

SMART Technology Approach for WASH

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CWAS CENTER
FOR WATER
AND SANITATION
CRDF CEPT
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Gates Foundation

viega foundation

Small cities, Big Impacts !!!

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

Unprepared for the impact

Less focus of services impacts on climate



Inadequate staff

- Low technical staff
- Low engineering capacity



Distinct budget size

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



Insufficient infrastructure

CPCB mentions,

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

Need for innovation to solve modern urban challenges and achieve sustainable development

Urban Challenges

 <p>Traffic Congestion & Mobility</p>	 <p>Housing Shortage & Informal Settlements</p>
 <p>Unchecked Urban Expansion & Lack of Planning</p>	 <p>Governance & Financial Constraints</p>
 <p>Lack of Inclusivity & Biased Development</p>	 <p>Ecological Neglect & Incomplete Solutions</p>



India's National Missions oriented towards SDGs



National Urban Livelihoods Mission
Ministry of Housing & Urban Poverty Alleviation

Digital Technologies – Need of the hour to “modernize” WASH



Scale and variability of development needs in India is huge but human resource relatively limited



Some problems are decision and human resource intensive – segregation?



While for others, need to move away from human touch!

Moving to a “Developed” mindset!



Moving from infrastructure creation to service delivery

Data driven planning requires “digital data” & continuous, real-time monitoring

There is a need to go from “firefighting mode” to “predictive management”

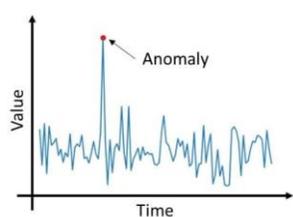
Various Government programs supporting digital shift and providing push for integration of digital technology to strengthen public services



Leverage tech and data to enhance services, sustainability, quality of life and economic growth

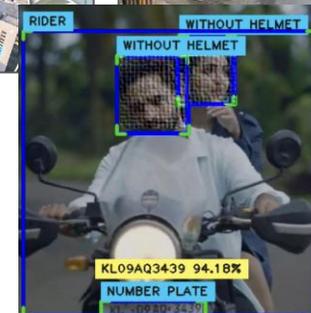
How can digital tech help?

Process large datasets to find trends and connections IoT devices – constantly collect data that may be converted to that may be missed by humans “actionable information” - image recognition, Speech recognition



Indian cities are taking it up in a big way

Urban mobility sector is the biggest adopter



Property tax assessment

- Property tax is one of the key sources of own revenue for Indian city governments
- Reassessment of property tax mandated by Municipal Acts of most states every 4-5 years – ensuring fair and updated taxation
- Billing efficiency – Often property tax billing covers only **63–80%** of eligible properties
- Reassessment is a very intensive exercise requiring highly skilled human resources.
- Modern Drone-based surveys and AI are making this easier



France and Greece – AI for improving property taxation

- Both countries tax swimming pools in properties as a “luxury living tax”
- Using drone / aerial images and AI to detect undeclared swimming pools and apply progressive tax based on size of pool
- In France – over 20,000 undeclared pools detected in 9 regions
- Further looking at undeclared annexes, extensions and verandas including permanent pergolas.



MCG & MCM now take AI route to boost property tax collection

Vishakha Chaman / Aug 07, 2025, 04:00 IST



Gurgaon: MCG and MCM have introduced artificial intelligence (AI) to boost revenue from property tax. MCG has so far generated a revenue of Rs 200 crore, which is around 72% of its target set for FY26, and MCM's has already crossed the Rs 29 crore-mark, the revenue it generated in the last

fiscal year.

Using AI, residents with outstanding dues are being identified and approached and their queries resolved. AI also assists them in paying their property tax dues.

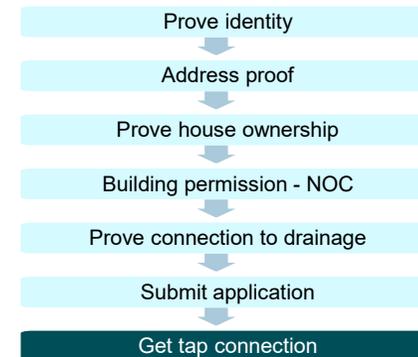
"We are using AI to boost our property tax collection. We have so far collected a

Gurgaon – AI phone bots to boost collection efficiency

- Collection efficiency of property tax in India is often low – high arrears, exemption schemes needed
- Gurgaon and Manesar governments – AI based phone robots called a list of property owners with the highest dues
- Bot gives reminder to pay and inquires about difficulties in payments – customer issue database created
- Most of the people contacted ended up paying the taxes

Water sector – data system strengthening to enable last mile connectivity – “har ghar nal se jal”

- The AMRUT mission has enabled networks to reach to vulnerable areas, though household connections need improvement
- A CWAS study noted that cities are improving “affordability” of getting connections, but legal and administrative barriers remain.
- In many cities, applying for a water connection requires submission of upto 20 legal documents



In India, linking identity proofs has streamlined banking and income tax. Can this help with urban services also?

Synchronize public databases for e-services?

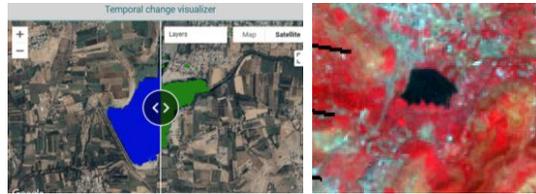


Lakes and remote sensing

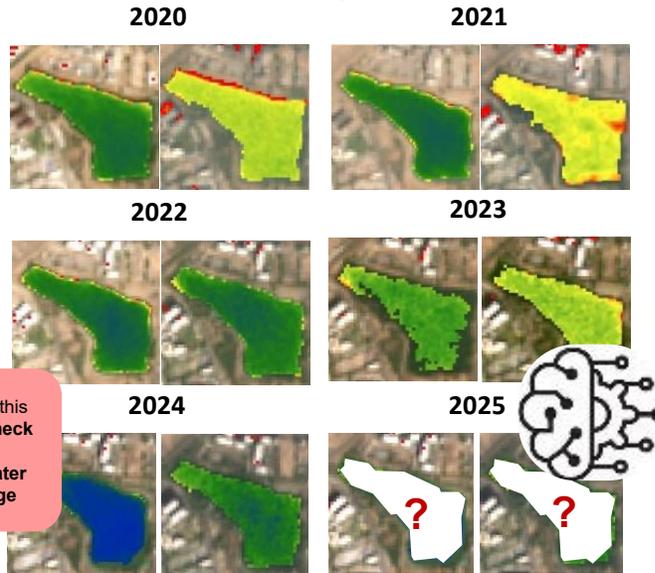
Harnessing digital technology for lake governance



- Using satellite images to estimate water spread and quality – no need for intensive lab testing
- Visualize across time
- Parameters like turbidity, PH, dissolved oxygen, chlorophyll, salinity etc



Machine learning to “predict”



Actionable insights for lake governance

Surface area of this lake is reducing year on year – **Check for encroachments**

High Nitrogen detected – **Check sewage outflows**

Dry lake this year – **Check for stormwater blockage**

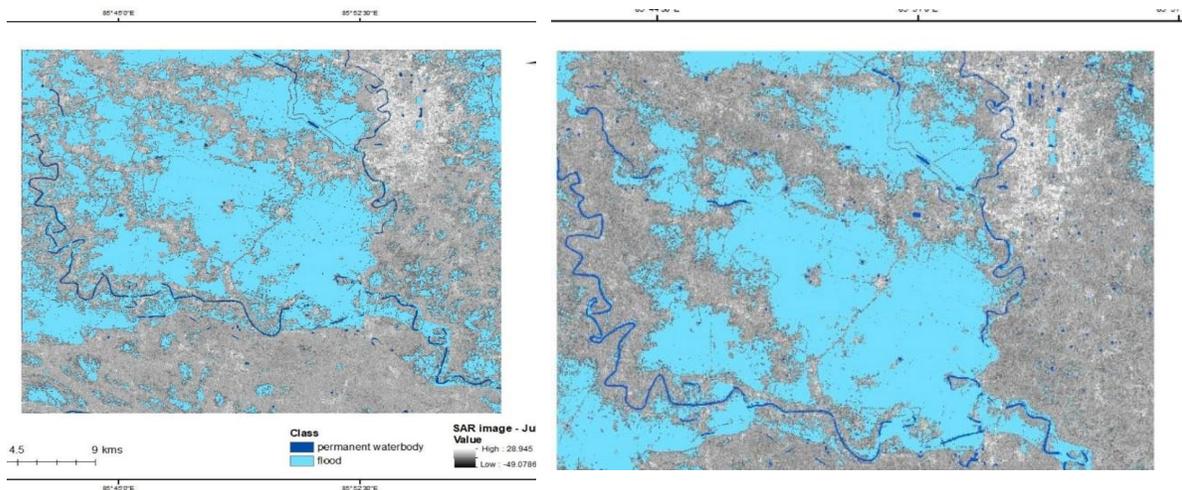
WQI increased

Application for Nadasan Lake

- Analysis and recommendations for lake improvement requested by local government
- Lake covered by hyacinth and water was accumulating in adjoining plot
- Contour analysis revealed natural flow paths had been disrupted by silting of original lakebed due to long-term wastewater disposal



Flood risk mapping using remote sensing



Solid Waste Management - Segregation

Segregation of waste

- Indian cities generate ~160,000 tonnes of municipal solid waste every day
- Most goes to dumpsites, which are already overflowing.
- Segregation helps divert 60–70% of waste away from landfills
- However, segregation is very human resource intensive



Sharjah – AI and robotics for waste



Combining AI, Camera inputs and robots to automate waste segregation - achieving 76% waste diversion rate

Illawarra, Australia – Rejecting plastic bags during collection



Household waste trapped in plastic bin bags makes segregation difficult. A pre-trained dataset curated from historical records of the recycling company Remondis uses camera footage directly from trucks to detect plastic bags in collected waste

Trashcon – segregation at treatment plant



Combination of mechanical and digital technologies to segregate waste on conveyor belts – size-based separation, weight-based separation, magnetic separation, AI / computer vision-based separation



Solid Waste Management - Collection

Collection of waste

- Door to door collection is also capital intensive, human resource and infrastructure intensive – a large amount of waste remains uncollected in cities
- – Garbage Vulnerable points - If collection coverage is low, uncollected waste is often visible on vulnerable points like street corners, open plots etc
- Uncollected waste on the roadside is often burned in Indian cities. Open burning of waste produces black carbon – a major short lived contributor to global warming



GIS-based route optimization for waste collection



- Daily D2D collection routes optimized using python code - Geospatial Distance Calculation, Route Distance and Time Estimation algorithms
- New optimized route resulted in - educe daily travel by 4.4 km per vehicle, leading to annual savings of approximately 30-35% of fuel costs per route and an estimated 536 kg reduction in CO₂ emissions each year per vehicle/route.

Clearbot – Autonomous trash robot



- Lake cleaning and pollution detection-trash, water hyacinth
- Autonomous – swim on its own
- One robot is able to collect a metric ton of trash a day

CCTV and Drone based surveillance – computer vision for illegal dumping, open burning



Monitoring of Garbage Vulnerable points through computer vision analytics

SMART bins

- Bin overflow monitoring through computer vision analytics
- Daily route assignment for pickup truck based on fill capacity of bins



Sewers and storm water drain maintenance

Sensors and machines for cleaning and inspecting sewers



- Choking and overflow of sewers is a common problem especially during monsoons
- In India, laws ban manual scavenging mandate mechanized cleaning
- Need to move away from “complaint redressal” to preventative maintenance – do not wait for the sewer to overflow

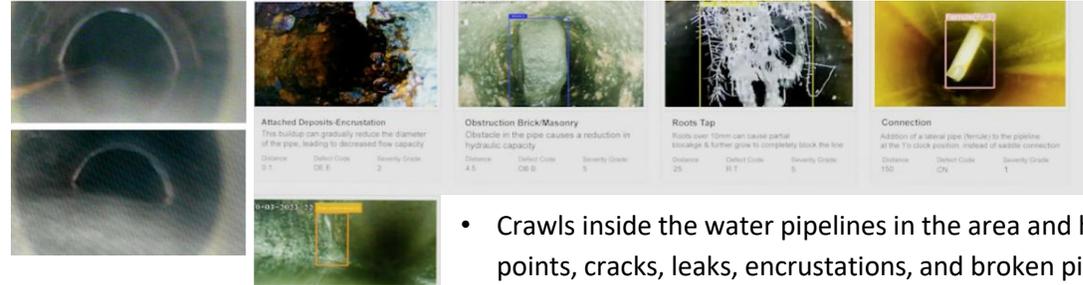
Stormharvester Intelligent sewer suite - UK



- IoT sensors under access covers and at outlets
- Alerts about blockages and potential pollutants
- Anomaly detection



Endobot robot and Swasth AI – Chennai, Goa



- Crawls inside the water pipelines in the area and helps identify contamination points, cracks, leaks, encrustations, and broken pipe walls
- Inclination calculations / network mapping for old infrastructure

Xena 6.0 Robot



Homosep Robot



Wipro Sewage Monitor



C-DAC Sewage Monitoring Sensor



Bandicoot robot – Kerala



- Equipped with human-like arms and a range of gas sensors to identify and assess sewage conditions inside drainage chambers
- Machine Vision: It uses machine vision technology for operators to see inside manholes, even in low-light conditions.

Bringing the small city governance into the age of technology



While India's SMART (and large) cities are building integrated command and control centres,

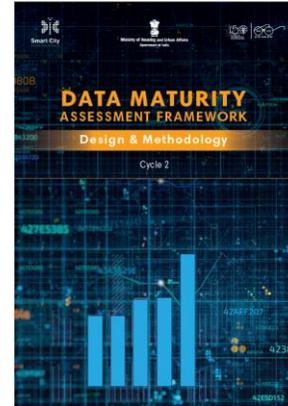
The reality in small cities is this



 No digital data for AI to work on!!
 Where to put the sensor??



Data Maturity Assessment Framework – needs to extend to all cities



DMAF 2.0 Performance Overview of 100 Smart Cities

DMAF 2.0 Performance Overview of 100 Smart Cities



45 Cities have drafted/approved their **City Data Policies**

69 Cities have deployed sensors for data collection across urban sectors.



32 Cities

had a **dedicated data budget** in 2020-21 for data-related activities.



63 Cities

have **published >30 datasets** on the Smart Cities Open Data Portal.



100 Cities have appointed **City Data Officers**.

62 Cities

have created **GIS layers** to view data effectively and support urban planning.



12 Cities

have formed **data alliances** and have achieved tangible outcomes.



29 Cities

have published **60+ data stories/blogs** on the Smart Cities Open Data Portal.



10 Cities

have conducted **data hackathons** for solving urban challenges.

32 Cities

are working on use cases using city's data to solve urban challenges



35 Cities

have leveraged their **data analytical capabilities** to generate actionable insights from available city data.



41 Cities

have leveraged their data for development of **portal and applications**



Technology uptake with caution!

THE WATER FOOTPRINT OF AI

A HIDDEN ENVIRONMENTAL IMPACT

- 1 Power Consumption**
A typical AI query for a model like GPT-3 consumes approximately 0.0006 kWh of electricity.


- 2 Water for Electricity**
In the U.S., it takes an average of 1.8 liters of water to generate 1 kWh of electricity. For a single 100-word query, this translates to a water footprint of 0.00108 liters (or 1.08 milliliters) for electricity generation.


- 3 Water for Direct Cooling**
Water use for cooling at data centers varies between 1 to 3 liters per kWh - thermoelectric plants! This adds an estimated 1.2 to 1.8 milliliters of water for a 100-word response.


- 4 The Total Water Footprint**
The total water consumption for generating a 100-word ChatGPT response is estimated to be between 2.28 and 2.88 milliliters.


- 5 The Bigger Picture**
If ChatGPT processes 1 million queries daily (each averaging 100 words), the water footprint amounts to 2,280 to 2,880 liters per day or up to 1.05 million liters annually.


- 6 Solutions**
Shift to renewable energy sources like solar and wind power. Adopt advanced cooling technologies like immersion cooling and free cooling to reduce water consumption.





"GIGO" stands for "Garbage In, Garbage Out," a principle in computer science - the output's quality is directly determined by the quality of the data fed into the system

Infamous case of / Grok

Grok AI trains using data on X – formerly known as twitter (such as public posts by users) to provide “up-to-date information and insights.”

A dangerous game – user comments may contain bias and cannot be taken as fact !



What we humans can still do better than AI



Natalie Laderas-Kilkenny The Bloke. (2024). Mistral Instruct (1.7B) [Large language model]. <https://huggingface.co/mistralai>

Thank You

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