

Positive impact of COVID-19 in refining air and improving river water quality in Delhi, India

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Abstract

Delhi, the capital of India, is a large metropolitan city with a population of nearly 19.5 million. Due to huge commercial activities, roar in construction, industries and vehicular traffic, the air and river water qualities in this very ancient and historical city is at the top of environmental risks. But in order to contain the outbreak of COVID-19, almost all activities across India have been locked down since the midnight of 24 March 2020. All academic institutions, industries, shops, rail-air and roadways services, offices, agricultural activities with a relaxation to emergency services ceased functioning till date. After almost three weeks of complete lockdown, concentration of certain air polluting agents has been found to decrease considerably in the aerial atmosphere of the state. It is reported that the concentrations of PM_{2.5}, PM₁₀, NO₂, Benzene, CO and SO₂ have declined to 46%, 50%, 81%, 47%, 37% and 19% respectively. Due to freshwater flow from upstream, considerable decrease in concentration of some parameters such as, EC, DO, COD and BOD etc. in the water of river Yamuna flowing through the city has also been observed which clearly indicates its lowered pollution level than before. The overall retrieval of air and river water qualities in Delhi, because of COVID-19, has been discussed in the present paper.

Keywords: COVID-19; Delhi; Air Pollution; Water Pollution; Recovery; Environment

1. Introduction

Over the past two decades there has been a rapid increase in urbanization and industrialization in many cities in India. It is reported that air pollution causes more than a million deaths and the loss of 4.6 million lives annually throughout the world [1]. Population explosion, industrial growth and increase in vehicles are the main reasons for air pollution [2]. Air pollutants such as particulate matters, SO₂, NO₂, CO, polycyclic aromatic hydrocarbons (PAH), formaldehyde and metals are the major risk factors for human health such as respiratory infections (pneumonia, tuberculosis and COPD), low birth weight, structural birth defects, cataracts, nutritional deficiencies, lung cancer etc.

Delhi is one of the fastest growing states of the country, bordered by the state of Haryana on three sides and by Uttar Pradesh to the east. The State has sizable different types of industrial, commercial and trading base. It is world's one of the most polluted state holding very high concentration of particulate matters (PM) in its aerial atmosphere.

In December 2019, a new infectious respiratory disease COVID-19 emerged in Wuhan, Hubei province, China [3]. This has affected in >200 countries as of April 29, 2020. The World Health Organization (WHO) has declared it as a global public health emergency due to its wide transmissibility. It has out broken in different corners of the world. In order to contain the transmission

of the disease and decrease the death toll, government of India decided to completely lockdown the country with effect from the midnight of 24th March 2020. Initially it was decided to continue the lockdown up to 14th April, but it was later on extended to 3rd May. Under the nationwide lockdown, all educational institutions, industrial, hospitality and transport services were suspended with exceptions of essential services. During the lockdown period, significant reduction in concentration of PM_{2.5}, PM₁₀, SO₂ and NO₂ in the atmosphere of the city was observed along with subsequent lowering of DO, EC, COD and BOD levels in the river Yamuna. It can therefore be considered as an unambiguous indication that the air and river water quality have been improved in Delhi during the lockdown period.

2. Research Methodology

Delhi, the capital of India, with population nearly 19.5 million is located in the Northern part in India. In the course of the present study of change in air and river water quality in Delhi state during COVID-19 related lockdown period (March 25, 2020 - April 15, 2020), all the data have been collected from the website of the Central Pollution Control Board (CPCB), India. A literature search was performed using the database, different websites, news bulletins, circulars, instructions, awareness creating audio-visuals by several authentic Govt. and non Govt. organizations, agencies, professional bodies like the WHO, UNICEF, Indian Medical

Association, Indian Council of Medical Research, Ministry of Health, Govt. of India etc.

3. Results and Discussion

3.1. Impact on air quality

According to the WHO, Delhi is the most polluted city in the world [4]. Every year, air pollution causes the death more than 10,000 people in Delhi. Poor quality air permanently damages the lungs of 50% of the children of the State. Extent of air pollution of a place can be understood by measuring the annual mean

followed by dust from roads & other sources (21.5%) and industries (18.6%) in 2018 [5].

The major sectors contributing to air pollution are transport, construction activities, industries, power plants, burning of trash and crop residues, road dust and residential activities. Last year during winter season the pollution of this beautiful ancient city reached unbearable levels; smog shrouded the city, visibility largely dropped down, and the air quality deteriorated so much so that inhabitants were craving for pure air to breathe, a number of flights were diverted, schools and colleges were temporarily closed.

A nationwide lockdown imposed across India on 24 March midnight to stop the spread of the COVID-19 disease. So all

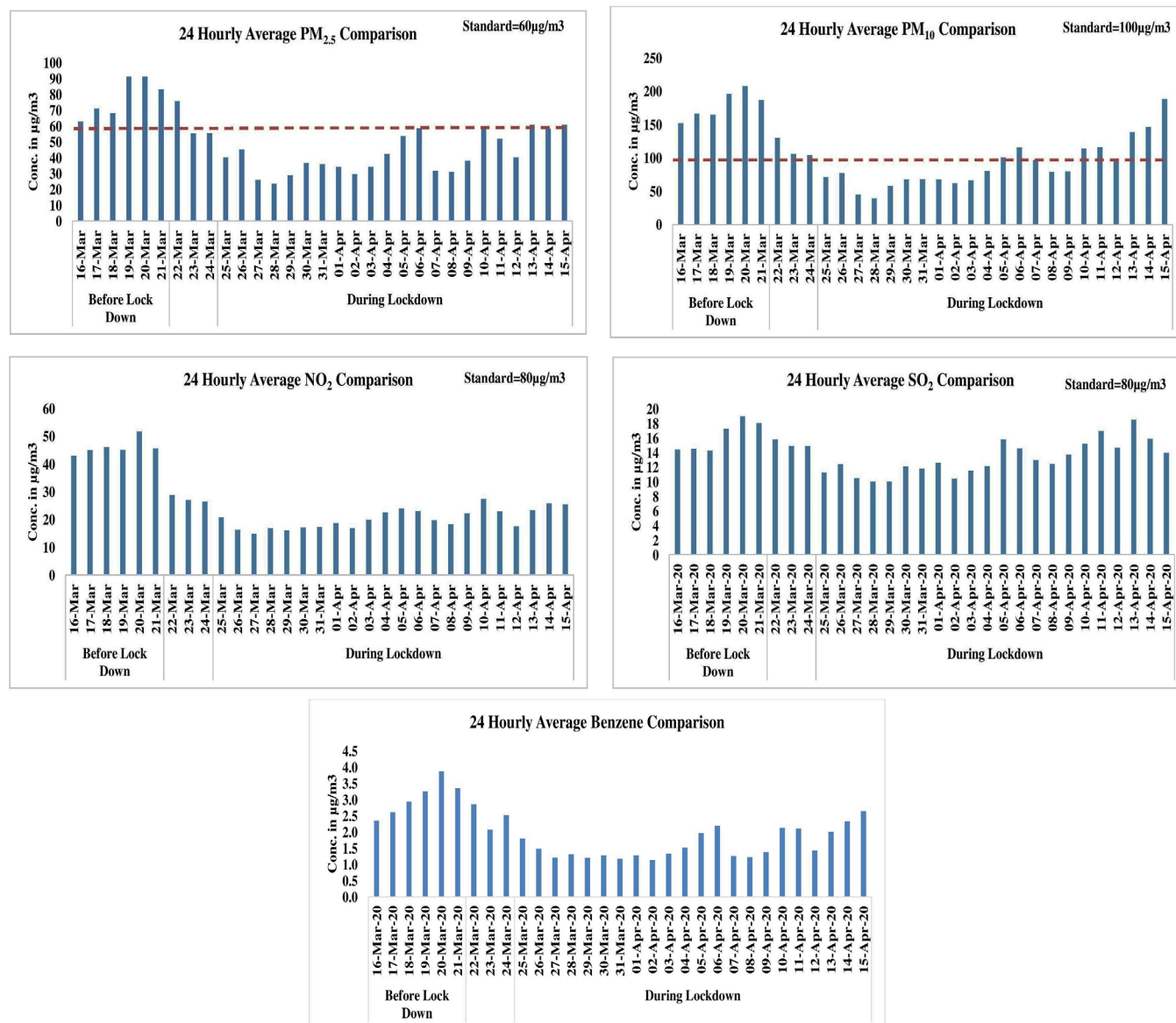


Fig. 1. Daily concentration trend for PM_{2.5}, PM₁₀, NO₂, SO₂ and Benzene in Delhi for before (16th March 2020 to 21st March 2020) and after lockdown (25th March 2020 to 15th April 2020)

concentration of particulate matters PM₁₀ (particles smaller than 10 microns) and PM_{2.5} (particles smaller than 2.5 microns). PM_{2.5} is largely responsible for aerial pollution in big cities as these can penetrate deeply into lung and cause moderate to severe respiratory disorders. According to the Ministry of Earth Science, Govt. of India, maximum PM_{2.5} is released (41%) from vehicular emission

educational institutions, factories, markets, shops, and transport are now closed and citizens are stay at home and practice social distancing. Less than six months ago, Delhi was gasping for breath. But mandatory lockdown in Delhi to prevent COVID-19 transmission has decreased environmental pollution significantly and as a result, some of the freshest air has been seen in decades.

Air quality trends have been studied in two phases: Pre-lockdown phase (16-21 March 2020) and Lockdown phase (25 March- 15 April 2020). Figure 1 show that air pollutants such as PM_{2.5}, PM₁₀, NO₂, Benzene, CO and SO₂ levels significantly decreased in Delhi. PM₁₀ and PM_{2.5} are caused mainly by road and construction dust, and are mainly generated locally. During the lockdown period, respective drop of 46% and 50% in PM_{2.5} and PM₁₀ levels have been observed.

The health risks in residential, commercial, and industrial zones in Delhi are chiefly due to SO₂ and NO₂. NO₂ is accumulated mainly from vehicular emissions, and nearly 81% of vehicles are off the road in Delhi, resulting nearly 56% drop in NO₂ levels. In Delhi, 70% of SO₂ originate from power plants, restaurants and some industries. Only 19% decrease of SO₂ levels in the city is due to the fact that the power plants have been functioning during the said lockdown period. As much as 37% reduction in CO levels and 47% reduction in Benzene levels have been observed during the lockdown period in Delhi. Sentinel-5P TROPOMI satellite image shows remarkable decrease in NO₂ levels in Indian atmosphere (Figure 2) [6].

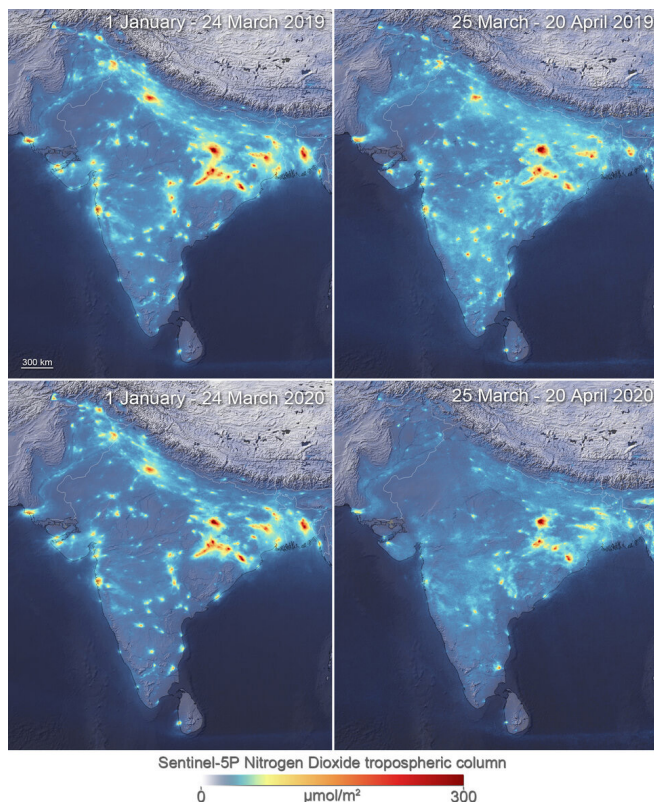


Fig. 2. NO₂ emissions in India before and after lockdown. (Source: ESA, 2020)

On 21 April 2020, the National Aeronautics and Space Administration (NASA) released an image, and the data retrieved by Moderate Resolution Imaging Spectroradiometer (MODIS), indicates that, in the beginning of April, just after a week of reduced human activities, the aerosol levels in northern India has been found to be lowest in the last 20 years (Figure 3) [7]. So the outbreak of the COVID-19 pandemic is secondarily correlated with cleaner air in Delhi as well as in other parts of the world. It is also found that, the atmosphere became so much clear so that the Himalayan peaks are now clearly visible from cities where the view had been obscured by fog for decades (Figure 4).

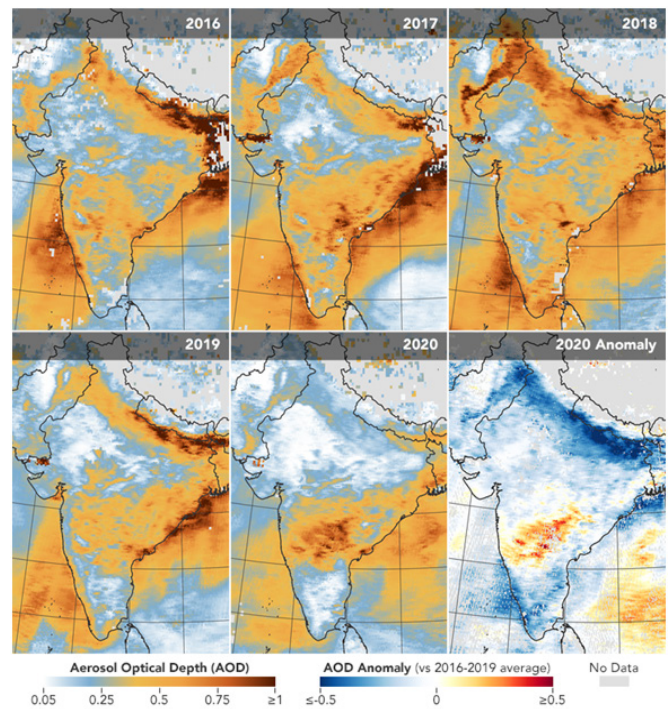


Fig. 3. Airborne particle levels plummet in Northern India before and after lockdown. (Source: NASA, 2020)



Fig. 4. Himalayas Visible after lockdown, (Source: <https://weather.com/health/coronavirus/video/himalayas-visible-for-first-time-in-30-years-due-to-lockdown>).

3.2. Impact on river water quality

Rivers and streams are essential ecosystems that maintain the life of humans and animals. Yamuna is the major branch of River Ganges helping almost 57 million citizens across its travelling length in India [8]. More than 70% of drinking water supply of Delhi is abstracted from river Yamuna. Over the last few years, the water quality of Yamuna has damaged due to human activity. The main sources of pollution of the river Yamuna are the urbanization, domestic and industrial sewage. These industries include paper, sugar, chemical, engineering, leather, distillery, pharmaceuticals, tannery, foods, glass, plastics, textiles, thermal power plants etc. Another potent Yamuna river pollutant is heavy metals. These heavy metals cause formation of tumours, muscular, gastrointestinal, neurological, reproductive, and hereditary disorders.

In view of the lockdown due to COVID-19 pandemic, water in Yamuna river looked cleaner than before as industrial units are shut. The stoppage of industrial pollutants, industrial waste and domestic

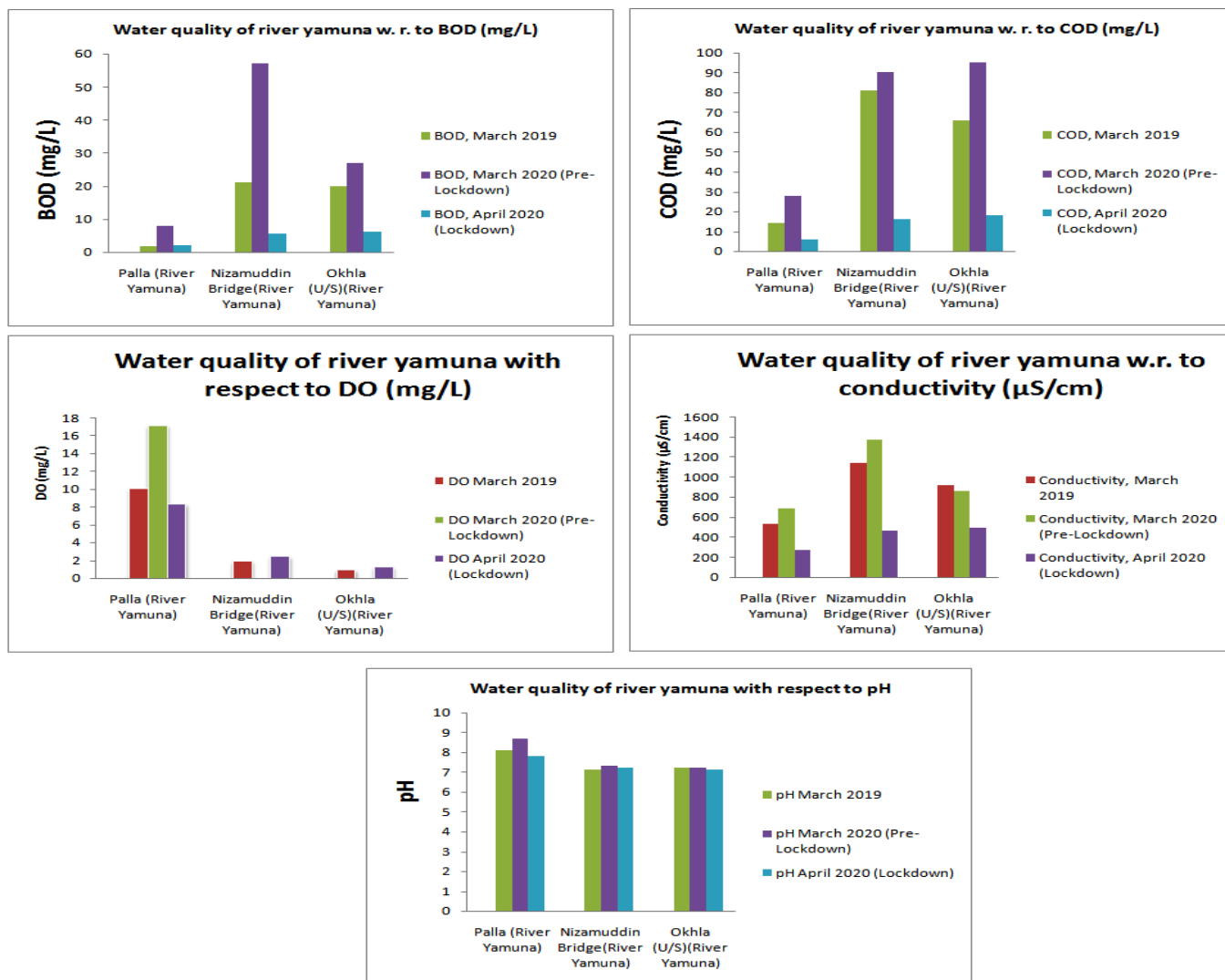


Fig. 5. Water quality trend of river Yamuna with respect to pH, EC, DO, BOD and COD during before and after Lockdown.

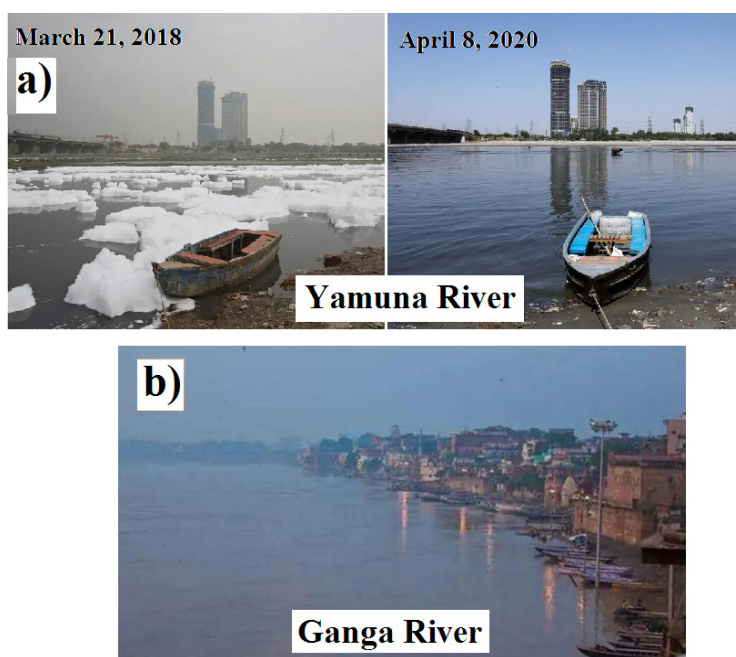


Fig. 6. (a) After and before lockdown Yamuna River in India (Source: <https://www.insider.com/before-after-photos-show-less-air-pollution-during-pandemic-lockdown>). (b) India coronavirus lockdown cleans up Ganges river (Source: <https://www.indiatoday.in/education-today/news/story/ganga-water-quality-improved-by-large-percentage-during-covid-19-lockdown-period-iit-bhu-professor-1663902-2020-04-06>).

Table 1: Percentage of reduced concentration parameter present in river Yamuna (Source: CPCB).

Location	BOD (% reduction)	COD (% reduction)	DO (% reduction)	EC (% reduction)
Palla	74.69	78.57	51.46	59.18
Nizamuddin Bridge	90.18	82.22		66.40
U/s of Okhla Barrage	77.41	81.05		43.32

sewage has a positive effect on water quality in Yamuna River. According to CPCB, 35.9 MLD of industrial sewage are reduced due to the shutting down industries. Water quality trend of river Yamuna with respect to BOD; COD; pH, electrical conductivity (EC), and DO as observed during pre-lockdown (March 04, 2020) and lockdown period (April 06, 2020) are shown Figure 5. Table 1 data shows that, the concentration of parameters (EC, DO, BOD and COD) at Palla, Nizamuddin Bridge, and U/s of Okhla Barrage location in Yamuna river significantly decreased during pre-lockdown and lockdown period. These results show that, water quality of river Yamuna has significantly improved (Figure 6a). According to the CPCB, the average water quality remarkably increase of the Ganga has been seen in recent days, which is suitable for bathing and breeding of wildlife and fisheries (Figure 6b).

4. Conclusion

Since last three months human civilization has been facing the most threatening challenge of the century, i.e, COVID-19, the pandemic that created havoc among the entire human population. This highly contagious disease is not only a serious public health concern anymore, but its consequences are also likely to produce long lasting dreadful scars on the economy, lifestyle, and employment of the world as a whole. But every cloud has a silver lining. This pandemic is not an exception. During the last few decades global warming, excessive air pollution, depletion of ozone layer, soil & water pollution etc. have been matters of serious concern of the environmentalists all over the world. COVID-19 has forced people throughout the world to stop all their activities by staying at home and allowed the environment to heal its wounds. Delhi is considered as one of the most polluted state/cities in the whole world where the pollution reached intolerable levels during last winter. But along with other parts of this planet, during the lockdown period Delhi has recovered its environment to fairly good extent. It improved its air & river water qualities significantly. Blue sky with high visibility, rivers flowing with clean water, birds retrieving their lost territories, clean air for breathers than ever clearly indicate that, the environment of Delhi has improved as an indirect consequence of COVID-19. Humans, in their effort to get rid of the pandemic have unintentionally reduced the pollution level of the nature within a very short period of time. This effect may be temporary, but in spite of the present-day frightening situation, people not only of Delhi, but all over the world have realized the spirit and necessity of unpolluted environment for their well being. So if we want we can bring about a change to revive the environment in a long-lasting manner by adhering to certain measures that COVID-19 has taught, and make the world a better place to live.

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