat stroke and increased death • Loss of working hours and income • Crisis of safe drinking water • Outbreak of vector- and water-borne disease • Cracks in flexible pavement roads • Increased fire hazards • High energy demand • High wind • Storm surge • Loss of biodiversity

Urban climate hazards related to sea level rise

Hazards	Impacts
Salinity **Erosion**	• Scarcity of water • Loss of livelihood • Loss of land • Loss of biodiversity • Damage of infrastructure • Damage to crops • Food insecurity • Displacement and increased migration

Climate impacts on marginalized groups

Residents of informal settlements have higher risks from excessive rainfall, extreme heat, severe water scarcity, and landslides.

3% of the total 31.66% urban population in Bangladesh lives in informal settlements with poor living conditions.

Many of these people use corrugated iron sheets for construction, which creates heat stress resulting in indoor temperatures being higher than outside.

Residents of informal settlements often lack access or have poor access to drainage systems, water & sanitation, safe and secure housing, and many other critical urban infrastructure and services.

Dhaka, Photo by Masud Ananda, Flickr

Climate impacts on marginalized groups

Women and girls are disproportionately impacted by climate change.

Societal norms, systemic gender inequalities and reproductive obligations increase their risk.

For example, water scarcity during heat waves increase their workload to collect and manage water, expose them to gender-based violence during collecting water from a distance, and reduce their time for studies and work to earn a living.

Coastal Bangladesh; Photo by Mohammad Jobayer Hossain, REACH

Climate impacts on marginalized groups

One in three and nearly 20 million **children** in Bangladesh are facing “extremely high” risk from climate change.

Children are particularly affected by climate-related water stress and water scarcity, as well as degraded water & sanitation conditions.

They are also highly vulnerable to climate-related food insecurity, leading to decreased nutritional intake which impacts their physical and cognitive development.

Children are also particularly vulnerable when climate hazards lead to displacement. This can impact their physical safety, create psychological damage, lead to increased school dropout or child labour, and potentially lead to premature death or injury. Girls who experience displacement are especially vulnerable, often being married off early, and experience higher risk of trafficking and sexual exploitation.

Photo by Stockbyte, Canva

Climate impacts on marginalized groups

More than 90% of employed women in cities work in the informal sector.

Informal workers, especially **female informal workers** are vulnerable in cities.

Their livelihoods remain at higher risks from uncertainty in cash-based, non-agricultural livelihoods.

Many also live as pavement dwellers, which intensifies their vulnerability and leaves them exposed to climate shocks.

Climate hazards such as heatwaves, waterlogging, flooding, excessive rainfall cause loss of working hours, income, and capital which disproportionately impact women.

Photo by Kuntal Biwas, Pexels

06 | Climate Risk Assessments

Photo by Aka_Sancho, Getty Images (licensed via Canva)

What is a Climate Risk Assessment?

A CRA identifies the likelihood of future climate hazards and their potential impacts for a city and its communities.

Outputs often include spatial patterns showing the impact of hazards on infrastructure, settlements and communities.

A CRA provides quantitative and qualitative estimates of climate risk.

Photo by Genevieve French, Greenpeace

Why do a Climate Risk Assessment?

A CRA is the foundation of a city's climate risk management/urban climate change resilience strategy and action planning.

Helps understand how specific climate hazards contribute to or exacerbate underlying vulnerability, inequality and exclusion in a city

Helps a city identify and measure its climate risks and evaluate response measures, creating an evidence base to engage in adaptation planning and mainstream climate action into policy and governance.

Helps understand the additional risk due to climate change, which provides a rationale for access to climate finance and further investment in development and/or infrastructure programmes.

Main Steps of a CRA

Step 01 | Establish the decision-making context. What are the objectives of the CRA? What decision is to be made? Set the scope.

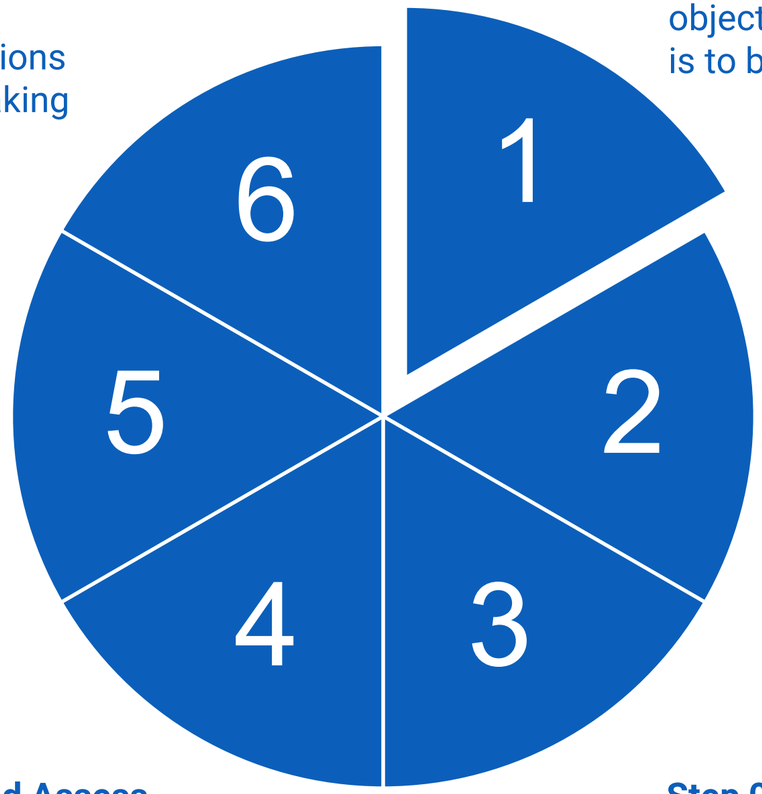
Step 02 | Assess hazards Identify the probability, intensity and timescale of current and future climate hazards.

Step 03 | Assess impact What are the potential impacts of those hazards on people, assets, services and the environment? Includes analysis of exposure, sensitivity and adaptive capacity.

Step 04 | Identify and Assess risks. Determine risks based on the likelihood of a hazard occurring and the consequence of the identified impacts.

Step 05 | Identify resilience building options Determine a long list of adaptation options.

Step 06 | Appraise resilience building options. Assess options against decision-making criteria; prioritize resilience options.



Dhaka; Photo by Michael Foley, Flickr

Step 01 | Establish the Decision-making Context

What decisions need to be made?

- Investing in a new infrastructure asset? Upgrading old infrastructure?
- Building resilience of a vulnerable sub-county or community?
- Developing a climate strategy? Integrating climate risk into existing policies or plans?

Questions to set the scope of the CRA:

- What is the system(s) of interest? (sector, assets, specific community)
- What resources are available?
- What are the geographic boundaries of the assessment?
- What are the relevant timescales for assessment?
- Which hazards are most relevant?


Photo by World Bank

Step 02 | Assess Hazards

2.1 | Determine relevant climate hazards

2.2 | Select relevant hazard indicators

2.3 | Analyze historical trends and events

2.4 | Analyze future projections across different scenarios

It can be helpful to categorize hazards by climate themes:

Drought:
Wildfires, Wind Erosion, Water Scarcity, Subsidence

Floods:
Flash Floods, River Flooding, Surface Flooding, Coastal Flooding, Erosion

Storms:
Tornados, Tropical Storms
Winter Storms, Thunderstorms, Coastal Flooding

Heat:
Ocean Acidification, Heat Waves, Urban Heat Islands

Khulna Dacope Koira, Bangladesh; Photo by Emdadul Islam Bitu, UNDP Bangladesh

Step 02 | Assess Hazards

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Examples of hazard indicators

Increasing temperatures:
- Annual seasonal monthly average (air) temperature

Heat waves:
- Heat wave frequency (avg. number of heat waves per year)
- Heat wave intensity (avg. temperature above local threshold during heat wave)
- Heat wave duration (avg. length of individual heat waves – no. days)

Sea level rise:
- Absolute sea level change (cm)
- Relative sea level change (incl. local land movement) (cm)

River floods:
- No. of days with precipitation > 100mm
- Flooding magnitude (peak discharge)
- Flooding frequency (avg. no. of flood days per year)

Wajir; Photo by Jarvis Sundays, Kenya Red Cross Society

Step 02 | Assess Hazards

2.1 | Determine relevant climate hazards

2.2 | Select relevant hazard indicators

2.3 | Analyze historical trends and events

2.4 | Analyze future projections across different scenarios

Key questions:

- What are key historical trends in the city? (looking back over 30 years is ideal)
- What major historical climate events have occurred for each relevant hazard?
- What were the impacts? (e.g. loss of lives and/or livelihoods, direct and indirect economic losses)
- What sectors and groups of people were most affected, including women, poor communities, children, the elderly, etc.?
- How have these hazards changed over time? (More/less frequent? More/less intense? Longer/shorter duration?)

Wajir; Photo by Riccardo Gangale, ILRI

Step 02 | Assess Hazards

2.1 | Determine relevant climate hazards

2.2 | Select relevant hazard indicators

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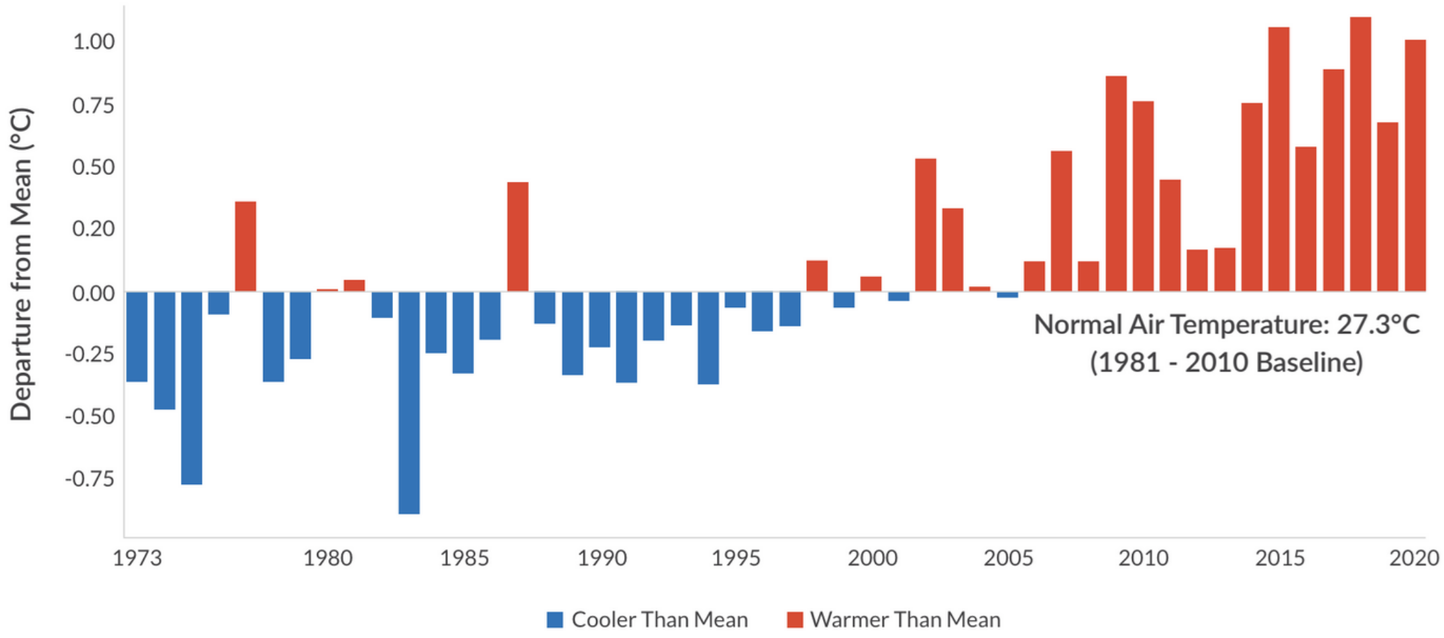
2.4 | Analyze future projections across different scenarios

Case Study | Air Temperature 1973-2020 | Mumbai, India



Annual air temperature anomalies between 1973 and 2020, from Mumbai's Climate and Air Pollution Risks and Vulnerability Assessment, 2022. Meteorological Data from Indian Meteorological Department (IMD) Santacruz station.

Step 02 | Assess Hazards

2.1 | Determine relevant climate hazards

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2.3 | Analyze historical trends and events

2.4 | Analyze future projections across different scenarios

Climate Models

- Tools that generate climate projections showing how the climate may change under various scenarios.
- Require technical expertise to access and interpret – this should be part of team conducting the CRA.

Scenarios

- A CRA should select multiple climate scenarios, usually a mid-range and a worst-case scenario.
- Projections of future climate change are usually presented as a range of values (e.g. sea level rise by 3-5 cm by 2050).

Time Horizons

- Typical time horizons include short-term (2030's), mid-term (2050's) and long-term (2100).
- A CRA should use time horizon(s) relevant to the life and planning timescale of the community / asset of interest.

Step 03 | Assess impacts

Assessing climate impacts:

Non-climatic variables contribute to the impact of climate hazards.

For example, a community with high levels of poverty living in informal settlements will be more vulnerable to flooding than a community with higher income levels living in solid, permanent housing.

CRAs need to understand the differentiated impact of climate hazards based on **exposure**, **sensitivity** and **adaptive capacity.**

CRAs should collect data on these metrics and ensure that data is disaggregated by gender and other vulnerable groups where possible.

Key questions for a CRA:

People

- What are the impacts of the climate hazard on people and their livelihoods?
- What are the impacts on particularly vulnerable groups most exposed to the hazard?

Environment

- What are the impacts of the hazard on the local environment e.g. biodiversity, air quality, water quality?

Economy

- What are the impacts of the hazard on the city's economy?
- Which sectors, industries and assets will be most impacted?

Homa Bay Town; Photo by Robert Omollo, The Star

Step 03 | Assess impacts

Exposure

Exposure = people, livelihoods or assets located in proximity to potential hazards.

Indicators may include:

- Population (including marginalized groups) exposed
- Value of economic services exposed
- Assets (e.g. housing) exposed
- % of livelihoods dependent on natural resources exposed

Sensitivity

Vulnerability is composed of **sensitivity** + adaptive capacity

Sensitivity = degree to which people and assets/systems are affected by their exposure to climate impacts

Indicators may include:

- Population of dependent demographic groups
- Livelihood dependence of affected sectors
- Condition of housing

Adaptive Capacity

Vulnerability is composed of sensitivity + **adaptive capacity**

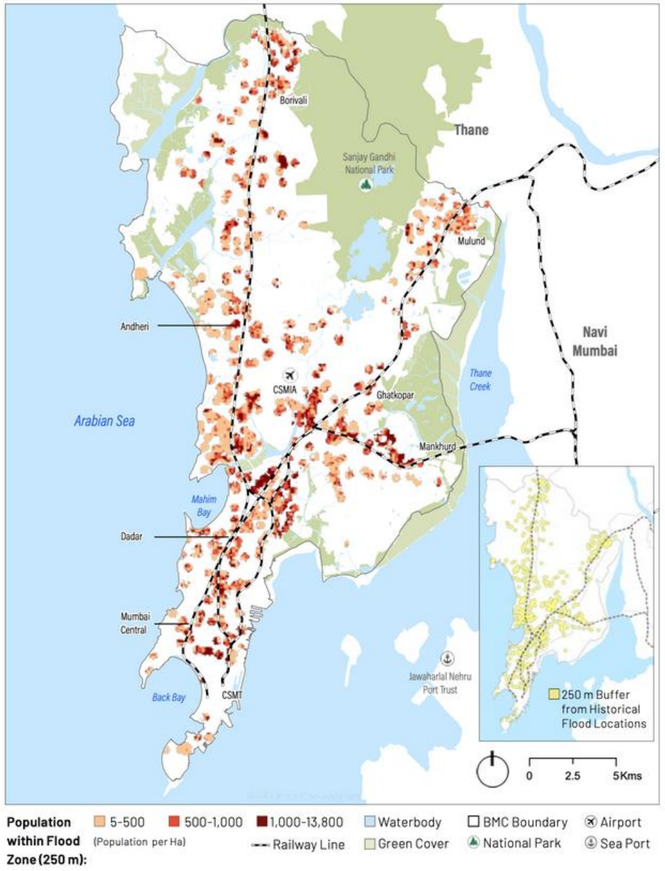
Adaptive capacity = potential of people and systems to adjust to the impacts of climate change or take advantage of opportunities that may arise from them.

Indicators may include:

- Access to basic services (water, sanitation)
- Access to healthcare
- Literacy
- Government capacity
- Unemployment
- Poverty

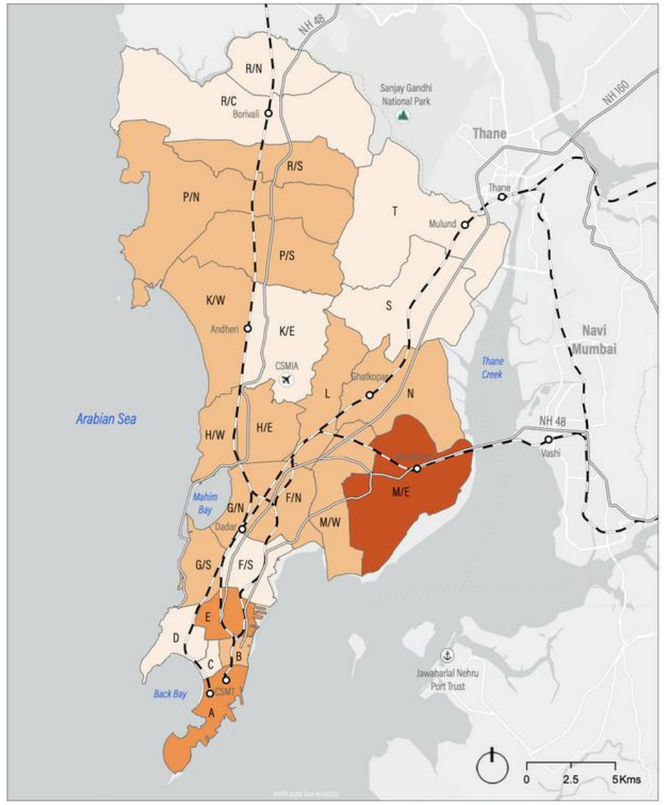
Step 03 | Assess impacts

Exposure



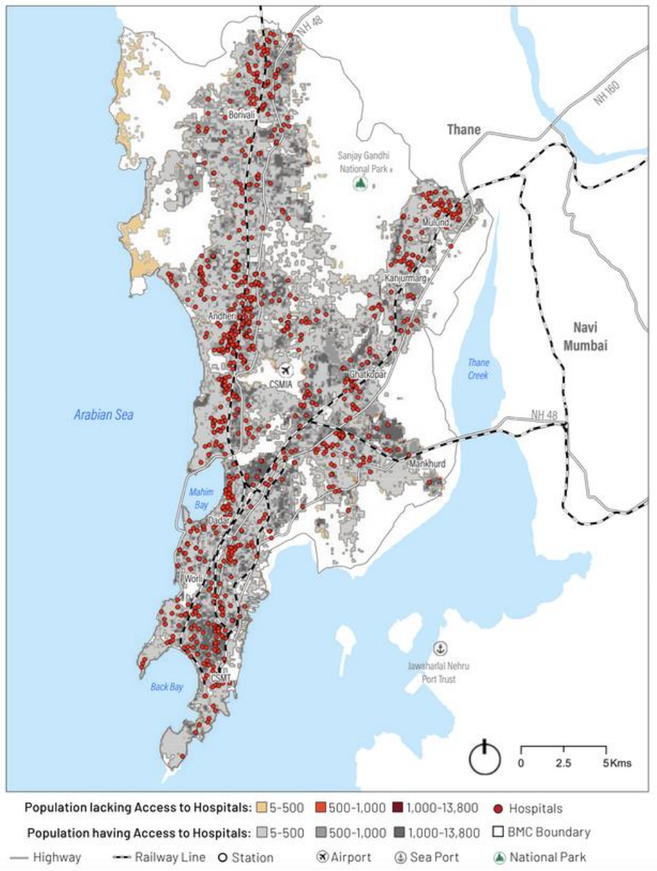
Population within flood zones (250m)
Mumbai's Climate and Air Pollution Risks and Vulnerability Assessment, 2022

Sensitivity



% households with temporary roofing material
Mumbai's Climate and Air Pollution Risks and Vulnerability Assessment, 2022

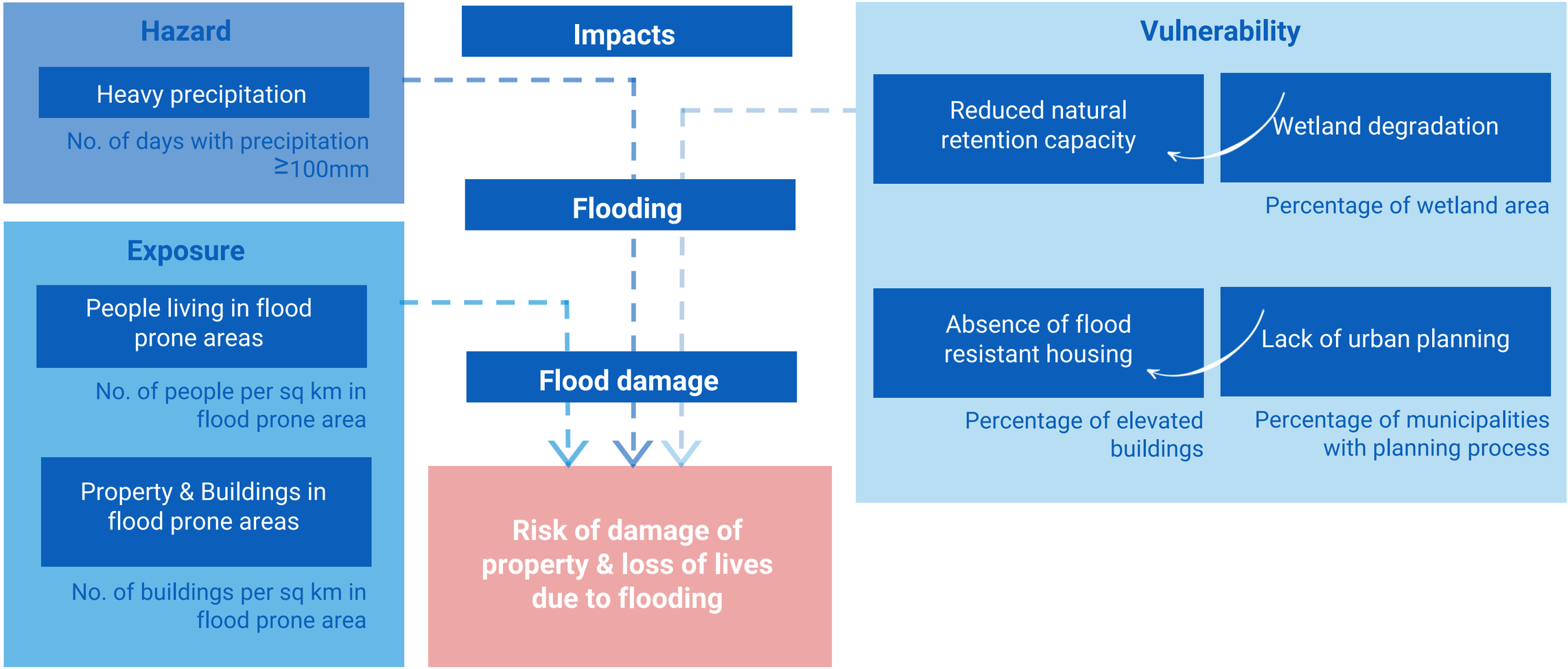
Adaptive Capacity



Population with / without access to hospitals
Mumbai's Climate and Air Pollution Risks and Vulnerability Assessment, 2022

Step 03 | Assess impacts

Example | Flood Risk Chain



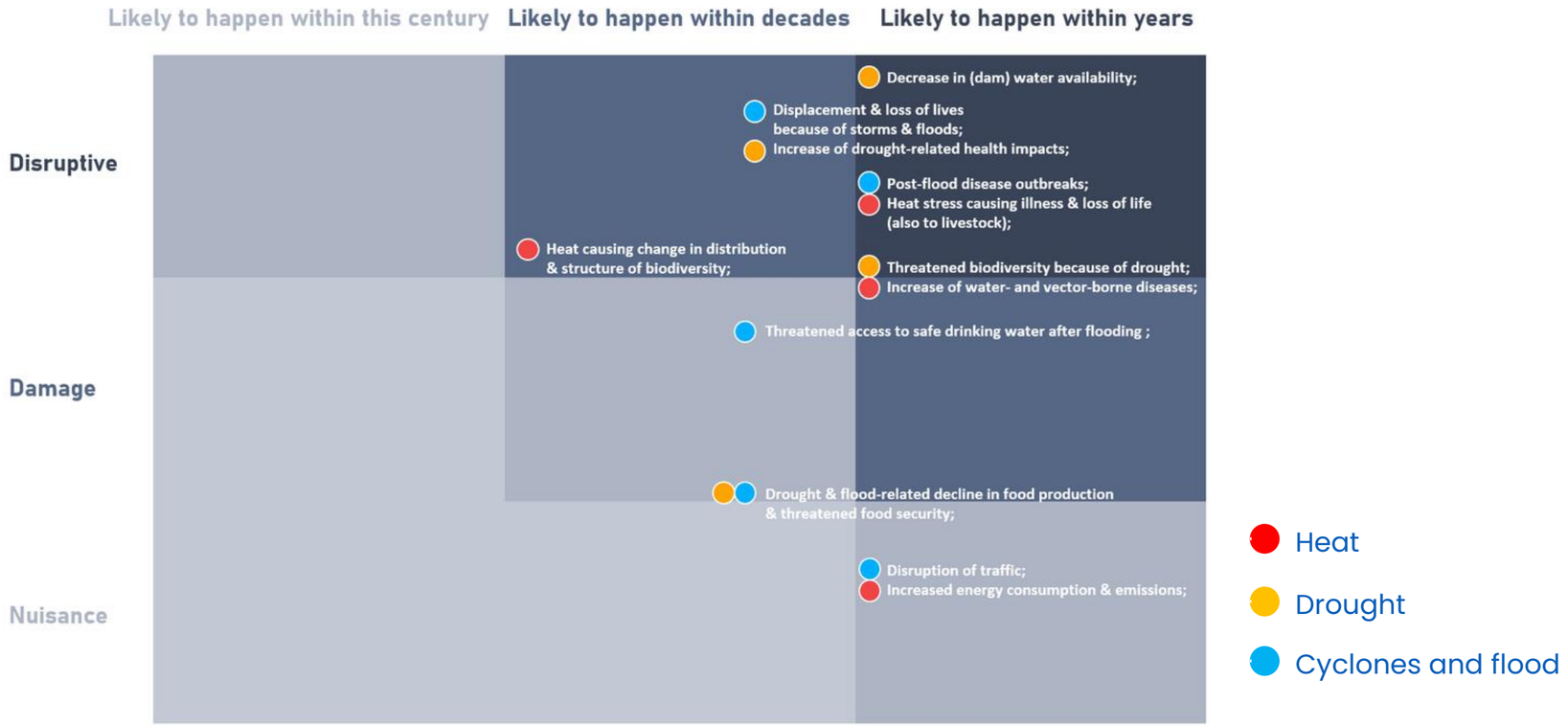
Step 04 | Identify & Assess Risks

Identify the key risks in your city by assigning a probability and consequence score to each identified risk.

Probability: how likely is the risk to occur?

Consequence: how serious would the consequences be if the risk did occur?

Case Study | Air Temperature 1973-2020 | Mumbai, India



Plotting risks on a matrix by probability and consequence is a useful way to visualize the most likely and most damaging impacts, to prioritize action

Step 04 | Identify & Assess Risks

Example | Risk Matrix

Likelihood Rating			Consequence Rating 1	2	3	4	5
Almost Certain	5	Recurrent events - expect this event almost annually. Single event - highly likely (>90% probability)	Medium	High	Very High	Very High	Very High
Probable	4	Recurrent events - expect this event several times in your career. Single event - more likely than not (50-90% probability)	Medium	Medium	High	Very High	Very High
Possible	3	Expect this event to occur once in your career, at any time. Single event - less likely than not, but still appreciable chance of occurring (10-50% probability)	Low	Medium	Medium	High	Very High
Unlikely	2	Event hasn't occurred during your career yet, but could occur at some time. Single event - unlikely but not negligible (1-10% probability)	Low	Low	Medium	Medium	High
Rare	1	Event has occurred elsewhere, but in exceptional circumstances. Single event - not expected to occur, but possible (<1% probability)	Low	Low	Low	Medium	Medium

Very High	Very high risks are unacceptable. When possible, identify options to avoid or transfer risk. Where not possible, discuss immediately with Senior Management.
High	Discuss options with Senior Management.
Medium	Medium risk is tolerated if analysis show that risk can be rendered as acceptable reducing residual risk.
Low	Low risks are acceptable.

Step 05 | Identify Options

- Many CRAs identify a list of options that can be taken to build resilience to climate risks.
- This should include a list of the main climate risks faced by a city, ranked in order of severity or priority for policymakers to address.
- It could also include an explanation of the main locations or groups of people that are vulnerable to climate hazards so that actions can be undertaken to ensure climate resilient priorities address equity & inclusion.
- It should then include a list of priority adaptation and resilience building measures to be taken - for example a list of priority sectors that need to be made resilience, or a list of priority actions to be undertaken to build resilience.

Photo by Poco_bw, Canva

Step 06 | Appraise Options

- Selecting adaptation options involves trade-offs between economic, environmental and social implications
- Adaptation often involves both financial and non-financial costs and benefits
- Involve affected stakeholders to agree criteria and their weightings, in order to capture different values in selection of options

There are many approaches to appraise adaptation options:

- Cost-benefit analysis
- Multi criteria analysis
- Cost-effectiveness analysis
- Expert judgment
- Stakeholder consultation

Githurai area of Nairobi; Photo by Patrick Ngugi, AP

Equity & Inclusion

A CRA should integrate considerations of equity and inclusion to understand differentiated impacts on vulnerable groups

CRA design should involve different stakeholder groups across gender, race, religion, age, ability, income etc.

Wide consultations with different population groups helps capture local knowledge and capacities to adapt.

Include indicators that reflect impacts on a wide range of groups, including the most vulnerable (e.g. women-headed households, female participation in the workforce, age-dependency ratio etc.).

Identify adaptation options that promote equity and inclusion/ build resilience of vulnerable groups.

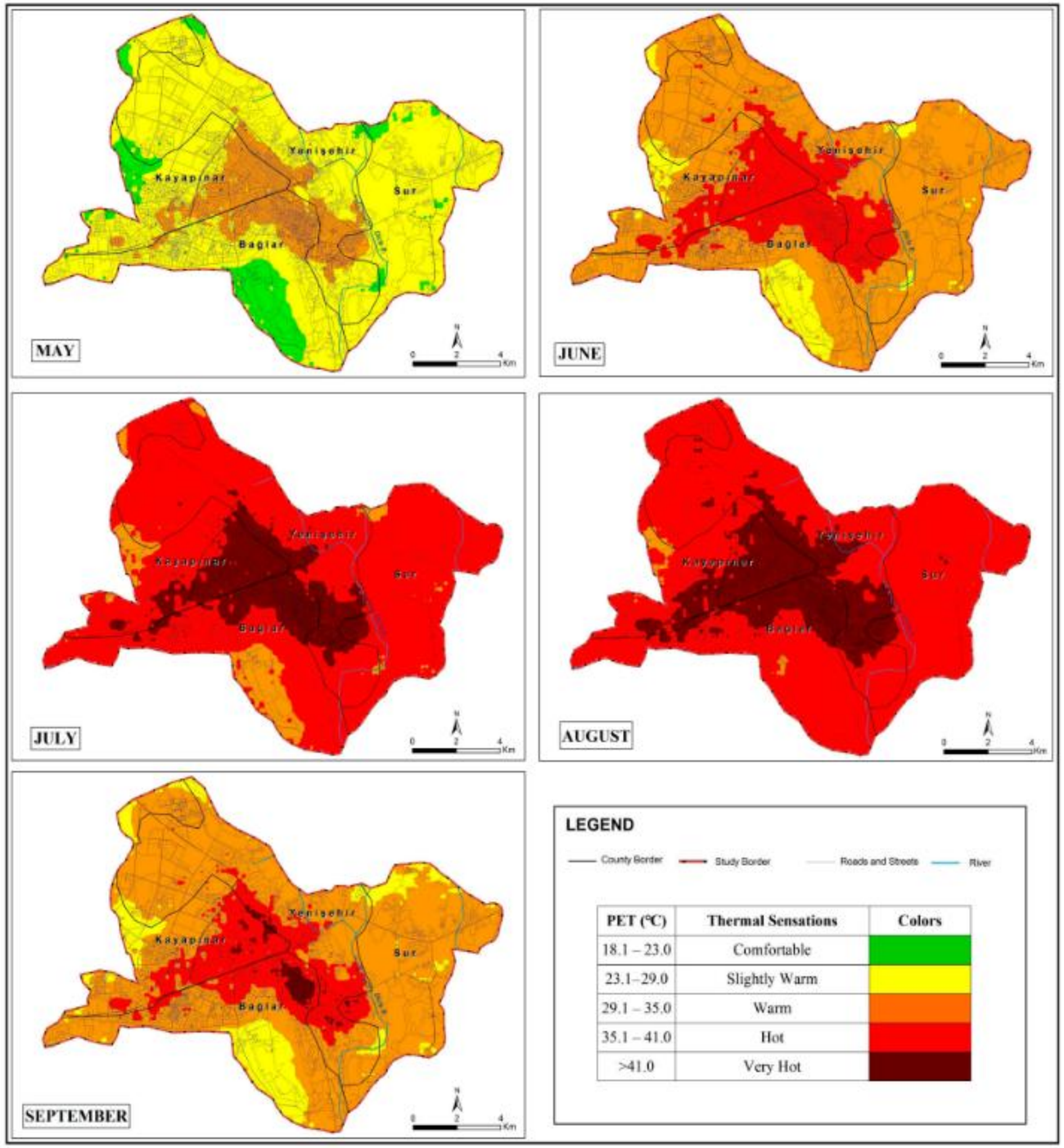
Photo by Riccardo Lennart Niels [illegible] Getty Images (licensed via Canva)

Different Types of CRA Outputs

Bangladesh; Photo by Sheikh Nayim Hasan, Pexels

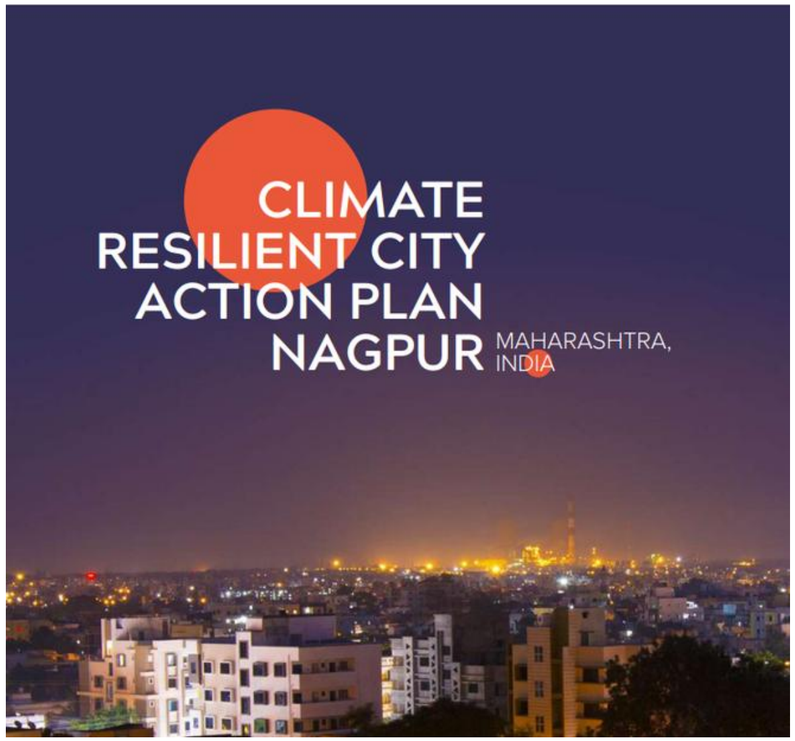
Types of CRA Outputs

- Risk Matrices
- Hazard, Risk and Vulnerability Maps
- Infographics
- Prioritized Adaptation Options
- Interactive Online Platforms



CRA Outputs | Risk Matrix

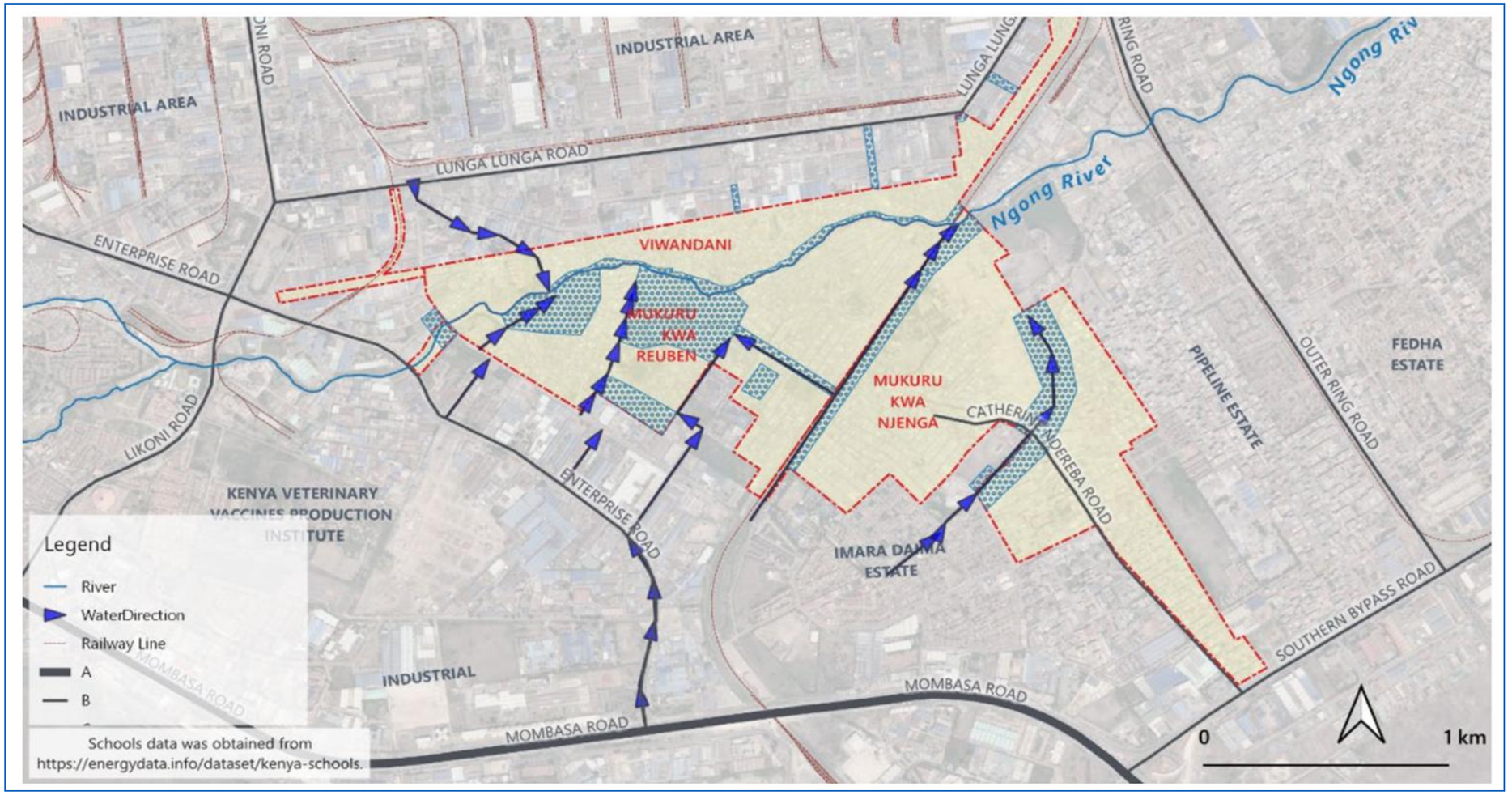
Case Study | Risk Matrix | Nagpur, India



S. No.	Urban systems	Climate fragility statement	Likelihood	Consequence	Risk score	Risk status
1	Water supply	High intensity & short duration rainfalls, rainfall irregularity and change in pattern will affect city's water supply.	4	3	12	Medium-High
		Increase in temperature will increase evapo-transpiration rate reducing available water quantity with degradation of quality and increasing water demand putting stress on ground water.	4	4	16	High
2	Sewage treatment	Mixing and overflows of sewage and storm water due to high intensity rainfall causes inefficient sewage treatment thereby polluting river streams, eventually affecting dependent farms.	4	2	8	Medium
		Increase in temperature causes septic conditions in open nullahs and drains thereby causing foul odour, toxic gas emissions eventually affecting wastewater treatment.	4	2	8	Medium
3	Storm water management	Dilapidated insufficient storm water drains get flooded due to high intensity rainfall causing water logging and backflow of contaminated water due to sewage mixing into residential/ commercial properties creates significant health risks and environmental pollution.	4	2	8	Medium

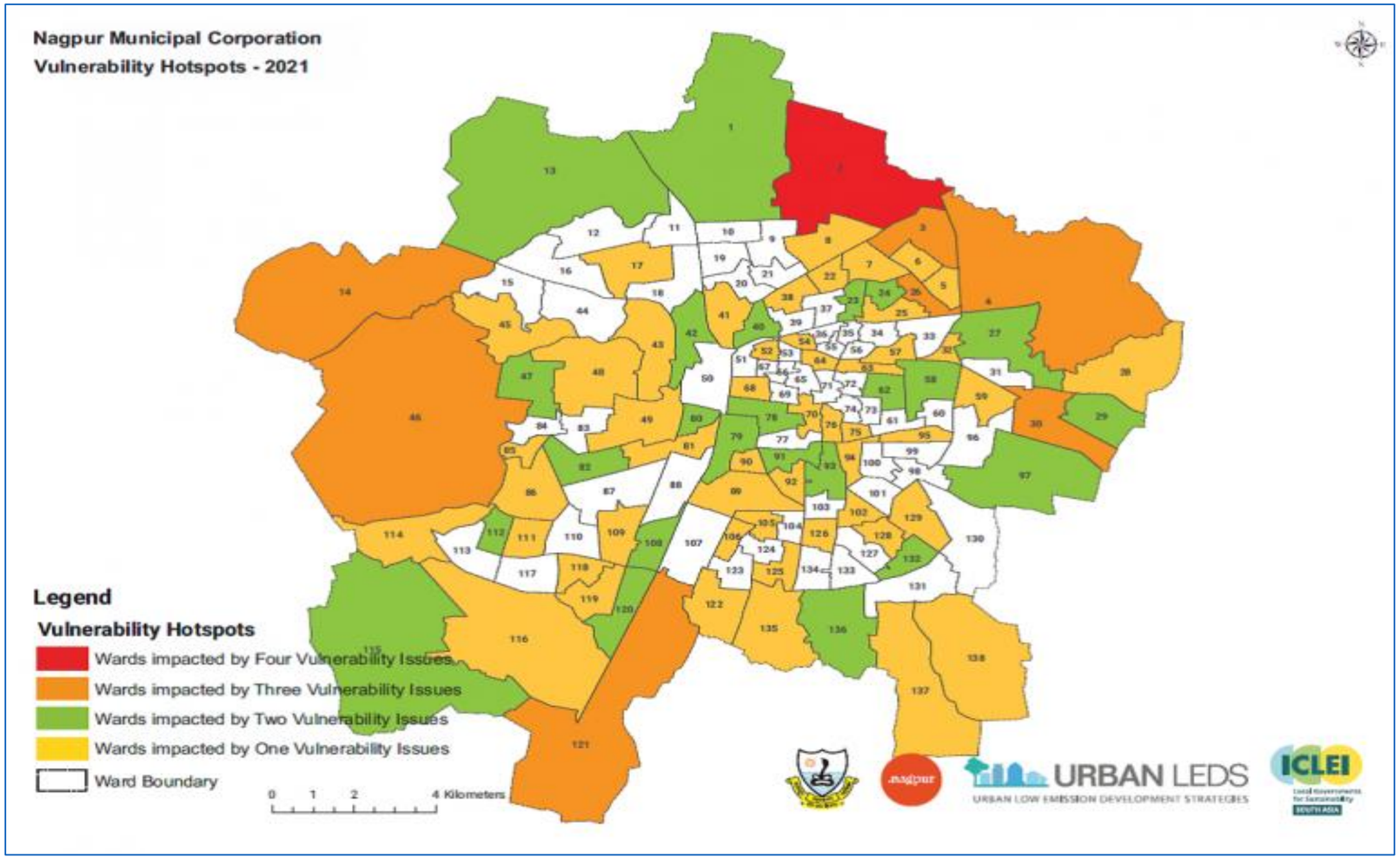
CRA Outputs | Hazard & Risk Maps

Case Study | Mukuru Flood Risk Map | Nairobi, Kenya



CRA Outputs | Vulnerability Maps

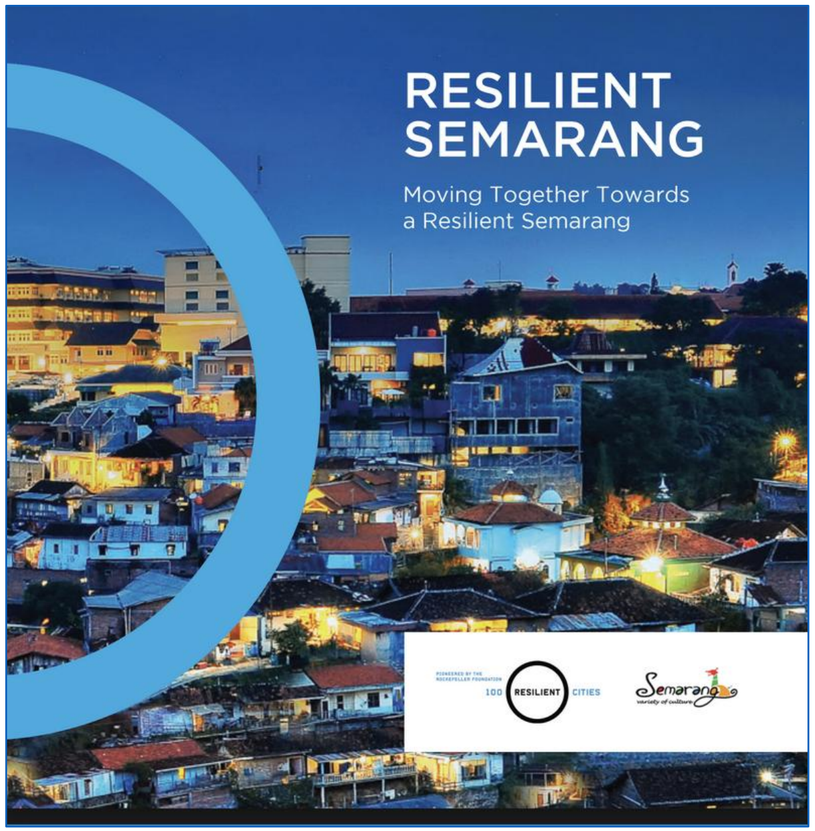
Case Study | Vulnerability Hotspot Map | Nagpur, India



Vulnerability hotspots, Nagpur (India)

CRA Outputs | Infographics

Case Study | Semarang, Indonesia

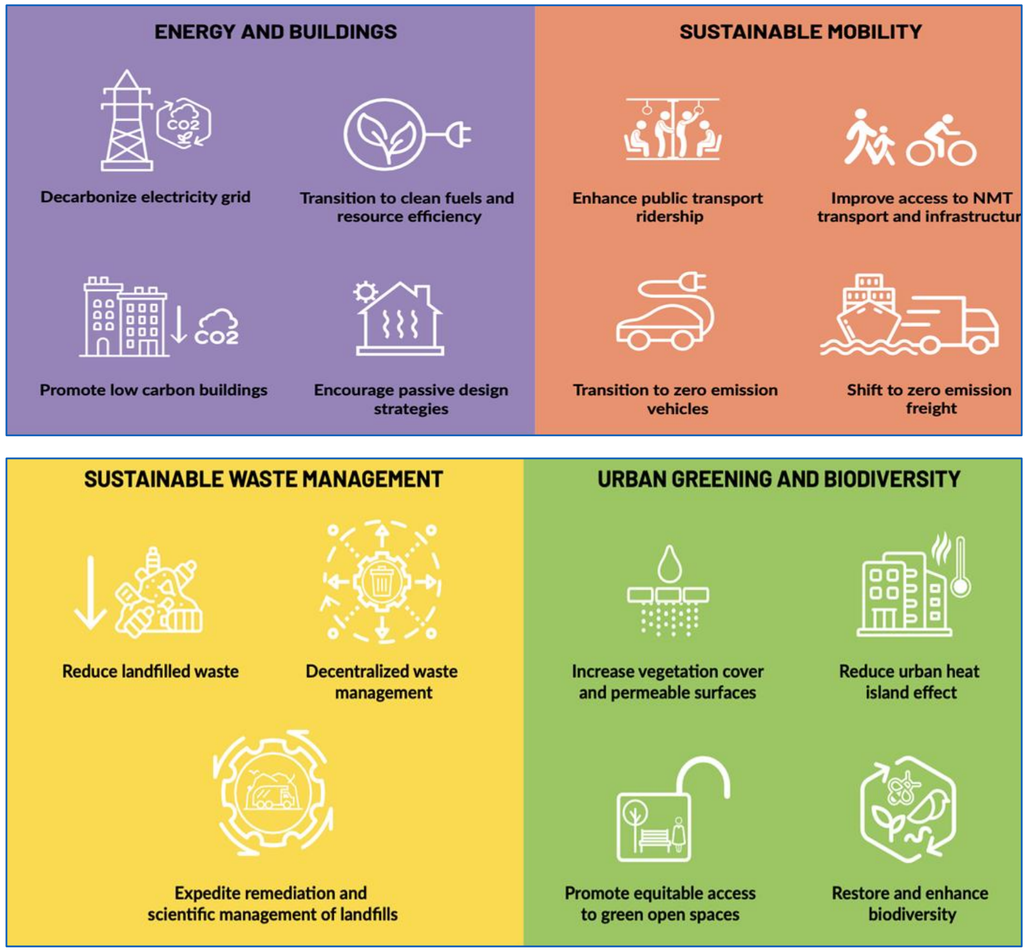


Shocks and stresses in Semarang:

- Flash flood from upstream areas
- One of Indonesian cities with the highest incident rate of dengue fever outbreak
- Limited provision of access that causes water scarcity
- Tidal flooding on lower Semarang coast
- Power outage
- River pollution, affecting Semarang water sources
- Excessive groundwater use and intensive development causing land subsidence
- Higher unemployment rate compared to provincial and national level of unemployment
- Landslides in upper Semarang and hilly areas
- Coastal erosion threatens coastal areas.
- More private vehicles, creating congestion

CRA Outputs | Prioritized Adaptation Solutions

Case Study | Mumbai, India



Priority adaptation actions for Mumbai (India)

CRA Outputs | Interactive Online Platforms

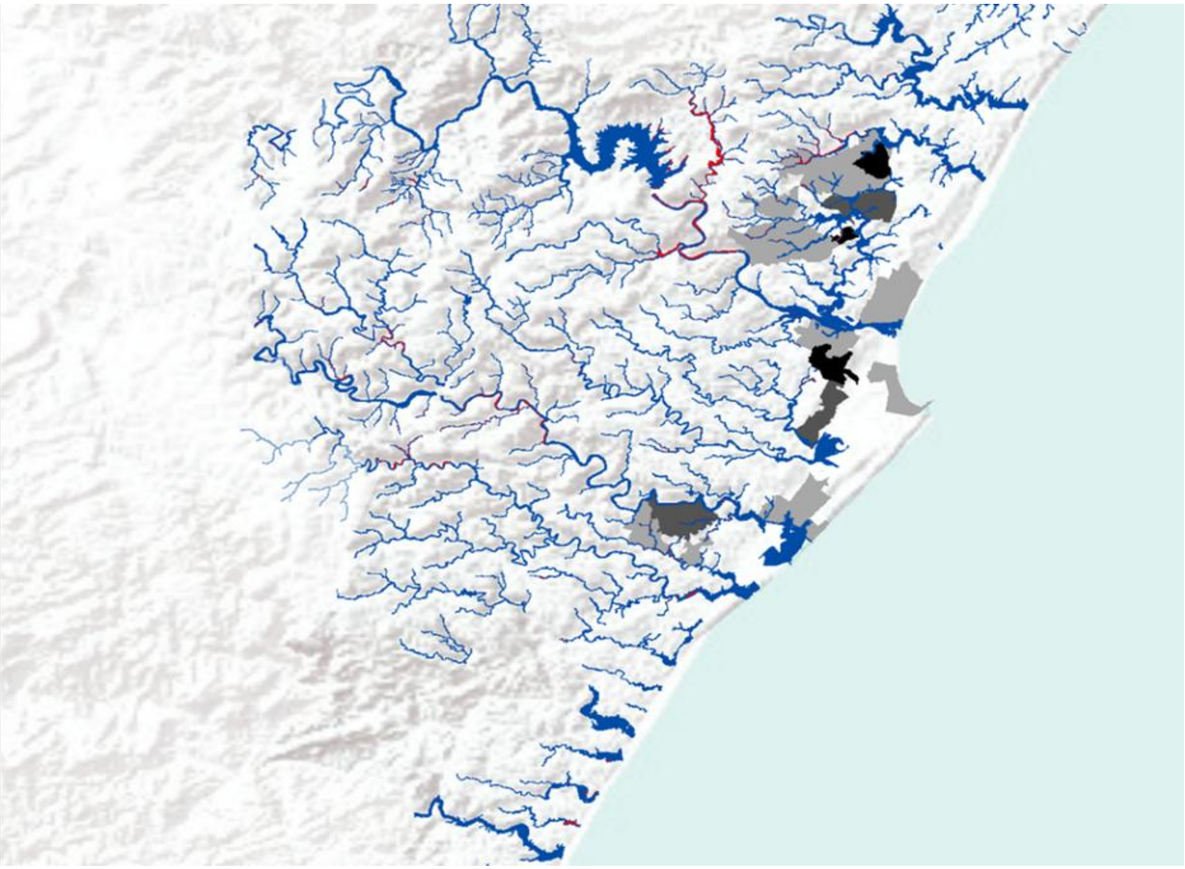
Case Study | eThekwini Municipality (Durban), South Africa

Pluvial flood

Durban's key risks for **pluvial flood**

Damage to public and private property	**VERY HIGH**
The major 2017 storm has cost Durban many hundreds of millions. Damage to public and private property could increase significantly if rainfall intensities continue to increase. This may also increase insurance costs.	
Decrease in water quality	**VERY HIGH**
Extreme rainfall can cause a decrease in water quality. More extreme storms will wash out increasing amounts of nutrients into rivers and coastal waters. High peak amounts will cause overflow of sewage systems.	
Increased upstream erosion and downstream siltation	**HIGH**
More frequent and intense showers may cause more erosion in the upstream area and siltation of the downstream wetlands. Changes in erosion and sedimentation are likely to result in soil loss and changes in biodiversity. Erosion fuels devastating mudslides.	
Overflowing sewage systems	**HIGH**
Extreme rainfall causes excessive stormwater to go into the sewer lines prior to reaching the sewer treatment plant. This can have major impacts on health and ecology.	

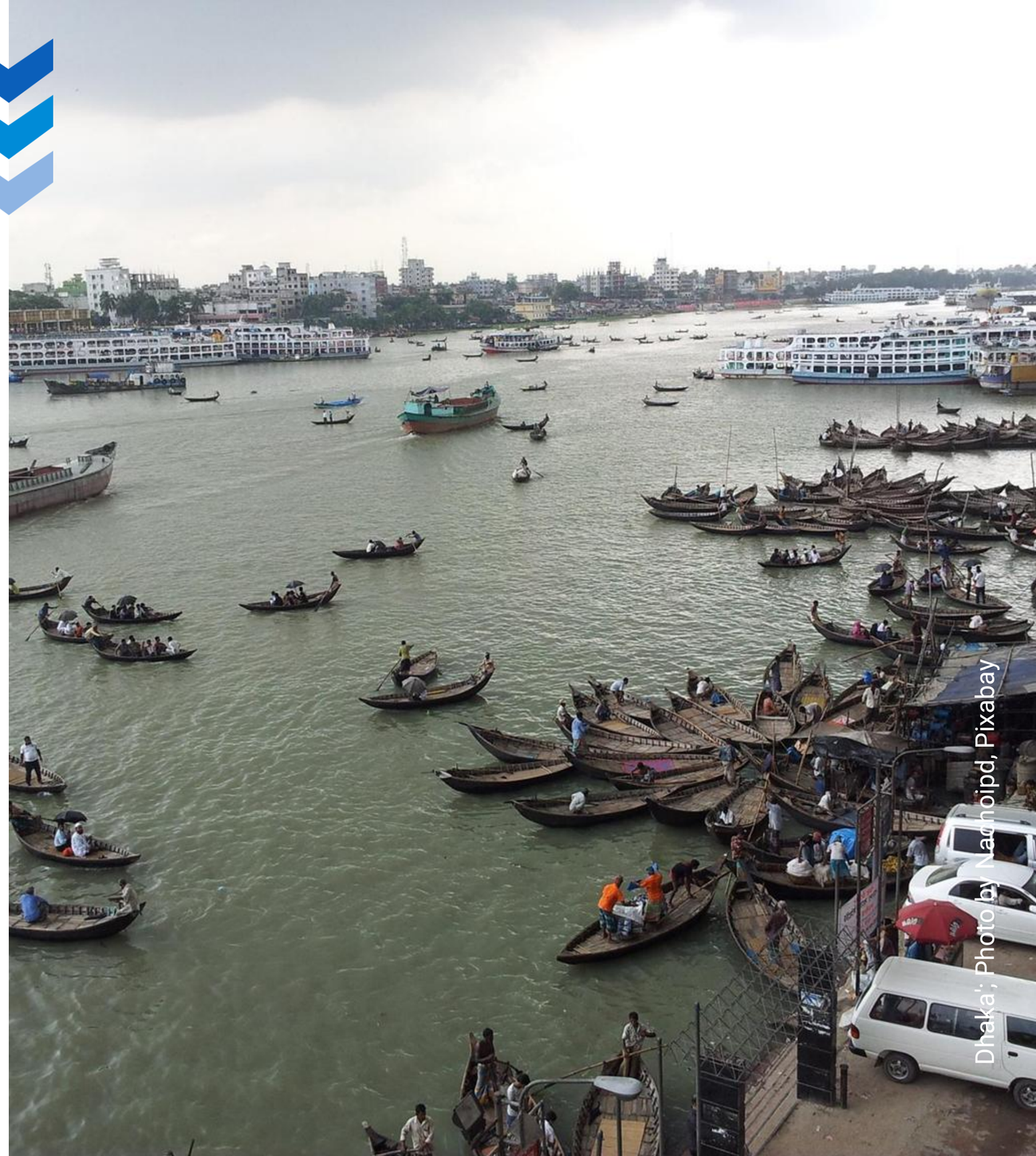
Risk is defined as the probability of occurrence times the magnitude of an impact. In order to assess Durban's climate risk, the likelihood of the climate impacts to occur and the damage in terms of severity related to these impacts need to be considered. Risks that are both likely to occur frequently and cause severe damage deserve specific attention in Durban's climate action plan. Based on expert judgement form the city specialists, the key risks above were identified.



Questions

Do you have any questions?

- Consider ‘how to conduct a climate risk assessment’.
- Is there anything introduced in this section that you are unfamiliar with and that you would like to discuss in further detail?



Dhaka'; Photo by Nachoipd, Pixabay

Experience Share

Your experiences with CRA outputs and / or decision making

- Have you had any experience working with CRA outputs?
- Have you ever use a CRA in decision making?

If you want to share an experience with the room, please raise your hand.

07 | CRA Case Studies

Photo by Canerozkan, Getty Images (licensed via Canva)

CRA Case Study | Mongla City Resilience Strategy

Mongla City Context

Mongla is the main seaport in the Bagerhat district of south-western Bangladesh with a total population of 39,837 people.

The economy is largely dependent on agriculture and fisheries, with some industrial and manufacturing activities in the Mongla Port and Mongla Export Processing Zone.

Mongla has historically been hit by a number of cyclones that have caused significant flooding in the city - including Cyclone Sidr in 2007, Cyclone Rashmi in 2008 and Cyclone Aila in 2009.

In 2016, Mongla Port Municipality developed a City Resilience Strategy through a partnership with ICLEI. This Strategy was based on a comprehensive CRA that analysed climate risk across 7 urban systems.

Photo by Amio James Ascension, Flickr

CRA Case Study | Mongla City Resilience Strategy

7 Fragile Urban Systems

The Mongla City Resilience Strategy analysed climate impacts on 7 fragile urban systems:

1. Water Supply
2. Transportation
3. Health Systems
4. Storm Water & Drainage
5. Solid Waste Management
6. Urban / Peri-Urban Agriculture, Pisciculture, Animal Husbandry
7. Sanitation & Sewerage

Main Climate Hazards Identified

The Resilience Strategy identified three priority climate risks:

1. Increased temperature
2. Increase in rainfall intensity
3. Increase in the frequency of cyclones

Key Stakeholders

- Low Income Group
- Middle Income Group
- Children
- Elderly
- Farmer
- Irrigation Department
- Daily Wage Labourer
- St. Paul's Hospital
- Private Clinics
- Paribarik Shastha Clinics
- Mongla Port Municipality
- Mongla Port Authority
- Transport Department
- Health Department
- Port Authority Hospital
- Agriculture Department
- Fishery Department

CRA Case Study | Mongla City Resilience Strategy

Process

- **Phase 1: Engagement and political support:** This involved forming a Climate Core Team responsible for the execution of project activities, comprising key officials from the city government and a Stakeholder Committee with citizen representatives from relevant organisations in the city

- **Phase 2: Climate Impact Assessment:** The Core Team and Stakeholder Committee identified the main climate impacts for the city through Shared Learning Dialogues. They conducted an assessment of past climate trends and future projections through secondary research. This was validated through analysis of city level data and local perceptions of city stakeholders. They also conducted a risk assessment for 7 fragile urban systems based on the likelihood and consequence of the climate risk statements for those systems.

- **Phase 3: Vulnerabilities Assessment:** Together, the two teams Identified key vulnerable areas and populations within the fragile urban systems, and assessed their adaptive capacities.

Photo by Masud Ananda, Flickr

CRA Case Study | Mongla City Resilience Strategy

Process

- **Phase 4: Resilience Strategy:** City government used the CRA outputs to identify relevant resilience interventions. These were prioritised on the basis of their feasibility and applicability to the city. The resilience strategy was then developed and ratified through political support.

- **Phase 5: Implementation**: After identifying the resilience interventions for the city, concrete project implementation plans can be prepared. Opportunities for financing and implementing these projects need to be explored.

- **Phase 6: Monitoring & Review:** Monitoring and review remains the city government mandate, with active involvement of the Climate Core Team.

Dhaka; Photo by Amir Jina

CRA Case Study | Mongla City Resilience Strategy

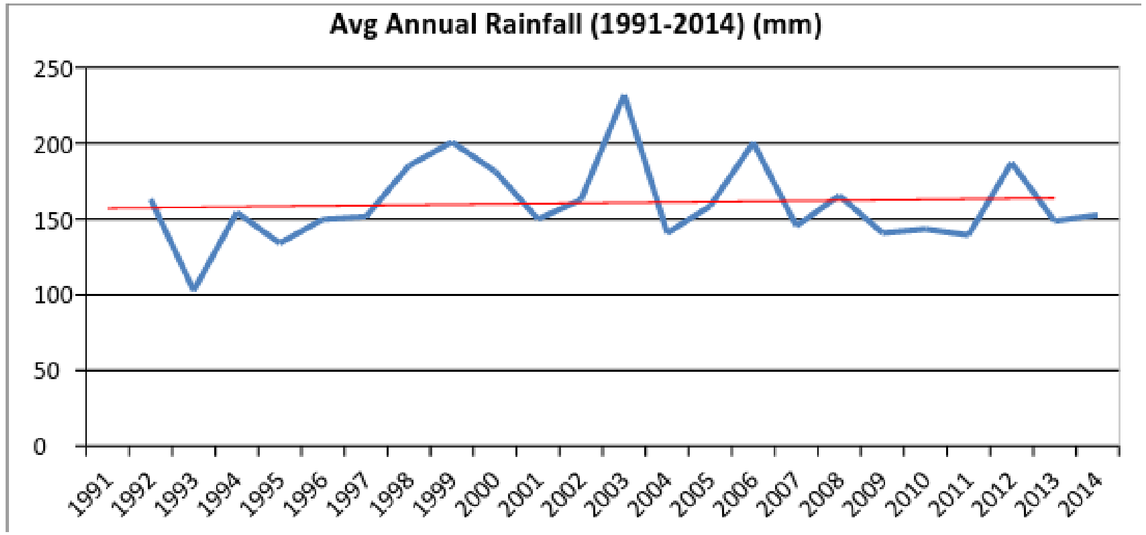
Climate Data & Projections

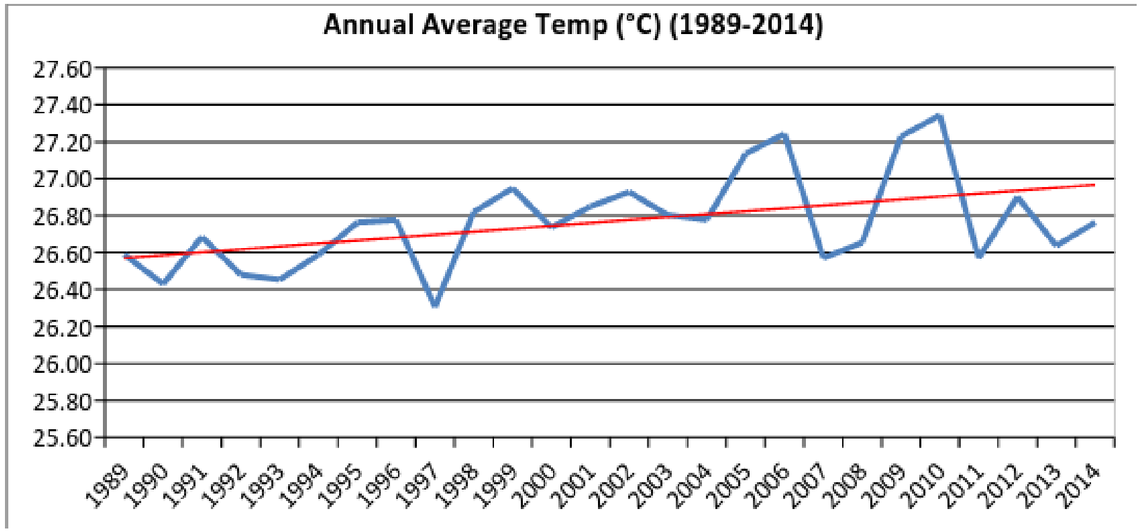
The weather station in Mongla city showed:

- An increasing trend in rainfall intensity and more frequent rainfall in a year.
- An increase in mean seasonal rainfall where:
  - Pre-monsoon rainfall increased 8-13 mm/year
  - monsoonal rainfall increased 21-24 mm/year
  - post monsoon rainfall increased 12-24 mm/year.
- Annual average temperature is increasing

Although climate projections are not available in the city, the assessment used the the best available information in:

- National Plan for Disaster Management (2010-2015) – uses downscaled climate model projections
- World Bank's Country Profile for Bangladesh (2011).





CRA Case Study | Mongla City Resilience Strategy

Risk Matrix

Urban system	Impacts of climate change	Likelihood	Consequence	Risk score	Risk status
Water Supply	Scarcity in water supply from greater demand from higher temperatures causing health issues.	5	4	20	Extreme
	System dependent on rainfall, so will be impacted by shortage of rain.	5	5	25	Extreme
	System failures due to flooding from cyclones and salinization of reservoirs.	3	4	12	High
Transportation	Destruction of roads due to excess rainfall or in cyclones. Disruption of import of food by water transport.	3	3	9	Medium
Health System	Stress on existing infrastructure to meet heat related health disorders	4	4	16	High
	Water borne diseases, skin diseases from water logging	3	4	12	High
	Malnutrition due to effect on import of food.	4	3	12	High
Storm Water Drainage	Odour pollution and health issues due to higher temperatures.	5	3	15	High
	Water logging from cyclones and extreme rainfall	5	3	15	High
Solid Waste Management	Spread of solid waste on streets and health issues during waterlogging	5	4	20	Extreme
Urban/ Peri-Urban Agriculture/ Pisciculture/ Animal Husbandry	Crops reduced due to lack of water because of greater demand on water due to high temperatures.	5	3	15	High
	Excess rainfall or flooding can cause salinity of soil damaging agriculture, fishery, animal husbandry.	5	4	20	Extreme
Sanitation and Sewerage	Excess rainfall or flooding can cause health impacts leading to loss of life and productivity.	5	5	25	Extreme
	Odour caused by higher temperatures and lack of proper disposal of sewage.	5	3	15	High

CRA Case Study | Mongla City Resilience Strategy

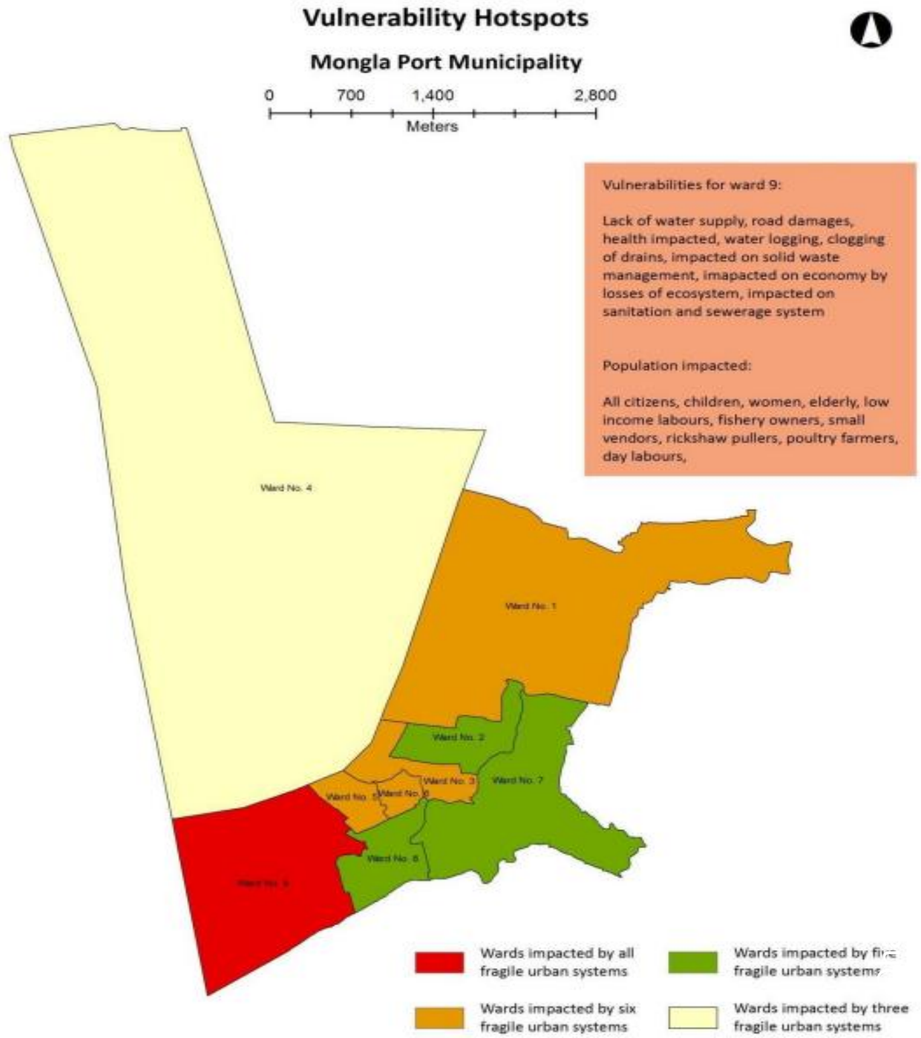
Vulnerability Hotspot Map

Mongla developed a consolidated Vulnerability Hotspot Map to show which wards are vulnerable to the impacts of climate change. This was calculated by counting how many of the seven fragile urban systems would be impacted by climate hazards in each ward.

The Vulnerability Hotspot Map helps to identify the wards which must be focused on for future interventions to build resilience that are identified in later chapters.

Ward 9 was found to be most vulnerable to all seven fragile urban systems. It is vulnerable to tidal influences and is downstream from two rivers, and therefore it is often flooded or waterlogged.

Wards 1, 3, 5 and 6 are vulnerable to six fragile urban systems. Wards 2, 7 and 8, are impacted by five fragile urban systems.



Source: City Resilience Strategy Mongla Port Municipality, Bangladesh

08 | How to Procure a CRA

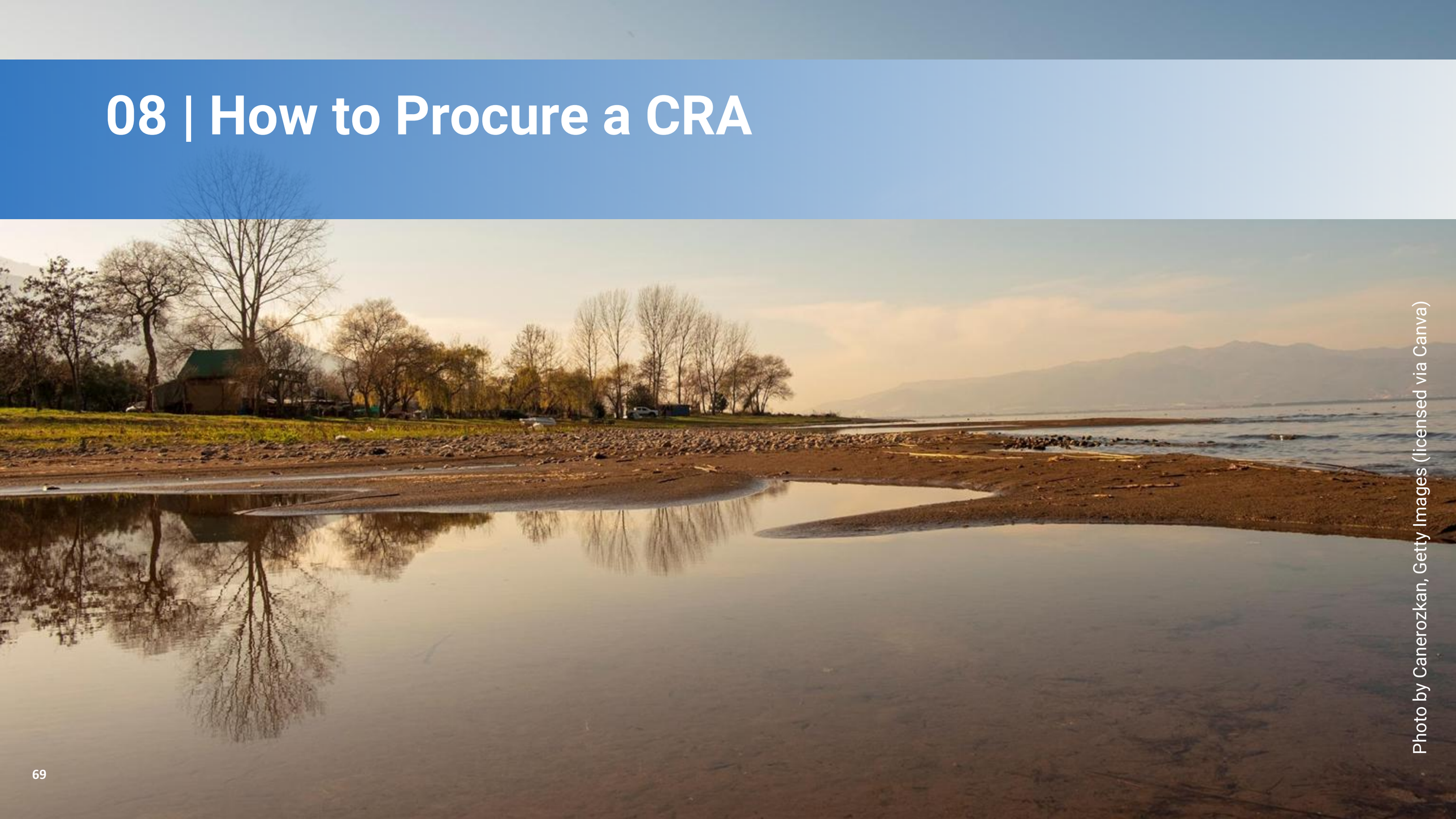


Photo by Canerozkan, Getty Images (licensed via Canva)

How to Procure a CRA

City officials wishing to undertake a CRA will likely need to procure from external consultants/experts. These are guidelines for procuring CRAs, following these 5 steps:

- **Step 01 | Prepare**
- **Step 02 | Draft ToRs**
- **Step 03 | Select CRA team**
- **Step 04 | Supervise CRA**
- **Step 05 | Communication**
- **Step 06 | M&E**

Kapiti Research Station; Photo by Paul Karaimu, ILRI

Step 01 | Prepare

Conduct a stocktake of existing relevant CRAs; if available at a higher level (state, district). Data, findings and methodological approach can help orient a city-level CRA.

Assess the availability of existing resources: this should include time and budget available, existing climate-related knowledge and capacity for supervision/oversight of the CRA, data availability, and level of stakeholder involvement possible

Kenya; Photo by Susan Markisz, UN Women

Step 02 | Develop Terms of Reference

Clearly define the **objectives and outcomes** of the CRA

Include an assessment of **adaptive capacity** to help identify entry points for integrating resilience building actions.

Include consideration of **equity and inclusion** in methodology e.g. in selection of indicators, stakeholder engagement design, selection of adaptation options.

Include a task on **interpreting the results** of the CRA to ensure that the results are communicated in a way that is relevant for decision-making. The report should outline all assumptions to guide interpretation of findings.

Ensure a cross-sectoral discussion of the results to **identify interdependencies** in city systems and cascading climate impacts

Kenya; Photo by Denis Onyodi, KRCS

Step 03 | Select CRA Team

An ideal team should include:

- Relevant technical expertise in climate science and climate modelling.
- Experience in the science-policy interface and translating technical results to actionable, user-friendly outputs.
- Experience conducting CRAs in data-poor contexts.
- Extensive local experience and ability to form partnerships with a diverse group of stakeholders and local partners

Kenya; Photo by Denis Onyodi, KRCS

Step 04 | Supervise CRA

Allocate time to work with consultants ensure the **decision-making context** of the CRA is well established at the beginning.

Facilitate **stakeholder engagement** across local, regional and national agencies and NGOs/communities, to aid in data collection, interpretation of results; buy-in and ownership of results and corresponding actions.

Schedule regular review by commissioning agency, across the steps of the CRA.

Kenya; Photo by Denis Onyodi, KRCS

Step 05 | Communicate CRA

Once the CRA has been conducted city officials should communicate the findings from the CRA to the general public. There are many different types of CRA outputs that cities can use to communicate these findings.

This should include outlining the main climate risks facing the city, as well as what actions & investments the city will make to build resilience to climate risks.

Communicating these findings are important because the public needs to be aware of the climate hazards they could face in the future as well as the potential impacts of these hazards on their lives and livelihoods.

This can help individuals, businesses, community based organisations and other actors to undertake their own actions, initiatives, and investments to build resilience.

Photo by Rein Skullerud, WFP

Step 06 | Update CRA

The CRA should include a mechanism for **revision/update** over time (for example, every 5 years) so that updated scientific information on climate risks can be included in city planning.

Report should include a clear **methodology** section so the CRA can be repeated in the future by city officials to ensure there is no risk that staff turnover reduces the capacity of the city to conduct a CRA.

Kanya; Photo by NVIDIA

09 | Interactive Exercise

Karmrangir Char, Dhaka; Photo by waterdotorga, Flickr

Start Your Journey

Module 2

Understanding Climate Risks in Your City

CRA procurement

Module 3

Locally Led Adaptation for Urban Resilience

Context mapping

Module 4

Ensuring Climate Resilience of Urban Infrastructure

Planning in uncertainty

Module 5

Step-by-Step Guidelines for Delivering Climate Resilient Infrastructure

Infrastructure planning

Module 6

Financing Climate Resilient Urban Infrastructure

Finance planning

The interactive exercises across the next 5 modules build on one another to link the content and support your understanding of the process to create adaptive and resilient infrastructure.

Mission

What is your goal for your city?

Actions

Steps required to reach the mission

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

Climate Risk Assessment

CRA Preparation

Objectives
What risks do you want to assess?

Resources available
What information sources are available?

Equity & Inclusion
E&I considerations for the CRA.

Outputs required
How do you want the results delivered?

Discussion

Share your CRA procurement canvas

- Take it in turns on your table to share your CRA procurement canvas.
- Ask questions and open up discussion.
- You maybe asked to share highlights from your table to the wider room.

10 | Summary

Photo by waterdotorga, Flickr

Using a CRA for resilient investments in your city

Why is a CRA important?

- A CRA provides an **evidence base** for climate action and investment.
- CRAs provide data on the locations, the types of infrastructure and the groups of people that will be negatively impacted by climate change.y
- The interpretation and use of a CRA in decision-making is important to how you address climate risk in your city.

What can you do with a CRA?

- Identify priority climate resilient infrastructure and services that need to be built in your city.
- Integrate resilience into long-term planning (e.g. master plans).
- Develop policies and strategies such as city-level Climate Action Plans.
- Secure finance for investment in priority adaptation and resilience options in your city.

Photo by AP

Summary & Next Steps

Congratulations on completing Module 2: Understanding Climate Risks in Your City!

Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
Introduction to Climate Change and Urban Resilience	Understanding Climate Risks in Your City	Locally Led Adaptation for Urban Resilience	Ensuring Climate Resilience of Urban Infrastructure	Step-by-Step Guidelines for Delivering Climate Resilient Infrastructure	Financing Climate Resilient Urban Infrastructure

The next module in the UCRMC is **Module 3: Locally Led Adaptation for Urban Resilience.**

Annex 1 | Climate Risk Assessments in Bangladesh

Photo by Bakhrom_Media, Pixabay

Climate-related data in Bangladesh

Future climate scenarios	Data at city level	Hazard maps	Vulnerability assessment
National Adaptation Plan (NAP) and other national documents that follow the future climate scenarios from IPCC.	City-level data is available in 35 cities where weather stations are located. Bangladesh Bureau of Statistics census data on population, economic activities, poverty, housing condition, access to water and sanitation, etc. is also available.	Climate Vulnerability Index (CVI), National Adaptation Plan (NAP), and Climate Risk and Vulnerability Assessment (CRVA) have hazard maps for Bangladesh.	A total of 11 cities with support of ICLEI have conducted participatory risk assessments to prepare City resilience strategies and Climate Action Plans. GIZ supported 2 cities to incorporate climate risk considerations in urban planning under the Climate Resilient Inclusive Smart Cities (CRISC) project.

Climate-related data in Bangladesh

Type of data	Organization
Metrological	BMD, BWBD, DDM, DoE, Ventusky, IQAIR, Earth-Env, AQICN
Hydrologic	BWBD, BDP, DoE
Ground & surface water	BWBD, WARPO, BADC, BMDA, BDP, DPHE, IWM
Waterbodies	BWBD, WARPO, BIWTA, ICZMP
Salinity	BWBD, ICZMP, SRDI
Infrastructure	BWBD, LGED, BBS, IWM, UDD
Settlement	SoB, LGED, MoL
Energy	WARPO, BREB, BPDB
Disaster/Hazard	WARPO, DDM, ICZMP, BDP, LGED, BARC, IWM, CDMP
Environmental	WARPO, DoE, UDD, Earth-Env
Pollution	BIWTA, DoE, IQAIR, AQICN

Source: Inventory of Climate Data, 2022

Climate-related data are accessible from different national and international organisations. Most of these data are publicly available with permission from the authorities.

- **BIWTA:** Bangladesh Inland Water Transport Authority
- **BMD**: Bangladesh Meteorological Department
- **BREB:** Bangladesh Rural Electrification Board
- **BWDB:** Bangladesh Water Development Board
- **CDMP**: Comprehensive Disaster Management Programme
- **DDM:** Department of Disaster Management
- **DoE:** Department of Environment
- **DPHE:** Department of Public Health Engineering
- **ICZM:**, Integrated Coastal Zone Management Plan
- **IWM:** Institute of Water Modelling
- **LGED:** Local Government Engineering Department
- **SoB:** Survey of Bangladesh (SoB)
- **UDD:** Urban development Directorate
- **WARPO:** Water Resources Planning Organization

CRA Expertise in Bangladesh

Academic and Research organizations

- Bangladesh Centre for Advanced Studies (BCAS)
- Bangladesh Institute of Development Studies (BIDS)
- BRAC Institute of Governance and Development (BIGD)
- Institute of Water and Flood Management (IWFM)
- Centre for Environmental and Geographic Information Services (CGEGIS)
- Centre for Climate Change and Environmental Research (C3ER)
- International Centre for Climate Change and Development (ICCCAD)
- Institute of Water Modelling (IWM)

NGOs

- Bangladesh Rural Advancement Committee (BRAC)
- CARE International
- International Council for Local Environmental Initiatives (ICLEI)
- Nature Conservation Management (NACOM)
- OXFAM
- Practical Action
- Red Crescent Society
- Save the Children
- Water Aid

Bangladesh; Photo by Bread For The World, Flickr

CRA Expertise in Bangladesh

Development Organizations

- Asian Development Bank (ADB)
- Asian Infrastructure Investment Bank (AIIB)
- German Agency for International Cooperation (GIZ)
- Credit Institute for Reconstruction (KfW)
- Islamic Development Bank (IDB)
- Japan International Cooperation Agency (JICA)
- World Bank

Government

- Ministry of Environment (MoE)
- Department of Architecture
- Department of Environment (DoE)
- Palli Karma-Sahayak Foundation (PKSF)
- Urban Development Directorate (UDD)

Sundarbans Forest Area; Photo by K M Asad, IMF

Challenges in undertaking CRAs in Bangladesh

Down-scaling of data: National level CRAs cannot be used to make local decisions on climate risks and investment priorities, since they generally do not contain downscaled climate data that reflects climate hazards and risks in different locations.

Data limitations: CRAs require locally available data on climate parameters. Climate related data for rainfall and temperature are for locations with stations for collecting regular data, and not all cities collect local data.

Capacity constraints: Cities often have low capacity of local government officials to interpret climate data and use it to assessing climate risks and make climate resilient infrastructure plans & investments in their cities.

Reliance on external consultants: CRAs are usually carried out by academics, consultants, or international agencies as they require specific expertise and resources. Most cities do not have in-house capacity to conduct CRAs and therefore often need to commission CRAs.

Chattogram; Photo by waterdotorga, Flickr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