



## Review

## Nurture to nature via COVID-19, a self-regenerating environmental strategy of environment in global context

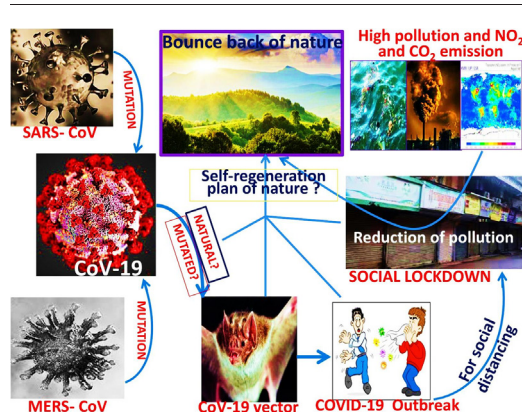
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## HIGHLIGHTS

- Social lockdown is the only preventive measure exist against Coronavirus (CoV-19).
- Lockdown found to reduce water and air pollution including CO<sub>2</sub> and NO<sub>2</sub> emissions.
- Temperature has negative correlation with growth and propagation of CoV-19.
- Use of mask and alcoholic based standard sterilisers are recommended.
- Mutation in CoV-19 seems a natural selection by nature to self-nurture.

## GRAPHICAL ABSTRACT



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## ABSTRACT

Coronavirus Disease (COVID-19) has become the largest pandemic that has affected 210 countries. Rolling data indicate that 257,3605 people are infected by the disease, from which 701,838 have recovered and 178,562 have died. No specific medicine or vaccine is available yet to control the disease, hence, social distancing via lockdown is widely adopted as the only preventive measure. Social distancing is observed at different level of strictness in different counties but it almost made the world to stands still. Although scientific articles on this largest social move are scanty, it resulted in benefiting the deteriorated environment to revive back. Many environmental indices such as lowering NO<sub>2</sub> and CO<sub>2</sub> emissions and reduction in particulate matters in air as a result of less human activities have led to clean air and pollution free water in many countries. Undoubtedly, the world was experiencing pollution in several countries due to mainly human activities including urbanization, industrialization, fossil fuel exhaustion etc. Under such situation a special (natural) a protective measure was awaited to fix environmental issues. Probably, the lockdown is one of the natural effects expected by nature via introduction of COVID-19. It is because, introduction of COVID-19 to nature was an outcome of mutation from two of its pre-existing forms, although, debate on it is still continuing. Viability of CoV-19 virus found to have a lot of correlation with aquatic and terrestrial environmental parameters such as pH, surface type, temperature etc. Air pollution is found to increase the risk of COVID-19 infection, therefore, use of mask and alcohols based standard

**Abbreviation:** ACE2, Angiotensin-Converting Enzyme 2 (ACE2); AQI, air quality index; PM, particulate matter; BBC, British Broadcasting Corporation; CO<sub>2</sub>, Carbon dioxide; NO<sub>2</sub>, Nitrogen oxide; CDC, Centres for Disease Control and Prevention; CoV, Coronavirus; COVID-19, Coronavirus diseases-19; CREA, Centre for Research on Energy and Clean Air; ESA, European Space Agency; FDA, Food and Drug Administration; HIV, Human Immune Deficiency Virus; MERS, Middle East respiratory syndrome; NASA, The National Aeronautics and Space Administration; NIH, National Institutes of Health; SARS, Severe Acute Respiratory Syndrome; SARS-CoV-2, Severe Acute Respiratory Syndrome Coronavirus 2; PM<sub>2.5</sub> and PM<sub>10</sub>, particulate matter with fine and coarse particles with a diameter between 2.5 and 10 µm, respectively.

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sterilisers is strongly recommended. However, the self-revival rate of nature shall continue during post-lockdown period and a master plan must be adapted by national and international (mostly political) bodies to revive the Mother Nature completely.

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## Contents

1. Introduction . . . . .	2
2. Controversy on the origin of COVID-19 versus natural selection . . . . .	3
3. Nitrogen dioxide (NO <sub>2</sub> ) level . . . . .	4
3.1. NO <sub>2</sub> emissions in Italy and China . . . . .	4
3.2. NO <sub>2</sub> emissions in India . . . . .	4
4. CO <sub>2</sub> emission . . . . .	4
5. Global impact of COVID-19 in terms of ecology; nature bounce back . . . . .	6
6. Wildlife and biodiversity . . . . .	6
7. Lockdown and the noise free environment. . . . .	6
8. Environmental factors verses COVID-19 . . . . .	7
9. Cleaner air, better visibility . . . . .	7
10. Are the environmental changes during COVID-19 period everlasting? . . . . .	8
11. The other side of COVID-19: food security to wild life . . . . .	8
12. Conclusion . . . . .	9
Authors contribution . . . . .	9
Funding . . . . .	9
Acknowledgements . . . . .	9
Appendix A. Supplementary data. . . . .	9
References. . . . .	9

## 1. Introduction

The Coronavirus Disease (COVID-19) is caused by a new strain of the pre-existing Coronaviruses called as CoV-19. The disease has been spread to 210 countries so far, therefore, made it the largest pandemic in world (CDC, 2020; FDA, 2020; WHO, 2020a). The infectious disease is caused by the seventh new strain of the CoV and experimentally it is proved that its genome has 50–80% sequence similarity as compared to the CoV that had caused Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). Due to the mutated form of the present CoV, exact medicines are not available for its treatment (Ashour et al., 2020; FDA, 2020; Jin et al., 2020). Patients suffering from this disease usually exhibit symptoms of dry cough, fever, tiredness and difficulties in breathing. The virus enters into the nasal passage of a healthy person from the infected person or from an object that carries the virus on it. Immunologically, the virus interacts with the ACE2- Angiotensin-Converting Enzyme 2 (ACE2) receptor of the host cell and diffuses its genome using its “S” protein. The virus gradually infects the upper respiratory tract, lower respiratory tract and then finally, reaches at the gas exchanging part i.e. alveoli of lungs. When the virus reaches the alveoli, it makes huge fibrosis, making the alveolar part unable to exchange CO<sub>2</sub> and O<sub>2</sub>. It leads to respiratory choke and finally, death of the patient. Many infected people also exhibit mild symptoms of the disease and are diagnosed with common cold associated symptoms while, some infected persons also remained as asymptomatic case i.e. they do not exhibit any clinical symptom. However, all categories of above infected people can infect healthy people.

Respiratory choke occurs in severely infected person and severity of patients is found to be dependent on their natural immunity. So, mild and asymptomatic people are usually found with strong natural immunity. Consequently, the morbidity rate by the disease is found to be very high in elderly patients, and also in patients with co-morbidities such as, cancer, asthma, diabetes, high blood pressure, and cardiac diseases because, their natural immunity is found to be compromised (Arabi et al., 2019; Ashour et al., 2020; Dong et al., 2020; WHO, 2020a; Zhou

et al., 2020). The virus CoV-19 usually propagates and induces the clinical symptoms in infected people within 14 days (Li et al., 2020a, 2020b; Huang et al., 2020). Earlier similar two forms of fatal COVID-19 were seen, and they were SARS, that was epidemic in China in 2003, and MERS, that was epidemic in Saudi Arabia in 2012 (She et al., 2020; Shereen et al., 2020). Few existing anti-bacterial, anti-malarial and ant-HIV medicines such as Hydroxychloroquine and azithromycin, lopinavir; ritonavir (remdesivir (GS-5734), tocilizumab, corticosteroids, certain nucleotide as inhibitors, COVID-19 protease inhibitors are re-proposed for the treatment of COVID-19 (Gautret et al., 2020; Smith et al., 2020; Swain et al., 2020) without much clinical experiences. Since no specific medicine or vaccine is available to control the disease, social lockdown is considered as the only preventive measure to control COVID-19 (Das and Paital, 2020; Paital et al., 2020).

Social lockdown is imposed on people to allow them to leave their home as infrequently as possible to shop for basic necessities such as food, to exercise each day, to collect medication or care for a vulnerable person, and to travel to and from work, but only if this is absolutely necessary and cannot be done from home (Das and Paital, 2020; Paital et al., 2020). Social lockdown is a direction for restriction of inter-individual physical interaction in order to avoid the person and outer environment. It is slightly different from curfew because under this condition, minimal emergency public movement is allowed. Emergency service providers such as people form medical care, food security; general security and medicine supply chain are usually allowed during social lockdown. However, under a strict social lockdown for few hours or days, few emergency services such as food and medical supply chain can also be closed. It clearly indicates that mass or community movement and interaction are not allowed during the lockdown periods. Strict regulatory mode is focused to forbid two people from different family or nearby inhabitants to come in close contact with each other during lockdown.

COVID-19 is a transmissible disease that mainly infects the healthy subjects when the person comes in (close) contact with the infected person(s). External or internal body fluid such as cough, sneeze, saliva

etc. from the infected patients can infect a healthy person. CoV-19 also can be communicated to a healthy person through any object(s) that carries the virus. Therefore, social lockdown is highly helpful to act as the only preventive measure to tackle CoV-19 infection. It therefore leads to a better consequence by 1) preventing huge load on healthcare system (by high infection rate) at a certain time point, 2) restricting mass/community infection, 3) providing better health care to the infected persons with limited health care resources. Also, it would provide more time to the researchers to work on the virus for production of specific medicine or vaccines against COVID-19. Owing to such importance of social lockdown, many nations started following it at different time points of the COVID-19 infection to their citizens with different level and strictness. As a result of social lockdowns, the entire world is found to stand still. On the other hand, due to casual follow up of this social move and many other reasons such as low immunity, ageing, co-morbidities, the disease has infected 2,573,605 people so far, out of which 701,838 individuals have recovered and 178,562 have lost their lives (CDC, 2020; WHO, 2020a). Analysis indicates that although the economy is drastically affected in the entire world by loss of human lives and fall in global stock market. Many a time, a pandemic or endemic is created by the dominant activities of human on the planet due to ecological disturbances. Therefore, few also opine that it is not a greatest concern as compared to all gain in environmental stability under COVID-19 pandemic because everything misbalances is manmade and they have to suffer. This was the theme once written in the “shock doctrine” of disaster capitalism, outlined by the author and activist Naomi Klein. In her book, the Canadian writer describes, how powerful global elite exploits national crises to push through unpopular and extreme measures on the environment and labour rights (Klein, 2007). As per her prediction, one day human has to pay the price for it and probably, the day has come now (Paital et al., 2020).

In relation to the above context, Mother Nature usually follows a natural transformation process to give checkmates to many of the environmental extremities in order to save the planet. Many species become extinct and many have occupied the world following such climatic events. It leads to stabilize the world as a unitary ecosystem. In this context, pollution and unhygienic level in many ecosystems under dominant activities of human (including urbanization, fossil fuel exhaustion, industrialization and discharges of its effluents to water bodies) are beyond the limit. For example, UK toxic air was claimed to place 1.24 million lives at risk in 2017 (Lancet Planetary Health, 2017, Figs. 1–3). Similarly, water pollution has been found to create tragedy in many water bodies including oceans (Paital et al., 2018, 2019). Under such conditions, probably Mother Nature was waiting for a break to revive her individual ecosystems. It seems that social lockdown to combat COVID-19 has given a much awaited break to her for self-regeneration. Humans are locked indoor and their dominant activities are stopped, as a result, important environmental indices such as the reduced  $\text{NO}_2$ ,  $\text{CO}_2$  emissions, water pollution, and increasing air quality in many polluted cities have been observed (Paital et al., 2020). How COVID-19 induced social lockdown has helped nature to nurture was the central focus of this review and emphasis was also given how long nature can able to maintain it. A light discussion was also made on whether the introduction of COVID-19 was natural plan by the Mother Nature to self-revive? All authentic news sources such as Reuters, BBC news, Times, Hindustan India, India Today, WHO etc. along with scientific literature were carefully analysed to reply above questions positively.

## 2. Controversy on the origin of COVID-19 versus natural selection

A brief discussion about the gradual introduction of COVID-19 from Wuhan city China to 210 countries of the world creating the pandemic by CoV-19 and its prevention by social lockdown is made recently (Paital et al., 2020). In this context, four aspects are now under high consideration from different angles so far. They are, 1) prevention of COVID-19),

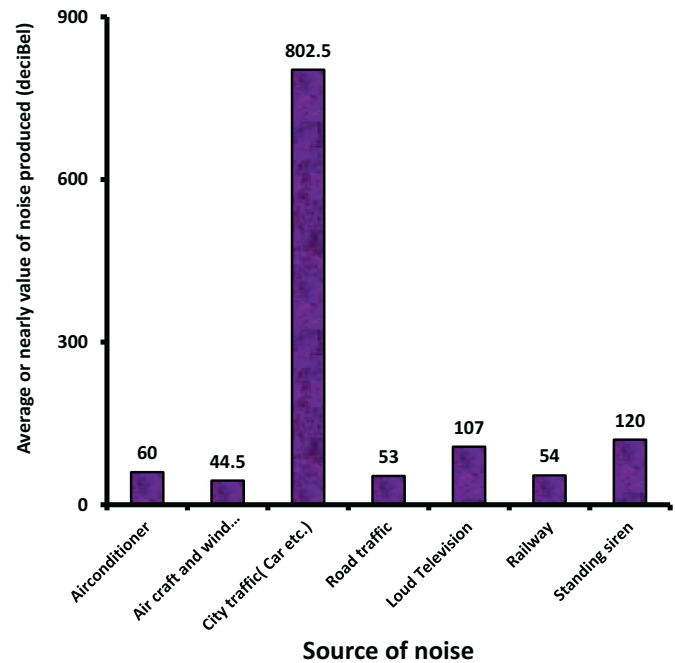


Fig. 1. Noise pollution produced from different sources.

2) its treatment, 3) impact of COVID-19 on the environment and vice versa and finally, 4) the controversial debate on the origin of CoV-19, whether it is a natural mutant or bio-engineered in laboratory to be used as bioweapon.

Development of a vaccine takes usually 12–18 months due to different phases of its trial. However, many claim for an early discovery of a vaccine against CoV-19. Still the world is eagerly waiting for a vaccine against COVID-19 and hopefully, it will be available soon (Ahn et al., 2020). To come up with specific drugs or vaccines, several research institutions are working 24/7 although, conventional or alternative medicines using both wet and dry laboratory approaches are suggested for the treatment of COVID-19 (Hati et al., 2012a, 2012b; Paital et al., 2014, 2017, Cao et al., n.d; Chu et al., 2004, Chafekar and Fielding, 2018; Mishra et al., 2019; Caly et al., 2020; Dong et al., 2020; Jin et al., 2020; Huang et al., 2020; Raja et al., 2020; Swain et al., 2020;

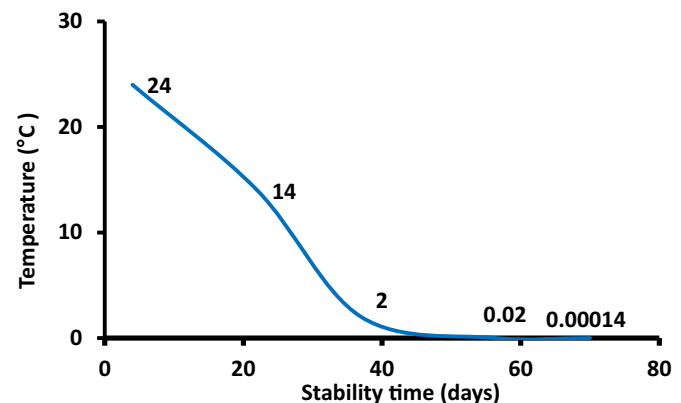


Fig. 2. Effects of temperature on the stability of Coronavirus-ID19. A negative effect was observed for the stability of CoV-19 virus against rise in temperature. Therefore, countries such as India, having hot and humid climate, might be getting its advantage to have low infection and death rate as compared to other cold climate countries. Social lockdown and immunity also could be counting factors for the Indians (Source Chin et al., 2020).

Vellingiri et al., 2020; Zhou et al., 2020). High throughput in silico screening is also suggested to find a suitable inhibitors against the viral proteins, like it has been found for other enzymes (Paital and Chainy, 2013; Paital et al., 2011, 2013, 2015a, 2015b; Swain et al., 2020). However, it is noticed that many existing remedies such as the anti-malarial drugs Chloroquine (Yao et al., 2020a, 2020b) and Hydroxychloroquine (Science News, 2020), anti-HIV drugs Lopinavir and Ritonavir, (Cao et al., n.d, Smith et al., 2020), nucleoside analogue Remdesivir (Brown et al., 2019; Ko et al., 2020; Wang et al., 2020; Wit et al., 2020), macrolides such as Azithromycin (Smith et al., 2020), monoclonal antibody namely Tocilizumab (Xu et al., 2020) and corticosteroid or infected blood plasma therapy are re-purposed to combat COVID-19 (Smith et al., 2020). Many are now concentrating on the plasma therapy against COVID-19, as the sources of getting infected plasma from the blood of the recovered patients from COVID-19 are plenty (ET PTI, 2020). And, it is one of the promising options for the treatment of COVID-19, as the first trial on it is found to be successful in India (Choudhary, 2020).

On the other hand, the debate on the origin of the virus is now slowly catching pace among many experts. Genetic sequence analysis of CoV-19 indicates that it has 50% and 79% similarities with MERS-CoV and SARS-CoV, respectively. So, experimental results disprove so far that CoV-19 is not engineered in laboratory rather it is a natural mutated strains from its above two pre-existing forms (Andersen et al., 2020; Guo et al., 2020; Science News, 2020; Scripps Research Institute, 2020; Shereen et al., 2020). However, the Nobel laureate Professor Montagnier, who had shared the 2008 Nobel Prize in Medicine (for his work on the identification of AIDS virus) with his colleague professor Françoise Barre-Sinoussi, claimed that *"The presence of elements of HIV in the genome of the coronavirus and even elements of the "germ of malaria" are highly suspect, the Wuhan city laboratory has specialized in these coronaviruses since the early 2000s. They have expertise in this area and therefore the theory that Covid-19 virus originated in the lab is making rounds for quite some time"* (DT NEXT, 2020). Similar stories are online that, Japan's Nobel Prize winning Professor of Medicine, Professor Dr. Tasuku Honjo has claimed that the Coronavirus is not natural but has been manufactured, although the statement is found to be fabricated (Guniganti, 2020). Conversely, if experimental results are to be believed, then it can be concluded that nature has introduced CoV-19 (Andersen et al., 2020; Guo et al., 2019; Science News, 2020; Scripps Research Institute, 2020). However, the question remained unsolved that for what purpose the Mother Nature has introduced it? It is a million dollar question, although, experts opines it as "just a natural evolutionary event" that the novel CoV-19 was emerged from two of its pre-existing form using bat as its host. On the other hand, the planet had witnessed many natural catastrophic events to make a pause or control over the misbalanced ecosystem or an overpopulation of a particular species. The extinction of dinosaurs is considered as one of such bright examples (Kumar, 2018; Brusatte et al., 2015; Donihue et al., 2018). It seems much philosophical but makes a valid discussion that nature wanted to self-regenerate with zero contribution of human being or keeping then indoor self-locked. And, it has been happening via introduction of CoV-19 followed by the imposed social lockdown. Study must be focused to answer this evolutionary question in order to teach human society to follow such lockdown voluntarily in order to allow for the self-regeneration of nature. This may be referred as natural selection by nature, for nature to self-regenerate. It is witnessed in Qatar, where, people have demanded COVID-19 like lockdown to resuscitate their deteriorated environment (Bir, 2020). The above point seems valid when climatic changes have been observed in several metro-cities in the planet. Although, articles on environmental impacts by COVID-19 outbreak indirectly are scanty as on 25.04.2020, many sources claim that nature is on bounce-back mode under the COVID-19 induced worldwide lockdown. This aspect is discussed in next parts of this article considering changes in different environmental indices in various cities during lockdown.

### 3. Nitrogen dioxide (NO<sub>2</sub>) level

Social lockdowns in many countries have some surprising side effects as evidenced by the reduced Nitrogen dioxide (NO<sub>2</sub>) emissions (Fig. 3). Nitrogen dioxide emissions are one of the major air pollutants emitted from industrial and vehicular operation. As both the above operations have come to a substantial halt for >100 days in many counties during this pandemic, NO<sub>2</sub> emissions are diminished, as visible from space. As per the image issued by The Centre for Research on Energy and Clean Air (CREA), from the satellite footage from NASA and also the European Space Agency (ESA), a radical drop in NO<sub>2</sub> emissions over recent months is indicated, particularly across Italy, China and also in India (Supplementary Fig. 1, Dahiya, 2020).

#### 3.1. NO<sub>2</sub> emissions in Italy and China

Due to the decrease in consumption of diesel, petrol and other petroleum combustions in USA, Italy and China, particularly in Wuhan city of China, NO<sub>2</sub> emission is magnificently reduced. A 10-day stirring average animation (from January 1st March 11th 2020) of NO<sub>2</sub> emissions across Europe has clearly demonstrates the drop of NO<sub>2</sub> emissions and its impact on the environment. As per the ESA, that's not all: a drop in boat traffic also means that Venice's canals of Italy are clear for the time being, as small fish have begun inhabiting the waterways again. Although, experts are cautious to note that this does not necessarily mean the water quality is better but the transparency is increased for sure.

The rate of NO<sub>2</sub> emissions in China is more noticeable. China is the world's greatest central manufacturing centre and acts as a substantial contributor to greenhouse gases in the entire world. However, in the month following the Lunar New Year (a week-long festival in observed in early February in China), satellite images have put forth a different story. Under COVID-19 infection, factories were shut down leading to the reduced NO<sub>2</sub> emission is observed in many cities of China. As a result, pollution is decreased and air quality is substantially increased. Images from NASA Earth Observatory indicate that NO<sub>2</sub> emission everywhere in the Hubei province, the original epicentre of the virus, was sharply dropped as factories were forced to shutter their doors for the time being (Supplementary Fig. 2). At the same time, use of coal fuel was also drastically dropped in Chia (Supplementary Fig. 3, McKay et al., 2020).

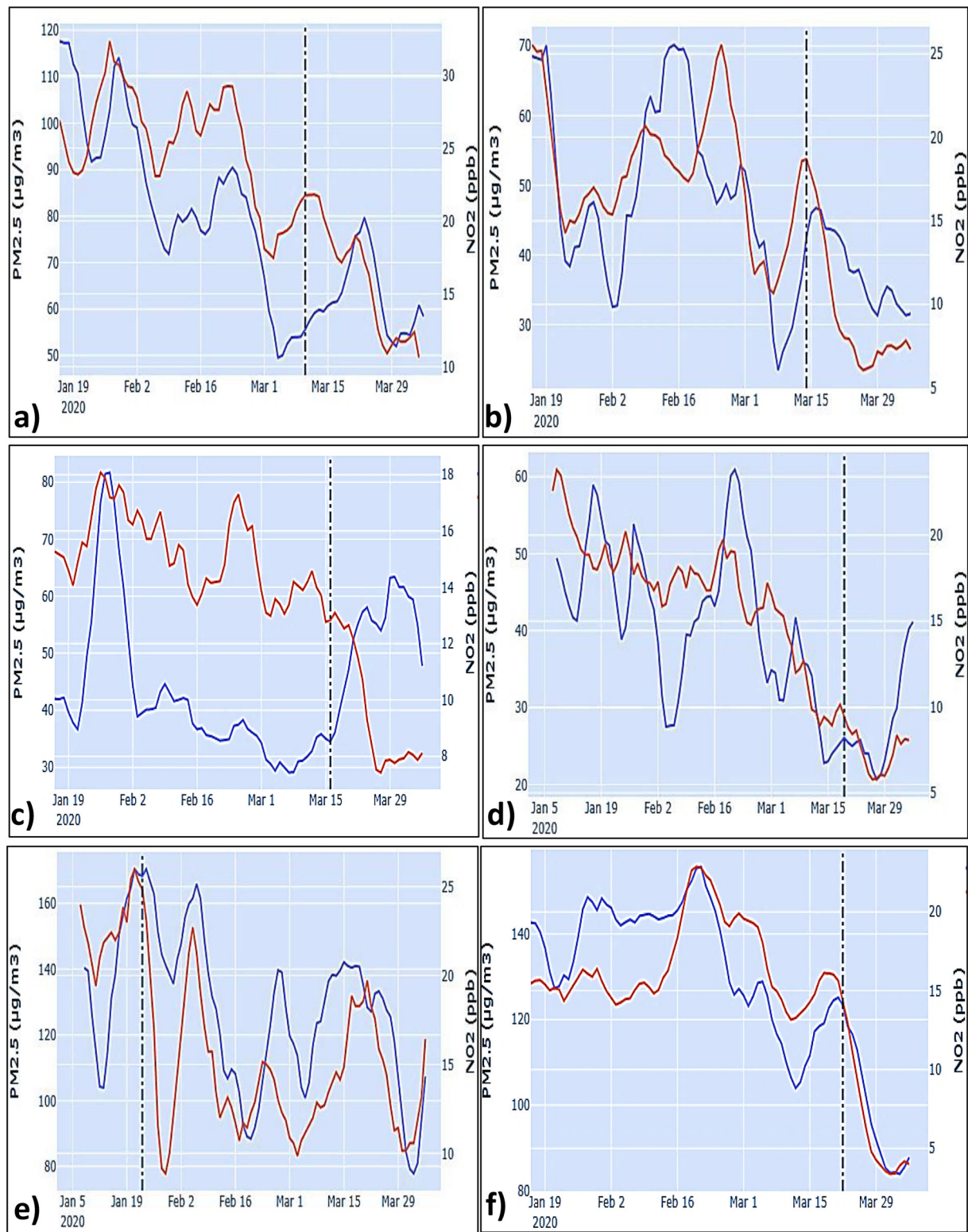
#### 3.2. NO<sub>2</sub> emissions in India

As a result of lockdown and in some places complete shutdown in India (where the disease hit to make it hotspots), air pollution is seen to be prevented to rise rather it is deceased to multi-folds. The reason was attributed to the reduction in emissions from fossil fuels from different sectors mainly industry and vehicular operation on road. The average NO<sub>2</sub> level in major cities such as Mumbai, Pune and Ahmedabad is reduced at east by 40–50% by March 2020 than March 2019 (Wright, 2020). The sky of New Delhi is clearly visible than four months ago. People are now feeling safe to breathe pollution free air. Hilariously, it has also been posted that unlike before, Burj Khalifa, Eiffel Tower is now can be seen from Noida city, New Delhi, which was not visible due to huge pollution (Kohli, 2020). However, effects lockdown on the reduction of pollution in New Delhi is seen to be accurate.

### 4. CO<sub>2</sub> emission

Under mild or severe lockdown in COVID19 affected 210 countries, motorways are cleared and factories are also closed. It is resulted the dirty brown pollution belts to shrink over multiple cities and industrial areas in country that follow lockdown. The gradual lockdown imposed in countries such as China, then Italy, UK, Germany and dozens of other countries are experiencing temporary falls in CO<sub>2</sub> and NO<sub>2</sub>





**Fig. 3.** COVID-19 induced social lockdown versus pollution in several nations (source [Bhattacharyya, 2020](#)). NO<sub>2</sub> level (red lines) and atmospheric particulate matter (PM<sub>2.5</sub>, blue lines) in a) Italy, b) Spain, c) France, d) Los Angeles, USA, e) Wuhan city, f) China and g) India as a function of lockdowns.

emissions of as much as >40%. As a consequence, it is improving air quality magnificently and the risk of respiratory diseases such as asthma, bronchitis, other lung diseases are found to be reduced substantially along with alleviated heart attacks risk ([Watts, 2020](#)). In China, responsible for the world's biggest carbon emissions, is noted to experience a temporary fall of ~18% CO<sub>2</sub> emissions during February

and March 2020. Around a reduction of 250 m tonnes of carbon sources are used in China which is equivalent to > half annual output values in the entire UK. Similarly, Europe is predicted to experience a reduction of around 390 m tonnes of carbon sources as a result of lockdown. In USA, the main source of CO<sub>2</sub> emissions is passenger vehicle traffic. It is magnificently reduced to ~40%. A reduction of ~44% car sells and huge

reduction in fossil fuel consumption in London add a glimpse note to the reduction of emission factor. Since consumption of fossil fuel is the main source of CO<sub>2</sub> emissions in industrial sectors and by vehicular traffic, both were shut down contributing to the observed changes. Rob Jackson, the chair of Global Carbon Project opines that *"The drop in emissions is global and unprecedented. Air pollution has plunged in most areas. The virus provides a glimpse of just how quickly we could clean our air with renewables"*. He also added *"I refuse to celebrate a drop in emissions driven by tens of millions of people losing their jobs because the human cost is too high and the environmental gains could prove temporary. So, we need systemic change in our energy infrastructure, or emissions will roar back later"* (Jackson, 2020). This is potentially good news for the weather as oil is the principal source of the carbon emissions that are heating the earth and upsetting weather cycles. It is believed that it could mark the start of a prolonged downward trend in emissions and the beginning of the end for huge fossil oils. However, such changes in CO<sub>2</sub> emissions are expected to bounce back after lockdown is lifted but Mother Nature has experienced the first fall in global emissions since the last 12 years (Watts, 2020).

## 5. Global impact of COVID-19 in terms of ecology; nature bounce back

Nature and its natural resources are over exploited by human for whom regular international and national meetings are held in our planet albeit expected results at the field level are always not satisfactory. The world has witnessed many such intra and inter-nation gatherings without any substantial results to save the environment. However, COVID-19 induced lockdown, push one third of human population into indoor and human being is practically doing nothing to save the environment but busy how to get rid from the virus that has caused pandemic. Probably, the Mother Nature is trying to bounce back when human is doing nothing for it, and that is the greatest contribution of human race ever towards nature (human has been doing a great job to revive nature by doing nothing). The world as an ecosystem belongs to every organism but was dominated by human, and, taking the advantage of their absence, wild animals are found moving across the roads, cities, and other human habitation. People are observing spontaneous changes in nature witnessing its self-revival. Air Quality Index (AQI) is a pretty robust metric which reflects to be changing in favour of the Mother Nature. Therefore, COVID-19, a naturally mutated strain introduced by nature via bat to human population (Andersen et al., 2020; Science News, 2020) may be a strategic plan by nature, which is focused in this article.

## 6. Wildlife and biodiversity

COVID-19 quarantine has locked humans at their home; it gives wild life a never seen freedom to leave an earmarked live. It is explored that in human-dominated areas or 'rewilding' urban areas, free movements of wildlife are observed. Wildlife Institute of India, issued a real time data using an app "Lockdown Wildlife Tracker" to share comfortable wildlife movement in human restricted zones. This free app makes it convenient to keep track on wildlife movements (captured and shared by any one in world) due to lockdown, and all data in the app will be stored and will be openly available for scientific research, education, and conservation (Wild Life Institute of India, 2020). Few of the facts that indicate use of human dominated zones by wildlife are, spotting coyotes (that normally timid of traffic) on the Golden Gate Bridge in San Francisco, USA, deer are grazing near Washington homes a few miles from the White House, wild boar are becoming bolder in Barcelona and Bergamo, Italy, peacocks have strutted through Bangor and goats through Llandudno and sheep in Wales (Loring, 2020, Supplementary Fig. 4). Number of trucks and cars are expected to be very less this year that predicted to lower the toll for road kills. For example, the annual hit and run cases of about 100,000 hedgehogs, 30,000 deer,

50,000 badgers and 100,000 foxes alone in UK are highly predicted to be lower down (Newburger and Jeffery, 2020) and, that will give protection to them.

In the short-term of lockdowns as compared to million years human dominant behaviour in the planet although resulted in dangerous to downturn in economic activity, it is considered as a benefit to fauna and flora of nature. Such temporary social move by human potentially demands the reduced call for the exploitation of many natural resources (Swain et al., 2020) put fewer loads on natural habitats in one hand and allows self-regeneration of nature on the other hand. Therefore, a temporary "post-human" era continuing for wildlife that makes a sarcastic comeback to the idea that wild lives are living in Anthropocene, but without human domination to reshape the planet by them. So, in Anthropocene era, human dominancy declines, where nature is the beneficiary. However, in poorer countries in southern hemisphere are predicted to be in fear because of an increased threat to wildlife. Potential reasons attributed to the decreased economic capacity in pandemic areas of such countries will be less money, and personnel that will make difficult to conserve endangered species and habitats (Loring, 2020; Newburger and Jeffery, 2020).

In Barcelona, Spain, boars are found to roam the city and roads where, vehicles rush the position. In Santiago, the capital of Chile, wild puma, hill dwellers, are noticed in night time. Marcelo Giagnoni, the director of the agricultural and Livestock Service have opined that *"This is the habitat they once had and that we have taken away from them"* (Reuters news, 2020). In Northern America, Orcas have also seemingly been encouraged to explore by human's momentary lack of presence, with locals reporting spotting the majestic whales in parts of a Vancouver fjord for the first time in last few decades (Child, 2020). Small herds of beautiful insects are found to fly over flowers and plants in UK. Moles are crawling above ground near footpaths where, human walking dominates always. Locals of UK are observing the highest blooming of wild flowers they have ever noticed (Child, 2020). It indicates that how the world can re-generate her faster without human interference. Therefore, stricter rules need to be adapted in post-COVID-19 period to implement social lockdown at regular intervals to nurture the nature.

## 7. Lockdown and the noise free environment

According to the WHO, noise pollution affects >100 million people across Europe. Remarkable health issues that can be arrived under noise pollution include internal stress at cell and organ level, overall stress, weakened mental acuity, elevated blood pressure and heart rates. These issues act as precursor to initiate several other physiological disorders and diseases (Chainy et al., 2016; Paital et al., 2016a, 2016b). In extreme cases, noise pollution can also lead to dementia, stroke, and heart attack (European Union, 2015). All sources of noise pollution are due to human activities. Residential noise (i.e. neighbours), noise from commercial premises (markets), building site, burglar alarm, loud speakers, noise in the street (vehicular traffic) and noise in air (aircraft) are few main types (European Union, 2015). Surprisingly, road traffic accounts for premature deaths equivalent to the loss of roughly "1.6 million healthy years of life" in Western Europe alone. Noise remains a big source of pollution for the other inhabitants of the planet as well, namely, animals and most importantly bird, the most noticeable and vocal animals observed everywhere (Simonsen, 2020). Chronic traffic noises are hazardous to birds and impose huge negative effect on their embryo mortality and growth in zebra finches. Noise pollution affects many other creatures ranging from frogs, to shrimp, to fish, mammals, mussels and snakes and they have different ranges of sensitivity to noise (Schuster, 2020, Table 1). And, most of the sources of noise such as air conditioner, air craft and wind turbine, city traffic (Car etc.), road traffic, loud television, railway, standing siren are found to be above the sensitivity level (Fig. 1). International flights are almost standing still due to lockdowns (Supplementary Fig. 5). So, most of the noise in every sector is created by human activities are

**Table 1**

Sensitivity and hearing level of different animals to noise pollution.  
(Source <http://fhwa.gov>).

Animals	Lowest	Highest	Sensitive
Mammals	<10 Hz	159 KHz	0 to 20 dB
Birds	100 Hz	8 to 10 KHz	0 to 10 dB
Fish	200 Hz	0.8 KHz	50 to 70 dB
Reptiles	50 Hz	2 KHz	40 to 45 dB
Amphibians	100 Hz	2 KHz	10 to 60 dB

Hz- hertz-, KHz- kilo hertz, dB-decibel. Both the lowest and the highest hearing range was found to be by mammals.

stopped for the time being. Last month, road and air traffic fell substantially in many counties. In Indian major cities such as New Delhi, Mumbai, Bengaluru and Chennai, the foot print (as measured by daily average changeover of foot prints (%)) in terms of walk-ins from home to bank, groceries, petrol pumps, and diagnostic centres) to the respective sectors are reduced during lockdown (Paital et al., 2020; Livemint, 2020). Similarly, the foot print has been drastically reduced in the UK by >70% when the Beatles were in shorts as compared to before lockdown. With less human movement, the planet has literally calmed: seismologists report lower vibrations from “cultural noise” than before the pandemic (Watts, 2020). Nevertheless, it a good sign for self-regeneration of nature.

## 8. Environmental factors verses COVID-19

Health of environment is an important factor to maintain human health also (Chainy et al., 2016; Paital, 2016b, 2016a, 2016c; Paital et al., 2016). Due to COVID-19 outbreak, many climatic data gaps have been arriving across the world. Climatic data collected on regular mode for the protection of mankind have caught a pause and the gaps prevailed during lockdowns are not going to be filled any more in future. For examples, twice per year, Ed Dever's group at Oregon State University in Corvallis heads out to sea off the Oregon and Washington coasts to refurbish and clean >100 delicate sensors that make up one segment of a US\$44-million-per-year. The Scientific network called it as the Ocean Observatories Initiative. As per Ed Dever “*If this had been a normal year, I would have been at sea right now*” (Vigione, 2020). On the other hand, due to lockdowns and industrial shutdowns as an effects imposed by COVID-19, pollution in city air and water bodies is receiving a down mode due to lack of massive use of fossil fuels and discharge of industrial effluents (Verkooijen, 2020; Levy, 2020). Two major factors i.e. CO<sub>2</sub> and NO<sub>2</sub> emissions are already discussed and examples of many sparkling water in rivers and canals of several countries are cited. However, one important aspects i.e. effects of environment on the propagation and infection of Coronavirus is yet to be studied. As discussed, temperature may have negative effects on the life cycle of the virus for which countries such as India with the 2nd highest population status is getting a delayed infection and death under COVID-19. Although a strict social lockdown is given credit for this achievement, the hot and humid climates could also be a reason in India for having a lower rate of infection (Paital et al., 2020). Debate was rigorous on the topic, whether the virus is really unstable at high temperature? However, putting an end to this hypothesis, a study published in Lancet indicates that CoV-19 has a negative correlation with temperature (Fig. 2, Chin et al., 2020). As per their statement “*SARS-CoV-2 in virus transport medium (final concentration ~6.8 log unit of 50% tissue culture infectious dose [TCID50] per mL) was incubated for up to 14 days and then tested for its infectivity (appendix p 1). The virus is highly stable at 4°C, but sensitive to heat. At 4°C, there was only around a 0.7 log-unit reduction of infectious titre on day 14. With the incubation temperature increased to 70°C, the time for virus inactivation was reduced to 5 mins*” (Chin et al., 2020). Further the authors have noticed that the virus has more stability on the smooth surfaces than rough one. The

virus lost its virulent capacity within 2 days on cloth and wood surfaces. Similarly, the virus can sustain on glass and banknote surfaces for 4 days and on stainless stills and plastics for 7 days. On the surface of the surgical mask, the virus can sustain up to 7 days. At room temperature (22 °C), the virus can sustain for 5 min and it can resist a wide range of pH starting from 3 to 10. Therefore, it is concluded that the virus can sustain longer in favourable conditions but are susceptible for standard disinfectants (Chin et al., 2020). So, the virus has different susceptibility to environment especially to temperature but normal alcoholic based disinfectants must be used to sterilise hands (Paital et al., 2020).

On the other hand, a positive correlation is noticed between COVID-19 infection and morbidity and air pollution. Case studies in many countries including Italy, USA, Philippines, Denmark, Chile, Brazil, Mexico and Peru have confirmed this fact. A case study in US indicates that COVID-19 associated death rates are raised by about 15% in areas where even a small increase in fine-particle pollution level is observed than pre-COVID-19 period. The Lombardy and Emilia Romagna regions of northern Italy that experience more air pollution, found to have 12 and 4.5% more death rates, respectively, as compared to other unpolluted areas of the country. And, since COVID-19 is principally a respiratory syndrome, polluted air can logically increase the risk of death of infected patients. In this context, it is noteworthy to mention that >90% of the world's population live in places, mostly in poor countries where, air pollution exceeds its guideline limits. It could lead to hypothesise that severity of the COVID-19 infection may be augmented by particulate matter present in air (Tables 2, 3, WHO, 2020b, 2020c). In one hand, the particulate particle may carry the virus itself or it may create more complication in the respiratory track of patients during CoV-19 infection. Therefore, using mask even inside home in severely air polluted area is strongly recommended.

## 9. Cleaner air, better visibility

Air quality and exposure to it is equally important as water to combat any stress (Paital, 2013, 2014). The COVID-19 has taken millions of people off the streets in Asia, Europe and the United States. All staying home are lifting the weight indirectly for a global environment what they even not imagined while working actively. Therefore, from cleaner air to sparkling water, lockdowns against coronavirus in the planet seem to have a number of positive and progressive effects on the environment but by putting a pause on modern social life of human (Child, 2020; Khadka, 2020). Cleaner air is perhaps the most valuable outcome

**Table 2**

Particulate matter in USA and its trend from data collected from 412 trend sites.  
(Source EPA, 2020).

Year	Mean	10th percentile	90th percentile
2000	13.48	8.75	17.85
2001	13.21	8.75	17.16
2002	12.81	8.64	16.34
2003	12.37	7.93	16.18
2004	12.01	7.83	15.46
2005	12.86	7.84	16.80
2006	11.61	7.76	14.94
2007	11.92	7.50	15.40
2008	10.88	7.40	13.67
2009	9.85	6.93	12.26
2010	9.95	6.69	13.15
2011	9.79	6.75	12.27
2012	9.15	6.65	11.27
2013	8.94	6.42	11.24
2014	8.82	6.11	11.11
2015	8.50	6.03	10.68
2016	7.71	5.60	09.55
2017	8.01	5.82	09.77
2018	8.16	6.01	10.47

Data are converted into either change in 10th or 90th percentile from the original values.



**Table 3**  
Average values of particulate matter found in some of the countries.  
(Source EPA, 2020).

Country	Average values	PM2.5	PM10
Australia	DAV	50	25
	ANV	25	8
Canada	DAV	150	75
	ANV	70	35
European Union	DAV	50	DNA
	ANV	40	25
Hong Kong	DAV	100	75
	ANV	50	35
Japan	DAV	100	35
	ANV	DNA	15
South Korea	DAV	100	35
	ANV	50	15
Taiwan	DAV	125	35
	ANV	65	15
USA	DAV	150	35
	ANV	DNA	12

Average fine PM<sub>2.5</sub> (particle size 2.5 µm) and course PM<sub>10</sub> (particle size 10 µm) found in some of the countries during pre-COVID-19 time period. After lockdown the data may be available about post)COVID-19 time period to be compared. DAV-Daily Average Value, ANV- Annual Average Value, DNA-Data Not Available.

of the lockdowns, for example, people in Northern India are now able to view of the overall image of Himalayan mountain range (Supplementary Fig. 6a). And, it has happened once in their life time due to massive drop of air pollution and settling down of air particulate matters. This was also the case in UK where, the reduction of NO<sub>2</sub> and particulate material in air has been dropped as compared to the same time point of previous year (Child, 2020). USA and other countries are also experiencing the same trend from their normal level of (PM2.5 and PM10) particulate matter (Tables 2 and 3, EPA, 2017, 2020, WHO, 2020a, 2020b). NASA, the European Space Agency (via Copernicus Sentinel-5P satellite) has clearly demonstrated a drastic decline in NO<sub>2</sub> and CO<sub>2</sub> emission in many countries including China, USA, and Italy (Zehner, 2020). It is the effects of less vehicular traffic and industrial exhaustion of fossil fuel including coal (Supplementary Figs. 1–3).

Due to pause in industrial effluent discharge into the canals of the famed canal city of Venice, Italy, its water found to glitter in March 2020. And, it was bit stinky previously but is currently visible with schooling of fish in its water along with swans hanging around enjoying the unusual urban peace and quiet. The alteration in clarity of water transparency has given a never seen offer to the locals to have a clear view of schooling of small fishes, crabs and lashing multi-coloured plants in the Lagoon of Venice. Due to uninterrupted boating and pollution, this was never possible earlier in last decades (Mack, 2020). As per the locals, “nature has returned and is taking back possession of the city” (Child, 2020). Shutdowns are likely to impact the amount of carbon in the atmosphere as well. Due to radical reduction of CO<sub>2</sub> (~25%) and NO<sub>2</sub> emissions and reductions in coal and crude oil burning in China, the country has been experiencing cleaner air. Last year at the same time, it was about 100 metric tons of CO<sub>2</sub> emission that contributed 6% of global emissions. In New Delhi, India, some of the river water bodies are found to exhibit never seen glittering scenery. The Yamuna river and its sky in New Delhi can be considered as an active example, in which, people have not ever observed the before seen sparkling Yamuna river water and the blue sky canopy over it (Paital et al., 2020). It may be due to the shutdown of industries in New Delhi and lack of release of their effluents into it (Gandhiok, 2020, Supplementary Fig. 6b). These are believed to be the results of dramatic effects of social lockdowns imposed by the COVID-19 outbreak. The question remained to be answered that whether it is a natural selection process by CoV-19 mediated nurturing to the nature? (Child, 2020; Bhattacharyya, 2020).

# 10. Are the environmental changes during COVID-19 period everlasting?

The self-regenerating nature to nurture her-self is overwhelming across the planet earth. It is predicted that such nurturing to global environment would not be possible in the Cop26 UN climate talk that was planned originally to be held at Glasgow. So the public debate is still continuing by UN leaders, scientists and environmental activists for the (self?) recovery of green environment and clean energy. Emphasis is given for building efficiency to make natural infrastructure to reinforce global environments. Open letters appealing governments must be posted to make equal strategies for recovery packages to revive nature (which is now easy to handle) along with getting back to business economy. As opined by Inger Andersen, UN's environment chief, “75% of new infectious diseases are usually animal born and they are communicated more rapidly to humans through wildlife trafficking (by direct contact), deforestation (force wildlife to invade human habitats) and then the epidemics spread in the planet via air travel and cruise-ship tourism. China being the world's biggest wild animal market probably has contributed to COVID-19 this way.” Now it appears that the country has accepted this and therefore, forbidding the farming and consumption of live wildlife and its trading. Such alarming calls are also getting a pace globally to “wet markets”. On the other hand, it gives a strong message that over exploiting nature, ignoring to dismantle natural settings, neglecting deforestation etc. put our own safety on earth at threat and, COVID-19 outbreak is the active example to be considered. So, the current pandemic is good or bad for the environment completely depends on human but not on the CoV-19, because the later has been acting as effect not as cause. So, post COVID-19 outbreak time must be utilised to put pressure from all sectors of society especially from political sections not go back to unsustainable business as usual rather than to emerge with a healthier environment (Andersen, 2020).

In China the COVID-19 graph is found to be flattened and hence the government may decide to bounce back to its normalcy for social and economic activities and that would get to pick back up in April 2020. So, it is questionable how long the pollution level will under the threshold and whether NO<sub>2</sub> emissions will rebound right back to their pre-pandemic levels. This bounce-back effect that sometimes reverses any overall drop in emissions is called as “revenge pollution”. The scenario during post COVID-19 pandemic period could be same for all other nations that enjoying current auto-regeneration of environment. It is very unusual to expect the reduction of emission in this way of pandemic. COVID-19 has taken a grim global toll on lives, health services, jobs and mental health. But, if anything COVID-19 has paid back to human society is climate recovery. It is a lesson to human that it is possible to reverse the impaired nature with mutual agreement among community as they did it for social lockdown in many countries. With a strong will at the national or international level, it is possible to save nature from the current time point. “So why haven't we for climate? And not with words, with real action” (Henriques, 2020). And, it is to be noted that how governments prime the economic pumps with the intention of a return to business as usual keeping environmental gains to be temporary or reversed? On the other hand, Qatar is witnessed as the first country to demand such lockdown on regular basis at its landscape, as its people understood environmental issues such as increase in sea level, temperature, ocean acidification, intensity of sand storms induced serious risk as a result of pollution and their management by lockdown. They feel that many ecological issues that arrived due to human activities can be paused or decreased by observing lockdown at regular intervals (Bir, 2020).

# 11. The other side of COVID-19: food security to wild life

Although deer in many parks such as in Japan's Nara Park are usually fed by visitors, but with that meal ticket suddenly dried up, they have left the park and taken to the streets of the city to look for food.



Comparable to above, in places like Lopburi, Thailand, Khandagiri and Udaygiri hills, Odisha, India (Mohanty and Paital, 2005), the local monkeys previously were depending on tourists for food. Following lockdown, they have mobbed the town in search of sustenance, sometimes fighting with each other in the process. On the other hand, when a large environmental move takes place, few pay the price for the larger benefit, what it is considered as nature is rejuvenating under social lockdown (Spektor, 2020). Therefore, government plans for establishment of natural restaurants for wild animals is also suggested (Paital et al., 2015; Paital, 2016c).

## 12. Conclusion

CoV infection has emerged as a deadly infectious disease causing the greatest pandemic in the planet. The entire world including 210 nations is following lockdown with a different level of stringency to combat COVID-19. Countries like India and China had been following a very stricter and early lockdown for which they are enjoying a controllable infection and death rate from COVID-19. However, the virus has a negative correlation with temperature for its propagation and alcoholic based standard sterilisers can deactivate it. On the other hand, reduction of human dominance in environment is resulted in a drastic climate change. Mostly due to shutdown of industries and restriction of vehicular traffic, as a result, use of fossil fuels is reduced substantially. Therefore, NO<sub>2</sub> and CO<sub>2</sub> emissions are radically reduced in many metropolitan cities across world. Such favourable natural changes have made wildlife to move with full freedom in one hand, and the biodiversity is elevated in any areas on the other hand. Due to the reduction in air particulate matter and fall in water pollution in many places such as Italy, Spain, France, Los Angeles of USA, Wuhan city of China and New Delhi of India, people are experiencing the never seen elevated environmental revival due to cleaner air, and sparkling water bodies and beautiful wild animals roaming around human habitats. Due to shutdown of bus, train and flights, wild animals especially birds are enjoying a noise free environment. It is nothing but the Mother Nature is trying to bouncing back. After the end of 100 days of lockdown in some of the countries, it has been felt that life is possible without so much modernised life style especially those acts associated with fossil fuels. Solar energy, wind meals etc. can be used instead. It is a glimpse of what the world might look like without fossil fuels but hopes that humanity could emerge from this horror into a healthier, cleaner world, and, will depend not on the short-term impact of the virus, but on the long-term political, institutional, social, communal and individual mind-set and collective decisions to give a checkmate to climate deterioration. Because, there is a chance that post-COVID-19 period would bring the pace of human dominance and environmental pollution back. Therefore, the self-regenerated nature without human effort can be everlasting with human interference during post-COVID-19 periods and regular interval lockdowns in entire planet coupled with long term holidays are suggested as one of the measures. On the other hand, as per recent studies, along with strict social lockdown, masks must be used to prevent COVID-19, even at home where, air pollution level is very high.

## Authors contribution

Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing - review & editing by BRP.

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The author 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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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.scitotenv.2020.139088>.

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