A status assessment of National Air Quality Index (NAQI) and pollution level assessment for Indian cities

CLEANAIR NATION

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TABLE 1

AQI Pollution Level and Health Impact

Number	Remark	Health Impact
1–50	Good	Minimal impact
51–100	Satisfactory	Minor breathing, discomfort to sensitive people
101–200	Moderate	Breathing discomfort to the people with lungs, asthma and heart diseases
201–300	Poor	Breathing discomfort to most people on prolonged exposure
301–400	Very Poor	Respiratory illness on prolonged exposure
401–500	Severe	Effects healthy people and serious impacts to those with existing diseases

Executive summary

Air pollution has emerged as one of the most serious threats to public health worldwide with 3.7 million deaths in 2012 from outdoor air pollution according to World Health Organisation (WHO)[1] and approximately 660,000 deaths in India as estimated by Global Burden of Diseases (GBD)[2] in 2013.

The announcement of a National Air Quality Index network to measure pollution provides a more official and coherent basis for comparing cities and their pollution levels than data that has been made available earlier. This data generation is essential to inform remedial measures. This report is the first analysis of air pollution levels in Indian cities carried out using the NAQI system.

1 http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/

2 Forouzanfar MH et al 2015: Global, regional, and national comparative risk assessment of 79 behavioral, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet. 2015 Sep 11. doi: 10.1016/S0140-6736(15)61455-6. Specific numbers for India were obtained through the Institute for Health Metrics and Evaluation "GBD Compare" tool (Accessed Dec 8, 2015) at http://vizhub.healthdata.org/gbd-compare/#

Key Findings:

- The official data confirms that exposure to toxic particulate pollution ($PM_{2.5}$ and PM_{10}) is alarmingly high in most Indian cities, and National Ambient Air Quality Standards are being continuously violated: the most polluted cities can go for months without a single day that meets the standard.
- The official data also shows that pollution levels in many Indian cities, including Delhi, Ahmedabad, Varanasi, Patna, Agra and Kanpur, exceed the famously toxic levels in Beijing and other Chinese cities, over the period covered by the NAQI data.
- The NAQI system represents a significant step forward in providing Indian citizens with timely, reliable and actionable information on air pollution levels. However, the coverage of the system is still very poor, with even most megacities lacking monitoring stations. Key steps to improve the system include dramatically increased coverage of all major cities and industrial clusters, and increased number of stations at cities already covered but with only one or two stations (only five cities currently have more than one station).

- Analysis of the NAQI data shows that air pollution regularly reaches levels in Indian cities that are both an acute short-term threat to the health of residents and a major long-term health risk. For the NAQI system to actually contribute to protecting Indians from hazardous levels of air pollution, efforts should be made to communicate air pollution levels through radio and TV as well as through the internet, and to give actionable instructions on personal protection. It is the duty of the government to protect citizens during air pollution episodes by e.g. issuing alerts, encouraging the use of air pollution masks (respirators), and installing air purifiers in schools, hospitals and other public buildings.

- The monitoring data shows that high pollution levels are truly a subcontinent-wide problem. With most of the pollution measured in cities typically caused by emissions from outside the city, national and regional level action is needed alongside local measures in cities.

- Tackling India's air pollution crisis and ensuring the right to clean air for all Indians requires an ambitious and systematic national action plan with targets and timelines, as well as measures to reduce air pollution emissions from all key polluting sectors, including power generation, industry, transport and agriculture. Many European countries have successfully tackled their air pollution problems, and China is currently making major strides in reducing air pollution, using a combination of policies including strict emission standards for power plants and industry, promotion of clean energy and clean fuels, energy efficiency and sustainable transport policies.


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Background

Many Indian cities have been established as world's most polluted cities. Recently a report published by WHO placed 13 Indian cities in the 20 most polluted cities of the world. This signifies the extent of pollution in Indian cities. Such pollution levels combined with high population density results into high mortality and health costs. Low average incomes, poor health facilities combined with inadequate awareness about the sources and treatment of health problems results in the loss of many lives every year. Particulate Matter (SPM, $PM_{2.5}$ & PM_{10}) is categorised as one of the major pollutant of concern in almost all the Indian cities. Particulate matter is largely generated by industries and vehicles.

Measuring a pollutant is essential to its management, or to the resolution of India's air pollution problem. Air pollution must be measured at different places over the country, in order to identify the sources and take corrective measures to reduce pollution levels which are dangerous or hazardous for human health.

TABLE 2

List of 20 most Polluted cities in World: WHO

S.No.	City	Country	$PM_{2.5}$ Annual Average (µg/m³)
1	Delhi	India	153
2	Patna	India	149
3	Gwalior	India	144
4	Raipur	India	134
5	Karachi	Pakistan	117
6	Peshwar	Pakistan	111
7	Rawalpindi	Pakistan	107
8	Khoramabad	Iran	102
9	Ahmedabad	India	100
10	Lucknow	India	96
11	Firozabad	India	96
12	Doha	Qatar	93
13	Kanpur	India	93
14	Amritsar	India	92
15	Ludhiana	India	91
16	Igdir	Turkey	90
17	Narayonganj	Bangladesh	89
18	Allahabad	India	88
19	Agra	India	88
20	Khanna	India	88

In 1984, CPCB started the National Ambient Air Quality Monitoring (NAAQM) programme by installing seven stations at Anpara and Agra. The name of the programme was later changed to National Air Monitoring Programme (NAMP). The objectives of the programme were:

- To determine status and trends of ambient air quality;
- To ascertain whether the prescribed ambient air quality standards are violated;
- To Identify non-attainment Cities where air pollutants are exceeded prescribed standards.
- 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

NAMP is a nationwide network which involves several agencies such as Central Pollution Control Board (CPCB); State Pollution Control Boards (SPCB); Pollution Control Committees (PCC) and National Environmental Engineering Research Institute (NEERI). CPCB co-ordinates with these agencies to ensure the uniformity, consistency of air quality data and provides technical and financial support to them for operating the monitoring stations.

According to CPCB there are 593 stations operating under NAMP as on 30th June 2015 which are spread over 249 cities in 29 states and 5 union territories in India. Out of 249 cities covered under NAMP only 16 cities are providing data on air pollutants through online portal managed by CPCB.

In addition to monitoring and data gathering on air pollution it is clear that sharing that data in real time to the affected public is necessary. Even as we struggle to tackle the pollution problem, we must provide the population with information on which to take informed decisions regarding their health. Some immediate and quick steps are required to safeguard people from high pollution levels through precautionary measures such as health advisories, alteration of personal activity schedules etc.

The CPCB's NAQI report mentions, "Since awareness of daily levels of urban air pollution is important to those who suffer from illnesses caused by exposure to air pollution, the issue of air quality communication should be addressed in an effective manner. Further, the success of a nation to improve air quality depends on the support of its citizens who are well-informed about local and national air pollution problems and about the progress of mitigation efforts."

Many countries, both developed and developing, have developed an Air Quality Index (AQI)[3,4,5,6] to address this. To compute the AQI values, weighted values of air pollution parameters such as $PM_{2.5}$, SO_2, CO, etc. are converted to sub index numbers or to a single indexes. There are two main dimensions to communicating the air pollution issues with the people in a comprehensible manner:

1. Translate the complex scientific and medical information into simple and precise knowledge and
2. Communicate with the citizens in the historical, current and futuristic sense.

To address these challenges development of an efficient and comprehensible AQI scale is required. This will help citizens and policymakers to take informed decisions to prevent and minimize air pollution exposure and health hazards induced from the exposure.

Realizing the need and importance of providing real time data to the public, the Indian government started the NAQI portal in April 2015. The NAQI portal accounts for pollutants which have short-term impacts. The purpose of the portal is to provide real time data to the public in their vicinity. As on 11th November 2015 NAQI web portal provides the AQI score for 16 cities. To get an updated AQI at short time intervals,

3 http://www.aqhi.gov.hk/pdf/related_websites/APIreview_report.pdf

4 Ontario. (2013) A review of the Ontario air quality index and air quality health index system.ISBN 978-1-4606-0936-1.Air Resource Branch, Ontario Ministry of the Environment, Toronto, Ont., Canada.

5 Shenfeld, L. (1970) Note on Ontario's air pollution index and alert system. J. Air Pollut. Control Assoc.20 (9): 622

6 Yao and Lu (2013) Particulate Matter Pollution and Population Exposure Assessment over Mainland China in 2010 with Remote Sensing. Int. J. Environ. Res. Public Health (11): 5241-5250

ideally eight parameters (PM_{10}, $PM_{2.5}$, NO_2, SO_2, CO, O_3, NH_3, and Pb) for which, short-term standards are prescribed, should be measured on a continuous basis.

India has two different kinds of air quality monitoring – online monitoring and manual monitoring. Each has different frequency of measurement and monitoring methodologies. Online monitoring network has automated air quality monitoring stations which record continuous hourly, monthly or annually averaged data. Currently we have ~40 automatic monitoring stations and data from these stations are available almost in real time. Online monitoring stations with continuous and easy availability of air quality data are really very good for computation of AQI and many more such stations should be installed over different Indian cities to provide real time data to public.

On the other hand, manual monitoring network has stations involve mostly intermittent air quality data collection, thus such stations are not suitable for AQI calculation particularly for its quick dissemination. The monitoring frequency is twice a week. In most of manually operated stations, only three criteria pollutants such as PM_{10}, sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) are measured, at some stations $PM_{2.5}$ and Pb are also measured.

Introduction

Exposure to fine particulate matter pollution is the largest environmental health risk in the world, increasing the risk of lung cancer, stroke, heart disease, chronic respiratory diseases, lower respiratory infections and asthma. $PM_{2.5}$ is estimated to have been responsible for over three million premature deaths in 2010[7]. The International Agency for Research on Cancer classified particulate matter pollution as carcinogenic to humans in 2013, and designated it as a "leading environmental cause of cancer deaths"[8]. India is one of the countries with highest population exposure to $PM_{2.5}$, and consequently health risks from $PM_{2.5}$ to the people in India are among the highest in the world.

Consistent time series of $PM_{2.5}$ measurements are hard to obtain for India, but satellite-based measurements indicate that particle pollution levels have increased dramatically over the period 2000-2012. Over the same period, the consumption of coal and oil (petrol, diesel, kerosene and other fuel oils) the two fossil fuels contributing most to air pollution has also increased by 110% and 70%, respectively.

The three key contributors to particulate pollution levels are emissions of dust & soot (so-called primary particulate matter), SO_2 and NO_x, which form particulate pollution in the atmosphere (called secondary particles). Analysis of the chemical composition of PM2.5 pollution indicated that during Delhi's most polluted season, 25% of the $PM_{2.5}$ is secondary, meaning that controlling regional SO_2 and NO_x emissions can be an important approach to tackle the pollution. In general, the analysis found that in four Indian cities (Delhi, Kolkata, Mumbai and Chandigarh), 15-25% of particulate matter was secondary[9].

Much of the debate on air pollution focuses on Delhi, but "Delhi smog" is actually a misleading expression. Satellite images of the wintertime pollution episodes show smog extending all the way from Punjab to Bihar, making "North India smog" a more appropriate label. This bird's eye view makes it clear that the problem and the solutions must be regional.

A modelling study carried out by two Indian researchers at IIT Delhi found that 60-90% of PM_{10} in Delhi is due to emissions outside the megacity,[10] and regional pollution is likely to play a significant role in other cities as well.

7 http://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2812%2961766-8/abstract

8 http://www.euro.who.int/en/health-topics/environment-and-health/urban-health/news/news/2013/10/outdoor-air-pollution-a-leading-environmental-cause-of-cancer-deaths

9 http://onlinelibrary.wiley.com/doi/10.1029/2007JD008386/full

10 http://www.atmospolres.com/articles/volume4/issue4/apr-13-046.pdf

FIGURE 1

Satellite view of the North India smog on Nov 29, 2015 (MODIS AQUA imagery via NASA World View)

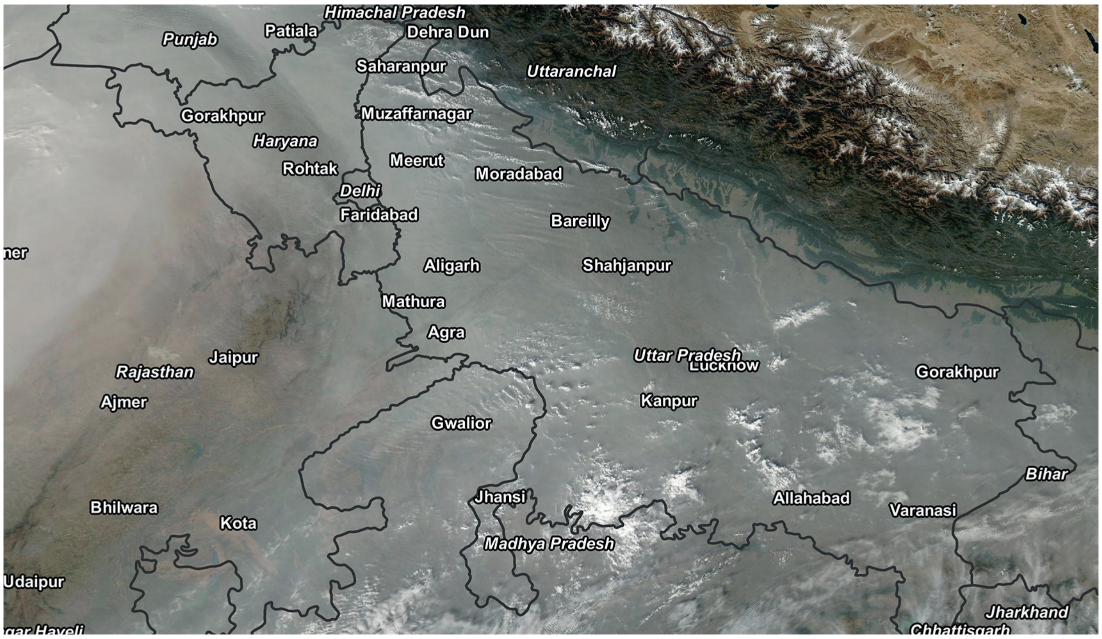


FIGURE 2

Change in average $PM_{2.5}$ levels in World, from 2000 to 2012, estimated from satellite-based aerosol measurements (µg/m³).

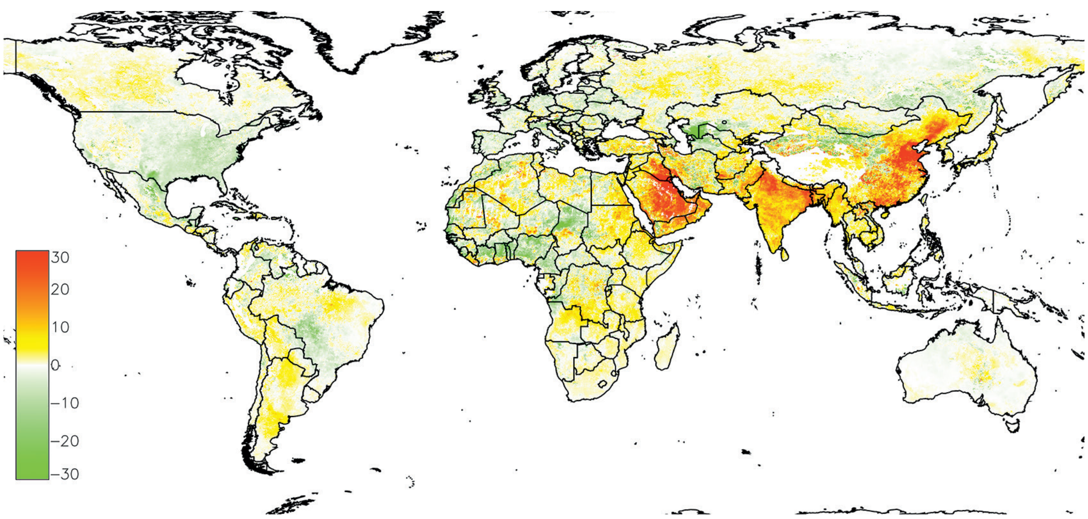
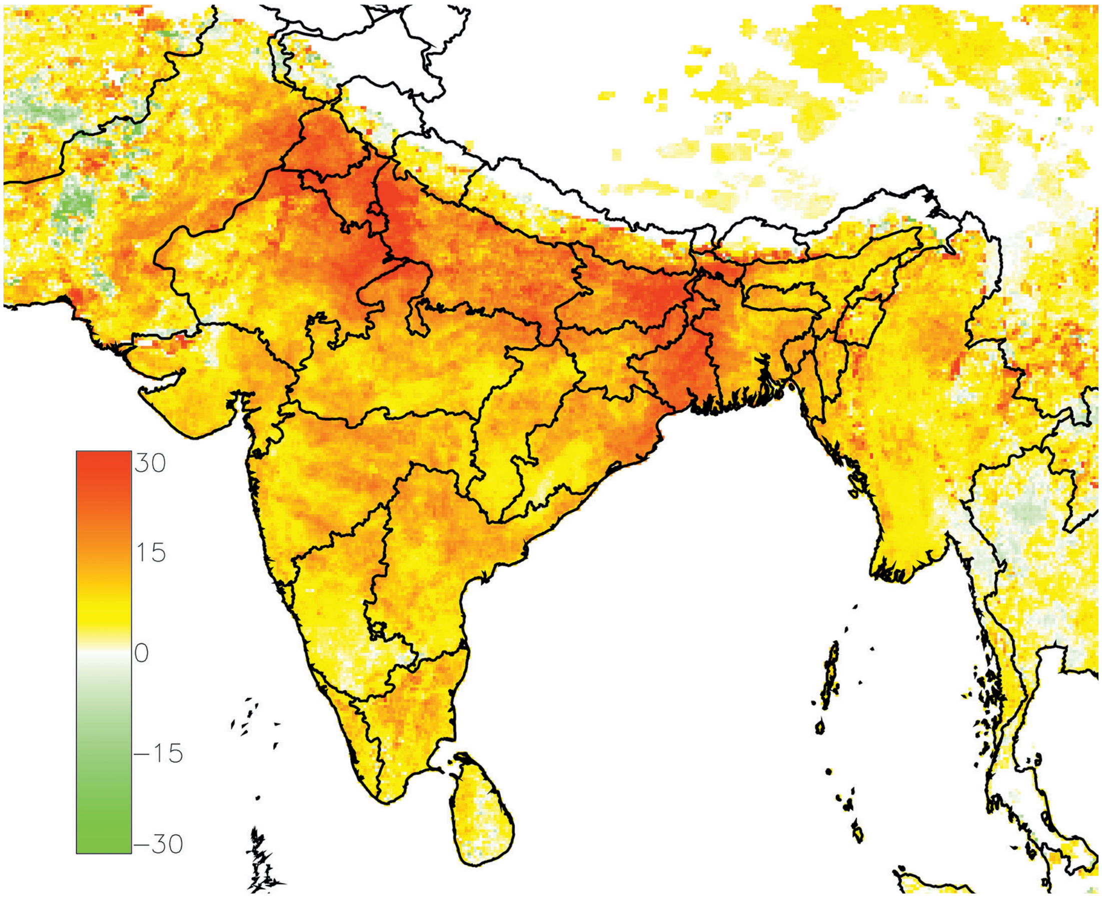
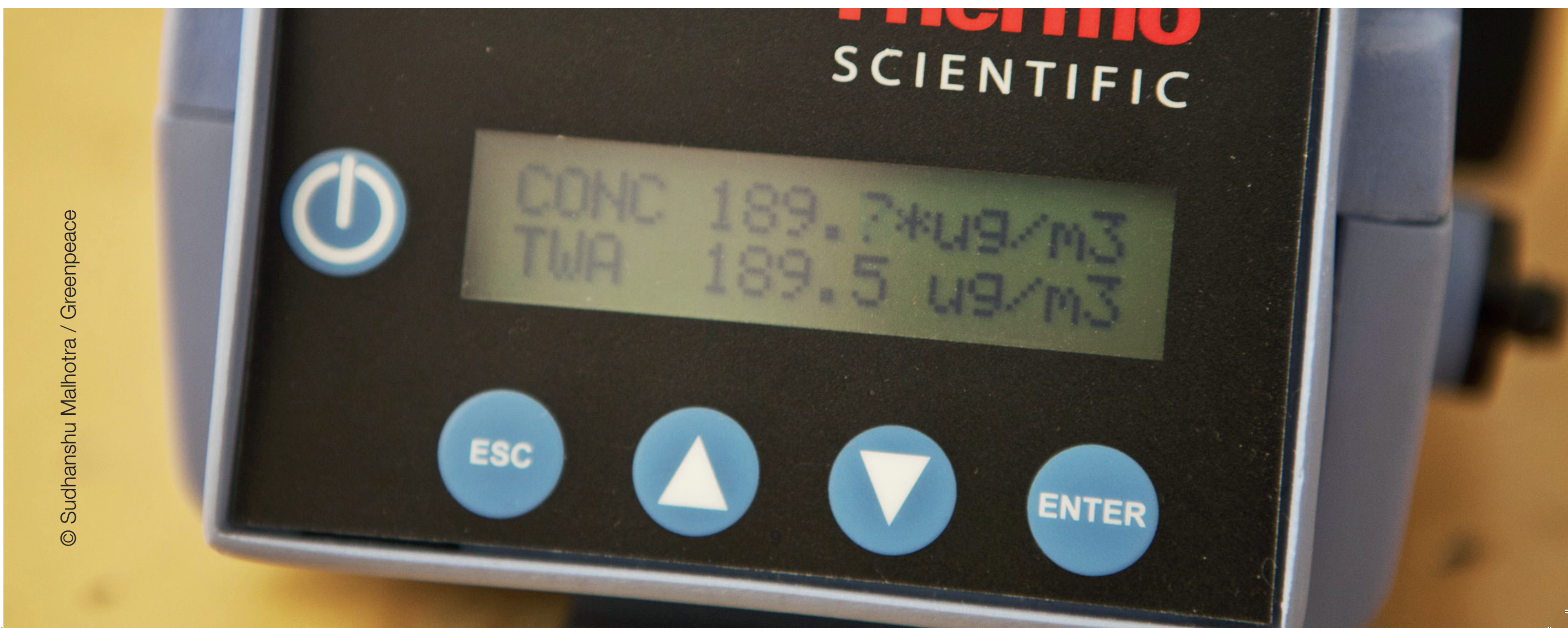


Figure 2 and 3 suggests that pollution levels have increased significantly across the subcontinent from 2000 to 2012 with Haryana-Delhi-Lucknow and West Bengal - Bihar regions experiencing the most dramatic increases.

FIGURE 3

Change in average $PM_{2.5}$ levels in India, from 2000 to 2012, estimated from satellite-based aerosol measurements (μg/m³).





Materials and Methods

The NAQI web portal was analysed to see the implementation and effectiveness of the program as it was conceptualized. Such analysis was performed to check the coverage in terms of spread as well as depth or completeness of the parameters identified to make NAQI web portal effective information and guideline sharing portal on air quality at different places over the country.

The comparison of air pollution levels and availability of air quality data in Indian cities is based on analysis of the hourly data made available through the government's NAQI initiative. AQI values for different pollutants were obtained for the April-November 2015 period and converted into 24-hour or 8-hour concentration values, as appropriate for each pollutant, based on the AQI definition.

For the purposes of calculating average pollution levels over different periods, a city or a station was only included when there were at least five days of data for each month during the period. The procedure that was followed to calculate averages was:

- Calculate monthly average for each station for each month
- For multi-station averages, calculate averages across stations for each month
- Average monthly levels over the period. This was done to give equal weight to each station and each month regardless of differences in data availability.

Limitations of the Study

This study relies entirely on official data made available through the NAQI platform; it has not been possible to verify the data independently.

One limitation of India's AQI system is that it cuts off at an AQI score of 500. This convention was adopted from the U.S., where regulators did not see the need to extend the index to higher levels. Unfortunately, pollution levels in India do "break the index", which means that levels higher than the maximum are understated in the analysis.

Conceptualization of NAQI

The NAQI programme was started with 10 cities providing air quality data to the web based system and is expected to cover 46 cities having population more than a million and 20 state capitals. Along with this the SPCB responsible for 46 cities (having more than one million population) were advised under NAQI to publicize the AQI score calculated from the manual station with minimum time lag. In terms of coverage of the cities, to compute the average AQI for a particular city and to compare the same with other cities a minimum of 3 stations should be available in the city.[11]

This report makes an attempt:

- To analyze the efficiency and status of implementation of the NAQI programme as a whole as well, and
- To analyze and assess the status of air quality in the cities where the programme is implemented.
- To rank the cities under NAQI according to the air quality monitored

11 http://cpcb.nic.in/FINAL-REPORT_AQI_.pdf

Implementation status of NAQI

At present the NAQI web portal provides data for nine states and union territories covering 16 cities, which includes Patna, Muzaffarpur, Delhi, Faridabad, Bangalore, Mumbai, Pune, Navi Mumbai, Chandrapur, Chennai, Hyderabad, Agra, Kanpur, Lucknow, Varanasi, Jaipur[12,13]. Out of the 16 cities Delhi has 10, Bangalore & Chennai three each, Hyderabad two and rest of the 12 cities only have one station each providing AQI score on the portal (table on the next page depicts the status of NAQI data availability as on 29th November 2015). Out of 32 stations two stations are providing four months old data (Civil Lines and IGI in Delhi) and one station provides about a week old data apart from them all other stations provided data from the same day or a day earlier. Three stations one each in Bangalore, Chanderapur and Lucknow showed insufficient data collection over the day and was not able to compute AQI score for the respective stations.

Only three cities reported PM_{10} levels for each month in April-November, and by November only eight cities were reporting PM_{10}. This is a gap in the system, as in those cities that report both $PM_{2.5}$ and PM_{10}, the national standard for PM_{10} is breached more often than the standard for $PM_{2.5}$. Once stations are connected to the system, data availability is generally quite good – almost all stations reported data on 80% of days or more.

12 Data for Jaipur is only made available from 21st November 2015, So it has not been used in the analysis

13 http://182.74.164.179:9000/

TABLE 3

Comparison to air quality monitoring networks in China, U.S., Europe

	EU			US			China			India		
Ranks	City	PM2.5 ug/m3	Station Sum	City	PM2.5 ug/m3	Station Sum	City	PM2.5 ug/m3	Station Sum	City	PM2.5 ug/m3	Station Sum
1	London	12,8	12	New York	10,6	11	Chongqing	63,4	17	Mumbai	38,8	1
2	Berlin	16,4	5	Los Angeles	12,9	2	Shanghai	52,6	9	Delhi	77,7	9
3	Madrid	9,9	9	Chicago	14,7	8	Beijing	81,4	12	Bengaluru	37,9	3
4	Roma	20,9	5	Houston	11,8	7	Chengdu	75,9	8	Hyderabad	52,1	2
5	Paris	15,7	7	Philadelphia	12,7	8	Tianjin	86,5	15	Chennai	43,8	3
6	Bucharest	24,5	1	Phoenix	14,7	8	Guangzhou	45,9	11	Ahmedabad	65,1	1
7	Vienna	18,8	4	San Antonio	8,9	3	Baoding	133,1	6	Kolkata	N/A	N/A
8	Hamburg	14,8	4	San Diego	16,9	4	Haerbin	68,1	12	Surat	N/A	N/A
9	Budapest	22,5	2	Dallas	10,7	5	Suzhou	65,9	8	Pune	39,6	1
10	Warsaw	26,0	3	San Jose	9,3	4	Shenzhen	31,9	11	Jaipur	N/A	N/A
11	Barcelona	13,9	15	Austin	10	1	Nanyang	N/A	3	Lucknow	54,6	3
12	Munich	14,9	4	Jacksonville	10,4	6	Shijiazhuang	127,8	8	Kanpur	65,3	1
13	Milan	33,2	1	Indianapolis	13,3	19	Linyi	92,4	4	Nagpur	N/A	N/A
14	Prague	18,6	5	San Francisco	10,8	1	Wuhan	83,5	10	Indore	N/A	N/A
15	Sofia	21,9	2	Columbus	11,3	2	Handan	116,0	4	Visakhapatnam	N/A	N/A
16	Brussels	18,7	5	Fort Worth	10,7	3	Wenzhou	45,8	4	Thane	N/A	N/A
17	Birminghar	15,6	1	Charlotte	9,2	3	Weifang	78,5	5	Bhopal	N/A	N/A
18	Cologne	16,2	2	Detroit	12	5	Zhoukou	N/A	4	Pimpri-Chinchwad	N/A	N/A
19	Naples	27,3	1	El Paso	11,2	5	Qingdao	56,6	8	Patna	108,6	1
20	Stockholm	6,7	1	Memphis	9,7	3	Hangzhou	61,3	11	Vadodara	N/A	N/A
Average		**18**	**4**		**11,59**	**5,4**		**75,9**	**8,5**		**58,35**	**2,5**
Total			**89**			**108**			**170**			**25**

Comparison of the $PM_{2.5}$ concentration and monitoring station numbers in the top 20 biggest cities in EU, US, China and India show that there are an average of 4 stations in each of the EU's top 20 biggest cities, 5 in US and 8 in China. The average $PM_{2.5}$ concentrations of these cities are 18, 11.6 and 75.9 ug/m3 in EU, US and China, respectively.

TABLE 4

Status of NAQI implementation as on 29th November 2015

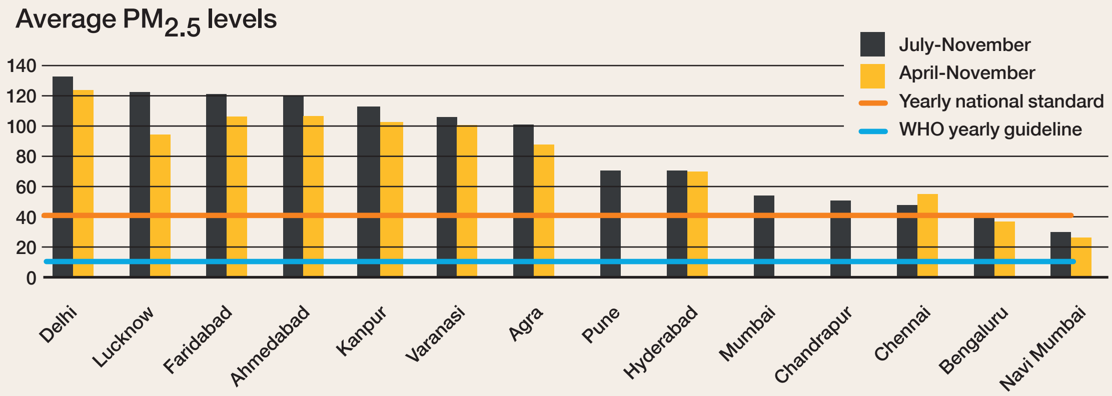
S.No	State	City	Name of the Stations	Number of Stations	Data Updated Upto (Date)	Remark
1	Bihar	Patna	IGSC Planetarium Complex - BSPCB	1	29th November 2015	
		Muzaffarpur	Muzaffarpur Collectorate - BSPCB	1	29th November 2015	
2	Delhi	Delhi	Income tax Office	10	24th November 2015	Data for $PM_{2.5}$ and PM_{10} not available making data insufficient to compute AQI score
			Shadipur		28th November 2015	
			IHBAS		29th November 2015	
			NSIT Dwarka		28th November 2015	
			Civil Lines		10th july 2015	
			IGI Airport		10th july 2015	
			Mandir Marg		28th November 205	
			Anand Vihar		28th November 2015	
			R k Puram		28th November 2015	
			Punjabi Bagh		28th November 2015	
3	Haryana	Faridabad	Sector 16 A	1	29th November 2015	
4	Karnataka	Bangalore	BTM Layout	3	28th November 2015	Data not available for sufficient duration to compute AQI
			Peenya		28th November 2015	
			BWSSB Kadabesanahalli		28th November 2015	
5	Maharashtra	Mumbai	Bandra	1	28th November 2015	
		Pune	Karve Road	1	29th November 2015	
		Navi Mumbai	Airoli	1	29th November 2015	
		Chandrapur	Chandrapur	1	28th November 2015	Data not available for sufficient duration to compute AQI
6	Rajasthan	Jaipur	VK Industrial Area	1	29th November 2015	
7	Tamil Nadu	Chennai	Alandur Bus Depot	3	28th November 2015	
			IIT		28th November 2015	
			Manali		28th November 2015	
8	Telangana	Hyderabad	Sanathnagar	2	29th November 2015	
			Zoo Park, Bahadupura West		29th November 2015	
9	Uttar Pradesh	Agra	Sanjay Palace	1	29th November 2015	
		Kanpur	Nehru Nagar	1	29th November 2015	
		Lucknow	Lalbagh, West Lucknow	3	28th November 2015	Data not available for sufficient duration to compute AQI
			Central School		28th November 2015	
			Talkatora District Industries Center		28th November 2015	
		Varanasi	Ardhali Bazar	1	29th November 2015	
Total:	City	16	Stations	32		

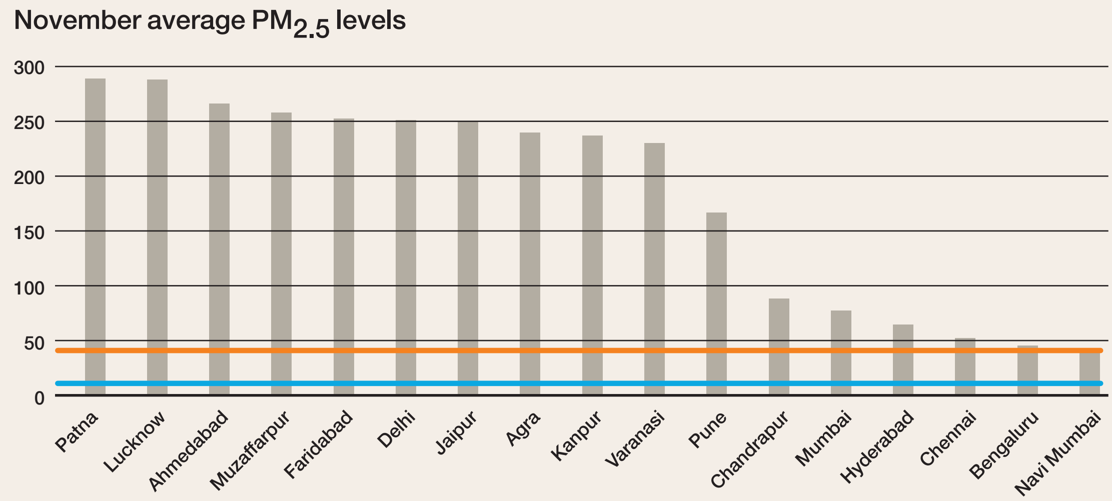
City Ranking and data on pollution levels

The NAQI platform data provides the most consistent look into pollution levels in Indian cities to date, and confirms the high pollution levels reported by earlier studies. The data so far covers the months from April to November, which excludes some of the winter months with highest pollution levels, but it enables initial comparisons of pollution levels to the annual standards. Delhi's levels over the eight months of data were 12 times as high as the WHO annual guideline and three times as high as the national standard. Another six cities – Lucknow, Faridabad, Ahmedabad, Kanpur and Varanasi – had average levels at least ten times as high as the WHO annual guideline.

FIGURE 4

Average pollution levels in April-November and in November[14]





14 World Health Organization guidelines from http://apps.who.int/iris/bitstream/10665/69477/1/WHO_SDE_PHE_OEH_06.02_eng.pdf

November average levels highlight the extremely serious and widespread wintertime pollution in north India. While Delhi garners the most attention, five other cities registered even higher levels in November, and all northern cities had average levels that would trigger a "red alert" in Beijing if they persisted for only four days.

TABLE 5

Average pollution levels in July-September 2015

City	$PM_{2.5}$	PM_{10}	NO_2	O_3
Agra	101	NA	23	54
Ahmedabad	119	NA	32	157
Bengaluru	41	NA	16	61
Chandrapur	50	130	3	26
Chennai	47	NA	15	69
Delhi	132	266	75	112
Faridabad	120	NA	26	40
Hyderabad	70	NA	18	44
Kanpur	112	NA	39	24
Lucknow	122	NA	21	69
Mumbai	53	87	20	41
Navi Mumbai	30	69	NA	NA
Pune	70	146	49	17
Varanasi	105	214	22	40

Comparing the situation in China and India, Delhi's $PM_{2.5}$ levels in July-November were almost twice as high as the levels in Beijing over the same period (132 vs 69µg/m3), and were even higher than the levels in the most polluted provincial capital, Jinan in Shandong. Out of the 14 cities for which data was available from July to November, seven other cities – Lucknow, Faridabad, Ahmedabad, Kanpur, Varanasi and Agra – had levels higher than both Beijing and Jinan. PM_{10} levels in Delhi were more than three times as high as in Beijing. Of the five other cities with PM_{10} data available, four had higher levels than Beijing.

FIGURE 5

Comparing July-November average $PM_{2.5}$ levels in Chinese and Indian cities

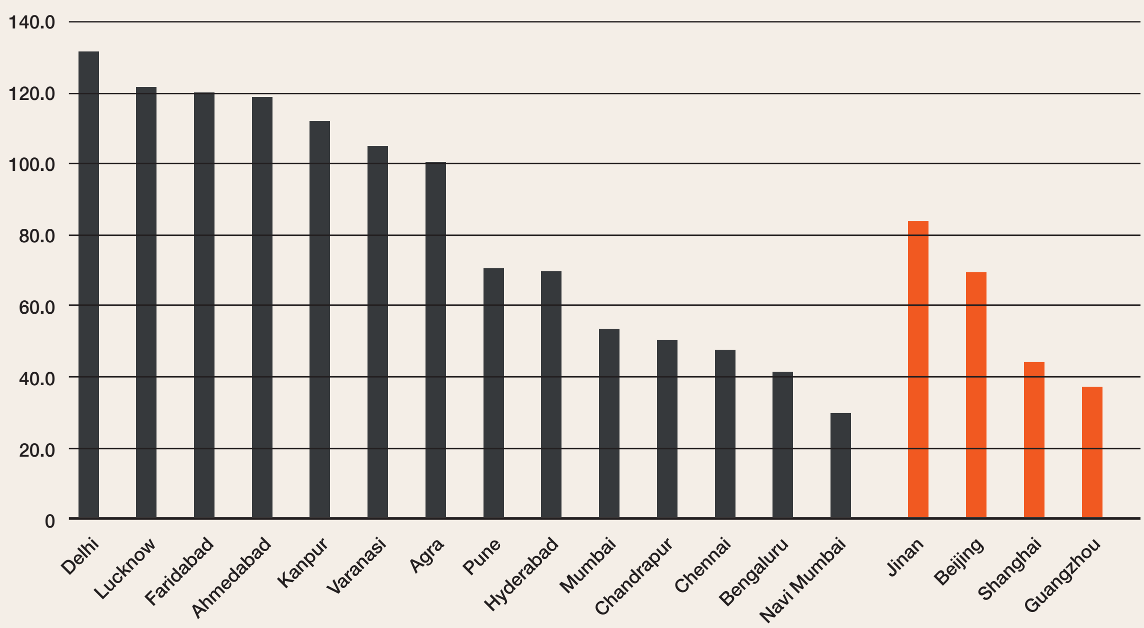
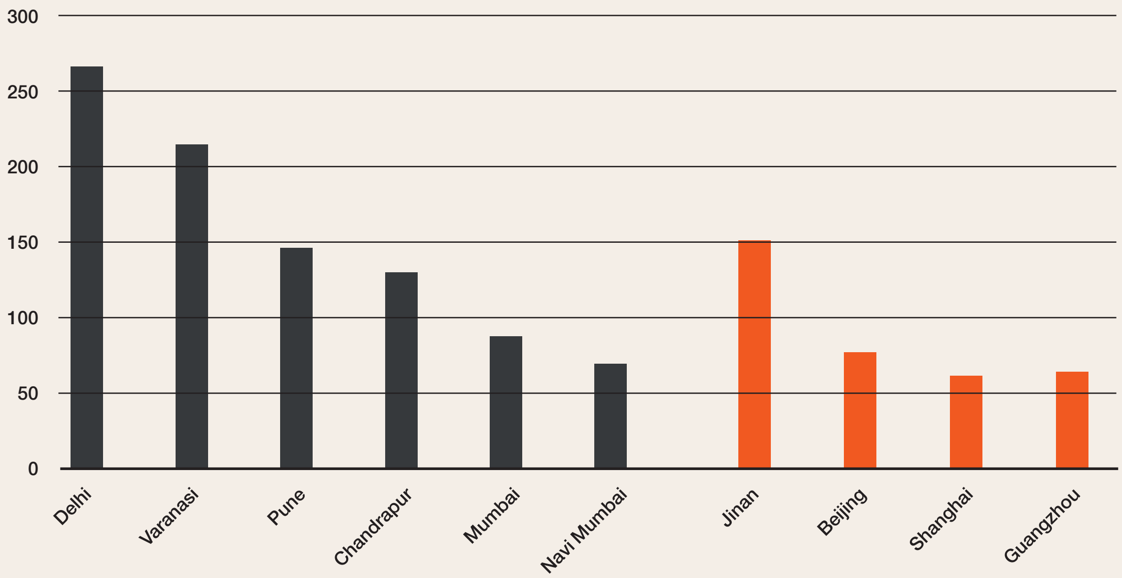


FIGURE 6

Comparing July-November average PM_{10} levels in Chinese and Indian cities



National standards for daily average pollutant levels were being exceeded in all cities, one city, Muzaffarpur, not reporting a single day of acceptable air quality, followed by Patna with only a single day and by Delhi with only 11 days out of 236 not exceeding the national standards. Jaipur only had 11 days of data in the study period, but not a single one of them had levels in compliance with national standards.

TABLE 6

Violations of air quality standards (on the basis of average levels at all stations)

City	Days with data	% of days exceeding standards		
		April-June	July-Nov	Total
Mumbai	142	NA	33%	33%
Hyderabad	232	44%	45%	45%
Navi Mumbai	217	57%	46%	50%
Agra	211	50%	51%	51%
Chandrapur	123	NA	54%	54%
Pune	141	NA	57%	57%
Ahmedabad	180	63%	60%	61%
Faridabad	179	79%	69%	72%
Bangalore	235	77%	70%	72%
Varanasi	218	86%	76%	79%
Chennai	233	99%	71%	81%
Kanpur	220	89%	81%	84%
Lucknow	232	99%	83%	88%
Delhi	236	100%	93%	95%
Patna	58	NA	98%	98%
Muzaffarpur	55	NA	100%	100%
Jaipur	11	NA	100%	100%

TABLE 7

Violations of air quality standards (by station)

S.No.	City	Station	Days with data	% of days exceeding national standard		
				April-June	July-Nov	Total
1	Mumbai	Bandra - MPCB	142	NA	33%	33%
2	Hyderabad	Sanathnagar	230	44%	37%	40%
3	Bangalore	Peenya	218	54%	47%	49%
4	Navi Mumbai	Airoli - NMMC	217	57%	46%	50%
5	Agra	Sanjay Palace	211	50%	51%	51%
6	Chandrapur	Chandrapur	123	NA	54%	54%
7	Bangalore	BWSSB Kadabesanahalli	212	67%	51%	57%
8	Pune	Karve Road Pune	141	NA	57%	57%
9	Ahmedabad	Maninagar	180	63%	60%	61%
10	Chennai	Alandur Bus Depot	213	86%	64%	70%
11	Faridabad	Sector16A Faridabad	179	79%	69%	72%
12	Chennai	Manali	230	99%	58%	72%
13	Chennai	IIT	195	98%	63%	72%
14	Hyderabad	Zoo Park, Bahadurpura West	69	NA	75%	75%
15	Bangalore	BTM Layout	182	81%	75%	77%
16	Lucknow	Central School	208	94%	68%	77%
17	Lucknow	Lalbagh, West Lucknow	198	86%	74%	78%
18	Varanasi	Ardhali Bazar	218	86%	76%	79%
19	Delhi	Mandir Marg - DPCC	215	95%	73%	80%
20	Kanpur	Nehru Nagar	220	89%	81%	84%
21	Delhi	NSIT Dwarka	169	97%	76%	85%
22	Delhi	IHBAS	52	78%	100%	87%
23	Delhi	Shadipur	225	86%	91%	89%
24	Lucknow	Talkatora District Industries Center	183	97%	86%	91%
25	Delhi	Punjabi Bagh - DPCC	209	99%	90%	93%
26	Delhi	R. K. Puram - DPCC	221	100%	89%	93%
27	Delhi	Civil Lines - DPCC	40	97%	100%	98%
28	Delhi	IGI Airport - DPCC	50	100%	89%	98%
29	Delhi	Anand Vihar - DPCC	210	100%	97%	98%
30	Patna	IGSC Planetarium Complex - BSPCB	58	NA	98%	98%
31	Muzaffarpur	Muzaffarpur Collectorate - BSPCB	55	NA	100%	100%
32	Jaipur	VK Industrial Area Jaipur - RSPCB	11	NA	100%	100%

The pollutant contributing most to the exceedances of national standards was particulate matter, being the pollutant responsible for most violations in 12 out of 17 cities, and most important or second most important in all but one. The two other pollutants that were responsible for a significant number of bad air quality days were carbon monoxide and ozone. Particulate matter (PM) is also the pollutant causing the largest health effects in India according to the findings of the Global Burden of Disease project.

TABLE 8

Which pollutants contribute most to bad air quality days?

City	PM	CO	Ozone	NO_2	SO_2
Agra	Most	Second most	Third most		
Ahmedabad	Most	Second most	Third most		
Bangalore	Third most	Most	Second most		
Chandrapur	Most	Second most	Third most		
Chennai	Second most	Most			Third most
Delhi	Most	Third most	Second most		
Faridabad	Most	Second most	Third most		
Hyderabad	Most	Second most	Third most		
Kanpur	Second most	Most	Third most		
Lucknow	Second most	Most	Third most		
Mumbai	Most		Second most		
Muzaffarpur	Most	Second most	Third most		
Navi Mumbai	Second most	Most			
Patna	Most	Second most			
Pune	Most	Second most	Third most		
Varanasi	Most	Second most	Third most		

Contribution to bad Air days

- Most
- Second most
- Third most

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Conclusion

The NAQI system represents a major improvement in reporting on air quality in some large cities in India. However, data is only available for 16 cities at present, which is shockingly low number given that India has more than 50 cities with one million or more people and there are many more industrial clusters which are assigned to be polluted even more than the most polluted cities in India. Major steps which can be implemented to make NAQI an effective tool are:

- Expending the NAQI network over the country to cover important and significant places, making every city equipped with at least 3 to 5 monitoring stations.
- Upgrading manual stations to continuous ambient air quality monitoring stations feeding data to online NAQI portal.
- Expanding the distribution and reach of such real time data to the general public through various mediums, such as TV, Radio, News Papers, Mobile Apps and Web Portals.
- Issuing real time health advisory with the data on air pollution to the general public suggesting them to take concerned actions and activities with the varying pollution levels.
- Including long term and chronic health impacts from air pollution in the health advisory to be issued.
- Strengthening the emission standards for thermal power plants and other industries to reduce the pollution levels with proper implementation of the existing laws.
- Making public transport more reliable and safe so that people can shift from polluting individual private vehicles to public transport.
- Implementing stricter norms for vehicles and upgrading to more efficient and stricter emission norms emission.

Above mentioned steps are just immediate steps to reduce the personal exposure to high pollution levels by knowing the pollution levels around the areas we live, work or travel and taking the appropriate actions according to the health advisory. This will safeguard us from the high pollution levels till the time we take strong corrective measures to reduce the pollution levels from diverse sources and such strong actions have to be taken as soon as possible to reduce and minimize health impacts from the pollution levels.


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