URBAN SH/FT Cities4Forests WRI INDIA

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

The self-learning module introduces the Climate Hazard and Vulnerability Assessment (CHVA) Framework. The framework encourages 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 module

- This self-learning capacity building module has been developed by **WRI India** with support from **UrbanShift** and **Cities4Forest**.
- 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 module 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**.

This self-learning capacity-building module has been developed by WRI India with support from UrbanShift and Cities4Forest. It introduces the CHVA Framework and is based on the publication Cities: *Assessing Differential Vulnerability to Climate Hazards in Urban India*. This report draws on WRI India's experience in developing climate action plans for five cities. You can access the full report here: [Climate-Resilient Cities: Assessing Differential Vulnerability to Climate Hazards in Urban India]

Module 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

The training is divided into four parts:

1. An introduction to the topic and the importance of assessing climate hazards and vulnerabilities.
2. A detailed overview of the CHVA Framework.
3. Guidance on applying the framework in collaboration with local governments, cities, and communities.
4. A discussion of its limitations and real-world applications.

Two extremes of climate change

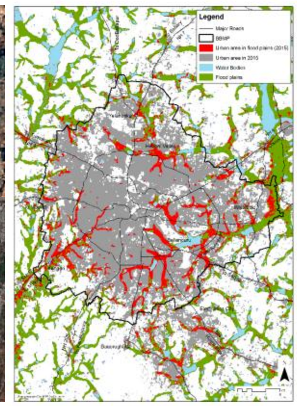
FLOODING

DROUGHT

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

As extreme climate events become more frequent worldwide, cities are increasingly bearing the brunt—through displacement, health crises, livelihood disruptions, interruptions to essential services, and other weather-related challenges. The spectrum of climate disasters is widening, ranging from devastating wildfires and prolonged droughts to intense rainfall and catastrophic flooding. Alongside these sudden events, cities face slow-onset disasters such as rising temperatures and escalating water stress, necessitating urgent long-term planning. Experts emphasize the need for integrating risk and vulnerability mapping into urban planning, policymaking, and strategy development to build resilience against these growing threats.

How are cities expanding? And where are we building?

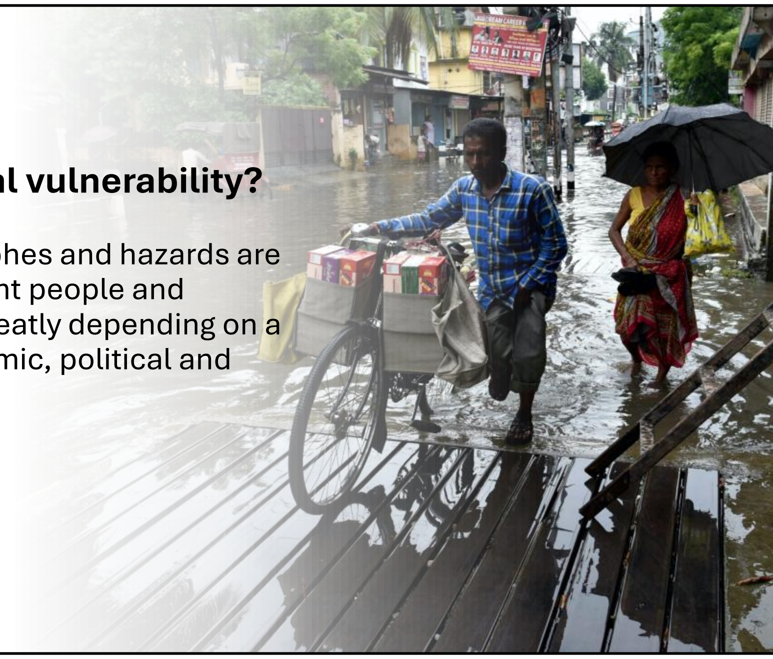


Example: 85% of floodplains in Bengaluru are built upon

As climate risks intensify—whether through extreme events or slow-onset disasters—urban areas are rapidly expanding, often in ways that heighten their vulnerability to climate hazards. In many cases, city development is exacerbating these risks rather than mitigating them. For example, in Bengaluru, a major city in southern India, nearly 85% of its floodplains have been built upon or developed, significantly increasing the risk of severe flooding. Without better urban planning and proactive resilience strategies, unchecked urban growth may leave cities even more exposed to climate-related disasters.

What is 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 impacts of climate disasters are not experienced equally across all communities. Social, economic, political, physical, environmental, and cultural factors shape how different groups are affected—a concept known as **differential vulnerability**. Marginalized populations, such as low-income communities, the elderly, or those living in informal settlements, often face greater risks and possess fewer resources to recover from climate-related events. A new framework seeks to highlight these disparities and make the uneven impacts of climate change more visible. Experts stress that recognizing these differences is essential for designing response strategies that prioritize the needs of the most vulnerable, ensuring urban adaptation efforts are both effective and equitable.

The **Climate Hazard and Vulnerability Assessment (CHVA) Framework** aims to assist urban planners, policymakers, and practitioners in understanding the interactions between climate hazards and socioeconomic factors—interactions that are often challenging to consider or correlate.

The CHVA framework aligns with 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 **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 **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).

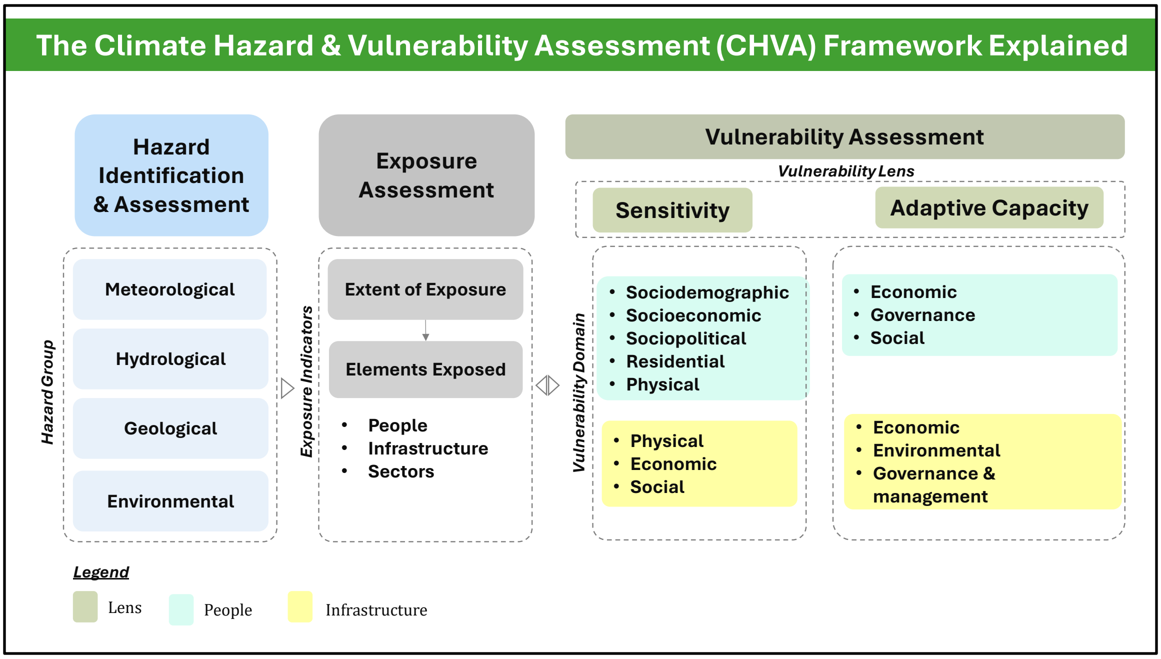
The CHVA Framework aligns with the IPCC's definition of risk: "*In the context of climate change, risks can arise from potential impacts of climate change as well as human responses to climate change. […] In the context of climate change impacts, risks result from dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system to the hazards*" (IPCC 2022, 2921).

The CHVA Framework is divided into three key steps

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

Based on the IPCC’s determinants of risks, the CHVA Framework is divided into three broad steps: **Hazard Identification & Assessment (HIA), Exposure Analysis,** and **Vulnerability Assessment**.

- **HIA** focuses on identifying hazards, understanding their intensity, trends, frequency, and probability of occurrence, and recurrence. It also determines which elements of the city—including people and infrastructure—can be impacted by the identified hazards given hazards’ historic severity, and projected trends.
- **Exposure Analysis** provides with details of who and where all these elements are located that are at risk of exposure to a single or compounded multiple hazards. This step allows to spatialise the extent of exposed areas. It also helps with identifying, based on the rate of exposure, such as for what time – in the year or a day – people or infrastructure is exposed to hazards. Hence, helping identify who and where all are the elements at risk of prolonged exposure to hazards.
- **Vulnerability Assessment** examines sensitivity and adaptive capacity, helping cities understand how vulnerabilities are distributed due to underlying socioeconomic, political, and demographic drivers.

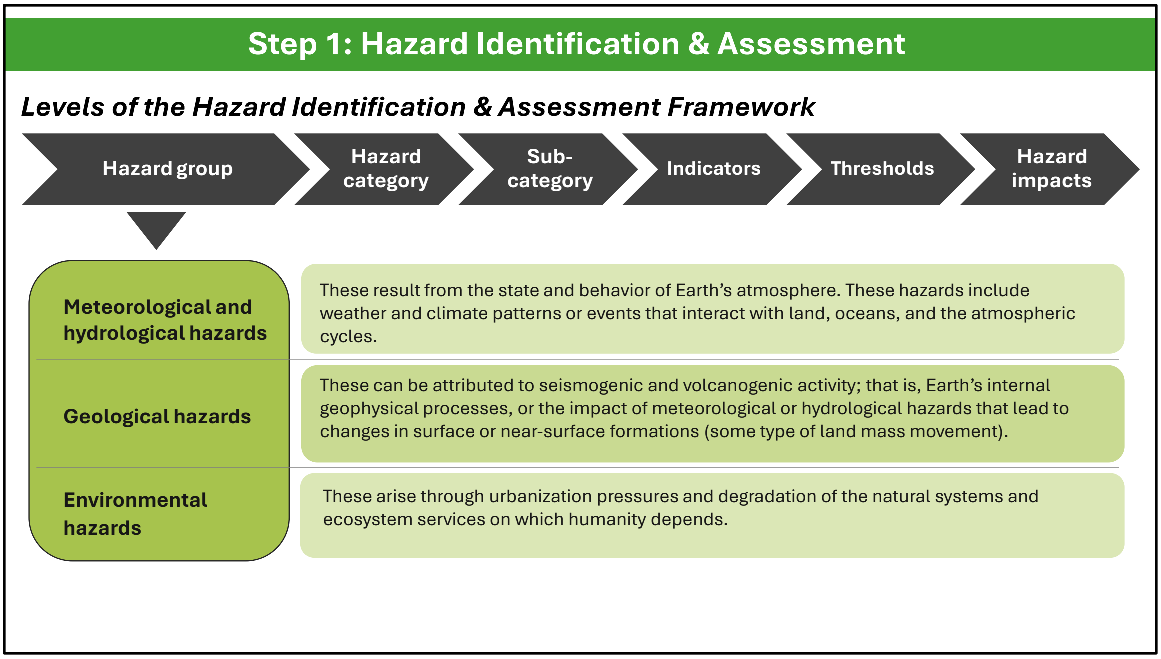


A flow chart outlines the components of the 3 steps of the CHVA framework described in the preceding section:

To undertake **HIA**, it is crucial to identify key hazards relevant to the geography of interest and align them with the city's profile. Hazards should be categorized into four groups based on their nature and origins. Each hazard group identifies hazard categories based on the 'causal sequence or aspects of geo-climatic conditions.

Exposure Analysis focuses on the physical domain of hazards. This step identifies high-risk areas, or "risk hotspots," that allows to demarcate who and what lies within the extents of the areas exposed to hazard occurrence. The objective is twofold: first, to quantify and locate the share of the population or communities living in hazard-prone areas; second, to evaluate the exposure of critical infrastructure, such as mass transportation networks or water supply systems.

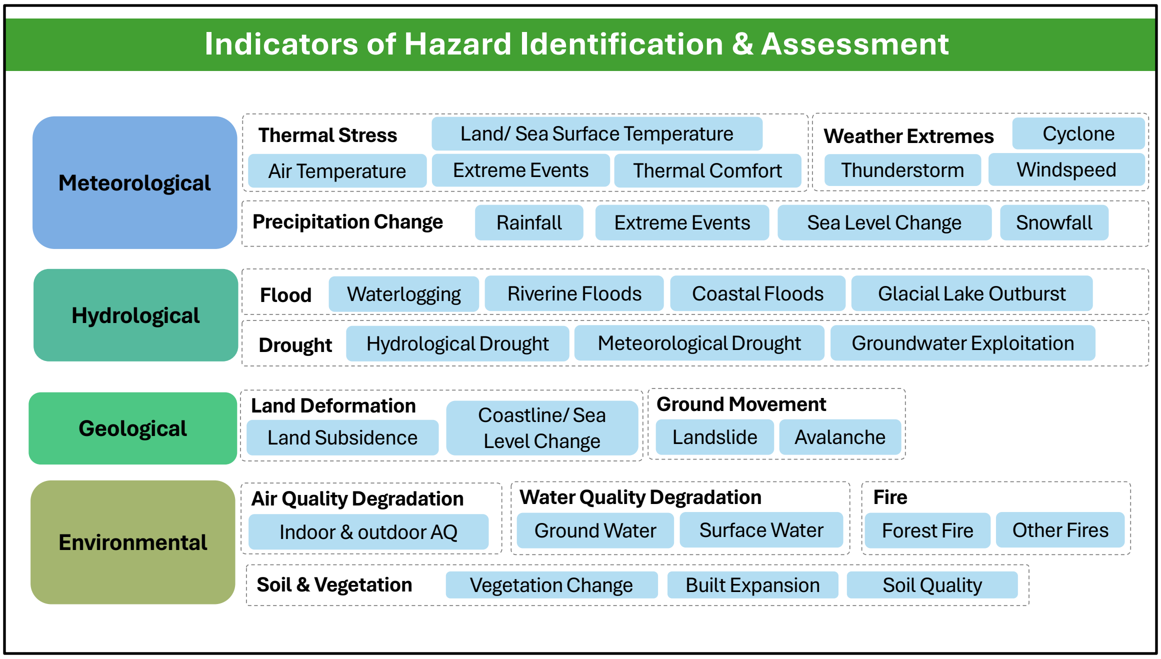
Vulnerability Assessment incorporates sensitivity and adaptive capacity of both people and infrastructure through an equity lens. It builds upon HIA and Exposure Analysis to identify the differential risks faced by people and infrastructure. The degree of impact is influenced and accelerated by the complex interplay of cultural, social, fiscal, political, governmental, and environmental factors. These deeply rooted characteristics often manifest as limited access to essential infrastructure and resources or inadequate functional capacity to provide services to those most in need—whether during a disaster, after it, or in day-to-day operations. In the CHVA report, each of the steps are detailed using the levels of assessment that flows from the conceptual understanding of the hazard to measurable units, further to thresholds that help identify the propensity of the hazard impacts. These can be referred in Ch 2-4 of the report.



Delving deeper into the assessment with step 1—**Hazard Identification and Assessment (HIA)**. HIA lists hazard groups, categorized into four: **Meteorological Hazards**, **Hydrological Hazards**, **Geological Hazards**, and **Environmental Hazards**.

- Meteorological and Hydrological Hazards result from interactions between land, atmospheric cycles, oceans, and climate patterns.
- Geological Hazards are caused by seismic activities driven by the Earth's geophysical processes, leading to surface or near-surface land movements.
- Environmental Hazards arise from anthropogenic and urban pressures that degrade natural ecosystems.

These groups are further divided into subcategories with measurable indicators to evaluate hazard location, intensity, frequency, magnitude, and likelihood as detailed in the next section.



The indicators for each hazard group and sub-group are based on definitions provided by key climate research agencies such as NOAA, EPA, and IMD in India. The rationale for these indicators is detailed in the report's annexures and can be tailored to suit local contexts. For example, thresholds for extreme rainfall events in India are derived from India Meteorological Department (IMD) standards. Similarly, definitions from the African Center of Meteorological Applications for Development (ACMAD), or the World Meteorological Organisation – region relevant agencies corresponding to weather/ disaster/ climate/ health and planning management services can be used for establishing the thresholds based on the study area.

Often, 30-year baselines or longer are employed to identify changing trends. Extreme anomalies or continuous variations over these periods help determine whether phenomena are evolving into hazard events. For instance, temperature trends reveal whether conditions are warming or cooling, while rainfall trends show whether a region is becoming drier or wetter compared to historical baselines.

Some hazards are fundamentally interlinked, often triggering a domino effect that results in sequential or concurrent events or contributes to long-term changes accompanied by post-disaster impacts. For example, an increase in sea surface temperature can lead to cyclone formation, which may cause high-intensity rainfall events or unseasonal rainfall that triggers localized flooding, landslides, and other cascading impacts. Capturing and understanding these **cause-relay-impact relationships** across climate-related phenomena is critical for assessing hazards in a specific geography. Refer to Chapter 3 of the report for more details.

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.

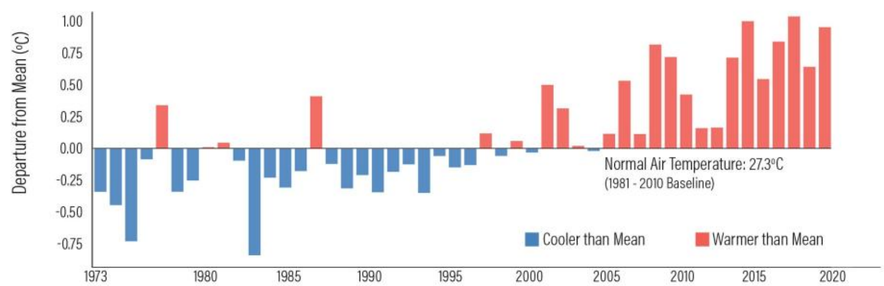
Case examples

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

The detailed methods of assessing each indicator provide a flexible approach and can be tailored based on the purpose and publicly available data sources that are acceptable to the CHVA team. CHVA framework uses publicly available data sources, which are scalable and updated at regular intervals, such as Census data, satellite-derived information, and weather bulletins. These are detailed in Chapter 5 of the report, along with data sources, output illustrations for each indicator, and use cases from WRI India projects. For example, on the slide, we see methods listed for Hazard Identification and Assessment, alongside corresponding datasets, data sources, and examples from the report that demonstrate how these insights can inform climate action.

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

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



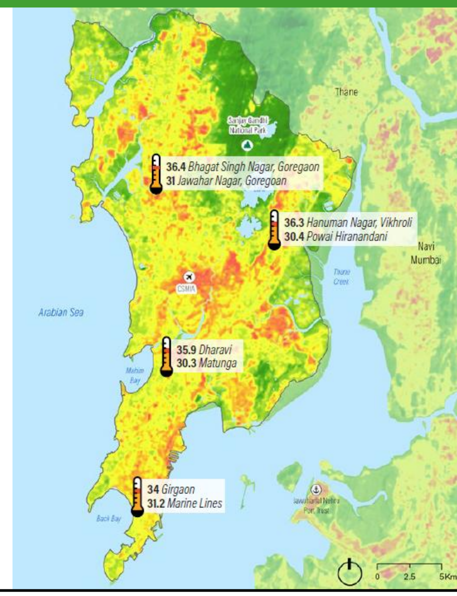
Source: Mumbai Climate Action Plan, 2022 ; Municipal Corporation of Greater Mumbai (MCGM), C40 Cities

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.

This is an example of how a potential output for trend analysis, detailed in previous slides, could look like. This case example is from Mumbai, a linear trend plot of annual average air temperature data from a weather station in the city and compare each year's average air temperature with a 30-year long average called baseline. These observations for Mumbai revealed that between 2015-2020, annual air temperature has been nearly 1°C higher than the baseline.

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

- Cities are known to experience **urban heat island effects** – the more 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 residential areas.



Mean LST: +25°C +42°C

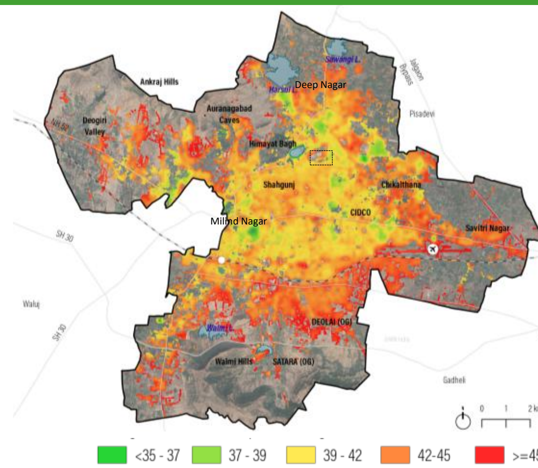
Waterbody | BMC Boundary | Airport | National Park | Sea Port

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

Using the previously discussed methods and data sources, satellite data can also be utilized to derive **Land Surface Temperature (LST)**, which is widely used to assess urban heat island (UHI) effects. Cities, with their high concentration of paved surfaces, trap heat, causing them to remain warmer, especially at night. In this example from Mumbai, we used daytime LST—a granular version of surface temperature derived from satellite data—to identify neighborhoods at higher risk of heat stress. The data showed that informal settlements in Mumbai experienced LST about 5°C higher than neighboring residential areas. Such visualizations provide deeper insights into the dynamics between built environments, anthropogenic activities, habitat conditions, and surrounding land cover (e.g., greenery and water bodies), which significantly influence microclimatic conditions.

Case Example: Identifying areas experiencing UHI effects

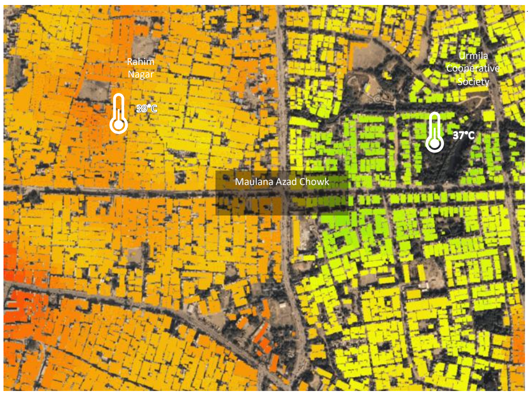
- Peri-urban areas of the cities, especially in smaller cities, LST can have **influence of non-irrigated, bare soil, fallow land or non-vegetated areas that can easily heat up during the day hours**.
- In such cases, it is important to focus on the **urbanized core of the city where higher share of population resides** to identify heat islands with the city.

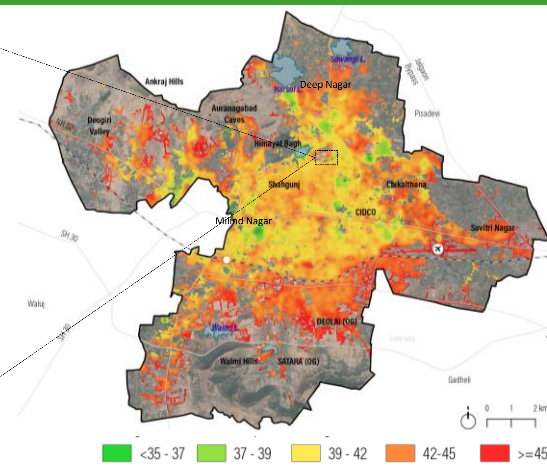


Source: Average Summer Day time LST, Chhatrapati Sambhajinagar Climate Action Plan, 2023

As the name suggests, **Land Surface Temperature** is derived from satellite data and depends on the nature of land surfaces observed. Different land covers exhibit varying thermal characteristics. For example, during the day, natural surfaces like bare soil or non-irrigated lands heat up quickly but cool down as the sun sets. In contrast, concretized urban areas, often concentrated in city cores covered with all paved surfaces, retain heat throughout the day and night. These areas frequently house a large share of the population, increasing their exposure to heat stress. For instance, in Chhatrapati Sambhajinagar (a Tier-2 city in India), we observed similar patterns where densely populated, concretized zones faced heightened heat stress risks.

Case Example: 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.).

On the left, the zoom in of an area in the city core, we can see that the areas on the left with tightly packed built settlements and no green areas is having 2°C warmer LST than its neighbouring area which has well ventilated block sizes, avenue greening, and well-maintained green pocket parks.

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.

The final step of completing the **Hazard Identification and Assessment (HIA)** involves determining who and what in the city is impacted by the identified hazards. The **Impacted Elements Checklist** provides an exhaustive inventory of critical infrastructure networks, service systems, communities, and other key components essential for the city's functioning. This checklist helps link specific climate or environmental hazards to the elements they impact, allowing for a deeper assessment of how and to what extent these elements are affected. Additionally, it aids teams using the CHVA framework in summarizing the scope of hazard assessments and prioritizing areas of focus based on available resources and time constraints.

Case Example: Impacted Elements' Checklist

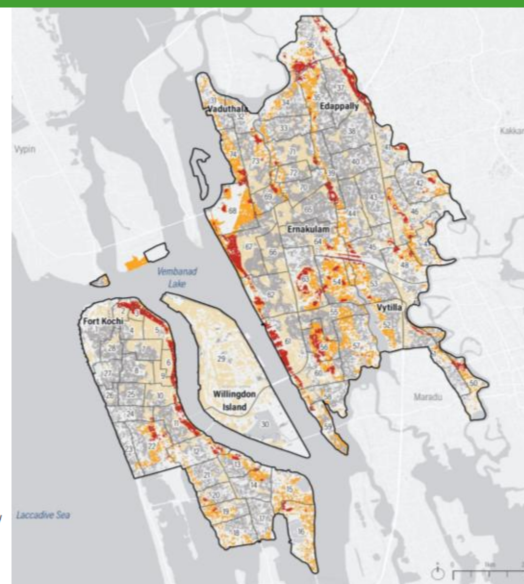
IMPACTED ELEMENTS	METEOROLOGICAL					HYDROLOGICAL		GEOLOGICAL		ENVIRONMENTAL				
	TS	Pr	Wn	WE	SL	Fl	Dr	LD	GM	AQ	WQ	SQ	Vg	Fr
Population	√	√		√	√	√		√		√			√	
Natural environment	√	√		√	√	√		√		√			√	
Built environment	√	√		√	√	√		√						
Jobs and livelihood	√	√		√	√	√		√		√			√	
Infrastructure	√	√		√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

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

For example, in the checklist developed for Mumbai, the team identified key hazards affecting the city. However, due to limited data availability, the assessment of water quality impacts was deferred. Instead, the focus shifted to building institutional awareness of how water quality data can offer critical insights into urban health conditions. This step underscores the importance of the checklist as a pragmatic and foundational tool that shapes the course of the entire assessment. It allows for visual comparisons of impacted elements at risk from multiple hazards, helping teams prioritize and plan their analyses effectively.

Case Example: Multi-hazard mapping

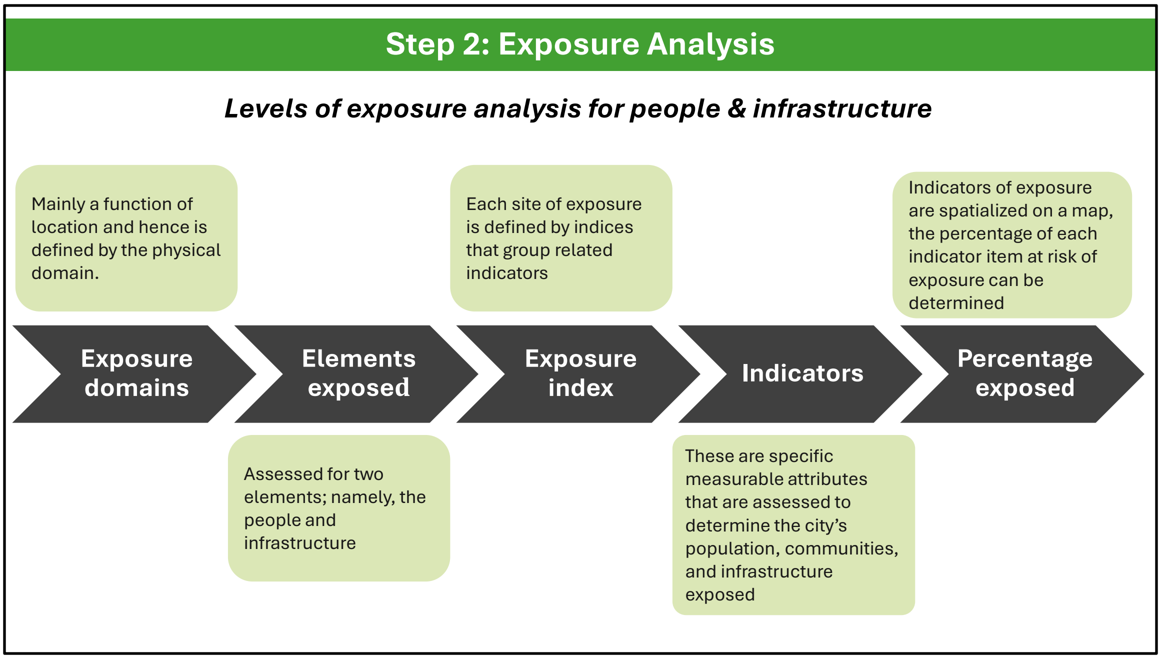
- A form of **composite mapping using spatial extents for key hazards** identified, overlaid and compiled as **multi-hazard zones**. Thes zones can be categorized based on the intensity and frequency of hazards.
- Assessment of the multiple hazards in Kochi revealed that 25% of the built area in the 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.

For instance, when we did the assessments for understanding the areas susceptible to heat and floods in Kochi (a city in southern state of Kerala, in India), the results showed that that around 7% of the settlement areas were impacted by both the hazards with risk of prolonged exposure given that high heat months and monsoons with extreme rainfall stretch along after the other.



Same as Hazard Identification and Assessment, **Exposure Analysis** is explained through a flow diagram. This step focuses on understanding where the impacted elements (from the previously discussed checklist) are located, the intensity of their exposure to hazards, and the timescale of exposure—whether short-term or prolonged. Exposure Analysis considers a wide range of elements across **people and infrastructure categories**, mapping their distribution within the city and analyzing their "physical domain" of exposure. Like HIA, this step relies on specific measurable indicators, whose results can be spatialized on maps. This allows teams to quantify the share of each element at risk, such as the percentage of the population or the percentage of roads exposed to hazards.

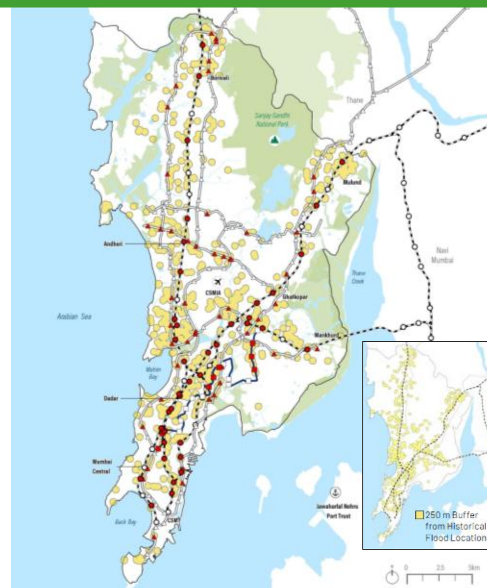
TABLE 7 | Framework for analyzing exposure to hazards

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

The table provides extensive listing of elements (people category) that can be potentially at risk of direct exposure to climate and environmental hazards. Variation in population density allows to understand areas with more no. of people clustered, slums based on their underlying socio-economic conditions, and job employment clusters help to locate areas which at large host more number of people either residing or working. Overlay of hazard extents with density variations can help prioritise actions. Chapter 4 of the report provides a comprehensive list of indicator items that can be used to spatialize exposure for both people and infrastructure.

Case Example: Exposure Analysis of Infrastructure in Mumbai

- 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.**

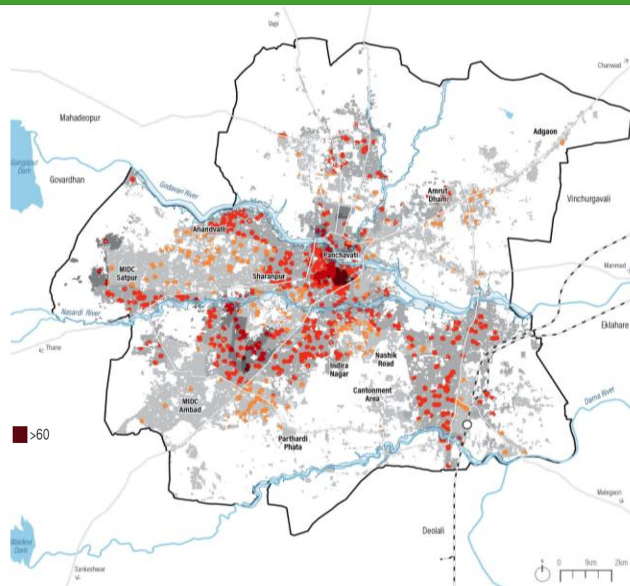


Source: Mass Transit Stations with Limited Physical Access, Mumbai Climate Action Plan; Brihanmumbai Municipal Corporation 2022

This example from Mumbai demonstrates how complaints data for waterlogging over several years, combined with local knowledge about waterlogging spread (typically 100-200 meters around roads or settlements), was used to map the city's mass transit networks against hotspot areas. By overlaying this data, we identified which transit stations might potentially become unserviceable during extreme rainfall events due to restricted physical access caused by waterlogging. The analysis revealed that waterlogging exposure could impact one-third of Mumbai's transit network.

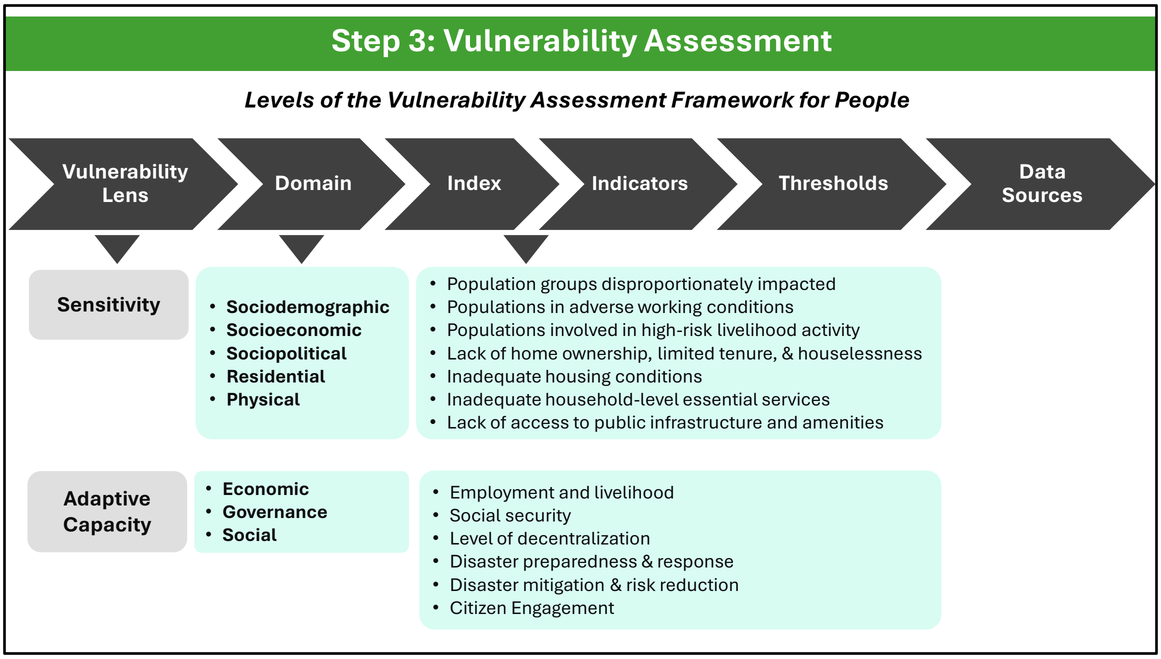
Case Example: Exposure Analysis of people in Nashik

- 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.**

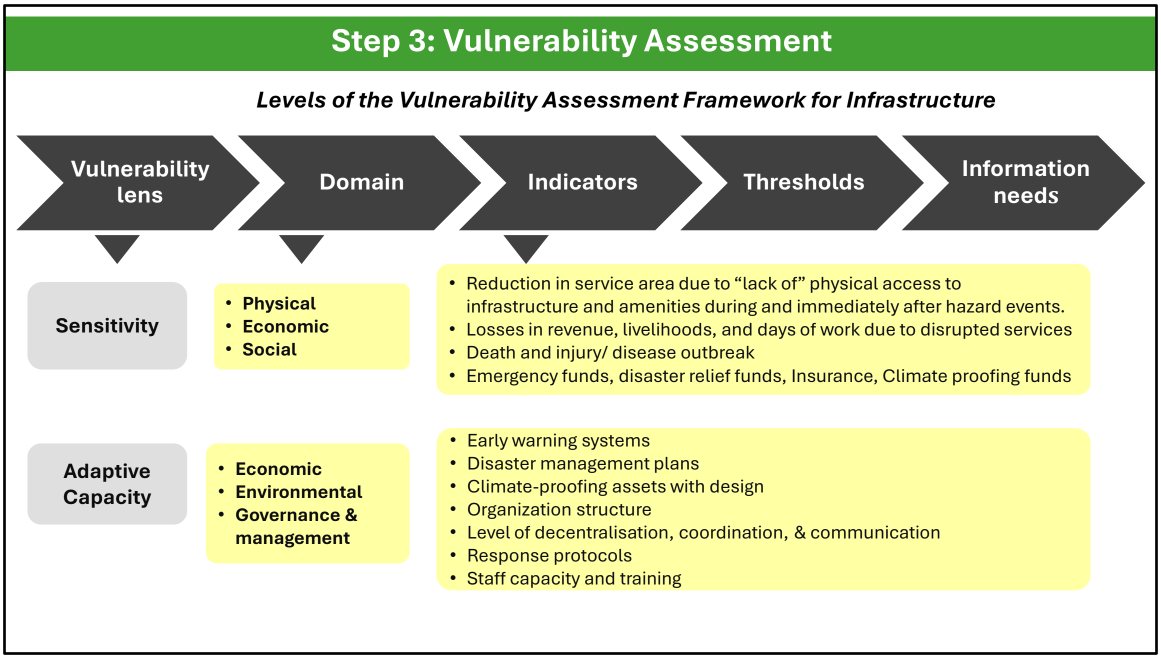


Source: Population density exposed to flooding, Nashik Climate Action Plan, 2024.

Similarly, in Nashik, we combined waterlogging complaints data with the high flood line from the river to assess which settlements were affected. The analysis relied on an impact radius derived from local knowledge and institutional memory of areas historically impacted. These insights were gathered through a series of consultations, which are an integral part of the CHVA framework – explained in Chapter 6 of the report.



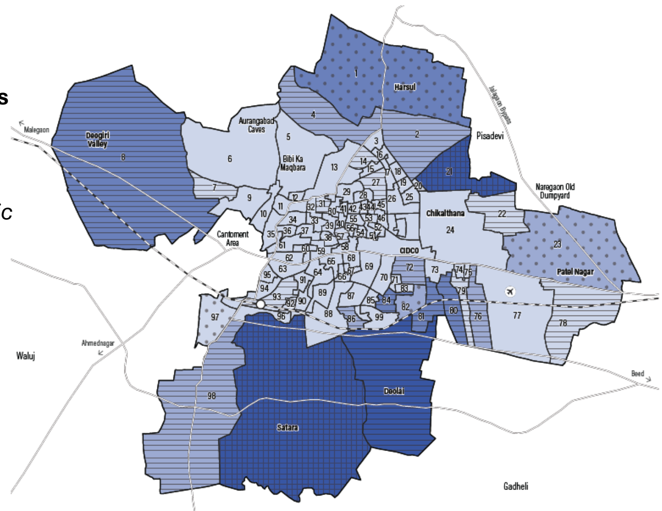
Moving to the third step, the flowchart illustrates the levels of **Vulnerability Assessment** for people. It highlights how the framework captures variations in population characteristics, considering factors such as inherent demographics, livelihoods, equity perspectives, political and cultural dynamics, resource availability and accessibility, and the agility of individuals, communities, and institutions to respond, recover, and reduce risk proactively.



Similarly, vulnerability of infrastructure is assessed through multiple lenses, including physical design, standard protocols around loss and damage, service disruptions, productivity losses across sectors, and impacts on lives and livelihoods. Preparedness levels at both the asset and network management levels are examined, with governance structures playing a key role. Consultations, surveys, and in-depth reviews of existing policies and plans provide qualitative insights. The assessment not only evaluates the abundance of amenities but also measures their efficiency, effectiveness, and functional capabilities. Methods to assess these aspects are detailed in Chapters 4 and 5 and the annexures of the report.

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.



Percentage of households without drinking water inside premises:
0–18 | 18–35 | 35–53 | >53

Percentage of households without access to treated drinking water:
0–25 | 25–50 | 50–75 | >75

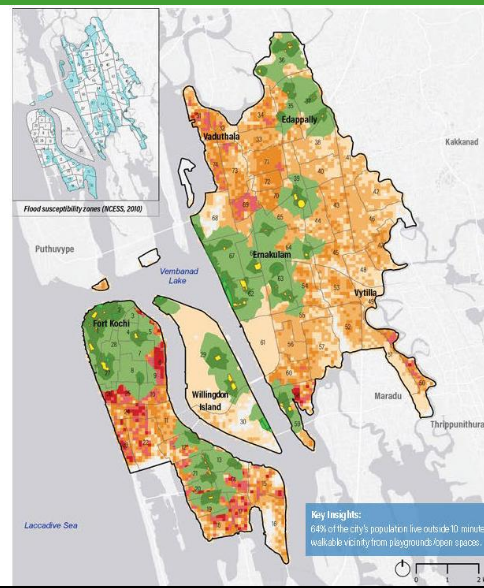
Airport | Railway station | Railway | Major road | Ward boundary | City boundary

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

Here is a case study on **differential vulnerability of people** highlights the indicator of access to critical water resources. Using census data at the ward level (the smallest administrative unit in Indian cities), the share of households with access to treated water and whether the water was available within household premises were compered. In the city of Chhatrapati Sambhajinagar, mapping this indicator showed that core areas had better access to water facilities, whereas peri-urban and newly developing areas lacked such access. These underserved areas are highly sensitive to risks like heat stress, water scarcity, and other climate-related challenges.

Case Example: Vulnerability Assessment of Infrastructure in Kochi

- **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

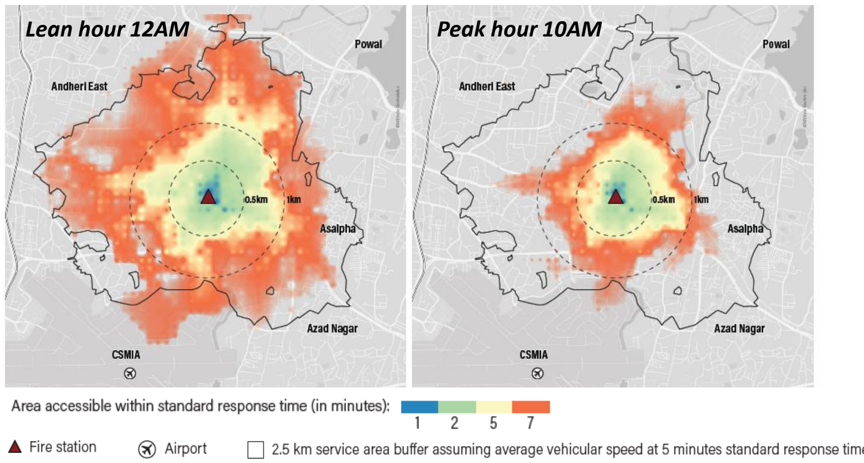
Population with Walkable Access: within 300m | within 800m

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.

We saw that the previous example of access to utility was based on provision of water network, but in case of hazards the ability to adapt – for example, to be able to quickly access social amenities, is critical as well. For instance, in Kochi, we mapped areas outside an 800-meter walkable distance (approximately a 10-minute walk) from parks and playgrounds—critical green social assets of the city which are often key for low-income population. The areas beyond this 10 min walk distance are underserved.

Case Example: Vulnerability Assessment of Infrastructure in Mumbai



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

Being able to physically access any public amenity is also a function of the road network and traffic on the roads or congestion. Efficient connectivity ensures that services can be accessed within standard delivery times. For example, mapping the serviceable area of a fire station using real-time traffic data from Google Maps revealed a significant reduction in the fire station’s service radius during peak traffic hours. While the service exists, its effectiveness during emergencies is compromised during peak times, raising critical concerns. Understanding these functional aspects of the critical infrastructure networks is highly important to identify who, where, why, and how can be potentially at risk.

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

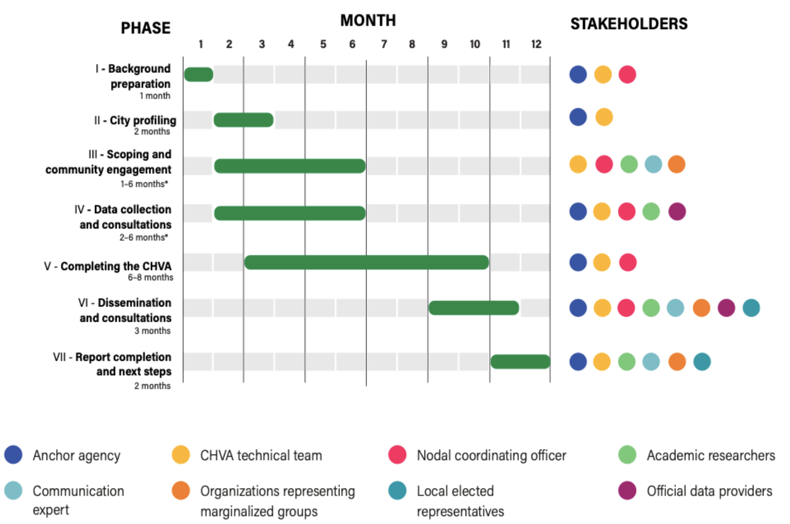
- **Nestled alongside the Ngong River, the settlement in Kibera** was at the mercy of the riverbed. During heavy rain, the river water spilled over, invading homes.
- **Kounkuey Design Initiative (KDI) on the Kibera Public Space Project**, a finalist for the 2020-2021 Prize for Cities, co-developed **solutions 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

A successful example of mapping public amenities and points of service to reduce risks comes from the **Kounkuey Design Initiative** in Kibera, along the river in Nairobi. This initiative, started at the community level, focused on understanding neighborhood issues and co-developing solutions. These solutions were later formally integrated into the city's **Special Planning Area** plan, demonstrating how community-driven approaches can enhance preparedness and resilience against climate hazards.

Operationalizing the CHVA Framework

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



To operationalize the CHVA process on the ground, we have outlined a 7-phase framework. These phases are adaptable and can run parallelly, depending on the city's context, needs, and available resources. The timeline and duration for each phase can be modified accordingly, making the process flexible and city specific.
To ensure the success of CHVA, we have identified eight key stakeholder groups who can drive the process effectively:

1. Anchor Agency or Department:
   This is often a city corporation, smart city office, or a dedicated department like environment or disaster management. This agency oversees the entire CHVA process.
2. Nodal Officer:
   A critical individual, typically appointed by the anchor agency, to coordinate and lead the CHVA process. This officer ensures smooth communication and alignment across stakeholders.
3. CHVA Technical Team:
   This team includes GIS analysts, applied researchers, sectoral experts, climate scientists, and urban planners. They bring the technical expertise necessary for conducting assessments and generating actionable insights.
4. Academic Researchers and Institutions:

Social scientists, equity experts, and researchers play a vital role in bringing an academic perspective, ensuring the inclusion of equity-focused, data-driven methodologies.

5. Communication Experts:
   This group handles website development, data visualization, graphic design, copy-editing, media outreach, and social media engagement. Their role is to translate complex technical information into easy-to-understand formats for a wider audience.
6. Representatives of Underserved/Marginalized Communities:
   Individuals or organizations from working groups, CSOs (Civil Society Organizations), CBOs (Community-Based Organizations), rights-based groups, and directly affected communities. They ensure the process remains inclusive and community-centered.
7. Official Data Providers:
   These include municipal departments, service-providing agencies, and government/semi-government organizations responsible for providing accurate and up-to-date data critical to the assessment.
8. Locally Elected Representatives:
   Politicians and local leaders who can take political initiatives to advance climate action and ensure that CHVA outcomes are aligned with local governance priorities.

By engaging these stakeholders in a collaborative manner, the CHVA process becomes more holistic, inclusive, and impactful. Each stakeholder brings unique expertise and perspectives, ensuring the assessment aligns with both technical needs and community priorities while fostering political will for effective climate action.

The first phase is **Background Preparation**. This entails:

- Establishing the overarching need for conducting such an assessment and determining what the geographic and technical scope and scale would be (this could be related to a city's climate action plan, development plan or other resilience plans).
- Identifying nodal agencies that will anchor the CHVA (could be within a corporation, municipality, or smart city)
- Identifying and mapping out the governance ecosystem, including all relevant agencies, actors and organizations that will provide data, information, engagement, inputs across administrative boundaries relevant to the study area.
- 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 in Tamil Nadu

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

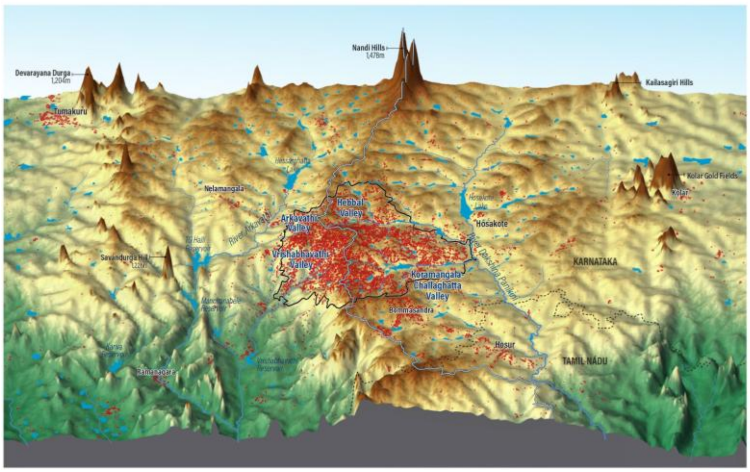
National Programme on Climate Change and Human Health (NCDC)
Capacitating Healthcare systems at different levels

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

This is an example of Tamil Nadu's governance ecosystem that was mapped out while developing a heat mitigation strategy. It includes a list of ministries ranging from environment & climate change to housing & urban development; and various departments within these ministries ranging from the state pollution control board to the forest and disaster management depts, the directorate of town & country planning and so on. Additionally, the team has identified a range of documents, plans, guidelines and reports that are relevant to develop the heat mitigation strategy. This agency matrix along with corresponding studies, policies and plans helps create a base for the CHVA process and is the first step towards operationalising such an effort on-the-ground.

Phase 2: City Profiling

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



- 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 prioritie**s and dependencies
- Identifying **vulnerable groups** and communities
- Analyzing **linkages** between biodiversity, ecological systems, livelihoods, and local economies

The second phase is **City Profiling**. It provides a baseline for the CHVA process by capturing the city's climatic, environmental, socioeconomic, and governance context. Key steps include:

1. Detailing the **geographic context** so that citizens can understand the city's administrative boundaries, topography and location with respect to the watershed; proximity to ecologically sensitive locations such as forests, water bodies, and mountains; and general agroecological factors.
2. Understanding the **urban context not just within the city but also in the peripheries**, where most urban expansion is occurring, especially in environmentally sensitive areas, by reviewing changes in land use, built infrastructure, and built form density over time that are threatening the natural ecological systems of the city
3. Identifying **vulnerable groups** or communities or frontline workers in the city that could benefit from inclusive climate action.
4. Establishing the **climate vulnerability context** by assessing secondary reports and climate action plans at the national and state levels, district disaster management plans, and so on, to include information about predominant seasons, weather patterns, environmental trends, and climate hazards identified at the macroscale to identify known climate stresses in the region.

5. Referring to global, national, and state **climate reports** and commonly cited **climate projection models** to determine potential future climate variations for the region under various Representative Concentration Pathway (RCP) scenarios.
6. Analyzing the **ecological system**, including plants, animals, marine life, wetlands, grasslands, and other ecosystems present in the city and how they are linked to biodiversity, ecosystem services, 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

The third phase is **Scoping & Community Engagement**. This phase gathers qualitative insights on community vulnerabilities and experiences.

1. It is important for the coordinating team to have a fuller qualitative understanding of the forms and experiences of vulnerability that communities face.
2. This additional data can be layered with official data to help contextualize the dataset and ground it in community experiences.
3. In this phase, we suggest that the team conducting the CHVA, led by the city government, undertake exercises to gain a more complete understanding of community needs, **by engaging and partnering with organizations working with underserved communities and marginalized groups**.
4. It is recommended that the lead government agency factor in the resources needed to support such consultations or commission community-level surveys with support from community groups, civil society organizations (CSOs) and community-based organizations (CBOs), nongovernmental organizations (NGOs), academic institutions, and others.
5. Compared with other phases of the CHVA, this phase is flexible and can be conducted in as much depth as time and available resources allow.

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

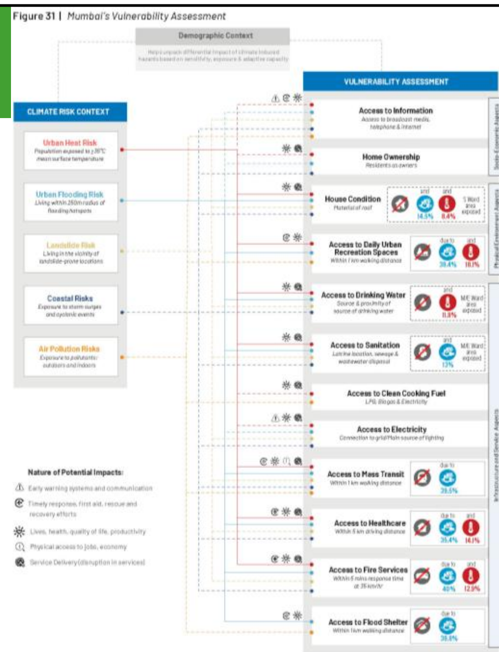
The fourth phase is **Data Collection and Stakeholder Consultations**. Some key steps in this phase include:

1. Identifying relevant hazards and indicators depending on the city context and scale.
2. Creating a checklist of indicators by priority and organizing the data needs, preparing data formats and identify potential sources.
3. Collecting and analysing key data on hazards and vulnerability by assigning roles and persons of contact (PoCs) for relevant agencies. Collecting data can often be challenging, and much of this phase will involve soliciting with various departments and agencies at the urban and state levels for data and information.
4. Checking the data for accuracy and robustness and ensuring that hazards relevant to the city or vulnerability indicators have not been overlooked. Often, data are received from government agencies in formats that are not conducive for immediate analysis; for example, as manually captured data maintained in a physical format.
5. Before analysing the collected datasets, users must scan, digitize, clean, and standardize datasets so it can be stored in a common master database.
6. Engaging with relevant stakeholders and conducting preliminary consultations to close data gaps and share their initial findings with the appropriate stakeholders.

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*



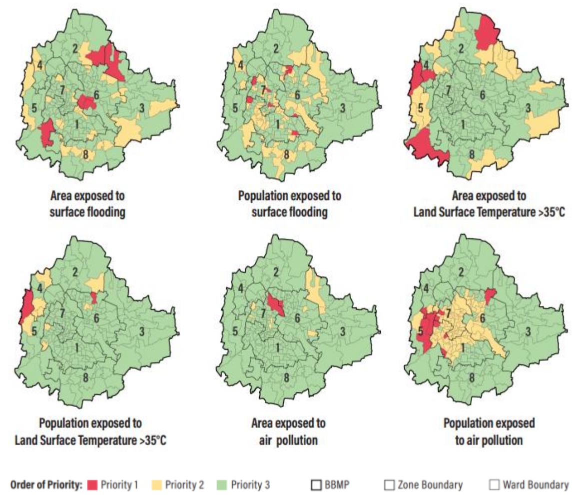
The fifth phase is **Completing the CHVA Framework**. It is the most important phase of the assessment cycle and involves producing an assessment of the main climate-related hazards and vulnerabilities in a city.

1. Using the assessment tables, analytical methods, and data sources, practitioners can complete the CHVA for a given city.
2. First, the Hazard Identification and Assessment is completed, which identifies the dominant hazards and potential impact groups.
3. Next, the Exposure Analysis is conducted to identify populations and infrastructure systems potentially at risk of climate hazards, and finally, the Vulnerability Assessment is completed to assess people, communities, and infrastructure networks that are most vulnerable to impending climate risks.
4. Hazards, exposure, and vulnerability indicators are assessed together, to map differential vulnerabilities across on socioeconomic factors. The complete CHVA is submitted to the nodal department as a draft to take it forward to the next phase of internal and external consultations.

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.

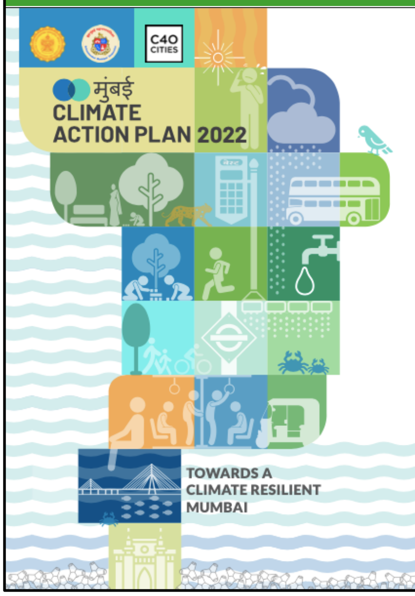
Figure 15 | Summarising order of priority based on hazard exposure - Surface flooding, urban heat and air pollution



The sixth phase of the assessment period is **'Dissemination and Consultations'**.

1. It is essential to disseminate information and insights from the CHVA to multiple city-level stakeholder groups and at different scales of the city such as the ward and the zone (see the following case example of Mumbai).
2. Stakeholders could include the local bureaucracy and departments; implementing agencies; local NGOs, CBOs, CSOs, residential welfare associations (RWAs), and citizen groups; commercial establishments; and people at large.
3. For example, in the following case example of Bengaluru, insights from the CHVA were translated into local languages for developing a prioritization framework to disseminate focused insights to people and decision- makers.
4. Such strategies can help users of the proposed framework in ground truthing, exploring entry points for action, creating an ecosystem of climate actors and collaborators, and building consensus to move from assessment to action.
5. During this phase, practitioners and users must disaggregate information and contextualize and simplify dissemination material for different stakeholder groups.
6. Consultations can be prioritized and planned considering the needs of the city and the chosen stakeholder groups.
7. This phase can potentially facilitate dialogue on issues of climate change and vulnerability among impacted groups, policymakers, and changemakers, and can build on previous phases to map out a wider range of stakeholders in the city.

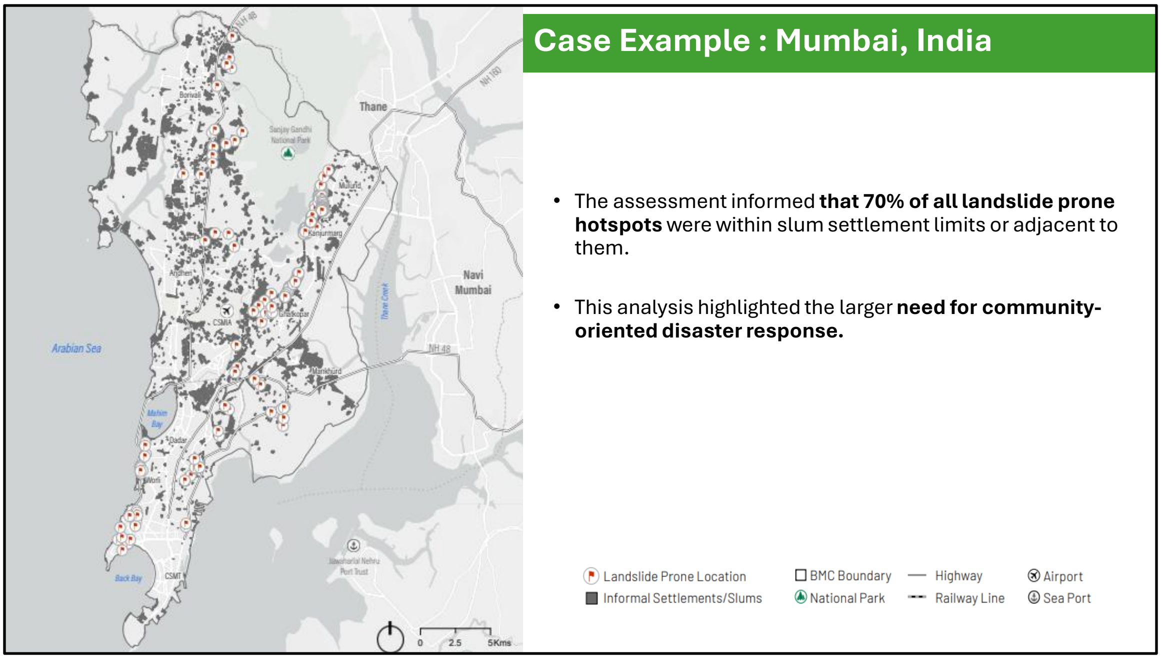
Phase 7: Report Completion and Next Steps



- 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

Phase 7: Report completion and next steps

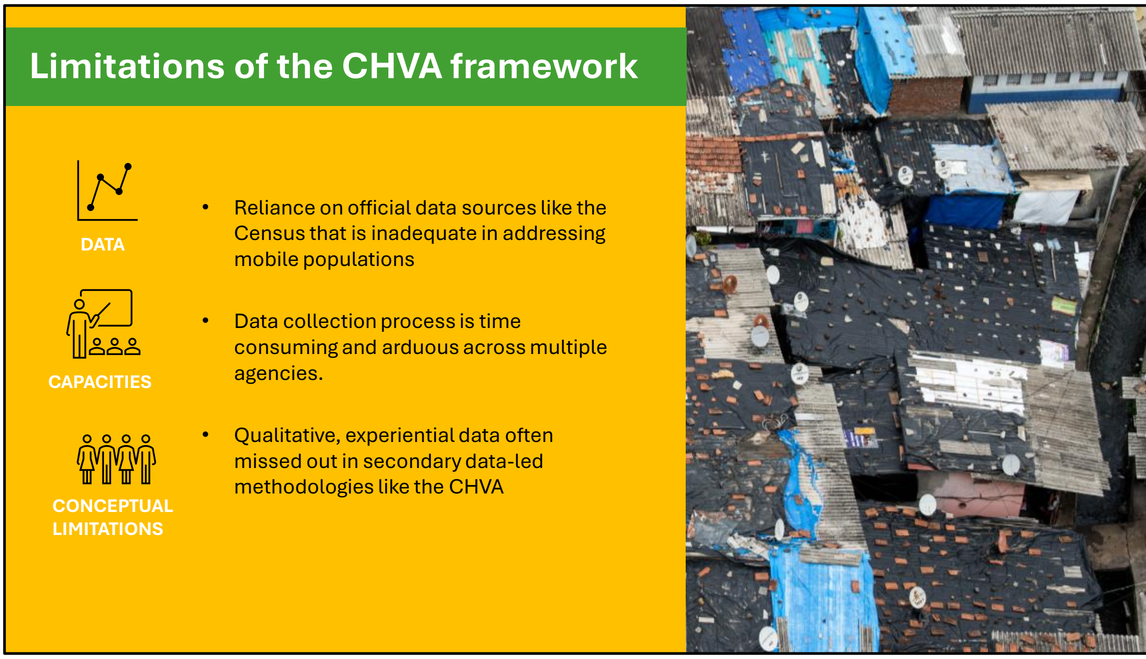
1. The last phase focuses on putting together and assembling information, the process, maps, insights, and so on, and developing a comprehensive report for the relevant stakeholder groups and policymakers.
2. The report will provide an overview of the city and its features, describe the key hazards it faces, and establish the vulnerability landscape of the city.
3. In this phase, quantitative and geospatial analysis will have to be explained, providing explicit insights to readers.
4. Vulnerable groups, locations, wards, and neighborhoods will have to be highlighted so that public and private changemakers can prioritize action in the city.
5. The practical utility of this exercise could range from climate action, development, and resilience to disaster reduction plans and initiatives.
6. This could potentially provide an evidence base that cities can use to identify projects and obtain climate or development finance.
7. It could also be used to explore governance interventions in order to reduce vulnerability and demonstrate the need for coordination and communication across departments and agencies.



This slide illustrates how the project team attempted to translate the Mumbai Climate Action Plan (MCAP) into action and implementation on-the-ground.
To operationalize the MCAP, four multi-stakeholder workshops were conducted in Mumbai focusing on flood risk mitigation, nurturing vegetation and community-based adaptation in vulnerable neighborhoods, air quality improvement, and decarbonizing the energy and buildings sector. Key insights from the climate risk and vulnerability assessment were shared at these workshops to foster a constructive dialogue and build a network of changemakers for implementation.
At the flood risk workshop, a critical finding from the assessment highlighted that 200 of Mumbai's 287 landslide-prone locations overlap with slums or informal settlements. Slum community members affected by these landslides participated as key stakeholders, alongside representatives from relevant BMC departments and local organizations. This collaborative approach enabled difficult yet essential conversations between impacted communities, policymakers, bureaucrats, and civil society organizations (CSOs), paving the way for actionable solutions.

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

One significant outcome of the discussions from the flood risk workshop was the city corporation's decision to facilitate landslide preparedness training sessions for high-risk communities. While not a permanent solution, these sessions were identified as an urgent measure to mitigate the immediate impact of landslides in slums and informal settlements. For a sustainable, long-term approach to reducing landslide risks in vulnerable communities, improving urban service delivery would be a critical component.



While the CHVA framework is a valuable tool for cities, it does come with certain limitations:

1. **Data Limitations:**
    - CHVA relies heavily on official data, which often forms the backbone of the analysis. However, in data-deficient situations, challenges arise due to data that may be outdated, insufficiently granular, inconsistent or entirely unavailable.
    - Official data frequently overlooks the lived experiences of migrants and informal communities, leaving critical gaps in understanding vulnerability.
2. **Capacity Constraints:**
    - Processes such as data collection, sorting, quality checks, and formatting require significant time, resources, and technical expertise. Implementing CHVA demands a strong commitment to capacity-building within city teams.
3. **Conceptual Gaps:**
    - The framework is primarily quantitative and data-driven, which means qualitative and experiential aspects of vulnerability may be overlooked. This creates the risk of missing context-specific nuances, particularly in communities where data is scarce or informal systems dominate.

Cities adopting the CHVA framework should remain mindful of these challenges and take complementary steps to address gaps, such as integrating community-based insights and qualitative data where possible.

Key Recommendations

To move from assessment and planning 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

To address some of the limitations of the framework and move from assessment and planning to action, we have a few recommendations for users:

1. **Improving access to high-quality data:** This can be done by enabling well-maintained and open-source data repositories that are coordinated across national and state-level agencies.
2. **Conducting robust city-level baselines**, promoting community-based assessments to ground-truth city-level datasets, and tapping into local resources and knowledge pools. (with students, academic institutions, researchers, community-based organisations etc)
3. Institutionalize the CHVA **through capacity-building programs and governance interventions** for better interdepartmental coordination. Additionally, coordination with local and global organizations could also inform holistic and coordinated adaptation actions.
4. Prioritize and **accelerate adaptation action in high-risk areas and within underserved communities** by promoting community-level needs assessments and through deeper forms of engagement.
5. Incorporate **quantitative and qualitative assessments** of the social drivers of vulnerability into ongoing planning and implementation processes. Users can tailor the framework to decide at what stage they want to introduce more

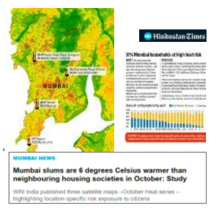
qualitative methods.

6. And finally, we encourage users to not stop at the assessment or planning stage and **facilitate co-development of projects** and implementation with municipal departments and community groups.

Case Example: Shaping a Climate-Forward Mumbai

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

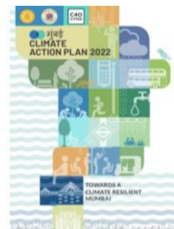


City level GIS heat maps created as part of vulnerability assessment of Mumbai (shared widely by media) using a complex framework of indicators to quantify & spatialize differential vulnerabilities based on socio-economic characteristics and hazard mapping

2 Engagement and buy-in with Champions of Change

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

3 Data based Climate Action Planning with BMC



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

4 NBS pilot interventions launched citywide

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

Operationalizing this framework not only ensures technical comprehensiveness but also fosters extensive engagement—both horizontally across departments and agencies and vertically with communities, leaders, and decision-makers.

Mumbai serves as a remarkable success story of CHVA application. The journey began with mapping urban heat spatially and progressed to engagement with the Ministry and high-level departments on climate, forests, and urban development. This collaborative effort culminated in India's first city-level Climate Action Plan, which included a GHG inventory, future emissions scenarios, and area-level climate vulnerability assessments within the city.

The Mumbai Climate Action Plan not only outlined a set of commitments for city agencies and communities to enhance resilience but also initiated actionable steps through micro-projects. These included identifying pilot sites for nature-based solutions (NbS) to address heat and flood resilience, in collaboration with local NGOs, and the creation of the Mumbai Greening Handbook—marking the start of CHVA's practical application to solve identified challenges.

Case Example: Mapping Flood & Heat Exposed Areas in Kochi (continued)

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

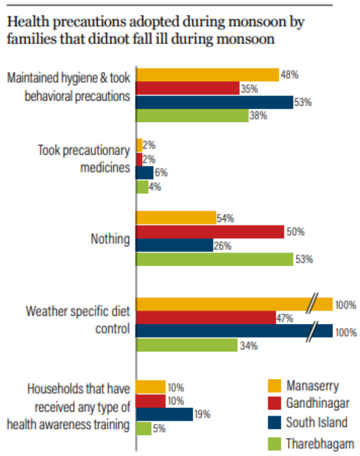


Fig 32 | History of Early Warnings vs Source of Early Warnings in Vulnerable Communities

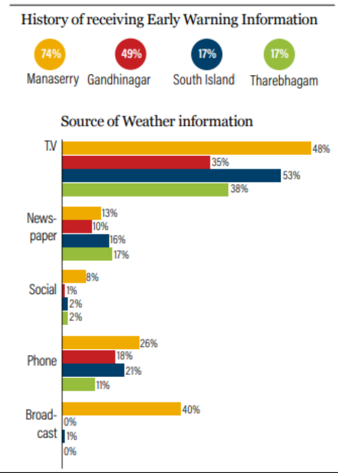


Figure 26 | Climate Impact Assessment in UCRA pilot locations

CHVA is a highly flexible framework allowing for dynamic inputs and mergers with other open methodologies (based on CHVA team's focus themes). In Kochi, CHVA was used to evaluate individual and community capacities - social security, familiarity with local climate risks, early warning systems and disaster readiness - into broader urban resilience evaluations. One can see how city level information was strengthened further with community level adaptive capacity information. The study combined CHVA and Urban Community Resilience Assessment tool – can be referred here https://www.wri.org/initiatives/urban-community-resilience-assessment#:~:text=The%20Urban%20Community%20Resilience%20Assessment,Work%20Program%20on%20Resilient%20Cities%20.

Case Example: Identifying Areas for intervention, Co-Developing Strategies in Kochi (continued)

Vacant Plots identified by citizens in Vaduthala East and West wards

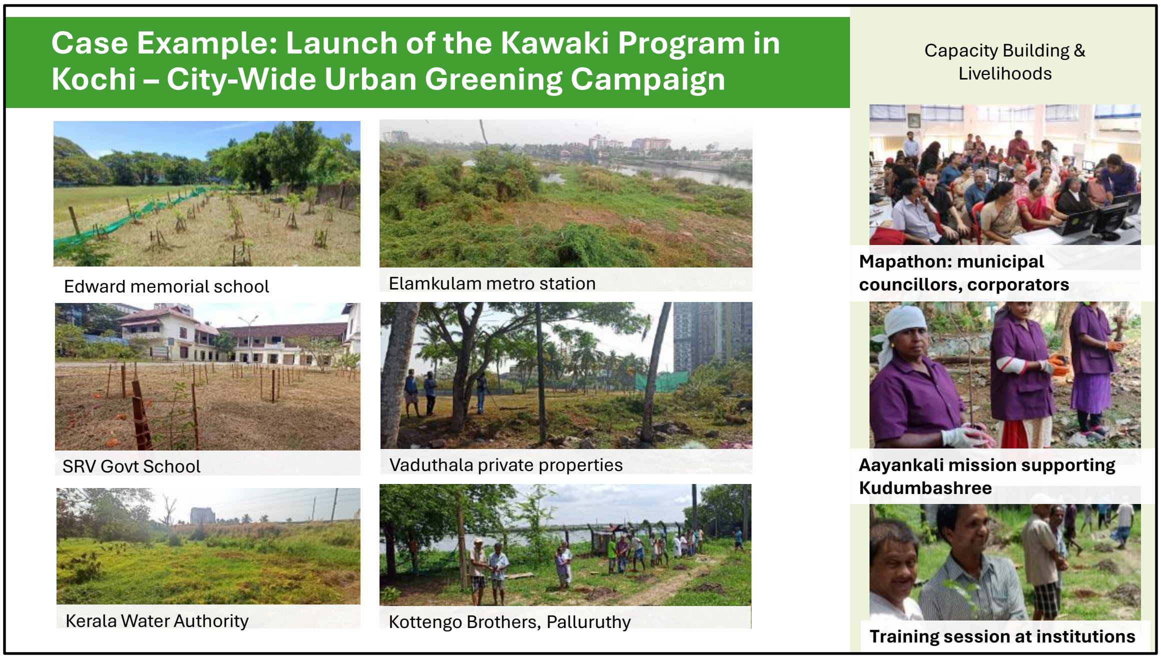
Presentation to concerned stakeholders and critical inputs from State Government

The process of integrating community level adaptation capacities involved extensive bottom-up engagement with multiple stakeholders in the form of mapathons, panel discussions, Focussed Group Discussions , ward/ community level consultations etc.

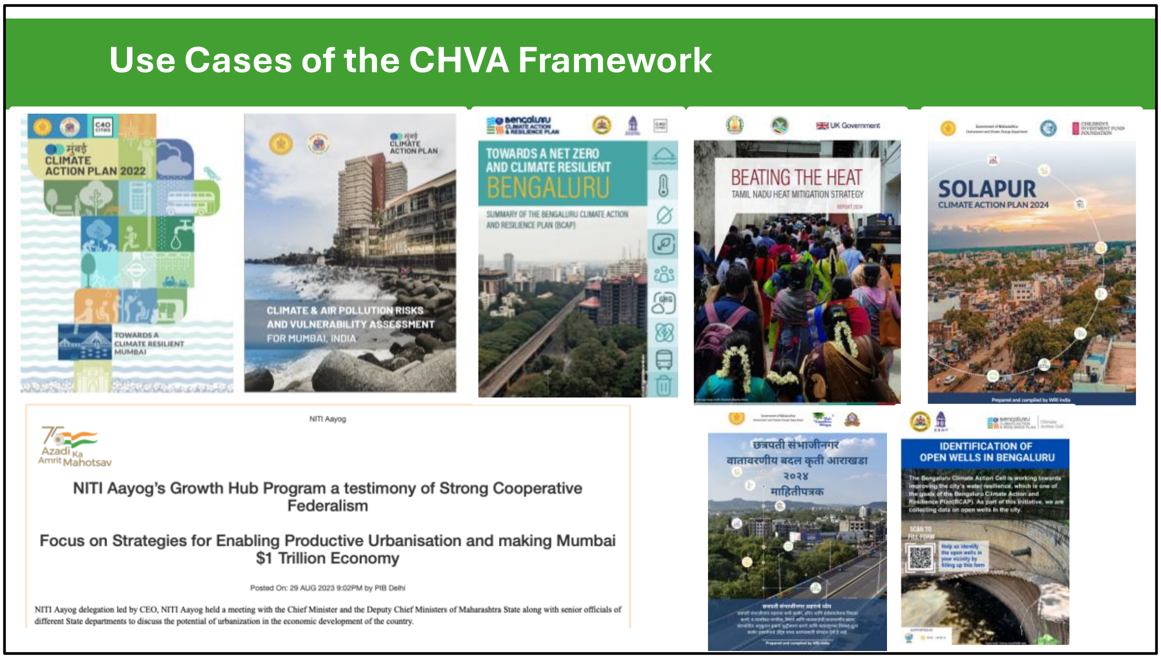
Case Example: Influencing the City Disaster Management Plan (continued)

- 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**

The extensive assessment and management efforts resulted in a comprehensive disaster management plan for Kochi, India, shifting the focus from rescue and recovery to resilience and preparedness. Over one million citizens benefited from the exercise, which also catalyzed local actions through nature-based solutions (NbS) interventions such as the Kawaki initiative.



Kawaki is a community-led urban greening movement implemented in Kochi. The focus of this project is to develop and conserve urban forests at extremely heat-vulnerable localities in the city. Read more about Kawaki at - https://www.wri.org/initiatives/urban-community-resilience-assessment#:~:text=The%20Urban%20Community%20Resilience%20Assessment,Work%20Program%20on%20Resilient%20Cities%20.



The CHVA framework has proven to be highly versatile, driving the creation of impactful policies and plans focused on climate, environmental, economic, ecological, and infrastructure development. From city-level climate action plans across diverse geographies to regional strategic plans for sustainable economic growth and climate-sensitive investments, the framework has delivered transformative outcomes. It has been instrumental in crafting targeted hazard mitigation strategies and conducting sector-specific evaluations using sensitivity and adaptive capacity indicators.

CHVA is also being applied to identify infrastructure needs, such as assessing WASH (water, sanitation, and hygiene) infrastructure in cities, with an emphasis on climate-proofing and resilient design. Beyond assessment, the framework facilitates critical discussions on differential vulnerability and community needs, offering an opportunity to learn, act, and build mechanisms for inclusive and climate-resilient development.

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