Original Research Article

URBAN SUSTAINABILITY INDEX:

MEASURING PERFORMANCE OF 15 METROPOLITAN CITIES OF INDIA

ABSTRACT

Around the world, sustainable development has become a top policy discussion as countries struggle to maintain or enhance economic growth without compromising the future. Nowhere is the issue more pressing than in India, where urban areas and their economies are expected to grow rapidly over the next few decades and where resource use and environmental quality are already raising grave concerns. Sustainable development, economic growth that improves the lives of the people without exhausting the environment or other resources, is especially critical in developing countries, where mass urbanization is taking place at a time when man's impact on the environment has reached a critical juncture. The study investigates if the present pattern of urban development in India in the creation of mega cities is sustainable. The indicators represent a primary tool to provide guidance for policy makers and to potentially assist in decision-making and monitoring local strategies/plans. The outcome of the study will contribute to the design of policies, tools, and approaches essential for planning to attain the goal of sustainable development and the social cohesion of metropolitan regions.

Keywords: Affordability, Environment, Sustainable Development, Urban Sustainability Index.

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1. INTRODUCTION

India is growing fast. Economic reforms and policies have already unleashed investment and growth is offering its citizens rich opportunities. Although the Indian economy has been resilient so far, the key issue now is how to sustain this momentum. Turning around its cities and releasing their dynamism will be critical to India's future economic growth.

Unlike many countries that are grappling with aging populations and rising dependency ratios, India has a young and rapidly growing population - a potential demographic dividend. A study conducted by McKinsey Global Institute claims that cities could generate 70% of net new jobs created to 2030, produce more than 70% of Indian GDP, and drive a near 4x increase in per-capita incomes across the nation.[1]

- **5 times - India's GDP** is expected to increase by 2030
- **590 million people** will be living in cities
- **270 million net increase** in working-age population
- **70% of net new employment** would be generated in cities
- **91 million urban households** would be middle class, up from 22 million people today
- **68 cities** will fall in the million+ category, up from 53 today
- **$1.2 trillion investment** is required to meet the projected demand of Indian cities
- **30 rural dwellers**, shift to cities every minute
- **800 million m^2 of residential** & commercial space needs to be built
- **1/3rd of the urban population** will face the affordable housing challenge by 2025
- **7400 KMs of metros & subways** need to be constructed, 20 times the capacity added in last decade

Urbanisation is now commonly regarded as one of the most important social processes and has enormous impact on the environment at local,

[1] McKinsey Global Institute 2010: India's urban awakening - Building inclusive cities, sustaining economic growth

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regional and global scales. It is now widely acknowledged that the impact of urbanisation will continue to bring about major global and local changes in economic, environmental and social arenas.

Around the world, sustainable development has become a top policy discussion as countries struggle to maintain or enhance economic growth without compromising the future. The issue is most pressing in India and China, where resource use and environmental quality are already raising grave concerns. Fortunately, national and local leaders have responded to the challenge by making sustainable development a high priority.

Sustainable development, economic growth that improves the lives of the people without exhausting the environment or other resources, is especially critical in developing countries, where mass urbanization is taking place at a time when man's impact on the environment has reached a critical juncture. Because of the exceptional growth rates they are witnessing, cities in the developing world are the focal point of this struggle for sustainable growth.

The main aim in this study is to investigate if the present pattern of urban development in India in the creation of mega cities is sustainable. This is proposed to be done by performing an indicator-based evaluation of 15 most populous cities of India against international benchmarks and for the purpose we chose Copenhagen, honoured as the Most Sustainable City of the World.

Using a new metric, the **Urban Sustainability Index**, we've found mixed results for this nascent effort. While India's current model of urban growth does not meet global benchmarks for sustainability, but there are positive examples of sustainable development that could be copied elsewhere in India. Without doubt, most cities in India lag those in developed countries across most measures of sustainability, though many are showing positive trends and are trying to improve.

1.1. A Tale of 100 Smart Cities:

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The new Government's agenda is to build 100 Smart Cities in India. It is a monstrous ambition that is fast becoming a social and economic imperative as at least 50 per cent of Indians are set to live in urban areas by 2050, as against just 32 per cent today. India must provide for these 814 million people in cities with minimum disruption and least chaos. The existing cities have failed to do so for lack of focus or planning. Rs.40 L Cr of investments required to build basic infrastructure, including transport, water and sanitation, in all urban areas, including 500 cities and smart cities.

Benchmarks[2]:

- Availability of high frequency mass rapid transport system **within 800 m** of areas having 175 persons/ha or higher density, **connecting 95%** of employment, institutional and public services
- **135 L of per capita** supply of water to **100% households** with 24x7 direct supply
- **100% households** should have access to **toilets**
- **100% efficiency** in the collection & treatment of **waste water**
- **100%** collection, segregation & recycling of **solid waste**
- **100% households** have electricity, telephone & wireless internet
- **100% access** to telemedicine facilities, **30 mins. emergency** response time, **500 beds hospital** per lakh population
- **1 school** per lakh & **1 college** per 10 lakh population
- Adherence to **green building norms**, rainwater harvesting, rooftop solar- panels

2. OBJECTIVE

The objectives of the study are:

a. creating an urban sustainability index covering all the relevant sectors of a typical city
b. establishing a benchmark indicator base from a benchmark city

[2] http://indiansmartcities.in/downloads/Benchmarks_for_Smart_Cities1.pdf

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c. develop a database for the 15 cities selected for the study using similar methodology
d. comparing and evaluating the indicators with benchmark indicators using gap analysis approach
e. comparing the cities among themselves and with the benchmark city

The remainder of this report will look in more detail at the components of the Urban Sustainability Index. In this context the social, economic, physical and environmental sub-systems of an urban system will be studied and analyzed.

3.LITERATURE REVIEW

There is considerable overlap between aspects of social sustainability and concepts like 'sustainable community', Such communities are widely envisaged to provide a setting for long-term human activity and interaction that is equitable, inclusive and sustainable in the broader sense of the term (economically and environmentally as well as socially). Dempsey et al., (2011) examines the underlying principles of social sustainability and their interpretation and provides a definition of social sustainability with particular reference to the British urban context.

Seyfang (2011) studied the community action for sustainable housing with the view point of constructing buildings with low-carbon emission. Seyfang addressed this problem by investigating the scope and potential of a previously unsearched sustainable housing initiative, to contribute to building low-carbon, sustainable communities.

Singh and Pandey (2012) forecasted the urban growth of India for the year 2050 if, sustainable housing is adapted. They studied that India will be the most populous country, with a projected population of 1.69 billion, compared with China's 1.30 billion.The model results for India shows on average a 4.84% urban land expansion growth rate with 30% from

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population growth and around 23% from growth in GDP per capita for the period 1970 to 2000.

Chakrabarty (2001) analyzed the urban crisis of India and suggested the new initiatives required to be adapted to attain sustainable cities in India. He inferred in this study that the unplanned and uncontrolled growth of large cities has had negative effects on urban dwellers and their environment.

Ding G.K. (2008) *Sustainable construction—the role of environmental assessment tools*, an overview of environmental building assessment methods: Building designers and occupants have long been concerned about building performance. Separate indicators, or benchmarks based on a single criterion, have been developed to monitor specific aspects of environmental building performance such as air quality and indoor comfort. The building research establishment environmental assessment method (BREEAM) in 1990 was the first such comprehensive building performance assessment method. It was the first environmental building assessment method and it remains the most widely used. The BREEAM system has been constantly updated and extended to include assessment of such buildings as existing offices, supermarkets, new homes and light industrial buildings. An environmental building assessment method reflects the significance of the concept of sustainability in the context of building design and subsequent construction work on site. It provides a way of structuring environmental information, an objective assessment of building performance, and a measure of progress towards sustainability.

The academic perspective on policy & practice in India of affordable housing, has been examined and it starts with the question that why is Affordable Housing Important? First is the progressive urbanization hand in hand with a growing urban population, from 109 million in 1971 to 377 million in 2011 toward a whopping 600 million by 2030. Second, rising incomes have led to the expansion of the middle class. This has led to a spike in demand for housing that is affordable but also includes basic

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amenities. Third, the real estate sector is a major component of Indian economy. At Rs.170 crores, it has contributed 4.5 percent crore in India's GDP and employed 7 percent of the urban workforce in 2006-07. Housing is the largest component of the financial sector and construction sector as well.

Mahadevia, D. (2002) *Sustainable urban development in India: An inclusive perspective,* Mahadevia emphasises that the move towards a 'sustainable city' has to be an 'inclusive approach' based on 4 pillars:

- environmental sustainability;
- social equity;
- economic growth with redistribution
- political empowerment of the disempowered.

This holistic approach incorporates all dimensions of development, including the interests of the poor and the disempowered. It would challenge the existing unequal systems, from global to local that have led to unsustainable development.

Reddy and Balanchandra (2013) *Benchmarking Urban Sustainability - A Composite Index for Mumbai and Bangalore,* the study involving Mumbai and Bangalore and three other megacities for comparison demonstrates the value of benchmarking and provides a better understanding of the practical and data-related aspects of benchmarking cities for sustainability. The study demonstrates the value of these comparisons in the context of four dimensions - economic, environmental, social and governance. Measuring the sustainability of urban regions poses many challenges. It must be noted that the selection of indicators should be done with the clear understanding of the needs where these are going to be applied.

Sustainability issues are inherently interconnected, and any approach that needs implementation requires the administration to think across various sectors, viz., housing, transportation, education and workforce, and energy policy and act collaboratively to construct feasible sustainability plans.

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The Urban Sustainability Index: A New Tool for Measuring China's Cities, Analysis using the Urban Sustainability Index and subsequent field visits has shown that some Chinese cities are making clear strides toward sustainable development. Their success is based not only on execution capabilities, but on an unwavering focus on industrial restructuring, designing sensible transit systems and green space, pushing improvements through standards, monitoring and pricing, and exploring ways to make industries more resource efficient. The best performing cities displayed a clear, long-standing commitment to achieve their sustainable 'vision'. However, no deterministic relationship between economic growth and performance on our Index, our research exposed an unmistakable opportunity for other cities in China to learn from the practices of their better-performing peers.

World Bank (2013) *Urbanisation beyond Municipal Boundaries: Nurturing metropolitan economies and connecting peri-urban areas in India,* India's policy makers may want to pay immediate attention to three priority areas as they try to harness economic efficiency and manage spatial equity associated with urbanization. **First,** to enhance productivity, invest in the institutional and information foundations to enable land and housing markets to function efficiently, while deregulating the intensity of land use in urban areas. **Second,** to improve liveability, rationalize the rules of the game for delivering and expanding infrastructure services, such that providers can recover costs yet reach out to poorer neighbourhoods and peripheral areas. **Third,** for better mobility, invest in improving connectivity between metropolitan cores and their peripheries, as these are the areas that will attract the bulk of people and businesses over the medium term.

Land policy, infrastructure services, and connectivity—integrated improvements in this triad can help India reap dividends from improved spatial equity and greater economic efficiency that comes with urbanization.

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4. METHODOLOGY

4.1. Measuring Sustainability

The Urban Sustainability Index was created to fill a gap in current analysis of sustainable development. In recent years, there have been many efforts designed to compare economic growth and environmental sustainability.[3]

Table 1: Various definitions of sustainability

NAME	DEFINITION	DATASOURCE
Bruntland Report	Meeting the needs of the present generation without compromising the ability of future generations to meet their needs	World Development Report 1984
SustainLane	Maintaining standards of living & structural preparedness to meet the environmental challenges of an uncertain future	U.S. Census Bureau, surveys & interviews
UN	The integration of economic, social and environmental issues in decision and policy making	National publicly available data
World Bank	No explicit definition, but implicitly defined by a selection of indicators used to measure sustainability	Self-reported data on website with city member enrolment
OECD	Competitive green growth as defined through considerations of urban form, lifestyle and energy sources	Various development and multilateral agencies
Siemens	Acting responsibly on behalf of future generations to achieve economic, environmental and social progress	National statistics, city authorities, national environmental bureaus
Yale - Columbia	Society's capacity to improve its environmental performance over time	WHO; Experts from Yale and Columbia
National	Greenness as defined by household carbon	Chinese statistical

[3] McKinsey Global Institute 2013: The Urban Sustainability Index: A New Tool for Measuring China's Cities

Bureau of Economic Research, China	emissions	yearbooks

Little work is available to measure the sustainability of developing country cities, where the challenge is most acute. In Urban Sustainability Index an attempt is made to address this gap. Selected indicators are worked upon that are more readily available in developing economies and more relevant. For example, the index looks at basic needs such as water availability, which varies widely in developing countries, but would be near universal in developed economies.

4.2. The Urban Sustainability Index – Scope

The Urban Sustainability Index (USI) is designed to measure relative performance over time of Indian cities across a common set of sustainability categories. A comprehensive 4-part definition of sustainable development encompassing 15 individual indicators is composed to gauge not only the environmental sustainability of the cities being analysed, but also the level of services required to handle a growing urban population and each city's resource efficiency. These indicators represent the best set of data for commonly accepted indicators that are available in India from both national and local sources.

The Index measures a city's performance against 4 aspects that are critical to sustainable development:

Basic Needs: Decent income for a good standard of living, affordable living space, adequate healthcare and education are priority needs that help sustain an urban population.

Resource Efficiency: Low carbon emissions, efficient use of water & energy and high gross domestic output contribute to better functional resource management, providing overall benefits.

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Environmental Health: Lessening exposure to harmful pollutants and heightening water treatment and waste management efficiency helps induce cleaner and healthier urban environments.

Built Environment: Increased liveability and efficiency of communities comes with equitable access to green space and public transportation, as well as efficient population distribution.

Table 2: 4 part index of urban sustainability

CATEGORY	DEFINITION	INDICATORS	DESCRIPTION
BASIC NEEDS	Able to sustain a decent standard of living	Housing Affordability	Affordability index (n)
		Income	Per-capita income ($)
		Education	Literacy rates (%)
		Healthcare	Healthcare access (n)
RESOURCE EFFICIENCY	Efficient management of fundamental resources	Power	Electricity consumption MU/GDP ($)
		Water supply	Per-capita water supply (lit/day)
		Output	GDP/km^2
		GHG Emissions	CO2 kTons/GDP($)
ENVIRONMENTAL CLEANLINESS	Cleaner air, water & lesser solid waste	Air Pollution	Concentration of SOx, NOx & PM10 ($\mu g/m^3$)
		Sewage Treatment Rate	Waste water treatment capacity (%)
		Waste Management	Per-capita domestic waste collected & treated

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			(kg/day, %)
BUILT ENVIRONMENT	Density, transit orientation, green space	Population Distribution	Persons/km^2
		Mass Transit Accessibility	Accessibility index (n)
		Public Green Space	Per-capita green space (m^2)

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275 **The Cities**

276 The following cities of India have been selected on the basis of their
277 population as per 15th Census of India, 2011. Due to limitations forced
278 upon by unavailability of data and time, the number of cities have been
279 restricted to 15, the top ones when sorted according to population.

280 Table 3: Selected 15 cities for the study

#	CITY	STATE	POPULATION 2011
1	**Mumbai**	Maharashtra	18414288
2	**Delhi**	National Capital Region	16314838
3	**Kolkata**	West Bengal	14112536
4	**Chennai**	Tamil Nadu	8696010
5	**Bengaluru**	Karnataka	8499399
6	**Hyderabad**	Telangana	7749334
7	**Ahmedabad**	Gujarat	6352254
8	**Pune**	Maharashtra	5049968
9	**Surat**	Gujarat	4585367
10	**Jaipur**	Rajasthan	3073350
11	**Lucknow**[4]	Uttar Pradesh	2901474
12	**Nagpur**	Maharashtra	2497777
13	**Indore**	Madhya Pradesh	2167447
14	**Coimbatore**	Tamil Nadu	2151466

[4] Failing to gather data and very close proximity both in distance and data, Kanpur is skipped from the list.

15	**Kochi**	Kerala	2117990

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282 **4.3. Framework**

283 In real-life situations, indicator values have different measurement units
284 (income in local currencies, electricity in KWh, etc.). For developing
285 composite indicators, it is essential to transform the values of all these
286 indicators into some standard form. Thus, for each of the indicator included
287 in the analysis, a relative indicator is estimated using the actual and the
288 sustainability threshold values. For each indicator, a minimum and
289 maximum threshold value will be determined. The relative indicator is
290 developed using a scaling technique where the minimum value is set to 0
291 and the maximum to 1.

292 The equation used for this is:

$$Relative\ Indicator = \frac{Actual\ Value - Minimum\ Value}{Maximum\ Value - Minimum\ Value}$$

293 *…equation (1)*

294 This Relative indicator is referred to as '*Dimension Index'*.

295 The next step is to derive the composite indicator dimensions from
296 appropriate indicators belonging to that particular dimension. There are
297 two ways to develop the composite indicator dimensions. One is to use the
298 weights of the indicators in relation to a given dimension and combine the
299 indicators to form a composite indicator dimension. The other is where the
300 indicator weights are not available, the composite dimension index is
301 computed as the root mean square of the relative indicator variables
302 belonging to that particular dimension.

303 The equation used is as follows:

$$D_j = \sqrt{\frac{\sum_i V_{ij}^2}{i}}$$

304 *… equation (2)*

305 where, D_j = Dimension of type '*j*'

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V_{ij} = Variables '*i*' belonging to dimension '*j*', i = 1, 2, …, I

I = Number of variables in a dimension

The Urban Sustainability Index can be computed using the above mentioned formula for each city.

4.4. Creating Circles of Sustainability

As stated, the indicators of sustainability for each of the dimensions that is being determined for the 15 cities will be compared with the benchmark indicators from a few selected cities of the world (discussed next). The maximum and minimum values are derived from the best and the worst values obtained for a given indicator by those cities. Then, the standardized indicator dimensions for the specific study city (one of the 15) and the sustainable city will be mapped on a radar diagram. The distance between the two points of a given dimension for the two cities gives the prevailing gap. The dimension gaps for the study city suggest how far they are from achieving the level of a benchmark sustainable city, and also provide insights into the dimensions seriously lacking. Thus, the quantified gaps in dimensions as well as individual indicators can provide greater insights into the reasons for the existence of such sustainability gaps, targets that need to be fixed to bridge them and strategies that need to be adopted for achieving these targets.

For the present study, the indicator data were gathered mainly from secondary sources of information such as journal papers, reference books, government reports, project reports, websites of concerned government departments and ministries, websites related multilateral agencies and variety of databases from the internet.

4.5. The Benchmark Cities

For the purpose of obtaining maximum and minimum values, we select the cities Beijing, China and Copenhagen, Denmark. Reason for choosing these

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two cities is obvious – Copenhagen[5] has the honour of being called as the most sustainable city of the world, thanks to the government efforts and mass awareness and on the other hand, Beijing[6] which is notorious for being one of the most polluted cities in the world owing to its massive industrialisation and urbanisation.

5. RESULTS

5.1. Profile of the selected Cities:

Here a comparison is made of each city against Copenhagen and along with that maximum values obtained from India, irrespective of cities, and average value of all indices across cities is shown in the radar diagrams.

4-point radar

- Copenhagen (COP) = Blue line
- India Maximum (MAX) = Yellow line
- City = Green Line

14-point radar

- India average (AVG) = Lighter shade of Green
- India Maximum (MAX) = Medium shade of Green
- City = Dashed & bold, dark Green Line

Post city profiles, all the cities are depicted in one graph for each parameter. These diagrams are useful for inter-city comparison of specific indicators.

5.2. City performance by Index

Table4:City performance by Index.

CITY	CODE	USI	RANK
Mumbai	MUM	53.06	1
Delhi	DEL	43.64	11

[5] http://www.siemens.com/entry/cc/features/greencityindex_international/all/en/pdf/report_en.pdf
[6] http://edition.cnn.com/2013/01/14/world/asia/china-smog-blanket/index.html

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Kolkata	KOL	52.86	2
Chennai	CHE	52.02	3
Bengaluru	BEN	48.33	5
Hyderabad	HYD	43.07	12
Ahmedabad	AHM	44.59	9
Pune	PUN	42.57	14
Surat	SUR	44.18	10
Jaipur	JAI	48.37	4
Lucknow	LUC	45.17	8
Nagpur	NAG	47.06	7
Indore	IND	38.33	15
Coimbatore	COI	42.80	13
Kochi	KOC	48.26	6
Copenhagen	COP	86.06	-
India Average	AVG	46.29	-

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360 Table 5: City wise Composite Indices

PARAMETERS	**MUM**	**DEL**	**KOL**	**CHE**	**BEN**
URBAN INFRASTRUCTURE	43.46	49.62	61.38	59.67	63.57
ENVIRONMENTAL CLEANLINESS	45.71	24.76	28.53	36.90	39.27
RESOURCE EFFICIENCY	69.08	54.12	60.55	50.92	40.62
BASIC REQUIREMENTS	50.11	40.16	54.13	57.52	45.93
	HYD	**AHM**	**PUN**	**SUR**	**JAI**
URBAN INFRASTRUCTURE	47.68	37.06	38.25	45.75	61.73
ENVIRONMENTAL CLEANLINESS	43.84	46.97	40.77	41.28	36.94
RESOURCE EFFICIENCY	42.21	49.83	40.33	43.87	48.24
BASIC REQUIREMENTS	37.99	43.46	49.98	45.68	43.09

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	LUC	**NAG**	**IND**	**COI**	**KOC**
URBAN INFRASTRUCTURE	56.55	55.54	44.71	53.10	65.18
ENVIRONMENTAL CLEANLINESS	40.76	43.77	37.36	34.32	42.47
RESOURCE EFFICIENCY	41.08	43.56	34.07	40.29	25.18
BASIC REQUIREMENTS	40.19	44.30	36.33	41.30	51.28

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365 Table 6: Benchmarks

PARAMETER	**CODE**	**MAX**	**MIN**	**H/L**
Population Density (/KM^2)	DENS	22000	2700	L
Per-capita Income ($)	INCOM	60578	5004	H
GDP per Sq.KM ($/KM^2)	GDP/SQKM	484	25	H
CO2 Emissions/GDP (ton/mi$)	CO2/GDP	242	21	L
Sulphur Dioxide (µg/M^3)	SO2	90	3	L
Nitrogen Dioxide (µg/M^3)	NO2	130	13	L
Particulate Matter (µg/M^3)	PM10	250	11	L
Water Supply (MLD)	WATER	355	36	H
Sewage (MLD)	SEWAG	334.7	20	H
Waste Generation KG/capita	WASTE	0.84	0.15	L
Sewage Treatment Dummy	TREAT	8	0	H
Electricity Units/GDP (MU/mi$)	ELE/GDP	125	34.72	L
Public Transport Index	TRANS	5	0.25	H
Health Care Index	HEALT	600	50	H
Literacy Rate (%)	LITER	100	42	H
Housing Affordability Index	HOUSE	5	0.1	H
Per-capita Green Space (M^2)	GREEN	35.8	0.04	H

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6.DISSCUSSION

What follows is a quick summary of results respective of cities:

1. Mumbai

With an urban sustainability score of 53.06, Mumbai ranks on top of the 15 cities besides being one of the most populated city in the world, the financial capital of India manages to come at the top, owing to efficient usage of resources and high gross domestic product. Also, the per-capita air pollution, sewage treatment and waste management is good among the selected Indian cities. Mumbai has the lowest affordability in the country.

2. Delhi

A 43.64 score of urban sustainability makes the National Capital of India a below average performer. Delhi showed worst indices among Indian cities in terms of environmental cleanliness, no doubt it is called as the most polluted city in the world[7]. Delhi has the highest population (21.75 million), ahead of Mumbai, and 2nd highest GDP in the country but high levels of air pollutants and low levels of water & waste treatment makes it the most polluted city. Public transport systems in the city are good due to existence of Metro Rail.

3. Kolkata

2nd in terms of urban sustainability score (52.86) is the former capital of India. With a difference of 0.20 points than Mumbai, probably owing to lower environmental cleanliness, Kolkata stands at second position. The city showed best health care index, only after Chennai. The urban infrastructure of Kolkata is better than Mumbai or Delhi, because of relatively lesser population and larger area.

4. Chennai

The 4th largest metropolitan city of India, stands 3rd in urban sustainability (52.02) with just 1.04 points less than Mumbai. Overall Mumbai, Kolkata & Chennai, all 3 are the best performers among the selected Indian cities. The looking at the urban sustainability score of Copenhagen, Denmark at 87,

[7] http://www.bbc.com/news/magazine-32352722

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there's a long way to go. Chennai comes 1st when talking about basic requirements, as it shows highest per-capita income in the country due to a diverse industrial base.

5. Bengaluru

The silicon valley of India is an above average performer with an urban sustainability score of 48.33, it holds 5th position. Due to recent developments, Bengaluru has good urban infrastructure to accommodate its people. In the rest 3 factors, the city is an average performer.

6. Hyderabad

Hyderabad is a below average performer with a composite index value of 43.07. The city is bad when it comes to basic requirements, it has one of the lowest health care index. On the other hand, Hyderabad is doing well in environmental cleanliness, the sewage treatment rate is highest amongst all the cities and the level of pollution is also less than the other mega cities.

7. Ahmedabad

Ahmedabad is also a below average performing city with an urban sustainability score of 44.59. The city has the lowest number when considering urban infrastructure, most of it is because of high population density and poor public transportation facilities. This might change once the MEGA Metro Rail project comes into action. On the other hand, Ahmedabad has best environmental cleanliness index amongst the selected cities, surprisingly, ahead of Kochi.

8. Pune

Pune ranks second last, only ahead of Indore. The sustainability index of Pune is 42.57. With an unprecedented growth in migration due to increasing IT settlements in the city, the present urban infrastructure is not able meet the requirements. The public transportation accessibility index is worst among all the cities. Pune should fast move on to other faster modes of transportation like Metro Rail to keep up the pace. The city has decent score when it comes to meeting basic requirements, with good health care and per-capita income.

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9. Surat

The city of diamonds is below average performer with an index score of 44.18. The city does not show good score in any of the 4 dimensions except in urban infrastructure, where it is even lesser. The city's development authority has joined hands with Microsoft Corporation to jointly develop it as a Smart-city.

10. Jaipur

Although ranked 4th among the selected cities, Jaipur is a just above performer, with urban sustainability score of 48.37. Because of relatively lesser population, the city does well only in urban infrastructure index, in rest 3, it has average scores. Recently Metro Rail system has been launched in the city.

11. Lucknow

The capital city of Uttar Pradesh is just below average performer with an urban sustainability score of 45.17. It does slightly above average in urban infrastructure, whereas below average in basic requirements. Lucknow shows highest electrical energy requirements per unit of GDP which is bad, also it is the most affordable city among the selected 15. It has alarming high levels of PM10 pollutants in the atmosphere and poor sewage treatment ratio (right next to Delhi). The per-capita solid-waste generation is lowest for Lucknow

12. Nagpur

Nagpur manages to stay above average with an urban sustainability score of 47.06, it holds 7th position that way. The city is good in terms of environmental cleanliness; in the rest 3 dimensions it does average. Nagpur has lowest per-capita income among the selected city, due to low GDP.

13. Indore

With an exceptionally low score of 38.33, this city of Madhya Pradesh is the worst performer in terms of urban sustainability among all the selected cities of India. The credit goes to bad infrastructure facilities, poor usage of resources and above all not meeting the basic requirements. The city

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shows lowest value of healthcare index and poor public transport accessibility,

14. Coimbatore

Coimbatore has an urban sustainability score of 42.80, which holds it at last 3rd position. It has high electrical energy requirements per unit of GDP which is bad and high amount of per-capita solid-waste generation. The green cover per-capita value of the city is high.

15. Kochi

This city in *'Gods Own Country'* is a decent performer with an urban sustainability score of 48.26, ranked at number 6. The city is best in terms of urban infrastructure but is, bizarrely, the worst in resource efficiency. Not to mention that it does well above in other 2 dimensions. The city has highest literacy rate, highest green cover per-capita, remarkably low levels of air pollutants and lowest population density among the 15 cities. Now coming to darker side, it has highest value of per-capita solid waste generation and high electrical energy requirement per unit of GDP – which keeps it from being called the Copenhagen of India.

7.CONCLUSION

Subsequent analysis using the Urban Sustainability Index has shown that Indian cities are substantially lagging towards sustainable development. It is realised that the high performing cities or the mega-cities of the country are largely doing better than the smaller 'emerging' class of cities. But there still remains a long-standing commitment towards achieving the sustainable 'vision'. Moreover, a deterministic relationship between economic growth and performance based upon the index could not be established. The research exposed an unmistakable opportunity for other emerging cities in India to learn from the practices of their better performing peers, as well as successes further abroad. The challenge faced by rapidly growing cities in developing countries, especially in India and China, is enormous. Using the Urban Sustainability Index as a yardstick to measure success of cities in emerging markets will help highlight

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initiatives that work and can help other cities achieve sustainable development.

This study involving the 15 most populated cities of India and 2 other megacities of the world for comparison demonstrates the value of benchmarking and provides a better understanding of the practical and data-related aspects of benchmarking cities for sustainability. The study demonstrates the value of these comparisons in the context of four dimensions — basic necessities, efficient use of resources, environmental care and infrastructure. Although it is not an in-depth research of the urban performance of Indian cities, it is a relatively quick demonstration of using the existing data sets that benchmarking can be an effective tool in identifying areas for improvement.

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