The Smart City Mission in India: Has it addressed environmental considerations?

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Abstract. The second most urbanized nation globally, India encourages environmental sustainability through its various urban development initiatives. India is committed to COP21, aiming to reduce emissions by 30-35% by 2030 as compared to the 2005 emission levels of the country. One such important initiative has been launching the Smart City Mission by the Government of India in 2015. The paper highlights five smart cities selected in the first round of the brilliant city challenge across varied geographies New Delhi Municipal Council – Northern India, Bhubaneswar -Eastern India, Chennai – Southern India, Pune – Western India, and Bhopal – Central India. The paper assesses the environmental concerns of these cities. It reveals that besides the 5 towns, 35 additional smart cities are selected out of 100 that are ranked among the 336 globally most polluted cities, as per the Numbeo Pollution Index 2020 Mid-Year. The study further analyses the projects undertaken by the five towns, and it has been observed that the framework of the smart city is more tilted towards the Area Based Development (ABD) rather than the pan-city, with the ABD accounting for a minuscule area (1.41 percent)for the five selected cities. Further, with the projects and investments being concentrated in the ABD area, the study concluded that although environment-related projects have commenced and are a case of work in progress, it has not yet resulted in any significant measurable changes concerning the environment. The sample study undertaken by the researchers has gained essential insights from its limited framework. It assists in making pertinent recommendations that will help frame the new format of Smart City Mission II, taking significant strides to move towards sustainable urban development – keeping in mind the environmental consideration.

Key terms: Air Pollution, Air Quality, Environment Considerations, Smart City Mission, Urbanisation.

INTRODUCTION AND BACKGROUND OF THE STUDY

India is the second most urbanized country globally after China. The urban population is projected to rise to 600 million by 2031 [1], inching up from 377 million per the 2011 census, accounting for 31.2 percent of the total population. In 2019, India's urban population accounted for 472 million and 34.5 percent of the total population as per the[2]. There are 468 Class I Urban Agglomerates (U.A.) / towns that accounted for 70.2 percent of the urban population. In contrast, the 53 million-plus cities accounted for 42.6 percent of the urban population, showing a high concentration of people and urban being top-heavy concentrated in either the million-plus or Class I cities. The pace of urbanization in India for 2015-2031 is likely to increase at a Compound Annual Growth Rate (CAGR) of 2.1 percent, almost double China's growth rate[3].

In the context of ecology and environment, cities across the globe are known to consume 75 percent of the world's natural resources 80 percent of the world's energy. They account for 75 percent of global carbon emissions, resulting in significant greenhouse gas (GHG) emissions, with transport and building being among the leading contributors (UNEP, n.d.). In 2012, 81.3 percent of fossil fuels (oil, coal, and gas), 9.7 percent nuclear power, and only 9 percent renewable energy sources (such as hydro, wind, biomass, and solar) were the sources of global energy supply (UNHABITAT, n.d.). Since human activity is an outcome of enhanced urbanization, this can have a tremendous impact on climate change, putting cities at risk concerning extreme weather events such as floods, droughts, storms, and the increasing spread of tropical diseases.

According to [4], the data for global CO2 emissions places India at third rank with a 6.8 percent share of total emissions, with China and the U.S. accounting for 28.03 percent and 15.9 percent share, respectively. With the contribution of 7 percent to greenhouse gas emissions, India has already surpassed Russia, which has a share of 5 percent[4]. Further, concerning GHG emissions, India is the fourth largest emitter accounting for nearly 6.96 percent of global emissions [5]. Concerning tons of emission per capita, India substantially lags behind the other three top emitters - China, the U.S., and the E.U. with 2.44 tons of emission per capita due to a compromised quality of living of its large population. Further, with the rise in the emission of 67.1 percent in India from 1990 and 2012, and a 2030 growth projection of 85 percent [6], a business-as-usual scenario cannot be adopted. Therefore – some alternative strategies are required to be included to address such concerns.

DOI: 10.9756/INTJECSE/V14I4.369

TABLE 1. Top 10 World's Carbon Emitters (in metric tons CO_2)

Rank	**Country**	**MtCO_2**
1	China	10065
2	United States of America	5416
3	India	2624
4	Russian Federation	1711
5	Japan	1162
6	Germany	759
7	Italy	720
8	South Korea	659
9	South Arabia	621
10	Indonesia	615

Source: Global Carbon Atlas (2018).

Table 1 above shows the top 10 carbon-emitting countries in the world. As per the Global Carbon Atlas, China ranks first, followed by the United States of America, and India ranks third with 2654 MT CO2.

The World Air Quality 2019 report, which ranks cities on the PM 2.5 (particulate matter 2.5 micrometers or less in diameter), has six Indian cities features in the world's top list of most polluted cities. These cities are Ghaziabad (rank 1), Delhi (5), Noida (6), Gurugram (7), Greater Noida (9), and Bandhwari (10). Other cities are from Pakistan, namely Gujranwala (3), Faisalabad (4) and Raiwind (8), and China- Hotan (2) (IQAir.com). Exposure to PM 2.5 poses a significant threat to health, affecting the lungs and respiratory system. Air pollution alone has caused about 1.1 million premature deaths in 2015 in India, as reported by the State of the Global Air.

The Ministry of Housing and Urban Affairs (MoHUA), in 2015, unleashed a host of schemes like the Smart City Mission (SCM), Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Swachh Bharat Mission, and Prime Minister's AwasYojana (PMAY-Urban), with the main concern being to address the prevailing urban challenges in India. The various initiatives are likely to translate to a $1,123 billion investment opportunity for building urban infrastructure (Ministry of Urban Development, 2016) and will result in creating resilient cities which are also sustainable and inclusive, as defined by Sustainable Development Goals (SDGs 11), which were officially adopted on January 1, 2016, by 193 countries.

The brilliant city concept has no commonly accepted definition globally. Its understanding varies across cities and nations and therefore evolving, depending on the requirement of development, reforms, and resources needed to fulfill the aspirations of the citizens. Smart city in India also varies, based on a city's state of development and the infrastructure required for making the city more liveable. 100 smart cities were selected in India through various challenge rounds out of 468 cities and urban agglomerations reported under Census (2011). The SCM involves the strategy of area-based development (ABD) and pan-city, wherein under ABD, the city earmarks a specific small area which could be developed through - retrofitting (city improvement), redevelopment (city renewal), and Greenfield development (city extension). In contrast, the pan-city involvesengaging projects in larger areas of cities.

The focus of the SCM is on building the core infrastructure, including services like water supply, affordable housing, electricity, sanitation, solid waste management, urban transport, and improving public transport services, primarily focusing on the poor and marginalized section of the society. The idea is to make cities smart by enabling robust network I.T. and digitization with the help of good governance, ensuring citizen participation. In addition to that, focus on sustainable environment, health, education, safety, and security of citizens, especially for women, elderly, and children, have also been the priority.

Over the years, it has been observed that the budgetary allocation for the SCM has been steadily rising from Rs 4,000 crores in 2017-18 to Rs 6,169 crores in 2018-19 and further to Rs 6,450 crores in 2019-20. The [7]presented that since the launch of SCM in 2016, around 5151 intelligent city projects are in the different phases of implementation, with projects cost amounting to Rs 2 lakhcrore.

Connecting the dots and links between India's cities being messy and hidden[8], plagued by pollution and environmental concerns, the present study attempts to analyze the Government of India's SCM to understand if the select smart cities (selected in the first round - January 2016) and their projects underway, address the critical environmental issues and concerns - be it explicitly or tacitly.

The paper is divided into four parts. While the first segment of the article gives the introduction, setting the urban background in sync with environmental concerns, highlighting the research objectives and context of the study, part two elaborates on the related literature review. Part three of the paper discusses and analyses the various innovative city projects undertaken by the selected cities, assessing their ability to address

DOI: 10.9756/INTJECSE/V14I4.369

environmental concerns. The final part of the paper puts forth the conclusions and pertinent recommendations to enable Indian cities to be environmentally sustainable and 'smart' in the true sense of the term.

REVIEW OF LITERATURE

The Smart City concept and initiatives globally are emerging as an essential basis for the future of cities, with European cities pursuing varied such programs. Since more than half of the world's population are living in cities, characterized by high-density population, placing increasing demands on energy, transportation, water, buildings, and public spaces - making it imperative that cities find solutions that are not only 'smart' - highly efficient, sustainable and at the same time bring about social wellbeing and economic prosperity. Thus there is a need for channelizing the resources and coordinating the actions with new technologies and futuristic strategies and policies. Smart City initiatives include six characteristics: Smart Living; Smart People; Smart Mobility; Smart Environment; Smart Economy and; Smart Governance[9].A growing population requires structured civic services and processes to address the physiological necessities (food, water, and shelter), followed by safety and security, love and belongingness needs, and self-esteem needs as given by Maslow's hierarchy of needs. This very need requires a proper strategy, and the various innovative city projects (SCP) can address the same[10].Dutta has pointed out that Smart Cities have emerged as urban instruments, which propel growth in an environmentally sustainable manner. In comparison, another study has identified six environmental factors - climate, pollution, water, energy resources, landscape and geography, and green spaces, which should be included in the planning and implementation of smart cities[11].

For instance, the city of Bengaluru has developed as an industrial hub with strong digital networks, online grievance redressal systems, and other such solutions. Still, it cannot be considered a smart city due to the poor quality of essential urban and public utilities, including electricity and waste disposal services. Similarly, Gurgaon, the National Capital Region (NCR) 's satellite city, is far from achieving sustainable development despite being surrounded by well-connected metro systems, industrial corridors, high-tech infrastructure, and modernized private hospitals. The city has become the image of concrete jungles, experiencing civic chaos mainly due to unplanned and haphazard development processes[12]. Therefore, it can be inferred that the execution and delivery of services are essentially intelligent and successful. Although SCM has been initiated as a catalyst to sustainable growth, a blueprint document is absent, or detailed guidelines to incorporate green growth as astrategy[13].Thus, making intelligent cities requires the cities to have a strong bent towards being inclusive, safe, resilient, and sustainable, which go a long way to realizing the Sustainable Development Goal (SDG) 11. However, this would require a focus on poverty reduction, hazard and disaster management, equal access to resources, usage of land to reduce loss to biodiversity, and creating a society with energy-efficient and low-carbon resources. The use of big data of socio-economic and environmental can help better prepare for disaster and ensure equal distribution of resources. This would help in creating liveable cities, which are better responsive to changing and dynamic environments. The usage of big data in China, Zurich, and Serbia has been successful in various environmental factors, especially in checking air pollution. However, Information and Communication Technology (ICT) use has been limited to water management, while other components have not yet been integrated. There is, therefore, a need for big data to be embedded in the study of the environment and cities in India.In[14], their study points out that the selected smart cities of India are dispersed in various geographical regions and are prone to different climatic and environmental challenges. The understanding of these risks should be the essential focus of savvy city planners. Policies should be devised for cities, wherein climate-related data with accurate time information from local and global institutions concerning rainfall, temperature, humidity, wind velocity, and evapotranspiration should be embedded. The study further points out that the SCM concept in India has used minimal environmental components, and some critical ideas are absent- "green spaces" and "climate change" in the mission vision, statement, and guidelines, despite the growing importance of environmental factors recognized globally[15].Comparing SCM sustainability indicators with that of the United Nations Department of Economics and Social Affairs (UNDESA) sustainability indicators, including environment, economy, equity, and implementation, highlights that SCM lacks focus on environmental sustainability. Six components of sustainability are included in the definition under UNDESA - atmosphere, water, natural hazards, sea, ocean and coasts, land, and biodiversity. However, the urban environment sustainability concept under SCM only discusses three components: energy, water, and atmosphere.

It has discussed the concept of intellectual development to conserve, protect, and enhance the environment and is based on three factors- equity, environment, and economy [16]. However, in the significant factors measuring the quality of life such as water supply, sewage treatment, solid waste management, transportation, vehicular congestion, open spaces, slum, health, and education, Indian cities fall short in the delivery of the basic standard of living to its citizens as per the 2010 data shown in Table 2.

TABLE 2. Livability Indicators Performance of Cities

S.No.	Indicator	Current	Basic	Best

DOI: 10.9756/INTJECSE/V14I4.369

1	Water Supply (LPCD)	105	150	220
2	Sewage Treated (%)	30	100	100
3	Solid Waste Collected (%)	72	100	100
4	Transportation (% of trips)	30	50	82
5	Vehicular Congestion (V/lane km)	170	112	85
6	Open Spaces (sqm/person)	3	9	16
7	Slum (%)	24	0	0
8	Health (beds/1000)	2	4	7
9	Education (S-T Ratio)	48	30	16

Source: - McKinsey and Company Report (2010)

A working paper showed that urban water supply service status among the Indian States regarding access to improved water supply service has improved, with the all India average of service showing 95.3 percent of the households have improved water supply service [17]. In terms of enhanced urban sanitation service, the all-India average stood at 88.7 percent of the homes. For reliable management services, it was 78.6 percent, thus requiring more attention from the urban planners. The electricity penetration among urban households has improved significantly as all India average 94.7 percent of urban households have electricity supply service.

The section on the literature review throws light on the concept of a smart city, which has become an urban tool for sustainable development. While focusing on addressing Maslow's hierarchical needs of the citizens, the SCM in India should also include the intelligent embedding of the environmental factors to ensure India'sglobal commitment to reducing GHG and addressing environmental concerns. This can be achieved with the help of information technology, big data, and the application of Artificial Intelligence (A.I.).

ANALYSIS OF SELECTED SMART CITIES

Selection of the Cities

To understand the linkage of the SCM with environmental considerations, the authors have taken five smart cities that got selected in the first round of the brilliant city challenge (January- 2016). The select cities also fulfilled geographical heterogeneity and dispersion criteria, thereby representing various parts of the country. Further, considerable time had passed since these cities were selected. Therefore, the researchers would have better access to information and data about the implementation of the projects in the fourth year. These cities also have active websites that provide updates, enabling the assessment of their performance for the given period from January 2016 to July 2020. The selected cities include:-

i) Bhopal - Central India
ii) Bhubaneswar - Eastern India,
iii) Chennai - Southern India
iv) Delhi (New Delhi Municipal Council – NDMC) - Northern India
v) Pune - Western India.

Smart City Profile

The select cities have been assessed based on the projects planned and earmarked for pan-city and ABD. The researchers have studied the innovative city projects for each city by dividing them into two categories - i) those that reflect environment considerations (both explicitly and tacitly identifiable) and ii) non-environment-related projects. To better understand the selected cities, some important indicators have been highlighted and compared in Table 3.

TABLE3. Profile of Cities

S.No.	Indicators	Bhopal	Bhubaneswar	Chennai	Delhi	Pune
1	Population	1,798,218	843,402	4,646,732	257,803	3,124,458
2	Rank as per population in India for city (2011 Census)	16	58	6	NA	9
3	Metropolitan population	1,886,100	886,397	8,653,521	16,349,831	5,057,709
4	Population as on 2020	2,389,547	1,162,886	10,971,108	30,290,936	6,629,347
5	Annual % Growth Rate of Population	2.53	2.93	2.54	3.21	2.90

DOI: 10.9756/INTJECSE/V14I4.369

	since 2015					
6	Area (in sq. km)	285.9	161	462	43.7	331.2
7	ABD Area (247.105 acres = 1 seems)	342 acres = 1.38 sq. km (0.4 % of the total area of the city)	985 acres = 3.98 sq. km (2.4% of the total area of the city)	1,717 acres = 6.94 sq. km (1.5 % of the total area of the city)	550 acres = 2.22 sq. km (5.08% of the total area of the city)	900 acres = 3.64 sq. km (1.1% of the total area of the city)
8	Budget as per proposal of ABD and Pan city (planned for 5 years)	ABD=Rs 1443.5cr Pan City = 1275.21	ABD = Rs. 40945crores- Pan City = Rs. 442 crores	ABD = Rs. 878crores- Pan City = Rs. 488 crores	ABD = Rs. 812 crores- Pan City= Rs. 2186	ABD = Rs. 1706croresand PAN City = Rs 447 crores

Source: Row 1-3: Census of India
Row 4: World Population Review
Row 5-8: Smart city proposals of each city

Table 3, reveals a brief profile of each city concerning population, growth of population, area, and highlights the ABD area and Pan city in terms of location and proposed budget. It is observed that other than Bhubaneswar, the select cities were with a million-plus population, with NDMC being a part of the larger city of Delhi. The annual growth of people since 2015 has ranged from 2.53 percent for Bhopal to 3.21 percent for Delhi in 2020. Further, the cities in terms of the area went from 43.7 sqkms for NDMC, which is one of the five local bodies of the capital city Delhi, to the Chennai sprawl - 462 sqkms.

It can be further observed that the ABD area chosen for each of these cities is relatively minuscule compared to the area of the whole town. For example, the ABD area constitutes 0.4 percent of the total area of Bhopal; 2.4 percent for Bhubaneswar; 1.5 percent concerning Chennai, 5.08 percent for NDMC; and 1.1percent of the total area of Pune. Concerning the full size of the five select cities amounting to 1283.8 sqkms, the ABD areas accounting for a significant percentage of the smart city budget sums up to 18.16 sqkms (1.41 percent of the total area of the five cities).

Additionally, Bhubaneswar has the highest total proposed expenditure, with the ABD area accounting for nearly90 percent of the total SCM budget. In contrast, Pune accounted for 72 percent of the proposed payment, Chennai at 64 percent, and 53 percent for Bhopal.

Environment Parameters of the Select Smart Cities

The authors have selected the following three sources for analyzing the environmental status of the cities: i) Pollution Index by Numbeo as it covers 336 cities across the world on a real-time basis. The Numbeo Pollution Index assigns an enormous weight to air pollution, followed by water pollution/accessibility, and small weights are given to other pollution types. The index provides an estimation of the overall pollution in the city. Also, 53 Indian cities feature on this index. ii) The World Air Quality Report (2019) concerning PM 2.5, as the report refers to 90 Indian cities, covering four of the cities under consideration. iii) National Air Quality Index portal of Central Pollution Control Board launched in 2015. For the excluded city of Bhubaneswar, the authors referred to data from the State Pollution Control Board, Odisha, media, and other web-based analyses to understand the city's air quality, as shown in Table 4.

TABLE4. Selected Environment Parameters for the Smart Cities

S.No	City	Global Ranking on *	AQI levels as of January 1 2020 ^	Total Smart City Project (SCP) (in no.)	SCP related to the environment positive (in no and %)	Percentage of Budget Expenditure on the background out of Smart City Budget	Does the city have an Environment Status Report?
1.	Bhopal	163	238-Poor	15	7 (46%)	N.A.	No (State report)
2.	Bhubaneswar	202	NA	13	5 (38%)	10.23% (Rs. 466.05 crore)	No

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3.	Chennai	76	95-Satisfactory	27	9 (33%)	44.21% (Rs. 604 crores)	No (State report)
4.	NDMC	15	449-Severe	27	12 (44%)	NA	No
5.	Pune	89	111-Moderate	52	22 (42%)	42.86% (Rs. 1243 crore)	Yes

Authors calculations from the various projects
^AQI-https://www.IQAir.com/India
** Number Pollution Index by City 2020 Mid-Yearhttps://www.numbeo.com/pollution/rankings.jsp*

Environment data of the cities revealed that NDMC - one of the five municipal corporations of Delhi city, when taken as a unified city and the capital of India, was globally ranked as the 15th most polluted city and the most polluted capital city in the world. This is further followed by Chennai (76), Pune (89), Bhopal (163), and Bhubaneswar (202), as per the Numbeo Pollution Index 2020 Mid-Year. Further, 53 Indian cities featured on the Numbeo Pollution Index list, out of the world's 336 municipalities, accounting for 26.2 percent of the globally most polluted cities. A deeper delve into the 53 Indian cities revealed that 40 of these were identified as the smart cities (75.5 percent) that have been selected in the various challenge rounds. This points to the fact that many of the smart cities in India face environmental concerns and these challenges need to be addressed.

While the Numbeo Pollution Index gives a broader overview, the researchers also viewed the Air Quality Index (AQI) as of January 1 2020. The AQI throws light on PM 2.5, which has a hazardous effect on health, since it is made up of fine particles impacting the respiratory tract and reaching the lungs. In 2019, India stood as the fifth most polluted country, concerning the global air pollution index and PM 2.5 [18]. While the AQI concerning PM 2.5 levels in India improved in 2019 (58.80), in comparison with (72.54) in2018, this has been attributed to the economic slowdown from 6.12% in 2018 to 5.024% in 2019(World Bank, n.d.), to some favorable meteorological conditions and efforts from various stakeholder towards cleaning the air, with the recent introduction of the National Clean Air Programme (NCAP) and cleaner fuel emission norms as defined in the Bharat VI. However, [19] it was also observed that no Indian city met the World Health Organisation (WHO) target for annual pollution exposure standards of 10ug/m3 during 2019.

TABLE5: Ranking of the Select Cities as per the 2019 World Air Quality Report (PM 2.5)

City	**2019 Global / India Ranking**	**2017 AVG**	**2018 AVG**	**2019 AVG**	**Status**
Bhopal	174/55	NA	NA	44.6	Unhealthy for sensitive group
Bhubaneswar#	NA	57	52	N.A.	Unhealthy for sensitive group
Chennai	320/78	39.8	43.2	34.6	Has transformed marginally from Unhealthy for the sensitive group to moderate
Delhi	5/2	144.6	135.2	110.2	Unhealthy
Pune	299/74	37	46.3	35.7	Unhealthy for sensitive group

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Source: World's Most Polluted Cities https://www.iqair.com/world-most-polluted-cities?continent=59af92b13e70001c1bd78e53&country=SPLi4goKT3JDgP4Mm&state=&page=2&perPage=50&cities
*#For Bhubaneshwar data was retrieved from State Pollution Control Board, Odisha*http://ospcboard.org/environmental-monitoring-data/
Analyzing data across three years (2017 – 2019), Table 5, highlighted the following – i) NDMC – ranked as the second most polluted city in India. This is although the city's PM 2.5 levels had improved, from 135.2 in 2018 to 110.2 in 2019, thereby awarding NDMC the unhealthy status ii) As for the other cities, while the PM 2.5 has improved over the years, the environment status for Bhopal and Pune was labeled as unhealthy for sensitive groups iii) Chennai has transformed its environment status marginally from sick for an enthusiastic group to moderate iv) While Bhubaneswar does not feature on the 2019 World Air Quality Report, but updates from the State Pollution Control Board Odisha revealed that especially during the December and January months - the city exhibited higher PM 2.5 compared with June and July [20]. Further, air quality to the town of Bhubaneswar ranged from moderate to unhealthy for sensitive groups.
The study further analyzed the monthly air quality index values from August 2018 for 25 months to August 2020 for four of the five select cities taken from the National Air Quality Index portal (data for Bhubaneswar was not available) [21]. As shown in Figure 1, the graph highlights that Delhi, followed by Chennai, is a poor-performing city in terms of air quality, while Bhopal and Pune experience lower air quality levels than Delhi and Chennai. However, in absolute terms, the latter two cities are also suffering from poor air pollution quality as the PM 2.5 levels exceed the limits, especially in October, November, December, and January [22]. The graph with two years' data on AQI of the four cities suggests that for the months from October to January, the cities experience poor air quality. In contrast, June to August are months with relatively better air quality observations.

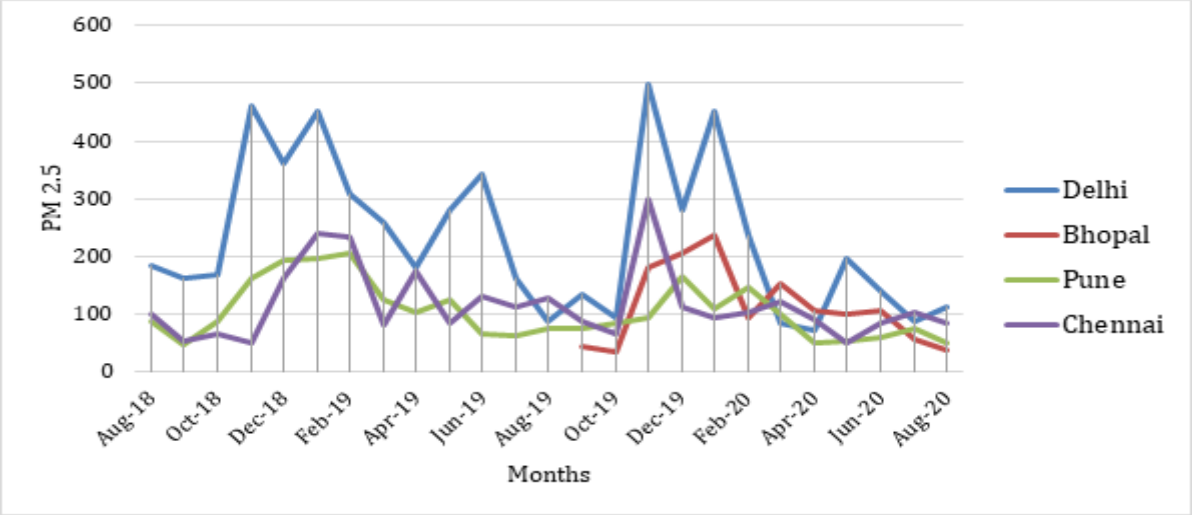

FIGURE 1. AQI values from 2018-2020
*Source: - CPCB*https://app.cpcbccr.com/AQI_India/
Smart City Projects of the Select Cities
Given the fact that all the five cities ranked on the global air pollution index, the researchers study the nature of the innovative city projects undertaken for each of these cities.
It was observed that for the city of Bhubaneswar, the environment-related projects stood at 5, with the maximum number of such projects being 22 for Pune city. However, in percentage terms, Bhopal ranks the highest with 46 percent of its innovative city projects related to the environment, followed by NDMC at 44 percent, Pune at 42 percent, Bhubaneswar at 38 percent, and Chennai accounted for 33 percent of such projects. Further, it was observed that the various innovative city projects are broadly related to water, public transport, open spaces, green spaces, footpaths, non-motorized transport modes, solid waste collection, river cleaning, solar energy, etc. which not only address Maslow's hierarchical needs but in the opinion of the researchers have been categorized as environment positive, as they help in improving the sustainable urban environment in the long run.
The study further analyzed the significant projects of the select cities, which were above Rs 100 crores, to understand the nature of these projects and their impact on both Pan City and ABD areas. It was observed that many of the projects included were both explicitly and tacitly connected with uplifting the city's environmental profile and compliance and are highlighted below in Table 6.

TABLE 6. Projects above Rs 100 crores for the select cities as proposed

DOI: 10.9756/INTJECSE/V14I4.369

Serial No	City	Projects	ABD (Rscr)	Pan (Rscr)	Comment
	Bhopal	ABD: Robust I.T., Intelligent Traffic Management, Smart Parking, and Additional Smart Applications PAN City: Smart Unified Governance City level application and innovative dashboard, City Level GIS, Waste to Energy conversion, GPS based garbage vehicle tracking, RFID tagging of garbage bins, Waste network simulation, GIS-based grievance redressal, Geo-fencing of assets) + Intelligent Street Lighting (Intelligent street light with scheduling, Surveillance, and SOS, Environment and water level sensors,	150	668.21	4.45times was spent on the PAN City wrt environment considerations when compared with the ABD area
	Bhubaneshwar	ABD: TOD projects for Railway Station Multimodal Hub, Urban Mobility for roads, cycle lanes and E- Rickshaw scheme and city Wi-Fi Project, Smart metering and Digital Literacy PAN City: Traffic Management	1121.5	101.5	Nearly 11 times more on the ABD area
	Chennai	ABD: Electrical & ICT utility Corridor, (Desalination Plant) for 24 X 7 water supply, Augmentation - stormwater network, Pedestrian-Friendly Pathways & Non- Motorised Transport PAN City: Street light monitoring system and Intelligent Traffic Management System	582.83	348.47	The ABD area spent nearly 1.7 times that of the PAN City.
	NDMC	ABD: Multi-level automated parking + sensor-based Common Service Utility Duct + Rooftop solar panels PAN City: Smart Grid and Energy Management + Solar Power Projects + Smart Water and waste-water Management	445	2106.42	The Pan city had nearly 4.7 times expenditure compared to the ABD area.
	Pune	ABD: Transport related – road widening, E-Buses, BRTS, Street redesign, Electricity Solar, Smart Grid, River Front PAN City: Adaptative Transport Control System	1178	269	ABD area spent nearly 4.4 times what was spent on the Pan city

Source:-(Ministry of Housing and Urban Affairs, n.d.)

It can therefore be seen that the Smart City Mission, which commenced in 2015, with city selections in 2016, has begun with baby steps concerning projects that are more concentrated on just 1 percent of the area for the select intelligent cities. Urban missions across various states will need to be forthcoming and proactive, with

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urban being a State subject if we are concerned with the wellbeing of our citizens and committed to contributing to environmental measures to address the health of our citizens.

CONCLUSIONS AND RECOMMENDATIONS

Given that only a few cities in India may adhere to air quality standards as prescribed by the World Health Organisation, the study concludes that the SCM needs to ensure and embed parameters to address this inconsistency.

The study reviewed the framework of the five selected cities concerning the projects undertaken and observed and sums as follows: while the cities laid a lot of emphasis on the projects and investments in the ABD area and while the projects undertaken revealed an explicit or an implicit tilt to the environment, however, it was a case of work in progress but the outcomes accrued will lead us to conclude that it is a case of too little to result in a substantial impact to address and revert the environment challenges existing. Since a large part of the projects and investment were earmarked for the ABD area, which is minuscule and insignificant – this will require massive allocation of assets and projects in the future to result in a pan-city impact. Further, the scale of such interventions should address not only the intelligent cities but across the 9391 urban settlements (towns, urban agglomerations, outgrowths) as highlighted in the 2011 Census.

The research journey for the present study was mired by asymmetric information across cities belonging to various states concerning data, nature of the progress of the innovative city projects undertaken, and even information regarding the different environmental parameters. This posed a considerable challenge to the researcher to take a more significant sample of cities for analysis, thereby restricting the study to an example of five selected cities, keeping in mind comparable data. The authors go on to make the following recommendations:

i) For smart cities to be a success, it requires persistent inputs from the government. Thus the renewed framework of the Smart City Mission II – should be introduced by 2022. The revised format should concentrate on the success of the projects implemented in the ABD areas and can now be replicated at the pan-city level. Further, the new projects to be implemented should collectively realize progressive/favorable measurable environmental outcomes.

ii) All smart cities need to have a dashboard for daily monitoring of the city's crucial environmental parameters. This should be displayed at prominent locations to help citizens realize the health hazards related to cities.

iii) One of the critical factors observed is that all States should follow the Maharashtra model, wherein it is mandatory as per the Maharashtra Municipal Corporation (MMC) Act 1949, section 67(A), for all Urban Local Bodies (ULBs) of the state, to submit an annual Environmental Status Report (ESR) before July 31, of the year.

iv) While technology should not be the only focus, big data and the use of A.I. must be applied as tools for measurement and the delivery of intelligent outcomes concerning various utilities like water, energy, and transport, which positively impact the environment and result in being able to quantify measurable changes.

v) ICT can help with monitoring the progress of the projects and environment indicators. What is needed is a standard set of urban environmental and economic indicators to measure the growth process to achieve sustainable growth. For example, market information and knowledge of the local environment can help assess local energy use and relate emissions to economic activities.

vi) The investments required concerning green infrastructure for both the Statutory and the neglected Census Towns are colossal; the time is right to institute a particular development bank like the National Bank for Agriculture and Rural Development (NABARD) with an urban focus *Bank for Urban Transformation and Development (NABUTAD).* One bank of the focussed attention to lead the cities, which are drivers of growth into creating low-carbon cities. Once such an apex bank is in place, it will innovate new financial instruments to initiate green growth goals in urban areas.

vii) The newly created national framework - National Clean Air Programme, launched in January 2019, should be more visible and active to bring down annual pollution by 20 -30 percent by 2024. It should be empowered with funding (refer to point vi) and a legal framework to ensure effectiveness.

viii) Finally, ignoring the 3894 census towns in India accounting for 14 percent of the urban population, wherein these towns evolve in a chaotic and unplanned manner as they lack proper governance – is like not addressing an issue, as rural local governments administer the census towns – is a case of abandoned towns which will be the need to create order from the chaos that will emerge due to lack of planning and governance.

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