

## Study of Air Pollution during Lockdown for Different Cities of India

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**Abstract:** India, which has a population more than 1.3 billion, has got lockdown down from 25 March 2020 till 1 June 2020 due to the covid19 pandemic. With that many people home, traffic is virtually non-existent, factories are closed, and construction has come to a halt in the country which has the world's second largest population. India's overall ranking is 177 among 180 countries and it is likely to have poor performance in the environmental health policy and deaths due to air pollution categories. Environmental problems in different cities of India are a threat to the well-being of the country and country's inhabitants as well as the flora and fauna. Overpopulation and the ensuing overuse of scarce resources such as water put heavy pressure on the environment. Different cities in the country suffer from air pollution caused by road dust and industry, with comparatively smaller contributions from unclean engines in transportation. This study can state that the country has seen a massive dip in vehicular movement and industrial activity, which have resulted in clean and fresh air perhaps in decades which had lowered the rate of air pollution in different cities of India due to the nationwide lockdown imposed in the wake of the novel coronavirus outbreak.

**Key word:** Air Pollution, lockdown, control measure, health, population, environment.

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### I. Introduction

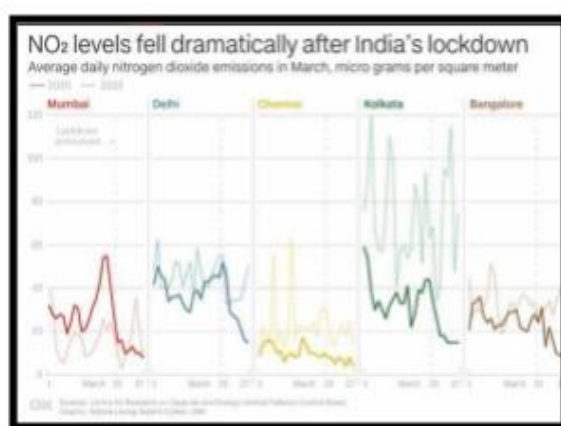
Pollution has become the major environmental cause of many diseases and premature death worldwide.<sup>[1]</sup> In fact, according to the World Economic Forum, in February, India was home to six out of 10 of the world's most polluted cities.<sup>[2]</sup> On March 25, when India ordered a 21-day lockdown amid the spread of the coronavirus pandemic, it created the world's largest lockdown, encompassing 1.3 billion people.<sup>[3]</sup> The world's largest lockdown means all factories, markets, shops, and places of worship are now closed, most public transport suspended and construction work halted, as India asks its citizens to stay home and practice social distancing.<sup>[4]</sup> As the end of the first lockdown period approached, state governments and other advisory committees recommended extending the lockdown. The governments of Odessa and Punjab extended the state lockdowns to 1 May. Maharashtra, Karnataka, West Bengal and Telangana followed suit. On 14 April, Prime Minister Narendra Modi extended the nationwide lockdown until 3 May, with conditional relaxations after 20 April for the regions where the spread had been contained or was minimal. On 1 May, the Government of India extended the nationwide lockdown further by two weeks until 17 May. The Government divided all the districts into three zones based on the spread of the virus green, red and orange with relaxations applied accordingly. On 17 May, the lockdown was further extended till 31 May by the National Disaster Management Authority. On 30 May, it was announced that the on-going lockdown would be further extended till 30

June in containment zones, with services resuming in a phased manner starting from 8 June. It is termed as "Unlock 1". With that many people home, traffic is virtually nonexistent, factories are closed, and construction has come to a halt, leading to pollution.<sup>[5]</sup> Air pollution levels have dropped significantly in India owing to the nationwide lockdown imposed in the wake of the Novel Coronavirus outbreak. The country has seen a massive dip in vehicular movement and industrial activity, which have resulted in clean and fresh air perhaps in decades.<sup>[6]</sup> Air in India is a serious health issues. Of the most polluted cities in the world, 21 out of 30 were in India in 2019. As per a study based on 2016 data, at least 140 million people in India breathe air that is 10 times or more over the WHO safe limit and 13 of the world's 20 cities with the highest annual levels of air pollution are in India. The 51% of pollution is caused by the industrial pollution, 27% by vehicles, 17% by crop burning and 5% by Diwali fireworks. Air pollution contributes to the premature deaths of 2 million Indians every year.<sup>[7]</sup> Whereas in the study we have found that the level of particle pollution dropped by nearly 60% in New Delhi. The reduction of vehicular transport in Chennai during the first phase of lockdown has had the greatest impact on improving Chennai's air quality and the major cities like Mumbai have also seen a dip in the

air pollution level during lockdown from 25 March 2020 to 1 June 2020. In India a few studies have shown the positive impact of the lockdown on air and water pollution (Sharma et al. 2020; Mahato et al. 2020; Gautam 2020).<sup>[8]</sup> In this research paper we will study the overall effect of air pollution in India due to lockdown as it was very challenging for the people and the government of India and its drastic effects on the environment.

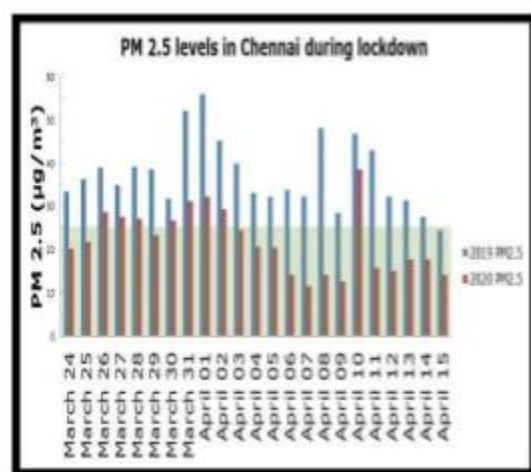
## **II. Air Pollution Study of Different Cities During Lockdown**

Air pollution is a familiar environmental health hazard. Air pollution is a mix of hazardous substances from both human-made and natural sources. Vehicle emissions, fuel oils and natural gas to heat homes, by-products of manufacturing and power generation, particularly coal-fuelled power plants, and fumes from chemical production are the primary sources of human-made air pollution. Nature releases hazardous substances into the air, such as smoke from wildfires, which are often caused by people; ash and gases from volcanic eruptions; and gases, like methane, which are emitted from decomposing organic matter in soils. Ozone, an atmospheric gas, is often called smog when at ground level. It is created when pollutants emitted by cars, power plants, industrial boilers, refineries, and other sources chemically react in the presence of sunlight. Noxious gases, which include carbon dioxide, carbon monoxide, nitrogen oxides (nox), and sulphur oxides (sox), are components of motor vehicle emissions and byproducts of industrial processes. Particulate matter (PM) is composed of chemicals such as sulphates, nitrates, carbon, or mineral dusts. Vehicle and industrial emissions from fossil fuel combustion, cigarette smoke, and burning organic matter, such as wildfires, all contain PM.



### **2.1 Delhi**

As per an analysis by experts at the nonprofit Center for Science and Environment, days after the coronavirus lockdown was put into force on March 25 in India, the level of particle pollution dropped by nearly 60% in New Delhi. Amid the coronavirus lockdown, countries across the globe have reported a significant drop in air pollution and witnessed improved air quality. According to the World Air Quality Index, countries like the United States, Spain, Italy, China, France, Mexico and the UK have reported a drop in the level of NO<sub>2</sub> levels in April as compared to the same period last year. The most significant improvement in air quality was seen in New Delhi. Amid the lockdown, India's national capital reported a drop in its NO<sub>2</sub> levels. Nitrogen dioxide or NO<sub>2</sub> is a gas emitted by motor vehicles and factories mostly and therefore, a drop in its level was indicative of reduced human activity outside the home amid the coronavirus lockdown. As per an analysis by experts at the nonprofit Center for Science and Environment, days after the coronavirus lockdown was put into force on March 25 in India, the level of particle pollution dropped by nearly 60% in New Delhi.



## 2.2 Chennai

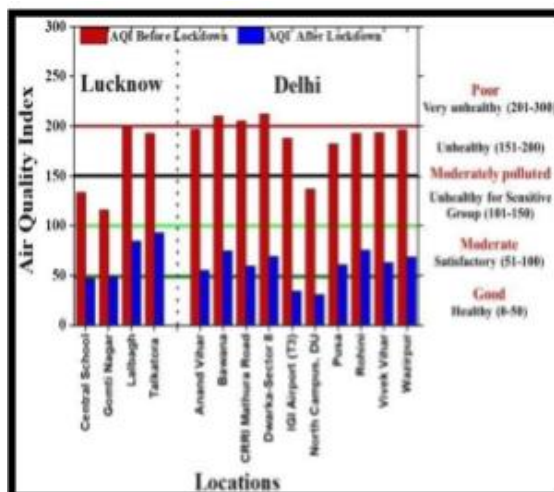
In one way, the lockdown has been a boon for Chennai as air pollution levels saw a sizable reduction with residents of the city breathing better than their counterparts in the other southern metros of Bengaluru and Hyderabad. The most significant reduction during the first phase of lockdown (1.8 fold) was seen in levels of PM 2.5 on 15 out of 22 days of the lockdown. A similar reduction of 1.8 fold was seen in the levels of NO<sub>2</sub> during the lockdown period for the whole city. No significant reduction was seen in levels of SO<sub>2</sub> and ozone in Chennai during the first phase of lockdown, while CO levels had reduced by 1.6 fold as compared to 2019 levels. The reduction of vehicular transport in Chennai during the first phase of lockdown has had the greatest impact on improving Chennai's air quality.

## 2.3 Mumbai

The pollutant-measuring indicator, air quality index (AQI), in Mumbai was 37 (good), making it the cleanest air day so far this year, while Pune recorded 47, also under the 'good' category. Drastic NO<sub>2</sub> decline in Mumbai indicates that vehicular emissions play a major role in contributing to overall air pollution. Stringent restrictions imposed during the lockdown helped in bringing down the pollution level. Even industrial emissions were lower. Meanwhile, the Central Pollution Control Board (CPCB) also recently published its analysis of Mumbai's air quality between March 16 and April 15. The analysis revealed that Mumbai had witnessed a 40% reduction in PM<sub>2.5</sub>, 43% decline in PM<sub>10</sub> (larger coarser particles), 77% reduction in NO<sub>2</sub>, 59% fall in average benzene levels (contributes to volatile organic compounds) and 50% drop in sulphur dioxide (SO<sub>2</sub> – colorless gas with pungent odor that causes respiratory diseases). The absence of non-essential vehicles, combustion activities in industries and commercial construction sites during the period may be attributable to the decline the air pollution in the city.

## 2.4 Kolkata

Very little commercial activity during the over one-month-long lockdown and the spells of rain have improved the air quality in Kolkata, an official of the West Bengal Pollution Control Board (WBPCB) said on Wednesday. The Air Quality Index monitoring station at Ballygunje in south Kolkata recorded an AQI of 33 (PM 2.5) on Wednesday, which is 'good' in environmental parlance. The AQI hovered between 100 and 260 across different air monitoring stations before the lockdown began on March 25, the official said. This is better than the national standard of 60 (PM 2.5). It happened because of very little commercial activity during this lockdown period, which has pushed pollutants like sulphur dioxide, nitrogen dioxide, carbon monoxide to be very low.



### 2.5 Lucknow

The AQI was also calculated for 14 locations for before and after lockdown in two cities (Fig. 4). The AQI of Lucknow was found to be in the range of 115.80 to 199.50 and remained in the unhealthy moderately polluted to poor range (AQI between 101 and 200) as described in the NAQI (Table S2). After the implication of lockdown, the AQI was significantly changed and was found to be in the range of 46.64 to 93.11 which falls in Good (0–50 at Central School and Gomti Nagar) to satisfactory (51– 100 Lalbagh and Talkatora) AQI range.

### 2.6 Bangalore

One of the co-benefits of the ongoing lockdown (besides the opportunity to flatten the rising curve of infections) is the dramatic improvement in the air quality of various cities, including Bengaluru. For example, as shown in the Chart, the Air Quality Index (AQI), which is a composite measure of air quality (calculated using the values of both particulate matter pollutants as well as gaseous pollutants), in the Central Silk Board area has reduced to 50 (good category) during the lockdown period ( March 25 to May 3) compared to a level just over 100 (satisfactory category) during the corresponding period in 2019. The improvement in the air quality in the Peenya Industrial area is particularly sharp since almost all industries were inoperative during this period. Consequently, the AQI which used to exceed 150 (crossing over into the ‘moderately polluted’ category) on several days during 2019 was consistently around 50. The levels of NO<sub>x</sub> pollution in the Central Silk Board area (generated primarily by vehicular exhaust) reduced by 70-90 per cent during the lockdown period compared to the corresponding period in 2019.



### 2.7 Pune

Pune also contributes heavily to air pollution on non-lockdown days; the PM<sub>2.5</sub> fell by 25%, while the PM<sub>10</sub> saw a 26% reduction in the air. NO<sub>2</sub> emission fell by 57%. The data was provided by the system of air quality weather forecasting and research (SAFAR).

## **2.8 Agra**

In Agra, the AQI remained around 60 in the first phase of lockdown, which is the best air quality in five years for that particular date. According to a Central Pollution Control Board (CPCB) report, the air quality, in the month of March, remained good for 14 days and average for 11 days. In the entire month, the particulate matter, dust, and carbon monoxide values remained low. The lockdown, as well as the rains have caused this drastic improvement in the air quality of Agra. Agra has a lot of dust in the air on normal days which were suppressed due to the rains. With the vehicular traffic coming to a stop, along with the construction work, the air quality has further improved. The entire month of March 2020 saw good rainfall, factories are under lockdown and the vehicles are not moving so the air quality was bound to improve. If we look at the Air Quality in 2018, March 18 was the worst day with an AQI of 96, while in 2017; the AQI had crossed 300 for 6 days.

## **2.9 Nagpur**

Air pollution emission sources in Nagpur are similar to sources in any other urban center. There are no region specific sources in Nagpur. Also, the ambient air pollution levels in the city are not very high like in Delhi-National Capital Region. The overall air quality of the city has significantly improved post the nationwide lockdown. According to the analysis, major pollutants including particulate matter PM<sub>10</sub>, PM<sub>2.5</sub> and nitrogen dioxide (NO<sub>2</sub>) show reduction in concentration due to the lockdown. The daily mean value of PM<sub>10</sub> has come down from 61 to 47 while that of PM<sub>2.5</sub> has come down from 31 to 23. Further, NO<sub>2</sub> has come down from 48 to 25, indicating absence of vehicles on the road. In the analysis, the hourly variation of PM<sub>2.5</sub> averaged for the lockdown period indicates a single set of sources which is now absent, causing constant reduction. After 6pm the PM<sub>2.5</sub> levels increase due to setting up of temperature inversion which restricts vertical movement of pollutants in the skies of Nagpur. While, during the day, the pollution sources are relatively high compared to night, the heating of ground surface from bright sunshine causes pollutants to move in the upper atmosphere. The daily averaged SO<sub>2</sub>, which is an indicator of fossil fuel combustion, was found to be 9 micrograms per cubic metre (mpcm) before the lockdown. Post lockdown, the pollutant's level further reduced to 2 mpcm, which was far much lower than the regulatory limit value of 80 mpcm prescribed by the Central Pollution Control Board (CPCB), Delhi. Since the lockdown was imposed, the air quality in Nagpur has shown drastic improvement due to the eradication of local pollutants generated from various activities. The lockdown led to a significant reduction in the major criteria air pollutants, namely PM 10, PM 2.5 and nitrogen dioxide (NO<sub>2</sub>). Particulate Matter (PM) is a mixture of solids and liquid droplets floating in the air.

### **III. Result and Discussion over Air Pollution**

1. Results of the present study indicate a sharp decline in overall air quality indexes and in the concentration of primary air pollutants. The study needs to be extended to analysis of secondary air pollutants, such as ozone, also. However, such a lockdown cannot be planned in normal conditions in such a huge country and therefore it cannot be considered as a permanent solution.
2. After studying deeply into the topic, we can state that, in every 3 to 6 months, a short 3 to 5 days complete/partial lockdown can be practiced to mitigate environmental pollution especially air pollution. During such a lockdown, people should be encouraged to have regular walk and jogging in nearby areas without vehicular use. In this way, people would not only avoid continuous indoor air and mental stress of lockdown but would also enjoy outside clean air.
3. We have also concluded that the lockdown has caused 70 percent decreases in the air pollution of various cities in India during the period from 25 March 2020 to 1 June 2020.
4. We can also conclude that 70 percent of the air pollution or harm to the lives of people is due to vehicles, improper management, and illegal industries.
5. In conclusion and studying the topic deeply, we may urge people to use cycles as much as they can to avoid the use of fuel vehicles which causes more air pollution.
6. We can also use public transport as an option to avoid the increase in air pollution by our own individual vehicles, as we have been doing in the lockdown.
7. CNG or electric vehicles should be used more and all the fuelled vehicles should be made CNG or Electric (only vehicles travelling in between the city)
8. Road signs should be improved to minimize the long route run of the people.
9. Solar power should be used by companies to save electricity.
10. This was the first time in 100 years that people have shut their business, work, vehicles, and industries and stayed at their homes for a long time. So we can also give a statement that the environment got his time to heal itself as we have done a lot of harmful things during our normal life as it.

#### IV. Conclusion

From the above research it can be concluded that the difference in pollution before and after lockdown is quite huge. The quality of pollution has improved to yet another level after the commencement of lockdown. After having research on the above cities, we can conclude the same.

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