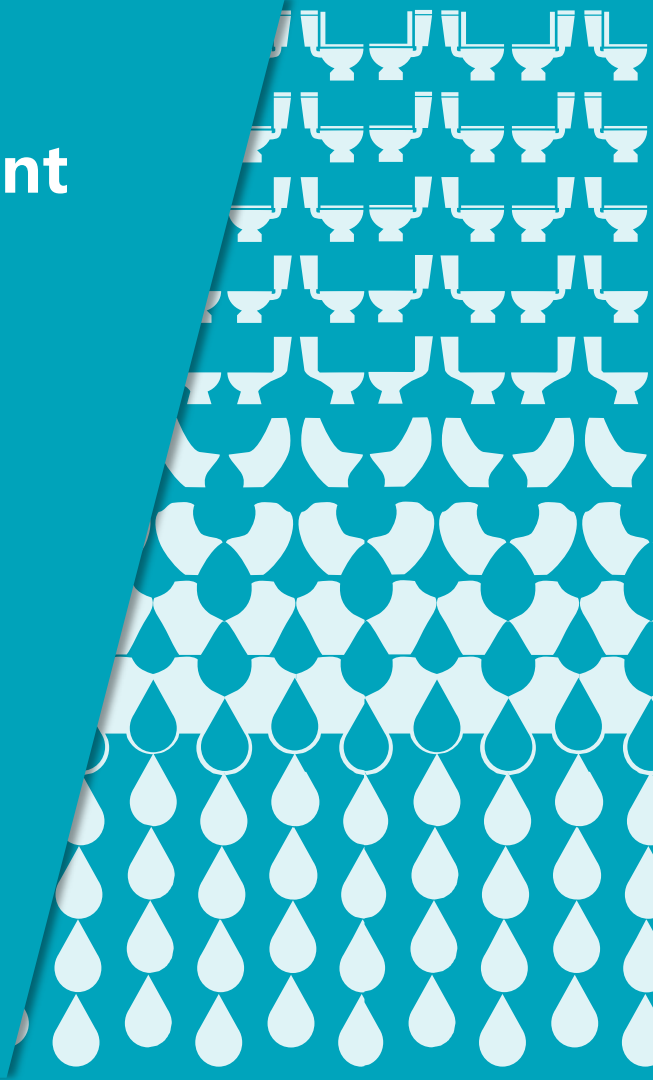
Moving towns towards climate resilient waste management services

Global South Academic Conclave 2026



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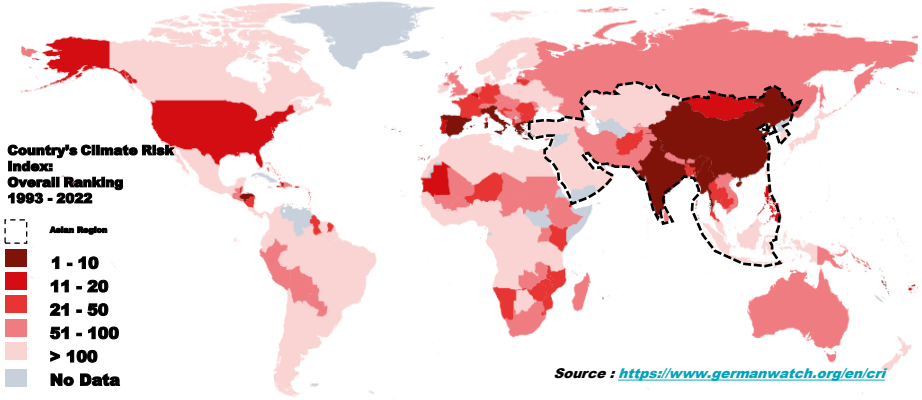
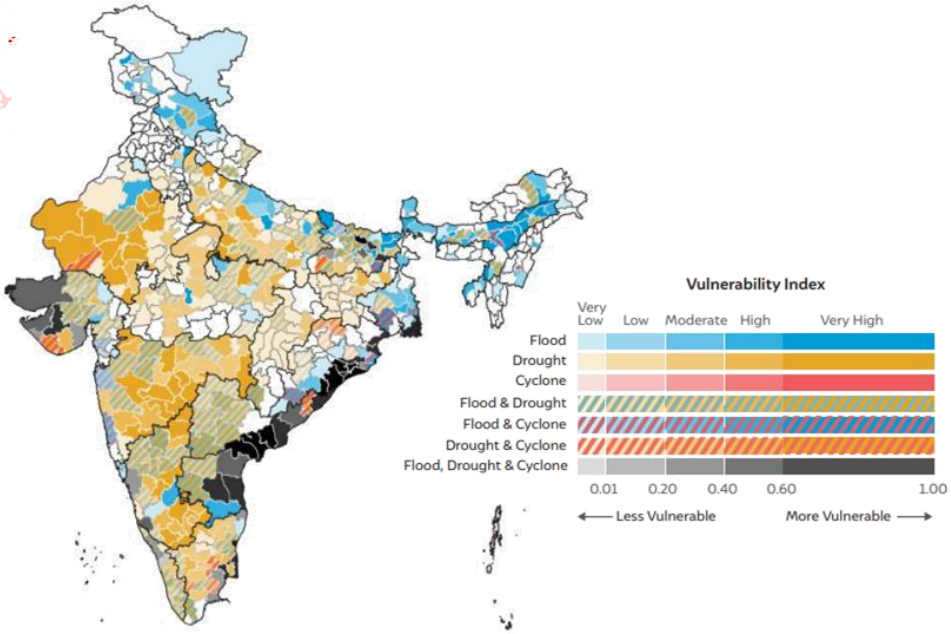
Global South countries mainly affected by recurring extreme weather events



6 Asian countries are ranked in world's first 10 most affected countries by climate risk[1]

India is in top five countries mainly affected by recurring extreme weather events



CEEW and IIC, 2021

https://www.germanwatch.org/de/cri

The frequency and scale of these impacts are increasing

50 degree Celsius in Delhi, India

Typhoon in Puri

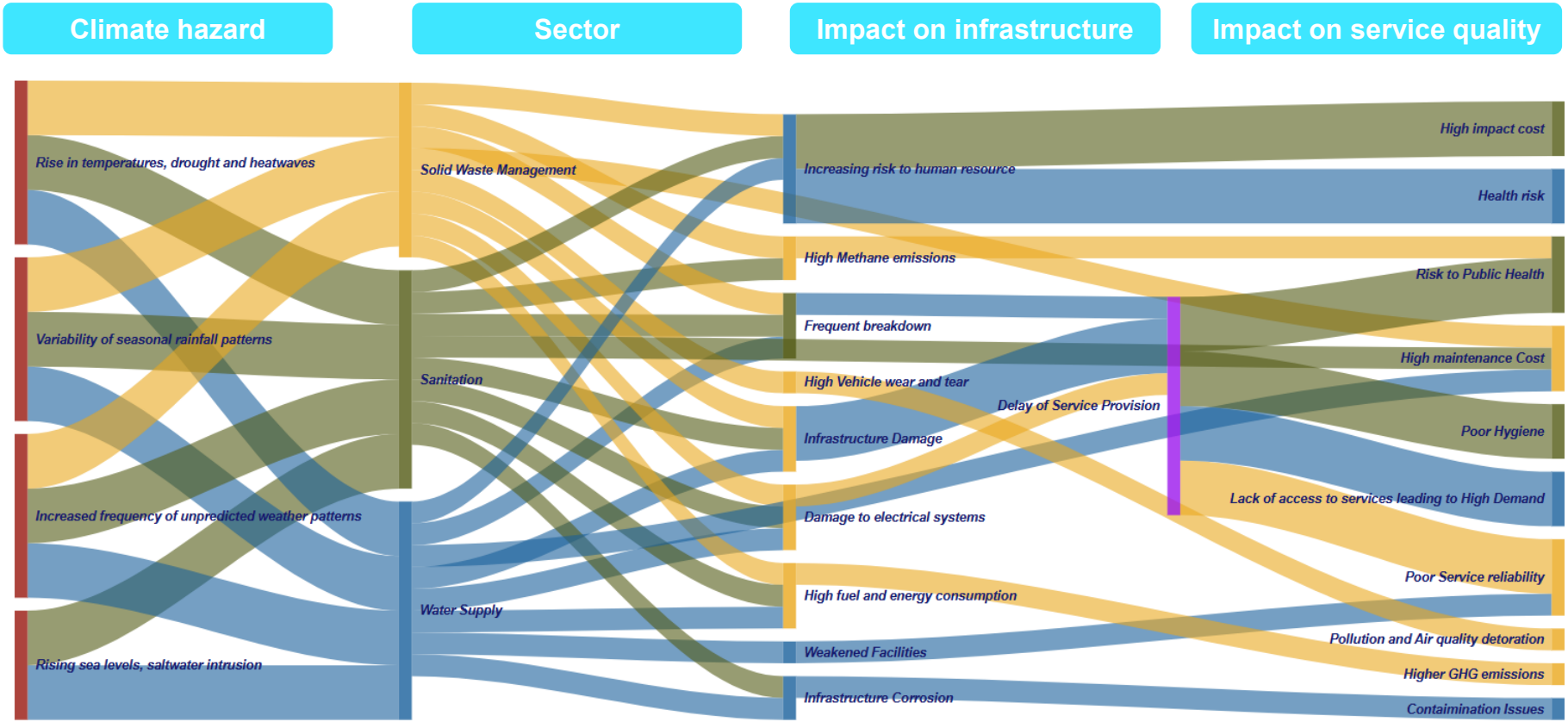
Flooding in Odisha

Flooding in South Indian cities

Day-zero in Chennai, India

Droughts in Kachchh

Water and waste sector being highly impacted



Climate change threatens every stage of WASH & SWM services — reducing reliability, quality, and equity of essential services.

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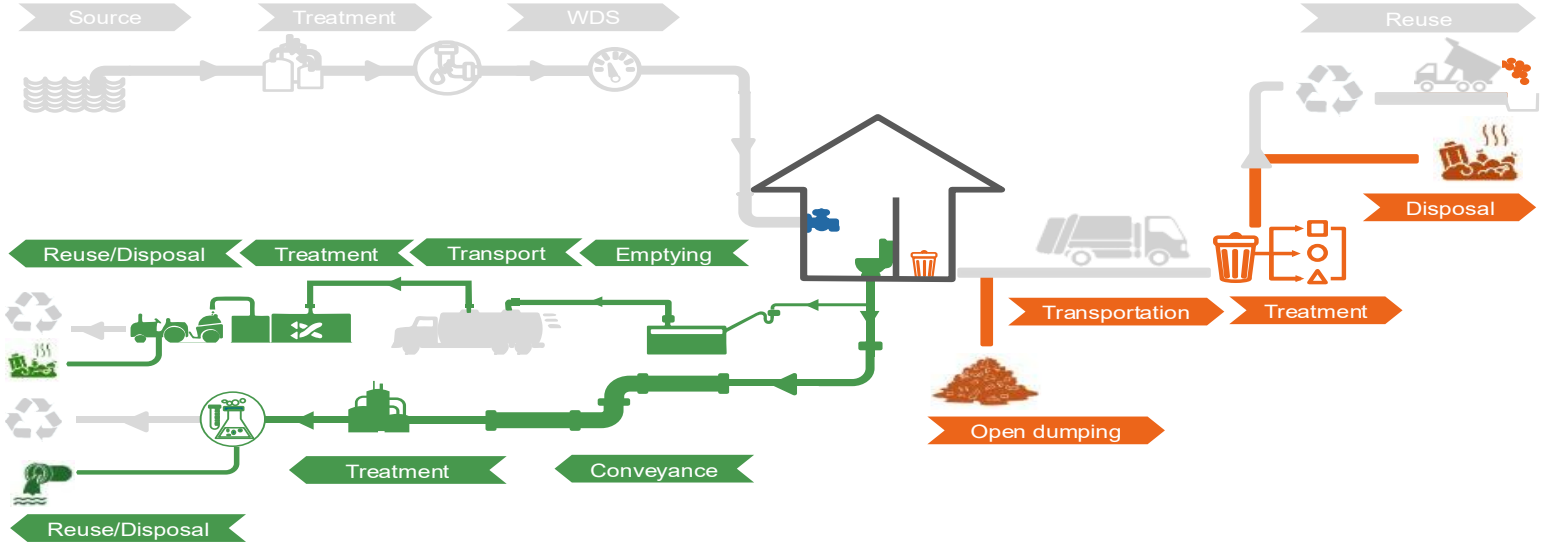
On the other hand, GHG emissions also comes from WASH sector impacting climate change



Sanitation sector contributes to GHG emissions mainly from use of energy as well as effluent and sludge management process

Solid waste sector contributes to GHG emissions through use of energy as well as degradation of organic waste, open dumping, burning of waste and landfill site

Small cities, Big Impacts...!!!

Small and medium towns more vulnerable to climate change impacts on WASH services

Unprepared for the impact

Less focus of services impacts on climate

Inadequate staff

- Low technical staff
- Low engineering capacity

Distinct budget size

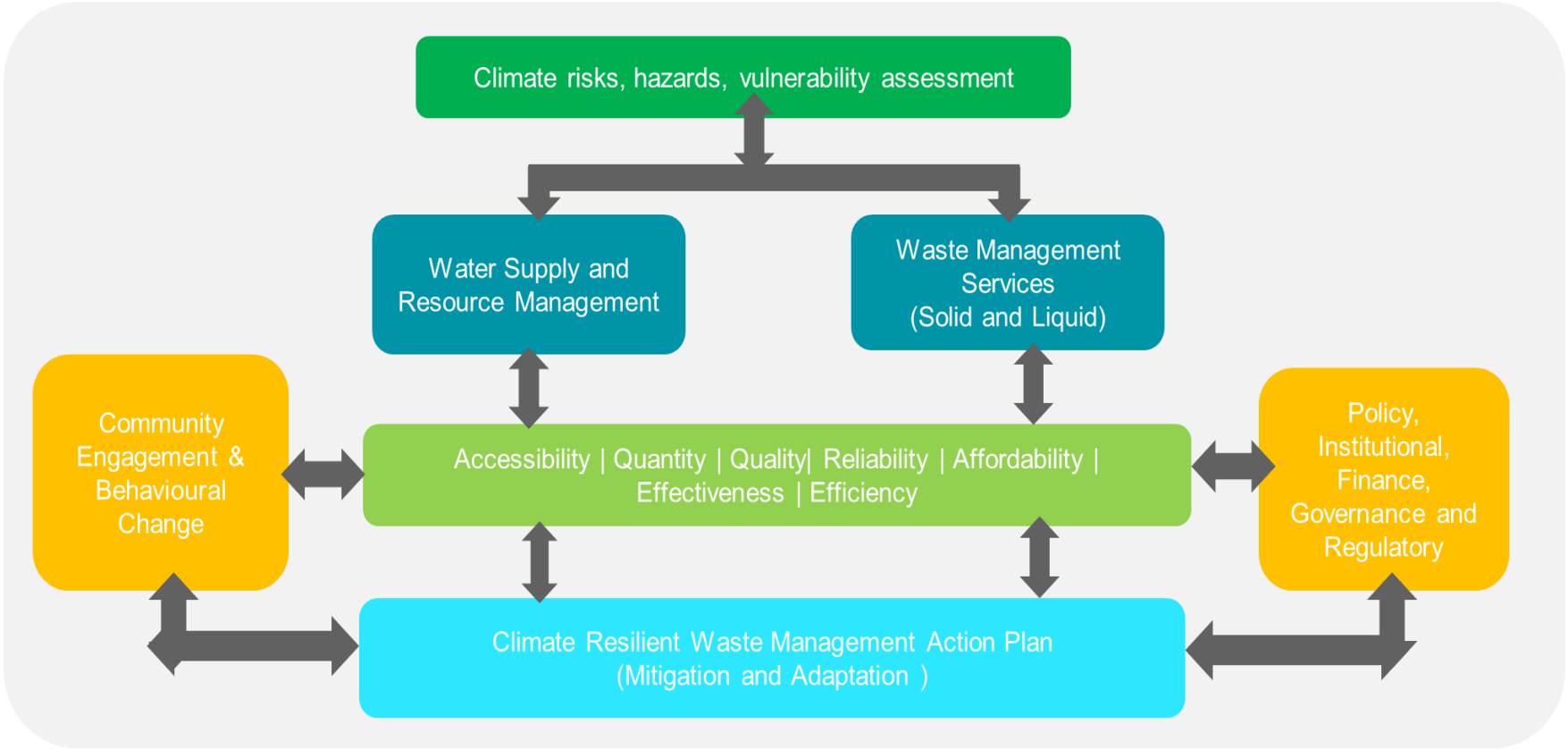
- Budget size is very small
  - Ahmedabad budget size- 12,000 crore (INR) to 17,000 crore (INR)
  - Mansa budget size- 20 TO 50 crore (INR)
- low own revenue sources-
- leading to financial constraints

Insufficient infrastructure

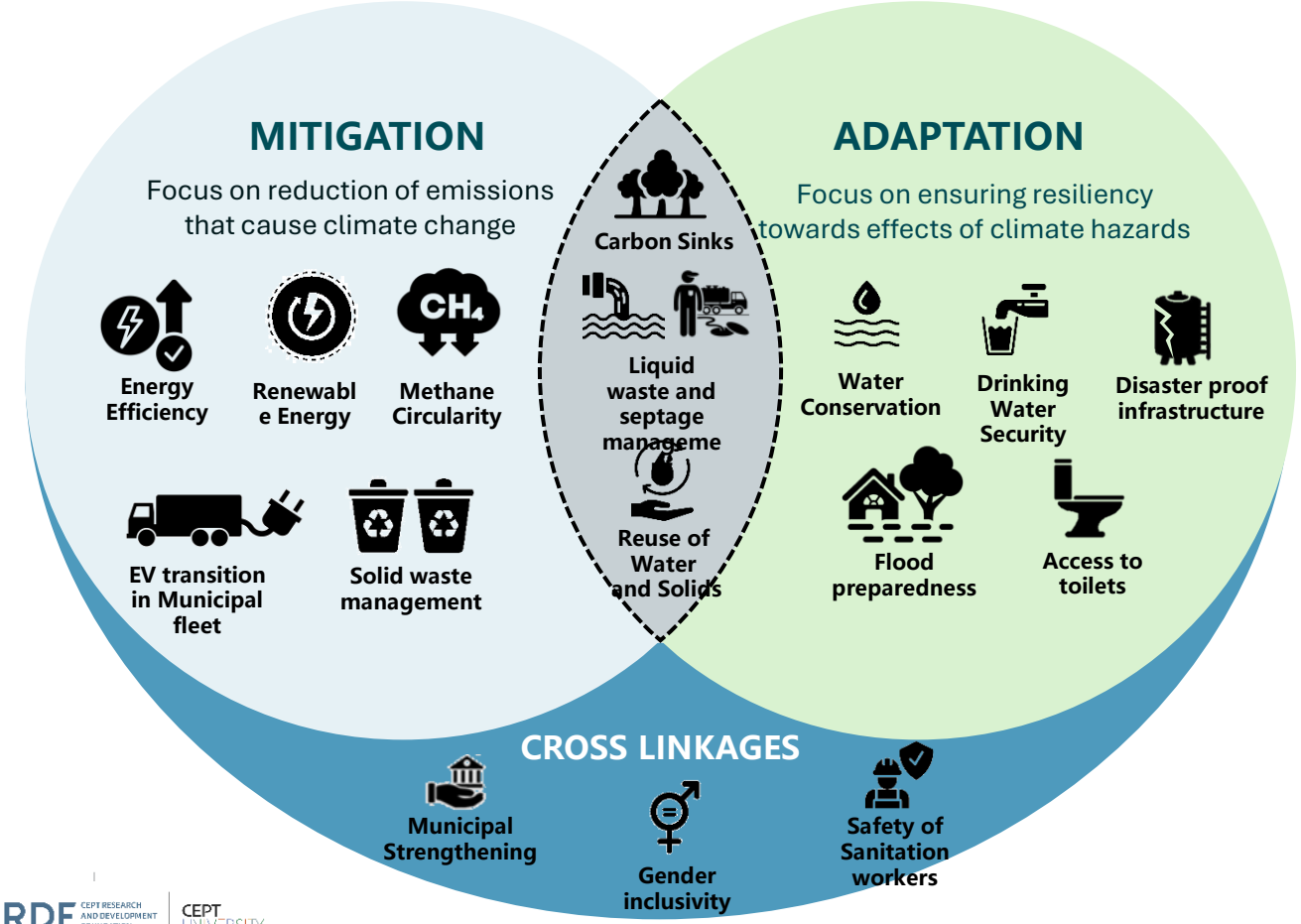
CPCB mentions,

- class I towns: pop > 10 lakhs, the treatment capacity gap ~ 67%.
- class II towns- pop: 50,000 to 1 lakh, the treatment capacity gap ~95%

WASH climate resilient assessment framework



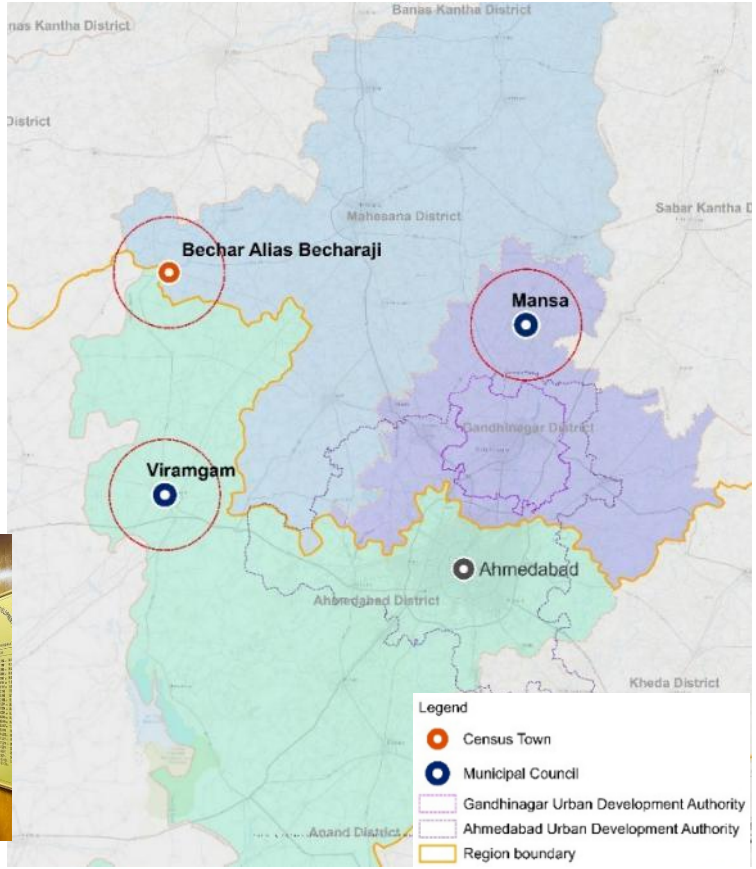
Adaptation and mitigative efforts to support climate resilient services



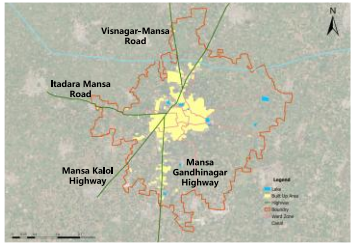
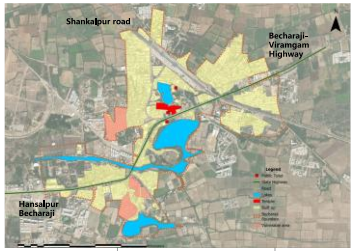
CWAS is working with three small and medium towns supporting them to move towards climate resilient waste management services

Category	Shortlisted towns
Medium town (50,000- 1,00,000)	Viramgam
Small town (20,000- 50,000)	Mansa
Small town (20,000- 50,000) Former Census town	Becharaji

MoU signed and exchanged all



Three towns have varied characteristics ranging from an industrial town to temple town

Selected cities/ Town	Demographic Profile	Growth Pattern and connectivity
Viramgam 	**99.54** Sq. Km **9** Wards **75,775** **20,500 (20%)** Slum Population **24,005** Households **4,549** Slum HHs	• Earlier a **textile hub**; **Current industries - semi-conductors, pharma and rubber**; • **Slow growing** city – population growth with addition of new areas into administration boundary • Situated on **State Highway 17**, Viramgam is well connected with **Ahmedabad**
Mansa 	**27.33** Sq. Km **7** Wards **41,968** **13,010 (31%)** Slum Population **6,458** Households **2,595** Slum HHs	• **Historical City-** princely state ruled by the Chavda Rajputs • **Growing** towards **south-west direction** • Located **40 km from Gandhinagar (state capital) and w**ell connected to **Ahmedabad** (65 kms in west direction)
Becharaji 	**8.77** Sq. Km **16** Wards **30,568** (as per SBM Gramin) ~ **7,000** Households	• **Temple Town** with high **floating** population • **Influx** of **people** settling in the town, post 2015 due to **Mandal Becharaji Special Investment Region** • Growing **Auto-hub** – **Maruti Suzuki, Honda** etc. • Well-connected to major cities like **Ahmedabad, Mehsana, and Patan** through state highways and a railway line

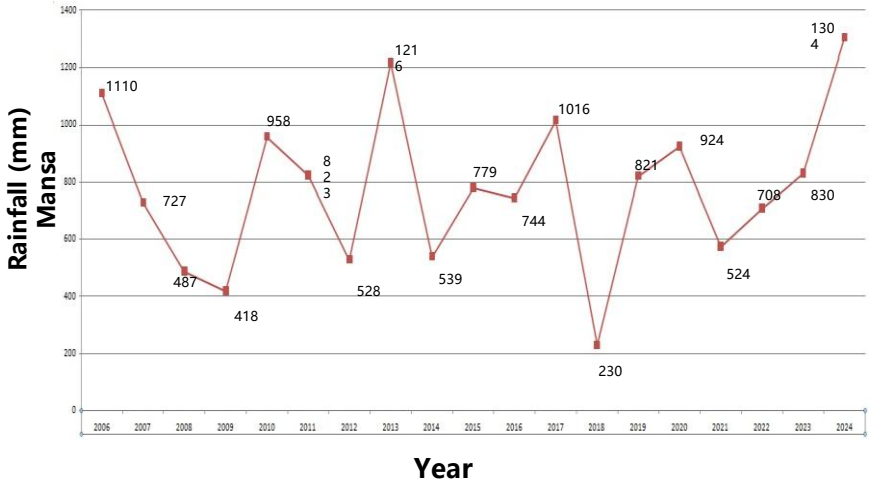
Towns face erratic rainfall and urban flash floods challenges

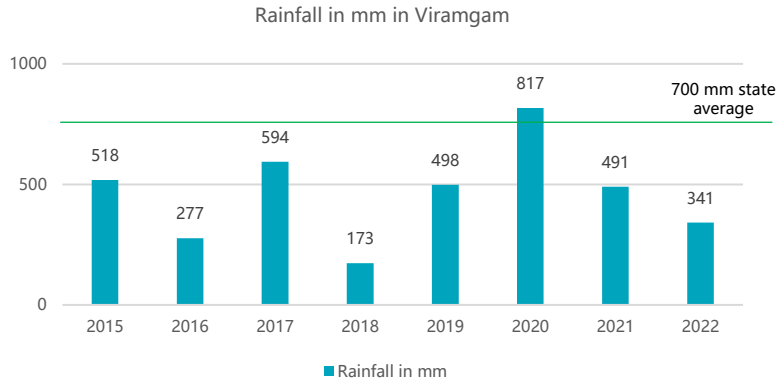
Natural climate impacts

- Erratic rainfall and storms are the climatic impacts on these towns
- All towns have experienced flash floods in particular low lying areas
- Slums and vulnerable areas face more impact of these conditions

Induced impacts

- Depleting groundwater level due to lack of regulations on groundwater draft
- Contamination of groundwater and municipal water due to sewer leaks and septic tank/ pits leaks (more prevalent during monsoons)





Daily water supplied, but major dependency on groundwater and distant water sources

Source

- **Dependency** on **distant and ground** water sources
- **Climate impact** on **distant surface** source
- **Groundwater depletion** - No regulation on ground water draft

Treatment

- **Viramgam** has own **WTP**
- **Mansa and Becaraji** depend on **GWSSB (state agency) for water treatment**
- **Water quality testing** conducted till **WTP level**
- No testing at **ground water source, WDS and household level**

Water Distribution System

- **Cities/ town have sufficient storage infrastructure to provide daily supply of water**
- **Energy cost for pumping is the major expense which the cities incur**
- **Mansa and Bechraji have dependency on water tankers both municipal as well as private tankers**

Customer End

- **Water is supplied on daily basis**
- **Cities supplies ~100 LPCD, which is within the state norms**
- **70-80% coverage of municipal water connections across three cities including slums.**

- Ground water depletion
- No plans to augment local resources

- Dependence on conventional energy sources for pumping water

- Spatial variation observed in terms of supply hours

Sanitation infrastructure is there, potential to improve last mile connectivity, monitoring of services and reuse

User Interface

- **Good coverage** of **individual toilets** in non-slum area
- Few slums do not have individual toilets and the ones which have **are not connected to conveyance systems**

Access to toilets in vulnerable areas a challenge

Conveyance and containment

- **Sewer network** laid in three towns in **80-90% area including slums**
- Sewer network connections are not provided to all
- Sewer **overflows and leakages** are a big challenge in all towns, especially during rains
- Households with **septic tanks/pits get it desludged** based on **demand** (when it is full/overflows)- without monitoring of sludge disposal

- Flooding increases sewer overflow episodes
- Unmonitored disposal of sludge

Treatment

- **Sewage Treatment Plants (STPs)** are **present** in all the three towns with SCADA systems
- STPs constructed and operational by a **private operator** appointed by **GWSSB.** Will be handed over to cities in upcoming two-three years.
- Two towns have inadequate STP capacity and partial untreated usedwater goes to water bodies

- Access to STP a challenge during flooding episodes
- Unmonitored disposal of sludge
- Less focus on reuse and circular economy aspects

Reuse

- **50% waste-water reuse** is practiced in one town- Mansa
- **Eutrophication of lakes** in Viramgam due to disposal of untreated sewage and wastewater

Potential to improve segregation, efficient collection of waste , its processing and forward linkages for SWM

Source Segregation

- **No source segregation** in any city

No segregation- low processing rate- more methane emissions

Collection

- Door to door collection services provided in all, though **not efficient**
- **Irregular D2D collection** in Becharaji and Mansa
- **Lack of efficient monitoring** of D2D collection in all three towns
- **Presence of Garbage Vulnerable Points and burning of waste**

Irregular door to door collection- more energy consumption- garbage burning- more CO2 emissions

Waste Processing and Treatment

- **SWM plant** is constructed at dumpsite (Viramgam and Mansa)
- **Partially operational** in Viramgam but doesn't receive segregated waste.
- Yet to be operational in Mansa
- **No treatment facility** in Becharaji

- No/ Low processing of waste- leads to dumpsite formation- more methane emissions
- Flooding causes difficult access to processing site and impacts its operations

Recycle/Reuse

- There is a **presence of an informal market of recyclers** in cities which is being utilized by all three towns to recycle their waste.
- **Becharaji** and **Mansa** have **no formal engagement** for recycling of processed waste
- **Need to identify forward linkages** for reuse of waste

Disposal of partially treated usedwater as well as solid waste has deteriorated the quality of lakes

VIRAMGAM

- Gangasar lake is the biggest lake with an area of 0.37 Sq.km but is in **eutrophication state because of disposal of used water.**

Gangasar lake

BECHARAJI

- Becharaji has three major lakes and all the lakes are eutrophied with algal growth due to disposal of solid waste and untreated wastewater.

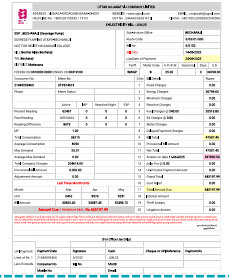
Bandheliya lake

Mitigative approaches

Making SWM processing plants energy neutral and moving towards greener energy at STPs

Discussion with ULB and respective authorities for understanding the need

Electricity Bill analysis for running the various municipal infrastructure

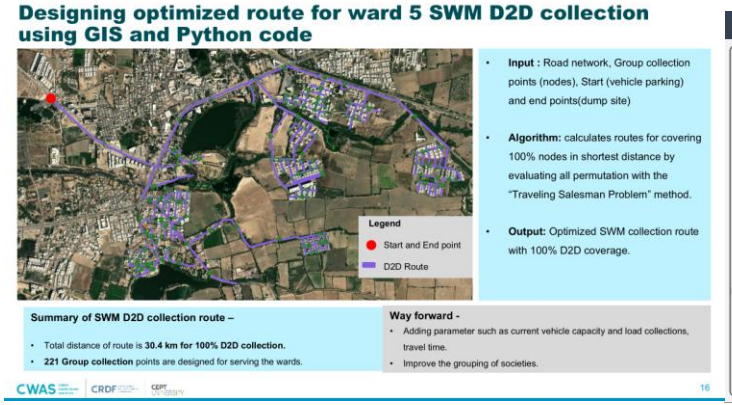


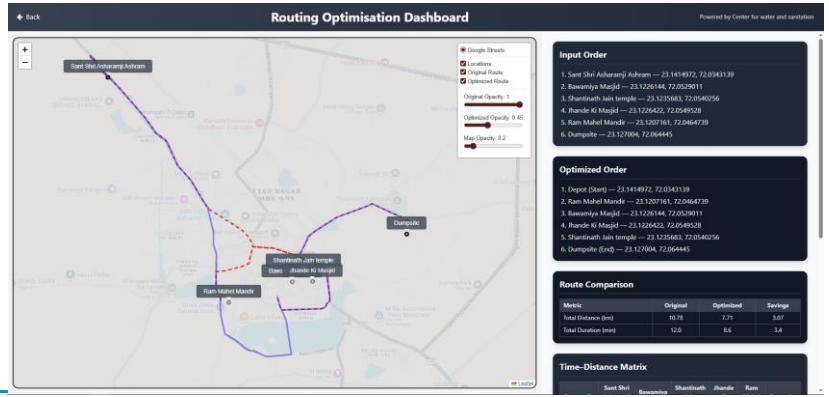
Feasibility study for various locations in the three Cities/Town

Name of City/Town	Location	Total solar KW requirement	Planned Installation Capacity (KW)
Viramgam	SWM Shed	1.5	10
Mansa	Lake	32.3	20
	SWM Shed	3.3	20
Becharaji	STP	75.2	40

Use of digital innovations to improve door to door collection services by reducing fuel consumption and emissions

Geospatial Distance Calculation, Route Distance and Time Estimation algorithms using Mapbox Directions API and Optimization API





New optimized route

- Daily travel: **4.4 km reduction**
- fuel cost saving **: INR 18,000**
- CO2 emissions**: 536 kg reduction**

Approach:

- Apply graph size reduction techniques such as clustering, zoning, or spatial aggregation to reduce nodes and edges before routing.
- Treat vehicle capacity and operational limits as constraints, not as edge weights.
- Generate k-shortest paths instead of relying on a single shortest path to improve robustness and route quality
- Track clear KPIs (travel time, computation time, route stability, constraint violations) to validate improvements.
- Parallelly, discussions with stakeholders on field to understand their requirement- timing of collection, days of dry and wet collection

Parallelly providing handholding support to private operators, improving monitoring

Handholding Support to Door-to-Door Private Contractor: Capacity building and technical guidance for effective monitoring, along with structured training of drivers and helpers on waste collection and source-level segregation

Upgrading door to door monitoring system

1. Geo fencing of each POI (entry-exit)
2. Route Deviation Alerts
3. Easy download of Vehicle travel reports

Developing sweeping Plan focusing on distribution of workload between sweepers with designated routes

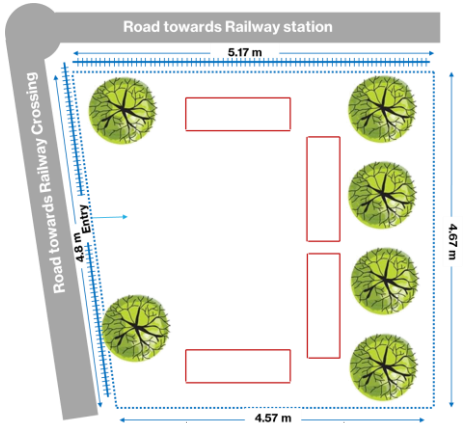
1. GPS Marking of Bits(Route allocated to sweeper) per sweeper
2. Allocated Sweeping routes to all the sweepers
3. Gender based PPE kits to all the sweepers

Transforming Garbage Vulnerable Points into public spaces to avoid burning of waste and reducing emissions

Key points considered for GVP transformation

- Assessment on reason of GVP formation
- Surrounding landuse
- Financing available

GVP Design: as a seating space



This Garbage Vulnerable Point (GVP) has been developed into a seating space because

- The active use of this area as a public seating space will discourage littering, as regular occupancy and an appropriate design will prevent it from being used as a dumping spot.

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Adaptation approaches

Innovative options for providing preventive maintenance of sanitation services- cleaning and inspecting sewers and monitoring sensors

- As cities are facing challenges related to **overflow of sewers and dustbins**
- **E**xploring innovative and AI/ML-based solutions to automate and improve these systems.
- Exploring options for **mechanized cleaning as well as IoT solution for monitoring machine holes and waste bins**.

Homosep Robot

Robot for cleaning machine holes and septic tanks

Endobot

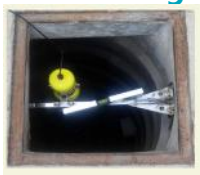
Sewer inspection and detecting blockages

Xena 6.0 Robot

Solar powered machine hole cleaning robot system

Wipro Sewage Monitor

C-DAC Sewage Monitoring

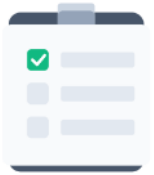


Sensor based public dustbin monitoring

Monitoring sensors for sending alerts to concerned officials and developing strategic plan

Next steps:

Meeting with vendors and developers



Understanding prerequisites

Feasibility considering small towns (for IoT systems)

Financial requirement for implementation

Rejuvenating water bodies and sustaining local water sources

There are major four methods for the removal of hyacinth :

Physical Removal

Chemical Removal

Biological Recovery

Key reason of hyacinth

- Nutrient-rich water via sewage and runoff
- Stagnant water
- Slow flow
- Eutrophication

The Circular approach for lake rejuvenation

Resource Recovery

Creating awareness and strengthening of various stakeholders

Awareness campaigns for promoting waste segregation attracting more than 1000 stakeholders

Engaged 50+ vendors for spreading awareness on ban on single use plastic

300+ sanitation workers- Capacity strengthening

1 Day Training Program for Urban Sanitation Workers in three cities of Gujarat

Tentative Agenda for the training program (9.30 to 17.15)

Session	Content to be covered	Mode of Delivery	Duration
Day 1			
Welcome and Registration of the participants			30 mins 9.30-10.00
Session 1.	Introduction of participants	Ice Breaking activity	30 mins 10.00-10.30
Session 2.	Training objectives and pre assessment (show of hands / pictoral assessment)	Presentation + Interaction +	30 mins 10.30-11.00
Session 3.	What are the legal provisions around manual scavenging and sanitation work • Legal framework: PEMSR Act 2013	Presentation + Interaction	30 mins 11.00-11.30
	Tea Break		11.30-11.45
Session 4	Across all Job Roles • Health and safety at workplace • PPE, safety devices, and equipment • Maintenance of PPE	Presentation + PPE Game Exercise of donning & Doffing	1 hr 30 mins 11.45- 13.15
Lunch Break			13.15- 14.15
Session 5.	Job Role wise – Dos and Donts and Use of Equipment • O&M of CT/PT • Desludging / Emptying of Septic tanks / Pits • Solid Waste Management- Collection/ Segregation/ Handling of waste • Sewer Line Cleaning • O&M of STPs/FSTPs Drain Cleaning	Presentation + Interaction	1 hr 30 mins 14.15- 15.45

- **Legal provisions** around manual scavenging and sanitation work,
- **Health and safety** at workplace,
- **PPE, safety devices**, and **equipment**,
- **Use and Maintenance** of PPE and Rights and
- **Entitlements** of Sanitation Workers
- Waste segregation- **role of sanitation workers**

Scaling up technical support and capacity strengthening support at state level and district level

District level

- **Supporting the District Development Officer (DDO) waste management team** for **115 villages** of district for managing their liquid and solid waste
- Supporting in **preparing strategies for improving services**

State level

- **Sharing lessons from these three cities at state level as a Swachhta Knowledge Partners (SKP) to Govt of Gujarat**

Partnership and collaboration to attain scale

सत्यमेव जयते
Urban Development
&
Urban Housing Department
Government of Gujarat

स्वच्छ भारत
एक कदम स्वच्छता की ओर

GUJARAT URBAN DEVELOPMENT YEAR 2025

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Viramgam
Nagarpalika

બેચર-બેચરાજી ગ્રામ પંચાયત
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About us

The Center for Water and Sanitation (CWAS) is a part of CEPT Research and Development Foundation (CRDF) at CEPT University. CWAS undertakes action-research, implementation support, capacity building and advocacy in the field of urban water and sanitation. Acting as a thought catalyst and facilitator, CWAS works closely with all levels of governments - national, state and local to support them in delivering water and sanitation services in an efficient, effective and equitable manner.

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