समीक्षा SERIES

National Institute of Urban Affairs

सार SAAR

THEME NO. 7:
USE OF ICT FOR WATER SUPPLY AND SEWERAGE SERIVCES IN SMART CITIES

SAAR- Sameeksha Series - Impact Assessment Studies of Smart Cities Mission

Smart City

SMART CITIES MISSION

MINISTRY OF HOUSING AND URBAN AFFAIRS

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Executive Summary

This research report assesses the impact of Information and Communications Technology (ICT) in enhancing water supply and sewerage services across 100 smart cities in India under the Smart Cities Mission (SCM). It provides a comprehensive analysis of ICT integration in urban water and sewerage infrastructure, detailing the types of projects implemented, key challenges, quantifiable outcomes, and policy recommendations for future urban missions.

The SCM had aimed to optimize the performance and efficiency of urban infrastructure by integrating ICT and various Internet of Things (IoT) devices across 100 smart cities. Among these, 94 cities responded to the national-level questionnaire floated in this study, providing the required data for assessment. The cities were categorized into small towns, medium-sized towns, large towns, metropolitans, and megapolises, based on their population.

- A total of 94 cities responded to the national-level assessment questionnaire. The nature of interventions includes SCADA application in water and sewerage infrastructure like Water Treatment and Wastewater Treatment Plants, Pumping stations etc., DMA zonation, Smart Metering, 24X7 water supply, smart water management, Water auditing, smart grid for wastewater reuse management, smart toilets, IoT devices for flow metering system, Infrastructure creation by laying of pipelines, Household sewer connections, STP augmentation, WTP source augmentation, etc.
- 63 cities have implemented ICT-based projects in water supply and sewerage services:
    - Out of these 63 cities, 48 cities have used SCADA (Supervisory Control and Data Acquisition) for real-time monitoring.
    - 30 respondent cities have installed 9,65,176 smart meters for accurate billing and leakage detection.
    - 31 respondent cities have implemented DMA (District Metered Area) zonation to improve water distribution.
    - 14 respondent cities have linked SCADA with ICCC (Integrated Command and Control Centre) for improved monitoring and automation.

Key Findings

a) Environmental Impact

- 12% of the respondent cities reported NRW reduction after integrating their water supply system with ICCC and can generate more revenue for their city.
- Deployment of flow meters, actuators, and pressure sensors in cities led to better leakage detection, water conservation, and optimized water supply.

- The Energy Service Company (ESCO) model in Dehradun led to 29% energy efficiency improvements

b) Economic Impact

- Cities like Agra reported annual savings of ₹30.24 lakh due to optimized water supply and NRW reduction.
- 13% of cities reported increased revenue collection post-integration of water billing with ICCC.
- Automated metering in Naya Raipur eliminated billing errors and improved revenue collection, with 49,932 bills generated in 2022.

c) Social Impact

- Per capita water availability increased in various cities, with a shift towards 24x7 water supply.
- Real-time monitoring via SCADA-ICCC integration led to faster response times to water-related complaints.
- Cities like Udaipur and Vadodara adopted innovative ICT solutions such as manhole level sensors and automated water audits for equitable distribution.

Challenges and Constraints

- Technological limitations: Some cities have shown limited progress in digitalization due to infrastructure gaps. For instance, Raipur's water audit project failed to reduce NRW (Non-Revenue Water) due to insufficient ICT capabilities.
- Financial constraints: 21 cities leveraged AMRUT funding in convergence with SCM funds to bridge financial gaps.
- Integration and capacity: Limited digital literacy among urban local bodies (ULBs) hindered full automation and its adaptation to the existing system.

Recommendations and Future Directions

- Replicable Best Practices: Cities like Dahod and Bilaspur demonstrated scalable models for real-time water quality monitoring and digitalized distribution networks.
- Capacity Building: Greater investment in training municipal staff for ICT-enabled water management.
- Infrastructure Resilience: Integration of smart solutions with disaster-proof designs for extreme climate conditions.
- Convergent Funding Approach: Improved financial coordination between SCM, AMRUT, and other government programs.

Conclusion

The integration of ICT in urban water supply and sewerage services under the Smart Cities Mission has yielded significant economic, environmental, and social benefits. Despite challenges, the success stories from Agra, Dehradun, Naya Raipur, Thoothukudi, and other cities present a roadmap for future smart city initiatives. Continued investment in technological innovation, capacity building, and policy support will be critical in ensuring the long-term sustainability of urban water management systems in India.

Keywords: DMA Zonation, NRW Reduction, ICCC, SCADA, Smart Metering, Smart Cities Mission, Water Auditing.

Acknowledgements

We extend our sincere gratitude to Shri Kunal Kumar IAS, Joint Secretary, Ministry of Housing and Urban Affairs (MoHUA) and Director, Smart Cities Mission (SCM) for providing us with the opportunity to conduct this impact assessment studies. As the SCM comes to an end, this study under 50 designated themes aims at assessing the impact that the mission had in fulfilling the objectives as envisioned during the inception of the mission. Shri Dinesh Harode, Sr. Urban Planning Specialist at Smart Cities Mission Management Unit (SCMMU), MoHUA) and his team support for providing comprehensive information from the cities have been crucial to our analysis and findings.

Our appreciation to the Smart City CEOs and their dedicated team for their co-operation during data collection and consultation meetings instrumental for assessing the impact of the mission on improvement of water supply and sewerage sector as assigned to NIUA. Their providing support and valuable feedback. Special thanks to the officials of four cities that were visited as a part of primary assessment, namely, Agra, Rajkot, Thoothukudi and Solapur. Much thanks to the officials from 8 cities that were consulted for detailed VC for understanding their interventions and innovations, other than the primary visit: Chandigarh, Dehradun, Thanjavur, Surat, New Town Kolkata, Udaipur, Naya Raipur, Vadodara.

This report is of considerable importance for policy planning and will provide valuable insights for future smart city schemes. We hope the recommendations and findings will contribute to enhancing the effectiveness of urban development initiatives and address the evolving needs of cities.

The authors are grateful to SCM team involved in formulation the mission, and thriving through the years of challenges and hard work top make 100 cities smarter digitally, and smarted developments. Your support and efforts have been integral to the successful completion of this report, and we look forward to future opportunities to collaborate on advancing smart city projects.

List of Abbreviations

AMI	Advanced Metering Infrastructure
AMR	Automated Meter Reader
DMA	District Metered Areas
ESR/ELSR	Elevated Service Reservoir
HSC	Household Sewer Connections
ICT	Information and Communications Technology
IoT	Internet of Things
IVR	Interactive Voice Response
lpcd	Litres per capita per day
MOHUA	Ministry of Housing and Urban Affairs
MLD	Million litres per Day
NRW	Non-Revenue Water
NIUA	National Institute of Urban Affairs
PLC	Programmable Logic Controller
RF	Radio Frequency
SCADA	Supervisory Control and Data Acquisition
SCM	Smart Cities Mission
SJMMSVY	Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana
SCMMU	Smart Cities Mission Management Unit
SAAR	Smart cities and Academic towards Action and Research
STP	Sewage Treatment Plant
UHF	Ultra High Frequency
UGR	Underground Reservoir
VHF	Very High Frequency
WTP	Water Treatment Plant

Source: Google Images

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Graphic by NIUA Team

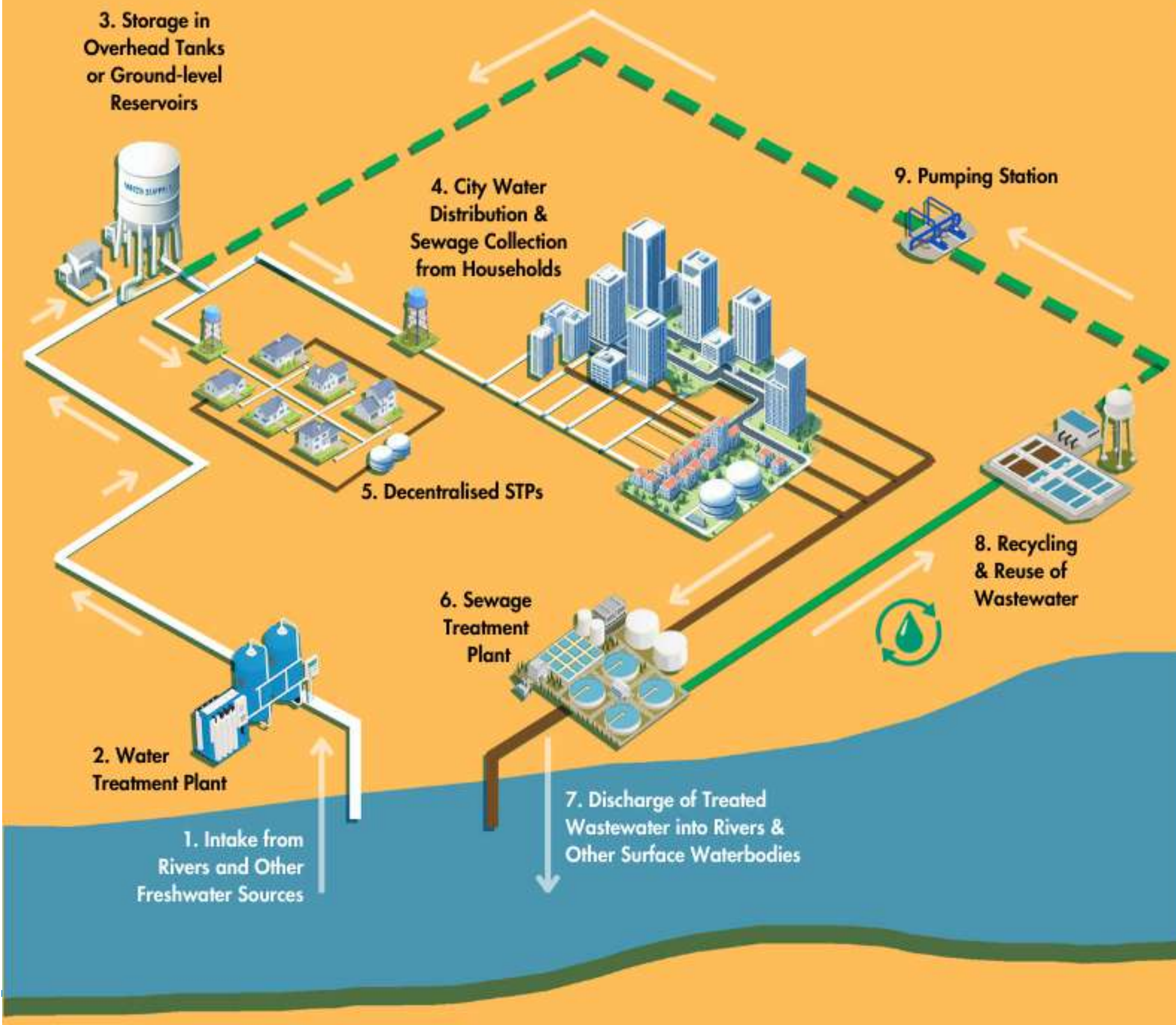
1 Introduction

Water scarcity is a global challenge. As the demand for water increases, organizations across the world are turning to technological solutions. New and emerging digital technologies including Artificial Intelligence (AI), Internet of Things (IoT) sensors, data analytics, smart water grids, and smart water management solutions are being used to build more efficient water and wastewater management systems.

Information and Communications Technology (ICT) refers to the broad range of technologies used to manage, transmit, and process information. It encompasses various hardware, software, networks, and services that enable the collection, storage, retrieval, manipulation, transmission, and presentation of data and information. The application of ICT in context of water supply and wastewater management would include (not exhaustive) real-time monitoring of water and sewage parameters, facilitating swift responses to water quality issues and system failures etc. Predictive maintenance, driven by AI and IoT based sensor technologies, helps prevent breakdowns, maintains treated wastewater output quality, and manages the operational costs of treatment facilities. The data collected during operations and maintenance (O&M) and service delivery outcomes can be harnessed to optimize resource allocation, enhance system performance, make informed decisions regarding infrastructure expansion and upgrades, and manage the energy requirements of the treatment facilities. Globally and domestically, the implementation of digital initiatives has shown the potential to accelerate outcomes, reduce O&M costs, and elevate the overall utility service delivery levels of a utility provider or an urban local body (ULB).

Smart Cities Mission (SCM) guideline at large defines the use of ICT in its 100 smart cities to improve their operational efficiency, share information with the public and provide a better quality of government service and citizen welfare. Under the aegis of 'Smart solutions', ICT is sought to play a crucial aspect in improving city infrastructure systems, data analytics, e-governance services, urban mobility, energy, waste and water management amongst others. Several cities of the SCM have incorporated ICT within their governance systems for improvement in water supply and sewerage services. In certain cities where advanced levels of data driven governance were possible, Integrated Command and Control Centre (ICCC) has been interlinked to their core municipal services like Water Supply & Sewerage Systems (using SCADA system). Some of them have also focused on real time monitoring of these municipal services through sensors, smart meters, etc. Through utilization of these sensors and real-time monitoring systems, efficient monitoring of water distribution networks and sewage systems, leakage detection and reliability of services has shown tremendous improvement.

Graphic by NIUA Team



Water Supply and Sewerage system in Urban Context

1.1 Aim and Objective of the Study:

The Sameeksha series is an initiative to carry out a research-based impact assessment of the initiatives undertaken by the cities under the SCM. The key objective of this research study is to assess the impact of the use of ICT in improvement of water supply and sewerage services across the cities under the SCM. The specific objectives of the study are:

- To examine the impact of ICT enabled interventions in water supply and sewerage sector from the lens of better governance, service level improvements, and citizens' perspectives germinated and promoted under Smart Cities Mission.
- To understand the key challenges faced by cities in the application of ICT projects, its implementation and service delivery.
- Based on the assessment, provide suggestions/recommendations for similar future missions to be undertaken at the national/State/City level.

1.2 Scope and Limitations:

The SCM has implemented approximately 8,000 urban innovation projects throughout the span of 9 years of the mission in 100 cities. In the context of this impact assessment study, the national level impact of application of ICT in water supply and sewerage services has been based on the responses to the questionnaire as shared with the 100 smart cities. The impact assessment is based on the face value of responses as shared and does not include extensive level of data validation given the limited research series. The detailed assessment and validation for this assessment study has been done at two levels:

- Video conferencing call with selected cities (13 cities) based on analysis of master data shared by the SCM team.
- Primary visit to 4 cities for in-dept impact assessment

The detailed methodology and process of selection of cities for detailed primary field visits has been presented in Section 5 of this study.

2 Literature Review

The management of water and sewerage infrastructure is critical for ensuring the sustainability and efficiency of urban water systems. ICT interventions have emerged as pivotal tools in optimizing the operation, maintenance, and monitoring of these systems. This literature review explores various ICT technologies utilized in the management of water and sewerage infrastructure, highlighting their benefits and challenges.

A. Supervisory Control and Data Acquisition (SCADA) Systems

- System of software and hardware elements that allows to control and monitor industrial processes by directly interfacing with plant-floor machinery.
- Provides real time data collection, monitoring and control of water treatment plants and distribution networks.
- Enable operators to detect and respond to anomalies promptly, thereby improving the reliability and efficiency of water systems.

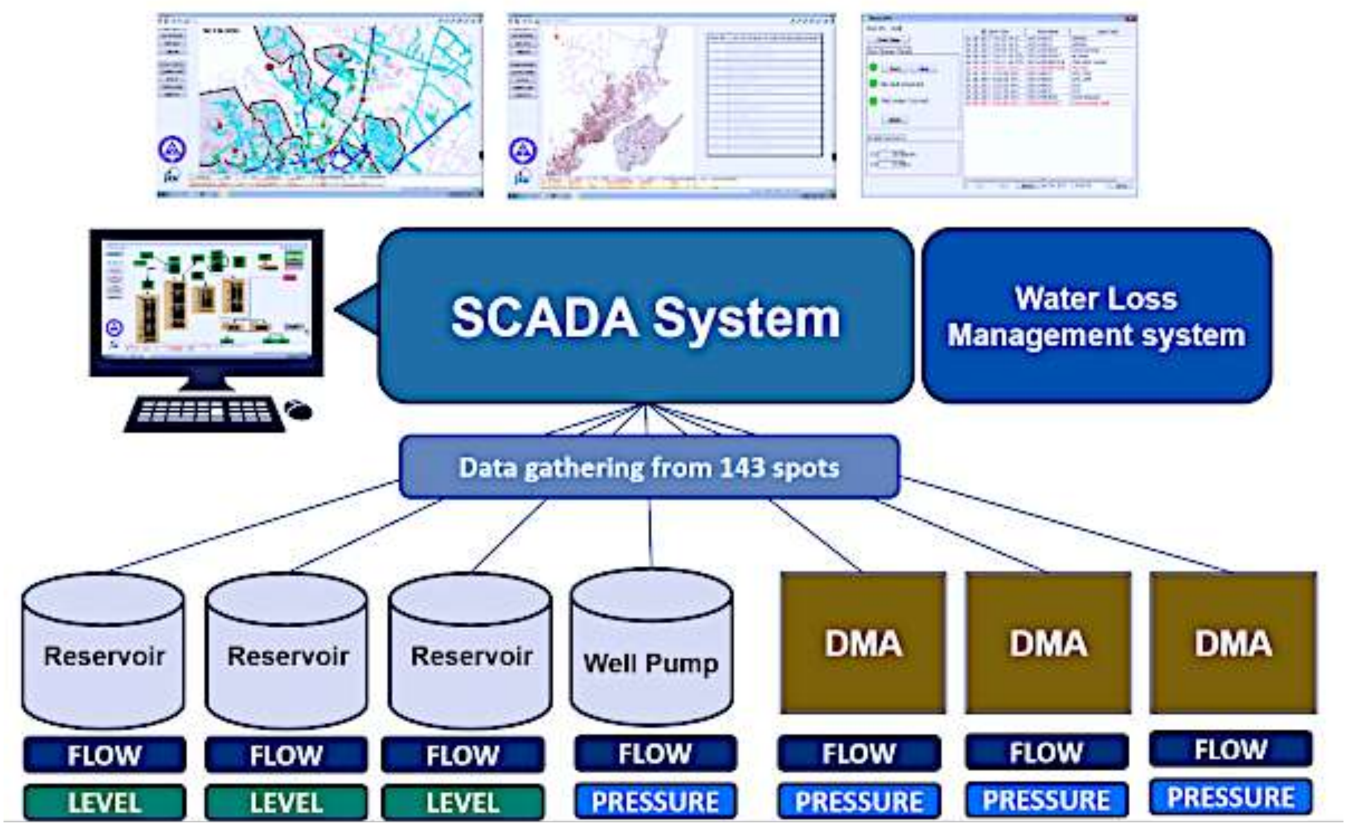


Figure 1: SCADA System Overview, Source: Yokogawa water innovation services

B. Smart Sensors and IoT

- IoT-enabled water management systems use sensors, controllers, meters, and other devices connected to mobile, web apps, and data processing and analysis tools. All this creates a platform for efficient water supply management, freshwater quality checking, pollution detection, and more.
- Facilitate continuous monitoring of water quality, flow rates, water level, temperature and pressure, enabling predictive maintenance and reducing downtime.
- IoT-based solutions can also enhance leak detection and water conservation efforts.

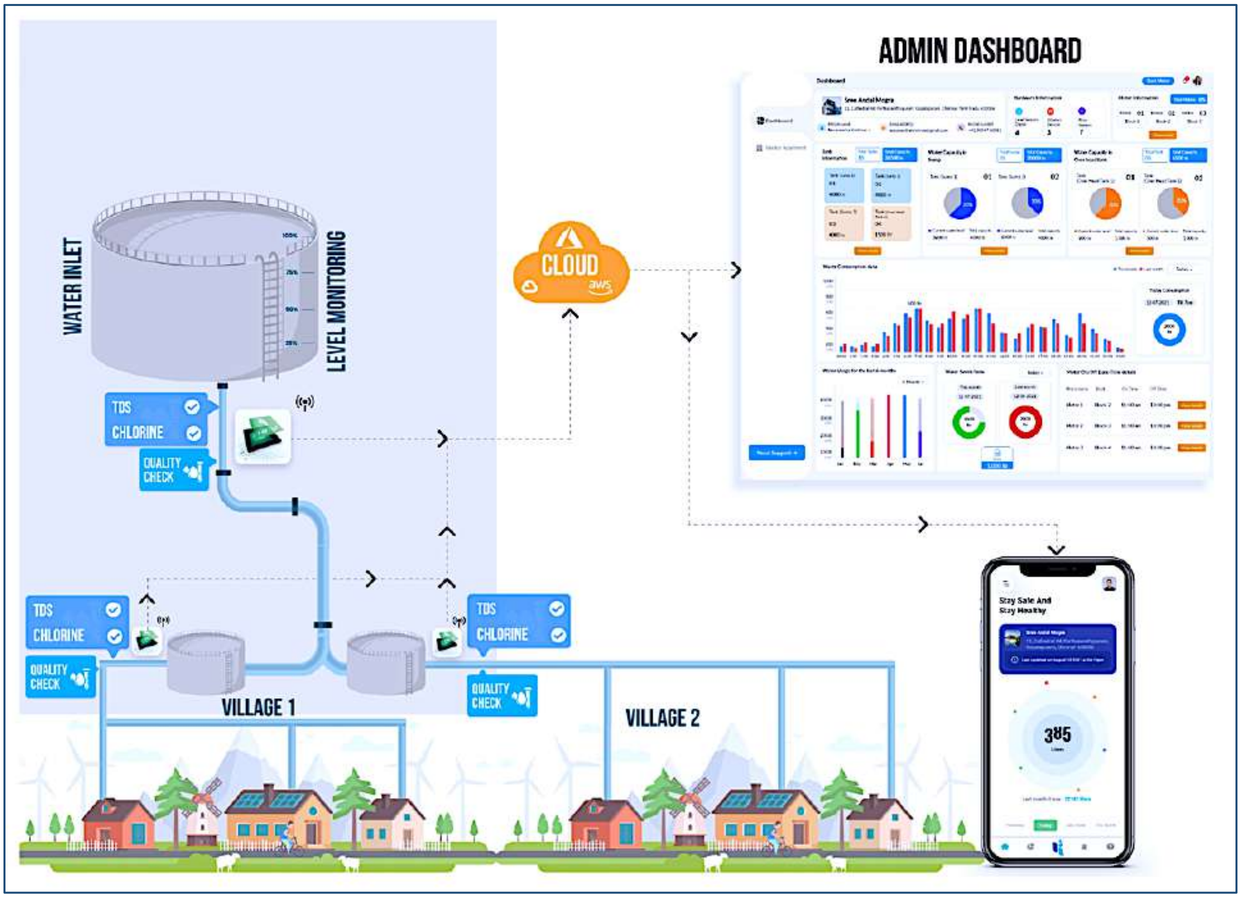


Figure 2: Smart Water Management with IOT, Source: MDPI's article on Smart water management

C. Programmable Logic Controllers (PLCs)

- It includes actuators, control valve etc. to automate and control processes.
- To automate the control of pumps and related machinery.
- To perform specific tasks such as starting/stopping pumps, adjusting flow rates, and managing alarms.

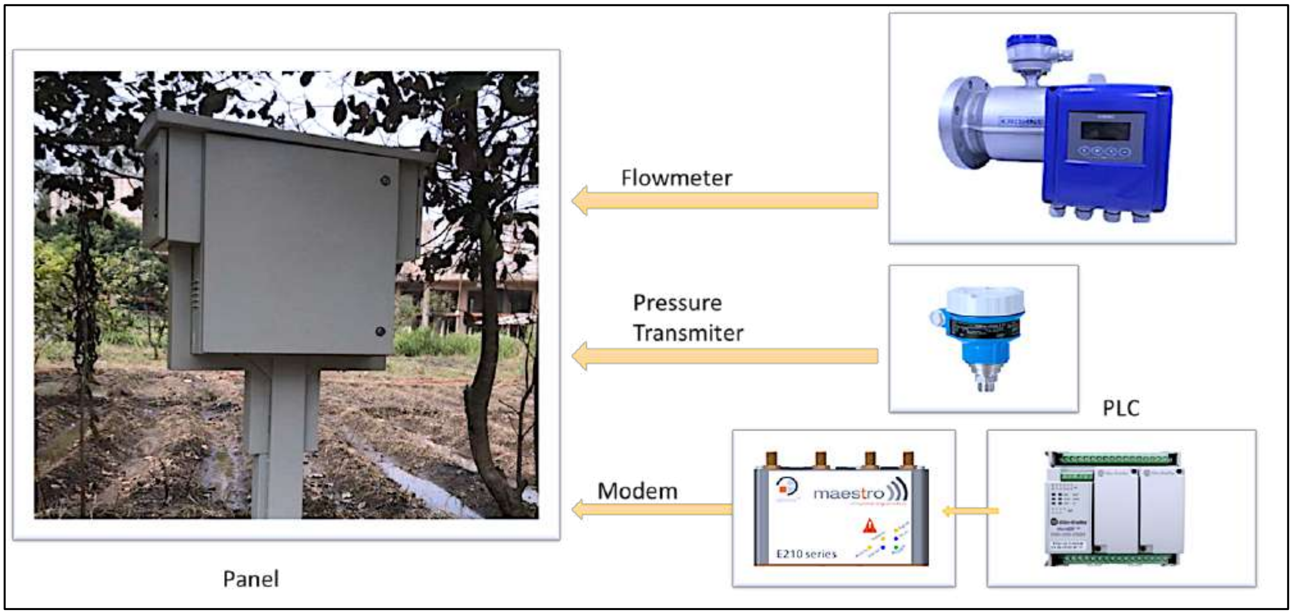


Figure 3:Integration of Smart Sensors, IoT Devices and PLC Machinery, Source: PLC247.com

D. Advanced Metering Infrastructure (AMI)

- Smart meters and communication networks that provide detailed consumption data to utilities and customers.
- Enable accurate billing, demand forecasting, and water usage analysis.
- Helps in identifying and addressing issues such as water theft and meter tampering

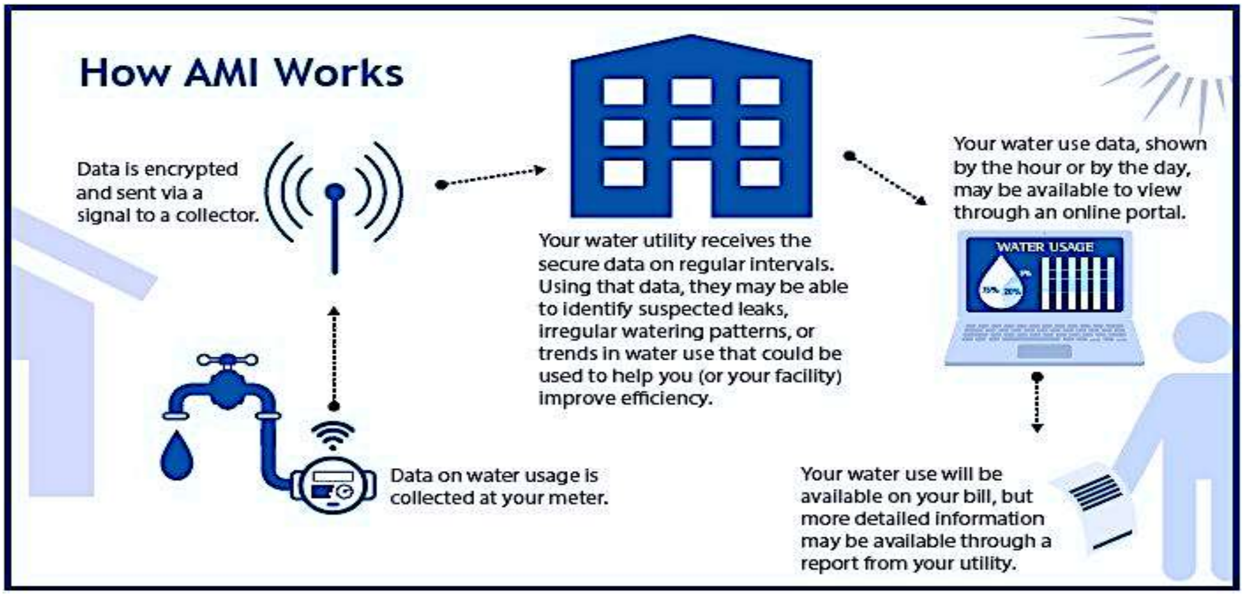


Figure 4 Advanced Metering Infrastructure (AMI), Source - A review of the application of machine learning in water quality evaluation 2022

E. Big Data Analytics and Machine Learning

- To analyze vast amounts of data generated by water management systems.
- Help in optimizing operations, predicting failures, and improving decision-making processes.
- For example, machine learning models can predict pipe bursts and maintenance needs based on historical data.

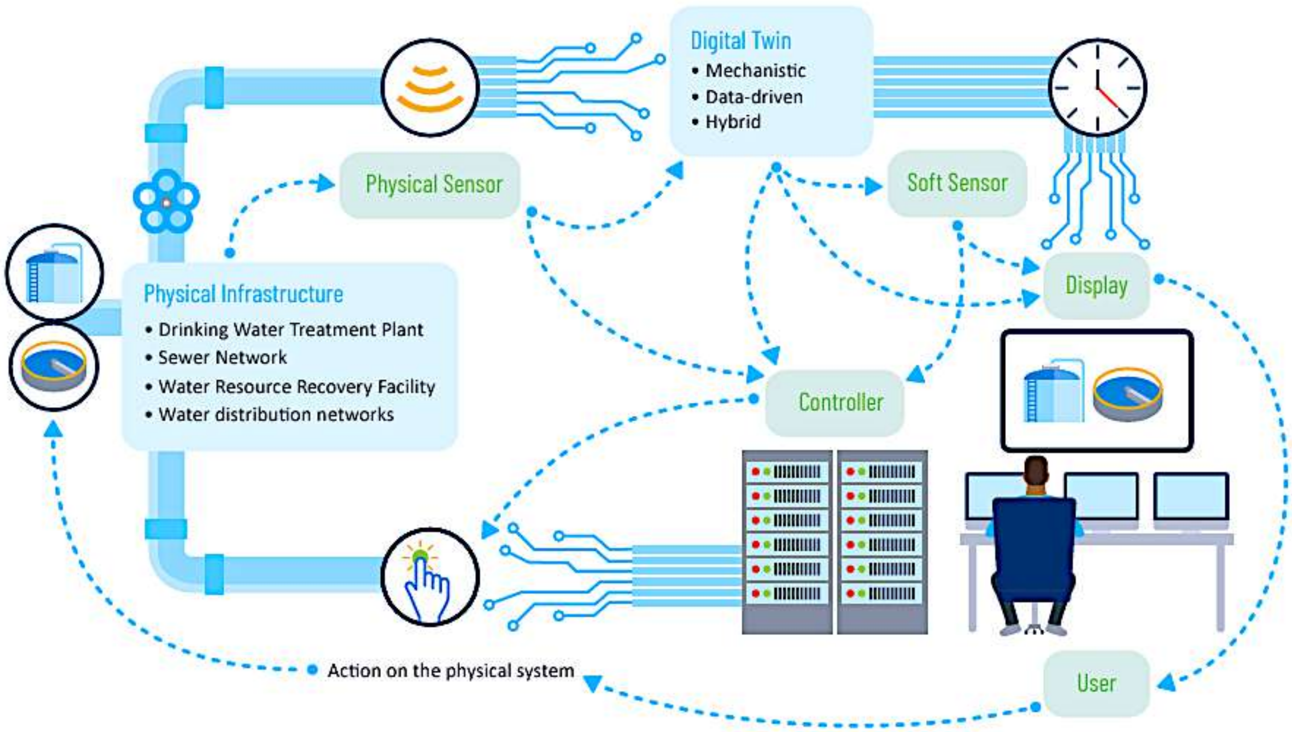


Figure 5: Application of Machine Learning in Water Quality Management, Source - A review of the application of machine learning in water quality evaluation, 2022

F. Geographic Information System (GIS)

- Used extensively for mapping and analyzing water and sewerage networks. It aids in asset management, planning, and decision-making by providing spatial data visualization and analysis capabilities.
- GIS can also integrate with other data sources to enhance the understanding of network conditions and performance.

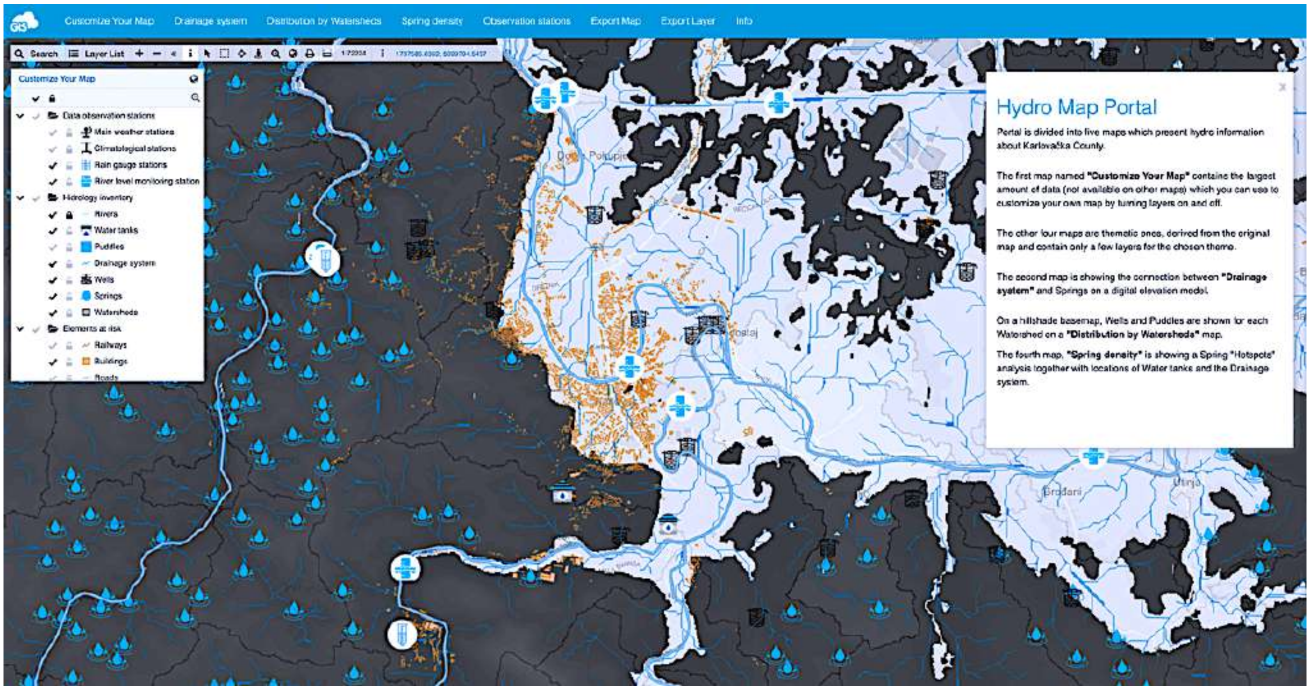


Figure 6:GIS based Hydrology Mapping, Source - https://www.giscloud.com/blog/how-to-create-a-hydrological-map-portal/

Water Supply Value Chain

Graphic by NIUA Team

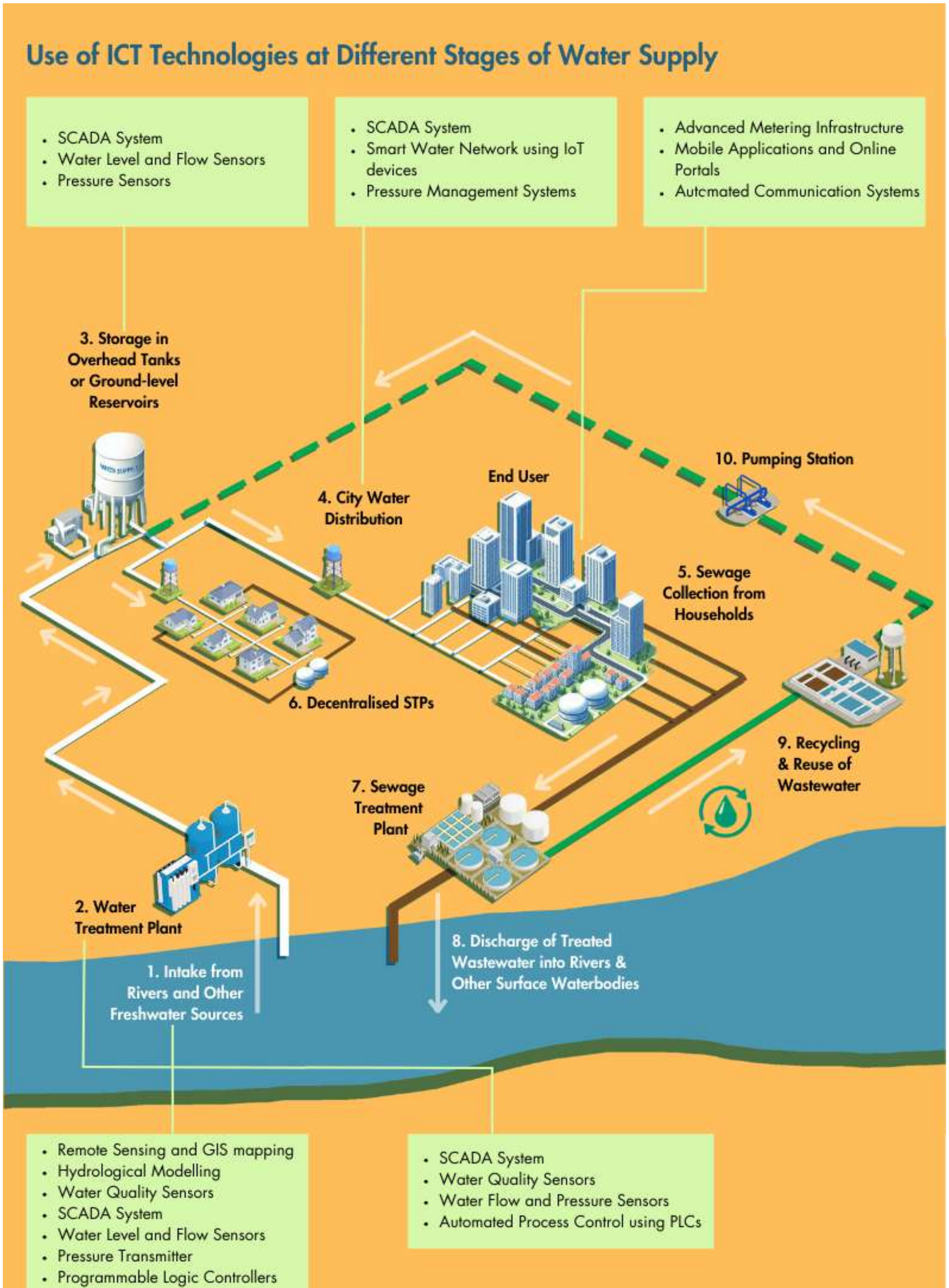


Figure 7: Water supply Value Chain diagram

Sewerage Management Value Chain:

Graphic by NIUA Team

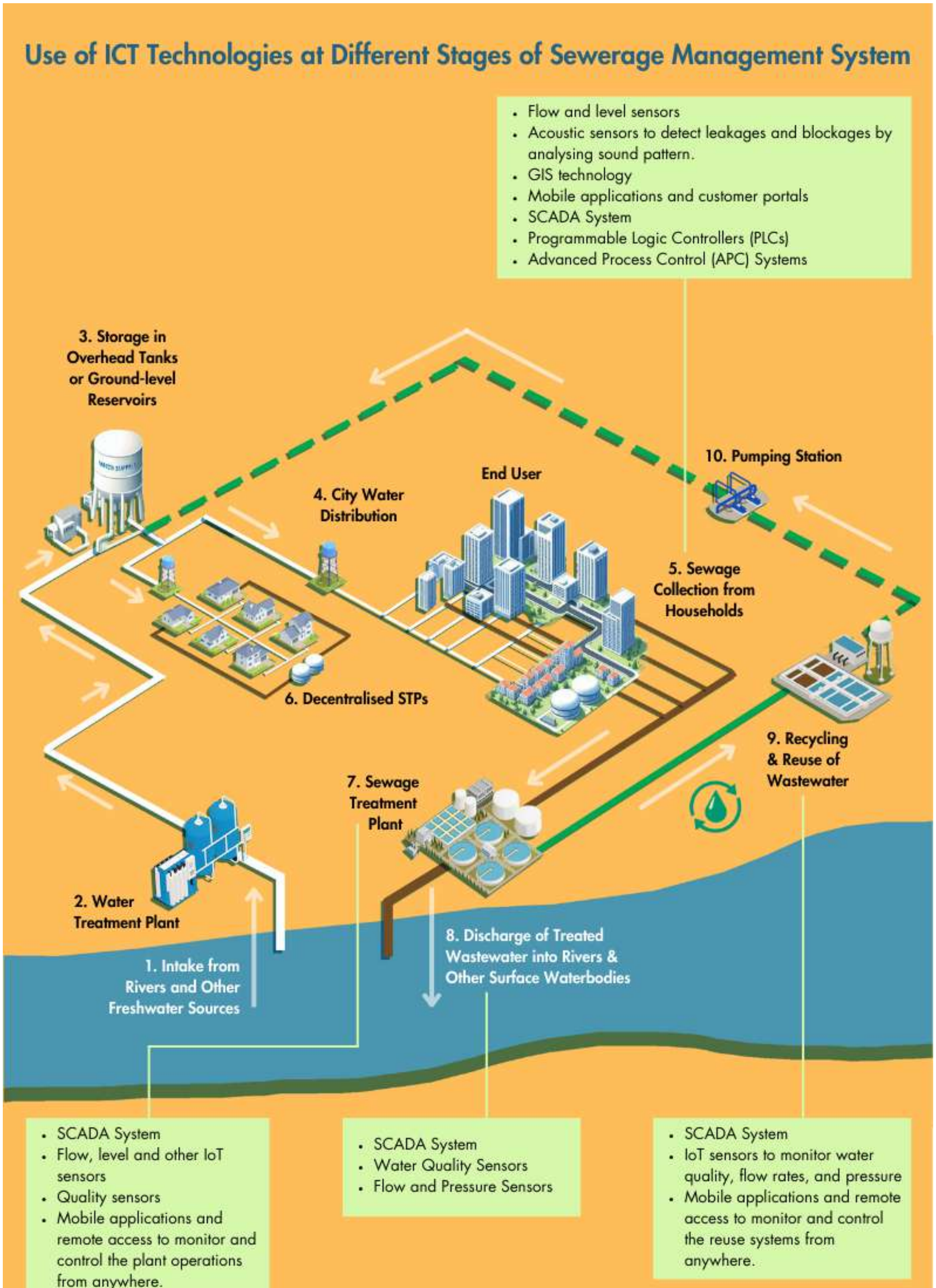
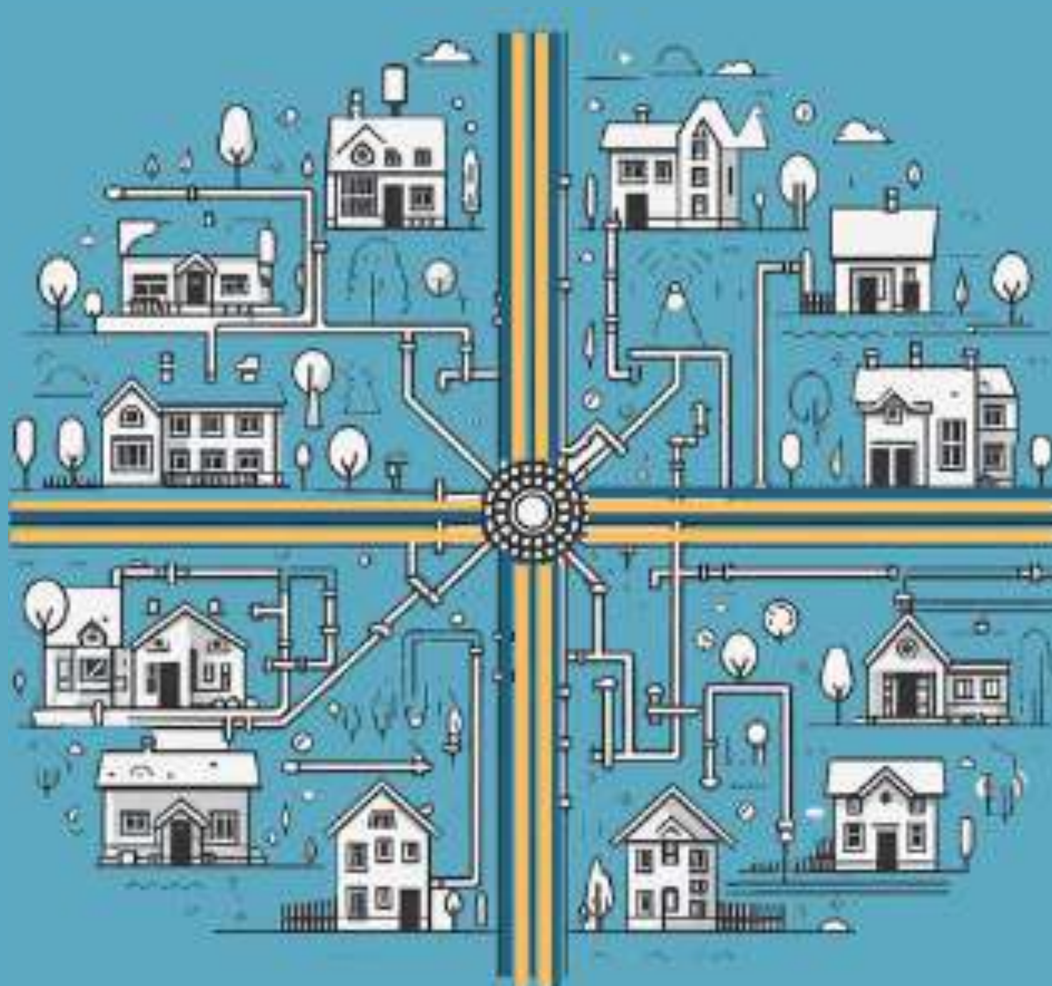


Figure 8: Sewerage Value Chain Diagram

Graphic by NIUA Team



3 National/ International Case Studies

Some of the case studies from India and other countries capturing various approaches adopted for managing water supply and sewerage systems is presented below:

3.1 Singapore City, Singapore

Singapore City is known for its smart city initiatives, advanced infrastructure and innovative approaches mainly with regards to management of freshwater resources. Singapore's national water agency, the Public Utilities Board (PUB), has implemented Smart Water Grid system which includes sensors and analytic tools all over the island. These help to provide real-time monitoring and data collection, supporting decisions and enabling PUB to manage the water supply network efficiently.

- **Leak management and enhancing network operations:** The dedicated Water-Wise software system developed by PUB comprises 300 multi-parameter probes to detect both leaks and water quality issues in real-time.
- **Water Quality Monitoring:** Besides leak detection, the Water-Wise system also includes multi-parameter probes that enhance water supply network's ability to detect water quality issues in real-time. Each multi-sensor probe measures the following water quality parameters: pH, oxidation reduction potential (ORP), conductivity, temperature and turbidity.
- **Automated Meter Reading (AMR):** The Water Supply Network (WSN) department had previously piloted two fixed network AMR systems in 2010 to assess the technical feasibility of deploying short-range fixed network AMR systems in Singapore's high-rise and low-rise industrial estates. WSN had also successfully implemented AMR to acquire water consumption data from the top 100 commercial and industrial customers in 2014. The data from the first phase provided a good sense of the causes behind the fluctuations of Singapore's daily demand, especially in analyzing the increase in Singapore's demand during the dry season.

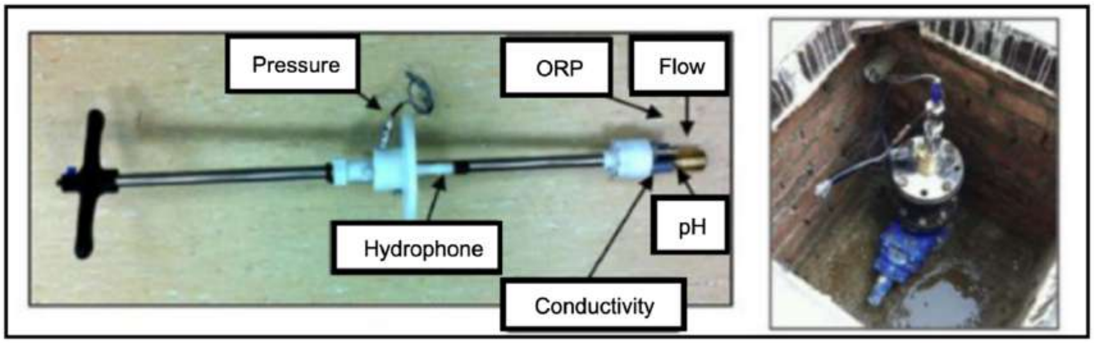


Figure 9:Installation of Water-Wise Sensors across Singapore, Source - Managing the water distribution network with a Smart Water Grid, 2016

Figure 10: Aquasuite Pure's Dashboard, Source: (https://aquasuite.ai/)

3.2 Seosan City, South Korea

To improve country's water management, the Korean government has put power in local government hands since the 2000s to tackle local water-related issues proactively. Aware of the rampant leakage, the Seosan city government sought suggestions from K-water, a state-owned enterprise responsible for water-pipe optimization, and adopted smart water management (SWM) to deal with the challenge. The city government incorporated ICT tools into its existing water supply network in 2016 to: (i) minimize the loss of revenue incurred by water leakage and (ii) secure the city's finite water resource

- **Smart Metering System:** Digital meters were installed in the first step which measures water flow multiple times a day and convert data into electric signals sent to remote transmitters through direct wires. Remote transmitters send the data to a base station through wireless communication, and then the base station transmits the received data to an internet server. The server transfers the data to a monitoring system that the city government operates. This allowed the city government to respond to water leakage detection and pipe repair more efficiently as the city officials were able to notice which neighborhood's revenue water ratio was significantly lower than other places.

- **Smaller District Metered Areas (SDMAs) using smart meters:** The city authorities installed 1,550 smart meters on major pipes at the household level, built 30 base stations, and subdivided the two original DMAs into nine SDMs. The smart meters monitored water flows in both the DMAs and the SDMAs, providing a more accurate calculation of minimum night flow. With the combination of smart meters and SDMAs, water leakages could be identified more easily.
- **Water Pressure Optimization:** After learning how water was used in different SDMAs, the Seosan city government used an automatic remote-control system to adjust water pressure in pipes accordingly.

Three months after the smart metering system was installed, the revenue water ratio in Palbong-Myeon district reached 90% (grew by about 20%). Data on water flow, pressure and user habit can be acquired automatically through smart meters and sensors. This is the building block for delivering big data solutions to water management.

3.3 Puri City, Odisha State, India

Government of Odisha has implemented 'Drink from Tap' quality piped drinking water to citizens on a 24x7 basis. Water received from the tap can be used directly for drinking and cooking without any further filtration. After successful running of the project in pilot zones for about a year, especially supply to slum/low-income group areas, Water Corporation of Odisha (WATCO) upscaled it to entire Puri city covering a population of 2.5 lakhs spread across 32 wards by providing 32,300 house service connections (HSC). This includes 64 slum areas having population of 66,000 slum dwellers. The jurisdiction of each service tank was considered as the service area of the DMA, thus making the decentralized control of supply and demand. For the success of the project, 100% metering coverage was ensured. With the 24x7 water supply the slum households in the city now stores less water. Also, the NRW is less than 20% in all DMAs, while the water quality samples test satisfactorily most of the time.

A centralized customer care centre is provided with the facility of IVRS based automatic complaint logging, transfer to concerned staff for action and online real-time tracking of redressal. Both assets and consumers in the entire city including slums pilot areas have been geo mapped on the GIS platform and real time data is obtained from the PLC (Programmable Logic Controller) /SCADA (Supervisory Control and Data Acquisition) to a central server.

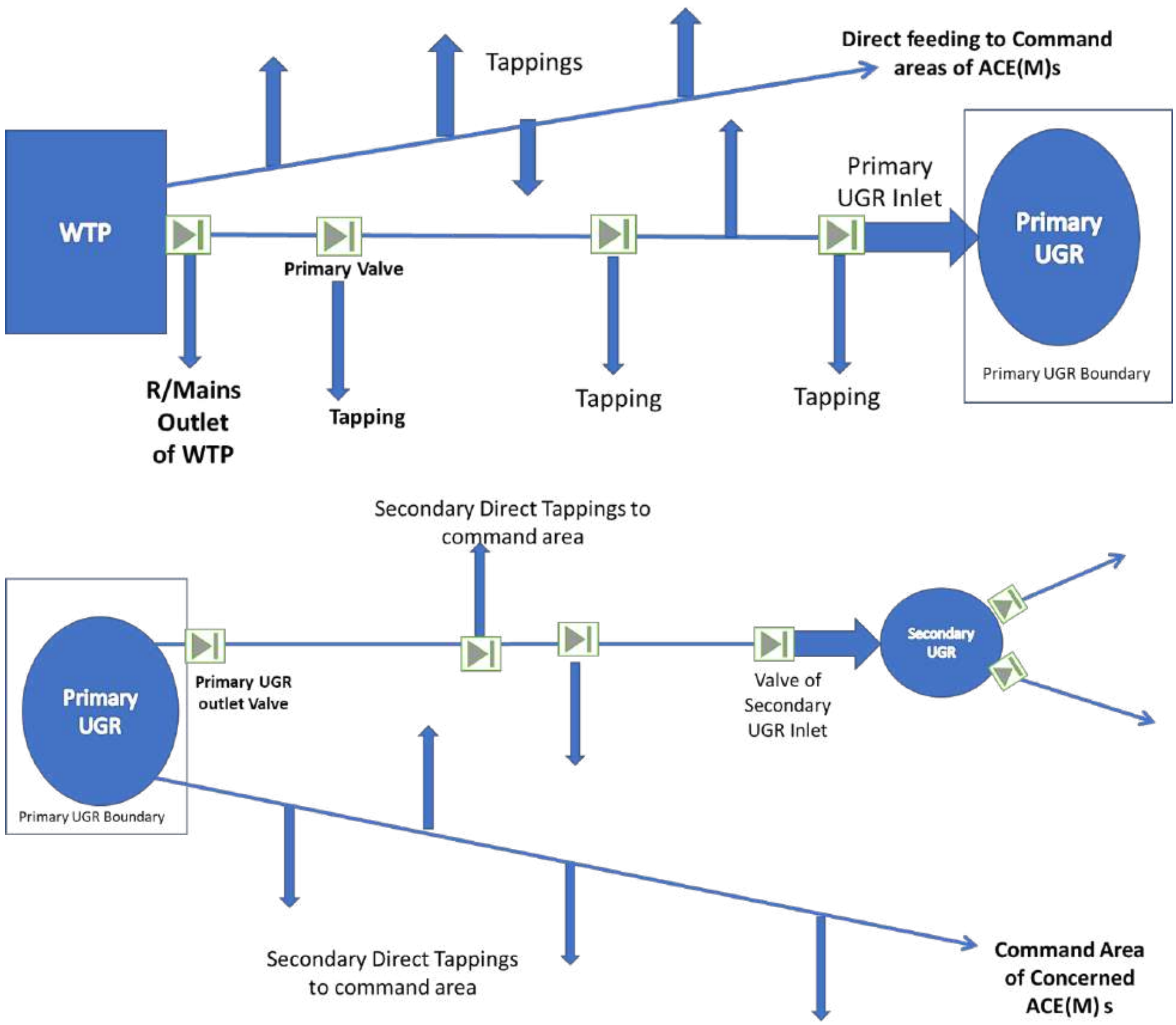


Figure 11: System Architecture of Smart Water Management System in Puri, Source: Puri Smart city Website

To achieve real-time data capture, analysis, decision making and public reporting, the 'Smart Water Management System' under 'Drink from Tap Mission' was conceived and has been implemented initially in 4 pilot zones of Puri City. 100% metering and volumetric billing have helped to reduce the leakages and wastages in water supplies.

Figure 11 depicts the flow diagram of Water supply for Puri city, starting from Water Treatment plant (WTP) to Primary UGR as the primary supply line, followed by secondary supply line up to secondary UGR. The flow diagram depicts installation of primary valves and various tapping in between to feed the respective command areas.


Source: Google Images

4 Approach & Methodology for conducting the research study

The impact assessment study has been designed with a comprehensive approach having an intermix of primary and secondary research.

The secondary research has been aimed at taking stock of the range of application of ICT tools in water supply and sewerage services based on the secondary literature available (in the form of project reports, case studies, best practices, videos etc.) as provided by the SCM. The national level impact assessment has been based on the broader set of questionnaires circulated by SCM team within 100 cities.

The primary research involved an in-depth analysis of four cities (Agra (Uttar Pradesh), Rajkot (Gujarat), Solapur (Maharashtra) and Thoothukudi (Tamil Nadu) to understand the finer nuances of ICT applications in the water supply and sewerage sector.

4.1 Primary Research - Level 1

Government A questionnaire was designed to capture information on interventions undertaken by the smart cities with regards to managing the water supply and sewerage systems (Annexure 1). Based on the information received from 94 out of 100 smart cities, a national level comparative analysis has been conducted that includes understanding of the nature of implemented project, scale of application of the intervention, and basic information related to ICT applications.

Further, a detailed questionnaire was designed to capture more detailed information from amongst the selected cities (Annexure 2), followed by interaction with city officials via a video conference call. The cities responded regarding change in service improvement pre and post ICT application in water supply and sewerage services, challenges faced by the cities in planning and implementing the ICT interventions, innovation in ICT application for service delivery, improved governance, enhanced capacities for delivering the services etc.

Based on the data provided by the smart cities in response to the broad questionnaire shared, a comprehensive understanding of the ICT application in cities with regards to water supply and sewerage services was developed and assisted in documenting the impact assessment. This got further strengthened by engaging with selected cities that have been progressive in ICT application. The interactions with the selected cities paved the way in developing further understanding of the interventions undertaken by the city and its impact on service delivery improvements. List of reports provided by SCM have been added as Annexure 3 to this report.

4.2 Primary Research - Level 2

Based on the interaction with 13 selected cities, four cities were selected for in-depth understanding of the ICT interventions undertaken by the respective cities with regards to water supply and sewerage services. The research team made a visit to each of the selected city and evaluated the impact of ICT application mainly from the lens of the journey undertaken by the city in applying the ICT tools, the nature and extent of ICT application, improvements affected by the application with regards to service delivery, governance mechanisms (planning, trouble shooting, decision making etc.) and most importantly capturing the citizen’s perspective on the impact that these ICT applications have brought in their lives.

The cities for the primary visit were selected based on the following criteria:

- Scale/coverage of implementation (Pan City/ABD/Project Specific)
- Extent of ICT usage in water and sewerage sector or both
- Innovation in technology implementation and service delivery
- Population size and geographical distribution of the cities
- Degree of Impact

Please refer next page for a graphic illustrating the approach and methodology adopted for conducting the impact assessment study.

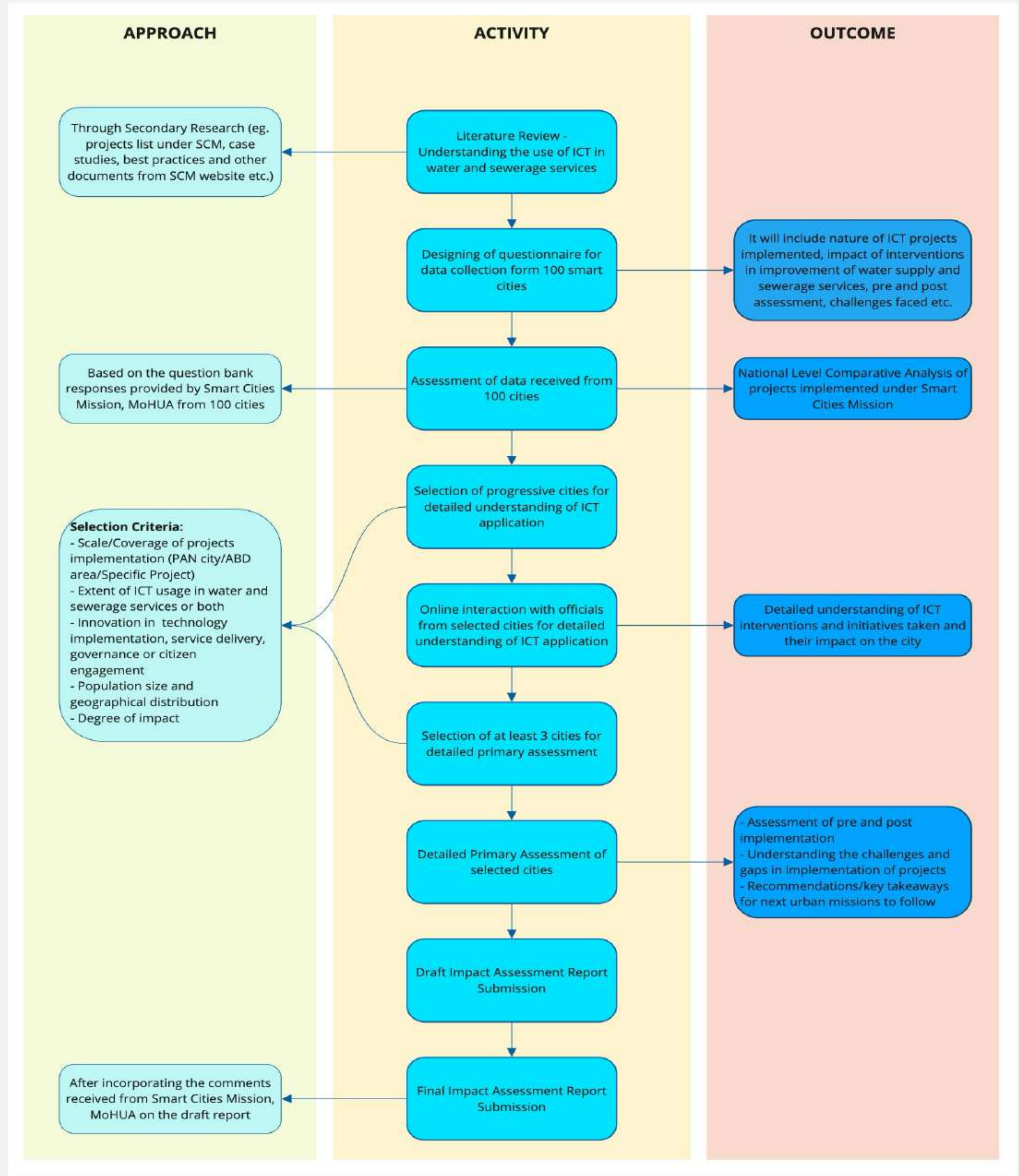


Figure 12:SCM Impact Assessment Study Methodology

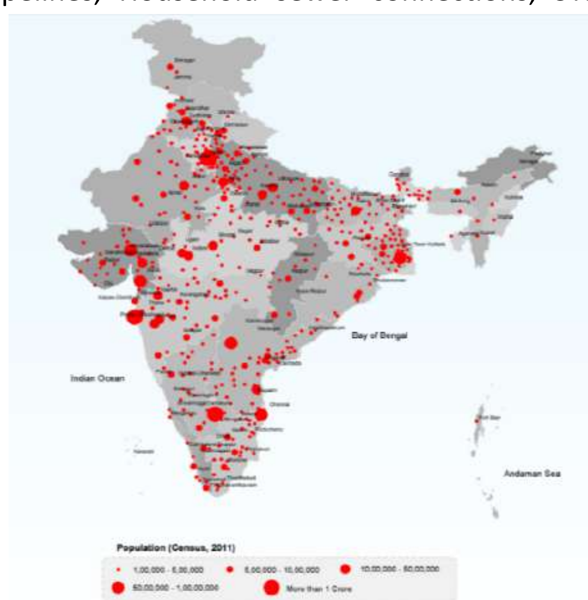
Graphics by NIUA team

5 Impact Assessment Inferences

5.1 National Level Theme-based Impact Assessment

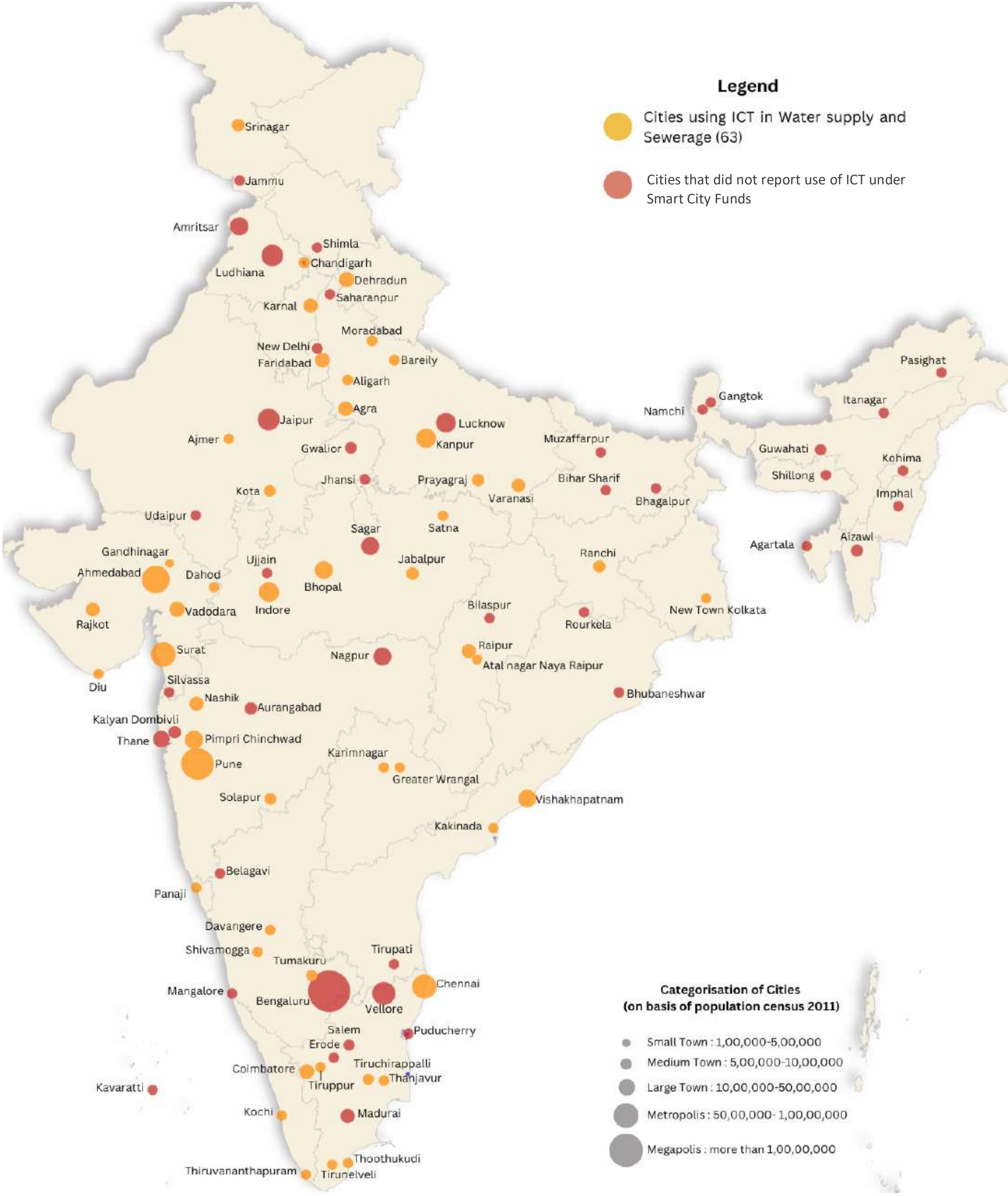
The smart city mission contemplated to optimize the performance and improve the efficiency of cities by integrating ICT (information and communication technology), and various physical devices connected to the IOT network in water supply and sewerage services of all 100 smart cities. Out of 100 smart cities that participated, there were small towns (new town Kolkata, Dahod, Thoothukudi, Namchi and Kavaratti), medium sized towns (including Solapur, Gandhinagar, Gangtok and others), large towns (including Agra, Rajkot, Vadodara, Bhubaneshwar and others), Metropolitans (including Pune, Ahmedabad and others) and megapolis (including Bengaluru, Surat and Chennai).

- Out of these 100 smart cities 94 cities responded to the broad questionnaire that was circulated at National level. Certain observations were made which further contributed in assessing the impact of use of ICT in water supply and sewerage services in these 94 cities.
  Out of the 94 cities that responded to the questionnaire, 35 are small towns, 20 are medium towns, 36 are large towns, 2 metropolitan and 1 megapolis.
- A total of 63 cities reported ICT interventions implemented in water supply and sewerage services. The nature of interventions includes SCADA application in water and sewerage infrastructure like Water Treatment and Wastewater Treatment Plants, Pumping stations etc., DMA zonation, Smart Metering, 24X7 water supply, smart water management, Water auditing, smart grid for wastewater reuse management, smart toilets, IoT devices for flow metering system, Infrastructure creation by laying of pipelines, Household sewer connections, STP augmentation, WTP source augmentation, etc. These identified projects can be broadly categorized into three components:
  a) Infrastructure creation
  b) Integrating technological/ IT digital solutions for ease of governance
  c) Procurement of IOT devices and their 5 years operation and maintenance cost.



Categorization as per population:
Small Town : 1,00,000 -5,00,000
Medium Town : 5,00,000-10,00,000
Large Town : 10,00,000-50,00,000
Metropolis : 50,00,000-1,00,00,000
Megapolis : more than 1,00,00,000

Use Of ICT in Water Supply and Sewerage Services in Smart Cities



Maps 1 : Map depicts 94 cities color coded according to usage of ICT in water and sewer services and sized by population

Most of the cities were able to create infrastructure with the existing expanse of knowledge. However, the master datasheet of the project details depicts that advancement in technological solutions has been limited to certain cities. Example: Raipur smart city mentioned the project implementation of Water audit and assessment of NRW in WSS (project no. 840 in the list). However, in the final response to the questionnaire, it is found that no reduction in NRW has been observed in Raipur city. Such incidences direct the assessor to the anticipation that not all cities were technologically capacitated for use of digitalization solutions in water supply and sewerage sector.

Parallelly, the adaptation of smart solutions like, installation of level indicator sensor on manholes 0.5m below the road level connected with ICCC alert mechanism in Udaipur city, Water auditing by Vadodara to calculate the unaccounted water and to manage the flow and pressure with automation for equitable supply are some un-conventional solutions adopted by the cities.

Most of these cities utilized the funds under SCM (smart cities mission for implementing these projects. However, in some cases where more funding was desired, cities utilized convergence funding to execute the overall projects. A total of 21 cities utilized AMRUT funding in convergence to SCM funds for holistic execution of the project. Most of these projects impacted assured water supply or improved sanitation in the city. This clearly depicts the adaptability of the mission's logistics and flexibility in urban governance.

Disclaimer:

a. Inferences drawn in this section of National level assessment are based on the responses received from 94 cities for the joint questionnaire shared by the SCMMU team. No data validation has been carried considering the time-bound study limitations.
b. Only projects under SCM are covered in the study, the city may or may not have taken up SCADA and ICT projects under a different program/ mission of Centre/ State.

5.1.1 Smart City Website/ App

- Out of 94 cities that responded to the questionnaire, 85 cities have smart city website while 52 cities have developed Smart city Mobile app. It is worth noting that out of these 52 cities, 16 are small towns, 12 are medium towns, 22 are large town, and remaining two are metropolis. The penetration of IT digitalization and smart solutions, and their adaptation by the cities is quite equitable. However, it is difficult to classify this variation based on zones of India (North, South, Central, and East Zone).
- Out of total 52 cities using mobile app, 35 cities have linked payment portal for municipal bills (water, electricity, etc.) to the smart city app created, 19 cities have integrated water and sewerage related public information alerts and notifications on this mobile app, and 34 cities have integrated the public grievance redressal and complaint mechanism on this app.

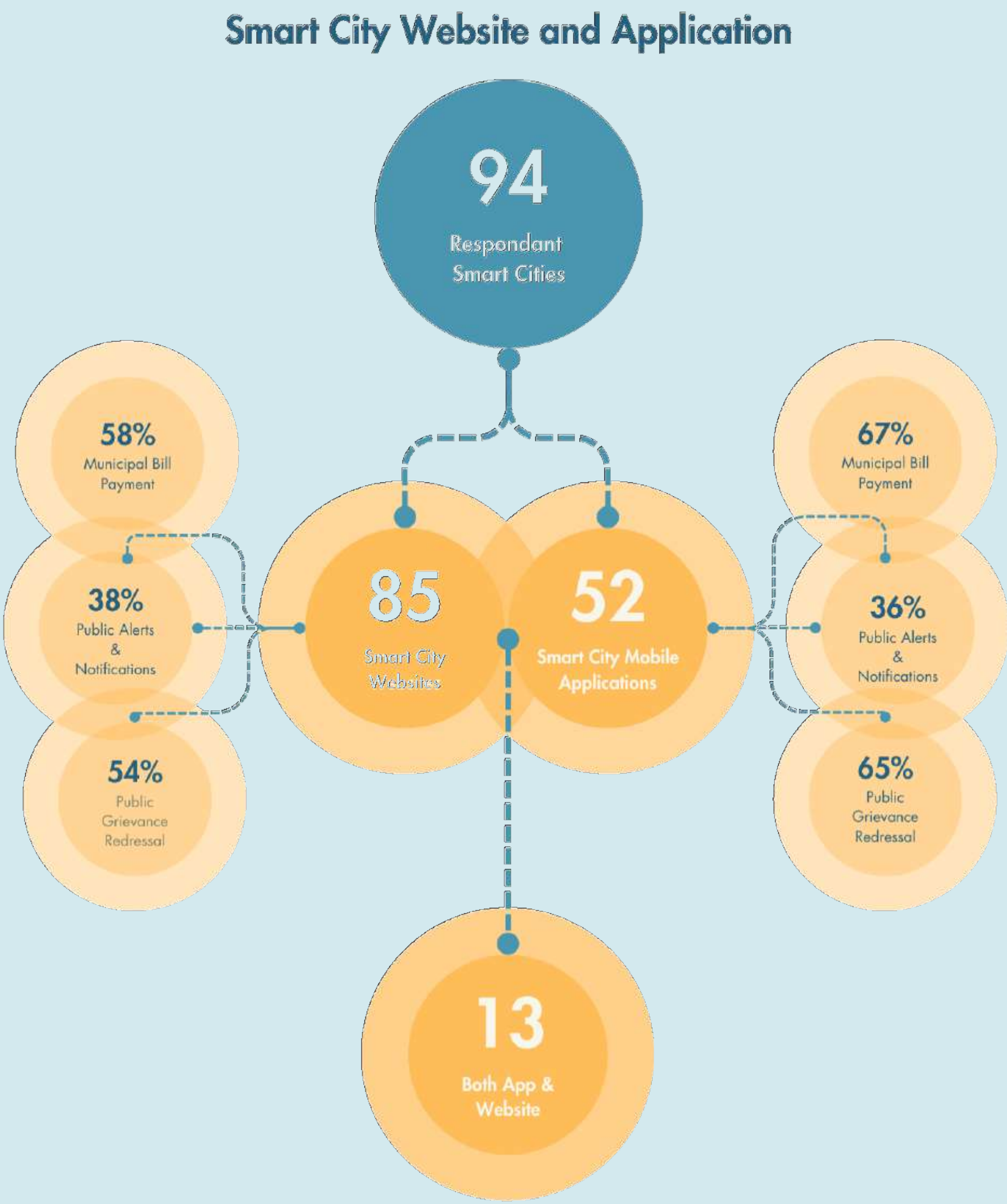
  Out of 85 cities that have developed a smart city website, 50 cities have linked payment portal for municipal bills, 33 cities have integrated water and sewerage related public information alerts and notifications, 46 cities have integrated the Public grievance redressal and complaint mechanism on this web portal.

  When we analyze these number of cities in form of percentage out of total cities implementing these three parameters, it is found that both smart city website and mobile app have equitable percentage distribution of website and mobile app users. Refer figure 12.

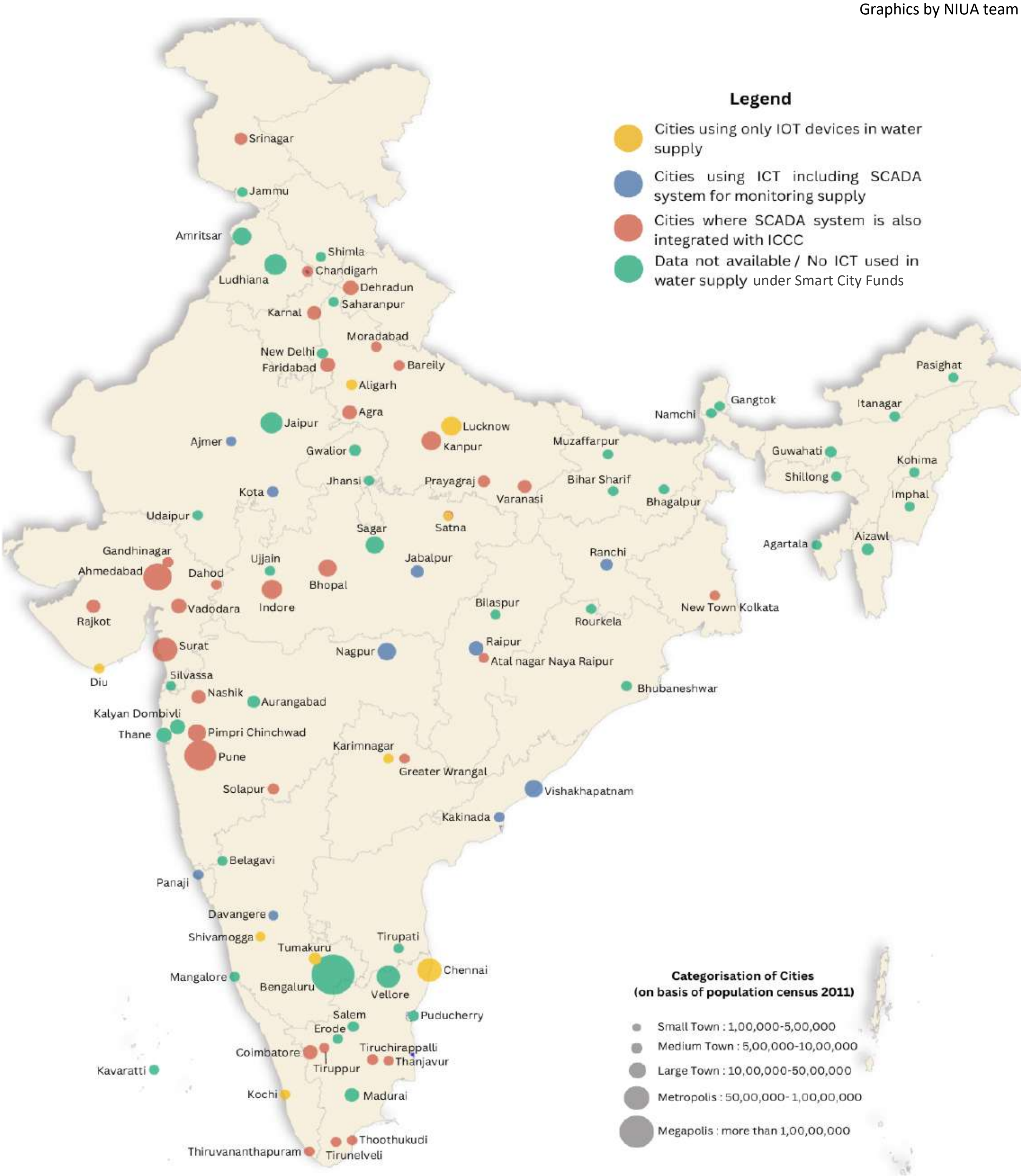
5.1.2 SCADA application in Water Supply system

- Out of the 94 cities that responded to the questionnaire, 48 cities have been using SCADA or some form of IoT for monitoring water supply system in their cities. Refer Map 02.
- Out of the 48 cities using SCADA/IoT for water supply in their respective cities, only 31 cities have linked their SCADA system to ICCC, with a total of 17026 kms length of pipeline being monitored. 51 cities have utility management (water and electricity, etc.) integrated with ICCC. Bengaluru, the only megapolis amongst 94 cities that responded has not reported the integration of SCADA in their utility management services. However, it is heartening to see SCADA application in water supply services across so many small, medium and large-sized towns.

Graphics by NIUA team



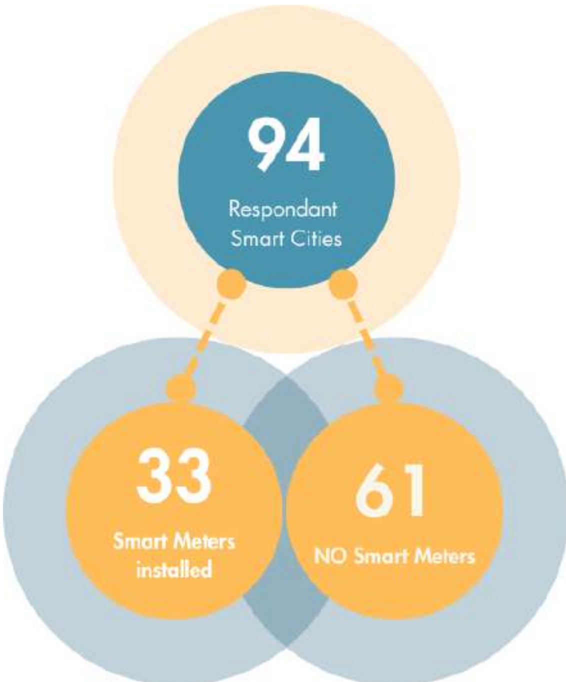
Graphics by NIUA team



Maps 2: Map depicting Smart cities that a) Use ICT in Water Supply, b) Use SCADA system for monitoring c) SCADA integrated with ICCC. These three components have been color coded on basis of components and sized on the basis of population of the city

5.1.3 SCADA application in Water Distribution Network

- Out of the 94 respondent cities, 29 cities have applied ICT in their water distribution system at pan city level whereas 19 cities have applied the same within the ABD area or some specific part of the city under SCM funds.
- A total of 30 cities have installed smart meters in the water distribution network with a total of 9,65,176 Water Meters.



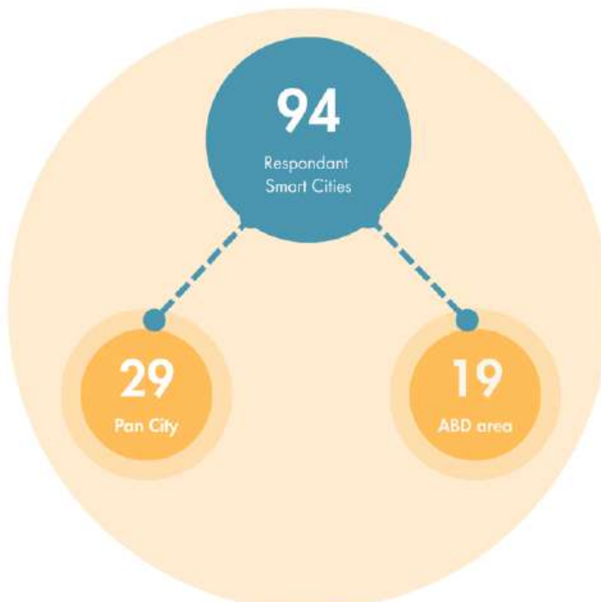
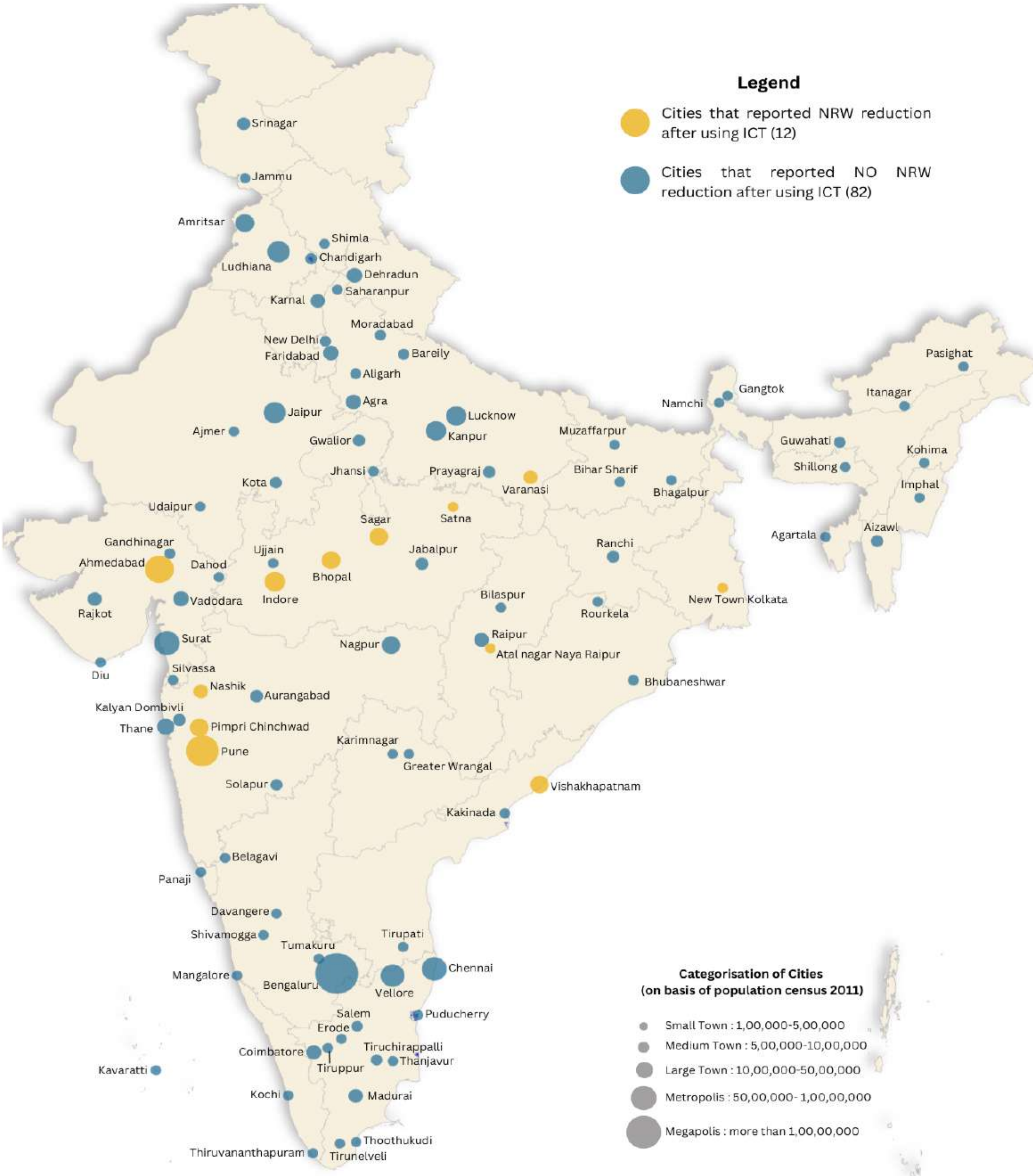


Figure 16: Number of cities that utilized ICT in water sector at pan city level v/s partially in ABD area

Figure 15: number of cities where smart meters were installed, Source: Authors

5.1.4 Contribution of ICCC towards Revenue Collection

- 13% of the respondent cities reported increase in revenue generation post integration of water supply fees/charges with ICCC.
- Reduction in NRW: 12% of the respondent cities reported NRW reduction after integrating their water supply system with ICCC and can generate more revenue for their city.

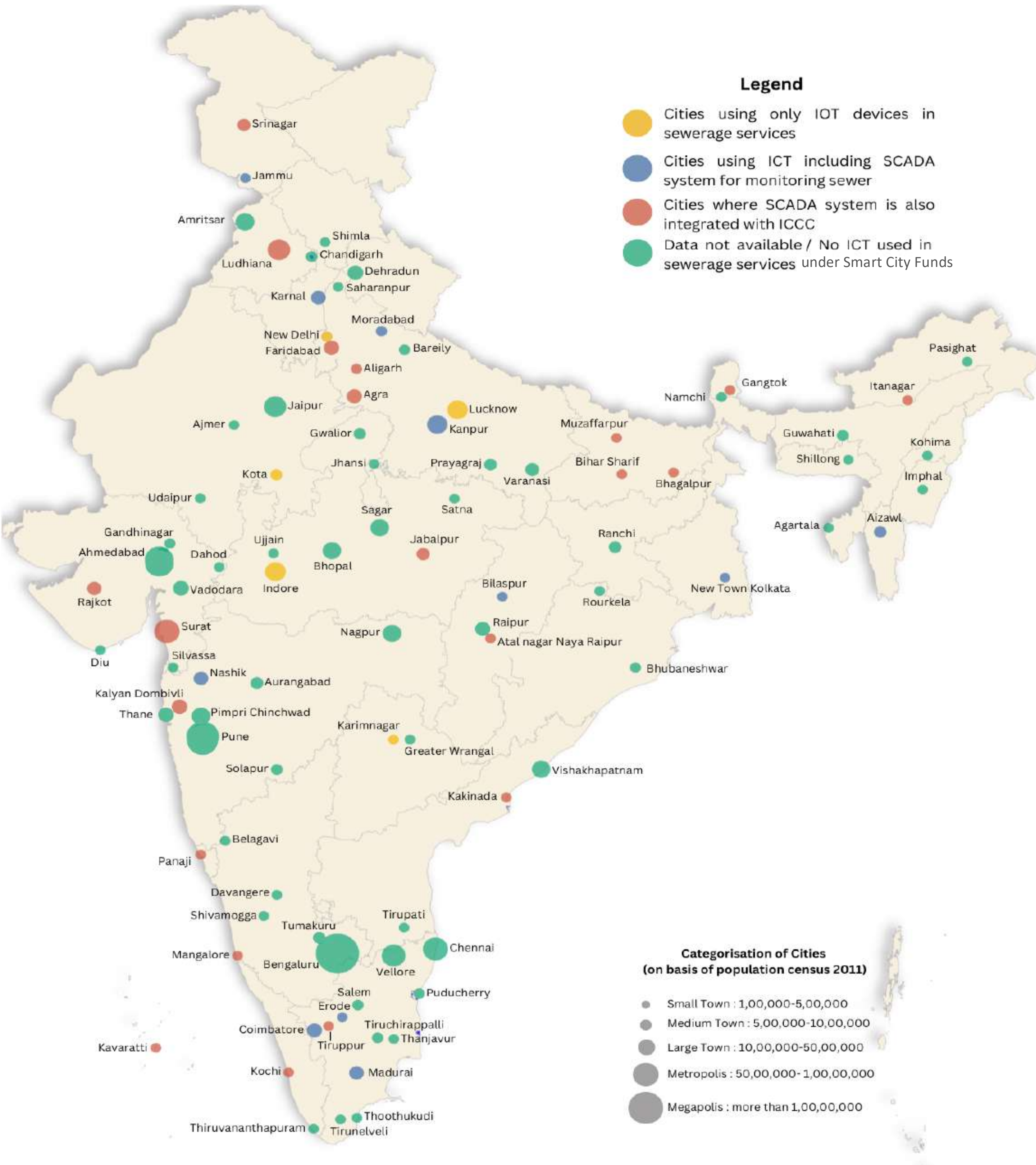


Maps 3: Cities that reported NRW reduction post-implementation of ICT in their water and sewerage services

5.1.5 SCADA application in Sewerage System

- Number of cities using ICT tools like SCADA/ IoT for monitoring of sewerage system is 22. Out of these 22 Cities, 7 are small towns, 2 are medium size towns, 12 are large towns, and 1 metropolitan city. Refer figure 8.
- Out of the 22 cities that are using ICT or IoT of any kind for managing the sewerage system, 14 cities are using SCADA of which 9 cities reported linking of SCADA system to ICCC.
- The application of ICT solutions in managing the sewer network pan-city is observed in 13 cities, whereas 13 cities reported application in ABD or limited city area.

Graphics by NIUA team



Maps 4:Map depicting Smart cities that a) Use ICT in Sewerage Services, b) Use SCADA system for monitoring c) SCADA integrated with ICCC. These three components have been color coded on basis of components and sized on the basis of population of the city

5.2 Success Stories from Selected Cities

Based on previous assessments by smart cities PMU unit, secondary data research and detailed analysis of compendiums available on SmartNet, it was observed that a few cities have outdone themselves while planning for context- specific smart solutions. A few of these projects got special mentions and awards during various stages of the mission. The list of cities that were awarded or accoladed for special approach to the problem using technological solutions are as follows:

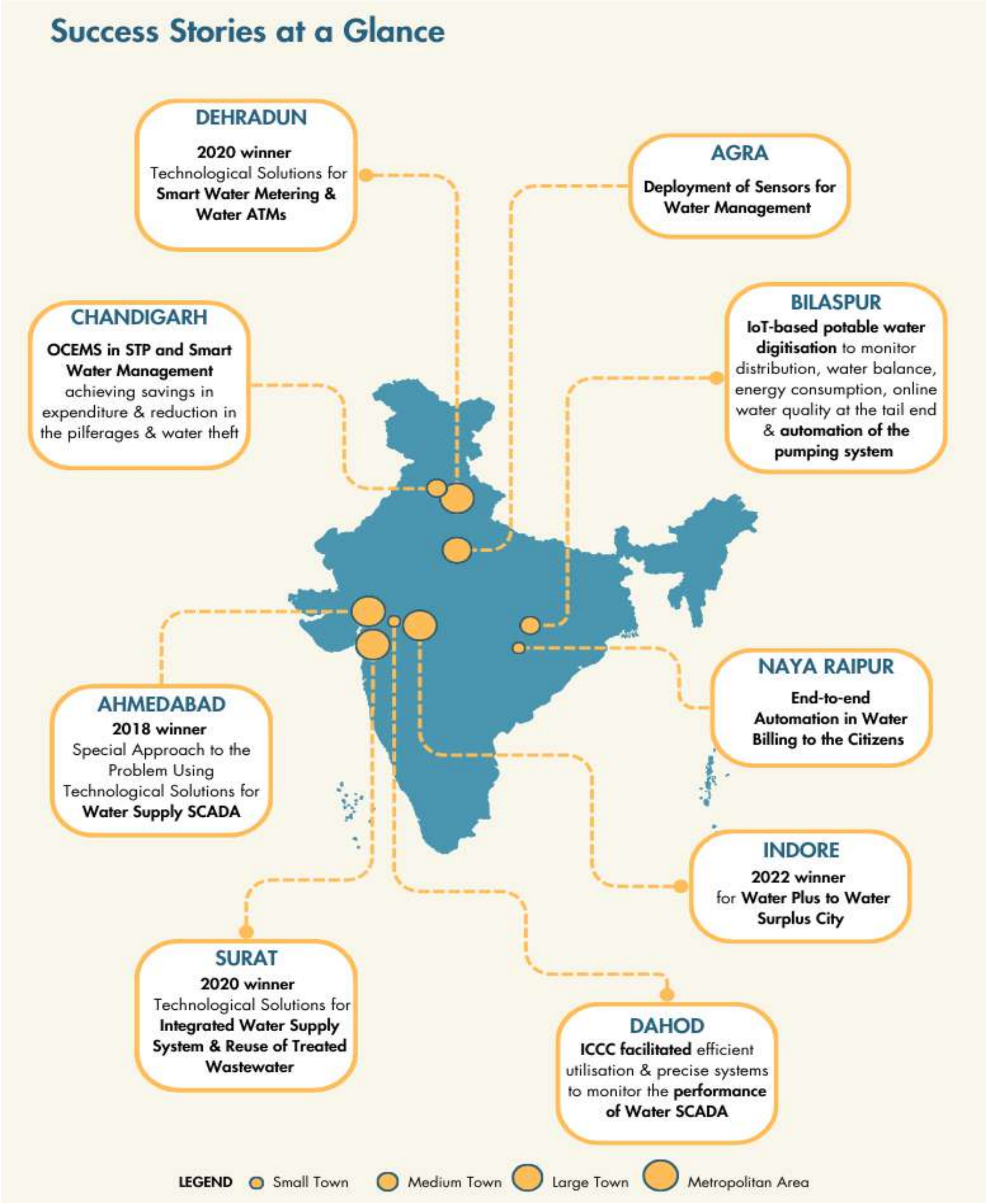


Figure 17: Success stories at a glance

A. IoT based potable water digitization to monitor distribution, water balance, energy consumption, online water quality at the tail end and automation of the pumping system in Bilaspur City

Problem: Old Bilaspur city had the typical problem of more expenditure by PHE department than the revenue earned form the water bills. This was owed to non-payment by the consumers as they claim non-availability of water. The water was supplied 30 minutes twice a day. There was no accountability of water losses due to leakages, water theft etc. There is a lack of data on distribution efficiency, leakages/NRW losses compared to benchmarked municipalities. Water was supplied twice a day for about 30 min in the morning and evening by manually opening various distribution valves in a sequential manner. The amount of water delivered in the tail end was not measured. Also, water quality was checked once a in fortnight with no real-time visibility of water quality parameters.

Solution: Digitalization of water distribution network by measuring supplied water at source, water supplied at tail end, water usage performance index (KW/KL), NRW losses and water quality using sensors and cloud-hosted software. The engineers were able to make data-driven decisions, using Water Balance diagram of the scheme. Following parameters were monitored:

- Water Usage Performance Index in KW/KL
- Operational efficiency & water balance of treatment plants
- Excess usage / leak detection
- Sustainability options of the water supply scheme
- Comparison of performance of water utilities across schemes
- Automation of critical assets/operations and troubleshooting support
- Low-cost digital twin for real time monitoring:

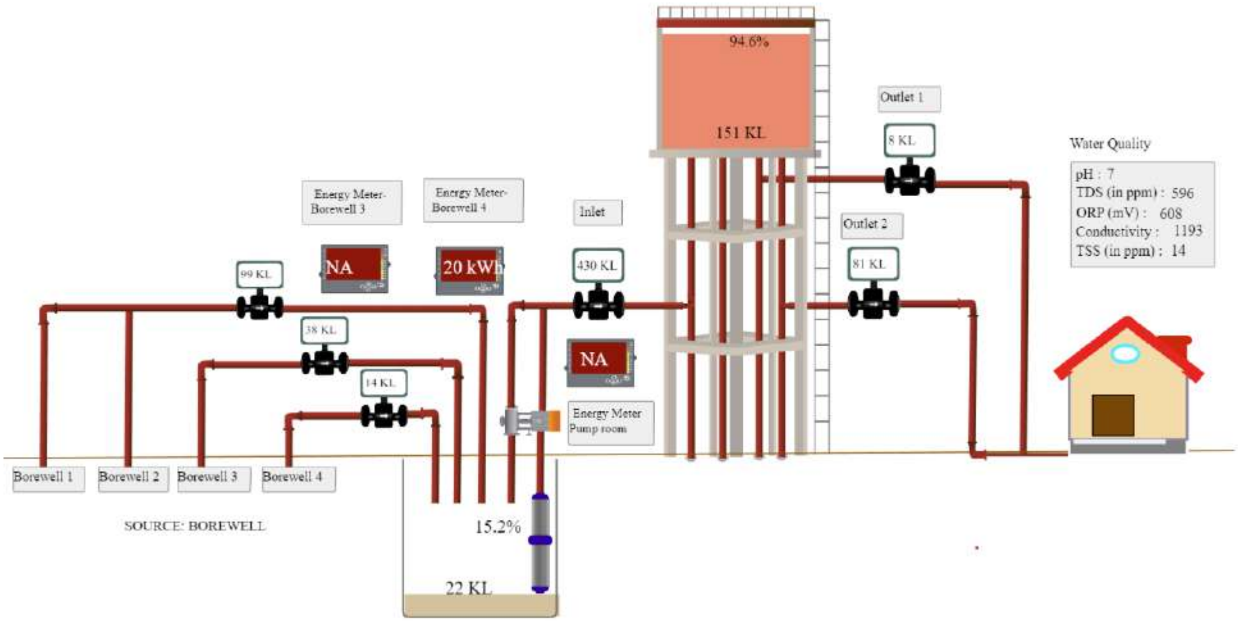


Figure 18: Layout and section of Water distribution network details in Bilaspur City, Source: SCMMU

Dashboard - Water Quality:

Figure 19: Dashboard screenshot for water quality for Bilaspur City, Source: SCMMU

Site Pictures:

Report Summary			
Sl No	**Description**	**Responsible- Team**	**Photo**
1	Real-time tank level and flow meters, along with energy monitoring systems, have been successfully installed at the site. The live data is now accessible through the Greenvironment dashboard, providing users with accurate information regarding quantity and tank levels. Additionally, a digital display on-site allows for convenient viewing of this data.	Greenvironment	
2	A real-time monitoring (RTM) system, equipped with high-quality sensors such as pH, TDS, ORP, and TSS, has been installed at the tail node to accurately assess the water quality of the supplied water.	Greenvironment	
3	Flow meters for monitoring the water from the borewell have been installed at the site and are connected to the digital display.	Greenvironment	
4	Flow meters to measure the quantity of supply water to the households have been installed at the site.	Greenvironment	
5	The control panel for the borewell needs to be replaced with a new one at 3 locations to automate the pumps based on the tank level	Greenvironment & BSCL	

Figure 20: Site pictures from water distribution network in Bilaspur City, Source: SCMMU

B. Water saving through deployment of sensors in Agra ABD Area

With ICT interventions in water management, Agra city has been able to achieve savings in expenditure and reduction in the leakages and water theft through the following actions:

- **Reduction in the Non-Revenue Water -** With ICT interventions through SCADA, Agra smart city was able to map and track the water consumption in the city and understand the consumption pattern by analyzing the data. This helped them to optimize the volume of water to be supplied resulting in water savings. Further, the ICT interventions helped in identifying the leakages and pilferages, which they have been able to reduce by at least 15%.
- **Optimization of water volumes treated and supplied -** Previously UP Jal Nigam was supplying the water based on grievances received or based on historical data. With ICT interventions, they are able to analyze the demands, predict the consumption patterns and supply the necessary amount of water. Because of these actions, the stress on water treatment infrastructure has considerably reduced and correspondingly there has been reduction in generation of wastewater volumes and savings in cost for operating the wastewater treatment infrastructure.
- **Increasing legal water connections landscape** - Due to the ICT interventions and installation of smart water meters, the city has been able to check on no-metered connections and areas with pilferages in water supply network. This has led to better monitoring of water supply and correspondingly increase in collection of water charges thereby increasing the revenue for the city. Reference Calculation is given in the table below: -

Heads	Number
Amount of water being saved/day	1200 KL
Cost of procuring and distributing water	Rs. 5/ KL
Amount of savings/month	1200*5*30 = Rs. 1,80,000
Amount of savings/year	180000*12=2160000 (A)
Cost of treating and transferring wastewater/KL-	Rs 2/ KL
Amount of savings/month	1200*2*30=72000
Amount of savings/year	72000*12=864000 (B)
Total Savings/year (A+B)	Rs.30,24,000

Table 1: Revenue saving by Agra Smart city using ICT in water sector, Source: SCMMU

C. End-to-end Automation in Water Billing to the citizens in Naya Raipur

Problem: Naya Raipur (Atal Nagar) is a green field fast growing city predominantly housing residential sectors in the form of individual row houses as well as residential towers.

The city draws water from the Mahanadi River to cater the needs of the city. Water SCADA has been implemented under the Smart City Project in various locations such as intake well, WTP, underground reservoirs etc. to control the flow of water as well as maintain the quality of the water to be supplied in all the houses/offices across the city. As of now the water consumption billing done to the citizens had manual interventions. In several cases this led to errors in the final bill amount and there was scope for tampering as well.

Solution: Under the scope of the Naya Raipur Smart City Project, the concept of Smart Metering-Water was introduced in the city. AMR Water meters were installed in all the sectors (residential, commercial) across Naya Raipur city.

With the help of these AMR meters, tracking the exact consumption of water per household/ office was initiated. This lead to the shift of entire process of manual bill generation to end-to-end automated data collection and billing process. The exact consumption of water is now captured through an RF-based handheld device and accordingly through API integration the water bill gets generated automatically from the billing application under the e-gov module.

Outcome and Key Impact figures:

- The end-to-end automation of the AMR meters with the billing application has helped to remove any errors due to manual interventions in the billing process.
- This relieves the citizens from getting erroneous water consumption bills from the concerned department.
- Approx. **49,932 nos. of Water bills** have been generated in the year 2022.

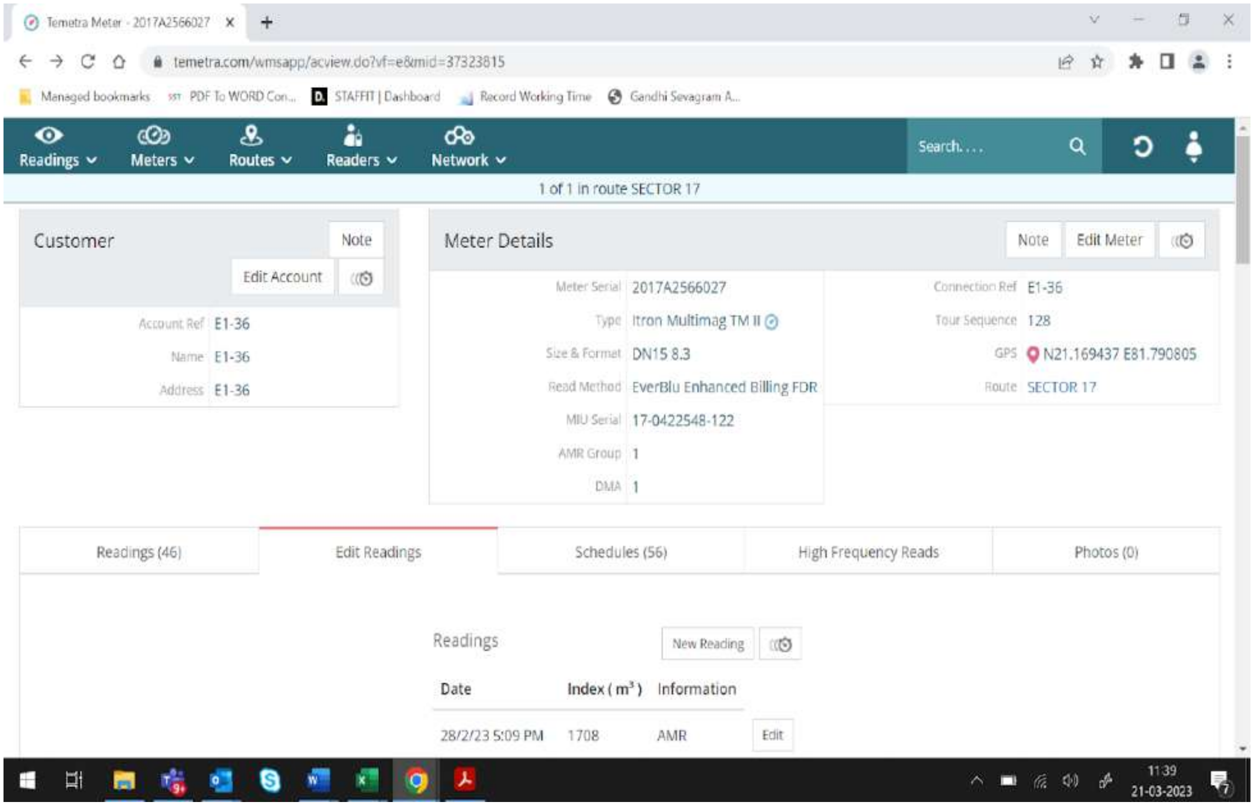


Figure 21:Screenshot of Smart meter reading dashboard in Naya Raipur smart city, Source: SCMMU

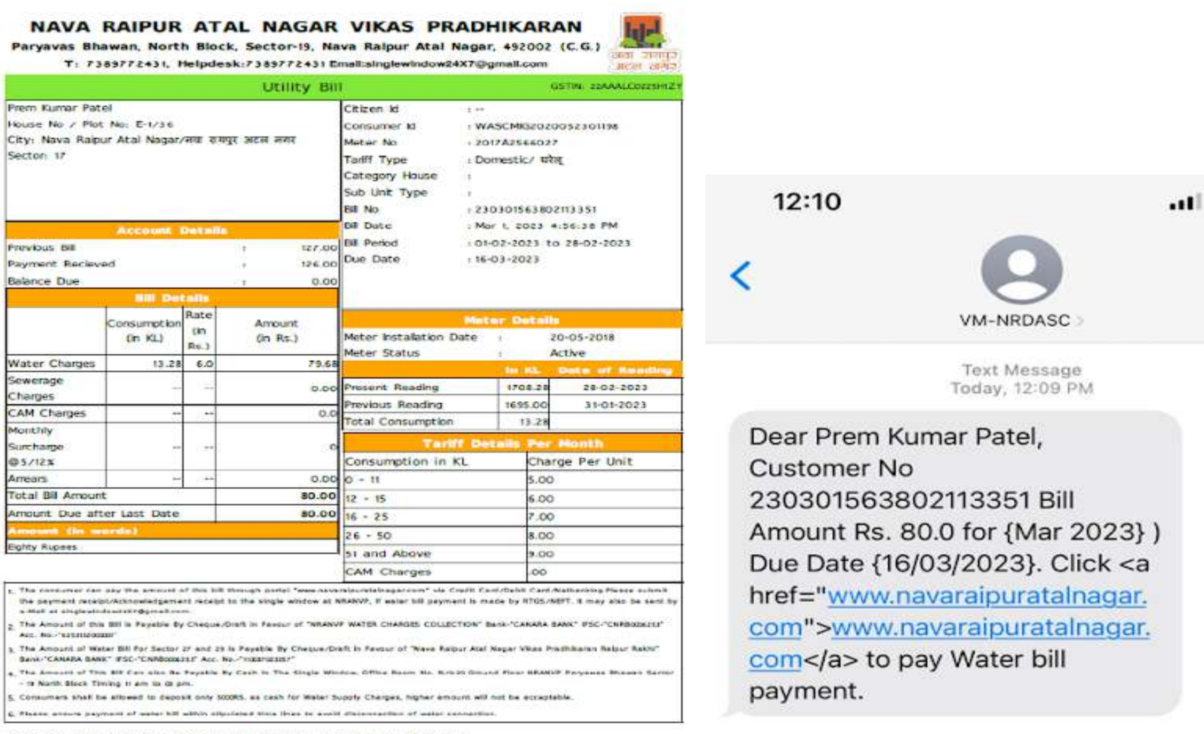


Figure 22: Consumer bill screenshot from Naya Raipur Smart city, Source: SCMMU

D. SCADA for Water quality monitoring in Dahod Smart City

Problem: Dahod Smart City struggled with delivering clean drinking water due to poor water quality and significant water wastage. Despite having multiple pumping stations and pipelines, the city faced challenges in ensuring equitable distribution and maintaining efficient water management.

Solution: ICCC facilitated utilizing efficient and precise water monitoring systems to help the authority to monitor the performance of Water SCADA. The live feed from Water SCADA is integrated with ICCC for real-time monitoring of water system Key performance Indicators (KPIs). Visualization of the Water SCADA parameters is generated after treatment of water at ICCC. The pH values of the following parameters are collected, visualized, and analyzed:

- Average Inflow pH
- Average Outflow pH
- Average Inflow
- Average Outflow
- SCADA Effluent Key Parameters Data

Outcome and Key Impact figures:

- Sustainable water management system: ICCC facilitated utilizing efficient and precise water monitoring systems to help the authority to monitor performance of Water SCADA.
- Improved water quality monitoring: Authority can easily monitor different water quality parameters like pH, COD, BOD, TSS, TKN, NH3-N, TP & FC. Thus, providing the city with clean, affordable water.
- Identify and address issues promptly, like leaks, pressure fluctuations, or water quality concerns.
- Optimize water management by efficiently allocating resources and ensuring equitable distribution.
- Improve overall service delivery by providing citizens with reliable and safe water access.

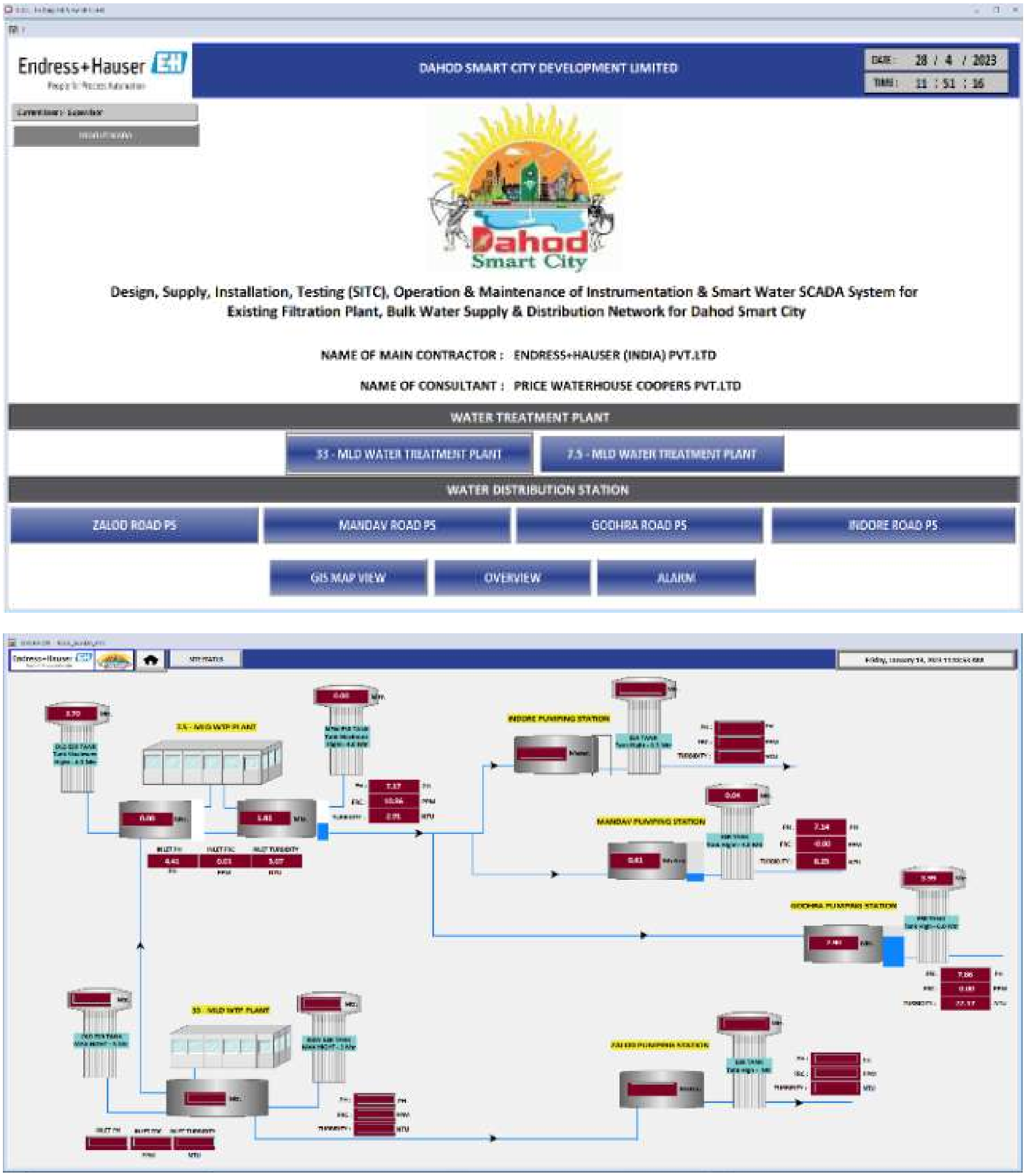


Figure 23:Dahod Smart city ICCC dashboard for water, Source: SCMM

E. ESCO model in Dehradun Smart City

Problem: Dehradun has had a piped water supply dating back to 1885, it started with a 25 km pipeline which has now expanded and evolved into a 564 km network comprising of 203 Tubewells/ booster pumps, 72 Over Head Tanks (OHTs) and 02 Water Treatment Plants (WTPs). All the water supply scheme in the city is implemented by Uttarakhand Pay Jal Nigam (UPJN) and maintained by Uttarakhand Jal Sansthan (UJS). Surface water is the main source of supply for the North Zone, whereas the other zones heavily rely on ground water for water supply. The current water supply infrastructure in Dehradun has been operational for more than three decades and running under stress for huge electricity bills while maintaining efficient water supply.

Solution: The ESCO model adopted for execution of this project is a “shared saving model”. As part of this model the ESCO assumes both the technical and credit risk. This model helps in reducing the upfront capital cost, reduce water and energy loss and the payment made to the ESCO is based on savings that would be obtained.

The ESCO model implemented two main solutions:

- Upgrading pumping equipment: Existing pumps were replaced with energy efficient pumping equipment, and various instrumentation devices, such as flow meters, valves, actuators, sensors, and remote terminal units (RTUs).
- Implementing a centralized monitoring system: A SCADA system was deployed and integrated with central and local control stations enabling real-time monitoring, data acquisition, and optimized decision-making for improved energy efficiency.

As part of this model, ESCO is responsible for inspecting, analyzing, assessing, and estimating the necessary works required to achieve at least 20% energy saving against the present energy consumption. The process commenced with conducting a baseline assessment, followed by upgrading the existing WSS infrastructure with more energy efficient components. The scope of work included establishment and integration of a SCADA, local control system (LCS) and master control system (MCS). The selected ESCO firm is responsible for the Operations and Maintenance (O&M) of the system for a period of 10 years, i.e., guaranteed saving for 10 years.

Outcome and Key Impact figures:

These measures align with the Ministry of Housing and Urban Affairs, Government of India’s policy recommendations for developing energy-efficient systems.

- Reduction of non-revenue water (NRW) at the source
- Cost saving post implementation of ESCO model

Figure 24: SCADA Dashboard for Dehradun Water Supply project, Source: Dehradun Smart City

Table 2: Average e-value comparison pre and post implementation of ESCO model in Dehradun

S.No.	Zone	Average e-value during baseline (pre-implementation of ESCO model)	Average e-value from May-Dec 2023 (post implementation of ESCO model)	% reduction in e-value
1	Pithuwala	0.6331	0.4552	28%
2	South	0.9524	0.6560	31%
3	North	1.0696	0.7435	30%
4	Raipur	0.6732	0.5531	18%
	Overall	**0.8857**	**0.62757**	**29%**

5.3 City Visits & Detailed Primary Assessment

After secondary research and assessment of the best-case examples, a detailed interaction on VC call was conducted with 12 cities, based on best practices, variation in selection of projects, pan city v/s ABD coverage, population size and geographical distribution of city to understand the degree of impact on these cities and penetration of Smart city mission. Following cities were consulted:

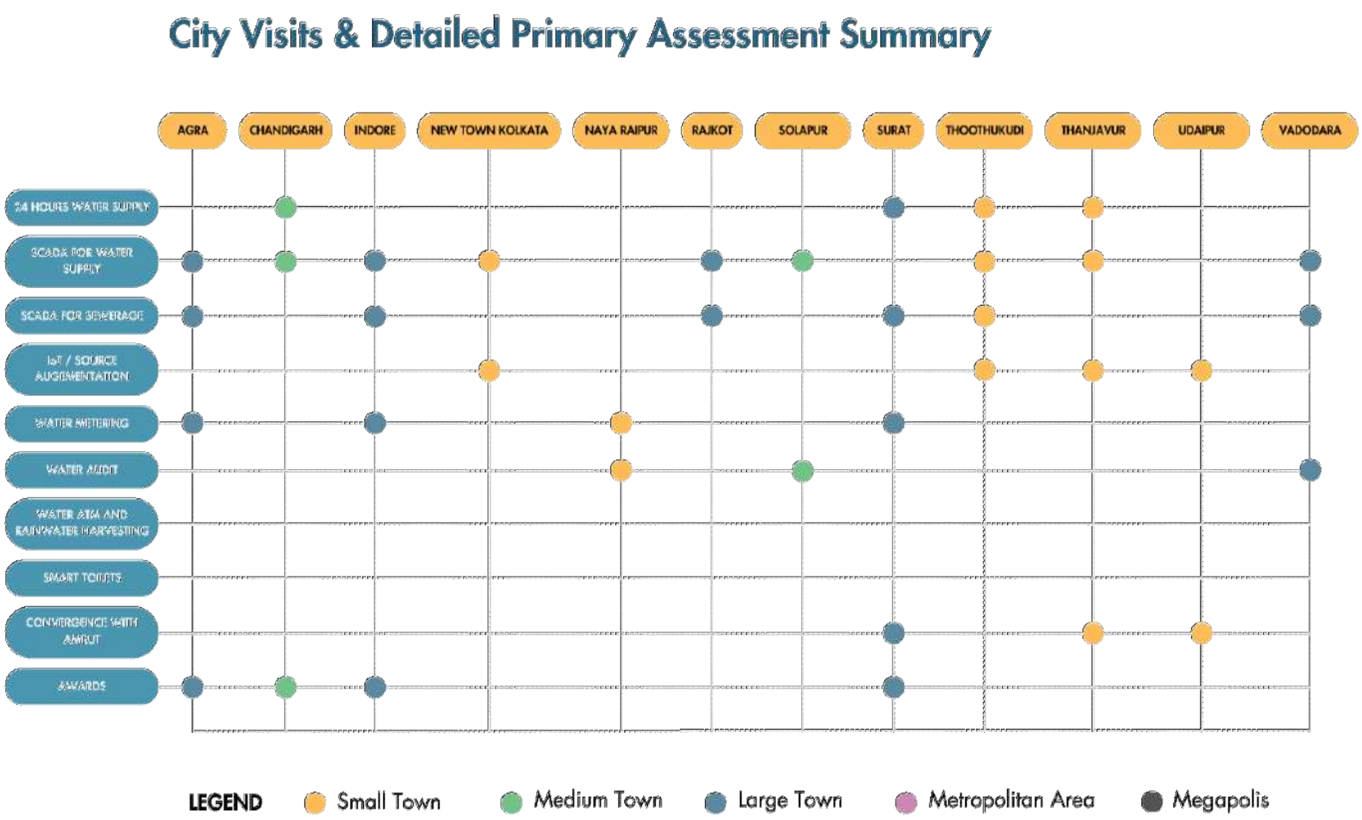
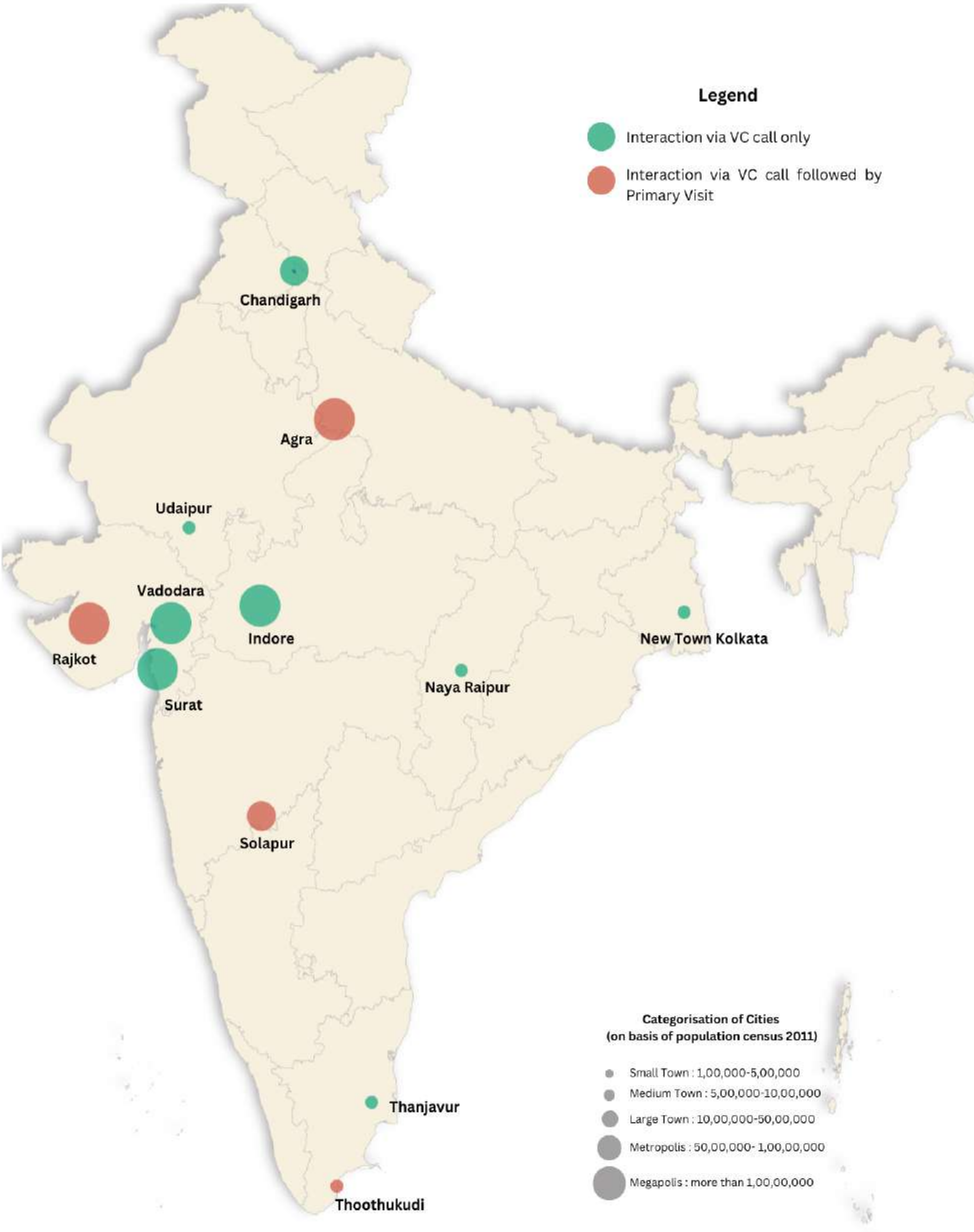


Figure 25: Infographic represents comparative of 12 cities that were assessed for different type of projects undertaken under Smart Cities Mission Scheme, Source: Authors

Further, based on the variety of projects these twelve cities offered and the degree of impact that was assessed, four cities were selected for detailed primary assessment; Agra, Rajkot, Solapur and Thoothukudi city, based on the geographical coverage, size of the towns, type of projects undertaken and the innovation used in implementation.

Graphics by NIUA team



Maps 5: Shortlisted Cities for primary assessment based on selection parameters criteria

Primary Assessment Summary

CHANDIGARH

NRW Reduction: from 37% to 32 %

Change in Service Area Coverage: 24X7 water supply in ABD

Change in per capita water supply: from 240 lpcd to 208 lpcd

Leakage Detection: Yes, pressure variation based

Smart Metering: in ABD area only

SCADA: in all 6 STPs, WTP and Water Distribution

AGRA

NRW Reduction: from 5% to 3-4 %

Change in Service Area Coverage: Water supply and sewerage network in ABD area

Change in per capita water supply: supply increased by 50%

Leakage Detection: None

Smart Metering: in ABD area but billing is manual

SCADA: in WTP and water distribution network

Innovation: Vacuum STP in low lying Old city

UDAIPUR

NRW Reduction: from 41% to 9.5%

Change in Service Area Coverage: Water - 30% Sewerage - 72%

Change in per capita water supply: from 280 lpcd to 150 lpcd

Leakage Detection: Yes, pressure variation based

Smart Metering: None

SCADA: in WTP and Water distribution network

Innovation: Sensor based Manholes linked to ICCC

NEW TOWN KOLKATA

NRW Reduction: less than 5%

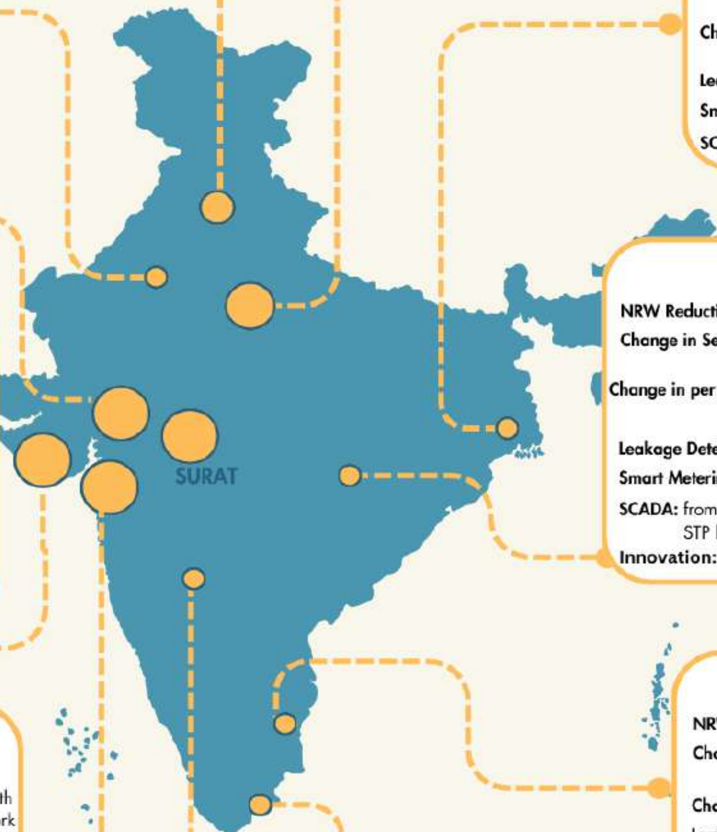
Change in Service Area Coverage: only 30% coverage under smart meters and flowmeters

Change in per capita water supply: supply increased by 50%

Leakage Detection: Yes, pressure variation based

Smart Metering: Installed but manual billing yet

SCADA: only in 2 WTPs



VADODARA

NRW Reduction: from 18% to 8%

Change in Service Area Coverage: 100% city connected with water and sewerage network

Change in per capita water supply: from 200 lpcd to 165 lpcd

Leakage Detection: Yes, pressure variation based

Smart Metering: None

SCADA: in WTPs, Water distribution network, and in STP.

Innovation: Water Audit ensures equitable water supply throghout the city. Energy Auditing saves 1 Cr annually.

NAYA RAIPUR

NRW Reduction: from 23-25 % to 18%

Change in Service Area Coverage: Water supply and sewerage network laying in ABD

Change in per capita water supply: 240 lpcd supply in all sectors and 24X7 supply in VIP sectors

Leakage Detection: Yes, pressure variation based

Smart Metering: Completed in phase 1, but billing is manual

SCADA: from source to WTP and water distribution network, STP has SCADA system but not linked to ICCC

Innovation: Recycled water network for landscaping.

RAJKOT

NRW Reduction: from 26% to 22%

Change in Service Area Coverage: 100% city connected with 92% city under sewerage network

Change in per capita water supply: from 130 lpcd to 135 lpcd

Leakage Detection: Yes, pressure variation based

Smart Metering: Only in ABD area, but billing not started yet

SCADA: all WTPs upto distribution level. STPs have OCEMS.

Innovation: Smart water management by inter-zonal transfers of water as per demand. RF based signal transmission.

Increase in Water tarrif: from Rs.840 to Rs. 1500

THANJAVUR

NRW Reduction: from 22-24% to 8-10 %

Change in Service Area Coverage: 100% Water network and 75% Sewerage-network

Change in per capita water supply: None

Leakage Detection: Yes, pressure variation based

Smart Metering: None

SCADA: Partially in distribution network

SURAT

NRW Reduction: from 26% to 22%

Change in Service Area Coverage: 85% city connected with water network, and 99% city under sewerage network

Change in per capita water supply: from 180 lpcd to 200 lpcd

Leakage Detection: Yes, pressure variation based

Smart Metering: Only in ABD area, but follows spot billing mechanism

SCADA: all WTPs upto distribution level, all STPs

Innovation: Recycled water network to industries (Awarded)

SOLAPUR

NRW Reduction: from 42% to 8-9%

Change in Service Area Coverage: 85% city connected with water network, and 99% city under sewerage network

Change in per capita water supply: from 105 lpcd to 127 lpcd

Leakage Detection: Yes, pressure variation based

Smart Metering: Only in pilot area (1600 meters)

SCADA: all WTPs upto distribution level, all STPs

Innovation: Laying of parallel pipelines due to horizontal expansion of city.
Installation of solar panels in Soregaon WTP saved Rs.1.38 Cr annually in electricity bills

THOOTHUKUDI

NRW Reduction: from 20-22% to 10%

Change in Service Area Coverage: 24X7 water supply near to completion. whereas only 25% city covered under sewerage network.

Per capita water supply: 135 lpcd

Leakage Detection: Yes, pressure variation based

Smart Metering: 60% conventional meters coverage, manual billing.

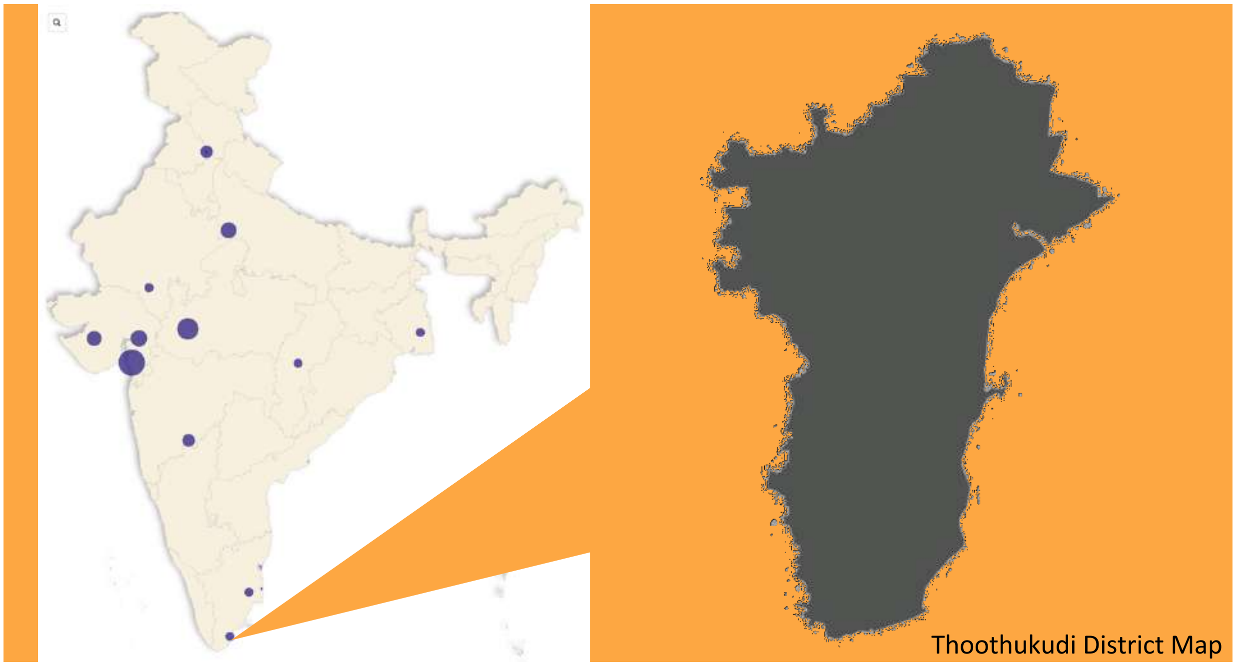
SCADA: WTP and STP, not integrated to ICCC.

Drawback: GSM based signal transmission failed during 2023 floods

Innovation: Urban Forest created and watered using treated STP water

5.3.1 Thoothukudi Smart City

A. Context Setting



S.No.	Description of Event	Responses
1	**Date of the Preliminary VC call**	**6th May,2024**
2	**Date of the Site Visit**	**29th May- 1st June,2024**
3	**Officers interacted**	• Sh. L. Madhubalan IAS, Commissioner Thoothukudi Municipal Corporation • Mr. Arivalagan, Team Leader, Thoothukudi Smart City • Mr. L.K. Baskar, City Engineer, Thoothukudi Municipal Corporation • Mr. M. Saravanan, Deputy City Engineer, In-Charge of ICCC, Thoothukudi Municipal Corporation • Mr. Prince Rajendran, Assistant Engineer, Thoothukudi Municipal Corporation • Rajesh Khanna, Data Operator, ICCC

B. Introduction

Thoothukudi, also known as Tuticorin, is a coastal city in Tamil Nadu state with a population of 400,739 as per the 2011 census. Port town situated in the Gulf of Mannar, experiences hot semi-arid climate characterized by sweltering summers, hot winters and occasional heavy rains during the North east monsoon. Notable flooding events occurred in November 2015 and December 2023, with water levels reaching up to 4 feet in some areas. Traditionally known as ‘Pearl city’ on account of prevailing Pearl fishing carried out in the town, the city has fascinating history dating back to 6^{th} century CE. It is a commercial seaport that serves the inland cities of southern India and is one of the sea gateways of Tamil Nadu.

Thoothukudi city corporation area is divided into four zones: North, South, East and West and 60 administrative wards. The functions of water supply, drainage and solid waste treatment are overlooking by the corporation along with six other departments. The city sources its water from the Thamarabarani River near Kaliyavoor in Tirunelveli district, approximately 40 km from the city center. Until 2011, only 21 MLD water was extracted from the river, which further increased to 65MLD in 2017 to cater the increasing population and rising water demand of this medium sized town. The corporation got 280 crores of JICA funding in 2014 that assisted in laying water pipelines, household connections, and most significantly

The city got its first water treatment plant having an ultimate treatment capacity of 84 MLD. A 60-feet diameter pipe at headworks (water source) was laid that extracts 65 MLD of water daily as on date. By adhering to water management strategies, city has managed to increase the per capita water supply from 105 lpcd in 2019 to 135 lpcd in 2024. The citizens get this supply 2 hours in the morning and 2 hours in the evening on rotation basis. Eventually, city officials are working on making the city 24X7 water secure city by July 2024.

The underground drainage system in the city was laid in 1984 and covered only certain zones of the corporation area until 2020. The remaining households depended on septic tanks and soak pits for disposal of sullage. In 2022-23, an extensive sewer network was laid covering 30,000 households and wastewater collected was treated at a 28 MLD STP based on Activated Sludge Process (ASP) technology. The remaining households are anticipated to be connected to the sewer network by 2024.

Water billing mechanism has been recently introduced in the city @Rs.15 per KL for residential, Rs 30 per KL for commercial and Rs.45 per KL for the bulk supply. However, sewerage revenue policy is still in process of approval by Tamil Nadu state.

C. ICT in Water Supply System

Thoothukudi city integrated the use of ICT in water supply, treatment and distribution network from 2017 onwards. The projects were conceptualized to lay water supply network throughout the city premises, replace the leaking pipelines, integrate SCADA system within existing Water Treatment plant, and installation of IoT devices that help in automation, monitoring and increase in efficiency of the existing water supply system at large.

ICT at water source:

- Intake well on Thamarabarani River near Kaliyavoor pumps 65 MLD water daily via 60 feet dia pipe through gradient.
- At the head works, the water is pumped from about 1m above the river bed and is installed with a level indicator that generates alert whenever the water column of the river goes less than 1.5m. Through this the water pumping is controlled and further helps in maintaining the health of water pumps, which might impact in case of less availability of water in the river.
- The headworks has 4 pumps, 2 working 2 standby that continuously (24X7 for 365 days) extract the water and pump it to the WTP. Other IoT devices installed here include actuators, electromagnetic flowmeter and PLC panel for automation. All these devices got linked to SCADA in 2022.

Figure 26: IoT devices and SCADA system at Kaliuyavoor Treatment Plant, Source: Authors

D. ICT at Water Treatment Plant:

- The WTP at Kaliyvoor is designed for treating ultimate capacity of 84 MLD (considering demand upto 2040), however currently only 65 MLD is extracted and treated for supply within Thoothukudi city boundaries @135lpcd per capita water demand.
- The cascading aerator at the start point, pushing water 3m above the ground level helps in supplying water on gradient without pumping to the rest of the treatment modules within the WTP.
- This WTP has all SCADA controls and is designed for automatic operations using The WTP consumes approx. 2.2 MW electricity generating 8 lakhs rupees electricity bill on monthly basis. Therefore, another project of installation of solar panels with cumulative capacity of 2MW was proposed in 2022 which is nearing to completion.
- PLC panels and actuator control valves for alum dosing, water quality parameters monitoring (pH and turbidity) at multiple stages, backwash alert, level indication, and flow and pressure measurement at both inlet and outlet. However, as on date WTP is functioning on manual mode with manpower employment of 20 people. This lagging is observed due to following reasons:
    a) Non-acceptance of automation within the municipal corporation system
    b) On-going works in DMAs for 24X7 water supply
- SCADA room here at WTP is used to monitor the overall functioning of water services, flow and pressure with which water is supplied, quantum of water supplied, quality parameters of the water at various stages and any variation from the standardized set-up if observed. A web portal is created for the internal team of engineers for monitoring the works continuously form their respective mobiles and computers. The generated alerts observed by SCADA operator are communicated to the concerned officials manually. The automatic system of alert notification is not enabled in the system. This SCADA system is further integrated to ICCC for monitoring only. No operations are controlled from ICCC room currently. However, operations can be controlled from SCADA room

Figure 27: Visit to WTP by NIUA team (left), Level Sensor (Middle), Acctuator Panel (Right)

Figure 28: Cascading Aeration (left), turbidity sensor and pH sensor (middle), Flowmeter and pressure transmitter (right)

E. ICT at Water Distribution Network:

- From WTP at Kaliyavoor, water is supplied by gradient to 30 elevated surface reservoirs (ELSR)/ Overhead tanks in HDPE piped network laid underground. 3 numbers pressure monitoring stations from WTP to city supply network have been created to monitor water pressure and flow quantum on a PLC panel. No functions are controlled from these monitoring stations, and are used for monitoring purpose only. This monitoring helps in detection of leakages and variation in pressure of water supply within the network.
- All flowmeters and pressure transmitters used are GSM based devices that transmit reading every 15 minutes on the SCADA monitor. No reading is received in case signal is lost.
- The city has been divided into 31 DMA zones (district metered areas) for water supply on the basis of zone of supply of each ELSR. Each DMA caters to approx. 1000-1500 households

supplying 135 lpcd ideally. (Not able to measure exact numbers because of work in progress in DMAs)

- Each ELSR is installed with flowmeter, pressure transmitter, flow control valve, actuator, level indicator, GSM modem and PLC panel with HMI unit collecting data for
  both inlet and outlet. Additionally, each ELSR is equipped with solar panel and batteries generating electricity that is further connected to the main grid. A minimum of 1.5m level is maintained in ELSR at all times. Any variation in levels beyond the maximum (4.7m) and minimum (1.5m) limit generates an alert in the system.
- A total of 98,462 household connections out of approx. 1,10,000 household connections in the city have been installed with AMR meters and the quarterly billing cycle has been initiated. Remaining 10% meters installation is in progress and anticipated to be complete by July,2024.
- The billing mechanism for water supply is manual, and chargeable at Rs.15 per KL for residential users, at Rs30 per KL for commercial users and at Rs.45 per KL for bulk users. The annual revenue of Municipal corporation is anticipated to increase with this billing system in place. Considering the limited funding avenues and huge cost of O&M for smart meters, conventional AMR meters were preferred for households.
- Within a DMA, pressure transmitter and flowmeter are being installed at multiple locations to check pressure and quantum of the supply.

Figure 29: ELSR (left), FLowmeter and pressure transmitter (middle), Acctuator (RIght)

Figure 30: Solar battery panel (left), PLC panel with HMI (Closed pic-middle, open pic-Right

F. Impact of ICT in Water Supply System/Services

- NRW reduction from 20% in 2019 to 14% in 2022, further envisioning <10% in 2024 with completion of ongoing projects.
- Laying of Water supply lines on gradient, closure of public fountains and tapping of slums helped in minimizing water losses.
- Solar panels installation at WTP to reduce energy bills.
- Response time reduced to immediate redressal with SCADA monitoring.
- Change in per capita water supply from 105 lpcd in 2019 to 135 lpcd (intermittent supply) in 2022 and 135 lpcd (24X7 supply) in 2024.
- Enhanced consumer grievance redressal mechanism.

G. ICT in Sewerage Services

Thoothukudi city got its underground drainage system partially laid in 2014, while the rest is still in process of getting sewered by using INR 120 Crores of funding from Smart City Mission from 2022 onwards. This includes laying of pumping mains, pumping stations, 3 no. Sewage Pumping Station (SPS) and internal plumbing of 23,405 household sewer connections. The city has a total of 43,405 household sewer connections, including the ones done in previous schemes. The remaining system of sullage disposal is

through ring wells, septic tanks and open drains. The decanting of septic tanks is done by corporation tankers and the sullage is discharged in sludge handling unit at STP. No specific IoT devices, sensors or other kind of ICT has been applied at any level of sewerage service network within the city. However, 10 zones of sewer collection have been created based on physiography of the city, connected to 11 collections wells (one in each zone) that further pump the sewage to the STP.

The city got its first STP of 28 MLD design capacity based on ASP technology. The plant is integrated with SCADA system and is designed for complete automation. However, due to the under-utilization (8MLD sewage currently received and treated at the STP) of the STP, the plant is operated on manual mode. This lag is owed to the incomplete sewer network and house sewer connections (HSC).

- SCADA system is utilized only for monitoring of water quality data as per the state pollution control board norms. All valves are operated manually and no PLC panel has been installed for on-spot reading of quality parameters at primary and secondary levels of treatment.
- The effluent is claimed for BOD<10, TSS <10, COD<10. Treated water is reused in 150 acres of urban forest created by the municipal corporation.
- Sewerage charges policy is in process of approval at state level. Therefore, no sewer charges are applied currently.
- 9 number e- toilets were constructed using SCM funding. Three- toilets have been installed with sensors to indicate the number of users and the gender of each user with data integrated in form of assessment report with ICCC.
- Online Continuous Effluent Monitoring System (OCEMS) will be implemented in the next phase of the project.
- Alerts generated are not categorized on the basis of priority, which leads to delay in response time due to manual intervention.

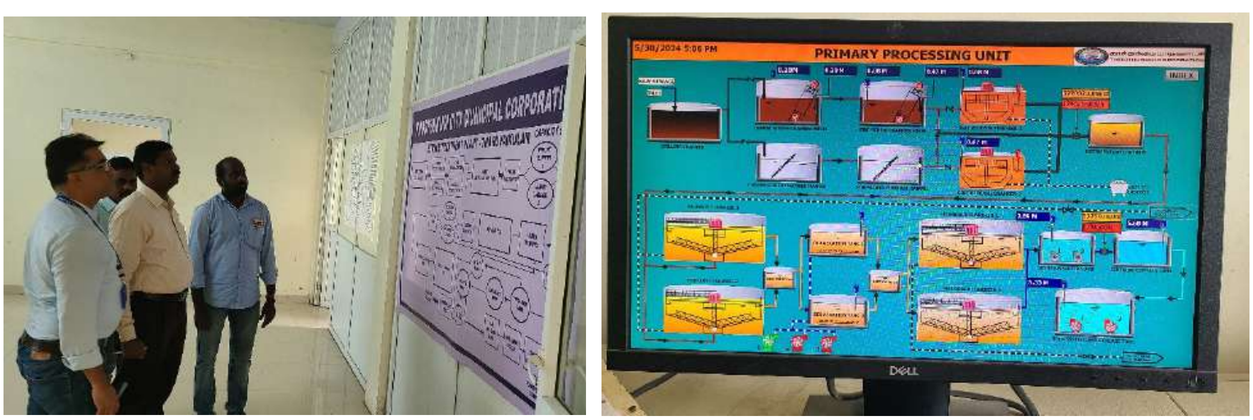


Figure 31: Inspection of STP SCADA by NIUA team (left), SCADA monitor screenshot (right)

Figure 32: Control Valve (left), Level Sensor (middle), PLC panel (right)

H. Impact of ICT on Sewerage System/Services

- Sewer network coverage increased to 86% resulting in prevention of sewage disposal into the ocean.
- 8MLD Treated used water used to create 150 acres urban forest in the city. Further, the reuse of treated water on full utilization of STP capacity is planned for industrial use, and a MoU with shipping and port industries is in process.

Figure 33: Dashboard for Impact of Water and Sanitation developed by SCM team, Source: Amplifi portal

I. Challenges in application of ICT in Water Supply and Sewerage services

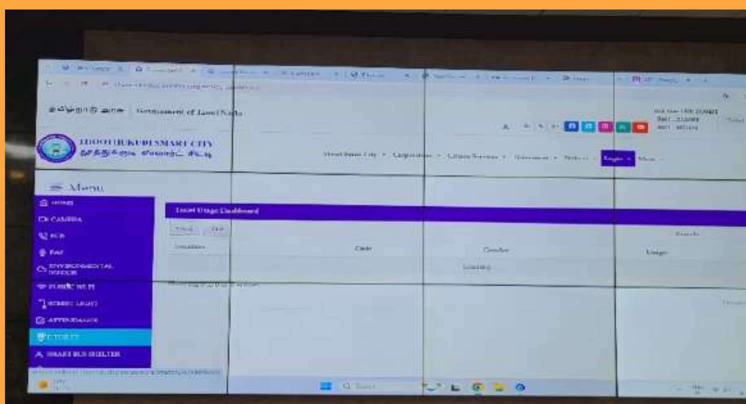
- The major focus in medium and small-town cities like Thoothukudi is laid onto the development of infrastructure with the limited funding that they can capture from the centrally funded schemes. Thereby, limiting the scope of inculcating technological advancements within the system. Thoothukudi smart city focused on developing water and sewerage network coverage and therefore automation at every step took a backseat.

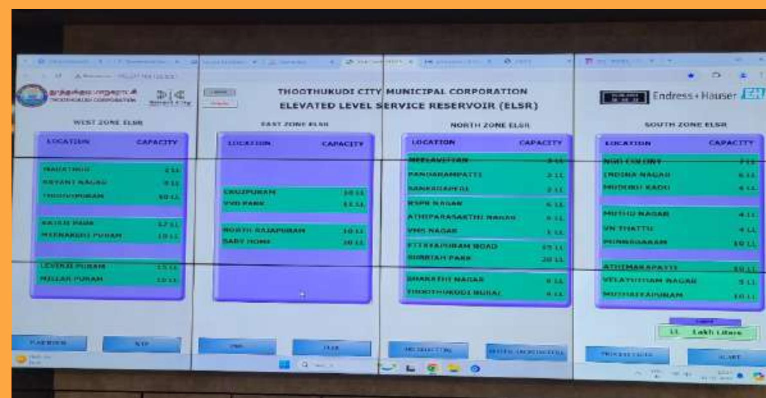
- Capacity building of officers was found as a challenge in making choice for implementing best technology out of the basket of technological solutions available.
- Access to technical experts is there, but inter-departmental coordination at administrative level is considered a big challenge.

J. Recommendations

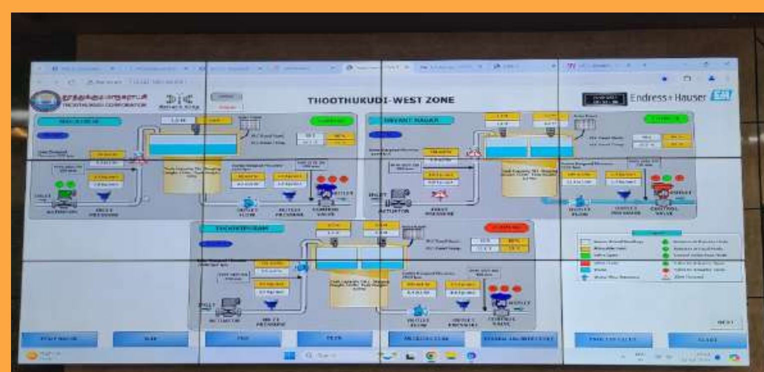
- The Integration of different web portals, apps and SACADA portal created should be given a standardized mandate at central level.
- Technical monitoring is suggested to happen at SCM central team to ensure seriousness of actual implementation. Example: Many times, tweaked reports are shared/ presented by local officials.
- A common interface API should be specified as per town size categorization so that all towns using same technology, and parity is achieved at national level.
- Capacity building of officers at state level is suggested.
- Administrative set up to be designed for smooth inter-departmental approvals and coordination of overlapping projects.


AUXILIARY ROOM




THOOTHUKUDI CITY MUNICIPAL CORPORATION
ELEVATED LEVEL SERVICE RESERVOIR (ELSR)
Endress+Hauser

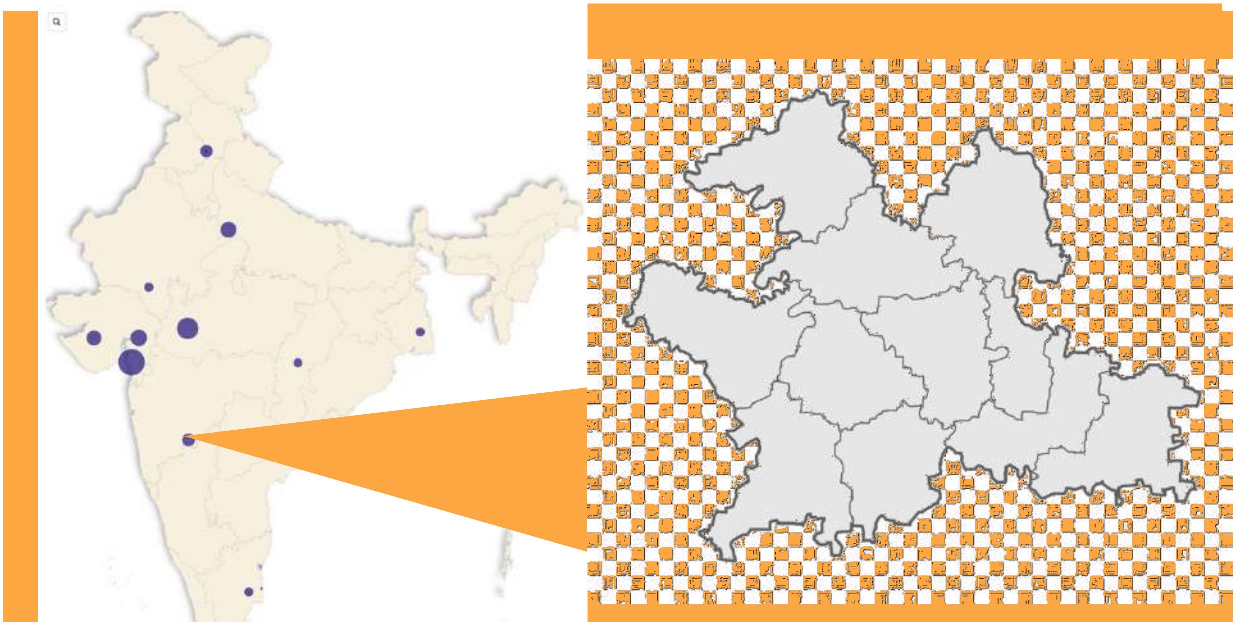

WTP ALARM
Endress+Hauser


THOOTHUKUDI-WEST ZONE
Endress+Hauser


THOOTHUKUDI
SMART CITY LTD

5.3.2 Solapur Smart City

A. Context Setting:



Solapur District Map

S.No.	Description of Event	Responses
1	**Date of the Preliminary VC call**	**12h April, 2024**
2	**Date of the Site Visit**	**22nd April- 25th April,2024**
3	**Officers interacted**	• Sh.Sandip Bhimashankar Karanje, Addl. Commissioner Solapur Municipal Corporation • Chief Technical Officer (CTO), Solapur Smart City • City Engineer (Water), Solapur Municipal Corporation • City Engineer (Drainage), Solapur Municipal Corporation • Omar Farooque, Executive Engineer, (water), Solapur Municipal Corporation

B. Introduction:

Solapur is a city located in the southwestern region of the Indian state of Maharashtra. It is known for its rich cultural heritage, historical significance, and industrial activities. Historically, Solapur has been an important center for textile manufacturing, particularly for its famous Solapur chadars and towels. The city serves as the administrative headquarters of the Solapur district and is a key trade and transport hub, benefiting from its strategic location on major road and rail networks.

The Solapur Municipal Corporation (SMC) is the primary local governing body responsible for the administration and management of civic amenities, including water supply and sewerage services within the city. The city's water supply primarily comes from the Ujjaini Dam, which is located on the Bhima River. The dam provides a significant portion of the water needed to meet the city's domestic, industrial, and agricultural demands.

C. ICT in Water Supply System:

City has a current population of 10,88,000 (as of 2024) and the total water supply is 180 MLD as informed by the SMC officials. City’s tap water coverage is more than 95% and frequency of water supply is once in 3-4 days. SCADA system was installed in the city in August 2024 and it was fully funded under Smart Cities Mission. Solapur is one of the few cities which has implemented ICT technologies in their water distribution system.

D. ICT at water source:

- There are 3 major water sources of the city i.e., 75 MLD from Ajni Dam, 110 MLD from Takadi intake well and 27 MLD from Hipar ka Talab. Flow meters and pressure transmitters have been installed at the source in order to measure the flow rate and pressure and it is also linked with central SCADA system.
- For the pumping of freshwater, city received the funding of 12 crore under AMRUT in 2018. Under this, new and energy efficient pumps were installed.
- All the operations at the pumping station has been automated:
- Value controllers, flow meters at inlet and outlet, pressure transmitter, sludge valve actuator and level regulators has been installed and linked at the local SCADA control.
- Solar panels have been installed at water head works for electricity bill saving.

E. ICT at Water Treatment Plant:

3 water treatment plants in the city are currently linked with central SCADA system:

- Bhavani Peth WTP – It is a 27 MLD plant and is linked with SCADA system. Water quality sensors for pH, chlorination and turbidity have been installed for continuous and efficient monitoring.
- Pakani WTP – Flow monitoring at the inlet and outlet is done at this 80 MLD WTP.
- Soregaon WTP – 108 MLD WTP where flow monitoring of inlet and outlet is done. Also, solar panels have been installed at this WTP which has resulted in saving of approx. INR 4 Crores in energy bills.

Bhavani Peth WTP:

- Flow meter has been installed at the inlet for intake monitoring.
- Before the filtration process, pH and turbidity sensors has been installed.
- Post this, level base sensors and actuators has been installed.
- pH and turbidity sensors again at the sump outlet have been installed.
- All the pumps at this plant are automated and linked with the SCADA.

F. ICT at Distribution Network:

There are 23 DMAs under the ABD area. GIS based mapping of the complete water supply system of the city has also been done.

- 603 flow meters has been installed at the valves in the water supply distribution network which helps in the flow analysis and leakage monitoring. This covers 60-70% of the city's distribution network. This is also linked with the ICCC.
- 1500 meters have been installed in the ABD area but due to lack of policy in place, fixed charges are applied currently:
    - 2,756 INR per year - for residential units
    - 11,000 INR per year - for commercial units
- Citizens are informed through text messages in case of any disturbance in the water supply.

G. Impact of ICT on Water Supply System/Services

- Post implementation of SCADA the city has been made tanker free.
- Quality of the supplied water is observed to be improved due to regular quality monitoring.
- With the continuous monitoring of water flow and pressures, the water lost due to leakages has been reduced from 42% to 9%.

- Earlier the water distribution was such that less water was supplied to the extended areas whereas post SCADA and implementation of smart water tools, there has been an equal distribution of water throughout the city.
- With the installation of actuators and automation of the complete system at the WTP site, manpower requirement has been reduced to only 4-5 persons (1/3rd of the earlier requirement).
- City plans to install the technology for leakage detection and installation of AMR meters across the city in the next phase.

Figure 35:Monitoring of Flow and Pressure at Ujjaini Water Source

H. ICT in Sewerage System/Services

The city is currently generating 144 MLD of sewage and there are 3 functioning sewerage treatment plants in the city i.e., 75 MLD Deogarh STP, 50 MLD STP and 12.5 MLD STP. All these 3 plants have local SCADA whereas integration of these with ICCC is currently in process.

- GIS mapping has been done for the complete sewerage system of the city.
- No sewage pumping station are there in the city currently. The sewerage flows through gravity.
- At Deogarh STP:
    - Actuator for automatic valve operation and flow meters (ultrasonic flow meters) has been installed at the plant's inlet and outlet.
    - Screening of waste is automated but it is not yet linked with SCADA system.
    - Operations of drought tube mixers has been linked with SCADA for switching on/off/standby operations.
    - Aeration process in the anaerobic digester has been automated.
    - Wall actuators has been installed for automation of the SBR basins.
    - DO sensors has also been installed
    - SBR basin levels are also monitored through SCADA.
    - Solar power plant has been installed at Deogarh STP which supplies 50-60% of electricity and has significantly reduced electricity bill from 21 lakhs to 12-13 lakhs.
    - Methane gas generated at the STP is used for electricity generation. 9000 units of electricity is generated per month from methane during summers months which contributes to the saving of 70000 – 80000 INR per month.
    - Treated wastewater is used for the cooling in the SBR process.
    - 50-60% of the treated wastewater is being reused in irrigation.
- 80% of the city has been covered under sewerage system whereas 20% is using septic tanks. Request for Vehicle for emptying of the Septic Tank - can be made through the SMC website.
- City is also using robotic devices for drain desilting and cleaning but this is not funded under SCM.

I. Impact of ICT in Sewerage System/Services

Service Quality improvement: Monitoring of flow, quality of effluent from STP, and reuse of treated used water indicates the improved service quality of the overall sewerage systems. Innovative approaches for electricity generation at the STP through methane and solar has significantly reduced the electricity bills cost for operation of the plant.

J. Challenges:

- Adoption of new technologies is one of the major challenges for the city as informed by the site staff.

- As technologies changes every 10 years, there is a challenge of adoption of new technologies due to lack of regular funding mechanism.

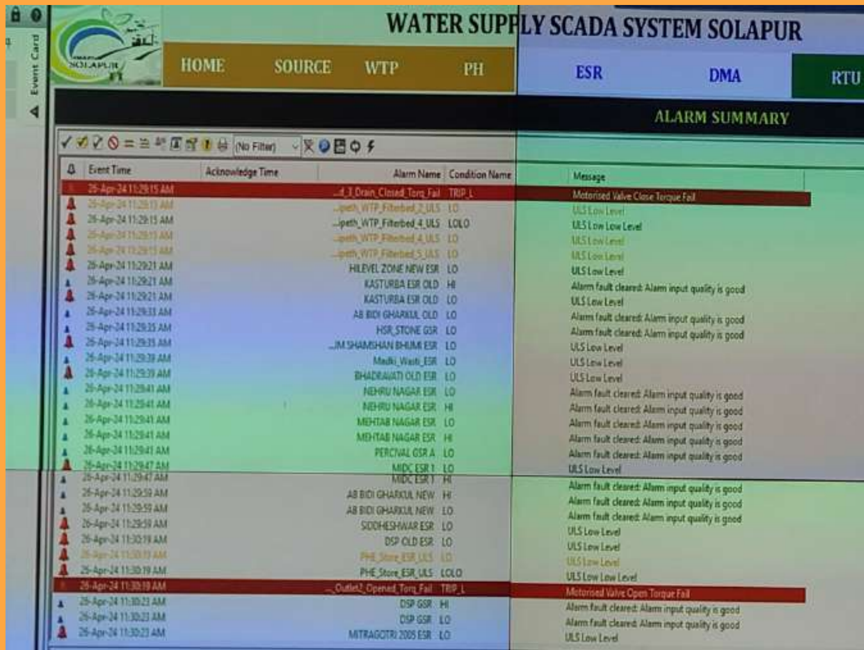
K. Recommendations:

As per the municipal corporation officials, the mission guidelines are very restrictive.

- Guidelines should be developed as per the demographics, geography of the city and not general for all cities.
- 24x7 water supply model is not successful in all the regions, especially in water scarce region like Solapur.
- Formation of Special Purpose Vehicle (SPV) should have been provided under the mission.
- Involvement of women in water and sewerage management should be promoted under the mission.
- Priority should be given to the undeveloped region of the city.
- Compulsory training programmes should be organized for the government officials and other administrative as well as elected members.

Figure 36: Ultrasonic Flowmeter reading (keft), Turbidity and pH sensor at WTP (right)

The projects aimed at improving its water and sewerage services. By integrating advanced technologies, upgrading infrastructure, and engaging the community, these initiatives are enhancing the efficiency, reliability, and sustainability of the city's water management systems.


WATER SUPPLY SCADA SYSTEM SOLAPUR
HOME
SOURCE
WTP
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ESR
DMA
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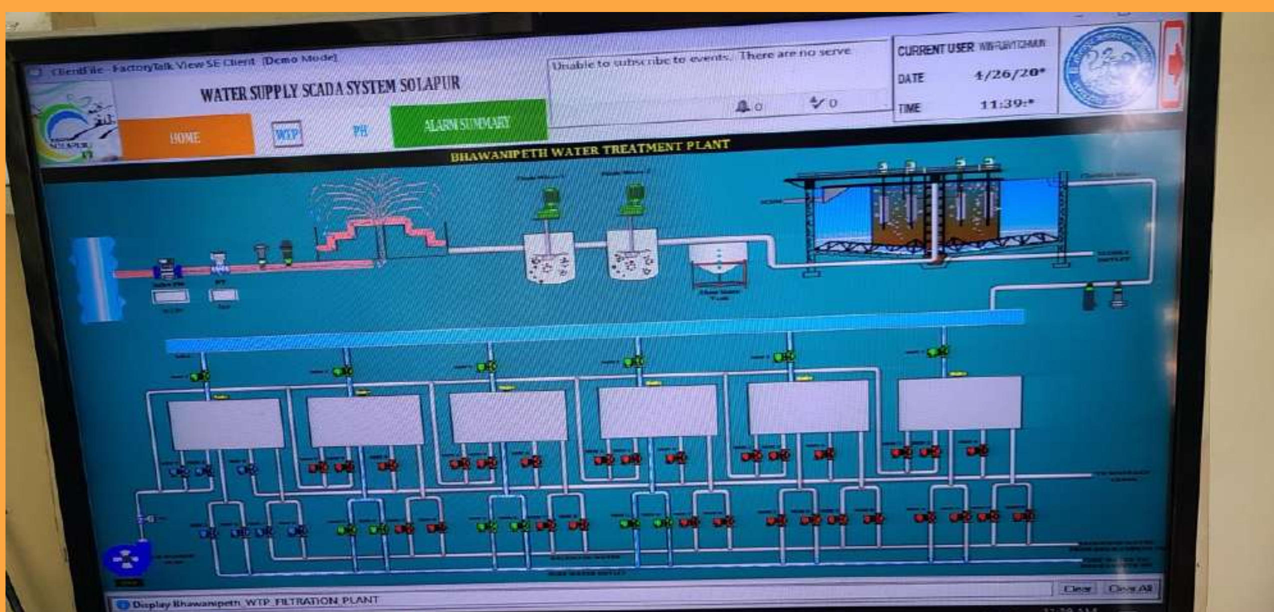
ALARM SUMMARY
Event Time
Acknowledge Time
Alarm Name
Condition Name
Message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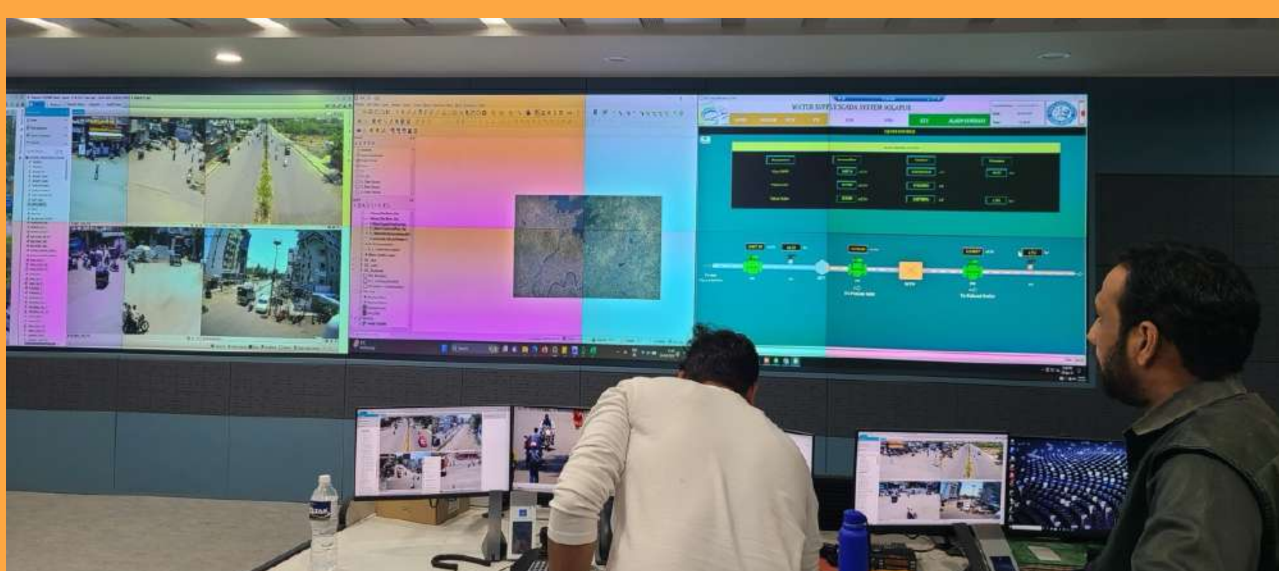
BHAWANIPETH WATER TREATMENT PLANT


5.3.3 Agra Smart City

A. Context Setting:

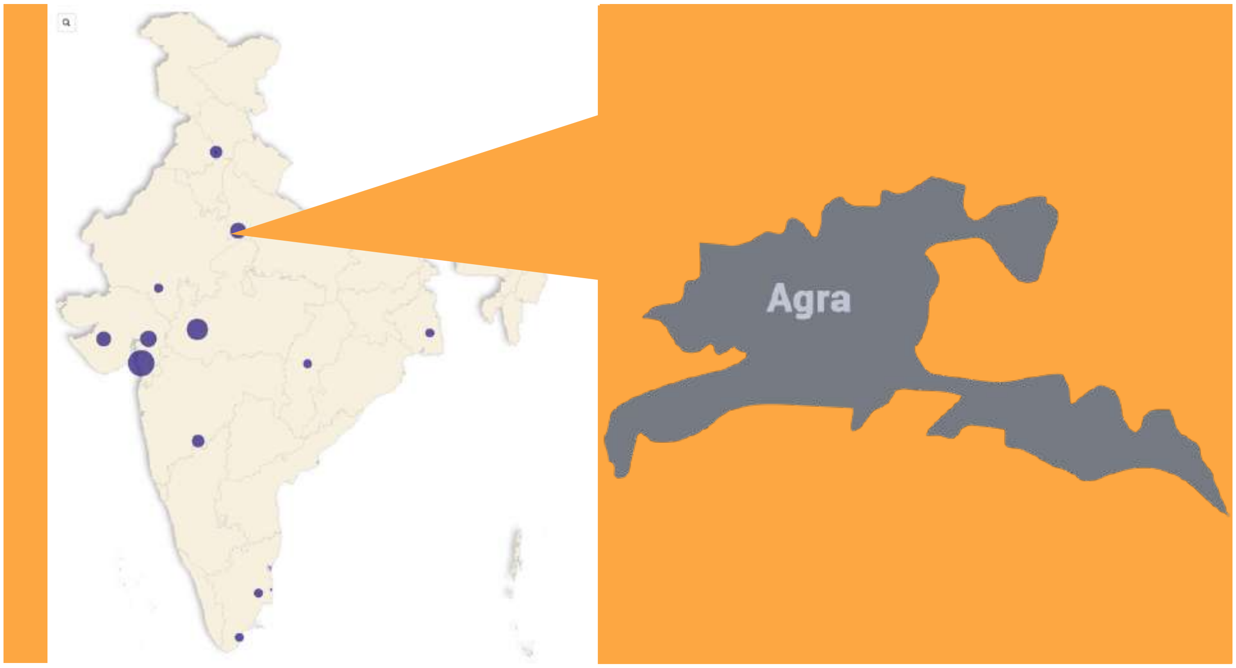


Figure 37: Agra District map

S.No.	Description of Event	Responses
1	Date of the Preliminary VC call	17th May,2024
2	Date of the Site Visit	27th May,2024
3	Officers interacted	• Sh. Arun Kumar, General manager, Agra Smart City Limited • Anand Menon, Team leader, Agra Smart City • Sourabh, Chief Data officer, SCADA, Agra Smart City • Manoj Kumar, Assistant Engineer, Agra Municipal Corporation • Amit Kumar, Junior Engineer, Agra Municipal Corporation

B. Introduction

Agra, located in the northern state of Uttar Pradesh, India, is a city of immense historical and cultural significance. Renowned globally for the iconic Taj Mahal, Agra attracts millions of tourists each year. It is part of the Agra Metropolitan Region and serves as an important economic hub with industries ranging from tourism to leather manufacturing.

The water supply system in Agra is primarily managed by the Agra Municipal Corporation (AMC) in coordination with other governmental bodies. The Yamuna River is the main source of water for the city, supplemented by groundwater and other minor sources.

Agra's water and sewerage systems suffer from aging pipelines and facilities that are prone to leaks and failures. Upgradation of infrastructure and integration of ICT technologies into Agra's water and sewerage systems is essential to address the city's current challenges and future needs.

Under the smart city mission, Integrated Command and Control Centre (ICCC) was established in Agra city. Along with this, IoT sensors and devices for smart water management, upgradation of STPs etc. was done for to enhance service delivery and efficiency. In Agra, all the infrastructure and technologies upgradation for water and sewerage was done within the ABD area. All the data provided below is for Agra's ABD area.

C. ICT in Water Supply System

The Jal Kal department provides treated water to Agra Smart City for the ABD area, which then pumps and distributes it to the end users. Since the water is pre-treated, Agra Smart City does not carry out any further treatment. With a population of 24,22,000, the city has an estimated water demand of 18-20 MLD. However, during the summer, only 5-8 MLD of the allocated supply is received due to shortages, while in the winter, the supply increases to 17-18 MLD. The shortfall is made up by residents using private boreholes.

D. ICT at Water Source:

- There is 1 Central Water Reservoir (CWR) at Geoni Mandi with a capacity of 20 MLD. Water to the ABD area is supplied from this CWR.
  - pH indicator, ULT indicator, flow meters, actuators valve and pressure transmitters has been installed at the CWR.
  - All the operations have been automated which has reduced the manpower requirement of the plant to 4 persons.
  - There is no alarm system present as of now.
- Another CWR is at Mugal Pulia which has a capacity of 1 MLD.

- pH indicator, ULT indicator, flow meters, actuators valve and pressure transmitters has been installed here.

E. At Pumping Stations:

- All the operations have been automated and linked with SCADA system.

F. At Distribution Network

- 34 flowmeters have been installed as per the DMAs. This is not linked to the SCADA system but its linked with the smart city app used by the operators and concerned officials.
- Staging height of OHTs in the city is kept 25 meters for better pressured water supply.
- There are mobile based applications such as *Mera Agra App* for grievance redressal and feedback from citizens.

G. Impact (Assessment (Water Supply)

- Post application of smart water technologies non-revenue water of the city is reduced from 5% to 3-4%.
- System operators can now manage hundreds of assets without actually going to each asset location. Integration of ICT enables system operators to remotely monitor measurements. Examples include: pressures, tank levels, flow rates, power usage etc.
- With the installation of IoT devices and other smart tools and systems, city is able to better manage its water more efficiently within the ABD area.
- Improvement in the efficiency of the system and response time in case of any fault.

H. ICT in Sewerage System

- In Agra, STPs has not been connected with any ICT devices as of now.
- Under the Agra Smart City mission, vacuum sewer network system technology has been implemented in Tajganj area as it is a highly dense and low-lying area. 500 houses in this area are connected with the vacuum sewerage system. Capacity of the system is 0.61 MLD.
  - All the sewage from the Tajganj area is collected using the vacuum sewer network and is conveyed to the Dhandupura STP.
  - There are vacuum sensors and level sensors installed that works on automation.
  - Alert/alarm system is also available in case of any leakage or during electricity or voltage problem.
  - Mail or text goes to the ICCC in case of any alert/alarm.
  - Under the mission, sewer network lines were laid in the ABD area.

- 9 automatic smart toilets have been installed in the city which are also linked with ICCC. All the cleaning and functioning of the toilets is automated.

pH Sensors Reading at the CWR

Smart Water Meters Damaged by Users

Vacuum Sewer System in Tajganj area of Agra

Automatic Smart Toilets System

I. ICT impact on Sewerage System/Services

- With the installation of vacuum pumping system, all the sewage from the low-lying area which used to get accumulated and becomes a problem during water logging and flooding, is now diverted to the sewer network.

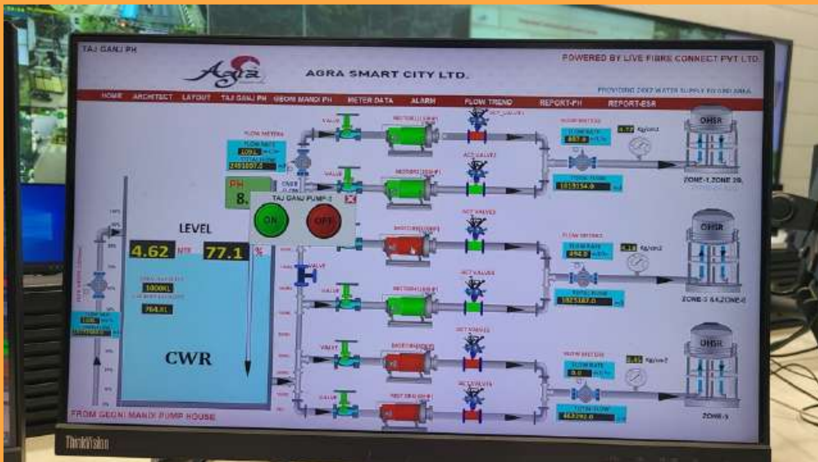
J. Challenges

- Agra Municipal Corporation does not have any control on the quality of water being supplied to the city. Jal Kal is responsible for the water treatment and hence any issues pertaining to the same has to be reported to Jal Kal only.
- Cooperation from all the line departments is a major challenge faced by the city as informed by Smart City officials.
- 17,000 smart meters were installed in the ABD area. Due to theft and damage only 14,000 meters have left now. Theft is a major problem in the city.
- There is a major challenge of enforcement of water billing system among the public.
- There have been instances of theft of reading panels of flow meters.
- Another major problem that the city faced was hacking of data from the ICCC center and because of this, data sharing and some automated processes have been hindered.

K. Recommendations

- There should be a special purpose vehicle for the implementation of mission.
- Funds should be decided as per the size and area of the city and not same for all the cities.
- Works done in the Agra ABD area should be replicated in the other areas of the city as well.

Implementation of ICT technologies in the Agra ABD area has been successful in terms of improving the efficiency, response time towards any failure, easy management and operations. Whereas there are some major challenges related to hardware and data theft which hinders the functioning of the system.


AGRA SMART CITY LTD.
POWERED BY LIVE FIBRE CONNECT PVT LTD.
LEVEL
4.62
77.1
CWR
FROM GEONI MANDI PUMP HOUSE


SYNERG
TELEMATICS

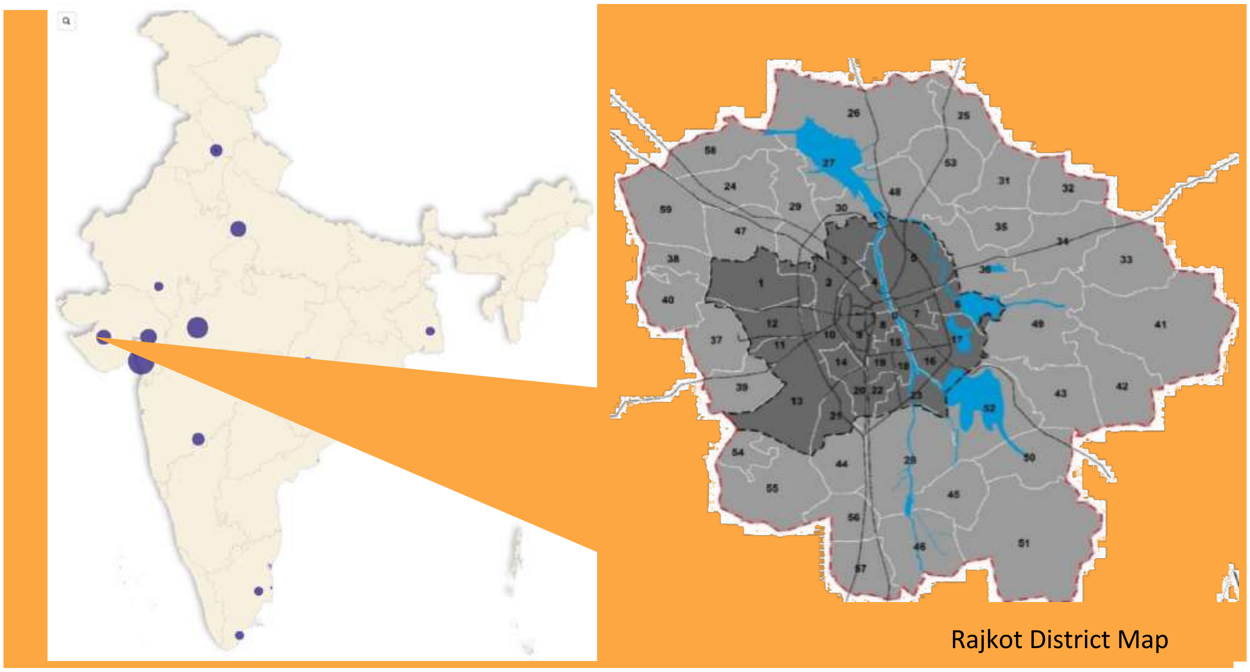

AUTOMATIC SMART TOILET
स्वचालित स्मार्ट शौचालय
Operated And Maintained By:-
Smart City
SICURO
TOILET
LADIES
शौचालय
महिला


ZONE-6
ZONE-2c
ZONE-3
ZONE-2a
ZONE-4
ZONE-2b
ZONE-5
TAJ MAHAL
3 Taj Signature Ho
ZONE-1
7 Mughal Heritage Museum Shilpgram Road Taj Nagri Phase-1
ZONE-2B -2000 KL
Amar Lok Colony Near Taj East Gate, Paktola 4
ZONE-6 -300KL
6 Nawada Bazaar
ZONE-3&4-4200 KL
1 Jalkal Land, Mughal Puliya
ZONE-5 -2500 KL OHT
1000KL -CWR
WATER PUMPING STATION

Figure 39: Screnshot of the Huge Security breach incident in ICCC data portal

5.3.4 Rajkot Smart City

A. Context Setting



Rajkot District Map

S.No.	Description of Event	Responses
1	**Date of the Preliminary VC call**	**1st April,2024**
2	**Date of the Site Visit**	**8-10th April,2024**
3	**Officers interacted**	• Assistant Commissioner Rajkot Municipal Corporation • Ms. Alpana Mitra, City Engineer, Rajkot Municipal Corporation • Y.K. Goswami, Rajkot Smart City • Mr. Kishore, Deputy City Engineer • Amit Shah, Assistant Engineer, Rajkot Municipal Corporation • Data Operator, ICCC

B. Introduction

Rajkot is the fourth largest city in the Indian state of Gujarat after Ahmedabad, Vadodara and Surat, and is in the centre of Saurashtra region of Gujarat. As of Census of India, 2011 Rajkot was a large town with population of 13,90,640, but in the last decade it is now the 35th largest metropolitan with population crossing 2 million. It has been awarded as the 6th cleanest city and 7th fastest growing city in the nation as of March,2021 (Source: Wikipedia).

The city involves development of a Green Field Area covering approximately 930 acres of land with an estimated project cost of Rs 2100 cr. The project is envisaged to have world class, Smart physical infrastructure with utilities that are environment friendly, sustainable, functionally smart and technology driven.

Water supply in the city happens through 122000 tap connections, 2100 stand posts and 550 tankers. After all the interventions since 2014, Rajkot has four water sources as on date: Aji Dam, Nyari Dam, Bhadar Dam and Narmada pipeline. A cumulative total of 400MLD is withdrawn from these sources, and post-filtration 375 MLD is used for supply within the city. This volume is sufficient to cater the population demand upto 2040. Currently with 18 lakhs population (2024 projection), the city demand stands on 270 MLD. RMC charges annually and bills are served category wise. The system of water charge bills is computerized and looked after by tax officer.

DMAs were created on the three existing zones of water supply: Central, West and east zone. Recently, a pilot project in west zone was implemented with 13000 meters in the greenfield ABD area, but the billing has not started yet due to minimal population staying in the zone.

The Rajkot city under-ground drainage project was conceptualized in 1981 and accepted for implementation by the World Bank. The project was delayed due to difficulties in excavation for laying the sewer network as well as other contractual problems. Phase-I is completed in all respect and 80,000 connections have been released so far. Sewage treatment plant with 44.5 MLD capacity and 7 pumping stations are under operation. The existing drainage network consists of 250 kms long network of collective system, 7000 number of manholes and 7 intermediate pumping stations. The Phase-I project covers only 60 Sq. Kms. The population covered is 60% of the city.

Under smart city mission, only SCADA interlinking with ICCC has been done. The city had implemented the SCDA in 2014-15 under Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojna (SJMMVY) scheme for both water supply and sewerage system.

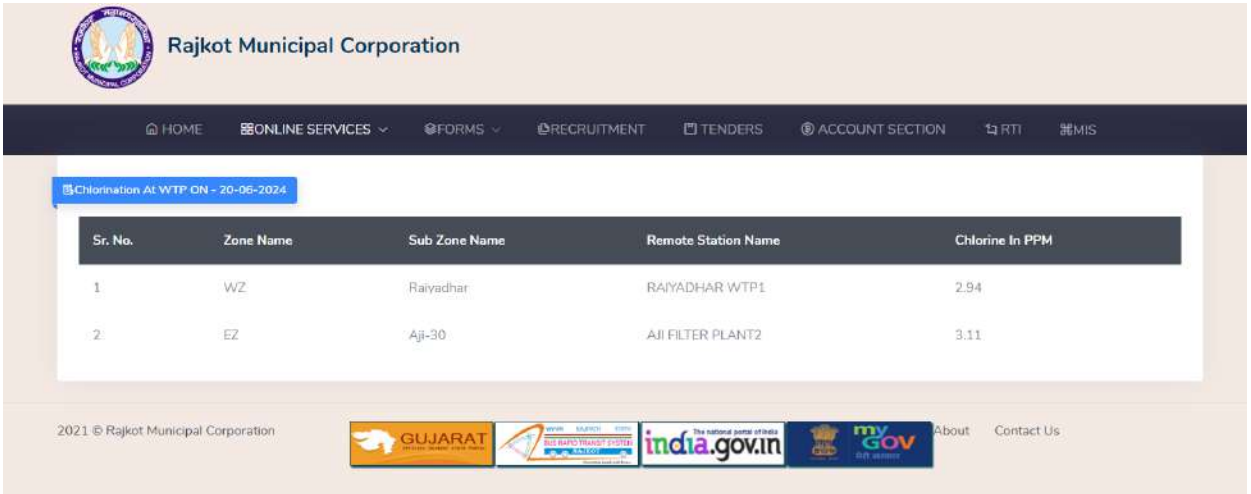


Figure 40: STP and WTP information on Rajkot Municipal Corporation website

C. ICT in Water Supply System/Services

Rajkot city integrated the use of ICT in water supply, treatment and distribution network from 2014 onwards under the funding from SJMMSVY. The projects were conceptualized to lay water supply network throughout the city premises, replace the leaking pipelines, integrate SCADA system within existing Water Treatment plant, and installation of IoT devices that help in automation, monitoring and increase in efficiency of the existing water supply system at large.

D. ICT in Water Source

- All four water sources and pumping stations have been installed with VHF (very high frequency) based flow sensors that reflect the reading in SCADA room at municipal corporation building. The VHF system enables data transmission even in case of loss of signals or network failure, making the technology disaster resilient.
- The installation of devices happened under SJMMSVY funding in 2014-15, but have now been integrated with ICCC under SCM funding in phase 4 of the project.

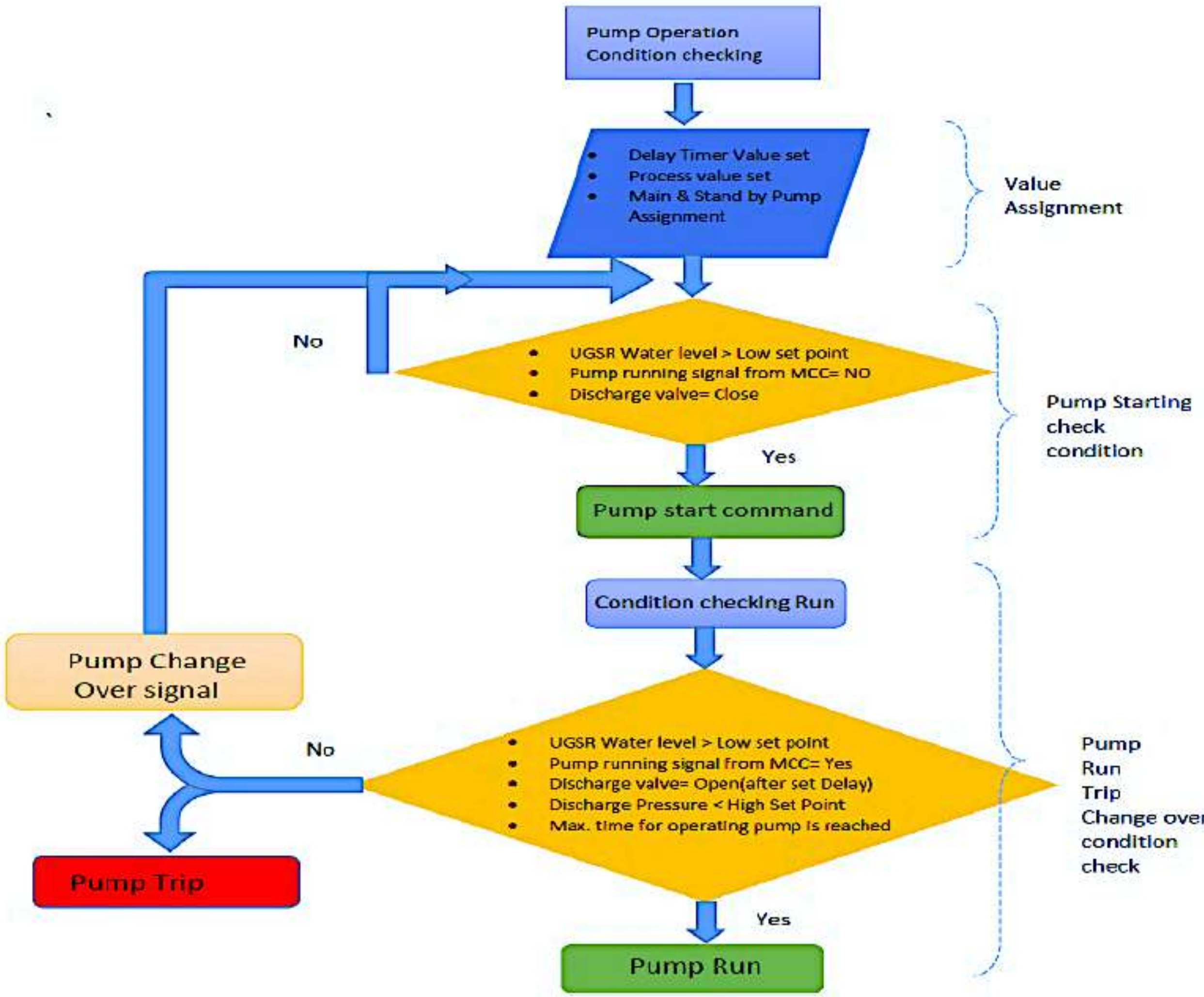


Figure 41: Typical operation flow and automation settings for Pump, Source: Rajkot Smart city officials

E. ICT at Water Treatment Plant:

- There are a total of 7 WTPs within the city catering to all 14 wards and the newly included parts of the city. Out of these 7 WTPs, only 2 newly constructed WTPs have SCADA controls, and remaining 5 have been functioning on manual mode as on date.
- The 2 WTPs that have SCADA controls, are Raiyadhar WTP and Railnagar WTP with 50MLD capacity each. IOT devices installed at these WTP include: Level indicator, flow meter, pressure transmitter and Chlorine sensor at both inlet and outlet.
- Both WTPs have local SCADA rooms, and an additional master SCADA control panel at Municipal corporation building, which was recently integrated to ICCC.

F. **ICT at Distribution Network**

- There are total 26 headworks / OHTs distributing water to all 18 wards in the city. Out of these 26, only 2 have SCADA controls whereas remaining 24 OHTs have no SCADA controls. However, flowmeters have been installed at all OHTs to measure the flow volume at inlet and outlet.
- DMA zonation of the city was done for smart water management and equitable distribution amongst citizens. All of the DMAs are connected via flow control valves operated manually for inter-zonal transfers of water. All of these operations are integrated with SCADA, but are controlled manually to avoid mechanical failures.
- There is a total of 3,45,000 household connections. However, no flowmeters have been installed beyond OHT level in the distribution network. These households have conventional meters installed, and only 14,000 households in greenfield ABD area have Smart meters. However, metering for these smart meters is not operational as on date due to very less population in ABD area, and ongoing construction works.
- 932 acres of ABD area has been completely oriented to automation. However, there is negligible population residing in this area as on date.
- Each zone is supplied 20 minutes of water as per time table feeded into SCADA monitor, at the rate of 450-500 pressure of supply and 130 lpcd in a closed loop supply system to ensure tail-end pressured water supply.
- Total cost of production of water from start to end till distribution is Rs.9.25 per KL. 35% of the cost is recovered from water bills in residentials, remaining is tackled as a subsidiary by the corporation. Average household gets 1500-2000 rupees annual water bill.
- Commercials are charged at Rs. 3000 annually for the consumption.
-

G. **ICT at ICCC**

- ICCC integration with SCADA and other IoT devices happened in phase 4 of the development project utilizing SCM funding. Only 2 out of 7 WTP have been upgraded with SCADA. But flowmeters and pressure sensors at all stages have been interlinked for smart water management throughout the city.
- ICCC is only used for monitoring, and an alert mechanism has been created, which sends all notifications to engineers on their internal app, and on the connected email. The response time for each alert is dependent on the gravity of situation. Red Alerts indicate immediate action, yellow alerts indicate subtle urgency, and green / brown alerts are for 24-48 hours response time. Such prioritization is automatically created by the system, on the basis of pre-fed data.
- The city is monitoring and measuring following additional services at ICCC, like water logging and flooding hotspots, solid waste management hotspots, GPS tracking of the garbage vehicles.

- The mobile app for engineers and the municipal corporation website upgrade happened in 2015 under SJMMSVY funds.

H. Impact of ICT on Water Supply System / Services

- NRW reduction observed from 26% in 2015 to 22% in 2022. Remaining NRW is unaccountable as on date due to supply to government schools, hospitals, offices, etc.
- Leakage detection upto OHT level in distribution system has helped increasing per capita water supply in the city to 130 lpcd at 450-500 pressure in closed loop system.
- With SCADA integration with mobile apps to engineers, Response time has reduced to almost immediate redressal. Emails and alerts on phone can be checked from anywhere and everywhere.
- Integration of SCADA with ICCC fosters the action-oriented approach for bureaucracy to take immediate decisions in case of extreme disturbances, disasters or other un-foreseen circumstances specially with Very High frequency sensors that can work without signal also.
- Enhanced consumer services and grievance redressal.

ICT in Sewerage Services

I. ICT at Sewage Collection Network (sewer network):

No IOT devices have been installed in sewer network or at manholes and septic tanks in the city.

However, the sewer line in the upcoming greenfield ABD area has been laid integrated with SCADA system to detect overflow and leakages.

J. ICT at Sewage Treatment Plant:

- STP has the SCADA system integrated, but it is not further linked with ICCC.
- OCEMS has been installed for treated water coming from 56 MLD STP at ABD area. This STP gets wastewater from ABD area and the nearby 4 zones also.
- A 8MLD tertiary treatment plant was installed under SCM funding to supply water in the Sarovar lake created in ABD area. Remaining secondary level treated water is currently sent for irrigation to Aji -2 Dam area.
- The STP has been installed with sensors measuring COD, BOD, Chlorine, TSS, and DO at the final discharge point. Wastewater parameters are checked at inlet and outlet and integrated with SCADA system.

- 92% of the city is covered with sewer network (17 lakh population approx.) and remaining 8% is still functioning with septic tanks that are regularly decanted by corporation.

K. Challenges and Suggestions:

- Pressure transmitters were not installed at key locations along with flowmeters, because of limitation in funding under SJMMSVY. They are planned to be installed in next phase of the project.
- No Water auditing is done. Pump-efficiency audit is done after every 3 years to ensure efficiency of operations.
- Alternate solution suggested to completely omit OHT s in cities where physiographic conditions permit and inculcate a direct supply line t prevent head loss and water loss. This could save a lot of energy and water bills for distribution.

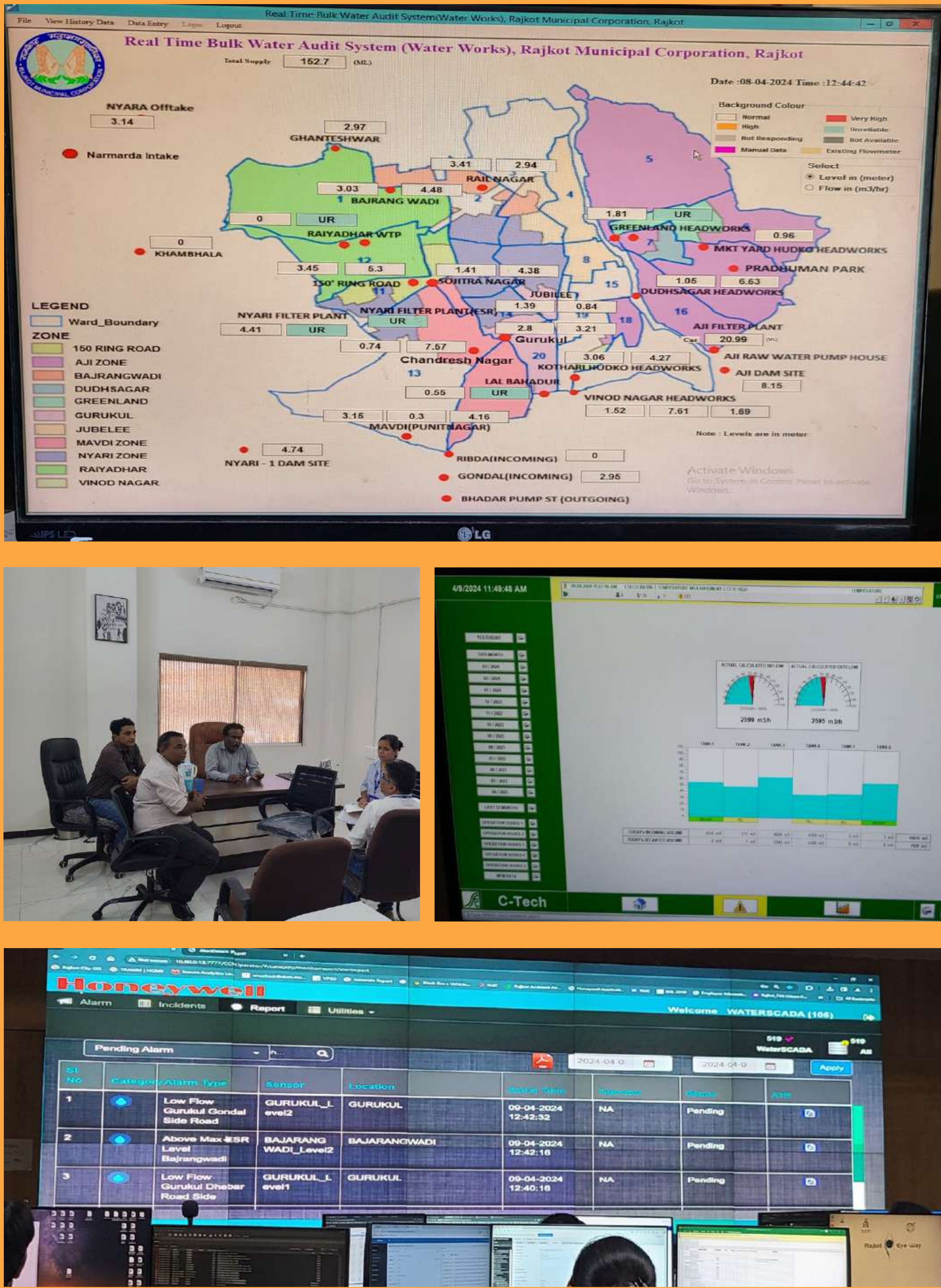


Figure 42: Alerts/ alarms generated on a specific day regarding water treatment plant in ICCC

6. Study Outcome and Conclusions

6.1 Critical Challenges

The cities while implementing the first of its kind technological additions faced several challenges. Each city had its unique experience of applying ICT solutions in water supply and sewerage services. For the ease of understanding we have categorized these challenges into four categories:

a) Integration with Existing Infrastructure:

- Many cities have outdated water and sewerage systems that are difficult to integrate with new technologies. Ensuring that new ICT solutions work seamlessly with existing systems and with each other can be challenging. Even if the cities try to integrate partly, the technological integration is not always possible, leading to isolated proposals and developments.

b) Data Management:

- Gathering accurate and comprehensive data from various sensors and devices is a technical gap. For example: Thoothukudi smart city when tries to integrate SCADA implemented in WTP during JICA project with ICCC, which got implemented years later under SCM; the server integration became a huge barrier. Either new compatible IoT devices needs to be installed or the data remains isolated.
- Processing large volumes of data to extract useful insights requires capacity building in the existing staff members.
- Protecting sensitive data from cyber threats and ensuring privacy is a huge threat to the cloud-based data-system.

c) Maintenance and Reliability:

- Ensuring that sensors and other IoT devices function correctly and consistently over time. The O&M of SCM projects is a limited period of 5 years, beyond which the cities need high capital to operate and maintain the system.
- Minimizing disruptions during maintenance or system upgrades to ensure continuous data reliability is important.

d) **High Capital Costs:**

- Significant upfront investment required for deploying ICT infrastructure, including sensors, networks, and data centers. Therefore, many cities limited their pilot projects to a specific area or specific type of projects. New funding sources need to be explored for commencement of remaining parts of the city, i.e. 100% city integration.

- Limited availability of public funds and challenges in securing private investments poses a challenge for scalability of the project.

e) Operational Costs:

- Ongoing costs for maintaining and upgrading technology involves financial and operational challenges in the process. Scalability of the projects require operation cost, scope of upgrading technology with time, and capacity building of the staff members for advancement in solutions and to operate the new systems.

f) Inter-Departmental Coordination:

- Such projects require convergence at various levels amongst various stakeholders. In Indian ULBs, this coordination is considered the most critical aspects because of overlap of authorities and no-man's land scenario in most of the decision-making points. Some projects require overlap of funding as well as team work which stalls the project into delays.
- Standard operating procedure for each department is different. Adhering to existing quality parameters check which adapting technological advancements is not widely accepted to all.

g) Community Engagement:

- Overcoming resistance from citizens and stakeholders who are accustomed to traditional systems. Example: Reuse of treated water has a psychological barrier in most of the communities.
- Such proposals and advancement of ICT in existing set up is a costly affair and not all ULBs can pursue with it without help from Central and state funding schemes. Example: Solapur was able to integrate SCADA upto distribution level because of funding assistance. However, they did not install smart meters due to 5X cost of each device.

6.2 Suggested Strategies:

These challenges require a range of strategies from general to specific. A few strategies suggested on the basis of the study are:

- Leveraging partnerships between governments and private companies to share costs and expertise. Though PPP is already a standard practice in ULBs, a detailed SOP on financial engagements and maintenance related initiatives need to be detailed. Exploring alternative financing models, such as green bonds or public-private investment funds might be required.

- At mission level, what happens to the SPVs (special purpose vehicles) that were created for smoother operations of the SCM needs to be decided with respect to who takes the responsibility of what sector and which projects.
- Involving community in the process of decision making might help in acceptance of the initiatives and advancements being undertaken by the cities. Strict regulations might be required in case of mandatory steps. Example: Indore's regulations of Swachchta mission.
- Flexible regulatory frameworks that can adopt new technological advancements after certain time period and changing conditions are required.
- Regulations could be segregated as mandatory and optional depending on the city size, type and actual requirements. Not all cities require similar projects to be implemented.
- Since, market of technological advancements is huge, sometimes decision making between two technologies becomes critical. Therefore, some cities also discussed about compendium of technologies to be made available for reliability of the systems and technologies based on their usability.

Annexure 1ure

6.3 Replicable Best Practices

Replicability and scalability are key considerations for projects in the water and sewerage sector under the Smart Cities Mission. These concepts ensure that successful projects can be duplicated in other cities and expanded to cover larger areas or populations.

a) Replicability:

Replicability refers to the ability of a project or solution to be duplicated in different locations with similar success. For water and sewerage projects, replicability involves several factors, including standardization, adaptability in the city, availability of knowledge, and collaboration with various agencies. Understanding the 94 cities for overall data and 12 cities for in-depth initiatives, it is observed that most of the cities adopted commonly known solutions for their challenges. The variation is observed when the size of city changes or in case of some unique challenges. For example:

- Agra Smart city adopted use of vacuum STP in low lying ABD area with dense developments. The strategy included laying of pipelines, suction pumps that plug the sewage into the main chamber which is further connected to a natural STP along the drain. The treated used water is channelized through the drain.

- Chandigarh is the first planned city of the country, with all sanitation infrastructure in place already. So, the city concentrated on smart meters installation along with optimizing the usage with the three-fold increase in population against the planned population in the city.

b) Scalability:

Scalability refers to the ability of a project or solution to be expanded to cover larger areas or serve more people without losing effectiveness. In the context of smart city water and sewerage projects, scalability involves modular approach to design strategies, i.e. the pilot that is undertaken in small part of the city, should now be scaled to the whole city by ULB. This involves phase-wise development strategy, integration between the phases, and its adaptability to expanded city areas. It also involves trained human resources, and funds to scale the project. At state level, regulatory framework might be required to scale the projects. Example:

- Smart metering policy in Tamil Nadu state is required. Cities are limited to installation of devices, where revenue generation is entirely dependent on state policy approvals.
- Implementation of Smart water meters by Surat and Pune prompted other cities to adopt similar solutions, considering the huge NRW reduction in the cities.
- Vadodara's Water auditing inspired many cities to adopt integrated water management proposal in their cities, which then encouraged the cities to consider reuse of treated water as an important strategy at ULB level.

6.3 Recommendations & Policy Directives

The Smart City Mission has significantly improved the water and sewerage sector through the use of ICT. Positive impacts include increased efficiency from real-time monitoring, data-driven decision-making, and advanced leak detection systems, leading to better water conservation and demand management. Enhanced customer service through transparent and accurate billing, along with environmental benefits such as reduced pollution and sustainable water management practices, have also been notable outcomes.

However, several challenges including, high initial costs and funding constraints hinder the widespread deployment of advanced technologies. Integration issues arise from difficulties in merging new technologies with existing legacy systems and ensuring interoperability. Data management poses challenges in maintaining privacy and security, and effectively utilizing collected data. Additionally, there are skill gaps and a need for continuous training among personnel. Public acceptance is another hurdle, with resistance to change and a lack of awareness about the benefits of smart technologies.

To address these challenges at the policy level, innovative financing models like public-private partnerships, green bonds, and international funding should be promoted. Subsidies and incentives can support the adoption of smart technologies. Developing standardized protocols and flexible regulatory frameworks will facilitate deployment and operation. Implementing stringent data privacy laws and secure data sharing policies is crucial for data governance. Comprehensive training programs and certification courses will help build the necessary skills and capacity.

At the mission level, pilot projects can test and refine ICT solutions before scaling up, and a phased implementation approach can manage costs and risks. Public awareness campaigns and stakeholder involvement will enhance community engagement. Promoting integrated systems and planning gradual upgrades of legacy systems will ensure smoother technology integration. Establishing clear performance metrics and mechanisms for continuous monitoring and improvement will help evaluate and enhance the effectiveness of implemented solutions.

To address financial sustainability, leveraging public-private partnerships can share financial burdens and bring in private sector expertise. Conducting thorough cost-benefit analyses ensures financial viability. Middleware solutions and open standards can facilitate system integration and interoperability. Investing in advanced analytics and robust cybersecurity measures will improve data management. Workforce development programs and a culture of continuous learning will bridge skill gaps and ensure readiness. Transparent communication and feedback mechanisms will build public trust and acceptance. By implementing these strategies, the Smart Cities Mission can effectively enhance the use of ICT in the water and sewerage sector, ensuring sustainable and scalable improvements while addressing existing challenges.

Conclusion:

The integration of ICT in water supply and sewerage services under the Smart Cities Mission has shown significant environmental, economic, and social benefits. While there are challenges to be addressed, the successful implementation in certain cities provides a blueprint for future initiatives. The report concludes with a call for sustained efforts in technological advancements, capacity building, and policy support to further enhance urban water management systems in India.

7. References

i. Government of India, Ministry of Urban Development, "Smart Cities Mission Statement & Guidelines", June 2015.
ii. MoHUA and UN Habitat report on Localizing SDGs
iii. Smart Cities Proposals:
    a. https://smartcities.gov.in/cities-profiles
    b. Smart City Proposal | Smartnet (niua.org)
iv. Document repository of Smart Cities Mission: Documents | Smartcities
v. "SAAR" reports 2023
    a. Compendium of Best Practices, 2023: https://smartcities.gov.in/sites/default/files/2023-09/Compendium%20of%20Best%20Practices_book_web_version_1.pdf
    b. Compendium of Award Winners, 2020: https://smartcities.gov.in/sites/default/files/2023-06/FINAL_Compendium_LOW_RES.pdf
    c. Compendium of Award Winners, 2018: https://smartcities.gov.in/sites/default/files/2023-07/SCM%20Compendium%20Book.pdf
vi. ADB's report on Issues and Challenges of Reducing Non-Revenue Water, by Rudolf Frauendorfer , 2010.
vii. Other web links and online reports include:
    a. https://www.grantthornton.in/insights/blogs/digital-initiatives-in-the-sewage-and-wastewater-sector/#:~:text=The%20Atal%20Mission%20for%20Rejuvenation,ULBs%2C%20and%20achieving%20100%20percent
    b. https://www.ey.com/en_in/technology/water-4-0-digital-journey-of-water
    c. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://iwa-network.org/wp-content/uploads/2022/09/IWA_2022_Digital_Water_Book_web.pdf
    d. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://iwa-network.org/wp-content/uploads/2022/09/IWA_2022_Digital_Water_Book_web.pdf
    e. https://www.smsfoundation.org/the-role-of-technology-in-water-management/

8. Appendices

Annexure 1: Reply to the questionnaire received from 94 cities, circulated by SCMMU for water supply.

Annexure 2: Reply to the questionnaire received from 94 cities, circulated by SCMMU for sewerage services.

Annexure 3: Case Study for Vacuum Sewer technology used in Agra.

Annexure 4: Case Study for ESCO model used in Dehradun.

Annexure 5: Matrix of city-wise ICT interventions.

Annexure 1

S.No.	City	State	Population (2011 Census)	ULB Area (sq.km.)	Area of ABD area (sq.km.)	Smart City Website	Smart City Mobile App	Mobile based application for grievance redressal, new connections, etc.	Platform for online bill payments	Public information system (alerts for water supply cuts, water quality etc.)	Payment portal for municipal payments (Bills, taxes, etc.)	Please list (at least) THREE municipal services, in order of importance starting from the most important	Is the city using ICT tools like SCADA, IoT or any other tools/technology for monitoring of the system in WATER	Daily volume monitored thru. SCADA	Coverage of the System (ABD area/ Pan City)	What are the total connections mapped to the system	What are the total number of residential connections mapped to the system	Is the system using SCADA system for monitoring	Is the SCADA system linked to ICCC	What is the number of smart meters installed	Are Utility management services (water and eelctricity) integrated with ICCC?	How is ICCC contributing towards revenue collection in the city?			Reduction in NRW
																						Initiatives implemented in your city	Total revenue collection from the activity in Financial Year 2017-18	Total revenue collection from the activity in Financial Year 2022-23	
1	Agartala	Tripura	400004	90	11.33	Yes	No	No	No	Yes	N/A	N/A	No	0	N/A	0	0	No	No	0	No	No	N/A	N/A	No
2	Agra	Uttar Pradesh	1585000	141	9.1	Yes	Yes	Yes	Yes	No	Yes	WATER TAX, HOUSE TAX, Complaints	Yes	12	ABD AREA	14718	14640	Yes	Yes	14718	Yes	N/A	N/A	N/A	N/A
3	Aizwal	Mizoram	1097206	129.91	129.91	Yes	Yes (yet to be launched very soon)	No	Yes	No	No	N/A	No	0	N/A	0	0	No	No	0	Yes	No	N/A	N/A	No
4	Atal Nagar Nava Raipur	Chhattisgarh	75000	93	5.26	Yes	Yes	Yes	Yes	Yes	Yes	1) Payment of Water Bills 2) Building Permission 3) Payment of Electricity Bill	Yes	20	Pan city	8000	4488	Yes	Yes	1926	Yes	Yes	0	45841695	Yes
5	Bareilly	Uttar Pradesh	9,03,668	106.47	5.127	Yes	No	No	Yes	N/A	N/A	N/A	Yes	N/A	PAN CITY	N/A	N/A	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
6	Belagavi	KARNATAKA	488157	94.08	10.78	Yes	Yes	Yes	No	No	No	NA	No	NA	NA	NA	NA	NA	NA	NA	Yes	No	NA	NA	No
7	Bengaluru	Karnataka	12765000	800	21	Yes	Yes	Yes	No	No	No	1. Grievances 2. Check Birth Certificate Status 3. Check Death Certificate Status	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	No	N/A	N/A	No
8	Bhopal	Madhya Pradesh	2371061	463	1.384	www.smartbhopal.city	Yes	Yes	NA	Yes	Yes	1- Electricity Bill Payment 2- Property & Water Tax Payment 3- Mayor Express 4 - Waste Collection - Greviances Redressal	Yes	~450 MLD	PAN City	179	NA	Yes	Yes	179	Yes	No	N/A	N/A	Yes
9	Dehradun	Uttarakhand	1696694	3088	3.54	Yes	Doon1 App	Yes	Yes	Yes	Yes	Solid Waste Management RTI Property Tax	Yes	275	Pan City	4832	4882	Yes	Yes	4882	Yes	N/A	N/A	N/A	N/A
10	Diu	Daman and Diu and Dadara Nagar haveli	52074	38.8	38.8	Yes	No	Yes	Yes	No	Yes	1.Bill Payment 2. Grivence 3. Digital door Numbering	Yes	7	N/A	25000	25000	No	No	No	Yes	Yes	N/A	N/A	N/A
11	Erode	Tamil Nadu	498121	109.52	15.61	Yes https://www.erodesmartcity.org/	yes	Yes	No	No	No	Payment bills, Property tax collection, Water tax collection, sewerage tax collection	No	N/A	0	0	0	No	No	0	No	No	N/A	N/A	No
12	Guwahati	Assam	968000	216.79	216.79	Yes	No	No	No	No	N/A	N/A	No	N/A	N/A	N/A	N/A	No	No	N/A	No	No	N/A	N/A	No
13	Gwalior	Madhya Pradesh	1054000	471	3.25	Yes	Yes	Yes	Yes	No	Yes	Related to Property tax, Water Tax, Building Permission	No	N/A	N/A	N/A	N/A	N/A	N/A	0	No	No	No	No	No
14	Jammu	Jammu & Kashmir	502197	240	4.08	Yes	Yes	Yes	M-Pay- JK Bank	No	Yes	Grievance Redressal Hoarding Booking	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	No	NA	NA	No
15	Srinagar	Jammu and Kashmir	1205361	262	4.78	Yes	Yes	Yes	Yes	Yes	Yes	*Water Bill * Birth and Death certificate* Municipal Tax * Tourism * Electricity Bill* Disaster Management releated announcements * Grievance/Complaint	Yes(Under Implementation)	Under Implementation	Both	Under Implementation	Under Implementation	Yes	To Be Linked	0	Yes	No	0	0	No
16	Aurangabad	Maharashtra	1175116	180	180	Yes	Yes	Yes	Yes	Yes	Yes	Property Tax, Water Tax, Grievance	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No	No	No
17	Chandigarh	Chandigarh	970000	114	5.6	Yes	Yes	Yes	Yes	No	Yes	1. Online Building Plan approval 2.Water & sewer connection, 3. Horticulture	Yes	40	ABD (under construction)	9000 (12800 Proposed)	9000 (12800 Proposed)	Yes	Yes	11000	Yes	No	NA	NA	No
18	Nashik	Maharashtra	1486053	259.12	2.38	Yes	Yes	Yes, Under Implementation	Yes, Under Implementation	Yes	No	Propoerty Tax Water Tax Building Plans	Yes	Under Implementation	Pan City	7.4K Non Residential and commercial connection (under Implementation)	Nil	Yes with Under Implementation	Yes with Under Implementation	5.7K (commerical & Non residential and balanced are under implementation)	Yes	No	No	No	Yes
19	Bhagalpur	Bihar	400146	30	7.22	Yes	Yes	No	No	No	Yes	# Property tax #Trade License # Building Plan approval	No	0	N/A	N/A	N/A	No	No	N/A	Yes	No	N/A	N/A	No
20	Indore	Madhya pradesh	2939974	276	3	www.smartcityindore.org	No	Yes	Yes	Yes	Yes	1. Shop registration 2. Birth and death certificate, 3. Boring ; home composting and rain water harvesting	Yes	446	Pan-city	268000	483000	Yes	Yes	NA	No	No	-	-	Yes
21	Kakinada	Andhra Pradesh	312538	31.95	5.15	Yes	No	No	Yes	Yes	No	N/A	Yes	48	Pan-city &ABD	37	0	Yes	No	37	Yes	Yes	0	0	No
22	Kalyan Dombivli	Maharashtra	1247327	116 sq km	11.75 sq km	yes	yes	yes	yes	no	yes	property tax, water tax, grievance	No	N/A	N/A	N/A	N/A	No	No	N/A	yes	no	N/A	N/A	no
23	Kohima	Nagaland	138000	20	1.1514	Yes	No	No	No	No	N/A	N/A	No	No	No	0	0	No	No	0	No	No	N/A	N/A	No

24	Madurai	Tamilnadu	14,68,989	150.68	5.3	No(In madurai corporation website information on smart city works are there)	No	Yes	Yes	Yes	No	N/A	No	N/A	ABD area	N/A	N/A	N/A	N/A	N/A	Yes	No	N/A	N/A	No
25	Pune	Maharashtra	7184000	518	3.6	Yes	Yes	Yes	Yes	Yes	Yes	Property Tax Bill Water Bill Birth & Death..etc	Yes	1350	Pan-city	500000	500000	Yes	Yes	119735	Yes	Yes	0	0	Yes
26	Visakhapatnam	Andhra Pradesh	2385000	681.96	6.68	Yes	Yes	No	Yes	N/A	Yes	property tax,professional tax,arena booking ,	Yes	1500kl	5.5	3800	3800	Yes	No	5700	Yes WATER	Yes	N/A	N/A	Yes
27	Tirupati	Andhra Pradesh	374260	27.44	3.01	No	No	Yes	Yes	Yes	Yes	Yes	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	0
28	SILVASSA	DADRA & NAGAR HAVELI AND DAMAN & DIU	98265	17.22	17.22	Yes	No	No	No	No	NA	NA	No	NA	PAN CITY	0	0	No	No	0	Yes	N/A	N/A	N/A	N/A
29	Solapur	Maharashtra	951558	179.38	4.208731	No	No	No	Yes	Yes	Not Applicable	Not Applicable	Yes	215	Pan City	603	1500	Yes	Yes	1500	YES	NO	0	0	NO
30	Thane	MAHARASHTRA	18.61LAKH	128.23	4.047	Yes	No	NA	Yes	Yes	Yes	Proprty tax, water tax and CFC	NA	NA	NA	NA	105927	NA	No	105927	No	Yes	0	0	No
31	Shillong	Meghalaya	143229	10.99	1.63	Yes	No	No	No	No	No	N/A	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A	N/A	N/A
32	Jabalpur	Madhya pradesh	1206000	263.49	3.00681	Yes	Yes	Yes	Yes	No	Yes	Solid waste management Water Supply Street light	Yes	NA	ABD	2155	2155	Yes	No	2000	Yes	No	NA	NA	No
33	Surat	Gujarat	44.61 lacs	461.6	8.77	Yes	Yes	N/A	N/A	N/A	Yes	N/A	Yes	N/A	N/A	N/A	N/A	Yes	Yes	0	Yes	-	-	-	-
34	Satna	Madhya Pradesh	280222	71.1	2.68	Yes	No	Yes	No	Yes	Yes	Certificates,Greivyance, Traffic Challan Payment	Yes	58	Pan City	0	0	Yes	Yes	N/A	Yes	No	0	0	Yes
35	New Town Kolkata	West Bengal	NA	28	21.69 sq km	Yes	Ongoing	Yes. IGMS	Yes	No	Yes	1. Collection and disposal of Solid Waste 2. Maintenance of drainage and sewerage 3. Water supply	Yes	30 MGD	Part of ABD Area	761	699	Yes	Yes	Bulk Water Meters - 70, Small Water Meters - 691	Yes	NA	0	0	Yes
36	Salem	Tamil Nadu	896201	91.34	7.15	Yes	No	Yes	Yes	Yes	Yes	Payment bills, Property tax collection, Water tax collection, sewerage tax collection	No	Water Supply Project is in implemetation stage	ABD Area	0	0	No	No	0	No	No	N/A	N/A	No
37	Pimpri Chinchwad	Maharashtra	2452000	29420	5.625 sq km	Yes	Yes	Yes	Yes	Yes	Yes	• Property Tax • Water Tax • Grievance • Nagarvasti schemes • Birth Certificate • death Certificate • SWM • Property KYC • Waste Collection • GIS for People • Pet License • Hording Permission • RTI • RTS • Tenders • Building Permission	Yes	NA	Pan-city	9268	8245	Yes	Yes	8245	Yes	yes	0	0	yes
38	Jhansi	Uttar Pradesh	505693	152	152	Yes	Yes	Yes	No	Yes	Yes	1. Property Tax 2. Grievance redressal system 3. Birth/Death Certificate	No	0	0	0	0	No	No	No	Yes	No	N/A	N/A	No
39	Nagpur	MAHARASHTRA	2405421	393.5	7	Yes	NO	No	Yes	Yes	No	No	No	Project in progress	ABD Area	In progress	N/A	Yes	No	N/A	No	No	0	0	No
40	Varanasi	Uttar Pradesh	13,000,00	160	15.77869	Yes	No	Yes	No	No	Yes	Sanitation, Sewerage Maintainence, Water Supply Maintainence	No not as an SCM Project	N/A	N/A	N/A	N/A	N/A	N/A	0	Yes	No	N/A	N/A	Yes
41	Ajmer	Rajasthan	542321	200	38	No	Yes	No	Yes	No	No	Sewrage connection application, City Bus route, trace the Garbage collection vehicle	Yes	N/A	N/A	170762	170762	Yes	No	57717	No	No	No	No	No
42	Davanagere	Karnataka	434971	68.63	3.2	Yes	Yes	No	Yes	No	Yes	1. Jahita Lodge your grievance 2. Bhoomi 3. Birth/Death Certificate	Yes	-	Pan-city	97589	97589	Yes	No	76516	Yes	Yes	NA	NA	No
43	Aligarh	Uttar Pradesh	874408	100.04	5	Yes	Yes	Yes	Yes	Yes	Yes	1. Property Tax Payment 2. Water Charge Payment 3. Grievance Redressal System	Yes	202.25	Pan-city	N/A	91553	Yes	No	0	Yes	Yes	N/A	2.85	No
44	Karimnagar	Telangana	293989	65	10	Yes	Yes	Yes	Yes	Yes	N/A	N/A	Yes	data awaited from other department	data awaited from other department	data awaited from other department	data awaited from other department	data awaited from other department	data awaited from other department	data awaited from other department	Yes	No	N/A	N/A	No
45	Lucknow	Uttar Pradesh	2.8 million	584 sq km	17.03 sq km	Yes	Yes	Yes	Yes	No	Yes	Attendance , m-challan,PGRS, Field Inspection	No	No	PAN-CITY	No	No	Only for Pump Station	Yes	No	Yes	No (done by LMC)	Not covered by ICCC	Not covered by ICCC	No
46	Namchi	Sikkim	35000	7.14	2	Yes	No	N/A	N/A	N/A	N/A	N/A	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not yet implemented	N/A	N/A	N/A	N/A
47	Ranchi	Jharkhand	1126720	2.65	2.65	Yes	Yes	No	No	No	No	N/A	Yes	N/A	ABD Area	0	16000	Yes	No	0	Yes	No	N/A	N/A	No
48	Saharanpur	Uttar Pradesh	650000	73.72	5.9	Yes	No	Yes	Yes	No	Yes	Tax, Sewer problem, Tax, Public Guidance, Birth & Death	No	N/A	N/A	0	0	No	No	0	No	No	N/A	N/A	No
49	Shivamogga	Karnataka	322650	70.01	6	YES	No	NO	NO	YES	NO	NO	YES	NA	ABD area	872	872	NO	NO	872	NO	NO	NA	NA	NO
50	Thanjavur	Tamilnadu	2,26,619	36.31 Sq.km	10.55 Sq.km	Yes	No	No	Yes	No	NA	NA	Yes	21.5	Pan city	NA	NA	Yes	Yes	NA	Yes	No	NA	NA	No
51	Thoothukudi	Tamilnadu	372408	90.66	35.48	Yes	Yes	Yes	Yes	Yes	No	Grievances	Yes (SCADA)	62	NA	34	NA	Yes	Yes	NA	No	NA	NA	NA	NA
52	Moradabad	Uttar Pradesh	887871	3741	261.87	Yes	Yes	No	No	No	Yes	Tax Payment, Birth Certificate,Death Certificate	Yes	NA	ABD Area	NA	NA	Yes	Yes	22750	Yes	No	N/A	N/A	No

53	Mangaluru	Karnataka	623841	170	7	Yes	Yes	No	Yes	No	No	WATER BILL,WASTE COLLECTION,DISASTER MANAGEMENT	No	N/A	N/A	N/A	N/A	No	No	N/A	Yes	No	N/A	N/A	No
54	Bilaspur	Chhattisgarh	715015	120	4.21	Yes	Yes	Yes	No	No	No	Lost and Found related,Safety & Security, Traffic Related	No	NA	NA	NA	NA	NA	NA	3500	NO	NO	0	0	NO
55	Raipur	CHHATTISGARH	1433000	226	4	Yes	Yes	Yes	Yes	Yes	Yes	1. Online Property Tax Payment System 2. Water Connection 3. Publice grievance redressal System	YES	285	Pan City	223251	217173	Yes	No	2002	No	No	NA	NA	No
56	Rajkot	GUJARAT	1390640	161.86	3.76	Yes	No	Yes	Yes	Yes	Yes	NA	Yes	300	Pan city	0	0	Yes	Yes	NA	Yes	No	N/A	N/A	NA
57	Kota	Rajasthan	1001694	221.36	6.61	No	No	No	Yes	No	No	N/A	Yes	400	80% / 100%	0	0	Yes	No	No	No	No	N/A	N/A	No
58	New Delhi	Delhi	1.68	42.7	42.7	Yes	No	No	No	No	No	N/A	No	N/A	N/A	N/A	N/A	No	No	N/A	N/A	N/A	N/A	N/A	N/A
59	Sagar	Madhya Pradesh	2378458	10252	5.9	Yes	Yes	Yes	Yes	Yes	Yes	a) Water b) Sanitation c) Economic Development	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	No	N/A	N/A	Yes
60	Ujjain	Madhya Pradesh	5,15,215	92.68	3.5	Yes	No	Yes	Yes	Yes	Yes	Grievance Redressal, Proprty Tax / Water Tax Payment, Birth / Death Certificate	No	N/A	N/A	N/A	N/A	No	No	No	No	No	N/A	N/A	No
61	Biharsharif	Bihar	297268	40.05	9.6	No	No	Yes	Yes	Yes	Yes	PROPERTY TAX, TRADE LICENCE, GRIEVANCE REDRESSAL SYSTEM	No	N/A	N/A	N/A	N/A	No	No	AWAITED	No	No	N/A	N/A	No
62	Imphal	Manipur	268243	35	2.2	Yes	Yes	No	No	No	No	1. Solid Waste Management	No	NA	N/A	N/A	N/A	No	No	N/A	No	No	N/A	N/A	No
63	Udaipur	Rajasthan	451100	64	3.24	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
64	Tiruppur	Tamil Nadu	877778	159.35	24.19	Yes	No	Yes	Yes	Yes	Yes	Payment bills, Property tax collection, Water tax collection, sewerage tax collection	No	Water Supply Improvement	Pan City	205000	0	Yes	Yes	0	No	No	-	-	No
65	Tiruchirappalli	Tamilnadu	916659	167.23	7	Yes	No	No	Yes	Yes	Yes	1. Water Supply 2. UGSS 3. Town Planning	Yes	140	Pan-City	0	0	Yes	Yes	10	Yes	No	-	-	No
66	Pasighat	Arunachal Pradesh	24656	12.7	3.9	Yes	Yes	no	no	no	no	na	no	no	0	no	0	no	no	0	no	no	0	0	no
67	Gandhinagar	GUJARAT	324486	195.6	7	Yes	NO	ND	ND	ND	no	no	yes	80	PAN	30900	30000	Yes	Yes	30000	No	No	-	-	NA
68	Vadodara	Gujarat	17.41 lakhs	220	0	Yes	Yes	Yes	Yes	Yes	Yes	Call Center, Taxes, Panic button	Yes	630	Pan-city	0	0	Yes	Yes	3000	yes	No	N/A	N/A	No
69	Kochi	Kerala	601574	94.88	6.73	Yes	Yes	N/A	N/A	N/A	N/A	N/A	Yes	N/A	ABD area	504	504	No	No	504	Yes (Electricity and water)	N/A	N/A	N/A	N/A
70	Kanpur	Uttar Pradesh	2764382	260	7	Yes	Yes	Yes	Yes	No	Yes	Birth & Death Registration Property Tax Payments Grevance Redressal	Yes	280	ABD Area	5 WTP, 6 ZPS, 5 Raw Water	0	Yes	Yes	0	No	Yes	0	0	No
71	Gangtok	Sikkim	100290	19.2		Yes	no	No	No	No	No	No	No	No	No	No	No	No	No	No	No	NO	0	0	NO
72	Tumakuru	Karnataka	391000	48	5.48	Yes	Yes	Yes	Yes	No	Yes	GPS Monitoring, Water logging, Illegal Banner Detection, UGD	Yes	NA	ABD Area	NA	NA	NA	No	NA	No	No	N/A	N/A	No
73	Thiruvananthapuram	KERALA	0	0		YES	YES	Yes	Yes	Yes	Yes	0	YES	9	ABD Area	9000	8765	Yes	Yes	9000	Yes	0	0	0	0
74	Itanagar	Arunachal Pradesh	59490	200	4.26	Yes	Yes	Yes	Yes	No	No	N/A	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	No	N/A	N/A	No
75	SHIMLA	HIMACHAL PRADESH	169578	35.34	0	Yes	yes	Yes	Yes	No	Yes	Water Connection, NOC of Electricity, Application for Permission of Canopy	No	0	N/A	0	0	No	No	0	Yes	No	Pertains to M.C.	Pertains to M.C.	No
76	Ahmedabad	Gujarat	55,77,940	466 (year 2006)	466 (year 2006)	Yes	No	Yes	Yes	Water	Yes	N/A	Yes	1750	4 Zones	Water	Water	Yes	Yes	1000 - 600 in Network and 400 in WDS	Yes	Property-Tax	N/A	N/A	SWM
77	Faridabad	HARYANA	APPROX. 18 LAKHS	189.9 km2	5.131	Yes	N/D	No	NA	No	N/D	N/D	Yes	130	Pan-city	NA	NA	Yes	Yes	0	No	No	N/D	N/D	No
78	Greater Warangal	Telangana	6,27,449	407.77	6.406	yes	yes	Data not available	Data not available	Data not available	Yes	Data not available	Yes	20.8	Pan City	Data not available	Data not available	yes	yes	Data not available	Yes	Data not available	Data not available	Data not available	Data not available
79	Jaipur	Rajasthan	3471847	462	6.47	Yes	Yes	No	No	No	No	SWM Vehicle Monitoring Sewer Manhole level Sensor Smart Parking	No	-	-	-	-	No	No	-	No	No	-	-	No
80	Karnal	Haryana	1505324	0	720 Acr	YES	NO	N/D	N/D	N/D	No	N/D	Yes	Under Progess	Pan-City	182	N/D	YES	Under Progess	182	No	Not Covered by ICCC	Not Covered by ICCC	Not Covered by ICCC	N/A
81	Amritsar	Punjab	2490656	2683	0	YES	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No	No	N/A
82	Ludhiana	Punjab	3498739	3767	N/D	No	No	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	NA	No	No	NA	NA	No
83	Coimbatore	Tamilnadu	1601438	257.04	N/D	Yes	No	N/D	N/D	N/D	Yes	Online Building Plan Approval , Utility Payment , Grievance Redressal	Yes	170	Pan - city	N/D	N/D	Yes	Yes	N/D	N/D	N/D	N/D	N/D	N/D
84	Vellore	Tamil Nadu	3936331	5920.18	31.32	yes	yes	YES	YES	YES	YES	N/A	NO	NO	NO	NO	NO	NO	NO	0	No	yes	N/D	N/D	0
85	Tirunelveli	Tamil Nadu	474838	108.65	7.67	N/D	N/D	No	No	No	No	No	yes	85	N/D	No	No	Yes	Yes	357	N/D	N/D	N/D	N/D	N/D
86	Rourkela	Odisha	3.85 Lakh	53.3	5	No	No	No	No	No	No	Solid Waste Management	No	No	No	No	No	No	No	No	No	No	N/A	N/A	No
87	Puducherry	Puducherry	N/A	N/A	N/A	Yes	No	No	Yes	No	N/A	N/A	No	100	50 sqkm	110000	102000	No	NOT APPLICABLE	Nil	Yes	N/A	N/A	N/A	N/A
88	Bhubaneswar	ODISHA	843402	186	3.9	Yes	Yes	N/A	N/A	N/A	Yes	Property Holding Tax,Trade License,Asset Booking	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
89	Chennai	Tamil Nadu	4681087	426	N/D	Yes	Yes	Yes	Yes	Yes	Yes	1. Grievance Redressal 2. Property Tax payment 3. Birth / Death Certificate	Yes	N/D	N/D	N/D	N/D	N/D	No	N/D	Yes	No	N/A	N/A	No
90	Dahod	Gujarat	94578	6.54	6.54	Yes	Yes	N/D	N/D	Yes	Yes	N/D	Yes	18 MLD	ABD Area	-	-	Yes	Yes	10000	Yes	No	N/D	N/D	No
91	Kavaratti	Lakshadweep	64473	4.22	4.22	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No

92	Muzaffarpur	Bihar	500000	26.68	5	Yes	Yes	Yes	Yes	Yes	Yes	Property tax, Trade License,Building Permission	No	N/A	NA	0	0	not yet	No	0	Yes	Yes	N/D	N/D	0
93	Panaji	Goa	40017	8.12	2	Yes	No	YES	YES	NO	YES	1.Electricity Bill 2.water bill	YES	21	PAN CITY	3000	3000	YES	NO	3000	No	No	NA	NA	No
94	Prayagraj	Uttar Pradesh	11,12,544	365	7.77	Yes	Yes	N/A	N/A	N/A	Yes	Property Bills Pay Property Tax dues Water Bills Pay Lease dues Pay waster tax dues etc	Yes	135	Pan City	N/A	N/A	Yes	Yes	N/A	Yes	No	N/D	N/D	No

Annexure 2

S.No.	City	State	Population (2011 Census)	ULB Area (sq.km.)	Area of ABD area (sq.km.)	Smart City Website	Smart City Mobile App	Is the city using ICT tools like SCADA, IoT or any other tools/technology for monitoring of the system in SEWER	Daily volume monitored thru. SCADA	Coverage of the System (ABD area/ Pan City)	What are the total connections mapped to the system	What are the total number of residential connections mapped to the system	Is the system using SCADA system for monitoring	Is the SCADA system linked to ICCC	Are Waste water management services integrated with ICCC?
1	Agartala	Tripura	400004	90	11.33	Yes	No	No	0	N/A	0	0	No	No	No
2	Agra	Uttar Pradesh	1585000	141	9.1	Yes	Yes	Yes (Under Implementation)	N/A	N/A	N/A	N/A	N/A	N/A	Yes
3	Aizwal	Mizoram	1097206	129.91	129.91	Yes	Yes (yet to be launched very soon)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No
4	Atal Nagar Nava Raipur	Chhattisgarh	75000	93	5.26	Yes	Yes	Yes	4 (Treated water discharge)	Pan city	8000	N/A	Yes	Yes	Yes
5	Bareilly	Uttar Pradesh	9,03,668	106.47	5.127	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No
6	Belagavi	KARNATAKA	488157	94.08	10.78	Yes	Yes	No	NA	NA	NA	NA	NA	NA	Yes
7	Bengaluru	Karnataka	12765000	800	21	Yes	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	No
8	Bhopal	Madhya Pradesh	2371061	463	1.384	www.smartbhopal.city	Yes	NA	NA	NA	NA	NA	NA	NA	Yes
9	Dehradun	Uttarakhand	1696694	3088	3.54	Yes	Doon1 App	N/A	N/A	ABD	N/A	N/A	N/A	N/A	N/A
10	Diu	Daman and Diu and Dadara Nagar haveli	52074	38.8	38.8	Yes	No	Yes	7	N/A	25000	25000	N/A	N/A	N/A
11	Erode	Tamil Nadu	498121	109.52	15.61	Yes https://www.erodesmartcity.org/	yes	No	N/A	N/A	0	0	No	No	No
12	Guwahati	Assam	968000	216.79	216.79	Yes	No	No	N/A	N/A	N/A	N/A	No	No	No
13	Gwalior	Madhya Pradesh	1054000	471	3.25	Yes	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	Yes
14	Jammu	Jammu & Kashmir	502197	240	4.08	Yes	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	No
15	Srinagar	Jammu and Kashmir	1205361	262	4.78	Yes	Yes	No	No	No	No	No	No	No	No
16	Aurangabad	Maharashtra	1175116	180	180	Yes	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	Yes
17	Chandigarh	Chandigarh	970000	114	5.6	Yes	Yes	Yes	225	Pan City	N/A	N/A	Yes	Yes	Yes
18	Nashik	Maharashtra	1486053	259.12	2.38	Yes	Yes	No	No	No	No	No	No	No	No
19	Bhagalpur	Bihar	400146	30	7.22	Yes	Yes	No	0	N/A	N/A	N/A	No	No	No
20	Indore	Madhya pradesh	2939974	276	3	www.smartcityindore.org	No	Yes	362	Pan City	4.86 lakhs	486000	Yes	Yes	Yes
21	Kakinada	Andhra Pradesh	312538	31.95	5.15	Yes	No	No	N/A	N/A	N/A	N/A	N/A	N/A	Yes
22	Kalyan Dombivli	Maharashtra	1247327	116 sq km	11.75 sq km	yes	yes	No	N/A	N/A	N/A	N/A	No	No	no
23	Kohima	Nagaland	138000	20	1.1514	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No
24	Madurai	Tamilnadu	14,68,989	150.68	5.3	No(In madurai corporation website information on smart city works are there)	No	No	N/A	pan city	N/A	N/A	N/A	N/A	No
25	Pune	Maharashtra	7184000	518	3.6	Yes	Yes	Yes	500	Pan-city	N/A	0	Yes	Yes	Yes
26	Visakhapatnam	Andhra Pradesh	2385000	681.96	6.68	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes
27	Tirupati	Andhra Pradesh	374260	27.44	3.01	No	No	0	0	0	0	0	0	0	0
28	SILVASSA	DADRA & NAGAR HAVELI AND DAMAN & DIU	98265	17.22	17.22	Yes	No	No	NA	ABD	0	0	No	No	Yes
29	Solapur	Maharashtra	951558	179.38	4.208731	No	No	No	0	0	0	0	0	0	No
30	Thane	MAHARASHTRA	18.61LAKH	128.23	4.047	Yes	No	NO	0	NA	7345	NO	NO	NO	No
31	Shillong	Meghalaya	143229	10.99	1.63	Yes	No	No	N/A	N/A	N/A	N/A	N/A	N/A	No
32	Jabalpur	Madhya pradesh	1206000	263.49	3.00681	Yes	Yes	NA	NA	NA	NA	NA	NA	NA	No
33	Surat	Gujarat	44.61 lacs	461.6	8.77	Yes	Yes	Yes	N/A	N/A	N/A	N/A	Yes	0	-

34	Satna	Madhya Pradesh	280222	71.1	2.68	Yes	No	No	11	Pan City	No	No	No	No	Yes
35	New Town Kolkata	West Bengal	NA	28	21.69 sq km	Yes	Ongoing	No	NA	NA	NA	NA	NA	NA	Yes
36	Salem	Tamil Nadu	896201	91.34	7.15	Yes	No	No	UGSS project is in implementation	ABD Area	8600	8600	No	No	No
37	Pimpri Chinchwad	Maharashtra	2452000	29420	5.625 sq km	Yes	Yes	Yes	NA	Pan-city	46	NA	Yes	Yes	Yes
38	Jhansi	Uttar Pradesh	505693	152	152	Yes	Yes	No	0	0	0	0	No	No	No
39	Nagpur	MAHARASHTRA	2405421	393.5	7	Yes	NO	No	0	0	0	0	0	No	No
40	Varanasi	Uttar Pradesh	13,000,00	160	15.77869	Yes	No	No not as an SCM Project	N/A	N/A	N/A	N/A	N/A	N/A	Yes
41	Ajmer	Rajasthan	542321	200	38	No	Yes	Yes	N/A	N/A	38224	0	0	No	No
42	Davanagere	Karnataka	434971	68.63	3.2	Yes	Yes	No	0	-	-	-	-	-	No
43	Aligarh	Uttar Pradesh	874408	100.04	5	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No
44	Karimnagar	Telangana	293989	65	10	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes
45	Lucknow	Uttar Pradesh	2.8 million	584 sq km	17.03 sq km	Yes	Yes	No	No	No	No	No	No	No	Yes
46	Namchi	Sikkim	35000	7.14	2	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not yet implemented
47	Ranchi	Jharkhand	1126720	2.65	2.65	Yes	Yes	Yes	N/A	ABD Area	0	16000	Yes	No	N/A
48	Saharanpur	Uttar Pradesh	650000	73.72	5.9	Yes	No	N/A	N/A	ABD Area	N/A	N/A	N/A	N/A	No
49	Shivamogga	Karnataka	322650	70.01	6	YES	No	0	0	0	Smart water	Smart water	0	0	yes
50	Thanjavur	Tamilnadu	2,26,619	36.31 Sq.km	10.55 Sq.km	Yes	No	No	18	Pan City	NA	NA	Yes	Yes	Yes
51	Thoothukudi	Tamilnadu	372408	90.66	35.48	Yes	Yes	Yes (SCADA)	8	NA	NA	NA	Yes	Yes	No
52	Moradabad	Uttar Pradesh	887871	3741	261.87	Yes	Yes	No	NA	NA	NA	NA	No	No	No
53	Mangaluru	Karnataka	623841	170	7	Yes	Yes	No	N/A	N/A	N/A	N/A	No	No	Yes
54	Bilaspur	Chhattisgarh	715015	120	4.21	Yes	Yes	No	NA	NA	NA	NA	NA	NA	NO
55	Raipur	CHHATTISGARH	1433000	226	4	Yes	Yes	No	150	Pan City	N/A	N/A	N/A	N/A	No
56	Rajkot	GUJARAT	1390640	161.86	3.76	Yes	No	Yes	250	Pan city	0	0	Yes	Yes	Yes
57	Kota	Rajasthan	1001694	221.36	6.61	No	No	Yes	128	65% / 100%	0	0	Yes	No	No
58	New Delhi	Delhi	1.68	42.7	42.7	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
59	Sagar	Madhya Pradesh	2378458	10252	5.9	Yes	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	Yes
60	Ujjain	Madhya Pradesh	5,15,215	92.68	3.5	Yes	No	No	N/A	N/A	N/A	N/A	No	No	No
61	Biharsharif	Bihar	297268	40.05	9.6	No	No	Yes	25	ABD AREA	30000	30000	Yes	N/A	No
62	Imphal	Manipur	268243	35	2.2	Yes	Yes	No	NA	N/A	N/A	N/A	No	No	No
63	Udaipur	Rajasthan	451100	64	3.24	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
64	Tiruppur	Tamil Nadu	877778	159.35	24.19	Yes	No	No	UGSS Scheme to Left out Areas	Pan City	75515	0	No	No	No
65	Tiruchirappalli	Tamilnadu	916659	167.23	7	Yes	No	No	0	-	0	0	No	No	No
66	Pasighat	Arunachal Pradesh	24656	12.7	3.9	Yes	Yes	yes	project under progress	ABD Area	1	0	yes	yes	no
67	Gandhinagar	GUJARAT	324486	195.6	7	Yes	NO	yes	45	PAN	30900	30000	No	No	No
68	Vadodara	Gujarat	17.41 lakhs	220	0	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No
69	Kochi	Kerala	601574	94.88	6.73	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
70	Kanpur	Uttar Pradesh	2764382	260	7	Yes	Yes	No	NA	NA	NA	NA	NA	NA	Yes, Water Supply Scada
71	Gangtok	Sikkim	100290	19.2		Yes	no	0	0	0	0	0	0	0	No
72	Tumakuru	Karnataka	391000	48	5.48	Yes	Yes	No	NA	N/A	N/A	N/A	N/A	N/A	No
73	Thiruvananthapuram	KERALA	0	0		YES	YES	0	0	0	0	0	0	0	0
74	Itanagar	Arunachal Pradesh	59490	200	4.26	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No
75	SHIMLA	HIMACHAL PRADESH	169578	35.34	0	Yes	yes	No	0	N/A	0	0	No	No	No
76	Ahmedabad	Gujarat	55,77,940	466 (year 2006)	466 (year 2006)	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Smart Street Light,Environmental Sensors,etc.
77	Faridabad	HARYANA	APPROX. 18 LAKHS	189.9 km2	5.131	Yes	N/D	Yes	10	ABD	0	0	Yes	No	No
78	Greater Warangal	Telangana	6,27,449	407.77	6.406	yes	yes	N/D	N/D	N/D	2,71,904	2,71,904	N/D	N/D	Yes
79	Jaipur	Rajasthan	3471847	462	6.47	Yes	Yes	Yes	98	ABD	-	-	No	No	Yes
80	Karnal	Haryana	1505324	0	720 Acr	YES	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No

81	Amritsar	Punjab	2490656	2683	0	YES	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No
82	Ludhiana	Punjab	3498739	3767	N/D	No	No	NA	NA	NA	NA	NA	NA	0	No
83	Coimbatore	Tamilnadu	1601438	257.04	N/D	Yes	No	Only in STP	55	Pan - City	N/D	N/D	N/D	N/D	N/D
84	Vellore	Tamil Nadu	3936331	5920.18	31.32	yes	yes	NO	NO	NO	NO	NO	NO	NO	No
85	Tirunelveli	Tamil Nadu	474838	108.65	7.67	N/D	N/D	No	N/D	N/D	N/D	N/D	N/D	N/D	N/D
86	Rourkela	Odisha	3.85 Lakh	53.3	5	No	No	No	No	No	No	No	No	No	No
87	Puducherry	Puducherry	N/A	N/A	N/A	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes
88	Bhubaneswar	ODISHA	843402	186	3.9	Yes	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A
89	Chennai	Tamil Nadu	4681087	426	N/D	Yes	Yes	Yes	N/D	N/D	N/D	N/D	N/D	N/D	No
90	Dahod	Gujarat	94578	6.54	6.54	Yes	Yes	N/D	N/D	N/D	N/D	N/D	N/D	N/D	No
91	Kavaratti	Lakshadweep	64473	4.22	4.22	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No
92	Muzaffarpur	Bihar	500000	26.68	5	Yes	Yes	yes	N/A	84	N/A	2500	Not yet	NO	0
93	Panaji	Goa	40017	8.12	2	Yes	No	NA	NA	NA	NA	NA	NA	NA	No
94	Prayagraj	Uttar Pradesh	11,12,544	365	7.77	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No

Annexure 3: Vacuum Sewer Technology in Agra

Introduction to the Technology:

Vacuum Sewer Technology is a method of transporting sewage from its source to a sewerage Treatment Plant using negative pressure.

Vacuum sewerage systems operate on a fundamentally different principle than traditional gravity-based systems. Instead of relying on the force of gravity to transport wastewater, these systems use vacuum technology to create a pressure differential that moves sewage from individual collection points to a central vacuum station.

It is a clean and highly efficient system for environmentally acceptable sewerage disposal. Compared with conventional sewerage systems, vacuum sewerage systems construction and installation is considerably simpler and cheaper.

How it works:

1. **Gravity**: Wastewater flows from buildings into a collection chamber.
2. **Vacuum valve**: When the sewage level reaches a certain point, a vacuum valve opens.
3. **Vacuum**: The vacuum valve empties the chamber, creating a vacuum in the pipe network.
4. **Vacuum pumps**: Vacuum pumps at a central station maintain the vacuum.
5. **Sewage**: The sewage travels through the vacuum main to the central station.
6. **Sewage pumps**: Sewage pumps move the sewage to a nearby treatment plant.

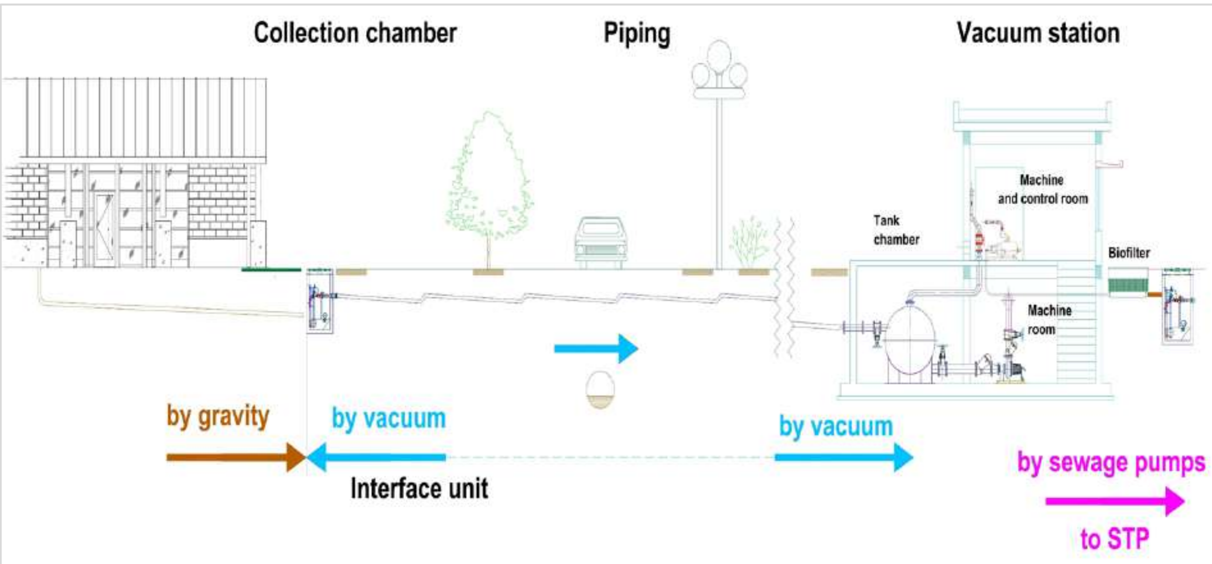


Fig 1: Principal Components of Vacuum Sewer Systems

Benefits over Conventional Gravity-based Systems:

1. **Cost Effectiveness**
    a. Cost-effective than traditional gravity-based systems, especially in challenging terrains or areas with low population density
    b. Low investment costs and minimal maintenance
    c. Less energy consumption. Energy is only required at the vacuum station
    d. Reduced need for extensive excavation and fewer materials contribute to overall cost savings.
2. **Adaptability**
    a. ability to be installed at a shallow depth in the ground
    b. can be installed easily in areas with a high-water table, hard rock or acid sulphate soil areas
    c. ability for pipes to go around, under or over obstructions or sensitive areas gives much greater flexibility
3. **Reduces Environmental Impact**
    a. reduced excavation requirements result in less disruption to the natural landscape
    b. systems can be installed with minimal impact on flora and fauna
    c. Reduces water consumption considerably
    d. No ground pollution as no leakages
    e. Consumes less energy
4. **Easy Installation and Expansion**
    a. modular nature of the technology also allows for easier expansion, making it suitable for growing communities or areas experiencing rapid development.
    b. Small diameter pipes
    c. No deep trenches required
    d.
5. **Efficient Sewage Management and Transportation**
    a. Ability to adjust the air liquid ratios remotely minimizes the risk of blockages and allows for the transportation of sewage over longer distances.
    b. Use of alternative wastewater handling (blackwater and greywater separation)
    c. Aeration of Sewage before it reaches treatment plants
    d. Possibility of monitoring vacuum station and collection chambers from remote
6. **Reduces Odor Issues**
    a. Due to the velocity of the system, septicity is unlikely to occur and the likelihood of foul odours is minimized. The closed nature of the vacuum sewerage system prevents the release of unpleasant smells, contributing to a more pleasant urban environment.

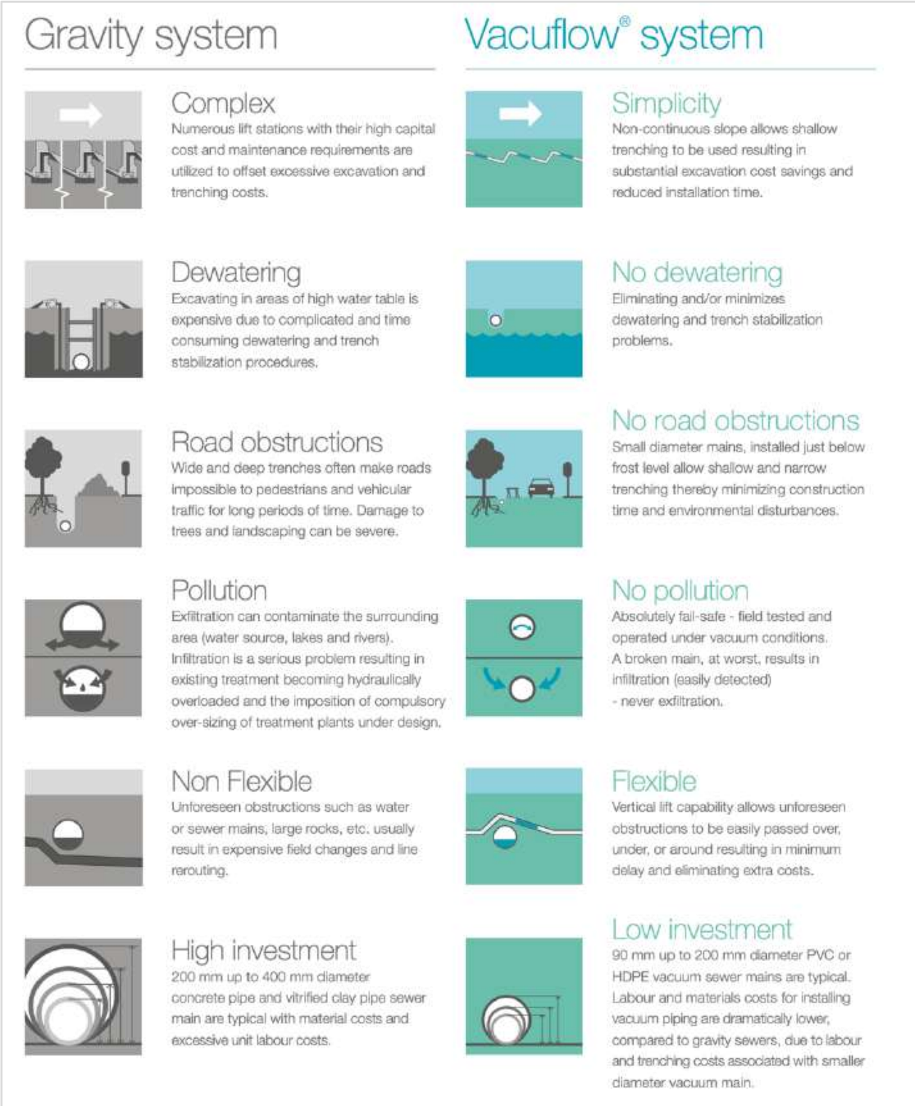


Fig 2: Advantages of Vacuum Sewer Systems Vs Conventional Sewer Systems

Applications:

1. Where expensive and big construction work is to be avoided.
2. Vacuum sewerage systems are ideal for:
    a. Flat areas with high ground water table
    b. Sea side areas
    c. Environmentally sensitive areas
    d. Rocky areas, Islands, artificial islands and areas where there is not much space for installation of a sewerage system.

Application in Agra

Tajganj, located in the historic city of Agra, is a densely populated area surrounding the Taj Mahal. It faces unique geographical and infrastructural challenges that hinder the installation of conventional sewer systems. Being a low-lying area, traditional gravity-based sewerage systems prove ineffective due to insufficient natural slope for wastewater flow. Additionally, the narrow lanes and congested urban fabric of the old city make excavation and installation of large-diameter sewer pipes difficult. Given these constraints, a vacuum-based sewer system was identified as the most suitable solution for effective wastewater management in Tajganj.

Name of the Technology: Vacuum Sewer Technology
Purpose: To provide sewerage system in low lying areas of Agra ABD
Technology Provider: Qua-Vac Infra Sewage Systems, Netherlands
Project Completed on: September 2021

Table 1: Design parameters for Vacuum sewer technology in Agra

Design Parameters	
Population	2500
Households	500
Daily Sewage flow	0.62 (MLD)
Project Highlights	
Smart Manholes with valve sensors and LoRA based Monitoring Devices	112 Nos.
Vacuum Sewer Main	1.8 km
Vacuum Station VS1	6.2 m x 5.2 m
3 x 100 M^3/hr Vacuum pumps	
2 x 425 L/min Discharge pumps	

To maintain the cleanliness of the Yamuna River (situated behind the Taj Mahal) and its surroundings, the vacuum sewer system was implemented under the Agra Smart City Project. The system effectively collects household wastewater and pumps it to the existing Dhandupura STP for treatment and discharge.

- The vacuum sewer network covers 500 houses in Tajganj, ensuring efficient wastewater collection.
- Automated monitoring systems, including vacuum sensors and level sensors, ensure seamless operation.
- An alert/alarm system is integrated to notify the Integrated Command and Control Centre (ICCC) in case of leaks, voltage fluctuations, or other operational issues.

Fig 3: Smart Manholes in Tajganj, Agra

Fig 4: Vacuum Sewer Main (1.8 km)

Fig 5: Vacuum Station

Fig 6: Display to monitor running of vacuum pumps and discharge pumps

Annexure 4: ESCO Model for Water Supply System, Dehradun

Introduction to the ESCO Model

In India, water supply systems (WSS) project, including operations and maintenance are often dependent on grants and aids from state or central governments. Sometimes the implementation agencies might face challenges in securing of funds, it becomes imperative to explore new and innovative approaches, which would not only help in increasing the overall efficiency of the system but will also contribute towards revenue generation.

One potential strategy to address these challenges can be the involvement of Energy Saving Companies (ESCOs). These companies offer energy services, which are typically design, retrofitting and implementation of energy efficiency projects, after identifying energy saving opportunities through energy audit of existing facilities. They utilize the Energy Saving Performance Contracting (ESPC) Model. ESCOs operate on a principle where facility owners do not need to invest upfront capital for energy efficiency projects and payment for these investments is adjusted from savings. This is facilitated through ESPCs, where payments are based on meeting predefined performance guarantees related to energy efficiency. This coupled with implementation of a SCADA system could offer a pathway forward to enhance efficiency in the WSS.

How it Works:

The ESCO model is a form of contracting agreement which is generally used in energy consumption -intensive industries. It is also known as “shared saving model” since it assumes both the technical and credit risk. As part of this model, ESCO firm is responsible for inspecting, analysing, assessing, and estimating the necessary works required to achieve at least 10% energy saving against the present energy consumption. The selected ESCO firm is also responsible for the Operations and Maintenance (O&M) of the system for a period of 10 years, i.e., guaranteed saving for 10 years.

- If overall saving is less then the 10% guaranteed saving, then ESCO firm will not get any payment and even then will have to pay to compensate the balance in the 10% guaranteed saving.
- If overall saving is more then the 10% guaranteed saving, the net saving after guaranteed saving will further breakup in ratio of 25% of net saving to client and 75% of net saving to ESCO firm as approved in bid of lowest ESCO firm.
- On completion of “ESCO O&M period” the contractor shall handover the project to the end-user or owner.

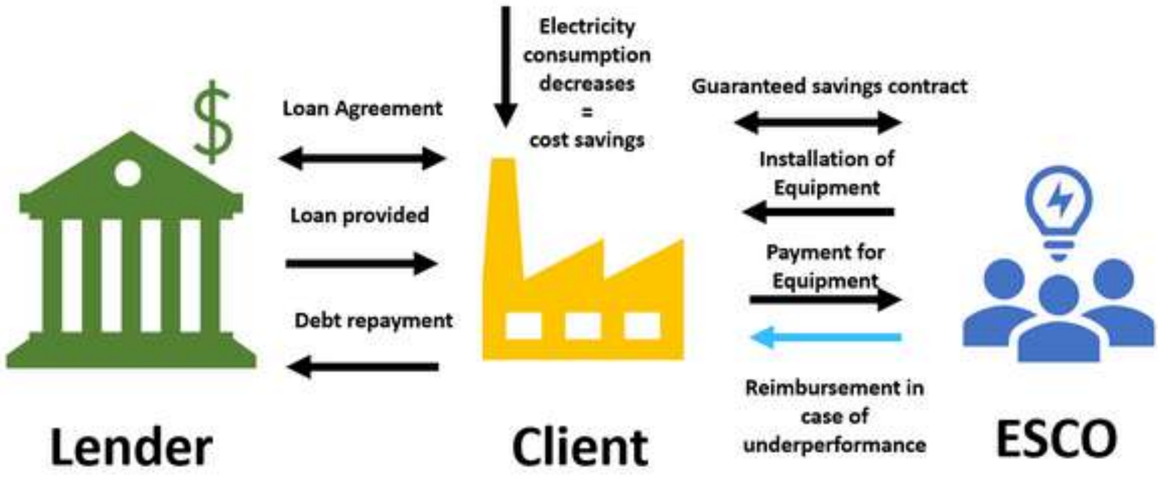


Figure 1: ESCO model diagram, Source: Google Images

Benefits over Conventional EPC Model

1. Energy Efficiency Improvements

- Optimized Operations: ESCOs bring expertise in optimizing water supply systems' energy use. By implementing energy-efficient technologies (e.g., energy-saving pumps, smart controls, or automated systems), ESCOs help reduce energy consumption in water distribution and treatment processes.
- Retrofitting Solutions: Water utilities can upgrade old, inefficient infrastructure with modern, energy-efficient equipment, reducing operational costs.

2. Cost Savings

- Reduced Energy Bills: ESCOs focus on improving energy efficiency, which directly translates to lower energy consumption and reduced electricity bills for water utilities.
- Performance-based Payments: In the ESCO model, the client typically pays based on the energy savings achieved, so the utility does not bear the upfront cost burden.

3. Risk Transfer

- Shared Financial Risk: Since ESCOs guarantee a certain level of energy savings, the financial risk is often shared between the service provider and the water utility. If energy savings don't meet expectations, the ESCO may be responsible for the shortfall.
- No Initial Investment: In many cases, the water utility does not need to invest upfront capital. The ESCO funds the project, recouping the investment through the energy savings over time.

4. Long-Term Sustainability

- Reduction in Carbon Footprint: By improving energy efficiency, the ESCO model helps reduce the environmental impact of water supply systems. This is in line with sustainability goals and can contribute to achieving climate change targets.
- Sustainable Operations: ESCOs can also implement renewable energy solutions, such as solar power for water treatment plants, making the system more self-sufficient and environmentally friendly.

5. Access to Latest Technology

- Advanced Technologies: ESCOs bring advanced knowledge and technologies, helping water utilities upgrade to modern, more efficient systems. This could include smart meters, SCADA systems, advanced filtration technologies, and more.
- Continuous Monitoring: ESCOs often provide ongoing monitoring and maintenance to ensure that the energy-saving measures continue to perform optimally.

ESCO Model for Water Supply SCADA in Dehradun Smart City

Name of the Innovation: Smart Water Management using ESCO Model
Purpose: To make water supply services self-sustainable financially
Project Completed on: March, 2023
Details:

- Tri-party contract between Dehradun Smart city limited, Uttarakhand Jal Sansthan and Contractor M/s GCKC Project & Work Pvt. Ltd.
- Capex Amount: 24.80 Cr. As on date, 100% Completed and presently running under ESCO O&M
- Saving of INR 25.169 Cr. by Selecting ESCO model SCADA in PPP mode. (EFC MOM 01/11/19)
- ESCO firm has replaced all 206 nos. of in RRR mode by energy efficient new pumps with free of cost. The system has been upgraded with out any expenditure by the state Govt.

Scope of work:-

a. Dehradun Smart City Limited (DSCL)
    - Provisions of INR 25,06,66,414/- for control and Measurements Equipments or automation Equipments.

b. Contractor firm (GCKC Pvt. Ltd.)
    - Installation Of SCADA Software and manage Remote Operations of T/W ,OHT & BPS’s.
    - Up Gradation of pumping machinery with Energy Efficient Equipments.
    - 10% Guaranteed saving against Electricity use.

- Provision to provide 25% additional saving to DSCL if savings increase more than 10%(Guaranteed saving)
- Establishment of Master control Station.
- 10 years complete O&M of Tube wells in ESCO mode no additional amount will be provided other than energy savings.

Dehradun has had a piped water supply dating back to 1885, it started with a 25 km pipeline which has now expanded and evolved into a 564 km network comprising of 203 Tubewells/ booster pumps, 72 Over Head Tanks (OHTs) and 02 Water Treatment Plants (WTPs). All the water supply scheme in the city is implemented by Uttarakhand Pay Jal Nigam (UPJN) and maintained by Uttarakhand Jal Sansthan (UJS). Surface water is the main source of supply for the North Zone, whereas the other zones heavily rely on ground water for water supply. The current water supply infrastructure in Dehradun has been operational for more than three decades and running under stress for huge electricity bills while maintaining efficient water supply. Key components of Capital work include:

i. Fixing flow meters, energy meters, depth sensors and pressure Transmitters.
ii. Fixing valve actuators, RTU panels and automatic power factor controlling panels.

Annexure 1ure

iii. Establishment of PLC SCADA with MCC room for round the clock monitoring and mobile connectivity to reduce down time.

Conducting the base line Survey for one month on all Pumping stations with a view to calculate existing energy consumption.

iv. The old inefficient Pump-sets replaced by Franklin make highly efficient Pump-sets.
v. Upgradation of all electrical and instrumentation control panels.
vi. Establishing war room for quick response and minimum down time

OuFigure 2: SCADA Dashboard for Dehradun Smart City water supply project

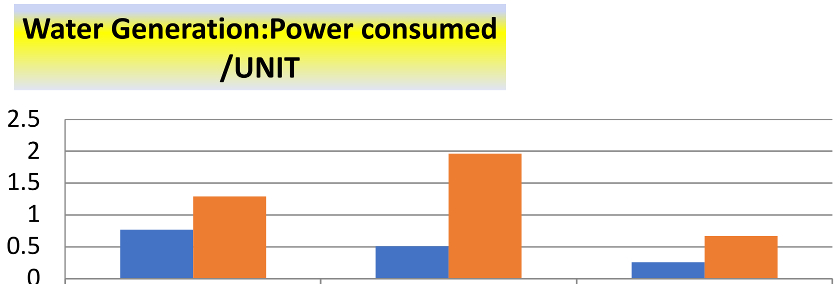
Figure 3: Implementation images from Dehradun Water Supply Project capital work

Outcomes:

Table 1: Power Consumed per unit for Water generation

ESCO O&M Energy Saving Received Approx. 1.49Cr./Month

ESCO O&M Energy Saving Received Approx. 34.07%



	Old machinery 1	During ESCO O&M up to Dec. 2023 2	Difference 3
KWh consumed/KL of water production	0.7724	0.5093	0.2631
KL of water produced per unit power consumed	1.2945	1.9633	0.6688

Table 2: Average e-value comparison pre and post implementation of ESCO model in Dehradun

S.No.	Zone	Average e-value during baseline (pre-implementation of ESCO model)	Average e-value from May-Dec 2023 (post implementation of ESCO model)	% reduction in e-value
1	Pithuwala	0.6331	0.4552	28%
2	South	0.9524	0.6560	31%
3	North	1.0696	0.7435	30%
4	Raipur	0.6732	0.5531	18%
	Overall	**0.8857**	**0.62757**	**29%**

Awards and Appreciations:

- ET Global Forum and Awards 2020 in one Category – Best Public Private Partnership (PPP) Initiative of the year SCADA Project.
- India Smart City Award Contest 2020 winning in Category- Smart Water Management Project Category.
- Elects' 2nd National Water & Sanitation Innovation Summit & Awards 2021 -Leading SCADA Implementation by a State for Water Management.
- India Scotch Award 2023- Water Supply Augmentation.
- During CAG Performance Audit the audit team appreciated the Smart Water Management Project as best practices of Dehradun Smart City Project.

Annexure 5: City wise Matrix of ICT Interventions

Cities using only IoT devices for monitoring of the WATER SUPPLY system (9 cities)	
1	Aligarh
2	Chennai
3	Diu
4	Kochi
5	Karimnagar
6	Lucknow
7	Satna
8	Shivamogga
9	Tumakuru

Cities using ICT including SCADA for monitoring of the WATER SUPPLY system (10 cities)	
1	Ajmer
2	Davanagree
3	Kota
4	Jabalpur
5	Kakinada
6	Nagpur
7	Panaji
8	Ranchi
9	Raipur
10	Vishakhapatnam

Cities using ICT including SCADA for monitoring of the WATER SUPPLY system			
1	Ahmedabad	18	Nashik
2	Agra	19	Prayagraj
3	Bhopal	20	Pimpri Chinchwad
4	Bareily	21	Pune
5	Coimbatore	22	Rajkot
6	Chandigarh	23	Srinagar
7	Dahod	24	Surat
8	Dehradun	25	Solapur
9	Faridabad	26	Thoothukudi
10	Gandhinagar	27	Thanjavur
11	Greater Warangal	28	Tirunelveli
12	Indore	29	Tiruchipalli
13	Karnal	30	Tiruppur
14	Kanpur	31	Thiruvanthapuram
15	Moradabad	32	Vadodara
16	New Town Kolkata	33	Varanasi
17	Naya Raipur/ Atal nagar		

Cities using ICT including SCADA for monitoring of the WATER SUPPLY system			
1	Amritsar	21	Kohima
2	Aizawl	22	Kalyan Dombivli
3	Agartala	23	Ludhiana
4	Aurangabad	24	Muzaffarpur
5	Belagavi	25	Madurai
6	Bengaluru	26	Mangalore
7	Bhubaneshwar	27	Namchi
8	Bhagalpur	28	New Delhi
9	Bihar Sharif	29	Puducherry
10	Bilaspur	30	Pasighat
11	Erode	31	Rourkela
12	Guwahati	32	Shimla
13	Gangtok	33	Shillong
14	Gwalior	34	Salem
15	Itanagar	35	Silvassa
16	Imphal	36	Sagar
17	Jaipur	37	Saharanpur
18	Jhansi	38	Tirupati
19	Jammu	39	Thane
20	Kavaratti	40	Udaipur
		41	Vellore

Graphics by NIUA team