INDIA EXTENDS ITS AIR QUALITY MONITORING NETWORK

Access to clean air is a fundamental right, however, the air we breathe today has become a grim killer globally. According to a WHO report, outdoor air quality alone kills over around 4.2 million every year; 90% of it in low- and middle-income countries. What we breathe indoors additionally impacts nearly half of the world's population. Consequences are alarming, especially for India where air pollution related death has multiplied six times in the last decade.

A Global Burden of Disease report states that approximately 620,000 premature deaths occurred in India from air pollution-related diseases in 2010, outdoor pollution being fifth largest after blood pressure, indoor air pollution, smoking and malnutrition. With nearly 20% of global air pollution-related deaths, the challenges are complex for India, the first problem being its 1.38 billion population as well as its inadequate infrastructure, technology and financial strength needed for mitigation, plus wide heterogenicity in the level of development, social and health factors across various Indian states. Although, over 90% of the world population fails to access the safe air quality suggested by the WHO; air quality deterioration in India is now critical.

A study by the Energy Policy Institute at the University of Chicago suggests that if Indian cities meet WHO suggested levels of air quality, citizens' life expectancy can be increased by up to 10 years. Shouldn't this be enough to guide India towards making a collective effort, with every stakeholder group, whether from the centre, states, independent and private institutions and most importantly every citizen of India. The first steps taken would be to create a system to accumulate sufficient and credible data on levels of pollution, types of pollutants, areas of concern and sources of pollution etc. Accessible, real-time data should be readily available to the relevant agencies for devising suitable action plans, implementing them and reviewing the progress.

What we breathe in

Ambient air pollution comes from industry, transport and naturally occurring phenomena. These pollutants include PM_{10} and $PM_{2.5}$, sulphur dioxides (SO_2) and nitrogen dioxide (NO_2) that majorly affect our respiratory and cardio-vascular systems. Other key pollutants that are included among the main 12 notified by the union Ministry of Environment, Forest and Climate Change (MoEF&CC) include carbon monoxide, benzo(a)pyrene, ammonia, ozone, hydrogen sulphide, benzene, arsenic and nickel.

Despite the fact that these standards are 2-3 times more lenient than WHO standards, Indian cities largely fail to meet, especially with PM_{10} and $PM_{2.5}$ levels. A WHO report finding 10 Indian cities among top 20 most polluted ones in the world, says it all.

The Air Act,1981 deals with the prevention and abatement of air pollution which empowers the Central Pollution Control Board (CPCB) and the State Pollution Control Boards (SPCBs) for taking corrective actions through enforcing emission norms, monitoring programmes, campaigns and action plans. There are industry specific norms for emission control, the National Air Quality Monitoring Programme (NAMP), Clean Air campaigns, City-wise Action Plans and the National Clean Air Programme (NCAP) in operation; however, these are inadequate and need to be augmented strongly.

Expanding the air quality monitoring framework

Monitoring air pollutants in a systemic way for long-term assessment is known as ambient air quality monitoring. It assesses the extent of pollution, provides information on air quality trends, evaluates the effectiveness of emissions control strategies, implementation of air quality goals, provides data for the evaluation of air quality models and research. Ambient air quality monitoring is important for an effective air quality management system, and therefore the CPCB has published the guidelines.

The CPCB executes the National Air Quality Programme (NAMP), presently with a network of 793 monitoring stations covering 344 cities and towns, with the objectives of determining status and trends of air quality, any violation of standards, identifying non-attainment cities, understanding natural cleaning processes and finally obtaining enough information for taking preventive and corrective measures. Under the NAMP, as well as regular monitoring of PM_{10}, $PM_{2.5}$, SO_2 and NO_x, the important meteorological parameters such as wind speed and direction, relative humidity and temperature are also monitored.

National Ambient Air Quality Standards (NAAQS), India

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)
Sulphur Dioxide (SO_2), µg/m³	Annual * 24 Hours **	50 80	20 80
Nitrogen Dioxide (NO_2), µg/m³	Annual * 24 Hours **	40 80	30 80
Particulate Matter (Size less than 10µm) or PM_{10}, µg/m³	Annual * 24 Hours **	60 100	60 100
Particulate Matter (Size less than 2.5µm) or $PM_{2.5}$, µg/m³	Annual * 24 Hours **	40 60	40 60
Ozone (O_3), µg/m³	8 Hours * 1 Hour **	100 180	100 180
Lead (Pb), µg/m³	Annual * 24 Hours **	0.50 1.0	0.50 1.0
Carbon Monoxide (CO), mg/m³	8 Hours * 1 Hour **	02 04	02 04
Ammonia (NH_3), µg/m³	Annual * 24 Hours **	100 400	100 400
Benzene (C_6H_6), µg/m³	Annual *	05	05
Benzo(a)Pyrene, Particulate phase only, ng/m³	Annual *	01	01
Arsenic (As), ng/m³	Annual *	06	06
Nickel (Ni), ng/m³	Annual *	20	20

* *Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.*

** *24 hourly or 8 hourly or 1 hourly monitored value, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days.*

Based on the monitored pollution data the air quality Index (AQI) is calculated for the region which signifies the overall pollution level of an area, categorised as Severe (401-500), Very Poor (301-400), Poor (201-300), Moderate (101-200), Satisfactory (51-100) and Good (0-50). Higher AQI represents lower air quality and, therefore, higher pollution and health implications.

It's important to understand that operating stations under NAMP covers merely 344 cities and towns presently, which is the tip of the iceberg compared to the coverage needed for around 5000 cities and towns located in India. If it is unknown what the air quality is or where it comes from or how it is produced, it will be impossible to rectify. It is therefore, necessary to set-up a national air quality monitoring network which covers the maximum areas in cities and towns across all Indian states. Data received from the network should be readily available to regulators and stakeholders at all levels and integrated at a national level for analysis and devising a suitable mitigation action plan.

New initiative for 42 'million-plus' people cities

Expanding the air quality monitoring network in India is needed and the good news is that the 15th Finance Commission has recommended and budgeted for over NR 4000 Crores for air quality improvements in urban areas of 42 'Million-Plus' people cities in it's 2020-2021 budget. These are the main polluted cities which are spread across 15 states. Most of these have prepared preliminary city action plans which are subject to modification based on scientific studies conducted by the respective cities. Under this programme, the NCAP has provision of a National Knowledge Network (NKN) to provide operational support to the Urban Local Bodies (ULBs), SPCBs and CPCB. Under this, Institutes of Repute (IoRs) with substantial experience in the field of air pollution management will support ULBs as knowledge partners to help with technical and scientific studies under the guidance of NKN, SPCB and CPCB. Financial support to SPCBs and ULBs may be available from the performance-based budget granted under this programme and other schemes available for improvement of air quality as well as funds generated by the individual states.

This scheme has set a baseline in respect of PM_{10} annual average concentration at 98% for each of the 42 cities at 2017-18 levels and thus, any improvement will be measured based on this. The activities under this programme will encompass strengthening of institutional framework, source-wise cause analysis of air pollution, development of IT-based emission inventory, tie-up with IoRs, monitoring of the progress, compliance of statuary guidelines and fund disbursement based on performance evaluation. The MOEF&CC deputed team comprising of experts from NKN, SPCBs, CPCB and MOEF&CC will assess the performance annually and accordingly funds shall be disbursed. For the first-year, funds are to be disbursed in full for infrastructure development, however, the action plan outcomes are expected to be observed after two years of the program.

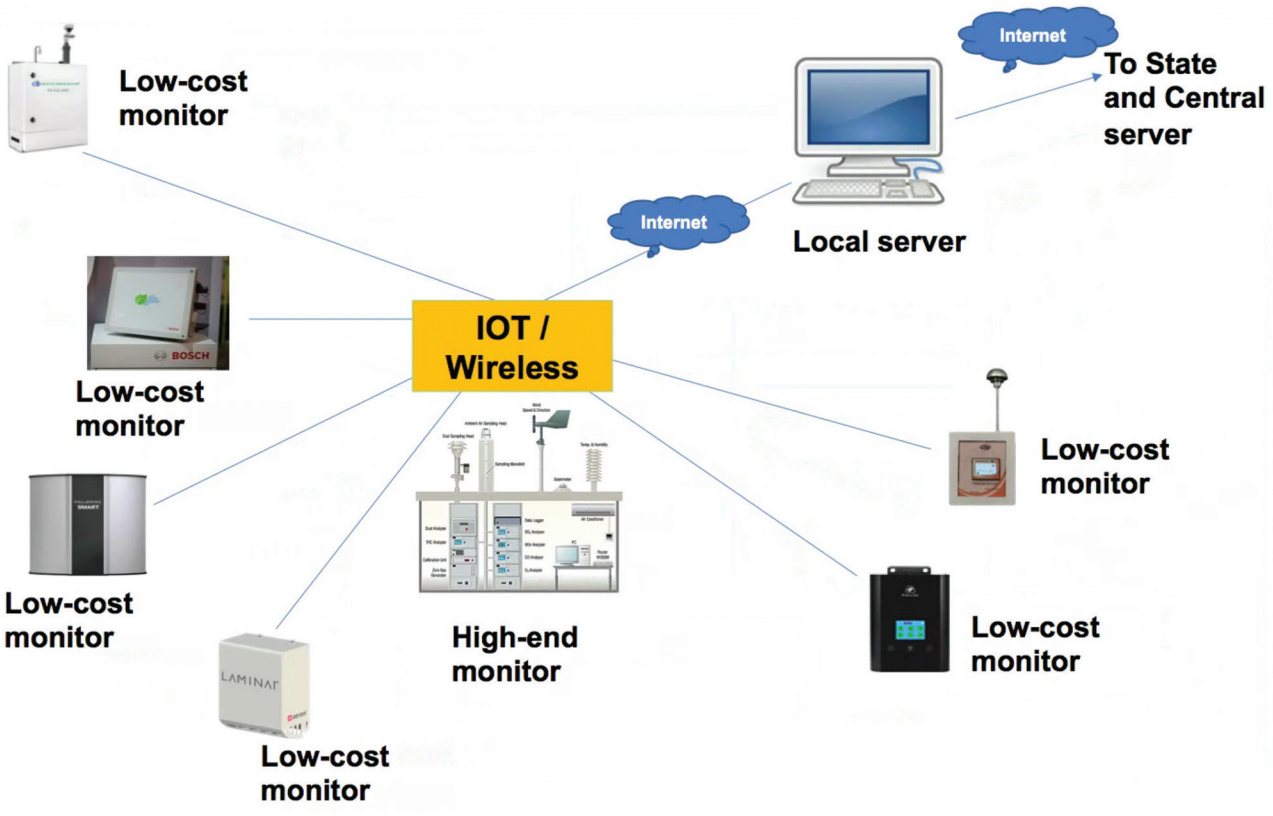
Setting-up an effective and suitable AAQ network

Planning an ambient air quality monitoring network is of utmost importance, yet difficult for a vast country like India. It's not economically viable and wise to create a network using high-end and costly continuous ambient air quality monitoring stations (CAAQMS) alone. It's best that a hybrid network using a mix of both- high end CAAQMS and low-cost sensor-based AAQ monitors suited to the specific airsheds are created, which will then be integrated to the NAMP.

Setting up a best suitable air quality monitoring network in an area requires a clear purpose of monitoring, available resources and background information on pollution levels, health and demographic information, topographical effects, local interferences, meteorological information and site accessibility. Similarly, the required number of monitors and their location depends on multiple variables, including the topography, local metrology, pollution sources, pollution concentration and population density. However, there has been a WHO reference criteria for suggesting the number of monitoring stations required in a city, the actual criteria followed at each site needs to be a balance between available resources and site-specific parameters, such as, city size, nature of terrain and spatial variations in the concentrations of the pollutants.

Currently, the Indian air quality monitoring network under NAMP mainly involves manual monitoring, therefore, the majority of the

A hybrid network of high-end and low-cost AAQ monitor



data is not available in real-time or in sufficient quantity for timely analysis and action. Moreover, maintenance and calibration of manual monitors are another issue which affects data quality as well. This issue has been in the process of being resolved through the installation of CAAQMS, which monitors in real time and sends data directly to the server, making it accessible to the respective authorities and stakeholders for action. There are multiple methods available based on which such CAAQMS work. The CPCB has released a list of suitable methods for ambient air pollutants measurement which are used by various technology providers in CAAQMS. This list is expected to be updated in order to include new, economical and better performance methods which are already being used outside of India. Many of these low-cost sensors are used with high-end CAAQMS, not for compliance checks, but to get enough supportive data for analysis. This hybrid monitoring type of network is economical, ensures wide coverage and provides sufficient data availability on a real-time basis, making it best-suited for India's needs. India is also working to develop a guideline for low- cost AAQ sensors in order to ensure a minimum qualifying criteria and reliable data with which to begin. The expectation for this is to bring quality control to this product market, which is rapidly expanding owing to flourishing, indigenous start-ups.

Air quality data on real-time basis

The National Clean Air Programme (NCAP) must include a smart monitoring network to get air quality data across the network on real-time basis and accessible to ULBs for quick action, technology partners for quicker maintenance, regulators for better policing, policy makers for suitable directives and also to the public for increased awareness. Such a smart network requires advance IT support including software architecture based on IoT protocols, push technology with local pooling and logging, internet as a backbone network, secured data format and encryption, smart data and big data features. Software and networking systems must be scalable and equipped with site and device diagnostic, a network management facility, two-way connectivity, an alarm system, a reporting system, authority, client and user authentication system, audit logs and data flag system.

Once a sophisticated air quality monitoring network under NCAP is set-up, sufficient data will be available for analysis, corrective action, review of improvement and also for mass awareness. To start with, the 42 'Million plus' cities scheme is a welcome step, however, the success of the same needs a careful and a thoughtful approach. It is important to note the fundamental needs of an adequate and effective solution: suitable sensors; analysers or combinations of them which are cost efficient, secure, tamperproof, easy to install and low maintenance; correct installation of these monitors for maximum coverage and representative sampling; a smart and scalable network system with important features. Finalising the guidelines to quality control for low-cost sensors will be crucial step towards making this goal possible. Not to forget, the skilled manpower and support are critical throughout. The combination of expertise such as in air quality monitoring, technology and operation, environmental regulation, control, policies and IT are must.

The average citizen, who contributes to and suffers from the air quality problems, must be involved as an important stakeholder- to remain aware, to play a watchdog role, to contribute for the cause by learning to live a responsible lifestyle for a better future - an important milestone in this success story.

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