



CLIMATE RESPONSIVENESS OF ULBS AND VULNERABLE COMMUNITIES

Assessing readiness and resilience during disasters: Case of Ichalkaranji
City, Maharashtra

DRP | S2026

STUDENT: ABHIPSA RAY

Guide: Arwa Bharmal, Kasturi Joshi, Bhushan Tawlare

WHY FOCUS ON FLOODS?

~40%

Of Global Climate Disasters

Floods account for nearly 40% of all recorded climate disasters globally, making them the most prevalent hazard category.

\$300B+

Annual Disaster Losses

Global economic losses from disasters exceed \$300 billion annually, with floods as the leading driver of financial damage.

1.2B

People Exposed by 2050

Projections indicate that 1.2 billion people will face significant flood exposure by 2050 under current climate trajectories.

INDIA: A PATTERN OF RECURRENT FLOOD DISASTERS

2005 – Mumbai

1

944 mm of rainfall recorded in a single 24-hour period – an unprecedented cloudburst that paralysed the financial capital and exposed critical infrastructure failures.

2

2018 – Kerala

Catastrophic flooding affected over **5.4 million people**, displaced hundreds of thousands, and caused widespread agricultural and infrastructural devastation across the state.

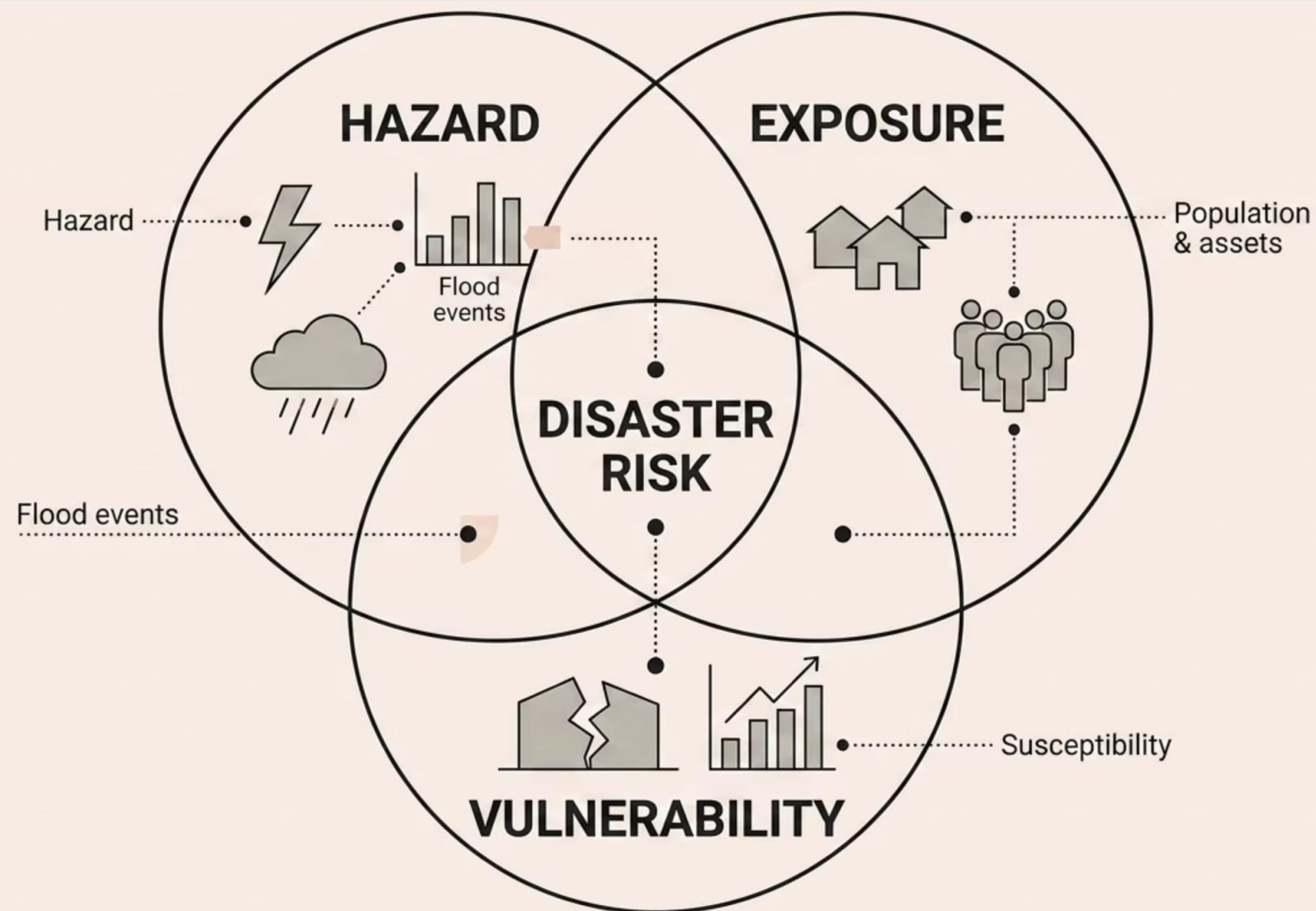
2019 – Maharashtra

3

Severe regional flooding impacted multiple districts, highlighting the vulnerability of both urban and peri-urban settlements to monsoon extremes in the Deccan plateau region.

WHAT IS THIS STUDY ABOUT?

This research investigates **climate responsiveness** – the capacity of urban governance systems and local communities to anticipate, respond to, and recover from climate-induced disasters. The analytical lens is grounded in the internationally recognised framework of **Disaster Risk**, which emerges from the interaction of three core components.



Climate Change & Flood Impacts: A Compounding Crisis

Climate Change Amplifiers

The **IPCC AR6** confirms that climate change is increasing both the frequency and intensity of extreme precipitation events. Urban infrastructure – designed for historical rainfall norms – is increasingly overwhelmed, exposing critical gaps in design standards and planning assumptions.

Extreme Rainfall ↑

Unprecedented precipitation intensities breach thresholds of existing drainage and stormwater systems.

Flood Intensity ↑

Higher peak flows cause deeper inundation, longer duration events, and wider spatial spread of damage.

Urban Vulnerability ↑

Informal and low-income communities face disproportionately higher risks with least capacity to recover.

Cascading Flood Impacts

Loss of Life & Property

Direct physical damage to homes, belongings, and livelihoods, disproportionately affecting low-income households.

Infrastructure Disruption

Roads, utilities, and services fail simultaneously, compounding difficulties for emergency responders.

Livelihood Impacts

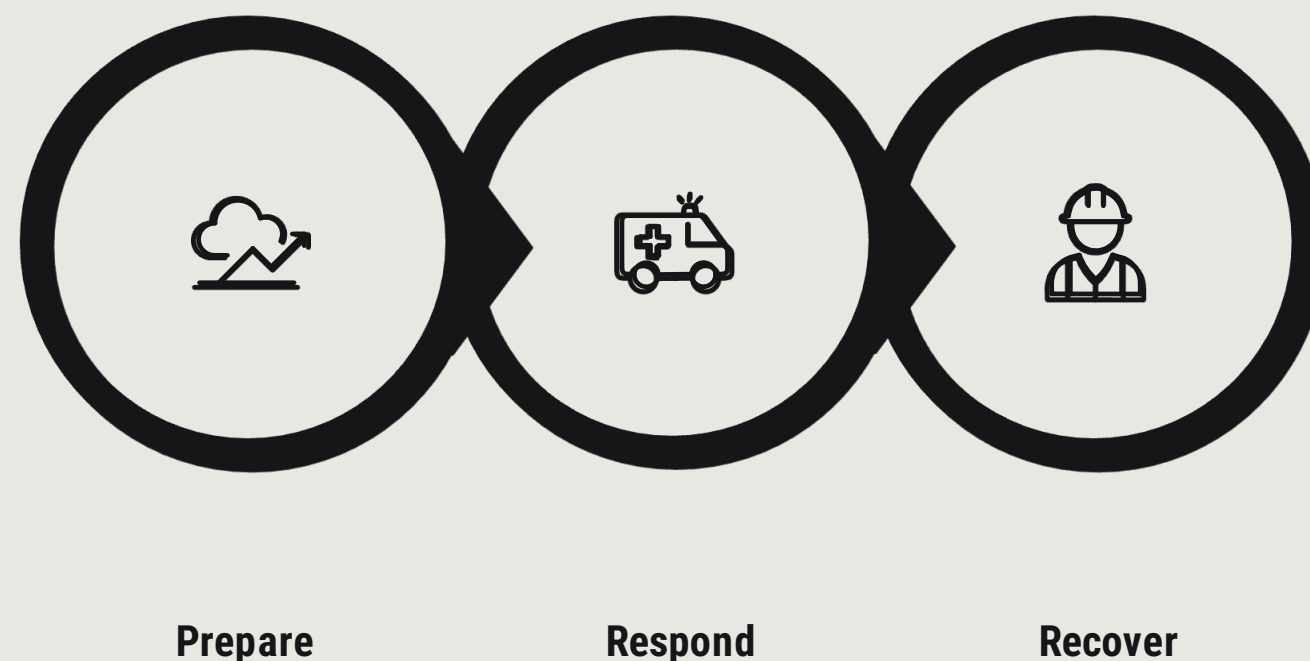
Daily wage workers and informal sector workers lose income immediately, with no safety nets for recovery.

Public Health Risks

Waterborne diseases, displacement stress, and mental health challenges persist long after floodwaters recede.

CLIMATE RESPONSIVENESS & THE DISASTER RISK FRAMEWORK

Climate responsiveness refers to the capacity of institutional and social systems to **anticipate, respond to, and recover** from climate-related hazards in ways that reduce long-term vulnerability. It is assessed through a disaster risk lens, recognising that risk is not simply about hazards but about how systems are exposed and how vulnerable they are.



Disaster Risk Formula (UNDRR): Risk = Hazard × Exposure × Vulnerability – the same rainfall event produces vastly different outcomes depending on infrastructure quality, governance effectiveness, and socio-economic conditions of affected communities.

The Sendai Framework: Recovery as Transformation

The **Sendai Framework for Disaster Risk Reduction 2015–2030** (UNDRR) provides the global normative context for this study. Its four priorities – understanding risk, strengthening governance, investing in DRR, and enhancing preparedness – directly frame the study's analytical dimensions.

1

Understand Risk

Disaster risk must be understood in all its dimensions – hazard, exposure, vulnerability, and capacity – at community and city levels.

2

Strengthen Governance

Effective disaster risk governance requires clear roles, inter-agency coordination, and accountability at all scales.

3

Invest in DRR

Public and private investment in structural and non-structural measures must be scaled up to build resilient infrastructure.

4

Build Back Better

Recovery is a transformative opportunity – not merely restoration, but rebuilding in ways that reduce future vulnerability and strengthen long-term resilience.

Key Takeaway: The Case for Integrated Assessment

Risk is a System. Recovery is its Test.

Disaster risk is not a single-dimensional problem of rainfall or infrastructure alone. It is shaped by **multiple interacting systems** – governance, physical infrastructure, and community capacity – whose failures compound one another during and after flood events.

Risk = System Interaction

Hazard, exposure, and vulnerability are shaped by governance decisions, infrastructure design, and the socio-economic conditions of communities.

Recovery Underexplored

While preparedness and response receive institutional attention, recovery – the phase that determines long-term resilience – remains systematically under-resourced and under-researched.

Need Integrated Assessment

This study adopts an integrated approach that simultaneously evaluates governance, infrastructure, and community systems across all three disaster management phases.

This integrated framing directly motivates the case studies that follow – examining what works, what fails, and what Ichalkaranji can learn from cities that have confronted similar challenges.

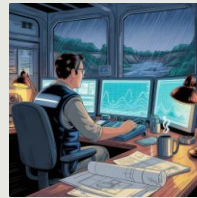
SURAT: GOVERNANCE & EARLY WARNING AS RESILIENCE ANCHORS

Following the devastating **2006 floods**, Surat undertook a systematic transformation of its disaster governance architecture. The city became a national model for how institutional coordination, when strengthened post-disaster, can dramatically reduce future risk – even in the absence of major structural infrastructure investments.



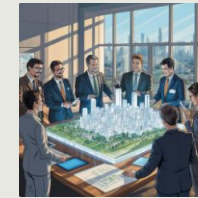
Institutional Coordination

Surat established real-time coordination between municipal authorities, irrigation departments, and dam operators – enabling anticipatory response before floodwaters reached the city.



Early Warning System

Real-time flood forecasting systems were introduced, connecting upstream hydrological data to city-level response protocols. This significantly improved preparedness timelines.



Key Learning

Strong governance = better preparedness. Inter-agency coordination and anticipatory governance are critical – especially for cities like Ichalkaranji dependent on upstream dam releases.

SURAT: QUANTIFIED IMPACT OF RESILIENCE

Surat's strategic interventions post-2006 floods led to significant, measurable improvements in the city's ability to cope with subsequent extreme weather events.

Impact Area	Before (2006 Flood)	After Interventions
City Area Flooded	~75% of city	Significantly reduced (implicit)
Economic Losses	₹21,000+ crore	Faster industrial recovery
Flood Warning Lead Time	Minimal	48–72 hours
Loss of Life (major events)	Severe	No major loss of life

Source: TARU, ACCCRN, city resilience reports

The data highlights a profound shift from reactive disaster response to proactive resilience, driven by improved governance and early warning systems rather than massive infrastructure projects alone.

CHENNAI: WHEN INFRASTRUCTURE PLANNING FAILS

Chennai's catastrophic **2015 floods** – among the worst in India's recorded urban flood history – were not primarily a failure of response. They were a failure of decades of urban planning that systematically encroached on natural floodplains, built over water bodies, and neglected stormwater drainage infrastructure.

What Went Wrong

Encroached Waterways

Lakes, tanks, and natural drainage channels were systematically filled and built upon, eliminating the city's natural flood buffering capacity.

Poor Drainage Infrastructure

Stormwater drains were undersized, poorly maintained, and disconnected from each other – unable to handle concentrated rainfall volumes.

Floodplain Urbanisation

High-density development in low-lying areas meant that when water had nowhere to go, it inundated densely populated residential zones.

Key Learning for Ichalkaranji

Chennai demonstrates that even robust emergency response systems **cannot compensate for weak infrastructure planning**. The lesson is clear: vulnerability is built in – literally – through decades of poor land use decisions.

Poor infrastructure planning = high vulnerability. Ichalkaranji must examine whether its own urbanisation patterns are replicating Chennai's mistakes along the Panchganga floodplain.

CHENNAI: QUANTIFIED IMPACT

The 2015 Chennai floods exposed severe vulnerabilities, leading to significant human and economic costs. Despite subsequent interventions, the city continues to face challenges in flood resilience.

Impact Area	2015 Flood Impact	Post-Intervention Outcomes
Loss of Life	422 deaths	No specific data, but recurrent floods still pose risks
Economic Loss	₹14,602 crore	Reduced in some areas, but significant losses in later floods (2019, 2021)
Infrastructure Failure	Airport closed ~1 week; massive infrastructure damage	Improved stormwater drains & canal restoration in parts of the city
Flood Recurrence	Major event	Flooding still occurred in 2019 & 2021; uneven performance

Source: World Bank, Government of Tamil Nadu

While investments in stormwater drains and canal restoration have led to **localised reductions in waterlogging**, Chennai demonstrates that **infrastructure upgrades alone are insufficient** without integrated planning and governance. Systemic vulnerability persists, as evidenced by recurrent flooding.

Key Learning: Infrastructure improved, but systemic vulnerability remains. Mere engineering solutions cannot fully mitigate risks rooted in poor urban planning.

ROTTERDAM: LIVING WITH WATER THROUGH DESIGN

Rotterdam, a low-lying Dutch city facing existential flood risk, pioneered a "**living with water**" philosophy that fundamentally reimagines the relationship between urban design and hydrological reality. Rather than fighting water, Rotterdam's approach integrates water management into the fabric of urban life.



Water Plazas & Retention Spaces

Public spaces are designed to temporarily store floodwater during peak events, converting recreational squares into retention basins and returning them to public use after rain subsides.



Flood-Adaptive Urban Design

Buildings, roads, and public spaces are designed with flood adaptation embedded – floating structures, elevated ground floors, and permeable surfaces are standard practice.



Integrated Planning

Water management is not the domain of a single department – it is embedded across urban planning, transportation, housing, and public works, enabling systemic and coordinated solutions.

Key Learning: Infrastructure can be *proactive* – actively managing water rather than reacting to it. This stands in sharp contrast to Indian cities where systems routinely fail under pressure precisely because they are designed only for average conditions.

ROTTERDAM: QUANTIFIED IMPACT

Rotterdam's proactive design philosophy has yielded measurable results, demonstrating how integrated water management can significantly reduce flood risk and enhance urban resilience, even for a city largely below sea level.

Contextual Risk	~90% of city below sea level; high exposure to river + sea flooding
Water Storage Capacity	Significantly increased urban water retention capabilities
Extreme Rainfall Handling	Many zones now handle extreme rainfall events without flooding
Emergency Response Dependency	Reduced reliance on reactive emergency flood response systems
Specific Example (Benthemplein)	Water Square stores ~1.7 million litres of water during peak rainfall

Rotterdam reduces flood risk not by preventing water, but by designing systems that absorb and manage it. This shift from pure flood defence to flood accommodation offers a powerful blueprint for other vulnerable cities.

Key Learning: From flood defence flood accommodation. Designing cities to coexist with water drastically reduces vulnerability and reliance on emergency measures.

COPENHAGEN: LONG-TERM CLIMATE ADAPTATION PLANNING

Following severe cloudbursts in 2011, Copenhagen developed a comprehensive **Cloudburst Management Plan** – widely regarded as one of the world's most sophisticated urban climate adaptation strategies. It combines green and grey infrastructure investments with a long-term financing and implementation horizon.

The Copenhagen Approach

01

Cloudburst Mapping

Detailed hydraulic modelling identified the most flood-prone streets and catchments, enabling targeted investment.

02

Green Infrastructure

Parks, streets, and rooftops were redesigned as water-absorbing and retention elements in the urban landscape.

03

Grey Infrastructure Upgrade

Underground tunnels and expanded sewer capacity provide additional conveyance for extreme events.

04

Long-Term Investment

€1.5 billion plan spread over 20 years, with clear cost-benefit analyses showing savings from avoided flood damage.

Key Learning for Indian Cities

Copenhagen demonstrates that flood management must be **integrated into urban planning as a long-term commitment** – not treated as an emergency-only operational issue activated only when floodwaters arrive.

The city's approach proves that combining green and grey infrastructure is both technically feasible and economically rational, with avoided damage costs far exceeding investment over time.

Integrated + long-term planning is not just aspirational – it is fiscally sound and technically proven at city scale.

COPENHAGEN: QUANTIFIED

Following the devastating 2011 cloudburst, which caused approximately **€800 million (₹7,000+ crore) in damages**, Copenhagen enacted its ambitious Cloudburst Management Plan. This plan sets clear targets for future resilience, focusing on reducing risk rather than reacting to past events.

Key Area	Post-Plan Target/Outcome
Extreme Rainfall Handling	Designed to handle 100-year rainfall events
Flood Damage Reduction	~30–50% reduction in flood damages (projected)
Urban Infrastructure	Streets redesigned as water channels and retention areas

Copenhagen's approach focuses on **reducing future risk** rather than reacting to past events, using integrated planning and hybrid infrastructure. This foresight is designed to deliver significant economic savings by avoiding future damages.

Key Learning: Long-term planning, informed by detailed risk assessment, significantly reduces future economic loss and builds systemic urban resilience.

AIM

To assess the **climate responsiveness** of urban governance institutions and vulnerable communities in **Ichalkaranji, Maharashtra** – with specific focus on flood disaster preparedness, response, and recovery.

OBJECTIVE

01

Identify Flood Vulnerabilities

Map and analyse the spatial, social, and infrastructural dimensions of flood vulnerability across the city.

02

Assess IMC Preparedness & Response

Evaluate the Ichalkaranji Municipal Council's institutional readiness, mechanisms, and response effectiveness.

03

Examine Community Coping & Recovery

Understand how vulnerable communities cope during flood events and what recovery strategies they employ.

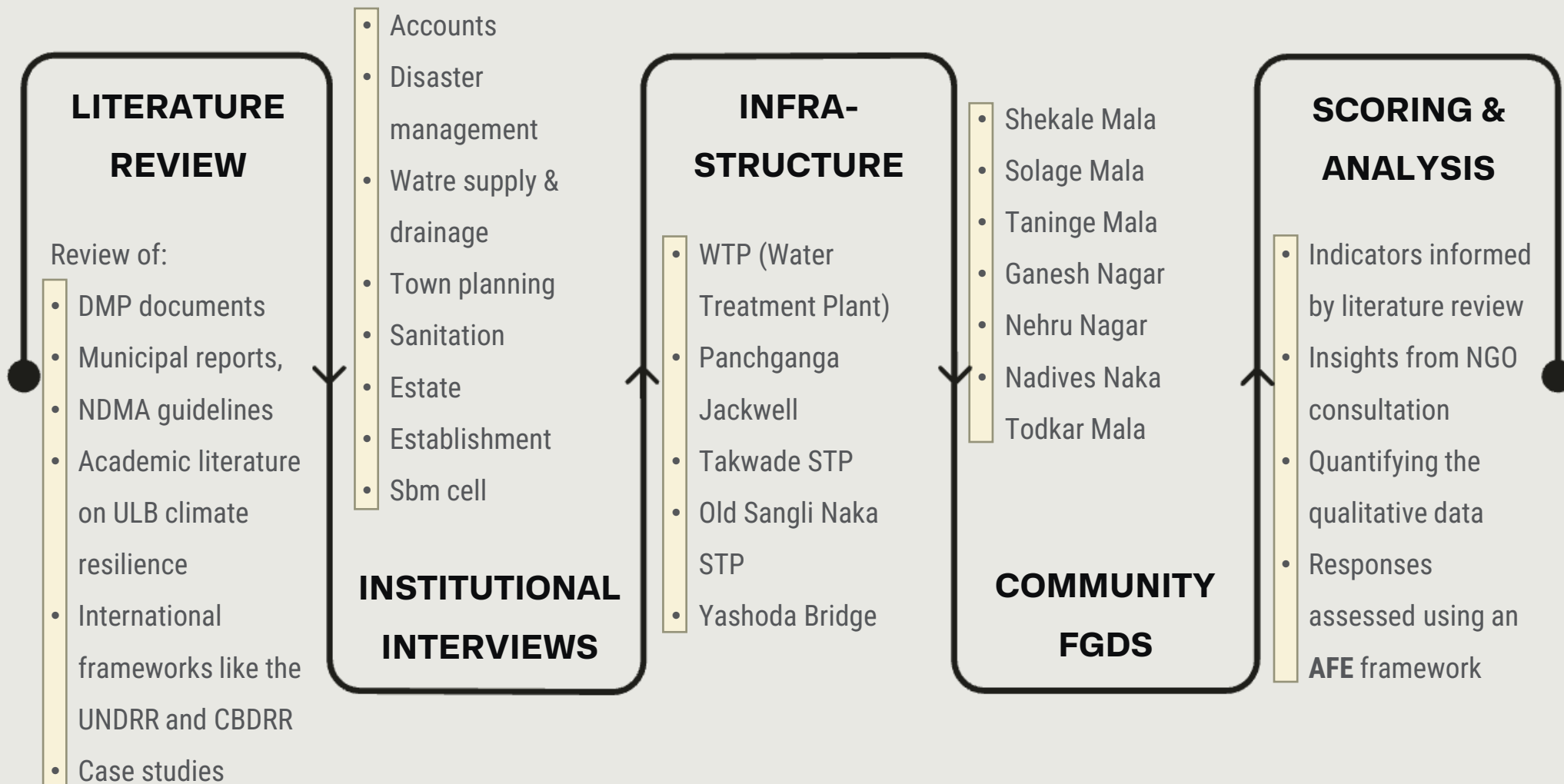
04

Identify Systemic Gaps

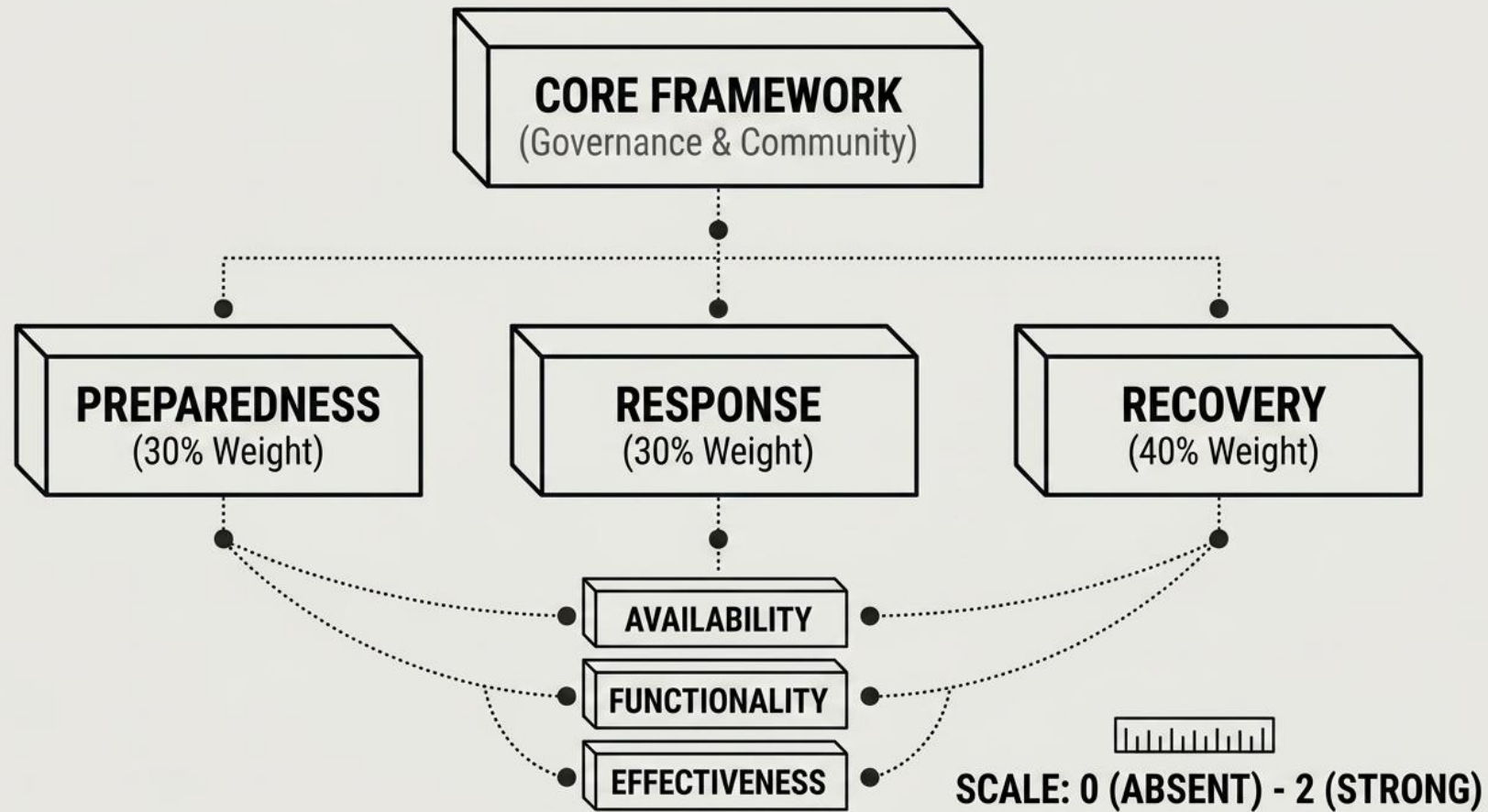
Surface the critical gaps between governance capacity and community need to inform policy recommendations.

RESEARCH METHODOLOGY

This study employs a multi-method qualitative and observational research design to assess climate responsiveness across institutional and community dimensions. Data collection was conducted during primary fieldwork in Ichalkaranji, combining structured interviews with key informants and focus group discussions with community residents



ANALYTICAL FRAMEWORK



CONCEPTUAL ALIGNMENT



OECD

Organisation for Economic Co-operation and Development

Aligned with performance evaluation approaches: relevance and effectiveness



WORLD BANK

Aligned with governance and resilience assessment frameworks



UNDRR

United Nations Office for Disaster Risk Reduction
Aligned with outcome-oriented evaluation principles

REGIONAL CONTEXT

Ichalkaranji is situated in Kolhapur district, Maharashtra, within the ecologically sensitive Panchganga river basin. The city's geographic position makes it inherently susceptible to recurrent and severe flooding, rendering it a critically important site for studying urban climate resilience.

1

INDIA

Western Deccan Plateau,
Maharashtra State

2

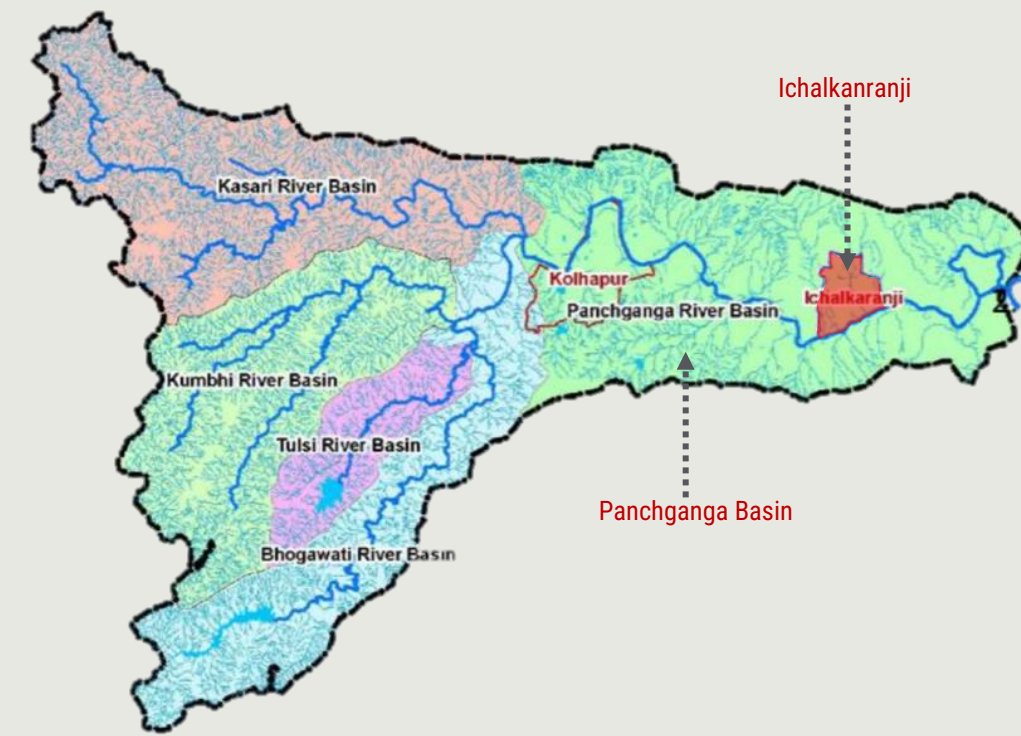
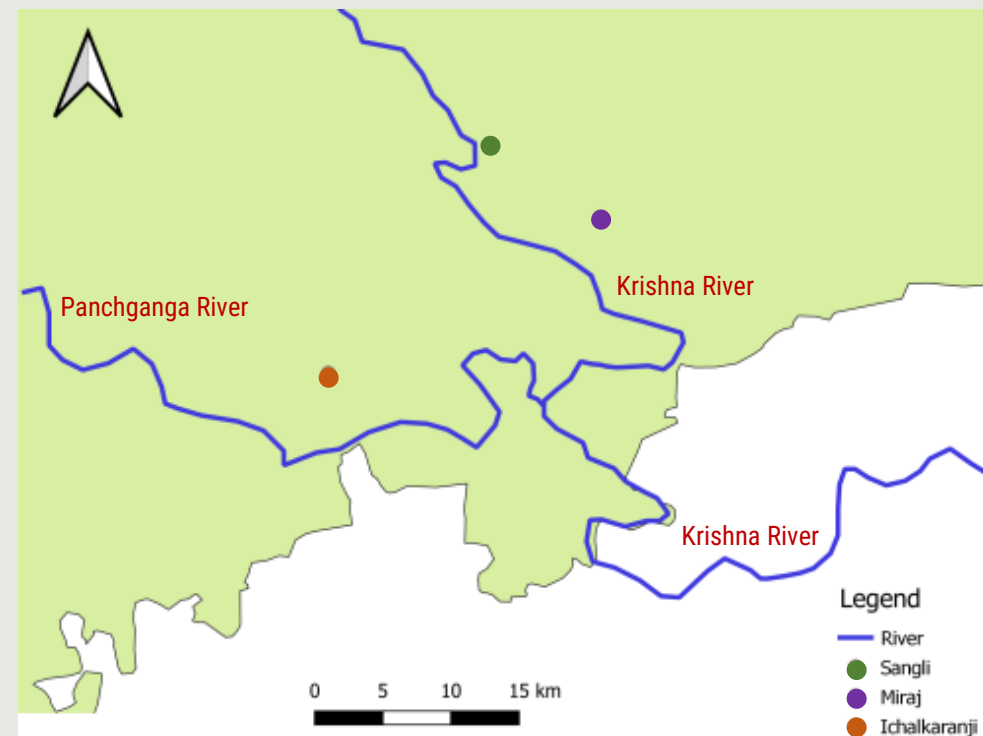
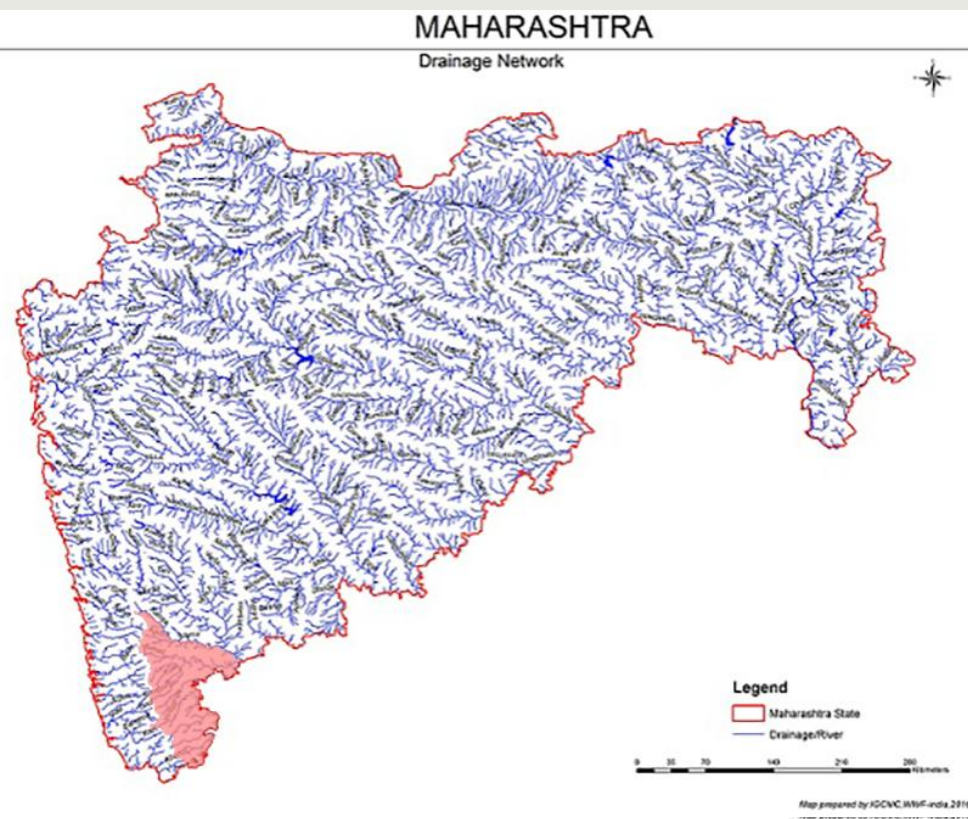
MAHARASHTRA → KOLHAPUR DISTRICT

Southern Maharashtra, agro-industrial belt

3

ICHALKARANJI

Panchganga Basin –
flood-prone urban centre



CITY PROFILE

Ichalkaranji is one of Maharashtra's fastest-growing industrial towns, characterised by a dense informal powerloom economy and a rapidly expanding urban footprint. Its 25 administrative wards house a predominantly working-class population with significant disaster exposure.

4.3L

POPULATION

Estimated resident population of approximately 4.3 lakh as per recent census data

29.8

AREA (SQ KM)

Total municipal area under the Ichalkaranji Municipal Corporation jurisdiction

25

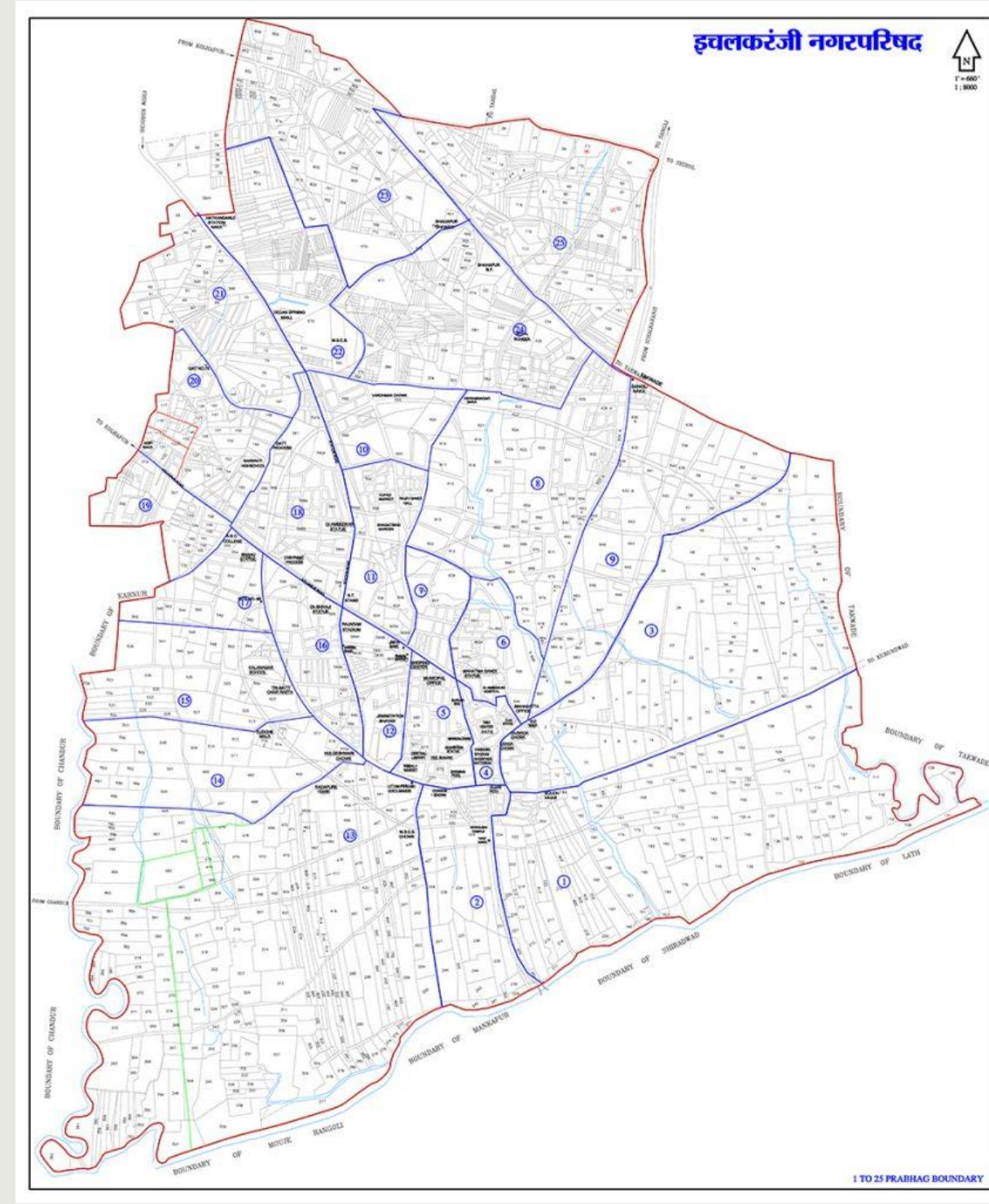
WARDS

Administrative wards governing urban service delivery and local representation

1.25L

POWERLOOMS

Approximately 1.25 lakh powerloom units forming the backbone of the local economy



FLOOD HISTORY

2005 Flood 1026 mm rainfall

1 Est. of DM Cell under the Disaster Management Act, 2005

Severely impacted Ichalkaranji due to the overflow of the Panchganga River and dam releases, causing major losses to its textile industry, widespread damage to infrastructure and agriculture, displacement of residents, and increased risk of water-borne diseases.

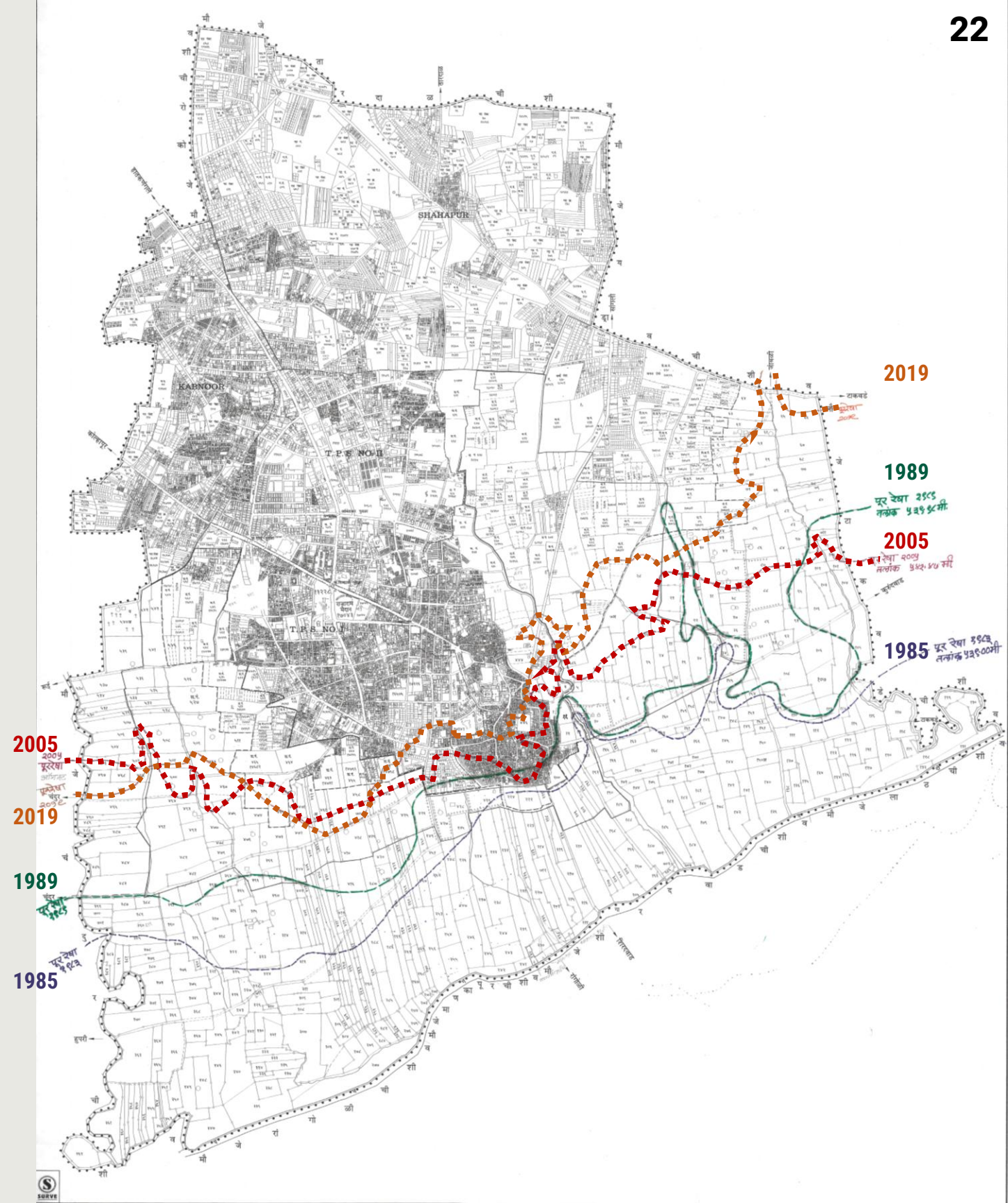
2 2019 Flood 3125 mm rainfall; 55 ft flood level

Severe inundation across multiple wards. Displacement of thousands of residents. Significant damage to residential and commercial properties along riverine zones.

3 2021 Flood 56 ft flood level

Recurrent large-scale impact with similar patterns of damage, highlighting the absence of meaningful structural improvements in the interim period.

Danger level - 43 ft



During 2019 Flood (Monsoon)



Panchganga Jakwell



Temple adjacent to the riverbank



Ghat at the river



Panchganga river

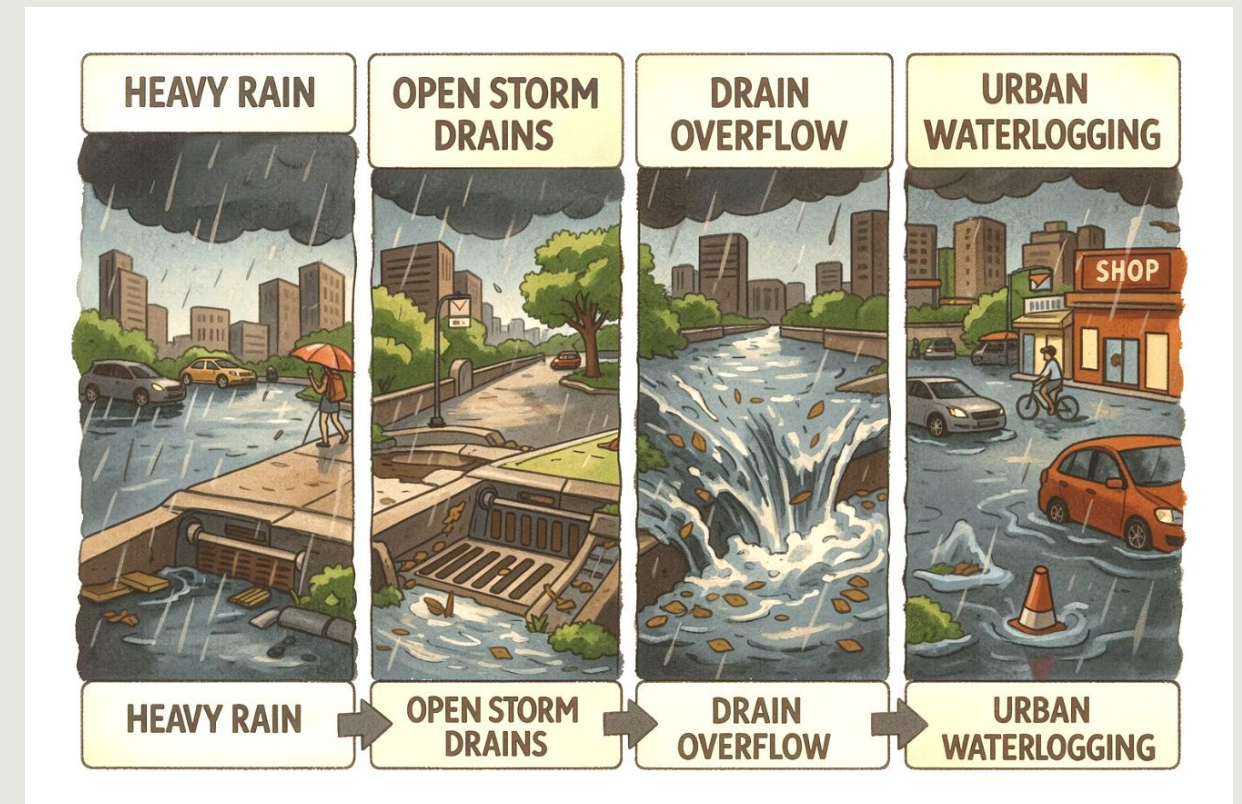
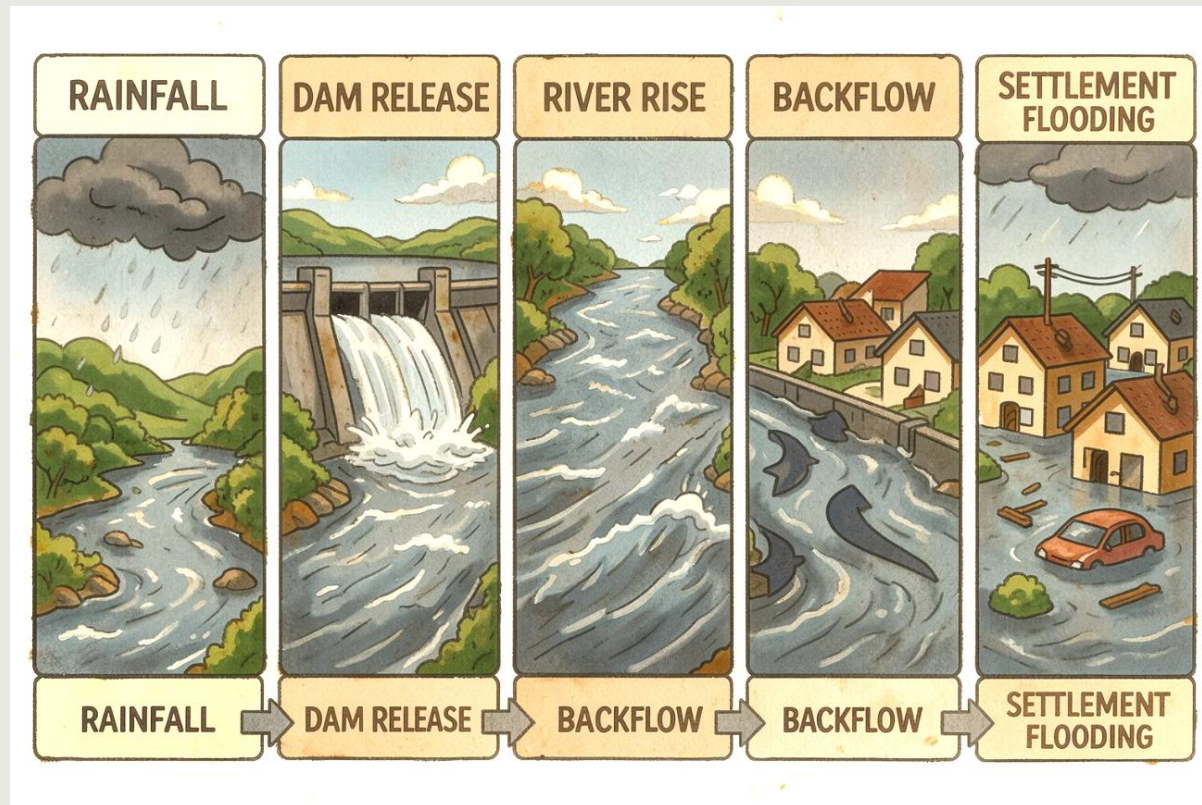


During Site Visit (Dry Months)



TYPES OF FLOODING IN ICHALKARANJI

Ichalkaranji experiences two distinct flood typologies, each driven by different hydro-meteorological triggers and affecting the urban fabric in characteristically different ways. Understanding these processes is foundational to assessing institutional and community preparedness.



RIVERINE FLOODING

Triggered by upstream dam releases following heavy monsoon rainfall. The Panchganga river rises rapidly, causing backflow into low-lying settlements. Flood waters can persist for 8–15 days, requiring full evacuation of affected communities.

URBAN WATERLOGGING

Caused by localised heavy rainfall overwhelming the city's drainage network. Unlike riverine flooding, waterlogging is highly recurrent, often occurring multiple times per monsoon season, with water depths of 2–3 ft and rapid but repetitive recovery cycles.

SPATIAL FLOOD VULNERABILITY

Flood risk in Ichalkaranji is spatially differentiated. River flood zones trace the Panchganga's floodplain, while waterlogging zones are concentrated in low-lying, paved urban areas with inadequate drainage infrastructure. The five FGD study locations were selected to represent the full spectrum of flood exposure.

River Flood Zones

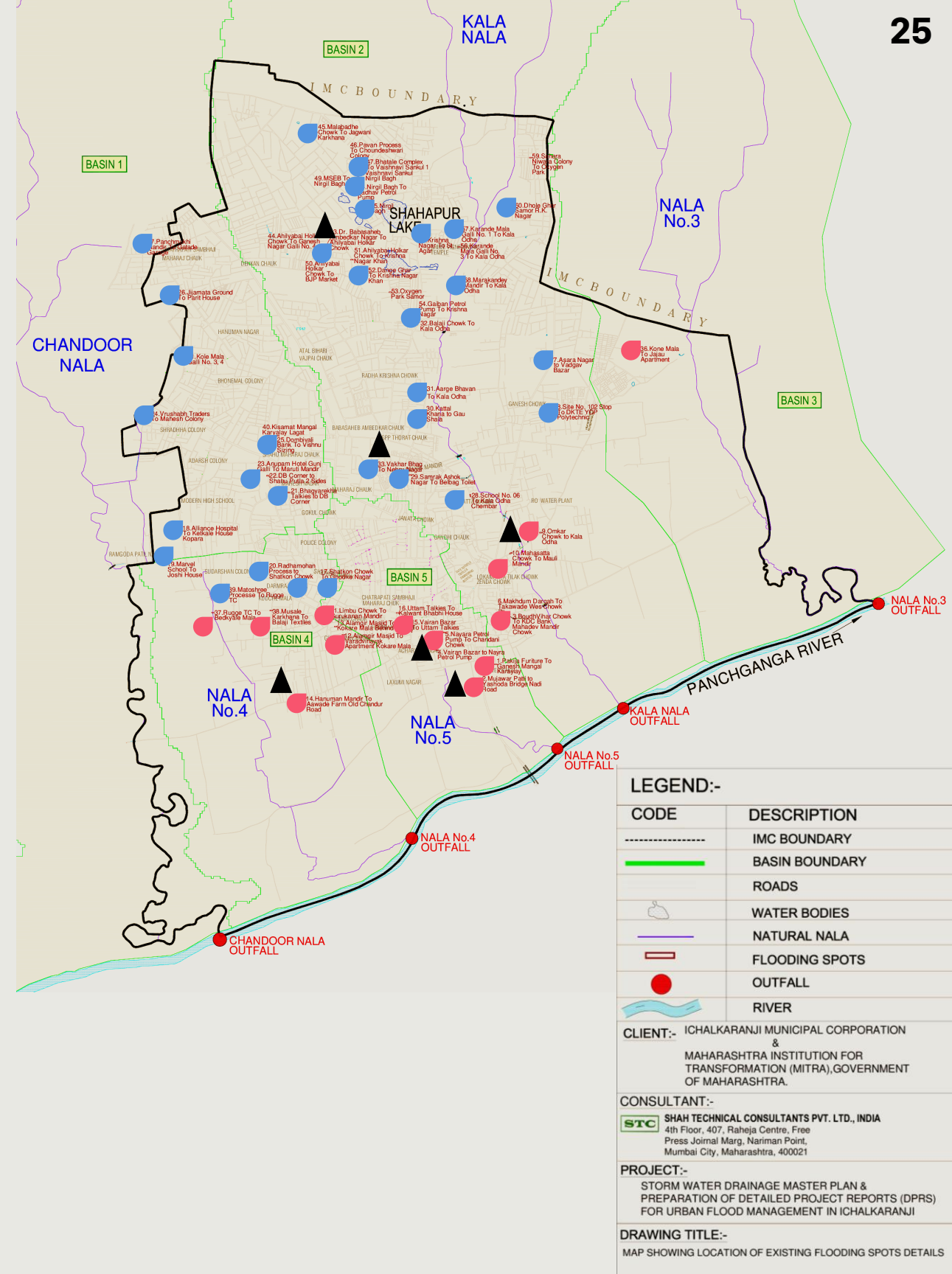
Settlements directly adjacent to the Panchganga river, exposed to dam-release flooding and prolonged inundation

Waterlogging Zones

Interior urban areas with poor drainage where stormwater accumulates rapidly during heavy rainfall events

FGD STUDY SITES

Shekale Mala, Solage Mala, Tanginge Mala, Ganesh Nagar, and Nehru Nagar – selected as primary community research locations



FLOOD IMPACT

The 2019 flood event remains the most significant reference point for both institutional memory and community experience in Ichalkaranji. Field visits and stakeholder interviews revealed multi-dimensional impacts across infrastructure, livelihoods, and daily life.

INUNDATION DEPTH – 2019

Flood waters reached approximately one full storey in height in severely affected areas, rendering ground-floor residences entirely uninhabitable for the duration of the event.

INFRASTRUCTURE DAMAGE

Critical urban infrastructure – including drainage systems, road surfaces, electrical substations, and water supply networks – suffered significant structural and operational damage during the 2019 flood.

LIVELIHOOD DISRUPTION

Powerloom operations, small businesses, and daily-wage employment were suspended for extended periods. Household economic losses ranged from ₹50,000 to ₹2 lakh, vastly exceeding official compensation of ₹5,000.



Peak levels during 2019 floods



Old STP pumping station got submerged and broke down



Damage to assets and belongings

INSTITUTIONAL PREPAREDNESS & FLOOD RESPONSE

Primary field interviews were conducted with senior officials across key IMC departments to assess institutional preparedness and flood response capacity. The following images document stakeholder interactions during field visits to the Ichalkaranji Municipal Corporation offices.

KEY DEPARTMENTS INTERVIEWED

DISASTER MANAGEMENT

TOWN PLANNING

WATER SUPPLY & DRAINAGE

SANITATION & HEALTH

ESTATE & ESTABLISHMENT

SBM CELL



RELIEF INFRASTRUCTURE

The IMC has established a geographically distributed network of relief shelters in and around flood-prone areas. These facilities play a critical role during evacuations, particularly during riverine flood events when communities may be displaced for 8–15 days.

40+

RELIEF SHELTERS

Distributed across flood-prone wards and surrounding areas for emergency evacuation

8/22

DEPARTMENTS ASSIGNED

Eight of twenty-two IMC departments have formally designated roles in the Disaster Management Plan

8–15

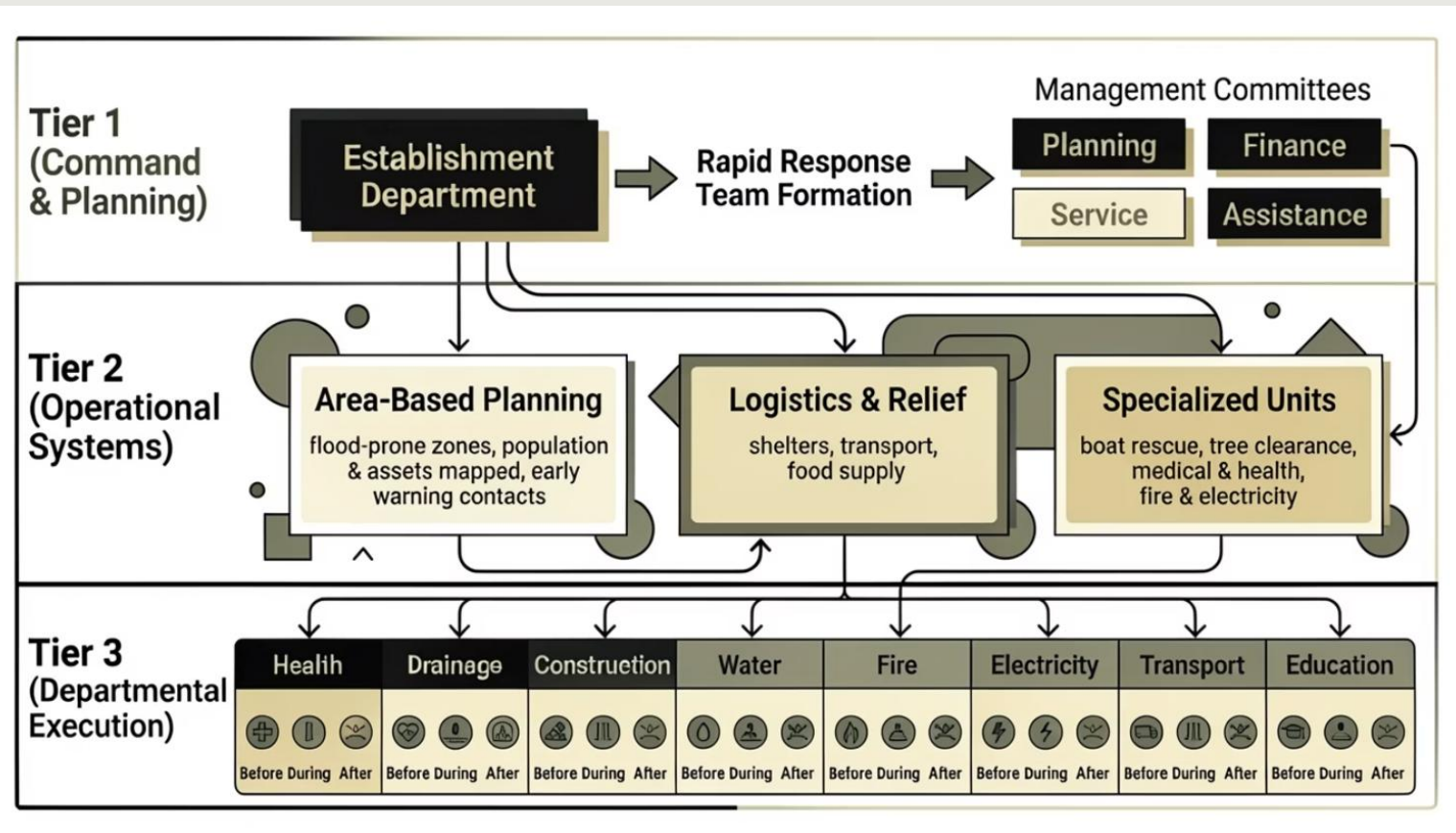
DAYS OF DISPLACEMENT

Average duration communities remain in shelters during a major riverine flood event



IMC DISASTER RESPONSE STRUCTURE

The IMC's disaster response architecture is organised into a three-tier hierarchical structure, enabling coordinated planning, operational deployment, and departmental execution across the full disaster cycle.



TIER 1 – COMMAND & PLANNING

Establishment Department leads Rapid Response Team formation; supported by Planning, Finance, Service, and Assistance Management Committees

TIER 2 – OPERATIONAL SYSTEMS

Area-Based Planning, Logistics & Relief, and Specialised Units (boat rescue, medical, fire & electricity) handle field-level operations

TIER 3 – DEPARTMENTAL EXECUTION

Eight departments (Health, Drainage, Construction, Water, Fire, Electricity, Transport, Education) execute phase-specific roles before, during, and after the flood

DEPARTMENT-WISE ROLES ACROSS PHASES

All eight operational departments carry distinct responsibilities across the three disaster phases – preparedness (Before), active response (During), and recovery (After). The table below provides a consolidated view of cross-departmental roles.



HEALTH

- Before: Preparedness planning, hospital capacity, staff training
- During: First aid, medical camps, ambulance coordination
- After: Fumigation, vaccination, health monitoring



CONSTRUCTION

- Before: Unsafe building identification, machinery prep
- During: Road clearance, debris removal, rescue support
- After: Infrastructure repair, damage documentation



FIRE

- Before: Equipment readiness, safety audits, rescue training
- During: Rescue operations, coordination with police & health
- After: Equipment repair, incident analysis



TRANSPORT

- Before: Vehicle readiness, fuel stock, identify additional transport
- During: Evacuation, relief transport, emergency movement
- After: Vehicle repair, logistics review



DRAINAGE

- Before: Flood mapping, drain maintenance, pump readiness
- During: Water removal, blockage clearance
- After: Drain repair, improved planning



WATER SUPPLY

- Before: Pipeline maintenance, backup supply
- During: Emergency supply to affected areas & shelters
- After: Safe drinking water restoration, quality monitoring



ELECTRICITY

- Before: Inspect lines, repair faults, backup power setup
- During: Power shutdown in flooded areas, emergency supply
- After: Restore electricity, replace damaged infrastructure



EDUCATION

- Before: Identify schools as shelters, ensure basic facilities
- During: Shelter management, relief coordination support
- After: Clean & restore schools, resume normal functioning

COMMUNITY RESPONSE – RIVERINE FLOODING

Communities in river flood zones have developed a well-practised but largely self-organised disaster cycle. While early warning systems allow some preparation, the recovery phase reveals a critical structural gap – the financial and social burden of recovery falls almost entirely on affected households.

BEFORE

- Flood expected annually – experience-based anticipation
- Belongings moved to upper floors
- Early warning received 2–5 days in advance

AFTER

Return followed by 8–10 days of cleaning

DURING

- Full household evacuation to shelters
- Stay duration: 8–15 days
- Transport self-arranged by families

2-3 lakhs

Loss incurred in 2019

50,000

Annual livelihood loss



ECONOMIC LOSS

- 1-2 months of livelihood disruption
- Household losses: ₹50,000-₹2 lakh
- Official compensation: only ₹5,000-15,000 (2019, 2021)
- Powerloom and daily-wage work suspended



...c flood losses; in opttaiss
sant of fõndian
by tha holc.

Heo'th ropirttios



Thealth and daaily life 'hife ish io
in trise home, this chasder for c
nousections.



HEALTH & DAILY LIFE

- 8-10 days of post-flood cleaning
 - Ground floors uninhabitable during event
 - Exposure to contaminated water
- Cumulative physical and mental stress

COMMUNITY RESPONSE – URBAN WATERLOGGING

Urban waterlogging presents a distinctly different challenge from riverine flooding. Though less catastrophic in individual events, its chronic and recurrent nature creates persistent economic and health burdens that are often invisible to formal institutional systems.

PHASES OF WATERLOGGING EXPERIENCE

1 BEFORE

No formal warning system. Preparation is entirely experience-based – residents act on observed weather patterns and past flooding memory.

2 DURING

No evacuation required. Water levels reach 2–3 ft. Daily activities – work, school, commerce – are severely disrupted but residents remain in place.

3 AFTER

Recovery is rapid (hours), but the event is highly recurrent – occurring multiple times per season, creating cumulative stress.



CHRONIC IMPACTS OF RECURRING WATERLOGGING

INCOME LOSS

Monthly income loss: ₹2,000–₹3,000 per household due to repeated disruption of livelihoods

HEALTH ISSUES

Skin diseases, vector-borne illnesses, and respiratory conditions linked to stagnant water and poor drainage

WATER QUALITY

Contamination of water sources during waterlogging events creates additional public health risks

Chronic exposure to waterlogging is systematically undercounted in official disaster records, as individual events fall below the threshold for formal disaster declaration.

KEY FINDINGS

WHERE DOES THE SYSTEM STAND?

● Preparedness

Moderate. Early warning systems, DMP documentation, and departmental assignments exist but are inconsistently operationalised across all departments.

● Response

Strong. Evacuation, shelter management, and emergency service deployment are well-practised. Institutional muscle memory around response is the system's clearest strength.

● Recovery

Weakest. Post-flood recovery is largely unsupported institutionally. Financial assistance is inadequate, livelihood restoration is absent, and documentation of recovery needs is poor.



SCORING

Institutional and community responsiveness was assessed using a three-dimensional scoring framework. Each dimension captures a distinct aspect of systemic readiness, enabling a nuanced evaluation of both strengths and gaps across disaster phases.



A – AVAILABILITY

Are resources, systems, and staff formally in place?

F – FUNCTIONALITY

Do systems work and are they regularly maintained?

E – EFFECTIVENESS

Do actions produce meaningful outcomes for communities?

SCORING

Governance Indicator Scoring				
Indicator	A	F	E	Score
Disaster planning & role clarity	2	2	2	2
Training & capacity building	1	1	1	1
Early warning systems	1	1	1	1
Evacuation & shelter systems	2	2	2	2
NGO coordination	2	2	2	2
Drainage maintenance	1	0	0	0.33
Feedback mechanisms	0	0	0	0
Recovery support systems	0	0	0	0
Institutional capacity (manpower, resources)	1	0	0	0.33

Community Indicator Scoring				
Indicator	A	F	E	Score
Awareness & early warning use	1	1	1	1
Evacuation preparedness	2	2	2	2
Coping mechanisms	2	2	2	2
Collective action	1	0	0	0.33
Livelihood resilience	0	0	0	0
Recovery capacity	0	0	0	0
Access to basic services	1	0	0	0.33
Long-term adaptation	1	1	1	1

SCORING

Phase-wise Average Scores		
Phase	Governance	Community
Preparedness	~1.1	~1.2
Response	2	2
Recovery	0.2	0.1

: Weighted Phase-wise Scores		
Phase	Governance	Community
Preparedness	0.33	0.36
Response	0.6	0.6
Recovery	0.08	0.04

CONCLUSION

THE SYSTEM IS RESPONSE-CENTRIC.

Ichalkaranji's disaster management architecture has been built primarily to **respond** – to evacuate, shelter, and rescue. It has not been designed to **recover**. This institutional blind spot means that vulnerability is not reduced after each flood; it is reset, and in many cases compounded.



RESPONSE-CENTRIC DESIGN

Institutional energy, training, and resources are concentrated in the during-flood phase. Pre-flood preparedness is moderate; post-flood recovery is largely absent from the formal system.



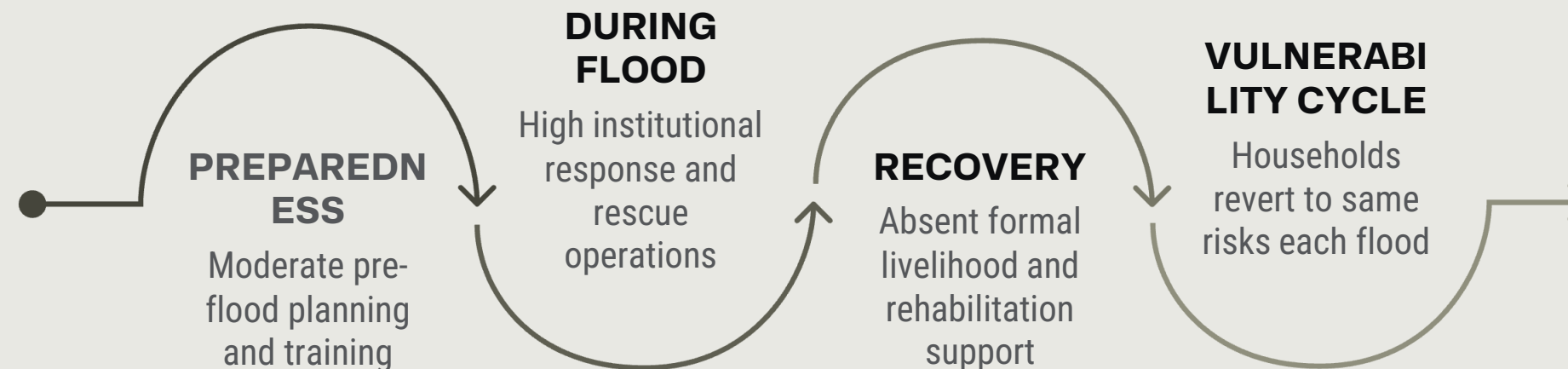
RECOVERY IS MISSING

No structured livelihood restoration programme, inadequate financial compensation (₹5,000 vs. losses of ₹50K–₹2L), and no formal re-entry or rehabilitation protocol for displaced communities.



VULNERABILITY RESETS EVERY FLOOD

Without meaningful recovery support, households return to the same conditions that made them vulnerable in the first place. Each flood cycle deepens cumulative disadvantage for the most exposed communities.



A SMARTER APPROACH: BUILD ON WHAT ALREADY EXISTS

Ichalkaranji has already taken decisive steps – decentralisation is underway and an emergency control room is being established. The strategic focus, therefore, is not on creating new systems from scratch, but on **improving the effectiveness, coordination, and reach of existing mechanisms** – particularly at the ward level where impact is most immediate.

BUILD ON EXISTING SYSTEMS

Leverage current infrastructure and institutional capacity rather than duplicating effort

OPERATIONAL EFFICIENCY

Optimise processes, scheduling, and resource deployment across all phases

WARD-LEVEL IMPLEMENTATION

Decentralise action to the last mile for faster, more accountable response



STRENGTHENING PREPAREDNESS & EVACUATION



LAST-MILE WARNING SYSTEMS

Ensure flood alerts reach all wards – including low-income and peripheral settlements – through multilingual, multi-channel communication



PRE-DEFINED EVACUATION ROUTES

Map and signpost dedicated evacuation corridors to reduce confusion during emergencies and prevent bottlenecks



WARD-LEVEL COORDINATORS

Appoint trained community coordinators in each ward to lead evacuation, manage shelters, and maintain order during flood events



REGULAR MOCK DRILLS

Conduct periodic simulations to build muscle memory, identify gaps, and improve community readiness before floods occur

IMPROVING INFRASTRUCTURE MANAGEMENT

Waterlogging in Ichalkaranji is **primarily a maintenance challenge**, not merely a design deficiency. A shift from reactive, crisis-driven cleaning to **preventive, scheduled management** – backed by adequate manpower and modern tools – can substantially reduce flood exposure across vulnerable wards.

CURRENT CHALLENGE

Drains are cleaned reactively – only after flooding occurs. Manpower is insufficient and equipment is outdated, leaving hotspots chronically underserved during monsoon season.

RECOMMENDED ACTIONS

- **IDENTIFY DRAINAGE HOTSPOTS**
Map chronic waterlogging zones using ward-level data and resident feedback
- **SCHEDULED DESLUDGING**
Implement pre-monsoon and mid-monsoon cleaning calendars with accountability
- **INCREASE MANPOWER & TOOLS**
Deploy adequate staff and invest in mechanical equipment for faster, effective clearing

STRENGTHENING RECOVERY SYSTEMS

CURRENT REALITY

~2 WEEKS

Average time for household cleaning & restoration

~1-2 MONTHS

Time to recover livelihoods after major flood events

HOUSEHOLD-DRIVEN

No structured institutional support for post-flood recovery

RECOMMENDED SOLUTION

1 IMC + NGO COLLABORATION

Formalise partnerships between the Ichalkaranji Municipal Council and local NGOs for coordinated relief deployment

2 MECHANICAL CLEANING SUPPORT

Deploy municipal machinery and trained teams to assist household-level cleanup in flood-affected wards

3 WARD-LEVEL SCHEDULING

Prioritise the most vulnerable households through structured, ward-by-ward recovery timetables



STRENGTHENING COMMUNITY-LED SYSTEMS

Ichalkaranji's communities do not wait passively. Residents already rely on **informal networks for early warning, self-organised evacuation, and mutual support**. These social assets are underutilised – integrating and training them within official systems can dramatically improve responsiveness at the ground level.



LOCAL VOLUNTEERS

Identify and formally recognise existing community volunteers; provide them basic training in first response, evacuation management, and damage reporting to embed them within official structures



INFORMAL NETWORKS

WhatsApp groups, neighbourhood associations, and community leaders already function as rapid warning nodes – these should be mapped, strengthened, and connected to the emergency control room



FEEDBACK SYSTEMS

Establish two-way communication channels so communities can report waterlogging, blocked drains, and unsafe conditions to the ward office in real time – enabling faster, data-driven municipal response

CLIMATE RESPONSIVENESS = EFFECTIVENESS OF EXISTING SYSTEMS

Improving Ichalkaranji's resilience to flooding does not demand an entirely new institutional architecture. The answer lies in **doing existing things better** – coordinating more effectively, monitoring more proactively, and supporting communities more systematically through every phase of the flood cycle.



COORDINATION

Align IMC departments, NGOs, and community actors around shared preparedness and response protocols



MONITORING

Track drainage conditions, warning dissemination, and recovery progress at the ward level with real-time data



RECOVERY

Formalise structured post-flood support to reduce the burden on households and accelerate community-level restoration

REFERENCES

Global Frameworks & Reports

- Intergovernmental Panel on Climate Change. (2021). *Climate change 2021: The physical science basis (Sixth Assessment Report)*. Cambridge University Press.
- United Nations Office for Disaster Risk Reduction. (2015). *Sendai framework for disaster risk reduction 2015–2030*. UNDRR.
- United Nations Office for Disaster Risk Reduction. (2019). *Global assessment report on disaster risk reduction*. UNDRR.
- World Bank. (2013). *Building urban resilience: Principles, tools, and practice*. World Bank.
- World Meteorological Organization. (2008). *Urban flood risk management: A tool for integrated flood management*. Associated Programme on Flood Management.

National Policies & Guidelines (India)

- Government of India. (2005). *Disaster Management Act, 2005*. Ministry of Home Affairs.
- National Disaster Management Authority. (2008). *National disaster management guidelines: Management of floods*. NDMA.
- National Disaster Management Authority. (2010). *National disaster management guidelines: Urban flooding*. NDMA.
- Kolhapur District Disaster Management Authority. (2024). *District disaster management plan 2024–2025*. Government of Maharashtra.

Case Studies & Applied Research

- TARU Leading Edge. (2011). *Surat city resilience strategy*. TARU, ACCCRN, Surat Municipal Corporation, and Southern Gujarat Chamber of Commerce and Industry.
- World Resources Institute. (n.d.). *Aqueduct global flood analyzer*. WRI.
- World Bank. (2015). *Chennai city flood recovery framework*. World Bank.
- Municipality of Rotterdam. (n.d.). *Rotterdam climate adaptation strategy*. City of Rotterdam.
- City of Copenhagen. (2012). *Cloudburst management plan*. City of Copenhagen.

Academic Literature (Ichalkaranji & Flood Impact)

- Sayyad, A., & Patil, D. (2020). Effects of floods on an industrial town—Ichalkaranji. *International Research Journal of Engineering and Technology (IRJET)*, 7(10), 738. <https://www.irjet.net>

Conceptual & Thematic References

- United Nations Office for Disaster Risk Reduction. (n.d.). *Terminology on disaster risk reduction*. UNDRR.
- World Bank. (n.d.). *Urban resilience framework*. World Bank.

Climate responsiveness is not measured by how swiftly a city evacuates – it is measured by how completely its most vulnerable communities are enabled to rebuild.

THANK YOU

