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WRI INDIA

An Introduction to the Climate Hazard Vulnerability Assessment Framework

A tool to prioritize resilience actions in cities

5 February 2025

9:30-10:45 GMT; 10:30-11:45 CEST; 12:30-13:45 EAT; 15:00-16:15 IST; 16:30-17:15 WIB

Part 1 of a 3-part webinar series on measuring and mitigating urban climate risks

Live Interpretation

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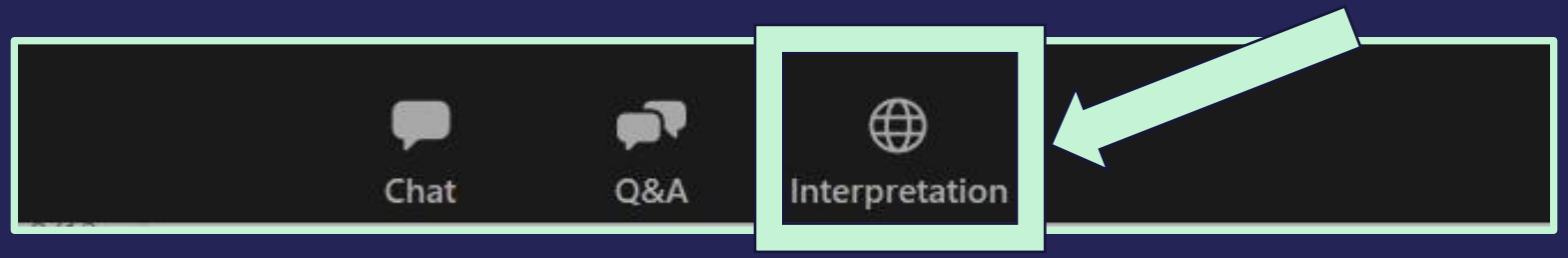

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SUPPORTED BY: LED BY:

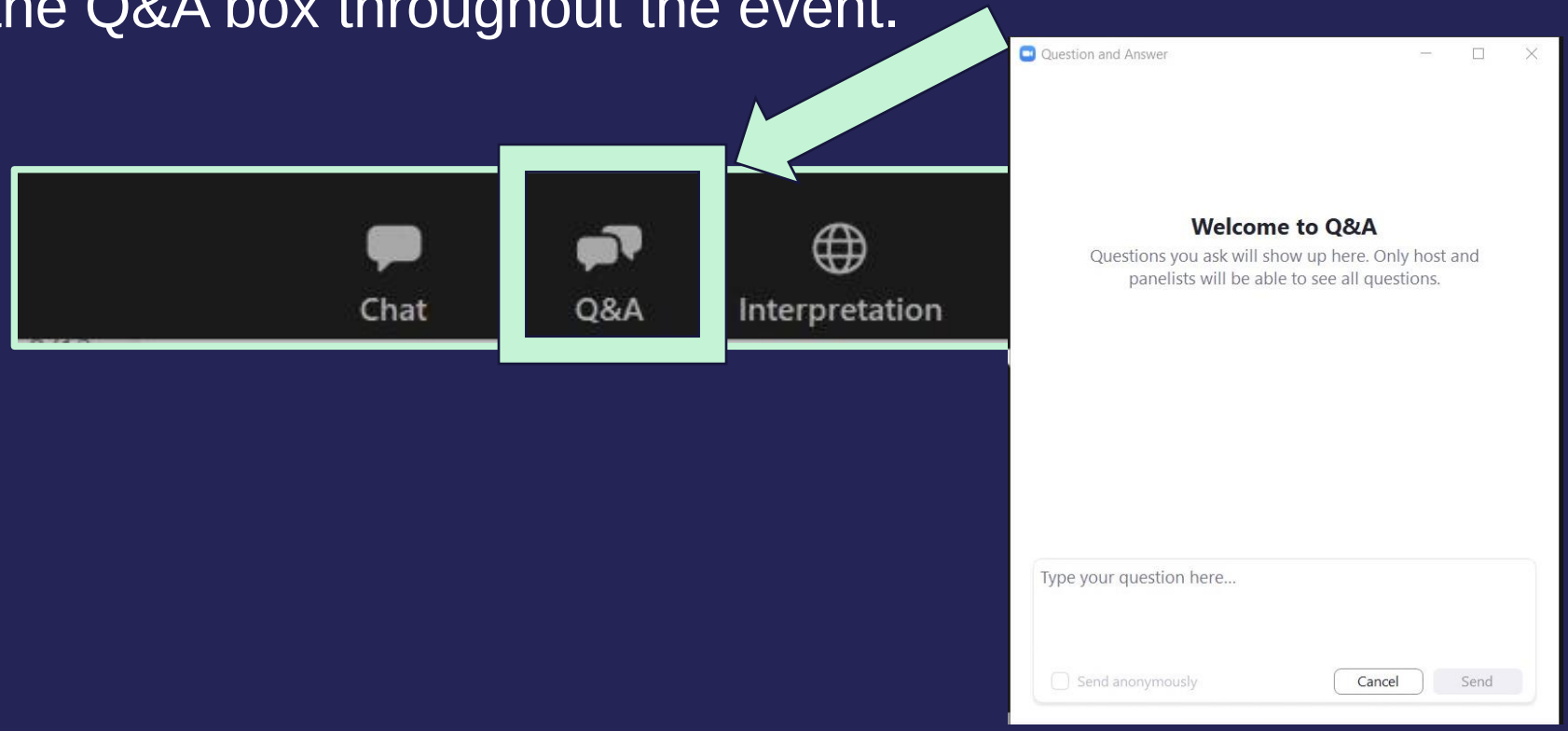
URBAN SHIFT | gef | UN environment programme

IN PARTNERSHIP WITH:

WORLD RESOURCES INSTITUTE | C40 CITIES | ICLEI Local Governments for Sustainability | UNDP | THE WORLD BANK | ADB

Audience Questions

If you have any questions about the presentations during the event, feel free to enter them into the question and answer box. We have a dedicated Audience Q&A session after the main presentation, and will respond to other questions entered into the Q&A box throughout the event.



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AGENDA

- **Welcome and Housekeeping**: John-Rob Pool, WRI
- **Introductory Remarks:** Climate Hazards and the Need to Prioritize Resilience Actions in Cities: Deepti Talpade, WRI India
- **Presentation**: An Introduction to the ‘Climate Hazard and Vulnerability Assessment (CHVA)’ Framework to Prioritize Resilience Actions in Cities: Avni Agarwal and Bhanu Khanna, WRI India
- **Live Audience Q&A**
  - Moderator: John-Rob Pool
- **Closing remarks**: Deepti Talpade

Introductory Remarks—Climate Hazards and the Need to Prioritize Resilience Actions in Cities

Deepti Talpade, Program Lead, Urban Development and Resilience, WRI India

About the Session

- This module has been developed by **WRI India** with support from **UrbanShift** and **Cities4Forests**.
- It is based on WRI India's recent publication, **Climate resilient cities: Assessing differential vulnerability to climate hazards in urban India**.
- It is designed for **city officers, experts, NGOs, community-based organisations** and **practitioners** working towards urban climate action and resilience.
- This session will introduce the CHVA framework, encouraging users to capture the forms of **socio-political and economic inequality that determine the differential nature** of climate vulnerability.
- This framework offers cities a good first step towards building urban climate resilience and move from **assessment to inclusive planning and implementation**.

About the Session

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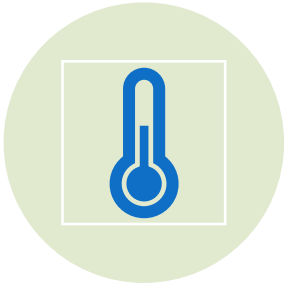
An Introduction to the 'Climate Hazard and Vulnerability Assessment (CHVA)' Framework to Prioritize Resilience Actions in Cities

Avni Agarwal and Bhanu Khanna, WRI India

Session structure



1. Why do we need to assess climate hazards and vulnerability?

2. Understanding WRI India's Climate Hazard and Vulnerability Assessment (CHVA) Framework

3. How do we operationalize the CHVA Framework?

4. Use cases and limitations of the CHVA Framework

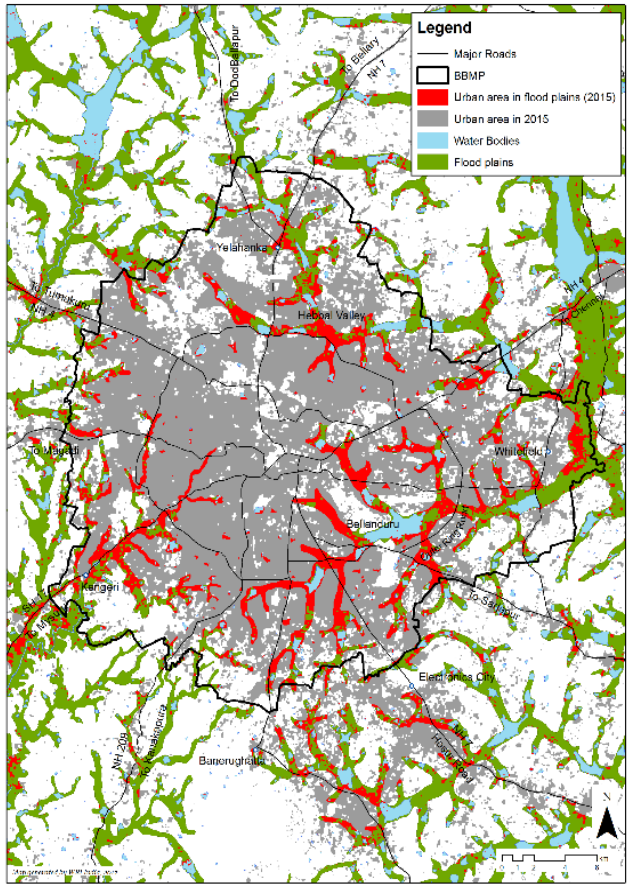
Two extremes of climate change

FLOODING

DROUGHT

This makes it critical to integrate risk and vulnerability mapping as part of urban plans, policies and strategies at all levels

How are cities expanding? And where are we building?



Example: 85% of floodplains in Bengaluru are built-up

Differential vulnerability: How climate catastrophes and hazards are experienced by different people and communities varies greatly depending on a range of social, economic, political and cultural factors.

The **Climate Hazard and Vulnerability Assessment (CHVA)** is a framework that helps urban planners, policymakers, and practitioners understand the interactions between climate hazards and socioeconomic factors

IPCC's Three Determinants of Risk

"The potential occurrence of a **natural or human-induced physical event or trend that may cause loss of life, injury or other health impacts,** as well as damage to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources" (IPCC 2022:2911).

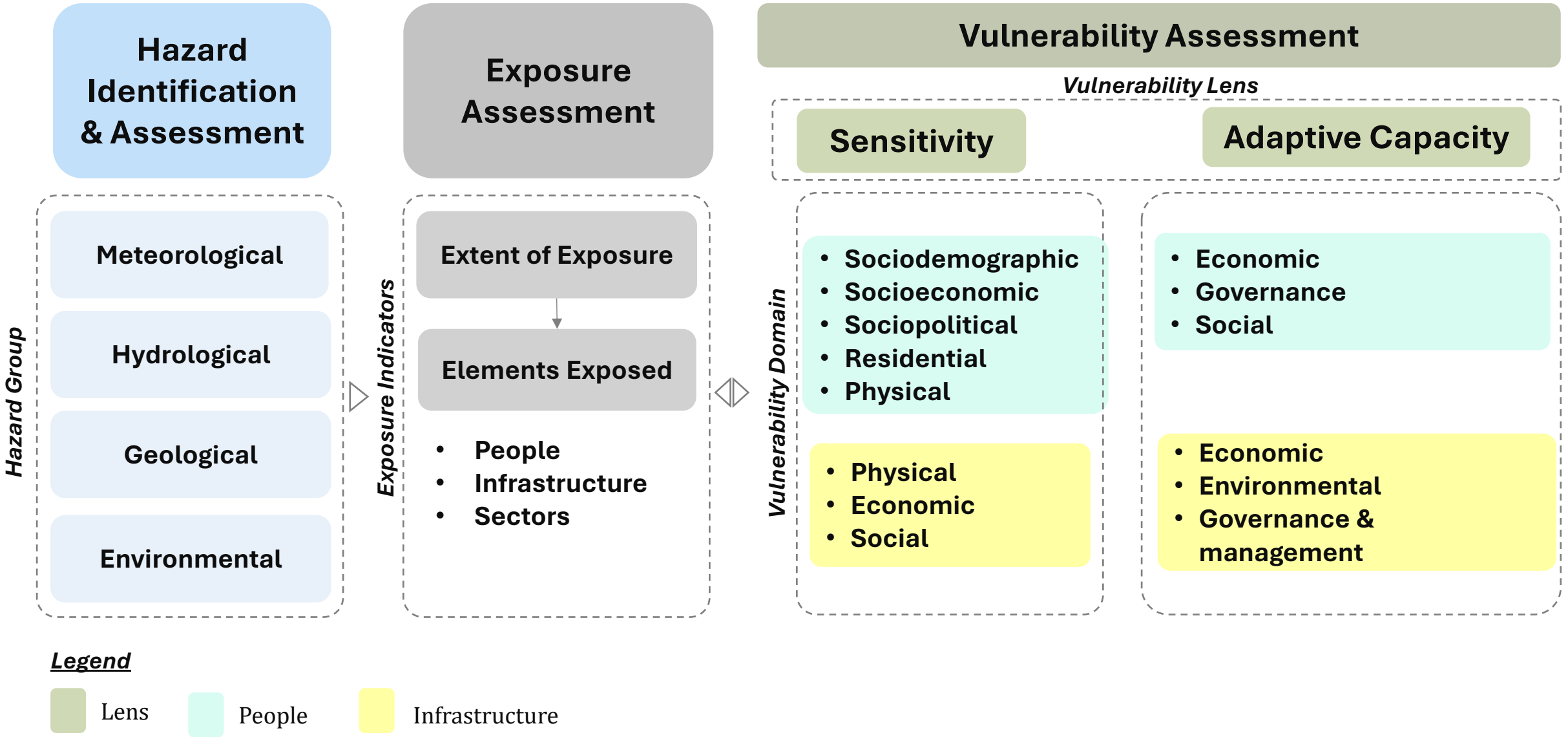
"The **presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets** in places and settings that could be adversely affected" (IPCC 2022:2908).

"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" (IPCC 2022:2927).

The CHVA Framework

Step 1	Hazard Identification & Assessment
Step 2	Exposure Analysis
Step 3	Vulnerability Assessment

The Climate Hazard & Vulnerability Assessment (CHVA) Framework Explained



Step 1: Hazard Identification & Assessment

Levels of the Hazard Identification & Assessment Framework

Meteorological and hydrological hazards	These result from the state and behavior of Earth's atmosphere. These hazards include weather and climate patterns or events that interact with land, oceans, and the atmospheric cycles.
Geological hazards	These can be attributed to seismogenic and volcanogenic activity; that is, Earth's internal geophysical processes, or the impact of meteorological or hydrological hazards that lead to changes in surface or near-surface formations (some type of land mass movement).
Environmental hazards	These arise through urbanization pressures and degradation of the natural systems and ecosystem services on which humanity depends.

Indicators of Hazard Identification & Assessment

Meteorological

- **Thermal Stress**
  - Land/ Sea Surface Temperature
  - Air Temperature
  - Extreme Events
  - Thermal Comfort
- **Weather Extremes**
  - Cyclone
  - Thunderstorm
  - Windspeed
- **Precipitation Change**
  - Rainfall
  - Extreme Events
  - Sea Level Change
  - Snowfall

Hydrological

- **Flood**
  - Waterlogging
  - Riverine Floods
  - Coastal Floods
  - Glacial Lake Outburst
- **Drought**
  - Hydrological Drought
  - Meteorological Drought
  - Groundwater Exploitation

Geological

- **Land Deformation**
  - Land Subsidence
  - Coastline/ Sea Level Change
- **Ground Movement**
  - Landslide
  - Avalanche

Environmental

- **Air Quality Degradation**
  - Indoor & outdoor AQ
- **Water Quality Degradation**
  - Ground Water
  - Surface Water
- **Fire**
  - Forest Fire
  - Other Fires
- **Soil & Vegetation**
  - Vegetation Change
  - Built Expansion
  - Soil Quality

Methodologies for Hazard Identification & Assessment

- **Trend analyses for different hazards:** Spatiotemporal trends, magnitude, baseline comparison, change point detection.

- **Spatial identification of areas impacted due to climate and environmental hazards**: Spatiotemporal analysis, hotspot analysis, aggregation, buffer/ zonation, modelling, correlations, change detection, spatial variability etc. these methods can be used on both satellite imagery and ground observational data

- **Impact assessment:** Hazard impact checklist, and multi-hazard mapping.

Data sources

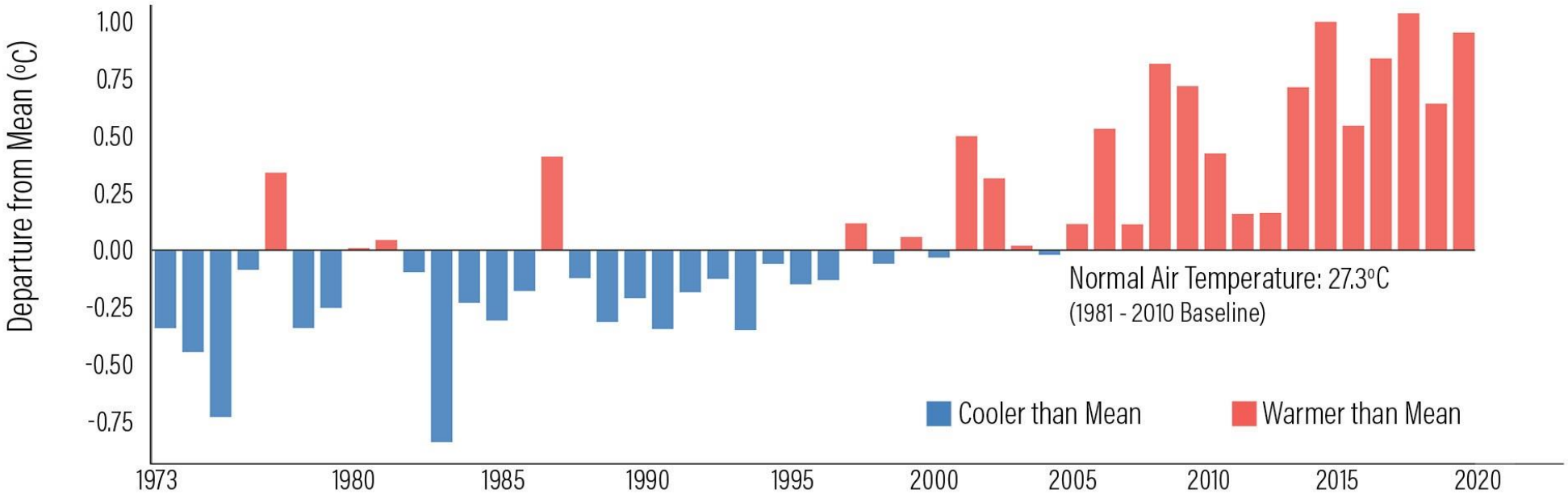
- **Satellite imagery (source):** Landsat, Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), Shuttle Radar Topography Mission (SRTM) (United States Geological Survey [USGS]/National Aeronautics and Space Administration [NASA]); National Remote Sensing Centre (NRSC); Sentinel (EU Copernicus); and Moderate Resolution Imaging Spectroradiometer (MODIS) (Land Processes Distributed Active Archive Center [LPDAAC])
- **Data products:** Aqueduct (World Resources Institute [WRI]) and World Settlement Footprint (WSF) (German Aerospace Center [DLR], European Space Agency [ESA])
- **Fire Information for Resource Management System (FIRMS) and hotspot data:** Disaster management department or authority and allied departments, municipal corporation, public health department, fire department, and other relevant agencies and departments.

Case examples

- **Hotspot analysis:** For the Solapur Climate Action Plan, areas facing intensified urban heat island stress were determined by using the annual average LST.

Case Examples: Trend of air temperature anomalies in Mumbai, India

Figure 5.2: Inter-Annual Air Temperature Anomalies from the Long-Term Baseline for Mumbai

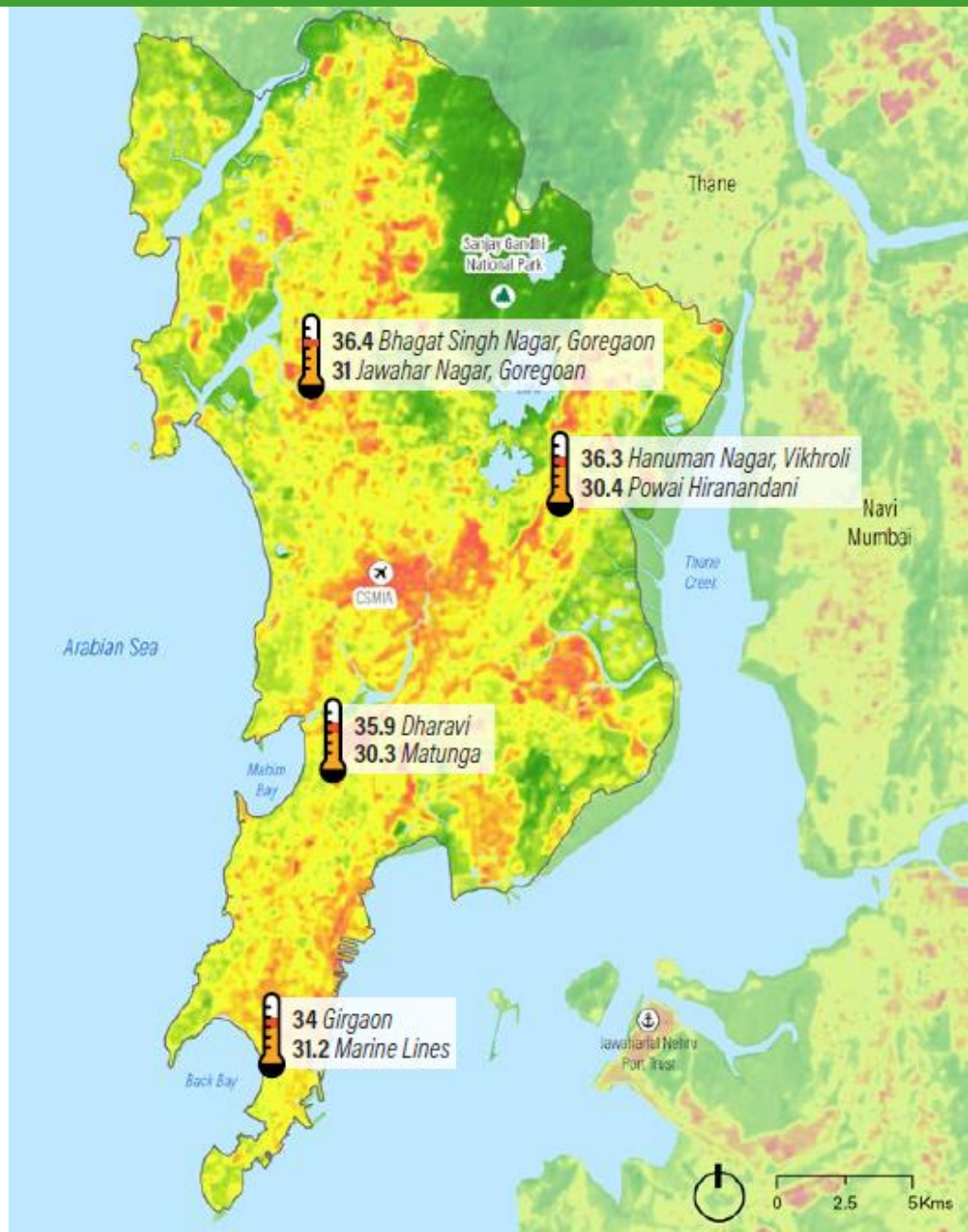


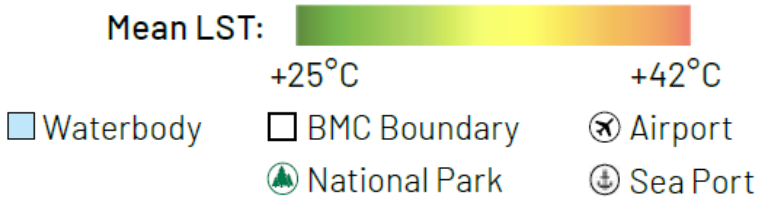
Source: Mumbai Climate Action Plan, 2022 ; Municipal Corporation of Greater Mumbai (MCGM), C40 Cities

Identifying anomalies in historical data using a long-term average (baseline) can share insights w.r.t the meteorological conditions significantly above the baseline. These observations for Mumbai revealed that since 2015, annual air temperature shows a departure of nearly 1°C.

Case Example: Identifying areas experiencing Urban Heat Island (UHI) effect

- Cities are known to experience **urban heat island effects** – more the paved surfaces greater the heat trap
- **Land Surface Temperature** is used to identify heat islands within the city, the neighbourhoods that are at relatively higher risk of heat stress owing to their built form and activities.
- **Informal settlements in Mumbai experience about 5°C warmer LST** than their neighboring other residential areas.



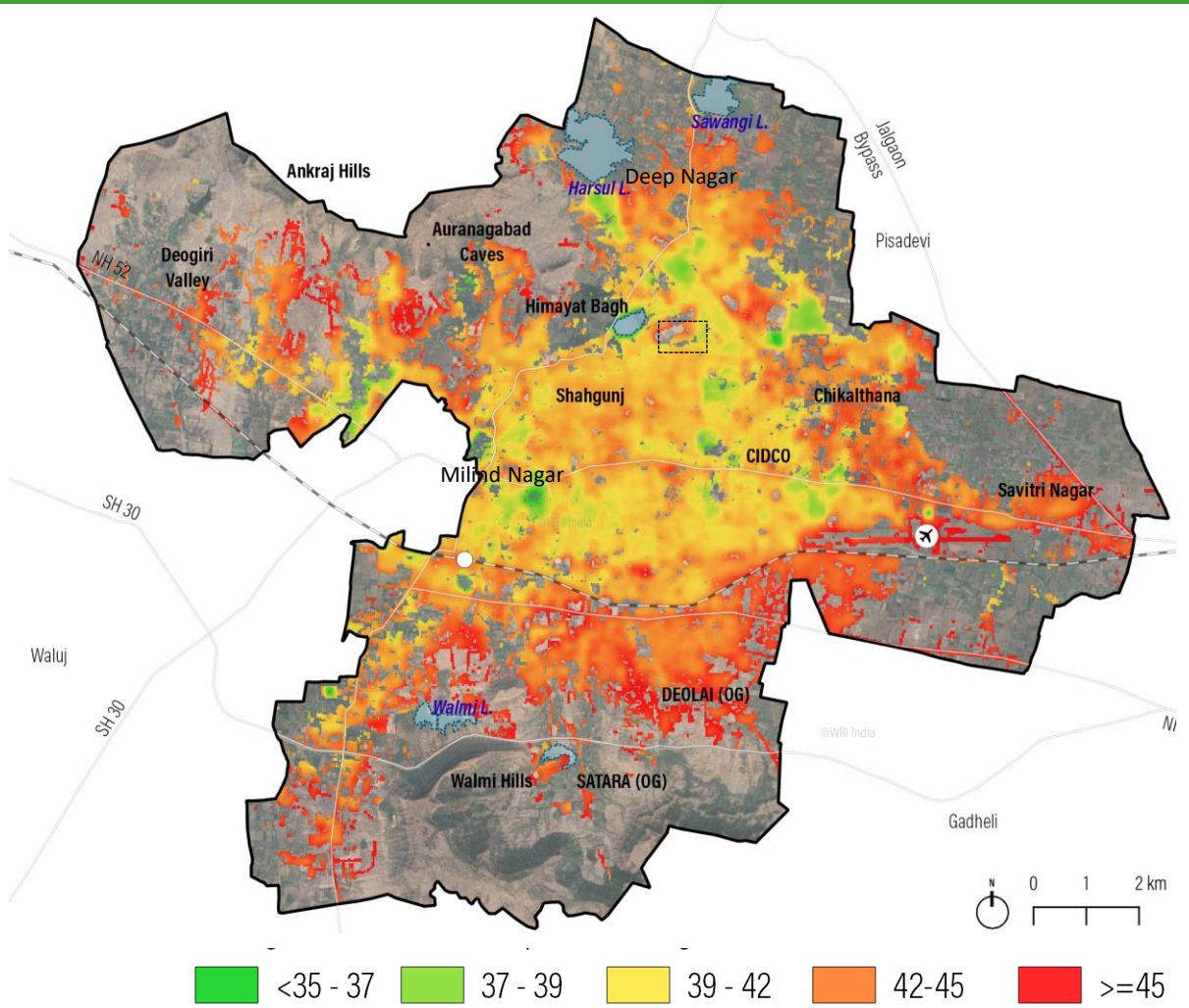


Source: Average summer LST 2017-19, Mumbai Climate Action Plan; Brihanmumbai Municipal Corporation 2022

Case Examples: Identifying areas experiencing UHI effects

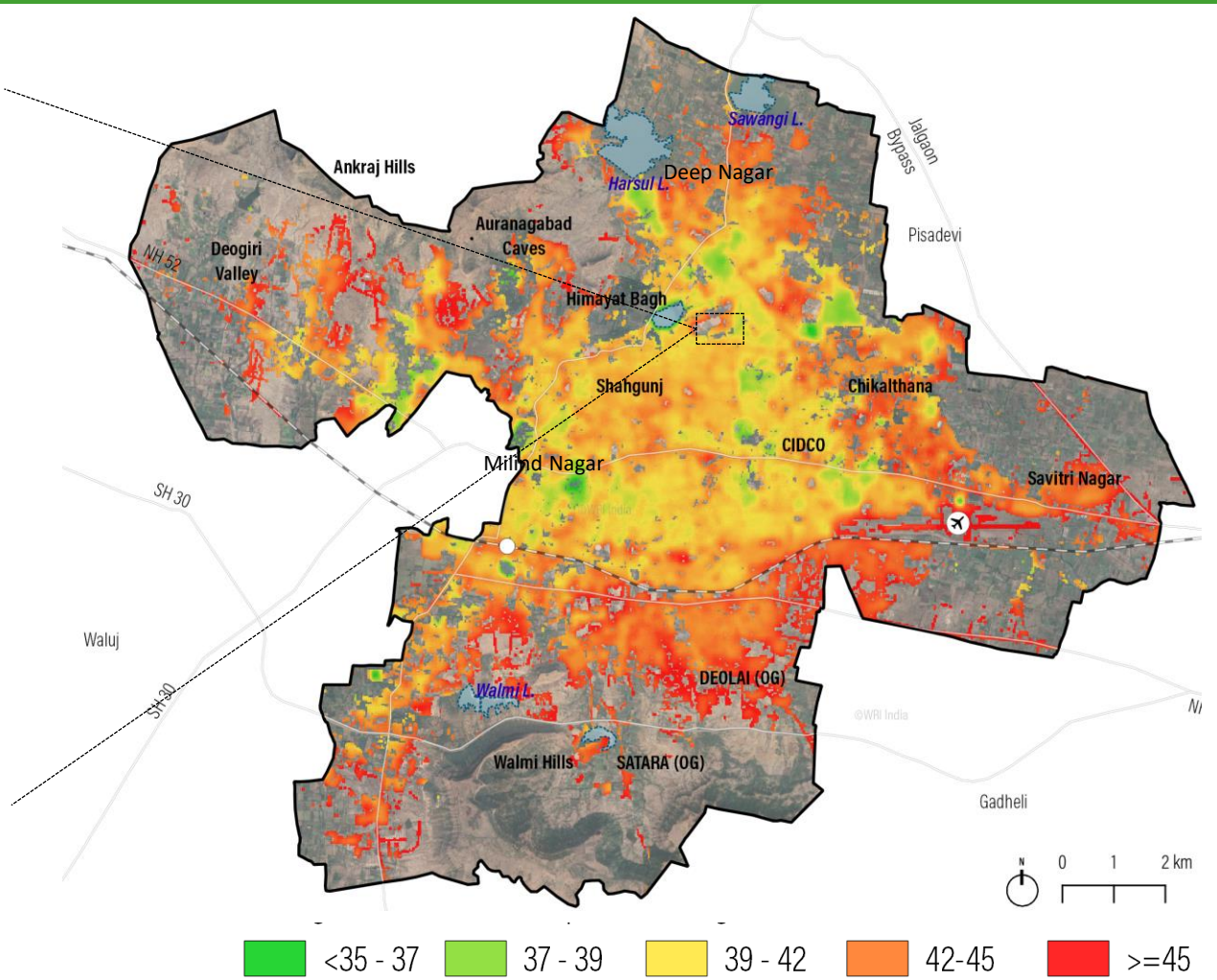
- Peri-urban areas of the cities, especially in smaller cities, LST can have **influence of non-irrigated, bare soil, fallow land or non-vegetated areas that can easily heat up during the day hours**.

- In such cases, it is important to focus on the **urbanized core of the city where higher share of population resides** to identify heat islands with the city.



Source: Average Summer Day time LST, Chhatrapati Sambhajinagar Climate Action Plan, 2023

Case Examples: Identifying areas experiencing UHI effects



Source: Chhatrapati Sambhajinagar Climate Action Plan, 2023

Tightly packed settlements, industrial and commercial land uses with heat-sensitive roofing materials have **significantly higher nighttime LST** than the organized layouts with vegetation, well-ventilated blocks, blue-green areas (forests, lakes and mangroves etc.).

Impact Assessment: Impacted Elements' Checklist

IMPACTED ELEMENTS	METEOROLOGICAL					HYDROLOGICAL		GEOLOGICAL		ENVIRONMENTAL				
	TS	Pr	Wn	WE	SL	Fl	Dr	LD	GM	AQ	WQ	SQ	Vg	Fr
Population														
Natural environment														
Built environment														
Jobs and livelihood														
Infrastructure														
Access to services														
Amenities														
Housing														
Food systems														

Notes: TS = Thermal Stress; Pr = Precipitation Change; Wn = Wind; WE = Weather Events; SLC = Sea Level Change; FL = Flood; Dr = Drought; LD = Land Deformation; GM = Ground Movement; AQ = Air Quality Degradation; WQ = Water Quality Degradation; SQ = Soil Quality Degradation; Vg = Vegetation Change; Fr = Fire.

Case Example: Impacted Elements' Checklist

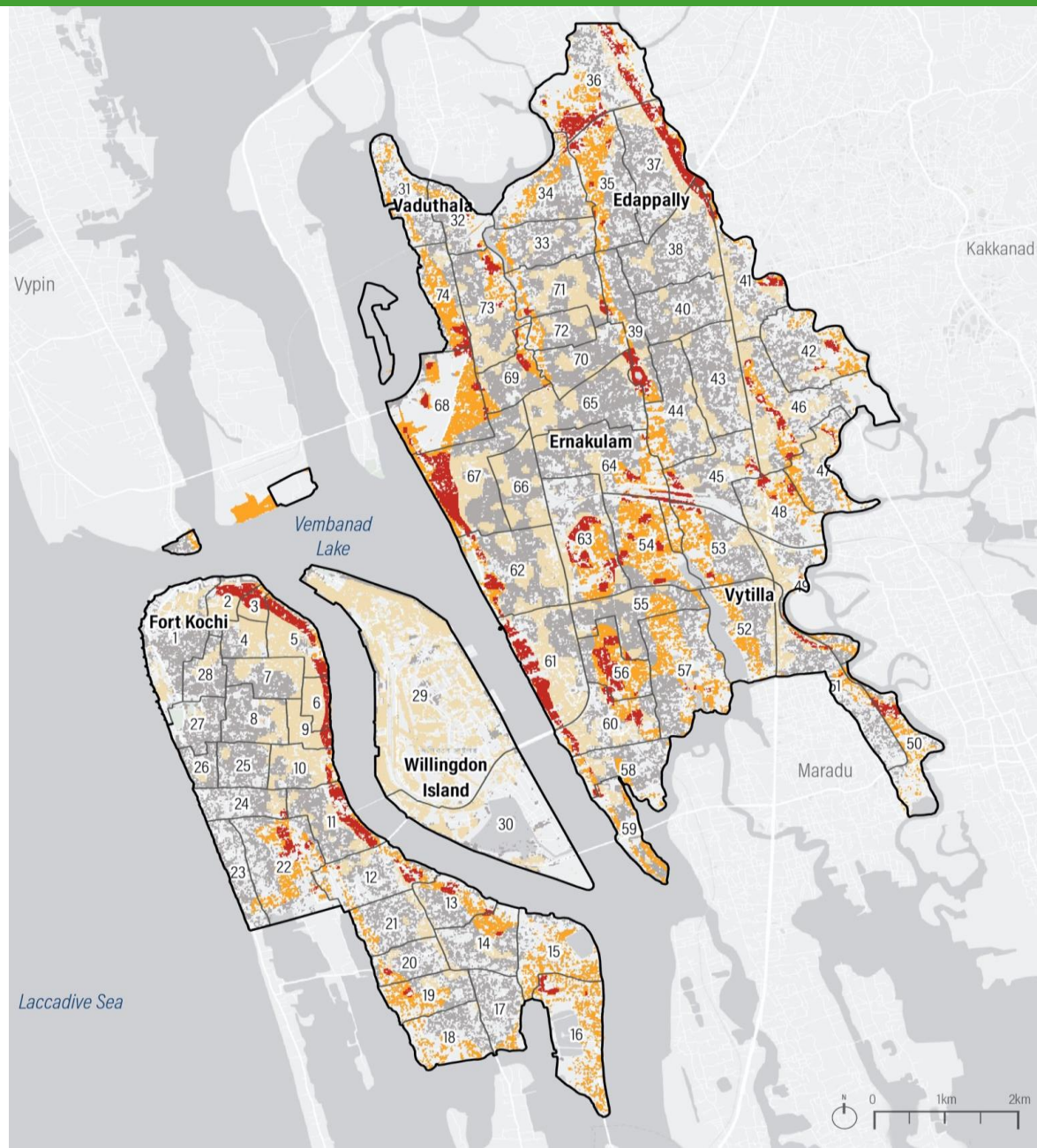
IMPACTED ELEMENTS	METEOROLOGICAL						HYDROLOGICAL	GEOLOGICAL		ENVIRONMENTAL				
	TS	Pr	Wn	WE	SL	Fl	Dr	LD	GM	AQ	WQ	SQ	Vg	Fr
Population	✓	✓		✓	✓	✓		✓		✓			✓	
Natural environment	✓	✓		✓	✓	✓		✓		✓			✓	
Built environment	✓	✓		✓	✓	✓		✓						
Jobs and livelihood	✓	✓		✓	✓	✓		✓		✓			✓	
Infrastructure	✓	✓		✓	✓	✓		✓						
Access to services	✓	✓		✓	✓	✓		✓						
Amenities	✓	✓		✓	✓	✓		✓		✓				
Housing	✓	✓		✓	✓	✓		✓						

Source: Based on Mumbai Climate Action Plan; Brihanmumbai Municipal Corporation 2022

Case Example: Multi-hazard mapping

- A form of **composite mapping using spatial extents for key hazards** identified, overlaid and compiled as **multi-hazard zones**. Thes zones can be categorized based on the intensity and frequency of hazards.

- Assessment of the multiple hazards in Kochi revealed that 25% of the built area in the city is vulnerable to flood risk, and 35% is vulnerable to heat risk, while around 7% is at risk of both the key hazards.



Percentage of households: 7% 25% 35% 48%

Settlements vulnerable to both heat and floods
Settlements vulnerable to floods
Settlements vulnerable to heat (above 30°C)
Settlements
Ward boundary
City boundary

Source: Climate Resilient Kochi, Narayanan et al. 2022.

Step 2: Exposure Analysis

Levels of Exposure Analysis for people & infrastructure

Mainly a function of location and hence is defined by the physical domain.

Each site of exposure is defined by indices that group related indicators

Indicators of exposure are spatialized on a map, the percentage of each indicator item at risk of exposure can be determined

Exposure domains → **Elements exposed** → **Exposure index** → **Indicators** → **Percentage exposed**

Assessed for two elements; namely, the people and infrastructure

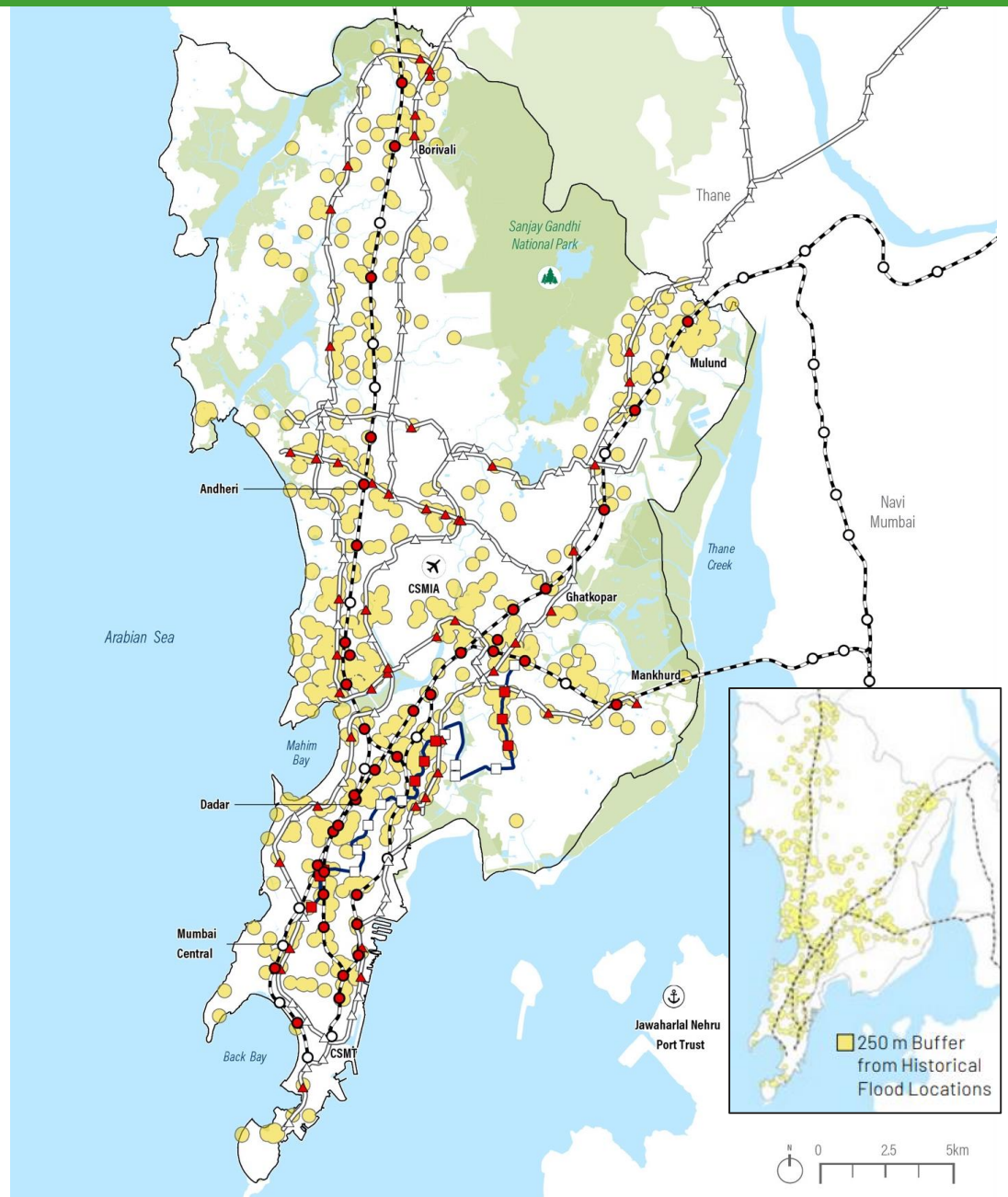
These are specific measurable attributes that are assessed to determine the city's population, communities, and infrastructure exposed

TABLE 7 | Framework for analyzing exposure to hazards

INDEX	INDICATOR	PERCENTAGE EXPOSED
Element exposed: People		
Variation in population density	Within or in close proximity to hazard-prone or hazard-impacted areas, such as: ▪ Thermal stress: Zones with land surface temperature (LST) ≥ threshold ▪ Flooding hotspots/Flood impact zones/Flood-susceptible zones/Area within high flood line (HFL) ▪ Land deformation/Landslide-prone locations or zones/sites of past landslides ▪ Areas prone to extreme weather events or impact areas from previous hazards ▪ Low-lying areas ▪ Coastal Regulation Zones (CRZs) ▪ Areas with air pollutant concentrations higher than the daily permissible limits ▪ Areas within threshold distance of polluted waterbodies/ environmentally sensitive areas, such as dumping grounds, and sewage treatment plants ▪ Areas prone to forest fires or other fire hazards ▪ Areas prone to multiple hazards	Percentage of urban area exposed
		Density of population exposed
Slums or informal settlements		No. of slums exposed
Variation in jobs (density) located ▪ Formal ▪ Informal ▪ Outdoor		Percentage of jobs (formal/ informal/outdoor) exposed

Case Example: Exposure Analysis of Infrastructure

- Overlaying the point locations of transit stations or other built assets and line networks of infrastructure and critical amenities over multi-hazard or hazard zone maps helps identify infrastructure that is at risk of exposure to one or more hazards.
- It helps **identify critical services that can have limited access or compromised service delivery due to a hazard**.
- Based on the flood hotspot influence zone analysis, **33% of Mumbai's mass transit network**—including its lifelines, the suburban rail network, metro line, and monorail—are **heavily impacted by inundation.**

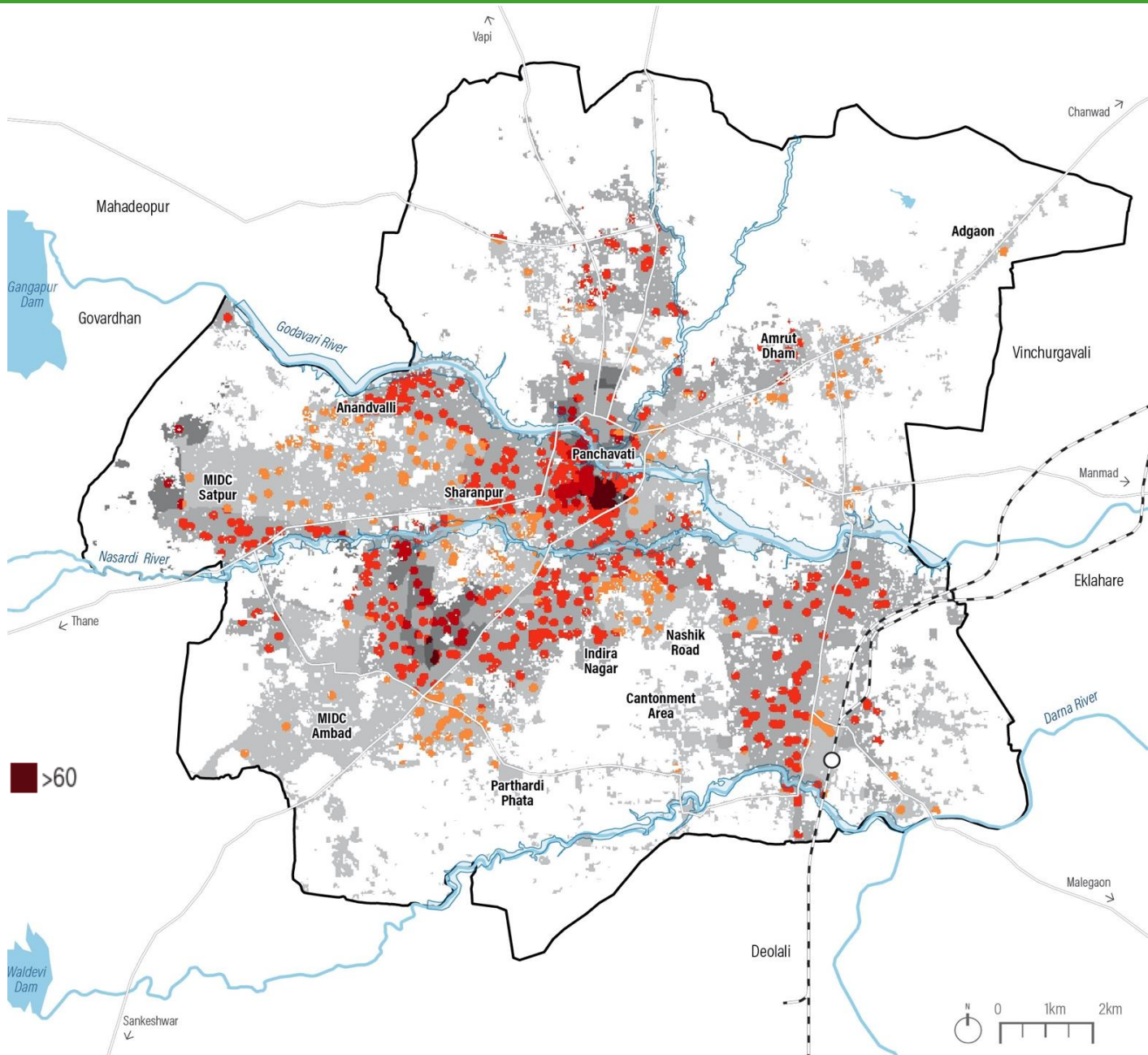


Transit Station: Railway Station, Monorail Station, Metro Station; Railway, Monorail, Metro; Airport, Seaport, Transit station at risk; Water body, Green cover; City boundary; 250 m Buffer from Historical Flood Locations

Source: Mass Transit Stations with Limited Physical Access, Mumbai Climate Action Plan; Brihanmumbai Municipal Corporation 2022

Case Example: Exposure Analysis of people

- To estimate exposure of people, **current population density is apportioned to the built density**.
- In Nashik, using flooding complaints data from 2017-2020, a radius of 100 meters of points was considered to be impacted.
- **Population lying within this impacted area is at the highest risk of exposure to flooding.**



Population density at risk due to flooding (per 1,000 sq. m): ≤10 10–30 30–60 >60

Population density (per 1,000 sq.m): ≤10 10–30 30–60 >60

Water body City boundary Floodplain using high flood line

Railway station Railway Major road

Source: Population density exposed to flooding, Nashik Climate Action Plan, 2024.

Step 3: Vulnerability Assessment

Levels of the Vulnerability Assessment Framework for People

Sensitivity	• **Sociodemographic** • **Socioeconomic** • **Sociopolitical** • **Residential** • **Physical**	• Population groups disproportionately impacted • Populations in adverse working conditions • Populations involved in high-risk livelihood activity • Lack of home ownership, limited tenure, & houselessness • Inadequate housing conditions • Inadequate household-level essential services • Lack of access to public infrastructure and amenities
Adaptive Capacity	• **Economic** • **Governance** • **Social**	• Employment and livelihood • Social security • Level of decentralization • Disaster preparedness & response • Disaster mitigation & risk reduction • Citizen Engagement

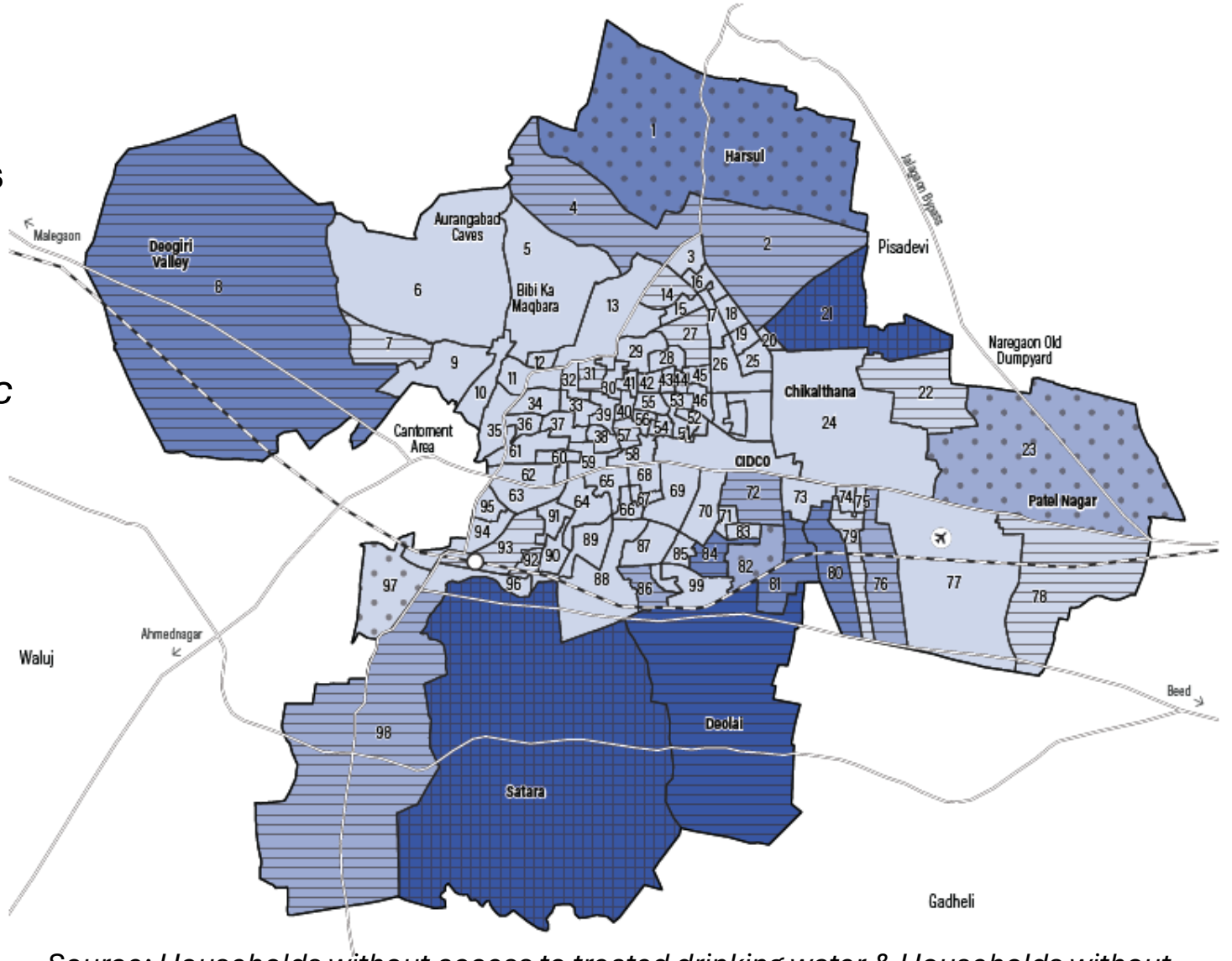
Step 3: Vulnerability Assessment

Levels of the Vulnerability Assessment Framework for Infrastructure

Sensitivity	• **Physical** • **Economic** • **Social**	• Reduction in service area due to "lack of" physical access to infrastructure and amenities during and immediately after hazard events. • Losses in revenue, livelihoods, and days of work due to disrupted services • Death and injury/ disease outbreak • Emergency funds, disaster relief funds, Insurance, Climate proofing funds
Adaptive Capacity	• **Economic** • **Environmental** • **Governance & management**	• Early warning systems • Disaster management plans • Climate-proofing assets with design • Organization structure • Level of decentralisation, coordination, & communication • Response protocols • Staff capacity and training

Case Example: Vulnerability Assessment of People

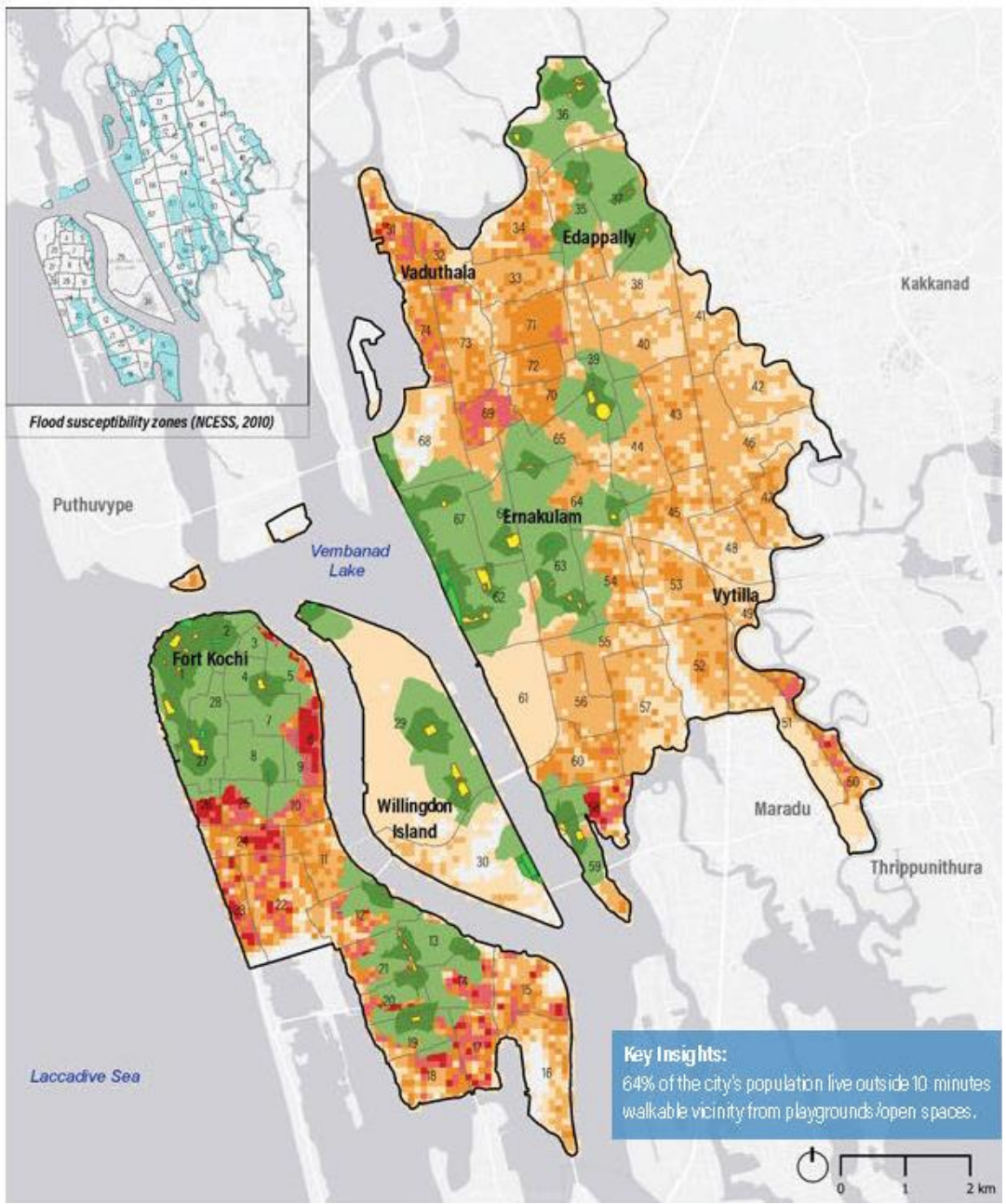
- Identify vulnerable population groups, to understand gaps and disparities, power dynamics, **opportunities, and constraints based on social and economic conditions**.
  (including gender dynamics, societal inequalities, and functional access to basic public services).
- Map shows **least serviced wards with access to household-level water supply** in Chhatrapati Sambhajinagar.



Source: Households without access to treated drinking water & Households without drinking water inside the premises; Chhatrapati Sambhajinagar Climate Action Plan, 2024

Case Example: Vulnerability Assessment of Infrastructure

- **Accessibility analysis** is used to identify areas and settlements that are **"underserved".**
- Infrastructure **at risk due to failure or disruption during extreme weather events**
- Further, **overlaying real-time traffic and road conditions data may reveal variability** in service area delineations through the day, which may be particularly important for emergency response services.
- The **aim is to assess the level of service** on regular days and compare it with that on extreme event days.
- **2/3rd of Kochi residents cannot access any park/garden/playground within 5-10min walking distance; a critical amenity for economically weaker.**



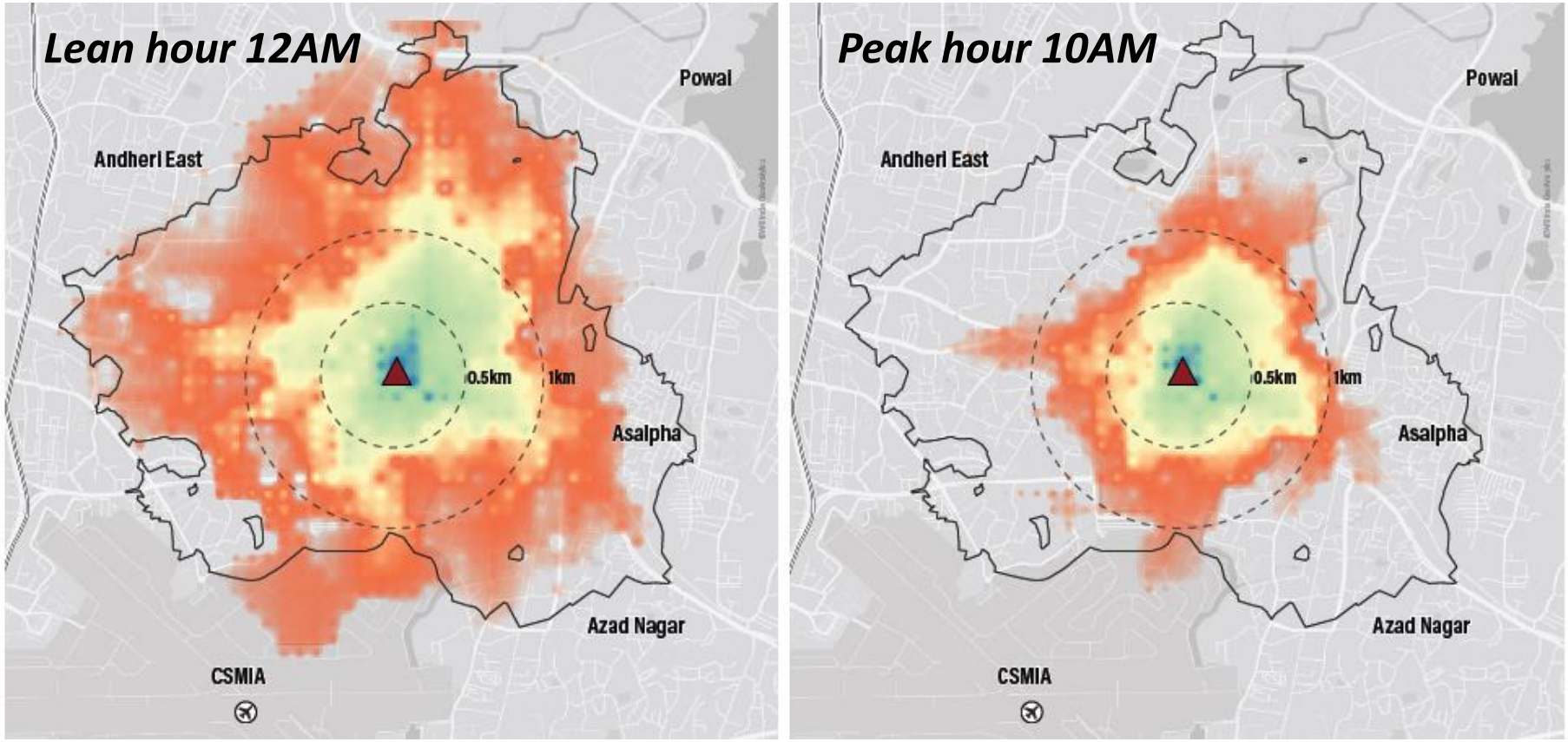
Open Green Spaces
Playgrounds
Flood Susceptibility Zones

Population with Walkable Access: within 300m, within 800m

Population with Limited Access: <50, 50-100, 100-150, 150-200, 200-300
(number of persons per hectare)

Source: Climate Resilient Kochi, Narayanan et al. 2022.

Case Example: Vulnerability Assessment of Infrastructure



Temporal analysis of service area changes of a fire station using near-real-time modeled traffic conditions shows more than 50% reduction in the service area given lesser speeds on the roads during the peak hours.

Source: Mumbai Climate Action Plan; Brihanmumbai Municipal Corporation 2022

Case Example: Redesign Public Spaces to Build Flood Resilience, Nairobi

- **Nestled alongside the Ngong River, the settlement in Kibera** was at the mercy of the riverbed. During heavy rain, the river water spilled over, invading homes.

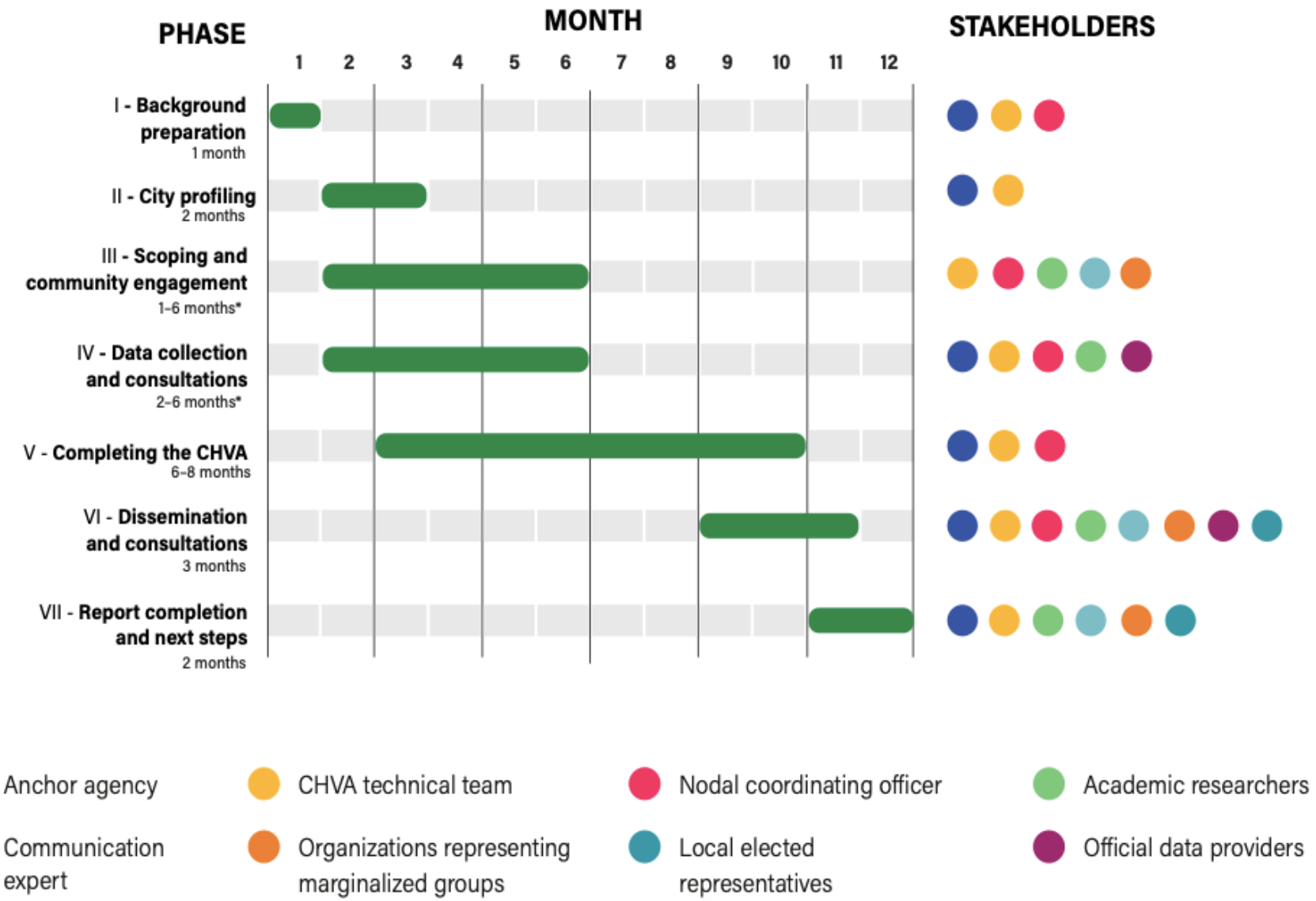
- **Kounkuey Design Initiative (KDI) on the Kibera Public Space Project**, a finalist for the 2020-2021 Prize for Cities, to co-develop **solutions for flooding and other challenges in the informal settlement**.

- **Nairobi Metropolitan Services approved a Special Planning Area (SPA) for Kibera** in late 2020, after two years of advocacy by KDI, beginning the process of **integrating the settlement into formal city planning practices.**

Source: nairobi-public-spaces-build-flood-resilience, WRI.org 2021

Operationalizing the CHVA Framework

FIGURE 25 | Seven-phase process for conducting the Climate Hazard and Vulnerability Assessment



Phase 1: Background Preparation

- Determining the **geographic and technical scope and scale** of the CHVA
- Identifying **nodal agencies** that will anchor the CHVA
- Identifying and mapping out the **governance ecosystem**
- Reviewing existing analyses and reports relevant to the CHVA
- Reaching out to stakeholders for **preliminary consultations and engagement** informing them of the CHVA exercise and its tentative timeline.

Case Example: Mapping the governance ecosystem

MINISTRY	DEPARTMENTS	ACTION PATHWAYS
LEADING AGENCIES		
Environment, Climate Change and Forests	• Environment and Climate Change Department • State Environment Impact Assessment Authority (SEIAA) • Tamil Nadu Pollution Control Board • Tamil Nadu State Wetland Authority • Forest Department • Tamil Nadu Forest Plantation Corporation Limited (TAFCORN) • Tamil Nadu Biodiversity Conservation And Greening Society (TNBCGS)	
Revenue and Disaster Management	• Disaster Management Department • State Disaster Management Authority • Commissionerate of Revenue Administration and Disaster Management	
Animal Husbandry, Dairying, Fisheries and Fishermen Welfare	• Department of Animal Husbandry and Dairying • Department of Fisheries and Fishermen Welfare • Tamil Nadu Co-operative Milk Producers' Federation Limited	
Housing and Urban Development	• Tamil Nadu Housing Board • Directorate of Town & Country Planning • Chennai Metropolitan Development Authority (CMDA) • Tamil Nadu Urban Habitat Development Board (TNUHDB) • Housing and Urban Development Corporation (HUDCO) • Chennai Metro Rail Limited	
Municipal Administration and Water Supply	• Directorate of Municipal Administration • Greater Chennai Corporation (GCC) • Tamil Nadu Water Supply and Drainage Board (TNWSDB) • Tamil Nadu Water Supply and Sewerage Board (TNWSSB) • Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) • Chennai Rivers Restoration Trust (CRRT) • Tamil Nadu Urban Finance and Infrastructure Development Corporation (TUFIDCO)	

Source: Tamil Nadu Heat Mitigation Strategy; TNSPC, BHC, WRI India, 2024

National Action Plan on Heat Related Illnesses (MoHFW)
Guidance to manage severe heat-related illnesses & strengthening health facilities and emergency response

India Cooling Action Plan (MoEFCC)
Integrated vision towards cooling across sectors

Tamil Nadu SAPCC 2.0
Strategic priority sectors

Heat Wave Action Plan
Thematic areas & recommendations

National Guidelines for preparation of action plan - prevention and management of heat wave (NDMA)

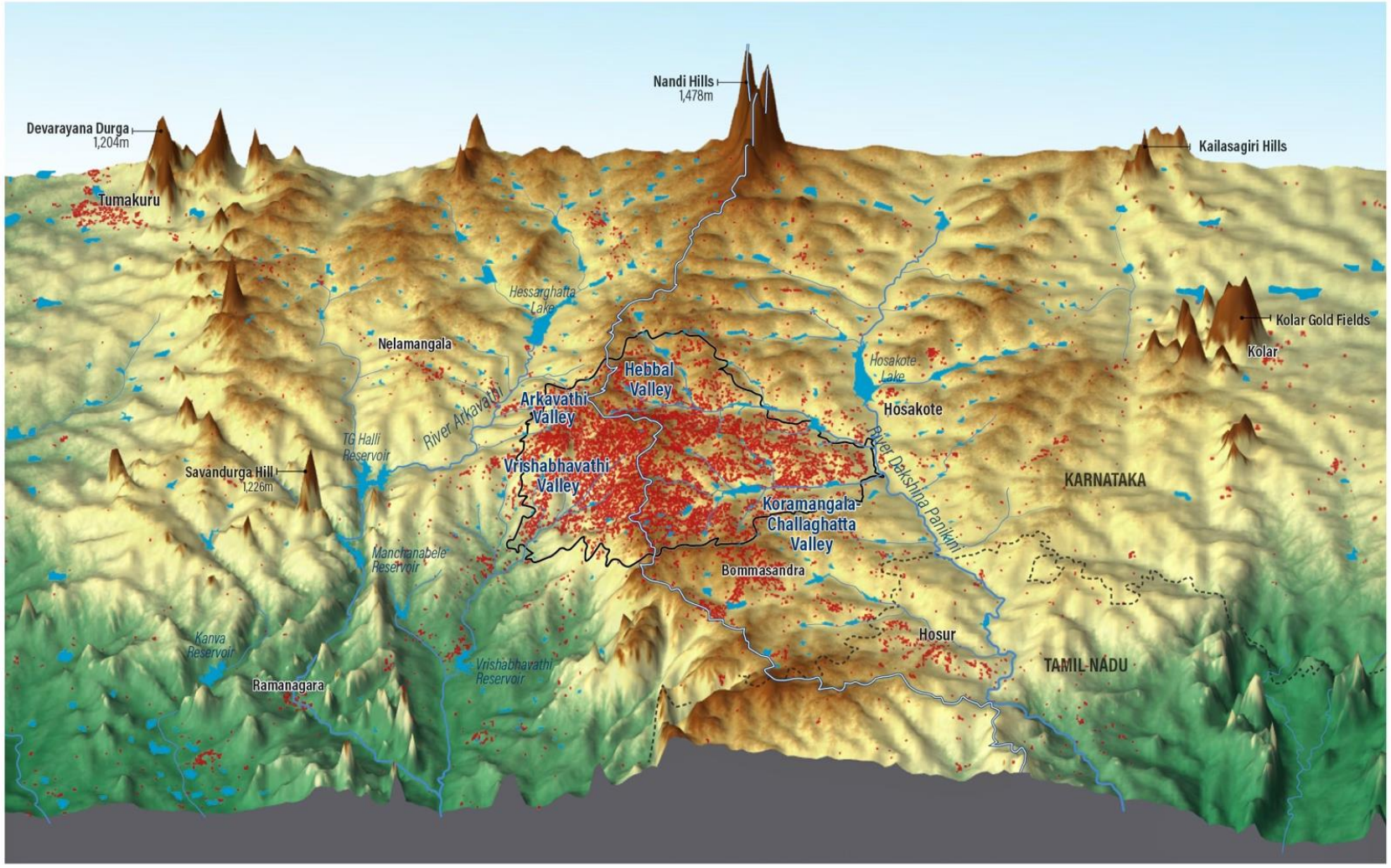
Climate Hazard Vulnerability Assessment (WRI – India)
Geospatial analysis of hazard and identification of vulnerable elements

National Programme on Climate Change and Human Health (NCDC)
Capacitating Healthcare systems at different levels

Agency matrix based on identified key sectors/ issues/ action pathways with corresponding studies on existing policies and plans.

Phase 2: City Profiling

Fig 6.3: Bengaluru Topography Map used for City Profiling showing Critical Natural Features in the Region & Urban Settlements



Source: Prepared for Bengaluru Climate Action Plan. Elevation derived using Shuttle Radar Topography Mission (SRTM); 'World Settlement Footprint (WSF)' 2019, European Space Agency (ESA)

- Detailing the **geographic context**
- Establishing **demographic and socioeconomic** distribution
- Mapping out the existing **policy and institutional ecosystem**
- Establishing **climate and environmental issues** at a macroscale
- Understanding **industrial sectors of the city region to identify priorities** and dependencies
- Identifying **vulnerable groups** and communities
- Analyzing **linkages** between biodiversity, ecological systems, livelihoods, and local economies

Phase 3: Scoping and Community Engagement

- Establish a **list of stakeholders** prioritizing those working with underserved groups and natural ecosystems
- Conduct a **kickoff meeting** with the anchor agency
- Consult with **practitioners and academics** through detailed discussions
- Carry out **townhalls, listening sessions, meetings and FGDs** with underserved groups and community members
- Establish **longer-term working groups** to encourage meaningful engagement and constructive feedback
- Identify **granular, community-level datasets** that various stakeholder groups hold which can feed into the CHVA process by presenting data needs to various groups

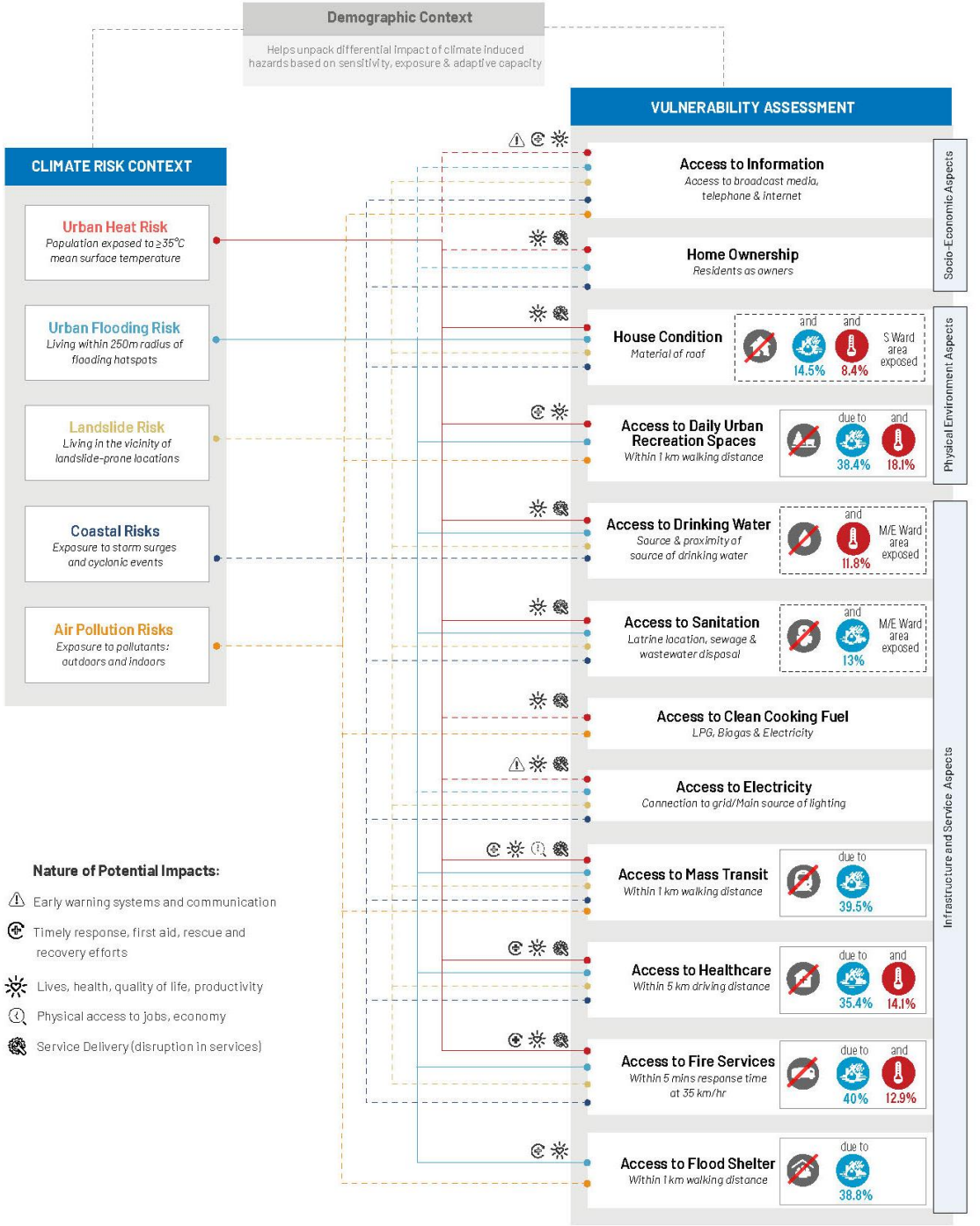
Phase 4: Data collection and Stakeholder Consultations

- **Shortlist indicators** to undertake analysis.
- Organize **data needs**, expected formats of data and identify potential sources.
- **Assign people to coordinate data collection** like PoCs, nodal officers etc.
- Understand the formats in which data might currently be available and create **data collection templates**
- Check the **quality of data** in terms of comprehensiveness, consistency, continuity, and coherence
- Create a **master database** of all data points
- Use **proxy indicators** and data sources to fill in data gaps
- Attempt to **scale nonspatial data** to appropriate spatial boundaries
- Consult with external stakeholders to **plug data gaps and validate** received data

Phase 5: Completing the CHVA Framework

- Create a **workbook to document details of the assessment** for shortlisted indicators
- Conduct the **CHVA in three steps**: Hazard identification and assessment; Exposure Analysis; and Vulnerability Assessment
- Establish **scientific thresholds** for all indicators based on secondary literature review and service delivery benchmarks
- Undertake **vulnerability assessment of critical infrastructure** by:
  - Creating a **list of all critical infrastructure** in the city and corresponding agencies/orgs that own, operate and maintain it
  - **Shortlisting relevant questions** and request appropriate agencies/depts for interviews/data
  - Scheduling **one-on-one meetings** for interview

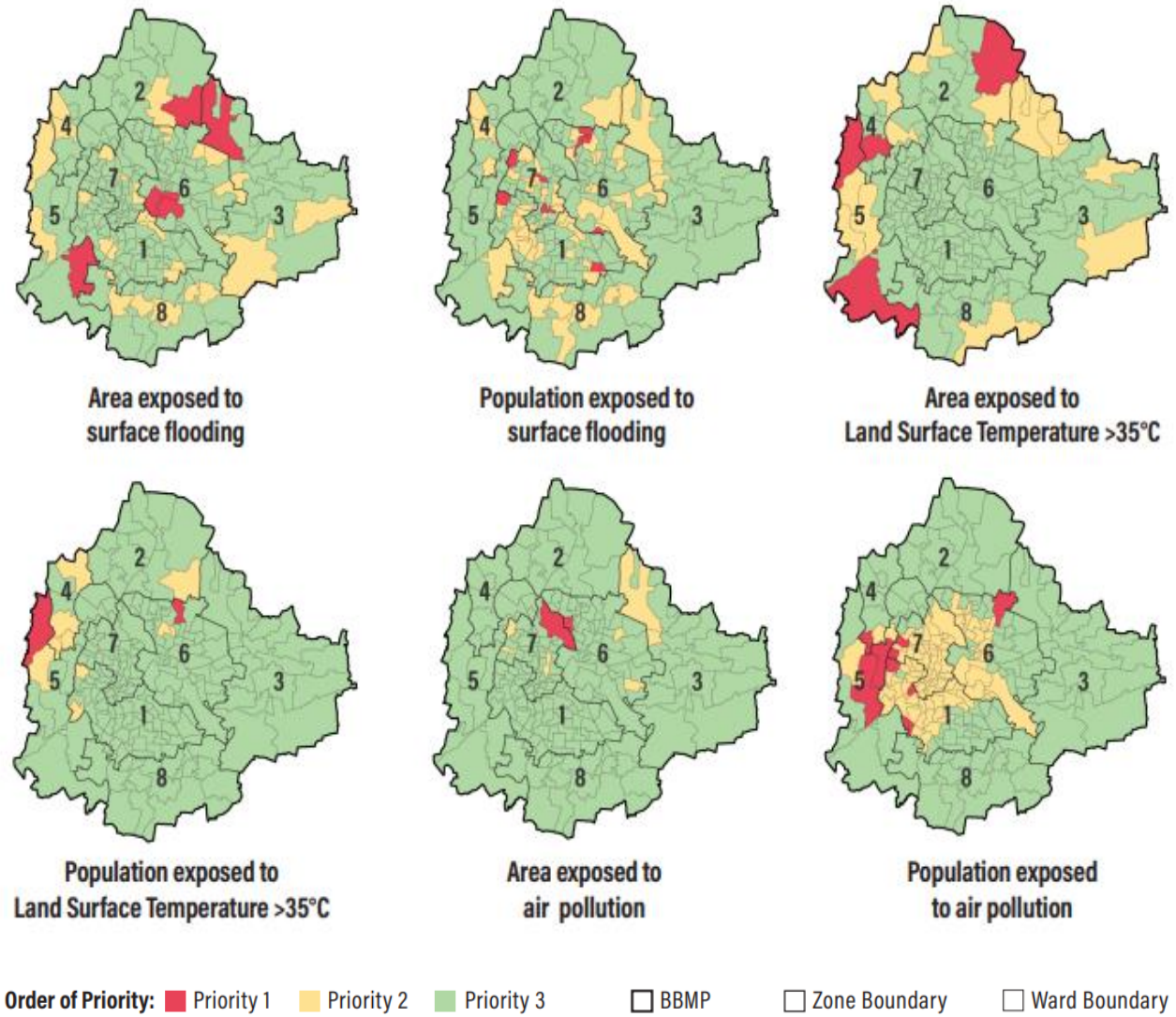
Figure 31 | *Mumbai's Vulnerability Assessment*



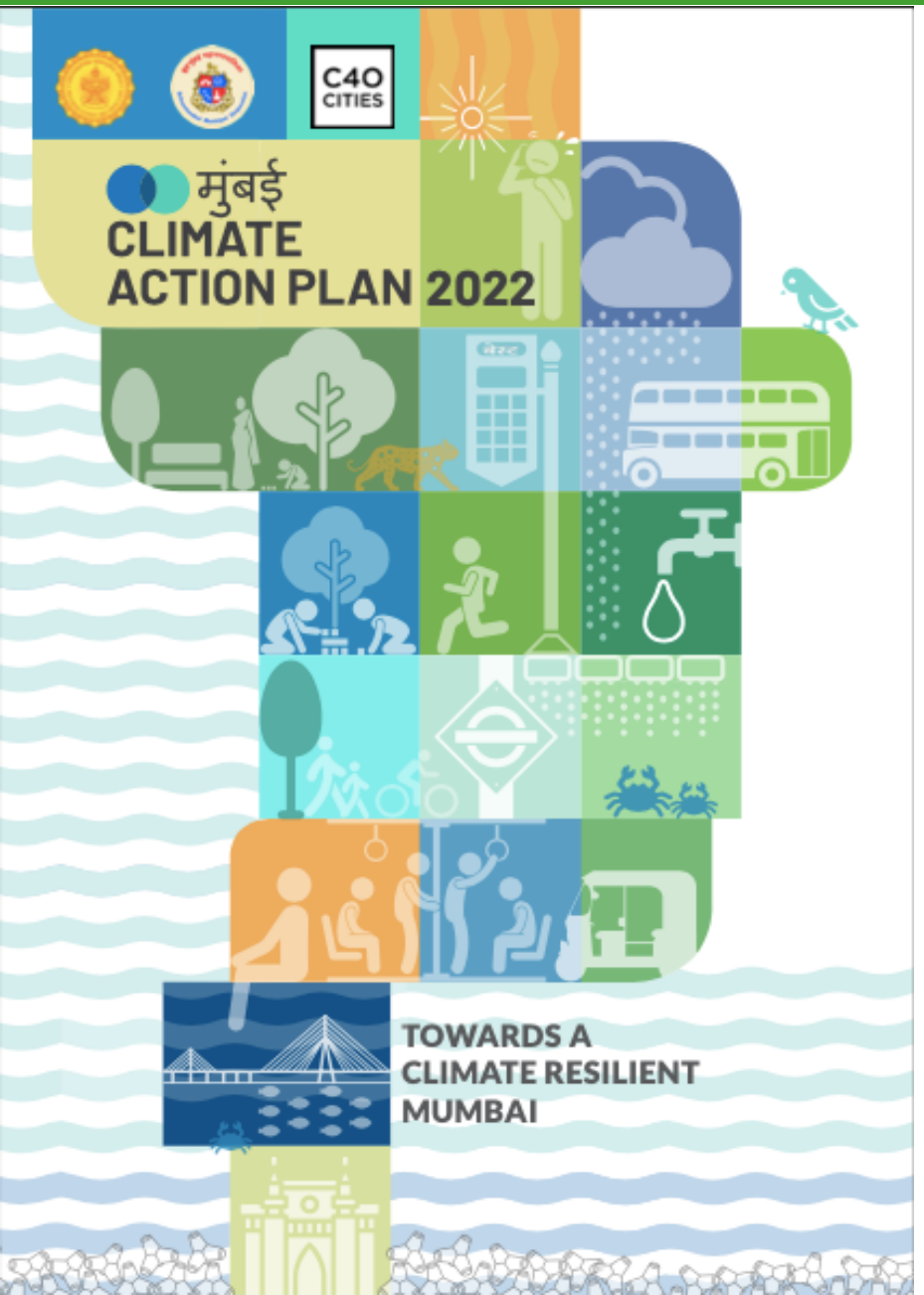
Phase 6: Dissemination and Consultations

- Make a list of **stakeholder groups** for the consultations, prioritizing vulnerable groups
- Identify the best way to **disseminate insights and information** from the CHVA
- Prepare **dissemination and sensitization** material and consider translating it into the city's local language.
- Conduct **workshops, meetings, group discussions, panel discussions**, and so on.
- Document **insights** from this phase and consider adding to/changing the CHVA report, as necessary.

Figure 15 | Summarising order of priority based on hazard exposure - Surface flooding, urban heat and air pollution

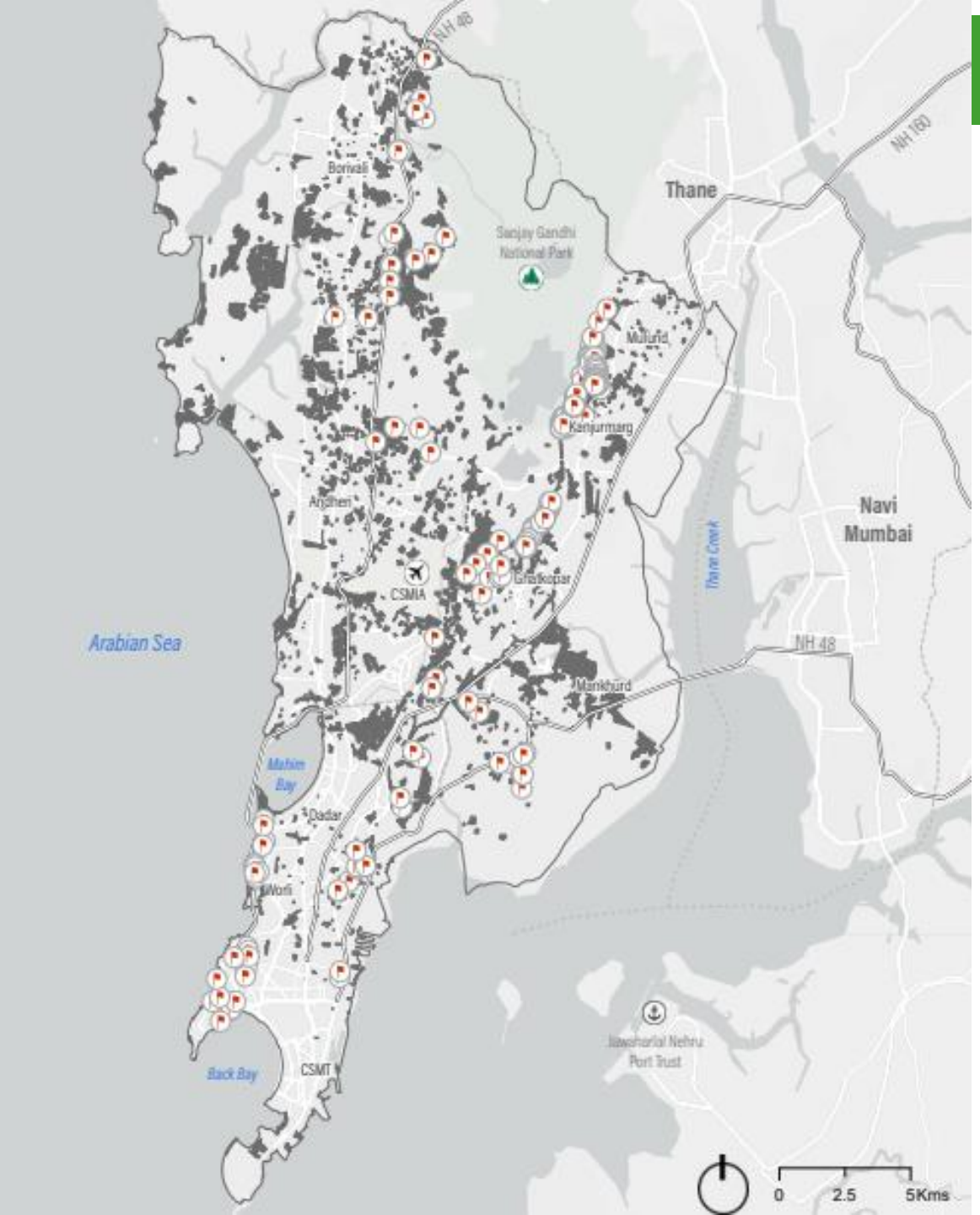


Phase 7: Report Completion and Next Steps



- Outline the **final report**
- Identify important **insights, maps and information** that need to be highlighted and explained in greater detail
- Use insights from the CHVA to make **recommendations and suggest strategies** for plans, projects, initiatives etc.
- Explore opportunities to **implement and co-develop projects** with relevant stakeholders
- Create a **summary, compendium or communication product** that can be understood by a wider audience

Case Example : Mumbai, India



- The assessment informed **that 70% of all landslide prone hotspots** were within slum settlement limits or adjacent to them.
- This analysis highlighted the larger **need for community-oriented disaster response.**

Landslide Prone Location
Informal Settlements/Slums
BMC Boundary
National Park
Highway
Railway Line
Airport
Sea Port

Community preparedness trainings in landslide prone locations that emerged from the vulnerability assessment conducted in Mumbai

Limitations of the CHVA framework

DATA

- Reliance on official data sources like the Census that is inadequate in addressing mobile populations

CAPACITIES

- Data collection process is time consuming and arduous across multiple agencies.

CONCEPTUAL LIMITATIONS

- Qualitative, experiential data often missed out in secondary data-led methodologies like the CHVA

Key Recommendations

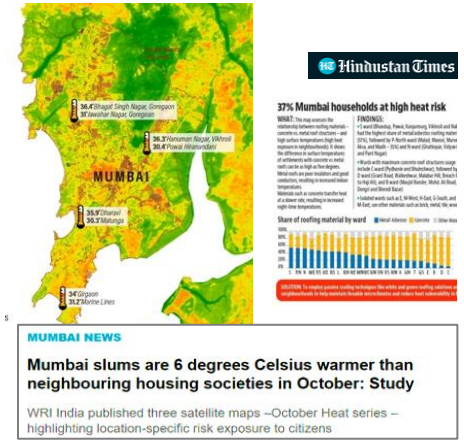
To move from assessment and plans to action

- Improve **access to high-quality data**
- Conduct **robust city-level baselines**, promote community-based assessments.
- Institutionalize the CHVA through **capacity-building programs and governance interventions**
- Prioritize and **accelerate adaptation action in high-risk areas** and within vulnerable communities
- Incorporate **quantitative and qualitative assessments** of the social drivers of vulnerability into ongoing planning and implementation processes.
- Facilitate **co-development of projects** with municipal departments and community groups

Shaping a Climate-Forward Mumbai

Case Study: Supported Mumbai's shift in investment approach – of over INR 50,000 crores by 2030 – towards disaster preparedness and climate resilience through first-ever Climate Action Plan for a city in South Asia

1. Geospatial data-based city profiling
2. Engagement and buy-in with Champion of Change
3. Data based Climate Action Planning with BMC
4. NBS pilot interventions launched citywide



City level GIS heat maps created as part of vulnerability assessment of Mumbai (shared widely by media) using a complex framework of indicators to quantify & spatialize differential vulnerabilities based on socio-economic characteristics and hazard mapping

Close engagement with Aditya Thackeray and Municipal Corporation of Greater Mumbai (MCGM) to support Climate Action Plan creation and develop a comprehensive strategy to tackle the challenges of climate change

Mumbai Climate Action Plan launched (based on GHG inventorization, geospatial analysis, vulnerability assessment and extensive consultations)

Nature based solutions (NBS) towards heat and flood resilience with 20+ pilot interventions identified including

- Low-cost solutions in informal settlements, most prone to heat and flood risk currently underway in collaboration with local NGOs
- Urban forests, mangrove forest parks, roof top nurseries, perimeter plantings and grey-black water recycling among other interventions to make the city more resilient

City Case: Mapping Flood & Heat Exposed Areas in Kochi

Fig 31 | Health Precautions vs Health Awareness Training received in Vulnerable Communities

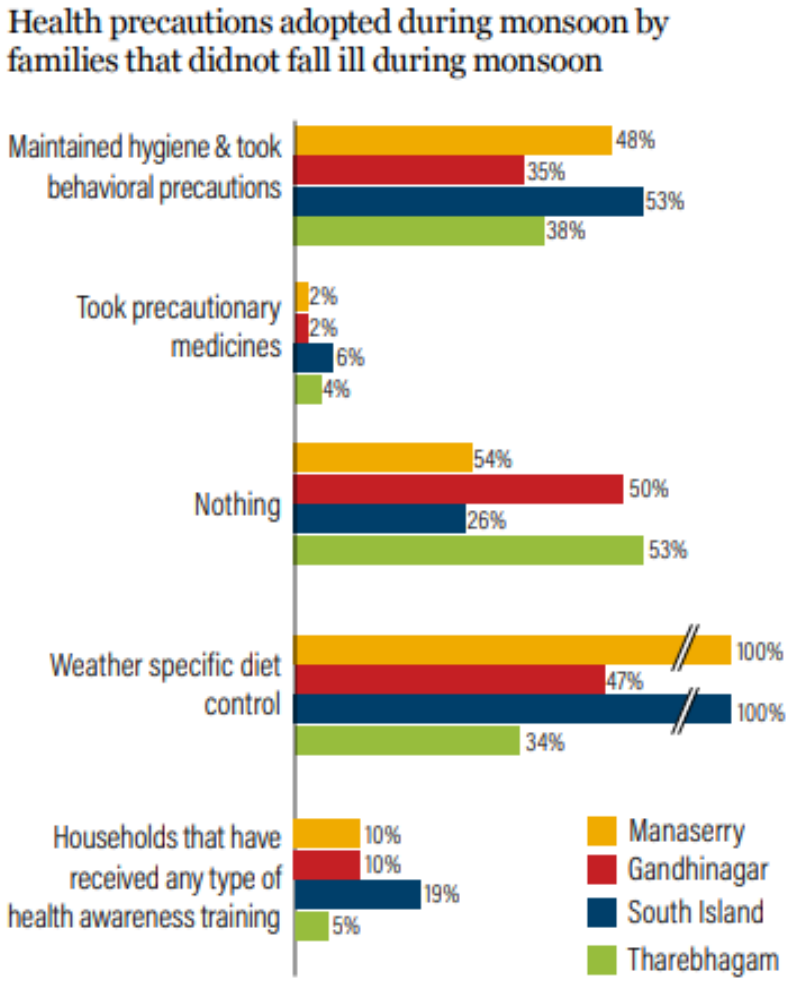


Fig 32 | History of Early Warnings vs Source of Early Warnings in Vulnerable Communities

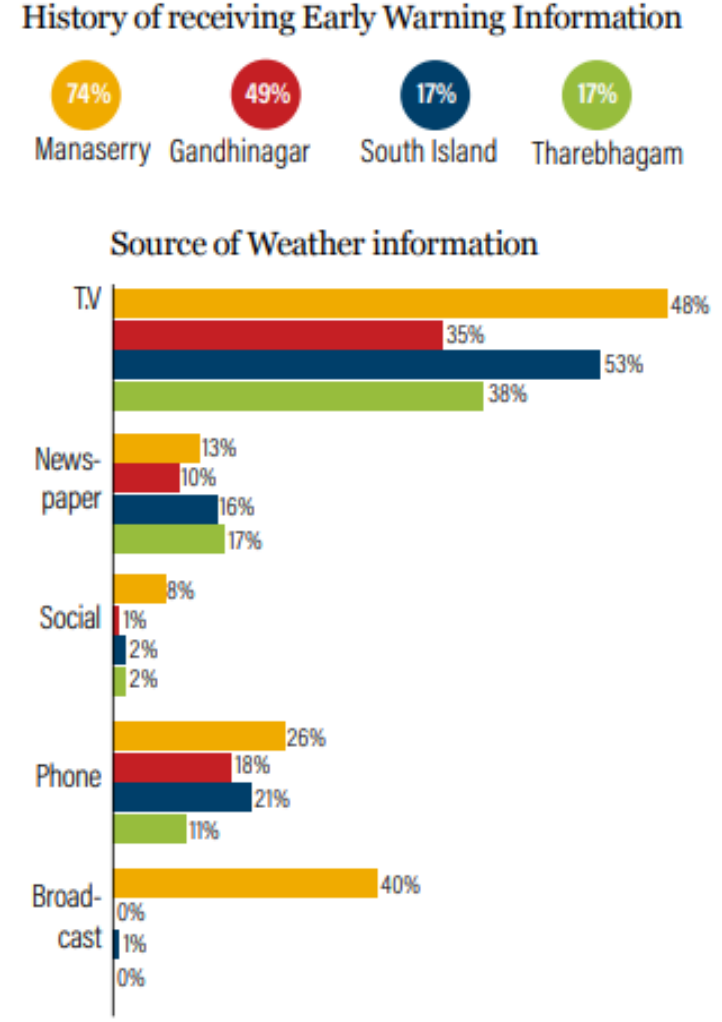
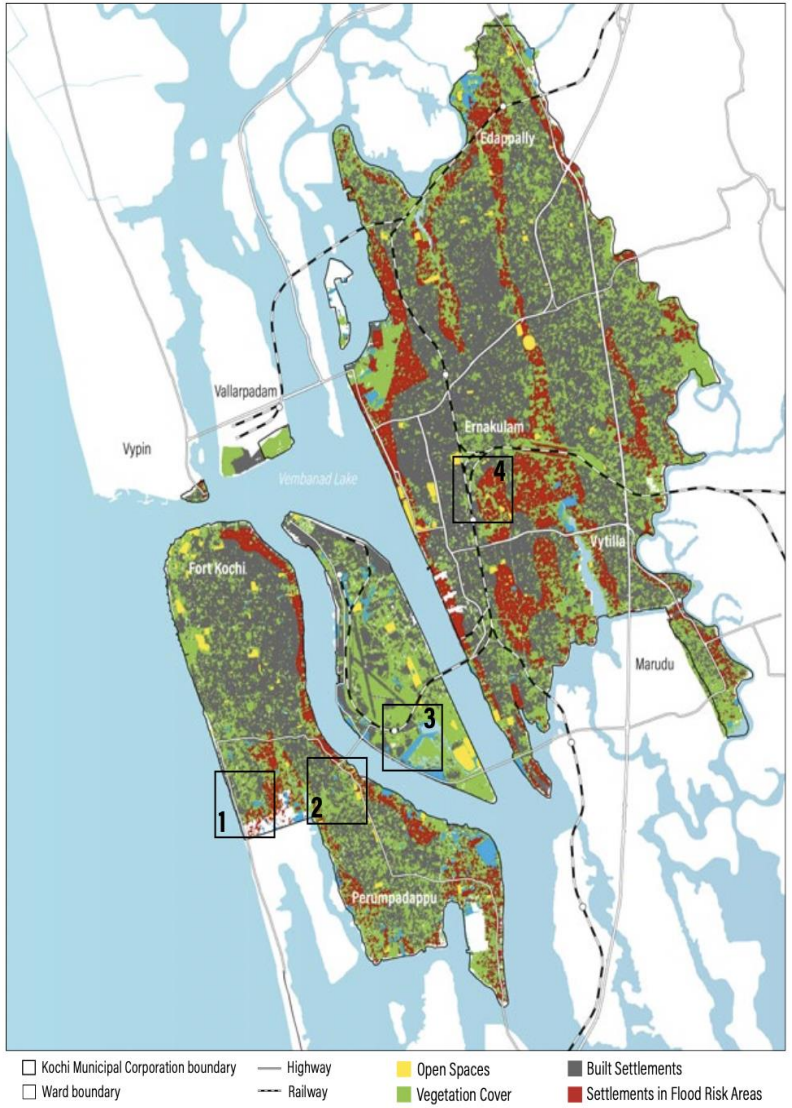
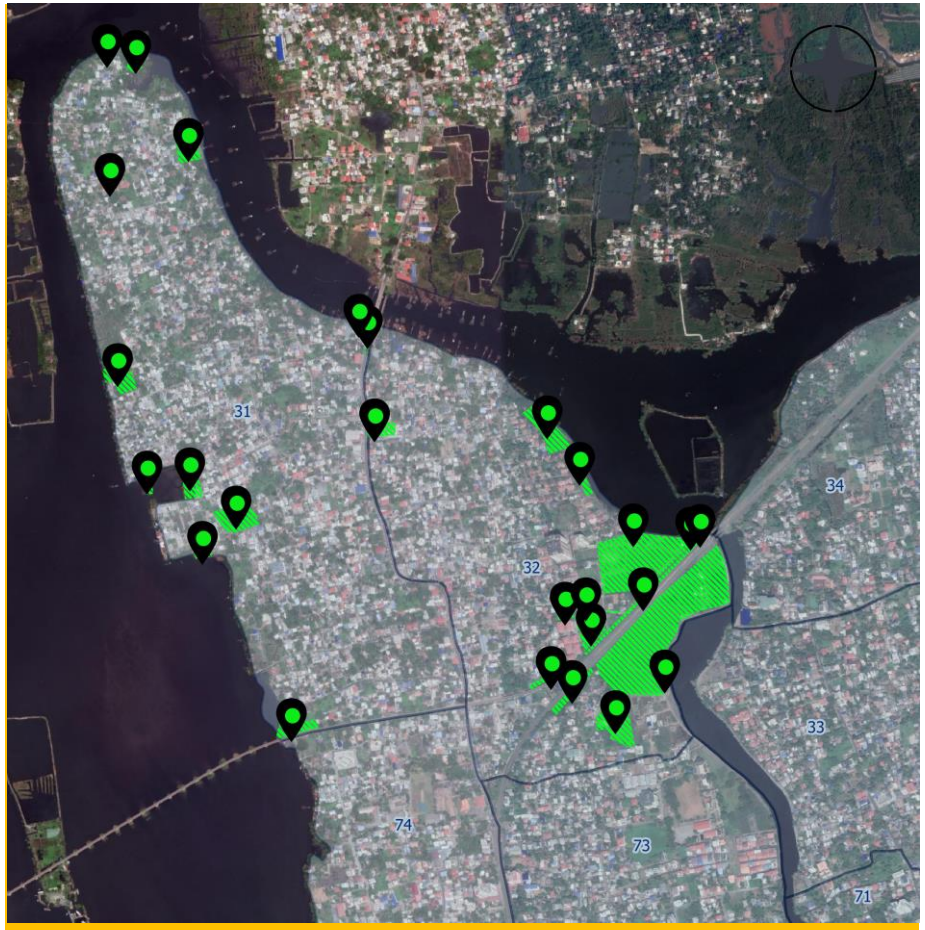


Figure 26 | Climate Impact Assessment in UCRA pilot locations



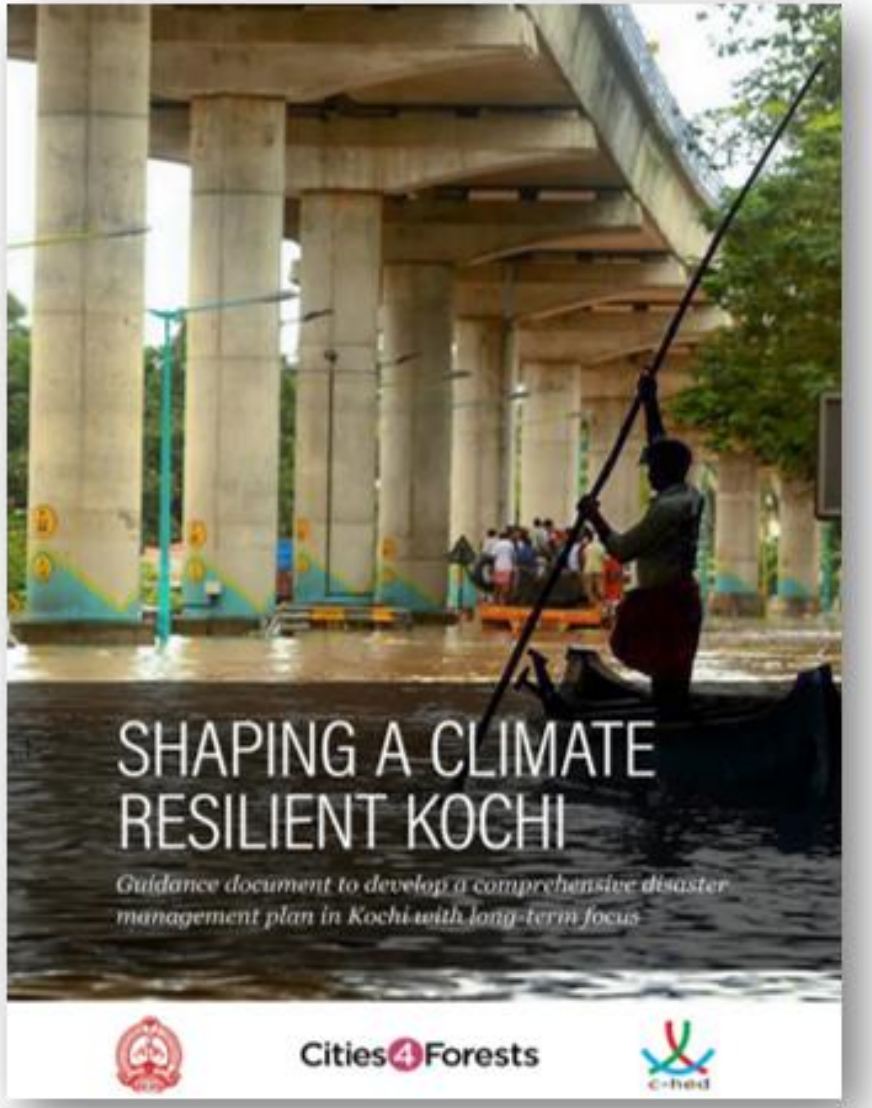
City Case: Identifying Areas for intervention, Co-Developing Strategies in Kochi



Vacant Plots identified by citizens in Vaduthala East and West wards

Presentation to concerned stakeholders and critical inputs from State Government

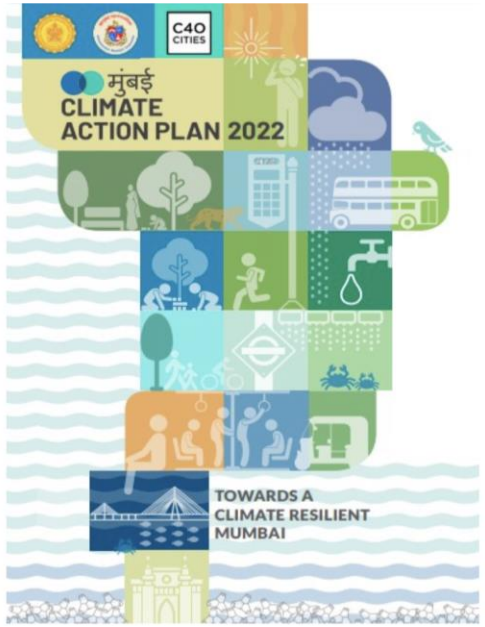
City Case: Influencing the City Disaster Management Plan

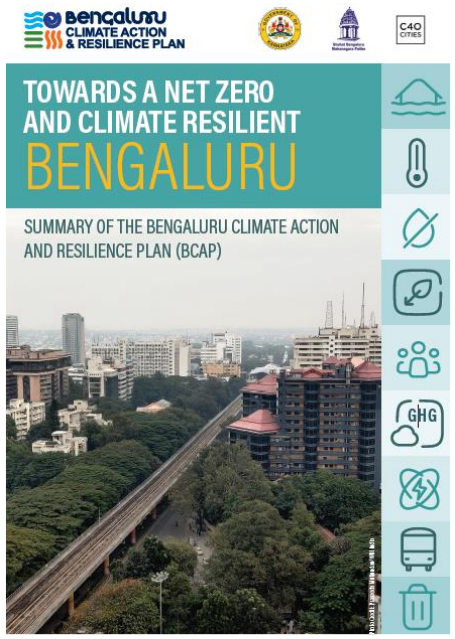


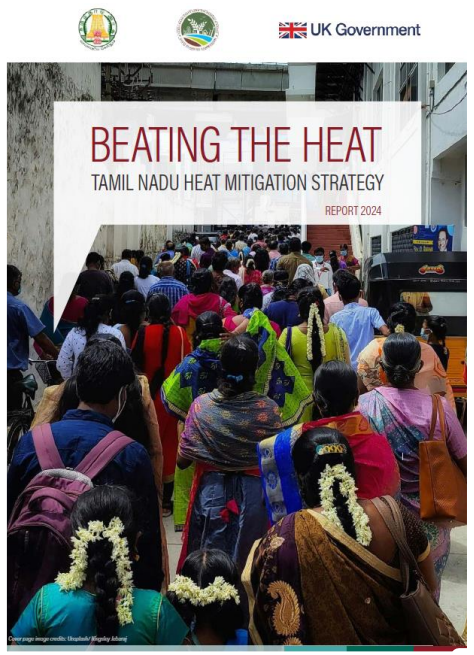
- Enabling city agencies involved in disaster management to shift the model of city disaster management from rescue and recovery to resilience and preparedness

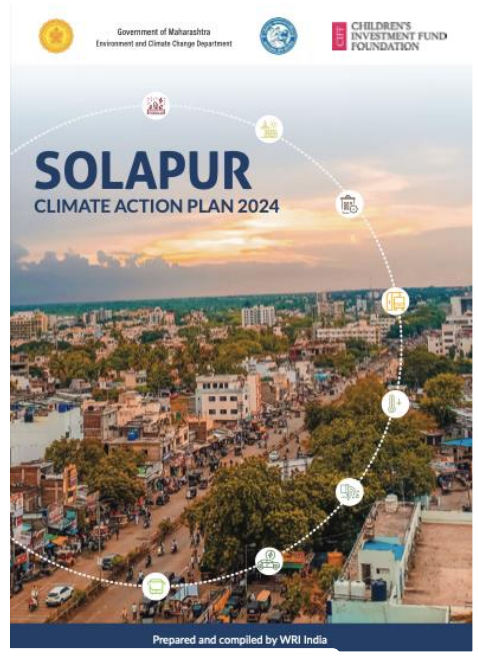
- **CDMP to impact 1+ million residents of Kochi**

Use Cases of the CHVA Framework









NITI Aayog

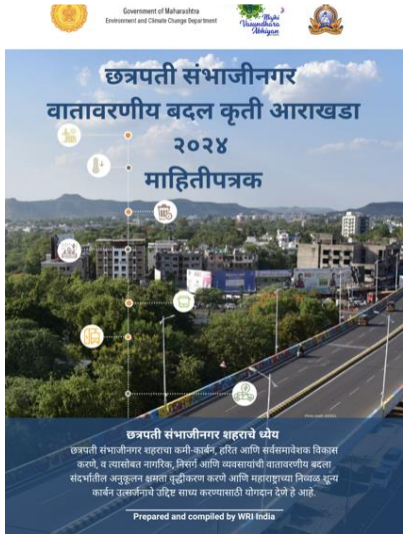
Azadi Ka Amrit Mahotsav

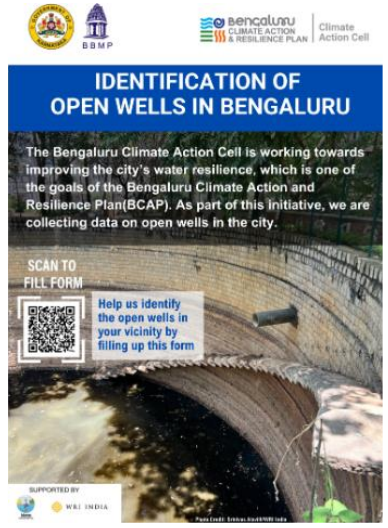
NITI Aayog's Growth Hub Program a testimony of Strong Cooperative Federalism

Focus on Strategies for Enabling Productive Urbanisation and making Mumbai $1 Trillion Economy

Posted On: 29 AUG 2023 9:02PM by PIB Delhi

NITI Aayog delegation led by CEO, NITI Aayog held a meeting with the Chief Minister and the Deputy Chief Ministers of Maharashtra State along with senior officials of different State departments to discuss the potential of urbanization in the economic development of the country.





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THANK YOU

To access the Climate Resilient Cities report, please scan the code below:

Closing Remarks

Deepti Talpade

- *Webinar 2:* Nature-based Solutions to Tackle Urban Heat in Cities *(Wednesday 5 March)*
- *Webinar 3:* Nature-based Solutions to Mitigate Flooding and Stormwater Risks in Cities *(Wednesday 26 March)*

URBAN SH/FT

Thank you!

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