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Research Article

ENVIRONMENT, SUSTAINABILITY AND SOLAR PROJECT: FOR SUSTAINABILITY IN INDIA AS SMART CITY PROJECTS AND INDIAN GOVERNANCE

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ABSTRACT

India, undergoing a rapid urbanization, is looking towards "Smart Cities" as a solution for efficient management and improved quality of life. This descriptive study explores the concept of Smart Cities in India, focusing on their potential for sustainability. There have been many ongoing and sustainable development processes that has faced some issues and challenges that is needed to be identified and rectified by applying the methods which is both way beneficial to the people of urban and it's infrastructure as well. Cities are like sources of economic expansion even if smart cities are starting to emerge, city growth has not always been "smart" sacrificing, for example, human health for better productivity since the industrial revolution, which has undoubtedly had an impact on affluence. Top smart cities in India; include Nagpur, Pune, Delhi, Ahmedabad, Indore, Chennai, Jaipur, etc. This research study examines the opinions of citizens and municipal officials on smart cities, focusing on important areas such as mobility, environment, economics, and governance. The findings provide insight into how smart cities are expected to develop in India. Policy makers and practitioners will get valuable insights from this study on smart and sustainable cities, and it will undoubtedly contribute to the growth of India's economy by creating employment, encouraging foreign investment, and advancing technical breakthroughs. For to boost Indian Economy Government is no focusing in RRR concepts with sustainable use of natural Resource among them use of Solar Energy is prime most important and currently trending in Indian Governance with subsidy rate higher for common Indian Citizen Energy is one of the important sources for the economic development of the country. Increasing energy demand needs huge investment to meet them.

Keywords: Smart city, Economic growth, Environment Sustainability, Development, Solar Energy.

INTRODUCTION

At present there are 100 smart cities in India, which are identified by the government for development. Madurai, is the only Smart city, which has completed 100% of smart city projects by December 2023. The Government is planning to transform these smart cities into technologically advanced and environmentally sustainable urban centers. The National Smart Cities Mission is an initiative of the Govt. of India that aimed at revitalizing and rebuilding cities across the nation by creating sustainable and intelligent urban areas. The word "urbanization," which is commonly used to characterize a broad transition from rural to urban regions in terms of population, land use, economic activity, culture, etc., is another synonym for smart cities. Some of the most prosperous and economically successful cities are facing threats from air pollution, which exacerbates the effects of already-existing environmental problems. Therefore, a green and sustainable approach in the design of urban areas is vital. This means environmentally friendly and healthy, with use of ICT (Information and Communication Technology) in smart cities which enhances productivity of urban infrastructure and services. This entails using networking technology, data analytics, and sensors to track and control several aspects of city life, including energy usage, waste disposal, traffic, and public safety. The goal of urban sustainability is to lessen the negative effects of cities on the environment by conserving resources, reducing pollution, and protecting

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biodiversity. The non-conventional methods of electrical energy generation without prime mover include magneto - hydro dynamic power generation, solar power generation, fuel cells power generation, thermoelectric power generation, wind power generation, geo-thermal energy generation, tidal power generation, bio-gas, using gravitational force etc. Among these various methods and techniques of non-conventional electricity generation solar power generation is the most convenient and popular method. This includes initiatives to promote renewable energy, improve water and air quality, rehabilitate green spaces, and mitigate the consequences of climate change. Sustainable cities foster economic prosperity by promoting innovation, entrepreneurship, and job creation. This includes investments in education, skills development, infrastructure, and technology that support economic growth, while ensuring equitable distribution of benefits and opportunities across urban populations.

Urban area development also depends on the application of cutting-edge technologies and the active participation of stakeholders and end users in energy saving. The concept of sustainability presents a number of challenges in India, mostly due to the passing of time and the requirement for specific investment along with altered tax laws and regulations to boost investment profitability. In order to meet the increasing demand for urban space while also developing a workable solution that stays within the tight budgetary constraints, this paper will look at the insights that urbanization has brought to smart cities as well as the issues associated with urban growth. One such possibility for cities of the future is believed to be the idea of smart cities, which simultaneously figure out a practical and sustainable solution within the financial constraints. One such answer for the cities of the future is thought to be the concept of smart cities. The purpose of this research study is to find the gap between different research findings done on this topic by the different authors. To be unable to reach out the best possible ways and techniques to enhance and built better positions of the smart cities in India. Research study conducted by the authors are definitely going to prove useful for the development of the infrastructure, education, health, employment, transportation etc., for the underdeveloped states of the countries so that there is a sustainability of smart cities in India. The study fully concentrates on the various issues to be dealt with regarding the sustainability of the cities from transforming developing cities to becoming the smart cities. A total of 97 cities will be targeted in phases for the building of comprehensive infrastructure.

Their exact temporal distribution in phase is: first spherical Twenty towns were chosen from 97 towns that were completed as part of the smart city mission for financing in the fiscal year 2015–16. The other towns were funded in the next three years (2017–2020). The second phase of the project (2016–17) included 54 towns that had amended ideas by June 30, 2016. The following 20 cities were chosen in 2015: Solapur, Devangere, Indore, NDMC, Coimbatore, Kakinada, Belagavi, Bhubaneswar, Pune, Jaipur, Surat, Kochi, Ahmedabad, Jabalpur, Visakhapatnam, Udaipur, Guwahati, Chennai, Ludhiana and Bhopal. This study is regarding the challenges that are faced by some cities, which are on the edge of transformation from mere city to becoming a developed state or city, and then sustainability plays a very important role in the development of the same. The usage of solar energy in urban areas has evolved over time. The incorporation of solar energy into smart cities has been greatly aided by early projects and milestones. The extensive use of solar panels and other solar technologies in urban infrastructure has been made possible by these initiatives. Solar Photovoltaic Systems: In solar photovoltaic conversion, sunlight is directly converted into electrical power by photovoltaic (PV) devices or solar cells.

MATERIALS AND METHODS

Study Area Allahabad city

The city of pious rivers like Ganga and Yamuna known for its confluence is taken as a case study where there is a holy confluence of religion, culture and heritage. A start in this direction is India's goal to establish 100 smart cities through its smart city program. The Ministry of Urban Development in India for see that one of the imminent smart cities would be Allahabad. India has embraced smart city technology, however with certain modifications based on the research field. A systematic approach that includes a thorough evaluation of the rudimentary and pivotal criterion for smart city modification as well as taking note of the city's willingness to realize the smart city vision has been adopted in order to understand the current state of Allahabad by analyzing various social, economic, and urban components and metrics and its readiness for smart city transformation." When a city plans its preventive maintenance activities, monitors security aspects, and keeps an eye on the state of all of its vital infrastructure—roads, bridges, tunnels, trains, subways, airports, seaports, communications, water, power, and even large buildings—it can more effectively manage its resources and maximize services to its residents." (Hall 2000).

Smart Cities Mission and Future Prospects

With the establishment of the "Smart City Mission" by the Ministry of Urban Development, Government of India in 2015, the country's policies toward urbanization and development underwent a paradigm change. The Indian government has changed its urbanization strategy to area-based urban development, concentrating on the cities that the Smart City Mission has identified as priority cities. With four development pillars inclusiveness, institutional, physical, and economic infrastructure smart cities will be equipped to meet the needs and ambitions of their populace. The idea of a smart city will provide a replicable model that will serve as a beacon of hope for other aspirational towns. The core infrastructure factors of a smart city shall include the improvement of Good water

deliver, assured energy supply, Sanitation, which includes waste management, efficient urban mobility & public delivery, affordable housing in particular for the negative, robust IT connectivity & digitization, precise governance, in particular e- governance & citizen participation, Sustainable surroundings, protection and protection of citizens mainly of girls, kids and the aged, health and education (Report of the Smart City Mission 2015) .

Enhancing great of existence

Improving the overall great of existence for city citizens with the aid of presenting better get admission to critical offerings which include clean water, sanitation, healthcare, training, and housing.

Infrastructure improvement

Upgrading and modernizing city infrastructure to meet the growing needs of city populations, which includes transportation systems, street networks, water supply, sewage remedy, and stable waste control.

Selling Sustainability

Integrating sustainable improvement ideas into city planning and design, together with the usage of renewable energy resources, power-green homes, green areas, and sustainable transportation answers to lessen environmental effect and useful resource intake.

Observations and Result

Our studies show that resource utilization, infrastructure management and services have improved in Indian cities due to the use of smart technology. For example, the use of smart meters for energy and water management has led to significant reductions in usage and costs. With the introduction of smart transportation systems, traffic flow in big cities has become uniform and traffic congestion has decreased. While India's smart city projects have advantages, they face challenges in terms of financing, technology, infrastructure and legal frameworks. The development of many efforts is hampered by insufficient funding, execution of work, and lack of cooperation from all parties. The digital divide and technology inequality also highlight concerns about integration and equity in the creation of smart cities. While the smart city strategy in India focuses on technological solutions to urban probl ems, environmental sustainability principles, which are important in urban planning and construction, need to b e prioritized. Reducing environmental impacts and building resilience to climate change requires strategies that include expanding renewable energy, sustainable housing and good transportation. Many studies have shown the importance of community participation and public participation in smart citie s and urban projects. It is important for residents, local communities and citizens to participate in the decision-making process in order for plans to meet the goals and needs and to benefit the public. In addition to supporting residents and communities, collaborative technology can also provide many long-term benefits. Research shows that it is important to put policy and governance in place for smart cities and urban sustainability in India. Establish clear targets, management incentives and construction standards should to ensure responsible urban development and encourage innovation and direct investment. Smart cities require good governance that encourages openness, collaboration and public participation. Monitoring and evaluation are necessary to measure the impact and success of smart projects in cities and towns. Monitor progress towards sustainable development goals and evaluate the effectiveness of measures using indicators such as energy efficiency, air quality, transport and equity. Data driven ideas such as impact assessments and performance evaluations can support municipal decision-making and guide future investments. Overall, the results highlight the importance of approaching smart cities and urban sustainability issues in India with comprehensive and integrated approaches. By solving problems related to technology, environment, people and government, cities can become engines of integration and positive and sustainable growth.

Limitations and Recommendations

While research on Smart Cities and Urban Sustainability in India provides valuable insights, it also has limitations that should be acknowledged. Here are some common limitations:

One of the key limitations is data availability and quality

It's a dearth of reliable information on critical indicators be it social equity, pristine air composition or efficient energy employment. The reality thus eludes easy grasp; it dances beyond evaluation that might offer clear conclusions, making impenetrable the cloak enshrouding urban sustainability with all its smart city guises.

Smart city and urban

Studies may have differing outcomes based on temporal as well as geographical disparities. The generalizability of findings can be hampered by differences in variables across cities and regions like topography, seasonality, and socio-economic status. There might not be applicable to all cities or even two different parts of the same city due to these varying local features.

Problems

that often appear in smart cities and urban research include deciding appropriate indicators, measurement techniques, and ways of data analysis. The use of different methods in different studies can make it difficult to compare results and reach consistent conclusions.

Problems in Urban Ecosystems

The concept of social, economic, environmental and political influences that make cities dynamic and complex. It uses a multidisciplinary approach that combines knowledge from a variety of disciplines, including urban

planning, environmental science, economics, health, and public policy rules, to understand the interactions and interactions in these systems.

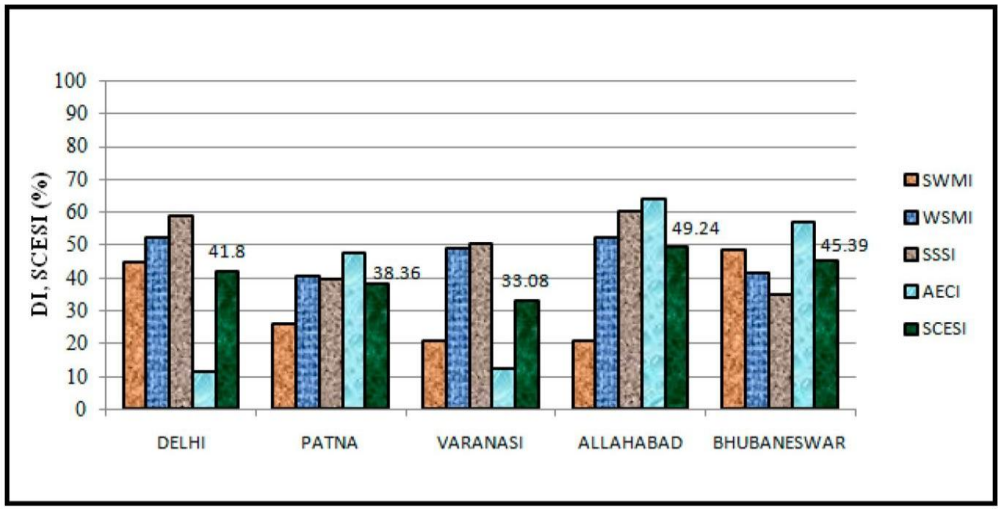

Figure 1. Showing data of Top 5 smart cities of India.

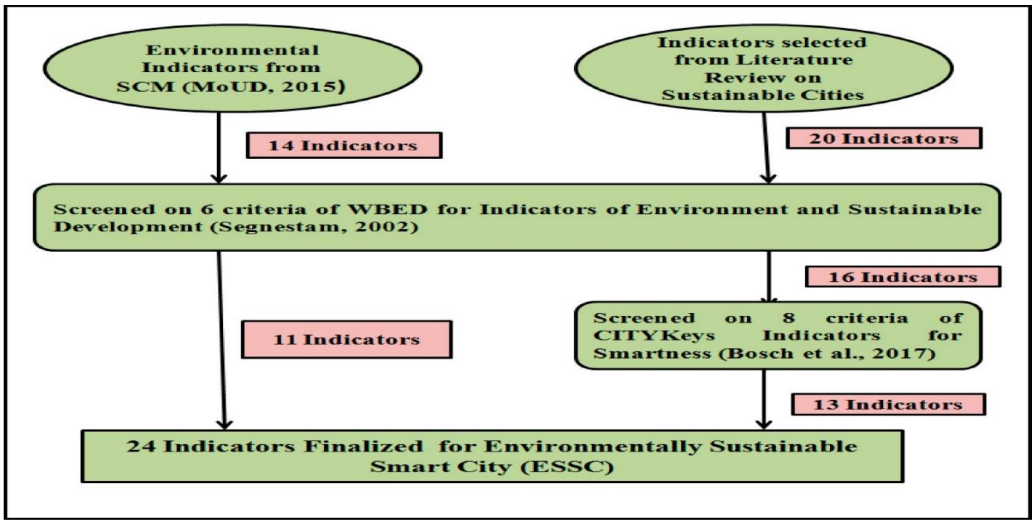

Figure 2. Process of indicators selection for Environmentally Sustainable Smart Cities (ESSC).

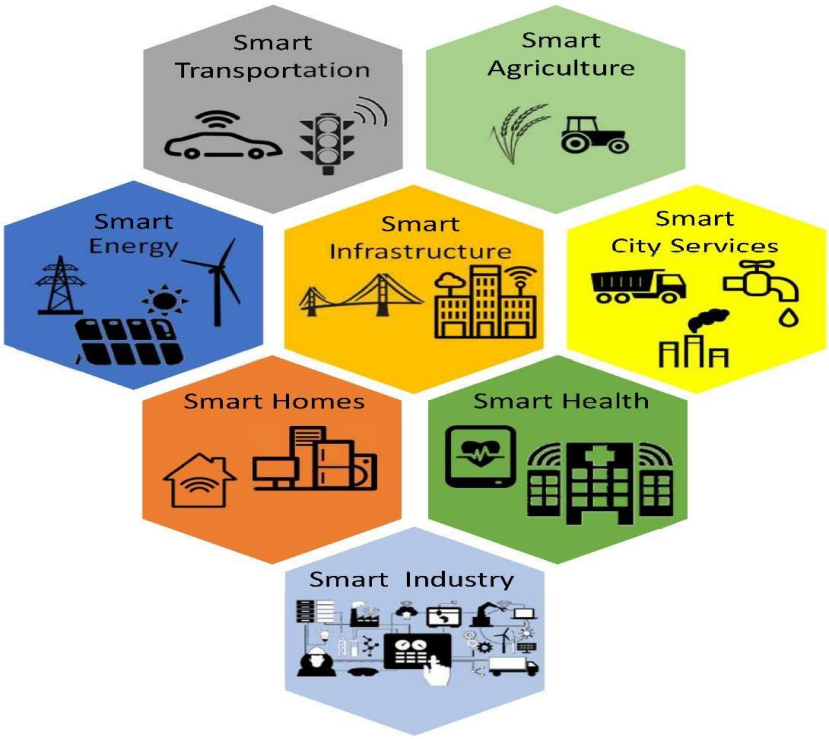

Figure 3. Image showing various aspects of smart cities in India.

Fact

Voluntary transfer of research from one city or region to another may not be possible due to difference s in local environment, culture, government policies, and development goals. The efficiency and sustainability of smart cities and urban services are greatly affected by different factors6. Few Long-Term Studies: A lot of research on urban sustainability and smart cities concentrates on immediate results, missing longer-term patterns and effects. Studies using a longitudinal design, which monitor changes over time, are crucial to comprehending the long-term efficacy and resilience of therapies. According to Shruti et al. (2020), study was conducted about the environmental sustainability in urban cities where it is difficult to stay amid air and noise pollution. The study's goals are to create a framework for assessing a smart city's environmental sustainability, progressing towards the creation and growth of environmentally sustainable smart cities: an approach of this tool consists in classifying smart cities according to environmental sustainability and revealing places of priority that need attention and action. Therefore, a concept of "Environmentally Sustainable Smart Cities (ESSC)" has been the matter of concern for few cities like Delhi; Patna; Allahabad; Varanasi; and Bhubaneswar have been examined. It is anticipated that the number of people living in cities would rise to 540 million, or 40% of the overall population. By 2030, this enormous expansion will account for 70% of new jobs and 70% of India's GDP.

Another study conducted by Praharaj, (2021) puts emphasis on the arguments made by so-called "smart cities" against real-world urban change and assesses how "inclusive" and "sustainable" these changes are and put a number on the scope and size of the smart city urban regeneration projects in the cities. In order to identify any inherent bias in these smart city efforts about the development types they favor and overlook, the paper also provides a statistical analysis of the sectoral emphasis and financial allocations of the projects under the Smart Cities Mission. The results show that a focus on digital urban regeneration in particular precincts and enclaves— dubbed "smart cities" leads to a rise in gentrification and social division. Sharma and Rajput (2017), lay stress on the integrated technique of remote sensing (RS) and geographic information systems (GIS) in Nagpur city was used to analyze the influence of urbanization on land surface temperature. The study shows that GIS was used to detect urbanization and measure land surface temperature in the area. In order to conduct more research into the association between land surface temperature behavior and urban structures, the land surface temperature data was then connected to land use data of Nagpur city. The findings show that metropolitan regions saw unequal growth over the research period. The urbanized area's surface radiation temperature has risen by 1.33 °C due to the fast expansion of cities. The study also demonstrates how useful the combined use of RS and GIS is for tracking and analyzing urban growth. Another research study conducted by Pathak (2020), states that basic infrastructure services are expected to be provided by the ULBS (Urban Local Bodies) with the supply of clean drinking water, sewage systems, housing, transportation, and communication, as well as health and education to promote equitable growth. However, due to

horizontal issues, the urban problems could not be resolved. The extension of urban regions to their unplanned peri-urban surroundings. Metropolitan de-concentration begun at the metropolises' cores, despite the fact that these areas are saturated. Urban growth now faces additional obstacles as a result of its challenges, which have spread to the unplanned perimeter. Smart metropolis calls for smart people to take part in the governance. The clever solution and implementation of reforms shall make the smart cities sustainable – ICT & cell primarily based tools will be used to combine the clever towns. Based on the findings of smart cities and urban sustainability in India, here are some recommendations for poli cy makers, urban planners and stakeholders:

Integrate innovation with sustainability

It is essential to ensure technology integration with sustainability standards in smart city studies. Create comprehensive plans that use smart methods to solve environmental pro blems, stimulate economic savings and improve urban equity. Promote integration: Highlight the integration relationship in the design and implementation of smart cities and prioritize the development of laughter equality. Ensure that policies and measures take into account the nee ds of all segments of society (disadvantaged groups and disadvantaged communities). Encourage the active participation of individuals, local communities and civil society in decision making pr ocesses for smart cities and urban sustainability to increase community participation. Establish a process for op en debate, consultation and participation to ensure public views are considered and heard.

Strengthening policy and regulatory frameworks

Develop and implement policies and regulatory frame works suitable for smart cities and urban development. Guide investment, stimulate innovation, increase urban development responsibility, clarify policy objectives, provide administrative incentives and establish institutional frameworks.

Investing in knowledge sharing and capacity building

To improve the planning and implementation of s mart cities and urban sustainability, government officials, city representatives, and community leaders should invest in resource development. Cities are encouraged to share best practices and expertise to support innovation and learning. Create a monitoring and evaluation system to measure the effectiveness and impact of smart city and urban sustainability initiatives. Develop metrics and key performance indicators to tra k achievement of sustainability goals and ensure accountability. Use a data driven approach to make decisions a nd inform future urban development. Promote PPP as a way to allocate resources, spread risk, and develop strategies for urban development and smart cities. Build partnerships between government, business, academia and civil society to promote collaboration, resources and knowledge for urban development. Making environmental sustainability a priority in smart city planning and development by promoting energy efficient buildings, renewable energy, green buildings and environmentally friendly transportation options. Provide urban climate change strategies designed to improve the capacity of cities to modify the effects of climate change.

CONCLUSION

To conclude, this analysis has shown that Smart City initiatives hold important promise for enhancing more sustainable future for Indian cities. By prioritizing realms like efficient waste management, renewable energy integration and sustainable infrastructure development, these projects can contribute to a cleaner environment, improved resource management and a higher quality of life for residents of urban areas. However, some issues remain in areas such that ensuring equal access to smart city benefits and mitigating the complex technological infrastructure involved. A continuous research, collaboration between stakeholders, and a focus on long-term sustainability will be crucial in determining the ultimate success of Smart cities in India.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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