Climate action plan for small & Medium Towns focusing on Adaptation, from urban water, wastewater & solid waste management perspective for a case city – Ichalkaranji

Master's in Urban Infrastructure
Directed Research Project – 2024
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Guides: Aasim Mansuri | Arwa Bharmal

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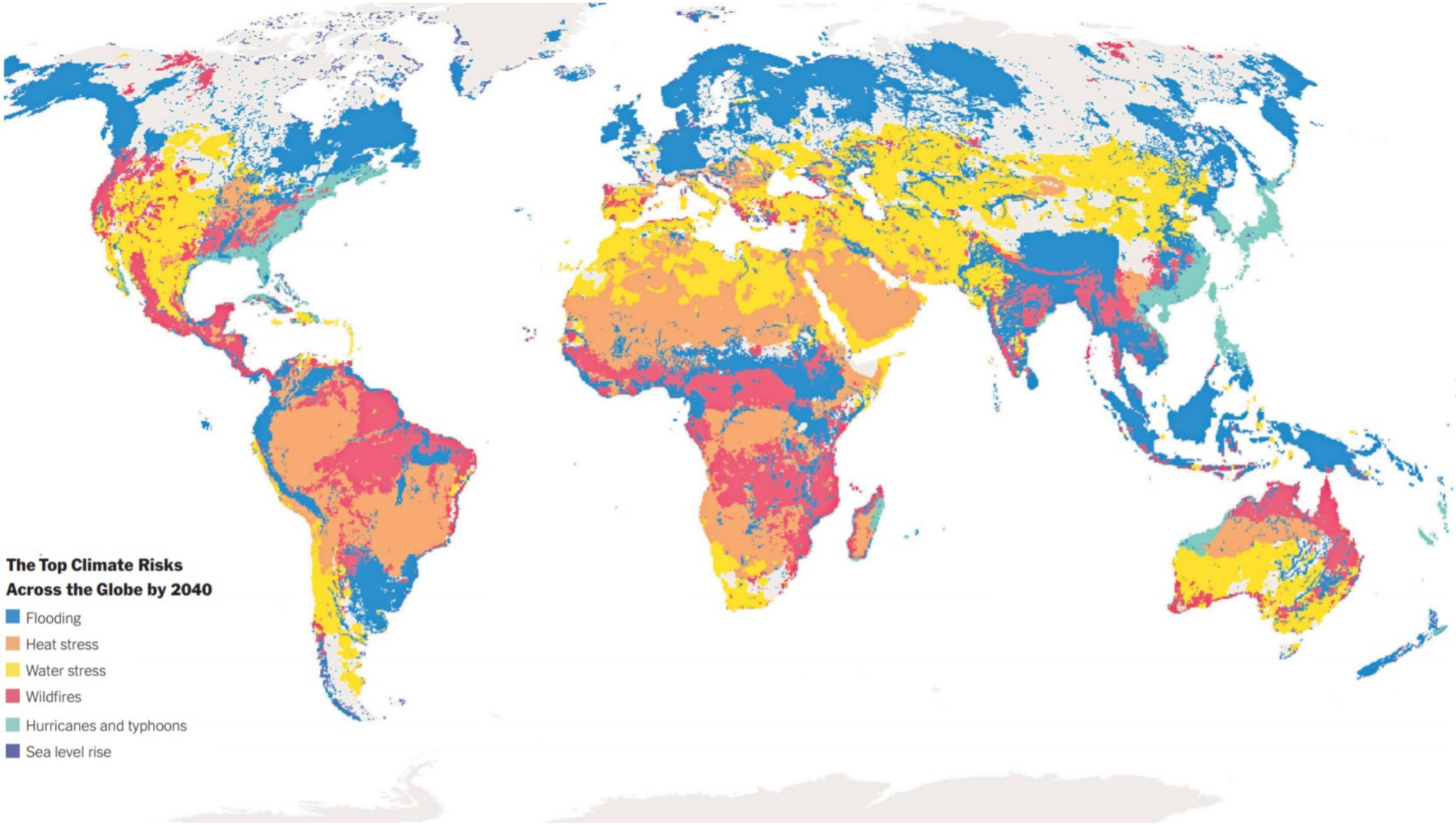
Climate Risks Across the Globe



Source: Four Twenty Seven and The New York Times, 2021

Initiatives to curb Emission globally!

1972

First UN environment conference in Stockholm
Focus on socioeconomic activities on the environment.

1990

IPCC Report
Suggests the temperature increase due to impact of climate change.(risen by 0.3-0.6C over the century)

1992

Rio Earth Summit
The 195 nations – "treaty's parties".

1997

Kyoto Protocol
Developed nations pledge to reduce emissions by an average of 5% by 2008-12

2000

Millennium Development Goals
(MDG) were launched

2010

Copenhagen Accord
Developed countries promised to provide $30bn for the period 2010-2012

2015

COP 21: Historical Paris Agreement
Legally binds the countries with international treaty on climate change.

2016

Sustainable Development Goals
were launched to achieve a better sustainable future for all

2018

Katowice Climate Package IPCC confirms the importance of 1.5 degree Celsius goal.

2021

COP 26 : Glasgow Climate Pact
WASH services were first considered.

2022

COP 27, Egypt
Provide loss and damage funds to Developing countries, Maintain warming Temperature within 1.5°C.

2023

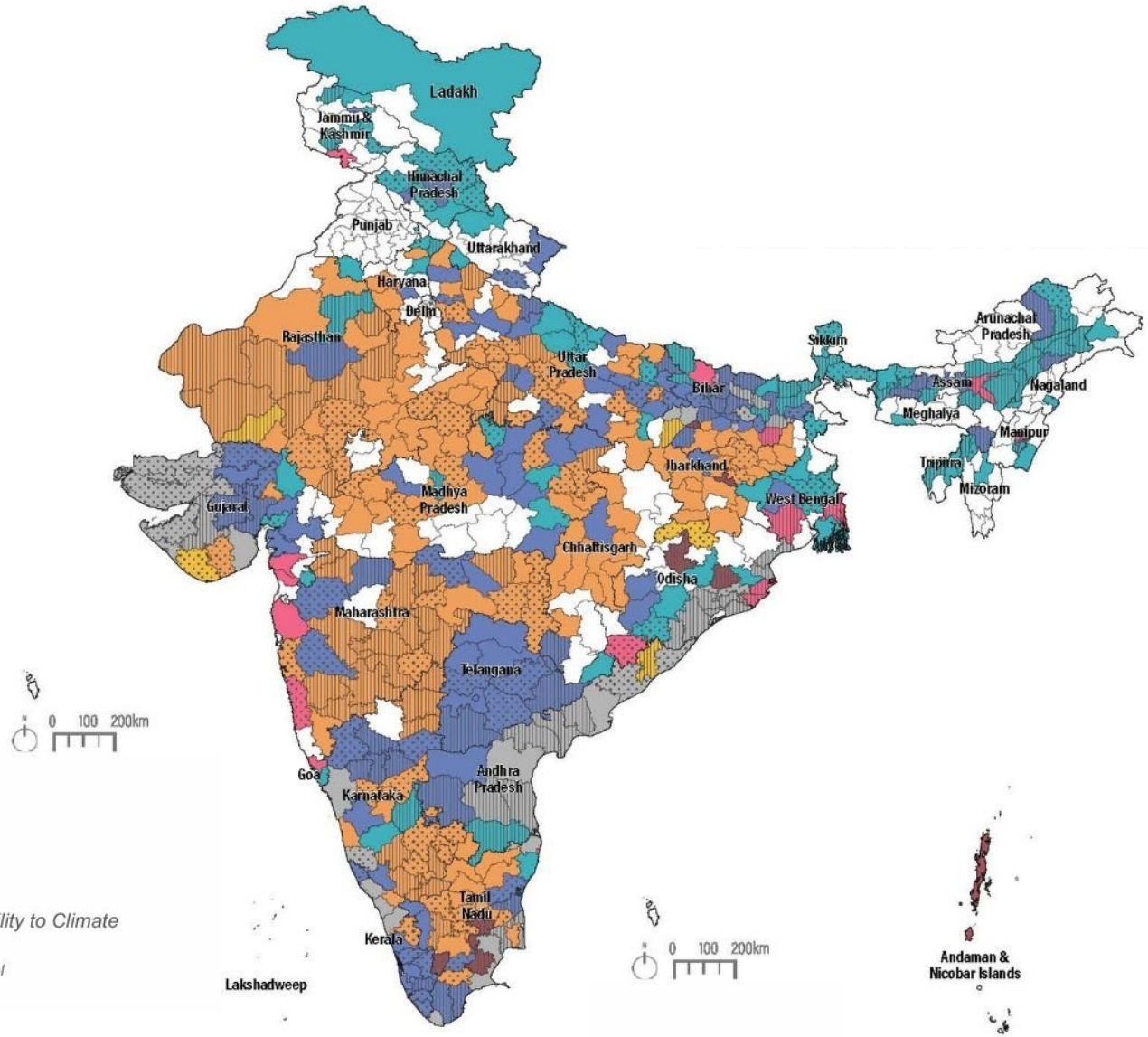
COP 28, UAE
1st Global Stocktake doubling in adaptation finance.

•Carbon levels in the air have kept on increasing and the world is not united to reduce emission levels.

Source: https://unfccc.int/timeline/ ; https://www.bbc.com/news/science-environment-15874560

Landscape of vulnerability in India

More than 80% of India's Population lives in districts that are highly vulnerable to the combined risk of hydrological and meteorological disasters (Floods, Droughts & Cyclones)



Level of vulnerability to mulitple hazards:

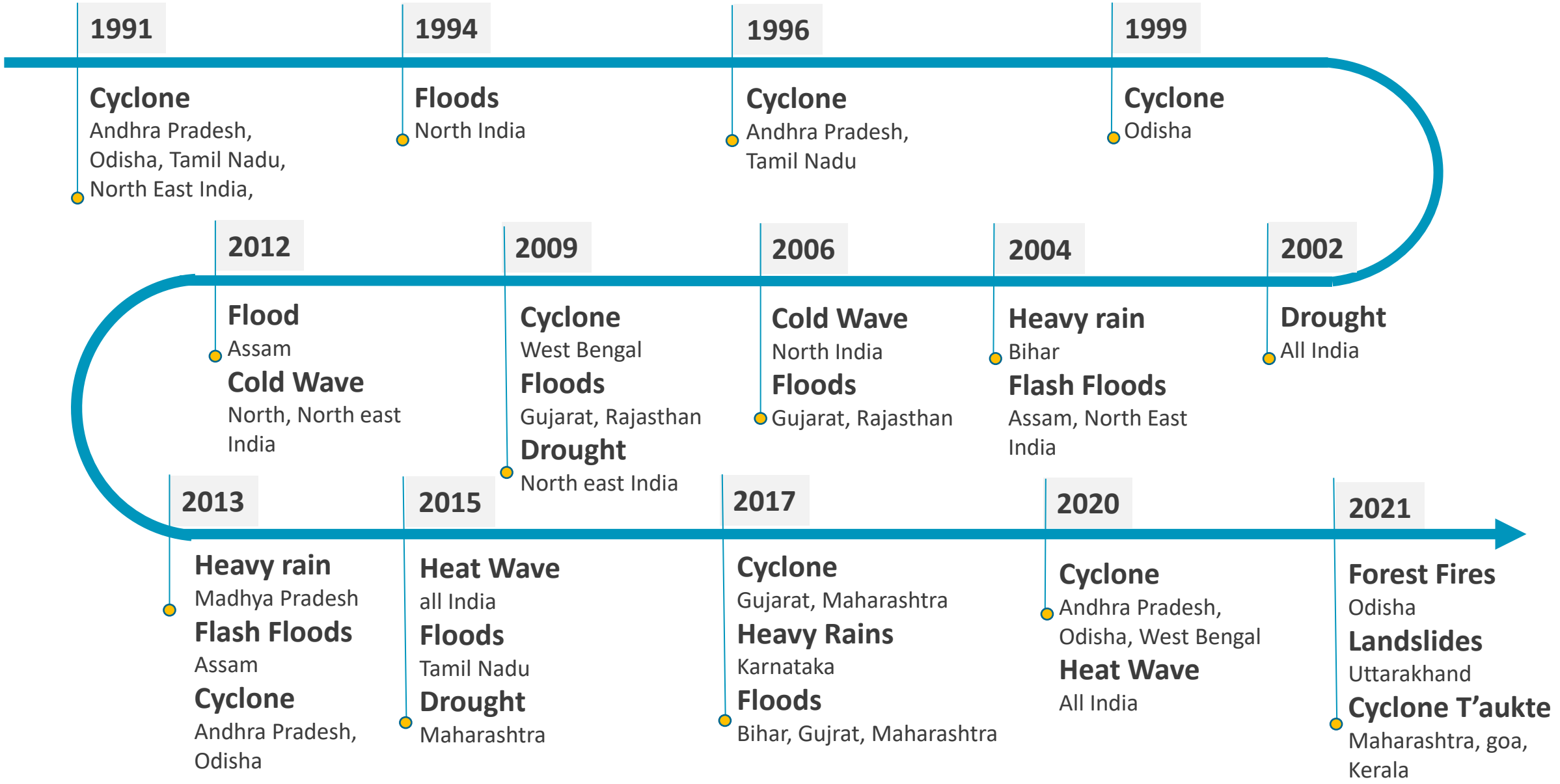
Low	Medium	High		Low	Medium	High	
			Flood				Flood & drought
			Cyclone				Cyclone & drought
			Drought				Flood, cyclone & drought
			Flood & cyclone				

SOURCE: Recreated by the authors of WRI India's 'Climate Resilient Cities: Assessing Differential Vulnerability to Climate Hazards in Urban India' based on Mohanty and Wadhawan (2021).

Disclaimer: This map is for illustrative purpose and does not imply the expression of any opinion on the part of WRI India, concerning the legal status of any country or territory or concerning the delimitation of frontiers or boundaries.

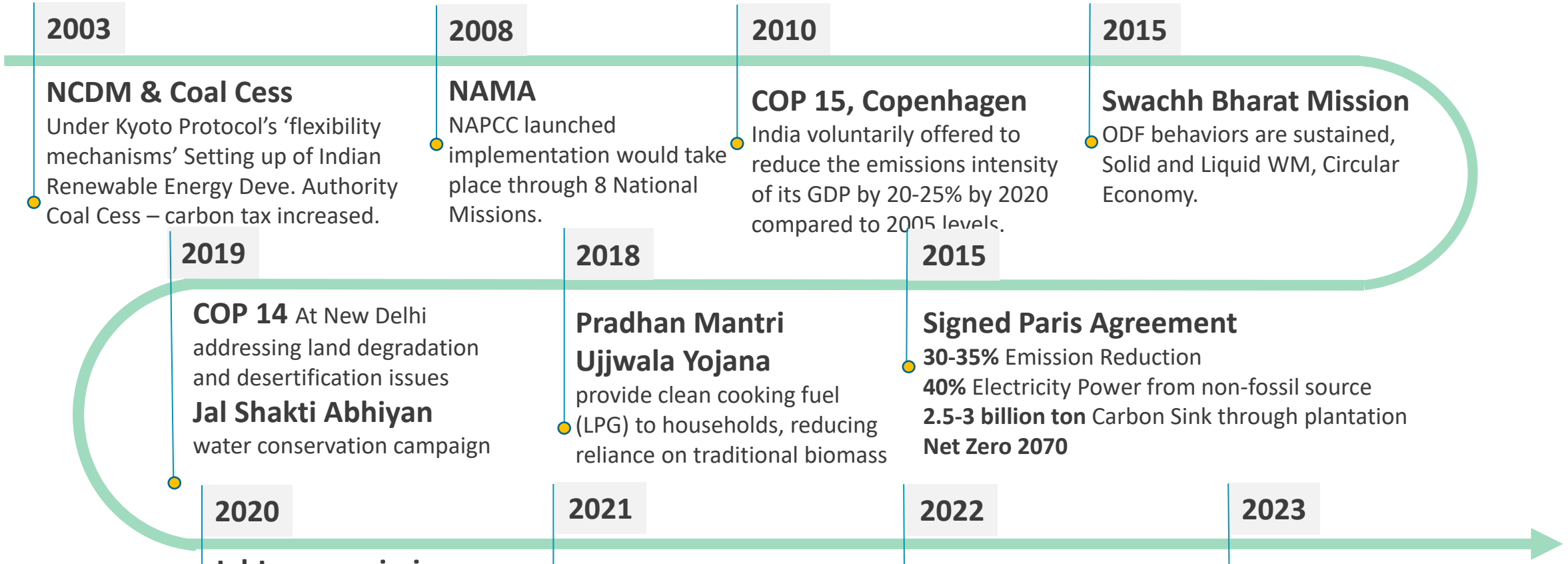
Source: WRI 2021

How India is Impacted by Climate Change!



Source: WRI Timeline

Actions taken by India to Combat Climate Change



2003

NCDM & Coal Cess
Under Kyoto Protocol's 'flexibility mechanisms' Setting up of Indian Renewable Energy Deve. Authority Coal Cess – carbon tax increased.

2008

NAMA
NAPCC launched implementation would take place through 8 National Missions.

2010

COP 15, Copenhagen
India voluntarily offered to reduce the emissions intensity of its GDP by 20-25% by 2020 compared to 2005 levels.

2015

Swachh Bharat Mission
ODF behaviors are sustained, Solid and Liquid WM, Circular Economy.

2019

COP 14 At New Delhi addressing land degradation and desertification issues

Jal Shakti Abhiyan
water conservation campaign

2018

Pradhan Mantri Ujjwala Yojana
provide clean cooking fuel (LPG) to households, reducing reliance on traditional biomass

2015

Signed Paris Agreement
30-35% Emission Reduction
40% Electricity Power from non-fossil source
2.5-3 billion ton Carbon Sink through plantation
Net Zero 2070

2020

Jal Jeevan mission
indirectly addresses Water scarcity

Atal Bhujal Yojana focused on sustainable groundwater

2021

AMRUT 2.0
aiming at water security

National Hydrogen Mission
to promote hydrogen as a clean energy

2022

SBM 2.0 were launched

Energy Conservation Act came to action, promoting energy efficiency and conservation

2023

G20 Summit
committed to tripling global renewable capacity by 2030

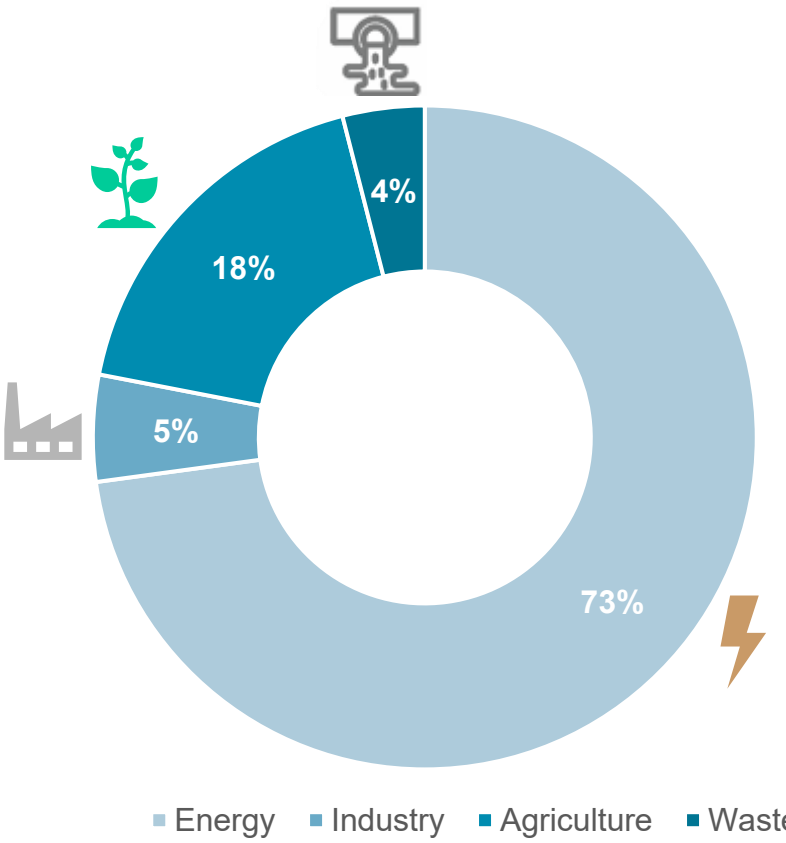
- NCDM - National Clean Development Mechanism CDM
- NAPCC - National Action Plan on Climate Change
- ODF- Open Defecation free
- WM – Waste Management

- **Efforts are not penetrating to the local level.**

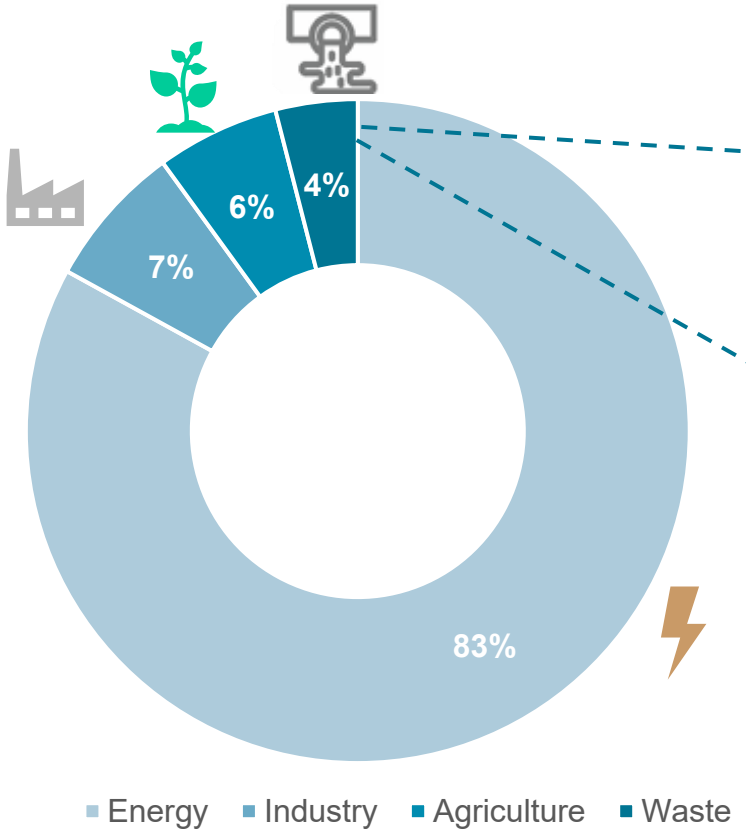
Source: WRI Timeline

GHG Emissions

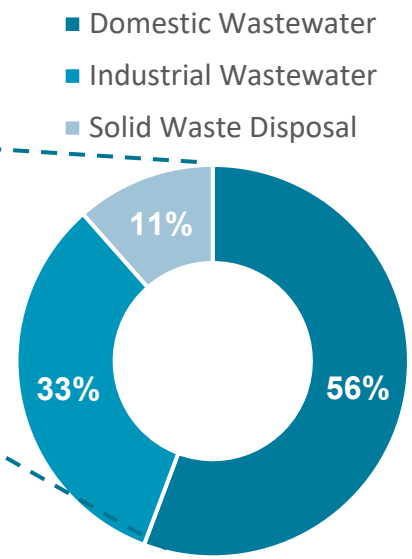
Global GHG Emissions



India's GHG Emissions



GHG Emission in Waste Sector



The **Waste sector** contributing to **4% of total GHG** Emissions
The numbers are small, but it is the **most affected** sector due to climate change

Cities are contributing 70% of the GHG emissions

Source: India GHG portal

How WASH services are getting affected by Climate Change Impacts

Type of Infrastructure Services	Extreme Heat	Drought	Precipitation/ Flooding	Sea Level Rise	Cyclone
Water	High Evaporation rate of water bodies, Water Demand Increases	Water scarcity & Reduction in Groundwater table	Interruption in services Affects the quality of water	Increase in salinity in coastal areas	Infrastructure Damage
Sanitation		Condition of infrastructure and facilities deteriorate	Interruption in services Health Hazards Risk of water contamination	erosion and coastal habitat destruction	Infrastructure Damage
Solid waste Management		Cleaning Issues	Contamination of water due to solid waste Health hazards		Infrastructure Damage
Blue Green Grey Infrastructure	Evaporation rate Increases, Depletion of Vegetation	Depletion of Vegetation & Water bodies, destruct ecosystem	Uproot vegetation, Damage Green Infra., Urban Flooding, water logging,	Depletion of Vegetation, Saline water contamination	Infrastructure Damage

- WASH Services: Despite Low GHG Contribution, Faces Greatest Impact from Climate Change

Source: Mohanty 2020, Mapping India's Climate Vulnerability: A District Level Assessment, CEEW 2021

What urgent action is needed to safeguard small & medium Indian Town's future?

Vision: To make small & Medium scale Town more resilient.

Aim

This study aims at identifying the implications of climate change and preparation of climate action plan focusing on Adaptation, from urban water, wastewater & solid waste management perspective for an Indian case city.

Objectives

- To identify the implications of climate change on urban water and wastewater systems through review of programs and case studies at national and international level.
- To prepare a climate action plan from urban water and wastewater perspective – A case of Ichalkaranji city.

Limitations:

- This study is limited to water, wastewater sector & solid waste implications of climate change and does not include the hygiene part of WASH sector.
- Climatic Risks – Air pollution & Land slide is not taken into consideration.

Methodology

Activities & Methods	Sub - objectives	Research objectives	Outcome
Reviewing Global & National Trends, policies & Missions on Climate Change	Understanding the relationship between WASH & Climate change	Understanding Climate implications on WASH Infrastructure	Establishing Need
			Research Scoping
	Understanding Types of Climatic Risks		Components of DRP
Review of Climate Action Plans City Level	Climate Change impacts on Solid waste & WASH services	A critical review of Vulnerability/Resilience Framework	Climate Risks in India
			Implications
Comparing available Vulnerability/ Resilience Assessment Frameworks	Finding suitable Vulnerability Assessment		Suitable Vulnerability Framework
Climatic trends, GIS mapping, Archived Data of Natural Hazards, PAS data source, Stakeholders con.	Case City's - Geography, Demography, Climate Profile, Socio-Economic Profile	Ichalkaranji – Overview, Assessment and Proposals	Case City Profiling
	Understanding Existing Solid waste & WASH services		Identifying Challenges and Opportunities
Field data Analysis, spatial mapping using ArcGIS, Google Earth Pro	Applying Vulnerability Assessment		
	Case studies to frame strategies for Adaptive measures		Climate Change Adaptation Actions
Stakeholder Consultation, Case Studies & available climate action plans	Linkage of the climate action plan to ongoing missions, projects, programs		

Source: Author

Contents

CAP comparison_ City Profile

Water Management Climate Action Plan	(Census 2011)Cities with the population less than or equals to 5 lakh (Census 2011)				
	Ujjain	**Udaipur**	**Siliguri**	**Satna**	**Sagar**
Population	• 515,215 , Floating (10K-60K)per day	• 451,100 • Floating 16K per day	• 513,264	• 282,977	• 318518
Area	• 92.68 sq.km	• 200 Km²	• 41.9 sq. km.	• 72 sq.km	• 49 sq.km
Gender Ratio Literacy rate	• **945/1000 males** • 74.76%	• **895/1000 males** • 62.76%	• **946/1000 males** • **77%**	• **926/1000 males**	• **895/1000 males** • 62.76%
Socio Economic Profile	• Pilgrim City	• Tourism oriented	• transport and tourism transit hub, for its tea industry	• Cement industry • Emerging City as have a low income today, and a high ratio of income growth with the growing population	• Tourism • city's projected economic growth is greater than projected population growth

Source: C40, ICLEI South Asia

CAP comparison_ Water Management

Water Management Climate Action Plan	Cities with the population less than or equals to 5 lakh				
	Ujjain	**Udaipur**	**Siliguri**	**Satna**	**Sagar**
Current measures being undertaken in the city	• 41% non- revenue water. • In 2018, 52% of the municipal households had in-house water supply connections and 10% of the HHs below poverty line had in-house water supply connection	• 90% piped supply • dependent on surface water to a large extent. • NRW is 40-30%	• non-revenue water 78% • Water resource assessment plan for increasing demand	• Only 42% of households having municipal water supply service • Not having water resources assessment or alternate source of water • Under smart city mission, city is introducing smart water meter	• City has 35% non-revenue water and has prepared a plan to reduce it. • 57% of households were connected to water supply as of 2017.
Areas of improvement	• Increasing the tap water connections to more than 90% HHs. • Introducing metering policy from immediate effect.	• NRW reduction • Water resource assessment is must • Water metering • Should install SCADA	• Reduce NRW • Increased chances of groundwater pollution	• City needs to conduct a flood and water stagnation risk assessment. • City needs to conduct a water resources assessment to assess status of existing water resources, its uses, along with projected future demand and availability • City needs to conduct an energy audit of its wastewater treatment system.	• Need to assess current water resources and future availability and prepare a demand management plan. • Need to prepare a flood risk management plan. • Conduct energy audits for water supply plants.

- Takeaway: Reduce NRW, water conservation practices, water-efficient irrigation practices in agriculture and water resource assessments planning to manage the demand in the small towns.

Source: C40, ICLEI South Asia

CAP comparison_ Used Water Management

Used Water Management Climate Action Plan	Cities with the population less than or equals to 5 lakh				
	Ujjain	**Udaipur**	**Siliguri**	**Satna**	**Sagar**
Current measures being undertaken in the city	• As per the data submitted for CSCAF 2.0, 54 MLD of wastewater is treated and is reused for gardening and agriculture purposes.	• Partial under ground drainage network • untreated sewage pollute surface as well as ground water. • water logging and flooding situation	• Overflow of sewage lines and dilution of waste water will impact efficient of waste water treatment • contamination of potable water during flood events	• <5% of wastewater is recycled. • partial underground sewerage network and does not have an installed sewage treatment facility. • Excessive sulphate & Nitrates - seepage of sewerage into groundwater, causing local pollution and contamination.	• Sagar also aims to increase water treatment capacity to 92.4 MLD. • Aim to improve rainwater harvesting and re-use in public buildings.
Areas of improvement	• Increasing wastewater reuse. • Increasing wastewater reuse. • Carrying out flood/ water stagnation risk assessment of the city	• Treatment & reuse • Due to heritage conservation – old areas must have Systematic plan for cleaning and maintenance	• Strengthen the Ground waste water system • Health measures	• Should install STPs & Tertiary treatment Plants to fulfill the Industrial demand • Strengthen the existing underground sewerage system	• 01 STP is installed in Sagar but not functional. • Need to reuse and recycle wastewater. • Conduct energy audits for waste water treatment plants

- Takeaway: Develop basic infra to reduce ground water dependency, Nature based - wastewater treatment plants, Reuse used water in Agriculture/Industrial purposes.

Source: C40, ICLEI South Asia

CAP comparison_ Solid waste Management

Solid Waste Management Climate Action Plan	Cities with the population less than or equals to 5 lakh				
	Ujjain	**Udaipur**	**Siliguri**	**Satna**	**Sagar**
Current measures being undertaken in the city	• 100% D2D • City has proposed construction of a sanitary landfill. • bio-methanation plant - 5 tones per day to treat vegetable waste. • Bioremediation of legacy waste has been completed. • Installed a 600 kg capacity organic waste converter.	• 100% collection without segregation • Disposed in an open dump with no treatment or processing.	• open dumps • Choking drains • Health hazard	• 100% door to door collection of solid waste and segregation • The city has a Cluster based Integrated Solid Waste Management (ISWM) facility • windrow composting	• 100% of door-to-door waste collection of solid waste. • 350 TPD cluster based integrated waste management facility constructed. • Awareness programs for waste segregation is underway. • Segregation at source initiated on pilot basis in 7 wards. • 30 TPD C&D waste processing & reuse facility.
Areas of improvement	• Reducing waste going to the landfill. • Source level segregation awareness • Monitoring the amount of methane collected from STPs and generating clean energy.	• Awareness for source level segregation • community driven private start-ups to manage solid waste in the city • Setting up plastic waste collection centers	• Segregation at source Level • Composting, re cycling, RDF pelletisation etc.	• Awareness is required for segregation at source6. • Setting up a bio methanation plant for managing the wet waste • Strengthening the Extended Producer Responsibility (EPR) of producers6. • Implementing measures for re-use of construction and demolition waste in building and road construction6. • Reducing greenhouse gas emissions from waste transport by shifting to alternate fuels.	• Need to increase awareness on source segregation. • Setting up of a bio-methanation plant. • Setting up plastic waste collection centers

- Takeaway: Awareness to Reduce waste generation & Promote source segregation, Expand collection services, Invest in processing facilities.

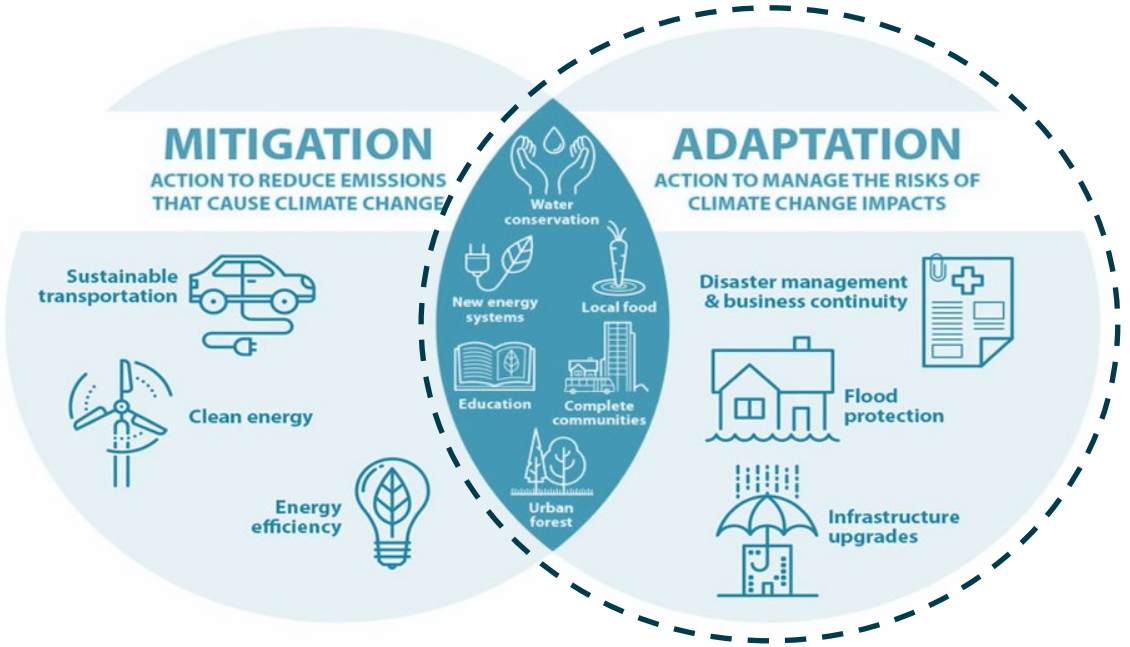
Source: C40, ICLEI South Asia

Key Learning From the Case Studies

For Small & Medium Towns Adaptation is more Important due to their **lesser emission contribution as well as Limited Resources**

- **Mitigation is also important, however it's a long way process**
- **To safeguard immediate future – Adaptation Measures are must**

High Impact through Cost-Effective Solutions: Smaller, cost effective and easily implementable solutions can create larger impacts in adaptation to climate change



Focus of this study

Focus on Water and Used water: Water is crucial for adaptation, strengthen water management.

Source: Calgary City Climate Resilience Strategy

The Importance of Adaptation

Climate change is already impacting WASH systems in small and medium towns across India & Compounding Existing Risks and Vulnerabilities.

- **Limited resources**
- **Infrastructure gaps**
- **Limited disaster preparedness**

The Risk of Maladaptation

While adaptation is crucial, we must also be mindful of maladaptation.

Maladaptation occurs when adaptation efforts unintentionally worsen the situation.

Examples: Building seawalls that disrupt natural coastal defenses, relying solely on water-intensive technologies during droughts.

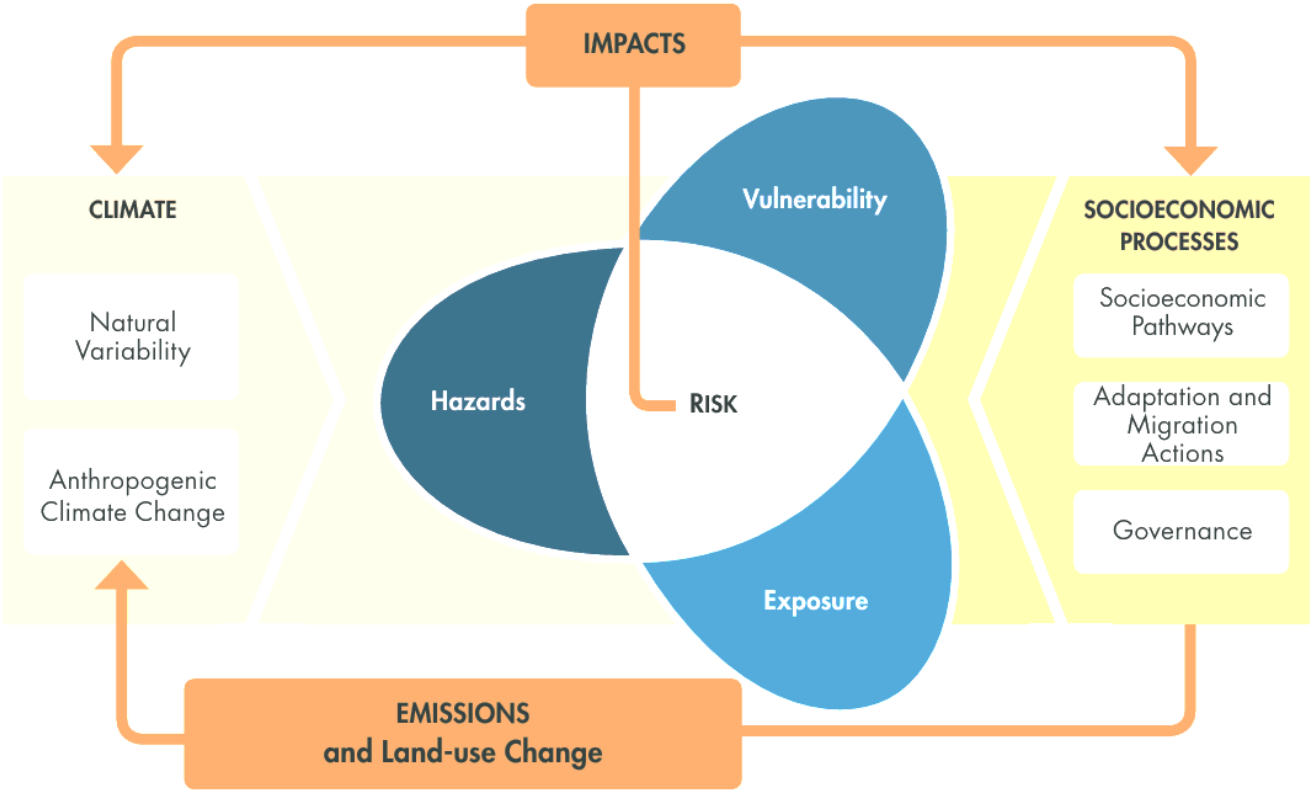
Importance of considering long-term consequences and potential unintended impacts.

- While large cities contribute more to national emissions, climate action plans are critical for small Indian cities due to their heightened vulnerability and the magnified impact of climate change on their limited resources and infrastructure. And that is why ADAPTATION is more important measures for small/medium scale towns.

Source: Calgary City Climate Resilience Strategy

Understanding vulnerability

Conceptualizing vulnerability based on IPCC Fifth Assessment (2014) framework.



Vulnerability Assessment = $\frac{\text{Exposure} \times \text{Sensitivity}}{\text{Adaptive Capacity}}$

Key Concepts

A climate-related hazard is the potential occurrence of an event that may cause loss of life or injury, as well as damage and loss to businesses, services and the environment. This can be an extreme weather event or a longer-term trend. *Adapted from: Seine-et-Marne, 2015*

Exposure is the presence of a human or natural element (people, species, ecosystems, environmental functions, economic activities, etc.) in places or settings that could be adversely affected. *Adapted from: IPCC, 2014*

Impact is the effect that a climate-related hazard has on natural and human systems. These effects manifest themselves locally on people's lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure. Impacts are also referred to as *consequences and outcomes*. *Adapted from: IPCC, 2014*

Vulnerability describes the propensity or predisposition to be adversely affected. It encompasses a variety of concepts, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. Vulnerability can therefore be shaped by a range of factors, including socio-economic inequalities, local urban development and the implementation of adaptation strategies. It is thus linked to an area's political strategies and decisions. *Adapted from: IPCC, 2014*

Source: . Source: IPCC (2014) Climate Change 2014. Impacts, Adaptation and Vulnerability. Summary for Policymakers

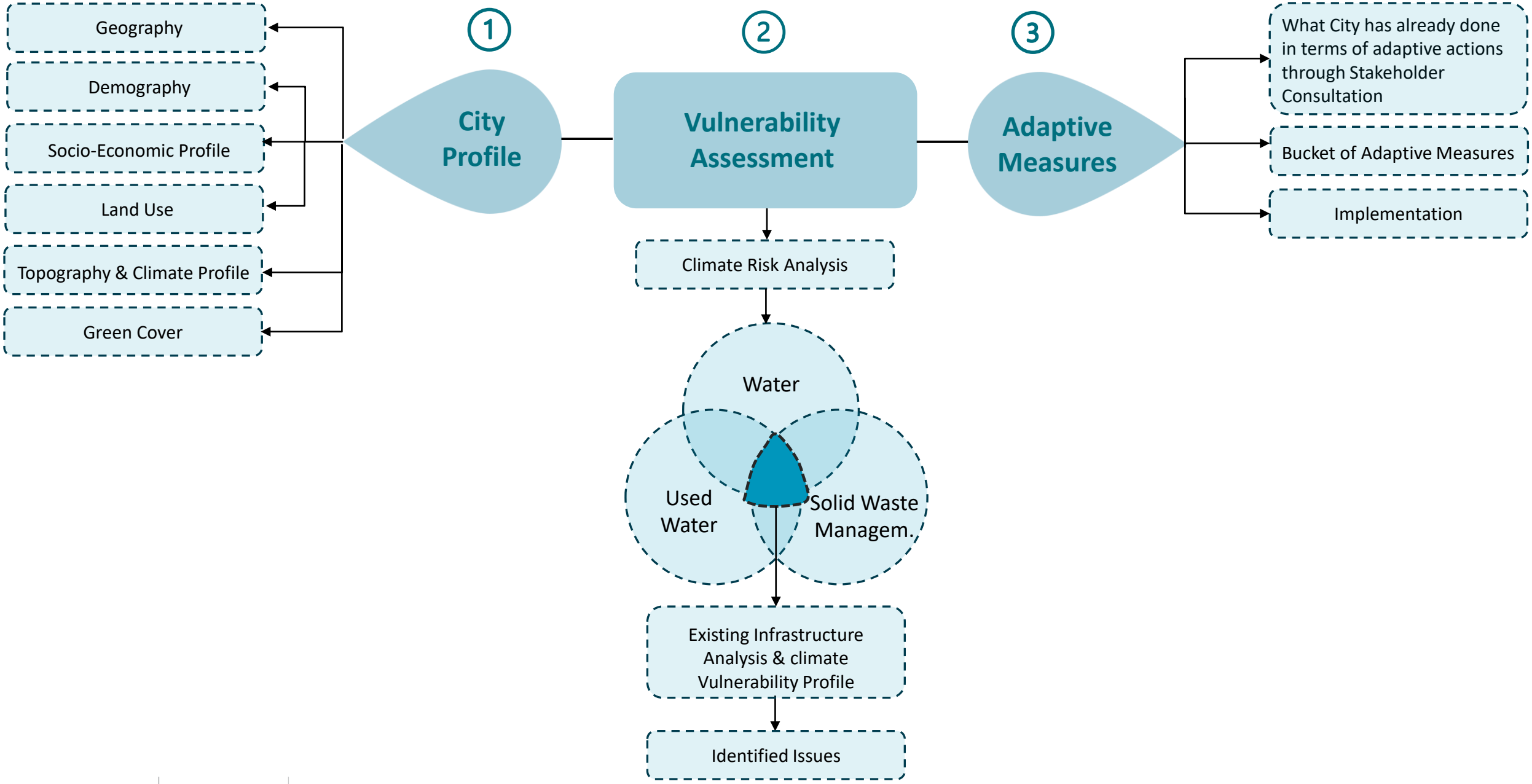
Types of vulnerability assessment frameworks

Vulnerability Assessment Framework

ARUP Climate Resilient Index	The Index will measure relative performance over time rather than a comparison between cities. It will provide an everyday basis for measurement and assessment to facilitate dialogue and knowledge sharing between cities.
Climate Change Risk Assessment (CCRA)	Help cities improve their performance standards according to some of the international guidelines in creating green, sustainable and resilient urban habitats.
The Climate Risk and Vulnerability Assessment (CRVA)	It uses tools like TEMPERATE to display city-specific potential future climate hazards. The CRVA aims to align adaptation plans
A Framework for Climate Change Vulnerability Assessments (By GIZ)	This framework was prepared to provide decision makers and adaptation implementers such as (local) government officials, development experts, civil society representatives with a structured

Source: ARUP - The Rockefeller Foundation, C40, ICLEI South Asia, GIZ

Framework for Small/Medium Town



Source: Author

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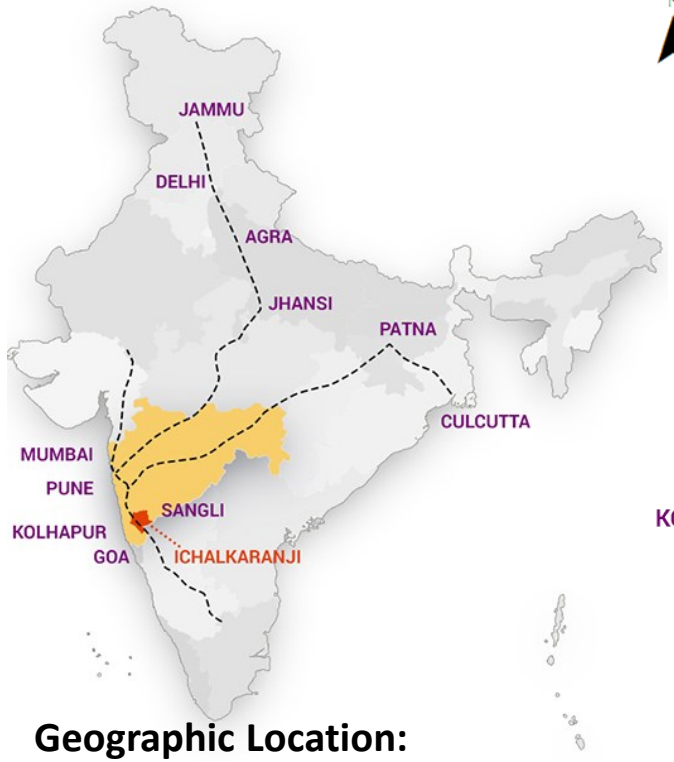
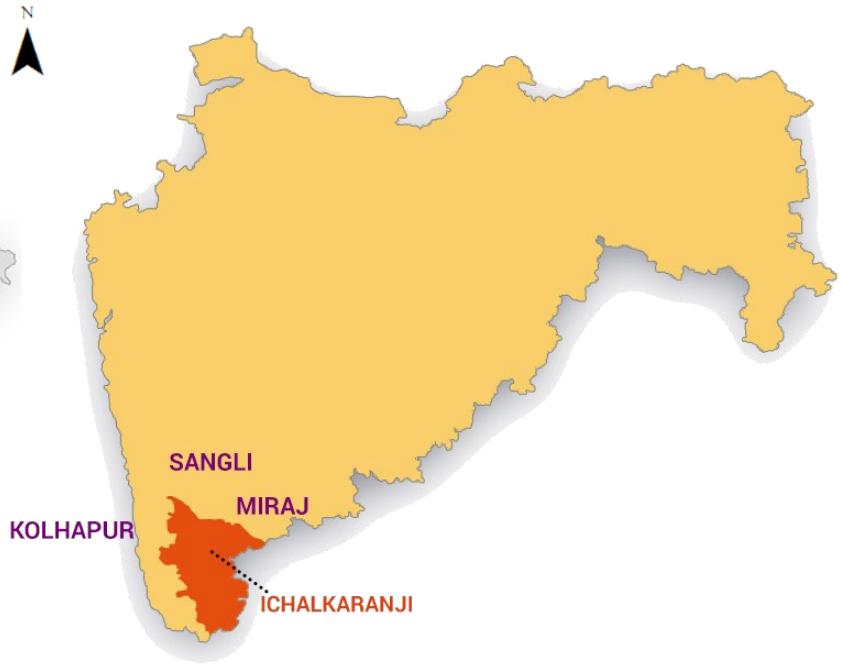
About Ichalkaranji





Geographic Location:

29 km east of Kolhapur

10 km south-east of Hatkanangale railway station

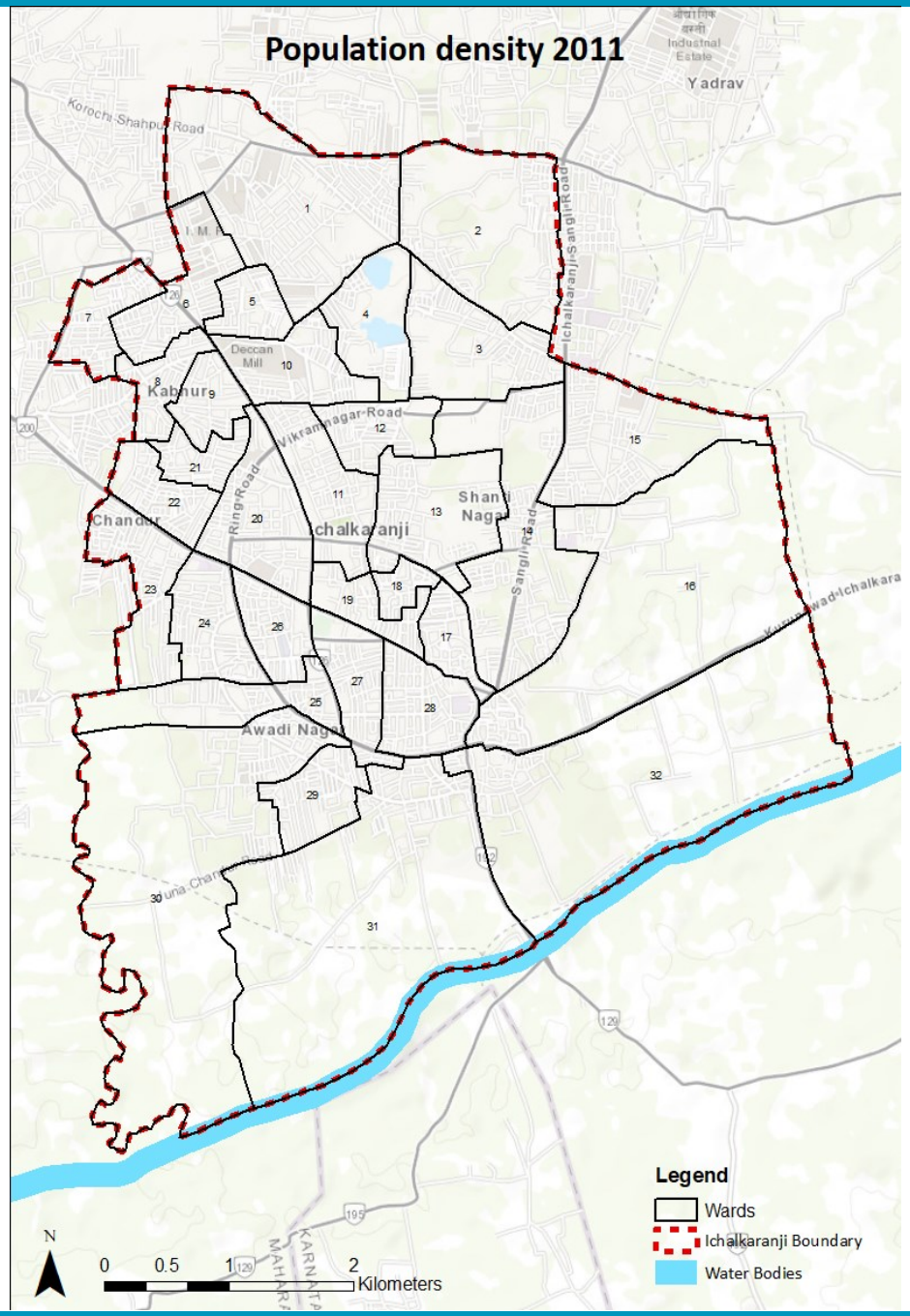
3,70,000
Population (2021-22)

29.84
Area (sq. Km)

67,813
Households (2021)

12,299 per square mile
Population Density

31
Wards



CWAS CENTER FOR WATER AND SANITATION | CRDF | CEPT UNIVERSITY

Source: Map - DKTE Society's, Textile and Engi. Institute, Ichalkaranji, IMC

Geology

Ichalkaranji lies in the Panchganga valley with its slope towards South East direction.

The city's average elevation is **538 meters (1,768 feet)** above sea level.

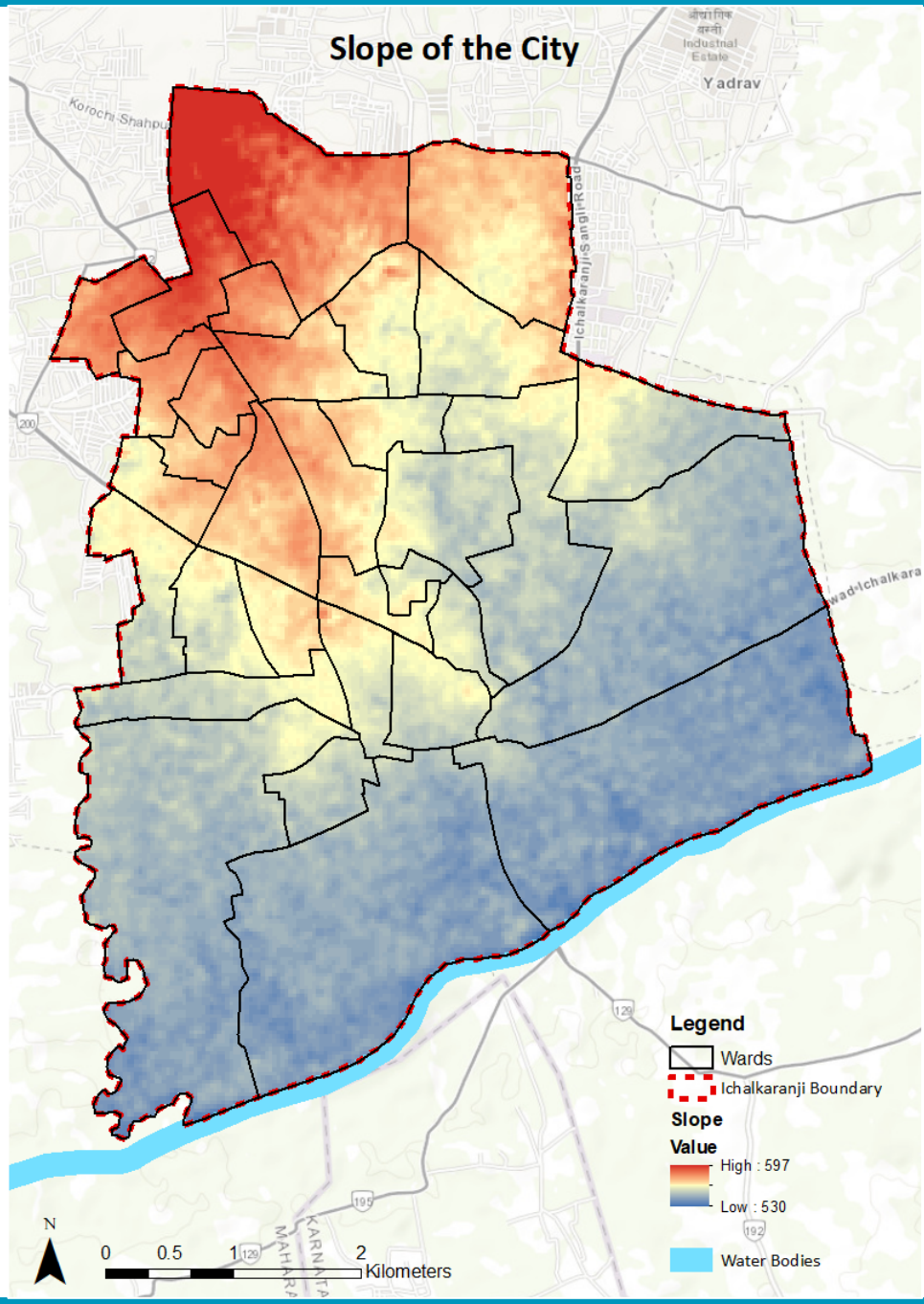
Climate

The climate of the district is characterized as general dryness except during southwest monsoon season.

The average ambient temperature remains **24.8°C**, and varies from 12.8°C to 38°C. The average relative humidity remains around 71.8%, and varies from 22.1% to 98.9%.

Rainfall

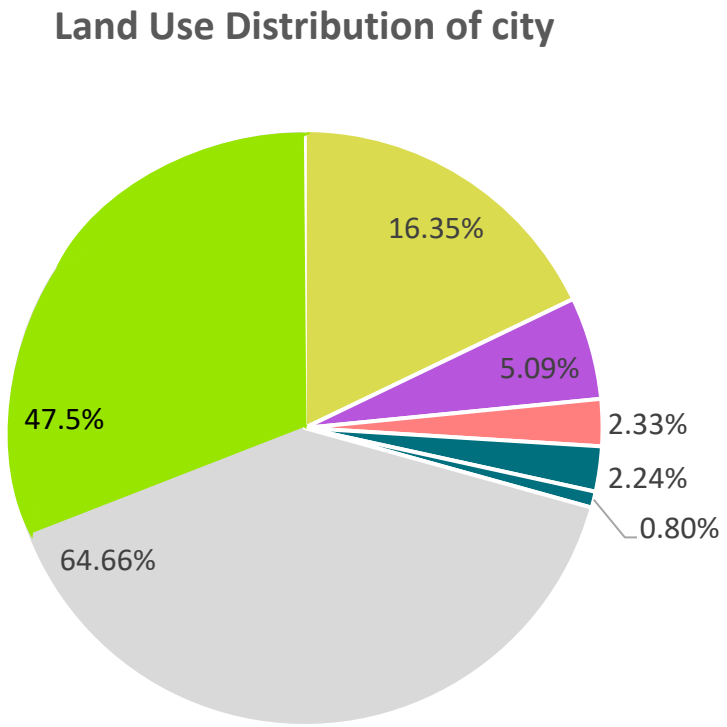
The annual average rainfall for Ichalkranji (Kolhapur District) is **1239 mm.**

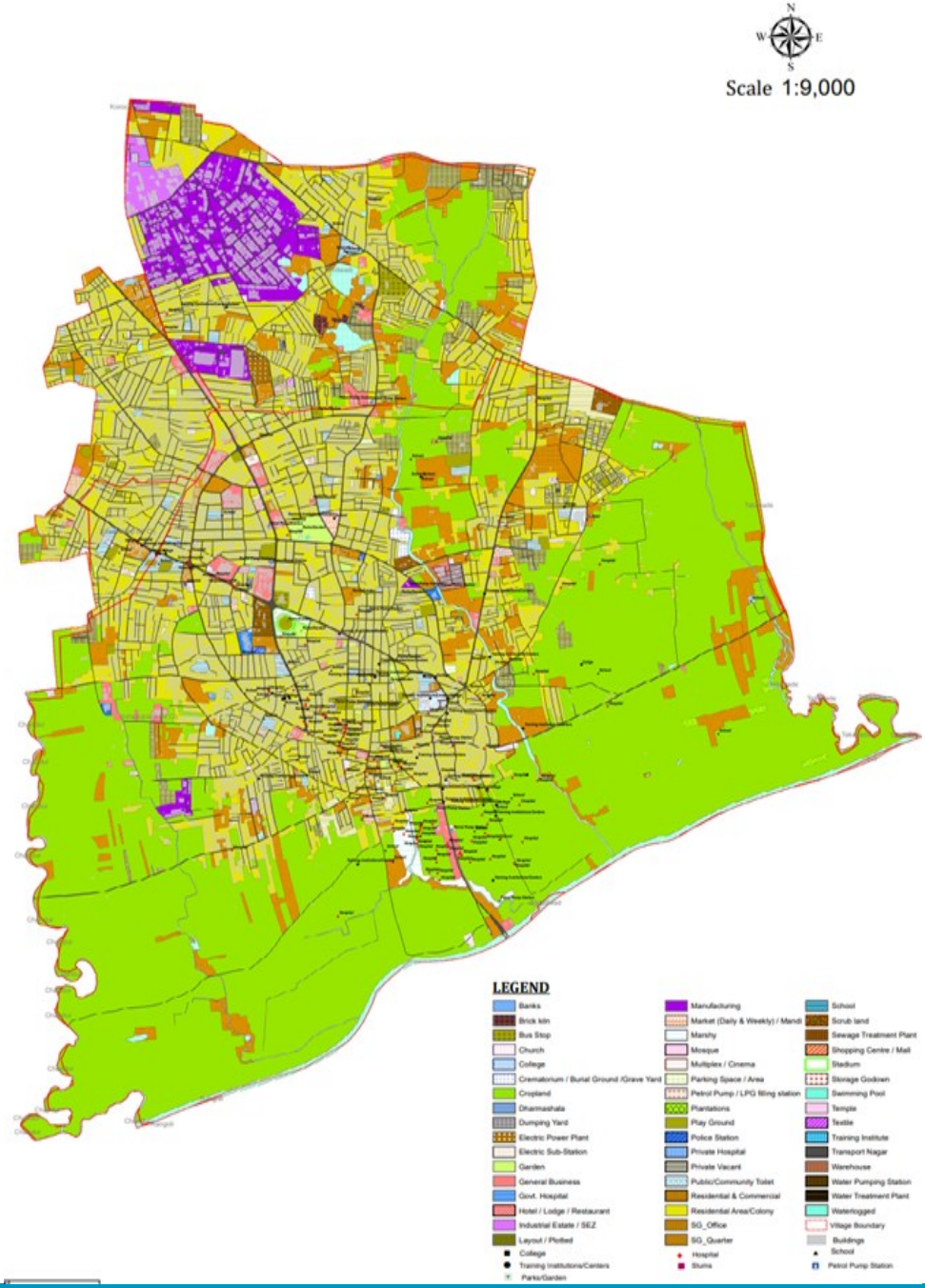


Source: CWAS. IMC Primary data Collection, SLB-PAS 2022

Land use Plan

- Currently in city there is 60% of developed area and 40% of undeveloped area.





Source: IMC & CWAS Primary Data Collection

Green cover in the city has Increased in last decade.

Total trees

173 thousand trees

Open space

29 spaces

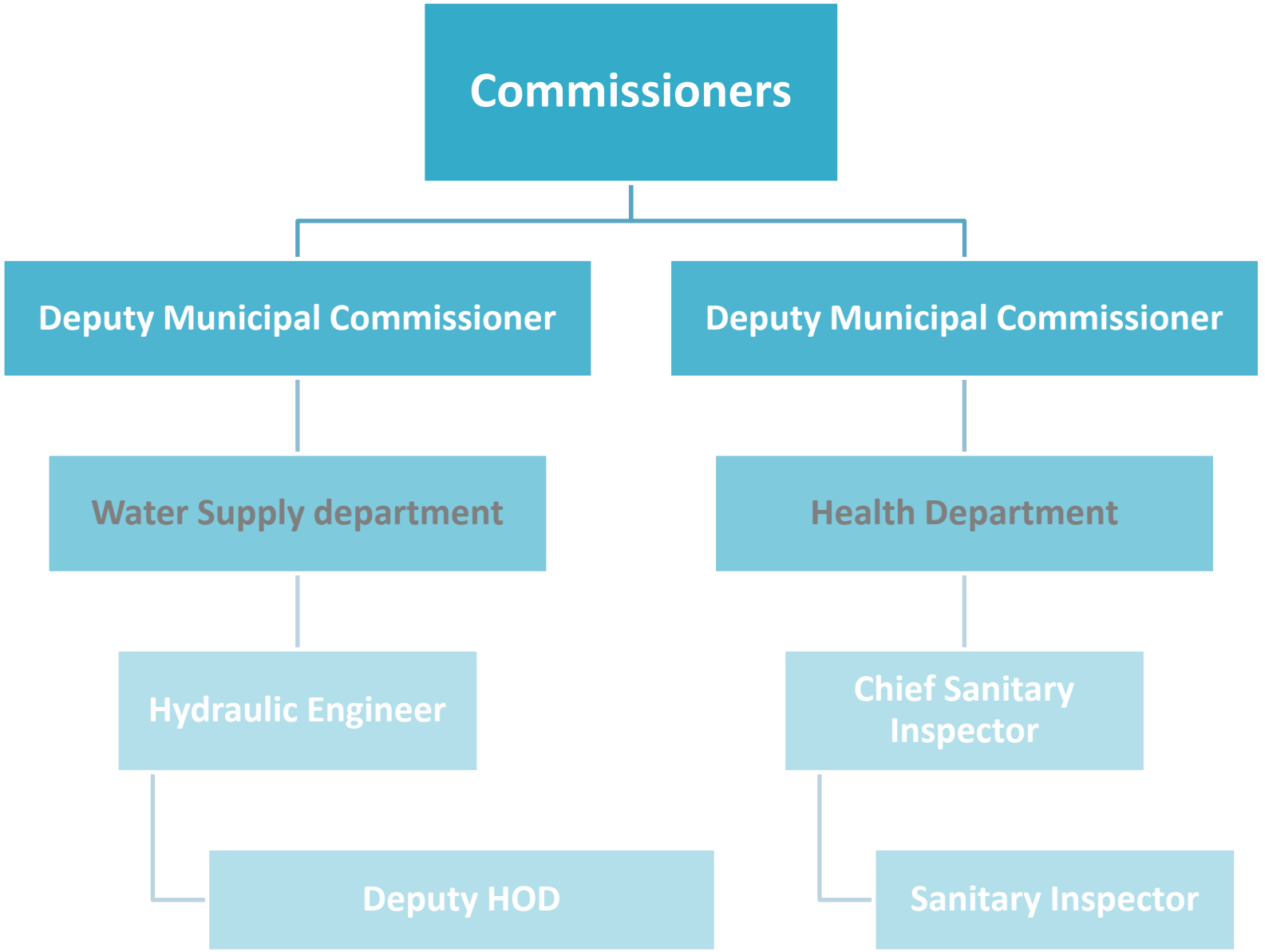
0.23 sq.km

Carbon sink

4.34 Million t Co2/year

Source: Author, April 2024

Organogram of Ichalkaranji Municipal Corporation



Source: IMC Organogram

Slum Profile

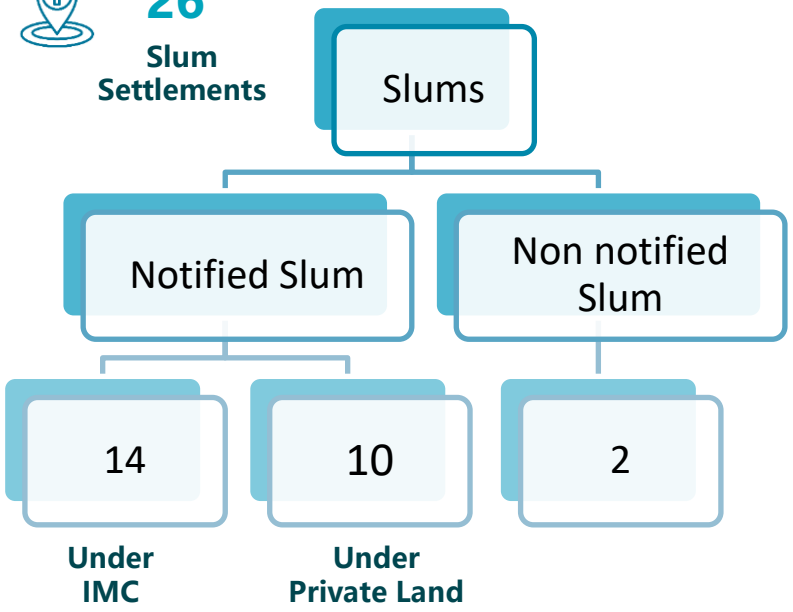
28,171
Slum Population (2021)

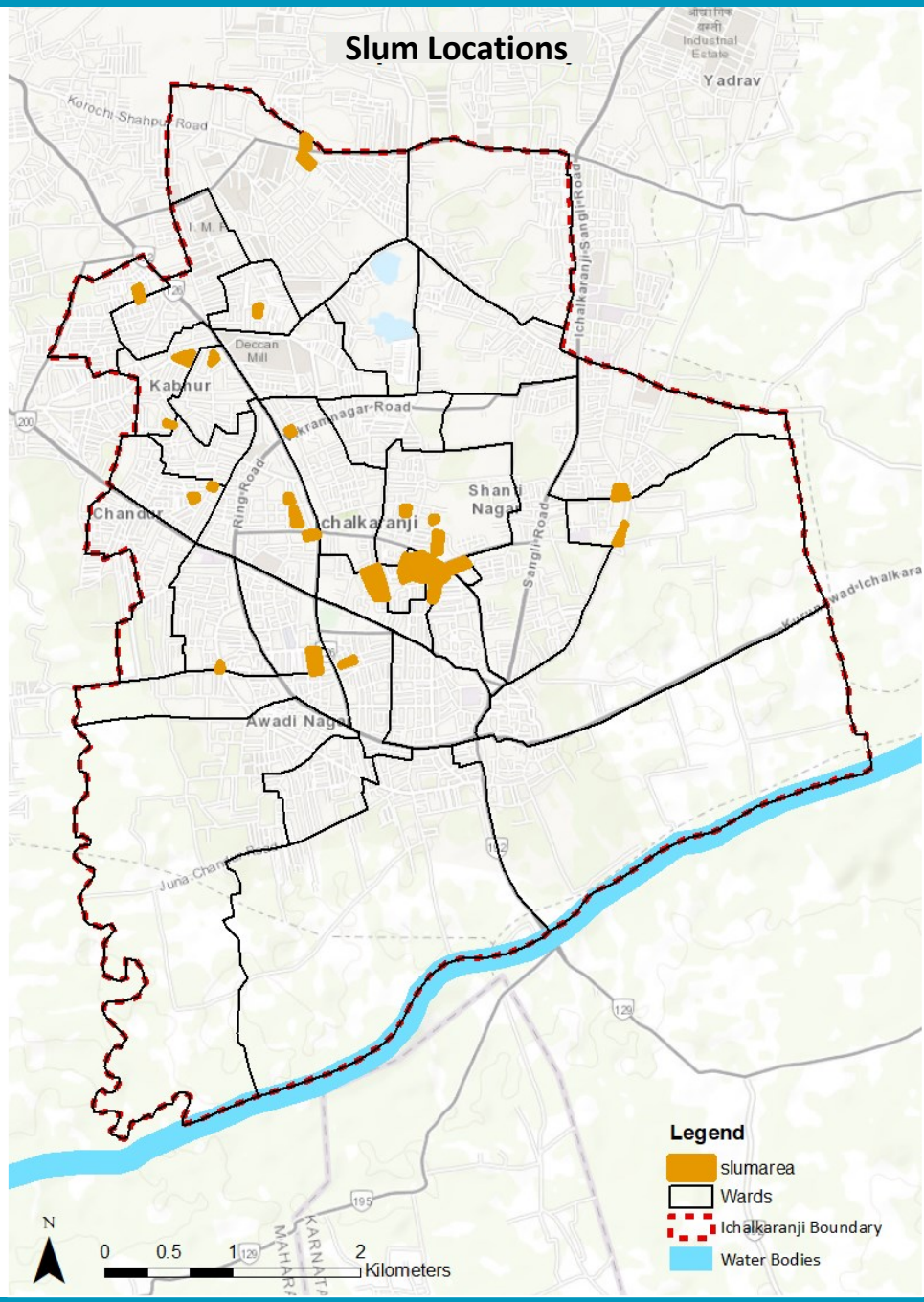
9.7 %
Of the City population

4047
Slum Households (2021)

- There are totally 29 slums in Ichalkaranji city, and the total population is around 3,68,916 which **is 9.79% of city population**.

26
Slum Settlements





Source: Map- Author, CWAS & Primary data collection

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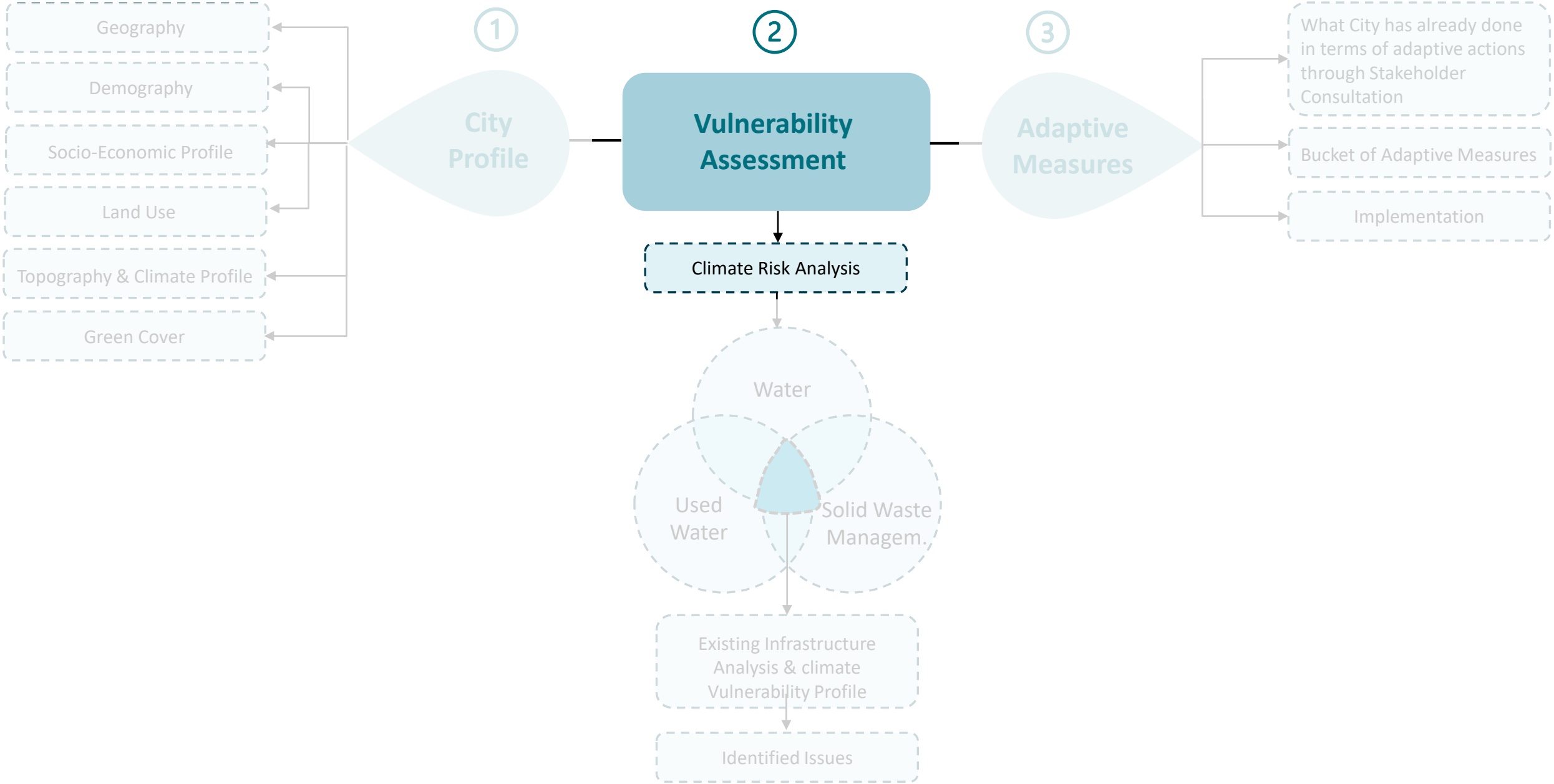


Source: Author

Indicators used to analyze Exposure of Climate risk

Sr.No.	Indicator	Methodology	Data Used	Data Source
1	History of climate related hazards in Ichalkaranji/Kolhapur district	Yearly matrix of events happned in the past 20 Years	Yearly and event based data	Disaster Management Kolhapur, News, Reports, Articles
2	Rainfall Trend and Extreme Rainfall Scenario	Analysis of annual rainfall and rainy days trends, intensity, and frequency of extreme rainfall events.	Daily and yearly rainfall data from 1970 to 2020.	IMD Pune
3	Air Temperature Trend	Historic trend analysis of annual air temperature (including minimum, mean, and maximum temperature)	Daily and yearly air temperature data from 1970 to 2020	IMD Pune
4	LST Analysis	Temporal analysis (pixel-based statistical analysis) of satellite imagery for day times for years 2013, 2018, and 2023 was conducted to understand the trend of LST. LST hotspots were identified. Hotspot areas with consistently higher land surface temperature as compared with median temperature above 37°C were considered.	Satellite imagery from May 2013, May 2018, and May 2023 (May 2023 – day time analysis considered for hotspot identification)	Day time Surface Temperature: 30X30m resolution LandSat8 image

Source: Author & CDP - Climate Risk And Vulnerability Assessment - Training guide for cities

In the past decade problems like heatwaves has emerged!

History of climate related hazards in Ichalkaranji/Kolhapur district

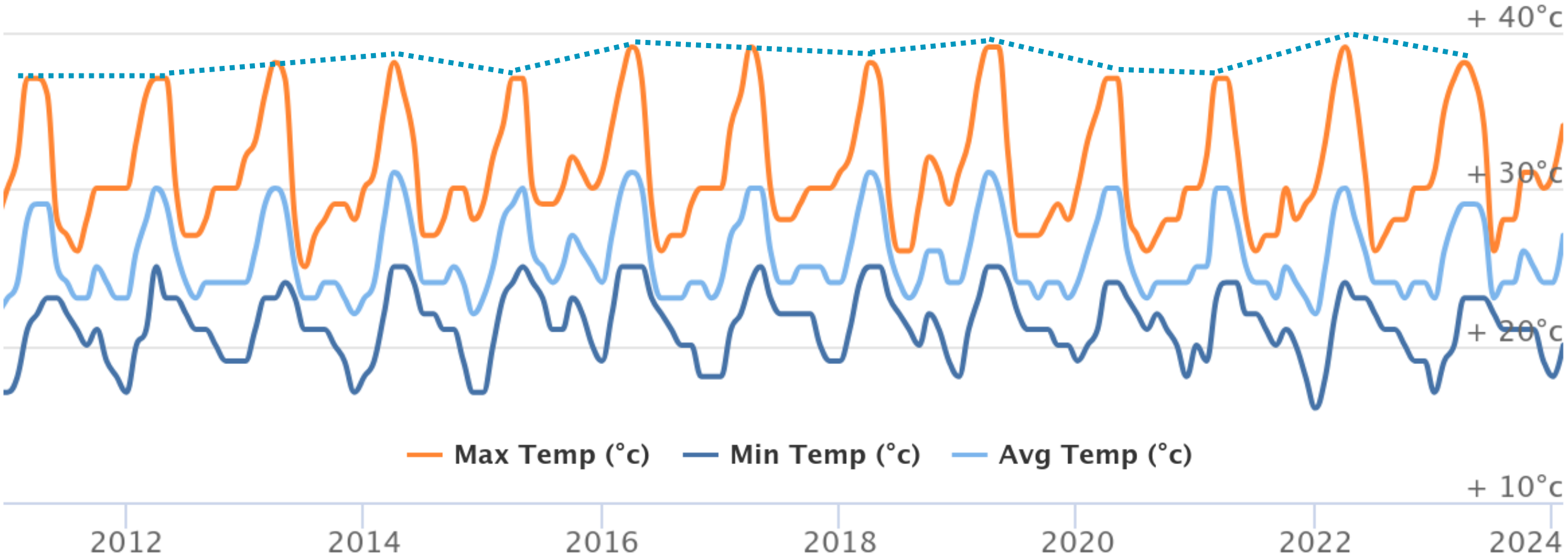
Hazard	Year																			
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Flood																				
Heat Wave																				

- Previous year flooding 1983, 1989.

Source: WorldWeatherOnline.com, Maharashtra State Adaptation Action Plan on Climate Change -MSAAP

In the past decade problems like heatwaves has emerged!

Maximum Minimum and Average Air Temperature (2011-2023)



Temperature has increased by **1.2°C** in past decade and summers are becoming warmer.

As per MSAAPC, Projected increase in minimum temperature in 2030s is **1.15-1.28 ºC** relative to **25.22 ºC annual mean temp.**

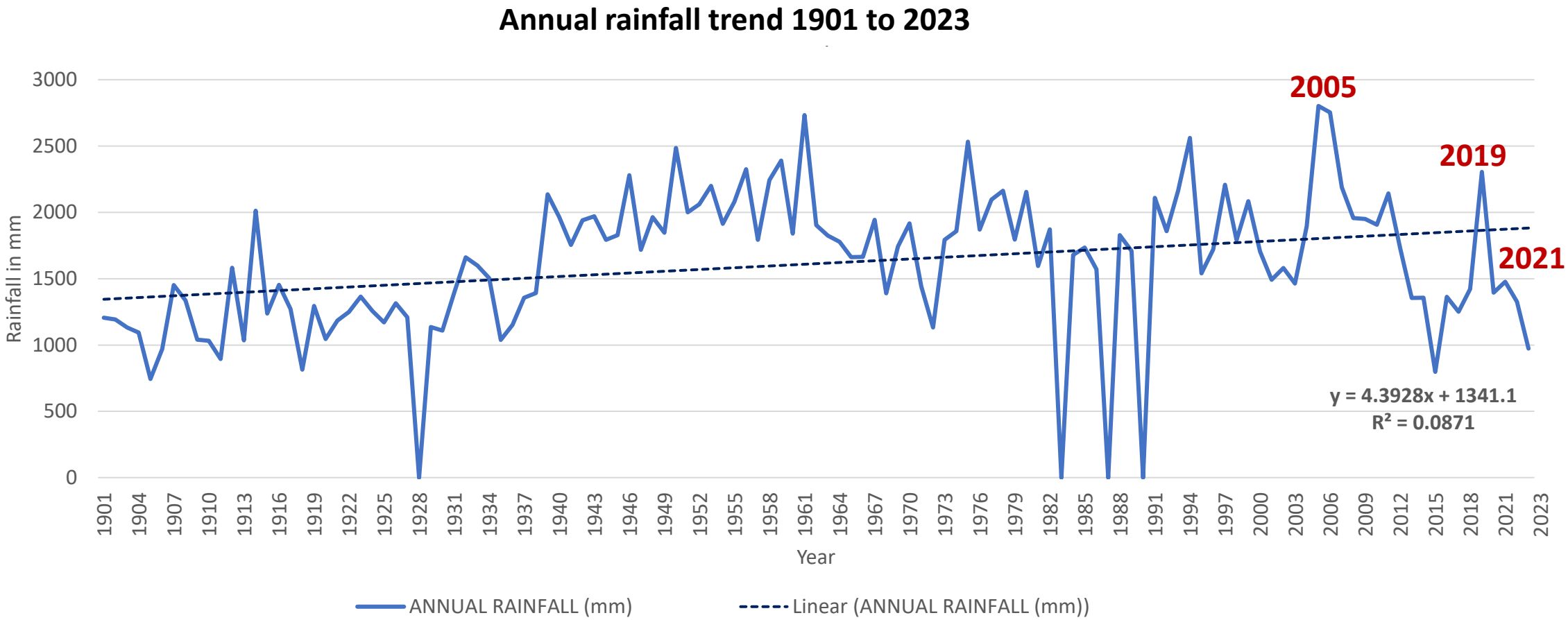
Source: WorldWeatherOnline.com, Maharashtra State Adaptation Action Plan on Climate Change -MSAAP

Impact on Land Surface Temperature!

Over the past decade, development and construction of concrete structures have led to increased land surface temperatures, with heat becoming trapped in urban areas.

Source: Author, March 2024

Increasing Rainfall Intensity

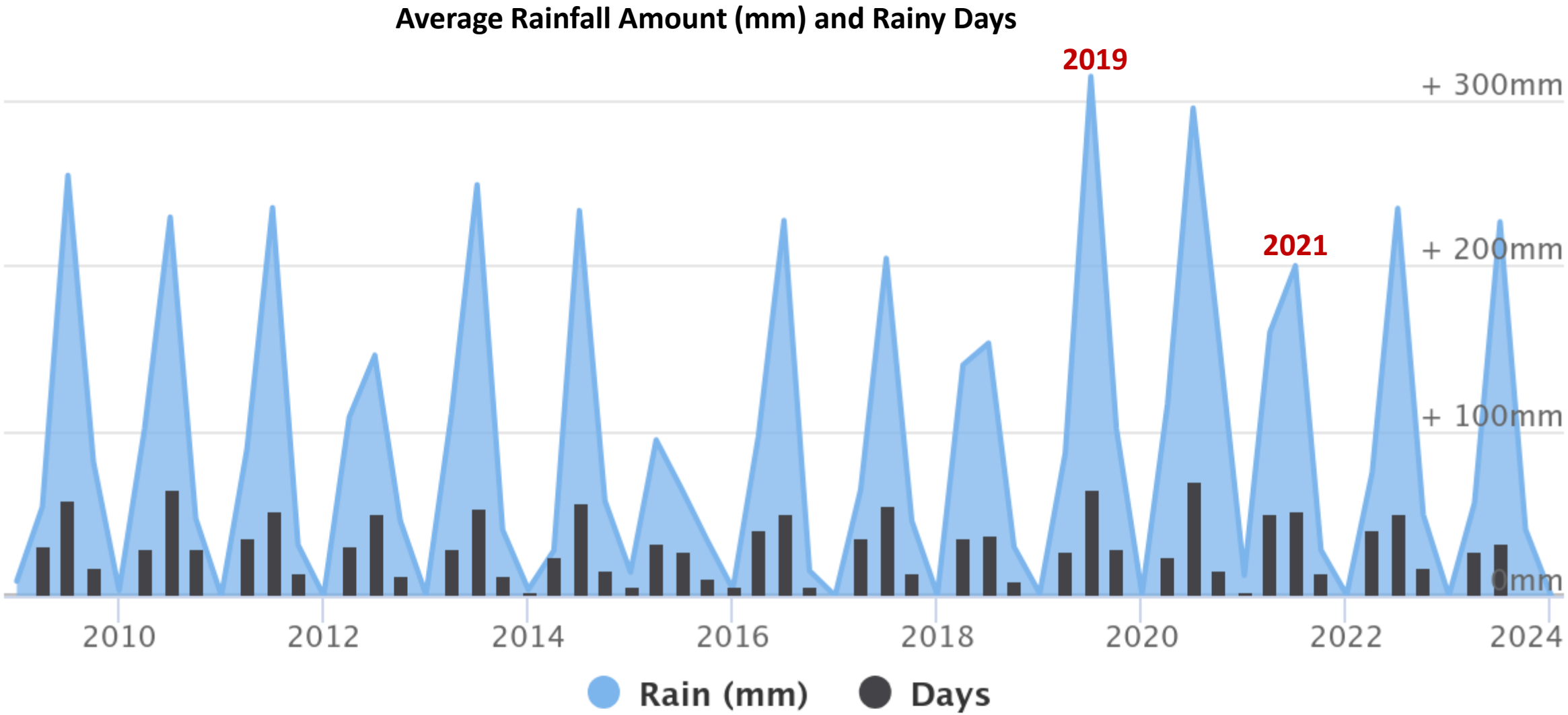


Average annual rainfall is increased by 4.4 mm per Year from 1901 to 2023

Major Recent Flood years – 2005, 2019, 2021

Source: WorldWeatherOnline.com & IMD Pune, Maharain.com

Increasing rainfall intensity!



Number of rainy days are decreasing, but the intensity of rainfall is increasing.

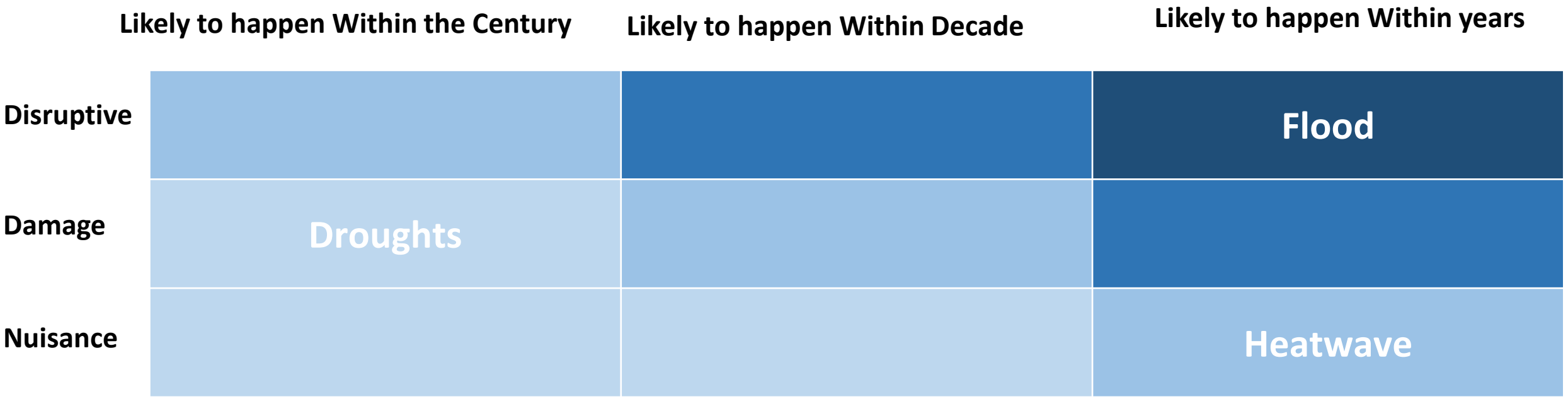
Major Recent Flood years – 2005, 2019, 2021

Source: WorldWeatherOnline.com

Risk Analysis:
Risk = Probability x Severity

Methodology :
Quantitative & Qualitative

Outcome:
Prioritise the Hazard Exposer

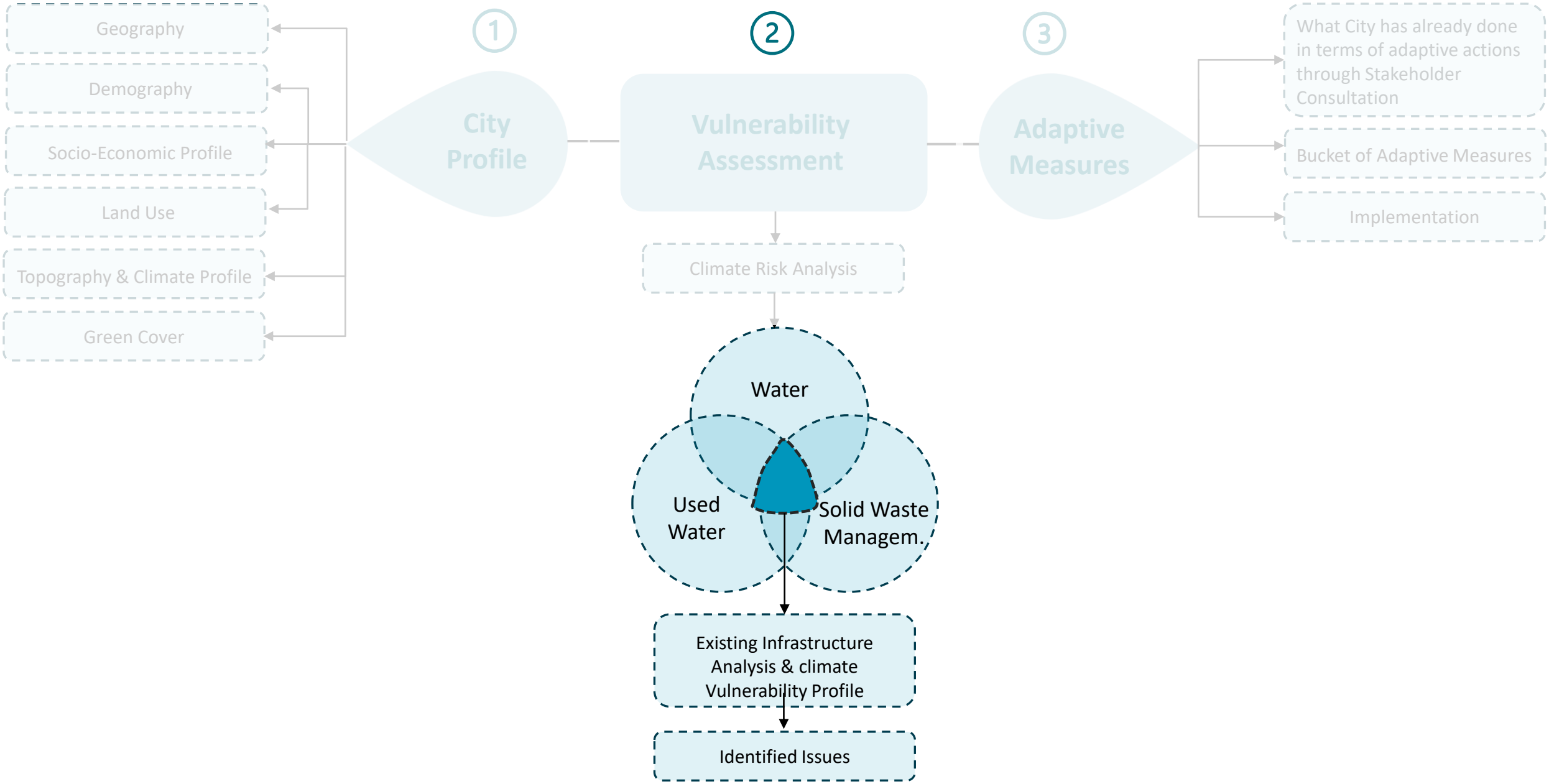


- It becomes more exposed and vulnerable when cause of flood is due to natural calamity, dependent on upstream rainfall as well.

- Note: City has No early warning system.

Source: CDP - Climate Risk And Vulnerability Assessment - Training guide for cities

About the Framework



Source: Author

In context of Water Supply & Climate Change

IMC
45 MLD Surface Water Supply
3 MLD On Bore well

8 Pvt. Water Tanker

16 ESR

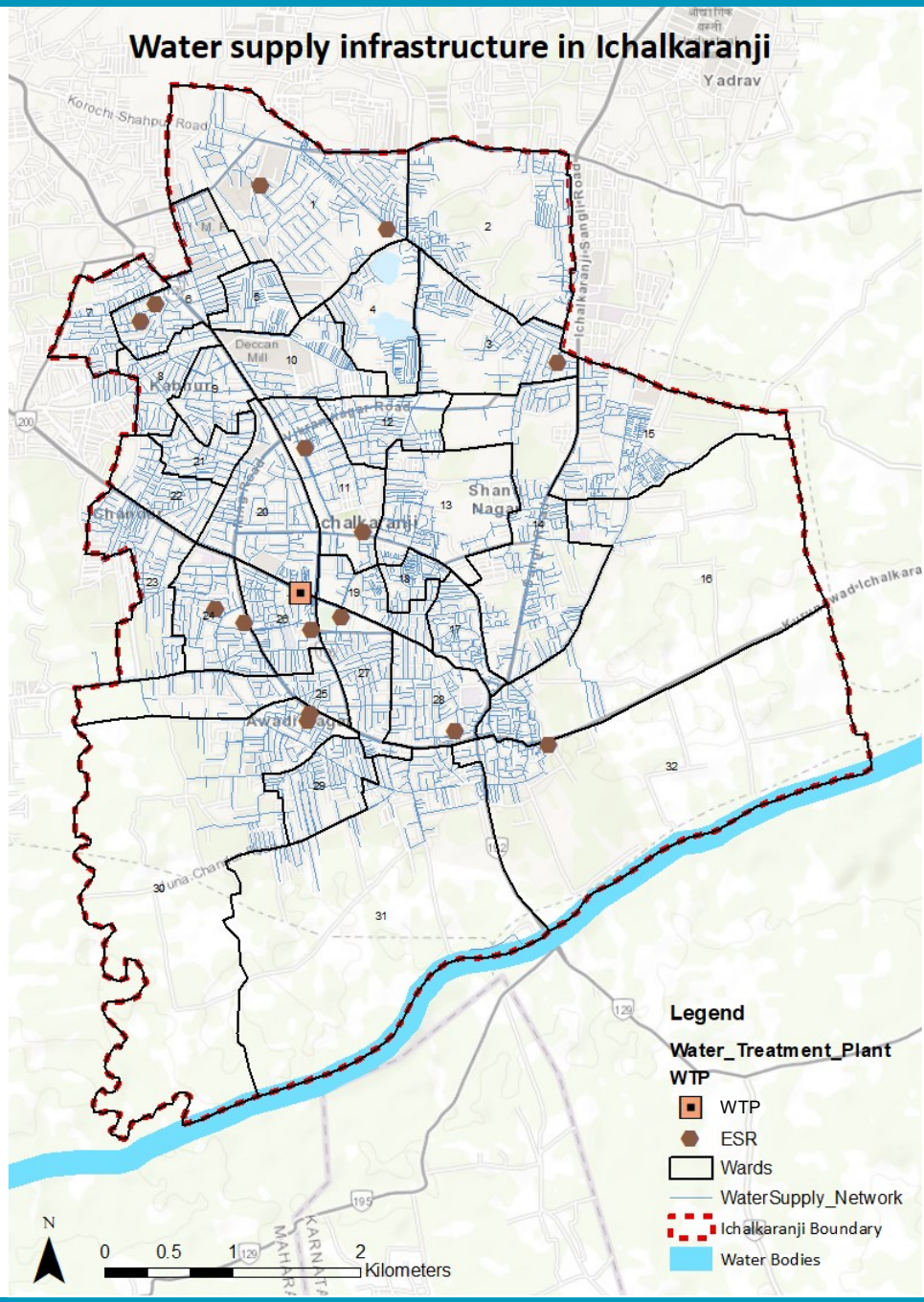
Pipeline Network: **488 Km**
Area Covered **: 28.9 Sq.km.**

Water Extraction Source → Treatment → Storage → Distribution → User End

Total Installed Capacity : **108 MLD**
Utilization : **45 MLD**

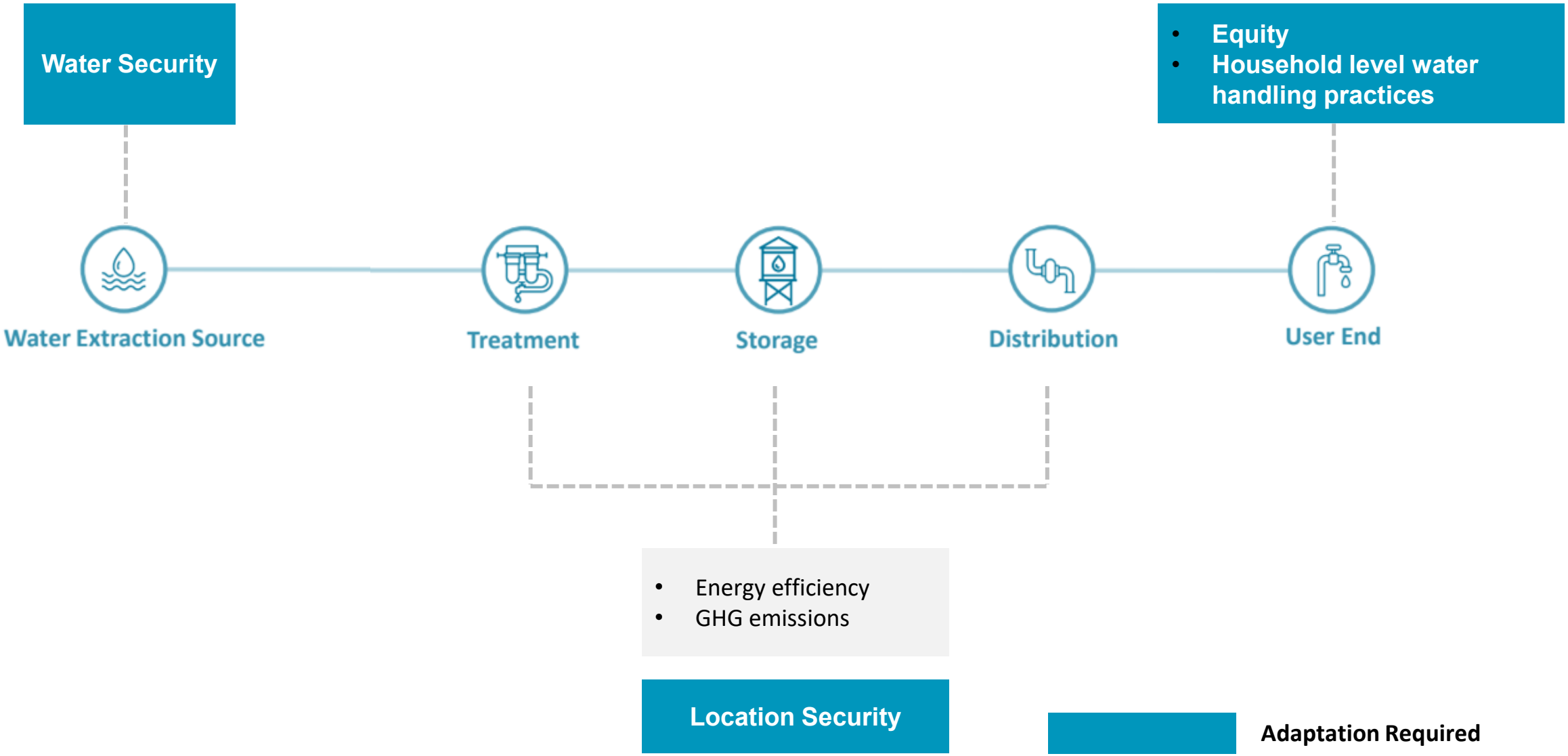
Total no. of connections in : **53448**
Individual connections **In Slums**: **714**
No of Functional Stand Post **In Slums** : **80**

101 LPCD
1.5 Hrs Alternate Day
Connections Coverage**: 77%**



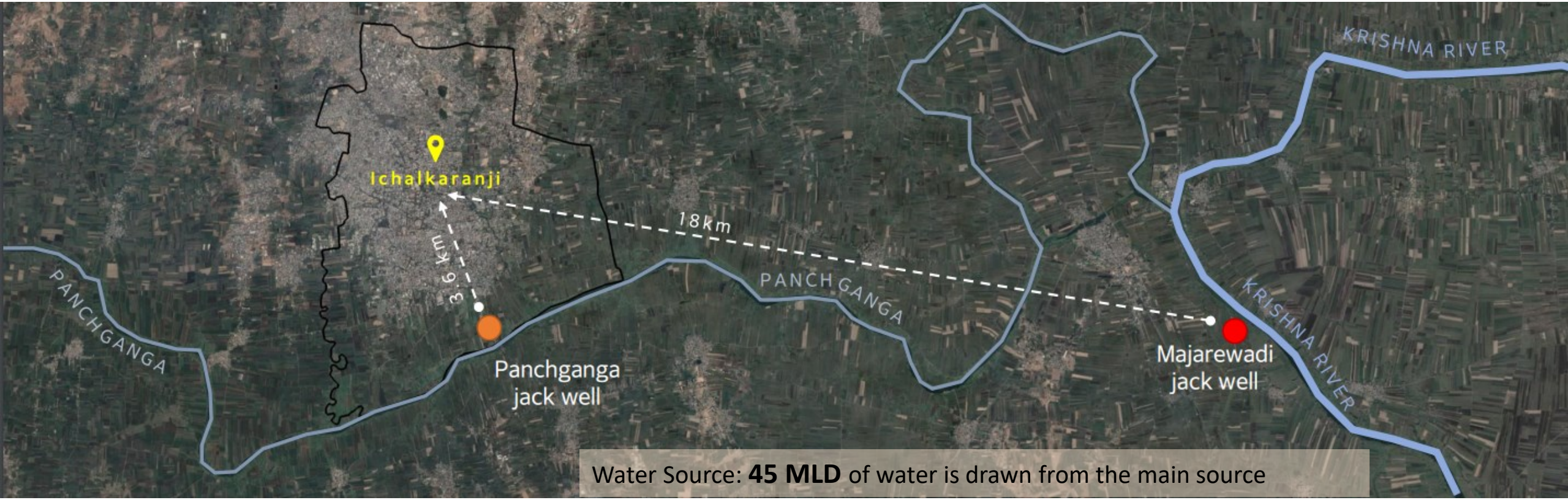
Source: CWAS. IMC Primary data Collection, SLB-PAS 2022

Issues in Water Sector from Climate Perspective

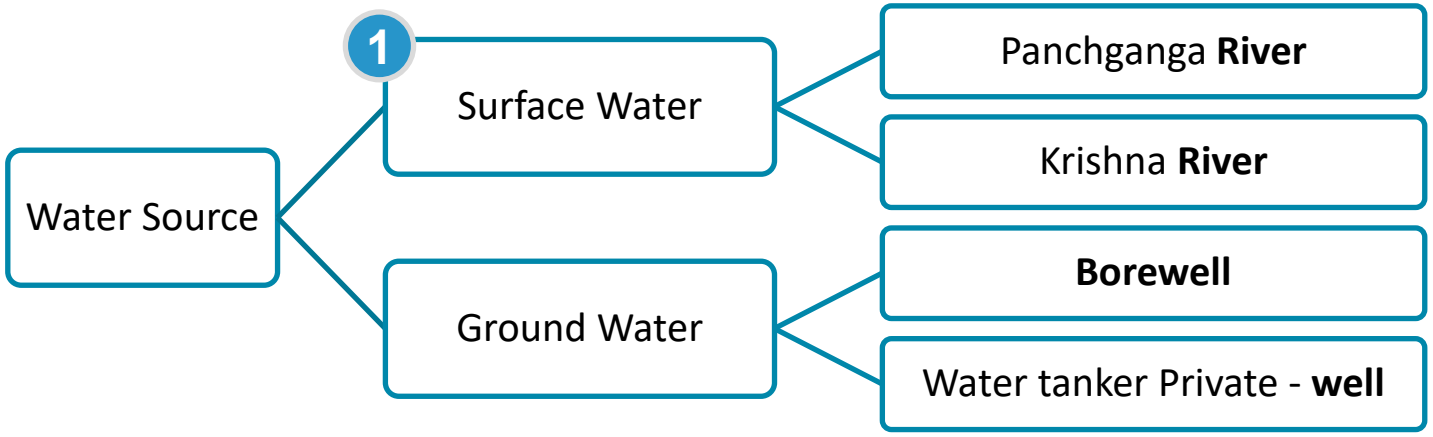


Source: Author

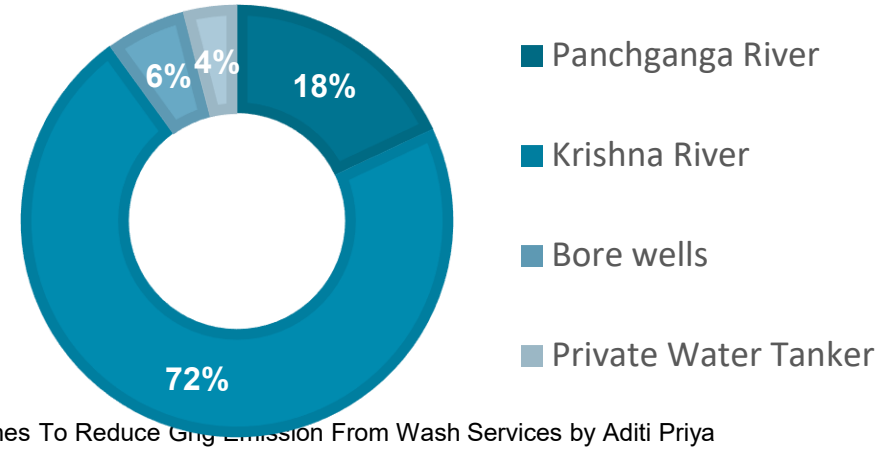
Source of Water supply



Water Source: **45 MLD** of water is drawn from the main source



Quantity of Water drawn from each Source



Source: CWAS. IMC Primary data Collection, SLB-PAS 2022, Map: Approaches To Reduce Ghg Emission From Wash Services by Aditi Priya

Ground water dependency - Borewells

- Water Source
  - Surface Water
    - Panchganga **River**
    - Krishna **River**
  - 2 **Ground Water**
    - **Borewell**
    - Water tanker Private - **well**

More than **900-1000** borewells in the city

15-18 MLD
Per day Water Extraction from borewells

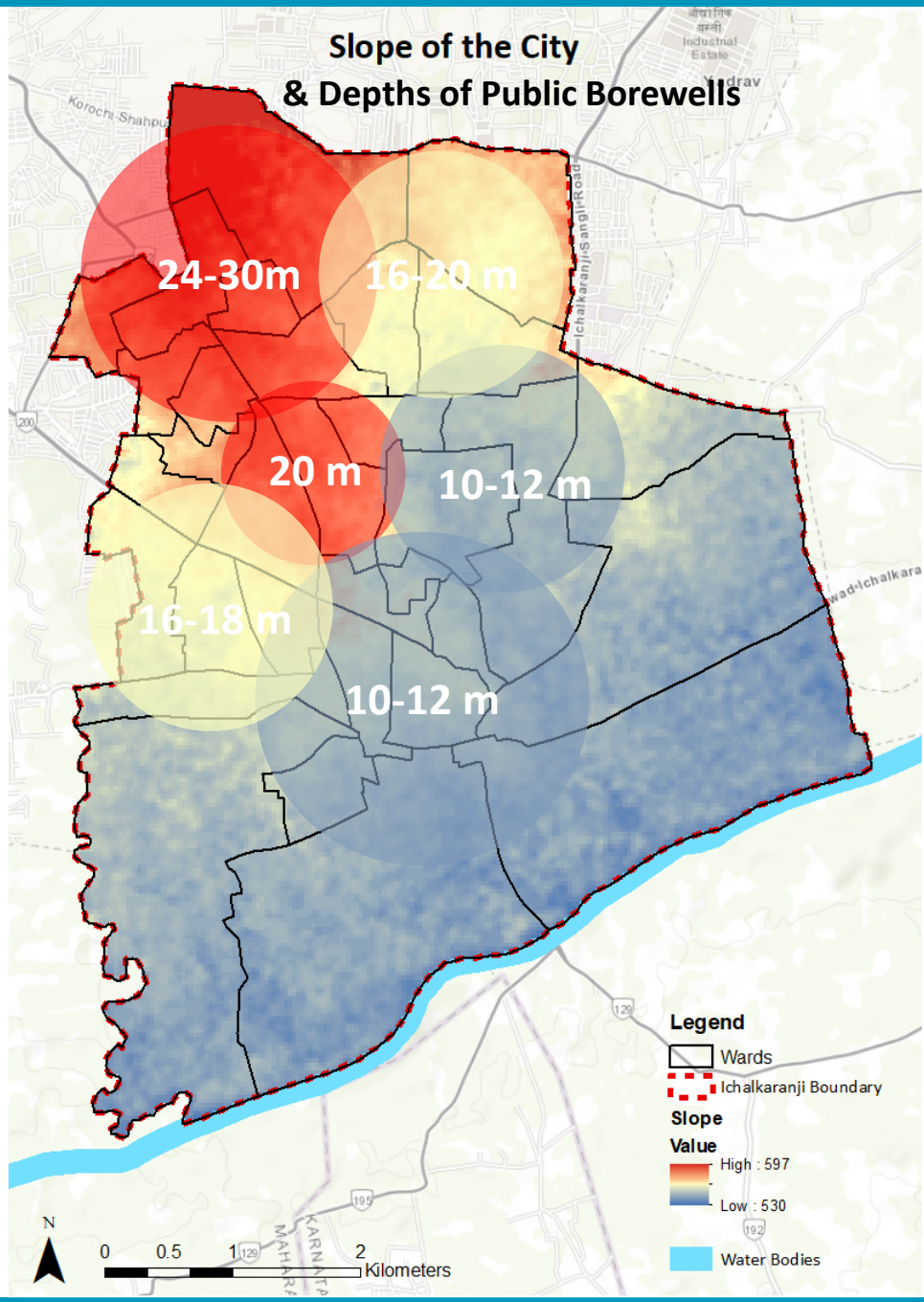
700
Public Borewells

3 MLD
Extraction by IMC

300
Borewells
Private Borewells
8 pvt. Tanker Water supplier

12 MLD
Extraction by Textile Industries

3 MLD
Private Tankers & Individual



Source: IMC Primary data & Kolhapur Ground water Department report

Ground water dependency - Borewells

- Water Source
  - Surface Water
    - Panchganga **River**
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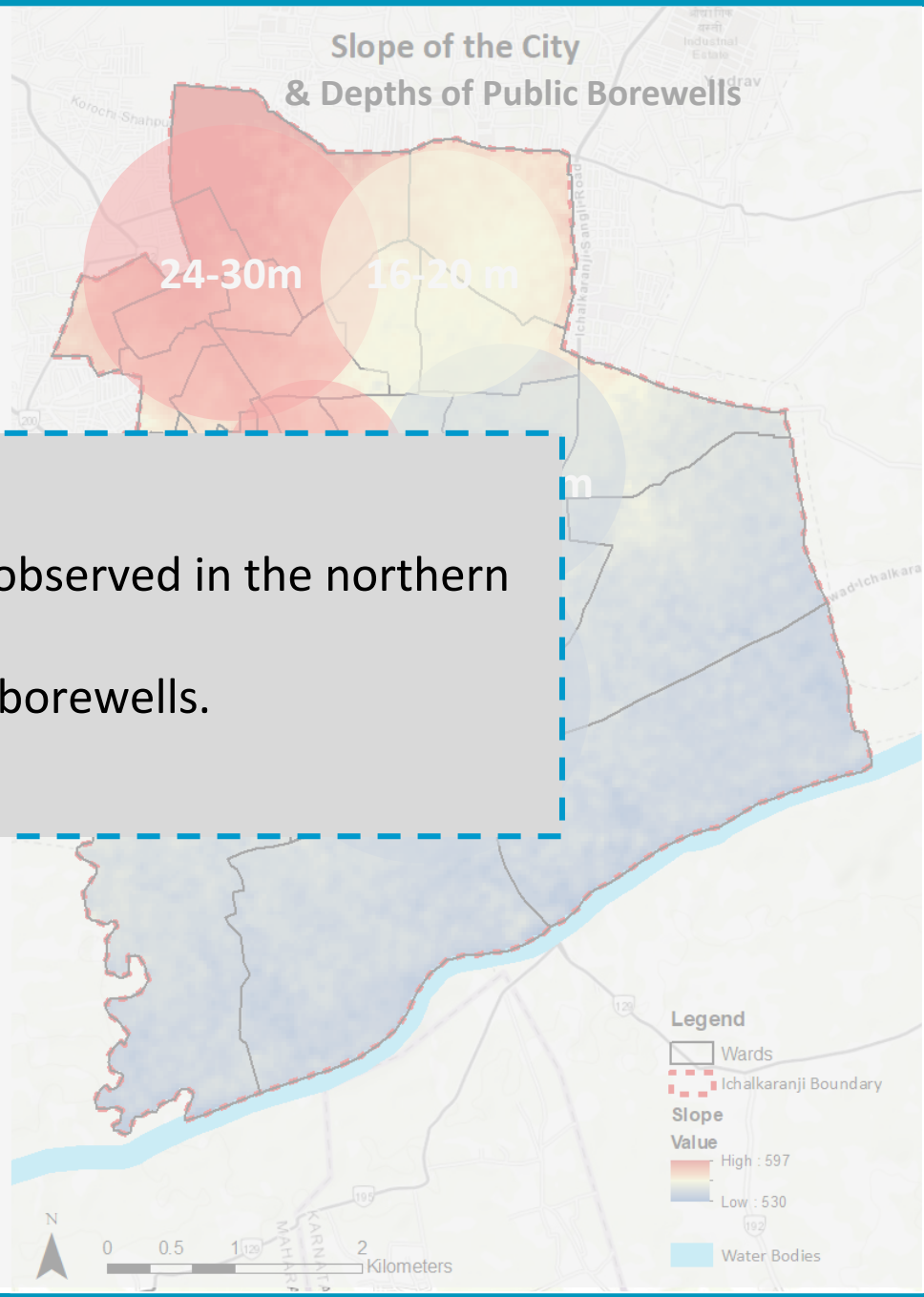


Issues

- In last decade, 4-6 m increase in depth of borewell is observed in the northern part of the city.
- No permission or restrictions on setting up of private borewells.
- No Recharge structures in the city

More tha
borewe

Public Borewells

300

Borewells

Private Borewells

8 pvt. Tanker Water supplier

Extraction by IMC

12 MLD

Extraction by Textile Industries

3 MLD

Private Tankers & Individual

Source: IMC Primary data & Kolhapur Ground water Department report

In context of Water Supply & Climate Change

69000
Households (2021)

77%
Total 53448 no. of HHs connections

74%
Water supply Connection Coverage

101 lpcd
Per Capita water Supply

Once in 2-3 Days
Once in 4 Days – In Summer
Frequency of water Supply

1.5 – 3 hrs
Duration of water supply

Issue:

- Poor services levels get reflected in lower cost recovery & collection efficiency for water supply services. There is high loss of water during transmission and this is a major concern.

Per capita expense – 572 Rs.

Per capita revenue – 303 Rs.

Avg. revenue per connection – 2084 Rs.

53 %
Cost Recovery

Source: CWAS. IMC Primary data Collection, SLB-PAS 2022

Service & Accessibility

69000
Households (2021)

77%
Total 53448 no. of connections

4047
Slum Households (2021)

17%
Individual water connections in slums : 714

80
No of Functional Stand Post in slum

3327 Slum HHs are Dependent

Issue

- Only 17% slum population has privilege of water connection.

CWAS CENTER FOR WATER AND SANITATION | CRDF | CEPT UNIVERSITY

Source: CWAS. IMC Primary data Collection, SLB-PAS 2022

In context of Water supply Service & Floods

Impact on Infrastructure and Facilities

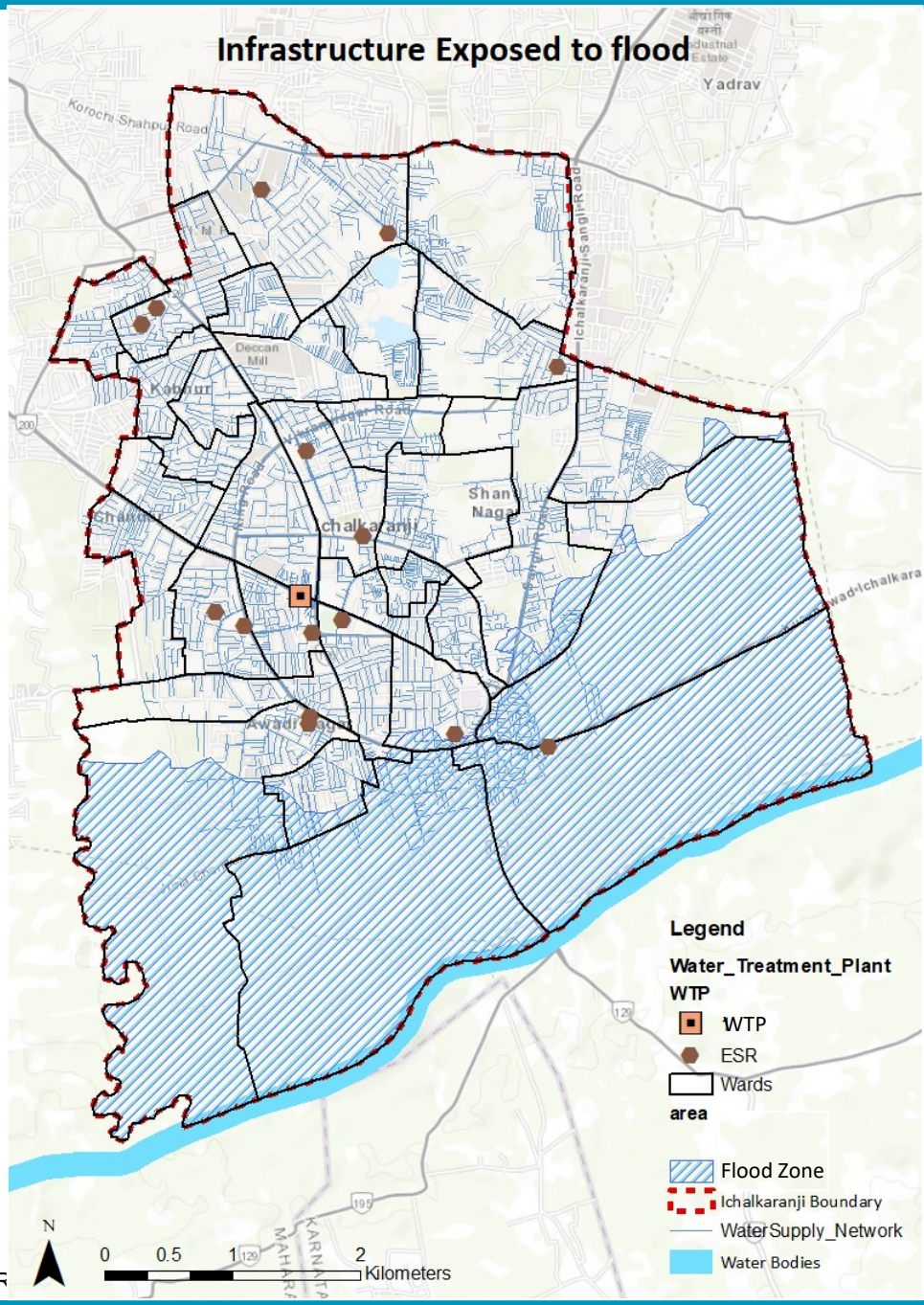
Facilities are weakened, less efficient and damaged: flooded wells, silting, flooded electrical equipment, erosion of facilities, weakened and burst pipes causing network leakages, etc.

Impact on Service Quality

Service interruptions due to damaged facilities.

Water quality declines due to increased **pollution** and higher **turbidity** from soil leaching and flooded sanitation facilities.

Water points are **inaccessible**



Source: CWAS. pS-Eau- WASH Services and Climate Change Impacts and R

Existing Used Water Management System

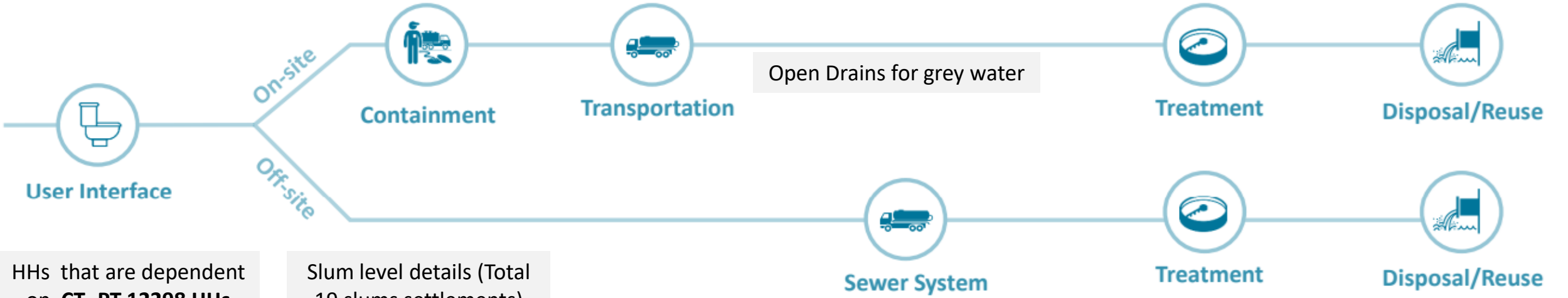
HHs dependent on **IHHTs 41203 HHs (77 %)**

HHs connected to septic tanks – **32285 HHs (59.6%)**
HHs connected to sewer network – **21869 HHs (40.4%)**

ULB has **1 desludging truck** of **4000 L capacity**; one private operator with **1 Nos. of Truck of 3000 Lit.** capacity. Desludging Charges **Rs. 700** per trip within city boundary and **Rs. 2000** outside the city boundary. Irregular desludging, emptied only when full **once in**

Co Treatment of septage at STP

Disposed at SWM site, No reuse plan



Open Drains for grey water

HHs that are dependent on **CT- PT 12298 HHs (23 %)**

Slum level details HHs dependent on **IHHTs : 3250 HHs (77 %) HHs** Dependent on **CT- PT : 919 HHs (23 %)**

Slum level details (Total 19 slums settlements)

12 slums with 2556 HHs connected to sewerage network

Remaining **694 HHs** in slum connected to Septic Tanks

Underground sewage system

The existing Sewage Treatment Plant of **20 MLD is operational.**
18 MLD STP under construction.
Manual log-books for monitoring FS loads

The treated wastewater from STP is reused by the farmers at downstream area.

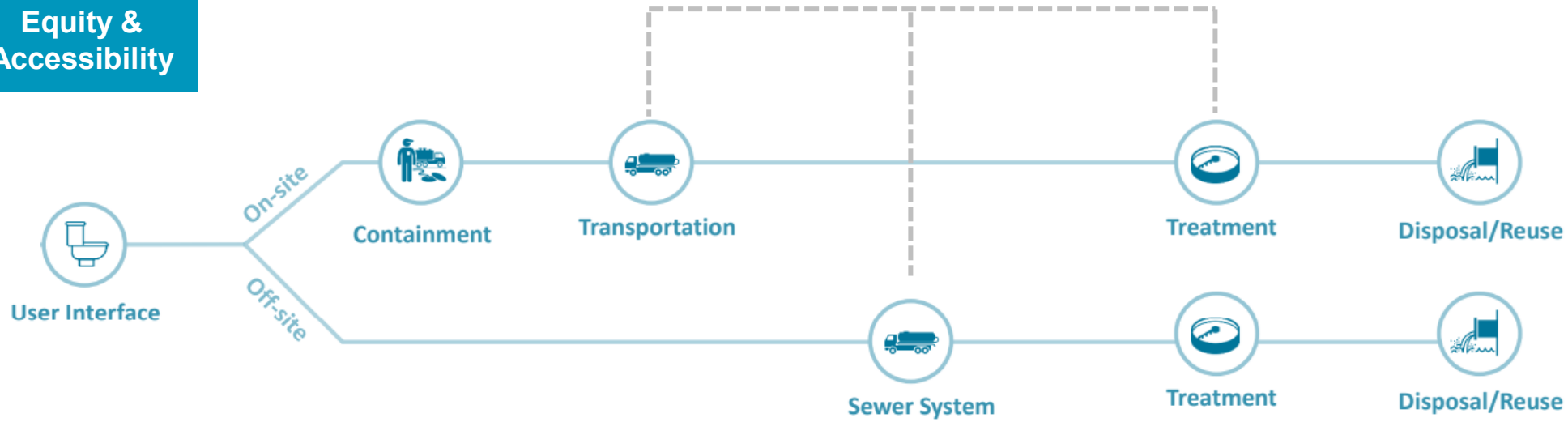
Source: CWAS. IMC Primary data Collection, SLB-PAS 2022

Issues in Used water Sector from Climate Perspective

- Energy efficiency
- GHG emissions

Reuse of septage

Equity & Accessibility



Household level Septage Management & used water handling practices

Alternative Source of Water

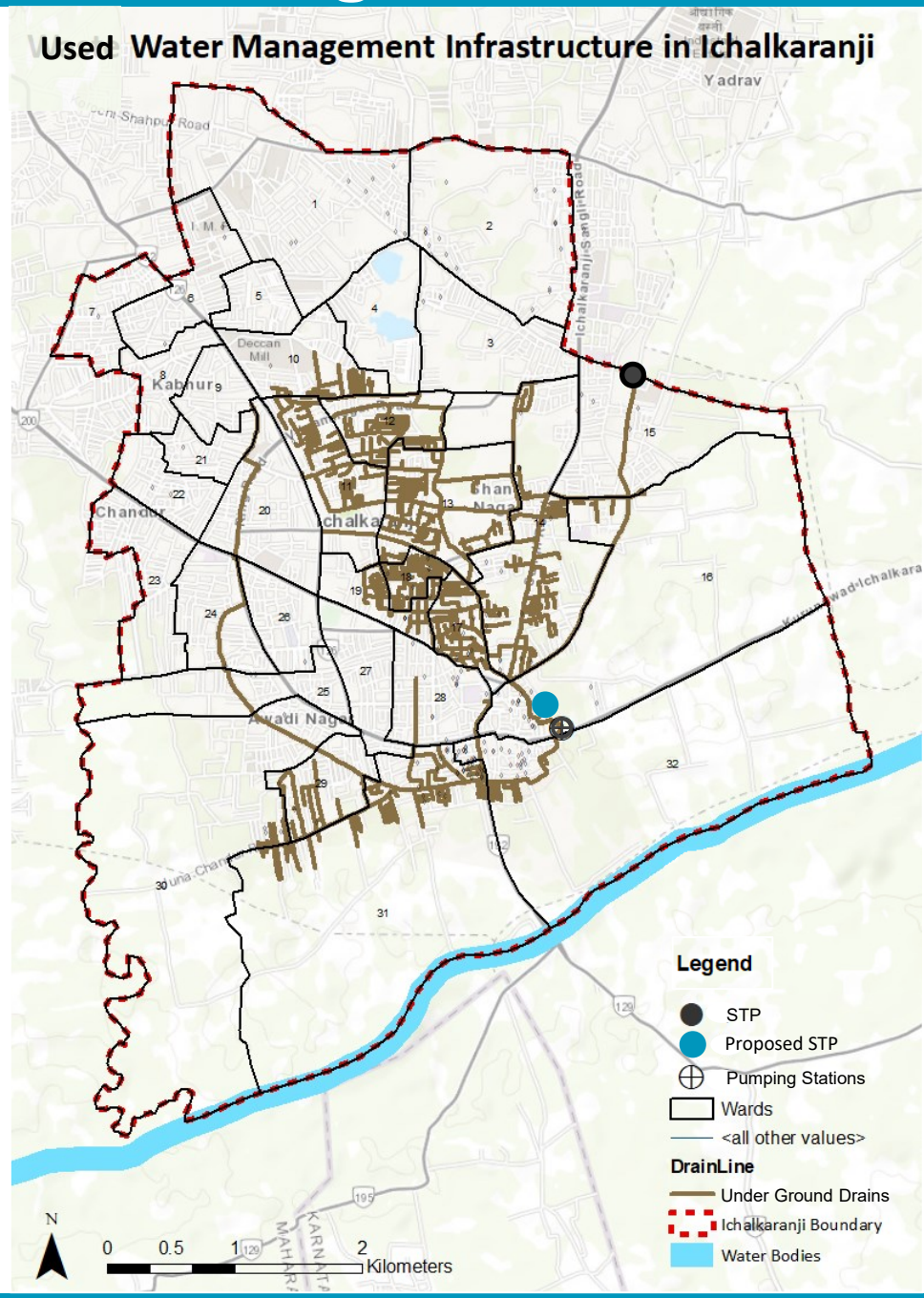
Adaptation Required

Mitigation Required

Source: Author

In context of Used water Management & Floods Existing Issues

- Limited capacity for treatment and reuse
- Higher dependency on septic tank yet No mandate on desludging of Septic tanks
- Inadequate fecal sludge and septage management
- Inadequate management of leakages regarding complaints
- Disposing residual waste into river/nallah/landfill sites instead of utilizing scientific landfill practices.



Source: Map: Author April 2024

In context of Used water Management & Floods

Impact on Service Operations

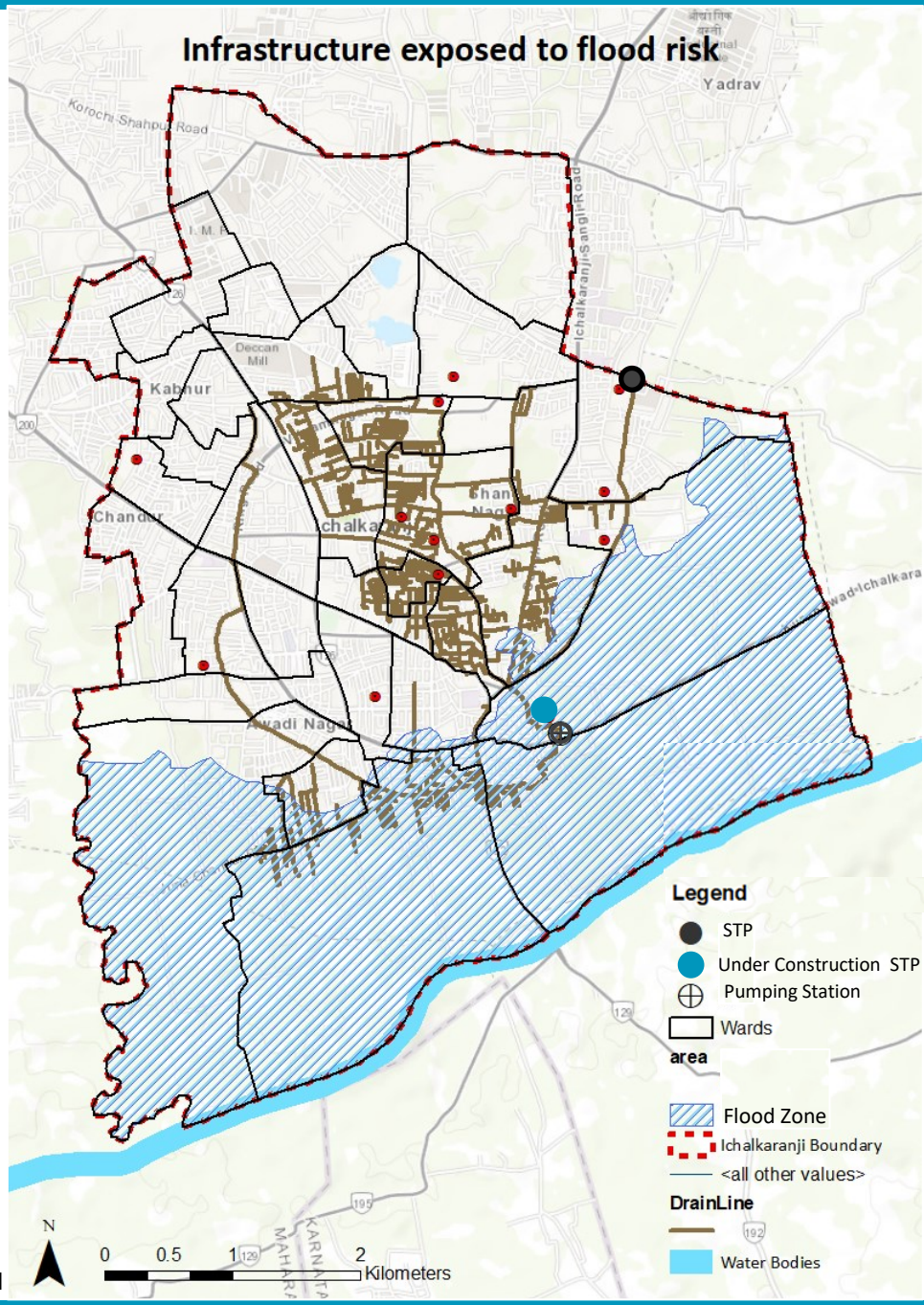
- Non-standard **latrines collapse**, impacting access rates significantly.
- Pit emptying **services are disrupted** due to inaccessible areas and increased frequency of pit emptying needs.
- Flooding causes **breakdowns in sewer** system lift pumps and electrical systems.
- Treatment processes **malfunction** due to hydraulic overload.

Impact on the Environment

- Increase in **untreated wastewater discharged** into the environment as: – Toilet pits are flooded and a **mixture of wastewater** and stormwater overflows onto public roads
- Stormwater runs into the sewers causing these to overflow, lift pumps become flooded and wastewater treatment plants are by-passed.

Social and Health Impacts

- People no longer have working sanitation facilities available
- Due to **water contaminations** – Risk of Vector Born deceases outbreak



Source: CWAS & pS-Eau- WASH Services and Climate Change Impacts and

Solid Waste Management

Waste generated per capita **320 gm**

Total Waste - **115.3 mtpd**
Wet Waste - **70 mtpd**
Dry Waste - **30-35 mtpd**

Ghanta Gadi - **68**,
Tipper truck - **04**,
Refused Compactor - **02**

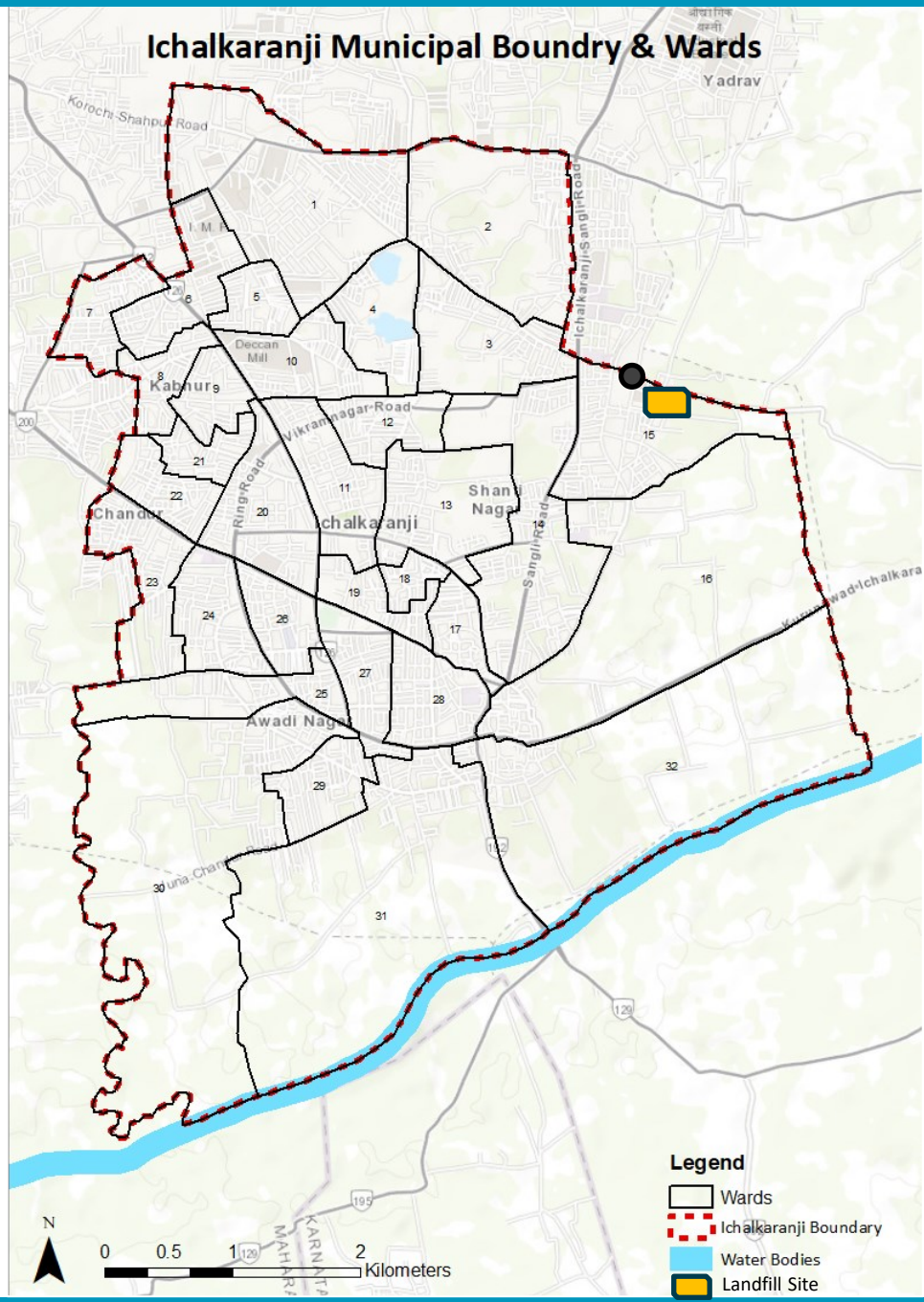
Landfill **15,000** Sq.m.

No Waste Received at scientific Landfill.

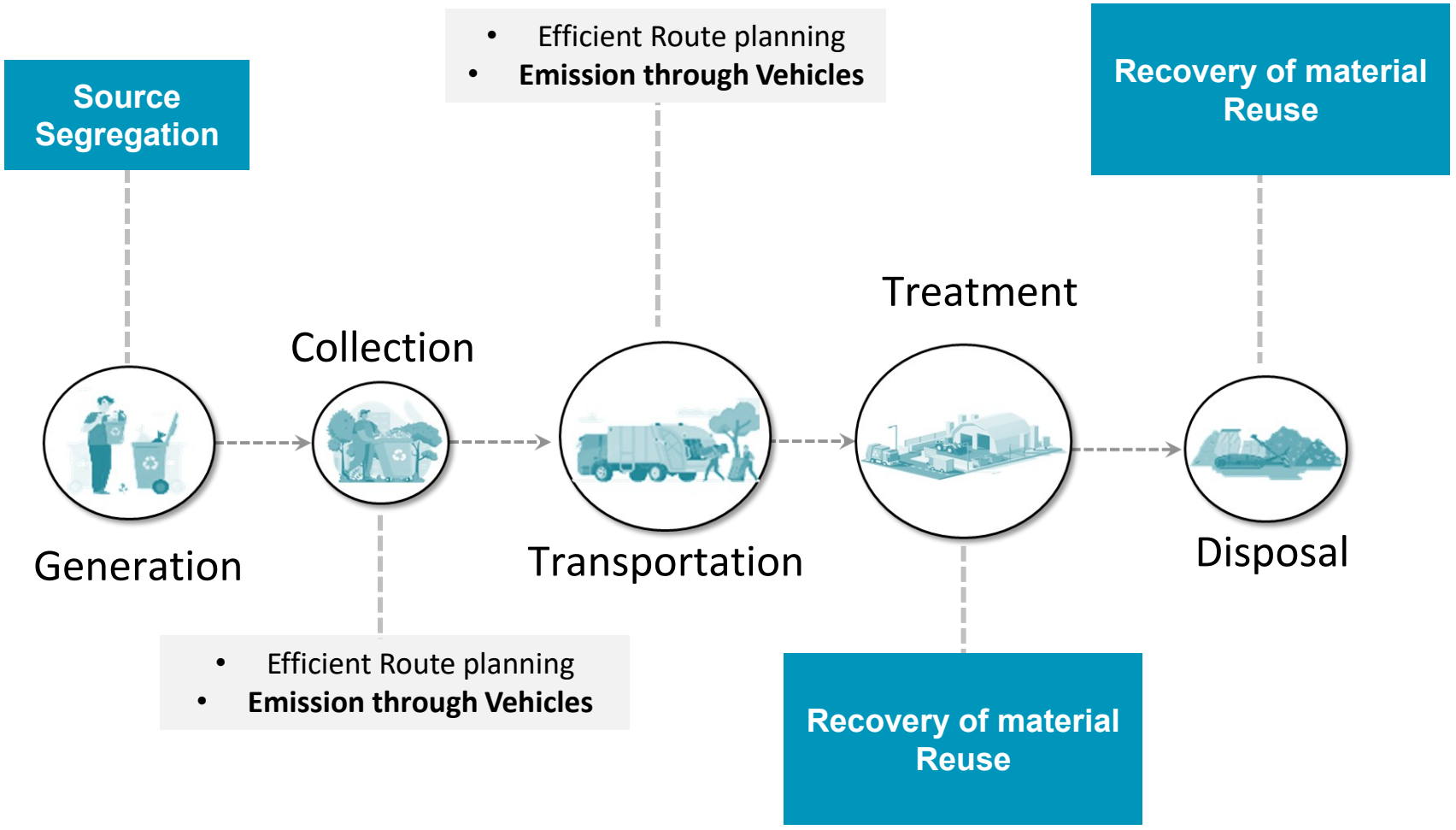
Legacy waste is **4 lakh MT**

Door to door collection (No. of households and establishments) – **68,785**

Quantity of waste treated- **89.5 tpd**



Source: Study of Solid Waste Management Using Geospatial Tools for City

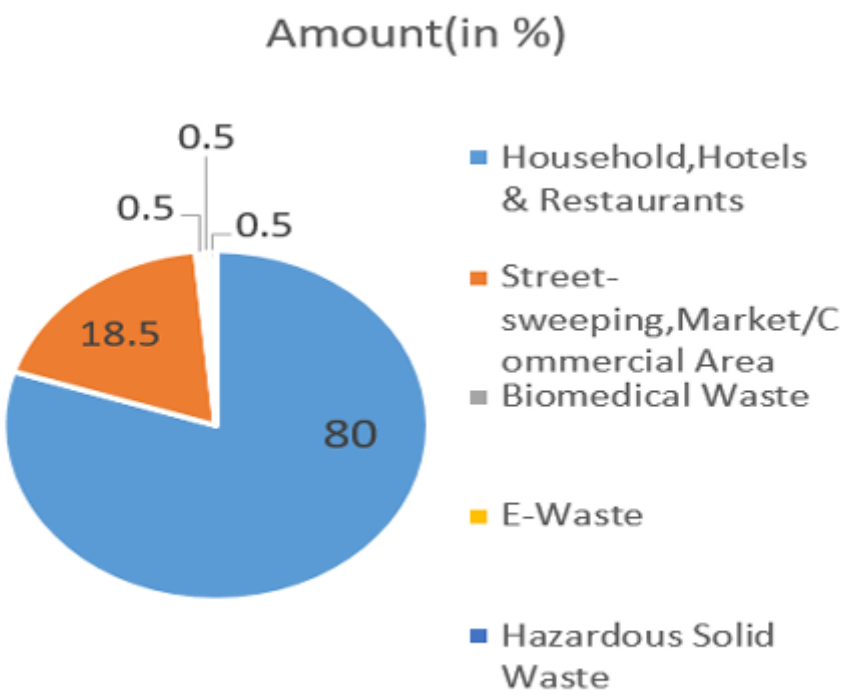


Adaptation Required

Mitigation Required

Source: Author

Solid Waste Management – Assessment through SLBs



Composition of waste

Dry Waste is Paper, plastic waste, textile waste & cardboards → Shredding > Selling to cement factory

Wet waste → Wet waste > Windrow Composting & Bio methanation

Improper segregation of wet & dry waste at source level

Light weight plastic & other waste is **clogging the drains** due to littering and illegal dumping

The **mixing of textile industrial waste** with household waste complicates recovery efforts and leads to wasted resources due to inefficient segregation.

There are **400,000 metric tons of** untreated **legacy waste** with no recovery or treatment plan in place.

Source: CWAS & stakeholder Consultation

In context of Solid Waste & Floods

Impact on Generation

- Increased waste generation due to **flood debris**, such as damaged furniture, electronics, and construction materials
- Difficulty in **storing waste** due to lack of space or damaged bins

Impact on Service Operations

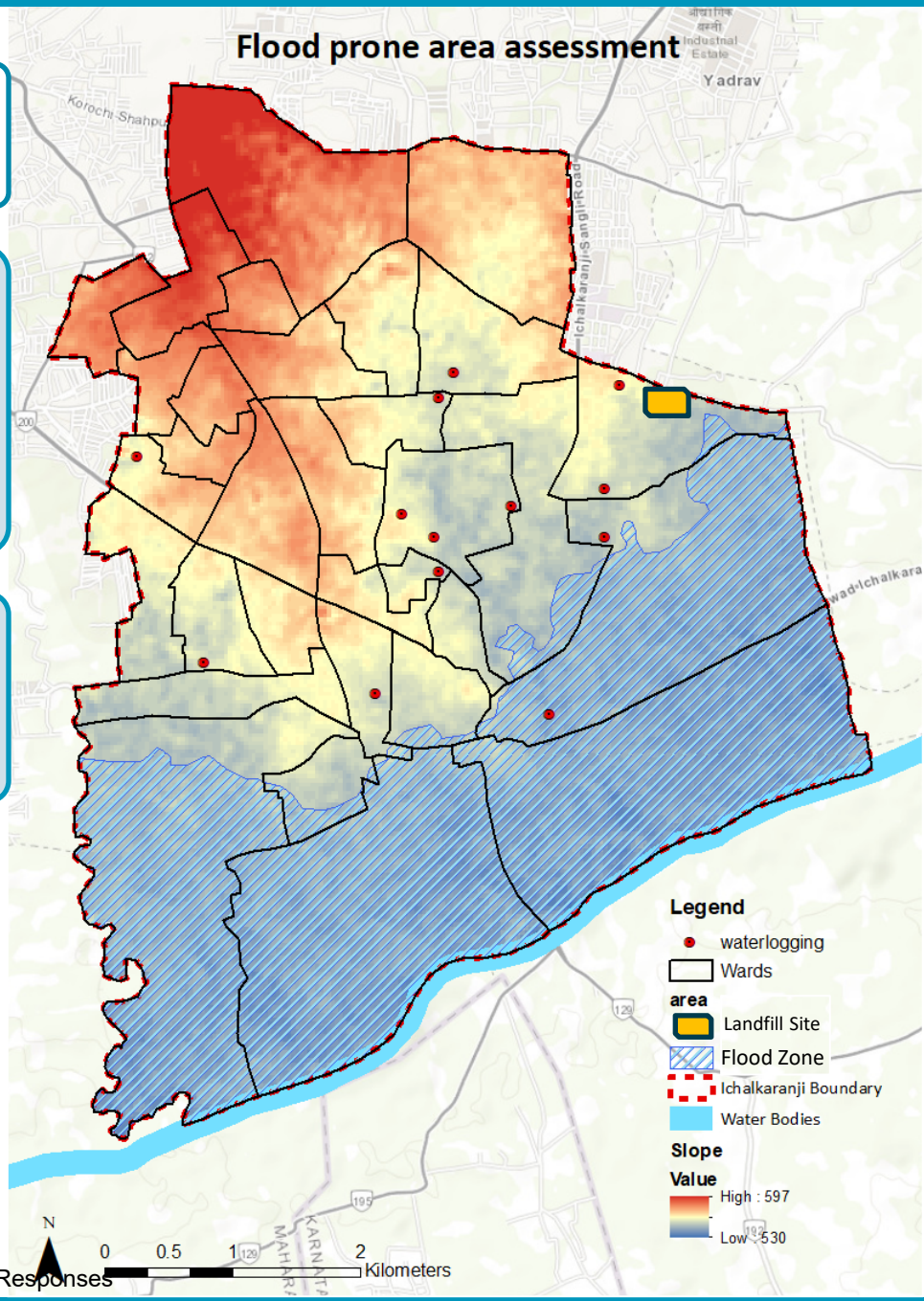
- Disruption of **collection services** due to damaged Vehicles & roads/ bridge & flooded inaccessible areas
- Increased risk of **littering and illegal dumping** due to missed collections
- **Damage to transfer stations**, sorting facilities, and **processing plants** due to flooding
- Disruption/Damage of **sorted and processed material**

Impact on the Environment

- **High Contamination** due to Hazardous Waste & **leachate water (4 lakh MT legacy waste)**
- **Slower** Down the **composting** Process
- Environmental pollution from **legacy waste, overflowing landfills** and improperly disposed waste

Social and Health Impacts

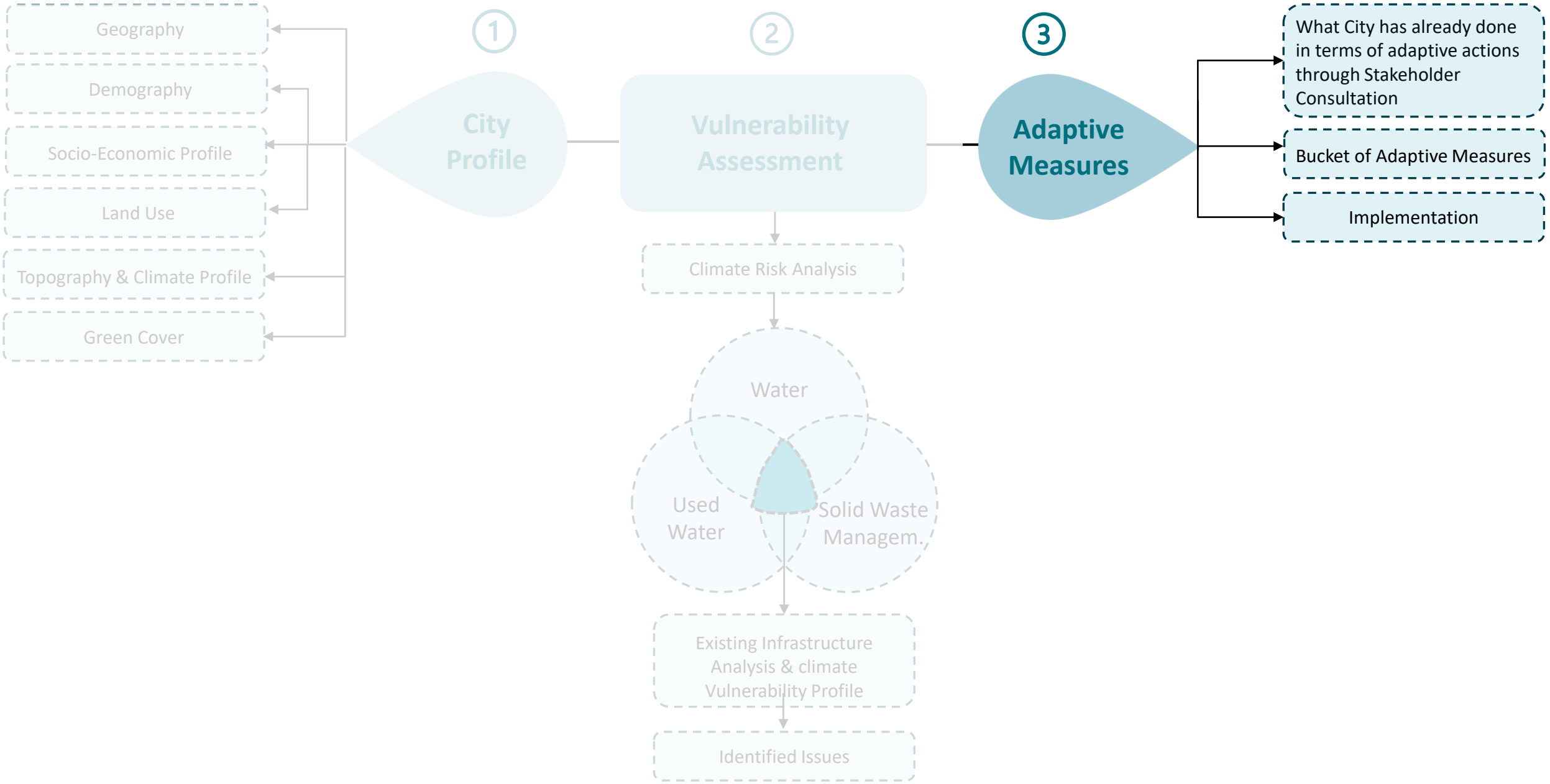
- Workers are highly exposed to flood debris & at Recovery as well as landfill sites Health issues
- Due to water contaminations – Risk of Vector Born deceases outbreak



Source: CWAS. pS-Eau- WASH Services and Climate Change Impacts and Responses

Contents

About the Framework



Source: Author

Stakeholder Consultation & their say...

Deputy engineer water and drainage dept. - IMC
Mr. Bajirao Kamble

"There is a significant need for increased rainwater harvesting and awareness among the people in Ichalkaranji"

Disaster Management Authority - Ichalkaranji
Mr. Sanjay Kamble

"Implementing an early warning system is imperative due to City's vulnerability to floods over the past decade, which has led to prolonged recovery periods."

SWM Department - IMC
Mr. Pravin Solanki

"There is a lack of awareness regarding wet and dry waste segregation in Ichalkaranji, contributing to issues with legacy waste management."

Source: Stakeholder Consultation

Major Issues & Adaptive action taken by city / Stipulated project

Sector	Major Issues	Adaptive action taken by city/ Stipulated project
Water	Ground water Scarcity	• Extensive afforestation along rivers and nallahs to revive local hydrological cycle and retain more runoff within the city. This will also be useful in reducing localized flooding • Renewable energy – solar panel installed on water treatment plant (Benefit - uninterrupted electricity supply during flood times) • City is offering 3% rebate on property tax, for doing RWH on private properties.
	High NRW	
	Inadequate Service	
Used Water	Inefficient Treatment & Disposal	• Raised STP foundation • Reusing treated used water while cleaning CT/PT
	Inadequate Service	
Solid Waste	Waste Segregation	• Leachate Treatment plant Proposal is in process – Decision pending on Board of review
	Legacy Waste	

Source: CWAS. Stakeholder Consultation

Reviving water resilience through Adaptive Measures

Strategy & Actions	Potential Locations	Lead & Supporting Authorities/ Agency	Possible Funding Source
Reviving water resilience			
(a) Compulsion on Rooftop RWH targeting schools, hospitals and other larger buildings	Commercial & Public buildings	IMC	Small Town Water Conservation Grant
(b) Reviving & rejuvenation of abandoned wells	Public/Private Borewells	IMC	Amrut 2.0
(C) Through water recharge structure in upstream ponds	Shahpur Lake	Shahpur Lake	Integrated Water Management Program/Amrut 2.0
(e) Recharge Through Existing wells & Approach industrial estates to implement such initiatives under CSR/CER	Public Wells 700 total	IMC	Industrial Estate CSR

NA – Not Applicable

Source: CWAS. Stakeholder Consultation

Providing efficient supply and equitable access to quality water

Strategy & Actions	Potential Locations	Lead & Supporting Authorities/ Agency	Possible Funding Source
Provide efficient supply and equitable access to quality water			
(a) Conduct a robust NRW study	Commercial & Public buildings	IMC	Urban Water Infrastructure Development Program
(b) Allocation of extra 0.5 FSI on inclusion of rainwater Harvesting in the buildings	Private Buildings	IMC	NA
(C) Providing water ATMs in slums	Selected Slums	IMC	CSR

NA – Not Applicable

Source: CWAS. Stakeholder Consultation

Used water handling practices by taking adaptive Measures!

Strategy & Actions	Potential Locations	Lead & Supporting Authorities/ Agency	Possible Funding Source
For onsite Sanitation system - Achieve 100% Sludge and Septage Management			
(a) Plan of schedule desludging or optimized route	Area with Less or no availability of Under Ground Drainage	IMC	Sanitation tax/Property tax
For off site Sanitation system - 100% Efficient sewage collection and treatment & Reuse			
(c) Mandating Under Ground Drainage connections wherever the network is accessible.	STP	IMC	Wastewater Treatment Fund
(d) Monitoring & Maintaining standard of treated used water			
(e) Reuse of treated used water by watering trees, treating further for Industrial use	Footpaths, Road Median & Gardening	IMC	NA

NA – Not Applicable

Source: CWAS. Stakeholder Consultation

Adopt circular economy principles in waste management

Strategy & Actions	Potential Locations	Lead & Supporting Authorities/ Agency	Possible Funding Source
Adopt circular economy principles in waste management			
Awareness regarding source level segregation of waste	Commercial & Public buildings	IMC	SBM 2.0
Disaster debris management plan	Household level	IMC	SBM 2.0
100% reuse of Industrial textile waste	Textile Industries	IDC & IMC	SBM 2.0
Legacy waste management plan through Bio Remediation – 4 lakh MT	-	IMC	ULB's allocated budget
Sell of Manure at competitive market prize due to good quality & Being Eligible for Harit Maha Compost	-	IMC	NA

NA – Not Applicable

Source: CWAS. Stakeholder Consultation

Addressing the social aspects of building climate resilience

Policy level Changes

Requiring the inclusion of climate change considerations in all upcoming water and wastewater projects in Ichalkaranji.

Enforcing rainwater harvesting through legislation or integration into development control regulations (DCR)

Compelling commercial offices and industries to manage and provide segregated waste.

Requiring households to segregate their waste before disposal.

To expedite the broader and swifter implementation of these climate-resilient WASH & solid waste strategies.

Stakeholder Participation

IMC Officials

Industrial Estate

Representatives & NGOs

Women SHGs

Local Community

Source: CWAS. Stakeholder Consultation

Way forward

- Doing feasibility studies for strategies in terms of Financial, Technical & Political will make larger Impact on City's vulnerability.

- High Impact through Cost-Effective Solutions: Smaller, cost effective and easily implementable solutions can create larger impacts in adaptation to climate change

- Regular interactions and consultations with IMC officials, will help in formulating better strategies.

- Similar research could be conducted in the future with more comprehensive data, as recommended. This would provide greater clarity on vulnerabilities and aid in identifying specific groups of vulnerable individuals at a more localized level.

Source: CWAS. IMC Primary data Collection, SLB-PAS 2022

Towards the better future....

Thank You

Example to understand the difference between the concepts of vulnerability and exposure

Source: WASH Services and Climate Change Impacts and Responses, pS-Eau (2018)

Definitions as per USAID

CLIMATE CHANGE ADAPTATION describes measures taken in response to actual or projected climate change in order to eliminate, minimize, or manage related impacts on people, infrastructure, and the environment.

VULNERABILITY is the degree to which a system is susceptible to or unable to cope with adverse effects of climate change, including climate variability and extremes. It is often defined as a combined function of exposure and sensitivity to the effects of climate change, minus the adaptive capacity of a system.

EXPOSURE refers to the extent to which a system comes into contact with a hazard.

RISK is the combined function of the likelihood that a hazard will occur and the resulting consequences.

SENSITIVITY is the degree to which a built, natural or human system is directly or indirectly affected by or responsive to changes in climate conditions or related impacts.

ADAPTIVE CAPACITY, as it relates to infrastructure and built assets, describes the degree to which the physical elements of a system can absorb, withstand, or respond to climate change impacts without incurring damage.

Source: USAID

Definitions as per IPCC Forth Assessment Report

Key Concepts

A climate-related hazard is the potential occurrence of an event that may cause loss of life or injury, as well as damage and loss to businesses, services and the environ
ment. This can be an extreme weather event or a longer-term trend. Adapted from: Seine
et-Marne, 2015

Exposure is the presence of a human or natural element (people, species, ecosystems, environmental functions, economic activities, etc.) in places or settings that could be adversely affected. Adapted from: IPCC, 2014

Impact is the effect that a climate-related hazard has on natural and human systems. These effects manifest themselves locally on people's lives, livelihoods, health, eco systems, economies, societies, cultures, services and infrastructure. Impacts are also referred to as consequences and outcomes. Adapted from: IPCC, 2014

Vulnerability describes the propensity or predisposition to be adversely affected. It encompasses a variety of concepts, including sensitivity or susceptibility to harm and
lack of capacity to cope and adapt. Vulnerability can therefore be shaped by a range of factors, including socio-economic inequalities, local urban development and the implementation of adaptation strategies. It is thus linked to an area's political strate
gies and decisions. Adapted from: IPCC, 2014

Sensitivity is "the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise)" (IPCC 2001).

Adaptive capacity is "the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (IPCC 2001).

Source: USAID

Key Considerations And Responses before making Adaptive actions

- Develop data sharing, production and monitoring systems by adapting indica tors to include climate change concerns; p
- Rank and prioritise responses based on the level of the assessed risk and availa ble resources; p
- Opt for flexible adaptation measures that can be adjusted as more information becomes available;
- Select ‘no regret’ options, namely responses that have immediate benefits and remain relevant regardless of the climate sce nario (including a scenario with no cli mate change). One example of this would be water-saving measures; p
- Adopt a long-term vision that focuses on service sustainability, synergies between sectors and environmental protection.

- Source:ps_eau_wash_services_climate_change_impacts_and_responses_2018 (1).pdf

Source: Case Studies

Water Supply – Assessment Comparing with the SLBs

74 %
Coverage of individual water supply connections in city
Benchmark: 100%

17 %
Coverage of individual water supply connections in slums Benchmark: 100%

100 lpcd
Per capita supply of water at consumer end
Benchmark: 135 lpcd

21 %
Extent of Non-revenue water
Benchmark:20%

44 %
Extent of functional metering of water supply connections
Benchmark:100%

100 %
Quality of water supplied
Benchmark:100%

100 %
Efficiency in redressal of customer complaints
Benchmark:80%

53 %
Cost recovery in water supply services
Benchmark:100%

37 %
Collection efficiency of water taxes & charges
Benchmark:90%

1.5 hr/ alternate day
of water supply
Benchmark:
24 hrs/day

Intervention/Improvement measures required

Source: Approaches to reduce ghg emission from wash services, CWAS. IMC Primary data Collection, SLB-PAS 2022

Impact on SLBs, after Adaptive Actions

74 %
Coverage of individual water supply connections in city
Benchmark: 100%

17 %
Coverage of individual water supply connections in slums Benchmark: 100%

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Intervention/Improvement measures required

Source: Approaches to reduce ghg emission from wash services, CWAS. IMC Primary data Collection, SLB-PAS 2022

Sewerage Management – Assessment through SLBs

100 %
Coverage of access to toilets to Citizens
Benchmark: 100%

40 %
Coverage of sewage network services
Benchmark: 100%

59 %
Collection efficiency of the sewage network
Benchmark: 100%

59 %
Adequacy of sewage treatment Capacity
Benchmark: 100%

100 %
Quality of sewage Treatment
Benchmark: 100%

23 %
CT-PT dependency

60 %
Dependency on Septic tanks

95 %
Extent of reuse and recycling of Sewage
Benchmark: 20%

100 %
Efficiency in redressal of customer Complaints
Benchmark: 80%

57 %
Extent of cost recovery in sewage Management
Benchmark: 100%

57 %
Efficiency in collection of sewage charges
Benchmark: 90%

Source: CWAS. IMC Primary data Collection, SLB-PAS 2022

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57 %
Extent of cost recovery in sewage Management
Benchmark: 100%

57 %
Efficiency in collection of sewage charges
Benchmark: 90%

Source: CWAS. IMC Primary data Collection, SLB-PAS 2022

Solid Waste Management – Assessment through SLBs

82 %
Household level coverage of SWM services
Benchmark: 100%

100 %
Efficiency of collection of municipal solid Waste
Benchmark: 100%

100 %
Extent of segregation of municipal solid Waste
Benchmark: 100%

78 %
Extent of municipal solid waste recovered
Benchmark: 80%

0 %
Extent of scientific disposal of municipal solid Waste
Benchmark: 100%

100 %
Efficiency in redressal of customer Complaints
Benchmark: 80%

74 %
Extent of cost recovery in SWM Services
Benchmark: 100%

98 %
Efficiency in collection of SWM charges
Benchmark: 90%

Source: CWAS. IMC Primary data Collection, SLB-PAS 2022

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