AIR QUALITY MONITORING REGIME IN INDIA

An Overview

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Pollution Monitoring Series: Briefing Note 1

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This briefing note is the first of a 3-part series on the subject of pollution monitoring in India. The note will support the thematic online map on 'Pollution in India'. Apart from providing a context to the map-generated information and its interpretation, it will help provide a better understanding to the user on air quality monitoring in the country. Issues concerning the type of pollutants measured, their standards, technologies that are used to monitor these pollutants, and brief analyses of legal, governance and enforcement issues pertaining to air pollution will be covered. The note is not meant to be a comprehensive analysis of the subject, but is expected to promote critical thought and encourage questioning amongst the public.

BACKGROUND

The apex regulatory agency on pollution issues in India, the **Central Pollution Control Board (CPCB)** is the sole agency that coordinates the air quality monitoring regime through its nation-wide programme known as the ***National Air Quality Monitoring Programme*** (NAMP). Initiated in 1984 at Agra and Anpara with 7 stations, the programme has since been substantially expanded and was originally called the National Ambient Air Quality Monitoring (NAAQM).

Under NAMP, using a network that consists of 342 pollution monitoring stations, the CPCB regularly monitors four air pollutants *viz* ., Sulphur Dioxide (SO2), Oxides of Nitrogen as NO2, Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter or Particulate Matter of less than 10µ size (commonly called PM10 or RSPM). The monitoring of meteorological parameters such as wind speed and wind direction, relative humidity (RH) and temperature are integrated with the monitoring of air quality. In addition, the monitoring has been extended to parameters such as Carbon Monoxide (CO), Ammonia (NH_3), Respirable lead, Hydrogen Sulphide (H_2S) and Polycyclic Aromatic Compounds (PAHs) in select cities[1].

The objectives of N.A.M.P[2],

- to determine status and trends of ambient air quality ascertain whether the prescribed ambient air quality standards are violated;
- to identify cities which are unable to attain the standards prescribed;
- to obtain the knowledge and understanding necessary for developing preventive and corrective measures and to understand the natural cleansing process undergoing in the environment through pollution dilution, dispersion, wind-based movement, dry deposition, precipitation and chemical transformation of pollutants generated.

Frequency of monitoring

The monitoring of air pollutants is carried out for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) with a frequency of twice a week, to have one hundred and four (104) observations in a year.

ISSUES TO CONSIDER

[1] Information received from CPCB through RTI application available with the author.
[2] Available at http://cpcb.nic.in/Objectives.php

The smooth functioning and overall sustainability of NAMP and efficacy of the system are vital in order to make environment and health decisions for the population. Data quality is essential, and with this in mind the CPCB has put in place various measures through its zonal offices. For the purpose of the overall programme, maintenance of monitoring stations through regular visits and inspections, quality control tests and trainings to field and laboratory staff are carried out. For the purpose of maintaining the quality of data, regular calibration, servicing and repair of the field-level instruments are carried out under the project *"Calibration and Evaluation of Ambient Air Quality Monitoring Stations in India"*[3].

While NAMP appears comprehensive, a recent Parliamentary Standing Committee has made significant observations on NAMP, while reviewing the functioning of the CPCB[4]. A critical examination of the programme is necessary to draw conclusions as to whether it is sufficient and is leading to pollution mitigation. This note will draw attention to and briefly analyze some key issues that need to be considered.

Adequacy of monitoring infrastructure

Stations: The parliamentary committee report finds that the number of monitoring stations is inadequate and needs to be expanded to 1000 stations. In response to the report, the Union Minister for State for Environment & Forests has clarified that 375 air quality monitoring stations (342 manual and 33 continuous online stations) are operational in the country to track pollution[5]. Considering the number of regular stations commissioned in a period of two years (2006-2008), it is notable that a mere 30-odd stations alone have been added[6]. Moreover, several Continuous Ambient Air Quality Monitoring (CAAQMS) stations are still not online. This is evident from the fact that Haryana Pollution Control Board has only recently invited tenders[7] for such stations and Tamil Nadu Pollution Control Board will be installing a third station at Manali industrial area shortly[8]. It is to be noted that the CAAQM to be installed in Manali was a recommendation of the Local Area Environment Committee in its July 2005 report[9] pertaining to pollution and hazardous waste management issues in Manali Industrial Area in north Chennai.

[3] Information available at http://cpcb.nic.in/QA_QC.php
[4] 192nd Report on the Functioning of the Central Pollution Control Board, Department-related Parliamentary Standing Committee on Science & Technology and Environment & Forests; June 2008; Chapter III, pp21-24
[5] Press Release, July 10,2008, Press Information Bureau, GoI; Avialable at: http://pib.nic.in/release/release.asp?relid=40241, accessed on 19 May, 2009
[6] Press Release, June 14, 2006, Press Information Bureau, GoI; Available at: http://pib.nic.in/release/release.asp?relid=18380
[7] Tender advertisement placed in the Hindu, 13-01-2009, Chennai
[8] http://www.hindu.com/2009/03/27/stories/2009032756620100.htm
[9] Interim report submitted to Supreme Court Monitoring Committee on Hazardous Waste; Local Area Environment Committee (Manali); July 2005

Technology: According to the guidelines[10] issued by the CPCB, modern methods of air pollution monitoring are being utilized under the NAMP. While there is limited information to rate the technologies on their adequacy and performance, experts[11] feel that some critical issues need to be looked into, which would be important to understand if the technologies measure up to the regulatory standard.

For example, the instrumentation that is imported for the monitoring stations are often built for colder climates. So these are designed to handle 'thawing' – a phenomenon that occurs under extreme cold conditions. On the contrary, in tropical zones problems such as corrosion and high-level of dust need to be considered and imported equipment may not be designed to handle the above conditions thus rendering the equipment inefficient.

Figure 1: Senors of online monitoring station

Similarly, the availability of 'standard gases' (that are used to calibrate gas analysers) for calibration purposes is another area of concern. These products are imported and not readily available. Often by the time the product reaches the destination it reaches its expiration date and is rendered unusable. As a result regular calibration of equipment maybe affected leading to faulty data.

There are other reasons that are cited [12] for delays in setting up sophisticated monitoring stations. For example, government buildings with appropriate elevation have to be identified at the site where monitoring is proposed. This can be a difficult task. If private buildings or other residential buildings are chosen the safety and maintenance of equipment become areas for concern.

Figure 2: Conventional (offline) air monitoring equipment

Adequacy of standards

The National Ambient Air Quality Standards (NAAQS) apply to India

[10] Guidelines for Ambient Air Quality Monitoring; NATIONAL AMBIENT AIR QUALITY MONITORING SERIES : April 2003; CPCB, Available at: http://cpcb.nic.in/newitems/7.pdf

[11] Pers. Comm.- Interview held with Dr.R.Swaminthan, ex-Scientist, NEERI, Nagpur on 1st May 2009

[12] Pers. Comm.– Interview with Dr.VN Rayudu, Environmental Consultant and Ex-Environmental Engineer, Tamilnadu Pollution Control Board; Interviews conducted on 18 December 2008 and 19 May 2009

(Refer Annexure). Developed by the CPCB, the standards pertain to 7
air pollutants – SO_2, NO_2, SPM, RSPM, Lead, Ammonia, & CO. These standards are applicable for three types of areas namely Industrial areas,
'Residential', 'Rural and other areas' and 'Sensitive areas' (also called 'Commercial areas'). Barring Ammonia, the six pollutants that are mentioned above are also called 'criteria' pollutants as their measurement is based on human health risk factors or risk criteria.

Standard setting: NAAQS has been in existence for over 14 years now and in 2008 a revision was undertaken. The new draft ambient air quality standards are pending before the Ministry for clearance. NGOs have claimed that the draft has been done secretively and an opportunity has been lost for greater debate and evolution of better standards, especially in the context of growing vehicular population[13]. Using the United States Environment Protection Agency's (USEPA) list of Hazardous Air Pollutants[14] , the new set of standards have included more number of pollutants (a total of 33 have been chosen) and the limits have been based on health factors and toxicity profiles[15]. The proposed standards have done away with land-use based area-wise standards for air pollutants[16] (Refer Annexure for the proposed standards).

Additionally, using the frameworks provided by the Air (Prevention and Control of Pollution) Act 1982, Environment (Protection) Act 1986, and the Environment (Protection) Rules 1986, the CPCB has also embarked on development of guidelines for location based standards for air, water and soil. The need for the same has been articulated in the guideline document as the rapid increase in pollutant generation and the inadequacies in merely adhering to national standards[17].

National vs. International standards: As evident from the list of non-attainment cities several are in frequent violation of the NAAQS[18] with regard to SPM and RSPM (PM10). This appears a major area of concern, but yet the proposed standard has not tightened the values for PM10. In comparison to the USEPA standard of 150 µg/cu.m. (which is being reviewed) the new standard fares better, however it is 5 times higher than the WHO standard/guideline value of PM10 is 20µg/cu.m. Overall, the proposed

[13] *Policy Police: Hush-hush public notice on emissions norms*; Centre for Science and Environment; available at http://www.cseindia.org/campaign/apc/hush_hush.htm
[14] Information available at http://www.epa.gov/ttn/atw/allabout.html
[15] Draft of Ambient Air Quality Criteria/Standards, pp2; 27 June 2008; Available at http://www.cpcb.nic.in/latest/27.06.08%20Draft%20of%20Ambient%20Air%20Quality%20Criteria%20Standards.doc
[16] Supra 14, pp4
[17] Guidelines for developing Location Specific Standards; PROBES 2008-09; Available at http://www.cpcb.nic.in/latest/Latest_32_title_pages_Location%20Specific%20Standard-Report_13.10.08.pdf
[18] 'List of non-attainment cities in India'; available at http://cpcb.nic.in/Non_attainment.php

standards seem progressive but there is apprehension that they may not see the light of day owing to heavy industry opposition[19].

Regulation and Enforcement

Based on trends analysed by the CPCB[20], it is claimed that SO_2 and NO_2 levels are predominantly within the prescribed standards in residential areas of all the cities, however there are seasonal fluctuating trends. CO and suspended particulate matter are often in excess of the NAAQS, as already pointed out in the previous section. Overlaying the provisions of the Air Act and the associated Rules on these trends, one would find several industries being closed down. In reality, a statement by former advisor to the Ministry *"No one has ever gone to Jail for Pollution"*[21] summarises the level of enforcement even today. According to the Parliamentary Committee, *"there seems no legal obligation for state and local governments to adhere to the standards"*.

Corruption and manpower shortage have often been cited as the main reasons for the laxity in enforcement. However, inferring from the analysis of the sections above it is evident that several other causes could be hampering enforcement.

KEY CHALLENGES

Despite shortcomings in the air monitoring regime, going forward, it is heartening to note that new set of standards are on the anvil, studies tracking new pollutants are in progress and improvements in the overall infrastructure of monitoring are taking place. Nevertheless, in the immediate to long term, there are several unanswered questions and major areas of concern that still require attention.

Upgradation of network

Of utmost priority is the expansion of the existing monitoring network. Regular monitoring stations need to be commissioned in proportion to the population density, traffic density, and industrial density. In accordance with the Parliamentary committee's recommendations, many more on-line stations need to be established to get real time information about the spatial distribution of pollution and areas of acute pollution.

Use of air quality information

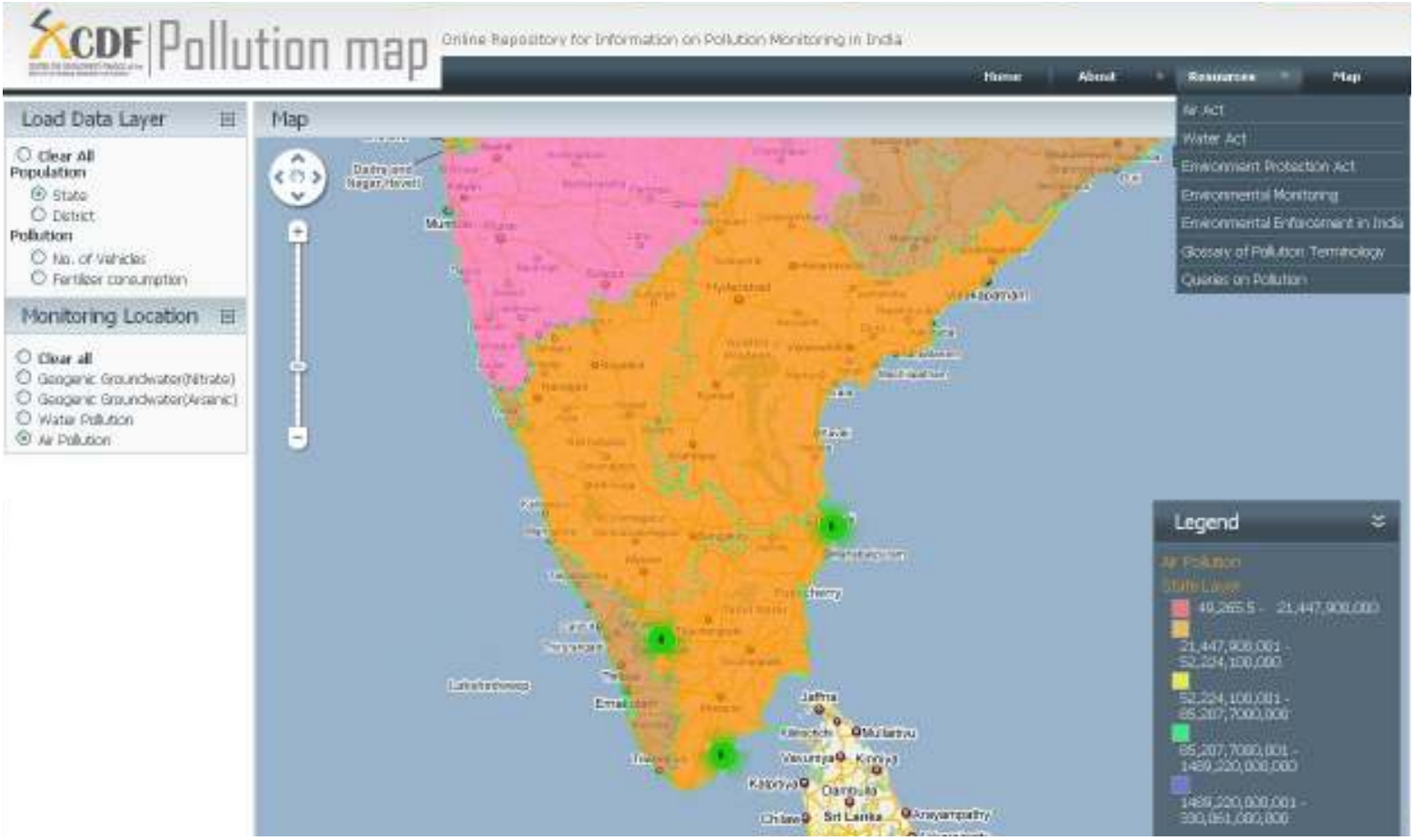
[19] Priyanka Chandola; *On the shelf?;* Sep 2008; Down to Earth Vol: 17 Issue: 20080930 pp: 9; available at http://www.indiaenvironmentportal.org.in/node/263893

[20] http://cpcb.nic.in/Findings.php

[21] Halarnkar in Divan, Shyam & Rosencranz, Armin; Environmental Law and Policy in India; OUP; 2nd edition; pg 252.

Information from sensors has to be systematically managed and without time delays it has to be innovatively and proactively disseminated so citizens can take preventive action. Policy makers and pollution control authorities need to develop city-wise and region-wise action plans to curb air pollution based on accurate information collected from the monitors. Failing which, the entire monitoring activity will be rendered redundant and the objective of mitigation would be difficult to achieve, eventually exposing citizens to adverse health risks.

Figure 3: Snapshot of Pollution map from the website showing number and location of air monitoring stations superimposed on population data for the state of Tamilnadu



Annexure I: NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

Pollutant	Time Weighted Average	Concentration in Ambient Air			Method of Measurement
		Industrial Area	Residential, Rural and other Areas	Sensitive Area	
Sulphur Dioxide (SO_2)	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	1. Improved West and Gaeke Method 2. Ultraviolet Fluorescence
	24 Hours Average**	120 µg/m^3	80 µg/m^3	30 µg/m^3	
Oxides of Nitrogen as NO_2	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	1. Jacob & Hochheiser modified (NaOH-$NaAsO_2$) Method 2. Gas Phase Chemiluminescence
	24 Hours Average**	120 µg/m^3	80 µg/m^3	30 µg/m^3	
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m^3	140 µg/m^3	70 µg/m^3	High Volume Sampling (Average flow rate not less than 1.1m^3/minute)
	24 Hours Average**	500 µg/m^3	200 µg/m^3	100 µg/m^3	
Respirable Particulate Matter (Size less than 10µm) (RPM)	Annual Average*	120 µg/m^3	60 µg/m^3	50 µg/m^3	Respirable Particulate Matter Sampler
	24 Hours Average**	150 µg/m^3	100 µg/m^3	75 µg/m^3	
Lead (Pb)	Annual Average*	1.0 µg/m^3	0.75 µg/m^3	0.50 µg/m^3	AAS Method after sampling using EPM 2000 or equivalent filter paper
	24 Hour Average**	1.5 µg/m^3	1.0 µg/m^3	0.75 µg/m^3	
Carbon Monoxide (CO)	8 Hours Average**	5.0 mg/m^3	2.0 mg/m^3	1.0 mg/m^3	Non dispersive Infrared Spectroscopy
	1 Hour Average	10.0mg/m^3	4.0 mg/m^3	2.0 mg/m^3	

Ammonia (NH_3)	**Annual Average***	**0.1 mg/m^3**	**-**
	24 Hour Average**	**0.4 mg/m^3**	

* Annual Arithmetic mean of minimum 104 measurements in a year twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.

NOTE

1. National Ambient Air Quality Standard : The levels of air quality necessary with an adequate margin of safety, to protect the public health, vegetation and property.
2. Whenever and wherever two consecutive values exceed the limit specified above for the respective category, it would be considered adequate reason to institute regular/continuous monitoring and further investigations.
3. The State Government / State Board shall notify the sensitive and other areas in the respective states within a period of six months from the date of notification of National Ambient Air Quality Standards

Source: www.cpcb.nic.in/National_Ambient_Air_Quality_Standards.php

Annexure II PROPOSED AMBIENT AIR QUALITY STANDARDS

	Parameter, units	Averaging Time				Analysis Method
		1-hr	8-hr	24-hr	Annual	
1	Benzene (C_6H_6), µg/m^3	-	-	15	5	- online gas chromatography - activated carbon/tenex adsorption and GC analysis
2	Carbon Monoxide (CO), µg/m^3	4000	2000	-	-	Non Dispersive Infra Red (NDIR), spectroscopy
3	Formaldehyde (HCHO), µg/m^3	80	45	-	-	Absorption in MBTH and spectrophotometer analysis
4	Polyaromatic Hydrocarbons (BaP) (particulate phase only), ng/m^3	-	-	5	1	Solvent extraction followed by analysis on GC/HPLC/GCMS
5	Arsenic, ng/m^3	-	-	20	6	AAS/ICP Method after sampling on EPM or equivalent Filter paper
6	Lead, µg/m^3	-	-	1	0.5	
7	Mercury(1) (total), ng/m^3	-	-	15	-	Particulate: same as for lead

Annexure II PROPOSED AMBIENT AIR QUALITY STANDARDS

	Parameter, units	Averaging Time				Analysis Method
		1-hr	8-hr	24-hr	Annual	
	Particulate phase, ng/m^3	-	-	3	-	above
	Vapour phase, ng/m^3	-	-	12	-	Vapour - Activated carbon or gold coated sand adsorption followed by analysis on AAS/ICP
8	Nickel, ng/m^3	-	-	25	-	AAS/ICP Method after sampling on EPM or equivalent Filter paper
9	Vanadium, ng/m^3	-	-	200	-	
10	Nitrogen dioxide (NO_2) General Area, $\mu g/m^3$	200	-	80	40	- Jacob & Hochheiser Modified Method - Chemiluminescences
	Nitrogen dioxide (NO_2) Sensitive Area[(2),] $\mu g/m^3$	-	-	-	30 (3-month Avg)	
11	Ozone (O_3), $\mu g/m^3$	180	90	-	-	- UV Photometric technology - Chemiluminescences
12	Particulate matter (PM_{10}), $\mu g/m^3$	-	-	100	60	- Approved Particle size cutoff

Annexure II PROPOSED AMBIENT AIR QUALITY STANDARDS

	Parameter, units	Averaging Time				Analysis Method
		1-hr	8-hr	24-hr	Annual	
	Particulate matter ($PM_{2.5}$), µg/m^3	-	-	60	40	sampler -Gravimetric analysis
13	BSF/TSF (benzene/toluene soluble fraction), µg/m^3	-	-	20	-	ASTM D4600-87,1990
14	Sulphur dioxide (SO_2) General Area, µg/m^3	260	-	80	50	- Improved West and Geake - Ultraviolet Fluorescence
	Sulphur dioxide (SO_2) Sensitive Area [(2)], µg/m^3				20 (3-month Avg)	
15	Ammonia (NH_3), µg/m^3	-	-	400	100	-Chemiluminescence - Indophenol- blue method

Source: http://www.cpcb.nic.in/latest/27.06.08%20Draft%20of%20Ambient%20Air%20Quality%20Criteria%20Standards.doc