GLOBAL CENTER ON ADAPTATION

Urban Climate Resilience Masterclass

Module 2

Understanding Climate Risks in Your City

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

UCRMC Course Overview

Welcome to the Urban Climate Resilience Masterclass! 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

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These contributions were instrumental in ensuring the relevance and quality of the UCRMC Modules.

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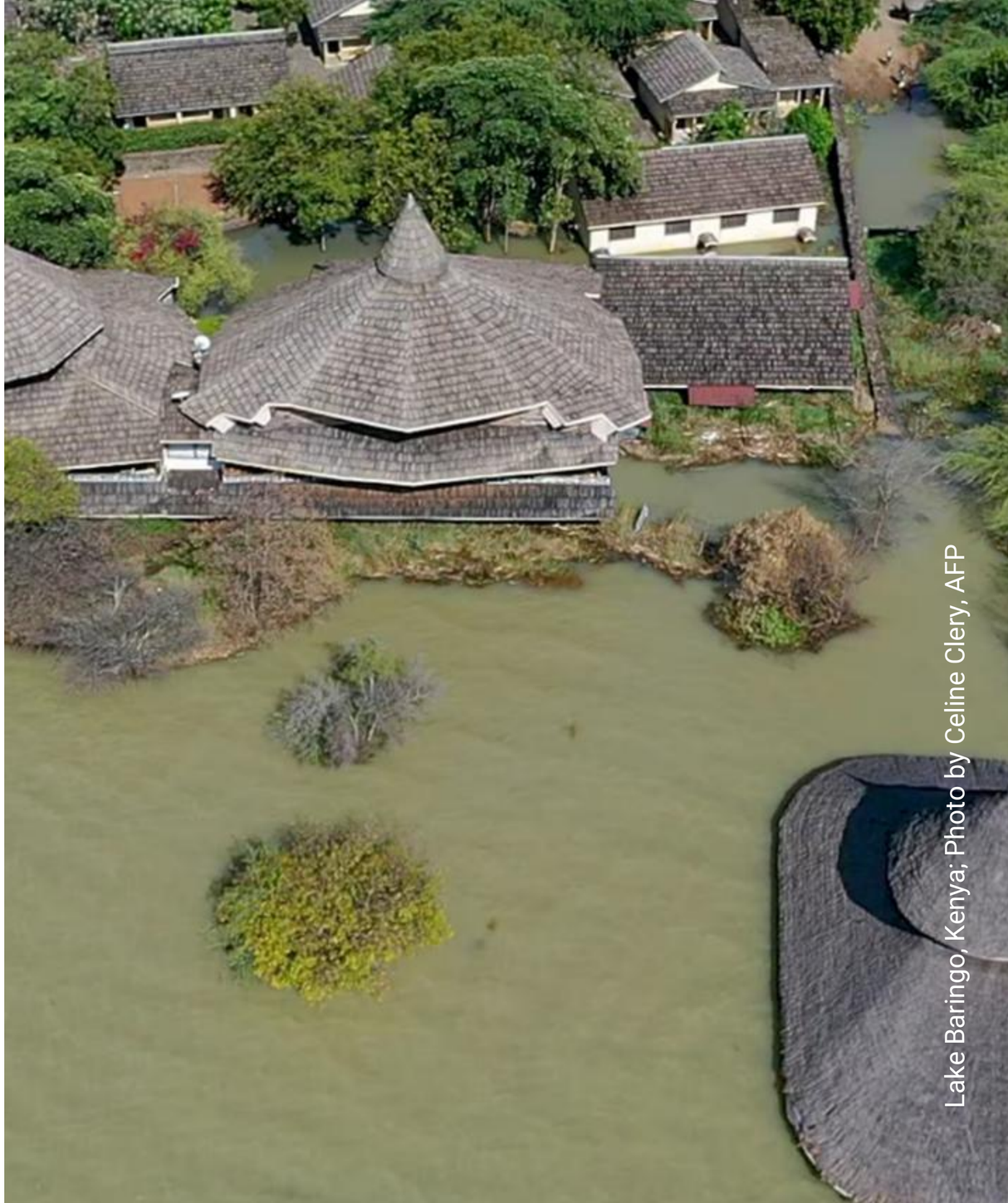


Lake Baringo, Kenya; Photo by Celine Clery, AFP

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 Kenya.

02 | Learning Objectives

Dhaka; Photo by Ferdous Hasan, Pexels

Learning Objectives

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

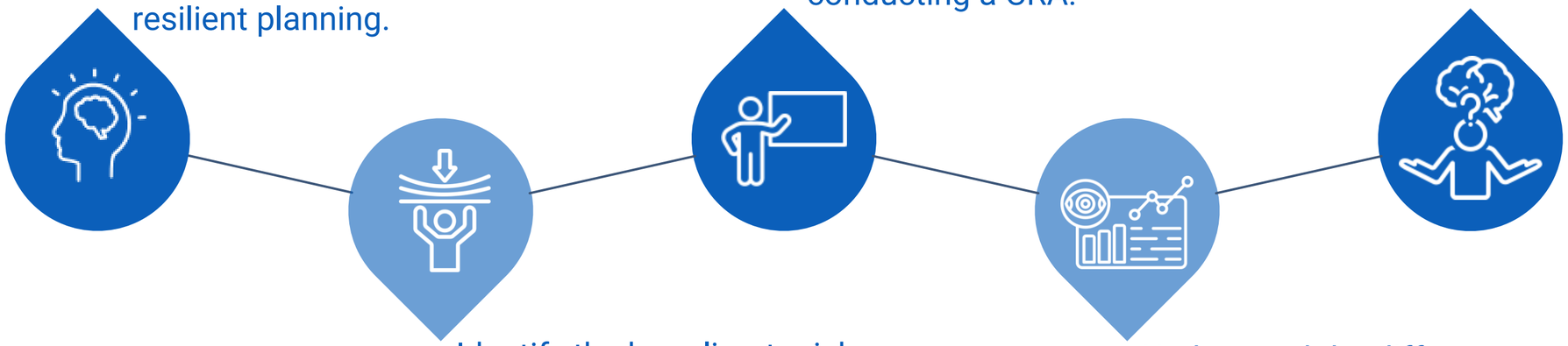
Understand the importance of climate risk assessments (CRA) as the foundation of climate-resilient planning.

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

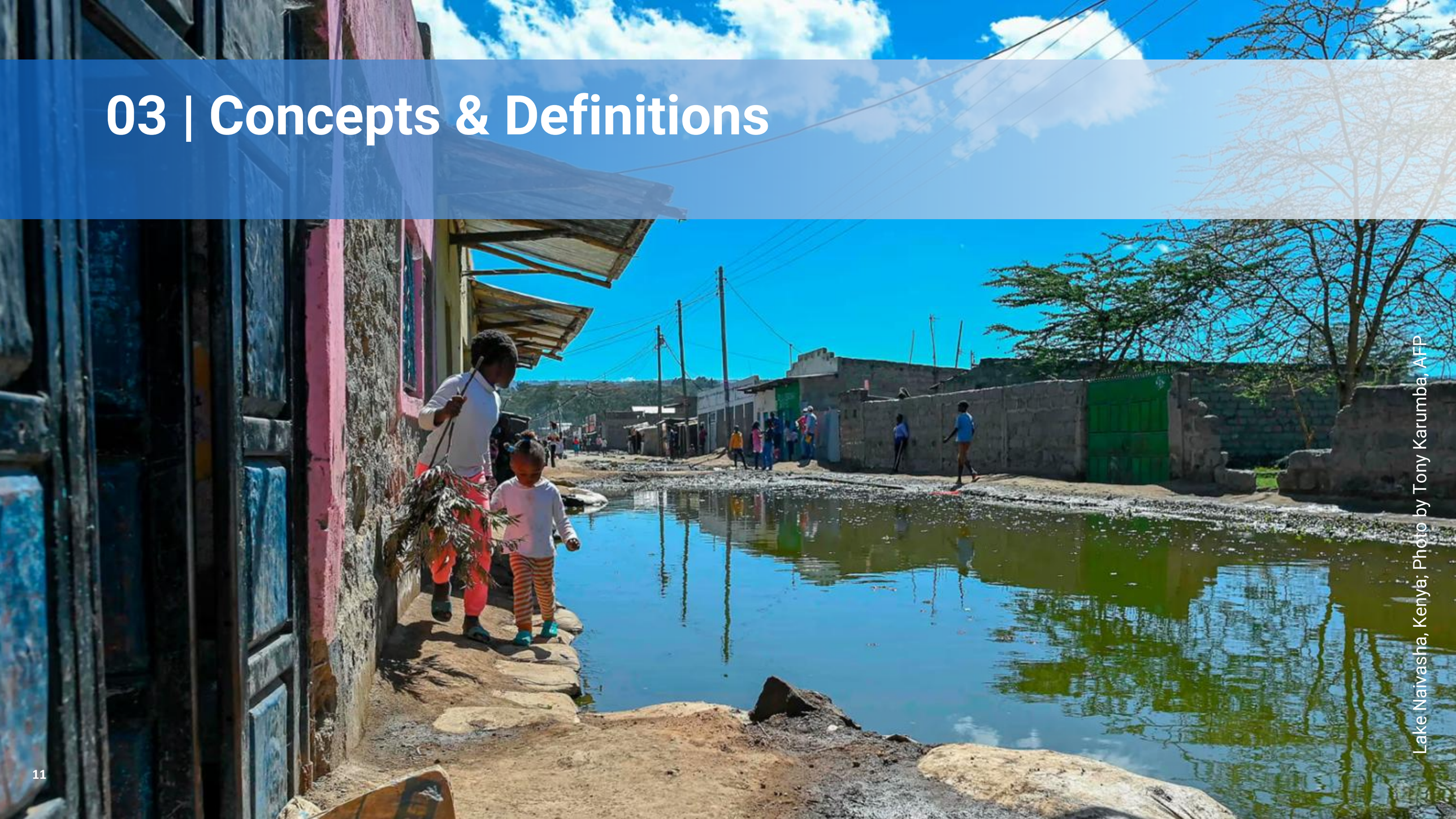
Outline the key steps involved in conducting a CRA.

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

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.

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.

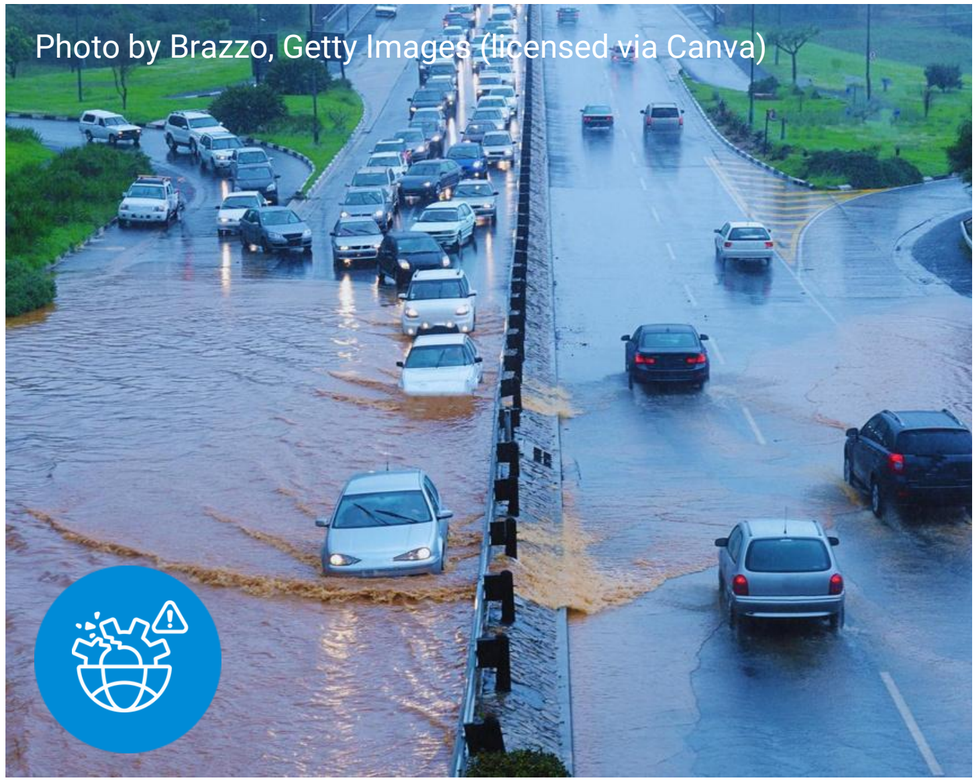


Photo by Brazzo, Getty Images (licensed via Canva)

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.


Photo by Africa Images, Canva

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.


Kenya; Photo by IHH Humanitarian Relief Foundation

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 Kenya

Photo by DW

Urban climate hazards in Kenya

- **Extreme precipitation and storms** lead to increased flood risks in Kenya, impacting disaster management, development planning, and local livelihoods.
- **Increased rainfall** causes water levels to rise in lakes including Lake Naivasha, Lake Nakuru, Lake Victoria, and Lake Turkana causing flooding in the respective cities.
- **Flooding** caused by a combination of factors including heavy rainfall, poor drainage, urban expansion, poor urban planning (e.g. construction on flood prone areas).
- **Drought** caused by prolonged periods without rain.
- **Heat stress** caused by extreme high temperatures, with record temperatures above 30 °C recorded in Nairobi, Mombasa and Lodwar town (39.8 °C).
- **Sea level rise** in coastal cities and municipalities e.g. Mombasa, Malindi and Lamu. It is projected that sea level rise of only 0.3m would submerge about 17% of Mombasa.

Rising lake levels in rift valley; Photo by Baz Ratner, Reuters

Urban climate hazards in Kenya

Extreme precipitation: Inundated section of Nairobi-Thika Highway. Photo by Xinhua News Agency

Increased rainfall in Mombasa;
Photo by Nairobi Leo

Flooding in Lake Victoria
Photo by Thomas Mukoya, Reuters

Landslides: damaged railway in Kijabe;
Photo by James Wakibia, SOPA Images

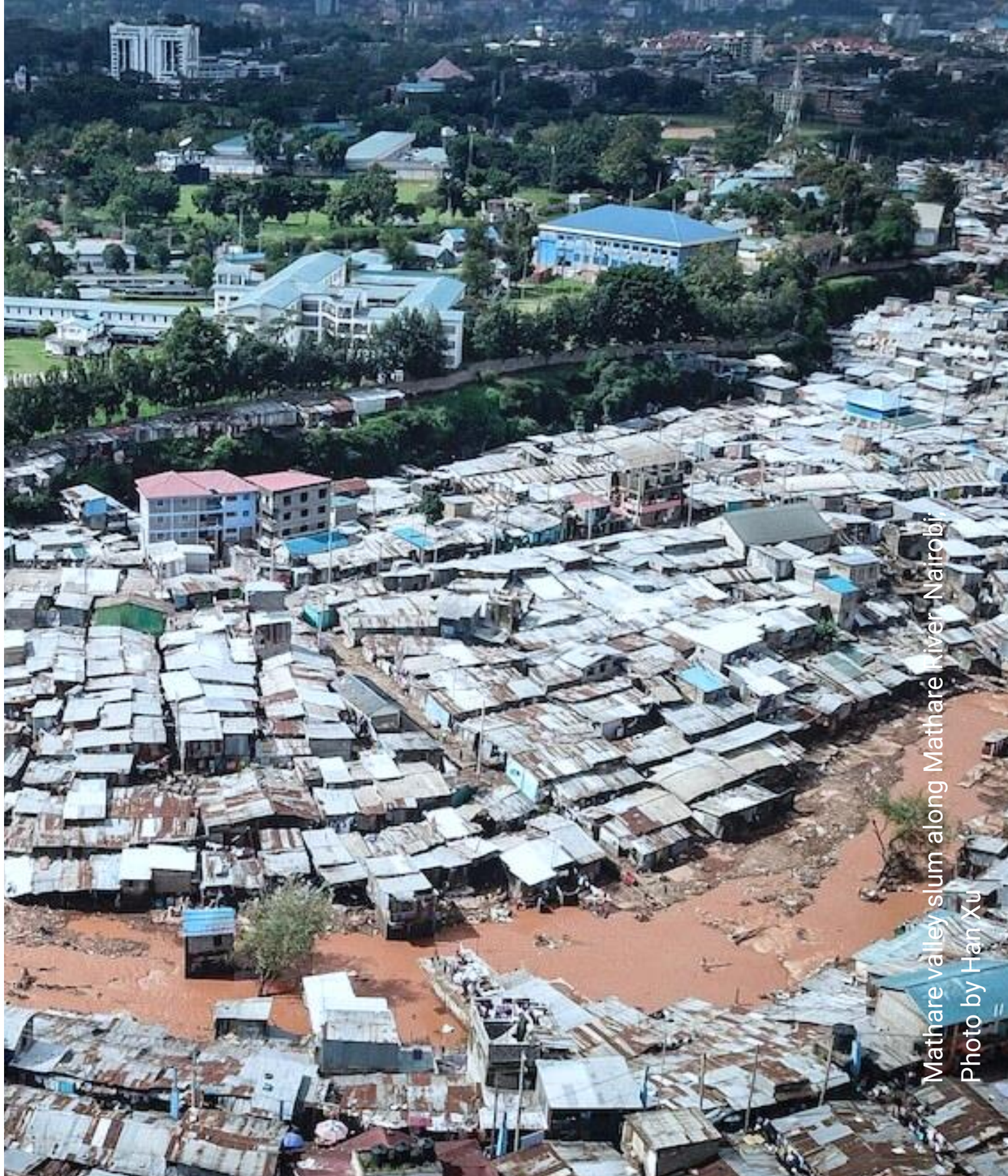
Droughts: dry riverbed in Isiolo;
Photo by Denis Onyodi, KRCS, CC

Heat stress;
Photo by Stephen Oduor, Nation Media Group

Climate impacts on marginalized groups

Informal settlements

- An estimated 55-60% of Kenya's urban population resides in informal settlements/slums, most of which are located on hazard prone sites such as river valleys, riparian zones, wetlands and derelict lands.
- These settlements are characterized by congestion, poorly constructed structures, limited or deficient infrastructural provisions, and high levels of poverty, which increase residents' vulnerability to climate impacts.
- They are highly susceptible to flooding, heat stress, water stress, and landslides which exacerbate health risks, cause loss of lives & livelihoods, displacement and forced migration.

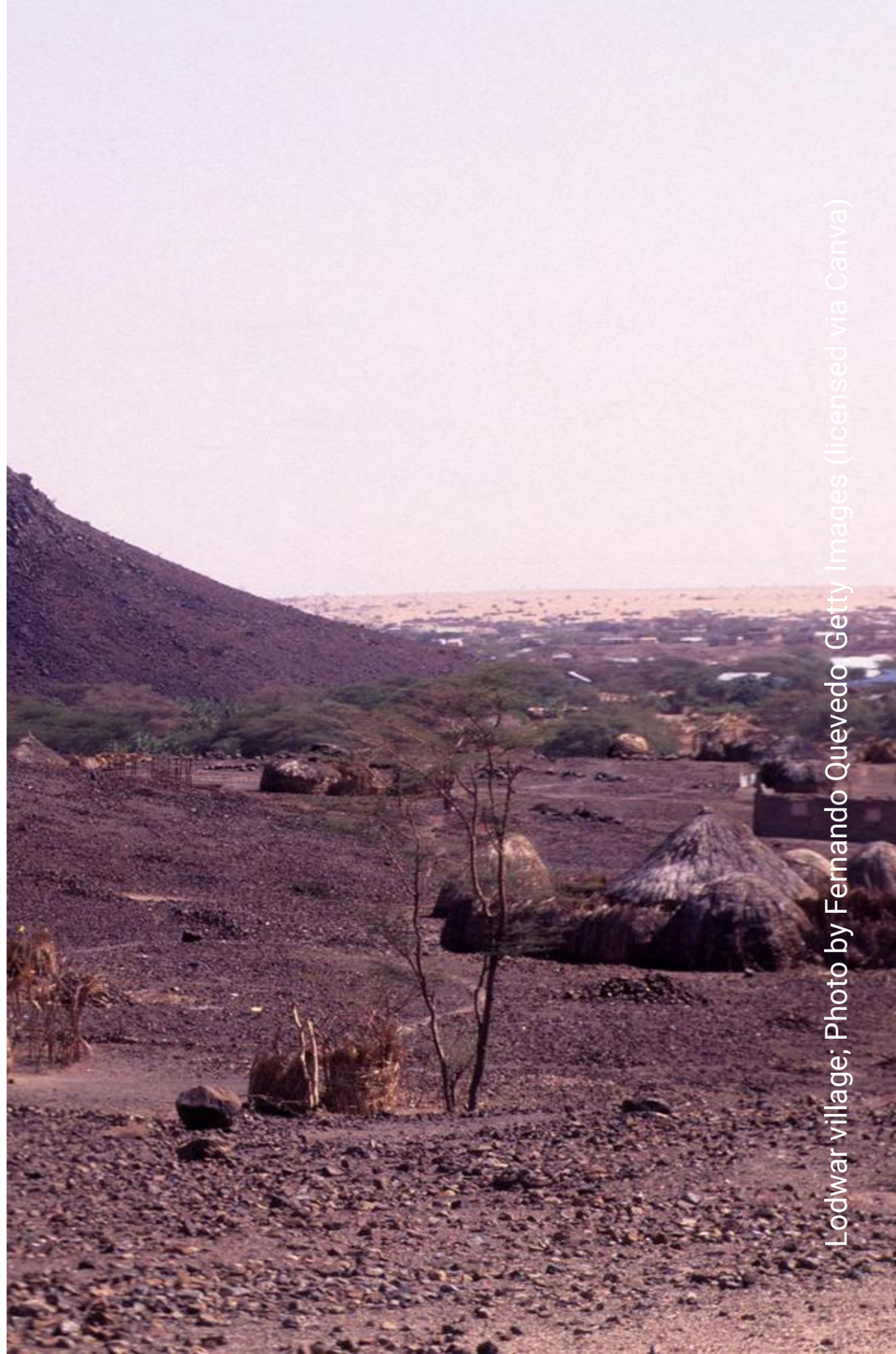


Mathare valley slum along Mathare River, Nairobi
Photo by Han Xu

Climate impacts on marginalized groups

Communities in Arid and Semi-Arid urban regions

- Arid and Semi-Arid lands (ASALs) are characterized by low and erratic rainfall, high temperatures, and sparse vegetation.
- They have historically been disconnected from national economic development due to geographical distance and lack of accessibility. Typically, they have insufficient infrastructure e.g. road networks, water, and electricity, which further exacerbates their isolation, impoverishment and underdevelopment.
- Urban areas in these regions include municipalities such as Lodwar (Turkana), Hola (Tana river), Isiolo, Maralal (Samburu), Marsabit, Kitui, Wote (Makueni), Kabarnet (Baringo), Garissa, Wajir, Mandera, Kapenguria (West Pokot); and towns such as Eldama Ravine (Baringo), Oloitokitok (Kajiado), among others.
- These communities are highly vulnerable to extreme drought, flooding, and heat stress, leading to water scarcity, food insecurity, livelihood disruption, health risks, conflict & migration.



Lodwar village; Photo by Fernando Quevedo, Getty Images (licensed via Canva)

Climate impacts on marginalized groups

Women & girls:

- A combination of social, economic, and cultural factors intersect with climate impacts making women and girls disproportionately vulnerable to climate risks.
- These factors include gender roles and responsibilities; limited resources; economic dependence; health risks, gender-based violence and limited decision-making power.

People living with disabilities

- These people face physical barriers that limit their mobility and ability to access information, services, and resources during climate-related emergencies e.g. inaccessible infrastructure and limited transportation options can hinder evacuation efforts and access to shelters.
- They are also more likely to experience poverty and economic marginalization, which can limit their ability to prepare for and recover from climate-related impacts.

Women in ASAL regions travel long distances for water; Photo by Bartosz Hadyniak

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.

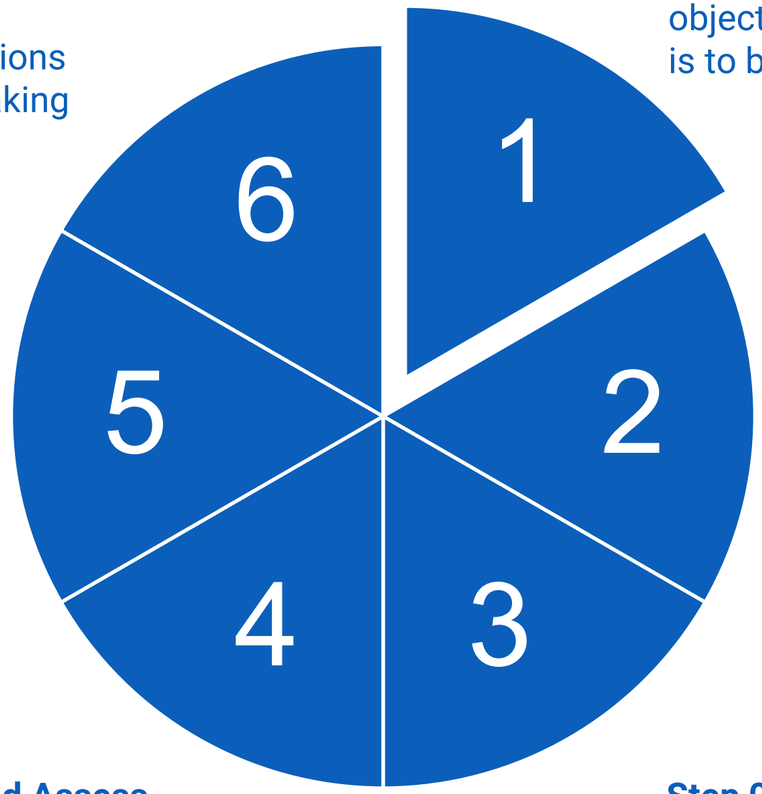
Step 02 | Assess hazards Identify the probability, intensity and timescale of current and future climate hazards.

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?

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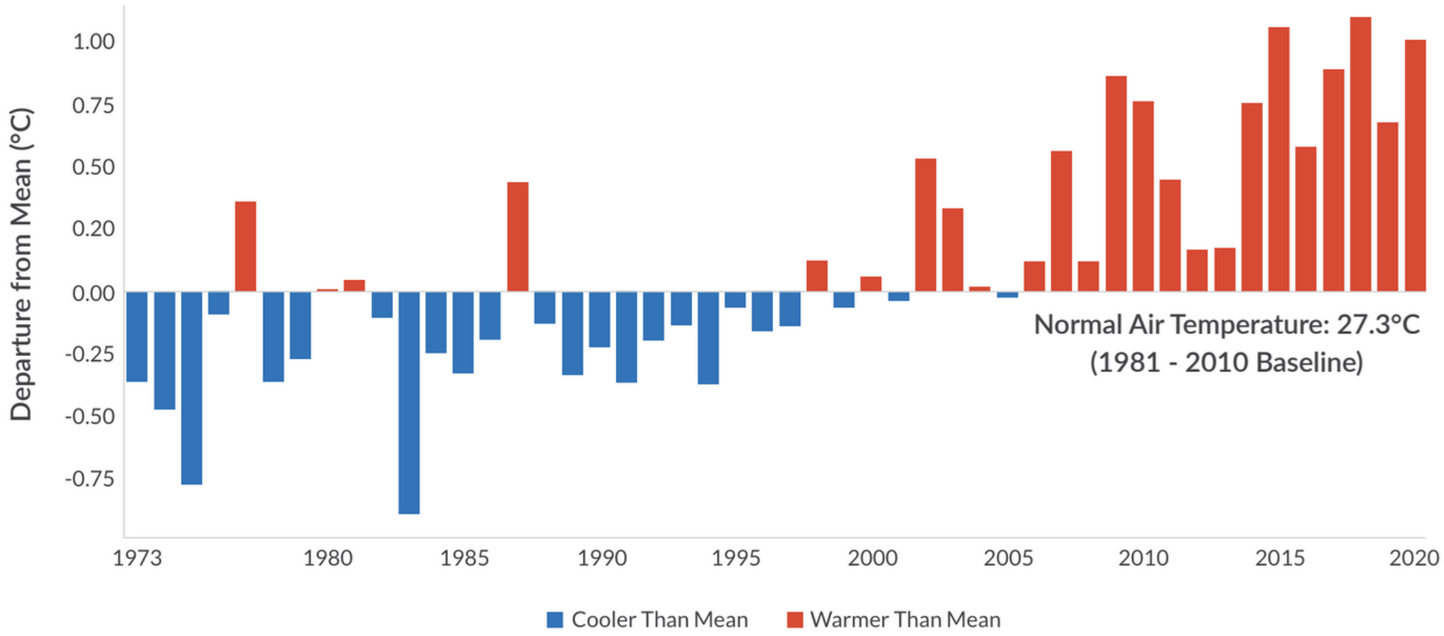
Case Study | Air Temperature 1973-2020 | Mumbai, India



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

2.2 | Select relevant hazard indicators

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**

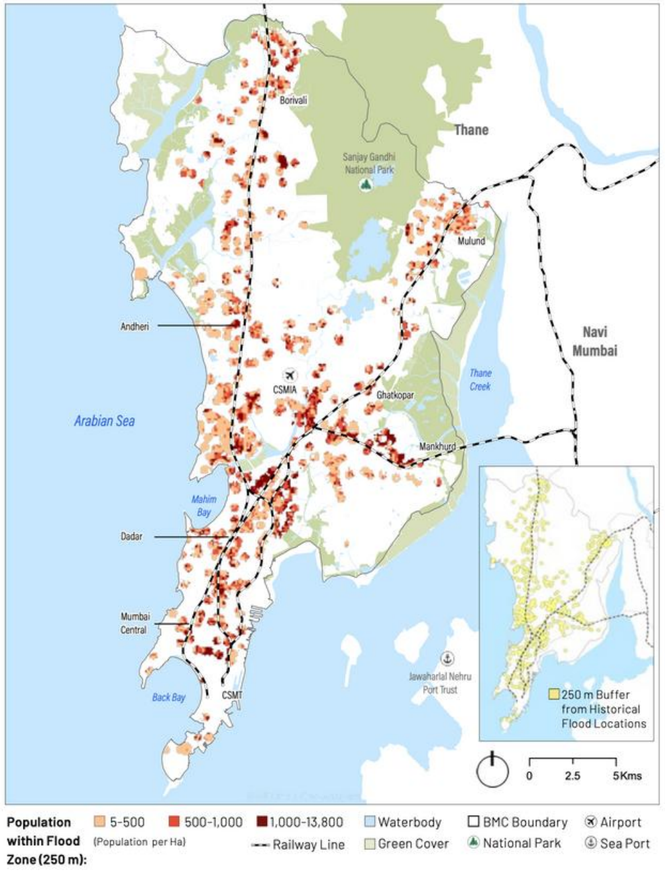
Adaptive capacity = potential of people and systems to adjust to the impacts of climate change or take advantage of opportunities that may arise from them.

Indicators may include:

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

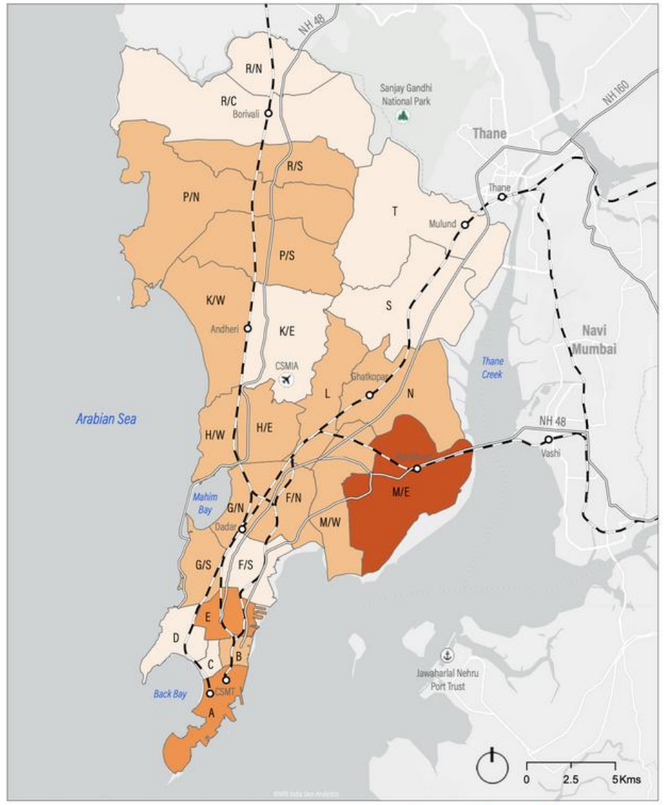
Step 03 | Assess impacts

Exposure



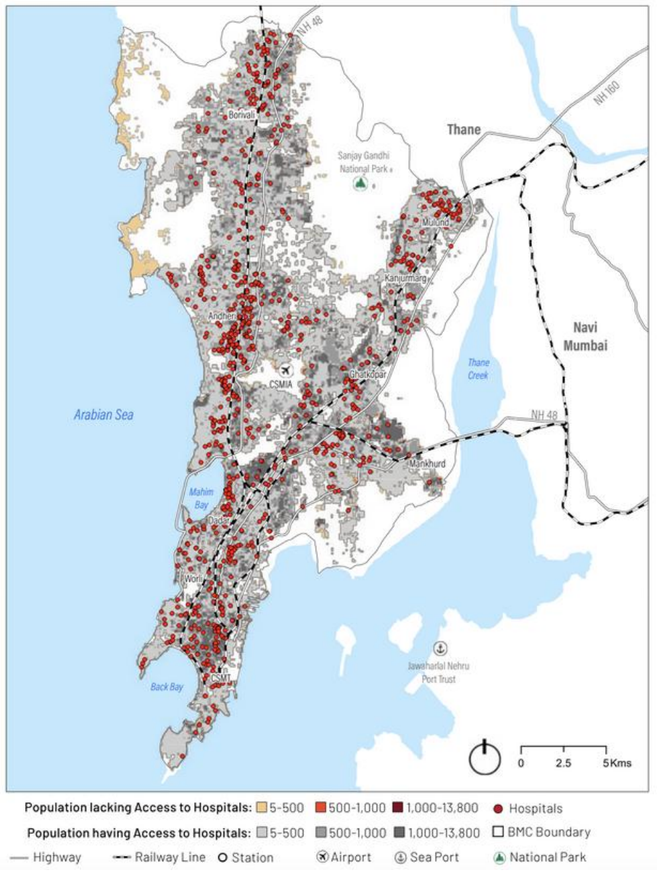
Population within flood zones (250m)
Mumbai's Climate and Air Pollution Risks and Vulnerability Assessment, 2022

Sensitivity



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

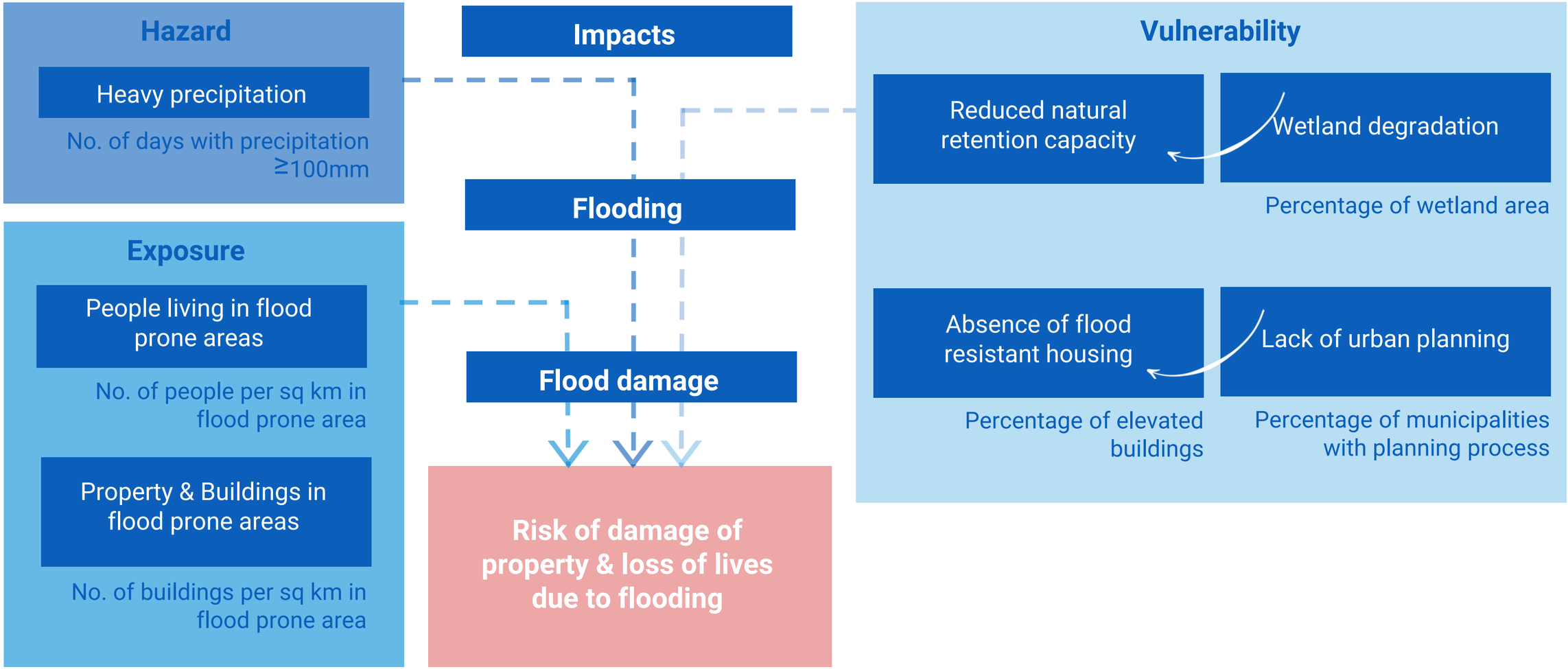
Adaptive Capacity



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



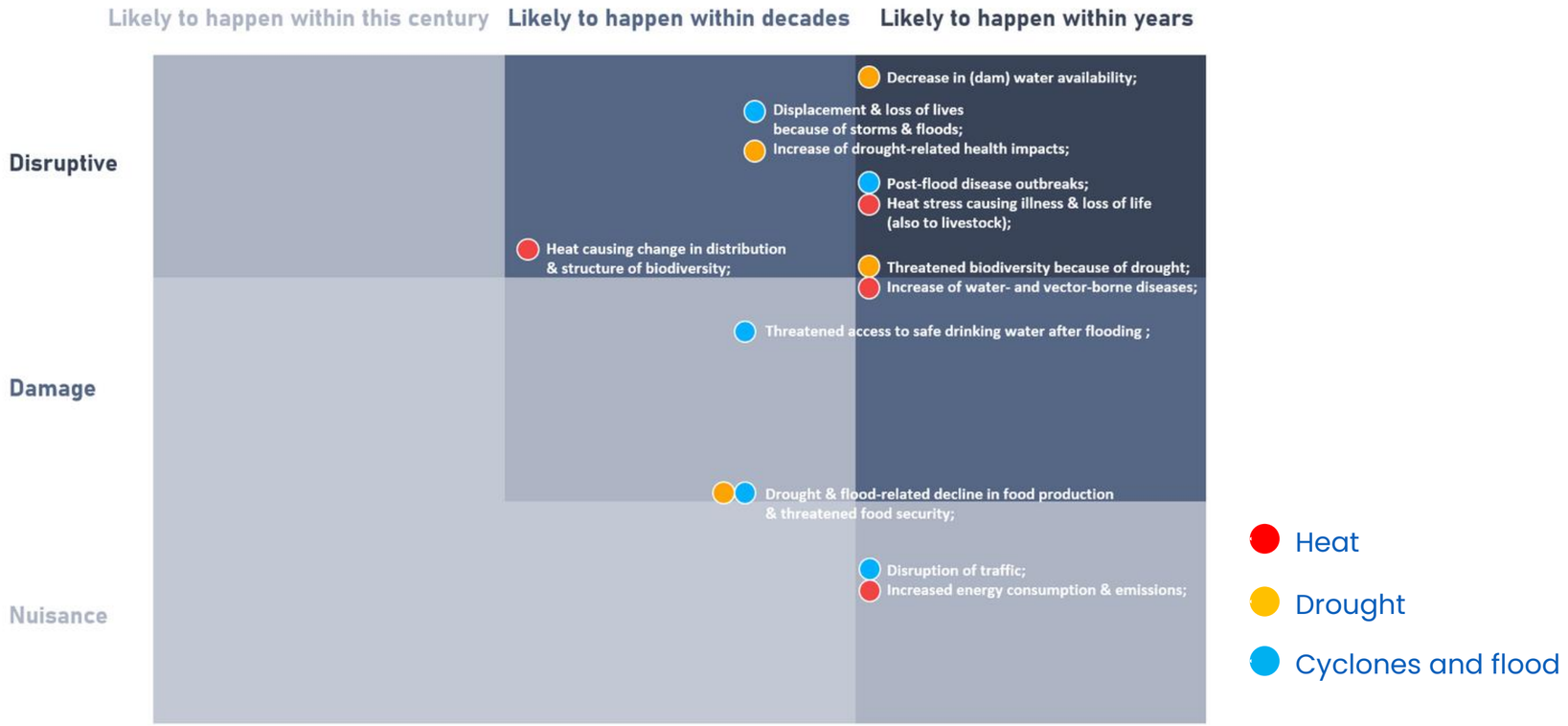
Step 04 | Identify & Assess Risks

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.

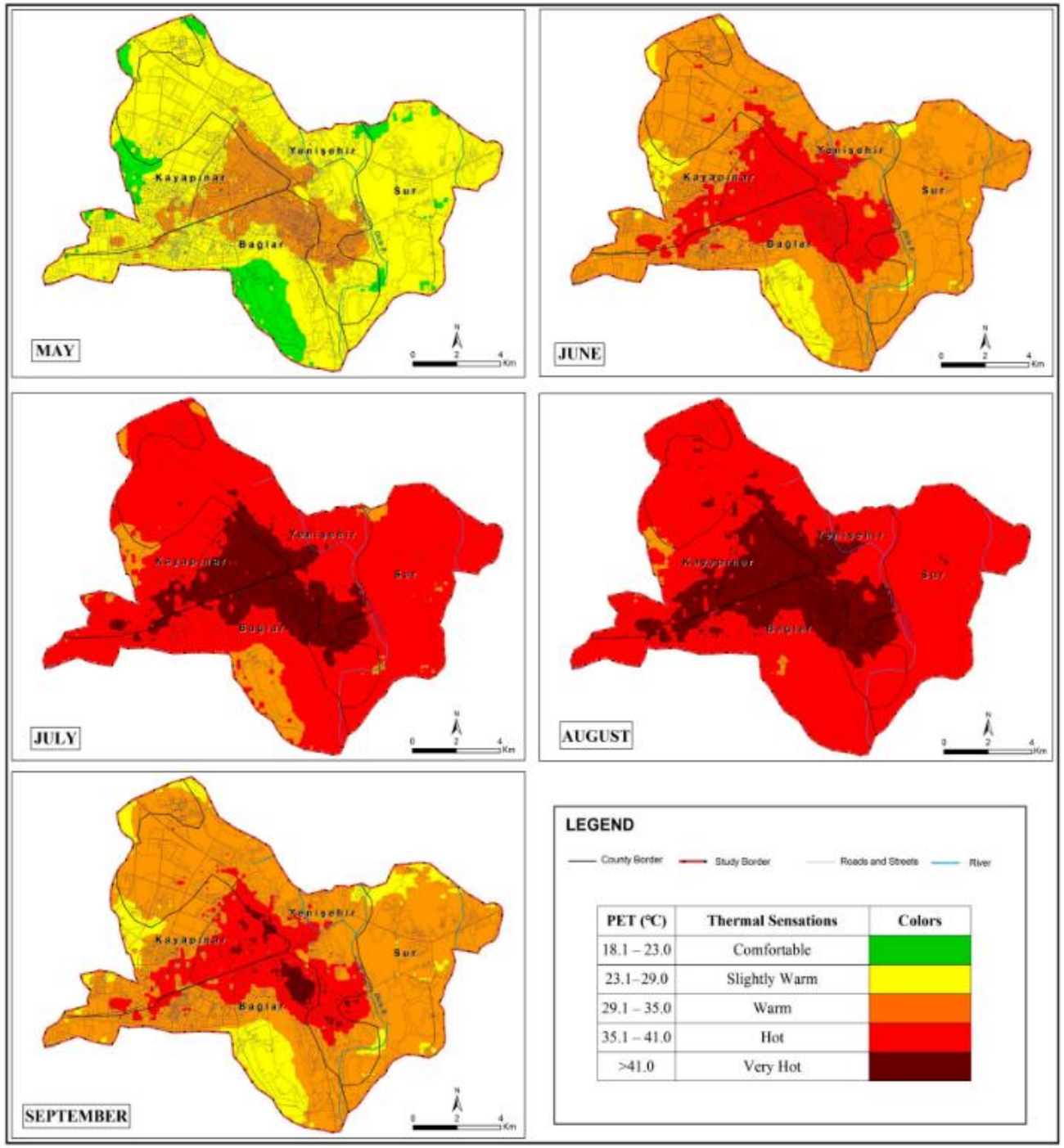
Photo by Riccardo Lennart Niels [illegible] Getty Images (licensed via Canva)

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

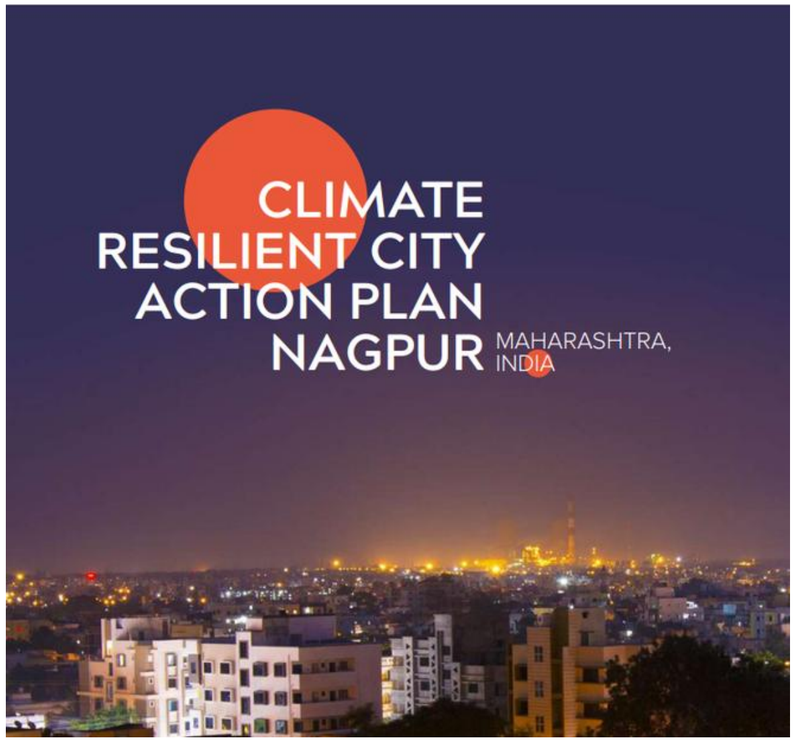


CRA Outputs | Risk Matrix

Case Study | Risk Matrix | Nagpur, India

URBAN LEDS
URBAN LOW EMISSION DEVELOPMENT STRATEGIES

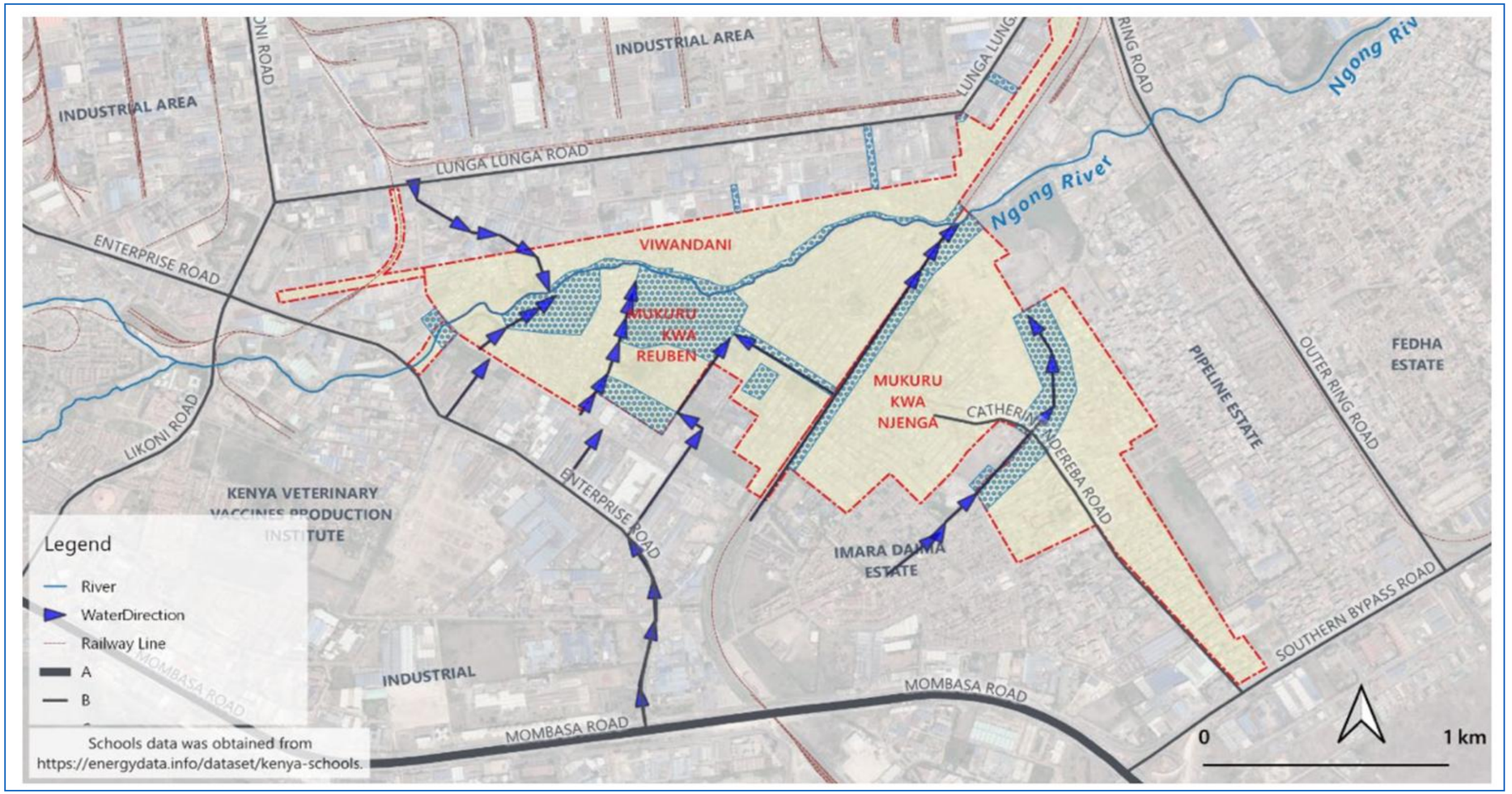
.nagpur



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

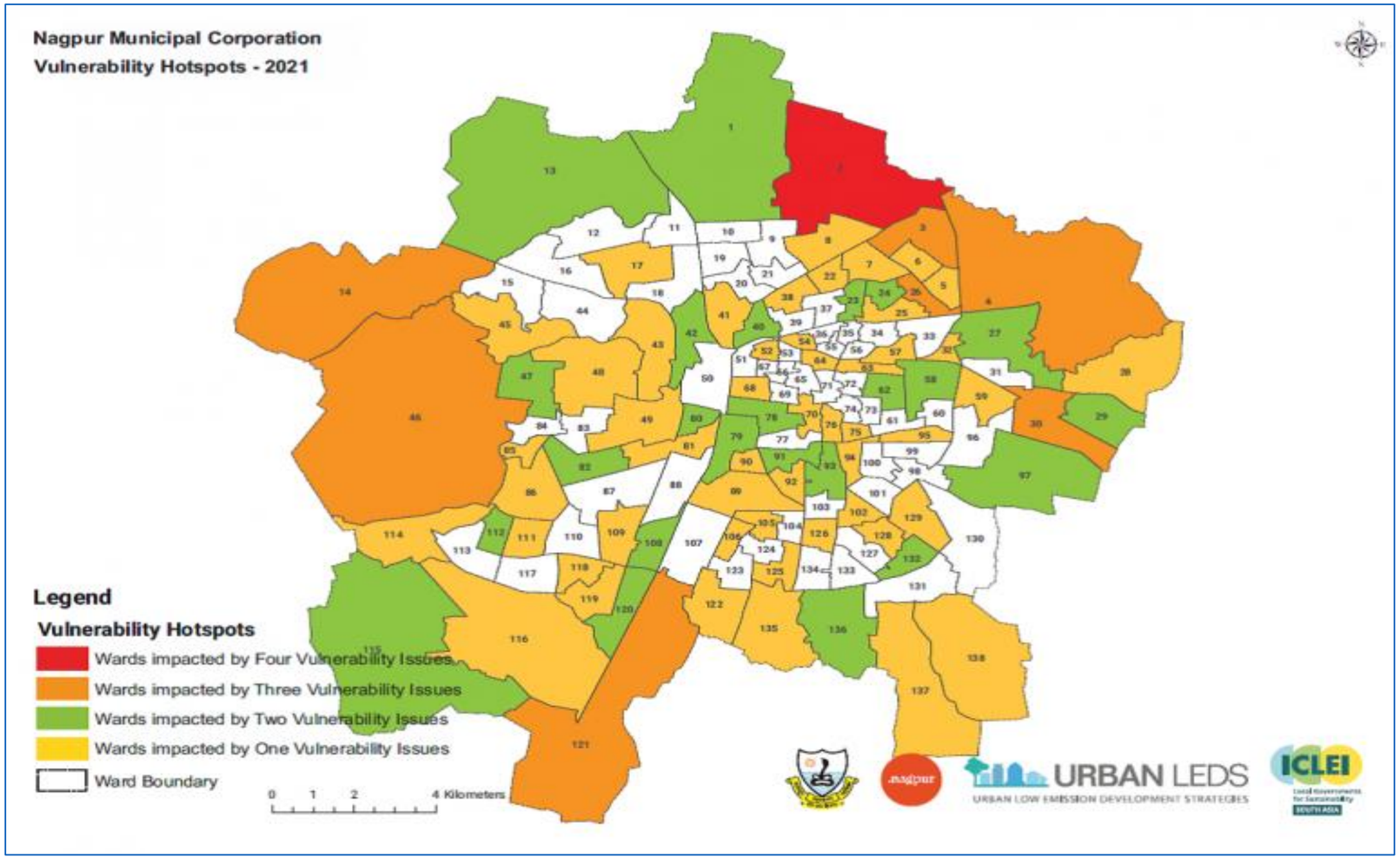
CRA Outputs | Hazard & Risk Maps

Case Study | Mukuru Flood Risk Map | Nairobi, Kenya



CRA Outputs | Vulnerability Maps

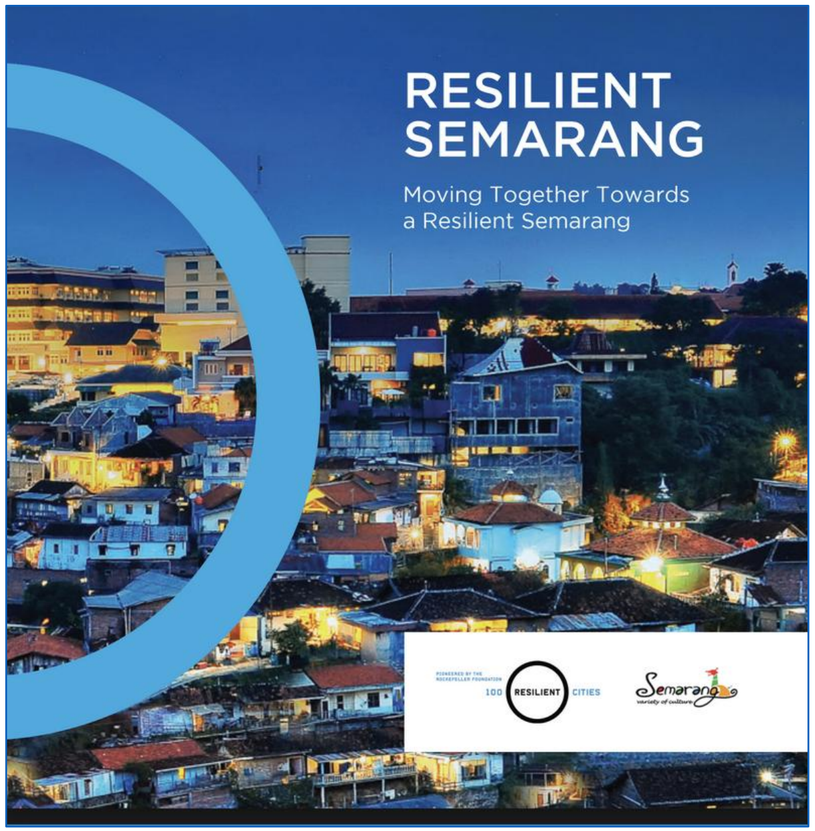
Case Study | Vulnerability Hotspot Map | Nagpur, India



Vulnerability hotspots, Nagpur (India)

CRA Outputs | Infographics

Case Study | Semarang, Indonesia

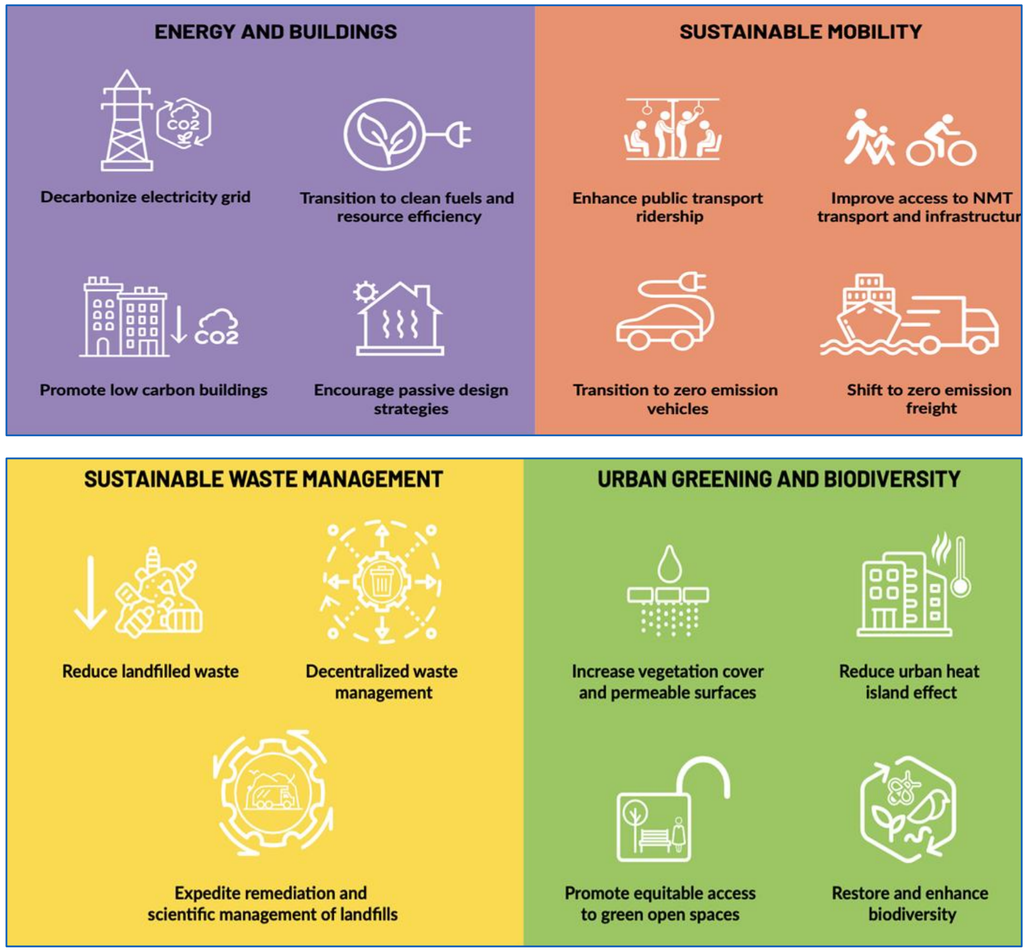


Shocks and stresses in Semarang:

- 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

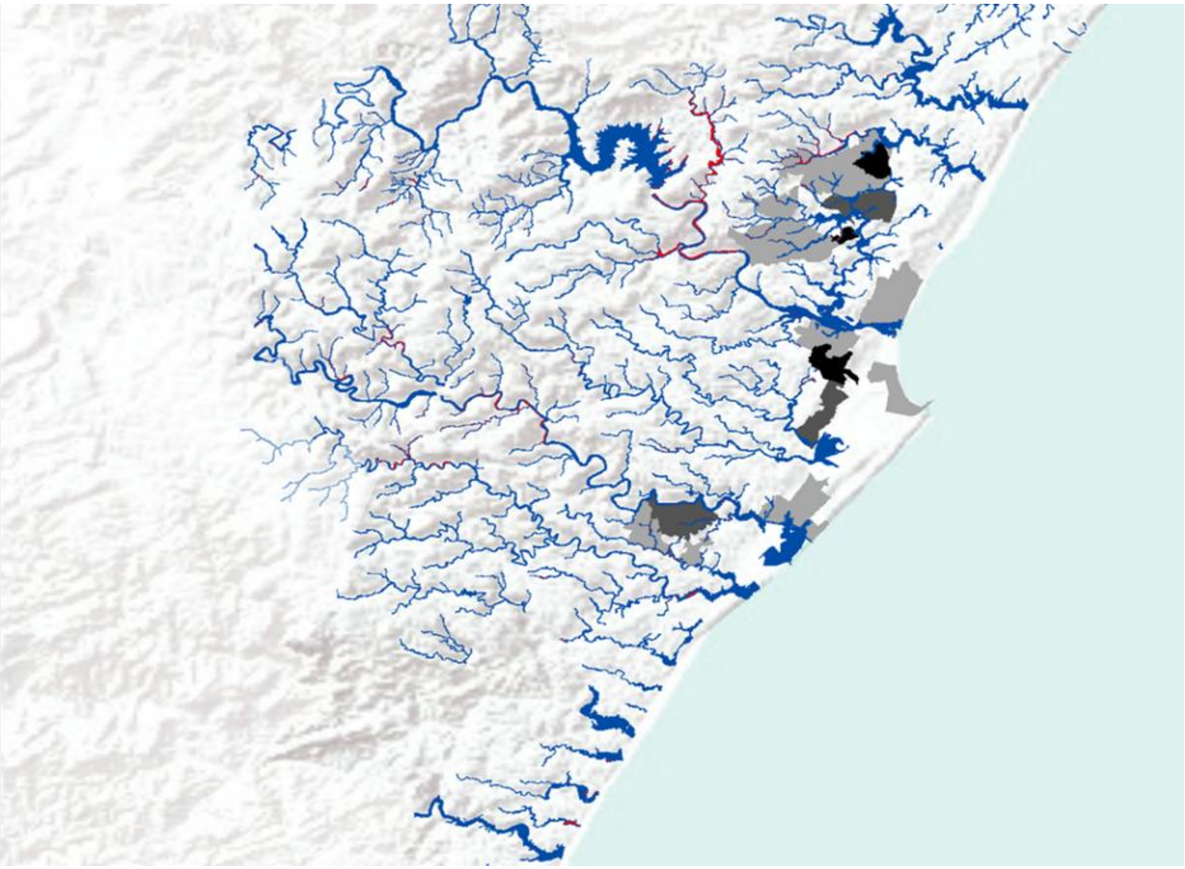
Case Study | eThekwini Municipality (Durban), South Africa

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.	

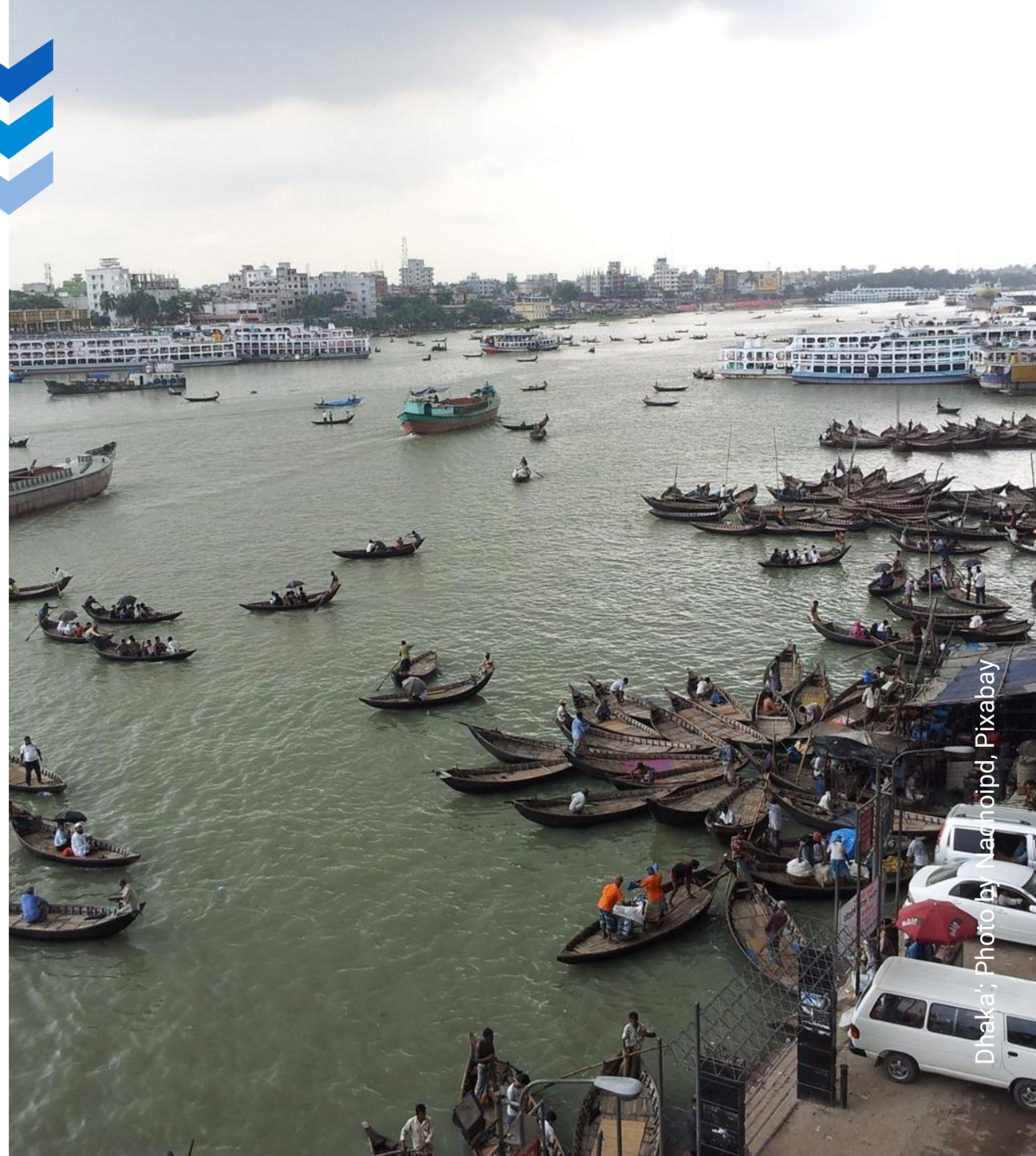
Risk is defined as the probability of occurrence times the magnitude of an impact. In order to assess Durban's climate risk, the likelihood of the climate impacts to occur and the damage in terms of severity related to these impacts need to be considered. Risks that are both likely to occur frequently 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 Study

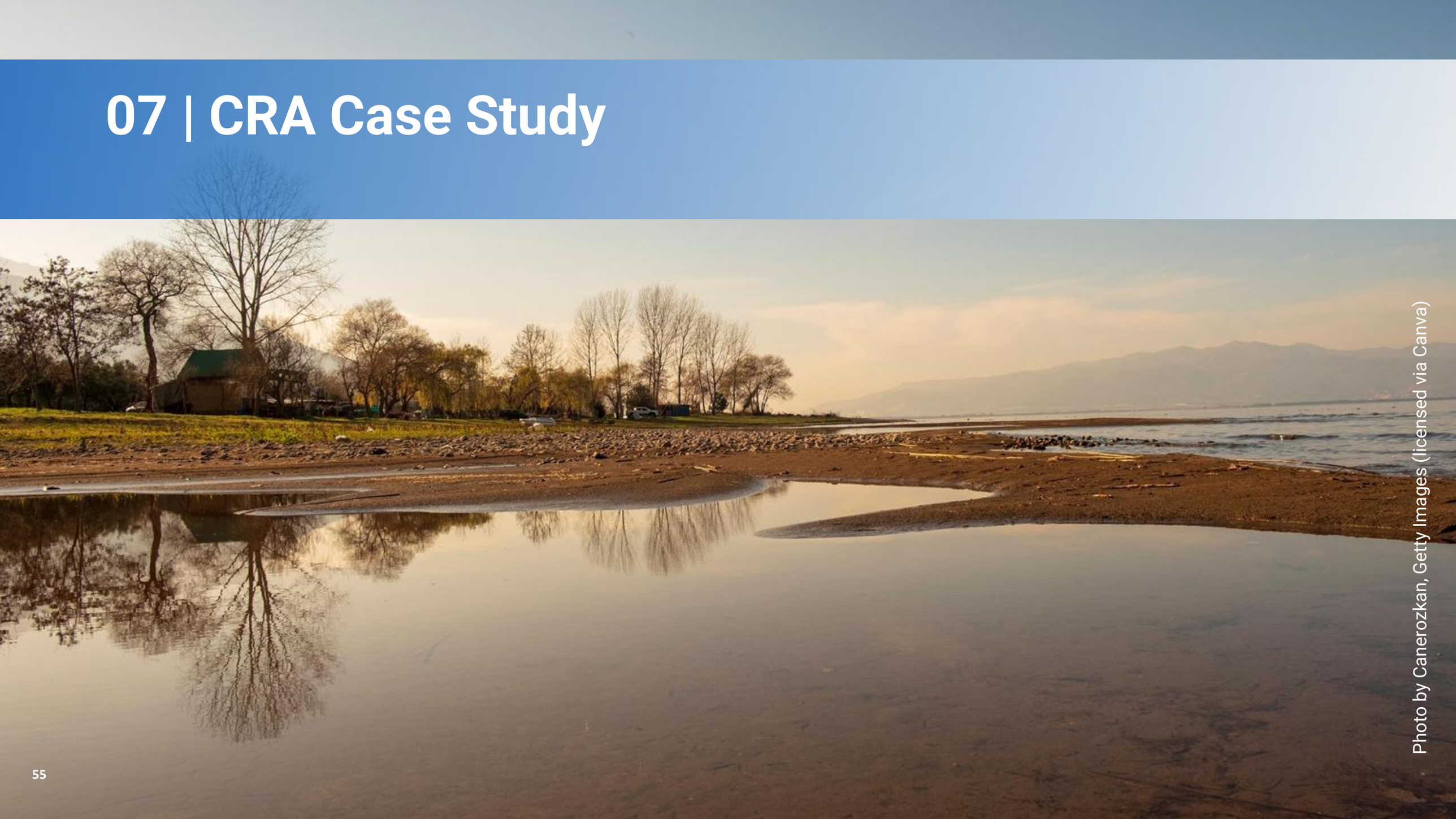


Photo by Canerozkan, Getty Images (licensed via Canva)

CRA Case Study | Isiolo Municipality, Kenya

Isiolo municipality is a predominantly arid urban area with a population of 121,061 people.

Isiolo experiences prolonged periods without rain (drought), often followed by spells of intense rainfall and floods.

Located on a low-lying floodplain and surrounded by steep slopes; this renders it susceptible to intense flooding from stormwater and flood water overflowing from a basin shared with neighbouring counties.

The arid terrain characterized by clay soil and sparse vegetation additionally hinders water permeation causing flooding during extreme precipitation. Flooding is exacerbated by poor stormwater drainage infrastructure.

Over the years, extreme weather events have impacted lives, livelihoods (mainly crop & livestock production) and infrastructure.

CRA Case Study | Isiolo Municipality, Kenya

Isiolo undertook a climate-smart Urban Economic Plan (UEP) which prioritised economic growth and climate resilient infrastructure to facilitate sustainable urban development.

Stakeholders involved: The UK Government, Isiolo county government and Isiolo Municipality through the Sustainable Urban Economic Development (SUED) programme.

A rapid CRA was undertaken to develop the environmental and climate change risk profile of the municipality.

CRA data included: historical and projected rainfall and temperature data, agroecological data, topographical data.

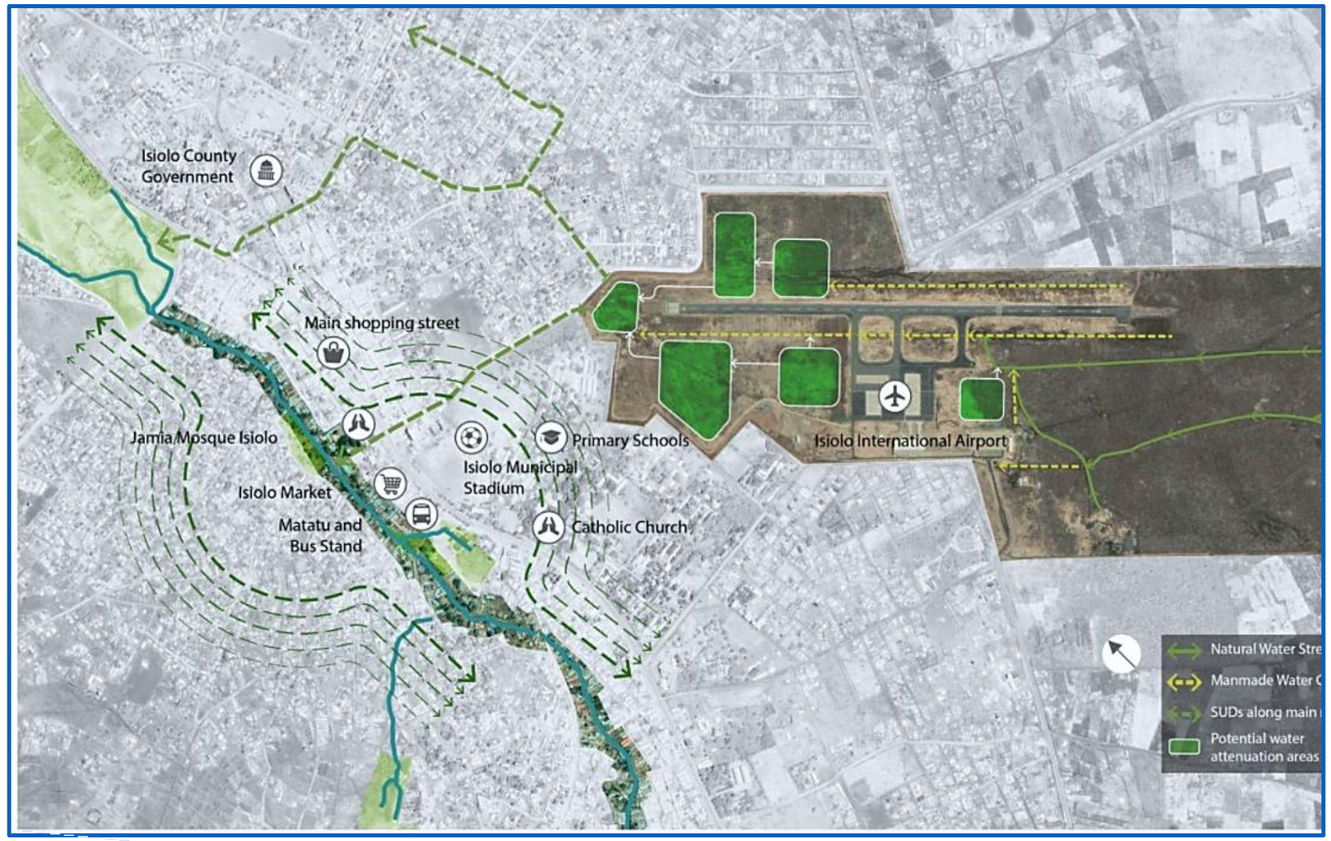
Sectoral focus: a SWOT analysis of various sector was undertaken (crop and livestock production, retail, water, infrastructure, energy, waste management, etc.).

CRA Case Study | Isiolo Municipality, Kenya

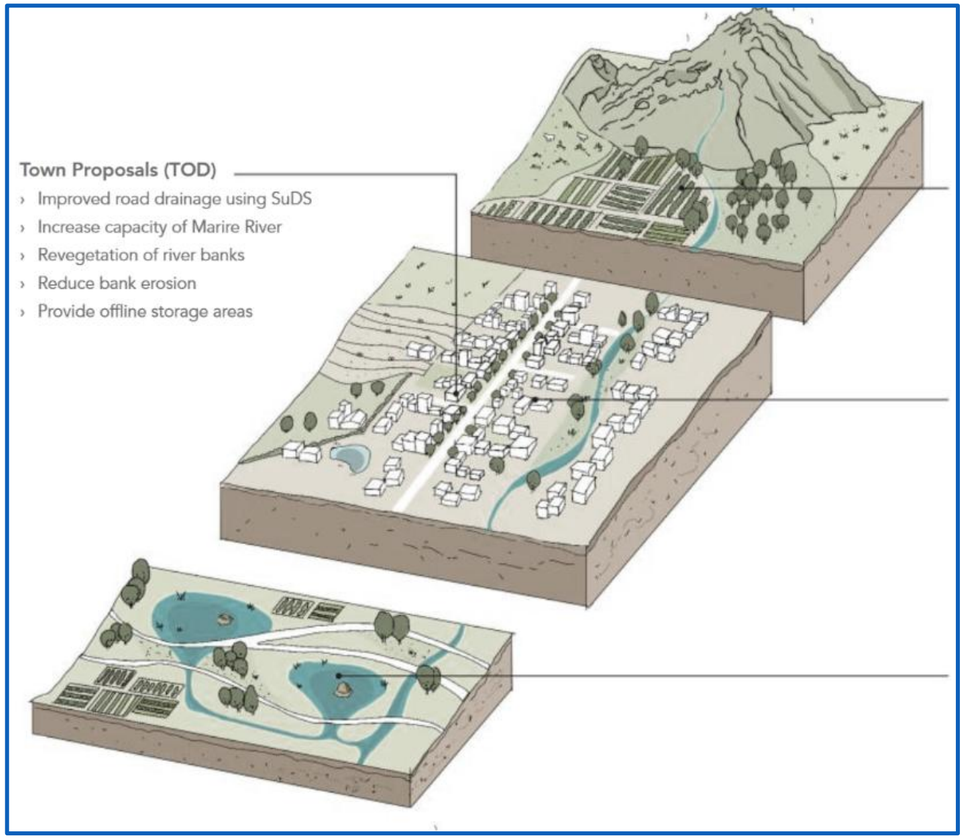
Hazards	Proposed priority resilience actions
Flooding	• **Development of Sustainable Urban Drainage System (SuDS)** to prevent flooding in the Central Business District of Isiolo municipality. Entails construction of drainage channels around Isiolo airport and feeder roads within the municipality as well as rehabilitation of drainage channels. • **Development of attenuation ponds:** SuDS would direct overflows to these ponds, which is estimated to absorb approx. 25% of the stormwater flowing into the municipality
Drought	• **Develop a semi-natural bio-park** to revegetate River Marire banks hence improve adaptation to water stress – and ensure water supply for farmlands and livestock watering points.

CRA Case Study | Isiolo Municipality, Kenya

Proposed flood and drought management interventions in Isiolo



Map showing proposed flood and drought management interventions
Source: Tetra Tech International Development (2020)



Prioritised actions
Source: Tetra Tech International Development (2020)

08 | How to Procure a CRA

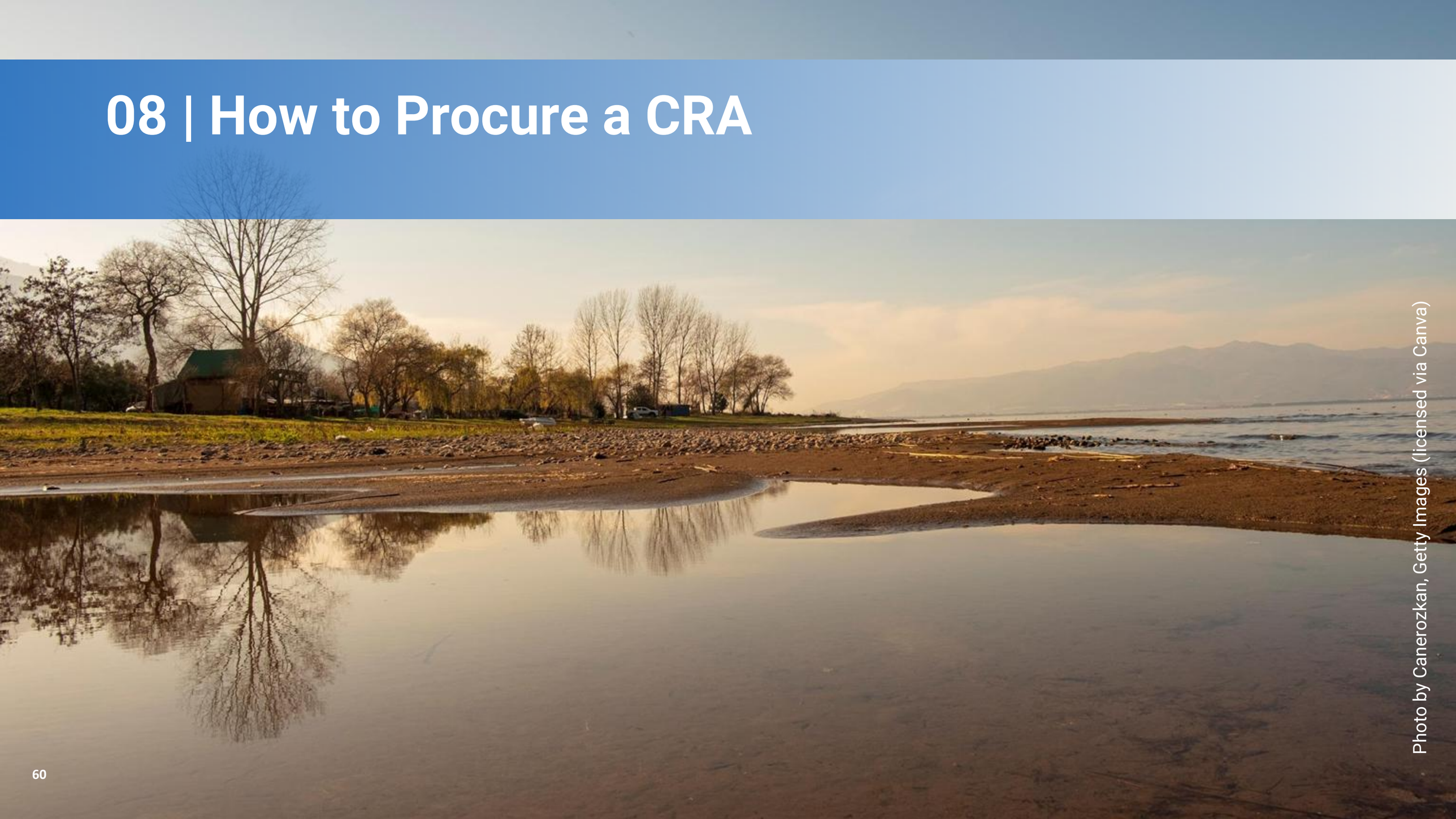


Photo by Canerozkan, Getty Images (licensed via Canva)

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.**

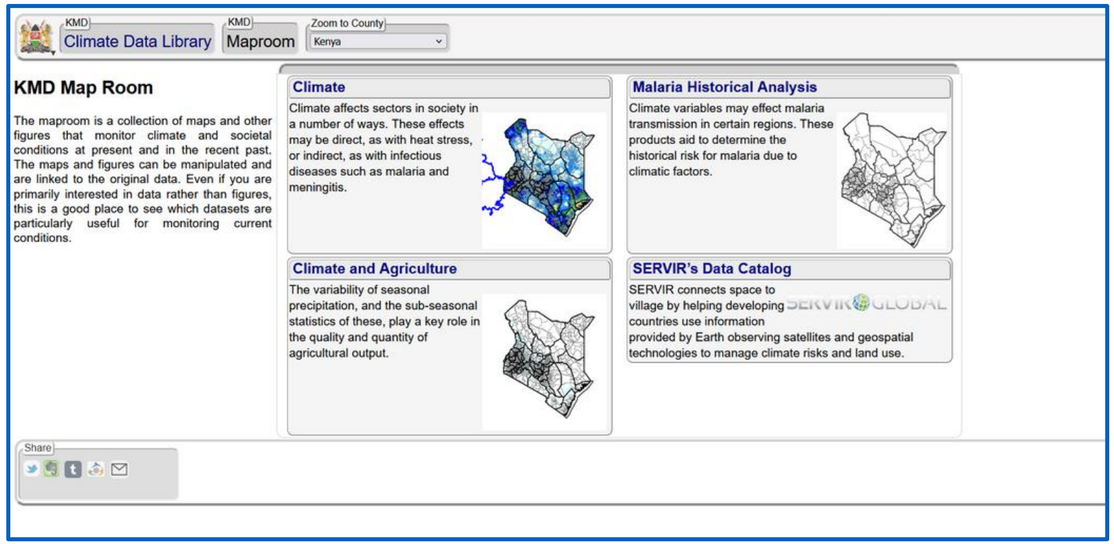
Annex 1 | Climate Risk Assessments in Kenya

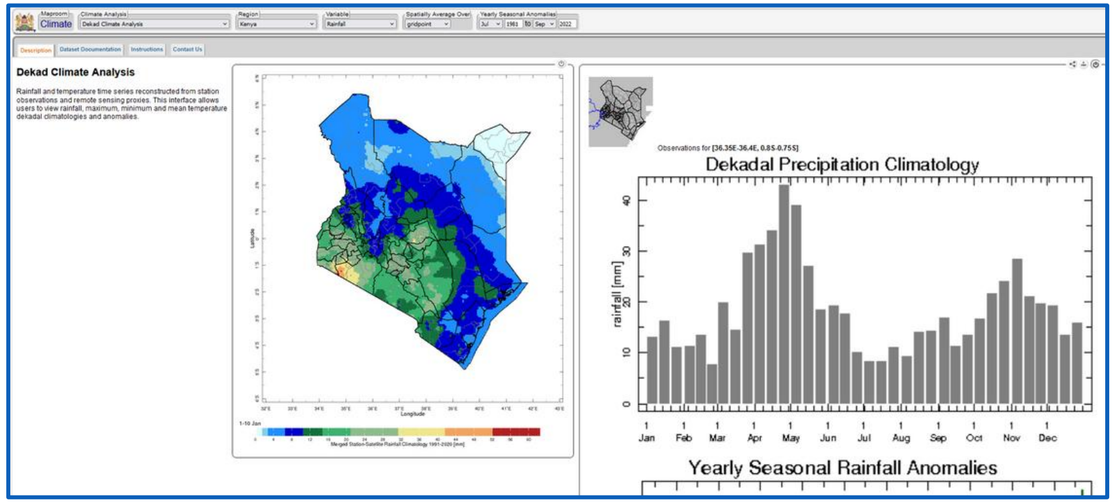
Kenya; Photo by UNICEF

Climate-related data in Kenya

National Meteorological data

- Kenya Meteorological Department (KMD), provides meteorological and climatological services to sectors including water resource management, agriculture, forestry, civil aviation and the private sector, research institutes etc.
- National meteorological data include systematic observations of temperature, precipitation, humidity, atmospheric pressure, wind patterns over time.
- The data is used for climate monitoring and analyses, climate impact assessments, and climate modelling and forecasts.
- The data is openly available to everyone online in a climate data library, accessible via: **http://kmddl.meteo.go.ke:8081/maproom/**

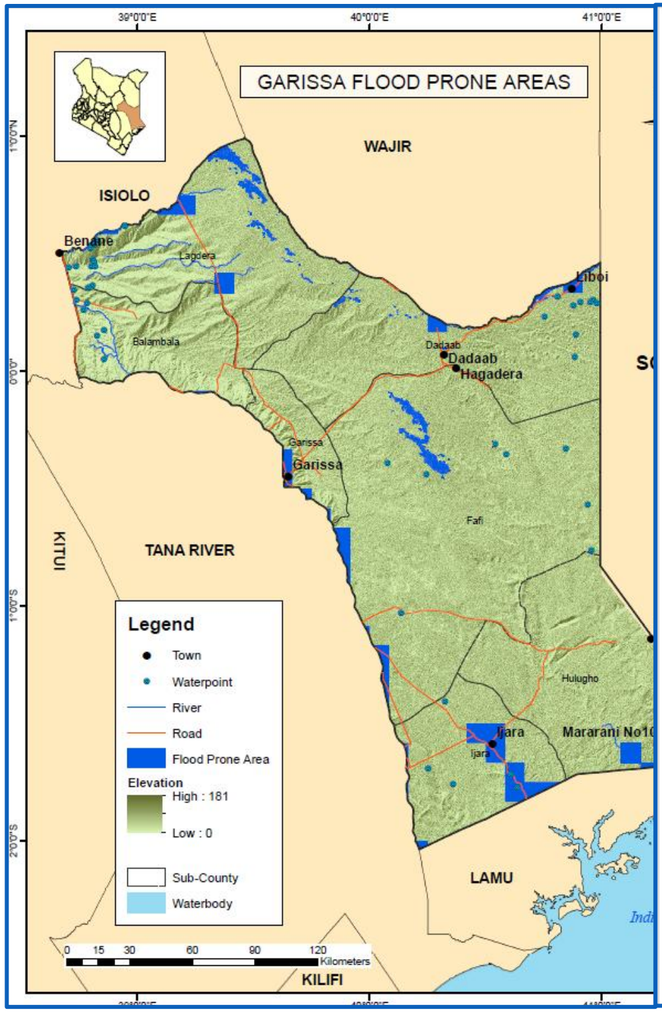


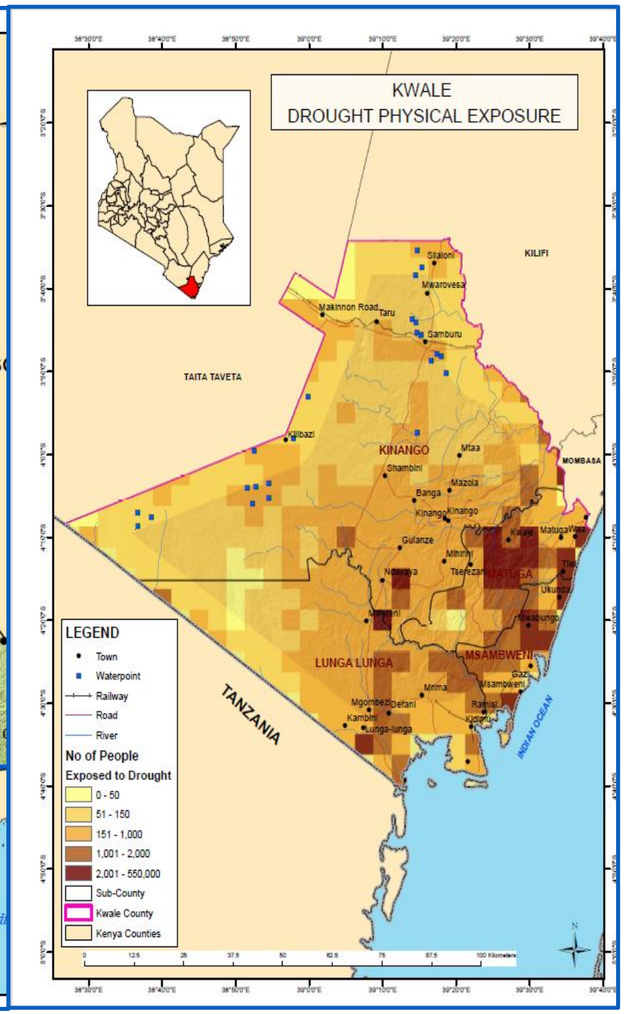


Source: Kenya Meteorological Department

Climate-related data in Kenya

- **Hazard atlases** are produced by the Regional Centre for Mapping of Resources for Development (RCMRD)
- They provide maps of potential climate hazards and their associated risks, which help to communicate complex climate-related information to policymakers, emergency responders, and communities
- Hazard maps can inform land use planning and development (zoning regulations, building codes, and infrastructure planning) by identifying areas prone to natural hazards such as floods, earthquakes, landslides, and droughts etc.
- Hazard related datasets are openly available via: **https://opendata.rcmrd.org/pages/atlases**





Source: Regional Centre For Mapping Of Resources For Development

Accessing climate-related data in Kenya

Government agencies

Agency	Type of climate-related data
Kenya Meteorological Department (KMD)	Data on temperature, rainfall, humidity, wind speed, and other atmospheric parameters.
National Drought Management Authority (NDMA)	Drought information including satellite imagery, remote sensing, and data on rainfall, temperature, soil moisture, and other indicators.
Kenya Forest Services (KFS)	Data on forest cover, deforestation rates, and forest health, forest carbon stocks data.
Water Resources Authority (WRA)	Hydrological data including river/water flow, lake levels, ground water, water quality, evapotranspiration, precipitation and flood data
National Environmental Management Authority (NEMA)	Data on air quality, greenhouse gas emissions, and climate change impacts.

Accessing climate-related data in Kenya

Regional intergovernmental organizations

Agency	Type of climate-related data
Regional Centre for Mapping of Resources for Development (RCMRD)	• Satellite data for monitoring land cover changes, vegetation health, and surface temperatures • Weather and climate models for future climate scenarios simulations • Remote sensing data for monitoring parameters such as rainfall, temperature, soil moisture, and vegetation dynamics • Climate datasets e.g. historical climate records, projections, and climate indices • Hydrological data such as river discharge, water quality, and groundwater levels • Hazard maps on floods, droughts, and landslides vulnerability (county level maps)
IGAD Climate Prediction and Applications Centre (ICPAC)	• Historical and real-time observations of weather parameters e.g. temperature, rainfall, humidity, wind speed and direction, atmospheric pressure, and solar radiation. • Climate models & forecasts • Drought monitoring & early warning data • Seasonal climate outlook &forecasts • Flood risk maps • Historical climate data

Accessing climate-related data in Kenya

Research institutes

Agency	Type of climate-related data
Kenya Marine and Fisheries Research Institute (KMFRI) hosts the Kenya National Oceanographic Data Centre	Spatial and temporal datasets on marine and aquatic biodiversity including sea surface temperatures, fish stocks, and coral health
International Livestock Research Institute (ILRI) Kenya	Data on livestock health, productivity, and grazing patterns and related climate impacts
International Centre for Research in Agroforestry (ICRAF)	Data on tree cover, soil health, and climate-smart agricultural practices.
University of Nairobi Institute for Climate Change and Adaptation (ICCA)	Data on climate impacts, vulnerability, and adaptation strategies
Kenya Red Cross	Data on climate-related disasters, vulnerabilities, and community responses.

Accessing climate-related data in Kenya

Multilateral organizations

Agency	Type of climate-related data
World Bank	Data on climate impacts, economic assessments, and adaptation strategies.
United Nations Environment Programme (UNEP)	Data on greenhouse gas emissions, environmental health, and climate impacts.
Food and Agriculture Organization (FAO)	Climate risk assessments to identify vulnerabilities and prioritize adaptation measures in agricultural systems. Agroclimatic data e.g. temperature, rainfall, humidity, solar radiation, and wind patterns to support climate smart agriculture.
United Nations Development Programme (UNDP)	Data on community vulnerability, resilience building, and project impacts.
United Nations Children's Fund (UNICEF)	Dashboard for identifying risks associated with climate and environmental shocks and stresses: the Kenya Subnational Children Climate Risk Index-Disaster Risk Model (CCRI-DRM).

CRA Expertise in Kenya

Kenya Meteorological Department: analyses historical and current climate data, including temperature, rainfall, humidity, and extreme weather events, to identify trends, patterns, and potential risks associated with climate variability and change at macro-level (national and county)

Regional Centre for Mapping of Resources for Development generates county hazard maps constituting spatial data on risk and vulnerability at national and county level

Universities and Research institutes: some of the climate experts from these intuitions have been relied upon by counties to guide CRAs

Photo by Rein Skullerud, WFP

Challenges in undertaking CRAs in Kenya

Data limitations: inadequate availability, accuracy and accessibility of reliable climate data, including historical weather observations, climate projections, and socio-economic data especially at city/municipal level

Capacity constraints: insufficient technical expertise, resources, and institutional capacity at the national and county levels to undertake CRAs effectively and interpret complex climate science and modelling outputs

Interagency & interdisciplinary coordination: Ineffective communication and collaboration among diverse stakeholders

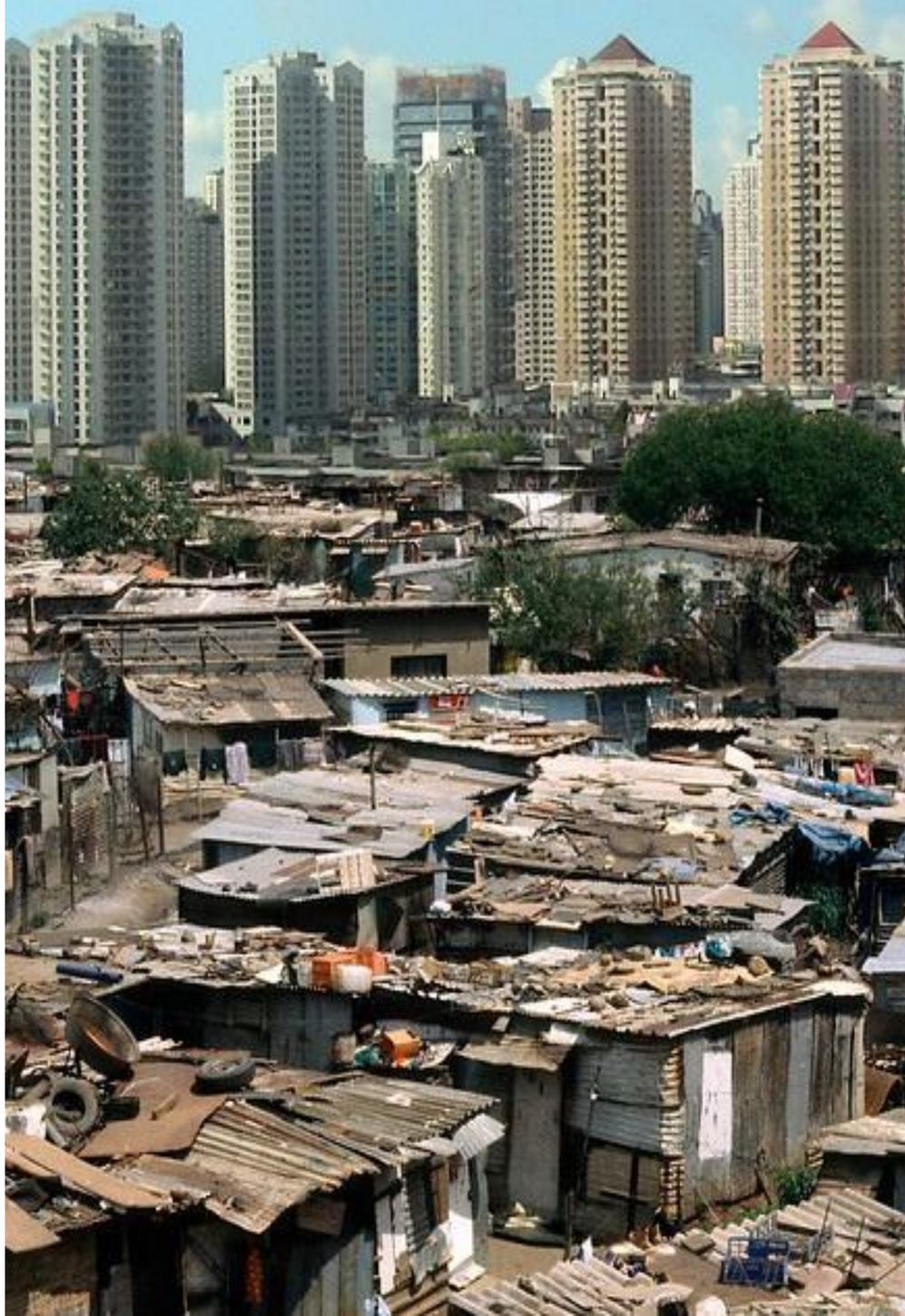

Photo by AFP

Challenges in undertaking CRAs in Kenya

Integration into planning processes: institutional inertia and competing priorities has hindered embedding climate risk into existing planning frameworks and decision-making processes at county, city and municipal levels, for example in development plans, land use planning, and infrastructure investments.

Funding constraints: limited financial resources and funding mechanisms for conducting CRAs, implementing adaptation measures, and building climate resilience.

Community engagement: engaging local communities in the CRA process to understand their vulnerabilities, priorities, and adaptation needs requires time, resources, and culturally appropriate approaches.

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