



# The impact of COVID-19 as a necessary evil on air pollution in India during the lockdown<sup>☆</sup>

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## ABSTRACT

The study objective is to contemplate the effectiveness of COVID-19 on the air pollution of Indian territory from January 2020 to April 2020. We have executed data from European Space Agency (ESA) and CPCB online portal for air quality data dissemination. The Sentinel – 5 P satellite images elucidate that the Air quality of Indian territory has been improved significantly during COVID-19. Mumbai and Delhi are one of the most populated cities. These two cities have observed a substantial decrease in Nitrogen Dioxide (40–50%) compared to the same period last year. It suggests that the emergence of COVID-19 has been proved to a necessary evil as being advantageous for mitigating air pollution on Indian territory during the lock-down. The study found a significant decline in Nitrogen Dioxide in reputed states of India, i.e., Delhi and Mumbai. Moreover, a faded track of Nitrogen Dioxide can be seen at the Maritime route in the Indian Ocean. An upsurge in the environmental quality of India will also be beneficial for its neighbor countries, i.e., China, Pakistan, Iran, and Afghanistan.

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## 1. Introduction

In December 2019, there was an eruption of a new pandemic in Wuhan city of China. At an early stage, it was unknown which later on spread so fast while capturing the whole world. This novel pandemic disease has been given the name COVID-19 a sequel of pneumonia which the Chinese government declared (Li et al., 2020). The symptoms of COVID-19 are quite similar to the already erupted pandemic SARS and MERS (Wang et al., 2020), but its fatality rate is different from them. The early signs are coughs, severe pain in the body and high fever which later on aggravated and causes severe infection to the lungs resulting in the ultimate death (Holshue et al., 2020; Perlman, 2020). World Health Organization (WHO) has declared health emergency all around the globe due to this novel infection disease. There were 1,279,722 confirmed infected patients till April (Şahin, 2020), which arose the primary concern of WHO while recommending drastic steps to curtail this disease via the implementation of social distancing to be restrained

of social interaction. In this regard, the countries have launched the lock-down campaign and even blocked activities such as airlines, trades educational institutes, and transportation activities. The optimal objective was to mitigate the social interaction among the public. Despite this, in February, the infectious disease spread in Iran and Italy. Till the end of the March, the pandemic had apprehended more than half of the population of the world.

Over time, it has been contemplated that COVID-19 has a linear relation with the weather, which can agitate this pandemic in the intensity of spread. Specific weather variables, such as temperature and humidity, can invigorate its potential ability (Tosepu et al., 2020). On the contrary, the air quality of different countries has witnessed to be improved significantly.

Argumentatively, owing to the lock-down of local transport, and regular social activities, the oil consumption of each country has been mitigated emphatically (Muhammad et al., 2020). According to the ESA report, the reduction in Nitrogen Dioxide improved the air quality in Wuhan city of China. The overall air quality has been enhanced (Dutheil et al., 2020) due to lock-down among many countries of the world. According to the world health organization, the death toll has reached 4.6 million people annually due to bad air quality (J. Cohen, 2020). More specifically, lousy air quality is also a vigorous cause of diseases related to lungs, heart diseases, and

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respiratory problems. Meanwhile, the emergence of COVID-19 has been observed in China, which had been suffering from aggravated air quality while causing death 4000 people per day (Brauer, 2010; A. J. Cohen et al., 2017).

Being neighboring with China, India with a mass population of more than 1.353 billion is also struggling against COVID-19. New Delhi is second of the most polluted city in the world which has PM<sub>2.5</sub> 32.8  $\mu\text{g}/\text{m}^3$  (World Health Organization). The effect of air pollution has severe impact on health. It is vital to study the current air pollution situation of such a country whose economy is depended on power, transport, power, construction, agriculture, rural development.

India reported 3 cases until the March 2, 2020 (Singhal, 2020), but the number of infected patients has been increased to a thousand in April (Mandal & Mandal, 2020). Due to the lock-down of a massive population (Mate et al., 2020), India has curtailed its oil consumption significantly<sup>1</sup> and launched strict lock-down measures. Previously, India had been suffering from severe air pollution problems as India was capturing 18% of the population of the globe while its territorial air pollution was contributing 26% of the world (Balakrishnan et al., 2019). Reasonably, the Indian economy will have to face decline (Mohan, 2020) while restraining the mass population for travelling, but the air quality of Indian territory has also been improved. Henceforth, the current study elucidates the effectiveness of COVID-19 on the air pollution of Indian territory while restricting the massive population through the lock-down. In this regard, the satellite map issued by the European Space Agency has been executed to ascertain the significant aftermaths of COVID-19. The current study reveals useful insights for academicians, researchers, government officials, environment control authorities, and policy-makers. The main objective of the study is to explore COVID-19 effect on air pollution in India. First, it will examine whether lock-down due to COVID-19 has improved the air quality in India? Second, does lock-down has decreased the energy consumption in India? Third, does variation in the mobility schedule imperatively impact the environmental quality? The answer to these questions will explore the other side of the picture of COVID-19. Previously, some studies have been conducted on the effects of COVID-19 and environmental pollution. Still, as per the author's best information, no one study has been conducted to ascertain the impact of COVID-19 and lock-down parameters on the air quality of India.

## 2. COVID-19 and environment

COVID-19 has not only breached the circle of the worldwide economy but also stopped transportation throughout the world. International and local transportation has been reduced, which lessens oil consumption and energy utilization. These variations have greatly influenced the environmental quality. National Aeronautics and Space Administration (NASA) and European Space Agency (ESA) reported that the level of Nitrogen Dioxide has imperatively diminished up to 30%, and there is a significant improvement in environmental quality. NASA and ESA published images of numerous nations taken through its satellite to indicate the environmental quality before and after COVID-19 lock-down. NASA utilized its Ozone Monitoring Instrument (OMI) through the AURA satellite, and ESA operated Tropospheric Monitoring Instrument (TROPOMI) through the Sentinel-5P satellite to collect this data.

On March 25, 2019, the Government of India implemented a

complete lock-down on its population to prevent the spread of COVID-19. All the factories, non-necessary shops, markets, temples and Mosques, were closed. Only essential services such as hospitals, water distribution, and electricity production were exempted during the lock-down.

Fig. 1 represents the environmental condition in India from the period of January 01, 2020 to March 24, 2020 (before lock-down) and March 25, 2020 to April 20, 2020 (after lock-down). It also makes a comparison with the same dates of 2019. This image is taken through the Copernicus Sentinel-5P satellite. The findings revealed a significant reduction in nitrogen dioxide concentrations. Moreover, the cities in India with full of a crowd in regular days, i.e., Delhi and Mumbai noted a 40–50% reduction in Nitrogen Dioxide emission as compared to last year (ESA, 2020). However, red dots in the image represents a high value of Nitrogen Dioxide emission in northeast India. Air quality was improved significantly just after few days of lock-down (Mahato et al., 2020).

This investigation indicated these clusters have direct linkages with coal-based power production units. The Vindhyachal Super Thermal Power plant is a leading power production unit in India, and it exposed merely a 15% drop in its production (ESA, 2020). Besides, the electricity consumption level in India has been declined by up to 9.2% during March 2020 as a result of lock-down, and it represents the fastest drop in electricity use (Reuters, 2020). Further, electricity use in vital industrial states of India, such as Tamil Nadu and Maharashtra, faced a 5% reduction during the ending week of March 2020. Nonetheless, the western state of Gujarat recorded a 30% decline in power consumption due to lock-down. The analysis revealed that customers consumed 100.2 billion kilowatt-hours (KWH) during March 2020, as equated to 110.33 billion KWH in 2019 (Reuters, 2020).

Fig. 2 shows the Maritime route of the commercial ship in the Indian Ocean before and after lock-down. The findings indicate a faint trail of Nitrogen Dioxide emission in the Indian Ocean at the Maritime route. The shipping lanes looked like a straight line as the ships follow the same tracks.

## 3. The validity of nitrogen dioxide from satellite images

To authenticate the Nitrogen dioxide from satellite images, this investigation utilized the real data of Nitrogen Dioxide emission measured by the 38 monitoring stations located in Delhi and 10 in Mumbai. Air pollution may be higher in some cities as compare to overall country (World Bank, 2015). This examination calculates the daily mean of Nitrogen Dioxide emission measured by these stations from the period of January 01, 2020, to April 20, 2020, which expressively represents the pre-lockdown and during the lock-down period. Fig. 3 depicts the day-wise Nitrogen Dioxide emission level in Delhi. The findings revealed that before the lock-down, the level of Nitrogen Dioxide emission in Delhi remains between 30 and 65 ( $\mu\text{g}/\text{m}^3$ ). However, as the lock-down announced in India, the level of Nitrogen Dioxide emission showed a dramatic decline. In Delhi, the average level of Nitrogen Dioxide emission during the lock-down period remains 12 to 25 ( $\mu\text{g}/\text{m}^3$ ).

Fig. 4 demonstrated the daily level of Nitrogen Dioxide emission in Mumbai. The results show that before the lock-down period, the level of Nitrogen Dioxide emission remains from 28 to 62 ( $\mu\text{g}/\text{m}^3$ ). Nonetheless, it faced an enormous deterioration with the beginning of lock-down in India. The study indicates that Nitrogen Dioxide emission remains low during the complete lock-down in Mumbai. Consequently, these statistics verified that lock-down in India has imperatively improved environmental quality. Also, it confirmed the accuracy of the information generated through satellite images. These findings are in line with the study of (Mahato et al., 2020).

<sup>1</sup> From the Economic time (Energy world.com), India has declined its oil consumption up to 18%.

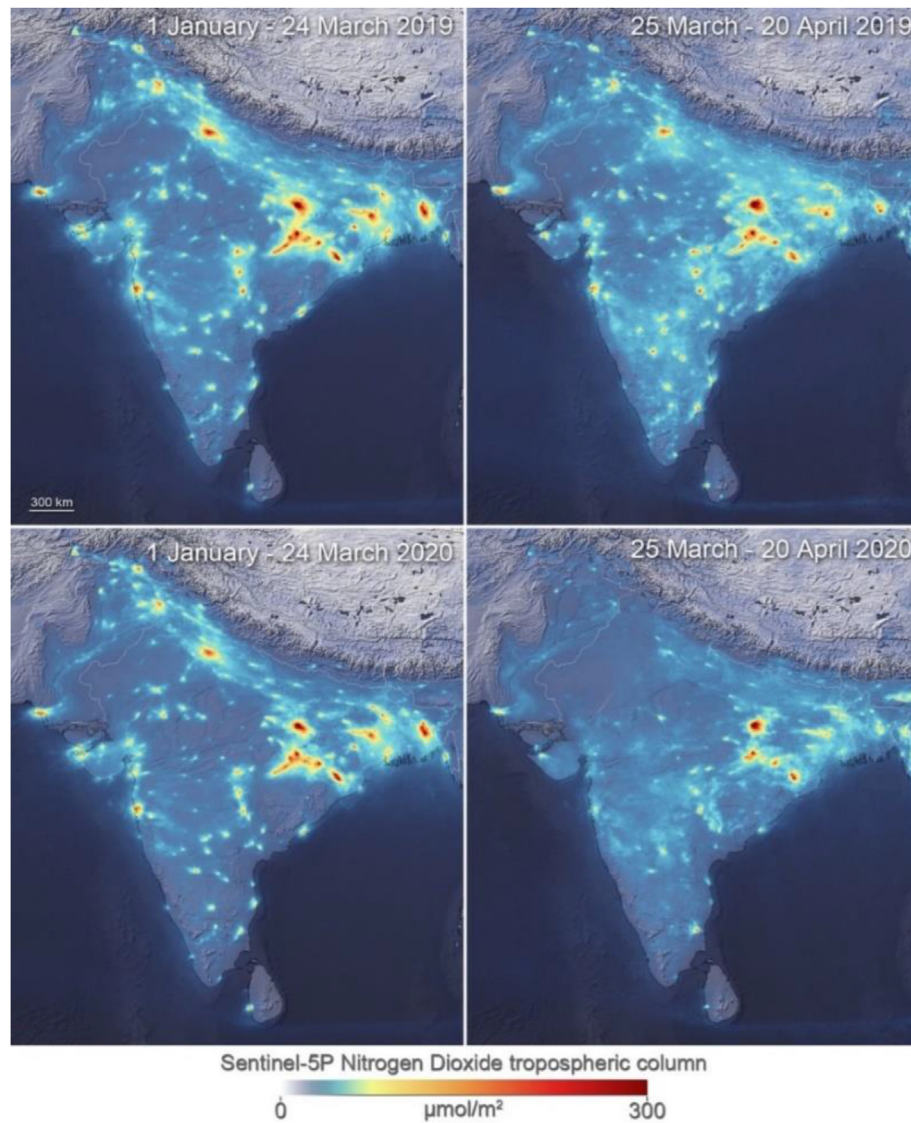


Fig. 1. Nitrogen dioxide emission before and after a lockdown in India.

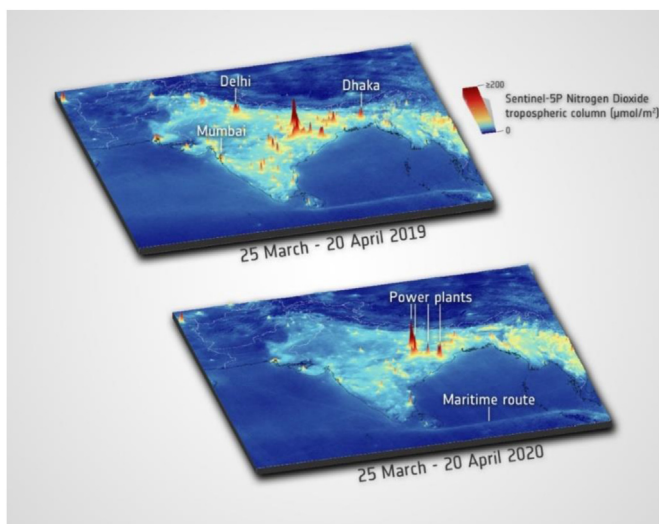


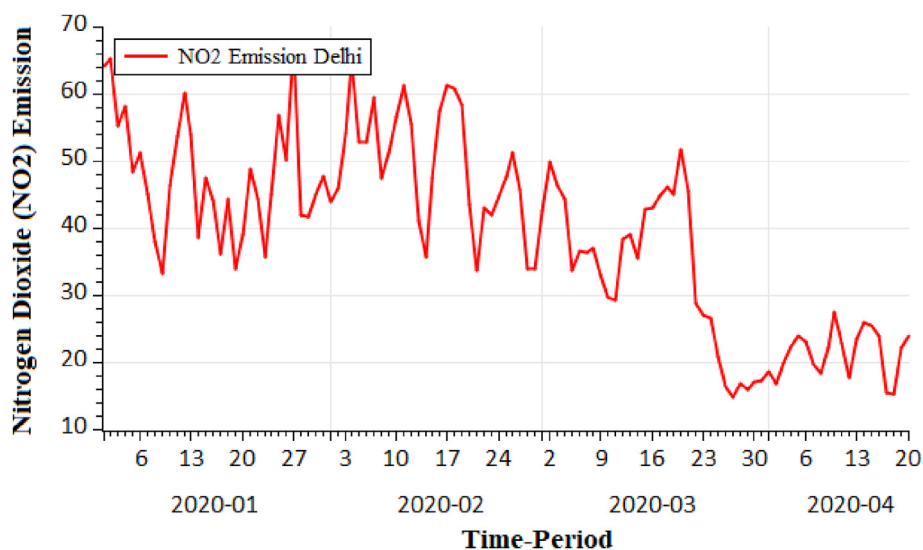
Fig. 2. Nitrogen Dioxide emission at Maritime Route in the Indian Ocean.

#### 4. Conclusion

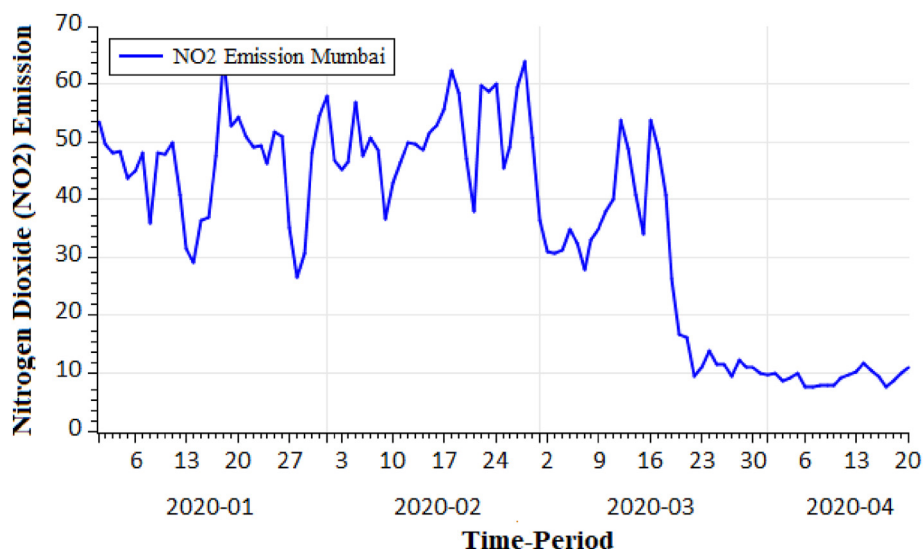
The COVID-19 has a far-reaching effect on the lives of people around the world. It showed a dramatic impression on international and local transportation. On the other hand, lock-down slowed the economic circle in the world, which results in shut down of production units and international trading. This study has evaluated the significant influence of lock-down due to COVID-19 on the India air quality and Pollution by collecting Sentinel – 5 P satellite images of the European Space Agency and National Aeronautics and Space Administration (NASA). The findings disclosed that the level of Nitrogen Dioxide emission had been expressively reduced. This impact is more evident in Delhi, Mumbai, and different states of Gujarat.

Moreover, energy consumption in India has also declined during March 2020. However, the power generation plant in India is a significant source of Nitrogen Dioxide emissions. Moreover, lock-down has also affected Ship transportation. The investigation revealed that there was a decline in the level of Nitrogen Dioxide at the Maritime Route of the Indian Ocean. Additionally, the study authenticated these findings through various environment





**Fig. 3.** Nitrogen Dioxide Emission Before and During the Lockdown in Delhi. Source: CPCB online portal for air quality data dissemination (<https://app.cpcbcr.com/ccr/#/caaqm-dashboard-all/caaqm-landing>).



**Fig. 4.** Nitrogen Dioxide Emission Before and During the Lockdown in Mumbai Source: CPCB online portal for air quality data dissemination (<https://app.cpcbcr.com/ccr/#/caaqm-dashboard-all/caaqm-landing>).

monitoring stations located in Delhi and Mumbai. The examination confirmed that lock-down has proved to be a blessing for the air quality in India. An improvement in the Indian air quality is not only beneficial for India but also has benefits for its surrounding nations, i.e., China, Pakistan, Iran, and Afghanistan. These results provide new insights to government officials, academicians, researchers, and pollution control authorities.

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## CRediT authorship contribution statement

**Khurram Shehzad:** Conceptualization, Investigation, Writing - review & editing. **Muddassar Sarfraz:** Conceptualization, Investigation, Writing - review & editing. **Syed Ghulam Meran Shah:** Writing - original draft.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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