IFC | INSTITUTE *for* COMPETITIVENESS

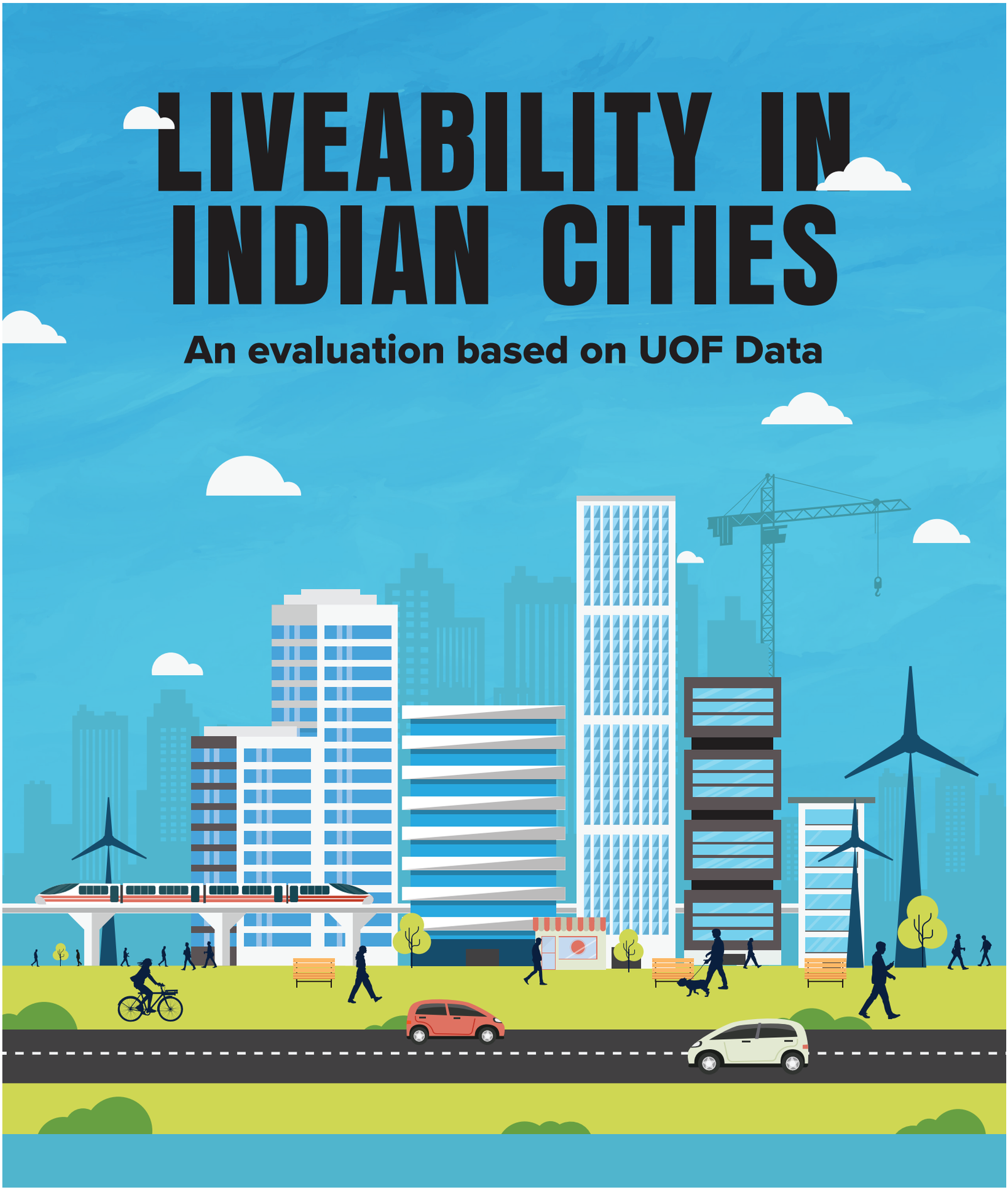
Smart City

Ministry of Housing and Urban Affairs
Government of India

National Institute of Urban Affairs

LIVEABILITY IN INDIAN CITIES

An evaluation based on UOF Data



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01 INTRODUCTION

India, with one-sixth of the world's population, is at the vanguard of this transformation. Urban India is undergoing a significant transformation. Since 1951, the urban population of India has increased by a factor of six, from 62.4 million in 1951 to 377.1 million in 2011.

The future of the world is in cities. In 2022, the world's population will reach 8 billion, with over half residing in urban areas.

By 2050,

70%

of the world's population is anticipated to reside in urban areas.

Approximately 1.1 billion people currently reside in slums or conditions resembling slums in urban areas, with an anticipated increase of 2 billion over the next 30 years.[1] Along with rising incomes and a transition away from agriculture and rural economies, this proportion is projected to rise sharply in the coming decades.

India, with one-sixth of the world's population, is at the vanguard of this transformation. Urban India is undergoing a significant transformation

Since 1951,

The urban population of India has increased by a factor of six, from

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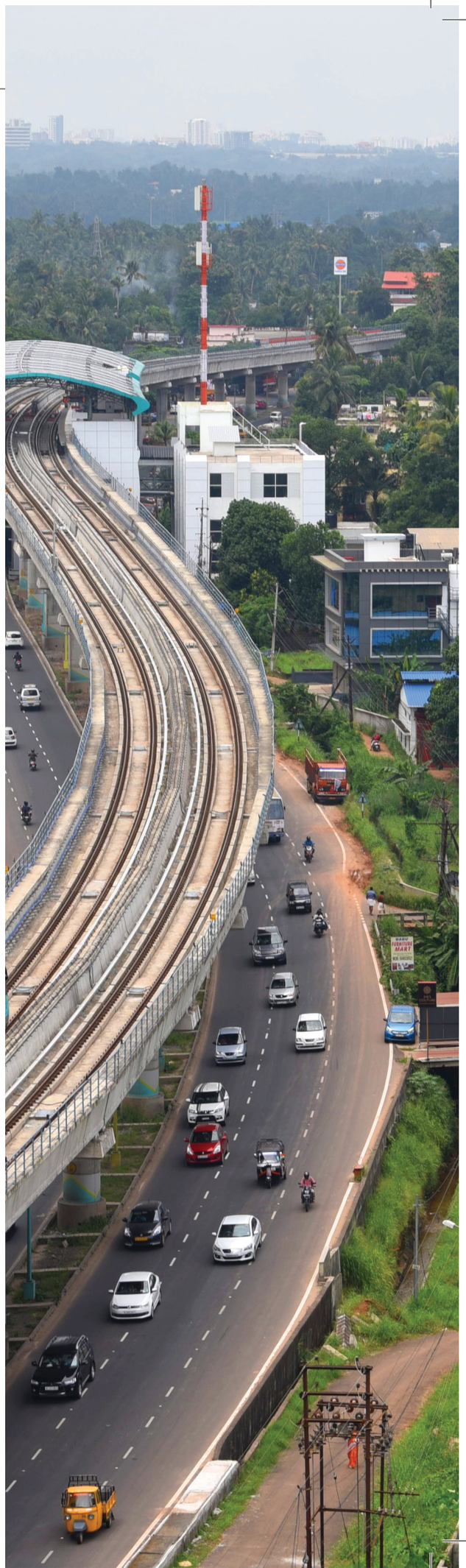
It is estimated that by 2030, 590 million Indians will reside in urban areas, which is more than the entire population of the United States.

In India, the urbanisation challenge and the responsibilities of achieving SDG 11[2] which is about making cities and human settlements inclusive, safe, resilient and sustainable are imperative.[3] This rapid expansion of urbanisation is driven by a variety of factors, including improved employment and economic opportunities, access to health care facilities, and an anticipated higher standard of living. Cities have come to play an increasingly crucial role in generating economic development, resulting in higher per capita income and fostering innovation, thereby improving the quality of life. However, the rapid tempo and scope of development are accompanied by a vast number of obstacles. The growing population density and limited resources pose a significant challenge to urban governance. There is an immediate need to meet the demands of a growing population through the development of infrastructure, the provision of economic opportunities, and the delivery of services such as affordable housing, pure water, and sanitation, among others. The economic and social fabric of cities with limited resources, ineffective management practices, and unsustainable land-use patterns is negatively impacted. In developing nations, informal and unplanned settlements account for roughly 90 percent of urban expansion in hazard-prone areas.



[1] Goal 11: Make cities inclusive, safe, resilient and sustainable
[2] Cities - United Nations Sustainable Development Action 2015
[3] India's Urban Story: SDGs and Urban Indices Across States | NIUA

> **The development of new cities and the modernization of services in existing cities are the two most important aspects of urban development.**

Moreover, urbanisation does not necessarily result in a more equitable distribution of the wealth it generates, and in many cities, inequality is increasing not only in terms of income but also in terms of quality of life—living and working conditions. Urban areas are projected to accommodate the entire global population growth between 2009 and 2050, with urbanisation concentrated in Asia and Africa. Thus, urban population growth is occurring in still-poverty-stricken regions, raising concerns about rising urban poverty and the inability of national and local governments to provide services to the residents of their rapidly expanding cities. In addition, cities consume over two-thirds of the world's energy and are responsible for over 70 percent of greenhouse gas emissions. The peril posed by climate change places cities at the vanguard of addressing this issue. These factors emphasise the need for building cities that are based on sustainability and operate efficiently. This necessitates India's Urban Story be designed keeping important aspects of urban development. **Honourable Prime Minister Modi in his address on the subject of 'Urban Development with focus on planning' emphasized the same. He reiterated that** "***the development of new cities and the modernization of services in existing cities are the two most important aspects of urban development.***"

Government of India has recognised this need and introduced a number of initiatives to help develop the urban economy, enhance the quality of life, and address emergent issues. All urban local governments implemented a number of programmes to address the significant issues of poverty alleviation, affordable housing, and sanitation. **These include the Deen Dayal Antyodaya Yojana-National Urban Livelihood Mission (DAY-NULM), Swachh Bharat Mission-Urban (SBM-U), Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Pradhan Mantri Awas Yojana-Urban (PMAY-U), Smart Cities Mission (SCM), Schemes and Projects for Urban Transport, and the Heritage City Development and Augmentation Yojana (HRIDAY). The Atal Mission for Rejuvenation and Urban Transformation (AMRUT)** addresses fundamental infrastructure issues, including water supply, sewage and septage management, runoff drainage, non-motorised urban transport, and verdant parks. As these industries require efficiencies of scale, they are implemented in 500 cities with a population of one million or more, encompassing 65 percent of the population. Moreover, challenges associated with liveability are addressed by paradigms of urban governance that place communities at the centre of all decisions and promote the use of digital technology to enhance urban infrastructure, services, and optimal resource utilisation.

The Smart Cities Mission (SCM) is implemented in 100 cities across India to achieve this objective. It has become increasingly important to construct cities that are not only functionally efficient but also sustainable and resilient. Several initiatives and programmes have been implemented to develop

The Smart Cities Mission (SCM) is implemented in 100 cities across India to achieve this objective.

and transform urban spaces in India in response to the urgency of this need. In such a scenario, it is essential to develop an evaluation instrument that provides cities with a comprehension of their performance in various development sectors. The data-driven insights gained from such assessments can be used as a springboard to initiate improved governance outcomes in accordance with the demands of citizens.

The Ministry of Housing and Urban Affairs (MoHUA) has developed a conceptual framework that defines ease of living as well as its key elements. **'Ease of Living', as defined by the Ministry, is underpinned by concepts of healthy communities, economic development, environmental sustainability, and social capital and cohesion. The evaluation report on 'Liveability In Indian Cities: An evaluation based on UOF Data'** incorporates ease of living definition as it captures both social and economic factors, measuring the quality of life holistically across the parameters of education, health, housing, water and sanitation, waste management, mobility, safety, and recreation. In addition to assessing the economic capacity of these cities to provide opportunities, the framework investigates how India's urban areas gain access to natural spaces while strengthening their resilience. To further substantiate the report's findings, a "Citizen Perception Survey" was conducted to gauge city residents' satisfaction with service delivery. The purpose of the survey was to determine if the citizens' perceptions of their city corresponded with the service outcome. Along with the Citizen Perception Survey, this study provides a comprehensive view of Indian cities. On the basis of the outcomes of these factors, they evaluate the ease of life in cities, local governance, administrative efficiency, and citizen perception.

The key objectives of this study are:

1. **Accelerate action to accomplish broader development outcomes, including the Sustainable Development Goals.**
2. **Generate information to guide policymaking based on evidence.**
3. **Promote citizens' perspectives on the city administration's services and function as a platform for dialogue between them.**

The sections that follow delve deeper into the report's underlying framework and the primary results that resulted from the data collected. It describes how 158 Indian cities are performing across the three dimensions and outlines measures that can be taken to increase the efficiency of urban governance.

02

FRAMEWORK & METHODOLOGY

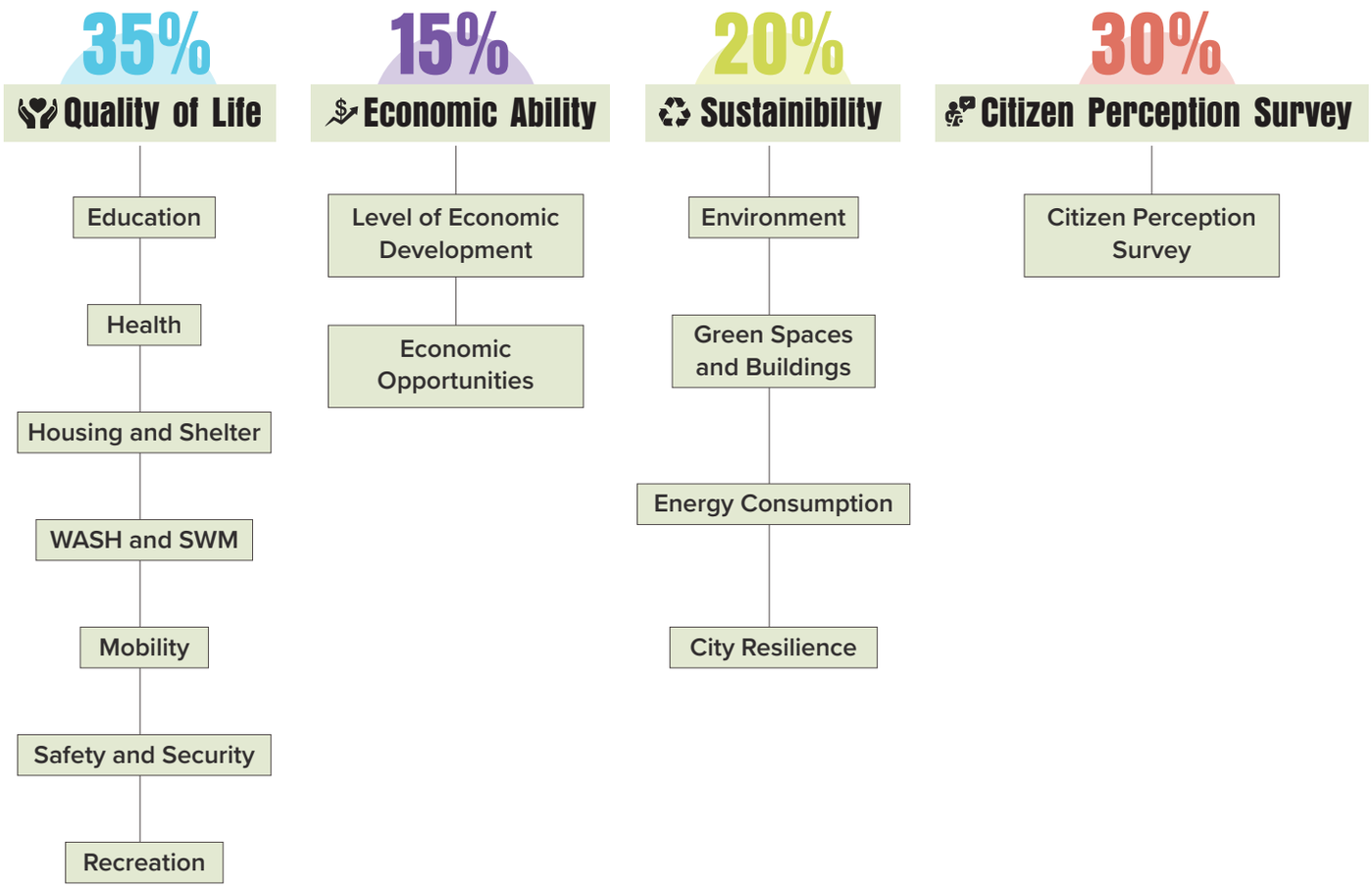
The Citizen Perception Survey (CPS) results were used to strengthen the framework further. It provides a perception of the city's residents and allows them to evaluate the level and quality of development in their respective cities.

This study evaluates the well-being of Indian citizens.158 cities are evaluated across various parameters that consist of four domains: quality of life, economic ability, sustainability, and the citizens perception survey. In total, 50 indicators were examined in 14 categories. The first domain on "**Quality of Life**" uncovers an understanding of the different aspects contributing to a decent urban life. By examining provisions for necessities such as affordable housing, access to clean water, basic education, healthcare facilities, safety and security, and recreation avenues, the goal has been to assess a holistic impression of the quality of life in India's urban cities. It has a weight of 35% in the final score. The second domain, "**Economic Ability**," captures the economic well-being of citizens by evaluating the level of economic development and inequalities that they encounter in a particular city. This domain holds a weight of 15%

in the final score. The third domain evaluates "**sustainability**" along the lines of availability of green spaces, promotion of green buildings, level of energy consumption, the quality of natural resources such as air and water, and the city's ability to withstand natural disasters. It holds a weight of 20% in the final score. The framework for the study has been calculated using the data provided by cities on these domains. It has also been validated through secondary sources to ensure a robust methodology and framework. The **Citizen Perception Survey (CPS)** results were used to strengthen the framework further. It provides a perception of the city's residents and allows them to evaluate the level and quality of development in their respective cities. Furthermore, the survey acts as a source to validate the findings of the study and examine whether they comply with the results of the data provided by the cities. The CPS domain holds a weightage of 30% in the overall score.

It is important to note that all categories are considered equally important in the framework and have been given equal weightage. However, since the number of indicators under each domain varies, then each domain have been assigned different weights.

Liveability, Sustainability and Economic Ability of Indian cities framework:



Categorization of cities

Indian cities are characterized by their varying levels of development and population sizes, have been systematically categorized into five distinct tiers. This stratification is pivotal in organizing the dataset for the purpose of our study. The categorization unfolds as follows: Category 1 encompasses cities with populations below 50,000, reflecting a specific subset of smaller municipalities. Category 2 encompasses cities whose populations fall within the range of 50,000 to 100,000, representing urban centers of moderate size and significance. Category 3 consists of cities with populations ranging from 100,000 to 500,000 signifying cities of substantial regional importance. Category 4 encapsulates cities with populations varying between 500,000 and 10,00,000, highlighting significant urban hubs within the Indian landscape. Lastly, Category 5 encompasses cities with populations exceeding 10,00,000, encompassing the country's major metropolitan areas. It should be noted that cities categorization is based on 2011 census value. This categorization may deviate if done on projected value of cities in 2021. However, it is crucial to recognize this inherent dynamism of urban economies. Our projections for the year 2021 introduce an additional layer of complexity, as the anticipated values may deviate from the initial categorization based on the 2011 census.

Acknowledging the complexity of urban dynamics, we recognize certain limitations and assumptions in our categorization process. These may include assumptions about population growth rates and potential changes in urban development patterns. However, the choice of the 2011 census as the base year stems from its reliability and stability, capturing a representative cross-section of urban characteristics. This census serves as a robust foundation for our categorization methodology. The values for 2021 were projected based on the formula outlined in the Urban Outcome Framework-part 1.

Scoring Methods

The data collected for the 50 indicators across the study had been obtained in various units. For instance, professionally trained teachers in schools is a percentage of the total teachers, while footpath density is a ratio of the total length of the footpath to the total length of road. Each of these indicators has had a different scoring mechanism.

Percentage

Since cities vary in population sizes and economic strength, most indicators need to be weighed for comparability. For instance, the total number of households connected to sewerage network needs to be weighed against the total number of households in the city. These indicators, therefore, take the form of percentages. These do not require any scoring mechanisms but were standardized, as explained below.

Ratio

Similarly, to weigh the data for comparability, some indicators were obtained in the form of ratios. For instance, transport - related fatalities were weighed by per lakh of population. Again, these did not require scoring mechanisms but were standardised.

Binary Marking

Some indicators take the form of yes or no questions to the cities. For instance, the indicator assessing if the city incentivise green buildings takes the form of a question. The response to this is binary, with the “yes” answer marked as 1 and the “no” answer marked as 0.

Data Transformation

All the indicators in the final set are modified so that a greater value means a higher score for the city. For evaluation indicators were modified to correlate with the aspects that are supposed to be examined through the study. In contrast, some other indicators are energy consumed from renewable sources, Literacy rate are positively related to citizens while the prevalence of crimes, i.e crime against women, crime against children are negative indicators. Negative indicators are transformed. An exhaustive list of indicators is provided in the appendix to the report.

Normalisation

Normalisation is required to make the indicators comparable with each other. It is critical to normalise the data before making any data aggregation as indicators have different units. For example, the sewerage network coverage is captured as a percentage of the total road while the pupil-teacher ratio is a proportion. These indicators are not comparable by any standards. The normalisation procedure is carried out to transform all the data into dimensionless numbers. This is done using z-scores that can be placed in a normal distribution. The z-score or the standard score indicates how many standard deviations an indicator value is from the mean. It ranges from -3 standard deviation to +3 standard deviation.

Standardisation

Standardisation helps solve non-comparability by making indicators unitless as it re-scales them with a mean of zero and a standard deviation of one. It is calculated using the following formula:

$Z= (X- \mu)/\sigma)$

Where Z represents z-score; μ is the mean; X is the indicator value, and σ is the standard deviation.

Aggregation

The study is based on three elements, i.e. indicators, sectors and domain that have been represented by A to M, and domain values have been represented by O, P and Q (as depicted by the table in the next section on Category Scores).

Sector Scores

The weights for each sector have been decided based on consultation with experts and proportionality of the said indicators across domains. The category values are calculated by summing the weighted scores using the following formula:

Sectors = Σ (wi * indicator)

For instance, the category Housing and Shelter has four indicators, so the weight of every indicator for calculating the score for category Health will be 20 percent or 0.2. This implies that:

Scores of Housing and Shelter = (0.2* Value of households with electrical connections + 0.2* Value of average length of electrical interruptions + 0.2* Value of beneficiaries Under PMAY+ 0.2* Value of Slum Population)

These scores have been transformed to a 0 to 100 scale. The calculation has been done using the following formula:
(X- Minimum Scores) / (Maximum Score-Minimum Score)
Where X is the city score. The category values are represented in the form of A to M in the table below.
Domain Scores:
The scores of the categories under each sector will be aggregated to arrive at the domain score. This will be calculated using the following formula:
Domain= Σ (wi *Sector scores).
Later for each category final scores are capped relative to Top Performing City. The table below presents the weights and the complete methodology for each domain.

Domain	Sectors	Score of Sectors
Quality of Life (35%)	• Education (A) • Health (B) • Housing and Shelter (C) • WASH and SWM (D) • Mobility (E) • Safety and Security (F) • Recreation (G)	O= [∑ (A+B+C+D+E+F+G)/ 7]
Economic Ability (15%)	• Level of Economic Development (H) • Economic Opportunities (I)	P= [∑ (H+I)/2]
Sustainability (20%)	• Environment (J) • Green Spaces and Buildings (K) Energy Consumption (L) • City Resilience (M)	Q= [∑ (J+K+L+M)/4]
Citizen Perception survey (30%)		

03

QUARTILE ANALYSIS

By categorizing cities into quartiles, policymakers can efficiently allocate resources, prioritize interventions, and monitor progress over time.

Municipalities, as integral components of the urban landscape, play a pivotal role in the socio-economic development of regions. Recognising the diverse population sizes and characteristics of cities, a systematic categorization has been undertaken, resulting in five distinct categories, each demarcated by specific population thresholds. Furthermore, within each category, cities have been meticulously classified into quartiles, allowing for a nuanced analysis that facilitates a deeper understanding of the dynamics at play. This structured approach to urban classification and quartile-level analysis holds immense importance in comprehending the evolving nature of cities and gauging the extent of change within each category.

City Categories and Criteria: The categorization of cities is based on population of cities, with each category representing a different range of inhabitants.

The five categories are as follows:

Category 1:

Cities with a population of less than **50,000**

(10 Cities)

Category 2:

Cities with a population ranging from

50,000 to 100,000

(9 Cities)

Category 3:

Cities with a population ranging from

100,000 to 500,000

(63 Cities)

Category 4:

Cities with a population ranging from

500,000 to 1,000,000

(32 Cities)

Category 5:

Cities with a population exceeding **1,000,000**

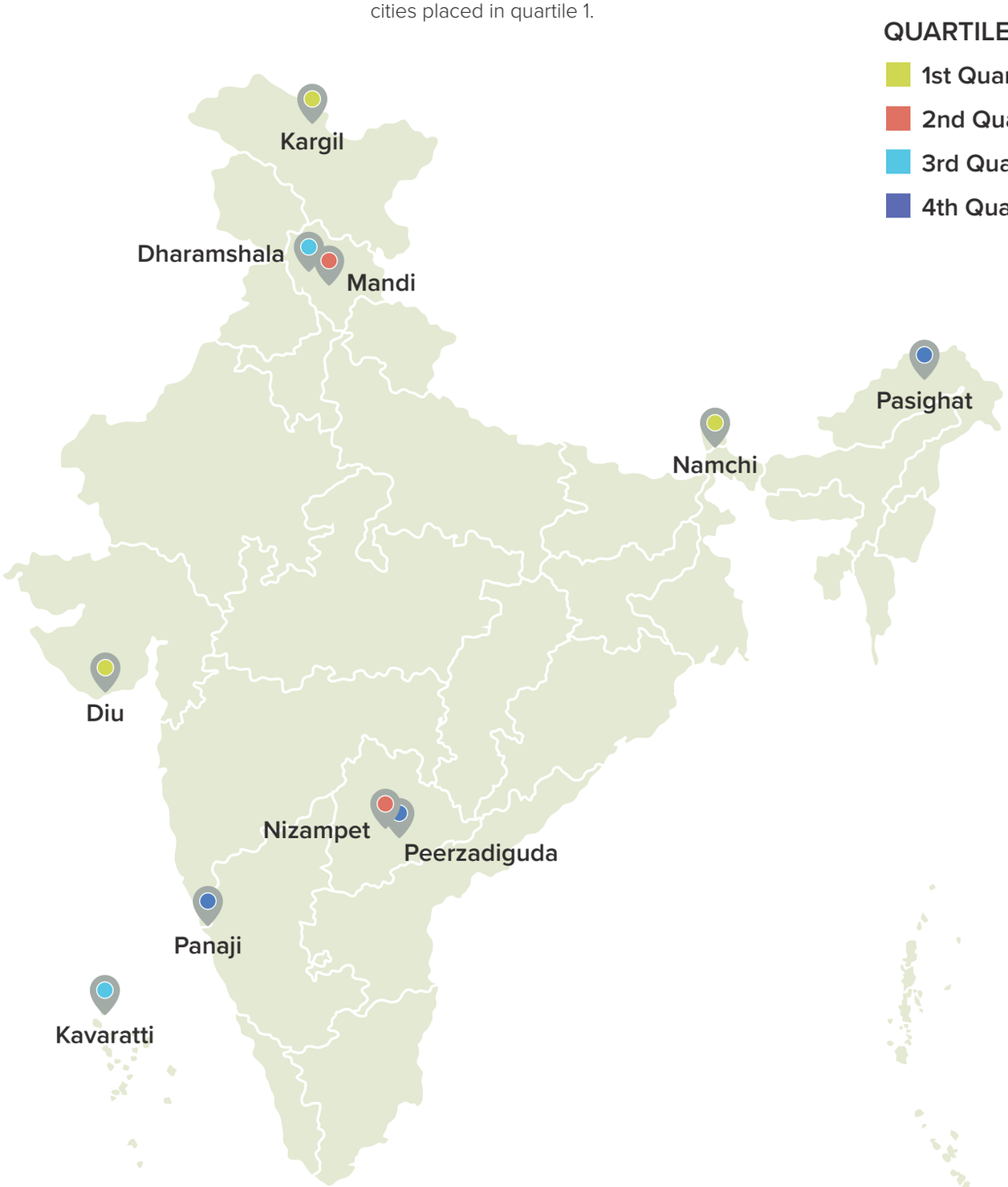
(44 Cities)

Establishing quartiles based on specific scores within each population category provides urban policymakers with a nuanced and targeted approach to city analysis. This granular method enables the identification of high-performing cities, allowing policymakers to understand and replicate successful strategies. By categorizing cities into quartiles, policymakers can efficiently allocate resources, prioritize interventions, and monitor progress over time. This approach facilitates the identification of best practices, promotes tailored policies to address specific challenges in lower-performing quartiles, and ensures that urban policies are customized to local realities. In essence, quartile-based analysis serves as a dynamic and adaptive framework, empowering policymakers to make informed, data-driven decisions for more equitable and sustainable urban development.

Category 1

Cities in Category 1

This map represents cities in category 1 with 10 municipalities. Among these, 6 of them are smart cities. The fourth quartile ranges from 82.66 to 100, the third from 72.50 to 82.66, the third from 68.14 to 72.50, and the scores below 68.14 are in the fourth quartile. Peerzadiguda, Panaji and Pasighat are some of the cities placed in quartile 1.



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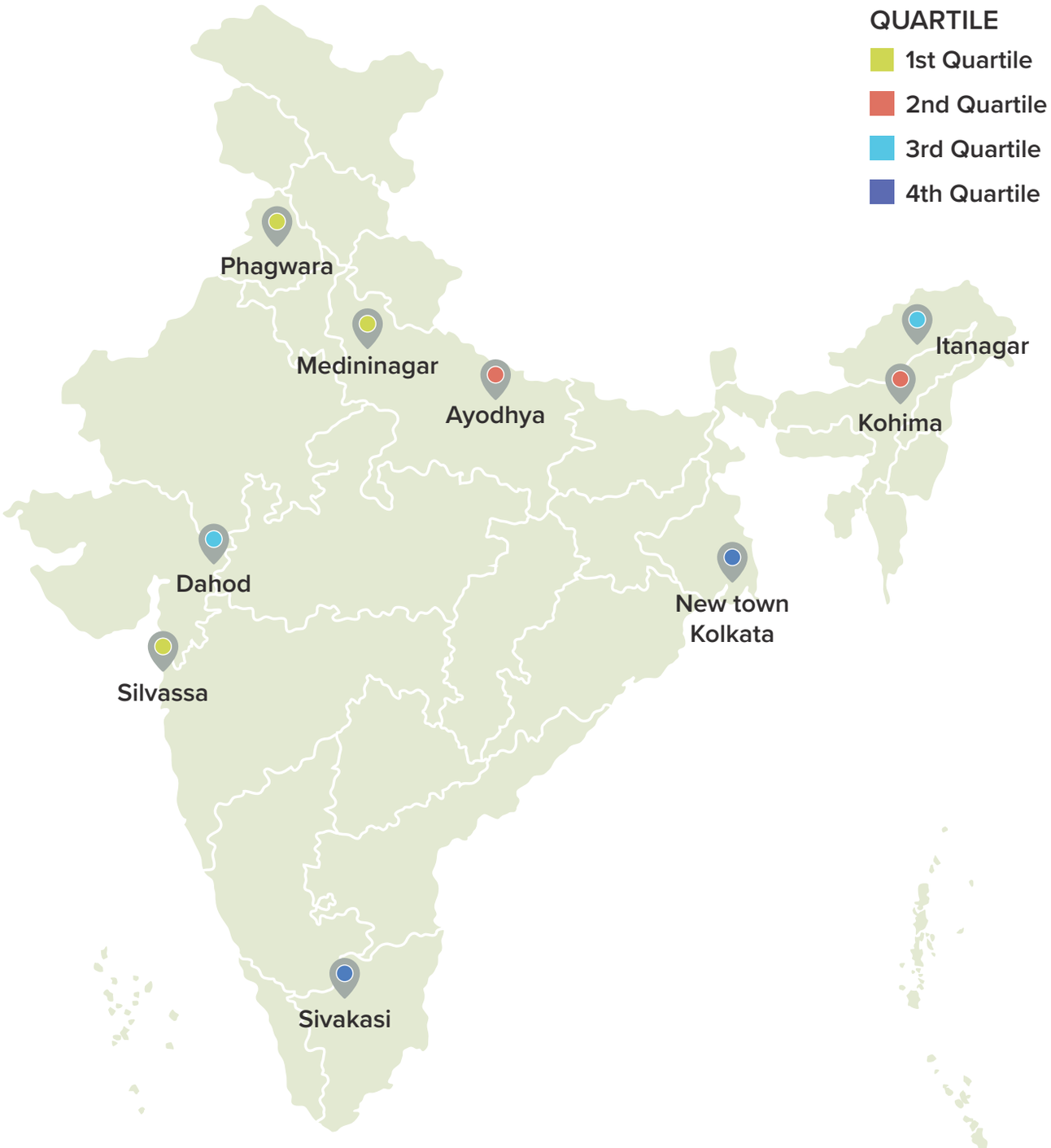
Category 2

This map showcases cities belonging to category 2, includes a total of 9 municipalities. Among these municipalities, four of these municipalities namely New Town Kolkata, Dahod , Itanagar and Kohima are smart cities. The cities are stratified into quartiles based on their scores: the fourth quartile ranges from 91.22 to 100, the third from 83.97 to 91.22, the second from 75.86 to 83.97, and any scores below 75.86 are placed in the first quartile.



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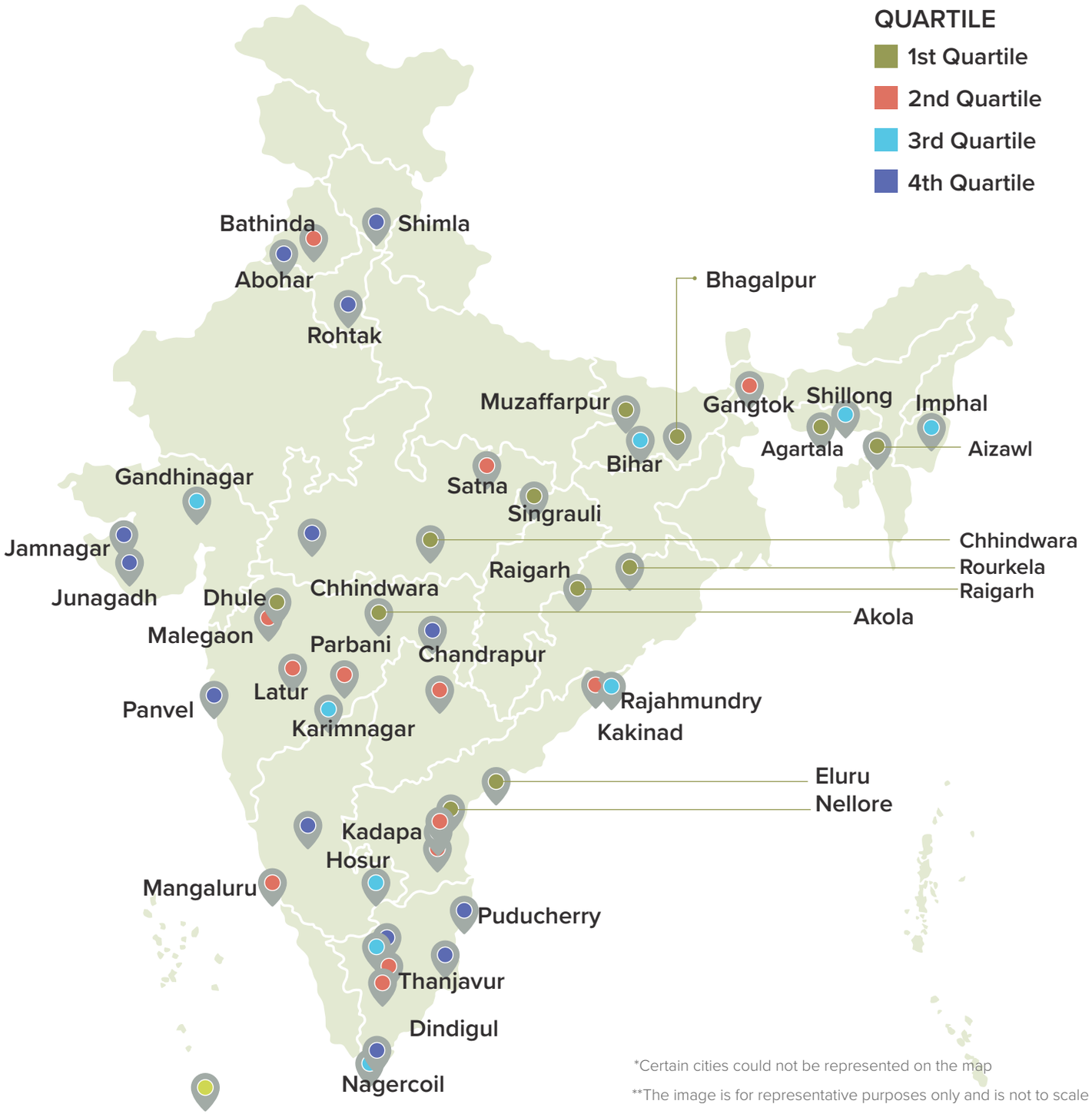
Category 3

This map illustrates cities under category 3, comprising a total of 63 cities, out of which 32 have been designated as smart cities. Each category of the cities is classified into quartiles - the first quartile ranges below 66.16, the second from66.16 to 75.37 , the third from 75.37 to 80.48 , and any scores above 80.48 are categorized in the first quartile. Erode, Panvel , Jamnagar , Shimla are some of the cities placed in quartile 4.



*Certain cities could not be represented on the map

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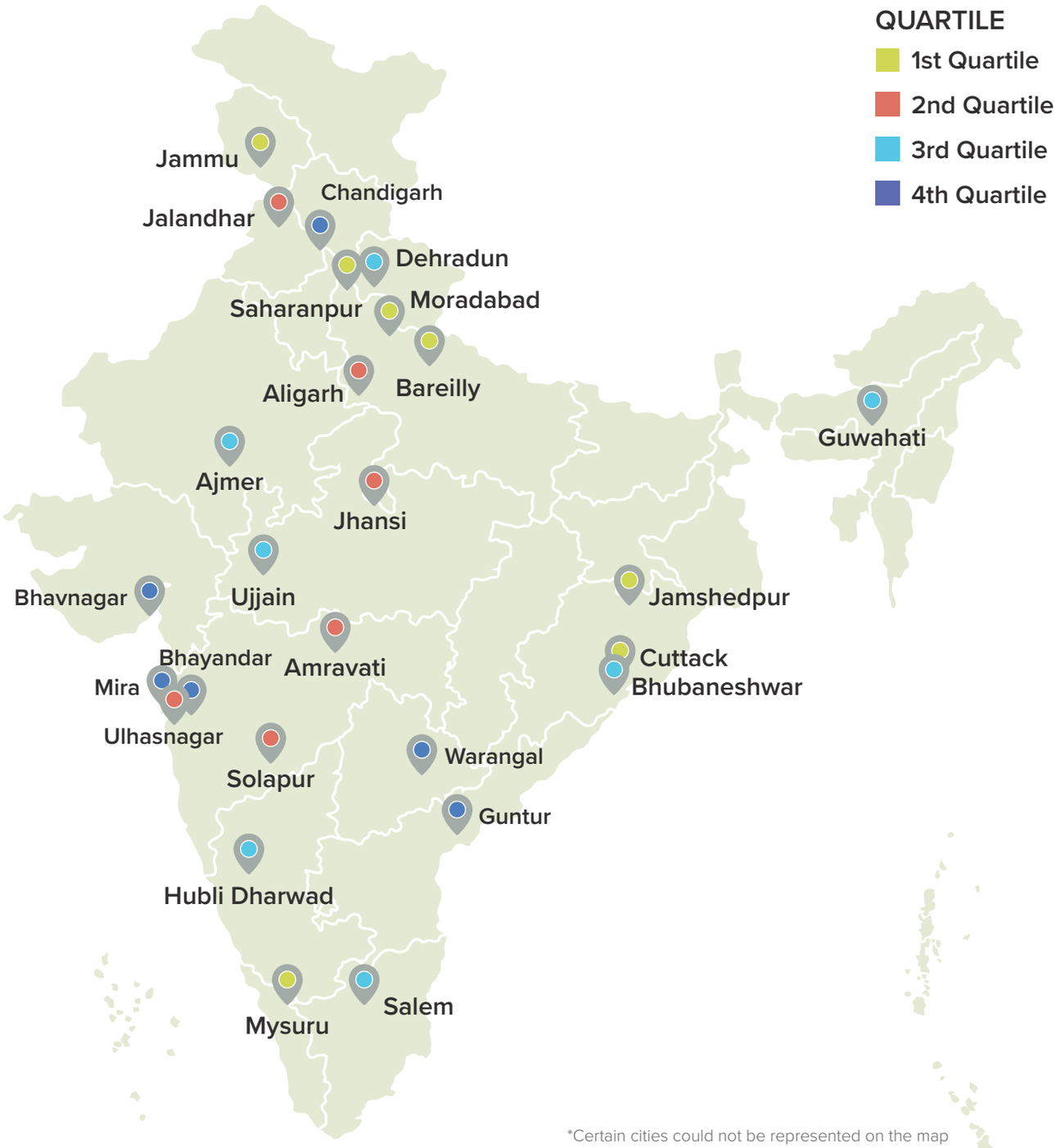
Category 4

This map depicts cities falling under category 4 with 32 cities out of which, 20 of them are classified as smart cities. The cities within each category are further organized into quartiles. Specifically, the fourth quartile ranges from 85.33 to 100, the third from 75.59 to 85.33, the second from 71.50 to 75.59, and any scores below 71.50 are assigned to the first quartile. Chandigarh, Tiruchipalli, Warangal and Gurgaon are some of the cities placed in quartile 4.



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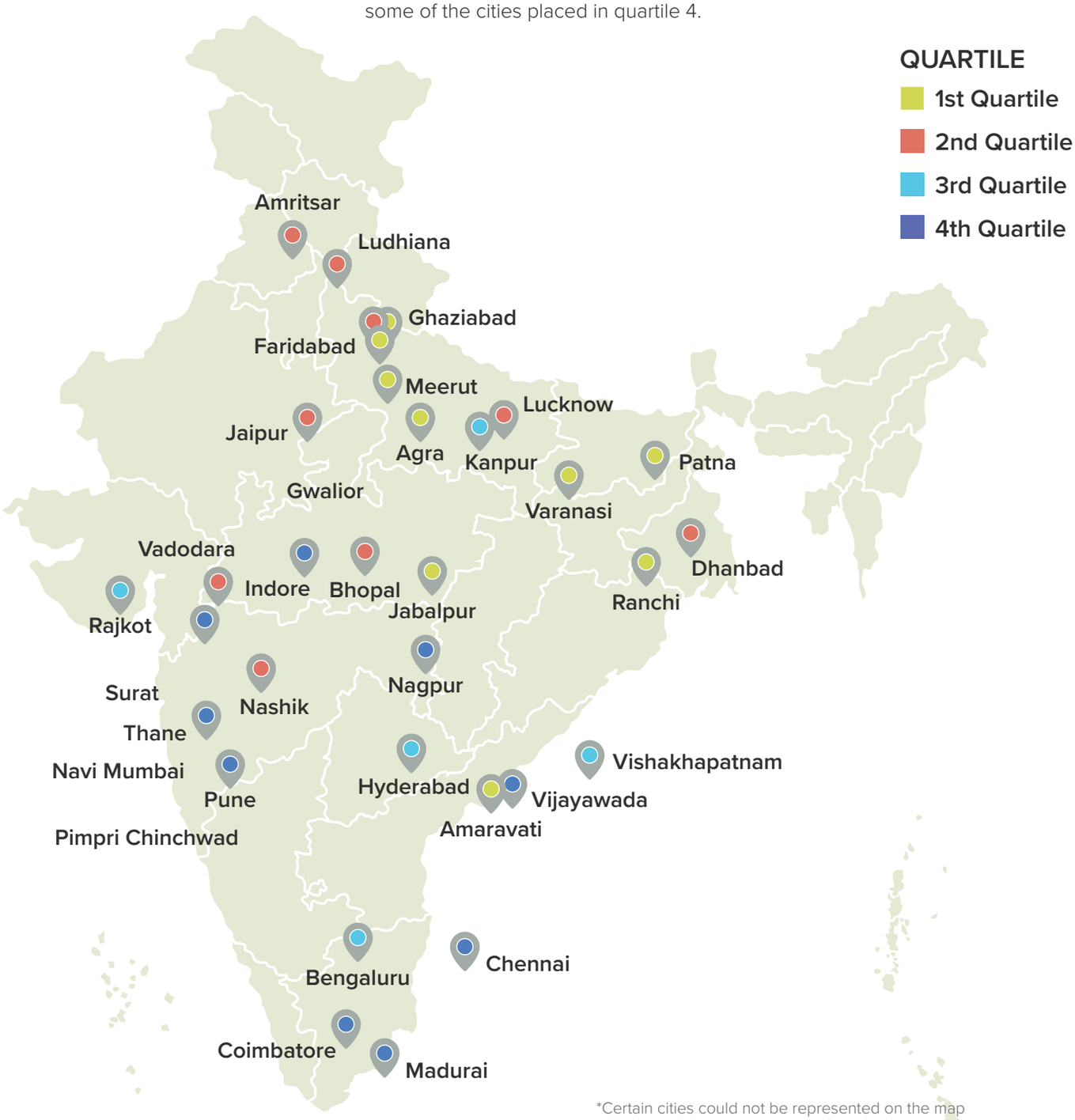
Category 5

This map presents cities under the parameters of category 5 which consists of a total of 44 cities, with 36 of them designated as smart cities. Each city category is classified into quartiles. Specifically, the fourth quartile ranges from 85.09 to 100, the third from 75.56 to 85.09, the second from 69.57 to 75.56, and any scores below 68.57 are assigned to the first quartile. Pune, Navi Mumbai, Nagpur, Madurai, Coimbatore, Vijayawada, Thane and Surat are some of the cities placed in quartile 4.



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04

DOMAIN & SECTOR LEVEL ANALYSIS

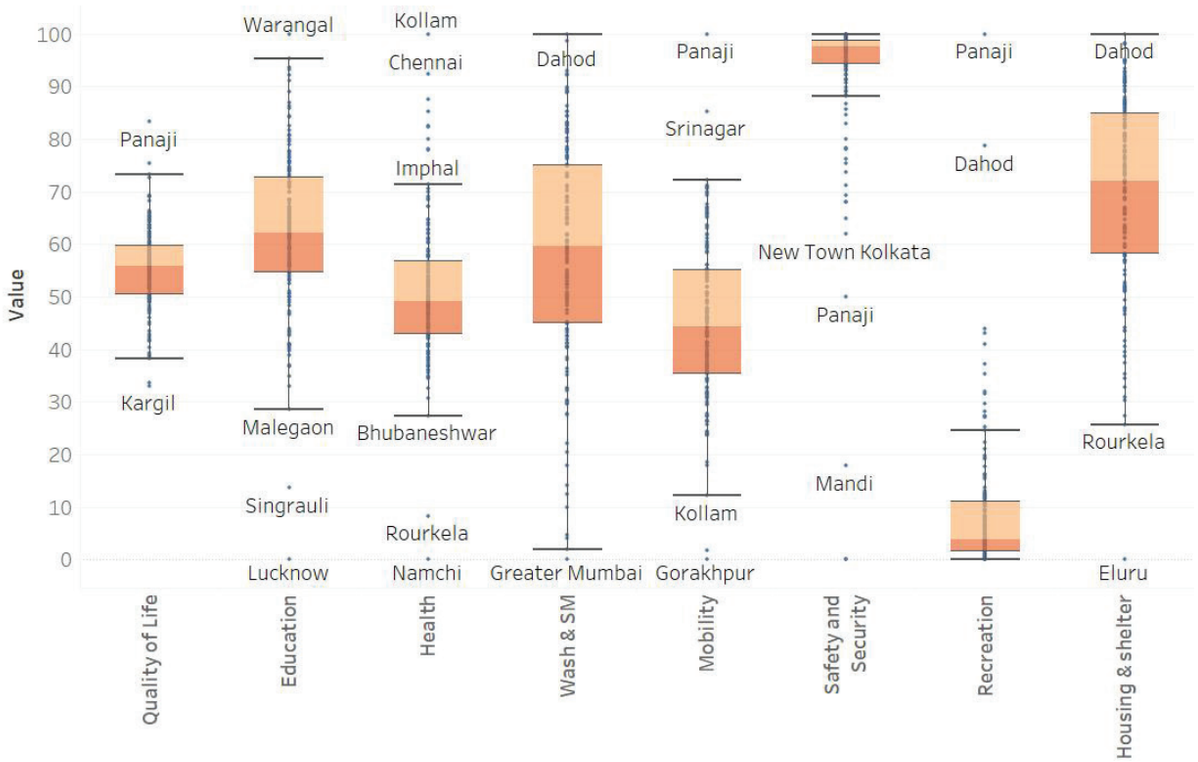
India, with one-sixth of the world's population, is at the vanguard of this transformation. Urban India is undergoing a significant transformation. Since 1951, the urban population of India has increased by a factor of six, from 62.4 million in 1951 to 377.1 million in 2011.

1. Quality of Life

The quality-of-life domain is an in-depth dimension that evaluates the various aspects of what constitutes the quality of life in an urban setting. Its significance is not limited to discrete areas such as education and health but also extends to a multitude of interconnected elements that collectively define the urban experience. The concept of liveability is tightly intertwined with the quality of life domain, which evaluates cities based on a variety of critical dimensions, including education, health, housing and shelter, wash and sanitation management, recreation, mobility, and safety and security.

50% **of cities demonstrated their dedication to improving the well-being and living conditions of their citizens.**

Figure 1 : Quality of Life Domain - Cities performance

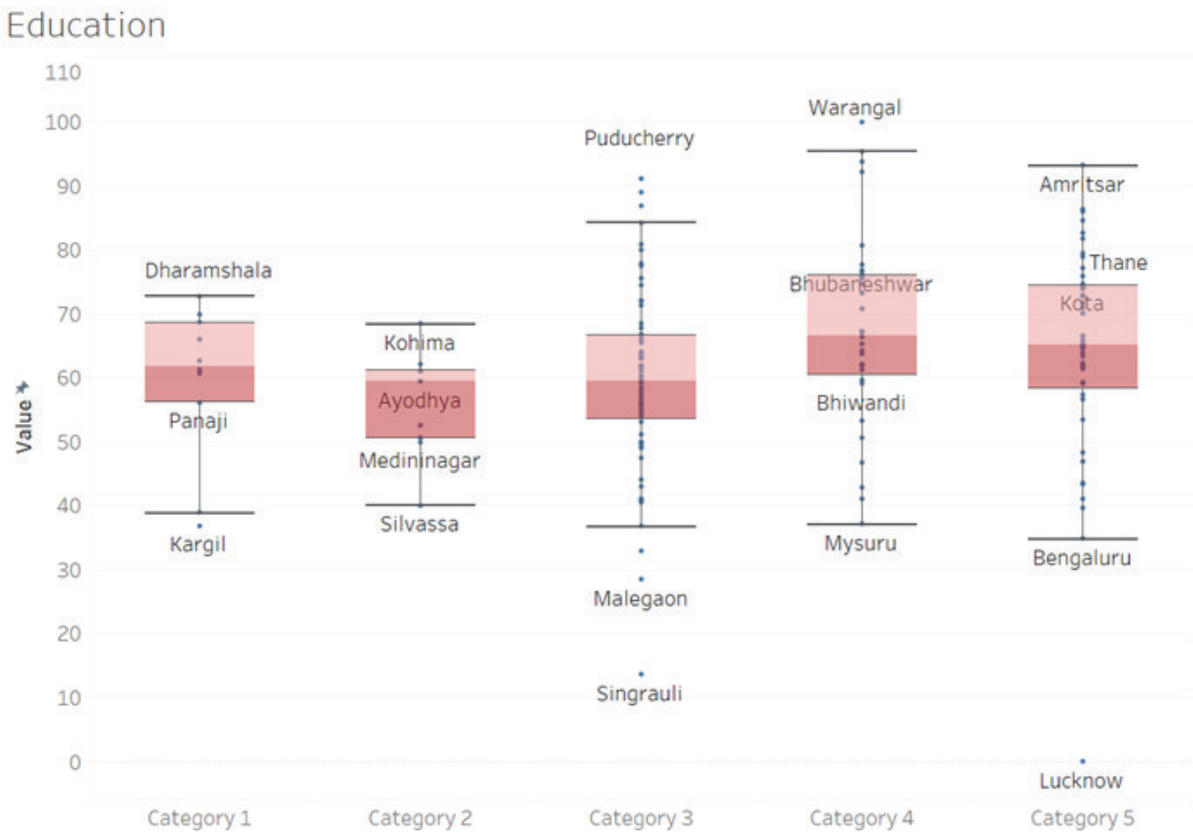


Panaji (83.27), Dahod (75.44), Chandigarh (73.25) and Pimpri Chinchwad (72.59) have emerged as top performers on this dimension, whereas Kargil (33.09), Raigarh (33.74), Singrauli (38.18) and Rourkela (38.77) have emerged as lowest performers in this sector's evaluation. It may be noted that most of the cities have low median scores on Health , Mobility and Recreation Sector.

1.1 Education

Education is a crucial aspect of human development because it is fundamental to enhancing human capabilities and functioning and serves as a tool for enhancing income and standard of living. As a result of the ratification of the Right to a free and compulsory education for all (RTE), the quality of education in various regions of the country has differed.

Figure 2: Education Sector - Category wise performance



Most of the cities in this sector have performed well on this sector. The sector captures several critical indicators related to the state of education within a region or country. These indicators provide valuable insights into the education system's performance and its impact on the overall well-being and quality of life of citizens. The education sector evaluates cities based on eight indicators:

- **Annual HH Expenditure on Education %**
- **Literacy Rate as per the 2011 Census**
- **PTR (Pupil-Teacher Ratio) at the Primary Level**
- **PTR (Pupil-Teacher Ratio) at the Upper Primary Level**
- **Dropout Rate from Grades 8–10 (Public and Private)**
- **Percentage of Schools with Access to Digital Education**
- **Professionally Trained Teachers%**
- **National Achievement Survey Scores**

Importance of the indicators: Higher expenditure indicates a greater emphasis on education, which can lead to better outcomes. A lower PTR indicates smaller class sizes, personalised instruction, and better learning outcomes. A high dropout rate indicates issues with education quality, a lack of resources, or socio-economic challenges. Access to digital education resources and well-trained teachers also contribute to better educational outcomes. Understanding these education-related indicators is vital for assessing the liveability for citizens because education plays a pivotal role in economic development.

These are some key insights on these indicators:

- **129 out of 158 cities have a literacy rate above 76.17 per cent, which is the national literacy rate for urban populations, indicating that the majority of cities have high literacy rates.** It is also further noted that 78 cities out of 158 spend more than 6.5 percent of their household expenditure on education.

- According to the 2009 Right of Children to Free and Compulsory Education (RTE) Act, the pupil-teacher ratio (PTR) norms set for the primary and upper primary levels are 30:1 and 35:1, respectively. Only 17 cities have PTRs for primary levels less than 30. All these cities belong to category 5, with a PTR ranging from 29 for Prayagraj to 8 for Raipur. The highest PTR at the primary level is observed in Bengaluru (427), followed by Lucknow (200), Patna (178), and Dhanbad (78). On the other hand, only 34 cities have PTR for upper primary levels less than 35. Lucknow (314), Prayagraj (181), and Ghaziabad (77). It is important to reduce such PTR trends to maintain access to quality education in cities.

- **Only 31 cities have less than 1 percent dropout rates at the secondary level. 13 cities have emerged as negative outliers in this indicator with dropout rates greater than 10 percent.** Namchi (23.91), Dhanbad (23.08), and Dhule (20) have the highest dropout rates.

- On the parameters of schools with digital education, 83 cities have reported that more than 50 percent of their schools have access to digital education.

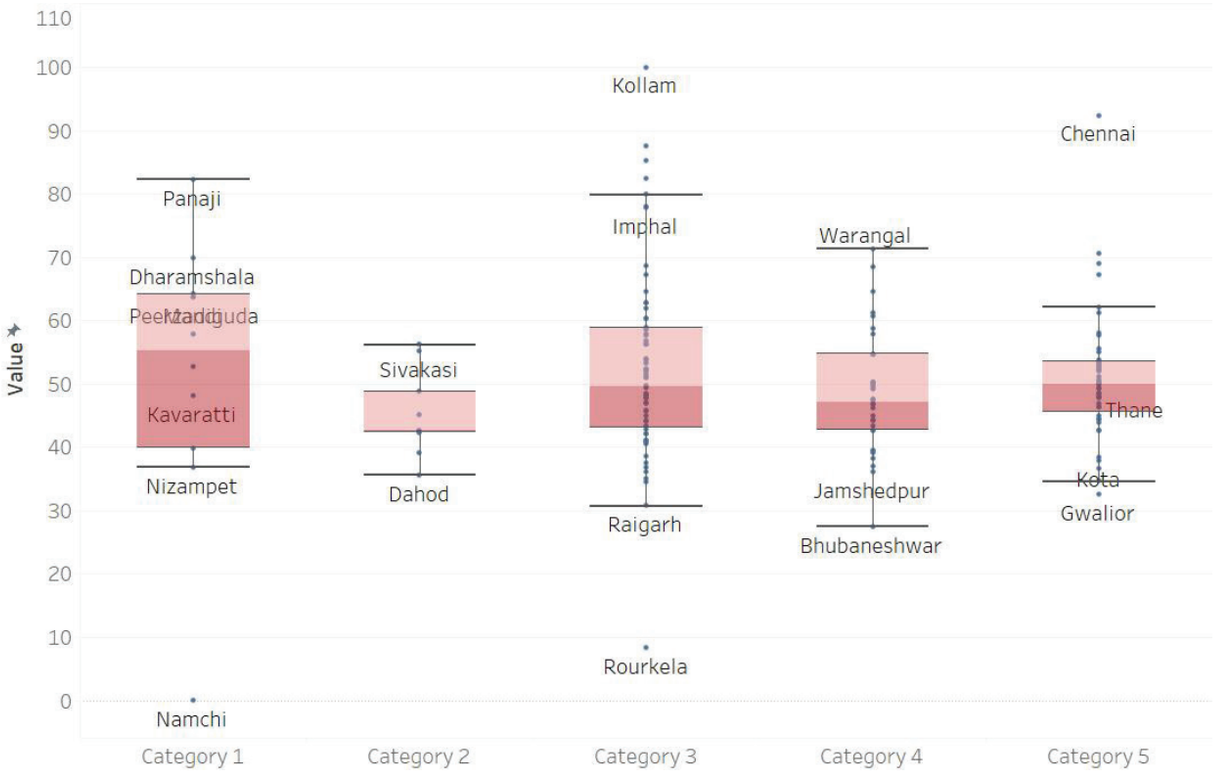
- **It is noted that cities that have reported a higher percentage of professionally trained teachers do not necessarily perform well on the NAS, or vice versa.** It is essential to note that while there is a general correlation between two parameters, there are other factors (factors such as government policies and incentives, teacher recruitment standards, availability of teacher training institutions, urban-rural disparities, socioeconomic status of students, quality of teaching and pedagogy, and parental involvement and support) that also influence these parameters.

1.2 Health

The role of health in determining an individual's well-being and quality of life is of the utmost importance, making access to affordable, high-quality healthcare a central issue in discussions of human development. Urban areas, which are endowed with the resources and infrastructure necessary to house health facilities, play a crucial role in facilitating this access. The health sector evaluates cities, focusing on key indicators such as household expenditures on health, availability of healthcare professionals, accredited public health facilities, availability of hospital beds, and disease prevalence.

In this context, Kollam has emerged as a standout performer in the health category, achieving a perfect score of 100. It is followed closely by Chennai (92.37), Kakinada (87.61), and Ahmadnagar (85.23). The exceptional performance of Kollam can be attributed to the city's notable availability of public health facilities, its higher concentration of healthcare professionals, and its lower disease prevalence. Localities allocate approximately 2.50 percent of their total household consumption expenditure to healthcare. **Category 3 cities such as Akolla, Kollam, and Bilaspur exceed this average, which demonstrates their dedication to healthcare investment. However, in only 59 of 158 urban areas, household health expenditure exceed this threshold.**

Figure 3: Health Sector - Category wise performance



Moreover, variations in the availability of healthcare professionals and hospital beds, with scores of 342.43 and 429.20 per lakh population, respectively, have significantly influenced the overall scores of the category. Furthermore, less than 23 percent of public healthcare facilities in more than half of the participating cities are accredited by a standard quality assurance programme.

Lastly, several cities, including Srinagar, Diu, Kargil, Shimla, Hosur, Itanagar, and Solapur, have reported the absence of diseases like malaria and dengue. However, they exhibit varying performance in other critical health indicators, such as healthcare expenditure, availability of professionals, hospital beds, and accredited facilities. While commendable in disease prevention, these cities face challenges in healthcare financing, infrastructure, and quality standards, underscoring the need for a comprehensive urban healthcare approach.

1.3 Housing and Shelter

With the prospect of improved jobs, livelihood opportunities, quality education, and access to healthcare, India's intrastate migrants are drawn to urban areas. As the urban population continues to increase at an exponential rate, access to affordable housing becomes increasingly challenging due to limited land and rising living costs. Adequate housing for all is fundamental to refining an individual's capabilities and investigating their full potential. Thus, the growth of cities is dependent on the availability of housing, which facilitates economic and social development.

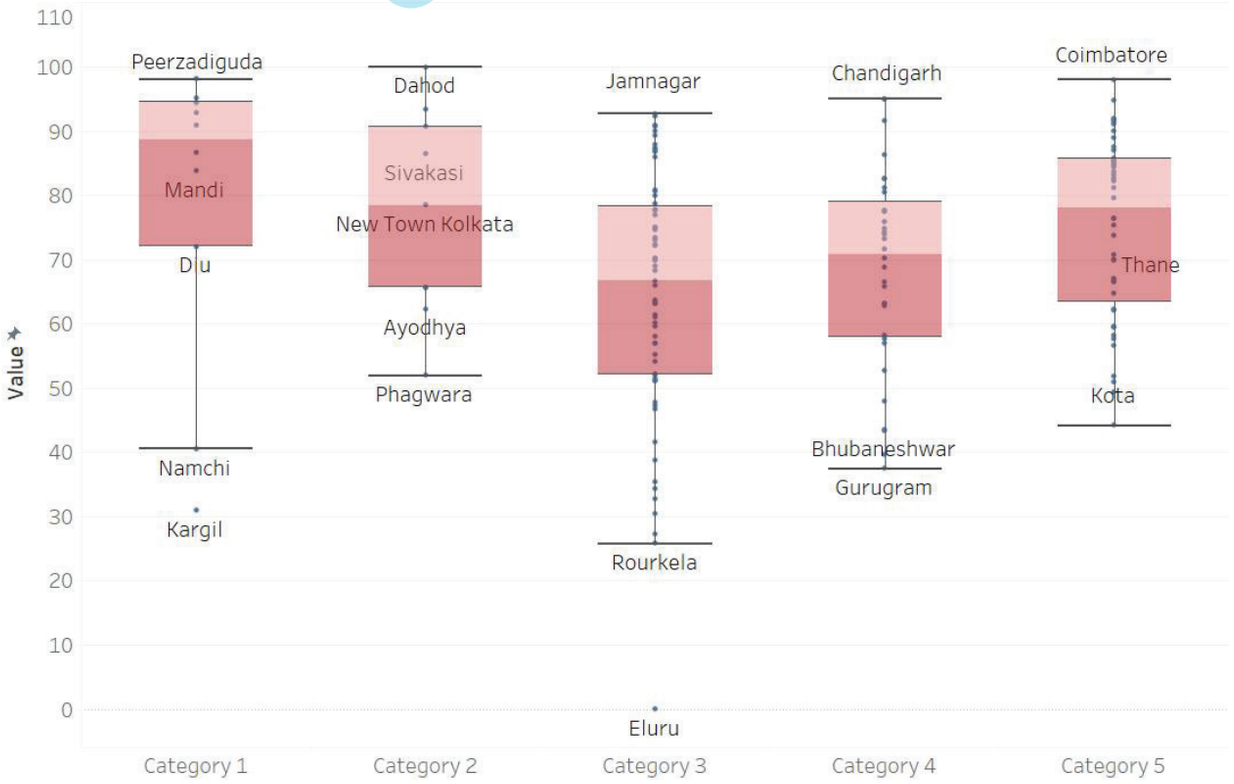
The "Housing and Shelter" sector assesses the accessibility and quality of housing and shelter services for citizens, which are crucial to their well-being and quality of life. Residents of a city or region enjoy a higher standard of living and a better quality of life when they have access to essential amenities and affordable housing options. This sector consists of three main indicators: households with electrical connections, PMAY-U (Urban Pradhan Mantri Awas Yojana-Urban) houses constructed, and the slum population.

Household with Electrical Connections (%)

This indicator measures the proportion of households that have authorised electrical connections. It indicates the degree of access to modern necessities such as electricity. A higher percentage signifies greater access to electrical services, contributing to enhanced living conditions and overall comfort for residents. **In 103 cities, 100% of all households have achieved authorised electrical connections. Most of these cities belong to category 3, 4 and 5. It is further noted that cities such as Gurugram, Kadapa, Parbhani, Kargil among others have scored low on this parameter due to non-availability of data provided by the cities.**[5]

[5] These cities have still not being marked zero on this parameter, a minimum value has been awarded to 12 cities such as Kadapa, Gurugram, Parbhani, Mangalagiri, Kargil, Chittoor, Satna, Karur, Guwahati, Raigarh, Amaravati, Malegaon

Figure 4: Housing & Shelter Sector - Category wise performance



PMAY Houses Constructed (%): Housing for all

The Pradhan Mantri Awas Yojana (PMAY) is a government programme that aims to provide affordable housing to economically disadvantaged segments of society. This indicator gauges the proportion of PMAY homes completed relative to those approved in a city. The 2015-launched Pradhan Mantri Awas Yojana (Urban) aims to improve people's lives by addressing the urban housing shortage among the Economically Weak Section (EWS) and Low-Income Group (LIG) categories, including slum dwellers, and by providing eligible urban households with a pucca (permanent) house. The initiative also promotes the empowerment of women by allowing female members to own homes individually or jointly. In line with the vision of Housing for All, PMAY (U) is one of the largest housing programmes in the world.

PMAY (U) aims to transform the lives of the impoverished through the provision of affordable accommodation, the improvement of living conditions, and the empowerment of women. The initiative has provided financial assistance for home ownership, ghetto rehabilitation, and access to essential amenities, resulting in a decrease in slum populations, an increase in employment opportunities, and an improvement in social inclusion.

Consequently, it has become an essential indicator for gauging the improvement of the citizens' ease of living.

Since 2015,

more than 74.25 Lakh houses

have been completed (as of May 24, 2023)[6]

A higher percentage indicates progress in providing affordable housing solutions, addressing housing shortages, and enhancing the living conditions of disadvantaged citizens.

At least 23 cities have achieved targets of PMAY (U). Whereas, 115 out of 158 cities have constructed more than 50 % of households under the scheme. Cities such as Imphal, Port Blair, Machilipatnam, Eluru and Aizawl however lag behind with 6.29, 12.43, 14.35,16.32 and 16.98 per cent respectively.

Slum Population

This indicator computes the proportion of the city's or region's population that resides in impoverished areas. Typical slums lack adequate accommodation, fundamental amenities, and sanitation facilities. **The national average of 14.63% is reported on this parameter. This seems lower indicating significant reduction in the prevalence of substandard living conditions, indicating an improvement in housing and overall living standards for a larger portion of the urban population.** But this may be the case of underestimation of urban slum dwellers. Before further investigation into insights from the slum population provided by cities, it is important to consider the specific context of each state/city's methodology for the identification of slums and then correlate its implications on urban policies.

It is essential to recognize that the definition of slums in India can vary significantly from one state to another and even within cities. At least 36 cities have either not provided data on this parameter or have reported a zero-slum population. This observation is particularly pronounced in cities like Srinagar and Lucknow, among others. Conversely, there are cities such as Vellore, Rourkela, Erode, and Warangal that have reported that more than 50% of their population resides in slum areas. Therefore, it is prudent to approach the insights derived from reported data by cities with caution. This nuanced understanding of the variability in slum definitions and the cautious interpretation of data underscores the importance of tailored urban policies and interventions that address the unique challenges faced by different cities and regions in India.

[6] PMAY(U) results in over 800 per cent Increase in Urban Houses

Box 1: Revisiting Complex Conundrum of Slums in Urban Policy: A Case of India

The term "slum" was initially used in London at the beginning of the 19th century to designate a "room of low repute" or "low, unfrequented portions of the city," but its definition and use have since undergone several changes (UN-Habitat U. N., 2003 b). Early definitions of slum housing incorporated physical, geographical, social, and even behavioural characteristics of urban poverty (UN-Habitat, 2003 a). However, the scope of these definitions has changed.
In fact, the United Nations Program on Human Settlements (UN-HABITAT) has redefined a slum as “a contiguous settlement where the inhabitants are characterized as having inadequate housing and basic services. A slum is often not recognized and addressed by the public authorities as an integral or equal part of the city” (UN-Habitat, Expert Group Meeting on Urban Indicators: Secure Tenure, Slums and Global Sample of Cities, 2002).

As per UN-Habitat, Slum communities are characterised by the presence of one or more of the following conditions:

1) Lack of access to improved water sources;

2) Lack of access to improved sanitation facilities;

3) Lack of sufficient living area;

4) Lack of housing durability; and

5) Lack of security of tenure.
In operational terms, UN-Habitat defines a slum household as lacking one or more of the following indicators: a durable housing structure; access to pure water; access to enhanced sanitation; adequate living space; and secure tenure. The first four are based on conventional definitions, while the fifth is the most challenging to measure and is not currently used in a slum measurement. (UN-Habitat U. N., 2003 b). UN-Habitat's definition goes beyond physical aspects and includes elements related to social and legal aspects, which can be crucial in understanding and addressing the complex challenges faced by slum dwellers globally. However, with urban areas in general, the definition of a slum varies by nation, state, and even cities and the case of India is no different than any developing country.

Complex conundrum - A case of India

In India, notification, or legal classification, as a slum settlement is important to the government's acknowledgement of slums and is intended, over time, to grant citizens the right to housing facilities. The definition varies from one state to another. Further research in Indian slums has also noted that many settlements displaying definitely slum-like traits are never classified (Subbaraman, et al., 2012). For instance, Delhi has a large number of slums but it has never been informed of any new slums since 1994 (Bhan, 2010). On the other hand, the UN definition contains legality and attempts to capture all impoverished places, not simply those identified as slums by the governments, which probably results to disputes over the allocation and absolute India's population of slum dwellers (Nolan, 2015).

Such issues have been identified by MOHUA in the report on the **Committee on Slum Statistics and Census**. It acknowledged and addressed the issue of various definitions of slums in India as a significant challenge (MOHUA, 2011). The report frequently emphasised the existence of multiple definitions of settlements across states. The significance of standardising ghetto definitions to ensure consistency and comparability of data across states and regions is already recognised. Standardisation is crucial for accurate slum-related assessment, planning, and resource allocation. The issue of multiple definitions also highlights the need to improve data acquisition techniques and ensure data accuracy. In general, it is acknowledged that variations in slum definitions can have policy implications. Data inconsistencies can affect resource allocation and the efficacy of urban redevelopment programmes (MOHUA, 2011).

Resolving these challenges is crucial for successfully attaining the target on SDG Goal 11 "By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums". It is measured by the indicator: Proportion of urban population living in slums, informal settlements or inadequate housing. With Pradhan Mantri Awas Yojana - Urban (PMAY-U), India has already laid the groundwork for accomplishing this objective, in the context of housing for all. However, urban futures will only be fair for all when the rights of vulnerable groups are safeguarded and when disadvantaged groups such as slum dwellers, the homeless, youth, and the elderly are empowered. This certainly needs a significant role in pushing more effective and equitable ways to tackle slum-related difficulties in India, from be it identification of slums or be its rehabilitation.


786 M.B
88 M.B

1.4 WASH & Solid-Waste Management

The Water, Sanitation, and Hygiene (WASH) and Solid Waste Management sectors are essential to the quality of life of citizens because they address fundamental aspects of daily life, including access to clean water, sanitation facilities, waste management, and a clean environment.

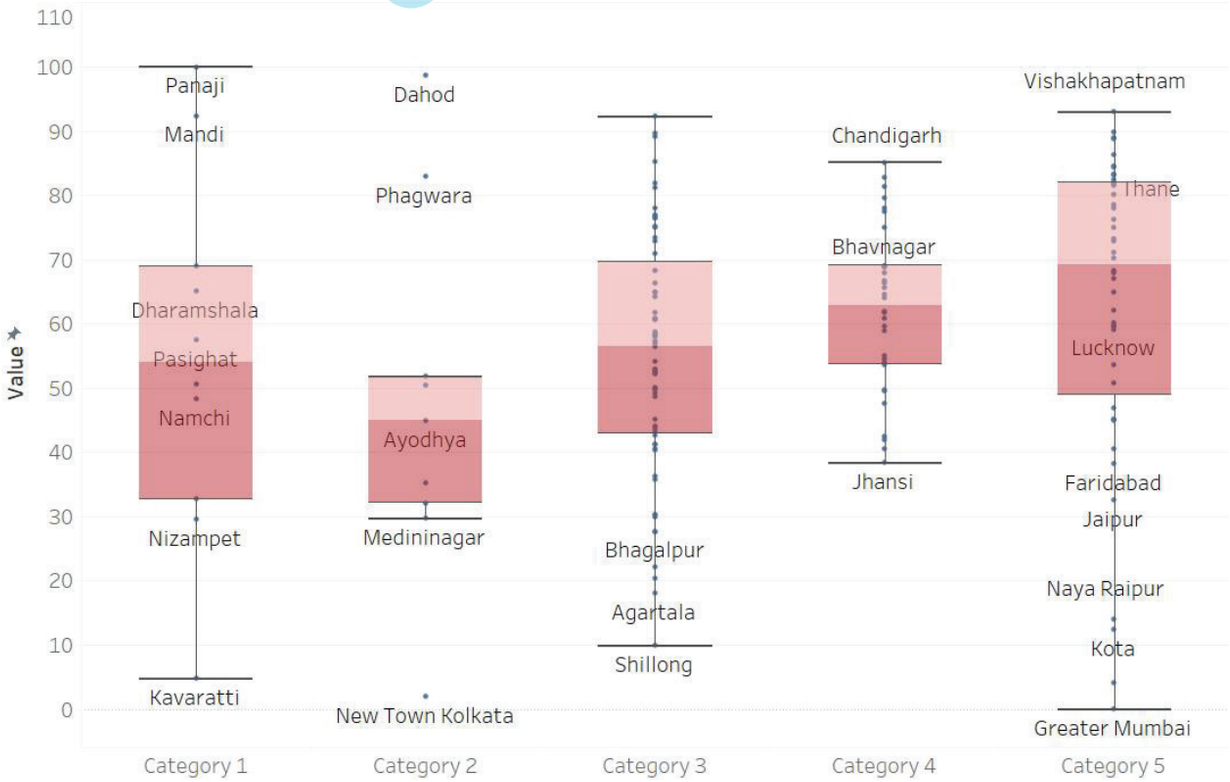
The indicators within the WASH and Solid-Waste Management sectors include:

- **Deviation of Total Water Supplied from Service-Level Benchmark**
- **Households with a Piped Water Supply**
- **Swachh Survekshan Score**
- **Wastewater Treated vs. Wastewater Generated**
- **Households connected to the sewerage network**
- **Coverage of the stormwater drainage network**

These indicators are of paramount importance in enhancing the ease of living for citizens in urban areas. To collectively ensure access to clean and safe drinking water, improved sanitation facilities, effective waste management, and a clean environment it is vital for the cities to focus on these indicators. They directly contribute to public health, hygiene, and overall well-being, reducing the burden on residents for basic necessities while fostering a safer, healthier, and more comfortable living environment. This, in turn, enhances the overall quality of life in cities.

A comprehensive assessment of cities in the context of the WASH (Water, Sanitation, and Hygiene) and Solid Waste Management sectors reveals some notable trends. Panaji stands out with a perfect score of 100, closely followed by Dahod (98.59), Vishakhapatnam (93.01), Mandi (92.39), Erode (92.23), and Surat (89.90). **These cities also excel in the Swachh Survekshan, underscoring their commitment to cleanliness and hygiene. Their high scores are primarily driven by their exceptional coverage of households receiving piped water supplies and connections to sewerage networks. Moreover, Panaji and Dahod have further boosted their scores with full stormwater drainage networks.**

Figure 5: WASH * SWM Sector - Category wise performance



Some Key insights on the indicator's performance:

- **34 cities meet the benchmark of supplying an average of 135 litres of water per capita, including Coimbatore, Erode, Jaipur, Port Blair, Guwahati, and Gwalior.**

- **Approximately 47% of participating cities have over 70% of households with piped water supplies,**

  while about 21 cities treat 100% of generated wastewater, including Mangaluru, Dhanbad, Panvel, Chandrapur, and Ujjain.

- Conversely, 24 cities have all households connected to the sewerage network, including **Panvel, Surat, Phagwara, Rajkot, and Panaji,** while 20 cities report no households connected to the sewerage network. Many cities lag behind in stormwater drainage networks, including Amritsar, Bengaluru, Chennai, Hyderabad, the New Delhi Municipal Council, Gwalior, and Bengaluru. These findings explain the varying levels of urban infrastructure development in WASH and solid waste management across Indian cities.

1.5 Safety & Security

This pivotal sector has assessment framework, focused on four key indicators that are evaluated relative to the city's population:

The indicators within the WASH and Solid-Waste Management sectors include:

- **Prevalence of Violent Crime**
- **Extent of Crime Recorded Against Women**
- **Extent of Crime Recorded Against Children**
- **Extent of Crime Recorded Against the Elderly**

Notably, the city of Diu has emerged as a notable outlier in this regard, securing an impressive score of 100. Diu's exemplary performance sets a high standard for safety and security within our nation. Following closely behind are cities falling under Categories 2 and 3, including Silvassa, Gandhinagar, Mangalagiri, Kadapa, Ayodhya, and Kohima, all of which exhibit a commendable record in terms of lower instances of crimes against the elderly and children. Most cities in this sector exhibit high performance levels with minimal variation.[7]

Nevertheless, it is prudent to observe that across the spectrum, cities tend to exhibit a higher median score when it comes to crimes recorded against women, as opposed to the prevalence of violent crimes or those against the elderly and children. This observation suggests the need for focused initiatives and policies aimed at mitigating violence against women, which remains a pertinent concern in many urban areas.

It is crucial to acknowledge that the performance of cities within this sector is significantly influenced by their respective populations. Cities categorized as Category 1, namely Dharamshala, Kargil, and Mandi are among the lowest-scoring cities in this sector, with scores falling below the threshold of 70. Alongside these are other cities such as Panaji, New Delhi Municipal council, New Town Kolkata and Raipur. These cities confront unique challenges in the domain of safety and security and should prioritize concerted efforts to enhance the well-being of their residents. We must persistently strive for improvements in ensuring safety of our citizens. Irrespective of a city's current score within this sector, it is imperative to recognize that the enhancement of safety remains an ongoing imperative.

[7] No boxplot is made where variation in values of cities is low

1.6 Mobility

Urban mobility emerges as one of the most significant obstacles to urbanisation. A growing economy and population necessitate the expansion of transport services. The prevalent modes of transportation in Indian cities differ in terms of public and private nature but are typically motorised. The Mobility Sector has four indicators to assess the mobility standards in Indian cities:

The indicators within the WASH and Solid-Waste Management sectors include:

- **Availability of public transportation**
- **Fatalities attributable to transportation**
- **Road infrastructure: footpaths**
- **Road infrastructure: road length**

Among these cities, Panaji stands out as a remarkable exception, having achieved a score of 100. This is followed by Srinagar with a score of 85.31, Greater Mumbai with 72.25, and Dharamshala with 71.25. It is pertinent to note that Panaji's exceptional score is predominantly attributed to its commendable public transport system, which is well-developed relative to its population and road infrastructure

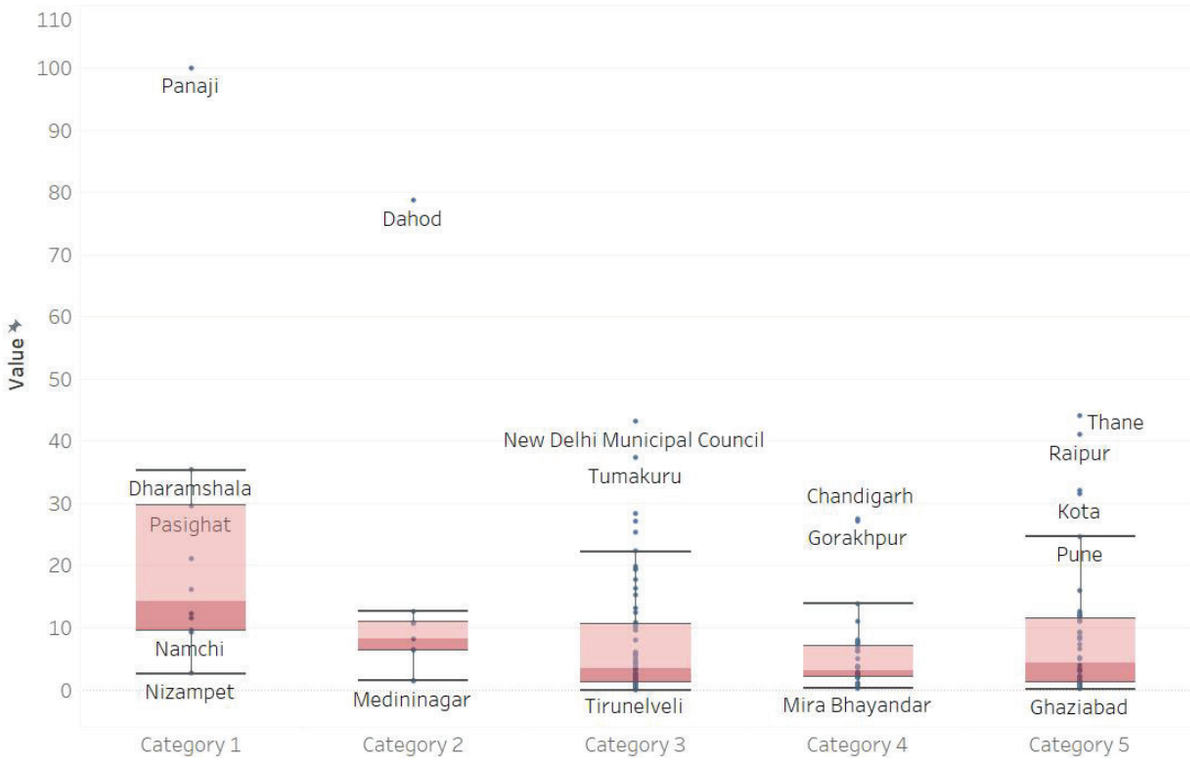
Furthermore, an analysis of transport-related fatalities reveals a significant disparity among cities categorised into different groups. Cities falling within categories 1 and 2, such as Ayodhya (1.13), Phagwara (4.23), Amaravati (12.05), Silvassa (13.31), Namchi (21.99), and Panaji (20.92), exhibit substantially lower fatality rates in comparison to their respective populations. In stark contrast, cities with populations exceeding one million, categorised within groups 3, 4, and 5, including Kollam (143.41), Kollam (128.82), and Sivakasi (116.26), experience a disproportionately higher incidence of transport-related fatalities relative to their population sizes. These findings underscore the critical role of urban planning and infrastructure development in shaping the safety and mobility outcomes of cities, and they emphasise the importance of addressing transport-related challenges in order to improve the overall quality of life for urban residents.

1.7 Recreation

The “recreation” sector is essential for determining a city’s quality of life and wellbeing. It evaluates the availability and accessibility of recreational and cultural amenities. It is measured by two indicators: i.e., the ratio of open areas to the total city area, which indicates the quantity of green spaces and outdoor facilities available. Another indicator is the density of cultural and entertainment venues relative to the population, which influences the vibrancy of the city’s cultural scene. This factor has a direct impact on the recreational opportunities, physical and mental health, and overall satisfaction with urban life of its inhabitants. A city with abundant recreational opportunities fosters community involvement, reduces tension, and improves the well-being of its residents, making it a more desirable place to live and work.

Notably, Panaji has stood out as a significant positive outlier, attaining a perfect score of 100. Conversely, cities such as Aizawl, Karur, Raigarh, and Singrauli, all falling within the same category, have registered the lowest possible score, which is zero.[8]

Figure 6: Recreation Sector - Category wise performance

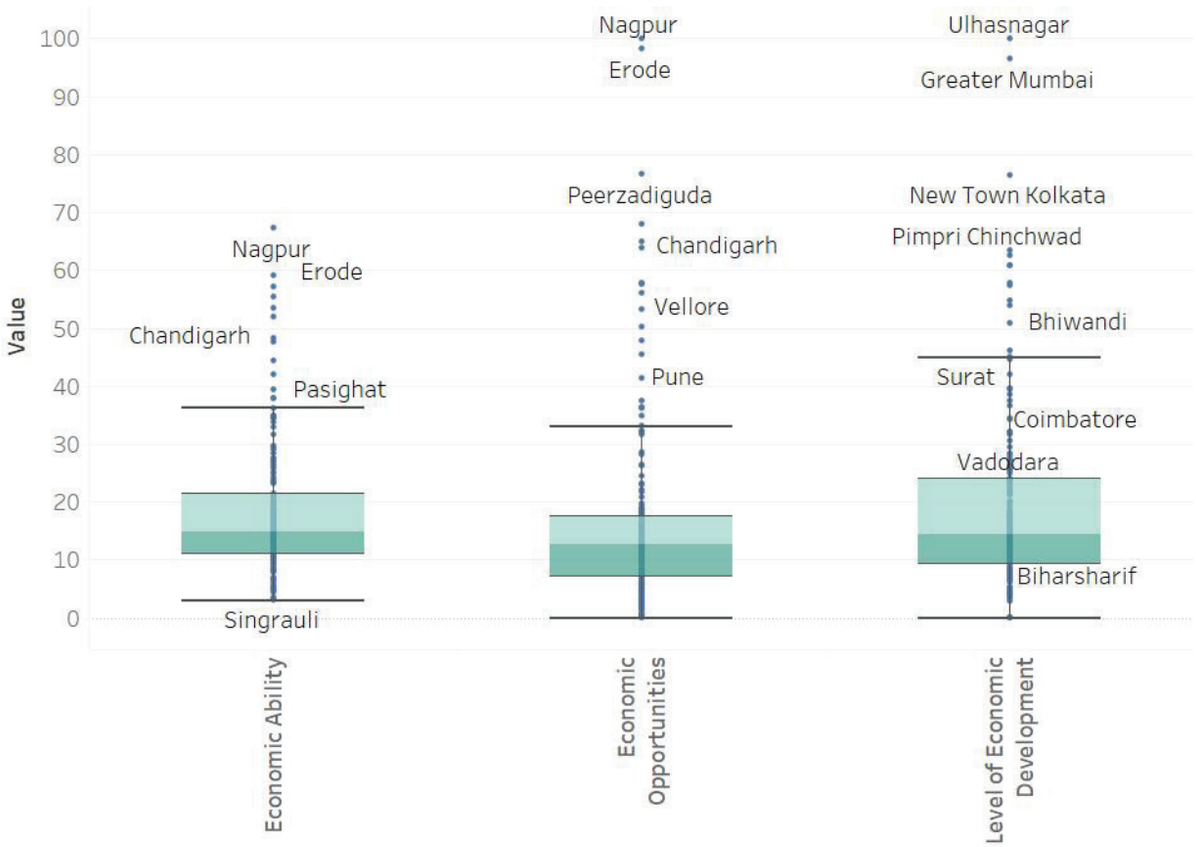


[8] It is important to note that this phenomenon can be attributed to the data being not provided by these cities. However, for the sake of maintaining the integrity of our analysis, a statistical assessment has been conducted, including the consideration of the minimum value for this parameter.

2. Economic Ability

The “Economic Ability” dimension is a crucial tool for assessing economic development and opportunities in a region or country. It highlights the role economic prosperity plays in shaping daily lives, offering job security, boosting income, fostering innovation, and entrepreneurship. The relationship between economic vitality and ease of living is essential for policy makers to understand the intricate interplay between urban development and well-being. This dimension comprises two primary sectors: “Level of Economic Development” and “Economic Opportunities.”

Figure 7 : Economic Ability Domain- Cities performance

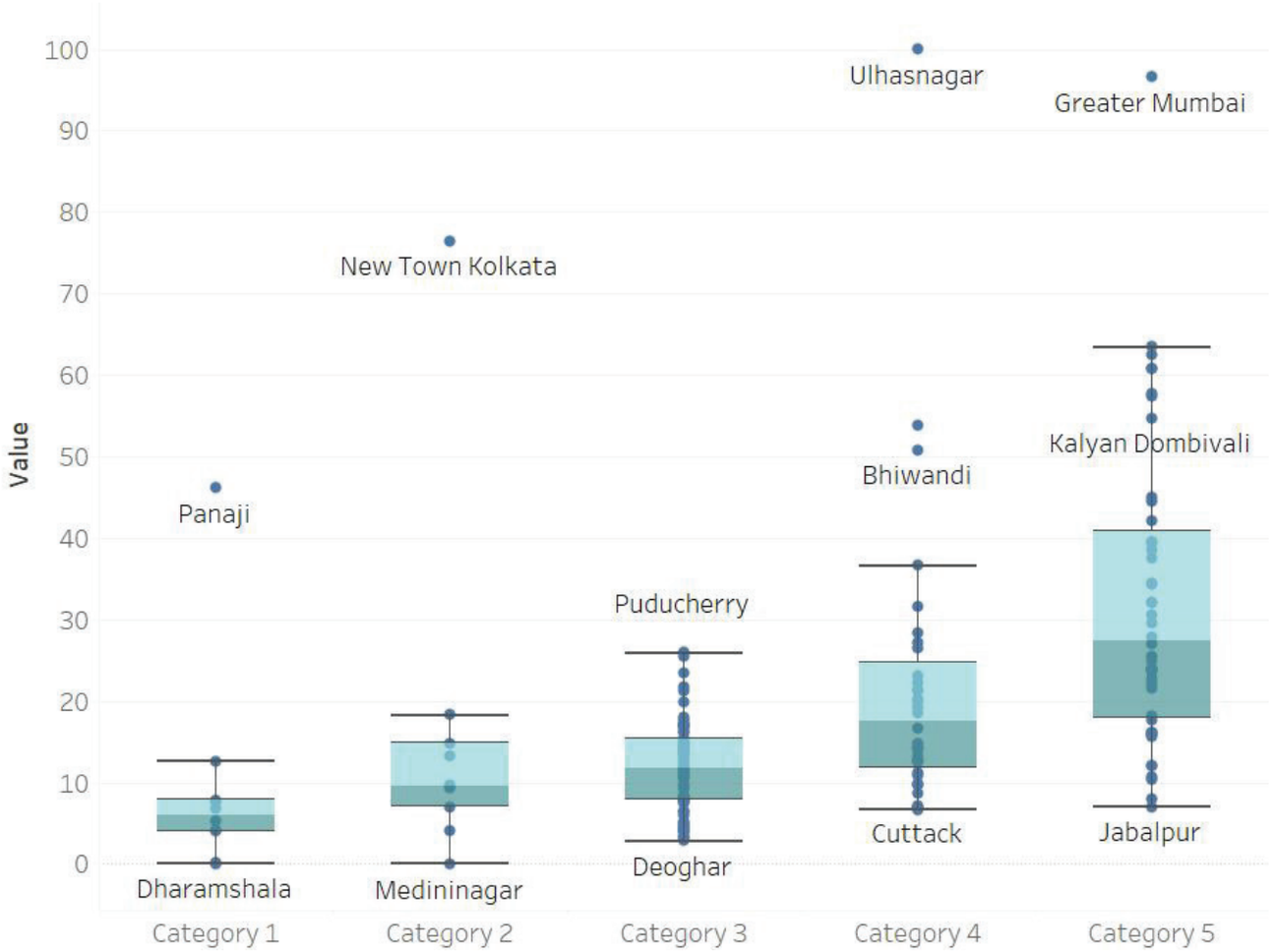


Noteworthy examples of cities that have demonstrated exemplary economic ability by scoring above 50 include Nagpur (Category 5), Erode (Category 3), Ulhasnagar (Category 4), Chennai (Category 5), Greater Mumbai (Category 5), and Pune (Category 5). Nagpur stands out with the highest score of 67.21, followed closely by Erode and Ulhasnagar with impressive scores of 59.11 and 57.22, respectively. This commendable performance is attributed to consistently high scores in the sub-sectors of "Level of Economic Development" and "Economic Opportunities."

2.1 Level of Economic Development

Level of Economic Development sector assesses cities based on MSME density and Cluster strength. In cities, a high density of Micro, Small, and Medium Enterprises (MSMEs) can signify a vibrant local economy. These businesses often provide job opportunities for residents and contribute to the city's economic growth. **Along with this, assessing cities based on cluster strength plays a significant role in understanding the economic development. Clusters are a geographic concentration of related economic activities, (Porter M. E., 2008).** Hence, the strength of a cluster (i.e., the presence of economic activity within a specific cluster category in a specific location) measured along different dimensions of size, specialization and productivity can have strong implications on ease of living in cities (Ketels & Protsiv, 2014).

Figure 8: Level of Economic Development - Category wise cities performance



Overall cities such as Greater Mumbai, Ulhasnagar, Bengaluru, Pune, Ahmedabad, and Thane, classified within categories 4 and 5, have exhibited high cluster strength scores, exceeding 90. This substantiates the presence of robust traded clusters within these urban centres. Furthermore, these cities exhibit an impressive concentration of Micro, Small, and Medium Enterprises (MSMEs) registered on the UDYAM portal in proportion to their respective populations reflecting presence of highly formal markets as these select cities alone contribute to approximately 30% of registered MSMEs on the portal. This confluence of high cluster strength and a substantial MSME presence in these urban centres suggests their pivotal role in fostering economic activity and entrepreneurship, rendering them key contributors to the national economic landscape.

Box 2: Clusters in India :Urban Districts Driver of Growth

In recent decades, India has experienced the rise of contemporary industrial clusters, mainly in the areas of information technology and software development driven from urban centres. Modern industrial clusters, such as Bengaluru city known as the Silicon Valley of India and the Automotive cluster in Pune, have emerged in India. Urban regions within districts play a significant role in driving economic activity by providing more employment opportunities and higher salaries.

Clusters are crucial for enhancing locational competitiveness and impacting the well-being of city residents. The presence or absence of robust clusters can significantly influence economic growth and liveability of urban areas. Weak clusters can hinder growth, job creation, and living standards improvement, while strong clusters contribute to these factors. Policymakers must understand and cultivate clusters to improve cities' competitiveness and prosperity.

Recent work by (Kapoor, Ketels, Debroy, & Negi, 2023) shows that in India, urban areas dominate the majority of traded clusters in terms of employment and wages. Currently, their analytical tool operates at the district level. However, it is worth considering the potential benefits of conducting similar analyses at the city level in India. Such an endeavour would likely yield more precise insights into the identification of critical clusters and the assessment of their regional impact. It is noteworthy that the United States has already implemented a comparable approach, led by the U.S. Economic Development Administration (EDA) and various other organizations. This suggests that adopting a city-level analysis for traded clusters in India could provide a robust framework for evaluating the economic landscape and making informed policy decisions. Such a strategy could contribute significantly to the enhancement of India's economic competitiveness and regional development.

2.2 Economic Opportunity

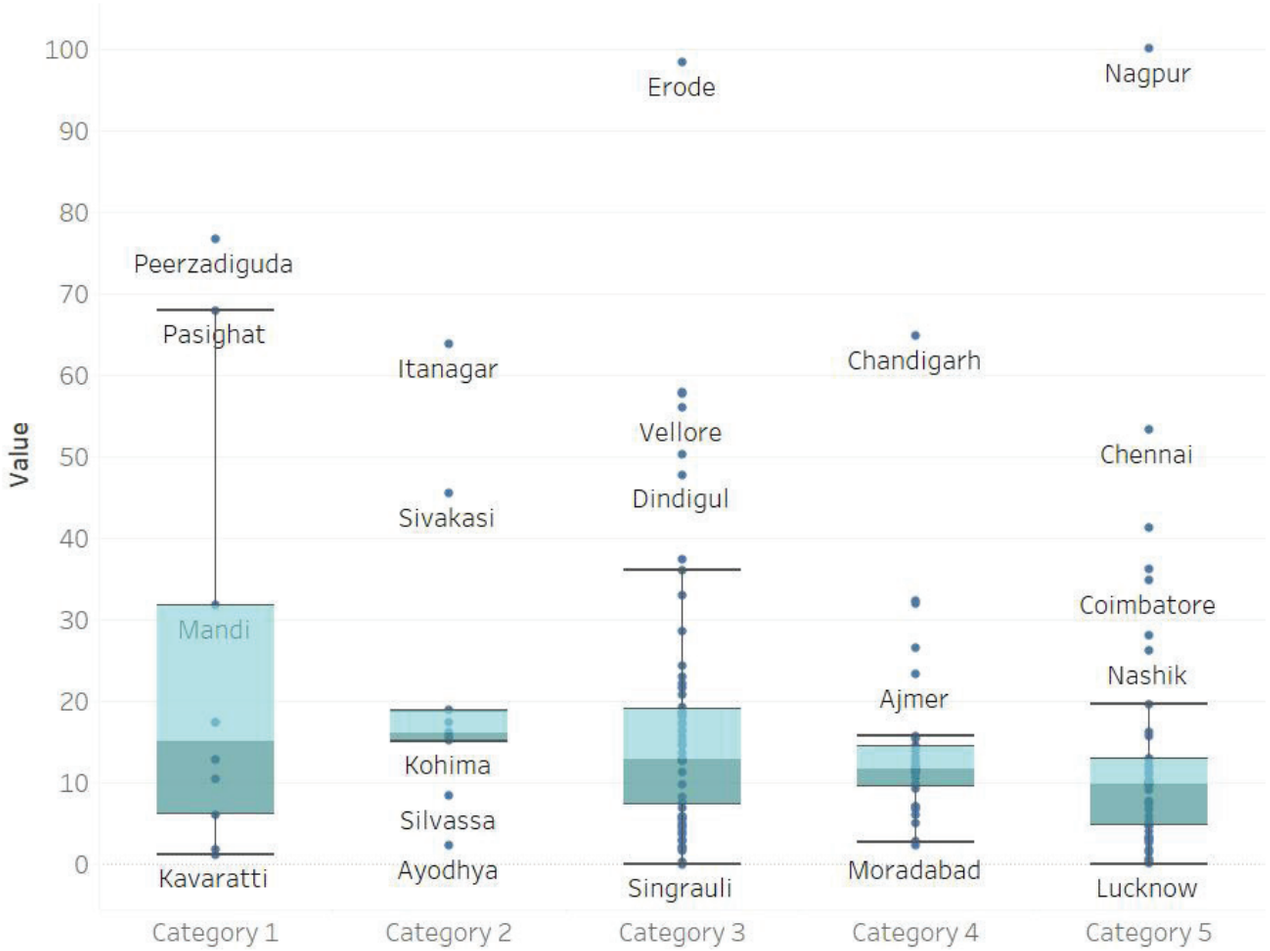
This sector assesses cities based on two parameters:

Incubation Centres per Million Population: Cities are epicentres for innovation and entreprenuership. A high ratio of incubation centres to population shows that the city actively supports and provides resources for startups and aspiring entrepreneurs. This can result in the formation of new firms, employment opportunities, and a thriving business environment in the city.

Credit Availability: Cities are typically financial and banking hubs. It is essential for urban inhabitants and businesses to have access to financing in order to invest in housing, education, and other urban amenities. The availability of adequate credit ensures that individuals and businesses have access to the finances necessary to better their living conditions and invest in economic activity. Understanding these proxies for economic opportunity is even more crucial in the context of cities due to their direct impact on urban life.

Erode of Category 3, has emerged as a noteworthy positive outlier, demonstrating commendable performance across both evaluated parameters. Particularly, it exhibits the highest credit availability relative to its population, a distinction that surpasses all other cities nationwide. In contrast, Singrauli registers the lowest score on this sector, an outcome denoting a score of zero.

Figure 9 : Economic Opportunities - Category wise cities performance



Further analysis highlights that Nagpur, Itanagar, Pasighat, Chandrapur, Vellore, Shimla, Erode, and Pune all possess an impressive density of incubation centers, exceeding 8 incubation centres per lakh population. This metric signifies a proactive and forward-thinking approach to cultivating entrepreneurship and fostering innovation within these urban centres. **In particular, both Nagpur and Pune stand out by reporting the highest number of incubation centres in the country, with counts reaching 825 and 291, respectively. This distinction underscores their commitment to providing a conducive environment for startups and entrepreneurs to thrive, facilitating economic growth, and nurturing innovation within their regions.**

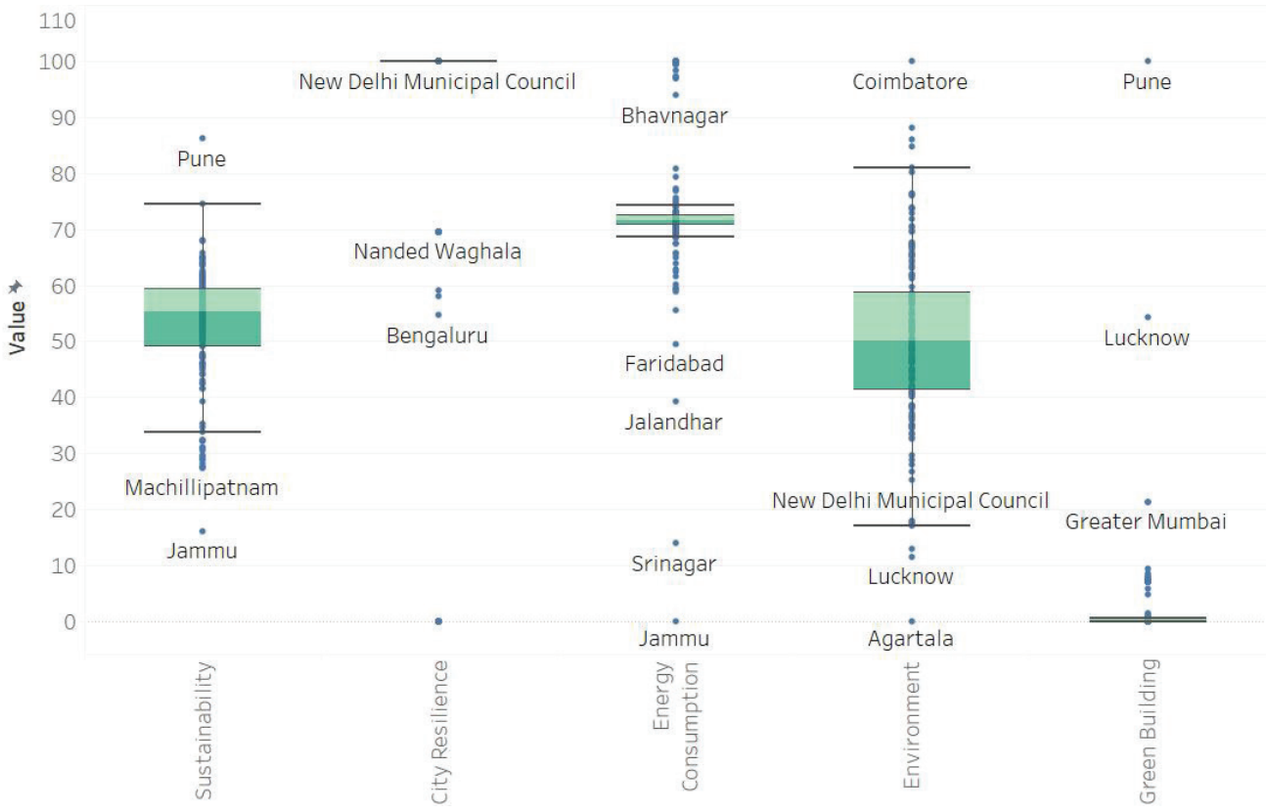
3. Sustainability

The sustainability sector, which evaluates cities based on resilient green buildings, environmental quality, and energy consumption monitoring, is of paramount significance for cities.

With the rapid expansion of urban spaces, infrastructure capacity, economic opportunities, and social services are already under enormous pressure. Meanwhile, imminent dangers arising due to climate change have the power to cause catastrophic harm to the world as we know it. In India, the impact could be even greater. Natural disasters and extreme weather events are among the top 5 risks for India according to Global Risk Report 2023.[9] In addition, the effects of climate change will not be distributed uniformly, as regions differ in terms of geography, population, resources, economic development, and social inequality.

There is evidence of the social impact of climate change in regard to the connection between climate change, destitution, and means of subsistence. However, the relationship between climate change and inequality within a country has not received sufficient attention. Therefore, it is crucial that urban policymakers make our cities more sustainable than ever before. The sustainability sector, which evaluates cities based on resilient green buildings, environmental quality, and energy consumption monitoring, is of paramount significance for cities

Figure 10: Sustainability Domain: Cities performance



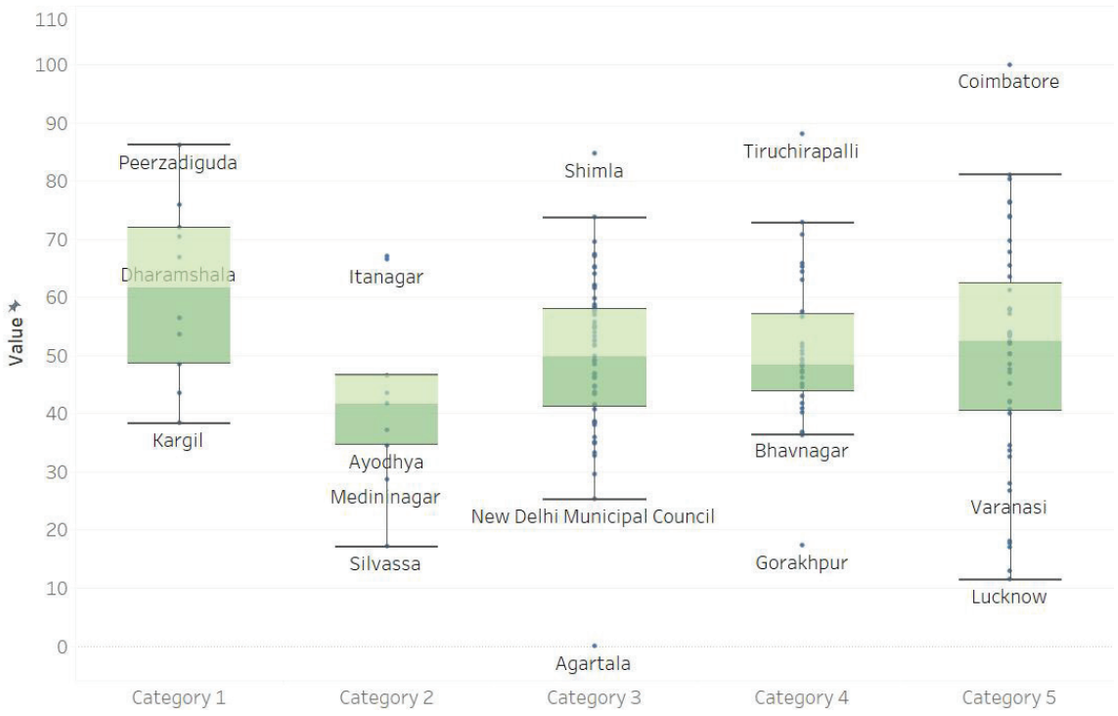
[9] WEF_Global_Risks_Report_2023

Jammu (16.12), Singrauli (27.41), Kargil (27.49), Machillipatnam (27.54), and Mysuru (28.13) are the lowest performers, indicating a need for targeted interventions. Pune, Coimbatore, Erode, and Chandigarh are frontrunners, with scores of 86.21, 74.58, 68.02, and 67.92, respectively. These cities demonstrate excellence in urban governance and development, highlighting the importance of visionary leadership, meticulous planning, and innovative strategies. These cities offer valuable lessons and inspiration for peer cities, emphasising the need for sustainable and equitable urban futures.

3.1 Environment

The Environment sector encompasses critical indicators, including water quality, total tree cover, households using clean fuel for cooking, hazardous waste generation, and the Air Quality Index (measuring SO2, NO2, and PM10). These indicators serve as barometers for assessing the environmental health of cities, directly impacting the quality of life and sustainability. **Notably, Tamil Nadu boasts four cities in the top ten best-performing cities, with Coimbatore leading the pack with a perfect score of 100.** Other strong performers include Peerzadiguda, Shimla, Pimpri Chinchwad, and Madurai, scoring 86.13, 84.74, 81.02, and 80.30, respectively. Conversely, the five lowest-performing cities in this sector are Agartala (0), Lucknow (11.49), Agra (12.91), Silvassa (17.16), and Bengaluru (17.97), primarily due to a lower percentage of households with LPG/PNG connections and functional rainwater harvesting structures compared to other cities.

Figure 11: Environment sector - Category wise cities performance



Furthermore, there is a pressing need to improve air quality in Indian cities, with cities like Parbhani, Biharsharif, and Karur achieving a score of 100 on the Air Quality Index. In contrast, Agartala, Ghaziabad, Kanpur, and New Delhi Municipal Council are among the lowest performers, with scores of 17.35, 54.75, 54.84, and 59.02, respectively. These findings suggest that it is imperative for cities to address environmental challenges, to enhance the overall quality of life and promote sustainability.

Box 3 : Ambient Air Pollution : A challenge for India

In the majority of Indian cities, exposure to ambient air pollution poses a significant hazard to human health. According to recent studies, more than three-quarters of the Indian population is exposed to pollution levels that exceed the National Ambient Air Quality Standards in India and are substantially higher than those recommended by the World Health Organisation CITATION Agr21 \l 16393 (Agrawal, Mohan, & Rahman, 2021).

Air pollution can cause serious diseases, such as bronchitis, heart disease, pneumonia, and lung cancer. It also contributes to global warming, acid rain, reduced visibility, smog, aerosol formation, climate change, and premature deaths. Changes in climate have a significant impact not only on humans and animals, but also on agricultural factors and productivity. An additional outcome that can be attributable to this is economic impairment (Kumar & Pande, 2023).

PM, or particulate matter, is a significant concern in the environment due to its varying diameters and chemical compositions. Fine particles (PM2.5) and coarse particles (PM10) are the most prevalent, causing adverse effects. Sources of coarse particles include re-suspension of loose soil, dust cyclones, and industrial processes, while fine particles (PM2.5) come from traffic activities, energy production, and biomass combustion. Variable meteorological conditions, land use patterns, and population density cause spatial and temporal variations in PM and other pollutant concentrations. (Fatima, 2022)

To address these issues, the central government launched the National Clean Air Programme (NCAP) on 10 January 2019 to combat air pollution in 102 cities, to which 20 additional cities were subsequently added. These cities are known as Non-Attainment Cities (NACs) because they did not meet the following National Ambient Air Quality Standards (NAAQS) for the period of 2011 to 2015 as part of the National Air Quality Monitoring Programme (NAMP). The NCAP has set a goal of reducing critical air pollutants PM10 and PM2.5 by 20-30% by 2024, using 2017 as a baseline.[10] Particulate matter is dangerous because it can cause severe health problems.

[10] NCAP - NCAP Tracker

Comparison based on WHO set guidelines11[11] :

Pollutants	Time weighted average	Standard Limits as per WHO	Standard Limits as per NCAP
PM 2.5	Annual Mean	10	40
PM 10	Annual Mean	20	60

Air quality index which assessed cities based on these parameters reveals the level of annual mean concentration of selected cities which also score low on this sector:

City/Unit of Measurement	Smart City/ Other City	Annual mean concentration of PM10	Annual mean concentration of PM2.5
Agartala	Smart City	574.2	355.96
Kanpur	Smart City	213.5	213.5
Ranchi	Smart City	108	106
Moradabad	Smart City	170	105
New Delhi Municipal Council	Smart City	190.96	103.28

These are some alarming PM levels therefore cities need to do more, because if they do not incorporate environmental sustainability into their economic development action plan, they are unlikely to achieve long-term consistency. **The average life expectancy of an Indian citizen is diminished by 5.3 years due to fine particulate air pollution (PM2.5), in comparison to the scenario where the WHO's (5 g/m3) threshold were adhered to. In the National Capital Territory of Delhi, the most polluted metropolis in India, air pollution reduces life expectancy by 11.9 years.[12] Cities have come to be regarded as the means to help acquire improved standards of living.** Given the urgency of climate change, this desire for progress also results in the concentration and depletion of resources, the degradation of the local environment, and governance challenges.

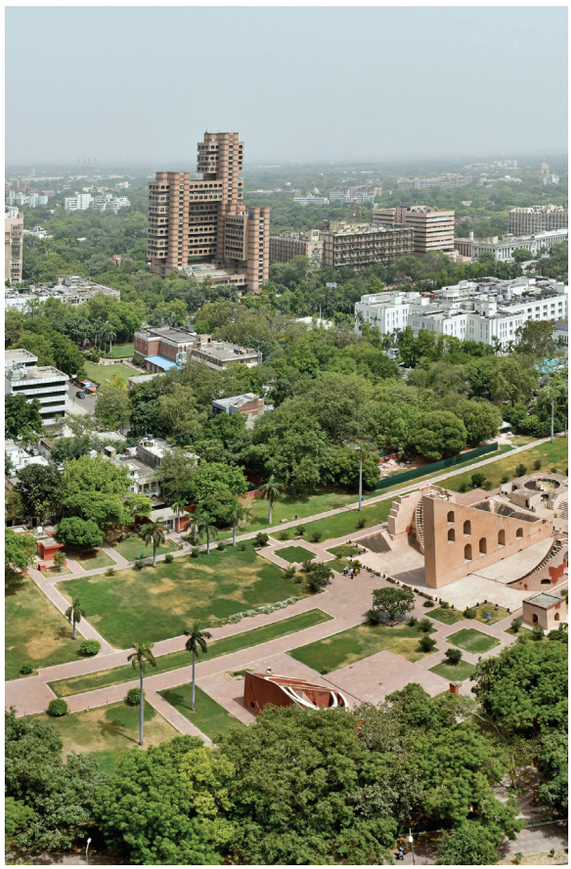
[11] Air quality database (who.int)
[12] AQLI India Fact Sheet

3.2 Green Space & Buildings

The building industry is one of the fastest-growing industries in India. Rising incomes and rapid urbanisation are driving unprecedented expansion in this industry, particularly in metropolitan areas. According to the most recent studies, 70 percent of urban India will not be developed by 2030. The volume of building that will occur in the next few decades is enormous. Moreover, construction activities have a significant influence on climate change (Soni, 2022). By 2050, at least half of the country's population will reside in urban areas, putting a great deal of pressure on the housing sector and infrastructure; green solutions will be required to meet the emerging demands.[13]

According to the International Energy Agency (IEA), buildings account for 38% of all energy-related greenhouse gas emissions. The operations of buildings contribute for 30 percent of world final energy consumption and 26 percent of global energy-related emissions (8 percent being direct emissions in buildings and 18 per cent indirect emissions from the production of electricity and heat used in buildings). Minimum performance requirements and building energy codes are expanding in breadth and rigour across nations, while the usage of energy-efficient and renewable building technologies is growing.

As much as 84 gigatonnes of CO2 (GtCO2) might be saved by 2050 by direct actions in buildings, such as energy efficiency, fuel switching, and the use of renewable energy, according to UNEP (2016). Therefore, to get on track with the Net Zero Emissions by 2050 (NZE) scenario, our cities and industry must make more rapid reforms. This decade is critical for implementing the steps necessary to meet the 2030 objectives of zero-carbon readiness for all new buildings and 20 percent of the existing building stock.



Given the anticipated increase, the construction industry has the potential to significantly contribute to reducing carbon emissions and combating climate change. In this environment, boosting green building construction is vital. So, what is a green building? [14]

[13] 12th GRIHA Summit
[14] Green Buildings

Box 4: What is a Green Building?

As per World Green Building Council, ***"A green building is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life"*** There are a number of features which can make a building 'green'. These include:

- Efficient use of energy, water and other resources
- Use of renewable energy, such as solar energy
- Pollution and waste reduction measures, and the enabling of re-use and recycling
- Good indoor environmental air quality
- Use of materials that are non-toxic, ethical and sustainable
- Consideration of the environment in design, construction and operation
- Consideration of the quality of life of occupants in design, construction and operation
- A design that enables adaptation to a changing environment

The analysis of this study reveals a significant gap in the performance of cities regarding green space and buildings, with an average score of 3.09, indicating a need for substantial improvement in this sector.

The Green Spaces and Buildings sector includes the following indicators:

- **Has the city implemented any measures that are aimed at incentivizing green buildings?**
- **Buildings that have received green ratings from green building rating/certification agencies**

Pune, Lucknow, and Greater Mumbai stand out as top performers, achieving scores of 100, 54.24, and 21.32, respectively, all falling within the category 5 bracket. Pune emerges as a positive outlier, not only demonstrating a robust commitment to incentivizing green buildings but also boasting the highest number of buildings certified by green building rating agencies, a notable 13,230. Hyderabad, Greater Mumbai, and Bengaluru follow with 506, 241, and 230 certified buildings, respectively. Most of the cities performance across this sector is low.[15]

[15] No boxplot is made where variation in values of cities is low

Given these findings, it becomes evident that both the public and private sectors should jointly promote the concept of ecological building. It is imperative that governmental bodies, including finance commissions and local governments, consider introducing tax incentives and other mechanisms to foster the development of green buildings, particularly given the stark observation that only 30 out of 158 cities have implemented measures aimed at encouraging green construction practices. Such initiatives are essential for driving sustainable urban development and enhancing the quality of life in our cities.

India has the potential to lead Green Building

According to CBRE's analysis of the certified built environment in India, this change has already begun. In comparison to the previous five years,

there has been a

37% 

rise in the number of certified buildings.

Green real estate assets have increased substantially over the previous decade, with their percentage of the overall office stock expanding from 24% in 2011 to 31% in 2021. Since 2011, certified stock has also expanded significantly, with a CAGR of 10.7 percent compared to 7.7 percent for total stock. The data reveals that Dehli-NCR and Bangalore are ahead of the curve and account for around 54 percent of India's total certified office stock. The national and state governments of India are giving a variety of incentives to encourage the construction of green buildings using various rating systems. In majority of the states, the Government of India (GoI) subsidises 30% of the installation cost of rooftop solar panels for institutional, residential, and social sectors. In addition, recipients can get a generation-based incentive of INR 2 per unit of generation if their annual production surpasses 1100–1500 kWh. Additionally, the surplus energy can be sold at a rate determined by the government. (CBRE, 2022)

3.3 Energy Consumption

Understanding energy consumption is essential for the ease of living of citizens, as it reduces environmental impact, provides stable energy prices, minimises disruptions to daily life, and contributes to improved air quality and public health. The "Energy Consumption" pillar evaluates the energy supply management of a city or region.

Several cities have demonstrated exceptional performance in this category, including Silvassa, Dindigul, Saharanpur, Bengaluru, Vishakhapatnam, Bilaspur, Bhubaneshwar, Aligarh, Muzaffarpur, Bathinda, Faridabad,

Jalandhar, Srinagar, and Jammu. These cities have not only outperformed their peers but also stand as exemplars in the pursuit of the defined benchmarks for urban development. There is low variation in performance of cities due to most of the cities showing satisfactory performance.

Figure 12: Energy Consumption sector - Category wise cities performance

Cities are assessed based on two key indicators: “Energy Consumed from Renewable Sources” and “Number of Sustained, Scheduled Electrical Interruptions.”

Energy Consumed from Renewable Sources: Renewable energy sources such as solar, wind, hydroelectric, and biomass contribute to a clearer, more sustainable energy mix, reducing greenhouse gas emissions and contributing to a cleaner planet.

Number of Scheduled, Sustained Electrical Outages: Frequency and duration of planned outages lasting longer than five minutes are used to quantify the dependability and stability of the electrical supply. Lower numbers indicate that power outages cause fewer disruptions to daily life.

The analysis of city performance has revealed notable outliers particularly in terms of energy consumption from renewable sources. Approximately a significant number of cities have reported 100% renewable energy consumption, but it's important to note that this may be attributed to variations

India was placed third in global ranking in renewable power capacity addition in 2021, surpassing China and the US.

in the understanding and measurement of energy units, necessitating caution when interpreting such data. **Furthermore, an alarming finding pertains to the occurrence of sustained electrical interruptions, lasting more than five minutes, in 14 cities, each experiencing more than 10,000 such interruptions. Jammu and Srinagar emerge as the most severely affected, recording well over 1 lakh electrical interruptions, followed closely by Jalandhar with approximately 49,000 interruptions.**

These challenges need to be addressed as India is committed to achieving Goal 7 of the Sustainable Development Goals, which focuses on energy access.

In fiscal year 2021–22,

the installed capacity of renewable energy sources in India grew by 16.4% excluding hydropower (MOSPI, 2023).

India was placed third in global ranking in renewable power capacity addition in 2021, surpassing China and the US. It has also increased its hydropower capacity by 843 MW, reaching 45.33 GW. Currently, it is the second-largest market in Asia for new solar PV capacity and ranks third globally in total installations. It is also ranked third in total installed wind power capacity. More than 51 cities have already established a total of 53 targets[16] for 2021. These targets reflect the commitment of Indian cities to address environmental and energy challenges by setting specific objectives in these areas.[17] However, more needs to be done to leverage these opportunities to make its cities energy-smart. Not only is India's pursuit of these ambitious energy goals essential for its sustainable development, but it also significantly contributes to the global effort to combat climate change and promote a greener future.

3.4 City Resilience

A city's disaster resilience pillar evaluates cities on several critical parameters:

- **Does the city have a disaster management plan in place?**
- **Is the city's DP in compliance with the NDMP and DDMP?**
- **Have you mapped all the identified risk areas in the city?**
- **Are early warning systems (EWS) in place for hazards?**
- **Have response teams (e.g., fire stations, police, and ambulances) been identified and prepared for disasters?**

[16] These targets are aimed at various aspects of sustainable urban development, including increasing the use of renewable energy sources, improving energy efficiency in buildings and industries (P), implementing sustainable heating and cooling solutions (H&C), or enhancing transportation infrastructure and services (T).

[17] Renewables 2022 Global Status Report : India factsheet

Box 5: "Harnessing Innovation: How Indian Cities are becoming Energy Smart"

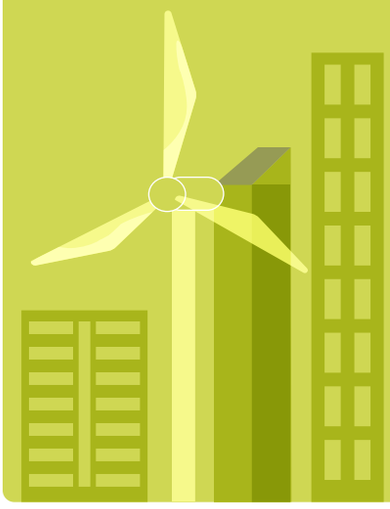
The adoption of renewable energy solutions in Indian cities is gathering momentum, with numerous initiatives and programmes contributing to the expansion of renewables in buildings and urban transportation. According to the Renewables in Cities 2021 Global Status Report by REN21, Indian cities are making substantial progress towards adopting renewable energy solutions. This report emphasises key developments in district cooling, municipal procurement, on-site generation, electrification of urban transport, and sustainable infrastructure, cementing India's path to a sustainable and energy-savvy future. (REN21, 2021)

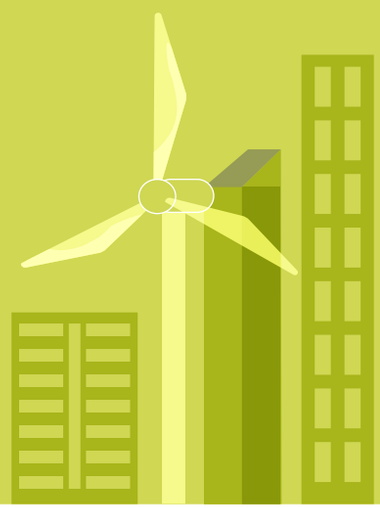
District Cooling Innovation:
The expansion of district cooling in the Indian cities of Amaravati and Rajkot is gaining momentum. Amaravati, the first state capital in India to construct a district cooling system, inked a concession for the development of a district cooling system scheduled for operation in 2021. This represents a major advance in enhancing energy efficiency and reducing carbon emissions in urban areas.

Municipal Procurement of Renewables:
Various Indian cities such as Chennai, are rapidly utilising municipal procurement strategies to meet their renewable energy goals. These municipalities are increasing their procurement of renewable electricity and collaborating with third-party operators to develop renewable energy initiatives. This strategy assists cities in achieving their sustainability objectives.

On-Site Generation of Renewables:
For example, in 2019, Delhi revised its solar policy to facilitate on-site generation of renewables. The implementation of virtual net metering enables homeowners and businesses to purchase solar energy systems. Also, solar PV installations on government and educational structures reached approximately 105 MW in 2019, with residential buildings contributing an additional 5 MW. Pune stood out as an industrial city with the maximum rooftop solar capacity, possessing 130 MW by the end of 2019.

Electrification of Urban Transport:
The electrification of urban transport is gathering momentum across the nation, with a clear connection to the expansion of renewable energy sources. India had 800 electric buses in circulation in 2019, and cities such as Ahmedabad, Bengaluru, Delhi, Gurugam, and Pune are actively expanding their electric bus fleets through procurement programmes launched in 2019 and 2020.





Infrastructure and Distributed Renewables:

Delhi and Nagpur have taken measures to ensure that their metros and trains are propelled by renewable energy. These cities have begun installing distributed renewable power capacity or signed contracts for new or existing renewable energy projects. In addition to subsidising the installation of charging infrastructure within city limits, Delhi has subsidised the adoption of electric vehicles (EVs), reinforcing its commitment to sustainable urban mobility.

These developments demonstrate a growing commitment among Indian cities to adopt renewable energy solutions, not only for electricity generation but also for critical sectors such as district cooling and urban transportation. Cities are poised to play a pivotal role in India's transition to a sustainable and energy-smart future as they continue to innovate and expand their efforts.

The city's disaster management plan, including the NDMP and DDMP, is crucial for effective crisis response. Compliance with these plans aligns efforts with broader disaster management priorities. Mapping risk areas aids in urban planning, early warning systems, and emergency response strategies. Identifying and preparing response teams ensures rapid, coordinated responses, potentially saving lives and minimising damage.

Only 66 out of 158 cities have every parameter checked. Only 19 cities have scored 0 as most of them are marked zero on all parameters due to either non availability of data or zero response being furnished by cities. Most of the cities performance across this sector is low.[18]

WHAT IS URBAN RESILIENCE?

Urban resilience is "the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience." Cities rely on a complex web of institutions, infrastructure and information for their day-to-day functioning. However, a city's ability to maintain essential functions is threatened by both acute shocks and chronic stresses (100 Resilient Cities, 2013).

[18] No boxplot is made where variation in values of cities is low

In the Indian context, several cities have successfully implemented urban resilience initiatives, such as Pune's 'City Resilience Strategy,' Chennai's focus on 'Urban Horticulture,' Indore's 'Integrated Disease Surveillance Project,' and Surat's 'End-to-End Early Warning System' for Ukai and local floods. These initiatives demonstrate a proactive approach to addressing vulnerabilities, mitigating risks, and preparing for unforeseen disasters within the unique Indian urban landscape. Recognising resilience-oriented approaches not only minimises future costs but also yields social, economic, and environmental benefits. Cities can enhance their resilience by ensuring access to basic services, fostering social cohesion, promoting reliable employment opportunities, and maintaining a well-balanced ecosystem, infrastructure, and services. Achieving this requires collaborative efforts between city leadership and local communities through integrated planning.

There is another parameter "Population Affected by Disasters" measured by ((Deaths due to disasters + Person directly affected due to disasters) / Population)*100. It was not assessed in cities' resilience due to concerns regarding data quality and statistical significance. Therefore, for a comprehensive assessment of city resilience, other more consistently measurable indicators were prioritized to ensure the robustness and reliability of the assessment. [19]

To illustrate this, we showcase the insights from the data submitted by cities:

According to data submitted by 154 cities, Puducherry, Madhya Pradesh, Uttar Pradesh, Punjab, and Bihar collectively account for a substantial 94 percent of disaster-related deaths. Furthermore, within Bihar, four cities alone are responsible for 42 percent of disaster-affected individuals, highlighting the concentration of such events in specific regions. Cities in Uttar Pradesh, Madhya Pradesh, and Puducherry also report around 12–13 percent of disaster-affected populations.

It's important to note that many of these cities may not necessarily perform well on other city resilience parameters. The data reveals that 66 cities provided no response on this parameter, while 56 cities reported zero values, indicating potential gaps in data collection and reporting. Moreover, cities from specific states have only reported significant figures in disaster-related statistics. This information underscores the need for a more comprehensive and standardized approach to disaster data collection and management to enhance the effectiveness of disaster mitigation and response strategies in cities.

[19] Collecting accurate and reliable data on disaster-related deaths and direct impacts on populations can be challenging and often subject to inconsistencies in reporting and data collection methodologies. Moreover, the statistical significance of this parameter may be limited, as the occurrence of large-scale disasters with a substantial impact on city populations can be relatively infrequent.

4 Citizen Perception Survey

The Citizen Perception Survey is poised to mark a significant milestone on the path to informed decision-making based on the invaluable insights gleaned from the residents of these cities.

The Citizen Perception Survey is another dimension which serves as an invaluable tool for validating and integrating citizens' experiential perspectives with this study's findings. Its primary objective is to evaluate the performance of administrative bodies in delivering public services and to obtain direct feedback from the individuals these services are intended to assist. Citizen evaluations are founded on fundamental factors such as service accessibility, affordability, and quality.

In November 2022, the Ministry of Housing and Urban Affairs launched the Citizen Perception Survey, which included both online and offline modes to collect citizen feedback on numerous facets of urban life, including public transport, education, healthcare, water availability, cost of living, and employment opportunities. More than 8.5 million responses were submitted to the survey between November 9, 2022 and January 31, 2023. This overwhelming participation demonstrates the vital importance of the survey in determining the needs and priorities of citizens. It is an instrumental instrument that will enable municipal administrations to advance the cause of creating more habitable and inclusive urban environments.

The Citizen Perception Survey is poised to mark a significant milestone on the path to informed decision-making based on the invaluable insights gleaned from the residents of these cities. This study's final questionnaire consisted of 12 distinct sectors, each containing an exhaustive set of 26 questions designed to elucidate the perspectives of urban residents on crucial issues. These sectors include Mobility, which focuses on transportation accessibility, affordability, and modes; Housing, which evaluates the simplicity of acquiring or renting property; Energy, which examines the frequency of power outages; and Water & Sanitation, which includes potable water availability and quality. Health, examining the cost, accessibility, and quality of healthcare services; Education, including accessibility, affordability, and quality of educational facilities; Economy, which includes the cost of living and job prospects; Environment, which examines air quality, solid waste management, and water and sanitation practices; planning and assessing the availability of recreational facilities; Safety and Security, determining safety perceptions and crime rates; and Governance and ICT, evaluating citizen-municipality interactions and satisfaction levels. By adopting such a comprehensive approach, the Citizen Perception Survey seeks to comprehensively capture the intricate ease of living, providing policymakers with the data-driven insights necessary to foster more responsive and citizen-centred cities.

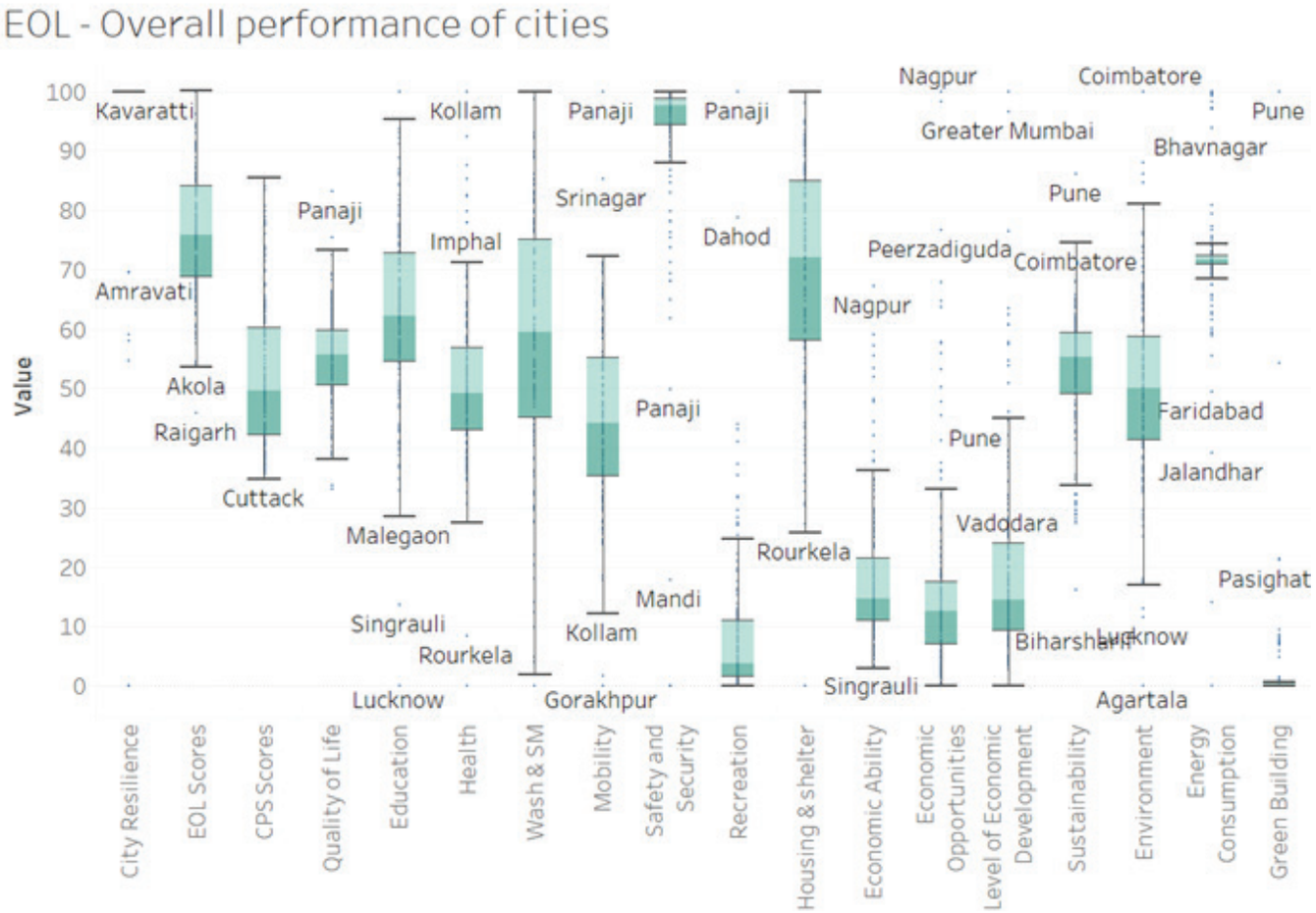
Notably, our evaluation of the city's performance highlights a substantial dissonance with the results of the citizen perception survey. In particular, the top ten cities identified through the citizen perception survey do not consistently exhibit strong performance in our comprehensive evaluation of cities. Conversely, the cities that secured the highest scores in our evaluation did not necessarily attain the highest rankings in the citizen perception survey. It is noteworthy that among the limited instances of convergence between the two assessments, Navi Mumbai, Machillipatnam, and Tiruchirapalli emerge as the only cities consistently identified as top performers. Despite these instances of alignment, an overarching observation is the absence of a linear relationship between the survey results and our comprehensive evaluation.

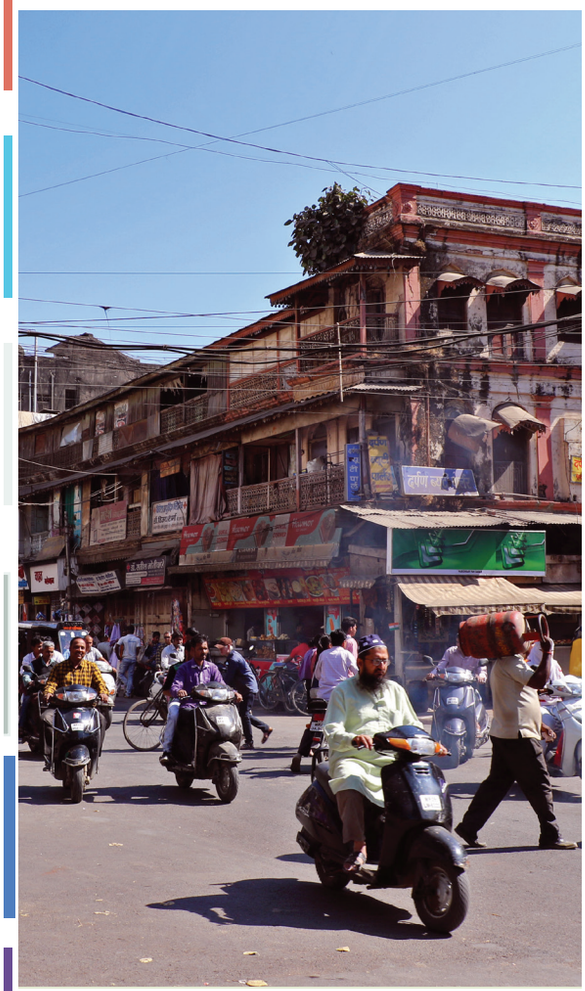
This divergence underscores the nuanced nature of city assessments, where citizen perceptions and quantitative evaluations may yield disparate results. The difference between the survey results and our evaluation means that the results need to be interpreted in a more complex way. This shows that city performance is complex and can't be fully understood through either subjective opinions or quantitative measurements alone. The results give the impression that residents of high-performing cities are evaluated more stringently than those of other cities. Even if their evaluated performance is lower, cities with greater access to governance information, facilities, and services are likely to perform well in the survey. Alternately, even if cities excel in performance across the index's pillars but fail to guarantee transparency and accessibility or have a low rate of citizen participation, their survey score is likely to drop.

05

OBSERVATIONS FROM VARIANCE OF SCORES

The variance in the scores of the pillars and categories of this study puts forth some interesting insight with respect to the scores of different cities.





Variance and median scores of cities across sectors and categories

Several important observations can be made regarding the evaluation of Indian cities.

- **First, it is apparent from the above figure that the median scores for quality of life sectors such as Education, Health, Housing and Shelter, WASH and SWM (Water, Sanitation, and Hygiene, and Solid Waste Management), and Safety and Security tend to be relatively high.** In contrast, the median scores for economic ability and its sub-categories, particularly level of economic development and economic opportunities, are significantly lower, with scores between 0 and 20 out of 100 for a large number of cities. Additionally, sustainability sectors have received high scores with the exception of green buildings, which are an outlier.

- Second, when examining the dimension of economic ability, both its sectors have low scores. Indicators of the level of economic development, such as the number of micro, small, and medium-sized enterprises (MSMEs) per one million people and cluster development, generate low scores for the majority of cities. Cities such as Ulhasnagar, Greater Mumbai, New Town Kolkata, Pimpri Chimni, Pune, Thane, Ahmedabad, and Bengaluru exhibit positive outliers.

- Thirdly, with regard to economic opportunities, which has a national average of 16.72 and a median score of 12.64, indicators focus on credit accessibility and incubation centres, which are essential resources for nurturing economic productivity. Positive outliers in this sector are typically industrial centres engaged predominantly in manufacturing, and they tend to be located in the southern and western regions of India. While low scores for most cities in this sector could be attributed to the indicators themselves, which may not account for the diverse character of economic activities, positive outliers like Bengaluru are substantially service-oriented.

- **Fourth, the inverse relationship between education and economic capability is a noteworthy observation. Cities with high education scores, such as Warangal, Jammu, Amritsar, Imphal, and Pimpri Chinchwad, typically have low economic ability scores. In contrast, cities with high scores for economic ability, such as Nagpur, Erode, and Ulhasnagar, tend to score poorly for health.** This suggests that major cities, which are known for attracting internal migrants, effectively leverage their advantages in terms of ease of living to nurture a cosmopolitan culture that promotes economic development.

- Urban agglomerations play a

vital role in bridging the urban-rural divide and cultivating a cosmopolitan culture through market connections and cultural interaction. However, the relatively low median scores for categories like recreation and green buildings and spaces indicate that the development of a cosmopolitan imagination in India's urban spaces is still in its early phases. This widens the gap between the nation's main cities and the rest of the nation's metropolitan centres, highlighting the need for greater investment in cultural and recreational infrastructure to promote a global mindset across the country.

In Alignment from SDGs: Insights from Indian Cities

India's commitment to this global agenda is particularly vital given the country's rapid urbanization, which plays a pivotal role in achieving broader human well-being targets by 2030. Central to this is the urban-nexus approach, which focuses on the interdependencies between water, energy, agriculture, and food, can help accelerate efforts to achieve India's development goals. This approach directly addresses the SDGs of zero hunger, clean water and sanitation, affordable and clean energy, sustainable cities and communities, and responsible consumption and production. India's commitment to achieving SDG targets is reflected in the alignment of the National Development Agenda with SDGs and the implementation of various programs, such as the Ayushman Bharat. However, implementing and tracking SDGs on the city level may yield more lucrative results. Cities with better urban management also have a better quality of life for their people. In this section of the report we discuss city's performance in achieving the Sustainable Development Goals (SDGs) of 53 cities that were part of our evaluation. It helps to identify the capacity of Indian cities to achieve broader development objectives and sustainable development goals. The data presented in the study elucidates areas for improvement, sectors needing improvement, and existing trends that must be considered before policymakers take decisive measures.

According to the SDG Urban Index dashboard[20], an assessment of city performance reveals commendable achievements in three Sustainable Development Goals (SDGs), i.e., SDG 12 (Ensuring sustainable consumption and production patterns), SDG 16 (Promoting peaceful and inclusive societies, providing access to justice for all, and building effective, accountable, and inclusive institutions at all levels), and SDG 7 (Ensuring access to clean and affordable energy). The national averages for these SDGs are notably high at 80.89, 79.5, and 77.16, respectively. However, the analysis underscores the need for significant improvement in SDG 2 (zero hunger) and SDG 8 (promoting inclusive and sustainable economic growth, full and productive

[20] SDG Urban Index & Dashboard | iTech Mission (niti.gov.in)

employment, and decent work for all). SDG 2's direct connection to health is emphasised, as it plays a critical role in an individual's ability to achieve a requisite quality of life, economic prosperity, and sustainability. Additionally, SDG 8's emphasis on driving economic growth and creating sustained jobs is highlighted as pivotal for enhancing the overall ease of living.

The overall national average for SDGs stands at 64.76. On a positive note, 31 out of 53 cities have surpassed this national average, indicating considerable progress in achieving the SDGs. Shimla emerges as the highest-performing city with an impressive score of 75.50, demonstrating satisfactory and exceptional performance across nine SDGs. This notable achievement is closely followed by Coimbatore, Thiruvananthapuram, and Chandigarh, scoring 73.29, 72.36, and 72.36, respectively. Additionally, three more cities—Kochi, Panaji, and Pune—have achieved scores exceeding 70. Conversely, Dhanbad, Meerut, and Itanagar emerge as the lowest-performing cities, with scores of 52.43, 54.64, and 55.29, respectively. These outcomes underscore the disparities in SDG implementation and highlight areas for targeted interventions to enhance sustainability and holistic urban development.

In conclusion, the SDG Urban Index provides valuable insights into city-level performance across diverse goals. The disparities identified offer a foundation for tailored interventions, while the exemplary performance of certain cities showcases the potential for positive impact. This formal assessment serves as a critical tool for policymakers, offering a nuanced understanding of the progress and challenges in achieving Sustainable Development Goals at the urban level.

Recommendation

- Effective urban governance is essential for enhancing municipalities' capacity to plan and administer local institutions and resources, accelerate urban growth, and promote sustainable development objectives at the city level. It is essential to build capacity and provide financial management, as many municipalities lack the skills, resources, and capacity to function effectively. Advancing sustainable development objectives at the municipal level can result in greater success and a higher quality of life for the populace.

- Access to resources such as affordable housing, waste management, pure water, and sanitation depends on the improvement of governance and services. It is essential to recognise and build on "sector characteristics" and "common constraints" in order to include specific considerations of urban characteristics that influence service delivery if governance constraints are to result in subpar service delivery.

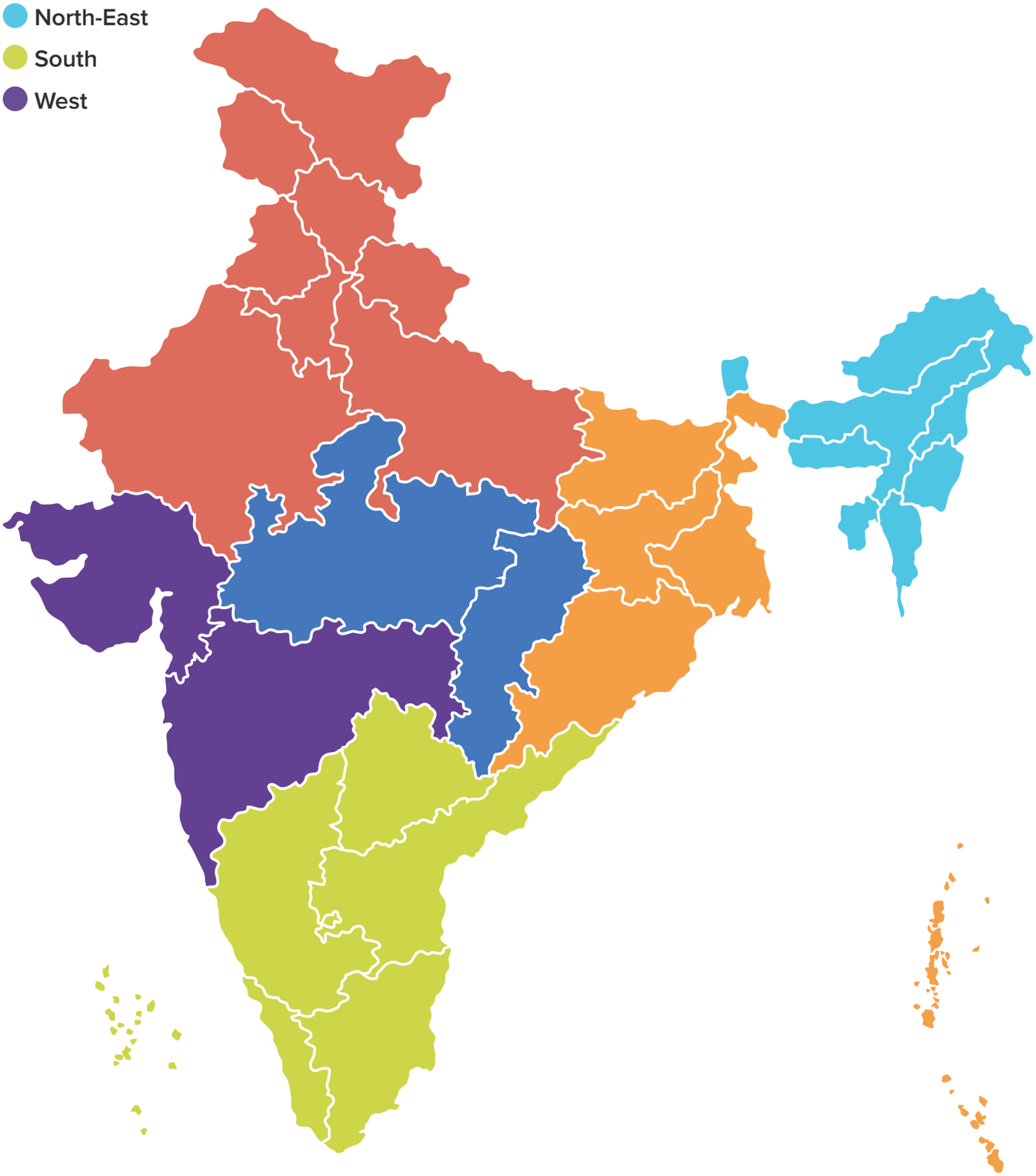
- Peer-learning for improved development outcomes is essential, as cities perform admirably across multiple sectors of quality of life, economic capability, and sustainability. Urban areas in India contribute between 52.6% and 64.9% of the country's output, but for urbanization to result in greater economic benefits, there must be a larger accumulation and aggregate of productive knowledge.

- Gender-sensitive governance practices can facilitate improved outcomes for women by recognising disparities and providing solutions to them. Having access to all levels of education, greater economic and employment opportunities, and lower levels of social and cultural constraints, cities guarantee women improved living conditions.

06

REGION-WISE ANALYSIS

The performance of smart cities varies across the country due to their diverse development and geographical distribution. To understand these disparities, six distinct regions have been identified: North, South, West, Central, East, and North-East. This categorization helps evaluate the varying degrees of regional performance in different parts of the country.



North Region

Sector	Regional Average	Cities scoring above national average	Performers
Education	64.4	22	Jammu (Jammu & Kashmir) is the highest performer. The city has performed well on the parameters of PTR at the primary and upper primary levels, as it is below 15, which is within PTR norms. The city has also reported 100 percent access to digital education and a nearly zero dropout rate. It is closely followed by other cities like Gurugram, Amritsar, and Chandigarh.
Health	46.67	10	Most of the cities of Himachal Pradesh and Uttar Pradesh perform well in this sector relative to other northern cities such of Punjab.
Housing & Shelter	72.18	22	Most of the cities of Uttarakhand and Himachal Pradesh perform well in this sector relative to other northern cities
Wash & SWM	60.13	22	Most of the cities of Himachal Pradesh and Punjab perform well in this sector relative to other northern cities
Recreation	8.96	11	NDMC (Delhi) and Dharamshala (Himachal Pradesh) have performed well in providing their city with abundant recreational opportunities.
Mobility	48.15	21	Srinagar (J&K) , Dharamshala and Mandi (Himachal Pradesh) have performed well on mobility parameters.
Safety and Security	88.55	30	Delhi , Kargil (Ladakh) , Dharamshala and Mandi (Himachal Pradesh) have reported higher crime rates in their cities relative to other northern cities.
Level of Economic Development	18.98	12	Ghaziabad and Prayagraj (Uttar Pradesh) have shown better performance relative to other northern cities and have demonstrated a greater concentration of small and medium-sized businesses within the city.
Economic Opportunities	13.93	7	Chandigarh demonstrates good performance on this sector , it is closely followed by cities like Shimla (Himachal Pradesh) , Dehradun (Uttarakhand) and Gurugram (Haryana).

Energy Consumption	68.36	6	Most of the northern cities have reported poor performance on the parameter of scheduled electrical interruptions in their cities , with the highest being recorded in Jalandhar (Punjab) , Srinagar and Jammu (J&K).
Green Building	2.56	6	Most of the cities in UP such as Lucknow , Ayodhya and Agra along with cities of Jammu and Kashmir have shown satisfactory performance in this sector.
Environment	43.43	11	Most of the northern cities have reported poor performance on this sector , which is driven by poor performance on air pollution parameters and less properties with functioning harvesting structures established.
City Resilience	89.13	30	Phagwara (Punjab) , Kargil and Jammu (Jammu and Kashmir) are the only northern cities which have reported no on the city's disaster resilience parameters.

Northeast Region

Sector	Regional Average	Cities scoring above national average	Performers
Education	64.68	6	Imphal (Manipur) emerges as a top performer in the region. The city has performed well on the parameters of learning outcomes and reported close to zero dropout rate for grade 8 and 10. It has also reported lower PTR at the primary and upper primary level i.e. less than 20.
Health	47.08	3	Most of the north eastern cities have shown lower performance in this sector , with an exception of cities such as Shillong (Meghalaya) , Pasighat (Arunachal Pradesh) and Imphal (Manipur).
Housing & Shelter	66.95	3	Most of the north eastern cities have performed well on parameters of this sector.
Wash & SWM	36.6	0	Most of the north eastern cities have shown lower performance, particularly in cities such as Shillong (Meghalaya) , Agartala (Tripura) and Imphal (Manipur)

Recreation	12.1	6	Most of the north eastern cities have performed well in this sector except Aizawl (Mizoram) .
Mobility	44.44	4	Most of the north eastern cities have performed well in this sector except Guwahati (Assam) .
Safety and Security	94.21	8	Most of the north eastern cities have reported lower crime rates.
Level of Economic Development	10.38	1	Guwahati (Assam) is the top performer with highest cluster strength and demonstrates a greater concentration of small and medium-sized businesses relative to other north eastern cities.
Economic Opportunities	21.83	3	Pasighat and Itanagar (Arunachal Pradesh) have shown better performance relative to other north eastern cities.
Energy Consumption	77.2	2	Most of the north eastern cities have shown a better performance on average in this sector.
Green Building	2.13	1	Most of the north eastern cities have performed low in this sector. Good performance is only observed in Pasighat (Arunachal Pradesh) .
Environment	50.12	5	Most of the north eastern cities have performed well in this sector. Very low performance is only observed in Agartala (Tripura) .
City Resilience	92.86	8	Most of the north eastern cities have performed well on city resilience , except Imphal (Manipur) and Aizawl (Mizoram).

East Region

Sector	Regional Average	Cities scoring above national average	Performers
Education	63.9	9	Bhubaneshwar (Odisha) is the highest performer as the city has performed well on the parameters of PTR at the primary and upper primary levels, as it is within PTR norms and reported zero dropout rate. It is closely followed by other cities Port Blair (Andaman & Nicobar Islands) , Ranchi and Jamshedpur (Jharkhand)
Health	40.8	2	Cities such as Jamshedpur (Jharkhand) , Rourkela and Bhubaneswar (Odisha) perform worst in this sector.

Housing & Shelter	63.56	5	Cities such as Jamshedpur (Jharkhand) , Rourkela and Bhubaneswar (Odisha) lag behind in this sector. Cities of Bihar perform relatively better in this sector.
Wash & SWM	43.23	2	Cities such as Jamshedpur (Jharkhand) , Rourkela and Bhubaneswar (Odisha) perform well in this sector.
Recreation	7.32	7	Almost all eastern cities except for Cuttack (Odisha) and Dhanbad (Jharkhand) have performed better in providing recreational opportunities to its citizens.
Mobility	40.51	6	Almost all eastern cities except for Rourkela (Odisha) and Medininagar (Jharkhand) have performed well on mobility parameters.
Safety and Security	88.35	8	Almost all eastern cities have reported lower crime rates.
Level of Economic Development	16.42	3	New town Kolkata (West Bengal) is the top performer with highest cluster strength and demonstrates a greater concentration of small and medium-sized businesses within the city.
Economic Opportunities	13.46	2	Port Blair (Andaman & Nicobar Island) and New town Kolkata (West Bengal) have shown better performance relative to cities of Jharkhand , Bihar and Odisha under this sector.
Energy Consumption	70.27	3	Most of the cities have performed well in this sector. Cities such as Bhubaneswar (Odisha), Ranchi (Jharkhand) and Muzaffarpur (Bihar) have reported near zero energy consumption from renewable sources and reported higher electrical interruptions.
Green Building	1.53	3	Almost all eastern cities except for New Town Kolkata (West Bengal) and Deoghar (Jharkhand) have performed low on this sector.
Environment	47.62	6	Most of the cities of Jharkhand have reported lower performance on all parameters of this sector.
City Resilience	83.54	11	All the eastern cities except for Jamshedpur and Deoghar (Jharkhand) have reported that there is no system for city disaster resilience.

South Region

Sector	Regional Average	Cities scoring above national average	Performers
Education	62.53	20	Warangal (Telangana) is the highest performer, with PTR rates lower than 10 for the city, and it is noted that at least 80 percent of the schools have access to digital education. Most of the cities have a saturated performance on NAS scores, with the exception of Warangal, which has scored 80. Other cities have NAS scores below 55.
Health	54.79	27	Overall satisfactory performance is observed in this sector as all the cities have less difference in terms of performance on health parameters with Kollam (Kerala), Chennai (Tamil Nadu) and Kakinada (Tamil Nadu) leading the pack .
Housing & Shelter	66.43	25	Most of the cities of Andhra Pradesh perform low on this sector. Cities of Tamil Nadu have emerge as the top overall performers.
Wash & SWM	59.63	27	Most of the cities of Andhra Pradesh perform low on this sector except for Vishakhapatnam which leads in the region. Cities of Tamil Nadu have performed well in this sector.
Recreation	6.29	13	Most of the southern cities lag behind in this sector.
Mobility	43.09	22	Most of the southern cities perform well on mobility parameters except for Kollam (Kerala) and Sivakasi (Tamil Nadu)
Safety and Security	96.28	40	Most of the southern cities perform well and have reported lower crime rates.
Level of Economic Development	17.85	15	Cities such as Chennai (Tamil Nadu) , Bengaluru (Karnataka) and Hyderabad (Telangana) with highest cluster strength and demonstrates a greater concentration of small and medium-sized businesses relative to other southern cities.
Economic Opportunities	20.38	16	Erode (Tamil Nadu) is the top performer with highest credit availability and presence of incubation centres and skill development centres. Most of the cities of Tamil Nadu perform well on this sector.

Energy Consumption	74.35	9	Most of the southern cities have performed well in this sector except Visakhapatnam (Andhra Pradesh) , Bengaluru (Karnataka) and Dindigul (Tamil Nadu).
Green Building	1.4	9	Most of the southern cities lag behind in this sector. Only 8 out of 48 cities have shown better performance in this sector
Environment	56.7	29	Most of the southern cities have performed well in this sector except Coimbatore (Tamil Nadu), Tiruchirappalli (Tamil Nadu) and Peerzadiguda (Telangana).
City Resilience	79.04	36	More than 80 % of the southern cities have reported yes on all parameters of city disaster resilience, showcasing superior performance across all cities

West Region

Sector	Regional Average	Cities scoring above national average	Performers
Education	62.29	16	Pimpri Chinchwad (Maharashtra) is the highest performer. It is closely followed by other cities in Maharashtra, i.e., Kalyan Dombivli, Chandrapur, and Nagpur. Most of the cities in Maharashtra perform well in this sector.
Health	56.13	21	Most of the cities in Maharashtra and Panaji (Goa) have performed well with Ahmadnagar and Latur emerging with good performance in this sector.
Housing & Shelter	74.62	25	Most of the cities of Maharashtra have performed low on this sector due to subpar performance in PMAY house construction.
Wash & SWM	68.4	24	Panaji(Goa) and most cities of Gujarat have performed better in this sector with Dahod, Surat and Rajkot emerging with good performance on this sector.
Recreation	12.34	11	Panaji (Goa) has outperformed all cities in providing abundant recreational opportunities.
Mobility	48.39	19	Panaji (Goa) and most of the cities of Maharashtra have performed well in the mobility sector.
Safety and Security	95.54	32	Panaji (Goa) and most of the cities of Maharashtra have reported higher crime rates

Level of Economic Development	30.81	21	Cities of Maharashtra such as Ulhasnagar , Pune , Thane and Greater Mumbai are the top performers in this sector.
Economic Opportunities	16.49	10	Nagpur (Maharashtra) is the top performer with higher credit availability and presence of 825 incubation centres and skill development centres. Most of the cities of Maharashtra perform well on this sector.
Energy Consumption	74.19	11	Most of the cities of Gujarat and Maharashtra on an average have showcased satisfactory performance in this sector.
Green Building	5.41	12	Only 33 percent of western cities have performed well in this sector.
Environment	49.49	15	Most of the cities of Maharashtra on an average have showcased lower performance in this sector.
City Resilience	91.84	29	All the cities of Gujarat have reported yes on all parameters of cities disaster resilience.

Central Region

Sector	Regional Average	Cities scoring above national average	Performers
Education	53.43	5	Ujjain (Madhya Pradesh) is the highest performer. The city has performed well on the parameters of 100 percent access to digital education and a lower dropout rate for grades 0–10, i.e., five. Most of the cities in Madhya Pradesh perform well in this sector.
Health	47.13	4	Chhindwara (Madhya Pradesh) , Bilaspur and Naya Raipur (Chhattisgarh) perform well on health parameters relative to other cities.
Housing & Shelter	71.53	8	Most of the cities of Madhya Pradesh lead in this sector with good performance on parameters of electricity and PMAY house construction.
Wash & SWM	55.13	9	Indore (Madhya Pradesh) , Bilaspur (Chhattisgarh) and Gwalior (Madhya Pradesh) perform well on parameters of this sector.
Recreation	7.92	3	Bhopal (Madhya Pradesh) have performed well in providing it's city with abundant recreational opportunities.

Mobility	**40.91**	**5**	Naya Raipur (Chhattisgarh) and Indore (Madhya Pradesh) have performed well on mobility parameters.
Safety and Security	88.31	8	Most of the cities of Madhya Pradesh have reported lower crime rates
Level of Economic Development	9.71	2	Indore (Madhya Pradesh) is the top performer with highest cluster strength and demonstrates a greater concentration of small and medium-sized businesses within the city.
Economic Opportunities	11.59	4	Raipur (Chhattisgarh) and Chhindwara (Madhya Pradesh) have shown better performance relative to other cities of Madhya Pradesh and Chhattisgarh under this sector.
Energy Consumption	75.54	3	Most of the cities in this sector have performed due to less scheduled electrical interruptions in the city. Bilaspur (Chhattisgarh) is the only city which has reported higher interruptions and less energy consumption from renewable sources.
Green Building	1.58	3	Cities such as Raipur (Chhattisgarh) Indore and Bhopal (Madhya Pradesh) have only performed well in this sector.
Environment	53.15	10	Most of the cities in this sector have performed well except for Singrauli and Dewas (Madhya Pradesh).
City Resilience	71.43	10	Most of the cities of Madhya Pradesh and Chhattisgarh have reported that there is a system for city disaster resilience.

07

WAY FORWARD

A noteworthy conclusion of this evaluation is the existence of disparities in the conception of ease of living. The metropolitan cities with the higher performance across all sectors are those with a long track record of industrialization, finances, and a service delivery-driven ecosystem.

Urbanization is at the core of development, and its accelerated growth accentuates the need for effective urban governance. This study aims to evaluate and emphasise the ability of cities to improve the living standards of their residents by mapping various aspects of living standards in various urban areas across the nation. **A noteworthy conclusion of this evaluation is the existence of disparities in the conception of ease of living. The metropolitan cities with the higher performance across all sectors are those with a long track record of industrialization, finances, and a service delivery-driven ecosystem. Consequently, these cities already have the historical advantage of being large cities, allowing them to further expand networks of urban governance and enhance their performance across all dimensions.**

Despite variations in scores across all sectors and categories, the average score of 52.42 on the Citizen Perception Survey demonstrates that citizens have a favourable opinion of their cities. **In fact, the CPS scores have considerably improved the ranking of a number of cities, even those with low scores in the sectors. This fact alludes to the disparity between a city's actual performance in the delivery of services that enhance the quality of life and the public's perception, which is shaped by the end-users of such services and the city's administration. This report seeks to emphasise not only the strengths of municipal administrations in ensuring a certain quality of life but also the weaknesses that impede local governance in its daily operations.** With the aid of this study, city administrations, policymakers, civil organisations, and researchers can generate and disseminate good practices that can enhance the ease of living of citizens. This study also aims to promote the vision of the 74th Amendment Act of 1992, which proposes to establish a uniform framework of municipal corporations, municipal councils, and Nagar Panchayats based on population and grants them constitutional status via universal adult franchise. It is anticipated that this index will facilitate an improvement in the ease of living for these urban bodies as they operate as efficient entities of local self-government.

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Methodology Notes

Population & Household Projections 2021

The population figures for the majority of cities in the 2001 and 2011 were sourced from census. Then Population projections for the year 2021 were calculated using the formula outlined in the Urban Outcome Framework-part 1.

Pit = Pil + [{(Pil- Pib)/(Pjl-Pjb)}(Pjt-Pjl)]

Pit- Population projection for the city in the target year (2021)

Pil- Population of the city in the launch year (2011)

Pib- Population of the city in the base year (2001)

Pjl- Population of the state to which city belongs in the launch year (2011)

Pjt- Population of the state to which city belongs in the target year (2021)

Pjb- Population of the state to which city belongs in the base year (2001)

- Population Projected for 2021 at state level was taken from main.mohfw.gov.in/sites/default/files/Population Projection Report 2011-2036 - upload_compressed_0.pdf

- The values were modified for specific cities whose projected population for 2021 was revised by the cities themselves or disclosed in the public domain.

- Household Projection Calculation: The average household size in urban areas, as per the information from the Ministry of Housing and Urban Affairs, Government of India, is 4.8. This data is sourced from [https://mohua.gov.in/upload/uploadfiles/files/Housing_in_. Projected value was divided by 4.

Raw Data corrections

1. Substitution of values

From the 107 cities that partook in the previous cycle, data entries marked as Not-filled (NF), Not-Available (NA), Awaited (AW), and Not-Applicable (N/A) were replaced for the cities that had provided data in the previous cycle but refrained from doing so in the current year. A cumulative total of 1494 data entries were substituted for the report on Liveability, sustainability and economic ability of Indian cities. Subsequent to these substitutions, the count of cities with an approval rate exceeding 50% witnessed an increment from 141 to 158.

2. Identification of discrepancies

Data entries are aligned with the preceding cycle's data for the 107 cities, and static data points such as the city's total area, aggregate green cover, etc. were determined. Cities exhibiting extreme values (exceeding absolute 3 sigma) were earmarked, and individualized interactions were facilitated to prompt them to amend their data points. Correspondence was dispatched to the Chief Secretaries of the respective States containing the list of data points. As a result, numerous cities have responded by providing either rectified values or clarification regarding the discrepancies.

3. Mismatch value correction

A meticulous verification was conducted comparing the data entries provided by the cities and the data depicted in the associated supporting documentation. This procedure was necessary in instances where cities had supplied a data entry that deviated from what was presented in the supporting documents. This process also necessitated rectification of identified Unit of Measurement (UOM) discrepancies. Consequently, on behalf of the cities, a cumulative total of 352 data entries were corrected for the Liveability, sustainability and economic ability of Indian cities were rectified under the evaluation study on cities.

4. Treatment of Zero Values

A specific pattern observed in the data entries supplied by the cities revealed that the cities often declared the data point value to be zero. From a statistical perspective, this creates difficulty in treating the data point for indexing, as it induces skewness in the distribution. Through domain expertise, data points which conventionally cannot be zero were singled out and excluded from the master sheet, thereby being treated as 'null values'. These will be addressed at the imputation stage. Such examples include the quantity of banks, ATMs, school enrollments, etc. It is noteworthy to mention that for categorical variables, i.e., the questions that required binary input, zero values for those data points have been treated as is.

5. Treatment of Outliers

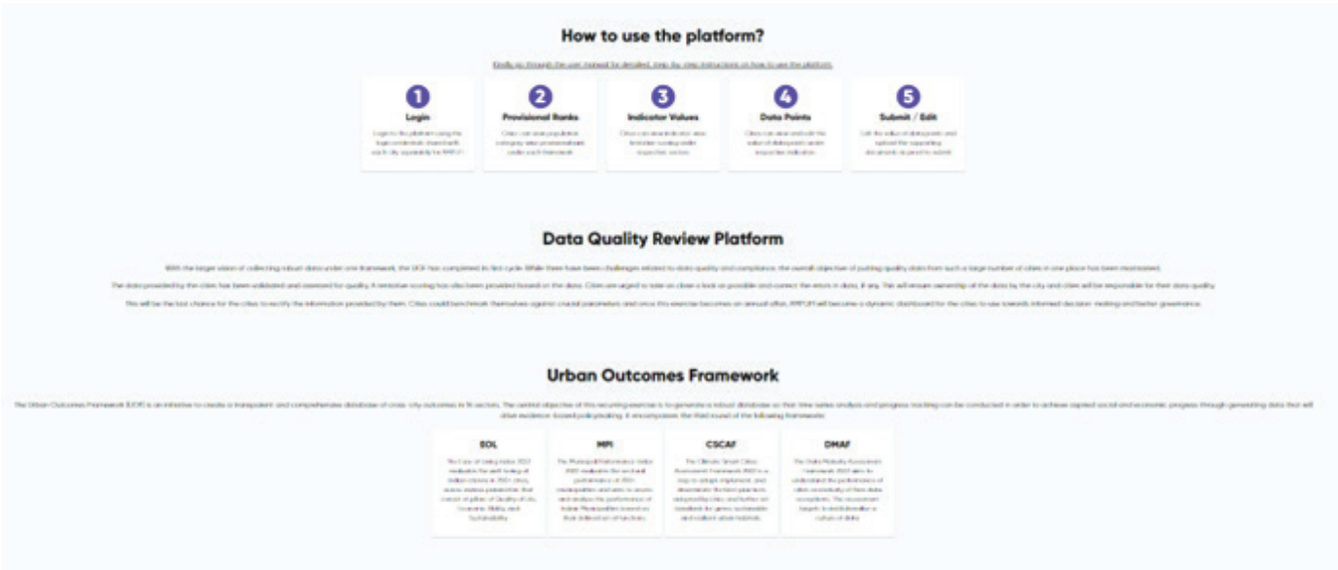
Outliers are data points that deviate markedly from the overall pattern of a given dataset, often referred to as anomalous or extreme values located substantially away from the mean of the distribution. A datum is deemed an outlier if it surpasses the absolute three standard deviation threshold in a log-normally distributed dataset. The data set here was plotted on log normal distribution to check the fit of the deviation.

The identification of outliers is undertaken for very data point subsequent to the classification of cities into distinct population strata, with the objective of mitigating the potential distortions caused by disproportionate figures in highly populous urban conglomerates such as Delhi, Mumbai, or Kolkata. Figure 1 provides a graphical representation of a log-normal distribution comprising various data points. The Interquartile Range (IQR) was also employed to distinguish outliers within the dataset.

The detected outliers underwent individualised handling with insights from subject-matter expertise. Instances where outlier authenticity was confirmed remained incorporated within the dataset, such as the population statistics for the Greater Mumbai and Municipal Corporation of Delhi. Conversely, inauthentic outliers were excised from the dataset, reclassified as "null values" and earmarked for subsequent handling. For instance, a claim made by the city of Patna regarding the presence of 25,000 ATMs with a mere 100 operational bank branches is an implausible circumstance and was, therefore, flagged as such. This process was consistently applied across all data points for the totality of the 225 cities that provided data.

6. Data Quality Peer Review Platform

All the issues listed above were shared with the cities along with raw data and the computed indicators thorough the Data Quality Peer Review Platform. Cities were able to rectify the data points by submitting the supporting document.



Indicator level Data Imputation

Data imputation involves the substitution of missing data employing a statistical methodology. Additionally, the methodology encompasses data normalization, a crucial step in ensuring equitable treatment of diverse indicators. The normalization process standardizes the range and scale of variables, enabling fair aggregation and comparison across indicators. Furthermore, score calculation involves distinct treatment of positive and negative indicators. Positive indicators, denoting desirable outcomes, are directly incorporated , contributing positively to the final score. Conversely, negative indicators, signifying areas requiring improvement, undergo a transformation that inversely contributes to the final score, thereby accurately reflecting areas of concern. This dual-handling approach guarantees a comprehensive evaluation of municipal performance, encompassing both strengths and areas in need of enhancement.

Dealing with missing values

In the process of formulating the treatment across various city/Urban Local Body (ULB) categories, the handling of missing values, outliers, and distinct indicators like “NA”, “AW”, “NF” and “N/A” is pivotal. This note elucidates the methodology employed to address missing data and outliers categorically, elucidating the rationale behind this approach. To ensure data accuracy, we adopted a meticulous strategy tailored to the attributes of each city/ULB category. Initially, missing data were identified and grouped based on their indicators. A multi-phased imputation process followed, utilizing suitable statistical methodologies including mean/mode imputation, regression-based imputation, and data augmentation approaches, however the approaches were not used due to complexity of data based on outliers found. Outliers underwent identification through established techniques such as Z-score analysis and interquartile range (IQR) methods. Flagged outliers were rigorously examined and either rectified using domain-specific insights . Finally it was decided that through the implementation of this category-specific methodology, the consistency of category-centric trends was maintained, mitigating biases that may arise from imputation practices. The tailored handling of missing values and outliers within distinct city/ULB categories ensures the resulting score precisely captures the intricacies of urban datasets. This approach forms the bedrock of the evaluation’s dependability and impartiality, establishing it as a pivotal instrument for informed urban development decisions and effective policy-crafting. In case of this study, after removing cities with less than 45 % missing values , identification of missing values across sectors was less.

Quartile delineation for Categories

Quartiles are statistical measures that divide a data set into four equal parts. Each quartile represents a specific point or set of points in the dataset, indicating the relative position of values. Categorizing scores into quartiles for each population categories offers a valuable approach for contextualized assessment and comparison. This method allows for a nuanced understanding of performance by considering unique characteristics within each category. Quartiles facilitate relative comparisons, identifying outliers and variations within specific groups. This approach enhances communication and reporting, making it easier for stakeholders to interpret results and policymakers to target interventions effectively. Additionally, it ensures fair comparisons within categories, avoiding bias from diverse characteristics. The dynamic monitoring capability of quartiles over time provides insights into trends and changes within each category, supporting informed decision-making. Before calculating quartiles, scores of each population category were capped with respect to highest performance of city within each category.

1. **Quartile Boundaries for Each Category:** Determine quartile boundaries for each category based on the scores within that category. You will have different quartile boundaries for each category

2. **Assign Quartiles within Each Category:** For each city, compare its score to the quartile boundaries. Here's a general description of how to categorize:

Here are the four quartiles:

1. **First Quartile (Q1):** This contains the lowest 25% of the scores. The value at the boundary between the first and second quartiles is often referred to as the 25th percentile.

2. **Second Quartile (Q2):** This is the median of the dataset and represents the middle 50%. The value at the boundary between the second and third quartiles is also the 50th percentile.

3. **Third Quartile (Q3):** This contains the next 25% of the scores, excluding the highest values. The value at the boundary between the third and fourth quartiles is the 75th percentile.

4. **Fourth Quartile (Q4):** This includes the highest 25% of the scores.

Appendix 1:

List of indicators under Liveability sustainability and economic ability of Indian cities study

Domain	Sector	Indicator	Unit	Description (Formula)
Quality of Life	Education	Avg. Household expenditure on education	Percentage	(Average annual household expenditure on education / Average annual household expenditure)*100
		Literacy Rate	Number	Rate from Census
		Teacher-Pupil Ratio at the Primary Level	Ratio	Teachers teaching in grade 1-5 / Students enrolled in grade 1-5
		Teacher-Pupil Ratio at the Upper Primary Level	Number	Teachers teaching in grade 6-8 / Students enrolled in grade 6-8
		Dropout rate from grade 8-10 for the academic year 2018-19 (public and private)	Number	Dropout rate from grade 8-10 for the academic year 2018-19 (public and private)
		Schools with access to Digital Education	Percentage	(Schools with access to digital education / Schools (Grade 1 to 10) in the city)*100
		Professionally Trained Teachers	Percentage	(Teachers (permanent as well as contractual) that are B.Ed or equivalent teaching in grade 1-8 / Teachers (permanent as well as contractual) teaching in grade 1-8)*100
		National Achievement Survey Score	Number	
	Health	Avg. Household Expenditure on Health	INR	Average annual household expenditure on healthcare / Average annual household consumption expenditure

Quality of Life	**Health**	Availability of Healthcare Professionals	Per Lakh of Pop.	(Accredited healthcare activists + Multipurpose healthcare workers + Registered dentists + Registered doctors (Allopathic) + Registered doctors (AYUSH) + Registered licensed pharmacists + Registered trained nurses) * 100k/ Population
		Accredited Public Health Facilities	Percentage	(Accredited public facilities (primary, secondary and tertiary) with accreditation certificates by a standard quality assurance program (NQAS/NABH/ISO/AHPI) / Total number of public health facilities) * 100
		Availability of Hospital Beds	Per Lakh of Pop.	Number of hospital beds * 100k / Population
		Prevalence of Diseases	Per Lakh of Pop.	(Reported cases of dengue & malaria * 100k) / Population
	Housing & Shelter	Households with Electrical Connections	Percentage	(Authorized electrical connections / Number of Households) * 100
		Beneficiaries under PMAY	Percentage	(Beneficiaries under the PMAY scheme / Eligible applicants under PMAY) *100
		Slum Population	Percentage	(Total number of people residing in slums / Population)*100
	WASH & SWM	Deviation of Total Water supplied from Service-Level Benchmark	lpcd	Average water supplied - Service Level Benchmark (135)
		Households with Piped Water Supply	Percentage	(Number of households covered with piped water connections / Number of households) * 100
		Swachh Survekshan Score	Number	
		Wastewater Treated vs Wastewater Generated	Percentage	(Amount of wastewater treated / Amount of wastewater generated) *100

Quality of Life	**WASH & SWM**	Households Connected to Sewerage Network	Percentage	(Number of households connected to sewerage network / Number of households)*100
		Coverage of Stormwater Drainage Network	Percentage	(Length of covered stormwater drains / Total road length)*100
	Mobility	Availability of Public Transport	Per Lakh of Pop.	(Seats in public transport buses or bus equivalent run/operated by the city*100k) / Population
		Transport related Fatalities	Per Lakh of Pop.	(Fatalities recorded due to road accidents * 100k) / Population
		Footpath Length	Percentage	(Footpath Length / Road Length)*100
		Road Infrastructure	per metre	Road Length of City / Area of City
	Safety & Security	Prevalence of Violent Crime	Per Lakh of Pop.	(Culpable homicides + Dowry deaths + Foeticides and infanticides + Grievous hurt cases + Kidnapping and abductions + Murders + Riots and Arson + Attempt to Murder)*100k / Population
		Extent of Crime Recorded Against Women	Per Lakh of Pop.	Crimes recorded (FIRs) against women *100k / Population
		Extent of Crime recorded against Children	Per Lakh of Pop.	Crimes recorded (FIRs) against children *100k / Population
		Extent of Crime recorded against Elderly	Per Lakh of Pop.	Crimes recorded (FIRs) against elderly *100k / Population
	Recreation	Share of Total Area of Cities that is Open Space for Public Use	Percentage	(Open area available for public use / Area of city)*100
		Availability of : a. Music, Dance and Drama Centre/ Theatres b. Community Halls c. Restaurants d. Cinema Halls (Number of Screens)	Per Lakh of Pop.	(Music, Dance and Drama Centre/Theatres + Community Halls + Restaurants + Cinema Halls (Number of Screens) * 100k / Population

Economic Ability	Level of Economic Development	Traded Clusters	Number	Number of manufacturing units / Population
		Cluster Strength	Number	Composite score depicting the productivity of manufacturing units in the city
	Economic Opportunities	Credit Availability	Per Lakh of Pop.	Score calculated of (Amount of credit disbursed by banks) branches)
		Incubation & Skill Development Centres	Per Lakh of Pop.	(Total number of incubation centres & skill development centres * 100k) / Population
Sustainability	Environment	Water Quality: Samples Tested that Met CPCB Norms	Percentage	(Samples that met CPCB Norms for assessment of water quality in public surface water bodies / Samples tested)*100
		Area Under Green Cover	Percentage	(Area under green cover / Total area of city)*100
		Households with LPG/PNG connections	Percentage	(Number of households with LPG/PNG connections / Number of Households)*100
		Properties with functional rainwater harvesting structures	Percentage	(Properties with functional rainwater harvesting structures / Total number of properties)*100
		Air Quality	Number	Annual mean concentration of NO2 & PM2.5 & PM10 & SO2/ 4
	Green Building	Has the city implemented any measures that are aimed at incentivizing green buildings?	Number	Has the city implemented any measures that are aimed at incentivizing green buildings?
		Buildings that have received green ratings from green building rating/certification agencies	Percentage	(Buildings that have received green ratings from green building rating/certification agencies / Total number of properties in the city)*100
	Energy Consumption	Energy Demanded vs Energy Supplied	Percentage	((Energy consumed - Energy demanded)/ Energy demanded)*100

Sustainability	Energy Consumption	Energy Consumed from Renewable Resources	Percentage	(Energy consumed from renewable sources / Energy consumed)*100
		Sustained electrical interruptions	Number	Number of Sustained (> 5 minutes), scheduled electrical interruptions
	City Resilience	Disaster Management Plan	Number	a. Does the city have a disaster management plan in place? b. Is the city DP is in compliance with the NDMP and DDMP? c. Have you mapped all the identified risk areas in the city?
		Disaster Management Preparedness	Number	a. Are Early Warning Systems (EWS) in place for hazards? b. Have response teams (e.g. fire stations, police, ambulances) been identified and prepared for disasters?
		Population Affected by Disasters	Percentage	((Deaths due to disasters + Person directly affected due to disasters) / Population)*100

Appendix 2: Indicator Treatment

List of indicators under Liveability sustainability and economic ability of Indian cities study

Sub - pillar	Indicator	Unit	Indicator Description	Indicator Treatment
Energy Consumption	Energy Consumed from Renewable Resources	Percentage	(Energy consumed from renewable sources / Energy consumed)*100	Missing value - Minimum Value national level Maximum value – capped with 100
Energy Consumption	Sustained electrical interruptions	Number	Number of Sustained (> 5 minutes), scheduled electrical interruptions	Missing value - Minimum Value national level
City Resilence	Disaster Management Plan	Number	a. Does the city have a disaster management plan in place? b. Is the city DP is in compliance with the NDMP and DDMP? c. Have you mapped all the identified risk areas in the city?	AW , NF , NA - awarded zero

City Resilence	Disaster Management Preparedness	Number	a. Are Early Warning Systems (EWS) in place for hazards? b. Have response teams (e.g. fire stations, police, ambulances) been identified and prepared for disasters?	AW , NF , NA - awarded zero
Environment	Water Quality: Samples Tested that Met CPCB Norms	Percentage	(Samples that met CPCB Norms for assessment of water quality in public surface water bodies / Samples tested)*100	Missing value - Minimum Value national level
Environment	Area Under Green Cover	Percentage	(Area under green cover / Total area of city)*100	Missing value - Minimum Value national level
Environment	Households with LPG/ PNG connections	Percentage	(Number of households with LPG/PNG connections / Number of Households)*100	Missing value - Minimum Value national level
Environment	Properties with functional rainwater harvesting structures	Percentage	(Properties with functional rainwater harvesting structures / Total number of properties)*100	Missing value - Minimum Value national level
Environment	Air Quality Index	Number	Annual mean concentration of NO2 & PM2.5 & PM10 & SO2/ 4	Definition revised with deviation from Missing value filled - with national average for each sub indicator before calculating score using PCA : and value is calculated as deviation from permissable cpcb guidelines for concentration , weightage identified & score given refer sheet of air quality
Green Building	Has the city implemented any measures that are aimed at incentivizing green buildings?	Number	Has the city implemented any measures that are aimed at incentivizing green buildings	AW , NF , NA - awarded zero

Green Building	Buildings that have received green ratings from green building rating/certification agencies	Percentage	(Buildings that have received green ratings from green building rating/certification agencies / Total number of properties in the city)*100	National average for missing city
Education	Avg. Household expenditure on Education	Number	Average Annual HH Expendiure on education	National average for missing city
Education	Literacy Rate	Percentage	Literacy rate as per 2011 Census	National average for missing city
Education	PTR Ratio at the Primary Level	Ratio	PTR Ratio at the Primary Level	National average for missing city
Education	PTR Ratio at the Upper Primary Level	Ratio	PTR Ratio at the Upper Primary Level	National average for missing city
Education	Dropout rate from grade 8-10 for the academic year 2018-19 (public and private)	Per Lakh of Pop.	Dropout rate from grade 8-10 (public and private)	National average for missing city
Education	Schools with access to Digital Education	Percentage	Schools with access to Digital Education	National average for missing city
Education	Professionally Trained Teachers	Number	Professionally Trained Teachers	National average for missing city
Education	National Achievement Survey Score	Percentage	NAS	National average for missing city
Health	Avg. Household Expenditure on Health	Number	Average annual household expenditure on healthcare / Average annual household consumption expenditure	National average for missinsg city
Health	Availability of Healthcare Professionals	Per Lakh of Pop.	(Accredited healthcare activists + Multipurpose healthcare workers + Registered dentists + Registered doctors (Allopathic) + Registered doctors (AYUSH) + Registered licensed pharmacists + Registered trained nurses) * 100k/ Population	Missing value - Minimum Value national level

Health	Accredited Public Health Facilities	Per Lakh of Pop.	(Accredited public facilities (primary, secondary and tertiary) with accreditation certificates by a standard quality assurance program (NQAS/NABH/ISO/AHPI) / Total number of public health facilities) * 100	Missing value - Minimum Value national level
Health	Availability of Hospital Beds	Per Lakh of Pop.	Number of hospital beds * 100k / Population	Missing value - Minimum Value national level
Health	Prevalence of Diseases	Per Lakh of Pop.	(Reported cases of dengue & malaria * 100k) / Population	Missing value - Minimum Value national level
Housing and Shelter	Households with Electrical Connections	Percentage	(Authorized electrical connections / Number of Households) * 100	Missing value - Minimum Value national level
Housing and Shelter	Beneficiaries under PMAY	Percentage	PMAY houses constructed / houses sanctioned	Capped highest value to 100
Housing and Shelter	Slum Population	Percentage	(Total number of people residing in slums / Population)*100	Category average
Wash & SWM	Deviation of Total Water supplied from Service-Level Benchmark	Number	Average water supplied - Service Level Benchmark (135)	Missing value – National average
Wash & SWM	Households with Piped Water Supply	Percentage	(Number of households covered with piped water connections / Number of households) * 100	Missing value - Minimum Value national level
Wash & SWM	Swachh Survekshan Score	Score	Swachh Survekshan Score	Missing value - Minimum Value national level
Wash & SWM	Wastewater Treated vs Wastewater Generated	Percentage	(Amount of wastewater treated / Amount of wastewater generated) *100	Missing value - Minimum Value national level
Wash & SWM	Households Connected to Sewerage Network	Percentage	(Number of households connected to sewerage network / Number of households)*100	Missing value - Minimum Value national level

Wash & SWM	Coverage of Stormwater Drainage Network	Percentage	(Length of covered stormwater drains / Total road length)*100	Missing value - Minimum Value national level
Recreation	Share of Total Area of Cities that is Open Space for Public Use	Percentage	(Open area available for public use / Area of city)*100	Missing value - Minimum Value national level
Recreation	Availability of : a. Music, Dance and Drama Centre/Theatres b. Community Halls c. Restaurants d. Cinema Halls (Number of Screens)	Per Lakh of Pop.	(Music, Dance and Drama Centre/ Theatres+ Community Halls + Restaurants + Cinema Halls (Number of Screens) * 100k / Population	Missing value - Minimum Value national level
Mobility	Public Transport seats	Per Lakh of Pop.	(Seats in public transport buses or bus equivalent run/operated by the city*100k) / Population	Missing value - Minimum Value national level
Mobility	Road accident fatalities	Per Lakh of Pop.	(Fatalities recorded due to road accidents * 100k) / Population	Missing value - Minimum Value national level
Mobility	Footpath length coverage	Percentage	(Footpath Length / Road Length)*100	Missing value - Minimum Value national level
Mobility	Road length coverage	Percentage	Road Length of City / Area of City	Category average
Safety and Security	Prevalence of Violent Crime	Per Lakh of Pop.	(Culpable homicides + Dowry deaths + Foeticides and infanticides + Grievous hurt cases + Kidnapping and abductions + Murders + Riots and Arson + Attempt to Murder)*100k / Population	Missing Value imputation Category wise- Highest value for each indicator as negative
Safety and Security	Extent of Crime Recorded Against Women	Per Lakh of Pop.	Crimes recorded (FIRs) against women *100k / Population	Missing Value imputation Category wise- Highest value for each indicator as negative
Safety and Security	Extent of Crime recorded against Children	Per Lakh of Pop.	Crimes recorded (FIRs) against children *100k / Population	Missing Value imputation Category wise- Highest value for each indicator as negative

Safety and Security	Extent of Crime recorded against Elderly	Per Lakh of Pop.	Crimes recorded (FIRs) against elderly *100k / Population	Missing Value imputation Category wise- Highest value for each indicator as negative
Economic Opportunities	MSME density	Number per capita	MSME at cities level calculated - MSMEs = MSMEs in districts *(city population / district population)	Category average
Economic Opportunities	Cluster Strength	Number	Composite score depicting the productivity of manufacturing units in the city	Category average
Economic Opportunities	Credit Availability	Per Lakh of Pop.	Score calculated of (Amount of credit disbursed by banks) branches)	Category average
Economic Opportunities	Incubation & Skill Development Centres	Per Lakh of Pop.	(Total number of incubation centres & skill development centres * 100k) / Population	Category average