Rejuvenating impact of COVID-19 lockdown on major environmental parameters: an Indian perspective

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Abstract The recent coronavirus outbreak caused severe impact on the life of people. Despite of several health and economic losses, COVID-19 pandemic induced lockdown proved to be a boon for the environment. This review highlights the positive impact of COVID-19 induced lockdown on the environment; enumerating its effect on air quality indices, water quality indices, wildlife and noise pollution, therefore, focussing on the brighter side of the effects of lockdown. Notably, in India, rivers like Ganga and Yamuna showed a drastic reduction in water pollutant levels. For the first time in a generation, the Himalayas were visible from various parts of India. The amount of waste generated also showed a decline during the lockdown, and wildlife was seen blooming. During the lockdown period temperature levels were also recorded low as compared to 2019 between March to June. Hence, this review emphasizes the beneficial impacts of lockdown on different pollution parameters as well as wildlife in India.

Keywords COVID-19 · Lockdown · Environment · Wildlife · Water quality indices · Air quality indices

1 Introduction

Coronavirus disease (COVID-19) designated as 2019-nCoV was first reported in Wuhan, China on December 31, 2019 [1]. COVID-19 caused by SARS-CoV-2 belongs to the family Coronaviridae, and is an enclosed RNA virus having a crown-like structure [2, 3]. With the unprecedented rise in the number of COVID-19 infections across the globe, coronavirus outbreak has been declared as public health emergency of international concern by the World Health Organization (WHO) on 30th January 2020 (WHO, 2020) [4]. Nonetheless, 2019-nCoV is the third coronavirus that arouse in the human population, alarming the whole global public health institutions after the outbreak of SARS-CoV (Severe Acute Respiratory Syndrome Coronavirus) in 2002–2003 and MERS-CoV (Middle East Respiratory Syndrome Coronavirus) in 2012 [1].

To fight back and curtail the spread of infection, nationwide lockdown was introduced in India [5]. Lockdown is meant to curb the spread of infection from humans to humans and to establish the healthcare network adequately [6]. The outbreak of COVID-19 was catastrophic and the implementation of lockdown was undoubtedly a major step for the movement and control of infection which slowed down the transmission but led to the loss of economy, unemployment, loss of jobs and sources of livelihood; in turn causing devastation for the humans in an unpredictable way. COVID-19 lockdown brought anxiety and a sense of fear all around the globe [7]. The negative impacts of pandemic are tremendous and terrible but there are unexpected beneficial and positive impacts too. Global lockdown has drastically revitalized the environment in different ways [8]. Lockdown proved to be a reset button for the environment helping it to bounce back. Prior to COVID-19, pollution was the primary issue, and
different organisations worked throughout the world to lower the pollution levels, particularly urban pollution in the form of carbon dioxide, nitrogen dioxide, sulphur dioxide, and particulate matter [4]. According to the report of WHO [20], almost 8% of total deaths in the world occurred due to air pollution. Profound impact on the environment has been seen right from the decline in air pollution, cleaner and healthier river water, decrease in carbon dioxide and aerosol level, dramatical drop in the level of nitrogen dioxide to clearer skies and improved climatic conditions. AOD (Aerosol Optical Length) values dropped over various regions of India and a significant reduction upto 50% was recorded over North-Central regions during the period of lockdown analyzed using MODIS satellite [5]. In crowded cities, noise pollution dropped below 60 db [9]. Even the generation of municipal solid waste (MSW) dropped considerably in India. Due to the reduction in pollution, the cases of jaundice, chikungunya, typhoid, respiratory disease, etc. also reduced in hospitals [10]. Restricted movement of human, vehicles and industrial production resulted in reduction in concentration of PM 10 and less man-made heat flux resulting from human movement caused declination in LST (Land Surface Temperature) [11]. Plants were seen growing better due to cleaner air and water and less human interference resulted in more coverage and oxygen.

As reported by Zambrano-Monserrate et al. (2020) [12], AQI (Air Quality Index) in North, South, East, Central and Western India showed sharp decline with 44, 33, 29, 15 and 32% respectively. The capital of India, Delhi saw the reduction of almost 70% in the levels of nitrogen dioxide and PM2.5 [13]. Rivers mainly Ganga and Yamuna in India were seen clearer and significant drop in the water pollution level [14]. The electricity usage saw a steep decline due to lockdown in India; Maharashtra and Tamil Nadu showed a 20–30% declination in electricity demand [15]. The quantity of waste generated also came down during lockdown, the percentage of solid waste and paper waste went down by 42 and 62% respectively in major cities of India [16]. Due to lower human intrusion and pollution rates, sea turtles were seen laying eggs on the beaches [17]. The lockdown gave a rare opportunity to witness clean air, water, calm wildlife and liveable cities which created a very positive impact on the environment. Reports state that Dhauladhar range in Himachal Pradesh, India was visible from Jalandhar and Mt. Everest was visible from parts of Bihar during lockdown. As reported by Guha and Govil [18] values of LST (Land Surface Temperature), NDVI (Normalized Difference Vegetation Index) and LST-NDVI correlation in Raipur, Chhattisgarh (India) showed the environment of Raipur city during the lockdown compared to previous years. In this present review, we tried to highlight some positive impact of COVID-19 induced lockdown on the environment of India and suggest some strategies to reduce pollution.

2 Methods

In this review, we emphasized on the positive impacts of COVID-19 induced lockdown on three pollution parameters, air, water and noise as well as on the wildlife. This study was performed in context to India mainly, therefore, the first step was to extract articles on COVID-19 and environment. For this study, we searched in SCOPUS database with keywords COVID-19, lockdown, positive impact, water quality indices, and air quality indices. PubMed and Google Scholar databases were also used for searching articles related to impact of lockdown on environment of India. The articles since the onset of this disease (March 2020) till July 2021 were used as a reference in this study. The articles selected for this review as reference were studied thoroughly. Several lockdown policies and duration were introduced in India at regular intervals from time to time as shown in Table 1. These lockdown policies were imposed to reduce the rate of COVID-19 infection and in other way proved to be boon for the environment. The positive impact here signifies the significant reduction in air pollutants, water pollutants, solid waste and decrease in noise pollution as shown in Fig. 1. The data for satellite images of India for the concentration of different air pollutants like PM2.5, PM10, CO2, SO2 and CO were retrieved from https://earth.nullschool.net [19]. The AQI details were obtained from CPCB website for different cities of India before and after lockdown. The water quality parameters like BOD, pH and DO were retrieved from CPCB website.

Table 1 Phases of lockdown in India, 2020

| Phase       | Period                              | Duration   |
|-------------|-------------------------------------|------------|
| Phase 1     | 25th March, 2020–14th April, 2020   | 21 days    |
| Phase 2     | 15th April, 2020–3rd May, 2020      | 19 days    |
| Phase 3     | 4th May, 2020–17th May, 2020        | 14 days    |
| Phase 4     | 18th May, 2020–31st May, 2020       | 14 days    |
| Unlock 1.0  | 1st June, 2020–30th June, 2020      | 30 days    |
| Unlock 2.0  | 1st July, 2020–31st July, 2020      | 31 days    |
| Unlock 3.0  | 1st August, 2020–31st August, 2020  | 31 days    |
| Unlock 4.0  | 1st September, 2020–30th September, 2020 | 30 days |
| Unlock 5.0  | 1st October, 2020–31st October, 2020 | 31 days   |
| Unlock 6.0  | 1st November, 2020–30th November, 2020 | 30 days  |
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3 Review of literature

3.1 COVID-19 lockdown and its impact on air pollution

Air pollution is the largest environmental risk in the world causing 8% of total world deaths [20]. Air quality index (AQI) is the evaluation of air quality and lower AQI value is directly proportional to better quality of air [4]. Due to significant slowdown of industrialization, urbanization and social and economic activities, air quality was seen improving in different parts of the world [21]. According to the reports of Health Effects Institute (HEI), 2019, 95% of the earth’s population are inhaling polluted air [3].

Lockdown measures proved to have a positive effect on environment which lead to the reduction in gases like NO₂, CO₂, CO, PM (particulate matter) [22] (Fig. 2). Carbon emissions resulted in 25% reduction due to lockdown as estimated by the Energy and Clean Air Research Centre [23]. Decline in fossil fuel consumption, air pollution dropped in countries like China, Italy and India [24].

India due to its large population, heavy traffic and number of industries lead to high AQI in all the major cities. The satellite images of India showing the pollutant concentration of PM2.5, PM10, SO₂, CO and NO₂ before and after the lockdown period is shown in figures 3, 4, 5, 6 and 7 [25]. In India 12.4 lakh deaths in the year 2017 occurred due to air pollution [26]. India has experienced fast industrialization during the past two decades but this development has come with a heavy price in terms of pollution [25]. However, due to lockdown India too witnessed reduction in various pollution. In the major cities of India such as Ahmedabad, Mumbai and Pune during the period of lockdown NO₂ levels decreased between 40 and 50% [27]. Mahato et al. (2020) [28] have reported, three weeks of lockdown in Delhi, India from 24th March, 2020 showed a steep decline in air pollution. In Lucknow a significant decline of NO₂ was observed from pre COVID lockdown to post COVID-19 lockdown period i.e., from 22–158 to 3–59 μg/m³ and also in New Delhi before lockdown NO₂ concentration ranged from 4 to 158 μg/m³ while post COVID lockdown it was found to be 9–112 μg/m³ (Fig. 7) [29, 30]. The air AQI in Mumbai in March, 2020, was approximately 153 but in June, 2020 air quality was recorded to be around 66, similar effect was also seen in Karnataka (Bangalore) [31].

Depletion of aerosol accumulation during COVID-19 lockdown was also observed in India which is the major cause of air pollution [32]. In New Delhi, whose AQI was around 300–400 due to smog and pollution lowered to 94
The highest improvement in Air Quality was recorded by West Bengal that was 64% while Orissa recorded the lowest improvement with a percentage of 10 with respect to PM 2.5 levels (Fig. 3); while the percentage reduction in PM 2.5 was more than PM10 in Haryana, Bihar and Uttar Pradesh (Fig. 4) [33]. According to IQAir 2019 World Air Quality Report [34], Ghaziabad-the biggest city of Western Uttar Pradesh reported to be the most polluted city among 14 cities of India out of the world’s 20 most polluted cities with a PM2.5 pollution level of 110.2 μg/m³ in 2019 which is much more than the permissible limit of 60 μg/m³ (Table 2) [25, 34]. It was found that 85% reduction occurred in PM2.5 concentrations due to lockdown in Ghaziabad [25]. Tremendous decrement has been recorded in the pollutant concentration in the major metropolitan cities of India (Mumbai, Kolkata, Delhi and Chennai during the lockdown [35–37]. According to the Energy and Resources Institute (T.E.R.I.), 2021 (Delhi), a 61% reduction of NOx was observed during lockdown and 43% reduction in P.M2.5. The meteorological parameters such as wind speed, mixing height and ventilation coefficient were observed to be less during the lockdown period. Moreover, during pre-lockdown period ventilation coefficient showed more depression and reduced ambient concentration (Table 3). In the year 2021, during the second wave of COVID-19 in India, once again Himalayas were visible from Saharanpur (Uttar Pradesh) where the AQI was 85 as stated by Indian Forest Service official Ramesh Pandey [38].

### 3.2 COVID-19 lockdown and its impact on water pollution

Locking down in homes and halting factories, aviation, vehicles remarkably reduced the pollution problem improving the quality of water. Under the pandemic situation industrial effluents (one of the major cause of water pollution) entering the rivers and water bodies came to a halt improving the water quality [25]. Due to reduction in 90% turbidity in the
canals, sunlight penetration reached the water beds, thereby providing benefits to the creatures in it [39]. As domestic sewage, industrial wastes, bathing of humans, and boat traffic were curtailed; quality of river water in India uplifted [4]. Ganga, the holiest river of India sadly has been the most polluted river in the world [40]. However, according to the reports of Dr. P.K. Mishra and real time water analysis of Central Pollution Control Board of India, water quality of Ganga was observed 40–50% improved (Table 4) [14, 35]. As per CPCB’s data, Ganga water at Haridwar and Rishikesh was found suitable for drinking as sewage and industrial effluents decreased to 500% [4]. Suspended Particulate Matter (SPM) of Lake Vembanad, Kerala dropped by 15.9% which improved the surface water quality of the lake [41]. Singhal and Mato (2020), reported the improved quality of all major rivers of India due to temporary suspension of industries during lockdown. Aman et al. (2020), [42] reported, the average SPM of river Sabarmati, Ahmedabad (Gujarat) decreased to 16.79% as compared to pre-lockdown period with 36.48 and average SPM. Data of UPCB (Uttarakhand Pollution Control Board) demonstrated that total coliforms (40–90 MPN/100 mL), biochemical oxygen demand (0.6–1.2 mg/L), pH (7.4–7.8) and Dissolved oxygen (DO) (9.4–10.6 mg/L) of river Ganga met the standard surface water quality of India [20] (Fig. 2). River Yamuna also showed decrease in level of water pollutants like pH, BOD, COD and DO during the lockdown period as compared to the pre-lockdown period as shown in Table 5.

The Vice Chairman of Delhi Jal Board stated that situation of river Yamuna too witnessed improvement in water quality and appeared blue [14]. Water quality of tributaries like Hemavati, Shimsha, Lakshamanathirtha and River Cauvery also reported significant improvement as compared to pre-lockdown period according to Karnataka State Pollution Control Board (Table 6) [43]. Faecal coliform level also showed significant reduction in river bodies. As reported by B.D. Joshi, an environmentalist, after a long period Ganga water became fit for ‘achaman’ meaning ritual sipping.
According to CPCB report of September 23, 2020 percentage increase in compliance to the bathing criteria in water quality of seven rivers were noticed during lockdown as shown in Table 7.

### 3.3 COVID-19 lockdown and its impact on fauna and wildlife

COVID-19 pandemic gave wildlife a period to bloom and to get out of their habituated places [3]. As humans were confined to their houses during lockdown, animals and birds came out in notice and were seen venturing the human-zones [4]. Due to peace and calm in urban areas, wildlife emerged to the residential areas [8]. Due to less noise and air pollution, resident birds were seen breeding much more than earlier [44]. Road—killing of both amphibians and reptiles reduced during lockdown [45].

Due to COVID-19 lockdown there were reduction in water pollution and improvement in water quality which imparted positive impacts on aquatic life too [40]. As reported on 25th April, 2020 by Times of India, Ganges Dolphin (a South Asian river dolphin) was back at Kolkata, India. Wildlife Institute of India (WII) using an app ‘Lockdown Wildlife Tracker’ tracked the comfortable movement of wildlife straying outside habitats which was a great initiative by WII [46]. Sambar deer was seen wandering on the roads of Chandigarh, a civet was spotted on a zebra crossing in Kerala, flamingos were seen congregating in Mumbai, a leopard was seen on the empty streets of Hyderabad. Flies, wasps, bees, butterflies were seen frequently in numbers on the crops and other plants indicating restoration of ecology and biodiversity [14].

### 3.4 COVID-19 lockdown and its impact on noise pollution

Noise pollution causes hearing loss or impairment and has several physiological and psychological effects [47, 48].

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**Fig. 5** CO emission in India, before and after lockdown
Fig. 6 SO$_2$ emission in India, before and after lockdown

![SO$_2$ concentration maps](image1.png)

Fig. 7 NO$_2$ emission in India, before and after lockdown

![NO$_2$ concentration maps](image2.png)
Globally around 360 million people are vulnerable to loss of hearing due to noise pollution [49]. In older people, noise pollution has been linked to high blood pressure and sensory impairment [50, 51]. Elevated levels of sound generated from construction works, machines, vehicles causes noise pollution leading to detrimental effects on human health [12, 52]. According to National Institute on Deafness and Other Communication Disorders, long or excessive exposure to sound at or above 85 decibels causes hearing impairment. As per WHO guidelines during the night for a peaceful sleep noise level should be 30 dB (Fig. 3). Man-made noises have negative impacts on wildlife and invertebrates too which causes imbalance in the ecosystem [20, 53].

The level of noise pollution decreased in most of the cities worldwide due to temporary suspension of human activities [12]. According to Central Pollution Control Board of India, noise level of residential areas of Delhi got reduced from 55 to 40 dB during daytime and during night it reduced from 45 to 30 dB [35]. In Delhi, April 2020, the average noise level was observed to be around 40–50 dB on an average while compared to last year (April, 2019) which was 100 dB and higher [54]. Chirping of birds can be heard more often due to reduction in noise pollution [54]. According to West Bengal Pollution Control Board, Kolkata’s noise pollution declined by 50–75% during the lockdown period. Underwater noise reduction in oceans during the lockdown proved to be good for whales and other sea mammals and for scientists, to study the effects of quieter oceans on marine wildlife [55].

4 Result and discussion

The review highlights the positive impact of COVID-19 induced lockdown on the environment of India. Table 1 shows the different lockdown policies introduced in India since the onset of this disease. The lockdown caused sharp decline in the Air quality indices with more than 50% decline in many states of India as shown in Table 2. Jalandhar showed highest percent reduction in Air quality parameters of 66% followed by Bangalore and Delhi (Table 2). The different parameters of air quality like PM2.5, PM10, NO2, SO2 and CO reported sharp decline in concentration as shown in the satellite images of India taken before and after the lockdown period (Figs. 3, 4, 5, 6 and 7). This decline was recorded in nearly all cities of India due to less use of automobiles and industries. The water quality parameters like pH, BOD, Ammonia, DO concentration decreased during the lockdown period as compared to the unlock period as shown in Table 4 in Ganga water at different monitoring locations of India. The pollutant level in water bodies declined due to shut down of industries and no human interventions. The water quality parameters of river Yamuna also witnessed improvement at different stations of India (Table 5). Water quality of many rivers like Chambal, Cauvery, Krishna, Godavari and many others showed a decline in all the water polluting parameters at different stations as shown in Tables 5, 6 and 7.

Due to rapid transmission of novel coronavirus disease (COVID-19), nationwide lockdown was adopted to restrict the human mobility to slow down the rate of ongoing infections. Undoubtedly, the imposition of lockdown was found to be advantageous for nature’s rejuvenation, as all kinds of commercial, social, industrial, economic and urbanization activities were suddenly put on hold. Consequently, nature restores itself and showed significant improvements in the air and water quality parameters, noise pollution as well as undisturbed and calm wildlife [30].

It is evident from the reports of several previous studies and other print and electronic media that water quality parameters of many rivers of India showed marked improvements including Ganga, Cauvery, Sutlej and Yamuna. The reason behind clean water in the rivers is that, very less
amount of industrial effluents was reaching into the river body amid the lockdown period. In addition to this, several other factors have also been showing ameliorating effect in enhancing the water quality indices in the rivers such that less demand of irrigation water, above average rainfall, substantial reduction in the religious and cultural activities like puja, cremations bathing and many other rituals which has been performed on the bank of rivers [56]. This resulted in increased DO of river Ganga from 6.5 to 8 ppm and reduced BOD from 4 to 3 ppm near Kanpur [57]. At some places due to the self-cleansing property of Ganga the water has reached drinking standards during the lockdown period. River Yamuna was also seen with blue and clear water with aquatic life moving around because of less detergents and chemicals due to lockdown. The clear water in river has significant effect on aquatic life as it flourishes in clean water as witnessed during lockdown.

The impact of COVID-19 lockdown on the improvement of air quality signifies the direct relation of air pollution with economic as well as energy generation activities. This calls for the requirement of green energy based system or use of renewable energy to reduce air pollution globally. COVID-19 lockdown reduced the use of fuel due to less traffic on road and airways, so public transport should be

Table 4  Assessment of water quality of Ganga as on March 28, 2020 at monitoring stations in different cities of India  (Source: SANDRP, 2020)

| Monitoring stations in Kanpur | pH | DO (mg/L) | BOD (mg/L) | Ammonia (mg/L) |
|-------------------------------|----|-----------|-------------|----------------|
| U/S of Ganga barrage          | 7.90 | 8         | 2.1         | 0.49           |
| D/S of Ganga barrage          | 7.91 | 7.90      | 1.2         | 1.1            |
| At Shuklagunj                 | 7.68 | 8.51      | 2.1         | 0.79           |

| Monitoring stations in Patna  | pH | DO (mg/L) | BOD (mg/L) | Ammonia (mg/L) |
|-------------------------------|----|-----------|-------------|----------------|
| Gandhighat, NIT Patna         | 8.05 | 8.5       | 1.8         | 0.22           |
| Gulabi Ghat                   | 8.10 | 8.5       | 1.8         | 0.21           |
| D/S Patna, Gaighat            | 8.04 | 8.4       | 1.8         | 0.12           |

| Monitoring stations in Allahabad | pH | DO (mg/L) | BOD (mg/L) | Ammonia (mg/L) |
|---------------------------------|----|-----------|-------------|----------------|
| Kadahat                         | NIL | 8.8       | 2.6         | NIL            |
| U/S Rasulabad ghat              | NIL | 9.4       | 2.7         | NIL            |
| D/S Sangham                     | NIL | 8.6       | 2.7         | NIL            |

| Monitoring stations in Varanasi | pH | DO (mg/L) | BOD (mg/L) | Ammonia (mg/L) |
|---------------------------------|----|-----------|-------------|----------------|
| U/S Varanasi                    | NIL | 8.5       | 3.6         | NIL            |
| D/S Varanasi                    | NIL | 8.4       | 3.7         | NIL            |
| D/S Tarighat                    | NIL | 8.9       | 3.5         | NIL            |

| Monitoring stations in Haridwar | pH | DO (mg/L) | BOD (mg/L) | Ammonia (mg/L) |
|---------------------------------|----|-----------|-------------|----------------|
| Harki Pouri                     | 7.6 | 10.2      | 0.6         | NIL            |
| U/S Bindhughat                  | 7.8 | 9.8       | 1           | NIL            |
| D/S Balakumari Mandir           | 7.7 | 10        | 1           | NIL            |

| Monitoring stations in West Bengal | pH | DO (mg/L) | BOD (mg/L) | Ammonia (mg/L) |
|-------------------------------------|----|-----------|-------------|----------------|
| Howrah–Shivpuri                     | 7.05 | 3.90     | 1.25        | 0.19           |
| Uluberia                            | 7.35 | 7.30     | 2.20        | 0.22           |
### Table 5  Water quality of River Yamuna, at different stations before and during lockdown period, 2020 (Source: https://www.dpcc.delhigovt.nic.in/home/monthly_analysis_report#gsc.tab=0)

| Location | Phase          | pH   | COD (mg/L) | BOD (mg/L) | DO (mg/L) |
|----------|----------------|------|------------|------------|-----------|
| Palla    | Pre-lockdown   | 7.8  | 8          | 2.5        | 8.4       |
|          | 16/03/2020     |      |            |            |           |
|          | Lockdown       | 8    | 12         | 2.8        | 6.9       |
|          | 06/04/2020     |      |            |            |           |
| Surghat  | Pre-lockdown   | 7.9  | 10         | 3          | 4.8       |
| (D/S of Wazirbad Barrage) | 16/03/2020 |      |            |            |           |
|          | Lockdown       | 8.06 | 16         | 3.8        | 6.8       |
|          | 06/04/2020     |      |            |            |           |
| Khajori Paltoon Pool | Pre-lockdown | 7.6  | 84         | 30         | NIL       |
| (D/S Najafgarh Drain) | 16/03/2020 |      |            |            |           |
|          | Lockdown       | 7.24 | 116        | 33         | NIL       |
|          | 06/04/2020     |      |            |            |           |
| Kudesia Ghat | Pre-lockdown | 7.6  | 80         | 28         | NIL       |
|          | 16/03/2020     |      |            |            |           |
|          | Lockdown       | 7.37 | 60         | 25         | NIL       |
|          | 06/04/2020     |      |            |            |           |
| ITO Bridge | Pre-lockdown | 7.9  | 76         | 25         | NIL       |
|          | 16/03/2020     |      |            |            |           |
|          | Lockdown       | 7.63 | 32         | 22         | 2.3       |
|          | 06/04/2020     |      |            |            |           |
| Nizamudin Bridge | Pre-lockdown | 7.7  | 76         | 24         | 0.8       |
|          | 16/03/2020     |      |            |            |           |
|          | Lockdown       | 7.46 | 42         | 16         | 2.3       |
|          | 06/04/2020     |      |            |            |           |
| Agra Canal (Okhla) | Pre-lockdown | 7.7  | 132        | 42         | NIL       |
|          | 16/03/2020     |      |            |            |           |
|          | Lockdown       | 7.46 | 42         | 16         | 4.8       |
|          | 06/04/2020     |      |            |            |           |
| After meeting Shahdara Drain (D/S Okhla Barrage) | Pre-lockdown | 8.0  | 152        | 58         | NIL       |
|          | 16/03/2020     |      |            |            |           |
|          | Lockdown       | 7.63 | 76         | 23         | NIL       |
|          | 06/04/2020     |      |            |            |           |
| Agra Canal (Jaitpur) | Pre-lockdown | 7.6  | 92         | 32         | NIL       |
|          | 16/03/2020     |      |            |            |           |
|          | Lockdown       | 7.45 | 48         | 17         | 4.2       |
|          | 06/04/2020     |      |            |            |           |

### Table 6  Compliance status of Rivers in April, 2020 (Source: CPCB, 2020)

| Rivers          | Total no. of monitoring locations | No. of complying locations with percentage | No. of non-complying locations with percentage |
|-----------------|-----------------------------------|-------------------------------------------|---------------------------------------------|
| Beas            | 22                                | 21 (95%)                                  | 1 (5%)                                      |
| Cauvery         | 33                                | 32 (97%)                                  | 1 (3%)                                      |
| Chambal         | 13                                | 6 (46%)                                   | 7 (54%)                                     |
| Ganga           | 54                                | 25 (46%)                                  | 29 (54%)                                    |
| Godavari        | 37                                | 29 (78%)                                  | 8 (22%)                                     |
| Krishna         | 18                                | 16 (89%)                                  | 2 (11%)                                     |
| Mahi            | 14                                | 1 (7%)                                    | 13 (93%)                                    |
| Sutlej          | 23                                | 18 (78%)                                  | 5 (22%)                                     |
| Tapi            | 8                                 | 7 (87%)                                   | 1 (13%)                                     |
| Yamuna          | 12                                | 8 (67%)                                   | 4 (33%)                                     |
an alternative to reduce air pollution even after lockdown. The COVID-19 lockdown gave a major improvement in air quality in short span of time. This lockdown provides solution for nature’s rejuvenation from time to time along with sustainable development. The lockdown gave a positive hope that there can be reduction in environmental pollution with less human intervention.

Wildlife also flourished during the lockdown period. Many birds and animals were seen in cities which were lost earlier due to pollution and human interventions. This provides an insight to researchers to plan in a meticulous way how the coexistence of humans as well as animals is possible on earth. Noise pollution also declined due to reduced use of automobiles, aircraft and industries. COVID-19 pandemic reduced human activity to a great extent and hence 50% reduction in noise pollution was recorded in India [58]. Overall this few months lockdown is not sufficient to curb the pollution, but it hints the government policymakers to induce such restrictions regularly. There should proper removal of wastages as well as sewage treatment plants needs to be installed to reduce the pollution level. So, comprehensive pollutant study at different locations is required to formulate accurate policies to reduce the pollution level.

### 5 Conclusion

The outbreak of COVID-19 pandemic has shattered millions of lives globally and is still hitting several countries around the globe severely. The tragic impacts of coronavirus bring a lot of negativity but somehow the lockdown measures have proved beneficial to the environment. The effect of lockdown led to reduction in pollution and the Mother Earth was seen restoring itself. This review provides evidences of significant reduction in air, water and noise pollution and the positive impacts of lockdown on wildlife giving a better insight of the effects of lockdown in India. This calls for policy makers to amend the national policies for better environment in long run. To mitigate the pollution problem in future, government and the citizens should adopt measures and ensure lockdown restrictions regularly to curb environmental deterioration. Therefore, adopting a good lifestyle that reduces the greenhouse gases and carbon footprint in the atmosphere is urgently needed for positive impact on environment as well as to restore wildlife on Earth.

### Declarations

**Conflict of interest** All the authors declare they have no conflict of interest.

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### Table 7

| Rivers       | % increment in compliance to the bathing criteria |
|-------------|-----------------------------------------------|
| Brahmani    | 85–100                                        |
| Brahmaputra | 87.5–96.97                                    |
| Godavari    | 65.8–78.7                                     |
| Cauvery     | 90.5–96.97                                    |
| Krishna     | 84.6–94.4                                     |
| Tapi        | 77.8–87.5                                     |
| Yamuna      | 42.8–66.67                                    |
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