Impact of Covid lockdown on Air Pollution Levels in Bengaluru

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CREA
Centre for Research on Energy and Clean Air

HEAL
HEALTH AND ENVIRONMENT ALLIANCE

THE GLOBAL CLIMATE & HEALTH ALLIANCE

Impact of Covid lockdown on Air Pollution Levels in Bengaluru

This analysis was completed by CREA, for the Health and Environment Alliance (HEAL) and the Global Climate and Health Alliance (GHCA). GCHA and HEAL support the Healthy Air Coalition Bengaluru, as part of a global health sector initiative advocating for clean air in cities in 2030. The Healthy Air Coalition has set up a network of 30 air quality monitors across the city to provide publicly accessible data to assess the health burden of air pollution in Bengaluru, and drive measures for improving air quality.

Background

Bengaluru is known as the silicon valley of India[1], and is one of the fastest growing cities. Increasing growth in population and economic development of the city is pushing rapid urbanisation, energy and water consumption, waste generation and transportation needs. One of the key challenges faced by the city due to this rapid urbanisation, is deteriorating environmental quality. While the abysmal conditions of the lakes/water bodies, green patches and waste management in Bengaluru are well known, even the air quality levels have been deteriorating over the past several years[2]. The primary reason for the decline in air quality is due to the mobility choices that the city has made over the past decade. Even though the city has a good bus and suburban rail network system, it has failed to keep up with the growing demand, leading to a boom in private vehicle usage.

There are many factors influencing Bengaluru's air quality such as DG (diesel generator) sets, industry, dust on road, waste burning , but the majority of the pollution within the city is contributed by transportation, due to increasing usage of private modes of transportation and increasing fossil fuel consumption[3].

Rising air pollution levels, deteriorating health and quality of life present enormous challenges and in order to find solutions to them first of all understanding needs to be increased on how air quality varies in different localities within a city. In a city of over 11 million there are only 10 official continuous ambient air quality monitoring stations connected to CPCB (Central Pollution Control Board) data portal, which does not give a detailed picture of air quality in the city. To respond to this limitation, the Healthy Air Coalition Bengaluru installed 30 air quality monitors across Bengaluru in 2019, at locations which are frequented by vulnerable groups[4] including near schools and hospitals

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1 http://elitebusinessmagazine.co.uk/global/item/how-the-tech-city-of-bangalore-became-the-silicon-valley-of-india

2 https://www.deccanherald.com/city/deteriorating-air-quality-703557.html#:~:text=As%20winter%20nears%20and%20the,difficult%20for%20them%20to%20breathe.

3 https://urbanemissions.info/india-apna/bengaluru-india/

4 http://www.healthyaircoalition.org/

Initial research during the COVID-19 pandemic indicates a possible association between regions with high pollution levels and those worst hit by 19 COVID-19. It has been suggested that the respiratory system of the population living in those areas was already compromised making them more vulnerable to the disease[5].

Responses to COVID-19 globally have included "lockdown" to restrict the spread of the disease. In India the national lockdown, enforced on 25th March 2020, required people to remain in their homes except for essential needs and work. During the lockdown, Bengaluru, similar to many other cities around the world, saw a drop in motorized transportation, along with reducing industry and power generation operations. The period saw a reduction in emission load of pollutants across contributing sectors in cities across the globe which is reflected in reducing air pollution levels. This study has analysed the air quality changes during lockdown in Bengaluru as a result of the decreased traffic and other polluting activities.

In the current analysis we have looked at localised data collected by air quality monitoring stations installed by the Healthy Air Coalition across Bengaluru as well as at satellite air quality data, to look at improvements in air quality in Bengaluru during that period.

Methodology

- *Localised daily air quality data was collected using 'Clarity[6]' air quality monitors at 26 locations[7] across Bengaluru city (data from other stations was discarded because of operation and data unavailability issues). The monitors are installed at or close to schools, primary health care centers, residential units and two busy traffic junctions.*
- *Station-wise data was averaged to arrive at averages for 45 days pre (8th February 2020 to 23rd March 2020) and during (25th March to 8th May 2020) the lockdown period to calculate the percentage change in the $PM_{2.5}$ levels for the period[8].*
- *Data from all stations was averaged daily for the study period to calculate city wise average $PM_{2.5}$ levels and change for before and during lockdown period.*
- *Google mobility data[9] was used to understand the mobility pattern and associated usage for Transportation services.*
- *TROPOMI Sentinel-5P satellite[10] data by the European Space Agency was used to analyse NO_2 levels before and during the lockdown period. The daily average data was averaged for 45 day periods before and during the lockdown period to calculate changes in NO_2 levels for the selected region.*

[5] https://www.sciencedaily.com/releases/2020/04/200406100824.htm
[6] https://clarity.io/solution
[7] 4 stations (out of 30 installed) have been excluded from the analysis due to operational issues, i.e., late installations, stoppage of operation of data in between etc. leading to data gaps during the analysis period.
[8] Historical data from CPCB suggests that the time period during analysis hasn't observed drastic changes in pollution levels around this time of the year over previous years and has been nearly the same. So this year's change can be attributed to prevailing factors such as lockdown etc.
[9] https://support.google.com/covid19-mobility#topic=9822927
[10] https://sentinel.esa.int/web/sentinel/missions/sentinel-5p

Results

Observations on percentage drop in pollution levels for 45 day average pollution levels before (8th February 2020 to 23rd March 2020) and during (25th March to 8th May 2020) the national lockdown, are summarized as:

- Four stations out of 26 stations with $PM_{2.5}$ data recorded more than 40% decrease in pollution levels, with stations near Bellandur Lake recording the highest drop of 75%.
- 21 stations recorded a 20-30 percent drop in pollution levels.
- Only one station recorded less than 20% drop, the monitoring station outside Halasuru Hospital showed only a decrease of 14%.

When the data was analysed, keeping in view the WHO guideline and India's CPCB recommended ambient air quality standards for $PM_{2.5}$, we found that:

- Six stations recorded daily pollution levels (during lockdown) below WHO's recommended safe standard.
- All stations with monitored data recorded pollution levels (during lockdown) under NAAQS by CPCB for daily $PM_{2.5}$.

The three least polluted locations in terms of $PM_{2.5}$ levels in Bengaluru during the first 45 days of national lockdown were:

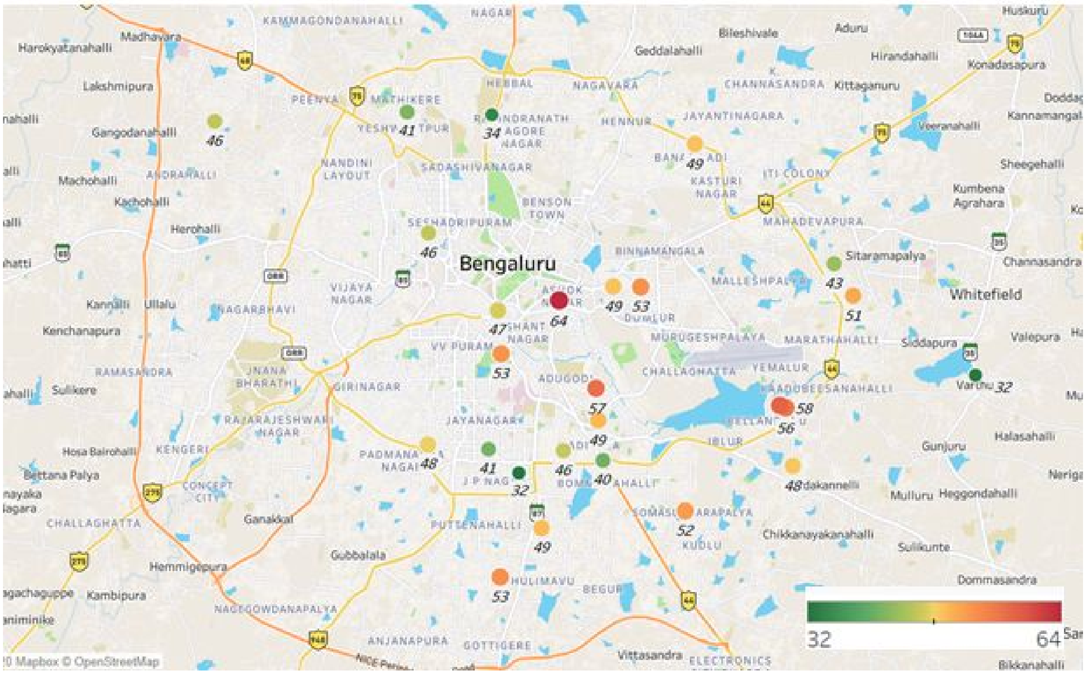
- Monitoring station near Bellandur Lake (near a dusty road)(14 $\mu g/m^3$)
- Monitoring station near Varthur Lake (17 $\mu g/m^3$)
- Monitoring station at Hosur Road and Outer Ring road intersection (21 $\mu g/m^3$).

The three most polluted locations in terms of $PM_{2.5}$ levels in Bengaluru during the first 45 days of national lockdown were:

- Monitoring station in Ashok Nagar (49 $\mu g/m^3$)
- Monitoring station in a residential society near Bellandur Lake (44 $\mu g/m^3$)
- Monitoring station at Hallasaur Hospital (42 $\mu g/m^3$).

On average $PM_{2.5}$ levels in Bengaluru from all monitoring stations reduced by approx 28 % in the 45 day period during the lockdown compared to 45 days before the lockdown.

45 Day PM2.5 average before the Lockdown



45 Day PM2.5 average after the Lockdown

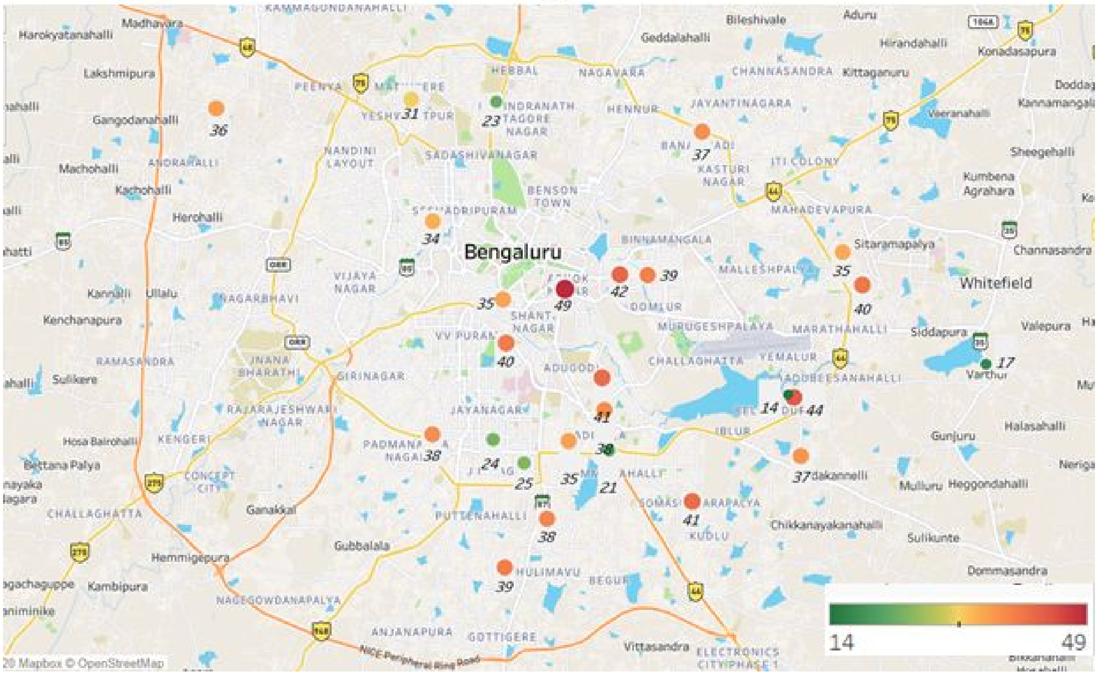
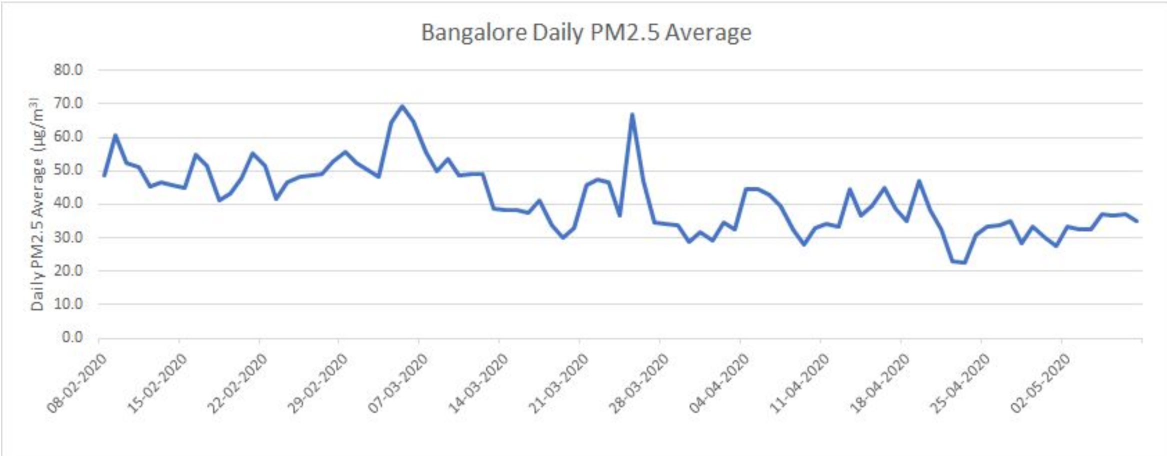
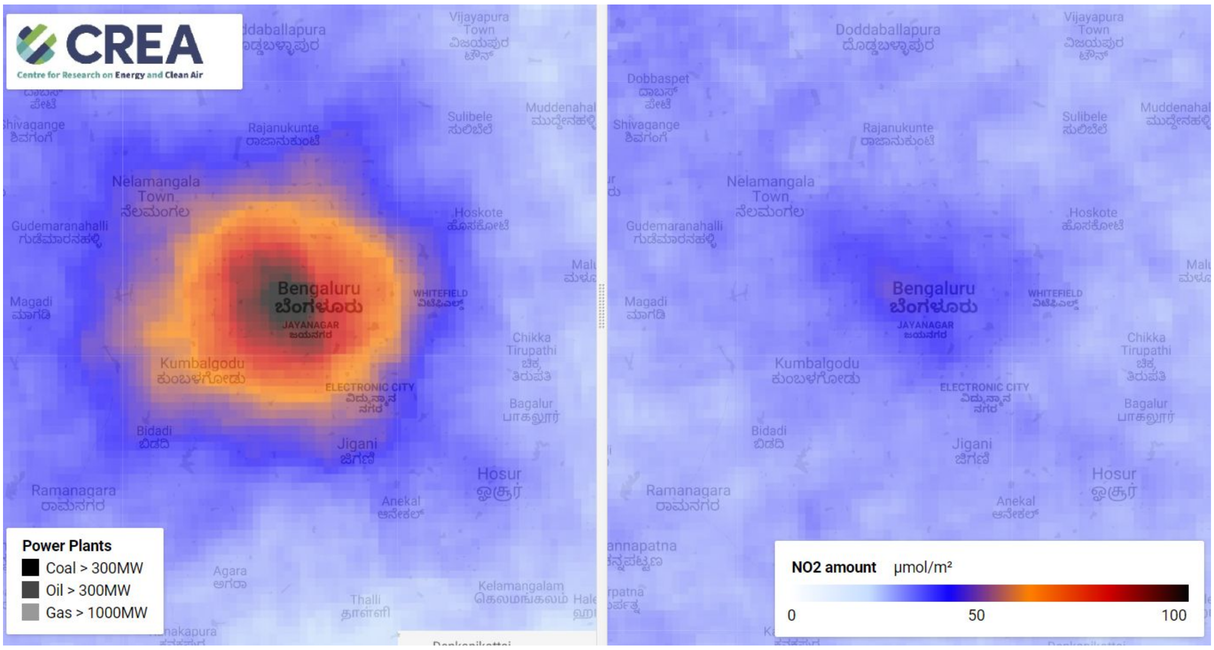


Figure 1: *Location wise recorded 45 day average $PM_{2.5}$ levels before and during the national lockdown*

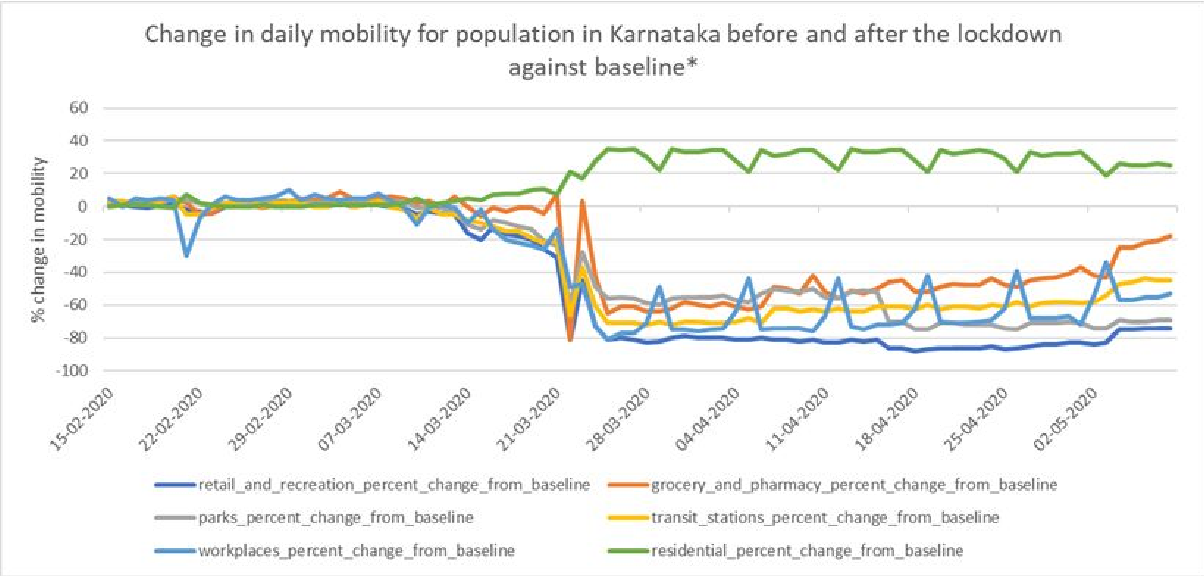


A similar declining trend was presented by the satellite data analysed for NO_2 data for pre and during the lockdown period. Observation of the satellite data revealed that the NO_2 levels in Bengaluru Urban region dropped by approximately 40 % on an average for 45 day during the national lockdown against 45 day average before the lockdown.



Google mobility data as collected by Google through location sharing services for their application, for use on mobile phones and other devices, shows a stark decline in mobility for all major classes apart from residential area mobility for the lockdown period compared to pre lockdown level baseline[11].

[11] The baseline day is the median value from the 5-week period Jan 3 – Feb 6, 2020



Inferences

Primary air quality data indicates a 28% drop in the $PM_{2.5}$ levels in 45 days during the lockdown compared to 45 days before the lockdown[12]. The decrease in pollution levels varied for locations ranging from the lowest 14% decline at Halasuru Hospital to maximum 75% reduction at the monitoring station near Bellandur lake. The primary reason for variations in pollution levels across the city is that contribution of the major pollution sources varies across the city depending on the type of activities undertaken in the area which adds to the background pollution coming from nearby surroundings.

The lower drop in $PM_{2.5}$ levels near Halasuru hospital might be attributed to a relatively lower decrease in vehicular emissions due to frequent hospital visits by patients, even during the lockdown. In comparison, the station at Bellandur lake is located near a dusty road where construction activities were put on hold during the lockdown. This resulted in a steep decline in vehicular movement and associated resuspension of dust. This appears to be reflected with the highest decline in $PM_{2.5}$ levels at the location.

The monitoring station located at Hosur road-Outer Ring road intersection showed a 48% reduction in $PM_{2.5}$ levels in the 45 day time period before and during the lockdown, reflecting a significant reduction in vehicular movement and congestion at the location.

Almost all industrial and commercial activities, along with the transportation system, came to a halt during the lockdown, reducing all major sources of pollution in the city. According to a study

[12] CPBC Data from 7 stations in Bengaluru showed a decrease of 42% in PM2.5 levels during the period, the difference in the data can be explained by the positioning of GCHA/HEAL air quality monitors at lesser height, closer to where people breathe to understand the real exposure of the population compared to CPCB station which are at a height of about 20 meters to capture ambient air quality. The second reason for the difference in data is that we have installed the air quality monitoring station at 26 locations compared to 7 locations (giving data) by CPCB and GCHA/HEAL monitors are near to the pollution sources at multiple places, such as road junctions and, as such places are more likely to pick-up higher pollution reading compared to ambient stations at a height..

by Urban Emissions[13], the transport sector contribution to the $PM_{2.5}$ emissions for Bengaluru in 2015 was 40%, followed by dust at 20%, waste at 11%, industries and brick kilns at 9% each, residential sector 7% and DG sets contributed 4% to the overall $PM_{2.5}$ emissions in the city.

The Google mobility data suggest that visits to retail stores and recreational places such as malls dropped by approximately 80% during the lockdown period followed by a 65-70 % drop in people attending workplaces, 62% drop in people visiting transit stations such as metro stations, bus stops, taxi stops, car rental agencies.. At the same time people spent more time at their homes resulting in an increase of more than 30% in mobility for residential areas, most of which was without usage of motorized vehicles and was undertaken by people to buy essential items such as food and medicines near their homes . The data signifies that the need for or usage of private vehicles and other transportation reduced significantly during the lockdown.

Google mobility data indicates that transportation activities dropped by nearly 70-80% in the city. The drop in transportation activities coupled with sectoral contribution of different sources in the city's pollution as indicated by Urban Emissions study inferes that the transportation sector played a major role in pollution reduction in the city during the lockdown. the highest drop in pollution levels, which was followed by reduction of the industrial and construction activities due to suspension of operations during the lockdown. As people mostly stayed at home during the lockdown there might have been a slight increase in contribution from the residential sector but this can not be verified through this study, further research is needed. and a further study with more robust data availability is required to comment further on this.

Mobility data, primary monitoring as well as source contribution/emission study points towards the transportation sector being the major sector responsible for significant drop in pollution levels in Bengaluru.

Another way to understand the changes in pollution levels at any location is by using the satellite data. Satellite NO_2 data also shows a drastic 40% reduction in NO_2 levels in the Bengaluru urban area indicating reduced vehicular movement and consumption of fossil fuels. NO_2 is a pollutant emitted by the burning of fossil fuels in the transportation sector or industries/power plants. As Bengaluru does not have any big power generation facility or industrial operations, most of the reduction in NO_2 in the city can be attributed to the reduced contribution from the transportation sector.

Way Ahead

It is clear that the Transportation sector plays a large role in air pollution in Bengaluru. It is also clear, from the "forced experiment" of reducing transportation activities during the COVID-19 pandemic-led lockdown, that the city can achieve breathable air quality if systematic and concrete

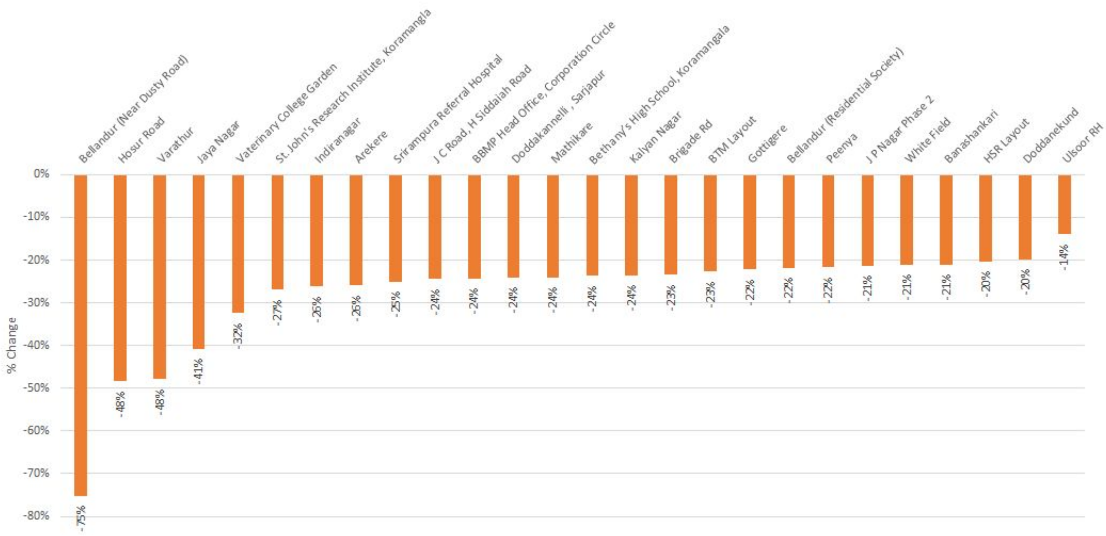
13 https://urbanemissions.info/india-apna/bengaluru-india/#:~:text=As%20the%20demand%20for%20housing,in%20and%20around%20the%20city.

steps to reduce emissions from transport are taken. Air pollution levels can be reduced in Bengaluru by:

- Building people friendly and safe Non-Motorised-Transportation systems for walking and cycling;
- Reducing the usage of cars or transportation needs;
- Shifting to cleaner fuel and renewable energy powered electric vehicles;
- Enhancing public transportation system capacity and quality by running them on electric energy and increasing the numbers and frequencies, i.e., electric buses, sub-urban railway and metro etc.;
- Reducing contribution from construction sector by taking proper safeguarding measures during construction and transportation of construction materials;
- Reducing waste generation and its disposal at landfill sites or in waste-to-energy plants by refusing unnecessary packaging material or plastics and reusing and recycling whatever possible ;
- Providing 24 hour electricity through aggressive adoption of roof-top solar energy and other renewable energy sources to reduce the usage of DG sets for electricity needs; and
- By adopting stringent emission standards for brick kilns and industries to reduce pollution at source.

Annex-I

% Change in Average $PM_{2.5}$ levels Before and During the Lockdown



Annex-II: Location wise $PM_{2.5}$ levels and reductions for 45 days average before and during the lockdown

S.No.	Location	$PM_{2.5}$ Average (μg/m^3)-45 Days Before National Lockdown	$PM_{2.5}$ Average (μg/m^3)- 45 Days After National Lockdown	% Change
1	Bellandur (Near Dusty Road)	58	14	-75%
2	Hosur Road	40	21	-48%
3	Varathur	32	17	-48%
4	Jaya Nagar	41	24	-41%
5	Vaterinary College Garden	34	23	-32%
6	St. John's Research Institute, Koramangla	57	41	-27%
7	Indiranagar	53	39	-26%
8	Arekere	53	39	-26%
9	Srirampura Referral Hospital	46	34	-25%
10	J C Road, H Siddaiah Road	53	40	-24%
11	BBMP Head Office, Corporation Circle	47	35	-24%
12	Doddakannelli , Sarjapur	48	37	-24%
13	Mathikare	41	31	-24%
14	Bethany's High School, Koramangala	49	38	-24%
15	Kalyan Nagar	49	37	-24%
16	Brigade Rd	64	49	-23%
17	BTM Layout	46	35	-23%
18	Gottigere	49	38	-22%

19	Bellandur (Residential Society)	56	44	-22%
20	Peenya	46	36	-22%
21	J P Nagar Phase 2	32	25	-21%
22	White Field	51	40	-21%
23	Banashankari	48	38	-21%
24	HSR Layout	52	41	-20%
25	Doddanekund	43	35	-20%
26	Ulsoor RH	49	42	-14%

About CREA

Centre for Research on Energy and Clean Air (CREA) is a new independent research organisation focused on revealing the trends, causes, and health impacts, as well as the solutions to air pollution. CREA uses scientific data, research and evidence to support the efforts of governments, companies and campaigning organizations worldwide in their efforts to move towards clean energy and clean air, believing that effective research and communication are the key to successful policies, investment decisions and advocacy efforts. CREA was founded in December 2019 in Helsinki and has staff in several Asian and European countries.

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About HEAL

The Health and Environment Alliance (HEAL) is the leading not-for-profit organisation addressing how the environment affects human health in the European Union (EU) and beyond. HEAL works to shape laws and policies that promote planetary and human health and protect those most affected by pollution, and raise awareness on the benefits of environmental action for health.

HEAL's over 70 member organisations include international, European, national and local groups of health professionals, not-for-profit health insurers, patients, citizens, women, youth, and environmental experts representing over 200 million people across the 53 countries of the WHO European Region.

As an alliance, HEAL brings independent and expert evidence from the health community to EU and global decision-making processes to inspire disease prevention and to promote a toxic-free, low-carbon, fair and healthy future.

HEAL's EU Transparency Register Number: 00723343929-96

Contact: info@env-health.org

About GCHA

The Global Climate and Health Alliance (GCHA) was formed in Durban in 2011 to tackle climate change and to protect and promote public health.
The Alliance is made up of health and development organisations from around the world united by a shared vision of an equitable, sustainable future. Our vision is a world in which the health impacts of climate change are kept to a minimum, and the health co-benefits of climate change mitigation are maximised.

Contact: press@climateandhealthalliance.org