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Perspectives Analysis Of Sustainable Smart Cities In India

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Introduction

The concept of smart cities originated at the time when the entire world was facing one of the worst economic crises. In 2008, IBM began work on a 'smarter cities' concept as part of its Smarter Planet initiative. By the beginning of 2009, the concept had captivated the imagination of various nations across the globe. A 'smart city' is an urban region that is highly advanced in terms of overall infrastructure, sustainable real estate, communications and market viability. It is a city where information technology is the principal infrastructure and the basis for providing essential services to residents. There are many technological platforms involved, including but not limited to automated sensor networks and data centres.

Conceptual Framework of Sustainable urban development and smart city

The concept of smart city is relatively new and can be seen as a successor of information city, digital city and sustainable city. However it has been used frequently, especially after 2013, when it exceeded a frequency of citations of other terms including sustainable city. The term smart city is, therefore, an umbrella concept that contains a number of sub-themes such as smart urbanism, smart economy, sustainable and smart environment, smart technology, smart energy, smart mobility, smart health, and so on (Gudes et al. 2010; Cocchia 2014; Lara et al. 2016). In fact, sustainable cities are now considered absolutely vital in achieving climate change goals. While countries were haggling for a favourable climate change deal in the run-up to the Paris conference in 2015, cities across the world had already starting forging partnerships and taking individual and collective actions on sustainability. While cities are extremely vulnerable to climate

change because of extremely large concentrations of population and infrastructure, they are also better placed to take actions owing to well-defined governing systems and much higher capacities to deal with the problem.

More than 4,000 cities, including at least 20 from India, have committed to more than 11,000 actions through Non-State Actor Zone for Climate Action (NAZCA) a platform launched during the 2014 climate change conference in Lima, Peru. These actions include improvement in energy efficiency, better public transport, direct reduction in greenhouse gas emissions, deployment of renewable energy sources, and increases in green cover. Organisations like International Council for Local Environmental Initiatives (ICLEI), have been partnering with cities for several years, helping them in achieving sustainability.

As a result, cities are in competition to reduce their carbon footprint. Cities like Berlin, Boston, Copenhagen, London, Sydney, New York, Washington, Yokohama and San Francisco have committed themselves to reduce their greenhouse gas emissions by at least 80 per cent of current levels by the year 2050 if not earlier. Almost 1,800 cities, having come together through a Covenant of Mayors, have pledged to reduce their greenhouse gas emissions by 20 per cent by the year 2020. Within India also, some cities have set very specific targets for themselves. Rajkot, for example, has promised to reduce its community carbon dioxide emissions by 14 per cent at the end of this year as compared to 2011 levels. Shimla has plans to improve its energy efficiency by 5 per cent by 2019 from 2011 levels. It also wants to increase the share of renewables in its energy mix by five per cent by 2019. Coimbatore has pledged to increase the energy efficiency of government operations by 5 per cent by 2020 on 2008 levels, and also increase the share of renewables in energy mix of government operations by 5 per cent by 2020.

Review of Literature

Despite the discussion about its concept in recent years, there is a lack of consensus on what a smart city is (Angelidou 2015; Hortz 2016). Although a number of authors have the difficulty of conceptualisation, these definitions are not contradictory but partially overlapping (Scheel and Rivera 2013; Cocchia 2014). In general, however, it is understood that smart cities make use of Information and Communication Technology (ICT) extensively to help cities to build their competitive advantages (Yigitcanlar and Baum 2008; Caragliu et al. 2011). In their literature review, Caragliu et al. (2011) conceptualise smart city with the following main characteristics:

(a) An enhanced administrative and economic efficiency that enables the development of culture and society by utilising networked infrastructures;

(b) An underlying emphasis on business oriented urban development;

(c) A strong focus on the goal of realising the social inclusion of different kinds of urban residents in public services;

(d) An emphasis on the significant role of high-tech and creative industries in long-term growth;

(e) A perspective to pay close attention to the function of social and rational capital in city development, and;

(f) A vision to take social and environmental sustainability as an important aspect of smart city development.

Some authors also point to the necessary ingredients for the composition of a smart city, such as: smart economy, smart mobility, smart environment, smart people, smart living and smart governance (Lazaroiu and Roscia 2012; Lee et al. 2014; Jong et al. 2015). Accordingly, the concept of smart city goes beyond the definitions of information cities, digital cities, and intelligent cities, because it contextualises technology to be used in favour of systems and services for people (Jong et al. 2015).

The evaluation of a smart city, as discussed by Marsal-Llacuna et al. (2015) should consider past experiences of environmentally friendly and liveable cities, encompassing sustainability and quality of life, in addition, of course, the composition of technological factors. Lazaroiu and Roscia (2012) state that it should represent a technological community, interconnected, sustainable, comfortable, attractive, and secure. In order to understand how it works in practice, smart cities make use of city data for traffic management, energy consumption statistics, security, and optimising the operation of municipal services (Harrison et al. 2010). This new reality is encouraging the increase of new suppliers to the smart city market niche, using technological resources for the management of urban services (Carvalho and Campos 2013; Angelidou 2015).

Schaffers et al. (2011), later on emphasised by Kramers et al. (2014), point out that to have a smart city is necessary: (a) Create a rich environment of broadband networks that support digital applications, and; (b) Initiate large-scale participatory innovation processes for the creation of applications. Some cities that have appropriated the concept of smart cities have applied themselves to enjoy their benefits so that the needs of the city are met. Barcelona defines smart city as a high-tech intensive and advanced city that connects people, information and city elements using new technologies in order to create sustainable greener city, competitive and innovative commerce and an increased life quality, while the city of Amsterdam addresses the issue as an innovative technology and is willing to change people's energy-related behaviour to tackle climate challenges (Lee et al. 2014). In the case of Doha, smart city practice is more of an interaction of urban technologies and knowledge economy activities (Conventz et al. 2015); whereas in the case of Brisbane, the practice is to integrate smart technologies into good urban and space design practices (Pancholi et al. 2015).

Nam and Pardo (2011) divide smart city into three dimensions: (a) Technology (hardware and software infrastructures); (b) Population (creativity, diversity and education) and; (c) Institutions (governance and policy). In view of this, investments in technology, population and institutions aiming at the concept of smart city generate sustainable development and quality of life, promoting responsible management of

natural resources and allowing institutions to contribute with innovation and better services for citizens, strengthening the debates and political participation (Caragliu et al. 2011).

When studying cities, to better understand the term sustainability, one must take into account the meaning of sustainable urban development (Dizdaroglu and Yigitcanlar 2016). This, in turn, can be seen as a process of change in which resource exploitation, investment direction, technological development and institutional change are consistent with present and future needs (WCED 1987). The term sustainable city as a concept became popular in the 1990s (Roy 2009) denoting the relationship between economic, social and environmental sustainability aspects from a combination of indicators of each of these components (Ahvenniemi et al. 2017). Although the current vision is to address these three issues to talk about sustainable cities, certain authors focus on one of only three. This is the case of Meadows (1999), who propose the inclusion of indicators such as pollution, waste generation and consumption of water and energy, unlike Rode and Burdett (2011), who direct efforts towards an interpretation More socioeconomic, such as social equity and a greener environment (Jong et al. 2015).

Considering all these aspects, Hiremath et al. (2013) define sustainable urban development as achieving a balance between the development of the urban areas and protection of the environment with an eye to equity in income, employment, shelter, basic services, social infrastructure and transportation in the urban areas. The spread of interest in smart cities and adjacent concepts is linked to a number of factors, including: most of the world's population living in cities, climate change, scarcity of natural resources, globalisation, and increased competition. With this, cities need to offer improved and customisable services for people (Angelidou 2015). According to Dhingra and Chattopadhyay (2016), a smart and sustainable city has goals to be achieved in an adaptable, reliable, scalable, accessible and resilient way, such as:

■ Improve quality of life of its citizens;

■ Ensure economic growth with better employment opportunities;

■ Improve well-being of its citizens by ensuring access to social and community services;

■ Establish an environmentally responsible and sustainable approach to development;

■ Ensure efficient service delivery of basic services and infrastructure such as public transportation, water supply and drainage, telecommunication and other utilities;

■ Ability to address climate change and environmental issues, and;

■ Provide an effective regulatory and local governance mechanism ensuring equitable policies.

It is observed that, when it comes to the environmental issues of smart cities, the discussion is more political in nature, considering international resolutions and innovative solutions to combat complex urban challenges. According to the same author, there are four attributes of the smart and sustainable cities:

(a) Sustainability;

(b) Quality of life;

(c) Urban aspects, and;

(d) Intelligence.

These are analysed under four main themes:

(i) Society; (ii) Economy; (iii) Environment, and; (iv) Governance

A similar concept, smart-eco city, proposes that the city should be ecologically healthy, using advanced technologies and having economically productive and environmentally efficient industries, have a responsible and harmonious systematic culture, a physically aesthetic and functionally living landscape (Yigitcanlar and Lee 2014).

Objectives of the Study

The objectives of the present study are:-

1. To examine which Indian city is dominating for smart city on demographical and ULB basis.

2. To assess the economic and financial position of the Indian Sustainable Smart City.

RESEARCH METHODOLOGY

The researchers have adopted analytical, descriptive and comparative methodology for this study. Reliance has been placed on secondary data sources such as books, journals, newspapers and online database. For this purpose various statistical methods have been used like Mean; Standard Deviation; co-efficient of variance; 't' test etc. However, the interpretation of the data and suggestions made assume importance for the healthy growth of the smart cities in the country.

ANALYSIS AND INTERPRETATION

Prospective Analysis of Sustainable Smart Cities in India has evaluated in the four aspects viz. (a) Demographic (b) Economic (c) Urban Local Body (ULB) (d) Financial aspect.

(a) Demographic aspect analysis

Table-1 Demography Profile of Indian Smart Cities

Sr.	Name of City	Population	Area (sq. m)*	Density of population (person per sq. km)*	Literacy Rate (%)
1	Bhubaneswar	840834	135	6228.4	91.89
2	Pune	3124458	276.4	11304	89.56
3	Jaipur	3046163	484.64	6285	83.33
4	Surat	4467797	335.82	13304	87.89
5	Kochi	602046	107.13	5620	97.36
6	Ahmadabad	5577940	468.92	11895	88.29
7	Jabalpur	1055525	152.53	6920	87.39
8	Vishakhapatnam	1728128	513.61	3365	81.79
9	Solapur	951558	178.57	5329	82.8
10	Davanagere	434971	77.12	5640	84.9
11	Indore	1964086	172.39	11393	85.87
12	Delhi	257803	42.74	6032	89.83
13	Coimbatore	1050721	105.6	9950	91.3
14	Kakinada	312538	57.36	5449	80.62
15	Belgaum	488157	99.61	4900	89.82
16	Udaipur	451100	56.92	7925	89.66
17	Guwahati	957352	219.06	4370	91.47
18	Chennai	4646732	175	26553	90.18
19	Ludhiana	1618879	159.37	85.77	84.11
20	Bhopal	1798218	285.88	6290	83.47
MEAN		1768750	205.18	7941.93	87.5765
S.D		1545019	141.67	1182.69	4.067
c.v.				14.89	4.644
't'				2.76133	

Source: Census of India, 2011
* District Census Handbook, Census of India, 2011

Table -1 reveals density of population and literacy rate of twenty Indian smart cities. In 2012, India's overall density was only 382 persons per sq. km. Mean value of smart cities is more than twenty times i.e. 7941.93. So, government would require a huge funds in the process of conversion of these cities into smart. Value of Standard deviation is less than mean value in the matter of density which proves a high degree of uniformity in these selected smart cities. Mean value of literacy rate of these cities was 87.5765 on the basis of census 2011 while urban literacy rate of country was 85 %. Value of Standard deviation and c.v. are 4.067 and 4.644 respectively. Co-efficient of variance is more for Density of population in compare to Literacy Rate. Hence Density of population shows greater variation. The 't' value 2.76133 is statically insignificant at 95% level of confidence. It is inferred that 87% literacy rate ensures the evaluation of smart city concepts. The literacy rate helps to easily judge the government policy for successful implementation of smart city development.

(b) Economic aspect analysis:-

Table-2 (i) Economic Profile of Indian Smart Cities

Sr. No.	Name of City	Per Capita Income (Rs.) at 2004-05 constant price *	Urban Poverty Ratio (% of urban population)**
1	Bhubaneswar	33312	4.7
2	Pune	88341	2.73
3	Jaipur	NA	5.92
4	Surat	NA	5.61
5	Kochi	63599	4.05
6	Ahmadabad	NA	6.64
7	Jabalpur	38968	16.93
8	Vishakha-patnam	50580	6.35
9	Solapur	45859	19.29
10	Davanagere	30219	23.76
11	Indore	52501	2.8
12	Delhi	112510	0.87
13	Coimbatore	65781	3.66
14	Kakinada	37712	4.64
15	Belgaum	28856	32.33
16	Udaipur	24135	15.97
17	Guwahati	43278	9.09
18	Chennai (M.Corp)	57706	2.34
19	Ludhiana	51633	9.51
20	Bhopal	47214	9.72
	MEAN	51306	9.35
	S.D	21665.62	8.71
	't'	2.9187	-2.3632
	c.v.	42.228	93.155

Source: * Directorate of Economics and Statistics of respective State Governments and for all India-Central Statistics Office
**Unit Level Data of National Sample Survey Organization, Household Consumer Expenditure in India, 68th Round, 2011-12

Table 2 (i) exhibit the per capita income and urban poverty ratio of selected small cities of India's in the first phase. The mean value of per capita income of these cities is Rs. 51306 while urban area per capita income for 2011-12 in the country was only Rs. 35497. Here, it should be noted that per capita income of Bhubaneswar, Davanagere, Belgaum and Udaipur was less than the urban area per capita income and rest of the cities was more than it. It is a good indicator for the selected cities. Standard deviation was 21665.62 which is less than mean value. It proves a high degree of uniformity of the per capita income of selected small cities as well as homogeneity in it. It should be noted that 't' value 2.9187 is statically significant at 95% level of confidence. The mean value of Urban Poverty Ratio of these cities is 9.35 while in the country it was 13.7%. Here, it should be noted that Urban Poverty Ratio of Jabalpur, Solapur, Davanagere and Belgaum was more than the Urban Poverty Ratio and rest of the cities was less in comparison to country urban poverty ratio. It is a good indicator for the selected cities. Standard deviation was 8.71 which is less than mean value. It proves a high degree of uniformity of the Urban Poverty Ratio of selected small cities as well as homogeneity in it. It should be noted that 't' value - 2.3632 is statically insignificant

at 95% level of confidence. Co-efficient of variation of Urban Poverty Ratio is less than the urban per capita income. Hence urban per capita income shows greater variation. It can be conclude that higher per capita income with lower poverty ratio of selected smart cities will ensure the development of the concept of smart people, smart services, smart transportation and communication etc.

Table -2 (ii) Sector-wise Distribution of Workers (%) in Smart Cities selected in India during 2011-12.

Sr. No.	Name of City	Primary	Secondary	Tertiary
1	Bhubaneswar	0.79	27.92	71.29
2	Pune	0.34	32.16	67.50
3	Jaipur	5.9	44.64	49.46
4	Surat	0.28	66.1	33.63
5	Kochi	5.1	31.28	63.62
6	Ahmadabad	1.94	47.76	50.30
7	Jabalpur	1.12	25.13	73.75
8	Vishakha-patnam	1.76	33.06	65.18
9	Solapur	21.17	27.47	51.36
10	Davanagere	15.38	21.68	62.94
11	Indore	1.26	25.97	72.77
12	Delhi	0	41.48	58.52
13	Coimbatore	9.29	44.5	46.22
14	Kakinada	9.69	28.06	62.25
15	Belgaum	26.01	24.39	49.60
16	Udaipur	7.6	28.89	63.51
17	Guwahati	15.96	18.59	65.45
18	Chennai (M.Corp)	1.33	27.24	71.43
19	Ludhiana	0.85	51.49	47.66
20	Bhopal	5.4	25.02	69.51
	MEAN	6.90	33.64	59.80
	S.D	12.34	8.696	6.17
	c.v.	178.75	25.85	10.32

Source: * Directorate of Economics and Statistics of respective State Governments and for all India-Central Statistics Office
***Unit Level Data of National Sample Survey Organization, Employment and Unemployment Situation in India, 68th Round, 2011-12

Table 2(II) exhibits sector wise distribution of workers in small cities selected in India during 2011-12. Belgaum was on the top in the matter of engaging workers in the primary sector (26.01) followed by Solapur, Guwahati, Devanagar, Kokinada and Coimbatore. These cities are providing more employment in primary sector in comparison to mean value of this sector, i.e, 6.9%. Rest cities are providing very less employment in this sector. S.D. of this sector was 12.34 which is higher than mean value. It proves low degree of uniformity. Mean value of secondary sector was 33.64%. Ludhiana providing highest employment in this sector ,i.e., 51.49% workers followed by Ahmedabad, Jaipur, and Delhi. Workers in the rest sixteen cities are employed less than the mean value of this sector. SD of this sector was 8.69 which is less than mean value. It proves a high degree of uniformity in employment in this sector. Mean value of tertiary sector was 59.8. Here, it should be noted that the cities Jaipur, Surat, Ahmedabad, Coimbatore, Belgaum, and Ludhiana providing less opportunity to workers in comparison to mean value while rest fourteen providing higher opportunities. S.D of this sector was 6.17 which is less than the mean value. Coefficient of variance of primary sector was 178.75 followed by Secondary sector (25.85) and tertiary sector (10.32). It can be revealed that tertiary sector

providing highest employment to workers ,i.e., 59.8% in the selected smart cities followed by secondary (33.64%) and primary sector ,i.e., 6.9%.

(c) Urban Local Body (ULB) Aspects

Table-3 Performance of Urban Local Body (ULB)

Sr. No.	Name of City	Credit Rating of ULBs (As on Nov 2012)*	Property Tax #		
			Coverage (%)	Collection Efficiency (%)	Amount(Rs.) Crore (2012-13)
1	Bhubaneswar	BBB	69	63	20.21
2	Pune	AA-	NA	NA	NA
3	Jaipur	BBB+	17	NA	26.68
4	Surat	AA-	100	92	355.88
5	Kochi	BBB-	90	86	(2013-14) 56.5
6	Ahmadabad	A+	97	92	321.53
7	Jabalpur	BB+	86	75	12.76
8	Vishakhapatnam	A	85	90	NA
9	Solapur	NA	NA	NA	NA
10	Davanagere	NA	NA	NA	NA
11	Indore	BBB	89	90	39.95
12	Delhi	AA-	85	82	300
13	Coimbatore	BBB+	97	91	(2013-14) 103.28
14	Kakinada	----	NA	NA	(2014-15) 33.57
15	Belgaum	----	NA	NA	NA
16	Udaipur	----	NA	NA	NA
17	Guwahati	BB	95	79	NA
18	Chennai (M.Corp)	BBB+	85	90	(2013-14) 495.18
19	Ludhiana	BBB-	57.1	68	61.33
20	Bhopal	BBB-	98	91	22.6

Source: *http://rmc.nic.in/

Reform Appraisal Report, JNNURM, Ministry of Urban Development, Government of India

Table shows the performance of property tax coverage, collection efficiency and credit rating of smart cities in India. The mean value of property tax coverage recorded to be 82.14%. It means Surat, Kochi, Ahmedabad, Jabalpur, Vishakhapatnam, Devanagar, Indore, Delhi, Coimbatore, Guwahati, Chennai, and Bhopal have good position in the coverage of property tax. The mean value of collection efficiency of property tax observed to be 83.76%. It proves that Surat, Kochi, Ahmedabad, Vishakhapatnam, Indore, Coimbatore, Chennai and Bhopal indicate positive signal for the concerned state. The credit rating indicate composite value for act. Ahmedabad and Vishakhapatnam have adequate credit rating. It can be said that above smart cities identify important aspects namely smart people smart environment, smart mobility, smart livelihood and smart governance. Ahmedabad and Vishakhapatnam attempt a model which can be applied to any city.

(d) Financial aspect

Table-5 Financial Performance of Indian Smart Cities

Sr. No.	Name of City	% of households with access to banking facilities *	Financial Status#		
			Income (Rs. Lakhs)	Expenditure (Rs. Lakhs)	Surplus/Deficiency
1	Bhubaneswar	72.54	35.88	35.99	-0.11
2	Pune	86.36	253795	259102.00	-5307.00
3	Jaipur	73.31	39532.37	33232.12	6300.25
4	Surat	53.51	164836.7	169802.33	-4965.67
5	Kochi	82.74	1326.833	1069.87	256.97
6	Ahmadabad	70.97	191800	136100.00	55700.00
7	Jabalpur	65.01	243.72	239.89	3.83
8	Vishakhapatnam	64.01	70836.41	60846.51	9989.90
9	Solapur	63.11	1737.897	2071.23	-333.33
10	Davanagere	53.28	37429.89	39260.96	-1831.07
11	Indore	67.78	133983.7	134604.97	-621.29
12	Delhi	88.63	167100	158654.21	8445.76
13	Coimbatore	69.52	36734.33	28324.00	8410.33
14	Kakinada	54.09	7085.395	6658.56	426.84
15	Belgaum	70.97	8665.517	6176.59	2488.93
16	Udaipur	83.29	6574.983	5827.13	747.85
17	Guwahati	84.46	N.A	N.A	N.A
18	Chennai	71.12	111033.4	89193.07	21840.31
19	Ludhiana	64.81	51651.55	50787.99	863.56
20	Bhopal	67.92	100033.3	114246.61	-14213.30
	MEAN	70.3715	72865.11	68222.84	4642.26

Note: Three years average has taken for income and expenditure of 2009-10, 2010-11 and 2011-12
Source: * Tables of Houses, Household Amenities and Assets, Census of India, 2011
#Information and Services Need Assessment (ISNA) Study for Urban Local Bodies, Ministry of Urban Development, Government of India, 2012

Table reveals the financial performance of smart cities in India for the period of 2009-10 to 2011-12. The final status of Bhuvneshwar, Pune, Surat, Solapur, Devnagar, Indore and Bhopal indicate the negative position. Final status . the mean value of final status recorded to be 12790.48. It proves that, overall final status of the smart cities are satisfactory. It can be inferred that positive financial status of the smart cities provide to be sustainable as well in order to ensure successful return on investment made in developing them. Thus, making cities smart will take time and efforts.

Finding and suggestion:

The mean value of financial status observed to be 12790.48. It means the overall financial status reflects the positive signal. It may prove to be sustainable as well in order to ensure successful return on investment in smart cities of India. The smart cities are giving top priority to tertiary sector, distribution of workers and least importance to primary sector in total sectorial distribution of workers. It proves that tertiary sector plays a major role in the development of the smart cities. The smart cities identify some important aspects namely smart people, smart environment, smart mobility, smart living and smart governance. The Ahmedabad and

Vishakhapatnam attempt a model which can be applied to any city. The coefficient of correlation between density of people and literacy rate are positively correlated the T value 1.73 is statically insignificant at 95% level of confidence. The higher mean value of literacy rate ensures the evolution of smart city concept. The literacy rate help to easily judge the government policy for successful implementation of smart city development. Finding of this paper may be useful to government city, mayors, city planners and their staff to develop smart city in India. The study suggests that the intervention in a smart city need to ideally culminate in such a decision-support platform, allowing different drivers, enablers and components of a city system to interact with each other.

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