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Enabling Circular Economy in Used Water Management in India

A Municipal Index for Assessing Urban Local Bodies' Performance

Saiba Gupta, Kartikey Chaturvedi, Ayushi Kashyap, and Nitin Bassi

Report | March 2024

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Contents

Treated used water can be used for numerous applications such as in parks and gardens, irrigation, industries, construction, road cleaning, and more.

Image: iStock

Executive summary

In 2021, Indian cities generated over 72,000 million litres of used water (domestic sewage) per day, of which only 28 per cent was actually treated (CPCB 2021). The remaining used water was discharged into natural water bodies, such as rivers and lakes. This is one of the main reasons for high levels of pollution in Indian rivers during non-monsoon months. The pollution load is concentrated in the stretches of rivers passing through urban areas, especially metropolitan cities. Further, the problem of water security is severe in rapidly growing urban areas, where there is increasing pressure on existing freshwater resources to meet the growing water demand. Given the quantum of used water generated in the country, reusing treated used water (TUW) can reduce the pressure on freshwater resources and water demand-supply gap, and improve the water environment in urban areas. Bassi, Gupta, and Chaturvedi (2023) estimate that sewage treatment capacity will be 80 per cent of sewage generation by 2050, making over 96,000 million litres per day of TUW available for reuse in India.

Over 96,000 million litres per day of treated used water will be available for reuse in India by 2050

Used water management, therefore, needs to be prioritised as an essential urban service. Urban local bodies (ULBs), which are the implementing authorities responsible for developing and maintaining used water infrastructure and service delivery in Indian cities, need to align with SDG 6.3: "By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally." In this context, the Government of India has recently undertaken various initiatives that focus on urban areas, to strengthen used water treatment and promote its reuse, and work towards water pollution abatement. Some of the important ones include the *Namami Gange Programme* and the *Atal Mission for Rejuvenation and Urban Transformation (AMRUT)*.

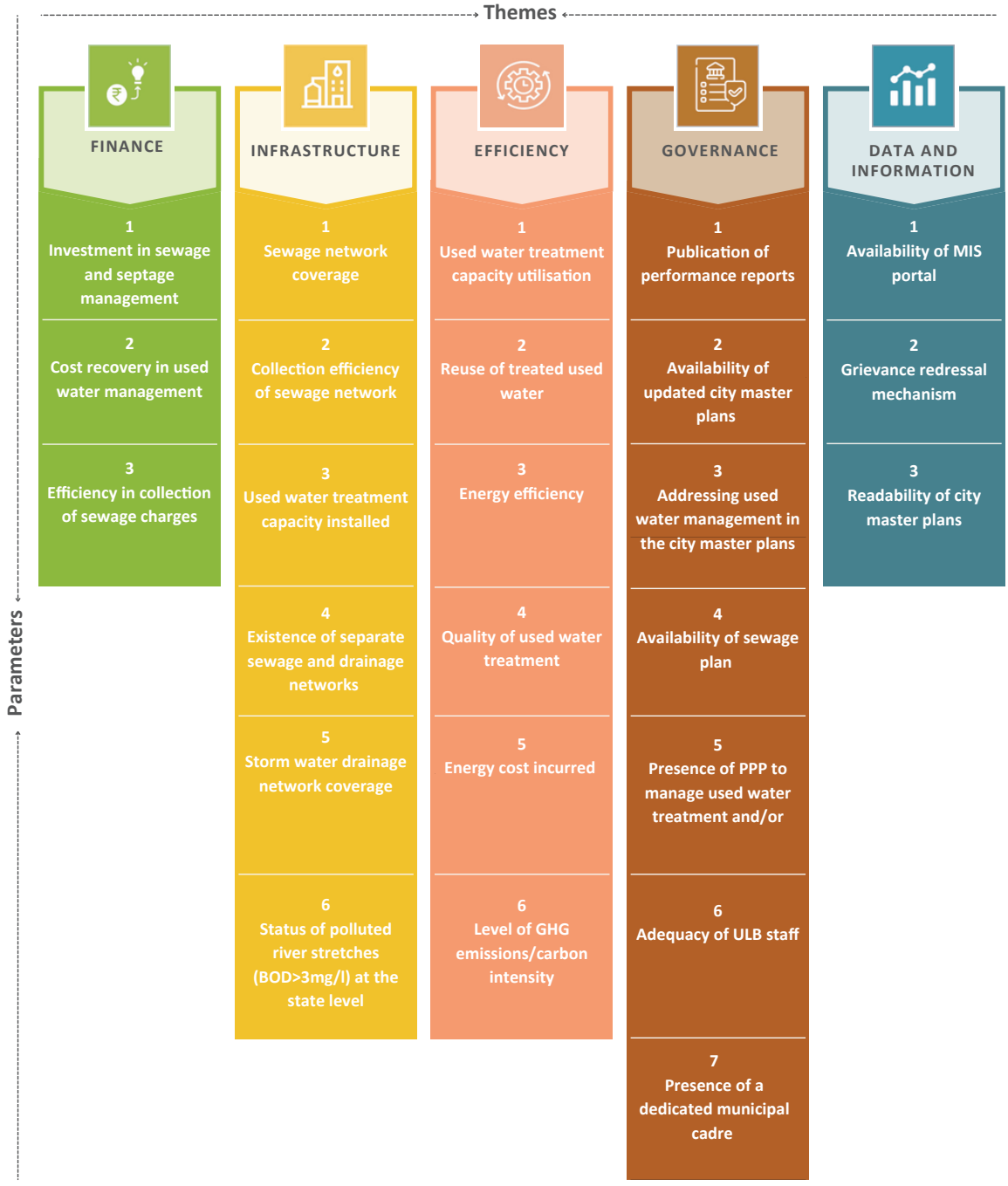
A. Objective of the Municipal Used Water Management index

Considering the importance of TUW, the objective of this research study was to develop and compute the **Municipal Used Water Management (MUWM) Index** for ULBs in India, to assess their performance in used water management. For this purpose, **503 ULBs** from class I (population above 1,00,000) and class II (population of 50,000–99,999) cities in **10 Indian states** that have adopted a TUW reuse policy were selected. The states were Andhra Pradesh, Chhattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Madhya Pradesh, Punjab, Rajasthan, and West Bengal. These progressive states had adopted reuse policies prior to the formulation of the *National Framework on Safe Reuse of Treated Water (SRTW)*, launched in January 2023 by the *National Mission for Clean Ganga (NMCG)*. As a first-of-its-kind, the MUWM Index highlights the progress made by ULBs in implementing a circular economy approach to urban used water management in India.

B. Methodology for the development and computation of the ULB-level MUWM index

To assess the performance of the selected 503 ULBs in the management of used water, a MUWM assessment framework was developed. The framework is based on a themes–parameters–indicators (TPI) approach, consisting of 27 indicators under 25 parameters across 5 themes. The themes and parameters are presented in Figure ES1.

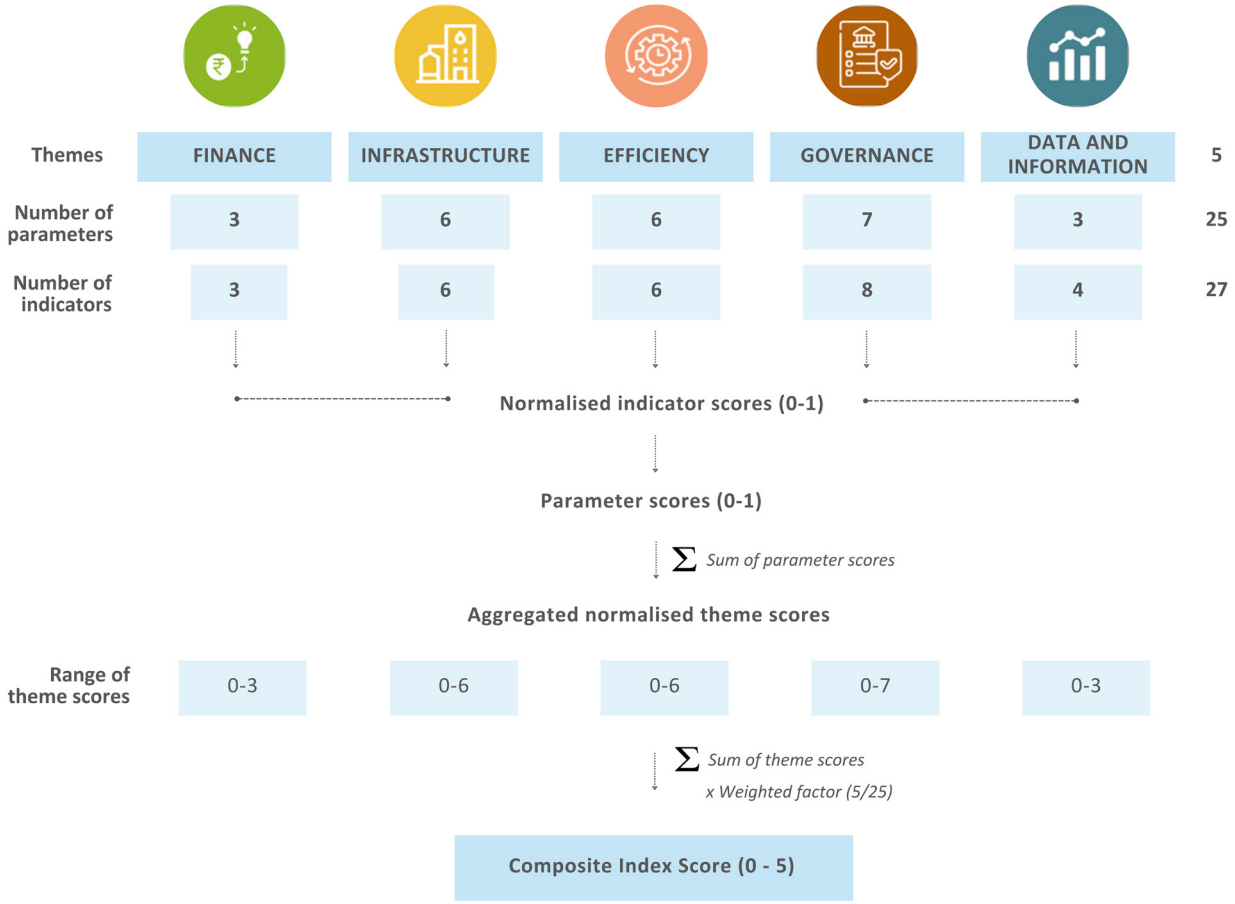
Figure ES1 MUWM assessment framework



Source: Authors' analysis

Each of the 25 parameters has one or more corresponding indicators that were used to compute the MUWM index. The indicators are both quantitative and qualitative in nature and are used to assign a score to the ULB, based on its performance in the corresponding parameter. The composite score computed for each ULB is on a scale of 0–5. The methodology used to compute the composite score for the ULBs is shown in Figure ES2.

Figure ES2 Methodology for computing the MUWM index composite score



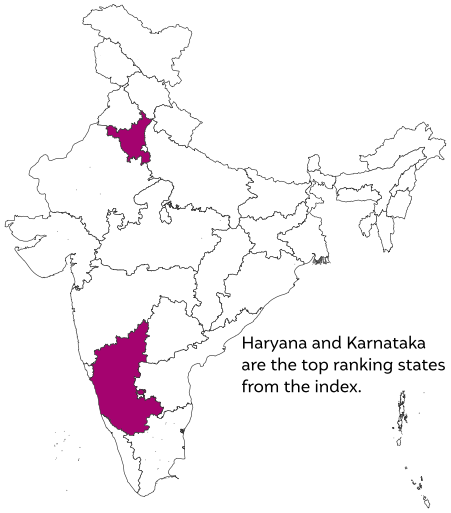
Source: Authors' analysis

C. Key findings

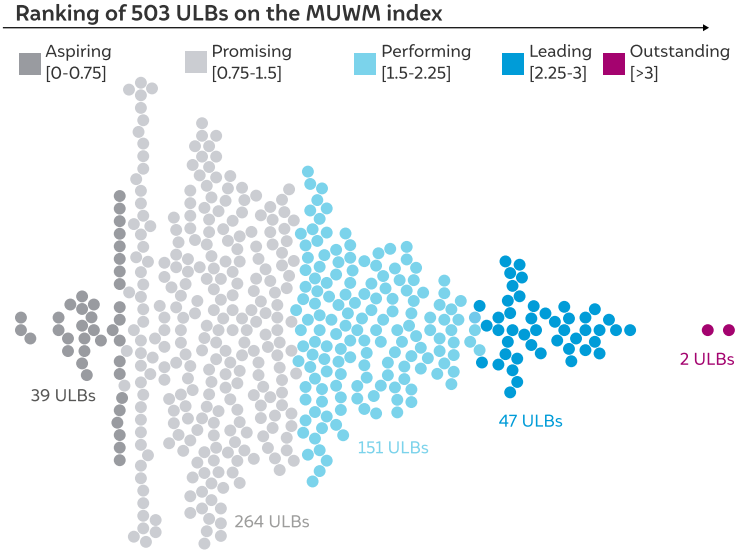
Based on their index composite scores, the 503 ULBs were classified into five award categories, reflecting their performance in used water management (Figure ES3). The categories are Aspiring, Promising, Performing, Leading, and Outstanding, with Aspiring representing the lowest scoring ULBs and Outstanding the highest. The score ranges for the award categories are based on the minimum and maximum composite scores achieved by the ULBs on the MUWM index. Further, the thematic assessment of ULBs is based on theme scores, calculated by aggregating the normalised scores of the individual parameters under each theme. State performance assessment is based on the state scores, calculated by taking the arithmetic mean of the aggregated composite scores of all ULBs considered in that state.

Figure ES3 Key findings of the MUWM index

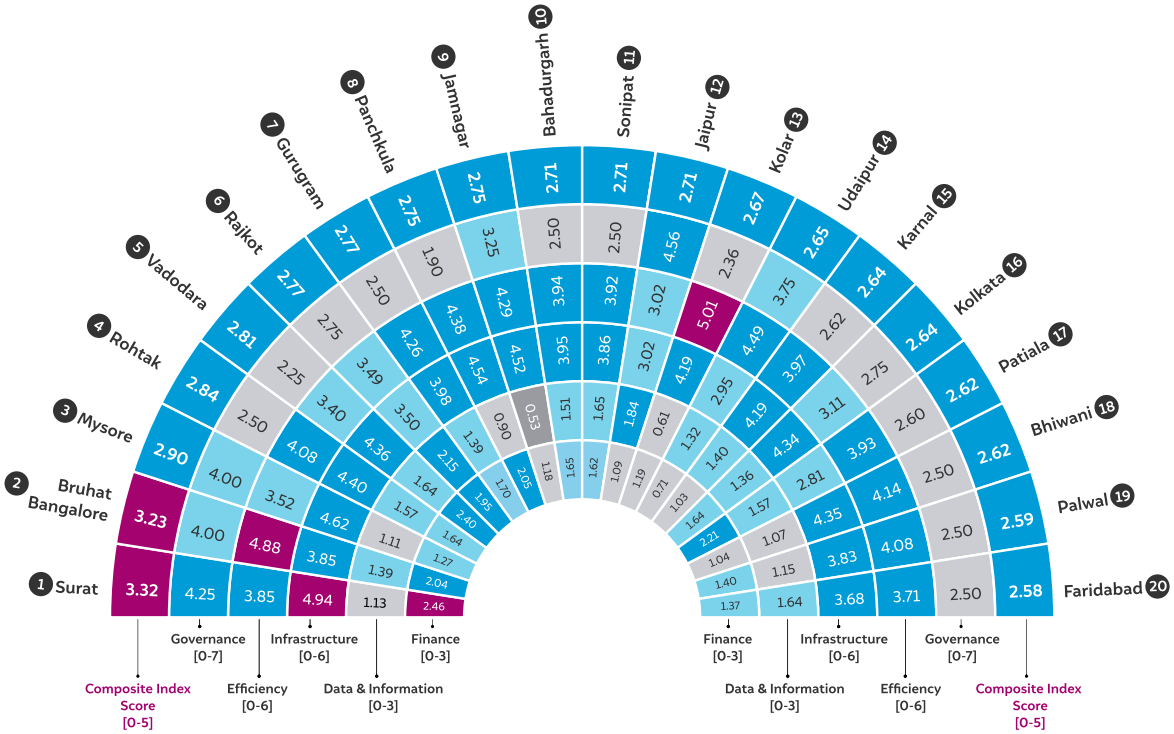
State snapshot



Ranking of 503 ULBs on the MUWM index



Top 20 ULBs on the MUWM index



How ULBs fare on the five themes of the index

90%
ULBs need targeted financial planning and investments in used water management.

78%
ULBs require strengthened governance measures in the sector.

60%
ULBs need to integrate efficiency measures with infrastructure planning.

49%
ULBs need to prioritise the availability and accessibility of municipal data related to used water management.

46%
ULBs have made substantial progress under infrastructure.

Source: Authors' analysis

(I) ULB performance as per the MUWM index composite score

- **52 per cent of ULBs fall under the 'promising' category as per the composite score**

  Of the 503 ULBs assessed, 264 (52 per cent) are categorised as promising (Figure ES3), which indicates that these ULBs have acknowledged used water management as a key focus area and are making efforts to mainstream reuse. However, their efforts are currently scattered, and they require a more holistic approach. Of the remaining ULBs, 151 (30 per cent) are categorised as performing, 47 (9 per cent) as leading, 39 (8 per cent) as aspiring, and only 2 (less than 1 per cent) as outstanding.

- **Surat and Bengaluru top the MUWM index**

  Two of the 503 ULBs assessed, namely **Surat Municipal Corporation (SMC)** and **Bruhat Bengaluru Mahanagara Palike (BBMP)**, are categorised as outstanding on the MUWM Index (Figure ES3). As per our analysis, the formulation of a dedicated action plan for used water management at the ULB level is a key enabler of their noteworthy performance. For instance, Surat has developed an action plan for the treatment and reuse of used water, which sets reuse targets for the city. Similarly, Bengaluru has formulated a comprehensive vision document for water management in the city, with quantitative and qualitative targets for sewage management.

(II) Thematic assessment

- **There is a need to focus on 'governance' and 'data and information' to improve used water management**

  According to the theme scores, 392 ULBs (78 per cent) and 246 ULBs (49 per cent) are categorised as promising under 'governance' and 'data and information', respectively (Figure ES3). This indicates that although efforts are being made under these themes by the majority of ULBs, these initiatives need to be strengthened further to make any substantial on-ground impact. Moreover, none of the ULBs are qualified as outstanding under these two themes.

- **Almost half of the ULBs assessed have made substantial progress under 'infrastructure'**

  Around 46 per cent of ULBs (230) are collectively categorised as performing and leading under the infrastructure theme (Figure ES3). This is the maximum number of ULBs under both these categories across all five themes. Hence, a considerable section of ULBs assessed have developed the primary infrastructure required for used water management.

- **Parameters under 'efficiency' need to be considered during infrastructure planning across ULBs**

  Almost 60 per cent of ULBs (295) are categorised as aspiring under the efficiency theme (Figure ES3). This indicates that parameters such as energy efficiency, used water treatment capacity utilisation, and quality of TUW under the efficiency theme are yet to be integrated with the infrastructure planning for used water management.

- **Targeted financial allocations are required for efficient used water management**

  About 90 per cent of ULBs (449) are collectively categorised as aspiring and promising under 'finance' (Figure ES3). This trend suggests that financial planning and investments in used water management are currently in the nascent stage, even in ULBs that have adopted state-level policies on used water treatment and reuse.

(III) State-wise performance as per the composite score

- **Western and north-western states and Karnataka are leading in used water management**

  Haryana and Karnataka have secured the top two state ranks, with scores of 1.94 and 1.74 out of 5, respectively (Figure ES4). These states have implemented comprehensive graded action plans for used water treatment and reuse. They have prioritised certain themes such as infrastructure and efficiency across all ULBs, leading to high state-wide performance on the MUWM Index. Punjab and Rajasthan follow on, in third and fourth positions, with scores of 1.71 and 1.57 out of 5, respectively.

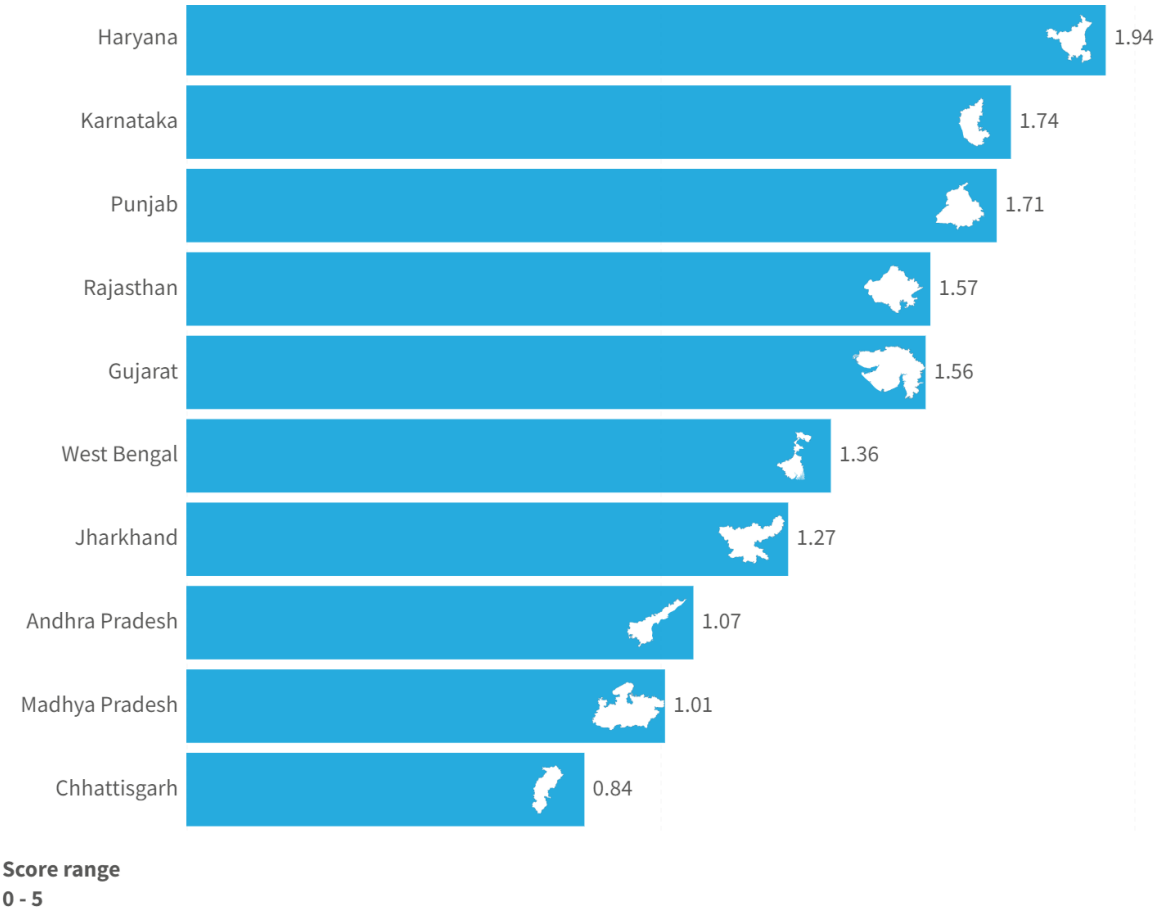
- **States in eastern India are catching up on used water management**

  In 8 out of 10 states, 85 per cent of ULBs collectively fall under the promising and performing categories. Notably, in states such as Jharkhand and West Bengal, nearly 90 per cent of ULBs belong to these categories, indicating significant progress in certain themes, with a long way to go to achieve comprehensive used water management.

- **The regular publication of performance reports can improve the accuracy of performance assessments of urban services across states**

  Chhattisgarh, Madhya Pradesh, and Andhra Pradesh are the bottom three states, with scores of 0.84, 1.01, and 1.07 out of 5, respectively (Figure ES4). These states have not put out compiled service-level benchmarking (SLB) performance reports in the public domain, in accordance with Ministry of Housing and Urban Affairs (MoHUA) directives. Thus, the lack of available data has affected the accuracy of performance assessments in these states, leading to low state-wide performance on the MUWM Index.

Figure ES4 Haryana and Karnataka are the top scoring states



Source: Authors' analysis using data sources for 27 indicators as detailed in Annexure 1

D. Conclusion and recommendations

Majority of the ULBs assessed using the MUWM Index have made notable progress in some aspects of used water management and are undertaking significant interventions to improve their performance. However, the reuse of TUW is an essential component of urban used water management, and is yet to be mainstreamed in Indian cities. The following are recommendations for mainstreaming the circular economy approach to urban used water management.

- **Empower ULBs to adopt long-term reuse plans**: The AMRUT 2.0 recommends the development of a city water action plan (CWAP) focusing on used water treatment and reuse, with the aim of meeting 20 per cent of the city's water demand through the reuse of TUW. ULBs, as the main implementing authorities, need to be empowered to formulate and adopt long-term, city-level reuse plans, with financially sustainable provisions for implementing reuse projects. These plans should align with the guidelines of the National Framework on SRTW and state-level reuse policies.
- **Enable the development of a comprehensive database to strengthen MUWM**: Access to updated and reliable data is essential to update existing reuse policies or formulate reuse plans. The comprehensive MUWM assessment framework allows ULBs across the country to maintain a baseline database for used water management. Also, performance assessments using the MUWM Index can provide ULBs with information on areas that require improvement, and enable them to formulate strategies to strengthen used water management in their jurisdictions. The index can hence be developed annually, based on a dynamic data inventory that is updated regularly with the support of ULBs.
- **Leverage existing national initiatives for used water management**: The progress of ULBs in terms of performance in used water management can be utilised by central and state governments as a criterion to provide incentives to local governments. Additionally, it can contribute to the Government of India's approach to mainstreaming river-centric urban planning, wherein reducing the demand for freshwater and abating pollution through effective used water management are important components.
- **Promote healthy competition among ULBs:** The 503 ULBs selected for this assessment belong to the 10 Indian states that have adopted TUW reuse policies. The implementation of these policies is a prerogative of local governments. Performance evaluations using the MUWM Index can foster a healthy sense of competition among ULBs, and help achieve the larger objective of mainstreaming used water treatment and reuse in cities.

The MUWM Index can aid municipal authorities in strengthening used water management and mainstreaming its reuse

India's urban local bodies are the paramount authorities in the management of urban domestic used water.

Image: iStock

1. Introduction

India's freshwater resources are under high pressure. As per our analysis using the Central Water Commission (CWC) estimates on basin-wise water availability (CWC 2021), 11 out of the 15 major river basins in India will experience water stress by 2025 (Bassi, Gupta, and Chaturvedi 2023), where the annual per capita renewable water availability will be below 1,700 cubic metres. Further, 311 river stretches in 279 rivers are polluted, with the biological oxygen demand (BOD) above the desired limit, i.e., 3 mg/L (CPCB 2022). Also, according to the Composite Water Management Index of India, about 70 per cent of India's water supply is contaminated (NITI Aayog 2019). Thus, both the quantity and quality of freshwater available are concerning. In the urban context, the problem is more severe, with rapid, unplanned urbanisation and industrialisation putting pressure on already stressed freshwater resources. Therefore, there is a need to look beyond conventional freshwater supplies. Reusing treated used water (TUW) offers one such opportunity.

Used water management needs to be prioritised as an essential urban service

In 2021, Indian cities generated over 72,000 million litres of used water (domestic sewage) per day, of which only 28 per cent was actually treated (CPCB 2021). The remaining untreated used water is discharged into natural water bodies, such as rivers and lakes, which pollutes the water and impacts communities, especially in the downstream areas.

Incorporating used water management as an essential urban service is important (Gupta, Chaturvedi, and Bassi 2023). In recent years, the Indian government has taken comprehensive steps towards strengthening used water treatment, promoting TUW reuse, and abating water pollution, through various national missions and initiatives. One such initiative is the *Atal Mission for Rejuvenation and Urban Transformation (AMRUT) 2.0*, launched in 2021 in 500 cities. The mission's reform agenda includes the development of a city water action plan (CWAP), which focuses on used water treatment and reuse, and aims to meet 20 per cent of city water demand and 40 per cent of industrial water demand through the reuse of TUW. Another initiative is the *Namami Gange* programme, which is being implemented to clean River Ganga and its tributaries. Among other things, the programme emphasises on the development of sewage treatment infrastructure, monetisation by urban local bodies (ULBs) through the reuse of TUW and sludge, and promotion of river-sensitive urban development. Further, the *National Framework on Safe Reuse of Treated Water (SRTW)* was launched by the *National Mission for Clean Ganga (NMCG)* in January 2023. The framework, while promoting the reuse of TUW for non-potable usage, provides guidelines for formulating state reuse policies and encourages the adoption of appropriate business models to ensure the financial viability of reuse projects at the city level. These initiatives by the Government of India align with SDG 6.3, which focuses on reducing water pollution and maximising used water treatment and the safe reuse of TUW.

Given this context, the CEEW has undertaken a study to estimate the market potential of the reuse of TUW (domestic sewage) at the national scale, and provide policy recommendations to strengthen the existing governance on used water management in the country (Bassi, Gupta, and Chaturvedi 2023). Following the study, we have developed and computed a **Municipal Used Water Management (MUWM) Index** to evaluate ULBs in India, based on their present performance in used water management. The ULBs selected for the assessment represent class I and II cities from 10 states in India that have adopted a TUW reuse policy (details in Section 2.4). The chosen states are Andhra Pradesh, Chhattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Madhya Pradesh, Punjab, Rajasthan, and West Bengal. These progressive states had adopted reuse policies even prior to the formulation of the *National Framework on SRTW*.

Given that the onus of implementing reuse policies lies with the local governments, the principal objective of developing the MUWM Index is to aid municipal authorities in strengthening used water management governance and mainstreaming the reuse of TUW. The methodology adopted to develop and compute the index is explained in Section 2. The results and findings of the MUWM Index are discussed in Section 3. The conclusion and recommendations are presented in Section 4.

2. Methodology

Image: Sneha Maria Ignatious/CEEW

CEEW team at a sewage treatment plant to understand its operation and monitoring systems.

The methodology adopted to develop and compute the MUWM Index in terms of the assessment framework, scoring, and selection of ULBs is explained in the following sections.

2.1 MUWM assessment framework

Reforms in governance, finance, technology and innovation, capacity building, and data and information are crucial to ensure progress towards achieving SDG 6 targets for safely managed water supply and sanitation. These five accelerators of the UN Water Global Acceleration Framework are equally crucial to the process of attaining SDG 6 (UN Water 2020). Based on this, a MUWM assessment framework was developed to evaluate the performance of selected ULBs in used water management. The assessment framework is based on a TPI (themes–parameters–indicators) approach, which consists of 5 themes and 25 parameters, with corresponding indicators that are crucial for comprehensive used water management in cities. These are the 5 themes used to assess ULBs:

Finance

The finance theme measures the amount invested, the method of cost recovery, and the overall effectiveness of public funds utilisation for used water management at the ULB level.

Infrastructure

The infrastructure theme assesses the extent of physical infrastructure for used water management at the ULB level – the existing used water treatment capacity, network coverage for sewerage and drainage, and water quality of water bodies.

Efficiency

This is an overarching theme that evaluates the efficiency of used water management systems at the ULB level, in terms of energy consumption, carbon emissions, actual used water treatment capacity utilisation, adherence to used water treatment quality standards, and the extent of reuse.

Governance

The governance theme gauges the effectiveness of municipal administration and governance instruments – city master plans, institutional capacities, and the implementation of TUW reuse projects at the ULB level.

Data and information

The data and information theme assesses the availability and accessibility of municipal data in the public domain, and the accountability of the administration in terms of grievance redressal for used water management–related services at the ULB level.

The MUWM assessment framework consists of 5 themes and 25 parameters, with corresponding indicators that are crucial for comprehensive used water management in cities

Each theme has a set of parameters with corresponding indicators that are used to assess the ULB's used water management. The theme-wise parameters are presented in Figure ES1.

2.2 Performance indicators

Each of the 25 parameters (see Figure ES1) has one or more corresponding indicators which were used to compute the MUWM Index. The 27 indicators are both quantitative and qualitative in nature and are used to assign a score to the ULB, based on performance under the corresponding parameter. The majority of the indicators pertain to the ULB level, and selected ones to the state level.

The parameter-wise indicators used for the assessment are detailed under the respective themes in Annexure 1. Each table outlines the indicators used for scoring, the formula used to calculate the value and its unit, the data sources, and any assumptions and/or limitations that were considered for the evaluation. The MUWM assessment framework was finalised after consultation with stakeholders from government agencies (including representatives from ULBs) and non-government experts working in the field of used water management, representing think tanks and academia.

2.3 Composite scoring

The indicators elaborated in Annexure 1 were used to assign scores to the ULBs selected for the MUWM Index. The following subsections explain the step-wise methodology adopted to compute the composite scores for the ULBs.

For the assessment, we considered over 500 ULBs from 10 Indian states that have adopted treated used water (TUW) reuse policies

Normalisation

The raw data collected for each of the indicators for all ULBs was normalised using the maxima and minima method, to transform the data into dimensionless numbers on a scale of 0–1. It is critical to normalise such data before carrying out data aggregation to render the indicators comparable with each other. The formula used for normalisation is as follows:

(X-Minimum score) ÷ (Maximum score-Minimum score).....1(a)

Where *X* is the value of the indicator in question for a specific ULB, the minimum score is the minimum value obtained for the indicator across the ULBs being assessed, and the maximum score is the maximum value obtained for the indicator across the ULBs being assessed.

In cases where more than one indicator corresponded to a given parameter, the arithmetic mean of the individual indicator scores was calculated. Hence, the scores for each parameter are obtained on a scale of 0–1, with 1 being the highest score and 0 being the lowest.

In some cases, a higher indicator value represents lower performance and vice versa. For instance, high energy consumption in used water treatment indicates low performance of the ULB in terms of energy efficiency. For such indicators, the following formula was used for normalisation:

(Maximum score - X) ÷ (Maximum score-Minimum score).....1(b)

This formula was applied to the following three parameters under the efficiency theme of the assessment framework: energy efficiency, energy cost incurred, and level of greenhouse gas (GHG) emissions/carbon intensity.

This method of normalising values as shown in formulae 1(a) and 1(b) was undertaken for quantitative indicators. For qualitative indicators, scoring was pre-defined within the 0–1 range (details are provided in Annexure 1).

Weightage

Since each of the 25 parameters are equally crucial to assessing municipal performance in used water management, they were given equal weightage. Aggregated theme scores hence depend on the number of parameters within each theme. A scale of 0–5 was considered for the index composite score, based on the number of themes. The following section explains in detail the methodology used to aggregate scores.

Aggregation

The normalised scores were aggregated for each theme by adding the individual parameter scores. The scores for each theme were further aggregated by adding the individual theme scores, and multiplying the sum by a weighted factor of 5/25, to obtain the composite score for each ULB. Hence the maximum composite score possible for each ULB is 5, on a scale of 0–5. The methodology used to compute the overall index composite score is given in Table 1. Further, state performance assessment is based on the state scores, which were calculated by taking the arithmetic mean of the aggregated composite scores of all ULBs considered in that state (details in Section 3.5).

Table 1 Methodology for calculating the index composite score

S. No.	Theme	No. of parameters	Aggregated normalised theme score	Range for normalised theme score	Weighted factor	Index composite score (0–5)
1	Finance	3	a	0–3	5/25	5/25 (a+b+c+d+e)
2	Infrastructure	6	b	0–6		
3	Efficiency	6	c	0–6		
4	Governance	7	d	0–7		
5	Data and Information	3	e	0–3		
Total		**25**	**(a+b+c+d+e)**	**0–25**		

Source: Authors' analysis

2.4 Selection of ULBs

For the assessment, we considered over 500 ULBs in 10 Indian states that have adopted TUW reuse policies that are available in the public domain (Table 2). Further, the 500+ selected ULBs represent class I (population above 1,00,000) and class II (population of 50,000–99,999) cities within the 10 states. Class I and II cities represent a major share of the total urban population in India (72 per cent), and contribute about 50 per cent of the total sewage generation in urban areas in the country (CPCB 2021).

Table 2 State-wise ULBs assessed using the MUWM Index

S. No.	States that have adopted TUW reuse policies	No. of ULBs representing class I and II cities
1	Gujarat	62
2	Haryana	29
3	Punjab	39
4	Rajasthan	55
5	Jharkhand	20
6	Chhattisgarh	15
7	Karnataka	65
8	Andhra Pradesh	71
9	Madhya Pradesh	60
10	West Bengal	87
Total ULBs		**503**

Source: Authors' analysis using data from Census of India (2011)

3. MUWM index results

Image: iStock

The MUWM Index was computed for the selected 503 ULBs in 10 states based on their composite scores, which were calculated by aggregating individual theme scores. The objective of developing this index is to promote healthy competition among the ULBs, to achieve the larger goal of mainstreaming the circular economy approach to used water management at the ULB level in India. The following sections discuss the results of the index in detail.

3.1 Award categories

Based on their composite scores, ranging from 0–5, the ULBs were classified into five award categories (Table 3), reflecting their performance in used water management, based on the developed MUWM assessment framework (see Section 2.1). The score ranges for the award categories are based on the minimum and maximum scores of the ULBs on the MUWM Index. The index composite scores for all 503 ULBs assessed are presented in Annexure 2.

Table 3 Award categories

Category	Index composite score range (0–5)	Description
Outstanding	3 and above	These notable ULBs have achieved the highest scores on the MUWM index. Their comprehensive approach to used water management can serve as an example for others to follow and take inspiration from.
Leading	2.25–3	These ULBs are front runners in terms of performance in used water management. They have achieved substantial success in most of the thematic areas, and even in the remaining aspects, their on-ground efforts have the potential to make an impact at scale in the near future.
Performing	1.5–2.25	These ULBs have made notable strides in used water management. They have made substantial progress on at least one or two themes, with efforts being undertaken across different parameters.
Promising	0.75–1.5	These ULBs are in the transition phase between aspiring and performing. They are yet to make any substantial progress on any of the themes, but have undertaken a number of interventions for used water management under different parameters.
Aspiring	0–0.75	Aspiring ULBs are in the initial stages of improving their used water management. They are exploring and laying the groundwork across different themes, but have yet to undertake any significant interventions.

Source: Authors' analysis

3.2 MUWM index composite score

The results and findings based on the composite scores computed for the 503 ULBs on the MUWM index are discussed below.

Overview of the MUWM index composite score

- Of the 503 ULBs assessed, 264 (52 per cent) are categorised as promising (Figure ES3), which indicates that these ULBs have acknowledged used water management as a key focus area and are making efforts to mainstream TUW reuse. However, their efforts are currently scattered and require a more holistic approach. For instance, **Barmer** in Rajasthan has fared relatively well under the infrastructure theme but has made little progress under the finance theme.
- 151 ULBs (30 per cent) assessed are categorised as performing (Figure ES3), indicating that they have made notable progress in at least one or two themes. Concurrently, they are making efforts to achieve on-ground impacts in the remaining themes, on which they have scored relatively lower. For instance, **Hassan** in Karnataka has scored 4.78 out of 6 or 80 per cent of the maximum score under 'efficiency', whereas under the remaining four themes (infrastructure, finance, governance, and data and information) its average aggregate score is around 33 per cent. These latter areas should be targeted for improvement.

- Of the remaining ULBs, 47 (9 per cent) are leading, 39 (8 per cent) are aspiring, and only 2 (less than 1 per cent) are outstanding.
- Just 2 of the 503 ULBs assessed, i.e., Surat Municipal Corporation (**SMC**) and Bruhat Bengaluru Mahanagara Palike (**BBMP**), are categorised as outstanding (Figure ES3). Their all-round performance in used water management can serve as an example to other ULBs.

'Finance' and 'data and information' are key impediments to upward mobility

There is a notable concentration of ULBs in mid-level categories, specifically promising and performing. Of the 503 ULBs, 151 are categorised as performing, while 264 fall under the promising category (Figure ES3). Collectively, these two categories account for a significant share, i.e., 82 per cent of the ULBs assessed. As per our analysis of the index results, one of the key reasons for this is the average performance of ULBs in the thematic areas of finance and data and information, with ULBs scoring an average of 0.47 and 0.93 out of 3, respectively. The former is less than 6 per cent and the latter less than 33 per cent of the maximum score that ULBs can obtain under these themes. Thus, parameters under finance and data and information need to be targeted for mid-level ULBs to improve their performance.

Tier 2 cities lead the pack in the aspiring category

More than 90 per cent of ULBs categorised as aspiring are in tier 2 cities. These cities often grapple with a multitude of challenges, including inadequate infrastructure, jurisdictional ambiguities, and most notably, a nascent state of affairs when it comes to the governance of used water treatment and TUW reuse at the local level, despite having state-level policies in place.

Around 40 per cent of ULBs have scored 0 in at least one thematic area

Municipal performance greatly varies across themes. 195 ULBs or 40 per cent of the total assessed using the MUWM Index have scored 0 in at least one thematic area (Figure 1). Thus, the strengths and weaknesses of the ULBs need to be analysed under each theme, to gain a better understanding of their performance. Theme-wise analyses of the results of the index are presented in Section 3.4.

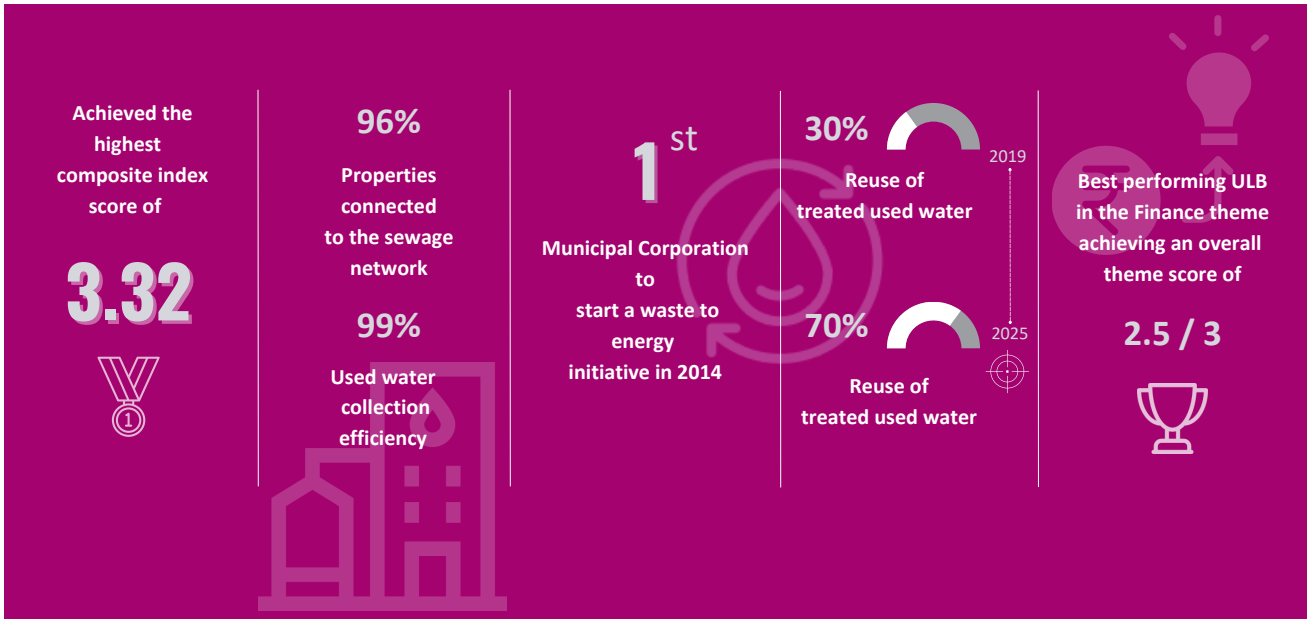
Figure 1 195 out of 503 ULBs have scored 0 in at least one thematic area

Source: Authors' analysis

3.3 Learnings from outstanding cases

Surat tops the chart, with SMC receiving the highest score of 3.32 out of 5 (Figure 2). It is performing exceedingly well across all themes, most notably in infrastructure and finance. The city's comprehensive sewerage network has expanded with its fast-growing population. SMC's used water management action plan (SMC 2019) and Gujarat's comprehensive reuse policy (GoG 2018) are based on the principles of conserving water and reducing the burden on conventional water resources. SMC's achievements on each theme of the assessment framework and learnings that can be used by other ULBs are presented in Table 4.

Figure 2 96% of properties in SMC are connected to a centralised sewerage network



Source: Authors' analysis using data from GoG (2017) and SMC (2019)

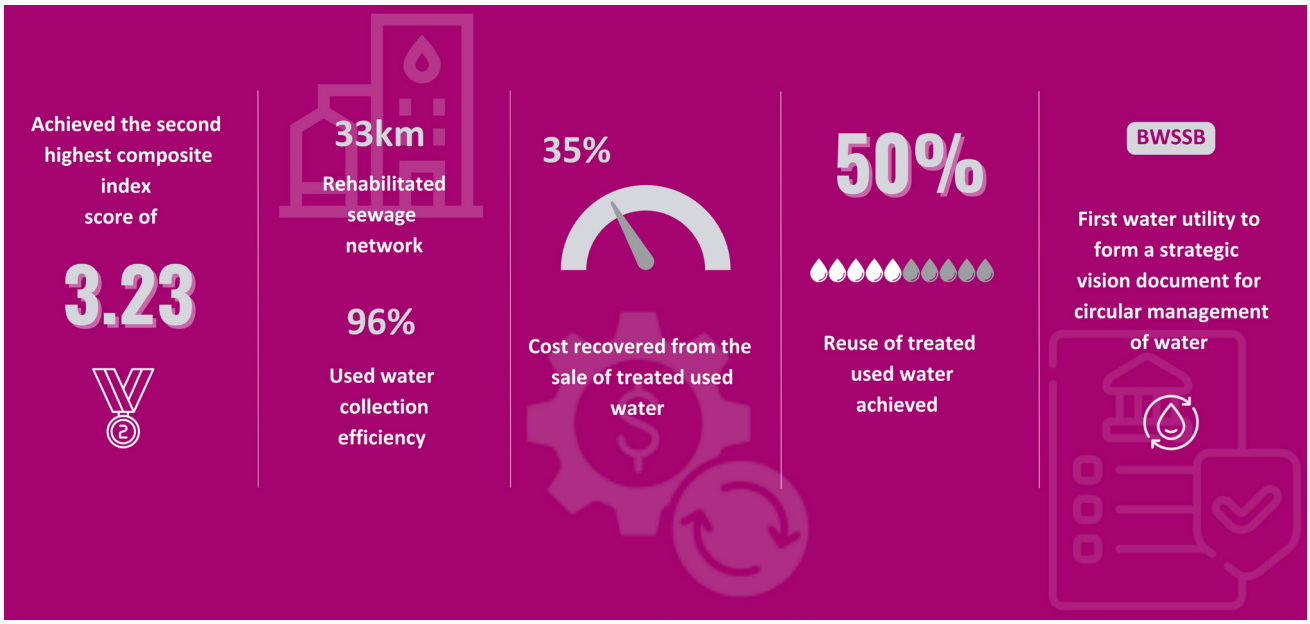
Table 4 Achievements and learnings from Surat

Themes	Achievements	Learnings
 Infrastructure	As of 2017, 96 per cent of properties in the ULB are connected to the centralised sewerage system (GoG 2017a). Collection efficiency stands at 99 per cent (GoG 2017a).	Used water infrastructure development should focus on both the extent of coverage and efficient functioning of the infrastructure, with an emphasis on monitoring operations and maintenance (O&M). Planning of urban infrastructure development should align with rapid urbanisation and the needs of a growing population.
 Efficiency	As of 2019, Surat was reusing more than 30 per cent of its treated water, which is 10 per cent above the service-level benchmarking (SLB) (SMC 2019). It is the first ULB to set up a waste-to-energy plant, thus contributing to improved energy efficiency and reduced GHG emissions.	The focus should be on resource recovery, such as through TUW, biosolids, and biogas.
 Governance	SMC adopted the Reuse & Recycle of Treated Used Water Action Plan in 2019, which has set targets of 70 per cent reuse by 2025 and 100 per cent by 2030 (SMC 2019). The action plan takes cognisance of the state policy on the reuse of TUW, adopted by the Government of Gujarat in 2018.	A dedicated city action plan, which aligns with existing policies and initiatives, and has provisions for short-term and long-term targets, enables actionable interventions.
 Finance	SMC is selling TUW to industrial clusters for reuse, enabling cost recovery in used water management. The Surat model is being used as a blueprint to develop sustainable city-specific reuse plans.	The TUW reuse model can be financially sustainable for the ULB through the revenue generated by the sale of TUW to different sectors. Investment by the private sector can be leveraged to successfully implement reuse projects.
 Data and Information	SMC maintains an updated website with detailed information on drainage and sewage and septage management. A one-stop portal for complaint registration and grievance redressal also exists at the ULB level.	Updated and accessible data and information is crucial for effective policy formulation, enabling ULBs to provide various citizen-centric services they are responsible for.

Source: Authors' analysis

Bengaluru has secured the second position on the MUWM Index, with a score of 3.23 out of 5 (Figure 3). The city faces numerous challenges, such as an exponential rise in its population, rapid urbanisation, and increased frequency of extreme climate events. These have been the drivers for strengthening the used water treatment infrastructure and promoting reuse, along with the rising water demand in the city. About 50 per cent of the TUW is being reused in the city for industrial purposes, construction activities, horticulture, and landscaping (GoK 2020). But there is a need to improve the stormwater drainage infrastructure in the city; this is essential to mitigate the occurrence of urban flooding and its associated impacts. BBMP's achievements on each theme of the assessment framework and learnings that can be used by other ULBs are presented in Table 5.

Figure 3 50% of treated used water is reused in Bengaluru



Source: Authors' analysis using data from GoK (2020) and BWSSB (2023)

Table 5 Achievements and learnings from Bengaluru

Themes	Achievements	Learnings
 Infrastructure	Bengaluru has achieved the highest score in 5 out of the 6 parameters under 'infrastructure'. Rehabilitation of the existing ageing sewage network is being carried out under a dedicated environmental action plan for rehabilitation, initiated in 2001 (BWSSB 2023).	Efficient and regular maintenance of the installed infrastructure is essential for effective used water management.
 Efficiency	Bengaluru fairs well in all parameters under 'efficiency', achieving a high overall theme score of 4.88 out of 6 (82 per cent). Specifically, it scored 92 per cent on the energy efficiency parameter, which assesses the annual power consumption of treatment plants per MLD (million litres per day) of actual used water treatment in the ULB. The city reuses 50 per cent of its treated water for industrial and non-industrial purposes (GoK 2020).	Installing energy-efficient treatment infrastructure can generate savings in energy cost and decrease the carbon intensity of the used water treatment process, thereby improving the overall efficiency of used water management. Diversification by supplying TUW for reuse to different sectors can mainstream reuse.
 Governance	The Bengaluru Water Supply and Sewerage Board (BWSSB) has developed a comprehensive vision document with holistic goals up to 2050 for different components of water management, setting qualitative and quantitative targets for used water management in the city (BWSSB 2018). To reduce the burden on its stormwater drainage infrastructure, an environmental action plan has been formulated to manage sewerage systems and prevent used water from flowing into stormwater drains.	Well laid out plans with comprehensive long-term visions, substantiated by short-term goals, promote efficiency in governance and strengthen operational capacity across verticals. Developing action plans with periodic targets, along with long-term visions for used water management is crucial for strengthening the existing governance.
 Finance	The Karnataka government has allocated INR 3,000 crore for the development of stormwater drainage infrastructure in its latest budget (GoK 2023). Around 35 per cent of BWSSB revenue is recovered from TUW reuse, which is channelled to enhance treatment capacity.	Allocated financial aid to tackle city-specific challenges can improve the operational performance of existing assets. Cost-recovery mechanisms and responsible allocation of financial resources are enabling factors for efficient used water management.
 Data and Information	Various initiatives concerning data and information, such as developing a centralised SCADA monitoring centre and an online complaint management system for used water–related queries, have been undertaken to build a comprehensive online database at the city level.	An online database allows for real-time and accurate assessment of performance and identification of gaps in used water management. Reliable and accessible data also helps to streamline policies and services.

Source: Authors' analysis

3.4 Thematic assessment

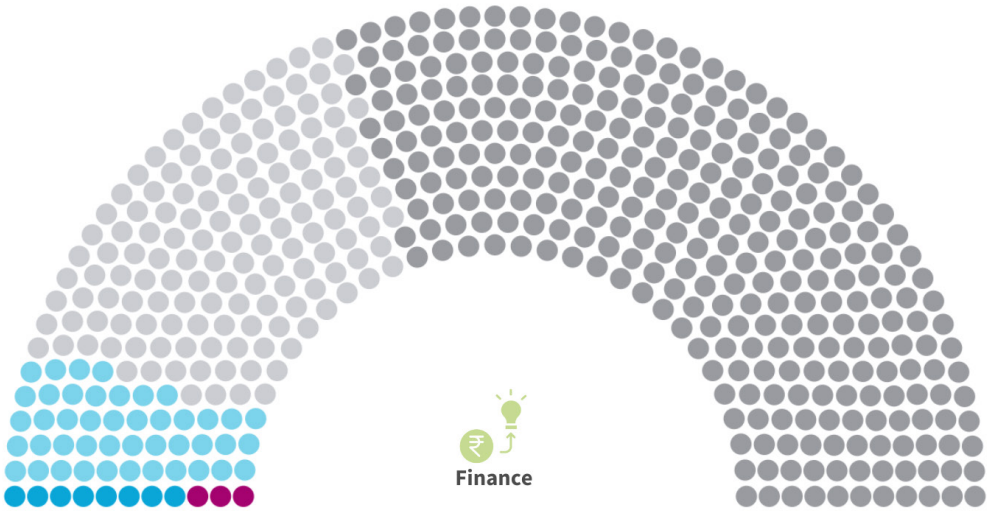
In this section, we analyse the performance of ULBs under each of the five themes, to develop an understanding of specific areas (parameters) that require improvement. This may enable targeted interventions to strengthen used water management at the ULB level. Thematic scores are calculated by aggregating the normalised scores of the individual parameters under each theme. Note that the maximum score that can be obtained under each theme depends on the number of parameters within it (see Section 2.3), as each parameter has equal weightage. Following are the results of the theme-wise assessment.

Finance

Parameters under 'finance' and 'data and information' need to be targeted by ULBs to improve their performance

- About 90 per cent of the ULBs are collectively categorised as aspiring and promising under 'finance' – 305 and 144 ULBs, respectively, out of the 503 assessed (Figure 4). This indicates that financial planning and investments in used water management are currently in the nascent stage, even in ULBs that have adopted state-level policies on used water treatment and reuse.
- Less than 10 per cent (44 ULBs) are categorised as performing, highlighting that only a handful have made significant strides in at least two parameters under 'finance' (Figure 4). Notably, ULBs such as **Gurugram** in Haryana and **Bardoli** in Gujarat are high performing in their efficient collection of sewage charges. Bardoli has also attained the maximum score for cost recovery in the used water management parameter.
- Only 2 per cent (8 ULBs) are categorised as leading (Figure 4). These ULBs are at the forefront of the finance theme, with high scores under the majority of the parameters. For instance, **Patiala** in Punjab has scored 73 per cent (2.21 out of 3), and topped the leading category.
- Just 3 of the 503 ULBs, which include **Surat**, **Vadodara**, and **Mangalore**, have been categorised as outstanding under 'finance' (Figure 4). Among them, Surat occupies the top position, with a score of 2.46 out of 3. Surat has adopted different public–private partnership (PPP) models, such as the end-user investment model, to achieve economies of scale and effective sharing of risks and responsibilities on the investments made in used water treatment. Surat's investment priority is evident – the city directed 92 per cent of its five-year consolidated investment towards the sewage and septage management sector (GoG 2017b).

Figure 4 Over 60% of ULBs are in the aspiring category under the finance theme



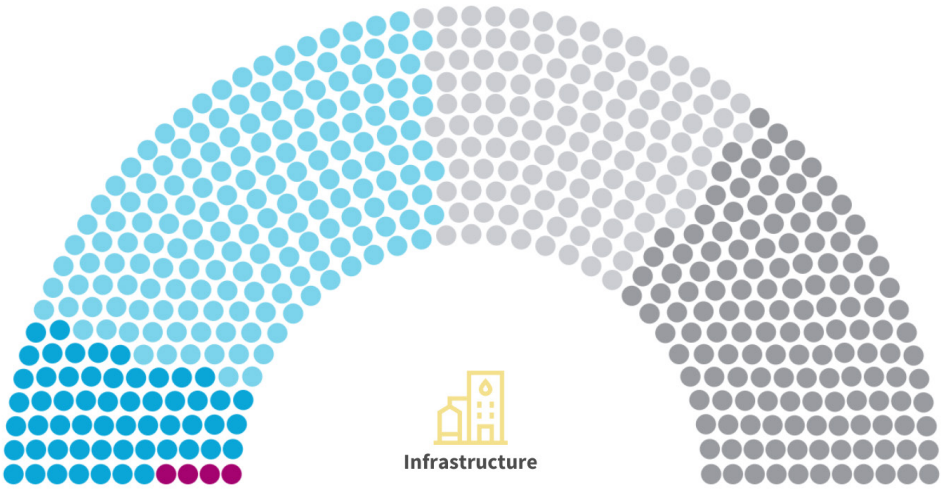
Categories	Number of cities
Outstanding	3
Leading	8
Performing	44
Promising	144
Aspiring	305

Source: Authors' analysis using data sources for 27 indicators as detailed in Annexure 1

Infrastructure

- Around 53 per cent of the ULBs are collectively categorised as aspiring and promising under 'infrastructure', representing 146 and 123 ULBs, respectively (Figure 5).
- The aspiring category mainly includes tier 2 cities that are lacking in primary infrastructure such as sewerage and drainage networks.
- ULBs categorised as promising have demonstrated noteworthy progress in at least one parameter under infrastructure. For instance, **Jaisalmer** in Rajasthan has performed relatively well under two parameters – existence of separate sewerage and drainage networks and sewerage network coverage.
- About 35 per cent of ULBs (174) are categorised as performing, indicating that they have made substantial progress in at least two parameters (Figure 5). For instance, **Ludhiana** in Punjab and **Vijayawada** in Andhra Pradesh both have separate drainage and sewerage networks. Additionally, **Ludhiana** has performed well in the collection efficiency of its sewerage network, while **Vijayawada** has made considerable progress in terms of the coverage of its sewerage network.
- Only 11 per cent (56 ULBs) are categorised as leading (Figure 5). These ULBs are at the forefront of the infrastructure theme and have made significant progress on the majority of parameters. For instance, Karnataka's **Kollegal** has secured more than 95 per cent (2.89 out of 3) in three of the six parameters (sewerage network coverage, collection efficiency of sewerage network, and stormwater drainage network coverage) under 'infrastructure'.
- A mere 1 per cent (4 ULBs) have been categorised as outstanding (Figure 5). Among these, **Gandhinaga**r has secured the top position, with a score of 5.19 out of 6 (86 per cent) in the overall infrastructure theme. The centralised sewerage network in the ULB covers 99 per cent of properties in the city. This, paired with 100 per cent collection efficiency of the sewerage network, strengthens the functioning of the sewage infrastructure (GoG 2017a).

Figure 5 35% of ULBs are categorised as performing under the infrastructure theme



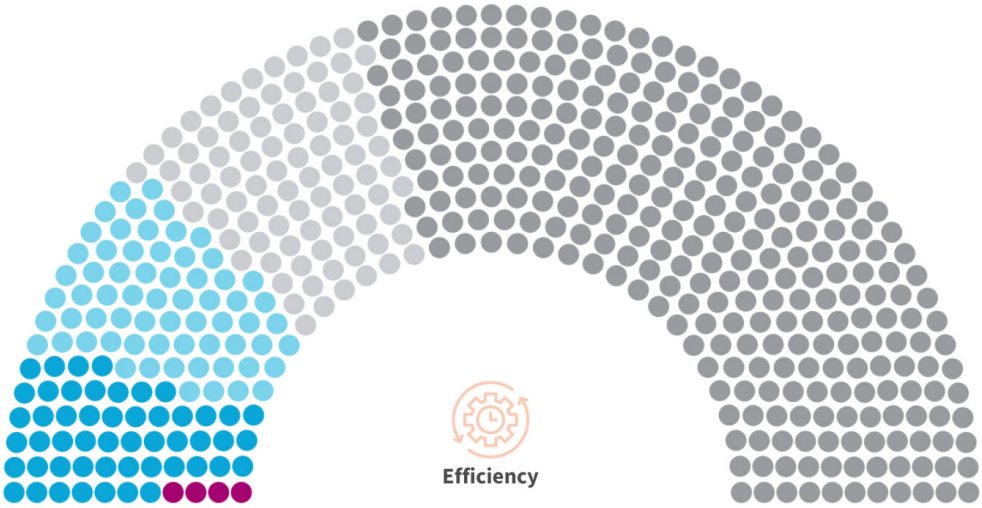
Categories	Number of cities
Outstanding	4
Leading	56
Performing	174
Promising	123
Aspiring	146

Source: Authors' analysis using data sources for 27 indicators as detailed in Annexure 1

Efficiency

- Around 60 per cent of ULBs are categorised as aspiring, while 17 per cent fall under the promising category, representing 295 and 88 ULBs, respectively (Figure 6). This trend highlights that parameters such as energy efficiency, used water treatment capacity utilisation, and quality of TUW have not yet been prioritised in the used water management sector in the majority of ULBs.
- Only 13 per cent (65 ULBs) are categorised as performing, indicating that they have made notable strides in at least two parameters under 'efficiency' (Figure 6). For instance, **Mysore** in Karnataka has shown considerable progress on the parameters of energy efficiency and energy cost incurred, with low GHG emissions from sewage treatment plants (STPs).
- Just 10 per cent (51 ULBs) are categorised as leading (Figure 6). These ULBs are at the forefront of the efficiency theme and have made significant progress across the majority of parameters. For instance, Rajasthan's **Dholpur** has secured 90 per cent (2.8 out of 3) in half of the parameters under the efficiency theme.
- All four ULBs categorised as outstanding under 'efficiency' are in **Karnataka**. Among them, **Kolar** has achieved the highest score of 83 per cent (5.01 out of 6). The ULB has 99 per cent energy efficiency in its treatment plants due to the deployment of waste stabilisation pond (WSP) technology for sewage treatment. This technology employs natural microbial processes for used water treatment and utilises negligible power during the treatment process (GoK 2020; GoI 2022).

Figure 6 295 out of 503 ULBs are categorised as aspiring under the efficiency theme



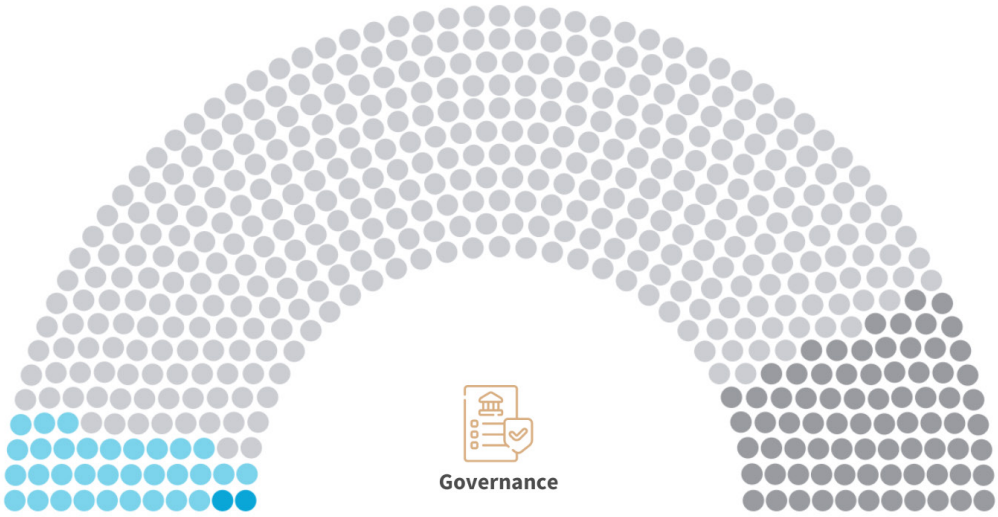
Categories	Number of cities
Outstanding	4
Leading	51
Performing	65
Promising	88
Aspiring	295

Source: Authors' analysis using data sources for 27 indicators as detailed in Annexure 1

Governance

- More than 75 per cent (392 ULBs) are categorised as promising (Figure 7). This indicates that the governance aspect of used water management (formulation of plans, publication of performance reports, and implementation of reuse projects) is in the initial stages in majority of the ULBs. Some efforts are being made to strengthen this aspect.
- Less than 7 per cent (32 ULBs) are categorised as performing, indicating that very few of them have made substantial progress in at least two parameters under 'governance' (Figure 7). For instance, **Adityapur** in Jharkhand and **Bhilwara** in Rajasthan have made substantial progress on the following two parameters: regular publication of performance reports (SLB) and the presence of PPP models to manage used water treatment and/or reuse.
- Only two ULBs have been categorised as leading, and none have been qualified as outstanding.
- **Jaipur** has emerged as the top-scoring ULB, with 65 per cent (4.56 out of 7) in the overall governance theme. The latest city master plan (2025) of Jaipur includes sewage-related targets on infrastructural requirements and collection efficiency of the sewerage network, in accordance with sewage generation projections for the master plan target year (JDA n.d.).

Figure 7 392 out of 503 ULBs are categorised as promising under the governance theme



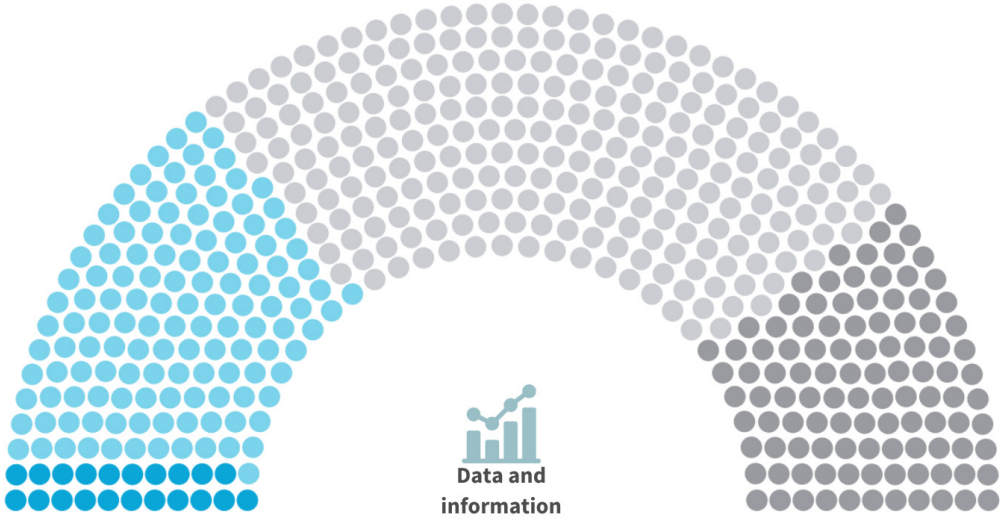
Categories	Number of cities
Outstanding	0
Leading	2
Performing	32
Promising	392
Aspiring	77

Source: Authors' analysis using data sources for 27 indicators as detailed in Annexure 1

Data and information

- More than 65 per cent of the ULBs are collectively categorised as aspiring and promising, representing 106 and 246 ULBs, respectively (Figure 8). This indicates that making municipal data on used water–related parameters available in the public domain is yet to be prioritised in the majority of ULBs.
- Around 25 per cent (130 ULBs) are categorised as performing, indicating that they have made substantial progress on at least two parameters (Figure 8). For instance, **Barnala** in Punjab and **Chittoor** in Andhra Pradesh have made headway in the following aspects: availability of a management information system (MIS) portal, presence of a grievance redressal mechanism, and readability of the city master plan.
- Only 21 ULBs have been categorised as leading and none as outstanding.
- **Visakhapatnam** has secured the top position, with a score of 75 per cent (2.25 out of 3) in 'data and information'. Availability of the city master plan in the regional language and an official language allows for wide dissemination of the policy among citizens and stakeholders (VMRDA 2020). The state of Andhra Pradesh also maintains an open-access MIS portal with records of ULB-level performance status in different sectors, including sewage management. This helps improve the availability and accessibility of data at the city level.

Figure 8 Only 21 out of 503 ULBs are categorised as leading under the data and information theme



Categories	Number of cities
Outstanding	0
Leading	21
Performing	130
Promising	246
Aspiring	106

Source: Authors' analysis using data sources for 27 indicators as detailed in Annexure 1

3.5 State-wise performance as per the composite score

This section focuses on the performance of the 10 states on the MUWM Index across all themes. State performance is based on the state score, which is the arithmetic mean of the composite scores of all ULBs considered in that state. Similarly, theme-wise state scores are calculated by taking the arithmetic mean of the aggregated theme scores of all ULBs in that state. The results and findings from the state-wise performance assessment are discussed below.

Western and north-western states and Karnataka are leading in used water management

- Of the 10 states assessed, **Haryana** has secured the top position, with a score of 1.94 out of 5, whereas **Chhattisgarh** is at the bottom, with a score of 0.84 out of 5 (Figure ES4).
- **Karnataka** has secured the second position. The state's scores under 'infrastructure' and 'efficiency' are well above the average state score (Figure 9). Moreover, 42 per cent of the ULBs in the state are categorised as performing, and 20 per cent as leading, with none falling under the aspiring category.
- Although **Punjab** has secured the third position in the state assessment, with a score of 1.71 out of 5 (Figure ES4), it has secured the top position under 'finance' and 'data and information', with scores of 1.09 and 1.78 out of 3, respectively (Figure 9).
- In the composite score (Section 3.2), 4 out of the highest performing 10 ULBs are in **Gujarat**, including Surat, which has topped the MUWM Index. However, in the state assessment, Gujarat is in fifth position (Figure ES4), on account of the varying performance levels across ULBs in the state. For instance, many ULBs in the state have zero sewerage network coverage and, consequently, low performance in various aspects of used water management. This reflects in the state theme scores, with Gujarat scoring 2.74 out of 6, 1.38 out of 6, and 0.79 out of 3 on the infrastructure, efficiency, and finance themes, respectively (Figure 9).
- **Rajasthan** has topped the governance theme with a score of 2.83 out of 7. It is also the first state to have formulated a policy on the reuse of used water in 2016.
- In **Chhattisgarh** more than 50 per cent of ULBs are categorised as aspiring and, in **Jharkhand**, over 70 per cent are categorised as promising.
- It is important to note that while state policies play a facilitating role, the impetus for implementing used water treatment and reuse lies in the action plans, guidelines, and projects realised at the ULB level.

States in eastern India are catching up in used water management

Haryana and Karnataka are the top ranking states on the index

- The state assessment reveals that 85 per cent of the ULBs assessed fall under the promising and performing categories in majority of the states. Notably, in states such as **Jharkhand** and **West Bengal**, nearly 90 per cent of ULBs belong to these categories, indicating significant progress on certain themes, but a long way to go to achieve comprehensive used water management.
- **West Bengal** has secured the second position under 'infrastructure', with a score of 2.83 out of 6, whereas **Jharkhand** has secured the third position under 'efficiency', with a score of 2.13 out of 6.

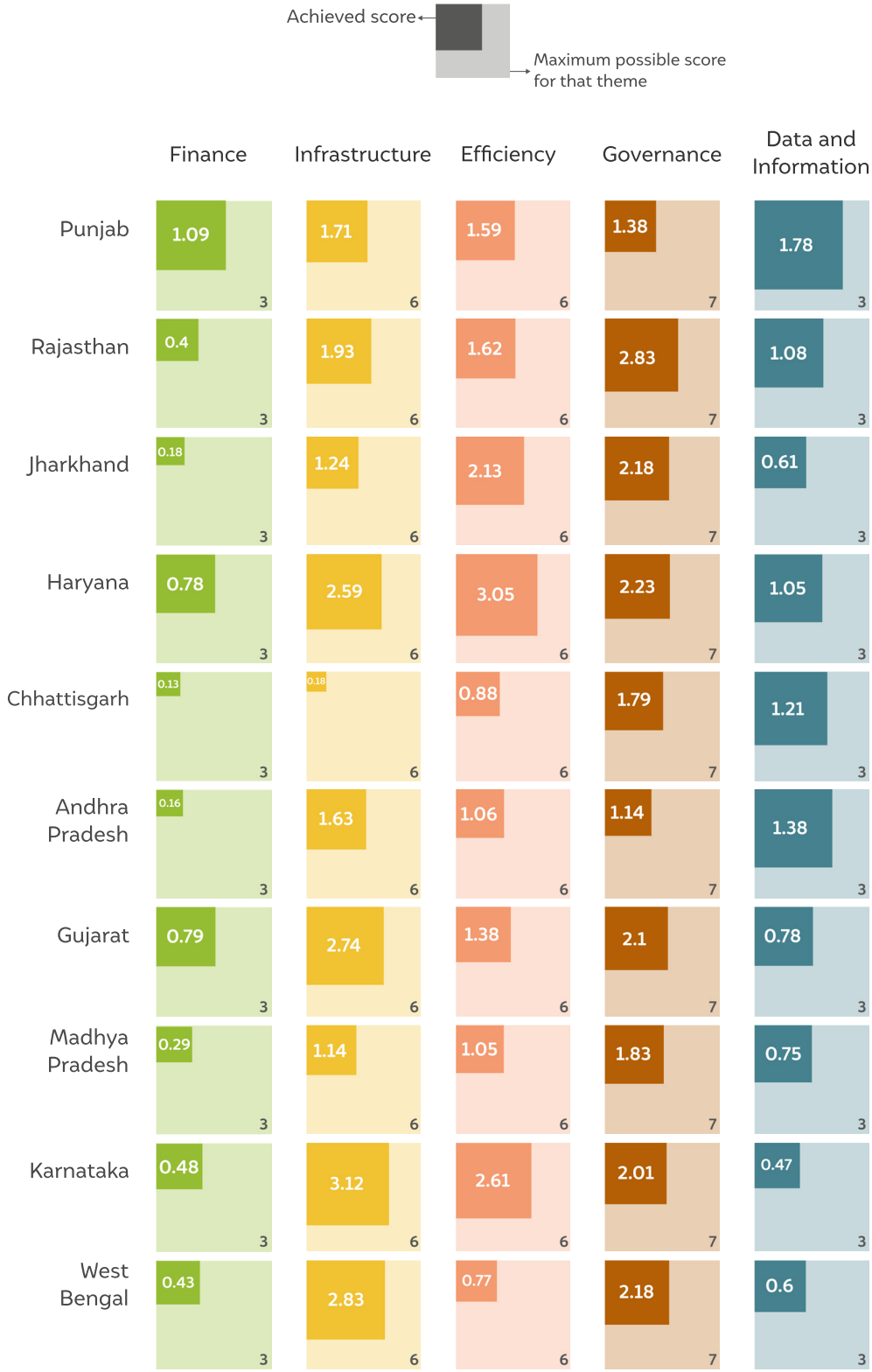
Regular publication of performance reports can improve the accuracy of the performance assessment of urban services

The Ministry of Housing and Urban Affairs (MoHUA) has developed an SLB framework to monitor urban services such as water supply, used water management, solid waste management, and stormwater drainage (MoHUA 2008). However, among the 10 states assessed, **Madhya Pradesh**, **Chhattisgarh**, and **Andhra Pradesh** have not published SLB reports. Further, although **West Bengal** and **Jharkhand** have published these reports, they do not provide complete or updated data for majority of the ULBs in the states. The lack of data availability has hence affected the accuracy of the performance assessment conducted in these states, leading to poor state-wide performance on the MUWM Index. Such baseline data is also essential for efficient planning and service delivery by local authorities.

The progress of Karnataka and Haryana provides inspiration for early starters

- **Karnataka** and **Haryana** have implemented comprehensive graded action plans for used water treatment and reuse. This is evident in their thematic scores and the distribution of ULBs across award categories on the MUWM Index.
- **Haryana** has invested INR 433.60 crore since 2014 to develop 73 new STPs and strengthen the existing sewage treatment infrastructure (Water Digest 2023). This is reflected in the state's well-above-average score on the investment in sewage and septage management parameter under the finance theme. The Haryana government has also prepared a joint state-wide strategy involving different departments – the public health engineering department (PHED), ULBs, and the irrigation department – to pool assets and reuse TUW efficiently, especially for irrigation.
- Early starter states can take inspiration from the development journeys of Karnataka and Haryana, which have involved prioritising sectors through dedicated action plans and simultaneously adopting comprehensive state-wide used water management action plans.

Figure 9 Punjab has secured the top position under 'finance' and 'data and information'



Source: Authors' analysis using data sources for 27 indicators as detailed in Annexure 1

The discharge of untreated domestic used water is a cause of high pollution levels in natural water bodies, especially concentrated in the urban stretches of Indian rivers.

Image: iStock

4. Conclusion and recommendations

ULBs in India are the paramount authorities in the management of urban domestic used water. The responsibility for developing and maintaining used water infrastructure and service delivery in cities lies primarily with them. The MUWM Index is a first-of-its-kind framework, specifically focused on used water management at the ULB level in India. The assessment shows that over 80 per cent of the ULBs assessed using the MUWM Index collectively fall under the categories of performing and promising. Hence, the majority of ULBs have made notable progress in some aspects of used water management and are making significant efforts to improve their overall performance.

ULBs should be empowered to formulate and adopt long-term used water reuse plans with clearly defined priorities and targets

The reuse of TUW is an essential component of urban used water management. It can reduce the pressure on already scarce freshwater resources, and generate economic benefits for the implementing authority. Some Indian cities – Surat, Bangalore, Ahmedabad, Indore, and Visakhapatnam, to name a few – are successfully implementing reuse projects. But TUW reuse is yet to be mainstreamed across the country.

The following are recommendations for mainstreaming the circular economy approach to urban used water management in India.

- **Empower ULBs to adopt long-term reuse plans**: ULBs should be empowered to formulate and adopt long-term used water reuse plans, with clearly defined provisions for identifying sectors and demand areas for reuse, allocation priorities among the identified sectors, appropriate used water treatment technologies, reuse-specific quality standards for TUW, and a dynamic pricing system based on end-use. A financially feasible reuse model can enable ULBs to cover the cost of treatment from revenues generated by selling the TUW of a prescribed quality to users such as industries and farmers. Additionally, TUW can be used for several other purposes: domestic use such as flushing and landscaping, road cleaning, irrigation of public parks and gardens, building and construction, fire hydrants, water body rejuvenation, and groundwater recharge. City-level reuse plans should align with the guidelines of the *National Framework on SRTW* and state-level reuse polices. Inspiration can be taken from cities like Surat and Bengaluru, which have formulated city-level action plans with targets for used water management and priorities for reuse, in line with the provisions of the respective state reuse policies. For instance, SMC has prioritised selling TUW to industrial clusters for reuse, in accordance with Gujarat's reuse policy. Such city-level reuse plans should also be developed in line with land use planning, as per the city master plan, accounting for current and future urban development.

- **Enable the development of a comprehensive database to strengthen MUWM**: According to the MUWM Index, 65 per cent of the ULBs assessed are collectively categorised as aspiring and promising under 'data and information', indicating that parameters under this theme are yet to be prioritised. Learnings can be derived from Andhra Pradesh, which has developed an open-access MIS portal with ULB-level performance data on different urban services including sewage management. The portal also has a dedicated public grievance redressal system, with a provision to submit customer satisfaction ratings. Access to updated and reliable data is essential to formulate new state reuse policies and update existing ones, and to draw up city-level reuse plans. The MUWM assessment framework allows ULBs across the country to maintain a baseline database for used water management. Further, the indicators used to develop the composite index score are both qualitative and quantitative in nature, and hence provide a comprehensive performance assessment of the ULBs. The index can give ULBs information on the areas that require improvement, and enable them to formulate targeted strategies to strengthen used water management in their jurisdictions. The index can hence be developed annually, based on a dynamic data inventory that is regularly updated with the support of ULBs. Going forward, the award categories used for the index can be updated based on improvement in the performance of ULBs. Further, the MUWM assessment framework, when applied by state governments or ULBs, should be customised, assigning weightage to themes based on local conditions and priorities for used water management.

The MUWM index can be developed annually based on a dynamic data inventory with the support of ULBs

- **Leverage existing national initiatives for used water management**: The progress of ULBs in terms of their performance in used water management can be employed by central and state governments to provide incentives to local governments. Further, the index can be integrated into initiatives of existing national missions. For instance, interventions/projects under the urban river management plans being prepared for river cities by *NMCG* can be designed based on the performance assessment of the index. This indexing can facilitate decision making and policy formulation towards the successful adoption of a river-centric approach to urban planning, wherein reducing the demand for freshwater and pollution abatement through effective used water management are important components. Further, schemes like *Amrit Sarovar* can be leveraged for the reuse of TUW in peri-urban areas for groundwater recharge and irrigation purposes.
- **Promote healthy competition among ULBs**: The 503 ULBs selected for this assessment are located in the 10 Indian states that have adopted TUW reuse policies. The implementation of these policies is a prerogative of local governments. A performance evaluation of ULBs using the MUWM Index can act as a cross-learning platform and foster healthy competition among ULBs, to help achieve the larger objective of mainstreaming used water treatment and reuse in cities. For instance, the Haryana government's joint state-wide strategy for effective reuse of TUW for irrigation, which involves a convergence of different departments to pool assets, can act as a template for early starter states to prioritise reuse sectors and develop actionable plans.

Acronyms

AMRUT	*Atal Mission for Rejuvenation and Urban Transformation*
BBMP	Bruhat Bengaluru Mahanagara Palike
BOD	Biological Oxygen Demand
BWSSB	Bangalore Water Supply and Sewerage Board
CAG	Comptroller and Auditor General
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health and Environmental Engineering Organisation
CWC	Central Water Commission
GHG	greenhouse gas
GoAP	Government of Andhra Pradesh
GoC	Government of Chhattisgarh
GoG	Government of Gujarat
GoH	Government of Haryana
GoI	Government of India
GoJ	Government of Jharkhand
GoK	Government of Karnataka
GoMP	Government of Madhya Pradesh
GoP	Government of Punjab
GoR	Government of Rajasthan
GoWB	Government of West Bengal
INR	Indian Rupee
kWh	Kilowatt hour
LPCD	Litre per Capita per Day

MIS	Management Information System
MLD	Million Litres per Day
MoHUA	Ministry of Housing and Urban Affairs
MUWM	Municipal Used Water Management
NbS	Nature-based Solution
NMCG	National Mission for Clean Ganga
O&M	Operations and maintenance
PPP	Public–private partnerships
SAAP	State Annual Action Plans
SCADA	Supervisory Control And Data Acquisition
SLB	Service-level benchmark
SLB	Service-level benchmarking
SMC	Surat Municipal Corporation
SRTW	Safe reuse of treated water
STP	Sewage treatment plant
TPI	Themes–parameters–indicators
TUW	Treated used water
ULB	Urban local body
VMRDA	Visakhapatnam Metropolitan Region Development Authority

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Annexure 1: Description of indicators

Theme: Finance

Parameter 1: Investment in sewage and septage management

Rationale: This parameter assesses the investment priority of the ULB in sewage and septage management services in relation to the overall investment in urban services including sewage and septage, water supply, stormwater drainage, urban transport, and parks and green spaces. It also evaluates the consistency of investments in the sector over a five-year period. The following indicator is used to assess this parameter.

Table A1: Description of indicator 1

Indicator 1	Formula	Unit	Data sources
Five-year consolidated investment in sewage and septage management as a percentage of consolidated investment at the ULB level for municipal services under the *AMRUT* scheme (2015–20)	(Consolidated investment for sewage and septage management over a defined time period/Total consolidated investment for municipal services over a defined time period) × 100	%	SAAP (2017–20)[1,2,3,4,5,6,7,8,9,10]
Assumptions/limitations			
• The data considered is only available for AMRUT cities in their respective State Annual Action Plans (SAAP). Hence, only AMRUT cities have been evaluated under this indicator.			
• Due to unavailability of sector-wise investment estimates in West Bengal's SAAP document, investment in sewage and septage management is taken as a percentage of total investment made in only two sectors: sewage and septage and water supply.			

1 *Government of Andhra Pradesh (GoAP). 2017. "State Annual Action Plan (FY 2017–18)." New Delhi: Ministry of Housing and Urban Affairs.*

2 *of Chhattisgarh (GoC). 2017. "State Annual Action Plan up to 2017–20 for Chhattisgarh." New Delhi: Ministry of Housing and Urban Affairs.*

3 *Government of Jharkhand (GoJ). 2017. "State Annual Action Plan of Jharkhand (F7 2017–18 to 2019–20)." New Delhi: Ministry of Housing and Urban Affairs.*

4 *Government of Karnataka (GoK). 2017. "State Annual Action Plan (FY 2017–18)." New Delhi: Ministry of Housing and Urban Affairs.*

5 *Government of Madhya Pradesh (GoMP). 2017. "State Annual Action Plan (FY 2017–18)." New Delhi: Ministry of Housing and Urban Affairs.*

6 *Government of Punjab (GoP). 2017. "State Annual Action Plan (FY 2017–20)." New Delhi: Ministry of Housing and Urban Affairs.*

7 *Government of West Bengal (GoWB). 2017. "State Annual Action Plan (FY 2017–20)." New Delhi: Ministry of Housing and Urban Affairs.*

8 *Government of Haryana (GoH). 2017. "State Annual Action Plan (FY 2017–18)." New Delhi: Ministry of Housing and Urban Affairs.*

9 *Government of Gujarat (GoG). 2017. "State Annual Action Plan up to 2019–20 for Gujarat." New Delhi: Ministry of Housing and Urban Affairs*

10 *Government of Rajasthan (GoR). 2017. "State Annual Action Plan (FY 2017–20)." New Delhi: Ministry of Housing and Urban Affairs.*

Parameter 2: Cost recovery in used water management

Rationale: This parameter assesses the financial sustainability of the ULB in terms of the return on investment in used water management, which is critical in the management of urban services. The expenses incurred by the ULB are the capital and operations and maintenance (O&M) costs of used water infrastructure and services. Revenues are recovered in the form of connection/user charges, sale of treated used water (TUW) and its by-products (sludge), and sewage/sanitation taxes. The following indicator is used to assess this parameter.

Table A2: Description of indicator 2

Indicator 2	Formula	Unit	Data sources
Annual used water revenues recovered as a percentage of used water expenses incurred by the ULB	(Total annual operating revenues in crore/Total annual operating expenses in crore) × 100	%	State SLB reports[11,12,13,14,15,16,17]; CEPT (2021)[18]

Parameter 3: Efficiency in the collection of sewage charges

Rationale: An essential element in ensuring cost recovery in used water management is efficient collection of sewage charges. This parameter hence assesses the ULB's efficiency in collecting used water revenues for bills raised within the same financial year, without letting dues (arrears) accumulate. The following indicator is used to assess this parameter.

Table A3: Description of indicator 3

Indicator 3	Formula	Unit	Data sources
Annual used water revenues collected as a percentage of total operating revenues billed by the ULB (includes taxes, charges etc.) during the given year	(Current revenues collected in the given year in crore/Total operating revenues billed during the given year in crore) × 100	%	State SLB reports[11,12,13,14,15,16,17]

11 *GoH. 2020. "Service Level Benchmark." Panchkula: Urban Local Bodies Department, Government of Haryana.*

12 *GoJ. 2019. "Service Level Benchmark at a Glance." Ranchi: Urban Development and Housing Department, Government of Jharkhand.*

13 *GoP. 2019. "Service Level Benchmark." Chandigarh: Department of Local Government, Government of Punjab.*

14 *GoR. 2020. "Service Level Benchmark." Jaipur: Local Self Government Department, Government of Rajasthan.*

15 *GoWB. 2019. "Service Level Benchmark." Kolkata: State Urban Development Agency, Government of West Bengal.*

16 *GoK. 2020. "Service Level Benchmark." Bengaluru: Urban Development Department, Government of Karnataka.*

17 *GoG. 2017. "Service Level Benchmark at a Glance." Gandhinagar: Department of Urban Development and Municipal Affairs, Government of Gujarat.*

18 *CEPT University. 2021. "Performance Assessment." Performance Assessment System. https://www.pas.org.in/web/ceptpas/toolkit?p_p_id=ToolKit_WAR_Portal&p_p_lifecycle=1&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=2&actionVal=GetScreen&tabId=1.*

Theme: Infrastructure

Parameter 1: Sewerage network coverage

Rationale: A sewerage system or a used water collection system is a fundamental infrastructure for used water management at the city level. This parameter assesses the coverage of the centralised sewerage network in the ULB by evaluating the level of access of properties to the sewerage network. The properties included are residential, commercial, and institutional. This parameter also evaluates the infrastructure gap in terms of the extent of the ULB area not covered by the centralised sewage network. The following indicator is used to assess this parameter.

Table A4: Description of indicator 4

Indicator 4	Formula	Unit	Data sources
Total number of properties connected to the sewerage network as a percentage of the total number of properties in the ULB	(Total number of properties connected to sewerage network/Total number of properties in the ULB) × 100	%	State SLB reports[11,12,13,14,15,16,17]; SAAP (2017–20)[1,2,3,4,5,6,7,8,9,10]
Assumptions/limitations			
• Due to unavailability of collated data, this indicator does not completely capture decentralised and on-site sanitation systems that may be present in the ULB. The evaluation is hence limited to the coverage of the centralised sewage network.			
• The data reported by the state service-level benchmarking (SLB) reports may include one or more properties connected to decentralised/standalone underground sewerage networks that meet adequate environmental standards.			

Parameter 2: Collection efficiency of the sewerage network

Rationale: This parameter assesses the collection efficiency of the centralised sewerage network installed in the ULB, in terms of the quantity of used water received by the sewage treatment plants (STPs) as a percentage of the total used water generated in the ULB. It hence builds on the previous parameter: where the sewerage network coverage is extensive, collection efficiency should be high; otherwise there is a gap in the functioning of the infrastructure installed. The following indicator is used to assess this parameter.

Table A5: Description of indicator 5

Indicator 5	Formula	Unit	Data sources
Quantity of used water collected at the intake of treatment plants as a percentage of the total quantity of used water generated	(Used water collected/[Total water supplied + estimated water use from other sources] × 0.8) × 100	%	State SLB reports[11,12,13,14,15,16,17]; SAAP (2017–20) reports[1,2,3,4,5,6,7,8,9,10]; ULB websites[19]
Assumptions/limitations			
• Total used water generated in the ULB has been estimated considering that 80 per cent of the water supplied to domestic users (including water drawn from other sources like bore wells) in urban areas returns as used water.			
• The data should be collected daily over a month from multiple points across the ULB (MoHUA 2008).			

19 *Indore Municipal Corporation. 2019. "Water Supply and Sewerage Project." Indore: Indore Municipal Corporation.*

Parameter 3: Used water treatment capacity installed

Rationale: This parameter assesses the extent of used water treatment that is possible, in terms of the installed capacity of the used water treatment infrastructure in the ULB. The installed treatment capacity is assessed as a percentage of the total used water generated in the ULB, thereby revealing the gap between used water generation and treatment. The following indicator is used to assess this parameter.

Table A6: Description of indicator 6

Indicator 6	Formula	Unit	Data sources
Installed treatment capacity as a percentage of the total used water generation at the ULB level	(Installed capacity in MLD/Total used water generation in MLD) × 100	%	CPCB (2021)[20]

Assumptions/limitations

- It is assumed that the National Inventory on Sewage Treatment Plants (CPCB 2021) provides an exhaustive list of the sewage treatment capacity installed across states.
- Total used water generation in the ULB has been estimated using 2021 urban population estimates, projected from official 2001 and 2011 urban populations (Census of India 2001, 2011).
- Hence, used water generation = urban population × 185 × 0.8; where 185 litre per capita per day (LPCD) is assumed to be the volume of water supplied to urban domestic users per capita per day, out of which 80 per cent (0.8) returns as used water.

Parameter 4: Existence of separate sewerage and drainage networks

Rationale: The existence of separate drainage and sewerage networks is important for a city to minimise flooding due to the mixing of stormwater runoff and sewage. It also optimises the performance of used water treatment facilities by keeping their load intake within certain limits. This parameter hence uses a qualitative indicator to evaluate whether ULBs have separate networks for drainage and sewage in place. The following qualitative indicator is used to assess this parameter.

Table A7: Description of indicator 7

Indicator 7	Formula	Unit	Data sources
Existence of separate sewerage and drainage networks	Present = 1 Absent = 0	NA	State SLB reports[11,12,13,14,15,16,17]

Assumptions/limitations

- Recorded length for drainage networks implies the existence of a separate stormwater drainage network in the ULB.

20 *Central Pollution Control Board (CPCB). 2021. "National Inventory of Sewage Treatment Plants in India." New Delhi: Ministry of Environment, Forest and Climate Change, Government of India.* https://cpcb.nic.in/openpdffile.php?id=UmVwb3JoRmlsZXMvMTIyOF8xNjE1MTk2MzIyX21lZGlhcGhvdG85NTYoLnBkZg==.

Parameter 5: Stormwater drainage network coverage

Rationale: This parameter builds on the previous one, and assesses the extent of coverage of stormwater drainage networks in ULBs that have separate drainage networks. It is essential that this infrastructure exists in conjunction with sewerage networks for efficient used water management in cities. The following indicator is used to assess this parameter.

Table A8: Description of indicator 8

Indicator 8	Formula	Unit	Data sources
Stormwater drainage network coverage	(Length of drainage network/Total road length in the ULB) × 100	%	State SLB reports[11,12,13,14,15,16,17]; SAAP (2017–20) reports[1,2,3,4,5,6,7,8,9,10]; State Finance Commission (n.d.)[21]

Parameter 6: Status of polluted river stretches at the state level

Rationale: The discharge of untreated used water (sewage) is one of the main reasons for high levels of pollution in Indian rivers, with the pollution load being concentrated in the urban stretches of rivers (passing through cities). This parameter hence assesses the status of polluted river stretches at the state level. The objective is also to identify the relationship between river pollution and level of untreated used water in the ULBs of a particular state. The following qualitative indicator is used to assess this parameter.

Table A9: Description of indicator 9

Indicator 9	Formula	Unit	Data sources
Whether the number of polluted river stretches (BOD >3 mg/L) have increased, remained constant, or decreased between the assessment years (2022 and 2018)	Increased = 0 Constant = 0.5 Decreased = 1	NA	CPCB (2022)[22]
Assumptions/limitations • Biological oxygen demand (BOD) of up to 3 mg/L is the primary water quality criteria for outdoor bathing. Hence, river stretches with a BOD of more than 3 mg/L are identified as polluted as per the periodic monitoring of water quality carried out by the Central Pollution Control Board (CPCB). • The quality of rivers cannot be assessed at the ULB level. Hence, this is a state-level parameter, and ULBs within a particular state are given the same scores.			

21 *Third State Finance Commission, Chhattisgarh. "Assessment of Physical Services Provided by the ULB." Government of Chhattisgarh. https://finance.cg.gov.in/state_finance_commission/TSFC/Reports/English/Chapter_12.pdf.*

22 *CPCB. 2022. "Polluted River Stretches for Restoration of Water Quality – 2022." New Delhi: Ministry of Environment, Forest and Climate Change, Government of India. https://cpcb.nic.in/openpdffile.php?id=UmVwb3JoRmlsZXMvMTQ5NF8xNjcxNzc3ODg2X21lZGlhcGhvdG8xODcoNi5wZGY=.*

Theme: Efficiency

Parameter 1: Used water treatment capacity utilisation

Rationale: In many STPs, the actual treatment capacity is lower than the installed capacity since the STPs do not function at maximum capacity due to lack of sewerage network coverage, O&M issues, and inadequate quality of treated effluents as per prescribed standards. Hence, this parameter assesses the level of actual utilisation of the installed treatment infrastructure at the ULB level, highlighting the importance of monitoring the O&M of the installed infrastructure. The following indicator is used to assess this parameter.

Table A10: Description of indicator 10

Indicator 10	Formula	Unit	Data sources
Actual treatment capacity as a percentage of installed treatment capacity in the ULB	(Actual capacity in MLD/Installed capacity in MLD) × 100	%	CPCB (2021)[20]
Assumptions/limitations			
• It is assumed that the National Inventory on Sewage Treatment Plants (CPCB 2021) provides an exhaustive list of sewage treatment capacities across states.			

Parameter 2: Reuse of treated used water

Rationale: The reuse of TUW is an essential element of used water management at the ULB level. It reduces the pressure on already scarce freshwater resources by providing an alternative source of water that can be utilised for various non-potable purposes, depending on the level of treatment; for example, irrigation of urban parks and gardens, construction activities, cleaning of roads, agriculture use, industrial use and domestic use (flushing, gardening, and car cleaning). Further, the market potential of TUW reuse from the sale of TUW and biosolids can contribute to cost recovery for ULBs, hence ensuring sustainability in used water management models. The following indicator is used to assess this parameter.

Table A11: Description of indicator 11

Indicator 11	Formula	Unit	Data sources
Quantity of TUW being reused in different sectors for non-potable purposes as a percentage of the total used water received by treatment plants in the ULB	(Extent of reuse and recycling in MLD/Total used water received by STPs in MLD) × 100	%	State SLB reports[11,12,13,14,15,16,17]; CPCB (2021)[20]; NMCG (2021)[23,24,25,26,27,28,29,30,31,32]; CPHEEO (2021)[33]
Assumptions/limitations In some cases, the actual treatment capacity in the ULB has been considered as the total used water received by treatment plants in the ULB.			

23 *GoAP. 2021. "Monthly Progress Report December 2021." New Delhi: National Mission for Clean Ganga, Ministry of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation), Government of India.*

24 *GoC. 2021. "Monthly Progress Report December 2021." New Delhi: National Mission for Clean Ganga, Ministry of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation), Government of India.*

25 *GoG. 2021. "Monthly Progress Report December 2021." New Delhi: National Mission for Clean Ganga, Ministry of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation), Government of India.*

26 *GoH. 2021. "Monthly Progress Report December 2021." New Delhi: National Mission for Clean Ganga, Ministry of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation), Government of India.*

27 *GoJ. 2021. "Monthly Progress Report December 2021." New Delhi: National Mission for Clean Ganga, Ministry of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation), Government of India.*

28 *GoK. 2021. "Monthly Progress Report December 2021." New Delhi: National Mission for Clean Ganga, Ministry of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation), Government of India.*

29 *GoP. 2021. "Monthly Progress Report December 2021." New Delhi: National Mission for Clean Ganga, Ministry of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation), Government of India.*

30 *GoMP. 2021. "Monthly Progress Report December 2021." New Delhi: National Mission for Clean Ganga, Ministry of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation), Government of India.*

31 *GoR. 2021. "Monthly Progress Report December 2021." New Delhi: National Mission for Clean Ganga, Ministry of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation), Government of India.*

32 *GoWB. 2021. "Monthly Progress Report December 2021." New Delhi: National Mission for Clean Ganga, Ministry of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation), Government of India.*

33 *Central Public Health and Environmental Engineering Organisation (CPHEEO). 2021. "Compendium of Recycle and Reuse of Used Water in 54 Million Plus Cities." New Delhi: Ministry of Housing and Urban Affairs, Government of India.*

Parameter 3: Energy efficiency

Rationale: STPs are highly energy intensive. The adopted treatment technology plays a key role in determining the energy consumption of the treatment infrastructure, and hence the energy costs. This parameter assesses the energy consumption of the treatment infrastructure in the ULB, based on the treatment technologies adopted. The following indicator is used to assess this parameter.

Table A12: Description of indicator 12

Indicator 12	Formula	Unit	Data sources
Annual energy consumption of treatment plants per MLD of actual used water treatment in the ULB	([Technology-specific power requirement in kWh/d/MLD × actual used water treatment] × 365)/Actual treatment capacity in the ULB	kWh/MLD	NMCG (2021)[23, 24,25,26,27,28,29,30,31,32]; CPCB (2021)[20]

Assumptions/limitations

- The energy consumption of the used water treatment infrastructure is based on the average daily power requirements of the respective used water treatment technologies adopted.
- Nature-based solution (NbS) technologies are assumed to have 0 power consumption (GoI 2022).
- Energy consumption related to pumping used water is not considered due to insufficient data availability at the ULB level.

Parameter 4: Quality of TUW

Rationale: TUW is often discharged into freshwater bodies such as rivers and lakes. Given its impact on the environment and public health, it is essential to ensure that the used water is treated to meet appropriate discharge quality standards. This parameter assesses the level of compliance with CPCB discharge standards by STPs in the ULBs. The following indicator is used to assess this parameter.

Table A13: Description of indicator 13

Indicator 13	Formula	Unit	Data sources
Percentage of STPs that comply with CPCB discharge standards out of the total STPs in the ULB	(Number of STPs complying/ Total number of STPs present in the ULB) × 100 OR (Number of samples that pass the specified secondary treatment standards/Total number of TUW samples tested in a month) × 100	%	CPCB (2021)[20]; State SLB reports[11,12,13,14,15,16,17]

Assumptions/limitations

- In cases where compliance status is not disclosed in the National Inventory on Sewage Treatment Plants (CPCB 2021), compliance is assessed using TUW sampling data in the state SLB reports.
- The state SLB reports provide data on the percentage of samples of TUW that pass the secondary treatment standards out of the total tested samples.

Parameter 5: Energy cost incurred

Rationale: STPs are highly energy intensive. Energy costs of treatment plants account for a significant share of their total O&M costs, with electricity consumption accounting for the majority of the total energy consumption. For efficient used water treatment, it is essential to adopt appropriate cost and energy-efficient treatment technologies that minimise O&M costs to ensure better cost recovery for the ULB. The following indicator is used to assess this parameter.

Table A14: Description of indicator 14

Indicator 14	Formula	Unit	Data sources
Annual energy consumption per MLD of actual treatment in the ULB multiplied by cost per unit of energy	(Energy consumption per day in kWh × State user charge in INR/kWh) × 365/Actual treatment capacity in the ULB	INR/MLD	State Electricity Regulatory Commissions[34,35,36,37,38,39,40,41,42,43]
Assumptions/limitations			
• State-specific energy charges applicable for used water treatment by STPs are used to determine energy cost.			
• Energy cost related to pumping used water is not considered due to insufficient data availability at the ULB level.			

34 *Andhra Pradesh Electricity Regulatory Commission. 2021. "Retail Supply Tariffs." Hyderabad: Andhra Pradesh Electricity Regulatory Commission.*

35 *Chhattisgarh State Electricity Regulatory Commission. 2021. "Tariff Schedule for FY 2021–22." Raipur: Chhattisgarh State Power Distribution Company Limited.*

36 *Gujarat Electricity Regulatory Commission. 2021. "Tariff Order." Gandhinagar: Gujarat Electricity Regulatory Commission.*

37 *Haryana Electricity Regulatory Commission. 2021. "Tariff for 2021–22." Panchkula: Haryana Electricity Regulatory Commission.*

38 *Jaipur Vidyut Vitran Nigam Limited. 2021. "Tariff for Supply of Electricity – 2021." Jaipur: Rajasthan Electricity Regulatory Commission.*

39 *Karnataka Electricity Regulatory Commission. 2021. "Tariff Order." Bangalore: Bangalore Electricity Supply Company Ltd.*

40 *Madhya Pradesh Electricity Regulatory Commission. 2021. "Retail Supply Tariff Order FY 2021–22." Bhopal: Madhya Pradesh Electricity Regulatory Commission.*

41 *Punjab State Electricity Regulatory Commission. 2021. "Schedule of Tariff." Chandigarh: Punjab State Electricity Regulatory Commission.*

42 *Udaipur Nagar Nigam. 2014. "Udaipur Nagar Nigam." Google Play. https://play.google.com/store/apps/details?id=org.udaipurmc.app&pli=1.*

43 *West Bengal Electricity Regulatory Commission. 2021. "Tariff Order." Kolkata: West Bengal State Electricity Distribution Company Ltd.*

Parameter 6: Level of GHG emissions/carbon intensity

Rationale: Urban domestic used water generates methane and nitrous oxide emissions – the former is the main source of GHG emissions. Methane emissions are generated during the treatment of domestic used water, and nitrous oxide emissions occur due to the degradation of the nitrogen present in domestic used water, on its disposal into water bodies. Further, as mentioned in Parameter 5, electricity consumption accounts for the majority of the energy consumption of used water treatment infrastructure. Hence, improved energy efficiency provides the climate co-benefit of reduced GHG emissions. This state-level parameter assesses the carbon intensity of urban domestic used water in terms of the per capita annual GHG emissions from used water treatment and discharge in the state.

Table A15: Description of indicator 15

Indicator 15	Formula	Unit	Data sources
Per capita annual GHG emissions from used water treatment and discharge at the state level	(Total methane generated emissions in CO2e per annum + Total nitrous oxide generated emissions in CO2e per annum)/ Total urban population (2018)	Tonnes of carbon dioxide equivalent (tCO2e)	Mishra et al. (2022)[44]
Assumptions/limitations			
• State-level emissions estimates from used water treatment and discharge have been derived from the GHG Platform India, which provides the latest estimates for 2018. Hence, the 2018 urban population has been considered. • Urban population estimates have been made using Census of India (2001 and 2011) data and decadal population growth trends.			

Theme: Governance

Parameter 1: Publication of performance reports

Rationale: As per the 14th Finance Commission, ULBs must publish yearly service-level benchmarking (SLB) reports for the following urban services: water supply, sewage, solid waste management, and stormwater drainage. These reports have been published by several states, with recent data on the performance parameters defined under the four urban services for ULBs within the state. The regular monitoring and reporting of performance against set targets/benchmarks will help ULBs make situational assessments, identify areas for improvement, and accordingly plan and prioritise interventions. Regular reporting of such data at the ULB level may also increase the accountability and transparency of local urban governance. The following qualitative indicator is used to assess this parameter.

Table A16: Description of indicator 16

Indicator 16	Formula	Unit	Data sources
Whether service-level performance reports are published by the ULB regularly	Yes = 1 No = 0	NA	State SLB reports[11,12,13,14,15,16,17]
Assumptions/limitations			
• SLB reports not available in the public domain are assumed to be unpublished.			

44 *Mishra, Prateek, Nikhil Kolsepatil, and Anandhan Subramaniyam. 2022. "Greenhouse Gases Emissions of India (Subnational Estimates): Waste Sector (2005– 2018 Series)." GHG Platform India. https://www.ghgplatform-india.org/waste-sector/.*

Parameter 2: Availability of an updated city master plan

Rationale: City master plans are statutory policy documents that govern the growth and development of cities over the next 20–30 years. The development of physical infrastructure and management of services related to the water supply, used water management, and stormwater drainage sectors are important aspects of city planning. Water-related infrastructure in these three sectors should be developed in line with land use planning as per the city master plan, enabling the development of integrated infrastructure that accounts for current and future urban development. This parameter hence assesses whether the ULB has an updated city master plan, that has been revised recently.

Table A17: Description of indicator 17

Indicator 17	Formula	Unit	Data sources
Whether an updated city master plan exists	Present = 1 Only land use plan present = 0.5 Absent = 0	NA	State government portals[45,46,47,48,49,50,5152,53,54]; ULB websites[55,56,57]
Assumptions/limitations • Master plans not available in the public domain are assumed to not exist. • Only master plans revised in 2021 or after are assumed to have been updated.			

45 *Directorate of Town and Country Planning, Raipur Chhattisgarh. 2023. "District Wise Development Plan Information." Raipur: Directorate of Town and Country Planning. https://tcp.cg.gov.in/TCP1-English/VY.html.*

46 *GoAP. 2018. "Master Plans." Directorate of Town and Country Planning. http://dtcp.ap.gov.in/dtcpweb/Master_Plans.html.*

47 *GoC. 2023. "Development Plan." Town Planning and Valuation Department. https://townplanning.gujarat.gov.in/dp-tps-information/development-plan.aspx.*

48 *GoH. 2021. "Town and Country Planning Department, Haryana." Department of Town and Country Planning. https://tcpharyana.gov.in/DevelopmentPlan.htm.*

49 *GoK. 2022. "Approved Master Plans." Director of Town and Country Planning. http://www.dtcp.gov.in/en/approved-mp.*

50 *GoP. 2023. "Approved Master Plans." Punjab Urban Planning and Development Authority. https://puda.punjab.gov.in/?q=approved-master-plans-links.*

51 *GoR. 2023. "Portal Rajasthan Sarkar." Government of Rajasthan. https://urban.rajasthan.gov.in/content/raj/udh/en/UDH/town-planning-department/master-plan.html.*

52 *GoWB. 2019. "Land Use Plans for All Urban Areas." Department of Urban Development and Municipal Affairs. https://www.wburbanservices.gov.in/page/cms/eodb_ludcp.*

53 *GoG. 2023. "Development Plan." Town Planning and Valuation Department. https://townplanning.gujarat.gov.in/dp-tps-information/development-plan.aspx.*

54 *Urban Development and Housing Department. 2023. "Master Plan." Urban Development and Housing Department. https://udhd.jharkhand.gov.in/Programs/MasterPlans.aspx.*

55 *Burdwan Development Authority. 2017. "Land Use Development Control Plan." Burdwan: Burdwan Development Authority.*

56 *Haldia Development Authority. 2014. "Proposed Land Use Plans." Haldia: Haldia Development Authority.*

57 *Kolkata Metropolitan Development Authority. 2008. "Land Use and Development Control Plan for the Howrah Municipal Corporation Area Being the Portion of the Kolkata Metropolitan Area." Kolkata: Kolkata Metropolitan Development Authority.*

Parameter 3: Addressing used water management in the city master plan

Rationale: This parameter assesses the level to which used water management is being addressed, in terms of the policies and provisions of the EDRTRFwhether sewage-related targets have been defined; for instance, to develop treatment infrastructure and/or a sewerage network by the target year. Second, whether there are provisions for monitoring and evaluation of these sewage related targets. The following two indicators elaborate on the above.

Table A18: Description of indicators 18 and 19

Indicators 18 and 19	Formula	Unit	Data sources
Whether the master plan mentions quantitative sewage-related targets	Yes = 1 No = 0	NA	State government portals[45,46,47,48,49,50,51,52,53,54]; ULB websites[55,56,57]
Whether sewage-related key performance indicators are mentioned as part of the monitoring and evaluation of the city master plan	Yes = 1 No = 0	NA	State government portals[45,46,47,48,49,50,51,52,53,54]; ULB websites[55,56,57]

Parameter 4: Availability of a sewerage plan

Rationale: In addition to the city master plan, a city sewerage plan can enable efficient used water management in urban areas. A sewerage plan will account for current and projected used water generation, based on the urban population, existing sewerage infrastructure, proposed sewerage infrastructure development projects, land availability, and site feasibility. There will also be provisions for an investment plan with cost estimates, and an implementation plan with time-bound targets specified for the schemes/projects proposed in the plan. This parameter hence assesses whether a city sewerage plan is available for the ULB.

Table A19: Description of indicator 20

Indicator 20	Formula	Unit	Data sources
Whether a sewerage plan is available for the ULB	Yes = 1 No = 0	NA	ULB-specific water and sewerage board websites

Parameter 5: Presence of PPP models to manage used water treatment and/or reuse

Rationale: As mentioned in the *Efficiency* theme of the MUWM assessment framework, cost recovery for the ULB is essential for long-term and effective used water management. ULBs can leverage public–private partnerships (PPP) to cover capital and O&M costs of the treatment infrastructure. Further, innovative business models involving the private sector can be adopted to make reuse projects financially viable for the implementing authority. The following qualitative indicator is used to assess this parameter.

Table A20: Description of indicator 21

Indicator 21	Formula	Unit	Data sources
Whether PPP models are being used for undertaking projects related to used water treatment and/or reuse at the ULB level	Yes = 1 No = 0	NA	Department of Economic Affairs (2019)[58]

Parameter 6: Adequacy of ULB staff

Rationale: Ensuring adequate and skilled human resources at the ULB level is a prerequisite for efficient local governance and urban service delivery. This parameter estimates the number of ULB staff per 1,000 in the population.

Table A21: Description of indicator 22

Indicator 22	Formula	Unit	Data sources
Number of ULB staff per 1,000 population	(Number of ULB employees/Total population of the ULB) × 1,000	NA	CAG audit reports, according to the 74th Constitutional Amendment Act [59,60,61,62,63,64]

Assumptions/limitations

- Data is published for a few test cities in selected states.
- The adequacy of staff is limited to the number of staff members. Capacities or skill development of staff has not been evaluated under this parameter due to insufficient data availability at the ULB level.

58 *Department of Economic Affairs. 2019. "List of All PPP Projects." Department of Economic Affairs.*
59 *CAG. 2022. "Performance Audit on Implementation of 74th Constitutional Amendment Act in Madhya Pradesh for the Year Ended 31 March 2020." Comptroller and Auditor General of India.*
60 *—. 2021. "Performance Audit on Efficacy of Implementation of the Constitution (Seventy-fourth Amendment) Act, 1992." Comptroller and Auditor General of India for the Government of Chhattisgarh.*
61 *—. 2021. "Performance Audit on Efficacy of Implementation of the Constitution (Seventy-fourth Amendment) Act, 1992." Comptroller and Auditor General of India for the Government of Haryana.*
62 *—. 2021. "Performance Audit on Efficacy of Implementation of the Constitution (Seventy-fourth Amendment) Act, 1992." Comptroller and Auditor General of India for the Government of Karnataka.*
63 *—. 2021. "Performance Audit on Efficacy of Implementation of the Constitution (Seventy-fourth Amendment) Act, 1992." Comptroller and Auditor General of India for the Government of Punjab.*
64 *—. 2021. "Performance Audit on Efficacy of Implementation of the Constitution (Seventy-fourth Amendment) Act, 1992." Comptroller and Auditor General of India for the Government of Rajasthan.*

Parameter 7: Presence of a dedicated municipal cadre

Rationale: The 74th Constitutional Amendment Act mandates the creation of a dedicated municipal cadre to strengthen local governance and municipal service delivery. The dedicated municipal cadre has three categories: first, a separate personnel system wherein municipal personnel are not transferable to other ULBs; second, a unified personnel system wherein municipal personnel are transferable to other ULBs within the state; and third, an integrated personnel system wherein municipal personnel can be transferred to other ULBs and to state government departments. The following qualitative indicator is used to assess this state-level parameter.

Table A22: Description of indicator 23

Indicator 23	Formula	Unit	Data sources
Whether the municipal cadre/ personnel system at the state level is classified under separate personnel, unified personnel, or integrated personnel systems	Separate = 1 Unified = 0.75 Integrated = 0.5	NA	74th Constitutional Amendment Act[65]
Assumptions/limitations • A separate personnel system at the ULB level is more efficient at delivering municipal services than a unified or integrated personnel system.			

Theme: Data and Information

Parameter 1: Availability of a MIS portal

Rationale: ULBs are responsible for delivering a number of urban services. A comprehensive management information system (MIS) is essential for efficient planning, implementation, and monitoring of such citizen-centric services. This parameter hence assesses whether a MIS portal is available for publishing data related to used water management at the ULB level. The following qualitative indicator is used to assess this parameter.

Table A23: Description of indicator 24

Indicator 24	Formula	Unit	Data sources
Whether a MIS portal is available for publishing data at the ULB level	Present= 1 Absent = 0	NA	ULB websites[66,67]

65 *The Constitution (Seventy-fourth Amendment) Act, 1992.*

66 *GoAP. 2023. "APPMS Dashboard." Andhra Pradesh Project Management System. http://appms.ap.gov.in/SEPL.PWIMS.Dashboard/APPMS_Dashboard/ViewDashboard.aspx.*

67 *GoP. 2022. "Information Centre." Government of Punjab. https://dwss.punjab.gov.in/right_to_info/.*

Parameter 2: Grievance redressal mechanism

Rationale: It is important that for essential services such as used water management, the ULB has effective systems to capture citizen complaints/grievances, escalate them internally for remedial action, and resolve them. This parameter hence assesses whether there is a grievance redressal mechanism available at the ULB level, and its efficiency, specifically in used water management services. The following two indicators are used to assess this parameter.

Table A24: Description of indicators 25 and 26

Indicators 25 and 26	Formula	Unit	Data sources
Whether a grievance redressal mechanism related to sewage management exists at the ULB level/state level	Present at the ULB level = 1 Present only at the state level = 0.5 Absent = 0	NA	ULB websites[68,69,7071,72]; state portals[73,74,75,7677,78,79,80,81,82]
The total number of sewage-related complaints redressed within 24 hours of receipt of complaints as a percentage of the total number of sewage-related complaints received in the given time period at the ULB level	(Total number of complaints redressed within the month/ Total number of sewage-related complaints received per month) × 100	%	State SLB reports[11,12,13,14,15,16,17]

68 *Gwalior Municipal Corporation. 2023. "Unified Complaint Management System." Gwalior Municipal Corporation. https://complaints.gwaliormunicipalcorporation.org/Home/Register_Complaint.*

69 *Jaipur Municipal Corporation. 2023. "Complaint Registration." Jaipur Municipal Corporation. http://samadhan.jaipurmcheritage.org/ComplaintRegistrationByWebsite/AddComplaintRegistrationByWebsite.*

70 *Kota Nagar Nigam. 2023. "Post Complaint." Kota Nagar Nigam. http://kotamc.org/UI/Dynamic/Grievance/postcomplaint.aspx?lang=1.*

71 *Nagar Nigam Ajmer. 2021. "Nagar Nigam Ajmer Complaint Portal." Local Self Gov. http://localselfgov.org/nnajmer.localselfgov.org/nnajmer/track_complain.php.*

72 *Udaipur Nagar Nigam. 2014. "Udaipur Nagar Nigam." Google Play. https://play.google.com/store/apps/details?id=org.udaipurmc.app&pli=1.*

73 *Bikaner Municipal Corporation. 2017. "Post Complaint." Bikaner Municipal Corporation. http://bikanermc.org/UI/Dynamic/Grievance/postcomplaint.aspx?lang=1.*

74 *GoAP. 2023. "Andhra Pradesh Municipal Administration Grievance Dashboard." Vassar Labs. http://ph.vassarlabs.com:3000/pgr/grievance/district//.*

75 *—. 2023. "Online Grievance Redressal Tracking System." CG Grievance. https://cggrievance.cgg.gov.in/.*

76 *GoG. 2013. "ENagar Complaint Registration." Government of Gujarat. https://enagar.gujarat.gov.in/DIGIGOV/#.*

77 *GoK. 2018. "Complaints." Karnataka Urban Water Supply and Drainage Board. https://kuwsdb.org/complainten.html.*

78 *GoMP. 2023. "MP E-Nagar Palika Portal." Madhya Pradesh E-Nagar Palika. https://www.mpenagarpalika.gov.in/irj/portal/anonymous/Grievance/qlNewGrievance?guest_user=anony2.*

79 *GoR. 2023. "Rajasthan Sampark." Government of Rajasthan. https://sampark.rajasthan.gov.in/.*

80 *GoWB. 2021. "Programme Implementation and Grievance Cell." Office of the Hon'ble Chief Minister, Government of West Bengal. https://cmo.wb.gov.in/default1.aspx#.*

81 *Public Health Engineering Department. 2023. "PHED – Consumer Services." Public Health Engineering Department. https://services.phedharyana.gov.in/.*

82 *Punjab Water Supply and Sewerage Board. 2017. "For Public Direct Complaints." Punjab Water Supply and Sewerage Board. https://pwssb.punjab.gov.in/complaint-form/.*

Parameter 3: Readability of city master plans

Rationale: City master plans are statutory policy documents that govern the growth and development of cities over the next 20–30 years. Wide outreach and a good understanding of the city's future growth and development can ensure well informed and active citizen participation at the local level. The readability of the master plan document, in terms of the language used, hence assesses the level of accessibility of the policy to diverse stakeholders. The following qualitative indicator is used to assess this parameter.

Table A25: Description of indicator 27

Indicator 27	Formula	Unit	Data sources
Whether the city master plan is available in the local language and any official language (English or Hindi)	Available in both = 1 Available in either the local language or any official language = 0.5 Absent = 0	NA	State government portals[45,46,47,48,49,50,51,52,53,54]; ULB websites[55,56,57]

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