Engineering the Urban Breath: An IIT Hyderabad Assessment of the Smart Cities Mission's Impact on Local Air Quality

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1. The Urban Imperative: Why Air Quality Demands a Smart Solution

India's journey towards becoming a leading global economy is inextricably linked to the rapid development and expansion of its urban centers. While this growth signals prosperity, it has concurrently generated significant environmental challenges, including unplanned migration, land-use changes, and, crucially, a considerable degradation of ambient air quality. Air pollution levels in Indian cities have been a major concern, with the rise in particulate pollution being identified as a big risk factor contributing towards the country's disease burden and impacting health, with exposure increasing the risk of illnesses such as bronchitis and lung cancer. Beyond local health crises, rising air pollution levels also contribute towards global climate change.

In response to this mounting challenge, the national administration, supported by the Central Pollution Control Board (CPCB) and State Boards, has launched several programs for source identification, monitoring, and action plan development. Amidst this, the Smart Cities Mission (SCM), a Central Sector Scheme under the Ministry of Housing and Urban Affairs (MoHUA), was hypothesized to have major positive implications on the improvement of local air quality (LAQ) through the integration of smart technologies and infrastructure.

This Sustainability Impact Assessment Study, conducted by the Indian Institute of Technology Hyderabad (IITH) under the SAAR-Sameeksha Series, aimed to meticulously examine the direct and indirect effects of SCM projects on enhancing local air quality practices across 100 Smart Cities. The specific objectives were to assess the present efforts for Air Quality Improvement at the National Stratum, undertake a Primary Impact Assessment through field visits, and propose appropriate recommendations for overcoming the identified gap areas.

2. Methodology: Bridging Policy and Field Reality

The study employed a robust, two-tiered methodology to ascertain the impact of SCM on LAQ improvement.

- **National-Level Theme-based Impact Assessment**: This involved the circulation of a comprehensive questionnaire to all 100 Smart Cities through MoHUA, which sought to quantify the status of LAQ within these cities.

City Visits and Detailed Primary Assessment: A total of five cities—Indore (Madhya Pradesh), Lucknow (Uttar Pradesh), Pune (Maharashtra), Surat (Gujarat), and Kochi (Kerala)—were strategically selected for in-depth field visits. Selection criteria included alignment of the city's projects with the LAQ theme and geographical representation of the Indian landscape.

These field visits allowed for a detailed assessment of the technical, social, environmental, and economic impacts of SCM projects.

It is important to note the study's observed limitation: since 'Air Quality Improvement' does not form one of the explicit thematic focus areas of SCM, projects directly associated with it are limited. Therefore, the assessment considered projects likely to improve urban air quality indirectly, such as the development of green spaces, renewable energy, and public transportation improvements.

3.National Inferences: The Green and Digital Pivot

The analysis of responses from all Smart Cities at the national level revealed that project implementation and data availability related to LAQ Improvement were still limited. Nevertheless, a clear trend emerged regarding the implementation of indirect LAQ-enhancing projects:

- **Green Infrastructure Focus:** The most common focus area through which SCM was contributing was the enhancement of urban green spaces. Projects related to the development of parks and open green spaces, along with roadside tree plantations, were implemented by almost all cities.
- **Source Understanding:** 'Urban Greening and Development of Open Public Spaces' as well as 'Source Apportionment to understand local sources of Air Pollution' were the key focus areas where several smart cities had implemented projects.
- **Clean Energy and Mobility:** Projects enhancing non-motorised means of transportation (such as public bike sharing systems) and popularization of renewable energy sources (solar photovoltaics) have been implemented by all cities, having a positive impact on local air quality.

Crucially, Integrated Command and Control Centres (ICCCs) in cities like Lucknow, Pune, and Surat are implementing smart solutions for traffic management through the Adaptive Traffic/Transit Management System (ATMS). This system is designed to reduce journey times and traffic congestions, and improve speed efficiency and access to public transportation. All these interventions ultimately result in the reduction of vehicular emissions, contributing significantly towards air quality improvement.

4.Field Visits: Case Studies in Urban Innovation

The primary assessment, based on field visits, provided granular details on how selected cities are leveraging SCM funds and infrastructure:

4.1. Lucknow: Collaboration and Smart Monitoring

Lucknow's approach is marked by an innovative, multi-stakeholder collaboration for LAQ improvement.

- **Integrated Traffic Management:** The ICCC's Integrated Traffic Management System (ITMS), which comprises the Adaptive Traffic Control System (ATCS), Traffic Surveillance System (TSS), and Traffic Enforcement System (TES), is fully functional. This system is leveraged by the Air Pollution Action Group (A-PAG), with which the Lucknow administration has signed an MoU (Figure 1).
- **Targeted Source Identification:** SCM-Lucknow provided A-PAG with 32 PTZ Cameras for the identification and monitoring of recurring/chronic issues leading to air pollution, primarily focusing on chronic garbage dumping sites. This strongly suggests that effective Solid Waste Management (SWM) through improved collection and segregation efficiency would lead to long-term reduction in open dumping, thereby having a net positive impact on LAQ.
- **Environmental Sensor Network:** Smart City Lucknow is monitoring data generated by a total of 35 environmental sensors installed across the city, including five installed by SCM-Lucknow, six by UPPCB and CPCB, and the remaining by a private vendor (LMC). This network monitors both air pollution parameters and hydro-meteorological parameters, allowing for the generation of alerts.

4.2 Indore: Citizen Awareness for Cleaner Transit

While Indore's reputation is largely built on SWM excellence (from the parallel SWM assessment study), its LAQ efforts through SCM are focused on citizen engagement as shown in Figure 2. Specifically, the city has undertaken citizen awareness campaigns for traffic awareness, which directly feeds into the reduction of vehicular congestion and, consequently, tailpipe emissions.

4.3 Surat: Promoting Clean Commute

Surat has actively promoted clean and non-motorised transportation under the SCM.

- **Public Transport and Bike Sharing**: The city has invested in a public bike sharing system, which provides a clean mode of transportation, improves last-mile connectivity, and has a potential positive impact on the health of residents. Data provided by the Smart City indicates that approximately 2.5 lakh commuters are daily using the public transport services.
- **Digital Traffic Management**: The city's ICCC also utilizes smart solutions for traffic management through ATMS.

4.4 Pune: Digital Management and Quantification Need

Pune's ICCC is instrumental in implementing smart traffic management solutions through the ATMS to reduce vehicular emissions. However, a key conclusion from the primary assessment, covering all cities including Pune, was that while projects contribute towards 'air quality improvement,' their specific impact needs to be better quantified through empirical evidences.

4.5 Kochi: Leveraging Renewable Energy

Kochi's projects are contributing to LAQ improvement by popularizing renewable energy (solar photovoltaics) sources. The installation of solar energy systems helps mitigate emissions associated with conventional energy generation, thus having a positive impact on ambient air quality. Also, the Public Bike Sharing System launched in 2019 in a PPP model with CSML and KMRL being the major stakeholders. Around 1000 cycles were procured as part of the project. Presently citizens can access around 900 cycles from 46 docking stations including 21 metro stations around the city as shown in Figure 3 benefit the local air quality.

5.Recommendations and Policy Directives

The study concludes that several SCM-medicated projects are contributing towards the cause of local air quality improvement. However, to truly harness the mission's potential for urban air pollution mitigation, future projects need to be significantly streamlined Based on the National Assessment and Field Visits, the IITH team proposes the following policy directives and future directions:

- **Direct Thematic Inclusion:** The most crucial requirement is an amendment to the SCM guidelines for the formal recognition of 'Local/Urban Air Quality Improvement' as a direct thematic focus area or vertical of the mission. Since SCM projects for LAQ are currently limited and indirect, this inclusion would significantly influence Smart City Special Purpose Vehicles (SPVs) to propose projects directly related to the abatement of air pollution.
- **Focus on Pan-City Initiatives:** Air quality improvement, like solid waste management, is inherently a pan-city initiative. Since most SPVs limit their civil and developmental works to Area-Based Development (ABD) areas, it is suggested that greater weightage be given to future proposals that incorporate pan-city developmental projects focused on LAQ improvement.
- **Boosting Academic-Industrial-Governance Collaboration:** The success of the Lucknow SPV's MoU with A-PAG is a valuable model. Boosting Public Private Partnerships (PPP) projects that target academic-industrial-governance collaborations is suggested for better source identification, data analysis, and timely mitigation of air pollution.
- **The Behavioral Change Imperative:** Citizens often perceive air as a "free resource," leading to a lack of demand for clean air standards in new developments. Smart Cities SPVs must plan and implement extensive awareness campaigns for a behavioral change among city residents, making them aware of their right to clean air. Once citizens demand the presence of clean air, upcoming projects would be bound to monitor and report emissions more robustly.

The findings of this sustainability impact assessment offer an insightful overview of city-specific challenges, gap areas, and strategies. By prioritizing the formal inclusion of Local Air Quality in the SCM mandate and leveraging the digital backbone of the ICCCs, India's Smart Cities can strategically transition from indirect contributors to direct mitigators of urban air pollution, securing a healthier, more sustainable future for its citizens.

Acknowledgement:
The authors would acknowledge the Ministry of Housing and Urband Affairs for the funding support to carry out the study on

To read the full report:
https://www.iith.ac.in/projects/sustainability_impact_assessment_local_air_quality/

Figure 1: Before/After Images depicting various types of issues (A: pothole; B: Unpaved Road; C: Bricks and concrete on public land; D: Garbage dumped on public land) impacting local air quality identified under the DSP initiative of A-PAG and their resolution (Source: A-PAG) in Lucknow

Figure 2: Pictures from the campaign (Red Light-On Engine-Off) organized to combat air pollution as provided by the Indore Smart city as well as from the visit to one of the several Ahilya Vans established across city to enhance urban green cover.

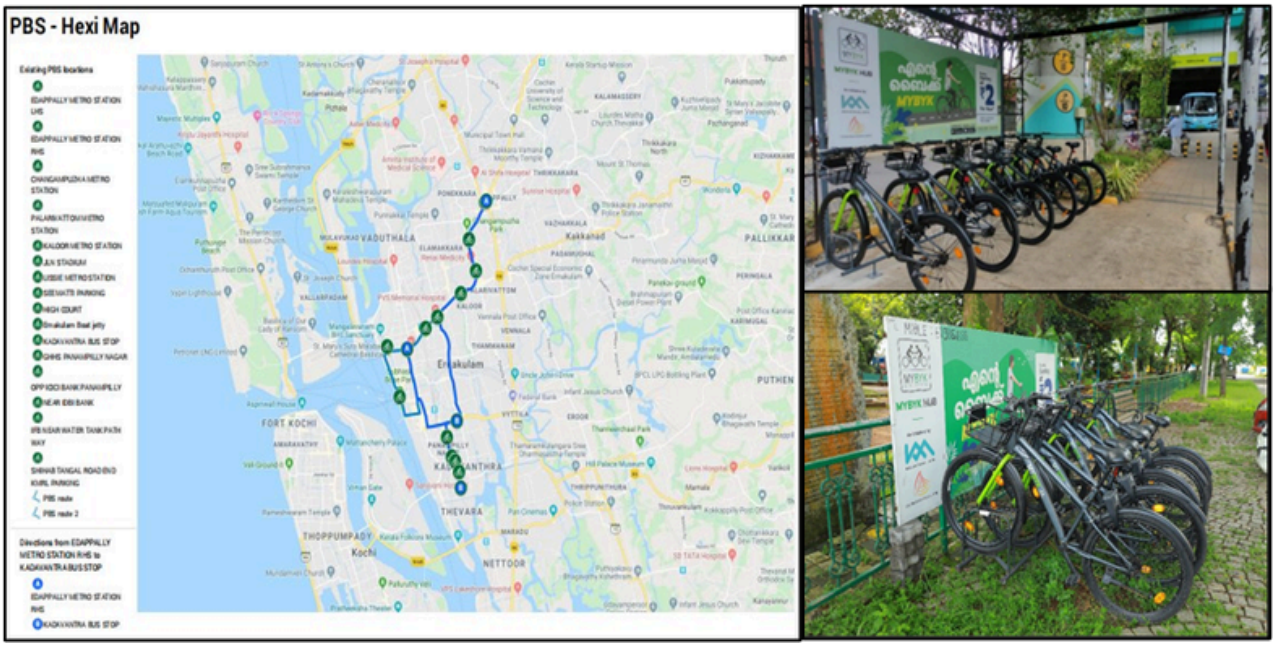

Figure 3: Map showing the location of the 46 docking stations developed under the PBS system and bicycles parked in some of the docking stations in Cochin (data provided by CSML)

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