

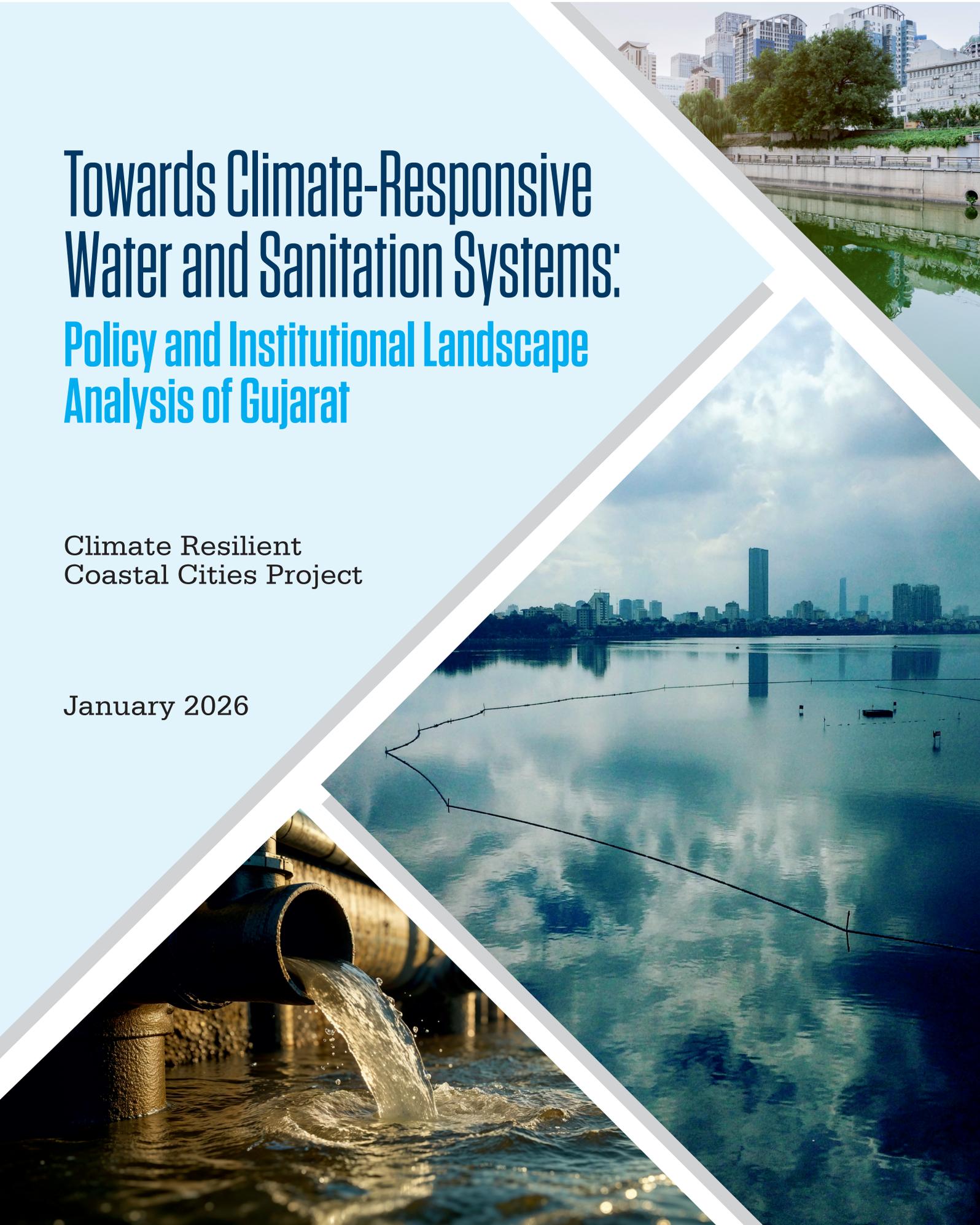
Supported by



# Towards Climate-Responsive Water and Sanitation Systems: Policy and Institutional Landscape Analysis of Gujarat

Climate Resilient  
Coastal Cities Project

January 2026





**Published January 2026**

#### **Authors**

Ashank Desai Centre for Policy Studies at Indian Institute of Technology Bombay: Neelam Rana, NC. Narayanan, Priyakshi Gogoi

#### **This report should be cited as**

Rana, Neelam, Narayanan, NC., & Gogoi, Priyakshi. (2026). Towards Climate-Responsive Water and Sanitation Systems: Policy and Institutional Landscape Analysis of Gujarat. Ashank Desai Centre for Policy Studies, Indian Institute of Technology Bombay. Mumbai, Maharashtra. India.

#### **Editing**

India Sanitation Coalition (ISC): Kriti Gupta, Nupur Krishna, Natasha Patel, Anjali Tripathy

#### **Design**

Cover Page, Front Matter, and Final Page Design: Visual Eyes

#### **Printing**

Visual Eyes

#### **Funding acknowledgments**

This report is part of the HSBC India-funded Climate Resilient Coastal Cities project, undertaken in collaboration with Ashank Desai Centre for Policy Studies, Indian Institute of Technology Bombay (Research Partner), Consortium for DEWATS Dissemination India (Research and Implementation Partner), and India Sanitation Coalition (Communication, Outreach, and Advocacy Partner).

#### **Copy Right Disclaimer:**

@2026

**This publication is freely available following the open-source concept for capacity development and non-profit use, so long as proper acknowledgement** of the source is made when used. Users should always give credit in citations to the original author, source and copyright holder.

# Acknowledgments

India Sanitation Coalition (ISC) expresses its sincere gratitude to all project partners of the *Climate Resilient Coastal Cities* initiative for their collaboration and commitment towards developing this report as part of the initiative's outputs.

We gratefully acknowledge HSBC India for its financial support to the *Climate Resilient Coastal Cities* initiative, which enabled the research presented in this report.

We express our appreciation to Ashank Desai Centre for Policy Studies at IIT-Bombay and the Consortium for DEWATS Dissemination India (CDD India) for their roles as research partners. Their technical expertise, methodological rigour, and sustained engagement were central to the town-, state-, and national-level assessments undertaken as part of the initiative. The contributions of their respective project teams in conducting field assessments, policy analysis, and in developing recommendations and action-oriented outputs are gratefully acknowledged.

We also thank the various stakeholders who engaged with the research, including government officials, municipal representatives, frontline sanitation workers, community members, and other local stakeholders. Their insights, cooperation, and on-ground perspectives were essential in ensuring that the research findings and recommendations are grounded in local contexts and responsive to the climate and sanitation challenges faced by coastal towns.

We further acknowledge the support of ISC's internal Private Sector Engagement team for facilitating coordination among initiative partners.

The collective research work undertaken through this initiative represents an important step towards advancing climate-responsive water and sanitation planning along India's west coast. The findings and recommendations presented in this report are intended to support urban local bodies and policymakers in strengthening the resilience, adaptability, and sustainability of WaSH systems.

# Preface

Evidence indicates a marked increase in the frequency and intensity of cyclonic events along India's west coast, accompanied by rising sea levels, saline intrusion, and extreme rainfall. These climate-related pressures are being compounded by rapid urbanisation, population growth, and expanding economic activity in coastal cities, placing significant stress on freshwater aquifers and essential urban services such as water and sanitation. Recognising this, HSBC India, India Sanitation Coalition (ISC) at FICCI, the Ashank Desai Centre for Policy Studies (ADCPS) at Indian Institute of Technology - Bombay (IIT Bombay), and the Consortium for DEWATS Dissemination India (CDD India) formed a strategic partnership in July 2023 to address the emerging climate risks confronting coastal urban regions. This collaboration was formalised as the *Climate Resilient Coastal Cities (CRCC)* initiative in September 2023. Phase I of the initiative was implemented between September 2023 and December 2025 across four coastal states along India's western seaboard: Goa, Gujarat, Karnataka, and Maharashtra.

Within this context, the CRCC initiative focuses on strengthening the climate resilience of Water, Sanitation, and Hygiene (WaSH) infrastructure and service delivery systems-critical foundations for public health, environmental sustainability, and the long-term viability of coastal urban settlements. The initiative adopts an integrated approach that combines applied research with targeted implementation to support informed planning and decision-making. The project was guided by four interrelated objectives: (i) assessing the climate resilience of WaSH infrastructure and services in selected coastal towns; (ii) analysing the water-energy-climate policy landscape relevant to coastal urban systems; (iii) designing and implementing targeted interventions to enhance resilience in priority locations; and (iv) developing practical, scalable recommendations to strengthen system-level climate resilience.

Under the CRCC initiative, ADCPS-IIT Bombay, as the core research partner, conducted town-level situation assessment studies along with national and state policy and institutional landscape analyses. The town studies assessed the status, challenges, risks, financial sustainability, and greenhouse gas (GHG) footprint of water and sanitation systems, and proposed recommendations to enhance the resilience of such systems. These studies were carried out in twelve towns-three each in Goa (Canacona, Mapusa, and Mormugao), Gujarat (Mandvi, Devbhumi Dwarka, and Valsad), Karnataka (Karwar, Kundapura, and Mangalore), and Maharashtra (Alibag, Ratnagiri, and Vengurla). The policy and institutional landscape analysis covered the national level and the four states, with the aim of examining how urban water, sanitation, and climate change policies interact to shape broader governance and planning frameworks for resilient urban water and sanitation systems. CDD India as a research and implementation partner focused on three coastal towns in Maharashtra (Dahanu, Guhagar, and Malvan), translating assessment findings into actionable Climate Resilient Sanitation Plans (CRoSAPs) to support local implementation and decision-making.

Implementation activities under the CRCC initiative included policy consultations, capacity-building workshops, and field exposure visits for government officials and key local stakeholders, including Self-Help Groups (SHGs). These activities were jointly facilitated by CDD India, ADCPS-IIT Bombay and ISC. The initiative also enabled structured engagement with sector experts and practitioners. Complementing these efforts, CDD India led community-level mobilisation activities in the study towns, including awareness campaigns and tree plantation drives, to foster local ownership and strengthen community participation in climate resilience efforts.

India Sanitation Coalition (ISC) at FICCI has served as the anchor organisation for the initiative, leading advocacy and outreach efforts and supporting the dissemination of evidence, best practices, and policy-relevant insights. ISC has also contributed to the editorial review of the reports to enhance clarity, coherence, and accessibility. In addition, ISC has articulated the potential role of corporate actors in supporting similar climate-responsive WaSH initiatives in the future. HSBC India has provided financial support for the research, implementation, and outreach components of the initiative. In parallel, the initiative seeks to catalyse larger-scale investments in climate-resilient WaSH infrastructure by aligning with and leveraging resources already committed under the Swachh Bharat Mission (SBM) 2.0.

The findings and learnings from the initiative are being disseminated through a comprehensive suite of outputs comprising one National Report, four State Reports (Goa, Gujarat, Karnataka, and Maharashtra), and fifteen Town Reports-three each from Goa, Gujarat, and Karnataka, and six from Maharashtra. This report constitutes one of the twenty reports produced under the CRCC initiative.

It is hoped that the insights from the study will inform future policy and planning actions and investments aimed at strengthening climate-resilient water and sanitation infrastructure and services in India's coastal towns.

# Table of Contents

<b>EXECUTIVE SUMMARY</b> .....	<b>4</b>
<b>1. INTRODUCTION</b> .....	<b>8</b>
<b>2. METHODOLOGY</b> .....	<b>14</b>
<b>3. STATE OVERVIEW</b> .....	<b>17</b>
<b>4. CLIMATE CHANGE AND VULNERABILITY</b> .....	<b>28</b>
4.1 CLIMATE CHANGE AND DISASTERS EXPOSURE AND IMPACT .....	28
4.2 CLIMATE CHANGE PROJECTIONS .....	35
4.3 VULNERABILITY WITH FOCUS ON SOCIO-ECONOMIC AND WATER AND SANITATION INFRASTRUCTURE AND SERVICES .....	36
<b>5. PROGRAMMES AND SCHEMES IN URBAN WATER AND SANITATION</b> .....	<b>40</b>
<b>6. POLICY AND INSTITUTIONAL LANDSCAPE OF CLIMATE CHANGE &amp; WATER AND SANITATION</b> .....	<b>50</b>
6.1 INSTITUTIONAL LANDSCAPE .....	50
<b>6.1.1 State Level</b> .....	50
<b>6.1.2 Town Level: Institutional Capacity and Constraints in Climate and Disaster         Planning</b> .....	54
6.2 POLICY LANDSCAPE.....	56
<b>6.2.1 Policies with Mitigation Focus</b> .....	57
<b>6.2.2 Policies with Adaptation Focus</b> .....	62
<b>6.2.3 Policies with Resilient Water and Sanitation Infrastructure Focus</b> .....	65
<b>6.2.4 Policies and Programmes Focussing on Coastal Areas</b> .....	68
<b>7. RECOMMENDATIONS</b> .....	<b>72</b>
7.1 FINANCIAL PROGRAMMES/ SCHEMES.....	72
7.2 INSTITUTIONAL LANDSCAPE .....	73
7.3 POLICY LANDSCAPE .....	74
<b>7.3.1 Mitigation</b> .....	75
<b>7.3.2 Adaptation</b> .....	77
<b>7.3.3 Infrastructure Resilience</b> .....	78
<b>7.3.4 Policies on Coastal Areas</b> .....	79
<b>REFERENCES</b> .....	<b>81</b>
<b>ENDNOTES</b> .....	<b>84</b>

Figure 1: Administrative Map of Gujarat .....	17
Figure 2: Landuse and Land Cover Map of Gujarat .....	19
Figure 3: Agro-climatic Zones in Gujarat .....	20
Figure 4: Annual Average Rainfall (mm) in Selected Districts of Gujarat for 2014 - 2023 .....	21
Figure 5: Major Rivers of Gujarat.....	23
Figure 6: Water Resources in Gujarat.....	24
Figure 7: Ground Water Level Pre-monsoon and Post-Monsoon 2021-22 and 2022-23 in Gujarat .....	25
Figure 8: Ground Water Extraction in Talukas of Gujarat .....	26
Figure 9: Gujarat District-wise Water Stress and Scarcity in 2025 and 2050 .....	27
Figure 10: Wind Hazard in Gujarat .....	29
Figure 11: Cyclonic Winds in Gujarat (based on wind speed data between 1891-2008).....	30
Figure 12: Average Number of Heat-wave Days in Gujarat for 2012- 2022.....	31
Figure 13: Flood Prone Areas in Gujarat.....	33
Figure 14: Change in Mangrove Cover between 2021 and 2023 in Gujarat .....	34
Figure 15: Change in Total Mangrove Cover (sqkm) for Districts of Gujarat between 2021 and 2023 .....	35
Figure 16: Allocations to State Climate Change Department for 2023 to 2026.....	41
Figure 17: Expenditure on Relief on Natural Calamities (2011-2024).....	42
Figure 18: Gujarat State Allocation towards Key Sectors including Water and Sanitation (2020 to 2023).....	44
Figure 19: Expenditure on Urban Development Sector as a Percentage of Total Expenditure .....	45
Figure 20: Own Tax and Non-Tax Revenue of Municipal Corporations in Gujarat (2019-24).46	
Figure 21: State-wise Comparison of Own Tax and Non-Tax Revenue of Municipal Corporations (2019-24): Gujarat, Maharashtra, Karnataka .....	47
Figure 22: State-wise share of Water Tax and Sewerage/Drainage Tax as percent of Own Sources Revenues (Average 2020-21 to 2022-23).....	48
Figure 23: Capital Expenditure (Lakh) in Sewerage and Drainage Sector at Municipal Corporation level In Gujarat .....	49
Figure 24: Sectoral Electrical Energy Sales as Percentage of Total in Gujarat (2018-23).....	59
Figure 25: Energy efficient pumps installed under MEEP in Gujarat (as of 23 April 2025) .....	60

Table 1: Data Collection Methods .....	14
Table 2: List of Towns Selected in Gujarat.....	15
Table 3: Climate Projections for Key Extreme Events for Gujarat (2021-2100) .....	36
Table 4: Key National Government Agencies in Urban Water and Sanitation and Climate Change .....	51
Table 5: Key State Government Agencies in Urban Water and Sanitation and Climate Change .....	53
Table 6: Town Level Institutional Arrangements in Sanitation Services: A Case of Valsad City .....	55
Table 7: Measures for Climate Resilient Water and Sanitation Infrastructure Proposed under Various Policies .....	67

## Executive Summary

Gujarat, while a frontrunner in economic growth and development, ranks among India's most climate-vulnerable states due to its arid geography and extensive 1,600 km-long coastline<sup>i</sup>—the longest in the country. Nearly 9.9 million people reside across 40 coastal talukas, rendering the region highly exposed to climate-related risks such as sea-level rise, cyclones, storm surges, salinity ingress, and extreme rainfall events. Gujarat is also a major greenhouse gas (GHG) emitter, primarily from the energy sector. Although the state has shown early leadership through the creation of a dedicated Department of Climate Change and the formulation of comprehensive State Climate Action and Disaster Management Plans, on-ground implementation remains uneven. Smaller towns in particular continue to face significant challenges, including inadequate sanitation infrastructure, poor wastewater management, and low adoption of adaptive and energy-efficient technologies. This summary draws on a detailed assessment of Gujarat's policy and institutional landscape related to water, sanitation, and climate change. Fieldwork conducted in the coastal towns of Mandvi, Devbhumi Dwarka, and Valsad identified key gaps in infrastructure, governance, and service delivery, alongside opportunities for strengthening institutional coordination, financing mechanisms, and policy alignment.

**The findings presented in this report are a part of a landscape study on four west coast states under the *Climate Resilient Coastal Cities* project, supported by HSBC-India.** The study includes a review of 15 coastal towns across Goa, Gujarat, Karnataka, and Maharashtra to provide illustrative examples of ground level conditions and challenges. Insights from this study aim to guide discussions on the development of resilient urban water and sanitation systems in the face of accelerating climate risks. The focus of resilience building encompasses both adaptation and mitigation strategies.

### 1. Financial Programmes and Schemes: Challenges and Recommendations

#### Challenges:

- Low sectoral allocations to sanitation despite multiple funding sources.
- Minimal integration of climate concerns in urban sanitation finance.
- Delays in completion of key sewerage projects.

## Recommendations:

- Increase budgetary allocations for urban climate resilience, particularly within the Climate Change Department.
- Enhance convergence between climate, disaster, and urban development schemes.
- Strengthen ULB financing via user charges, grants, and fiscal autonomy.
- Accelerate STP and sewerage infrastructure projects; prioritize decentralized solutions.
- Use GIS and MIS tools for data-driven, equitable infrastructure investments.

## 2. Institutional Framework: Challenges and Recommendations

### Challenges:

- Fragmented mandates across multiple departments (GWSSB, GUDC, GUDM, etc.).
- Weak enforcement of sanitation and disaster management responsibilities at ULB level.
- ULBs lack autonomy and operational capacity.

### Recommendations:

- Clarify institutional mandates to reduce duplication and conflict.
- Strengthen ULB technical and financial capacity.
- Decentralize project planning and technology selection.
- Establish coordination platforms across departments.
- Strengthen local disaster preparedness capacity at the ULB level.
- Improve enforcement of household sanitation regulations.

## 3. Policy Landscape: Challenges and Recommendations

**State policies and programmes place greater emphasis on climate adaptation, with comparatively limited focus on mitigation and the resilience of water and sanitation infrastructure.** This emphasis is well-founded—like most states in India, the priority must be to first strengthen adaptive capacity and enhance the resilience of communities before focusing on long-term mitigation goals.

**Adaptation Focused Policies:** Emphasis on water access, sanitation, groundwater recharge, and ecosystem protection. **Challenges** include poor enforcement, underutilized rainwater harvesting and wastewater reuse, and limited mangrove protection.

### Recommendations

- Enforce groundwater and wastewater regulations more strictly.
- Invest in wastewater recycling and sludge reuse infrastructure.

- Support smaller and medium towns with resources for decentralized treatment systems.
- Promote rainwater harvesting through incentives and awareness.
- Protect natural buffers like mangroves to reduce saltwater intrusion.
- Improve program implementation and monitoring, and
- Enhance coordination across departments and urban planning frameworks.

**Mitigation Focused Policies:** GHG from UWSS underreported. Narrow focus on energy savings in lighting, ignoring pumping and STPs.

**Recommendations:**

- Institutionalize GHG monitoring in UWSS.
- Expand energy efficiency and renewable energy in water and sanitation systems.
- Promote biogas recovery and decentralized treatment systems.
- Enforce by-laws and SOPs for onsite wastewater systems.
- Align urban development, energy, and climate policies.

**Infrastructure Resilience:**

Gujarat's coastal towns are increasingly exposed to climate risks—floods, cyclones, saltwater backflow, and power outages. Infrastructure, especially STPs and water treatment plants, remains vulnerable due to inconsistent implementation of climate-proofing measures.

**Recommendations:**

- Integrate climate-resilient design and planning into all water and sanitation infrastructure projects.
- Incorporate flood forecasting, early warning systems, and retention basins to manage overflow safely.
- Design stormwater infrastructure to accommodate future climate variability.
- Strengthen enforcement of land-use and building codes based on hazard and vulnerability assessments.
- Ensure effective coordination among the Gujarat State Disaster Management Authority, ULBs, and relevant departments.
- Develop and embed climate-resilient design standards into engineering manuals.
- Provide targeted training to ULBs on assessing Detailed Project Reports (DPRs) using climate-resilient standards.
- Explicitly integrate climate projections and risk assessments into future WaSH infrastructure planning.
- Conduct comprehensive climate and disaster risk assessments of existing WaSH infrastructure.

- Prioritize the upgrade and retrofitting of vulnerable infrastructure to withstand climate extremes.
- Institutionalize the use of advanced data-driven tools (e.g., IoT sensors, GIS mapping) for proactive risk monitoring and adaptive water system management.
- Ensure full coordination between disaster management authorities and ULBs.

### **Coastal Policy Landscape:**

Despite multiple initiatives—CZMP, SAPCC, GSDMP, and the Salinity Ingress Prevention Scheme—coastal areas continue to face saltwater intrusion, mangrove degradation, and groundwater stress. There is no dedicated national mission linking climate change and coastal areas. The key recommendation is to develop a dedicated national/state coastal climate resilience mission; enforce current CRZ policies and improve monitoring of coastal zones, and strengthen mangrove restoration and natural buffer systems.

## 1. INTRODUCTION

Global Climate Risk Index 2021 ranks India as the seventh-most exposed and vulnerable country to climate extremes<sup>ii</sup>. With high risk of concurrent flood incidents, the country is amongst the most climate-vulnerable, as per an IPCC report (Intergovernmental Panel on Climate Change, 2023). This is especially true for the nearly 171 million population in coastal districts. India is highly susceptible to cyclones and related hazards such as storm surges, intense winds, and extreme rainfall. More than 300 extreme events have occurred in the country in recent decades, causing financial losses of more than INR 5,600 billion (Mohanty, et al., 2020). A recent evaluation indicates that more than 75% of districts in India, including 95% of coastal districts, are hotspots for extreme events (Mohanty, et al., 2020).

### ***West Coast: Increasing Climate Risks***

While the east coast has faced greater exposure to tropical cyclones (TC), recent trends highlight the Arabian Sea (west coast) with increased cyclonic formations (Deshpande, et al., 2021). The Arabian Sea has emerged as a key region for tropical cyclones in recent years, that have led to severe impacts across the western coast of India (Thomas & Lekshmy, 2022). Between 2001 and 2019, the frequency of cyclonic storms in the Arabian Sea surged by 52%, while the Bay of Bengal (east coast) recorded an 8% decline (Deshpande, et al., 2021). Coastal districts of Gujarat, in particular, have become increasingly vulnerable (Boragapu, Guhathakurta, & Sreejith, 2023). This rise in frequency and intensity of Arabian Sea cyclones has been attributed to rapid increase in sea surface temperatures (Deshpande, et al., 2021). Compounding these risks, west coast states are more vulnerable to sea level rise; every one-metre rise in sea level can inundate almost 5,763 km<sup>2</sup> of land (Woodruff, BenDor, & Strong, 2018). The situation is further aggravated by the significant loss of mangrove ecosystems, which are projected to continue declining beyond 2100, as per UNFCCC-IPCC 2023 report.

### ***Climate Risks and Water and Sanitation Infrastructure and Services: Amplifying Inequalities***

Access to basic services such as housing, improved sanitation, and safe drinking water forms the first line of defence against the potential impacts of climate change. These services are essential for enhancing people's resilience and adaptive capacity. Especially following climate hazards such as heavy rainfall, ensuring access to appropriate and reliable WaSH services plays a vital role in protecting populations from water-related diseases and flooding (Carlton, et al., 2014).

**Further exacerbating the risks posed by climate change is the inadequate infrastructure and services in critical areas such as housing, sanitation, water, and public health, particularly for socio-economically disadvantaged groups** (Rumbach, 2018); (Yenneti, Tripathi, Wei, Chen, & Joshi, 2016). This is particularly critical in small towns, which are already finding it

challenging to provide universal access to water and sanitation services (Central Pollution Control Board, 2021), and are now exposed to climate change-related risks. The climate change induced water stress and insecurity can increase the incidences of waterborne infectious diseases, thereby, hindering or reversing advancements made in related Sustainable Development Goals (SDG) targets and amplifying inequalities (Braks & Husman, 2013). The IPCC views universal access to WaSH, i.e., achieving SDG 6.1 and 6.2, as a critical adaptation strategy, with high confidence (Caretta, 2022) and a low-regret adaptation measure (Cutter, 2012). Further, SDG 1 (No Poverty) is found to be statistically linked to SDG 6 (Clean Water and Sanitation), as reducing poverty enhances adaptive capacity in alignment with the Paris Agreement's adaptation goals (Pradhan, 2019) (Pradhan, 2019). Likewise, achieving SDG 3 (Good Health and Well-being) depends heavily on reliable access to water and sanitation infrastructure (Toni Delany-Crowe, 2019). The Intergovernmental Panel on Climate Change (IPCC) recognizes universal access to water, sanitation, and hygiene (WaSH)—as targeted in SDGs 6.1 and 6.2—as a critical, low-regret adaptation strategy, supported by high confidence (Caretta, 2022) (Cutter, 2012). Moreover, ensuring universal access to WaSH not only contributes directly to SDG 11 (sustainable cities and communities) but also promotes social equity and environmental sustainability.

Studies have predicted substantial economic losses across various sectors in India due to climate change (Chaturvedi, 2015); (Kumar & Maiti, 2024). For Mumbai, sea-level-rise-induced damage to building foundations between 2005 and 2050 is estimated at INR 1,501,725 crores (Kumar, Jawale, & Tandon, 2008). Further, a 2.5% decrease in growth rate is expected with one-degree Celsius temperature increase for India (Jain, O'Sullivan, & Taraz, 2020). Such economic losses may ensue from the diminished functionality of the infrastructure and, consequently, the provision of related services (Kreibich, et al., 2014) such as critical services like water and sanitation. For example, in Alibag (a small coastal town in Raigad district, Maharashtra) power lines were damaged, which led to the disruption of water supply. This lasted for 8 hours since the town did not have necessary alternative infrastructure to restore the power supply. In this context, IPCC underscores the importance of making WaSH infrastructure climate-resilient (Ben A. Smith, 2015); Shah et al., 2020) (Ashfaq Ahmad Shah, 2020). Resilient infrastructure systems should not only be able to absorb and resist the impacts of disasters but also ensure uninterrupted service delivery during crises. Moreover, they must recover quickly in a manner that reduces future vulnerabilities. Integrating resilience into the design, planning, and operation of water and sanitation systems is critical for safeguarding public health and ensuring sustainable service delivery in a changing climate.

**Beyond implementing new infrastructure, the expansion and replacement of existing WaSH systems offer crucial opportunities to integrate climate-resilient approaches and reduce**

**greenhouse gas (GHG) emissions** (Boholm & Prutzer, 2017), (Dickin, Bayoumi, Giné, Andersson, & Jiménez, 2020).

**With this understanding, a project a landscape study on climate resilient water and sanitation infrastructure across four west coast states was initiated under the *Climate Resilient Coastal Cities* project – a collaborative initiative of HSBC India, the India Sanitation Coalition (ISC) at FICCI, the Ashank Desai Centre for Policy Studies at IIT-Bombay (henceforth will be referred to as IIT-Bombay, unless specified otherwise), and CDD India.** The initiative aims to (i) assess the climate resilience of WaSH infrastructure and services in fifteen coastal towns across the four states of Goa, Gujarat, Karnataka, and Maharashtra, (ii) analyse the related water-energy-climate policy landscape, (iii) design and implement town-level solutions in select locations, and (iv) propose recommendations to strengthen the resilience of WaSH systems. IIT-Bombay and CDD India were the research and implementation partners. Both partners conducted town-level assessments of existing WaSH infrastructure, with CDD India focused on three towns in Maharashtra and translating the assessments into actionable climate resilient sanitation plans (CRoSAPs), and IIT-Bombay, focused on the remaining twelve towns (three per state) within the scope of understanding the water-energy-climate policy landscape. IIT-Bombay additionally focussed on providing similar analysis and understanding at the state level (for each state) and national level.

Among the selected states, **Gujarat, with a 1,600 km-long coastline<sup>i</sup>—the longest in India—and nearly 9.9 million people living across 40 coastal talukas, faces heightened exposure to climate-related hazards such as sea-level rise, cyclones, storm surges, strong winds, heavy rainfall, and salinity ingress.** Goa is highly vulnerable, with projections indicating that a 1-meter rise in sea level could affect nearly 7% of its population, potentially submerging key coastal areas. Maharashtra is listed among the top three most climate-vulnerable states (Mohanty & Wadhawan, 2021). Karnataka ranks among India's top four most climate-vulnerable regions (Mohanty & Wadhawan, 2021).

**The report focuses on presenting the findings for Gujarat.** As per the 2011 Census, the state ranks among the top 10 in terms of population, accounting for 4.99% of the national total. Approximately 43% of its population (60 million population as per Census 2011) lives in urban areas. Although Gujarat comprises only around 5% of the country's population, it contributed 8.27% to the national GDP in 2023 (Directorate of Economics & Statistics, 2024). **With a 1,600 km-long coastline<sup>i</sup>—the longest in India—and approximately 9.9 million people residing across 40 coastal talukas, the state is especially vulnerable to climate-related hazards such as sea-level rise, cyclones, storm surges, strong winds, heavy rainfall, and salinity ingress** (Government of Gujarat, 2021); (Gujarat State Disaster Management Authority, 2024). **In addition to rising sea levels, the state faces significant climate change risks, including**

**extreme temperatures and erratic precipitation patterns. By 2050, 19 of Gujarat’s 26 districts are projected to become climate hotspots, with temperatures expected to rise by 2–2.5°C (Government of Gujarat, 2021). These impacts affect agriculture (employs 50% of the workforce, contributes 9.5% to the Gross State Domestic Product), key economic sectors, infrastructure, and population groups (Government of Gujarat, 2021).**

To effectively adapt to the looming risks of climate change and build resilience, the state must ensure the delivery of basic services. **Notably, it performs well across several key development indicators.** For example, for instance, the state ranks ninth in per capita net GDP for the year 2022–23, trailing behind Goa (2nd) and Karnataka (7th) (RBI, 2024, pp. 65–68). **In terms of Sustainable Development Goals (SDGs), it ranks 6th nationally—tied with Andhra Pradesh and Telangana—with a composite score of 74 out of 100 for 2023–24 (NITI Aayog, 2024). It performs particularly well on SDG 6 (Clean Water and Sanitation), scoring 98 out of 100 and securing the 3rd rank. For SDG 11 (Sustainable Cities and Communities), the state scores 94, placing it among the top two states in the country (NITI Aayog, 2024).**

**However, the state shows only moderate performance in terms of installed sewage treatment capacity as a percentage of sewage generated in urban areas (NITI Aayog, 2024). This stands at 67.38%, which is better than Goa (59.09%) and Karnataka (60.83%), but significantly lower than Maharashtra, which exceeds 100% (107.82%) (NITI Aayog, 2024). This impacts not only water pollution, environmental degradation, and public health, but also contributes to greenhouse gas (GHG) emissions. For instance, the domestic wastewater sector, encompassing both rural and urban areas, accounted for 3.42 Mt CO<sub>2</sub>e i.e., 34% of total waste sector (10.11 Mt CO<sub>2</sub>e) GHG emissions in 2018 (GHG Platform India, 2018). The study, however, overlooks energy consumption in its analysis of GHG emissions from the domestic wastewater sector. Including this factor would offer a more comprehensive understanding of emissions.**

The state has implemented numerous initiatives to address climate change risks. **Gujarat is the only state in India to have established a dedicated climate change department over a decade ago, recognizing climate change as a critical concern for both the state’s natural ecosystems and human-made systems (Government of Gujarat, 2021).** The state has developed a Climate Change Action Plan aligned with the national climate action framework, complemented by several supporting policies. **The plan, recognizing the interconnectedness between adaptation and resilience, as well as adaptation and mitigation, proposes a set of integrated strategies and measures. Acknowledging the crucial link between climate change and human health, Gujarat has also crafted a specific climate action plan focused on human health.** Additionally, the state has adopted various mitigation policies, including renewable energy, solar energy, and water management policies.

**The findings provide insights on the policy and governance landscape in Gujarat concerning urban water, sanitation, and climate change, focusing on how these sectoral policies interact and the implications for both.** It reviews relevant policies, programmes, and schemes to assess how they address these intersections—whether through the lens of adaptation, mitigation, or infrastructure resilience. **Particular attention is paid to how climate change impacts water and sanitation infrastructure and services (adaptation, adaptive capacity, and infrastructure resilience dimensions), and conversely, how these sectors contribute to climate change (mitigation dimension).** This analysis draws on the Intergovernmental Panel on Climate Change (IPCC) understanding of *Adaptation, Adaptive capacity, and Mitigation*<sup>iii</sup>. **Within the IPCC’s framework of “universal access” to WaSH the key adaptation strategies highlighted are source water protection and augmentation (through conservation), integrated urban water management, strengthened water governance, rainwater harvesting, water conservation, leak reductions and infrastructure investments for resilience (Caretta, 2022).**

**This study specifically aims to identify such solutions, while drawing on insights from the town-level studies (Mandvi, Devbhumi Dwarka, Valsad) that assess their implementation status and the challenges encountered on the ground. Mitigation** refers to human interventions aimed at reducing greenhouse gas (GHG) emissions or enhancing carbon sinks. Accordingly, **this analysis focuses on identifying policies and programmes that directly or indirectly contribute to GHG mitigation.** Further, infrastructure resilience to disasters refers to the capacity of disaster-resilient infrastructure systems to withstand and absorb shocks, maintain service continuity during crises, and recover rapidly in ways that reduce future risks (CDRI)<sup>iv</sup>. **Accordingly, this report also examines whether and how the state policies incorporate resilience principles into the design, planning, and operation of critical infrastructure—particularly water and sanitation systems.** The analysis also maps the roles and responsibilities of key agencies involved in water, sanitation, and climate change.

*For clarity, this report is organised into seven sections. Section 1 offers a brief overview of the importance of studying the west coast in relation to climate change and its impact on the water and sanitation infrastructure and services in Gujarat and vice-versa. Section 2 outlines the methodology adopted for data collection, followed by a brief profile of Gujarat in Section 3. Section 4 explores the state’s climate exposure and vulnerability, with particular emphasis on the water and sanitation sector. Section 5 examines the prevailing funding landscape across key national and state-level programmes related to urban water supply and sanitation, while highlighting major implementation challenges. Section 6 analyses the institutional framework by examining key actors across three tiers of governance and their respective roles in delivering water and sanitation services. It further explores the policy landscape at the intersection of water, sanitation, and climate change, with particular emphasis on coastal policies—highlighting the state’s adaptation, mitigation, and infrastructure resilience*



*measures. Drawing on town-level assessments (Mandvi, Devbhumi Dwarka, Valsad), the section also reflects on ground-level implementation and institutional effectiveness. The report concludes in Section 7 with a synthesis of key insights and reflections intended to guide future planning and policy integration.*

## 2. METHODOLOGY

The study primarily relied on secondary data sources (as outlined in Table 1). A comprehensive desk-based review was conducted, systematically analysing national and state-level portals to compile an inventory of key policies and programmes related to urban water, sanitation, and climate change within the water and sanitation sector. This review also enabled the mapping of relevant stakeholders and their institutional roles in service delivery. Additionally, it provided an overview of the status of urban water and sanitation infrastructure and services in the state, as well as data on climate exposure, vulnerability, and projected impacts at the state and district levels—particularly important in the absence of such data at the town scale.

To complement the desk review, semi-structured interviews were carried out with key stakeholders and subject-matter experts to capture contextual insights on policy and institutional frameworks governing water and sanitation and climate change in the state. The study also draws on town-level assessments conducted in Mandvi, Devbhumi Dwarka, Valsad, which included field investigations and interviews with Urban Local Body (ULB) officials and management authorities. These town-level assessments provided a grounded understanding of how state and national policies are being implemented at the local level (detailed findings are presented in the respective town assessment reports).

*Table 1: Data Collection Methods*

Sl. No.	Objective	Data Collection Method	Data Sources
1.	To understand climate change projections, impacts and vulnerability	Secondary Data through Literature Review	Government reports: state climate change action plan, vulnerability assessment reports
		Stakeholder semi-structured Interviews	Devbhumi Dwarka, Mandvi, Valsad
2	To understand status of WaSH services in study area	Secondary Data through Literature Review, collection from ULBs	CPCB inventory report, State government reports, non-government sources (PAS website)
3	To understand linkages between climate change and WaSH policies	Secondary Data through Literature Review	Various reports
		Stakeholder semi-structured Interviews	Devbhumi Dwarka, Mandvi, Valsad
4	To map current institutional environment	Secondary Data through Literature Review	
		Stakeholder semi-structured Interviews	Devbhumi Dwarka, Mandvi, Valsad
5	To map current financial sources for climate change and water and sanitation	Secondary data through literature Review, collection from ULBs	SBM (urban), MoHUA website, Urban Development, Government of Gujarat

Note: The three towns were selected in consultation with the SBM State mission director. The towns fall under different Classes with respect to the population. Valsad is Class A Town with 1,70,000 population; Mandvi is Class C town with 51,376 population; Devbhumi Dwarka is Class C town with 38,873 population.

**The current study focusses on the three Urban Local Bodies (ULBs) in Mandvi, Devbhumi Dwarka, Valsad (Table 2).** The three towns were selected from a potential list after consultations with the State Mission Director of SBM-Urban, Gujarat. Selection criteria included climate change vulnerability, sanitation ladder position, city size, and governance structure to ensure diverse policy evidence linking WaSH and climate change.

*Table 2: List of Towns Selected in Gujarat*

State	Town	Population (2011)	Class
Gujarat	Devbhumi Dwaraka	38,873	Class-III
	Mandvi	51,376	Class-II
	Valsad	1,70,060	Class-I

### **Study Limitations**

The findings presented in this report should be viewed in consideration of a few study limitations: **Representation of Urban Areas** – Three towns were examined in greater detail to illustrate local realities. While these case examples provide valuable insights, they may not fully represent the diversity of conditions across all urban areas in the state unless specified otherwise. **Differences in Research Focus** – The *Climate Resilient Coastal Cities* initiative comprises a National Report, four State Reports, and fifteen Town Reports. This document represents one of the four state-level studies. This report primarily draws on research and analysis conducted by the Ashank Desai Centre for Policy Studies at IIT-Bombay. Variation in this report and other state reports (specifically, the Maharashtra State Report) is a reflection of differing research objectives of the two research and implementation partners under the initiative<sup>v</sup>. **Scope of the Report** – The study focuses on selected aspects of the water and sanitation sector that are most relevant for climate resilience and service delivery. It is not intended as an exhaustive review of the entire WaSH space but highlights priority areas where policy attention can strengthen outcomes. **Data Availability** – The study relies primarily on secondary research, and the extent of analysis is therefore dependent on the quality and availability of published data and literature. Wherever possible, secondary information has been supplemented with primary inputs. **District Boundary Changes** – Devbhumi Dwarka district was carved out of Jamnagar in 2013. Some maps in this report may not reflect the

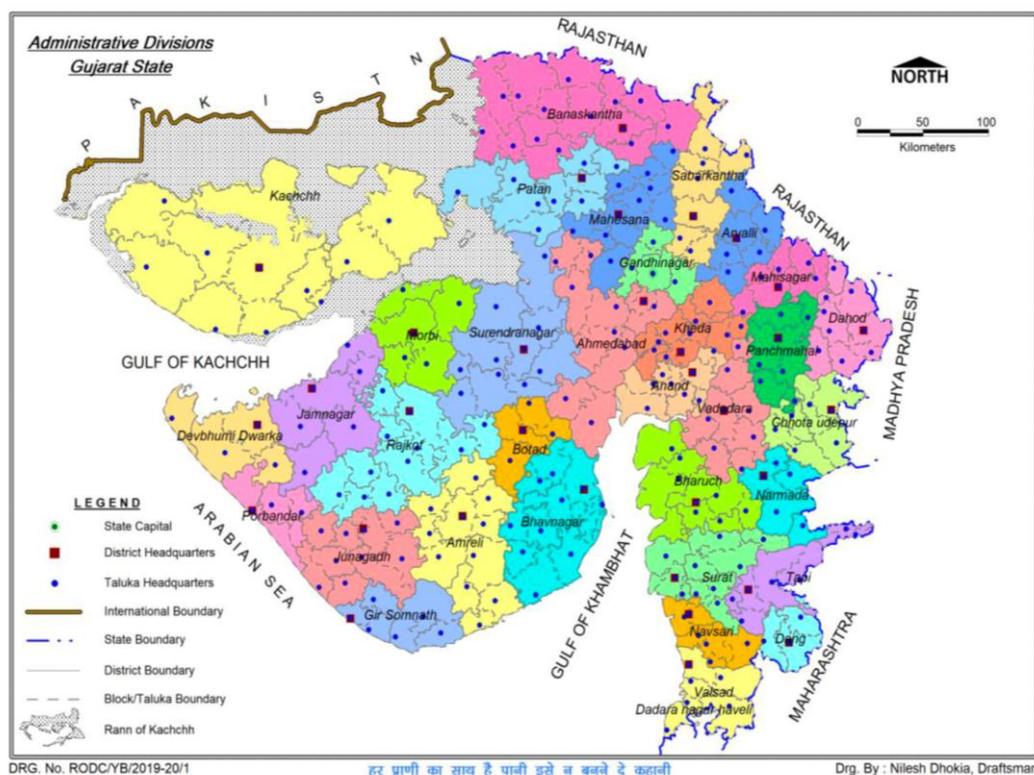


updated administrative boundary. However, the climatic and agro-climatic information presented, based on research and analysis by Ashank Desai Centre for Policy Studies, IIT-Bombay, remains valid for the corresponding geographic area.

### 3. STATE OVERVIEW

Gujarat is located on the western coast of India, between latitudes 20°6'N and 24°42'N, and longitudes 68°10'E and 74°28'E. It is the fifth-largest state by area, spanning 1.96 lakh square km. It shares its borders with Rajasthan to the northeast, Madhya Pradesh to the east, and Maharashtra to the southeast. The Union Territories of Dadra and Nagar Haveli, and Daman and Diu, lie to its south and southeast, respectively. To the northwest, Gujarat shares an international border with Pakistan. The Arabian Sea borders the state to the west and southwest, giving it a coastline of approximately 1,600 kilometres<sup>1</sup>—the longest in India (Government of Gujarat, 2021). The state is divided into 33 administrative districts and 248 talukas (tehsils), as shown in the Figure 1.

Figure 1: Administrative Map of Gujarat



Source: (Central Ground Water Board , 2023)

**Physiography:** Gujarat State can be divided into five major physiographical zones (Central Ground Water Board , 2023). **(i) Alluvial Plains:** Stretching from the northern edge of Banaskantha district to the southern parts of Valsad, Gujarat's alluvial plains cover the central areas of North and Central Gujarat, as well as the western region of South Gujarat. In the Rann of Kachchh, these plains are notably low-lying and saline. **(ii) Eastern Hilly Region:** This hilly

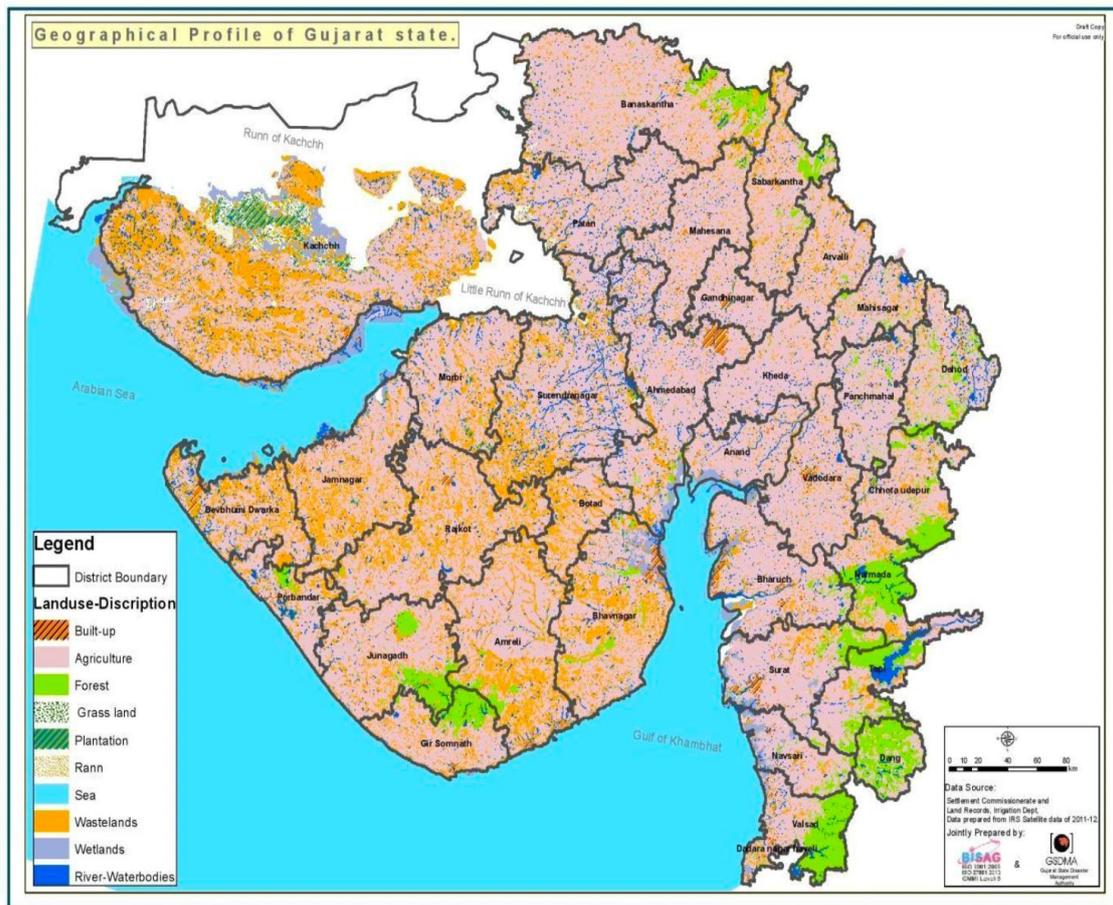
zone runs along Gujarat's eastern border, extending from the northeastern tip of Banaskantha to the southeastern end of the Dangs district. Elevations in this region range between 300 and 1,400 meters above mean sea level. Apart from major inter-state rivers like the Narmada and Tapi, most of Gujarat's rivers originate in these hills and flow south or southwest.

**(iii) Saurashtra and Kachchh Uplands:** The Saurashtra plateau is separated from mainland Gujarat by the Gulf of Cambay, while the Kachchh uplands are divided from both Saurashtra and the mainland by the Gulf of Kachchh and the Little Rann of Kachchh. Mount Girnar, located in Saurashtra, rises to 1,117 meters above sea level. These regions have a dome-like structure, sloping outward in all directions from their central highlands. **(iv) Coastal Alluvial Plains:** Running along the western edge of Gujarat, the coastal alluvial plains stretch for about 1,600 kilometres<sup>1</sup>—from Lakhpat in northwestern Kachchh to Valsad in the south. These plains are narrow and low-lying, with elevations ranging from just a few meters to around 25 meters above sea level.

**(v) The Rann of Kachchh:** The Rann of Kachchh, consisting of the Greater and Little Rann, is a vast, saline, and marshy desert located in the northern and southeastern parts of Kachchh district. This region, characterized by salt-laden clay soils, is largely devoid of vegetation and human settlement. Elevations generally range from 1 to 4 meters above sea level. During high tides, seawater from the Kori Creek and the Gulf of Cambay floods parts of the Rann. Some depressions in the area lie below sea level and form small saline inland lakes.

The Land Use and Land Cover map of Gujarat (Figure 2) indicates that **urban development is primarily concentrated in Ahmedabad, Vadodara, Surat, and Rajkot**. The Rann dominates much of the Kutch district in the northwest, while the remaining areas are largely comprised of forests and agricultural land (Government of Gujarat, 2021). **In 2019, the forest cover in Gujarat was recorded at 9.62% of the state's total area** (Government of Gujarat, 2021).

Figure 2: Landuse and Land Cover Map of Gujarat



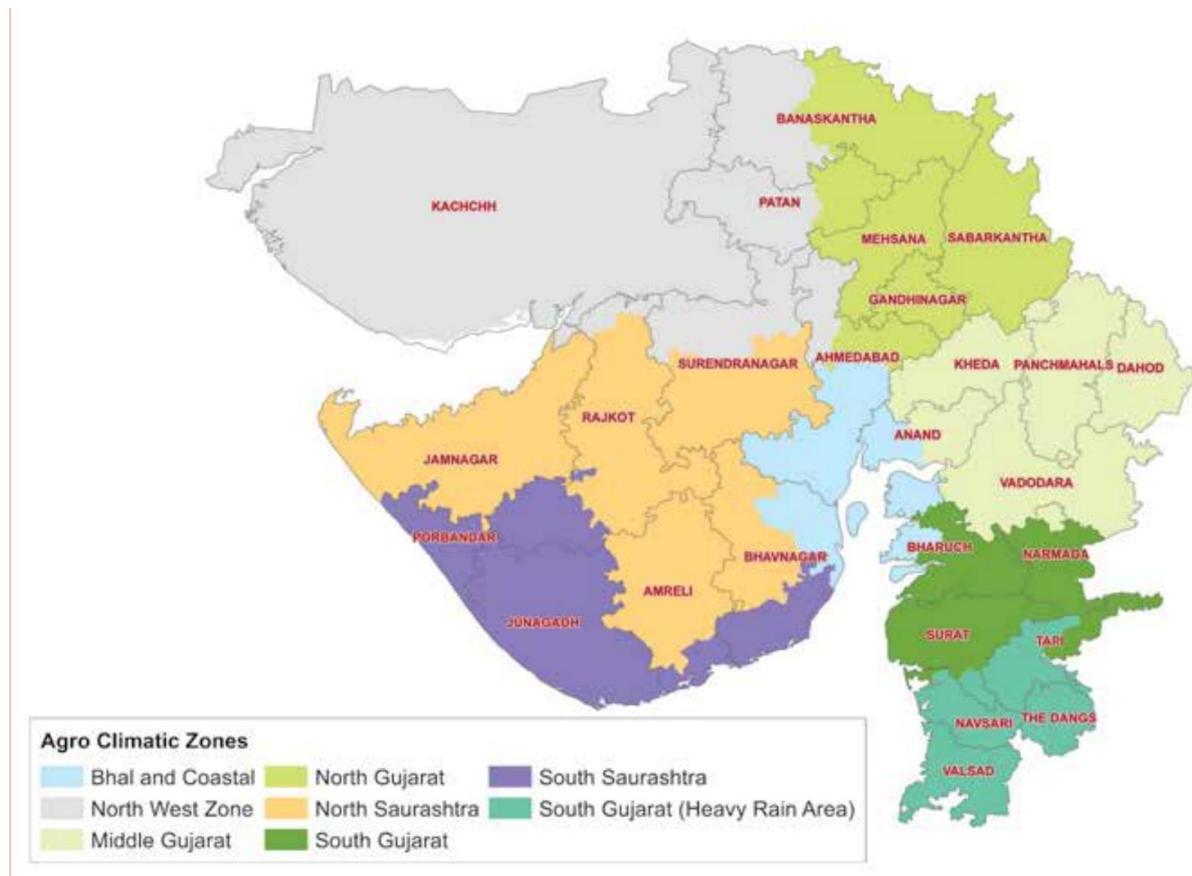
Source: (Gujarat State Disaster Management Authority, 2024)

**Climate Profile:** The state's elevation ranges from sea level to 812 meters, with the highest altitudes found in the Aravalli region, while much of the remaining terrain is relatively flat. Gujarat experiences a semi-arid climate, characterized by extremely hot and dry summers, with daytime temperatures reaching up to 49°C and night time temperatures around 30°C. Winters are mild and dry, with average daytime temperatures around 29°C and nighttime lows near 12°C (Government of Gujarat, 2021).

The state has eight agro-climatic zones (Figure 3), six of which are classified as semi-arid. **The selected towns—Mandvi, Devbhumi Dwarka, and Valsad—are located in the North West Zone (arid to semi-arid zone; rainfall 250 to 500mm ), North Saurashtra Zone (dry sub-humid; rainfall 400 to 700 mm), and South Gujarat Zone (Semi-arid to dry subhumid and rainfall 1500 mm and above), respectively** (National Dairy Development Board , 2014, pp. 109-111). **The Annual average rainfall for the state is 800-1000 mm** (Government of Gujarat, 2021). **Figure 3 illustrates the pattern of annual average rainfall for 2014-2023 in the selected districts—Kachchh, Devbhumi Dwarka, and Valsad—where the study towns are**

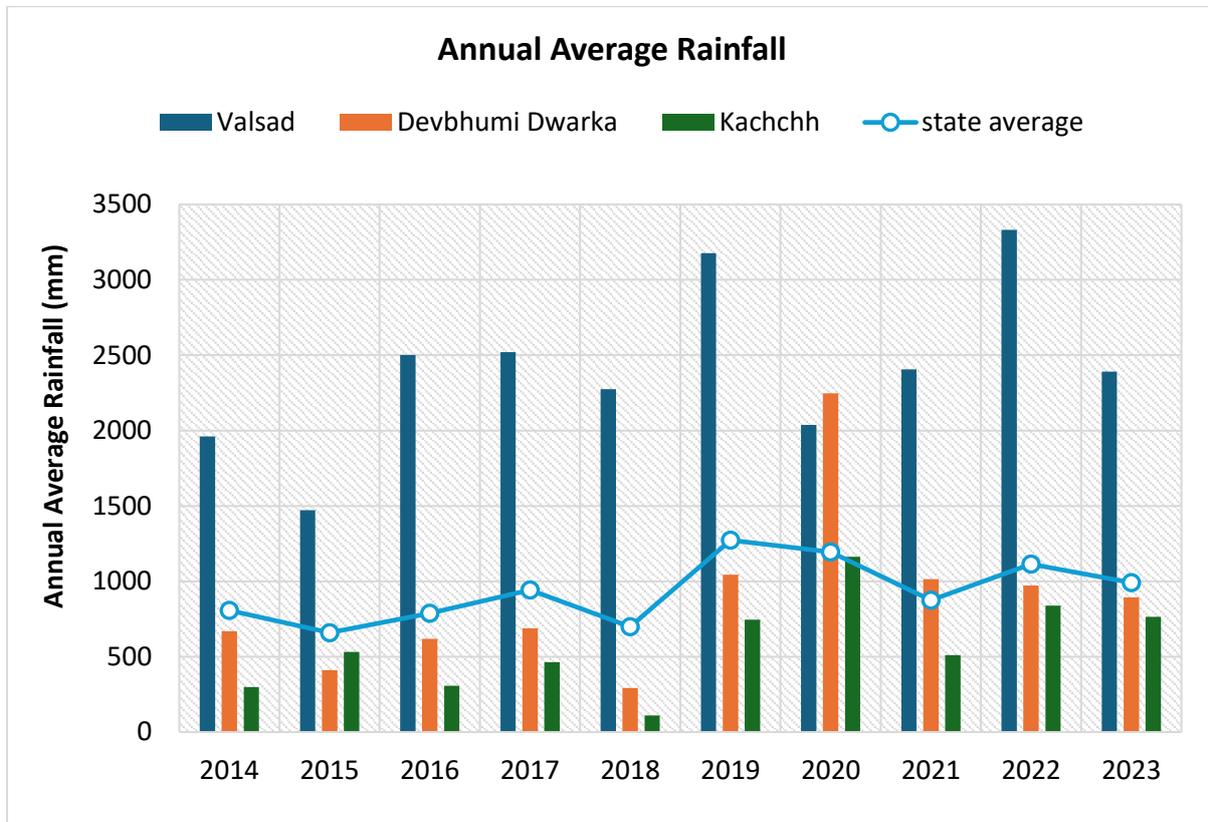
located. It is evident that Valsad receives the highest annual average rainfall, followed by Devbhumi Dwarka, while Mandvi, located in the North West arid to semi-arid zone, receives the least.

Figure 3: Agro-climatic Zones in Gujarat



Source: (National Dairy Development Board , 2014)

Figure 4: Annual Average Rainfall (mm) in Selected Districts of Gujarat for 2014 - 2023



Source: data from (Directorate of Economics & Statistics, Government of Gujarat, 2024b)

**Demography:** According to the 2011 Census of India, Gujarat had a population of 60 million, making it ninth-most populace state in the country. This marked a growth of 19.17% from 50,671,017 in 2001. The state’s population density increased from 258 persons per km<sup>2</sup> in 2001 to 308 persons per km<sup>2</sup> in 2011. Surat district recorded the highest population density at 1,337 persons per km<sup>2</sup>, while Kutch had the lowest at 46 persons per km<sup>2</sup>. Gujarat's sex ratio stood at 918 females per 1,000 males. The population of Scheduled Castes and Scheduled Tribes in the State is reported at 40.74 lakh (6.7%) and 89.17 lakh (14.8%) respectively (Directorate of Economics and Statistics, 2025). The literacy rates reported were 87.23% for males, 70.73% for females, and an overall rate of 79.31%. The state’s urban population rose from 34.5% in 1991 to 42.6% in 2011. Urban residents are concentrated in 159 municipalities and 8 municipal corporations, while the remaining 57.4% of the population lives in 18,584 villages.

**The primary occupation in the state is business, agriculture and industries workers.** As per the 2011 Census, the population distribution by economic activity in the state shows that

33.7% are main workers, 7.3% are marginal workers, and 59.0% are non-workers (Directorate of Economics and Statistics, 2025).

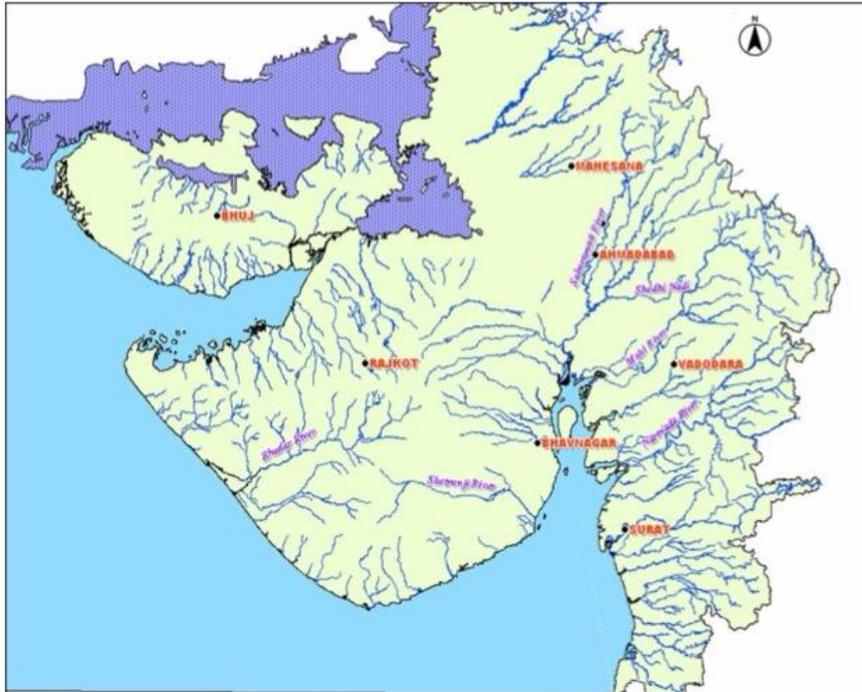
**Economy:** Although Gujarat comprises only around 5% of the country's population, it contributed 8.27% to the national GDP in 2023 (Directorate of Economics & Statistics, 2024). The Per Capita Income (Per Capita NSDP at Market Prices) at current prices is estimated at ₹2,73,558 for 2022–23 (Q), up from ₹2,41,930 in 2021–22 (P), reflecting a 13.1% increase over the year (Directorate of Economics and Statistics, 2024a). Gujarat is among the most industrialized states in India, with its industrial sector showing consistent growth over the years. Key industries in the state include cement, pharmaceuticals, dairy, chemicals, engineering, petrochemicals, textiles, gems and jewellery, and ceramics (Government of Gujarat, 2021). The share of primary sector (Agriculture, Forestry & Fishing, Mining & Quarrying, livestock) to the total GSDP is 20 %, while secondary sector (manufacturing, electricity, gas, water, other utility services, construction) contributed 44.6% in 2022-23 (Q) (Directorate of Economics and Statistics, 2024a). While The State's Primary Sector contributes about 7.7% to National Primary Sector, the State's Secondary Sector contributes about 13.5% to National Secondary Sector. In 2022–23 (Q), the Tertiary Sector accounted for 35.3% of the State's total GSDP and 5% to the national output of the sector (Directorate of Economics and Statistics, 2024a).

**Water Resources:** Rainfall is the primary source of both surface and sub-surface water resources in the state. During the monsoon season (June to September), the state receives an average annual rainfall of 875 mm. However, this rainfall is marked by significant spatial variability (Gujarat State Disaster Management Authority, 2024), which affects the regional availability of water.

The state has a river system consisting of 185 minor, major, seasonal and perennial rivers and river basins, Narmada, Sabarmati, Tapi and Mahi being the 4 largest ones (Figure 4) (Government of Gujarat, 2021). **Gujarat state's surface water availability is 38.1 billion m<sup>3</sup>** (Government of Gujarat, 2021), **while total annual extractable ground water resources is 25.41 billion m<sup>3</sup>** (Central Ground Water Board , 2023). **However, this water is unevenly distributed across the state** (Narmada, Water Resources, Water Supply and Kalpsar Department, 2025). **Based on the water resources availability, the state is divided into four distinct regions of Kuchchh, North Gujarat, South & Central Gujarat and Saurashtra.** Kuchchh falls under the arid zone as it experiences very little rainfall and lack of any perennial rivers. **The Saurashtra region is made of rocky formation leading to very low water recharge potential while the South and Central Gujarat have large ground water resources, they are heavily polluted due to salinity ingress and presence of large industrial areas** (Government of Gujarat, 2021). For example, Saurashtra and Kuchchh regions hold only 9% and 2% of the

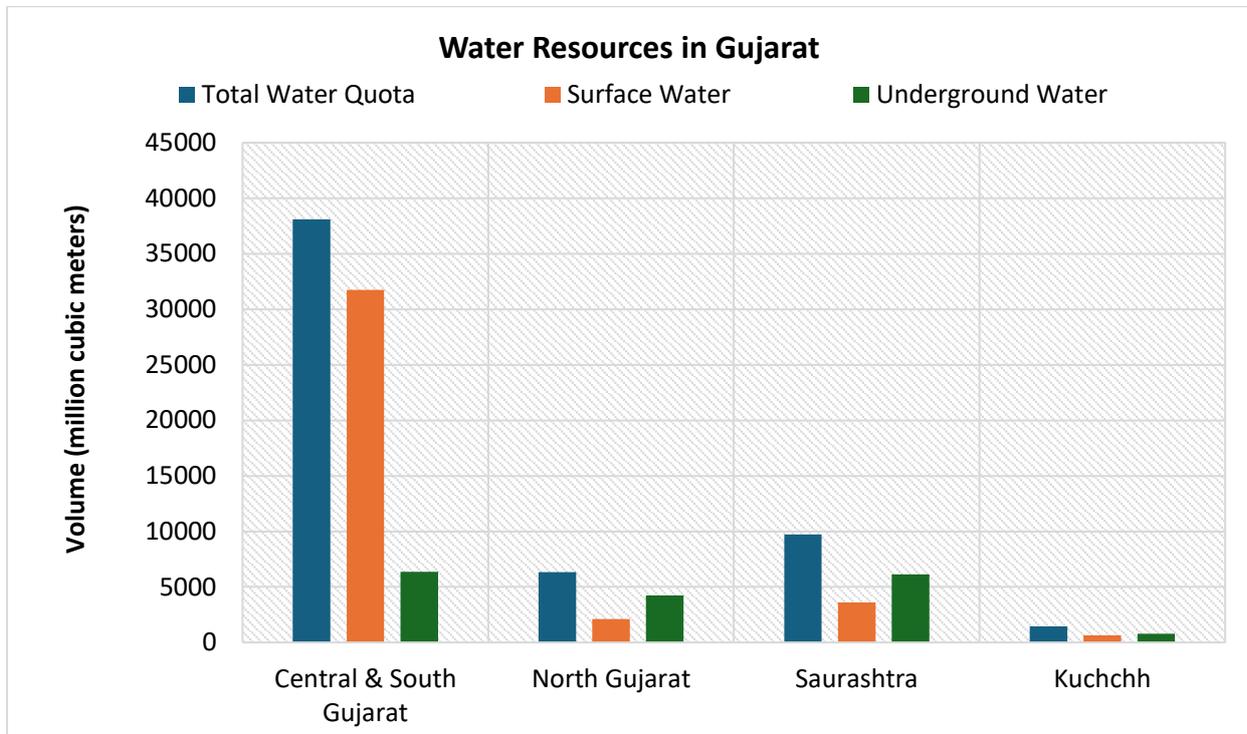
surface water resources, respectively (Figure 5 & 6) (Narmada, Water Resources, Water Supply and Kalpsar Department, 2025).

Figure 5: Major Rivers of Gujarat



Source: (Narmada, Water Resources, Water Supply and Kalpsar Department, 2025)

Figure 6: Water Resources in Gujarat



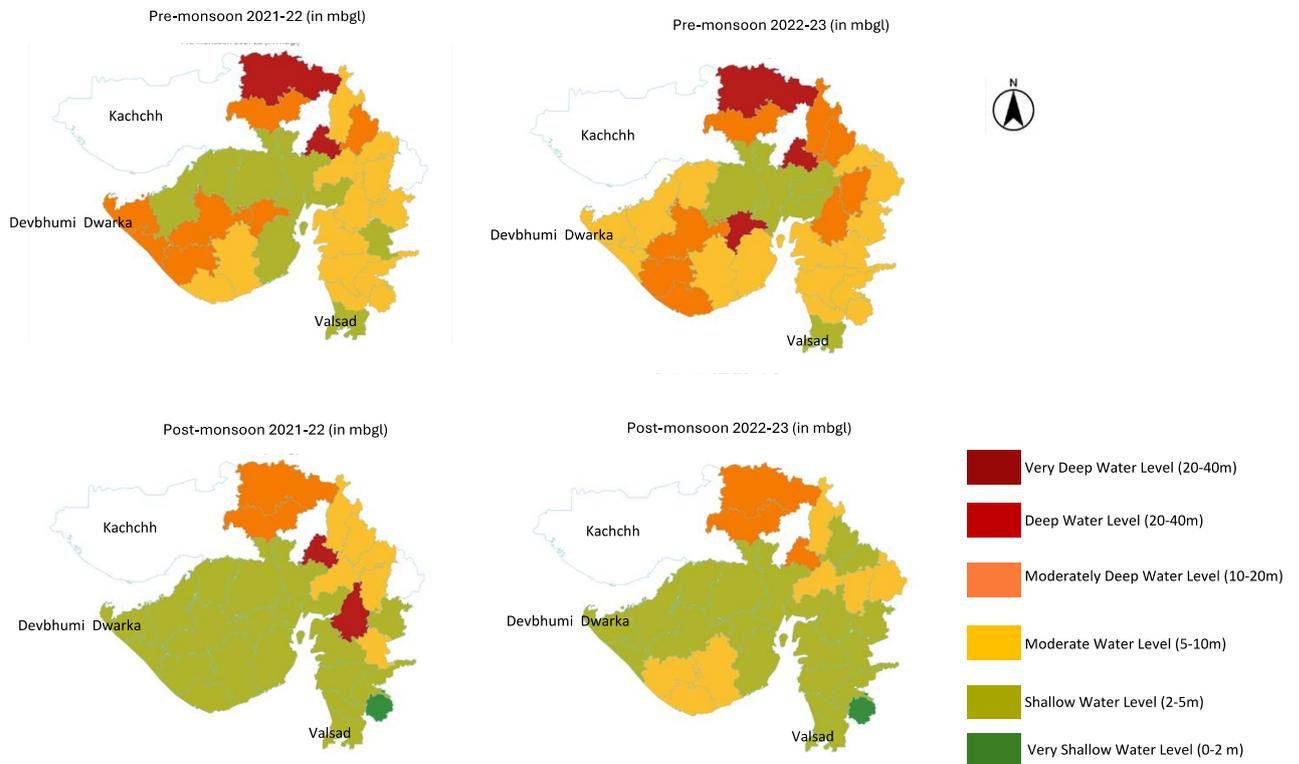
Source: data from (Narmada, Water Resources, Water Supply and Kalpsar Department, 2025)

The available surface and underground water are used for drinking purpose, industries, agriculture and hydro power, fisheries etc. Out of which, nearly 80% quota is used for agricultural production, in which irrigation also plays an important role (Narmada, Water Resources, Water Supply and Kalpsar Department, 2025).

### Water Scarcity Issues

Gujarat has experienced a range of serious water-related challenges, including groundwater depletion in North Gujarat, contamination of groundwater in South Gujarat, recurring droughts in Kutch and Central Gujarat, and frequent flooding in Saurashtra and South Gujarat (Gujarat State Disaster Management Authority, 2024). Figure 7 below presents groundwater levels before and after the monsoon for the period 2021–2023. While Valsad district shows little to no change between pre- and post-monsoon levels, Devbhumi Dwarka exhibits a significant fluctuation in groundwater levels.

Figure 7: Ground Water Level Pre-monsoon and Post-Monsoon 2021-22 and 2022-23 in Gujarat



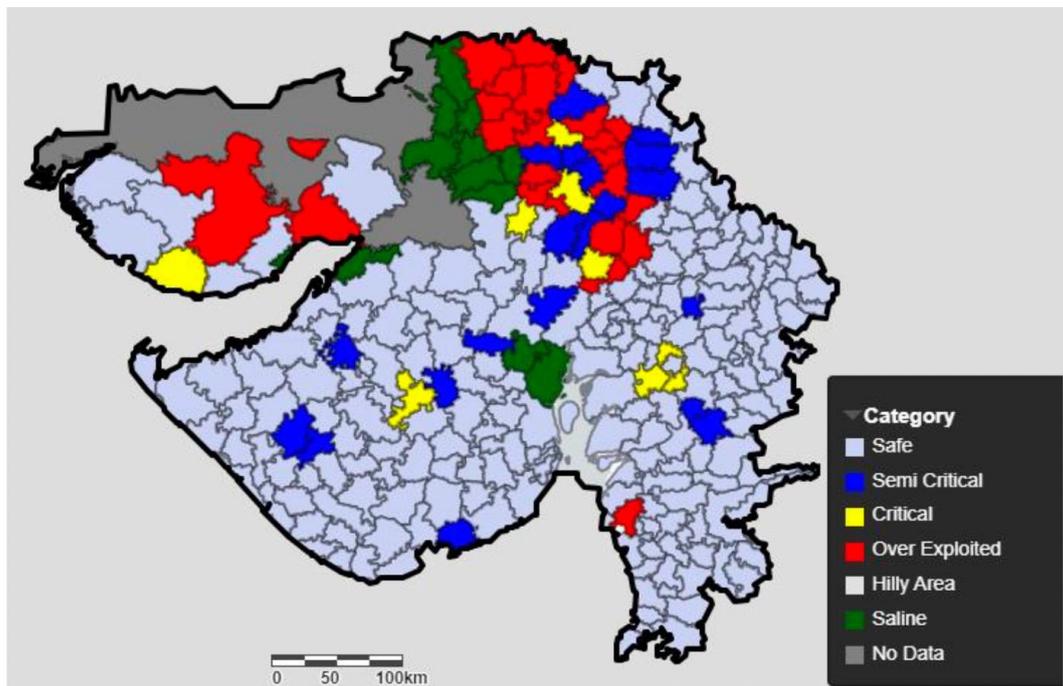
Note: White area means data is not available

Source: Data from CGWB on (NITI Aayog , 2024)

The Annual Ground Water Extraction has been assessed as 13.13 bcm and stage of Ground Water Extraction as 51.68 %. Of the 252 assessment units, 23 (9.13%) are classified as 'Over-exploited', 8 (3.17%) as 'Critical', 20 (7.94%) as 'Semi-critical', and 189 (75.0%) as 'Safe'. Additionally, 12 units (4.76%) fall under the 'Saline' category (Central Ground Water Board , 2023). Figure 8 shows water depth pre-monsoon and level stages of ground water extraction in different talukas of Gujarat.

Salinity poses a major challenge to groundwater development in Gujarat's coastal and deltaic regions, which form a narrow strip underlain by Tertiary sediments and alluvium. While these zones contain high-potential aquifers, excessive salinity limits their usability. Strict regulation of groundwater extraction is essential to prevent over-withdrawal, maintain the hydro-chemical balance, and avoid seawater intrusion. Generally, groundwater quality is suitable in both hard rock and alluvial regions, except in coastal areas, estuarine zones, and the Rann, where high mineral content and salinity are prevalent. Salinity issues also arise in the state's arid and semi-arid zones (Central Ground Water Board , 2023).

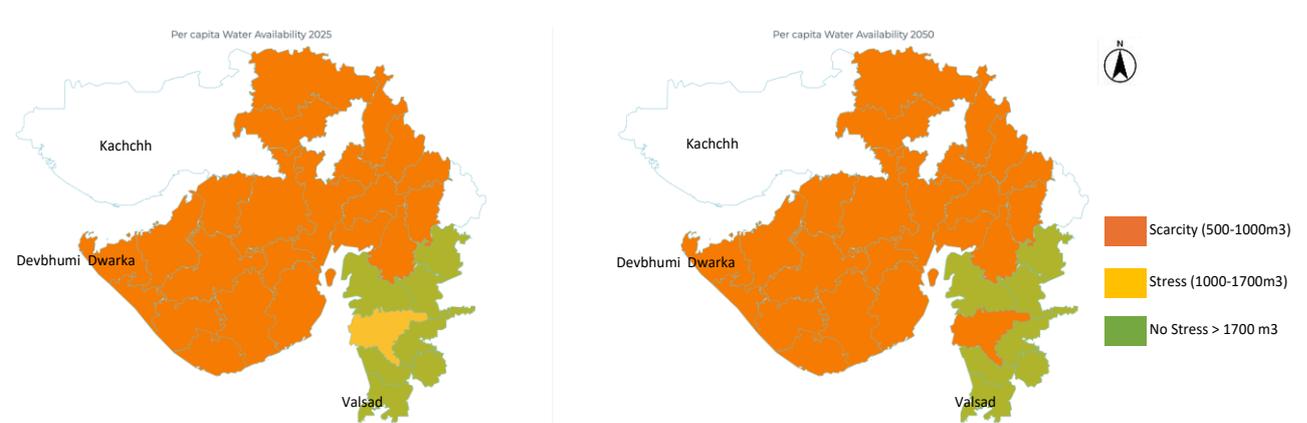
Figure 8: Ground Water Extraction in Talukas of Gujarat



Source: (Central Ground Water Board , 2023)

In terms of future projections, the selected towns, located in the districts of Devbhumi Dwarka, and Valsad are projected to fall under the scarcity and stress category in terms of per capita water availability by 2025 respectively. This status is anticipated to persist through 2050 (Figure 9).

Figure 9: Gujarat District-wise Water Stress and Scarcity in 2025 and 2050



Note: White area means data is not available

Source: (Niti Aayog, 2025)

## 4. CLIMATE CHANGE AND VULNERABILITY

Broadly, vulnerability is a function of exposure (to hazard), sensitivity, adaptive capacity (to adapt to changing circumstances), and resilience (to bounce back to the previous state). This section highlights the status and projected exposure to climate change events, along with their potential impact on people with special focus on water and sanitation infrastructure services.

The status of the water and sanitation services, at state and district level, as a function of resilience and adaptive capacity is also discussed. Since climate change exposure and vulnerability are not adequately addressed in the literature at the town level, this section focuses on the districts to which the selected towns to.

### 4.1 Climate Change and Disasters Exposure and Impact

#### Cyclones

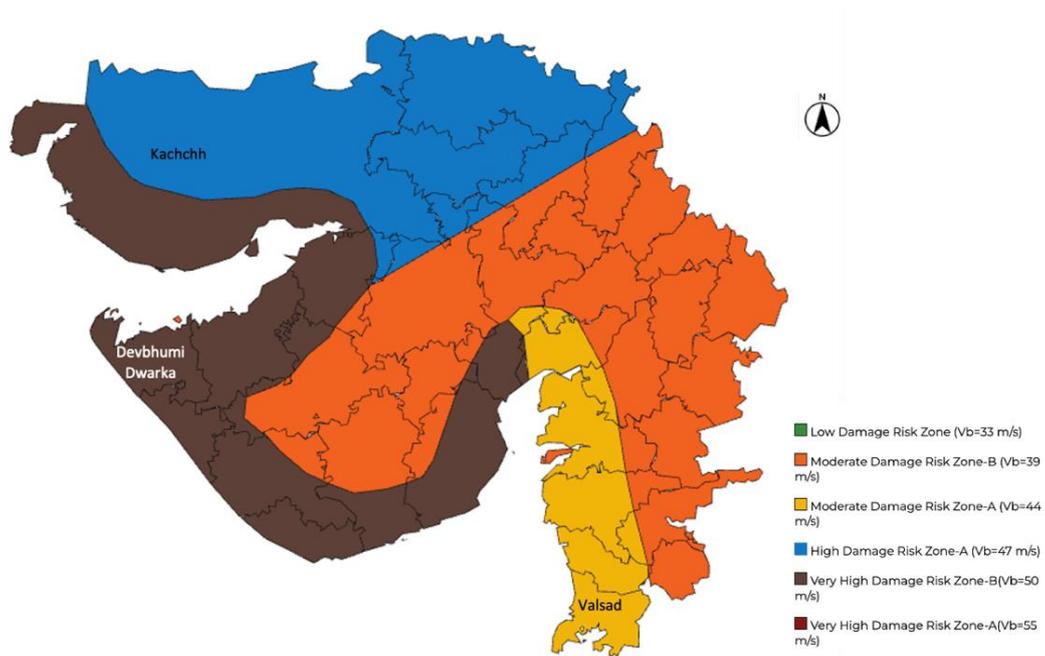
Gujarat lies within the tropical cyclone zone and, with the longest coastline in India—about 1,600 km<sup>i</sup>—it is particularly susceptible to cyclones and related hazards like flooding and storm surges. Over the past century, Gujarat has experienced more than 120 cyclones, with the Saurashtra region being particularly affected. Notable cyclones in recent years include Nilofar (2014), Vayu and Maha (2019), and Nisarga (2020) (Gujarat State Disaster Management Authority, 2024). As per NITI Ayog, different areas of Gujarat are differently impacted by the cyclones and storm surges (Niti Aayog, 2025).

Most cyclones impacting the state originate in the Arabian Sea, typically moving northeast ward and striking the coast, especially in southern Kachchh, southern Saurashtra, and western parts of Gujarat. Further, coastal areas of Kachchh, and Devbhumi Dwarka districts falls under the high maximum wind speed of 64-90 m/s and a very high damage risk zone (Figures 10 & 11). On the other hand, Valsad district moderate damage risk zone (Niti Aayog, 2025).

The cyclones and storm surges can impact infrastructure and services. For instance, Cyclone *Vayu*, which struck Gujarat in 2019 disrupted cargo operations at several ports, necessitating the evacuation of workers to safer locations. The cyclone also led to the suspension and cancellation of Western Railway services, and educational institutions were temporarily closed. Cyclone Biparjoy in 2023, a severe cyclonic storm, brought strong winds and heavy rainfall to Gujarat's coastal regions. Residents in low-lying areas of Devbhumi Dwarka and

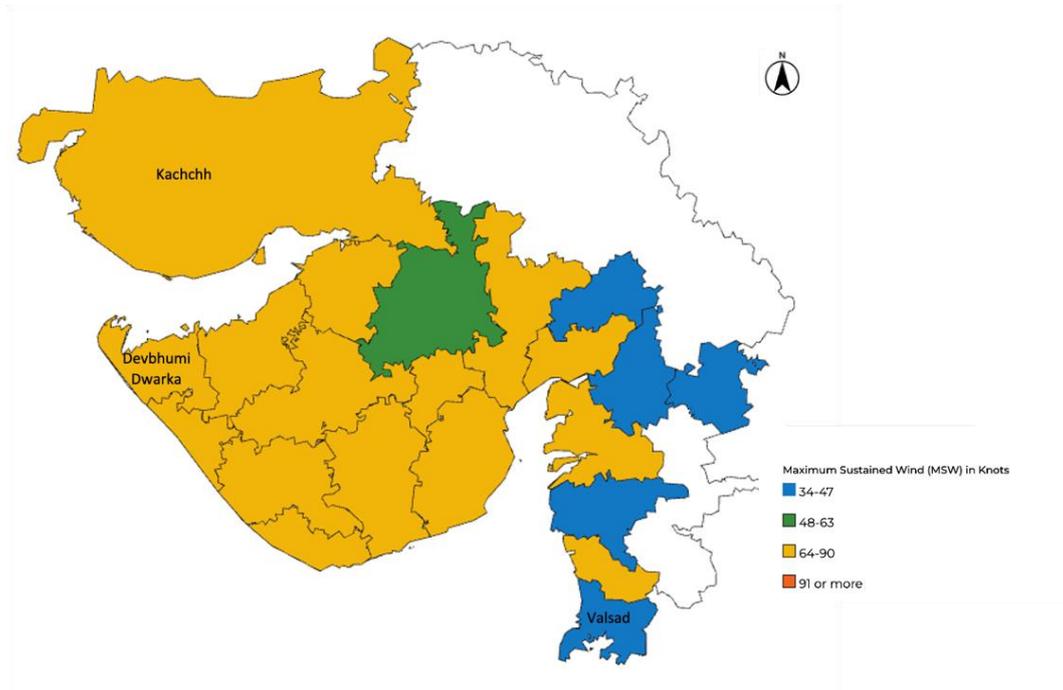
Kachchh districts were relocated to safer locations as a precautionary measure (Gujarat State Disaster Management Authority, 2024).

Figure 10: Wind Hazard in Gujarat



Source: (Niti Aayog, 2025)

Figure 11: Cyclonic Winds in Gujarat (based on wind speed data between 1891-2008)



Source: (Niti Aayog, 2025)

## Droughts

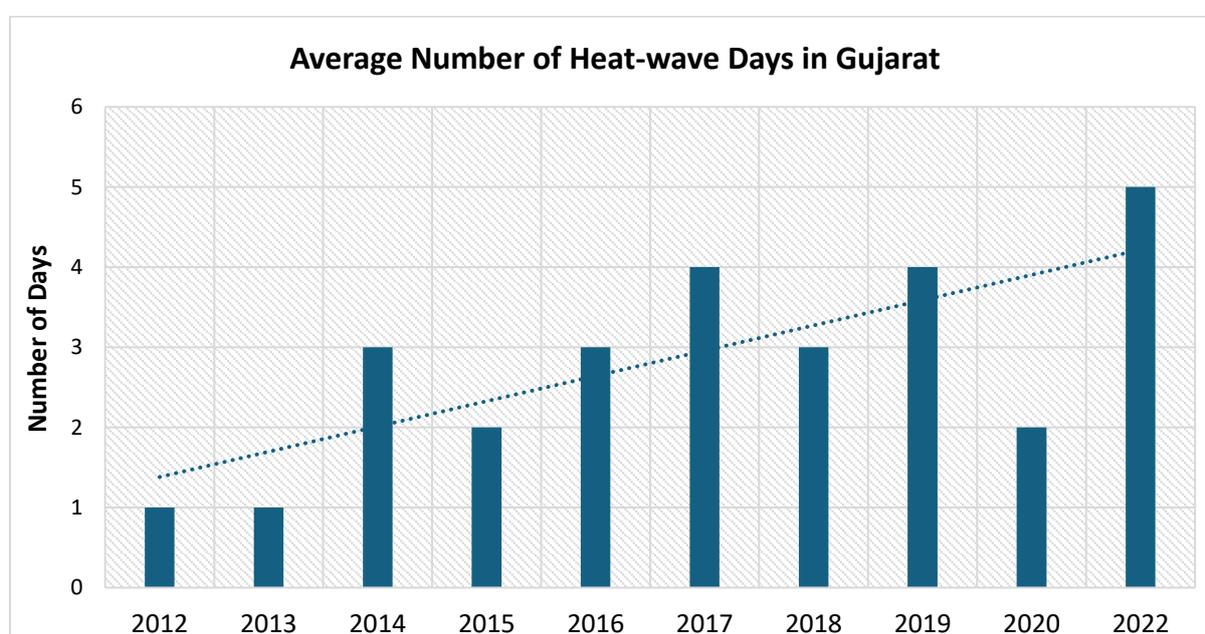
In Gujarat, 60% of the rainfall is erratic, unpredictable, and unevenly distributed. Additionally, around 75% of the state's land is unsuitable for groundwater extraction due to its rocky terrain and coastal zones. Combined with limited surface water availability, these factors have contributed to Gujarat's long-standing vulnerability to drought<sup>vi</sup>. Since 1900, the state has experienced water and food shortages nearly 30 times. With an average annual rainfall of just 700 mm—and over half its talukas receiving only 200–400 mm—Gujarat ranks among India's most drought-prone states (National Centre for Disease Control, 2022).

Large parts of Gujarat lie in arid and semi-arid zones, with regions like Saurashtra, Kutch, and North Gujarat experiencing famine approximately every three years. The scarcity of surface water has led to extensive groundwater exploitation. Monsoon delays and deficits have triggered severe droughts, notably in 2002 and 2016. Conversely, extreme and unusual rainfall events have caused major floods in the past, such as in Surat (2006) and Morbi (1979). These climatic extremes, coupled with overreliance on groundwater, increase public vulnerability to health risks associated with water scarcity, poor sanitation, undernutrition, and air pollution (National Centre for Disease Control, 2022).

## Heatwaves

Gujarat is among the states most vulnerable to extreme heat. Between March 11 and May 18, 2022, India recorded 280 heatwave days—the highest in 122 years. Five states—Rajasthan, Madhya Pradesh, Himachal Pradesh, Gujarat, and Haryana—accounted for 54% of these heatwave occurrences (National Centre for Disease Control, 2022). Over the decade from 2012 to 2020, Maharashtra recorded the highest annual average number of heatwave days, followed by Gujarat and Karnataka – Figure 12 (RBI, 2024).

Figure 12: Average Number of Heat-wave Days in Gujarat for 2012- 2022



Source: data from (RBI, 2024)

At district level, Banaskantha, Sabarkantha, Gandhinagar, Ahmedabad, Surendranagar, Rajkot, **Kachchh**, Junagadh, Porbandar, Gir-Somanath and **Valsad experienced heatwaves** (National Centre for Disease Control, 2022). In 2019, Gujarat reported 580 HRI cases and 8 deaths, followed by 64 reported cases in 2020. By June 2022, a total of 315 suspected heatstroke cases had been recorded in the state (ibid).

The state experienced an unusually high number of hot days in several years, including 1980 (55 days), 1998 (53), 2002 (52), 2009 (53), 2010 (75), 2015 (64), 2017 (53), 2018 (71), and

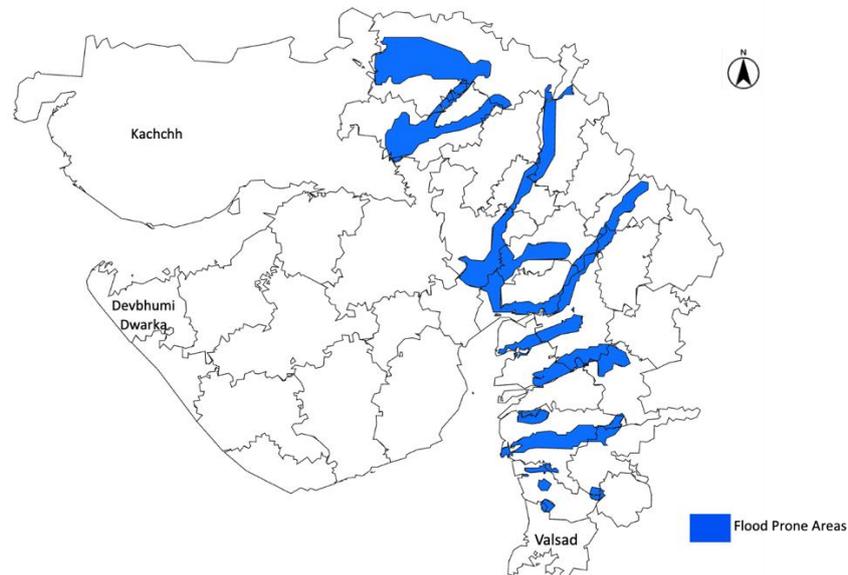
2019 (55). The state has largely seen an upward trend in the frequency of hot days, ranging between 36–37 days annually, with variations from 0.01 to 30.6 days per year. The highest number of hot days and the most significant increases have been observed in regions such as Kachchh, Jamnagar, Rajkot, Amreli, Gir Somnath, Junagadh, Porbandar, Devbhumi Dwarka, Morbi, and Bhavnagar. Similarly, the frequency of hot nights ranges from 36.4 to 36.9 days per year, with changes varying between 2.3 and 33.4 days. The most pronounced increases in hot nights have occurred in parts of Amreli, Bhavnagar, Junagadh, and Rajkot (Government of Gujarat, 2021).

### **Flooding**

Average seasonal rainfall has shown an upward trend in the Saurashtra and South Gujarat regions. Most of Gujarat's major rivers flow through extensive flat terrain before emptying into the sea. These low-lying areas in the lower river basins are particularly susceptible to flooding. Cities such as Ahmedabad, Surat, and Bharuch—situated on the flat alluvial plains of major rivers—have experienced urban flooding in recent years following intense rainfall events (National Centre for Disease Control, 2022). Floods cause widespread damage to infrastructure such as roads, buildings, and tunnels, while also increasing soil erosion—especially affecting railway lines and water infrastructure. They further disrupt waste disposal and drainage systems. In addition to causing fatalities and injuries from its immediate effects, flooding can also heighten the risk of both communicable and non-communicable diseases due to increased stress and disruptions in regular healthcare services.

Instances of floods has been reported every year since 2013 from the state with report of 27 deaths in 2019 and 29 in 2022 as per IMD. 2017 floods affected multiple cities and districts and lead to 224 deaths (National Centre for Disease Control, 2022). In the 2017 Gujarat flood, for instance, 753 villages were cut off, and extensive damage was reported: six national highways, 153 state highways, and 674 panchayat roads were affected (Government of Gujarat, 2021). The financial losses were estimated at INR 10 crore for national highways and INR 26 crore for state highways. Moreover, due to track damage near Palanpur, 11 out of 20 scheduled trains were cancelled (Government of Gujarat, 2021).

Figure 13: Flood Prone Areas in Gujarat



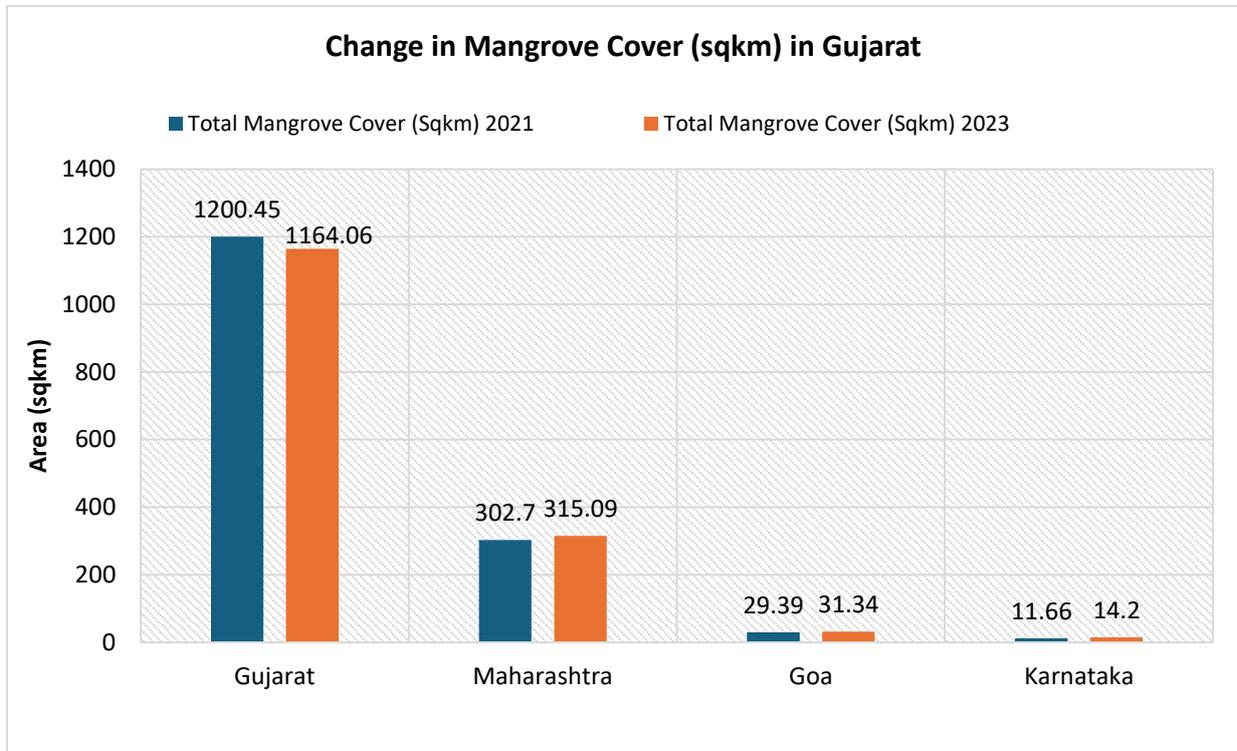
Source: (Niti Aayog, 2025)

### Sea level rise

Studies indicate that 45.67% of Gujarat's coastline falls under high to very high risk from projected sea-level rise, while the remaining 54.33% is considered to be at moderate to low risk. **The regions that are most at risk include the northwestern parts of the Gulf of Khambhat, the northernmost regions of the Gulf of Kachchh, and the western Kachchh coastline** (Gujarat State Disaster Management Authority, 2024); (Mahapatra et al., 2015 in (Government of Gujarat, 2021)). Rising sea levels are accelerating saltwater intrusion, disrupting daily life and posing health risks and loss of livelihoods for coastal communities.

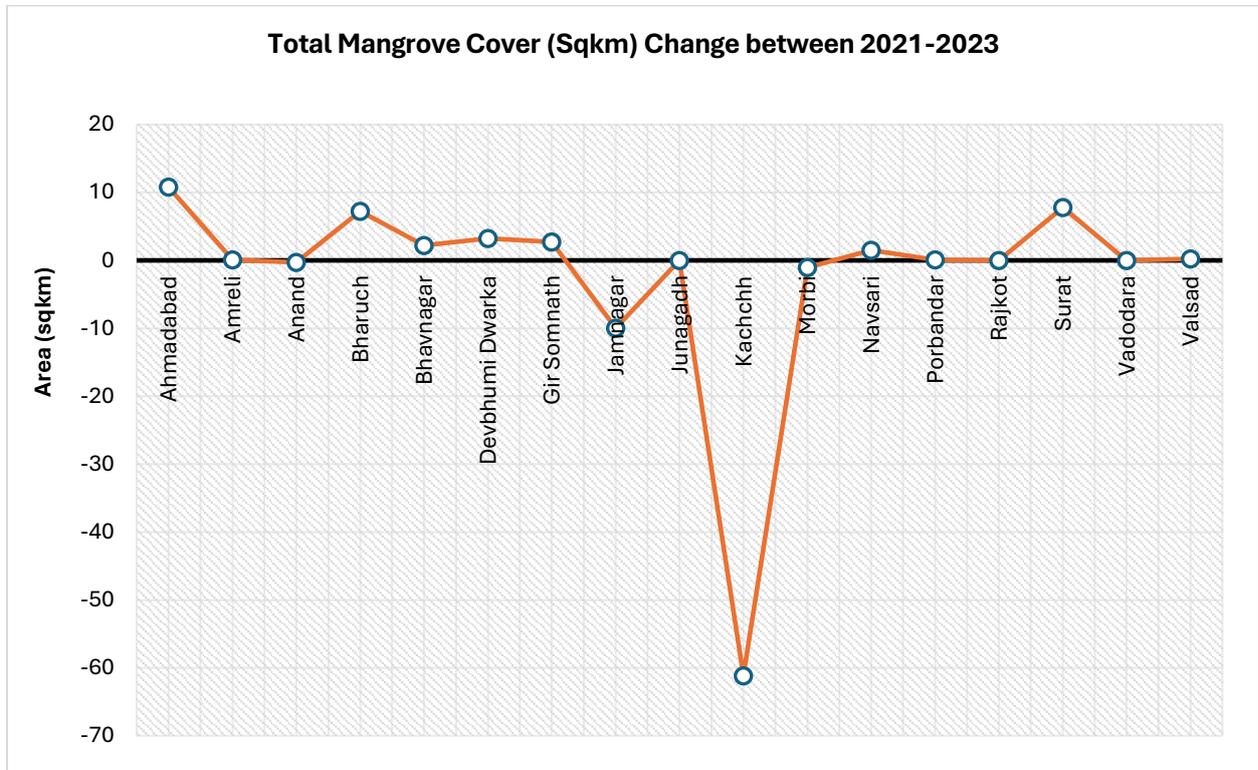
**To address saltwater intrusion**, which can lead to groundwater contamination, the state climate action plan **recommends increased mangrove plantation** along coastal areas and regulation of groundwater extraction (Government of Gujarat, 2021). However, the state is witnessing a decline in mangrove cover. As shown in Figures 14 and 15, **Gujarat lost approximately 36.39 km<sup>2</sup> of mangrove forest between 2021 and 2023. Alarmingly, this loss is most pronounced in one of the state's most vulnerable district i.e. Kachchh** (Forest Survey of India, 2023).

Figure 14: Change in Mangrove Cover between 2021 and 2023 in Gujarat



Source: data from (Forest Survey of India, 2023)

Figure 15: Change in Total Mangrove Cover (sqkm) for Districts of Gujarat between 2021 and 2023



Source: data from (Forest Survey of India, 2023)

## 4.2 Climate Change Projections

The State Climate Action Plan outlines climate projections for Gujarat across near-term (2011–2040) and mid-term (2041–2070) periods under RCP 2.6, RCP 4.5, and RCP 8.5 scenarios (Table 3)<sup>vii</sup>. This sub-section summarizes the key findings.

Under the RCP 2.6 pathway, changes in precipitation range from -28 to 24 mm in the near term, -90 to 0.73 mm in the mid-term, and 14 to 73 mm in the far-term (compared to the baseline of 1971–2000). Most parts of Gujarat are projected to see increased rainfall from the mid-term onward. The RCP 4.5 scenario shows precipitation changes from -38 to 41 mm in the near term, -16 to 36 mm in the mid-term, and a substantial increase of -1.3 to 178 mm in the far-term. **While declines are more common in the near and mid-term, a significant increase in rainfall is projected in the far future, particularly across southern Gujarat.**

Across all RCPs, precipitation is expected to rise overall, with southern districts projected to receive more rainfall than the northern regions. Mid- and far-term projections indicate a positive trend in wet events, while near-term projections show neutral to slight increases. Notably, the northwestern region, including Kachchh, is expected to experience the most significant changes across all scenarios.

Noticeable warming across Gujarat is shown under different RCP scenarios. For RCP 2.6, the projected rise in average daily maximum temperatures is between 0.9–1.2°C in the near term, 1.2–1.6°C in the mid-term, and 1.1–1.4°C in the long term. RCP 4.5 shows similar temperature increases, while RCP 8.5 anticipates much higher warming—up to 2.5°C by the long term. **The northern and northeastern districts—such as Banaskantha, Sabarkantha, Aravalli, Dahod, Patan, Mehsana, Gandhinagar, and parts of Kachchh and Ahmedabad—are expected to experience the more pronounced warming.** Some southern districts are also projected to warm under near- and mid-term RCP 2.6, and near-term RCP 4.5. **In terms of extreme heat events, the number of hot days and hot nights is expected to rise under all scenarios, based on comparisons with the 1951–2000 baseline.** Meanwhile, cold days and nights are likely to become less frequent across the state in future climate conditions.

Table 3: Climate Projections for Key Extreme Events for Gujarat (2021-2100)

Climate Driver	Current (1951-2019)	Future (2021-2100)
Mean Temperature	Increase	Increase
Extreme Heat (hot day and night)	Increase	Increase
Extreme cold (cold day and night)	Decrease	Decrease
Mean Rainfall	Increase	Increase
Extreme Rainfall	Increase	Increase
Extreme River Discharge	Increase	Increase

Source: (Government of Gujarat, 2021)

### 4.3 Vulnerability with focus on Socio-economic and Water and Sanitation Infrastructure and Services

Access to basic services such as housing, improved sanitation, and safe drinking water forms the first line of defence against the potential impacts of climate change. These services are

essential for enhancing people’s resilience and adaptive capacity. The Intergovernmental Panel on Climate Change (IPCC) recognizes universal access to water, sanitation, and hygiene (WaSH)—as targeted in SDGs 6.1 and 6.2—as a critical, low-regret adaptation strategy, supported by high confidence. Moreover, ensuring universal access to WaSH not only contributes directly to SDG 11 (sustainable cities and communities) but also promotes social equity and environmental sustainability. This sub-section discusses the status of these services with special focus on water and sanitation services. It also highlights GHG emissions related to water and sanitation and the financial performance of the sector, both of which have significant implications for climate-resilient planning.

### ***Sustainable Development Goals***

The state performs well across several key development indicators. For example, the state ranks ninth in per capita net GDP for the year 2022–23 (RBI, 2024, pp. 65-68). **In terms of Sustainable Development Goals (SDGs), it ranks 6th nationally in 2023–24 (NITI Aayog, 2024). The state scores 75 on SDG 1 (No Poverty), which is higher than the national average of 72, and shares the 9th rank with Assam. It performs particularly well on SDG 6 (Clean Water and Sanitation), scoring 98 out of 100 and securing the 3rd rank. For SDG 11 (Sustainable Cities and Communities), the state scores 94, placing it among the top two states in the country (ibid). However, the state shows only moderate performance in terms of installed sewage treatment capacity as a percentage of sewage generated in urban areas (ibid). This is discussed in the subsequent sections.**

### ***Water Supply***

As per National Family Health Survey (NFHS-5)-India (2019-20) report, in Gujarat, about 77% of households live in a pucca house and 97% have electricity. About 95% of households have access to basic drinking water services. The access to piped water is significantly higher among urban households (79%) compared to rural households (54%). Approximately **97.2% of the population relies on improved sources of drinking water**, while the remaining portion depends on **unimproved sources**, such as unprotected dug wells, surface water, and other untreated sources. Notably, **urban households do not report any dependence on dug wells**, whereas around **2.6% of rural households continue to rely on them**. However, only 65% have piped water directly into their home, yard, or premises. Additionally, just 22% of households use a suitable method to treat drinking water, with the most common practice being straining through cloth (International Institute for Population Sciences and ICF, 2021).

## **Sanitation**

In Gujarat, **19% of all households** and **31% of rural households** lack access to any form of sanitation and rely on **open defecation**. Overall, **82% of households** in the state have access to toilet facilities, with significantly higher coverage in **urban areas (97%)** compared to **rural areas (71%)**. Access also varies by social group, with only **62% of Scheduled Tribe households** having toilet access, in contrast to **95% among households not belonging to SC, ST, or OBC categories**. The access to a toilet facility in districts varies widely across the districts - from just **41% access in Dohad district** (and only **38% in its rural areas**) to **96% in Ahmedabad district**. Notably, **no district** in Gujarat has achieved **universal (100%) access** to toilet facilities (International Institute for Population Sciences and ICF, 2021).

Further, approximately **74% of households** have access to **improved, non-shared sanitation facilities**. This figure is notably higher in **urban areas (88.4%)** compared to **rural areas (63.2%)**. Around **57.9% of all households** use **flush or pour-flush toilets** connected to a **piped sewer system, septic tank, or pit latrine**. The prevalence of such sanitation systems is significantly greater in urban areas, where **77.1% of households** have these facilities, compared to just **43.4% in rural areas** (International Institute for Population Sciences and ICF, 2021). Households lacking improved sanitation are likely contributing to **water and environmental pollution**, as well as **greenhouse gas emissions**.

In the project study towns of Devbhumi Dwarka and Mandvi, field interviews with residents note the absence of toilets and practice of open defecation. Devbhumi Dwarka although seems to have 100% toilet coverage according to 2023-2024 SLB, field interviews suggest 35 households still lack both toilet facilities and piped water connections. Mandvi is reported to have 82.74% toilet coverage while some residents report continued practice of open defecation due to non-access to public or community toilets. Further, Mandvi is found to be declared ODF++ despite these occurring challenges. Valsad town is reported to have 99.59% toilet coverage according to the 2023-24 SLB data, although discrepancies between Swachh Bharat Mission – Urban Dashboard and information available at the ULB on number of community toilets were observed.

## **Wastewater Management and GHG Emissions**

As of 2023, the state generates approximately **5,013 million litres per day (MLD)** of wastewater (Government of India, 2023). According to the Gujarat Pollution Control Board, the state has an **installed treatment capacity of 5,271.18 MLD** across **185 sewage treatment plants (STPs)**. In addition, **58 new STPs are currently under installation**, and **27 are in the planning stage**. Furthermore, **170 townships and institutions** operate **decentralized STPs**,

contributing to localized wastewater management efforts (Gujarat Pollution Control Board, 2024).

Several assessment reports by the Central Pollution Control Board highlight the discharge of untreated or partially treated wastewater as a major contributor to poor water quality in Gujarat's surface water bodies, including rivers, canals, and creeks. A **water quality assessment conducted between 2019 and 2021 across 25 rivers at 64 monitoring locations** revealed that **25 locations on 13 rivers did not comply with the prescribed water quality criteria for Biochemical Oxygen Demand (BOD)**. The 13 polluted rivers identified are: **Amlakhadi, Bhadar, Bhogavo, Bhukhi Khadi, Damanganga, Dhadar, Khari, Mahi, Mindhola, Sabarmati, Shedhi, Tapi, and Vishwamitri** (Central Pollution Control Board, 2022, pp. 38-39).

Discharge of untreated wastewater and use of septic tanks are the key drivers of emissions due to Domestic Wastewater sub-sector for Gujarat. **In 2018, the domestic wastewater sector, encompassing both rural and urban areas, accounted for 3.42 Mt CO<sub>2</sub>e i.e., 34% of total waste sector (10.11 Mt CO<sub>2</sub>e) GHG emissions** (GHG Platform India, 2018). The estimations do not include GHG emissions from the electricity consumption. **For Gujarat, the electricity sales in the public water works amount to average 1.90% of the total energy consumption (124100.8 GWh) in the state between 2022-23, while it was only 0.16% for public lighting** (Central Electricity Authority, 2024). **If this is factored into the GHG emissions calculations, the overall emissions would likely be significantly higher.**

### ***Climate and Socio-economic Vulnerability***

According to the State Climate Action Plan, **district-level vulnerability**—shaped by the **interaction between climate hazards and socio-economic factors**—is found to be highest in the northern districts of the state (such as Kachchh, Banaskantha, and Patan), as well as in certain eastern districts like Dahod and Panchmahal (Government of Gujarat, 2021). The State Action Plan on Climate Change and Human Health too highlights Dahod district as one of the most vulnerable, based on social, demographic, biophysical, and institutional-infrastructural parameters (National Centre for Disease Control, 2022, p. 2).

**It was also observed that the volatility ratio**—which reflects how much climate conditions fluctuate relative to their average—**changes over time in all regions, but Kachchh always shows a higher volatility ratio than the others** (Government of Gujarat, 2021). A higher volatility ratio indicates that the region experiences more unpredictable and extreme changes in climate, such as sudden shifts in rainfall or temperature. This persistent variability increases Kachchh's vulnerability to climate-related risks, highlighting the need for targeted adaptation and resilient infrastructure planning in the region (ibid).

## 5. PROGRAMMES AND SCHEMES IN URBAN WATER AND SANITATION

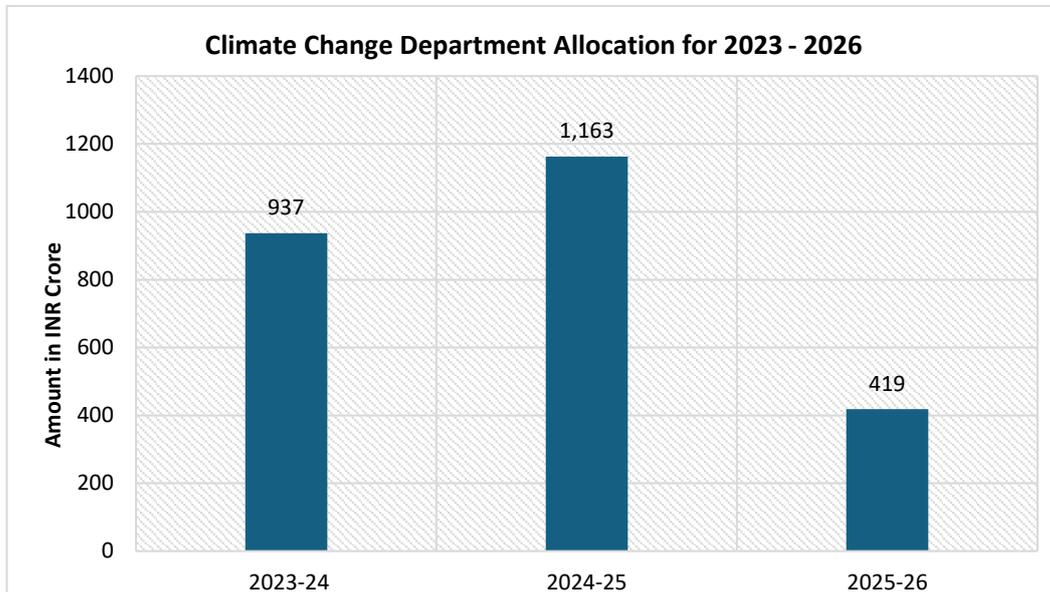
For the development of water and sanitation infrastructure and services in urban areas, the state depends upon both the centrally sponsored schemes such as the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), and the Swachh Bharat Mission (SBM) and state schemes such as Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana (SJMMMSVY) and its own funds. The section highlights key sources of funding for the water and sanitation sector and climate change in Gujarat state.

### Climate Change and Disaster

Established in 2009, the state's dedicated Department of Climate Change was the first of its kind in the country. The primary programmes under the climate change department since 2015 has been renewable energy and ecology and environment. The budget provision for 2020–21 (in INR crore) reveals that the Department of Climate Change received only 0.44% of the total state budget (Government of Gujarat, 2021).

Between 2023-2026 the focus of the department has been more on the solar energy related programmes. The Budget allocations to this department for 2023-2026 is presented in Figure 16 below. In addition to these, many other schemes and programmes under other departments that cater to adaptation and mitigation are present (Government of Gujarat, 2021, pp. 216-218)<sup>viii</sup>.

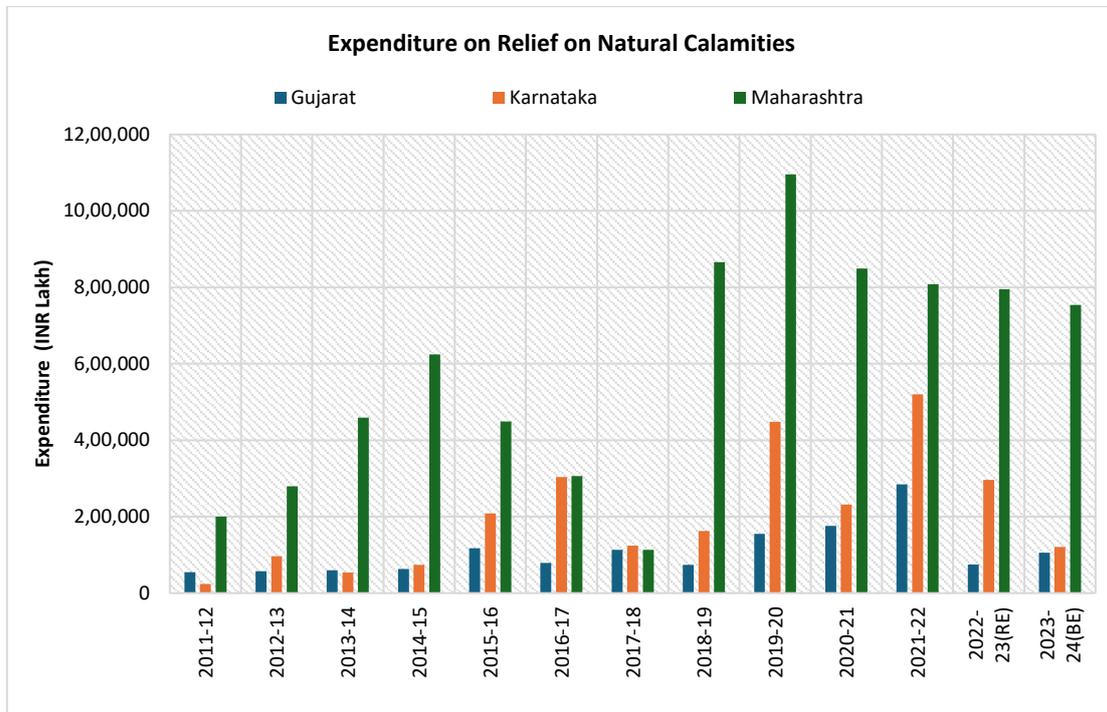
Figure 16: Allocations to State Climate Change Department for 2023 to 2026<sup>viii</sup>



Source: data from (Government of Gujarat, 2023)

**Among the selected states, Maharashtra allocates the highest expenditure for relief related to natural calamities, followed by Karnataka and Gujarat, with Goa spending the least (RBI, 2024).**

Figure 17: Expenditure on Relief on Natural Calamities (2011-2024)



Source: data from (RBI, 2024)

### Urban Development, Water and Sanitation Sector

This includes state schemes such as Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana, and central schemes such as AMRUT Mission, and Swachh Bharat Mission-Urban (SBM-U).

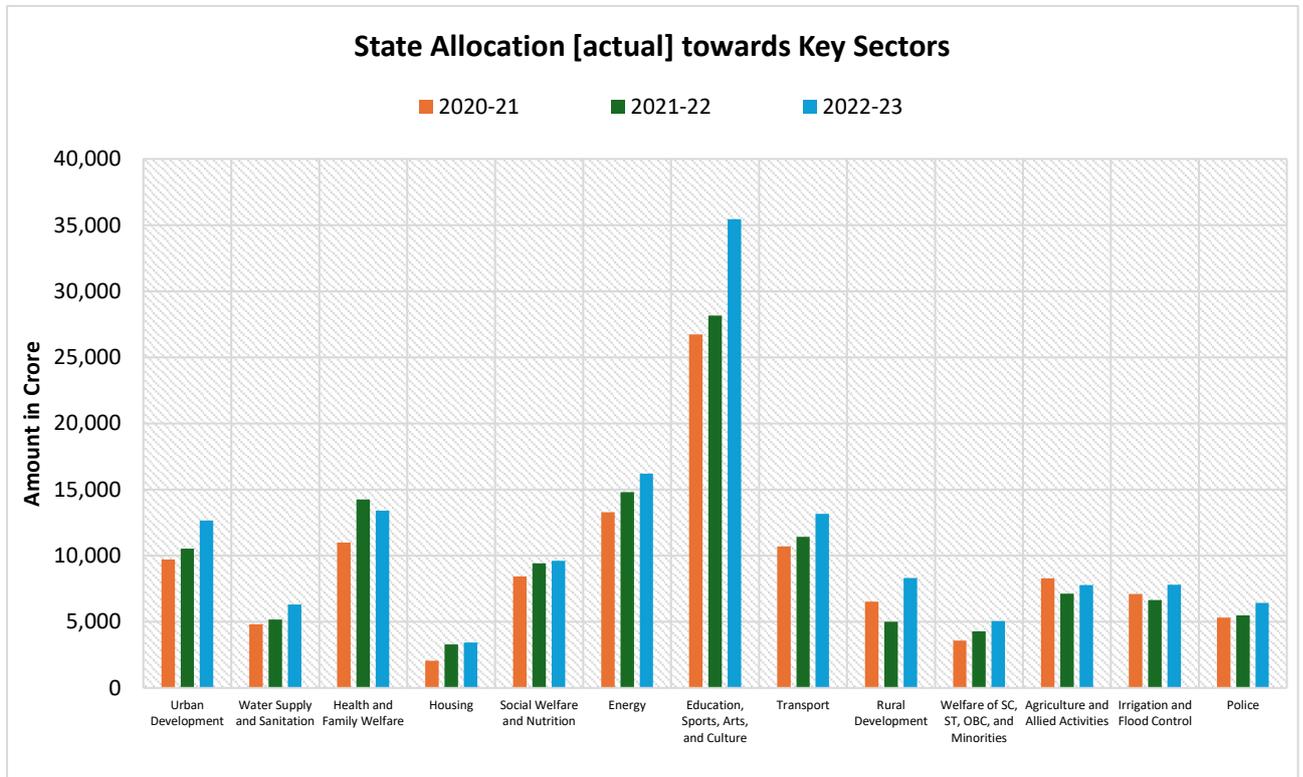
SJMMSVY was launched by the State Government in 2009 to mark Gujarat’s 50th anniversary. In Phase 1 of the scheme (2009–10 to 2012–13), a plan outlay of ₹7,000 crore was made. Phase 2, covering the period from 2012–13 to 2023–24, saw a significantly larger allocation of ₹40,402.25 crore. For the financial year 2024–25, a budgetary provision of ₹7,645.41 crore has been earmarked under the scheme (Directorate of Economics and Statistics, 2025). Under the SJMMSVY scheme, work is ongoing on the provision of Sewerage Treatment Plants (STPs) in municipal areas. So far, 128 STP projects have been completed across 120 municipalities, while 28 projects in 27 municipalities are in progress and 20 in 19 municipalities are under various stages of approval. Furthermore, 116 underground drainage projects (Part-II) worth ₹2,525 crore have also been approved under SJMMSVY (Directorate of Economics and Statistics, 2025).

Under AMRUT, between 2015–16 and October 2024, a total of 451 projects worth ₹5,166 crore were approved, out of which 443 projects valued at ₹5,093 crore have been completed, while 8 are currently in progress. Under the AMRUT 2.0 Mission, 922 projects worth ₹17,717 crore have been sanctioned. Of these, 612 projects amounting to ₹10,751 crore are underway, and 310 are at various stages of approval. To ensure clean drinking water across all municipalities in the state, 430 water supply projects worth ₹7,566 crore have been approved under AMRUT 2.0, with a target completion date of September 2026. Additionally, 171 sewerage projects worth ₹9,380 crore have been approved to provide underground sewerage systems for municipal corporations and municipalities, also scheduled for completion by September 2026 (Directorate of Economics and Statistics, 2025).

The Swachh Bharat Mission (Urban) was launched on October 2, 2014. Gujarat has constructed 5,60,046 individual household toilets across 157 municipalities and 8 municipal corporations. As a result, all these urban local bodies have been declared Open Defecation Free (ODF) by the Central Government. In the latest round of re-certification, 5 ULBs in Gujarat have achieved ODF+ status, 142 have been certified ODF++, and 18 have retained ODF+ status (Directorate of Economics and Statistics, 2025). **Valsad, Mandvi, and Devbhumi Dwarka were officially declared ODF++ in 2023–24. However, our town-level assessments reveal notable gaps between official status and on-ground realities, especially in Devbhumi Dwarka.**

**Overall Allocations and Expenditures:** Although allocations to the water and sanitation sector grew at a 10% CAGR between 2020–21 and 2022–23, it remains among the lowest both in absolute terms and as a proportion of the total budget. In contrast, the urban development sector ranks among the top five in terms of budget allocations. In contrast, the largest allocations were made to the education/sports/arts/culture, energy, transport, health and family welfare (Figure 18).

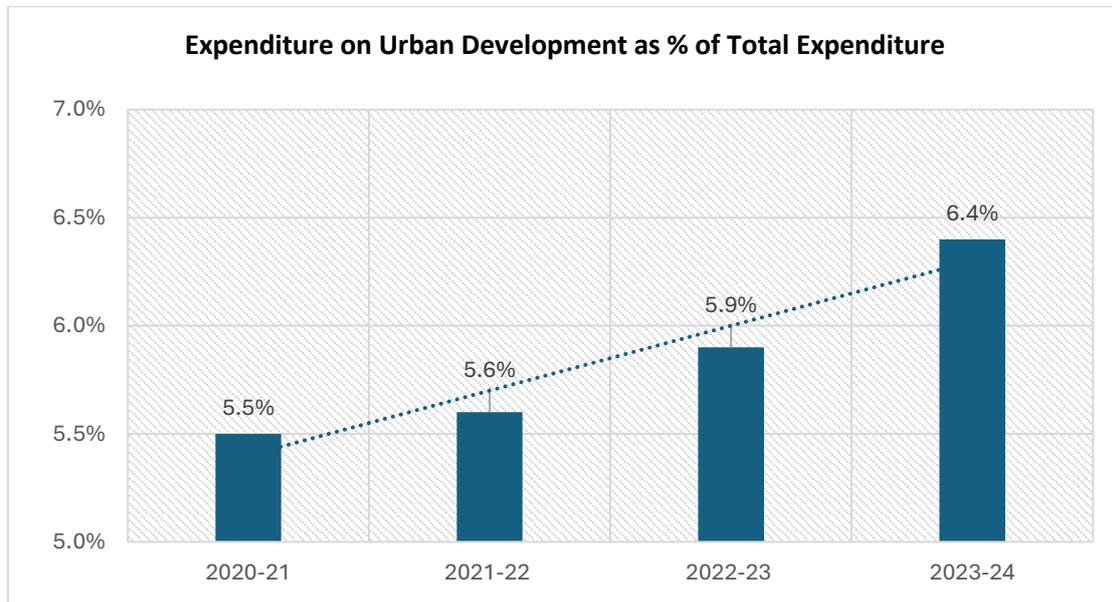
Figure 18: Gujarat State Allocation towards Key Sectors including Water and Sanitation (2020 to 2023)



Source: data from (PRS Legislative Research, 2024)

Figure 19 below shows expenditure on urban development sector as a percentage of total expenditure. There is a steady increase in the expenditure.

Figure 19: Expenditure on Urban Development Sector as a Percentage of Total Expenditure



Source: data from (PRS Legislative Research, 2024)

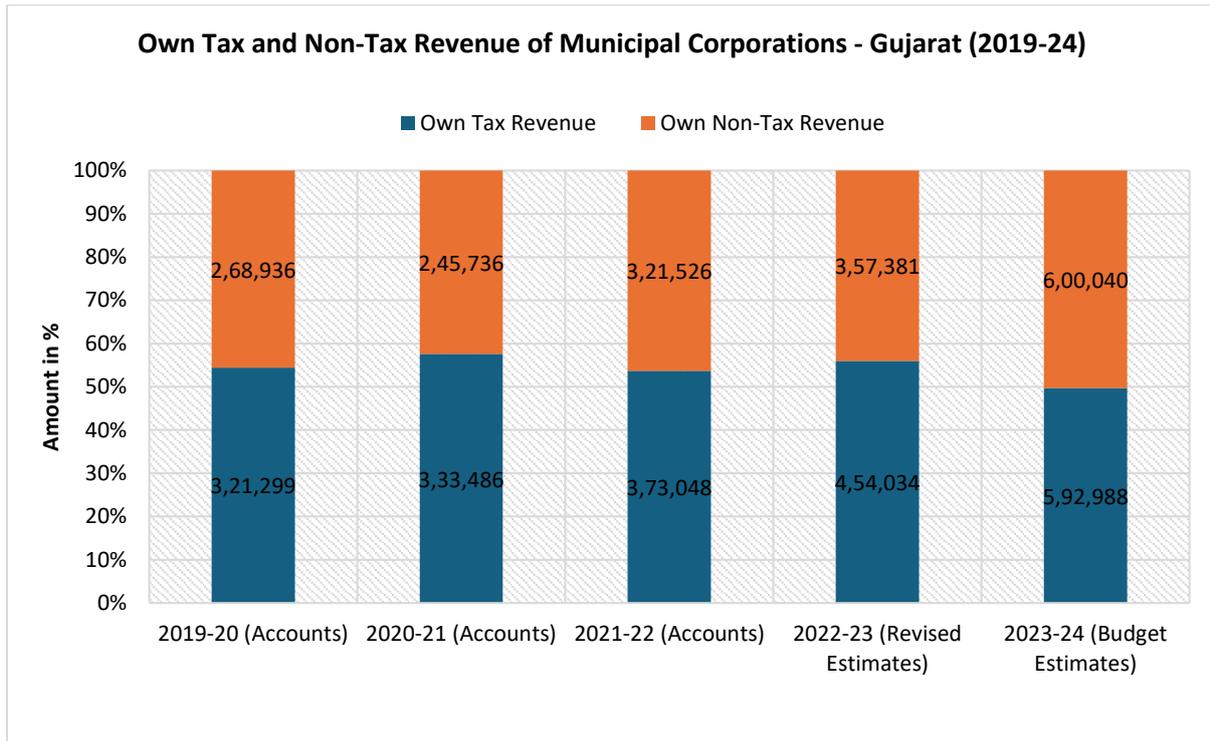
### Municipal Funds

The total resources of ULBs can be classified under four major categories: (i) Own resources: tax revenue (property tax, vacant land tax, water benefit tax, advertisement tax, sewerage benefit tax, tax on animals, and taxes on carriages and carts), non-tax revenue (user charges, betterment charges, development charges, sale and hire charges, water supply and sewerage donations, market fees, trade licensing fees, parking fees, layout/building approval fees, slaughterhouse fees, and birth and death registration fees) and other receipts; (ii) Assigned/shared revenues : taxes levied and collected by the State government and shared with or passed on to the local bodies such as Entertainment tax, professional tax, surcharge on stamp duty, entry tax, and motor vehicles tax; (iii) Grants: Central and State Finance Commission grants, central and state grants under various programmes and schemes such as Smart Cities Mission, Swachh Bharat Mission, Atal Mission for Rejuvenation and Urban Transformation; and (iv) Loans from State and Central governments, banks and borrowings through municipal bonds.

**Figure 20 presents the composition of own tax and non-tax revenue sources for municipal corporations in Gujarat between 2019 and 2024. Nearly 50% of their total revenue is derived from own tax sources—substantially higher than the corresponding figures for Maharashtra and Karnataka (Figure 21). This suggests relatively stronger financial health**

and revenue autonomy for Gujarat’s municipal corporations compared to those in the other two states.

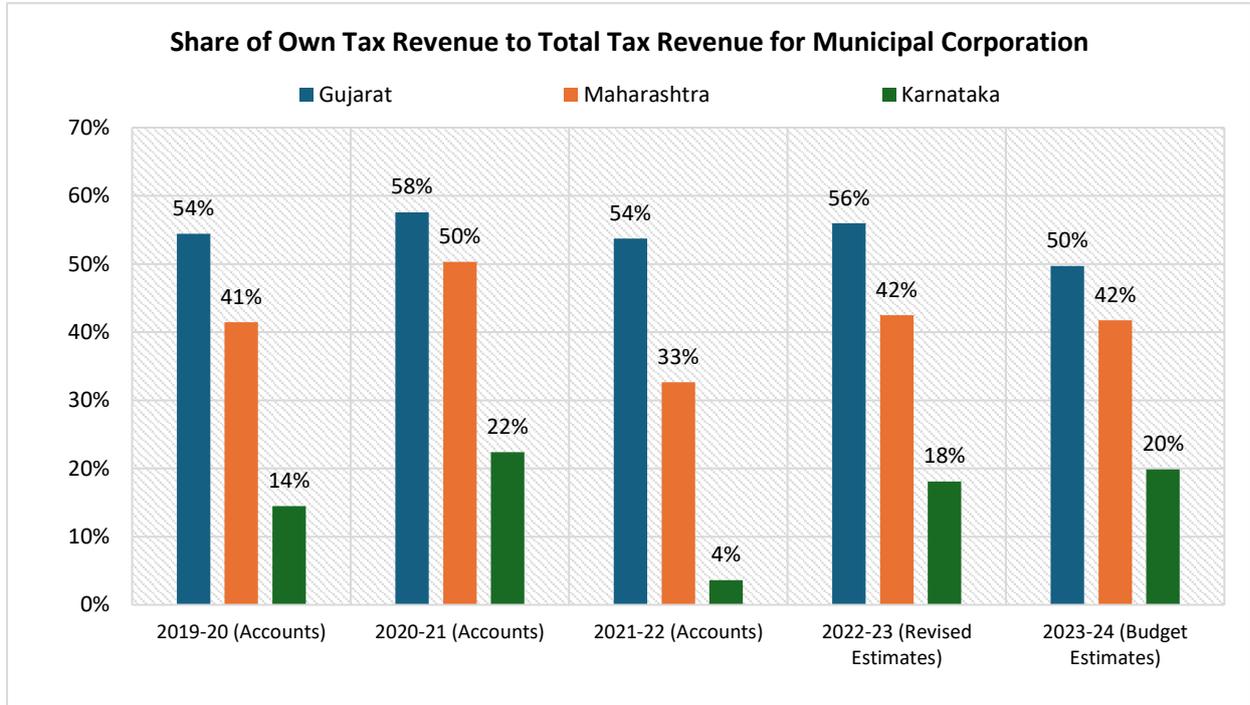
Figure 20: Own Tax and Non-Tax Revenue of Municipal Corporations in Gujarat (2019-24)



Note: Amount is in INR Lakhs

Source: data from (Department of Economic and Policy Research, 2024)

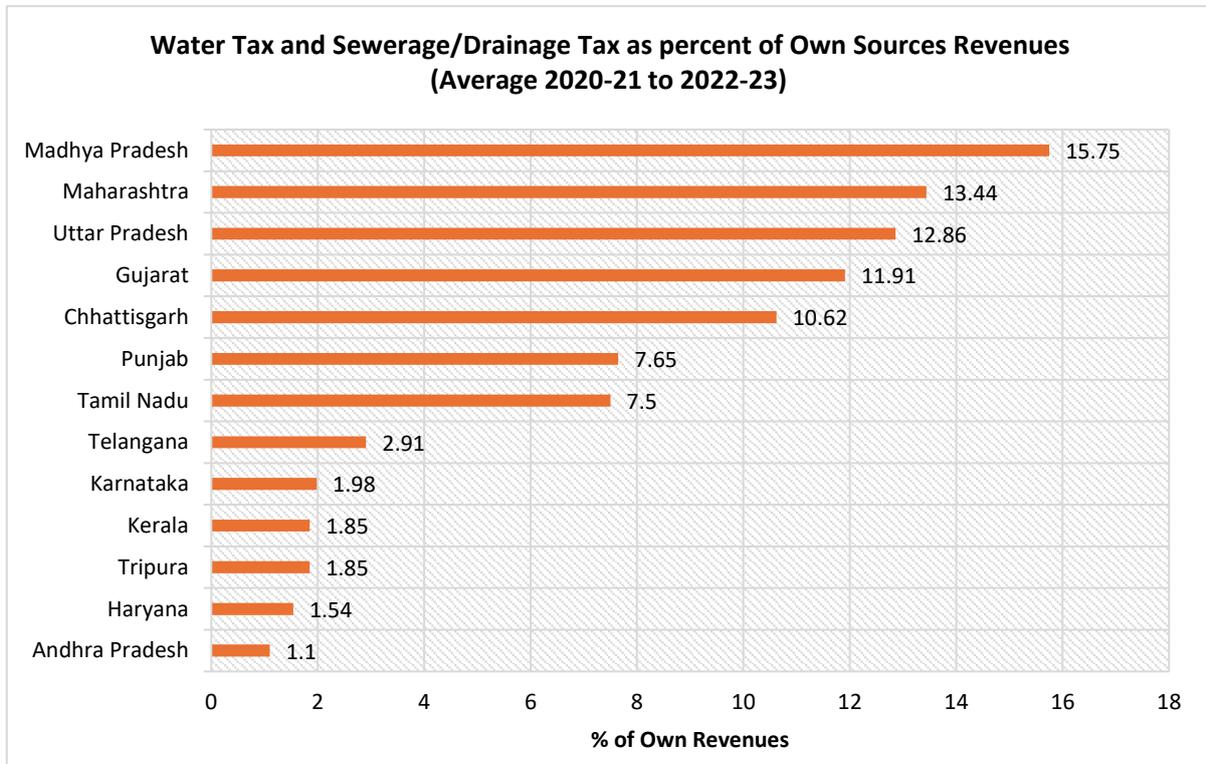
Figure 21: State-wise Comparison of Own Tax and Non-Tax Revenue of Municipal Corporations (2019-24): Gujarat, Maharashtra, Karnataka



Source: data from (Department of Economic and Policy Research, 2024)

As part of own revenue, property tax remains a main contributory sector across different cities in India (Department of Economic and Policy Research, 2024). **A comparison across states (Figure 22) shows that Gujarat performs relatively well in terms of the share of water and sewerage/drainage taxes as a percentage of its own revenue sources—particularly in comparison to the southern states.** This suggests effective tax recovery in the water and sewerage sector, contributing to the financial sustainability of the ULBs.

Figure 22: State-wise share of Water Tax and Sewerage/Drainage Tax as percent of Own Sources Revenues (Average 2020-21 to 2022-23)

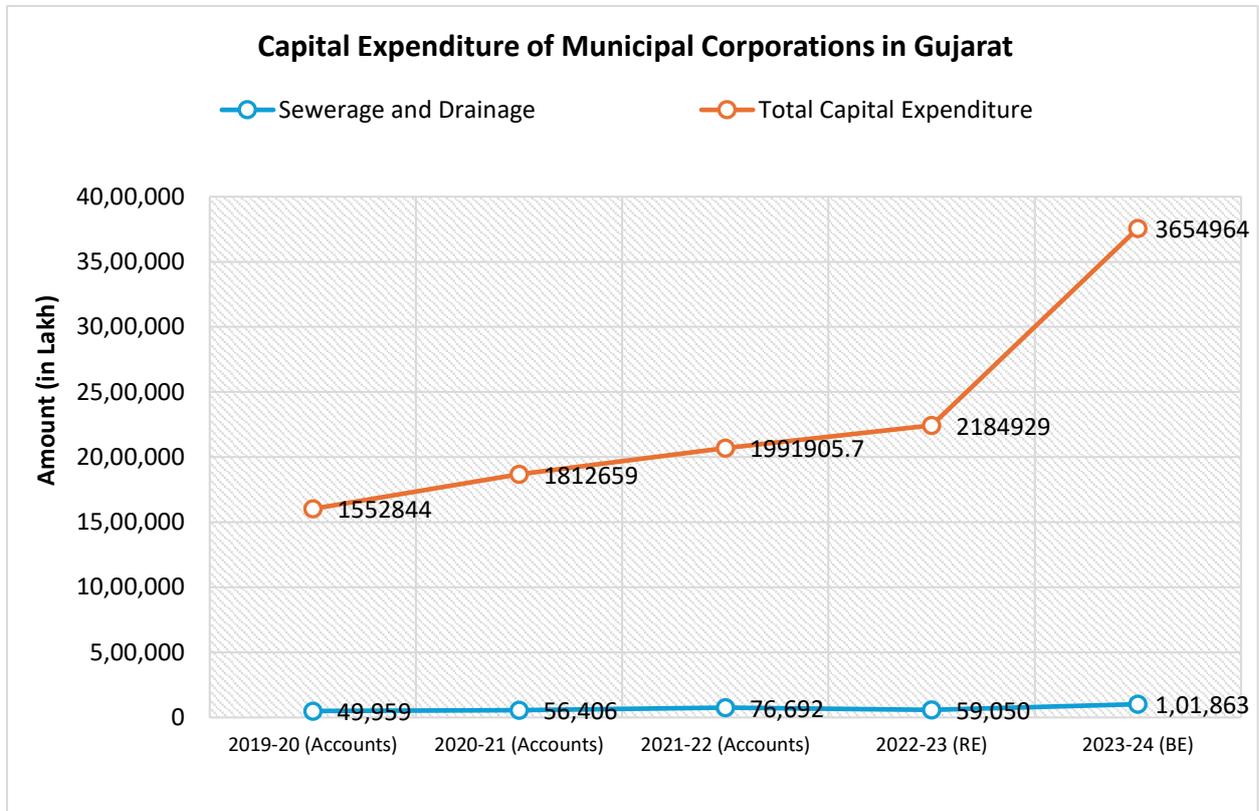


Source: data from (Department of Economic and Policy Research, 2024)

### ***Expenditure In Sewerage at Municipal level***

Figure 23 below illustrates trends in capital expenditure on sewerage and drainage by municipal corporations in Gujarat between 2019 and 2024. This sector consistently accounted for about 3–4% of total capital expenditure. While overall spending showed a steady upward trend, there was a noticeable dip in 2022–23. Over the five-year period, capital expenditure in this sector nearly doubled, reflecting an approximate 100% increase.

Figure 23: Capital Expenditure (Lakh) in Sewerage and Drainage Sector at Municipal Corporation level In Gujarat



Source: data from (Department of Economic and Policy Research, 2024)

## 6. POLICY AND INSTITUTIONAL LANDSCAPE OF CLIMATE CHANGE & WATER AND SANITATION

The climate change and water and sanitation sectors are governed by multiple institutions, each with distinct mandates and policy frameworks. Understanding these institutions is essential for identifying key stakeholders — including those responsible for financing, technology selection, infrastructure development, and policy implementation — as well as for assessing overlaps, and coordination challenges. This understanding is critical to enhancing resilience in the water and sanitation sectors.

**This section is organized into two sub-sections.** The first sub-section provides a comprehensive review of the current institutional landscape at both the national and state levels, highlighting the role of Urban Local Bodies (ULBs) in delivering water and sanitation services. It also identifies key institutional overlaps and challenges. The second sub-section examines relevant policies related to water and sanitation, climate change, and disaster management, with a focus on implementation challenges observed at the town level.

### 6.1 Institutional Landscape

#### 6.1.1 State Level

At the national and state level, various departments, agencies, and organizations are involved not only in the provision of water and sanitation infrastructure and services but also in broader climate change governance and disaster management (refer to Tables 4 and 5).

According to the 7th Schedule of the Constitution of India, water is a state subject and the state has the prerogative to take decisions about the available water resources within the state jurisdiction. The central ministry of housing and urban affairs (MoHUA) formulates the policies, rules or laws and the states have the authority to adopt the policies in their respective states.

The Central Public Health Environment and Engineering Organisation (CPHEEO) is the technical arm of the Ministry of Housing and Urban Affairs (MoHUA), which formulates and defines the service level benchmarks (SLBs) for water supply and sewerage. CPHEEO also drafts the manuals, guidelines, and policies that are applicable to all municipalities in the country. However, the state makes policies within the national policy framework. The Central Pollution Control Board (CPCB), under the Ministry of Environment, Forests, and Climate

Change, sets environmental pollution standards that State Pollution Control Boards (SPCBs) enforce. Urban local bodies and state water and sewerage boards must comply with these standards.

*Table 4: Key National Government Agencies in Urban Water and Sanitation and Climate Change*

Sl. No.	Name of Department/Institution	Roles and Responsibilities
1.	Ministry of Housing and Urban Affairs	Formulates policies, rules, laws for urban development in India
2	Central Public Health Engineering and Environmental Organisation	Technical wing of MoHUA serves as advisory body to Ministry for WaSH
3	Ministry of Jal Shakti	Responsible for development water resources, and providing quality drinking water and sanitation facilities
4	Department of Water Resources, River Development, and Ganga Rejuvenation	Formulates policy guidelines and programmes for the development, conservation, management of water resources.
5	Central ground Water Board	Scientific organisation under DWR RGDR, develops and disseminates technologies for sustainable groundwater management.
6	Ministry of Environment Forest and Climate Change	Plans, promotes, coordinates, and oversees the implementation of environmental and forestry conservation programmes.
7	Central Pollution Control Board	Statutory board established to control water and air pollution in India
8	Ministry of Consumer Affairs and Food and Public Distribution	Formulates plans, policies and programs for consumer protection, welfare, and food security.
9	Bureau of Indian Standards	Formulates standards, markings, and certifications for goods to ensure quality and safety.
10.	Ministry of Finance	Entrusted with formulation of budget, offering policy advice, and review of government programs. Accountable for finance, governance and financial management through funds, grants, and procurements.
11	Central Finance Commission	Recommends the distribution of tax revenues between the Union and the States and amongst the States themselves.
12	Ministry of New and Renewable Energy	Policies and schemes on renewable Energy from urban Waste, solar power
13	Ministry of Power	Bureau of Energy Efficiency (BEE), Energy Conservation Act

The institutional landscape for water, sanitation, energy, and climate resilience in Gujarat is organized across distinct functional domains (Table 5). **Planning and policy-making** responsibilities are primarily led by the Department of Narmada, Water Resources, Water Supply & Kalpsar, the Urban Development Department, the Gujarat Energy Development Agency (GEDA), and the Gujarat State Disaster Management Authority (GSDMA). **Financing**

**and project structuring** are handled by agencies such as Gujarat Water Infrastructure Limited (GWIL), the Gujarat Infrastructure Development Board (GIDB), and the Gujarat Urban Development Mission (GUDM). **Construction and infrastructure development** is undertaken by entities like the Gujarat Water Supply and Sewerage Board (GWSSB), Sardar Sarovar Narmada Nigam Ltd. (SSNNL), Gujarat State Electricity Corporation Ltd. (GSECL), and GUDM, particularly in urban water and sewerage projects. For **operations and maintenance**, key institutions include GWSSB, the Gujarat State Drinking Water Company, SSNNL, GSECL, and Urban Local Bodies (ULBs) operating under GUDM and the Urban Housing Department. **Regulatory and enforcement functions** are distributed among the Gujarat Pollution Control Board (GPCB), the Forest Department (for environmental regulations), and the Narmada Department (for water regulations). Finally, **research, training, and capacity building** functions are supported by the Gujarat Environment Management Institute (GEMI), the Water and Sanitation Management Organisation (WASMO) focusing on rural water mobilization, and GSDMA in the context of disaster preparedness and resilience.

Several institutional overlaps exist among Gujarat's state departments and agencies, particularly across water, urban infrastructure, climate, and environmental governance sectors. In the **water supply and infrastructure domain**, multiple entities such as the Department of Narmada, GWSSB, Gujarat State Drinking Water Company, GWIL, and SSNNL are involved in water planning, infrastructure development, bulk supply, and operations.

This creates overlapping responsibilities, especially in project implementation and asset management. For instance, both GWIL and GWSSB work on infrastructure, while SSNNL and the Drinking Water Company handle bulk supply, often within the same regions. In **urban infrastructure**, GWSSB, the Gujarat Urban Development Mission (GUDM), and the Urban Development & Housing Department and **Gujarat Urban Development Company Ltd. (GUDEC)** are all responsible for urban water, sewerage, and sanitation delivery, leading to blurred boundaries in planning, implementation, and funding. Likewise, the Climate Change Department and Gujarat State Disaster Management Authority (GSDMA) both focus on resilience and adaptation, often targeting the same districts with overlapping planning tools and frameworks. Lastly, in **infrastructure financing**, GIDB, GWIL, GUDM, and GEDA all engage in structuring and managing public-private projects, leading to role ambiguities in appraisal, investment coordination, and execution. These overlaps highlight the need for greater institutional coordination, clearer role definitions, and integrated planning mechanisms.

*Table 5: Key State Government Agencies in Urban Water and Sanitation and Climate Change*

Sl. N.o	Name of Department/Institution	Sector	Role / Responsibility
1	Department of Narmada, Water Resources, Water Supply & Kalpsar (GoG)	Water planning, regulation, river systems	Regulatory oversight of water sector; planning and O&M of river systems like Narmada; oversight of state water corporations
2	Gujarat Water Supply & Sewerage Board (GWSSB)	Urban water & sewerage	Implements and operates water supply and sewerage schemes for urban local bodies; inspects state-funded schemes
3	Gujarat State Drinking Water Co. Ltd.	Water bulk supply	Transports bulk drinking water to local bodies, GWSSB, industrial estates
4	Gujarat Water Infrastructure Limited (GWIL)	Water infrastructure SPV	Implements cascaded drinking-water grid projects (e.g. Narmada Master Plan across 9,490 villages & 173 towns) in partnership with GWSSB & SSNL
5	Sardar Sarovar Narmada Nigam Ltd. (SSNNL)	Water wholesale, resource development	Supplies Narmada water wholesale; operates major infrastructure like Sardar Sarovar Dam; supports irrigation & drinking water supply
6	Water & Sanitation Management Organisation (WASMO)	Rural water & sanitation	Implements rural tap-water access ('Nal Se Jal' Scheme / JJM), training, IEC, community mobilization; oversees flag- ship rural supply
7	Gujarat Energy Development Agency (GEDA)	Renewable energy & energy efficiency	Implements Renewable Energy Policy-2023; drives rooftop solar, wind, bio-energy, off-grid projects; conducts energy audits; promotes clean mobility, biogas, efficient crematoria, LEDs; supports Mission LiFE awareness; develops Gujarat Climate Action Tracker jointly
8	Gujarat Urban Development Mission (GUDM) (society SPV)	Urban infrastructure planning & water/sewerage delivery in AMRUT cities	State-level nodal agency for AMRUT 1.0/2.0, Smart Cities, SJMMSVY; plans, finances and coordinates urban water, sewerage, sanitation, non-motorized transport projects
9	Gujarat Urban Development & Urban Housing Department	Urban planning & infrastructure policy	Oversees holistic planning of urban areas, implementing schemes for water supply, sewerage, slum improvement, riverfront rejuvenation (Sabarmati riverfront), metro, housing
10	Gujarat Urban Development Company Ltd. (GUDC)	Urban planning & infrastructure policy	State-level Nodal Implementation Agency for schemes like AMRUT (Atal Mission for Rejuvenation and Urban Transformation) and Swachh Bharat Mission (SBM). It oversees DPR preparation, appraisal, monitoring, and fund disbursement.
10	Gujarat Pollution Control Board (GPCB)	Environmental protection, water & waste pollution control	Regulation, monitoring and control of water & air pollution, enforcement of environmental norms for industries and urban bodies; sewage/waste oversight together with ULBs
11	Gujarat Forest Department	Environmental conservation & biodiversity	Afforestation, wildlife habitat protection, forest fire control, eco-tourism, mangrove/biodiversity management along coastlines and inland ecosystems
12	Climate Change Department (GoG)	Climate change policy, cross-cutting coordination	First dedicated sub-national climate department in Asia, established in 2009. Integrates climate budgeting across ~18 departments, sets state-level climate strategy, oversees Gujarat Climate Action Tracker (GCAT) dashboard for district-level emissions and planning. Administers climate budget (₹165 crore in 2025-26), Climate Change Fund, climate awards, and supports district mitigation/adaptation planning
13	Gujarat State Disaster Management Authority (GSDMA)	Climate resilience &	Coordinates state disaster preparedness, mitigation, institutional frameworks, training, early warning systems and post-disaster response

		disaster governance	
14	Gujarat Infrastructure Development Board (GIDB)	Public-private infrastructure SPV	Facilitates PPP in sectors including water, sanitation and energy; supports infrastructure financing, project appraisal and institutional coordination

### 6.1.2 Town Level: Institutional Capacity and Constraints in Climate and Disaster Planning

While schemes and projects are implemented at the urban local level, their planning, funding, and oversight often involve coordination across multiple tiers of government. **The roles and responsibilities of stakeholders—from households to state-level institutions—are illustrated through the case of Valsad (refer Table 6).**

Sanitation is constitutionally a state subject, with Urban Local Bodies (ULBs) designated as the primary institutions responsible for water supply and sanitation services under the 74th Constitutional Amendment Act. However, in practice, sanitation governance is embedded within a complex, multi-tiered framework involving national, state, and city-level institutions. Despite this formal devolution, ULBs often operate within constrained capacities—both institutionally and financially—particularly when it comes to large-scale infrastructure planning and implementation.

At the household level, there is limited enforcement of standards for toilets or on-site sanitation (OSS) systems by either ULBs or other regulatory agencies. In contrast, for larger establishments, compliance mechanisms are in place through building plan approvals, which are overseen by state-level agencies such as the **Gujarat Urban Development Company (GUDC) and Gujarat Urban Development Mission (GUDM)**. For smaller public infrastructure such as community toilets (CTs) and public toilets (PTs), ULBs retain primary responsibility. They exercise autonomy in areas such as land selection, technology choices, operations and maintenance (O&M), and partial funding. Under Swachh Bharat Mission (SBM) 1.0, capital funding for CTs and PTs was provided through central support, supplemented by ULB revenues. O&M responsibilities are split—ULBs manage CTs directly, while PTs are typically outsourced to private vendors, who recover costs through user charges.

While ULBs act as the nodal agencies for sanitation service delivery, their role in the planning and implementation of large-scale infrastructure such as Sewage Treatment Plants (STPs) is often limited. Projects of this scale are primarily financed through central schemes like the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) 1.0, with key decisions regarding technology selection, approval, and execution resting with GUDC and GUDM. This centralised model reduces the operational and financial autonomy of ULBs and limits their

ability to shape infrastructure investments in ways that are locally appropriate and climate resilient.

In the context of disaster risk and climate resilience, ULBs face further constraints. Most do not have dedicated disaster response teams. Instead, they coordinate with the District Disaster Management Authority (DDMA) and other departments to mobilize staff, equipment, and emergency resources. ULBs initiate pre-monsoon preparedness around 60 days before the rainy season, focusing on flood mitigation and community safety. Activities include desilting and cleaning of underground drainage (UGD) and stormwater networks to prevent waterlogging, and preparing temporary shelters at community centres in low-lying areas, stocked with food kits, medical supplies, drinking water, and sanitation facilities. During the monsoon months, intensified water quality monitoring is carried out to safeguard public health. In high-risk zones such as the confluence of the Kaam and Maan rivers—where they form the Ornaga River—the DDMA has installed early warning systems to monitor rising water levels. Based on alerts from this system, the ULB coordinates public communication and evacuation efforts. However, the management and operation of the early warning system remain with the DDMA, highlighting the dependence of local bodies on district and state-level institutions in both infrastructure and emergency response planning.

*Table 6: Town Level Institutional Arrangements in Sanitation Services: A Case of Valsad City*

Intervention	Technology Selection	Land	Capital	Technology Provision	Technology implementation	O&M	O&M Funding
Toilets	HH	HH	HH	Local vendors/Masons	Local Vendors/Masons	HH	HH
On-site sanitation system	HH	HH	HH			HH	HH
						Septage removal by vehicles of ULB	
Community Toilets	ULB	ULB	ULB	ULB	ULB	ULB	ULB
			Central Government [SBM 1.0]				
Public Toilets	ULB	ULB	ULB	ULB	ULB	Sulabh international	

			Central Government [SBM 1.0]				Pay and Use by the Agency
<b>Sewage Treatment Plant</b>	GUDM	ULB	Central Government [AMRUT 1.0]	GUDM	GUDC	GUDC	GUDC
<b>Sewerage network</b>	GUDM	ULB	Central Government [AMRUT 1.0]	GUDM	GUDC	GUDC	GUDC

Source: Developed by Ashank Desai Centre for Policy Studies, IIT-Bombay; based on Interviews with Valsad Municipal Officials

**These institutional arrangements reflect both the strengths and limitations of Gujarat’s urban governance framework in addressing sanitation and disaster risks in a climate-sensitive context. While ULBs play a central role in frontline service delivery, their constrained autonomy in infrastructure development and emergency preparedness points to the need for greater decentralization, capacity-building, and integration across departments. Strengthening the institutional and financial capacities of ULBs—alongside more collaborative planning with state-level agencies—will be critical to building sustainable, climate-resilient, and inclusive urban sanitation systems.**

## 6.2 Policy Landscape

This section presents the findings of the comprehensive review that was conducted of policies within the climate change, urban water supply, and sanitation (UWSS) sectors, along with related areas such as energy, disaster governance and environmental governance. The section examines how adaptation, mitigation, and the resilience of UWSS infrastructure and services, are addressed across these sectoral policies. Additionally, it highlights findings from field research in the three selected towns —Valsad, Devbhumi Dwarka and Mandvi — that assesses the adoption and effectiveness of state-level policies and measures at the local level.

**The state’s commitment to addressing climate change is evident from the fact that it was one of the first states in the country to establish a dedicated Climate Change Department,**

which was set up in 2009. Approximately 128 key state-level policies and programmes implemented between 2005 and 2030 have a direct impact on climate change mitigation, adaptation, and vulnerability reduction (Government of Gujarat, 2021, pp. 110-114) .

### 6.2.1 Policies with Mitigation Focus

GHG emissions from the UWSS sector can be classified as either direct or indirect, arising from electricity consumption and biological processes. At state level, In the mitigation domain, there has been a noticeable shift in focus since 2019, with increased emphasis on promoting solar and wind energy. Further, prominent initiatives such as the UJALA scheme for efficient lighting and the Perform, Achieve and Trade (PAT) mechanism in the industrial sector also reflect the state's growing commitment to reducing emissions and enhancing energy efficiency (Government of Gujarat, 2021, pp. 110-114) .

**Within the municipal UWSS sector, the review of state policies reveals that mitigation efforts primarily focus on reducing electricity consumption and improving energy efficiency, with limited attention given to generating energy (from sewage management interventions). Mitigation efforts related to biological processes—such as the safe confinement, transportation, treatment, and disposal of grey and black water—fall under environmental pollution and governance. These processes also play a crucial role in ensuring access to services that contribute to public health and environmental well-being. This description of the array of policy options highlights the diversity of organizations, processes, and tools involved in mitigation efforts, emphasizing the critical need for policy coherence across different levels policy implementation.**

#### *Energy Efficiency*

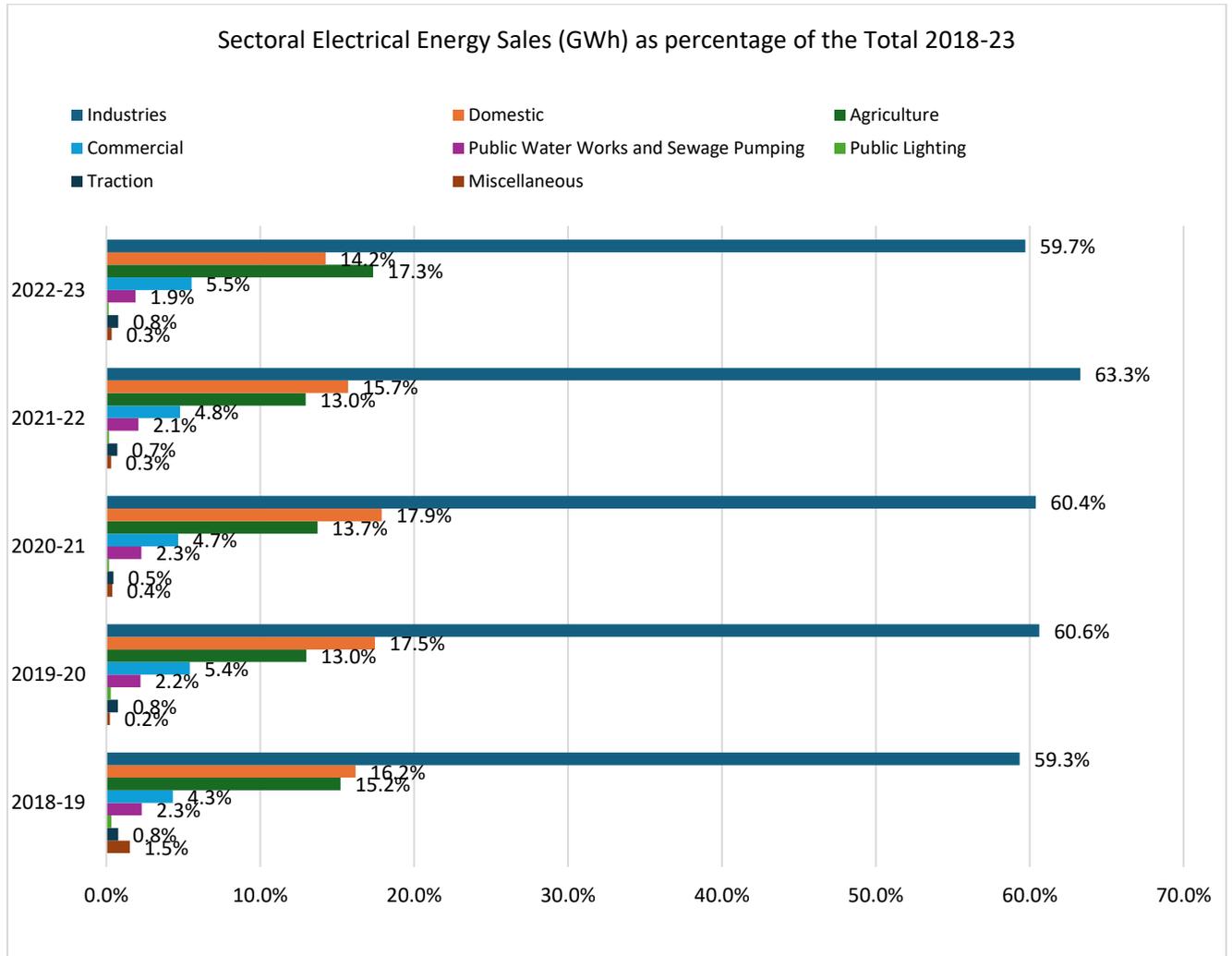
**Energy efficiency is one of the key focus areas in Gujarat's State Climate Action Plan.** Since energy sector and industrial processes are the second-largest contributor to greenhouse gas (GHG) emissions after the energy sector—accounting for 79% and 14% of Gujarat's total emissions of 286.98 Mt CO<sub>2</sub>e respectively in 2018 (GHG Platform India, 2018) - the plan prioritizes energy efficiency measures primarily within the energy and industrial sector. **The GHG emissions from municipal services—namely public lighting, public water works, and sewage pumping—are currently not estimated.** However, the GHG Platform India study provides an estimate for **emissions from domestic (urban) wastewater management, which accounted for 1.65 Mt CO<sub>2</sub>e, or approximately 0.5% of Gujarat's total GHG emissions in 2018** (GHG Platform India, 2018). These figures likely underestimate the actual emissions, as they

do not include the significant electricity consumption associated with the **public water works, and sewage pumping**.

For instance, if GHG emissions from electricity consumption in municipal public water works (including water and sewage pumping) in 2018 were accounted for, the total GHG emissions would rise by 95%, increasing from 1.65 Mt CO<sub>2</sub>e to an estimated 3.217 Mt CO<sub>2</sub>e (Figure 24). Further, as shown in Figure 24, the electricity sales to municipal services (public lighting and public water works and sewage pumping) accounted for approximately 2 to 2.7% of Gujarat's total electricity sales between 2018 and 2023, with public water works alone contributing nearly 90% of this consumption (Figure 24).

**Despite this, Gujarat—like several other states including Karnataka, Maharashtra, and Goa—has focused more on energy efficiency initiatives in public lighting such as replacing street lights by LED under Street Light National Programme (SLNP) under MEEP, while the significant potential for energy savings vis-à-vis GHG emissions mitigation in municipal water and wastewater services remains largely overlooked<sup>ix</sup>.**

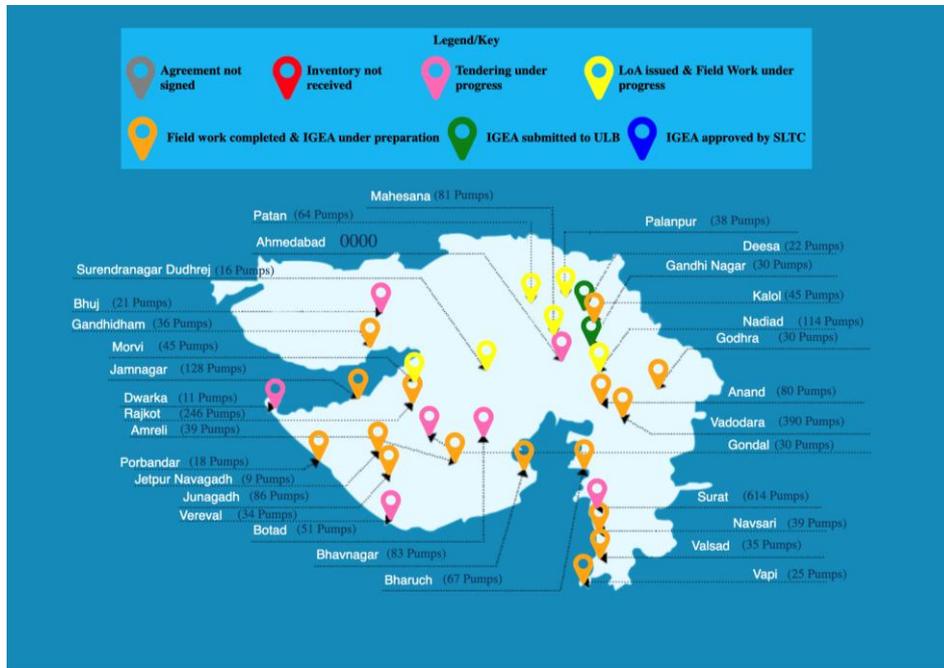
Figure 24: Sectoral Electrical Energy Sales as Percentage of Total in Gujarat (2018-23)



Source: Data compiled from All India Electricity Statistics. General Overview Reports for 2018-19 to 2023-24 by CEA

Within the UWSS sector, the MEEP (national Programme for Energy Efficiency) stands out as a key initiative (Figure 25).

Figure 25: Energy efficient pumps installed under MEEP in Gujarat (as of 23 April 2025)



Source: (EESL, 2025)

**At the town level, several initiatives are underway.** For instance, our field study in Valsad found that the ULB is implementing projects aimed at measuring and reducing its carbon footprint. This includes collecting data on electricity consumption, calculating the resulting carbon emissions, and exploring strategies to enhance the city's energy efficiency. Additionally, they are assessing the amount of renewable energy needed to meet their sustainability goals.

At the building sector level, key policies include the Energy Conservation Building Codes, and Solar Rooftop Scheme, and national programmes like Smart Cities Mission. These policies primarily focus on energy efficiency measures in water systems (chilling and heater facilities), appliances, lighting, and building materials, while there is limited attention to energy efficiency in wastewater management interventions. The State Action Plan on Climate Change and Human Health also calls for the greening of health facilities, including water and sanitation improvements. The task force on the 'Strategy for Government of Gujarat to Enable India to Become a USD 5 Trillion Economy' recommends several policy interventions. These include pursuing integration of solar rooftops, solar water pumping systems, and EV charging infrastructure within buildings through engagement with Urban Local Bodies (ULBs), as well as mandating energy efficiency disclosures during property transactions. The task force also

suggests encouraging high-rise urban real estate developments to adopt solar-powered water pumping systems to enhance energy sustainability (Task Force Committee , 2022).

### ***Generating Energy from UWSS***

**The Gujarat Renewable Energy Policy 2023 emphasizes the decarbonization of the electricity sector and aligns with national climate goals.** It seeks to strengthen the state's energy security and drive economic growth by promoting renewable energy, thereby reducing Gujarat's carbon footprint while also supplying clean power to other states. The policy envisions supporting the State's Sustainable Development Goals through an accelerated shift toward clean energy sources. **The policy however does not include energy generation from sewage management projects within its scope** (Government of Gujarat, 2023). Same is the case with the recent waste to energy policy -2022. Energy generation from STPs remains largely unexplored in most Indian cities. Field observations from Devbhumi Dwaraka, Valsad and Mandvi reveal that this option has not been considered by the respective municipalities. However, under the state's Solar Policy, the STPs in Devbhumi Dwarka and Valsad have been equipped with solar panels, reflecting a shift toward cleaner energy sources in public infrastructure. Similarly, in Mandvi, the Water Treatment Plant (WTP) is also fitted with solar panels. The power generated is sold back to the electricity board, effectively offsetting the facility's electricity costs. As a result, the STP operates without incurring any electricity expenses.

### ***Mitigation from biological process***

The state contributed 9.72% of the country's net GHG emissions in 2018 (GHG Platform India, 2018). In 2018, the energy sector was the largest contributor to the state's net GHG emissions, accounting for 79% of the total (227.40 Mt CO<sub>2</sub>e), while the waste sector—including solid waste, industrial wastewater and domestic wastewater—contributed the least at just 4%. **The domestic wastewater sector, encompassing both rural and urban areas, accounted for 3.42 Mt CO<sub>2</sub>e i.e., 34% of total waste sector (10.11 Mt CO<sub>2</sub>e) GHG emissions in 2018.** Rural areas, with 57% of the state's population, contributed approximately 52% of the domestic wastewater emissions (1.77 Mt CO<sub>2</sub>e) in 2018 (GHG Platform India, 2018). The primary drivers of emissions in this sector are the discharge of untreated wastewater and the widespread use of septic tanks (GHG Platform India, 2018).

Mitigation efforts related to biological processes—such as the safe confinement, transportation, treatment, and disposal of grey and black water—fall under both the urban development sector and environmental pollution and governance. Within the urban

development sector, the provision of toilets, on-site sanitation systems, underground networks, sewage treatment plants (STPs), and FSSTPs are addressed through schemes like SBM Urban, AMRUT, and state government funding. **The state has significant untapped potential for expanding its wastewater treatment capacity.** According to the SBM Urban Dashboard, Gujarat currently lacks Faecal Sludge and Septage Treatment Plants (FSSTPs), making it challenging to manage methane emissions from septic tanks that are not connected to the sewerage network or sewage treatment plants (STPs). As discussed in Section 5 of this report, the state is allocating substantial funds toward the development of sewage management infrastructure. However, **fieldwork conducted in Valsad, Mandvi and Devbhumi Dwaraka revealed inadequate sewerage connections and operational inefficiencies, resulting in the discharge of untreated or partially treated sewage, which contributes to both pollution and GHG emissions.**

**In terms of environmental governance, key policies include the consent mechanism by GSPCB and municipal by-laws by Town Planning and Valuation Department, which mandate that domestic, commercial, and industrial properties of certain sizes and water consumption install decentralized (non-network) wastewater management systems.** The adoption of non-network solutions diminishes operational GHG emissions by lowering the energy required for transporting water and wastewater over shorter distances. **Our fieldwork in Valsad, Mandvi, and Devbhumi Dwarka, along with interviews with relevant authorities, revealed that such policies have not been implemented in these towns.**

### 6.2.2 Policies with Adaptation Focus

Most policies at the intersection of climate change and water and sanitation are focused on adaptation strategies. Such policies are focussed on interlinked issues of: (i) water scarcity and water security, (ii) improved and equitable access to improved drinking water and improved sanitation services, and (iii) human and environmental health.

The policies addressing water scarcity and security primarily suggest measures such as diversifying water sources and water conservation such as rainwater harvesting, groundwater recharge, improving water use efficiency across sectors, regulating groundwater withdrawal, promoting the recycling and reuse of treated wastewater, protection from salt water intrusion (coastal areas). These measures are particularly relevant as Gujarat is one of the most water-stressed states in India, with a significant portion of the state being drought-prone and arid or semi-arid conditions.

The state climate change action plan calls for water source diversification and conservation : increase the number and capacity of rainwater harvesting tanks ; diversify water sources and

develop new water storage solutions; promote on-site recycling of used water and decentralized treatment systems (for industrial reuse and small-scale use) (Government of Gujarat, 2021).

**To address saltwater intrusion**, which can lead to groundwater contamination, the state climate action plan **recommends measures such as check dams, ground water regulation and increased mangrove plantation** along coastal areas and regulation of groundwater extraction (Government of Gujarat, 2021). However, the state is witnessing a decline in mangrove cover. **Gujarat lost approximately 36.39 km<sup>2</sup> of mangrove forest between 2021 and 2023. Alarmingly, this loss is most pronounced in one of the state's most vulnerable districts—Kachchh** (Forest Survey of India, 2023). **Moreover, the CAG report highlighted discrepancies in the reported data on the area brought under mangrove, particularly within various Coastal Regulation Zones (CRZ)** (Comptroller and Auditor General of India).

**In terms of building check dams as a measure to check salinity**, as of March 31, 2018, a total of 93,092 check dams had been constructed across 33 districts, contributing significantly to the state's water conservation initiatives (Government of Gujarat, 2021). The state has a dedicated *Salinity Ingress Prevention Scheme* under the Narmada, Water Resources, Water Supply, and Kalpsar (NWRWS&K) Department. As noted in the Comptroller and Auditor General (CAG) Report of 2018, the implementation of the programme has experienced initial delays, indicating opportunities for strengthening execution and monitoring mechanisms (Comptroller and Auditor General of India, 2018).

The key policies/programmes/guidelines addressing ground water regulation are the national “Guidelines to regulate and control ground water extraction in India-2020” (Ministry of Jal Shakti , 2020), Gujarat State Action Plan on Climate Change-2021, State Action Plan for climate change and human health - 2023, the State Water Policy, and the Gujarat Comprehensive Development Control Regulations - 2017. The policies and programs directly addressing access to improved drinking water and sanitation services include state government funding (discussed in previous section) and national funding programmes like SBM (Urban) and AMRUT. The state climate action plan suggests ground water recharging, and regulations and optimizing water use efficiency specifically in Kachchh Banaskantha, Patan, Mehsana, Ahmedabad, Gandhinagar, Sabarkantha, Aravali, Rajkot, Morbi, Junagadh, Surendranagar, and Porbandar districts. **However, our fieldwork in the Valsad (Class A town) and Mandvi and Devbhumi Dwarka (Class C towns) revealed a lack of implementation of ground water regulation policies.**

The policies and programs addressing **wastewater and sewage recycling** offer dual benefits: fresh water savings, and an additional revenue stream for utilities. At the national level, the *Guidelines to Regulate and Control Groundwater Extraction in India – 2020* (Ministry of Jal

Shakti , 2020) mandate that residential apartments, group housing societies, and government water supply agencies must obtain a No Objection Certificate (NOC) for groundwater extraction where usage exceeds 20 m<sup>3</sup>/day. In such cases, the installation of a Sewage Treatment Plant (STP) is compulsory. Additionally, treated wastewater from the STP must be reused for non-potable purposes such as toilet flushing, car washing, and gardening.

At state level, the state climate action plan calls for promotion of on-site recycling of used water and decentralized treatment systems (for industrial reuse and small-scale use) as an adaptation strategy for water conservation (Government of Gujarat, 2021). As per state policy for promotion of wastewater recycling and reuse - June 2017 "Universal Coverage of UGD with at-least 20% of wastewater to be recycled by using advance, proven, appropriate and sustainable technology in all towns and cities of Gujarat state" is needed. Additionally, it suggests usage of treated sludge for agriculture, road construction and land-filling etc. The current requirement under Gujarat's "Policy for reuse of treated wastewater-2018" is to maximise the collection and treatment of sewage generated and sustainable reuse of treated water thereby reducing dependency on freshwater sources. The policy puts forward an ambitious target of reuse of 70% of treated wastewater by 2025, and 100% reuse by 2030 (NITI Aayog, 2023). Similarly, the National Service Level Benchmarks recommend 20% recycle and reuse of treated sewage. The state climate action promotes wastewater recycling in rural areas as well.

These policies/regulations in practice are followed to varying degree of compliance and success. **At the municipal level, data from the Performance Assessment System (PAS) indicates that municipal corporations in Gujarat treat approximately 26.2% of their sewage—significantly higher than the treatment levels observed in small and medium-class cities. However, data from the Service Level Benchmarks (SLBs), along with interviews conducted with officials in Valsad, Devbhumi Dwarka, and Mandvi, reveal that key guidelines related to the recycling of treated effluent and sludge are not being effectively implemented.**

**In Devbhumi Dwarka, while the treated wastewater from the STP is provided free of cost to local farmers for agricultural use, the sludge generated is not treated or utilized. In Valsad, treated wastewater is reused for activities such as road cleaning and gardening. Additionally, a Memorandum of Understanding (MoU) has been signed to supply treated wastewater to private chemical industries requiring hard water. However, site visits revealed that the treated sludge remains unutilized. In Mandvi, the situation is more constrained, with no infrastructure currently in place for the reuse or recycling of wastewater and sludge. Instead, wastewater is discharged into two oxidation ponds, from which farmers draw water for irrigation.**

**At the level of residential complexes and commercial establishments, the adoption of sewage treatment systems is often unfeasible due to constraints such as limited space availability, as observed in Devbhumi Dwarka, Mandvi and Valsad. As a result, wastewater recycling is generally not practiced in these settings.**

The **rainwater harvesting (RWH) structures** provide both adaptation and mitigation co-benefits, including freshwater savings and improved energy efficiency. As decentralized systems, they are less energy-intensive compared to traditional water distribution networks. Atal Bhujal Yojana (ATAL JAL) has been launched with the objective to improve the management of ground water resources including rainwater harvesting in water stressed areas through community participation in identified priority areas in 7 states including. The state climate action plan-2021 views RWH as one of the key adaptation options of water security. As part of the water conservation scheme, across 25 districts of Gujarat, around 25,697 tanks have been deepened to support water harvesting efforts. By the year 2012–13, rainwater harvesting systems had been installed in 24,103 SM units, covering a total area of 366,204 hectares. Additionally, as of March 31, 2018, a total of 93,092 check dams had been constructed across 33 districts, contributing significantly to the state's water conservation initiatives (Government of Gujarat, 2021).

In urban areas, at municipal level building by-laws (Gujarat Comprehensive Development Control Regulations - 2017) mandate rainwater harvesting “in all buildings with ground coverage 80 sq.mt and above”. **Although regulations mandate the inclusion of RWH structures as part of the building plan approval process, fieldwork conducted in Mandvi, Devbhumi Dwarka, and Valsad revealed limited adoption on the ground. During interviews with municipal officials (March 2025), it was noted that small property owners often refrain from installing RWH systems due to space constraints and the high upfront capital costs. At present, there is no government-provided subsidy or financial incentive to encourage the adoption of RWH. Nonetheless, municipal buildings in Mandvi have incorporated RWH systems, reflecting some institutional commitment to water conservation.**

### **6.2.3 Policies with Resilient Water and Sanitation Infrastructure Focus**

Water and sanitation are critical infrastructure and essential services during disasters and extreme climate events, and their resilience is key to ensuring the continued well-being of communities in the face of climate change.

Two major policy frameworks that focus on enhancing the resilience of physical infrastructure in Gujarat are the State Climate Change Action Plan and the Disaster Risk Mitigation and Management Plan. A notable commonality between these frameworks is their shared

recognition of the interlinkages between their core objectives and the Sustainable Development Goals (SDGs) (Gujarat State Disaster Management Authority, 2024, pp. 11-13) (Government of Gujarat, 2021, p. 29).

The state's primary guidance document for climate action, the State Climate Change Action Plan-2021, **emphasizes the interconnectedness between climate adaptation and infrastructure resilience, identifying infrastructure as one of the key priority sectors for climate change adaptation.** It specifically highlights how past extreme events such as floods and cyclones in the state have led to significant damage to different infrastructure, including water supply systems and sewerage networks. These disruptions are often compounded by power outages, which further impair drainage and waste disposal systems, resulting in public health risks and interruptions to essential services. **The plan recommends a wide range of measures, including—but not limited to—design modifications to address erratic precipitation, rising temperatures, and flooding.** It also proposes structural interventions such as overflow tanks for sewage systems and alternative power systems, while emphasizing the need to climate-proof infrastructure investments.

The **Disaster Management Plan emphasizes the integration of disaster risk considerations into development planning, with the Gujarat State Disaster Management Authority (GSDMA) playing a central role.** All line departments, municipal corporations, district collectors, and development offices are expected to **adopt this framework to guide developmental project planning based on area-specific vulnerabilities.** Additionally, GSDMA provides advisory support to both government agencies and private industries, helping assess regional risks before major investments are undertaken.

Hence, relevant authorities are advised to **integrate a range of risk financing instruments into a comprehensive disaster risk reduction (DRR) strategy,** supported by enabling policies and a robust legal framework. **The plan also suggests the revision of land-use regulations and building codes and implementation of judicial and administrative measures to ensure effective enforcement.** At city level, the Smart Cities Mission encourages cities to incorporate risk resilience into their proposals by assessing the impact of each project on the environment and its ability to withstand disasters. Table 7 below lists few of the suggested measures:

Table 7: Measures for Climate Resilient Water and Sanitation Infrastructure Proposed under Various Policies

Sl. No.	Type of Measures	Measures
1.	Non-structural measures	<ul style="list-style-type: none"> <li>• Developmental project planning based on the hazard, exposure, risk, vulnerability</li> <li>• Land use planning based on the hazard, exposure, risk, vulnerability</li> <li>• Regulations to promote Flood resilient infrastructure</li> <li>• Revision of land-use regulations and building codes and introduction of judicial and other measures to ensure enforcement.</li> <li>• New constructions to follow safety building codes</li> <li>• Integrating risk financing instruments in DRR framework</li> </ul>
2.	Design and Planning	<ul style="list-style-type: none"> <li>• Integrate flood forecasting and early warning systems into sewerage and water supply, landfill operational planning.</li> <li>• Design water, drainage, and sewage systems using updated climate and precipitation projections.</li> <li>• Size stormwater and drainage infrastructure to accommodate future climate variability.</li> <li>• Plan retention and safety basins to prevent overflow into drainage systems and downstream pollution.</li> </ul>
3.	Material and Structural Resilience	<ul style="list-style-type: none"> <li>• Use corrosion-resistant and waterproof materials in construction.</li> <li>• Elevate mechanical and electrical components in operation and maintenance facilities.</li> <li>• Raise the elevation of storage infrastructure to protect against saltwater intrusion.</li> <li>• Reduce pumping from freshwater lenses to inhibit saline intrusion.</li> <li>• Equip sewage systems with independent power backup to ensure pump operation during blackouts.</li> </ul>

Source: (Government of Gujarat, 2021) ; (Gujarat State Disaster Management Authority, 2024)

**Despite calls for these measures, the field reality is different. The lack of climate-resilient planning and investment in climate-proof infrastructure is increasingly evident in practice. For instance, fieldwork in Devbhumi Dwarka town revealed that the 2024 floods inundated the newly constructed Sewage Treatment Plant (STP), which remained non-operational as of April 2025. Similarly, in Valsad, during periods of high tidal waves, seawater flows back and stagnates in the low-lying areas of the city, even in the absence of rainfall. This can flood critical infrastructure, and prolonged exposure to saline water can lead to corrosion, ultimately affecting the functionality and longevity of essential services. Moreover, seawater intrusion poses a significant risk to both ground and surface water quality, particularly through increased salinity. This also leads to loss of public investments. Moreover, the additional resources required to rehabilitate and restart the system place further strain on**

local body. This situation underscores the urgent need for protective infrastructure, such as sea walls, barriers, or barrage systems, to prevent seawater intrusion during such events. It also highlights the complex challenges coastal cities face, as they must simultaneously manage the risks associated with both riverine and coastal flooding.

Moreover, flooding, heavy rainfall, or strong winds can lead to power outages, disrupting critical services such as water supply. For instance, Biparjoy cyclone in Mandvi city in Kachchh district, caused severe flooding, with some buildings submerged and widespread power outages, highlighting challenges in disaster response and the gap between official claims and community experiences (interview with the ULB officials). Field work in Valsad further reveals that while the STP is equipped with a power backup system, the water treatment plant does not have such provisions. In the event of power failures, the ULB arranges for tanker water supply to ensure that residents continue to have access to water. Given the essential nature of water services, it is recommended that the ULBs install reliable power backup systems, such as generators or solar-powered solutions, at the water treatment plant to ensure uninterrupted water supply during extreme weather events.

#### 6.2.4 Policies and Programmes Focussing on Coastal Areas

There is no dedicated national mission for coastal areas and climate change under the National Action Plan on Climate Change (NAPCC). However, the National Water Mission addresses climate change impacts on coastal regions as part of its broader mandate.

“A National Water Mission will be mounted to ensure integrated water resource management helping to conserve water, minimize wastage and ensure more equitable distribution both across and within states. The Mission will take into account the provisions of the National Water Policy and develop a framework to optimize water use by increasing water use efficiency by 20% through regulatory mechanisms with differential entitlements and pricing. It will seek to ensure that a considerable share of the water needs of urban areas are met through recycling of waste water, **and ensuring that the water requirements of coastal cities with inadequate alternative sources of water are met through adoption of new and appropriate technologies such as low temperature desalination technologies that allow for the use of ocean water**” (Ministry of Jal Shakti , 2021, p. 8). Key concerns included are saltwater intrusion due to sea level rise, which significantly impacts groundwater quality and access to drinking water. **Coastal regions, along with drought-prone areas, flood-prone areas, regions with deficient rainfall, and areas classified as over-exploited, critical, or semi-critical in terms of groundwater development and water quality, have been prioritised under the mission. Strategies for these priority areas include:** Improving water use efficiency by 20%, for which the Ministry has established the Bureau of Water Efficiency (BWE);

Assessing the impacts of climate change on water resources; Maintaining a comprehensive water database in the public domain; **and** Publishing the **Composite Water Management Index (CWMI)** to track and promote effective water management practices.

In 2011, the Ministry of Environment, Forest and Climate Change (MoEF&CC) established the **National Centre for Sustainable Coastal Management (NCSCM)** as an autonomous institution to support coastal protection, conservation, rehabilitation, and policy guidance. NCSCM promotes the **Integrated Coastal Zone Management (ICZM)** approach using science-based decision support systems and by facilitating collaboration among communities, government bodies, and national and international institutes. To implement this integrated approach, the Government of India launched the **Integrated Coastal Zone Management Project (ICZMP)** under the **CRZ and IPZ Notifications (2011)**. The project has enabled key activities such as **hazard line mapping, identification of eco-sensitive areas, and delineation of sediment cells** along the entire Indian coastline, laying the groundwork for climate-resilient coastal planning and governance. For implementing the provisions of the **CRZ Notification, 2011**, the Gujarat Coastal Zone Management Authority (GCZMA) was constituted. Its mandate includes protecting and improving the coastal environment, controlling pollution, and examining proposals for changes in CRZ classifications. The Authority is also empowered to investigate and review violations under the **Environment Protection Act** and **CRZ regulations** within Gujarat. **The state has developed CRZ master plan.**

Since its initial approval in the mid-1990s, the Gujarat CZMP has undergone periodic updates to reflect new scientific data, technological advancements, and evolving policy frameworks, including revisions following the 2011 and 2019 CRZ Notifications. **The latest approved plan incorporates improved GIS mapping, enhanced environmental safeguards, and stronger climate change adaptation measures.** The primary objectives of the CZMP are to protect coastal ecology, regulate development, promote sustainable livelihoods, and support climate change adaptation. It aims to preserve sensitive coastal ecosystems such as mangroves, coral reefs, beaches, tidal flats, and estuaries, which are vital for biodiversity and provide natural protection against storms and erosion. The plan sets guidelines and restrictions on construction, industrial activities, waste disposal, and other developmental projects within designated coastal zones to minimize environmental damage. By managing coastal resources responsibly, the CZMP also supports the livelihoods of coastal communities, especially fishermen and others dependent on marine and coastal ecosystems. Additionally, it incorporates measures to address climate change impacts including sea-level rise, coastal erosion, saltwater intrusion, and extreme weather events, thereby enhancing the resilience of coastal infrastructure and ecosystems.

The Gujarat State Action Plan on Climate Change (SAPCC) addresses the vulnerability of its extensive coastline to climate change impacts such as sea level rise, saltwater intrusion, extreme weather events, and coastal erosion, which threaten water availability, sanitation infrastructure, and public health. To mitigate these challenges, the plan emphasizes sustainable water resource management through groundwater regulation, rainwater harvesting, and aquifer recharge to combat over-extraction and salinity intrusion. It prioritizes upgrading sanitation and sewerage infrastructure by promoting decentralized wastewater treatment plants and eco-friendly sanitation technologies adapted to saline coastal environments, thereby preventing contamination of coastal waters. The SAPCC also focuses on controlling water pollution by enforcing strict regulations on domestic and industrial effluents, monitoring pollution hotspots, and encouraging cleaner production methods. Groundwater management is strengthened through GIS-based monitoring systems, community participation, and sustainable extraction limits to prevent saline intrusion. Additionally, the plan supports nature-based solutions such as mangrove restoration and coastal afforestation to protect water and sanitation infrastructure from storm surges and erosion. Disaster preparedness measures, including early warning systems and contingency planning, are integrated to maintain essential services during climate-induced events.

The latest Gujarat State Disaster Management Plan (GSDMP) for 2024–25 places significant emphasis on coastal areas, recognizing their heightened vulnerability to natural hazards such as cyclones, tsunamis, and coastal flooding. These regions, particularly in districts like Kutch, Jamnagar, and Gir Somnath, are identified as "Highly Prone" to cyclone hazards, with wind speeds reaching up to 180 km/h in certain zones. To address these risks, the GSDMP outlines a comprehensive approach encompassing preparedness, mitigation, response, and recovery strategies. Key initiatives include the establishment of 76 multi-purpose cyclone shelters across coastal districts, equipped with community kitchens and medical facilities, to provide safe havens during disasters. Additionally, the plan emphasizes the importance of early warning systems and community-based disaster preparedness, as demonstrated by the tsunami preparedness exercises conducted in Rapar Garh village. The plan also integrates climate change considerations, acknowledging the increasing frequency and intensity of extreme weather events. It advocates for the construction of resilient infrastructure, such as elevated shelters and reinforced buildings, and the implementation of ecosystem-based solutions like mangrove restoration to buffer against storm surges and coastal erosion. Moreover, the GSDMP underscores the necessity of continuous monitoring and capacity building at the community level to enhance adaptive capacities in coastal regions.

Further, Gujarat has implemented several schemes to address saltwater intrusion in its coastal areas, focusing on protecting freshwater resources and ensuring sustainable water availability. One key initiative is the **Salinity Ingress Prevention Scheme** managed by the

Gujarat Water Supply and Sewerage Board, which regulates groundwater extraction to prevent excessive pumping, promotes artificial recharge through check dams and recharge wells, and encourages the adoption of salt-tolerant crops to mitigate agricultural impacts. Additionally, the **Kalpasar Project** aims to create a large freshwater reservoir in the Gulf of Khambhat by constructing a dam that will store river runoff, providing an alternative freshwater source to reduce reliance on groundwater and curb saltwater intrusion. Gujarat also participates in the **national Atal Bhujal Yojana scheme**, which emphasizes community-driven groundwater management to improve water use efficiency and prevent over-extraction. Together, these initiatives demonstrate Gujarat’s integrated approach combining infrastructure, sustainable practices, and community engagement to manage and mitigate saltwater intrusion along its coast.

## 7. RECOMMENDATIONS

Gujarat's policy and institutional landscape was examined through a grounded assessment in the towns of Mandvi, Devbhumi Dwarka, and Valsad to understand how water, sanitation, and climate change policies interact, and to identify key policy, institutional, and implementation challenges. **This section presents an analysis of these challenges and offers targeted recommendations under key themes: financial programmes and schemes, institutional frameworks, and the broader policy landscape.**

Gujarat, while a top performer in economic and human development, is both a major contributor to India's GHG emissions and one of its most climate-vulnerable states due to its arid geography, long coastline, and exposure to extreme weather events. The state has demonstrated early policy leadership through the establishment of a dedicated Climate Change Department and the formulation of a State Climate Action Plan and Disaster Management Plan, both of which advocate for climate-proof infrastructure and integrated governance. However, practical implementation remains limited. **Key challenges include inadequate water and sanitation infrastructure in smaller towns, limited uptake of rainwater harvesting and wastewater recycling due to weak incentives, and insufficient efforts in mangrove restoration to combat saltwater intrusion.** Fieldwork in coastal towns like Mandvi, Devbhumi Dwarka, and Valsad confirms these gaps. Although wastewater contributes minimally to GHG emissions, its poor management carries significant health and environmental costs. Municipal electricity use is heavily skewed toward water pumping, yet energy efficiency initiatives have largely focused on public lighting rather than pumping systems. Fragmented governance and overlapping mandates across state departments further hinder effective policy implementation and coherence.

### 7.1 Financial Programmes / Schemes

**Key challenges** in Gujarat's urban water and sanitation sector include low overall budget allocations despite multiple funding sources, limited integration of climate change efforts with urban sanitation as the Climate Change Department's focus is primarily on solar energy, and relatively modest capital expenditure on sewerage infrastructure, despite some improvements. The key **recommendations** are:

1. **Raise Budgetary Allocations:** Raise state-level budget shares for water, sanitation, and climate adaptation in urban areas, especially under the Climate Change Department.

- 2. Strengthen Scheme Convergence:** Enhance coordination between climate change, disaster management, and urban development departments to mainstream resilience into WaSH infrastructure planning.
- 3. Decentralise Financing:** Empower ULBs with more flexible financing, improved user charges, and performance-based grants to ensure autonomy and sustainability.
- 4. Prioritise Sanitation and Wastewater Management:** Accelerate the completion of pending STP and sewerage projects under SJMMSVY and AMRUT 2.0, with a focus on quality execution, especially in underserved and smaller municipalities. Explore decentralised wastewater treatment solutions in areas where centralised infrastructure is unviable or cost-inefficient, to ensure inclusive and effective sanitation coverage.
- 5. Capacity Building and Technical Support:** Build municipal capacity for project planning, financial management, and climate-resilient design with state support and technical partners.
- 6. Expand ODF++ Certification:** Extend SBM-U efforts beyond toilet construction to ensure effective faecal sludge and septage management, especially in smaller municipalities.
- 7. Data-Driven Governance:** Use GIS and MIS tools to map sanitation gaps, vulnerability hotspots, and infrastructure needs, and guide equitable investment distribution.

## 7.2 Institutional Landscape

Gujarat's institutional framework for water, sanitation, energy, and climate resilience is highly fragmented, with multiple departments and agencies—such as the Urban Development Department, GWSSB, GUDC, GUDM, GIDB, and GEDA—sharing overlapping responsibilities across planning, financing, implementation, and regulation. This overlap has led to inefficiencies and duplication in infrastructure development, particularly in urban water, sewerage, climate resilience, and disaster management.

### Key Challenges

- 1. Highly fragmented institutional framework:** Multiple departments and agencies (Urban Development Department, GWSSB, GUDC, GUDM, GIDB, GEDA) have overlapping responsibilities, causing inefficiencies and duplication in infrastructure planning, financing, implementation, and regulation.
- 2. Overlapping roles leading to inefficiencies:** The overlap especially affects urban water supply, sewerage, climate resilience, and disaster management infrastructure development.

3. **Limited financial and institutional autonomy of Urban Local Bodies (ULBs):** Although ULBs are constitutionally responsible for sanitation, they often lack resources and autonomy to plan or implement large-scale infrastructure such as sewage treatment plants (STPs).
4. **Dependency on state agencies and central schemes:** Large infrastructure projects like STPs are driven primarily by state agencies under central government schemes (e.g., AMRUT), reducing ULB control and flexibility.
5. **Limited operational capacity of ULBs for disaster preparedness:** ULBs do not have dedicated disaster response teams and heavily rely on district-level authorities for emergency preparedness and response.
6. **Weak regulatory enforcement at household level:** Enforcement regarding household on-site sanitation systems is poor.

### Key Recommendations

1. **Clarify Institutional Mandates:** Define clear roles and reduce overlaps among agencies involved in water, sanitation, and climate governance.
2. **Strengthen ULB Capacity:** Enhance financial, technical, and human resource capacities of ULBs to independently plan and implement water and sanitation and climate adaptation projects.
3. **Decentralise Infrastructure Planning:** Allow ULBs greater say in project design and technology choice for water, sanitation and drainage.
4. **Promote Integrated Planning:** Establish joint task forces or other coordination platforms between climate, urban development, and disaster management departments.
5. **Improve Regulatory Enforcement:** Strengthen oversight of household sanitation through regular inspections and updated by-laws.
6. **Build Local Disaster Resilience:** More say of ULB in disaster and climate change planning. Equip ULBs with dedicated teams, early warning systems, and training for disaster response, particularly in flood-prone and high-risk zones.

## 7.3 Policy Landscape

State policies and programmes place greater emphasis on climate adaptation, with comparatively limited focus on mitigation and the resilience of water and sanitation infrastructure. This emphasis is well-founded—like most states in India, the priority must be to first strengthen adaptive capacity and enhance the resilience of communities before focusing on long-term mitigation goals.

### 7.3.1 Mitigation

Gujarat's Urban Water Supply and Sanitation (UWSS) sector contributes to greenhouse gas (GHG) emissions through both direct (biological processes) and indirect (electricity consumption) sources. Since 2019, the state has made notable strides in promoting renewable energy (solar and wind) and energy efficiency through schemes like UJALA and PAT. **However, in the UWSS sector, mitigation efforts are narrowly focused on reducing electricity use—primarily in street lighting—while opportunities to generate energy from wastewater (e.g., biogas at STPs) remain underexplored.**

#### Key challenges

- 1. Underestimated GHG Emissions:** Official data significantly underrepresents municipal UWSS emissions by excluding electricity consumption from water pumping and sewage operations.
- 2. Neglect of Energy Generation from Wastewater:** Policies like the Renewable Energy Policy (2023) and Waste-to-Energy Policy (2022) do not cover energy recovery from STPs. Field studies reveal that municipalities like Valsad and Mandvi have not yet considered biogas recovery.
- 3. Inefficiencies in Wastewater Treatment Infrastructure:** Inadequate sewerage connections, absence of Faecal Sludge and Septage Treatment Plants (FSSTPs), and operational bottlenecks contribute to untreated wastewater discharge and methane emissions.
- 4. Weak Policy Implementation:** Although decentralized wastewater systems are mandated in building by-laws, they remain poorly enforced in towns surveyed.
- 5. Skewed Focus on Lighting over Water Systems:** While LED-based street lighting has seen state-wide rollout, substantial energy-saving potential in water and wastewater services is overlooked.
- 6. Limited Municipal Initiatives:** Although some towns like Valsad are experimenting with carbon footprint tracking and solar installations at STPs, such practices are not widespread.

#### Key Recommendations

- 1. Institutionalize GHG Monitoring and Reporting:** Develop robust systems for regular GHG accounting from municipal services, especially public water works and sewage pumping. Integrate GHG estimates into the State Climate Action Plan and urban sector strategies to enable informed mitigation planning.
- 2. Expand Energy Efficiency Initiatives in UWSS:** Extend energy efficiency programs (e.g., MEEP) beyond public lighting to cover municipal water pumping, sewage pumping stations, and STPs. Retrofit outdated pumps and motors with high-efficiency

equipment in water and wastewater utilities. Build technical and financial capacity of Urban Local Bodies (ULBs) to implement and monitor energy-saving interventions.

3. **Enable Energy Generation from Wastewater:** Amend **Renewable Energy Policies** and **Waste-to-Energy Policy** to explicitly include energy generation from sewage treatment plants (STPs) and Faecal Sludge and Septage Treatment Plants (FSSTPs). Provide fiscal incentives, technical guidance, and performance-linked grants for ULBs to set up **biogas recovery, co-generation, or sludge-to-energy** systems. Promote solar integration at WTPs/STPs, building on examples from Devbhumi Dwarka and Mandvi.
4. **Strengthen Decentralized and Non-Network Solutions:** Enforce by-laws and state mandates requiring large properties to install **on-site decentralized wastewater treatment** systems. Develop clear guidelines, Standard Operating Procedures (SOPs) along with environmental standards, and establish robust monitoring and regulatory frameworks at both the Urban Local Body (ULB) and regional State Pollution Control Board levels for decentralized wastewater treatment systems. Recognize the GHG reduction co-benefits of decentralized systems and incorporate them into climate mitigation frameworks.
5. **Septic Tanks, Sewerage Networks and FSSTP Infrastructure:** Fast-track completion of pending sewerage projects under **AMRUT 2.0** and **SJMMSVY**, especially in underserved municipalities. Enforce and ensure compliance with BIS standards for toilets and on-site sanitation systems, particularly in new building constructions, through coordinated efforts between Urban Local Bodies (ULBs) and the Town Planning Department. Invest in Faecal Sludge and Septage Treatment Plants (FSSTPs) and strengthen Urban Local Body (ULB)-level sludge and septage management infrastructure to effectively reduce high methane emissions from unconnected septic tanks. Conduct infrastructure audits to identify service gaps, operational inefficiencies, and leakages.
6. **Improve Interdepartmental Coordination and Policy Coherence:** Establish a cross-sectoral platform linking **Urban Development, Energy, Environment, and Disaster Management** departments to harmonize policies on mitigation. Align UWSS-sector interventions with state climate action plans, human development indicators, SDGs, and disaster risk reduction plans to avoid duplication and enable synergistic outcomes.
7. **Strengthen Localized Climate Action and ULB Capacities:** Support ULBs to create **local carbon mitigation roadmaps**, conduct energy audits, and plan for solar and renewable energy transitions. Provide training, tools, and fiscal resources for ULBs to independently plan, implement, and maintain climate-resilient and low-carbon UWSS systems. Encourage real estate and public infrastructure to adopt **solar-powered water systems** and mandate **energy efficiency disclosures** during property transactions.

### 7.3.2 Adaptation

Gujarat's climate change and water-sanitation policies primarily focus on adaptation strategies addressing water scarcity, equitable access to drinking water and sanitation, and human/environmental health. Key recommended measures include diversifying water sources, promoting rainwater harvesting, groundwater recharge, efficient water use, groundwater regulation, treated wastewater recycling, and protection against saltwater intrusion. Despite robust policy frameworks—such as the State Climate Action Plan, national groundwater extraction guidelines, and state-level wastewater reuse policies—several **challenges** limit effective implementation and outcomes:

#### Key challenges

- 1. Water Stress and Groundwater Challenges:** Gujarat faces severe water stress with large drought-prone and semi-arid areas. Saltwater intrusion threatens groundwater quality, yet mangrove cover, a natural buffer, is declining sharply, especially in vulnerable districts like Kachchh.
- 2. Implementation Gaps:** While infrastructure like check dams and rainwater harvesting tanks exist, their effectiveness is limited by poor enforcement, delayed execution (notably in salinity ingress prevention schemes), and lack of monitoring.
- 3. Regulatory Compliance Issues:** Groundwater regulation policies and wastewater recycling mandates show poor compliance, especially in smaller towns like Valsad, Mandvi, and Devbhumi Dwarka, where groundwater extraction regulation and wastewater reuse are weak or absent.
- 4. Limited Wastewater Treatment and Reuse:** Although municipal corporations treat about 26% of sewage, smaller cities lag behind. Treated sludge is often underutilized, and infrastructure for wastewater and sludge reuse is inadequate, particularly in smaller towns.
- 5. Constraints in Residential and Commercial Settings:** Space limitations and lack of incentives hinder the adoption of onsite sewage treatment and wastewater recycling in residential complexes and commercial establishments.
- 6. Insufficient Adoption of Rainwater Harvesting:** Despite regulations mandating rainwater harvesting for large buildings, adoption is low due to space constraints, high upfront costs, and absence of government subsidies, especially among small property owners.

#### Recommendations

- 1. Strengthen Implementation and Monitoring Mechanisms:** Improve execution and monitoring of key programs such as the Salinity Ingress Prevention Scheme and groundwater regulation policies to ensure timely and effective results. Address data

discrepancies (e.g., mangrove cover in CRZ areas) through enhanced transparency and coordinated reporting among departments.

2. **Enhance Groundwater Management and Regulation:** Enforce groundwater extraction regulations strictly, including mandatory No Objection Certificates (NOCs) and installation of Sewage Treatment Plants (STPs) for large water users. Promote groundwater recharge programs more effectively, especially in drought-prone and water-stressed districts.
3. **Promote Wastewater and Sludge Recycling and Reuse:** Scale up infrastructure for sewage treatment and ensure the reuse of treated wastewater for non-potable purposes such as agriculture, landscaping, and industrial use. Develop facilities and policies for sludge treatment and utilization, such as its use in agriculture or road construction, to prevent environmental hazards.
4. **Support Small and Medium Towns in Capacity Building:** Provide technical and financial support to smaller urban centres to adopt wastewater treatment, recycling, and reuse technologies. Encourage decentralised wastewater treatment solutions suited to local conditions.
5. **Encourage Adoption of Rainwater Harvesting (RWH):** Provide subsidies or financial incentives to property owners, especially small-scale, to install rainwater harvesting systems. Increase awareness and simplify approval processes to improve adoption rates in urban and rural areas. Promote community participation and support for RWH as part of water security strategies.
6. **Restore and Protect Natural Buffers:** Prioritize mangrove conservation and afforestation efforts to combat saltwater intrusion and protect coastal ecosystems, with stronger enforcement and community involvement.
7. **Integrate Multi-sectoral Coordination:** Foster collaboration between state departments, municipal bodies, and community stakeholders to harmonize efforts in water, sanitation, and climate resilience. Align urban planning regulations (e.g., building by-laws) with climate adaptation and water conservation goals.

### 7.3.3 Infrastructure Resilience

Gujarat's coastal areas are highly vulnerable to extreme climate events such as floods, cyclones, and heavy rainfall, which severely disrupt water supply, sewerage, and sanitation systems, posing significant public health risks. Coastal towns face compounded threats from both riverine and coastal flooding, including seawater backflow that degrades water quality and reduces infrastructure longevity. Extreme weather often causes power outages, disrupting water treatment and sewage operations; however, backup power systems are inconsistently implemented, with many Sewage Treatment Plants (STPs) having backups while water treatment plants often lack them. **Although the State Climate Change Action**

**Plan and the Disaster Risk Mitigation and Management Plan emphasize climate-proofing infrastructure, many facilities remain vulnerable in practice.** For instance, the sewage treatment plant in Devbhumi Dwarka was flooded and rendered non-operational after the 2024 floods, and seawater intrusion in coastal cities like Valsad continues to cause corrosion and service disruptions.

**To address these challenges,** following are the recommendations:

1. Integrate climate-resilient design and planning into all water and sanitation infrastructure projects.
2. Incorporate flood forecasting, early warning systems, and retention basins to manage overflow safely.
3. Design stormwater infrastructure to accommodate future climate variability.
4. Strengthen enforcement of land-use and building codes based on hazard and vulnerability assessments.
5. Ensure effective coordination among the Gujarat State Disaster Management Authority, ULBs, and relevant departments.
6. Develop and embed climate-resilient design standards into engineering manuals.
7. Provide targeted training to ULBs on assessing Detailed Project Reports (DPRs) using climate-resilient standards.
8. Explicitly integrate climate projections and risk assessments into future WaSH infrastructure planning.
9. Conduct comprehensive climate and disaster risk assessments of existing WaSH infrastructure.
10. Prioritize the upgrade and retrofitting of vulnerable infrastructure to withstand climate extremes.
11. Institutionalize the use of advanced data-driven tools (e.g., IoT sensors, GIS mapping) for proactive risk monitoring and adaptive water system management.

#### **7.3.4 Policies on Coastal Areas**

Gujarat's coastal regions are highly vulnerable to climate change impacts such as sea-level rise, saltwater intrusion, cyclones, coastal flooding, and extreme weather events. Despite this, there is **no dedicated national mission for coastal climate change adaptation**, and existing measures under the **National Water Mission** only partially address the unique challenges faced by coastal cities. These include degradation of groundwater due to salinity, lack of freshwater alternatives, and poor wastewater management. Although Gujarat has developed coastal zone management plans (CZMP) and state-level climate and disaster management plans **addressing vulnerabilities such as sea level rise, erosion, and extreme weather,**

**enforcement and integration of these policies remain complex.** Challenges persist in managing saline intrusion, protecting sensitive ecosystems like mangroves, and ensuring sustainable water resource use in the face of over-extraction and pollution. Despite multiple schemes—such as the Salinity Ingress Prevention Scheme, Kalpasar Project, and Atal Bhujal Yojana—focused on groundwater regulation and saltwater intrusion mitigation, the scale of vulnerability and coordination across agencies continues to pose risks to water and sanitation infrastructure and coastal livelihoods.

While existing plans like the Coastal Zone Management Plan (CZMP), State Action Plan on Climate Change (SAPCC), and the State Disaster Management Plan (SDMP) acknowledge these risks, their enforcement and integration remain fragmented. To strengthen resilience, the state should develop a coastal-specific climate adaptation strategy that builds on but goes beyond the National Water Mission. This includes enhancing groundwater management in salinity-prone areas through scaled-up implementation of the Salinity Ingress Prevention Scheme, the Kalpasar Project, and Atal Bhujal Yojana, alongside promoting rainwater harvesting, desalinization, and wastewater reuse as alternative freshwater sources. Wastewater and faecal sludge management systems in coastal towns must be upgraded to prevent pollution and groundwater degradation. Protecting and restoring coastal ecosystems like mangroves and wetlands is equally critical, as they act as natural buffers against sea-level rise and storm surges. All water and sanitation infrastructure should undergo climate and disaster risk assessments, especially in low-lying zones. In parallel, building the capacity of Urban Local Bodies (ULBs) and other local institutions on resilient planning and disaster preparedness is essential. **Finally, establishing a cross-sectoral coastal resilience coordination mechanism would ensure alignment among various state departments, local governments, and stakeholders, enabling effective planning, financing, and implementation of adaptation measures across Gujarat’s vulnerable coastal belt.**

## References

- A. Jain, R. O’Sullivan and V. Taraz, “Temperature and economic activity. Evidence from India,” *Journal of Environmental Economics and Policy*, vol. 9, no. 4, p. 430–446, 2020.
- A. Rumbach, “At the Roots of Urban Disasters: Planning and Uneven Geographies of Risk in Kolkata, India’,” *Journal of Urban Affairs*, vol. 39, no. 6, p. 1–17.\, 2018.
- Central Electricity Authority, “All India Electricity Statistics. General Overview (2022-23),” Ministry of Power, Government of India, New Delhi, 2024.
- Central Ground Water Board, “Report on Dynamic Ground Water Resources of Gujarat State- 2023,” New Delhi, 2023.
- Central Pollution Control Board, “National Inventory of Sewage Treatment Plants,” Ministry of Environment, Forest and Climate Change. Government of India, New Delhi, 2021.
- Central Pollution Control Board, “Polluted River Stretches for Restoration of Water Quality -2022,” Ministry of Environment, Forests & Climate Change, New Delhi, 2022.
- Comptroller and Auditor General of India, “Report No.1 of 2018 - Economic Sector Government of Gujarat,” New Delhi, 2018.
- Comptroller and Auditor General of India, “Performance Audit of Conservation and Management of Coastal Ecosystems in Gujarat. Report No. 03 of the year 2022”.
- Department of Economic and Policy Research, “Report on Municipal Finances. Own Sources of Revenue Generation in Municipal Corporations: Opportunities and Challenges,” Reserve Bank of India, Government of India, New Delhi, 2024.
- Directorate of Economics & Statistics, Government of Gujarat, “District-wise Details of Annual Average Rainfall of Gujarat from 2014 to 2023,” 22 November 2024b. [Online]. Available: <http://data.gov.in/resource/district-wise-details-annual-average-rainfall-gujarat-2014-2023>. [Accessed April 2025].
- Directorate of Economics and Statistics, “State Domestic Product Gujarat State 2022-23 (Base Year 2011-12),” Government of Gujarat, Gandhinagar, 2024a.
- Directorate of Economics & Statistics, “Statistical Overview of Gujarat State-2023,” Government of Gujarat, Gandhinagar, 2024.
- Directorate of Economics and Statistics, “Socio-Economic Review of Gujarat State - 2024-25,” Government of Gujarat, Gandhinagar, 2025.
- EESL, “MEEP Dashboard,” 2025. [Online]. Available: <https://meep.eeslindia.org/dashboard/states/gujrat.aspx>. [Accessed April 2025].
- Forest Survey of India, “India State of Forest Report -2023,” Forest Survey of India, Ministry of Environment, Forest & Climate Change, Government of India, Dehradun, 2023.
- GHG Platform India, “Trend Analysis of GHG Emissions of Gujarat: Analysis of Greenhouse Gas Emissions from 2005 to 2018,” 2018.

- Government of Gujarat, “Gujarat State Action Plan on Climate Change,” Gandhinagar, 2021.
- Government of India, “State-wise Details of Sewage Generation and Processing in Gujarat, Madhya Pradesh and Maharashtra (in Reply to Unstarred Question on 15 December, 2022),” 19 May 2023. [Online]. Available: <https://www.data.gov.in/resource/state-wise-details-sewage-generation-and-processing-gujarat-madhya-pradesh-and-maharashtra>. [Accessed April 2025].
- Government of Gujarat, “Budget 2023-24 Press Note: Climate Change Department,” 24 February, 2023. [Online]. Available: [https://financedepartment.gujarat.gov.in/Documents/Bud-Eng\\_1211\\_2023-24\\_470.pdf](https://financedepartment.gujarat.gov.in/Documents/Bud-Eng_1211_2023-24_470.pdf). [Accessed April 2025].
- Government of Gujarat, “Gujarat Renewable Energy Policy -2023,” Government of Gujarat, Gandhinagar, 2023.
- Gujarat Pollution Control Board, “Annual Report 2023-24,” Government of Gujarat, Gandhinagar, 2024.
- Gujarat State Disaster Management Authority, “Gujarat State Disaster Management Plan -2024-25,” Gandhinagar, 2024.
- H. Kreibich, J. C. J. M. v. d. Bergh, L. M. Bouwer, P. Bubeck, P. Ciavola, C. Green, S. Hallegatte, I. Logar, V. Meyer, R. Schwarze and A. H. Thieken, “Costing natural hazards,” *Nature Climate Change*, vol. 4, no. 5, pp. 303- 306, 2014.
- International Institute for Population Sciences and ICF, “National Family Health Survey (NFHS-5)-India (2019-20),” IIPS, Mumbai, 2021.
- K. Yenneti, S. Tripathi, Y. D. Wei, W. Chen and G. Joshi, “The Truly Disadvantaged? Assessing Social Vulnerability to Climate Change in Urban India,” *Habitat International*, vol. 56, p. 124–35, 2016.
- M. A. Braks and A. M. d. R. Husman, “Dimensions of Effects of Climate Change on Water-Transmitted Infectious Diseases,” *Air Water Borne Diseases*, 2013.
- Ministry of Jal Shakti, “Gazatted Notification-Guidelines to regulate and control ground water extraction in India,” New Delhi, 2020.
- National Centre for Disease Control, “State Action Plan on Climate Change and Human Health: Gujarat,” Government of India, New Delhi, 2022.
- National Dairy Development Board, “Dairying in Gujarat- A Statistical Profile -2013,” 2014. [Online]. Available: [https://dairyknowledge.in/dkp/sites/default/files/7.\\_agriculture.pdf](https://dairyknowledge.in/dkp/sites/default/files/7._agriculture.pdf). [Accessed April 2025 ].
- Narmada, Water Resources, Water Supply and Kalpsar Department, “Map of river,” 17 April 2025. [Online]. Available: <https://guj-nwrws.gujarat.gov.in/showpage.aspx?contentid=1524&lang=English>. [Accessed April 2025].
- NITI Aayog, “Reuse of Treated Wastewater in Urban/Peri-Urban Agriculture in India,” NITI Aayog, Government of India, New Delhi, 2023.

- NITI Aayog, “Economy and Demography,” 25 November 2024. [Online]. Available: <https://iced.niti.gov.in/economy-and-demography/key-economic-indicators/gdp>. [Accessed November 2024].
- NITI Aayog, “SDG Index India -2023-2024,” Government of India, New Delhi, 2024.
- NITI Aayog, “Natural Disasters In India,” 1 January 2025. [Online]. Available: <https://iced.niti.gov.in/state-report/karnataka>.
- N. Kumar and D. Maiti, “The Dynamic Causal Impact of Climate Change on Economic Activity. A Disaggregated Panel Analysis of India,” Centre for Development Economics, Delhi School of Economics, New Delhi, 2024.
- PRS Legislative Research, “Budget Analysis,” 2024. [Online]. Available: <https://prsindia.org>. [Accessed Feb 2025].
- RBI, “Handbook of Statistics on Indian States 2023-24,” Government of India, New Delhi, 2024.
- RBI, “Handbook of Statistics on Indian States,” Government of India, New Delhi, 2024.
- R. Kumar, P. Jawale and a. S. Tandon, “Economic Impact of Climate Change on Mumbai, India,” *Regional Health Forum*, vol. 12, no. 1, pp. 38-42, 2008.
- S. K. Mohanty, R. B. Bhagat, L. K. Dwivedi, S. Sharma, J. Jose, A. Nair and R. Chandrasekar, “Assessing Urban Vulnerabilities in Maharashtra,” Government of Maharashtra, UNICEF, IIPS, 2020.
- Task Force Committee, “Strategy for Government of Gujarat to enable India to become a USD 5 trillion economy,” Government of Gujarat, Gandhinagar, 2022.
- V. Chaturvedi, “The Costs of Climate Change Impacts for India. A Preliminary Analysis,” CEEW, New Delhi, 2015.

## Endnotes

<sup>i</sup> The coastline length of Gujarat referenced in this report is based on sources reviewed and compiled by the author. During report finalization, the official coastline length of Gujarat was revised to 2340.62 km as per the Press Information Bureau (PIB), Government of India, Delhi vide press release dated 04 December 2025, (Release ID: 2198800). <https://www.pib.gov.in/PressReleaseDetailm.aspx?PRID=2198800&reg=3&lang=1>

<sup>ii</sup> Global Climate Risk Index 2021. Who suffers Most from Extreme Weather Events? Weather-related Loss Events in 2019 and 2000 to 2019 <https://www.germanwatch.org/en/19777>

<sup>iii</sup> As per IPCC, Adaptation is understood as adjustments in human systems in response to actual or expected climate impacts, aimed at moderating harm or capitalizing on beneficial opportunities. Adaptive capacity refers to the ability of systems, institutions, and individuals to adjust to potential damage, seize opportunities, or respond effectively to consequences.

<sup>iv</sup> CDRI. <https://lexicon.cdri.world/topic/240> Retrieved on 23 July 2025.

<sup>v</sup> The *Climate Resilient Coastal Cities* initiative was rolled out in September 2023. Project partners include - Funding Partner: HSBC; Communications, Outreach, and Advocacy Partner: India Sanitation Coalition (ISC); Research Partner: Ashank Desai Centre for Policy Studies (IIT-Bombay); Research and Implementation Partner: CDD India.

<sup>vi</sup> Gujarat Infrastructure Development Board (GIDB). 2025. Water Supply Scenario in Gujarat. <https://gidb.org/water-supply-scenario-in-gujarat> Retrieved on March 2025.

<sup>vii</sup> Representative Concentration Pathways (RCPs) are used by the IPCC to describe different GHG concentration trajectories and their associated climate outcomes by 2100. RCP 2.6 represents a very low emissions pathway with strong mitigation, limiting global warming to around 1.5–2°C above pre-industrial levels. RCP 4.5 is an intermediate scenario with moderate mitigation, leading to stabilization of emissions and approximately 2.4–3°C warming by the end of the century. RCP 8.5 reflects a high-emissions pathway with minimal climate action, resulting in continued reliance on fossil fuels and warming of 4°C or more.

<sup>viii</sup> At the time of report finalisation, it was noted that these figures reflect the authors' interpretation.

<sup>ix</sup> Till July, 2019, 2.63 lakh streetlights are replaced by Municipalities and Municipal Corporation by their own and around 8.70 lakh street lights are replaced by EESL (Government of Gujarat, 2021, p. 106)







Supported by



Ashank Desai  
Centre for Policy Studies  
Indian Institute of Technology Bombay  
Insight ♦ Dialogue ♦ Impact



CDDIndia  
Water | People | Nature



**INDIA  
SANITATION  
COALITION**

BUILD • USE • MAINTAIN • TREAT

### India Sanitation Coalition

FICCI Federation House, 1 Tansen Marg, New Delhi – 110001

Ph: 011-23487266

[www.indiasanitationcoalition.org](http://www.indiasanitationcoalition.org)