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BUILDING HEALTHY CITIES

INCREASING COMMUNITY PARTICIPATION IN AIR POLLUTION MITIGATION

Executive Summary

The United States Agency for International Development (USAID)-funded Building Healthy Cities (BHC) project led an innovative air pollution study in Indore, India. The purpose of the study was to assess opportunities for community participation in both measuring and identifying main sources of air pollution, and mitigation measures using local data from low-cost air quality sensors (LCS). This work is increasingly urgent as recent evidence demonstrates significant impacts from air pollution on maternal health outcomes, including low birth weight and stillbirths.

This study was conducted in close consultation with the Madhya Pradesh Pollution Control Board (MPPCB) and Indore Smart City Development Limited (ISCDL), and with implementation support from the Indore School of Social Work, TD Environmental Services, and Skymet Weather Services.

Methods

This study focused on 19 strategic locations, which were identified in consultation with city authorities, covering residential, industrial, commercial, and traffic locations. LCS were procured, calibrated, and installed at all locations. For each site, a local community volunteer was identified and trained as a Clean Air Guide (CAG), with three main functions: maintain and read the LCS; educate the community; and organize and support advocacy efforts.

This mixed-method participatory action research study was carried out in Indore, India, with active data collection occurring between March 2021 and March 2022. The quantitative portion included community survey and air quality data from 19 neighborhoods. Pre- and post-training knowledge tests were also collected from the CAGs. The qualitative data included group discussions with community members, in-depth interviews of individuals including city officers and service managers, and information collected through journey maps.

THRIVE NETWORKS

International Organization for Migration (IOM) The UN Migration Agency

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Results

The objectives and results of the study were broken down into the following research questions:

1. How have LCS been used by low-income communities in Indore to effectively monitor air quality in their neighborhood?

BHC found that in general, the participating communities were interested in, and accepting of, air quality data from the sensors and the CAGs. When using these LCS in these communities, it is important to consider where to install them, and who makes that decision. BHC negotiated the placement across multiple neighborhood types with city officials, and ensured the locations met the technical requirements provided by Skymet. Functionally, once collocation was completed the LCS worked well in these local settings. Performance assessments of the Skymet LCS relative to the MPPCB's reference instrument at Chhoti Gwaltoli indicated the LCS met or exceeded the U.S. Environmental Protection Agency's (EPA) performance targets for air sensors.

While there were some gaps in the LCS data due to connectivity issues, the completeness rate exceeded EPA targets and was 93 percent at the collocation site. As a cadre, the CAGs appeared to provide a useful service. Based on $PM_{2.5}$ levels, CAGs prepared color-coded charts to illustrate the air quality for each day of the month. They also described variations due to climate conditions, festivals, and ceremonies. Community members were able to understand air quality better using color-coded charts rather than numeric values. CAGs used these charts in group sessions with community members and during public awareness campaigns.

2. Did these data make any difference in the knowledge, attitudes, and/or practices relating to air pollution creation or avoidance, first in the CAGs, and then in their communities?

There was evidence that the CAGs gained knowledge about air pollution and air quality in their neighborhood. The average knowledge score for CAGs increased from 68 percent pre training to 86 percent post training ($P<0.05$). The monthly meetings that BHC held with CAGs also provided insights into their changing perspectives.

The community survey provided evidence on any changes in general citizen knowledge, attitudes, and practices during the study. On average, respondents who lived in areas with higher $PM_{2.5}$ readings were more likely to say their community suffered from air pollution; respondents in residential areas always had a higher perception of air pollution when compared to respondents from the other types of areas. By round 2 of the survey, respondents from all site types increased their perception that efforts were being made to change air quality.

Respondents who thought air pollution had an adverse effect on health dropped from 92 percent in the first round of the survey to 78 percent in the second, but the change appeared to be in those areas with the lowest levels of air pollution. In round 2, 20 percent of respondents mentioned that their health problems not related to COVID-19 had increased over the last year. There were higher rates of nose, throat, and breathing problems, eye irritation, skin issues, and cancer in the areas with higher $PM_{2.5}$ values.

We saw promising results around changing practices in the second round of the survey. When asked if citizens saw any greater efforts to control air pollution since January 2021 (near the start of the study), 51 percent said they did see an increase. Among those who said that efforts had increased, nearly 70 percent said those efforts included building green spaces. The next most common answer was better traffic management, followed by curbing waste burning, mechanical sweeping of roads, and promotion of liquefied petroleum gas through the Ujjwala scheme. Nearly a quarter of respondents had also newly started various air quality activities since 2021, and about half had increased these activities during the study period.

3. Have the LCS been effective in identifying locations with higher pollution across the city and potentially identifying sources of air pollutants? How does the air quality data lead to action by CAGs or the community?

Formal source apportionment studies are effective at identifying sources of pollution but can be expensive and time consuming. One question this study aimed to answer was how much information on sources of pollution can be gleaned by triangulating data from LCS, community members who live in those environments, and visual observations by the CAGs.

This study was able to use the LCS to better identify patterns of air quality across the study sites to understand variations due to weather, time, type of site, and events that could deteriorate air quality. Seasonal variation in the LCS data matched with qualitative information from the CAGs. Higher values of $PM_{2.5}$ that occurred in April and November 2021 matched with qualitative information from the CAGs mentioning a higher number of deaths—leading to more cremations—during the second wave of the COVID-19 pandemic in April 2021 and the use of firecrackers during the Diwali festival in November of that same year.

In general, air quality worsened from the evening onward and $PM_{2.5}$ remained high during the nighttime. This may be due to waste burning, cooking, and lower temperature leading to inversion, which traps pollutants near the ground. Sites close to industrial zones and traffic congestion points also had more days with moderate to very poor air quality. On average, those living at the study sites spent 30 percent of their days at or above the Indian national daily threshold for air quality. Spot air quality index maps were used to illustrate variation across sites and the impact of specific events on air quality, such as Diwali, other festivals, COVID-19 cremation rates, and other locality specific events.

While these data are helpful, it is important to note what functions these data cannot perform. These data cannot be used to identify a specific causal link between a particular source and the air quality readings in the sensors. In addition, because the sensors BHC installed only read $PM_{2.5}$ data, other types of pollution will be missed. This may affect industrial areas in particular, where sulfur dioxide and nitrogen dioxide are more prevalent pollutants.

4. Have the sensor data been accepted by the official groups as valid and relevant? How does the air quality data lead to action by the government?

Aside from those official groups that had to hew closely to national guidelines on air quality monitoring, the LCS and CAGs were both received very positively by local government departments. The air quality data, along with the qualitative data and advocacy from the CAGs, led to interesting increases in action for air quality by the government. Some of the important issues discussed between CAGs and government authorities that resulted in action included:

1. Reducing burning of waste by community and/or Indore Municipal Corporation workers.
2. Promoting use of electric crematoria.
3. Improving traffic management.
4. Increasing compliance with guidelines at construction sites.
5. Reducing pollution from vehicles.
6. Reducing industrial pollution.

Discussion

This study adds to a small but growing body of evidence linking strategic community action to change in air and other types of pollution in urban settings. This type of work is not without its shortcomings, but can be a powerful, affordable way to expand the monitoring network for air pollution across cities, identify pollution sources that bother residents the most, mobilize residents and city authorities to act on pollution issues, and create citywide awareness.

The CAGs have been welcomed by ISCDL as a helpful cadre, and Indore Municipal Corporation has now included air quality as one of the goals of its Clean India (Swachh Bharat) campaign for 2022-23. Two of the CAGs were recognized with "air warrior" awards for their contributions, and seven CAGs were recognized with the MP Gaurav Ratna Samman award by Rashtriya Nari Sashaktikaran Sangh (National Women's Empowerment Group). Another CAG won first prize in a competition for a tagline for a Clean Air campaign.

Now that this study and the BHC project have ended in Indore, the LCS have been handed over to ISCDL. In order to sustain this work, ISCDL signed a memorandum of understanding with the Confederation of Indian Industries (CII). CII will continue our air quality approach of using LCS data in monitoring air quality, engaging community volunteers (now called Clean Air Champions) and expanding the network of LCS (30 more sensors were added by CII). In addition, the USAID-funded Clean Air Catalyst project is also actively working in Indore to make Indore cleaner and greener and will add three sensors of their own to the Indore context.

Recommendations

For those taking this work forward, and for those cities considering similar studies, the study team has pulled together the following recommendations:

- The CAGs (now Clean Air Champions) should continue as a regular, paid cadre to help mobilize residents and city authorities toward clean air activities. In order to sustain them,

the city will need to better understand what remuneration is needed, whether these would be part- or full-time positions, and how to retain their advocacy role within the community, even if they are being paid by the government.

- Indore is taking the lead in adding clean air to its definition of a clean city. The National Clean India Mission should consider how to integrate data from LCS as part of their monitoring and evaluation framework for the Swachh Bharat campaign.

- The current Central Pollution Control Board (CPCB) rules limit the ability of cities to use LCS for more widespread pollution control activities. Many major cities worldwide already allow for visualization of private LCS and official monitoring stations. CPCB should consider revising its guidance to allow for more integration of these two types of pollution data sources, while still fully acknowledging the official sensors as "gold standard" data.

- Cities should consider how best to connect CAGs with frontline health workers including accredited social health activists, Anganwadi workers, and auxiliary nurse midwives. This can also include coordination with Mahila Arogya Samiti under the National Urban Health Mission. While there should not be duplication of efforts, it would be useful to create regular communication between CAGs and frontline health workers about poor air quality. A potential result of this communication is a local monitoring and alert system for groups most vulnerable to poor air quality, such as pregnant mothers, children under 5 years old, and people with asthma, heart disease, and respiratory illnesses. This coordination could also inform a larger cross-city effort to develop automatic mechanisms to alert citizens when pollution levels rise.

- Air quality data should be integrated into existing information systems and networks. In Indore, these data have already been incorporated into the Smart City Integrated Command and Control Centre. There are also potential benefits for the planning and prevention of illness when these data are integrated into selected health management information systems such as the Integrated Disease Surveillance Project and databases of NCDs and their risk factors.

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