BENGALURU'S RISING AIR QUALITY CRISIS

THE NEED FOR SUSTAINED REPORTAGE AND ACTION

CONTENT

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ABBREVIATIONS:

$PM_{2.5}$ - Particulate Matter having an aerodynamic diameter equal to 2.5 µm

PM_{10} - Particulate Matter having an aerodynamic diameter equal to 10 µm

NAMP - National Ambient Monitoring Programme

CPCB - Central Pollution Control Board

KSPCB - Karnataka State Pollution Control Board

AQI - Air Quality Index

INTRODUCTION

India's rising air pollution levels across its cities and rural landscape has been a cause for worry. The World Health Organisation has identified 13 out of the 20 most polluted cities in the world to be in India. Ambient air pollution has been identified as a national problem since it is the fifth biggest cause of mortality in India[1].

While most of northern India's tier one and tier two cities have been in the news for consistently breaching air quality standards in the last few years, the cities in the south are also affected by poor air quality.

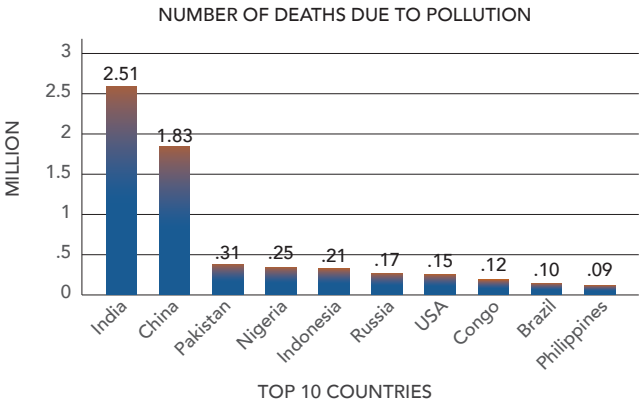
Under the National Air Quality Monitoring Programme (NAMP) implemented by the Central Pollution Control Board (CPCB), a network of 544 operating ambient air quality stations cover 224 cities/towns in 26 states across the country. Three major pollutants viz. PM_{10}, Sulphur Dioxide (SO_2) and Nitrogen Dioxide (NO_2) have been identified for regular monitoring at all locations. The annual permissible levels of PM_{10}, NO_2 and SO_2 are 60, 50 and 40 µg/m³.

Other parameters like $PM_{2.5}$ which is considered the most toxic due to its small size, Carbon Monoxide (CO), Ammonia (NH_3), Lead (Pb), Ozone (O_3), Benzene, Benzo pyrene ,Arsenic and Nickel are being monitored at select locations.

According to the ambient air quality data, CPCB notes that more than 80% of the Indian cities violate the PM_{10} standards.

The Health Impact

The Lancet commission study concluded that air pollution was the biggest contributor, linked to 6.5 million deaths in 2015, ahead of water pollution (1.8 million) and workplace-related pollution (0.8 million).



Indian cities today are among the most polluted areas in the world and it is estimated that outdoor air pollution leads to approximately 670,000 deaths annually[2]. Current regulatory standards, for particulate matter set by the CPCB are much higher than those recommended by the World Health Organization[3]. In addition, unlike other countries, the CPCB does not take into account findings from health literature when deciding on air quality standards[4].

The regulatory progress on air pollution owing to the heightened media focus has been largely limited to the National Capital Region. While the scale of the crisis across the Indo Gangetic Plain and the NCR region has been alarming, the lack of reliable and sufficient monitoring stations across other parts of the country has been a deterrent to understand the severity of the crisis. New Delhi has the most dense network of air quality monitoring in the country with 40 plus online monitors in place. In comparison, Bengaluru only has 10.

In 2017, the Karnataka State Pollution Control Board's data clearly indicates that the Particulate Pollutant levels exceeding the annual safety limits and $PM_{2.5}$ levels in particular has been observed to exceed the limit by 3-45%.

A study by UrbanEmissions shows how Bengaluru's pollution levels are three times the WHO's safety limit, and points to transport and open waste burning as the key sources of emissions.

The current media narrative acknowledges the need for urgent action on air pollution, but some cities seem to be in focus more than the others for various reasons including those of access and availability of data. Sustained reportage to ensure these gaps in data are met is an important step in addressing the crisis.

Studies done on the role of online media coverage on air pollution risks and policy action observe that *'Through greater elaboration of the health burdens and evidence-based policy actions, the media can play a critical role in galvanizing India's action on air quality. These data may suggest opportunities for media advocacy and greater public and policy engagement to address issues around air quality in India".*[5]

This report summarises what we know about Bengaluru's air quality as well as introduces ideas and solutions, some initiated by citizens themselves.

[1] http://www.cseindia.org/air-pollution-is-now-the-fifth-largest-killer-in-india-says-newly-released-findings-of-global-burden-of-disease-report--4831
[2] http://www.indiahealthpollution.org/wp-content/uploads/2015/03/AR_Hem-et-al-short-term.pdf
[3] https://www.researchgate.net/publication/225589736_Update_of_WHO_air_quality_guidelines
[4] https://www.researchgate.net/publication/225589736_Update_of_WHO_air_quality_guidelines
[5] https://www.ncbi.nlm.nih.gov/pubmed/28857062

BENGALURU'S PROBLEM

Bengaluru's rapid development and its changing urban landscape are a perfect example of an unplanned city, it has seen massive changes in its demography with a visible decline in its tree cover leading to a rise of temperature, increased number of vehicles along with rampant construction activity and unpaved roads. Bengaluru has the highest population density and is the only metropolitan city of Karnataka, with 94 lakh people as per the 2011 census.

The cities vehicular population is around 4.5 million, and contributes 60-70 per cent of the pollution load to the environment[6]. According to a 2012 dataset, nearly 900 new vehicles are added to the Bengaluru roads every day[7]. As per a conservative estimate, Bengaluru generates around 4500-5000 tons of waste per day. **The city has had its challenges with archaic system of waste collection, segregation and transportation of waste to dump yards, which resulted in emissions.** Poor logistics of collection has also resulted in road side burning of leaf litter and mixed waste. However it is now moving towards decentralised models of waste management.

In 2015, levels of key pollutants like $PM_{2.5}$, in Bengaluru's BTM Layout touched hazardous levels. Even in 2007, as per Karnataka State Pollution Control Board's publicly shared data, particulate levels were seven-and-a-half times above safe levels8. While data collected over the years doesn't seem consistent enough to identify trends, individual spikes in KSPCB data as well as citizen-initiated measurements show alarming levels of particulate matter.

[6] http://www.indiaenvironmentportal.org.in/content/374071/proceedings-of-the-workshop-on-air-quality-aq-monitoring-modeling-and-assessment-workshop-on-22nd-march-2013/

[7] http://www.thehindu.com/todays-paper/tp-national/tp-karnataka/karnataka-government-directive-to-civic-agencies/article18398011.ece

[8] http://www.indiaspend.com/cover-story/a-Bengaluru-neighbourhoods-toxic-air-portends-indias-future-55198

DATA CHALLENGES

According to the state pollution control board, the particulate matter pollution in Bengaluru for 2016-2017 is as follows:

~ The PM_{10} values have exceeded the National Ambient Air Quality Standards (60µg/m³) by 30% to 120% at all the 15 locations except at Saneguruvanahalli.

~ $PM_{2.5}$ values have exceeded the National Ambient Air Quality Standards (40.0 µg/m³) by 3% to 45%, at all 9 locations, due to vehicular traffic increase and construction activities.

The tabular column published by the PCB further explains that the averages and estimates generated for the year have been derived from both manual and online monitoring data collected throughout the year.

Annual average values of Air Pollutants at Bangalore City during the year 2016-17

Sl. No.	Name of the Station	SO2 µg/m3	NO2 µg/m3	PM_{10} µg/m3	$PM_{2.5}$ µg/m3	NH3 µg/m3	lead µg/m3	CO mg/m3	PM_{10} exceeded to the National Standards	$PM_{2.5}$ exceeded to the National Standards
1	Export promotional Park ITPL, Whietfield Road, Bangalore	2.0	33.1	**131.0**	**55.0**	29.3	0.1	*	**118 %**	**38 %**
2	K.H.B Industrial Area, Yelahanka	2.0	28.5	**111.0**	**54.0**	25.4	0.1	*	**85 %**	**35 %**
3	Peenya Industrial Area - RO	2.0	37.0	**109.0**	**52.0**	36.6	0.1	*	**82 %**	**30 %**
4	Swan Silk Peenya Indl Area	2.3	37.9	**99.0**	**50.0**	35.0	0.1	*	**65 %**	**25 %**
5	Yeshwanthpura Police Station	2.0	39.6	**93.0**	**46.0**	36.0	0.1	*	**55 %**	**15 %**
6	Amco Batteries, Mysore Road	2.0	38.0	**107.0**	**51.0**	36.1	0.2	*	**78 %**	**28 %**
7	Central Silk Board, Hosur Road	2.3	39.4	**132.0**	**58.0**	37.8	0.1	*	**120 %**	**45 %**
8	DTDC House, Victoria Road	2.0	33.7	**127.0**	0.0	23.9	0.1	*	**112 %**	**0**
9	Banswadi Police Station	2.0	26.8	**80.0**	**41.2**	22.0	0.3	*	**33 %**	**3 %**
10	CAAQM City Railway Station	6.5	**45.8**	**102.0**	0.0	0.0	0.0	0.9	**70 %**	**0**
11	CAAQM S.G.Halli	3.7	30.3	46.0	0.0	0.0	0.0	0.5	Within limit	0
12	Kajisonnenahalli, After white Field	2.0	24.3	**83.0**	40.0	22.0	0.1	*	**38 %**	Within limit
13	TEERI Office,Domlur	2.0	32.0	**120.0**	**55.0**	39.3	0.2	*	**100 %**	**38 %**
14	UVCE, K.R Circle	2.0	26.3	**86.0**	38.0	22.9	0.2	*	**43 %**	Within limit
15	Victoria Hospital	2.0	36.3	**80.0**	40.0	32.4	0.1	*	**33 %**	Within limit
16	Indira Gandhi Children Care (NIMHANS)	2.0	31.0	**78.0**	36.0	28.0	0.1	*	**30 %**	Within limit
	Standards	**50.0**	**40.0**	**60.0**	**40.0**	**100.0**	**0.5**	**2.0**		

Note:

The Board has monitored the ambient air quality of Bangalore city at 16 location including two Continuous ambient air quality monitoring stations under National ambient air quality monitoring programme (NAMP) covering Industrial area, Mixed urban area and Sensitive area. Monitoring is being carried out on twice a week 24 hourly at uniform intervals for PM_{10}, SO2, NO2,and other parameters.

~ The PM_{10} values have exceeded in the range of 30 % to 120 % to the National ambient air quality standards (60.0 µg/m³) at all the 15 locations except at CAAQM Sanegruvanahalli, during the year 2016-17, due to vehicular traffic and construction activities.

~ The $PM_{2.5}$ values have exceeded in the range of 3 % to 45 % to the National ambient air quality standards (40.0 µg/m³) at all the 9 locations as above during the year 2016-17.

~ Except City Railway Station, the concentration of NO_2 is within the National ambient air quality standards (40.0 µg/m³) in all the location during the year 2016-17.

~ The concentration of SO_2 is within the National ambient air quality standards (50.0 µg/m³) in all the location during the year 2016-17.

~ The concentration of NH_3, Lead and CO are within the National ambient air quality standards (100.0, 0.5 µg/m³ and 2.0 µg/m³) in all the location during the year 2016-17.

Status of Online Monitoring

The city currently has 10 online monitoring stations, of which 5 stations have been introduced in January 2018 with an additional feature to generate Air Quality Index. The five new online stations are located in Hebbal, Jayanagar, Kavika, NIMHANS, Silk Board[9].

However, in order to understand the levels and trends of $PM_{2.5}$ from the available data on the online portals, one has to analyse the data from continuous monitoring stations over the last few years. In this pursuit it was discovered that there are only three monitoring stations that monitored $PM_{2.5}$ in the last three years, namely BTM, BWSSB and Peenya;the missing data sets for several days in a row highlighted huge gaps in the data being used. Therefore the need to question the reliability and the transparency of data arises.

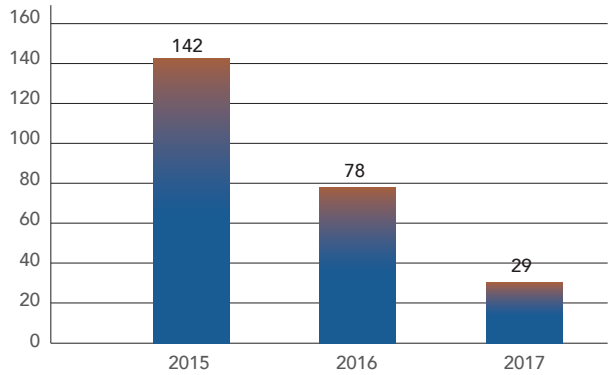
Note: RTIs filed to seek access to raw data were denied.

NON-AVAILABILITY OF DATA (TOTAL NO. OF DAYS)

STATION	2015	2016	2017
BTM	152	134	90
BWSSB	103	124	73
Peenya	104	276	79

Averages generated for the three years based on the available data online shows that the $PM_{2.5}$ values have significantly declined at all three locations in the last two years, which is sharp contrast to what individual data points are conveying.

$PM_{2.5}$ AVERAGES 2015-2017 BASED ON DATA FROM THREE STATIONS



Online monitoring stations

~ BTM
~ BWSSB
~ Peenya
~ S.G.Halli
~ CRS
~ Hebbal
~ Jayanagar
~ Kavika
~ NIMHANS
~ Silk Board

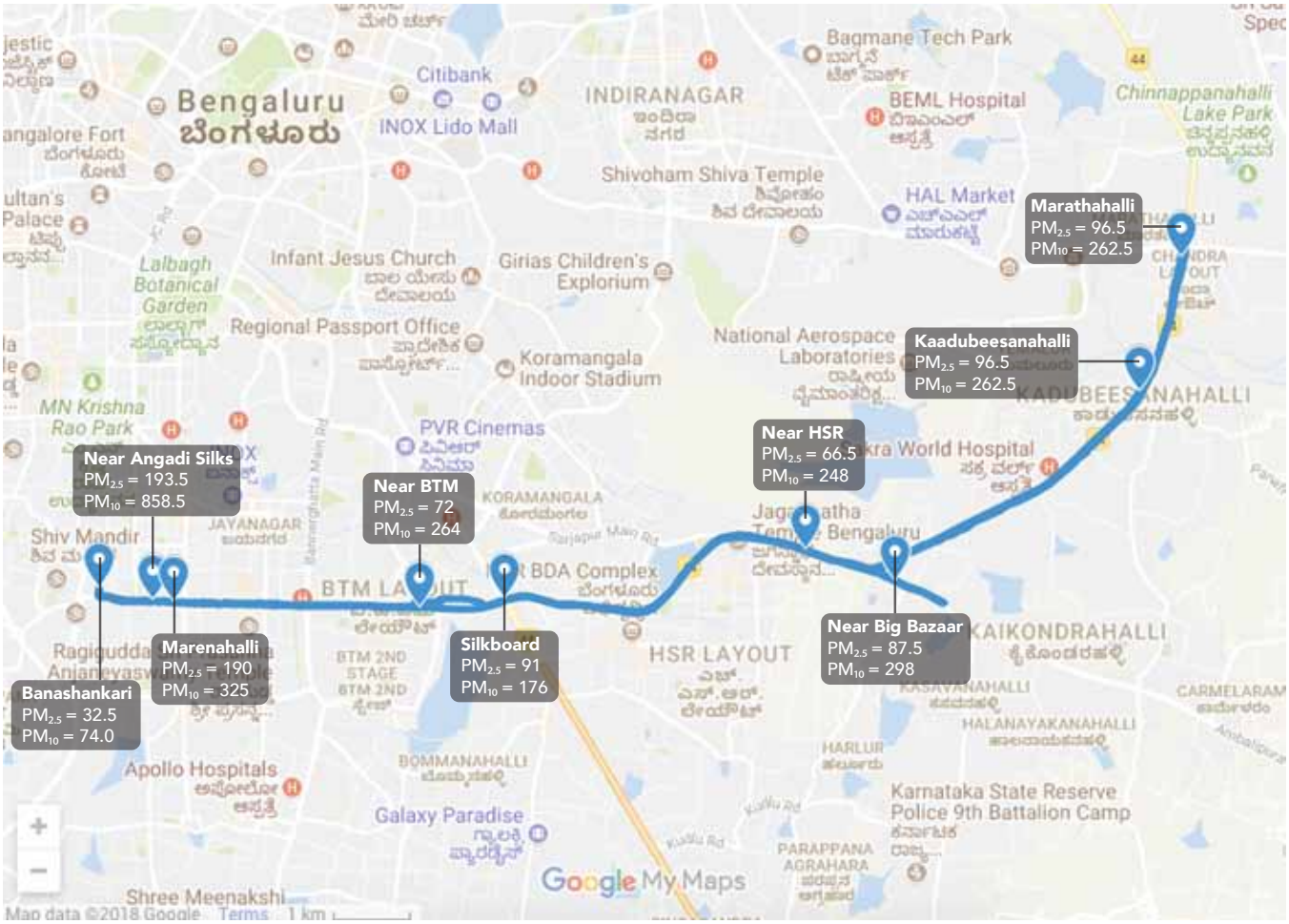
[9] https://www.eprolytics.com:9999/#/dashboard

PEAK HOUR POLLUTION

An exercise carried out to monitor air quality across several, select roads during the peak hour traffic revealed that those who are travelling in open vehicles are likely to be exposed to severe air pollution levels with drastic spikes in a short period of time. While most health data and norms applicable to exposure levels are set based on averages taken over 24hours and more, it is important to note that a significant amount of population, including school children in particular spend several hours in slow moving traffic every day, increasing their frequency of exposure to poor air quality.

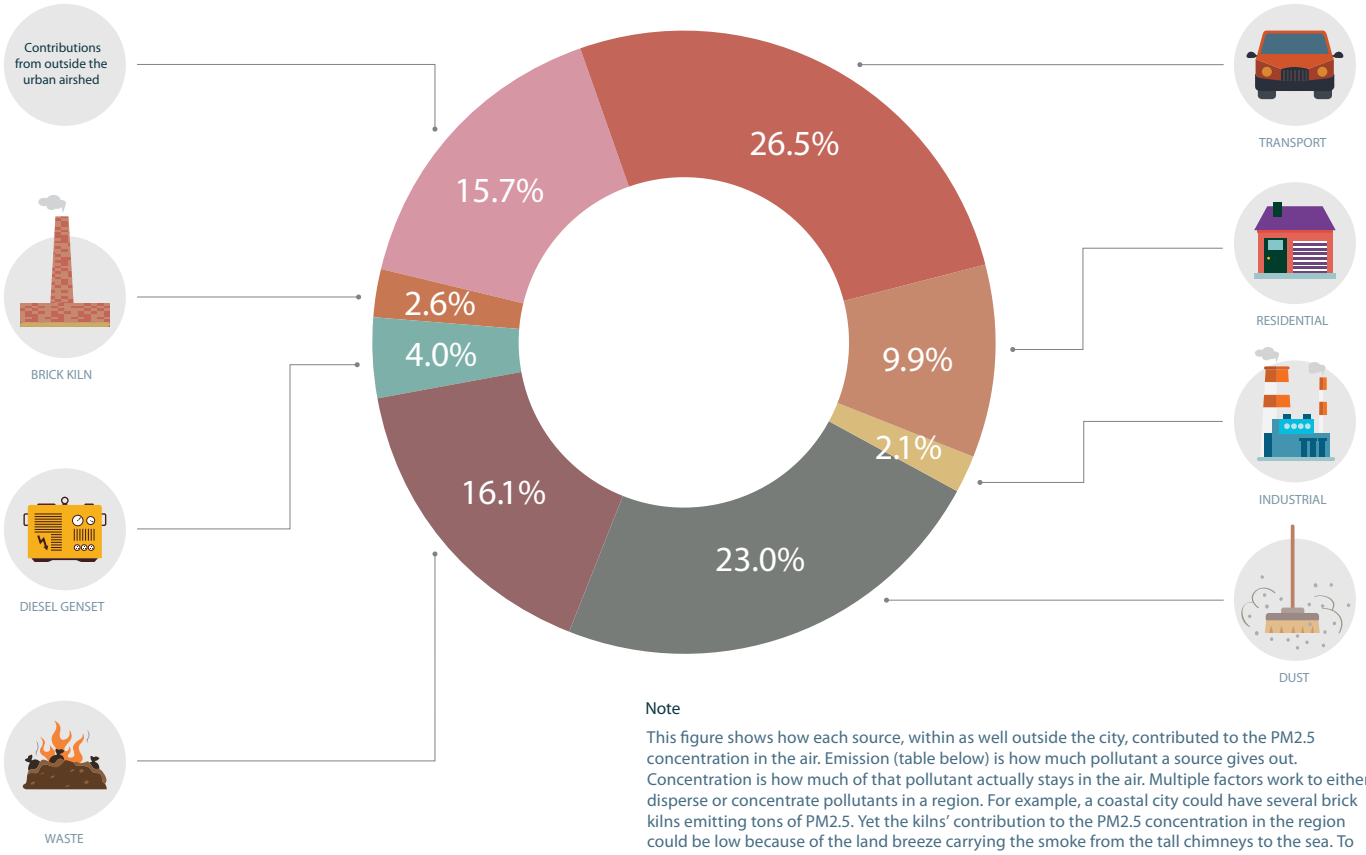
Route – Banashankari to Marathahalli

Between 8:30 AM and 10:30 AM, the particulate pollution levels varied from 70-800 micrograms per cubic meter.



SOURCES

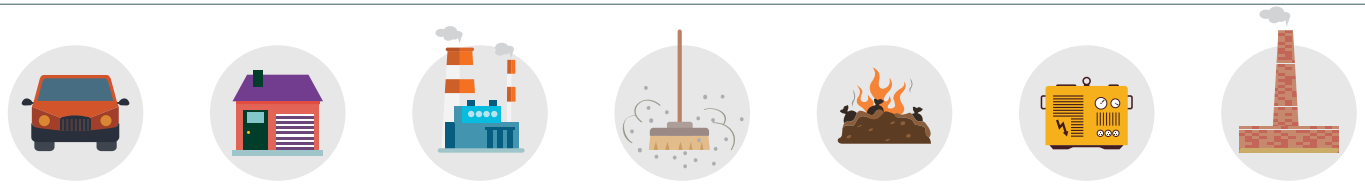
$PM_{2.5}$ emissions : source-wise share in tons in 2015 and 2030 (projected)



Note

This figure shows how each source, within as well outside the city, contributed to the PM2.5 concentration in the air. Emission (table below) is how much pollutant a source gives out. Concentration is how much of that pollutant actually stays in the air. Multiple factors work to either disperse or concentrate pollutants in a region. For example, a coastal city could have several brick kilns emitting tons of PM2.5. Yet the kilns' contribution to the PM2.5 concentration in the region could be low because of the land breeze carrying the smoke from the tall chimneys to the sea. To know how source concentration is calculated please visit the APnA city website.

$PM_{2.5}$ emissions : source-wise share in tons in 2015 and 2030 (projected)



12,550	2,050	2,650	6,400	3,500	1,250	2,900
19,050	2,400	4,750	11,700	5,050	1,450	3,750

Total emissions in 2015 = 31,300 tons Total emissions in 2030 = 48,150 tons

Info graphic source: UrbanEmissions

INTERVIEWS: HEALTH PROFESSIONALS

Dr. Rahul Patil, Jayadeva Institute of Cardiovascular Sciences and Research

A full time cardiologist and a close associate with the research wing at Jayadeva hospitals says that in the last five years, the statistics are clearly indicating a huge rise in the heart attack cases in the under 40 age group. ' We are the largest cardiac center in Asia and our records indicate a 22% increase and these cases come without any common risk factors like hypertension, obesity and diabetes. In age groups above 55 you have all other co-morbidities, including diabetes and hypertension'.

In April last year, in a span of 7-8 months our hospital registered 1000-1100 cases of heart attacks, all in the under 40 age group. The cases also included 19 and 20 year olds dying of heart attacks. Per month 250-300 patients get registered here.

How can we say it's due to pollution? Are these patients exposed to traffic? –

'We did a pilot last year with a sample of 1200 patients, to my surprise only 10% of them had diabetes and another 10% of them had hypertension and cholesterol. What's shocking is that 70-80% had no diabetics or hypertension, the common risk factors. Within this population, 48% had the habit of smoking. After excluding the population with all the risk factors, 30% of the sample consisted of either an auto or a taxi driver and most of them were from in and around Bengaluru. After eliminating stress and dietary habits in this population, we found that the cab drivers and auto drivers were the worst hit as they remain stranded for long hours in bad traffic and are exposed to high levels of pollution'.

'Most of the cab drivers they try to avoid ACs for various reasons, based on informal discussions we realised that they switch off the ACs while in traffic for fresh air. Research clearly indicates that particulate pollution gets lodged in the coronary arteries and as a result the blood starts to clot and that's how they end up getting an attack'.

'As a follow up, we now have a PCAD clinic – Premature Coronary Artery Clinic, the first of its kind in India, we would like to treat them and do a follow up for the next five years to observe the changes, this will help us understand the causes better too. The clinic will act as a research, follow up and as a registry unit.

The same effort was done in Canada and in 8 years they registered 1100 cases, in our case though we saw 1127 cases being registered under 8 months last year. India is going to become the cardio vascular disease capital of the world and the raw data is clearly indicating that'.

When asked about protection from bad air, Dr.Patil concluded saying *'As far as cities are concerned, preventing traffic snarls and reduction of traffic is a must. Pollution levels at signals are extremely high. People should avoid going for walks and cycling on busy roads as it's hard to say whether the benefits can outweigh the risks'.*

INTERVIEWS: HEALTH PROFESSIONALS

Dr.Paramesh H.

A Paediatric Pulmonologist at the Lakeside Center for Health Promotion, Dr. Paramesh is a practicing physician and an environmentalist at heart. He's globally known for his contribution to research and is the founder of the environment and respiratory chapter in Indian Academy of Paediatrics.

Backing his observations on hundreds of children and young adults over the years, he shares that in the last 3-4 years, Bengaluru's Air Quality has declined as in the case of other cities. *'Global warming and the changing climate are contributing to it and it's all quickly getting worse, they are all interrelated'.*

How bad is it in Bengaluru? What kind of cases have been on the rise?

'25% of Children suffer from Asthma and that's been the case for a while now and in that the persistence of asthma has increased and they need constant medication. Within that the persistent severe type has also gone up. These are cases which need constant hospitilation and emergency visits'.

The 2017 research he'd conducted saw a clear increase in the upper respiratory allergies and cough, in the last 17 years the cases with chronic coughs have more than doubled; from 10 to 21%.

'Earlier the lower respiratory cases were more and now it has shifted to nasal allergies, sinusitis and upper respiratory tract. There is also a seasonal variation that takes place; the incidence is seen more in the winters'.

'Asthma in children, bronchial infection, sleep disorder breathing, middle ear infections, pneumonia and COPD are all on the rise due to air pollution in the city.

A study done using a small sample of human volunteers concluded that inhaling Bengaluru's air for an hour will mean your lungs will need at least a month to heal, that's how long your mucous membrane will take to recover'.

What are the main pollutants we need to eliminate?

'We know that in the city, 50% of pollution load is from automobile emissions and major pollutants are suspended particulates and Ozone. $PM_{2.5}$ not only damages the lungs while entering the body, it gets absorbed in about 20 minutes into the blood stream leading to coagulation, heart attacks and also nervous damage. ' Lungs are an organ of insult' and then it spreads all over. Metabolic diseases like endocrine disorders and diabetics too are a result of $PM_{2.5}$ pollution'.

Precautionary measures for asthmatic children include avoiding mornings and afternoons and preferably also avoid being at school during those hours as using a mask doesn't always help in cases with exposure to finer particulates and volatile organic compounds.

CITIZEN INITIATIVES

CASE STUDY I - Solving Problem of Road Dust

By Deepa Vaishnavi

As a rapidly growing neighbourhood, Whitefield houses lakhs of apartments, individual residences and office buildings. Commuters' needs are served by BMTC buses, and to a lesser extent by the newly introduced suburban rail. Metro construction is still in progress.

All this means, private transport and taxis are however still the preferred mode of transport here resulting in traffic congestions every day. The major congestion points include Hope Farm Junction, Graphite India Junction, Varthur Kodi Junction, Hoodi Junction, Kundalahalli Junction and K R Puram Junction.

The members of Whitefield Rising, a local group of active citizens tracked air pollution levels in Mahadevapura for nearly a year through the KSPCB website while also urging BBMP to do something about it. During the latter half of 2017, alarmed by the lack of action, citizens decided to take matters into their own hands.

On 19 Nov 2017, armed with a standard handheld air quality measuring device, a few volunteers belonging to the Whitefield Rising group tested the quality of air at around 7.27 am in a residential gated community in the locality. High pedestrian traffic and Metro construction dust were the criteria for selecting this location. Observed air quality levels exceeded safety limits by more than five times, the particulate matter count was above 400ug/m³.

The fine dust generated by these activities does not settle due to non-stop movement of vehicles in the locality. Further, despite an order from the KSPCB, the BMRCL hasn't been getting the construction site vacuum cleaned regularly. Add to that the fact that daily manual cleaning of a busy area like most of Whitefield is near impossible by pourakarmikas alone. Besides being detrimental to their health given the ever-present pollution in the air, the aggravated traffic situation has also made it difficult for the pourakarmikas to clean the area safely.

Strategies

The residents group felt mechanised road cleaning was the best solution. They contacted a vendor to hire a mechanized cleaner. They identified six routes and the sections to clean on each road (both sides, medians only and or one side), based on presence of kerb-side and median-side silt and dust pollution.

They discussed with the ward committees (of Wards 83,84, 54, 85 and 149) and respective corporators, and reached an agreement to clean 24 kms of road length at a rate of Rs. 3500 per hour. The plan was to clean 3 kms of road length in an hour.

The budget of Rs. 50,000 was finalised and the members crowd sourced the funds to pay for the cleaning.

Challenges

Cleaning of the road commenced on the night of 25 Nov 2017. $PM_{2.5}$ readings at the spot exceeded 500. However, the dust and silt was so much that the machine barely covered a stretch of 4.5 kms in the allocated 8 hours and within the allocated budget. The residents had to give up the idea of getting the entire stretch planned.

Outcomes

On 27 Nov 2017, the WR team issued a letter to KSPCB from 5 ward committees and met the KSPCB Chairman Lakshman, who issued an order to BMRCL to use mechanized cleaning to remove the dust in addition to water sprinkling. However sprinkling is not very effective as the moisture quickly dries up.

After measuring $PM_{2.5}$ levels and PM_{10} levels and the sheer volume of dust collected in just 4.5 kms, the citizens realised that it was humanly impossible for pourakarmikas to clean the median area of a major road, and indeed not fair to expect it even. The probability of inhaling huge amounts of dust were very high not to mention the probability of being injured or killed in an accident given the very heavy traffic on these roads.

Though the cleaning did not go according to plan, Whitefield Rising volunteers feel that it served to prove the problem is fixable. Once done well, and if done on a regular basis, it will not cost much to maintain. Further, it will reduce other costs significantly in the long run including pollution and health care costs.

Preliminary observations also indicated that the silt collected could be of value - once cleaned, it could be sold as second-grade sand for laying pavers, or for other construction uses.

CASE STUDY II - Community-based leaf litter management

By Pinky Chandran, Buela Anthony and Priyanka

Context

Burning leaves is a common sight in India. And perhaps it is a much easy solution to reduce the mounds of dry leaves, rather than have the burden of collecting it and then transferring them to a garbage collection truck. The truck would in turn mix the leaves with other mixed waste so collected and make its way to the dump-yards away from the city. While the burning of the leaves was one problem, the burning of leaves combined with scraps of paper and plastic was adding fuel to the exiting fire.

Concerned residents saw a huge opportunity in managing leaf litter, instead of complaining to the municipality.

Strategies

Residents from Malleshwaram led by Dr. Meenakshi Bharath and Vani Murthy championed the cause of composting leaf litter from 2010.

They realised most people didn't know what to do with leaves. Either they burn it which is extremely bad for the environment or they bag it and give it to BBMP workers which goes to the landfills. Leaves are rich in carbon; they are part of the composting process. Vani and Dr. Meenakshi looked at setting up some kind of experiment for people to see and understand. **Dr. Meenakshi put up the first waste compost bed, and also took in kitchen waste along with cow dung, inspired by Vellore Srinivas's waste model.** Vani set up a variation with just leaves and cow dung, in Vani's backyard. They then out out a call to their neighbours to donate leaves and cow-dung. The BBMP also started bringing in leaves. After six to eight months, we saw our rich black gold. This experiment was instrumental reinstating that leaves are valuable resource.

> *"I collect leaves, the entire year. Living on the third floor, I am not fortunate to have a line off trees shedding leaves. So I pick it up from my neighbourhood."*
>
> *~ Vani Murthy*
> Radio Interview: Special Series AIR. @ Radio Active 90.4 MHz

In 2014, volunteers started raking the street for dried leaves and Pongemia flowers. Armed with gloves and broom, they swept the leaves and flowers into a heap, collect them for composting, every year during the season.

This was their second experiment because they found cow dung difficult to source at times. Pongamia flowers are rich in nitrogen and can be used as an alternative to cow dung. They created an enclosure with readily available materials like coconut, twigs and other garden waste. First step was to create space in their garden. They built a structure using coconut fronds, ripping out the dry leaves and using the thick part of the frond, weaving the coconut branches like a bed to hold leaves. They filled the bottom with coconut, twigs and other garden waste that help create an air tunnel and now add the leaves and flowers. In about eight months, they go rich leaf compost.

> *"These are beautiful purple flowers, and the roads are covered like a carpet. You need a combination of carbon and nitrogen, leaves and flowers. So Ravi Kaushik (a volunteer) suggested that we pick these flowers every day. So we started going around 5.30am every morning during the season and sweep Bengaluru's streets for these flowers."*
>
> *~ Vani Murthy*
> Radio Interview: Special Series AIR. @ Radio Active 90.4 MHz

In Koramangala 3rd block, the local RWA managed to go a step further by installing a leaf litter composting unit in 2013. A not-for-profit initiative Kora3B Compost is run in collaboration with the BBMP who collect leaf litter and provide space for composting. The process is simple and easy. First all material is put on a rotary sieve to remove other materials like plastic, twigs and stones. The leaves are then piled with water and cow dung added for composting. The pile is monitored is monitored regularly to ensure moisture and aeration. The compost is tested for quality by the University of Agricultural Sciences, Bengaluru and revenue generated from compost sales are used for operations of the unit.

Street-side leaf composters

Padmashree Balram, the President of 1st Block Koramangala Residents Welfare Association (Ward 151) decided to pilot with street leaf composter. She found leaf piles being used as a dumping point for garbage. At the end of the day, someone would set it on fire. This created a lot of discomfort for all residents. Despite many awareness campaigns, the practice would not stop.

Padmashree introduced mesh cylinder-like structures that could be used for leaf composting. Adopting that drastically stopped the burning. The neighbourhood now has 74 such structures around the block. Residents nearby volunteer to water and dd acow-dung into the composters. At the end of 40-50 days, they got compost, which is used by the residents in their gardens.

Pioneered by the residents of HSR Layout, the lane-wise composting pilot has metamorphosed into community gardens. Not surprising as a natural progression of composting is urban gardening. Around eighty patches have been identified and are offered to the residents of the Layout on a first come-first serve basis to grow their own vegetables.

In August 2017, the Karnataka State Pollution Control Board submitted a proposal recommending for issue of a notification banning burning of solid waste including twigs, dry leaves and other wastes in accordance with section 19(5) of the Air (Prevention and Control of Pollution) Act, 1981 to prevent its ill-health of general public as concentration of the Particulate Matter is now increasing in the urban areas because of solid waste in open places.

Source: KSPCB

Outcome

Concerned citizens around Bengaluru have started taking the initiative to tackle the problem of burning leaves, by composting in their gardens or empty plots.

CASE STUDY III - Holistic action for better neighbourhood

By Deepa Vaishnavi

Context

In 2015, the Directorate of Urban Land Transport (DULT) was looking for community partners in various areas to conduct Cycle Days in their own neighbourhoods. This led to T S Subbiah, a participant of the B.CLIP civic programme and his fellow Sanjay Nagar residents getting together to conduct the first 'Cycle Day' in Sanjaynagar in April 2015.

The idea of the Cycle Day was to get the community together, promoting cycling and reclaim the street. On that day, a large number of residents - young and old come out to take over the road on their cycles. **DULT also provides free cycles for people to rent and ride.** In addition, the traffic police' permission and support is obtained to block a portion of the road for vehicular traffic from 7.30 am to 10.00 am so that it is safe to cycle.

Routes are marked and sections of the cordoned off area has various activities like Zumba dance, traditional games, tug-of-war and yogasana for people to take part in.

Following the success of Cycle Day, the volunteers got together under the banner 'Team Sanjaynagar'. After successfully collaborating on a number of social initiatives, the core members involved in these activities decided to register a trust called 'CiFoS Trust' (where CiFoS stands for 'Citizens For Sustainability').

CiFoS is today working towards transforming their neighbourhood in the areas of mobility, safety, environment, health and education through sustainability and citizen participation. Many of their activities like encouraging non-motorised transport and public transport, improving waste management practices, help directly improve air quality.

According to Sathya Sankaran, CiFoS co-founder, *"The power [to fix] pollution lies in our hands, as citizens. It is not like somebody is sitting in Vidhana Soudha and creating pollution. Pollution was not created by one or two people (or in some other place). How do you tackle it as a social initiative? How do you change your personal practices? What are your individual responsibilities towards this?"*

Strategies

The members of CiFoS believe that a lot of social change and behavioural modification needs to be participatory in nature and therefore who better than a citizen organisation to initiate and create change in mindsets!

Walk to school

The team wanted children to experience walking to school. Saturdays were chosen as the school bag loads would be lighter since it is half day for most schools. The 'Walk to School on Saturday' was launched on 5th Dec 2015. Prior to the launch, the CiFoS team got permission from all the participating schools to address the students in the morning assembly and motivate them to come walking to school on Saturdays if they stayed within a kilometre or so from the school. If they stayed far away, they were encouraged to get dropped by their parents some distance away from the school and come walking the last stretch. Schools buses were also requested to stop a block away from the school so that the children could walk to the school.

Post the first walk to school Saturday, and for many months thereafter, volunteers from CiFoS and ESAF used to stand outside all the participating schools and motivate the children who continued to come walking.

Challenges

People's refusal to accept change was, according to the team, the most challenging aspect. For example, in the case of footpaths, they were more worried about losing a few feet of space for the cars rather than gaining space for walking. In addition, there were vested interests like politically connected people owning shops on the road who had violated building laws and were thus opposing the project on the pretext of lost parking space.

Outcomes

From conducting cycle days to coming up with a detailed plan for Sanjaynagar Main Road, CiFoS has traversed a fair distance since Feb 2015. By catalysing the walking-cycling ecosystem, attempts are being made to reduce motor vehicle usage, and, as a direct consequence, air pollution.

Seven schools and over 1500 children have participated in the Cycle Day initiative which has since seen an increase in cycles being used by school students on non-cycle days too. One of the schools now has around 45 students cycling to school from the initial 5; the total number of cycles being used have increased in all participating schools by different numbers.

By taking on the initiative of making Sanjaynagar Main Road cleaner, an attempt has been made to reduce the dust levels and particulate matter.

The various projects being currently undertaken by CiFoS include putting up 200 cycle stands in the area and public bicycle sharing system among others.

MOBILITY	ENVIRONMENT	CITIZEN ENGAGEMENT	SAFETY	HEALTH	EDUCATION
◦ City Signage Manual ◦ Mobility Index ◦ Cycle Routes ◦ Cycle Stands ◦ Shared Cycles ◦ Public Space Design ◦ Vending Zones	◦ Environment Index ◦ Air Quality Monitoring ◦ Tree Mapping ◦ Segregation ◦ Composting ◦ Lake Conservation ◦ Water Reuse ◦ Urban Waterway Design	◦ Cycle Day ◦ Walk to School ◦ CiFoS App ◦ Project Monitoring & Feedback ◦ Issue Management	◦ Safety Index ◦ Unsafe Spots Mapping ◦ Crime Map	◦ Health Index ◦ Disease Mapping & Analysis	◦ Education Index

CiFoS is taking help from Department of Urban Land Transport (DULT) to help provision for cycle stands in government schools. Residents from other areas like Indiranagar and Kumara Park are also working towards starting similar CiFoS units in their localities. B.PAC has started a programme similar to the ' Walk to School' initiative. Along with CiFoS and DULT, they are taking the idea of walking to school across Bengaluru.

ACT NOW

The 2018, Karnataka state budget allocated Rupees 96 crores to expand the real-time monitoring network across the state. While this is a welcome move, one does not know the exact number of stations Bengaluru will receive yet. Experts argue that a total of 41 monitoring stations are required to accurately assess the city's air quality. The new online stations will monitor $PM_{2.5}$ and generate a daily AQI value. However, one needs to remember that the AQI is a composite score and is largely generated by using the Particulate Pollution values. And, if majority of the stations do not maintain consistency in the levels being recorded, the AQI values too will become unreliable.

While health professionals from across the city do have a worrying account of the health impact on the city's children and its youth, there is need for much more research to be done on the long and the short-term impacts of poor air quality on health.

It is clear that Bengalureans are affected by air pollution and are beginning to act and lead on efforts to achieve clean air for their neighbourhoods and their city. **Various parts of the city continue to witness citizen-led movements in partnership with schools, local governments and the state machinery, a sight that is not too common in the other cities and is perhaps something to learn from.**

The state government has in the recent past initiated traffic-free Sundays in an effort to reduce air pollution, these efforts need to be backed with scientific data and should be part of an integrated strategy to mitigate the problem. As of today, the city lacks an implementable action plan to curb the rising air pollution levels. It is time city leaders and administrators act before it's too late. There are many citizen groups who have managed to chalk out community and ward-level plans to tackle the problem and the government needs to ensure that its citizens are taken into confidence before formulating action plans in order to ensure successful implementation.

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CLIMATE TRENDS