PRESS RELEASE

Mapping Bengaluru's air pollution using hybrid monitoring methods

For Immediate Release

Bengaluru, 27 July 2023

Air pollution poses a significant threat to human health, and accurate measurement at high spatial resolution is crucial for its effective management. However, maintaining a dense network of reference-grade instruments is often financially and technically burdensome, particularly in low- and middle-income countries. In a pioneering study conducted in Bengaluru, India, a hybrid approach combining novel monitoring methods has provided valuable insights into the city's air pollution patterns.

The study conducted by the Center for Study of Science, Technology and Policy (CSTEP) employed a hybrid measurement approach to generate high-resolution air pollution maps. A mobile monitoring campaign was conducted where various monitoring instruments were set up in a CNG-fuelled car, which covered approximately 10% of the city's roads, to measure on-road mass concentrations of fine particulate matter ($PM_{2.5}$), black carbon (BC), and number concentrations of ultrafine particles (UFPs). Additionally, a city-wide network of 55 low-cost sensors was established to measure ambient $PM_{2.5}$ levels. To minimise the inaccuracy in data from the low-cost sensors, the collected data underwent meticulous correction processes. These data sets were then utilised to predict on-road and ambient pollutant levels at 50-metre resolution using land-use regression models, a method used to develop prediction models.

The study findings highlight that there is not much difference in the ambient $PM_{2.5}$ concentration levels in urban and suburban areas of Bengaluru. A high $PM_{2.5}$ concentration level was observed in some parts of Bengaluru's Bruhat Bengaluru Mahanagara Palike (BBMP) area, particularly in the western parts (Dasarahalli, Rajarajeshwari Nagar, and parts of Bommanahalli) and major road networks (Bengaluru–Mysore Road, NICE Road, Kanakpura Road, Magadi Main Road, and Tumkur Road). CSTEP also observed that on-road pollutant levels were higher than ambient pollution levels during the study period.

To make this information more useful, CSTEP partnered with Google to develop hyperlocal air quality maps from the data collected and make them available to Bengaluru city officials through the Environmental Insights Explorer (EIE) tool. With the help of EIE, city officials can assess $PM_{2.5}$ and other pollutant concentration levels for major streets and highways in Bengaluru and effectively identify pollution hotspots to introduce interventions.

Dr P Niranjan, Chief Environmental Officer, Karnataka State Pollution Control Board (KSPCB), released the study report titled 'Mapping Air Pollution in Bengaluru Using Low-Cost Sensors and Mobile Monitoring Data' at a launch event in Bengaluru. CSTEP gave a brief presentation on findings from the report and the EIE tool to KSPCB members and experts from air quality Institutes of Repute (IORs). CSTEP will be working with KSPCB and IORs to help them access and use the air quality data in EIE for their monitoring activities.

Dr S N Tripathi, Professor of Civil Engineering and Sustainable Energy Engineering at IIT Kanpur and Coordinator of the National Knowledge Network, observed at the launch that the 'Environment Insight Explorer, EIE, which is an outcome of collaborative efforts of CSTEP and Google, can be a useful tool for city-level air quality monitoring. Innovative mobile monitoring by CSTEP has resulted in data that is powered by AI and ML to create the EIE tool that can be replicated in non-attainment cities'.

Dr R Subramanian, Sector Head of Air Quality, CSTEP, stated that the comprehensive study using a dense network of carefully calibrated low-cost sensors and mobile monitoring coupled with statistical modelling shows the importance of focusing on vehicular emissions for pollution abatement in Bengaluru. 'While $PM_{2.5}$ is fairly uniform across the city, combustion-sourced BC is more variable and can be significantly higher on-road, increasing the health risk of Bengaluru residents who spend a lot of time in traffic. This massive data set can be further mined to identify time-resolved hyperlocal hot spots and technology interventions to get us closer to clean air for all', he added.

Dr Pratima Singh, Senior Research Scientist at CSTEP, said, 'Regulatory monitors are the most reliable form of measurement; however, due to the high cost of these instruments, their spread is less. Having a network of low-cost sensors and using data from other forms of measurement will help cities and states to identify hotspots and develop strategies. CSTEP carried out mapping of pollutants using mobile and ambient measurements, which suggest interventions for improving the air quality in Bengaluru'.

Ms Selvi P K, Scientist, Central Pollution Control Board, and other dignitaries participated in the event.

About CSTEP: The Center for Study of Science, Technology and Policy (CSTEP) is one of India's leading think tanks, involved in solving the grand challenges that the country faces. These include Sustainable and Secure Future, India's Green Energy Transition, Clean Air for All, and Digital Transformation.

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