International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Analysis of Sustainable Smart Cities in India: Demographical and Financial aspect

Sunil Kumar[1], Joginder Singh[2]

[1]Associate Professor of Mathematics, Govt. Girls College, Sector – 18, Rewari (Haryana)
[2]Assistant Professor of Commerce, Govt. College, Bawal District – Rewari (Haryana)

Abstract

India is poised to become the world's most populous country by 2030, presenting an unprecedented market for global manufacturers and service providers. This demographic shift is also spurring rapid urbanization, with a growing population migrating to top-tier cities and emerging megacities expected to drive 80% of the nation's economic growth. These urban centers have significant potential to implement advanced technologies and infrastructure, optimizing scarce resources for sustainable development. The Government of India's Smart City Mission is a pioneering initiative aimed at fostering economic growth and enhancing quality of life by advancing local development through smart technologies. The mission seeks to create cities that provide essential infrastructure, a high standard of living, and a clean, sustainable environment. The approach centers on market-driven strategies to meet both supply and demand, aiming to raise awareness and optimize resources across sectors—residential, industrial, transportation, commercial, and recreational. This study explores the demographic and financial dimensions of sustainable smart cities and their contributions to economic development and societal well-being.

Introduction

The concept of smart cities emerged during a time of significant global economic challenges, with roots tracing back to IBM's "Smarter Planet" initiative launched in 2008. By early 2009, the idea of "smarter cities" had sparked interest and ambition worldwide. A smart city is an urban area that leverages advanced infrastructure, sustainable practices, and robust communications to enhance market viability and quality of life. Information technology serves as the backbone of these cities, supporting essential services and creating a connected, efficient environment. This integration relies on various technological platforms, including automated sensor networks, data centres, and intelligent data management systems, to drive continuous improvement and sustainability.

Conceptual Framework of Sustainable urban development and smart city

The concept of a smart city, though relatively new, builds on the ideas of the information city, digital city, and sustainable city. Since 2013, "smart city" has gained widespread use, surpassing other terms, including "sustainable city," in frequency and influence. As an overarching concept, a smart city encompasses various sub-themes, such as smart urbanism, economy, sustainable environment, technology, energy, mobility, and healthcare. Sustainable cities are now considered essential for achieving global climate targets, especially as urban areas house dense populations and critical infrastructure, making them both vulnerable to climate impacts and capable of driving significant environmental actions.

While nations negotiated global climate agreements ahead of the 2015 Paris Conference, cities worldwide had already begun forming partnerships and implementing sustainability measures. Over 4,000 cities, including 20 from India, have committed to more than 11,000 climate-related actions through the Non-State Actor Zone for Climate Action (NAZCA), a platform introduced at the 2014 climate conference in Lima, Peru. Sustainable urban development initiatives encompass actions such as improving energy efficiency, enhancing public transport, directly reducing greenhouse gas emissions, expanding renewable energy sources, and increasing green cover. Organizations like the International Council for Local Environmental Initiatives (ICLEI) have collaborated with cities for years, supporting them in achieving sustainability goals.

In India, several cities have set specific sustainability targets. For example, Rajkot aims to reduce its community CO_2 emissions by 14% compared to 2011 levels by the end of the year. Shimla has set a goal to improve energy efficiency by 5% from 2011 levels and increase its renewable energy share by 5% by 2019. Coimbatore has committed to increasing government operations' energy efficiency by 5% and expanding renewable energy use in government operations by 5% by 2020, compared to 2008 levels. Through these targeted actions, cities are taking meaningful steps towards a sustainable urban future.

Review of Literature

A review of the literature on sustainable smart cities highlights diverse perspectives on how digital technology, sustainability, and urban planning converge in response to contemporary urban challenges. Despite extensive discussion, there is no single consensus on defining a smart city, with definitions often overlapping but not contradicting each other (Angelidou, 2015; Hortz, 2016). Smart cities generally refer to urban areas that leverage Information and Communication Technology (ICT) to build competitive advantages, improve quality of life, and enhance sustainability (Yigitcanlar & Baum, 2008; Caragliu et al., 2011).

Characteristics and Conceptualization of Smart Cities

Caragliu et al. (2011) provide a foundational framework, identifying key characteristics of a smart city:

- Enhanced administrative and economic efficiency through networked infrastructures that support societal development
- Emphasis on business-oriented urban development
- Social inclusion across diverse urban populations in public services
- Focus on high-tech and creative industries for sustained growth
- Recognition of social and intellectual capital in urban development
- Integration of social and environmental sustainability as a core development goal

This characterization of smart cities emphasizes their role beyond technology, highlighting their social, economic, and environmental dimensions.

Core Components of Smart Cities

The literature identifies key components of a smart city—smart economy, smart mobility, smart environment, smart people, smart living, and smart governance—as essential to achieving holistic urban sustainability (Lazaroiu & Roscia, 2012; Lee et al., 2014; Jong et al., 2015). This broad view positions smart cities as evolving beyond "information cities" and "digital cities," where technology is deployed in systems and services to improve quality of life for urban residents (Jong et al., 2015).

Sustainability and Quality of Life

Marsal-Llacuna et al. (2015) argues that evaluating smart cities should incorporate principles from environmentally friendly and livable cities, focusing on sustainability and quality of life alongside technological factors. The increasing use of technological resources for urban management has opened opportunities for new market entrants focused on sustainable urban solutions (Carvalho & Campos, 2013; Angelidou, 2015).

Infrastructure and Citizen Participation

The creation of smart cities requires robust digital infrastructure and citizen-centered innovation. Schaffers et al. (2011) and Kramers et al. (2014) emphasize the need for:

- Comprehensive broadband networks to support digital applications
- Large-scale participatory innovation for application development

Cities like Barcelona and Amsterdam exemplify these principles. Barcelona views itself as a high-tech city that connects people, information, and urban elements to foster sustainability and improve quality of life, while Amsterdam focuses on changing energy-use behaviors to tackle climate issues (Lee et al., 2014).

Dimensions of Smart Cities

Nam and Pardo (2011) categorize smart cities into three dimensions:
(a) Technology (infrastructure),
(b) Population (creativity, diversity, and education), and
(c) Institutions (governance and policy).
Investments across these dimensions aim to create sustainable urban environments that improve quality of life and ensure responsible management of resources, while also fostering innovation and improving public services (Caragliu et al., 2011).

Goals of Smart and Sustainable Cities

Dhingra and Chattopadhyay (2016) outline several goals for smart, sustainable cities:

- Improve citizens' quality of life
- Foster economic growth and employment opportunities
- Ensure access to social and community services
- Promote environmentally responsible development
- Deliver efficient public services, including transport, water, and telecommunications
- Address climate change and environmental challenges
- Provide a governance model that promotes equity and participation

In conclusion, the literature on sustainable smart cities highlights the integration of digital innovation with sustainable practices to enhance urban resilience, quality of life, and environmental stewardship. While the definition of a smart city remains broad, the concept continues to evolve, with a focus on citizen-centered services, environmental goals, and innovative governance.

Objectives of the Study

The objectives of the present study are:

1. To identify which Indian city leads in terms of demographic factors as a sustainable smart city.

2. To assess the economic dimension of India's sustainable smart cities.

Research Methodology

This study employs an analytical, descriptive, and comparative methodology. Secondary data sources, including books, journals, newspapers, and online databases, form the basis of analysis. Statistical methods such as Mean, Standard Deviation, Coefficient of Variation, and the 't' test have been used to interpret the data. The analysis and resulting recommendations aim to support the robust growth of sustainable smart cities in India.

Analysis and Interpretation

The prospective analysis of sustainable smart cities in India is conducted across two key dimensions: demographic and financial. These aspects provide insight into the current status and future potential of smart city initiatives in the country.

(a) Demographic aspect analysis

Table 1 Analysis: Population Density and Literacy Rate 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 the population density and literacy rate of twenty selected Indian smart cities. In 2012, the national average density was 382 persons per sq. km, whereas the mean population density of these smart cities reached 7,941.93 persons per sq. km, over twenty times the national average. This high density indicates a substantial need for government funding in transforming these cities into smart cities. The standard deviation for density is significantly lower than the mean, reflecting a high degree of uniformity in population distribution across the selected cities.

The mean literacy rate of these cities, based on the 2011 census, was 87.58%, surpassing the urban national literacy rate of 85%. The standard deviation and coefficient of variation for literacy rate are 4.067 and 4.644, respectively, indicating less variation in literacy compared to population density. The higher coefficient of variance for population density suggests more variability in population distribution than in literacy rates. The 't' value of 2.76133 is statistically insignificant at a 95% confidence level, indicating that while literacy levels are high, there is no statistically significant difference in literacy rates across the cities studied. An 87% literacy rate, however, facilitates the effective adoption of smart city initiatives, as it ensures that the population can comprehend and benefit from new policies and technological advancements.

(b) Financial aspect analysis

Table-2 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 2 examines the financial performance of Indian smart cities from 2009-10 to 2011-12. Cities like Bhubaneswar, Pune, Surat, Solapur, Devnagar, Indore, and Bhopal showed negative financial standings, though the mean financial status across all cities recorded a satisfactory 12,790.48. This average suggests that the financial outlook for these cities is generally positive, supporting the notion that smart cities may provide a sustainable return on investment over time. However, transforming these cities into smart cities will require sustained effort and resources.

Findings and Suggestions

The positive correlation between population density and literacy rate, with an insignificant ‘t’ value of 1.73 at the 95% confidence level, reinforces the value of a high literacy rate for successful smart city implementation. The mean financial status value of 12,790.48 signifies an overall positive financial trend among Indian smart cities, suggesting potential for sustainable development and return on investment.

Key aspects of a successful smart city—smart people, smart environment, smart mobility, smart living, and smart governance—are being pursued across the cities studied, with Ahmedabad and Visakhapatnam emerging as model cities with scalable frameworks for other cities.

Suggestions

The study suggests that smart city initiatives in India should ultimately aim to create an integrated, decision-support platform. This platform would enable diverse city drivers, enablers, and system components to interact cohesively, enhancing the planning, development, and management of sustainable smart cities. The findings provide valuable insights for policymakers, city planners, and municipal leaders, aiding in the design and implementation of effective smart city strategies in India.

References

1. AIF, Poverty in India, Azad India Foundation, Kishanganj, India. available:http://www.azadindia.org/social-issues/poverty-in-india.html
2. Census of India, "Population Census-2011", Government of India, 2011. available: http://www.census2011.co.in & www.census.co.in
3. H. Chourai et. al. "Understanding Smart Cities: An Integrative Framework", Proc. IEEE Computer Science Society, 45th Hawaii International Conference on System Sciences, Hawaii, 2012, pp. 2289-2297.
4. http://smartcities.gov.in
5. J. Belissent, WEBINAR: The Core Of A Smart City Must Be Smart Governance, CIOS, Forrester, 2011.
6. available: https://www.forrester.com/The+Core+Of+A+Smart+City+Must+Be+Smart+Governance/-/E-WEB7738
7. M. F. Jawaid1, Saad A. Khan 'EVALUATING THE NEED FOR SMART CITIES IN INDIA' IJARSE, Vol. No.4, Special Issue (01), March 2015 ISSN-2319-8354(E) P a g e 991 -996
8. REPORT OF THE EXPERT GROUP TO REVIEW THE METHODOLOGY FOR MEASUREMENT OF POVERTY, Government of India, Planning Commission, June, 2014
9. The need to sustain development on a green plank, Indian Express, Published October 8, 2016.
10. www.makeinindia.com/article/-/v/internet-of-things-Smart_Cities_-_Make_In_India *(Assed on 6th Dec..2017)*