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REVIEW ARTICLE

A mini-review: positive impact of COVID-19 on Arial health and ecology

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Abstract

COVID-19 can cause global pandemics; however, no specific vaccine has been recommended for COVID-19. Nearly 216 countries are trying to stop the spread of the disease, recover from it, and improve its mobility. In a way that people have not experienced in recent years, the COVID-19 pandemic affected humans through the year 2020. To stop the spread of the disease, many governments declared a complete lockdown.The nationwide lockdown had some positive effects on the environment even though it led to a decline in global economic growth. Air pollution levels reduced dramatically as a result of this lockdown on pollution. Most of Europe's populated cities saw a reduction in NO2 concentration of 45–54%. COVID-19 and air, water, and ecology are connected via two pathways, one occurring before the spread of the disease and the other following after. As a result of industrial activity, transportation, and high human density, pollutants were high in many areas before the disease spread. There was a reduction in population movements as well as a decline in human activities which resulted in a reduction in carbon dioxide emissions, an improvement of the ozone layer, as well as improvements in the Earth's weather and environment. As a result of a COVID-19 pandemic, human activities are negatively impacted, and the environment is positively affected. Our objective is to provide an assessment of the impact of human activities on the environment and ecology. During times of lockdown, there is a correlation between atmospheric changes and the behavior of natural creatures. Several significant findings are presented, including air pollution reduction, air quality improvement, ozone healing, and ecological sustainability. COVID-19 is beneficial for aerial health, aquatic health, and ecology in this paper.

Keywords COVID-19 · Environment · Arial health · Ecology

Introduction

As a result of the coronavirus disease 2019 (COVID-19) pandemic, significant numbers of people have lost their lives worldwide (Wang, Li, Li, & Jiang, 2022). The World Health Organization (WHO) has reported around the world that coronavirus disease 2019 (COVID-19) is linked to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Globally, this virus has killed 0.59 million people and infected 16.26 million people since March 11, 2020, in Wuhan, Hubei province, China (D Atoufi, Lampert, & Sillanpää, 2021). Governments took immediate lockdown measures, travel restrictions, and quarantine to control the spread of the disease. The implementation of this policy reduced global carbon emissions and increased energy consumption by 2020. Since the USA, China, Europe, and India have the four largest carbon emission levels in the world, scholars have always focused their attention on the impact of COVID-19 on these four regions (Wang et al., 2022; Wang & Zhang,

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2021). On a global scale, there has been a decline of 8%, 5%, 2%, and 20% in coal, oil, gas, and electricity demand during the first quarter of 2020, compared with the first quarter of 2019. A further comparison by Qiang Wang took the form of two scenarios, one of which was the absence of pandemics, and the other of which represented China's actual energy consumption. Using their model, they found actual electricity consumption to be 29% less than it would have been without pandemics (Wang, Li, & Jiang, 2021).

As a result of these trends, there has been a decline of almost 8% in CO2 emissions, reaching a low never seen before. It is approximately six times greater drop in the CO2 emissions from the global financial crisis in 2009 when 400 million tons of CO2 was reduced (D Atoufi et al., 2021; Kemal & Genc, 2020). Approximately 92% of all people in the world live in areas that meet the minimum requirements for healthy air, as determined by the World Health Organization (WHO). It is important to make a couple of points here; first is that air pollution is a major contributor to the deaths of around 3 million people per year in China, where this figure is the highest. There seems to be an association between PM2.5 concentration and mortality rate in most industrial countries. The highest mortality rates in China are also observed in most industrial countries (Albayati et al. 2021; Isaifan, 2020). As Gautam (2020a) reported, the levels of NO2 in China and India significantly decreased after the lockdown with the latter dropping by approximately 30% and 70% (Gautam, 2020). During the latest European lockdown, crime rates dropped by 25% in Spain, 30% in France, and 20% in Italy. In the last few years, the percentage of air contaminants has fallen dramatically (Kanniah et al. 2020). Numerous countries have experienced a reduction in NO2 levels (Shrestha et al., 2020; Tobías et al., 2020; Wang & Su, 2020). As reported by Lokhandwala and Gautam (2020) (2020, the COVID-19 initiative had an impact on improving water bodies, including the Ganga River in India. Moreover, the lockdown rules have made it possible for wildlife to move freely in areas previously dominated by humans (Lokhandwala & Gautam, 2020). However, each of the factors mentioned can have a direct or indirect impact on disease control. Lockdown has a very positive effect on wildlife behavior. It is suggested that humidity, air pollution, and temperature all have a direct impact on the expansion of coronaviruses in a study by (Lal et al., 2020). COVID-19 so far has acted as a double-edged sword for the environment: it has reduced air pollution, greenhouse gas emissions, noise pollution, and human exposure to the environment, but it also has some negative impacts on the environment. The positive relationship between the environment and COVID-19 has been examined in several recent studies (Aydın et al., 2021; Chakraborty & Maity, 2020; Eroğlu, 2021; Gautam & Hens, 2020; Lokhandwala & Gautam, 2020; Mousazadeh et al., 2021; Saadat, Rawtani, & Hussain, 2020; SanJuan-Reyes, Gómez-Oliván, & Islas-Flores, 2021; Shakil et al. 2020). Table 1 summarizes some articles published on the impact of COVID-19 on the environment. In other words, you may experience many positive effects from COVID-19 rather than concern about the environment. It helped us spend more quality time with our family. Pandemics will be fought in the future by underdeveloped countries learning how developed countries like China and the USA upgrade healthcare facilities and digital technology. Cloud computing, big data, artificial intelligence, and 5G were the most effective weapons against COVID-19 in China. The importance of these technologies in controlling the spread of COVID-19 can be seen in their application (Wang, Su, Zhang, & Li, 2021a, b). In this study, two of the positive effects of pandemics on the environment are examined, namely those that affect the environment ecologically and those that affect the atmosphere.

Impact of the pandemic on the environment

An improvement in air quality

The ratio of polluting gasses decreases

As a result of a decrease in economic and social activities associated with the COVID-19 pandemic, PM2.5 concentrations in eight heavily populated US cities declined during the first 5 months of 2020 (Pata, 2020). COVID-19 has been linked to a reduction of measured air pollution in the USA, for example, a reduction of 4.8 parts per billion in NO2 concentration (25.5%). Rural counties (16.5%) saw a larger decrease than urban ones (26.0%) (Berman & Ebisu, 2020). There was a 46% reduction in PM2.5 and a 34% reduction in NO2 in India's most polluted cities in comparison with 2019 (Lokhandwala & Gautam, 2020). In the first isolation period, NO2 concentrations decreased by 53%, CO concentrations by 30%, and CO by 35%. Approximately 4 days after the commencement of lockdown, the air quality started to improve by 40 to 50%. Based on the data obtained from the first 3 weeks of March 2020, the AQI decreased by approximately 43% compared with the first 21 days of the isolation period (Mahato, Pal, & Ghosh, 2020). China was the first country to experience COVID-19 lockdowns, so China saw the improvements in air quality first. Therefore, the average AQI decreased 7.80% between January 1 and March 21, 2020, for 44 cities in northern China, with a 6.1% decrease in PM2.5, PM10, NO2, CO, and SO2 in each of the four categories (Bao & Zhang, 2020). The COVID-19 outbreak has hit Italy hard, and they put a lockdown on March 9, 2020. PM2.5, PM10, NO2, NOx, CO, SO2, and benzene levels were reduced by 47.4%, 48%, 61.4%, 74.4%, 57.6%, 25.4%, and 69% in Milan between February and March 2020 (Chakraborty & Maity, 2020).

Table 1 Summary of some articles published on the impact of COVID-19 on the environment

Topic	References	Study aims	Publisher	Journal	Target country
Pollution levels and quality of air in different countries impacts of COVID-19	(Albayati et al., 2021)	Various countries such as China, India, Brazil, and Russia, studied the air quality and the concentration of various pollutant gasses that contribute to air pollution	Elsevier	Journal of Transport & Health	Many Countries
Turkey's environment in relation to coronavirus (COVID-19)	(Aydın et al., 2021)	AQIs for secondary air pollutants, ozone, and 2.5 mm particulate matter (PM2.5), were investigated in Turkey during December 2019, April 2020, and May 2020	Springer	Environment, Development, and Sustainability	Turkey
COVID-19, the cause, effects, and prevention of the pandemic are discussed in this article	(Chakraborty & Maity, 2020)	Discusses the possible ways in which COVID-19 can be controlled as well as its impact on society and the environment	Elsevier	Science of the Total Environment	NA
Environmental challenges and opportunities in the review of COVID-19	(D Atoufi et al., 2021)	COVID-19 interacts positively with the environment, whereas the environment interacts negatively with it	Springer	Environmental Science and Pollution Research	Overall Globe
In the global environment, self-regeneration can be achieved by nurturing the natural world with COVID-19	(Paital, 2020)	COVID-19: a review of its impact	Elsevier	Science of total Environments	NA
Indirect environmental impacts of the COVID-19 initiative in India	(Lokhandwala & Gautam, 2020)	As part of COVID-19, air and water quality are measured during lockdowns	Elsevier	Environmental Research	India
COVID-19 acts as a major factor in affecting the global environment	(Lal et al., 2020)	The global environmental impact of COVID-19	Elsevier	Science of total Environments	NA
The global environment is significantly impacted by COVID-19	(Tahir & Batool, 2020)	Considering the environment in light of COVID-19	Elsevier	Science of the Total Environment	NA
Learnings from COVID-19	(El Zowalaty, Young, & Järhult, 2020)	Assesses how to continue to have a positive environmental impact	Taylor & Francis	NA	NA
COIVID-19 has an impact on the environment	(López-Feldman et al., 2020)	Regulation and policy implications of COVID-19	Springer	Environmental and Resource Economics	Latin America
Changes in climate and COIVID-19	(Mahmood et al., 2020)	Study the effects of hand sanitizers on human health and the environment	Elsevier	Science of the Total Environment	NA
Concerns about the environment and COVID-19	(Ghosh et al., 2020)	Assessment of COVID-19's environmental impact with the developed quality index	MDPI	Sustainability	India

CO2 and NO2 emissions are reduced

The restrictions on domestic activities during the lockdown period result in fewer industrial activities and fewer car movements, resulting in an overall reduction in air pollution and some improvement in the environment. The combustion of fossil fuels in industry, thermal power plants, air travel, and vehicular traffic mostly produces carbon dioxide. The level of carbon concentration goes down since industrial sectors were closed during the lockdown period. By extending the lockdown until the end of the year, the COVID-19 pandemic was estimated to reduce emissions by 7% (Bar, 2021) (Fig. 1).

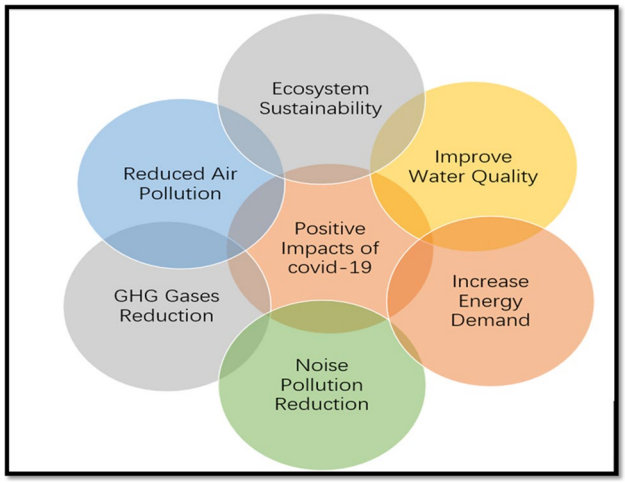

Fig. 1 Positive impacts of COVID-19 on environment

Petrochemical refineries, nitric acid-based manufacturing, and industries producing N-based products are some of the major sources of NO2 emissions. Factories, vehicles, and even household appliances are responsible for NO2 pollution when they burn fossil fuels, such as coal, gas, and oil. There is a variation in the data due to weather changes in some European countries, mainly Italy, Spain, France, Germany, etc., when lockdown measures are implemented. In Fig. 2, satellite images depict the NO2 concentrations from 13 March through 13 April 2020, along with the average concentrations from 2019 for March–April. Following strict national locking measures across Europe, populated cities such as Rome, Milan, and of course Paris have experienced declines of 45% in NO2 concentration in the atmosphere, while CO2 and NO2 have reported reductions of 54% (ESA-Copernicus-European Space Agency) (Bar, 2021; Wang & Su, 2020). We were able to reduce emissions by reducing contamination emissions sharply. Figure 3 illustrates how NO2 levels decreased before and after quarantine (Gautam,

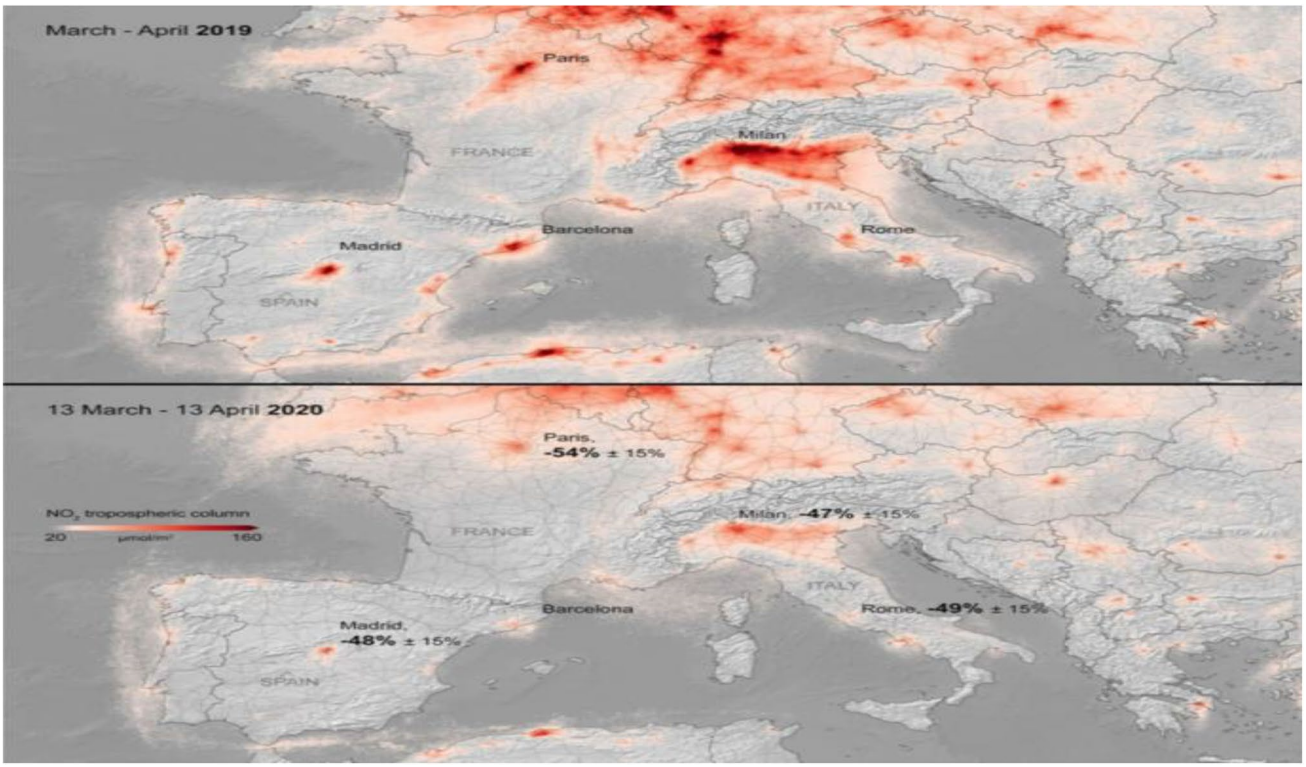

Fig. 2 A comparison of the NO2 concentrations in Europe in 2020 with those in 2019, based on satellite images collected between 13 March and 13 April 2020 ("ESA—Copernicus—European Space Agency," 2020)

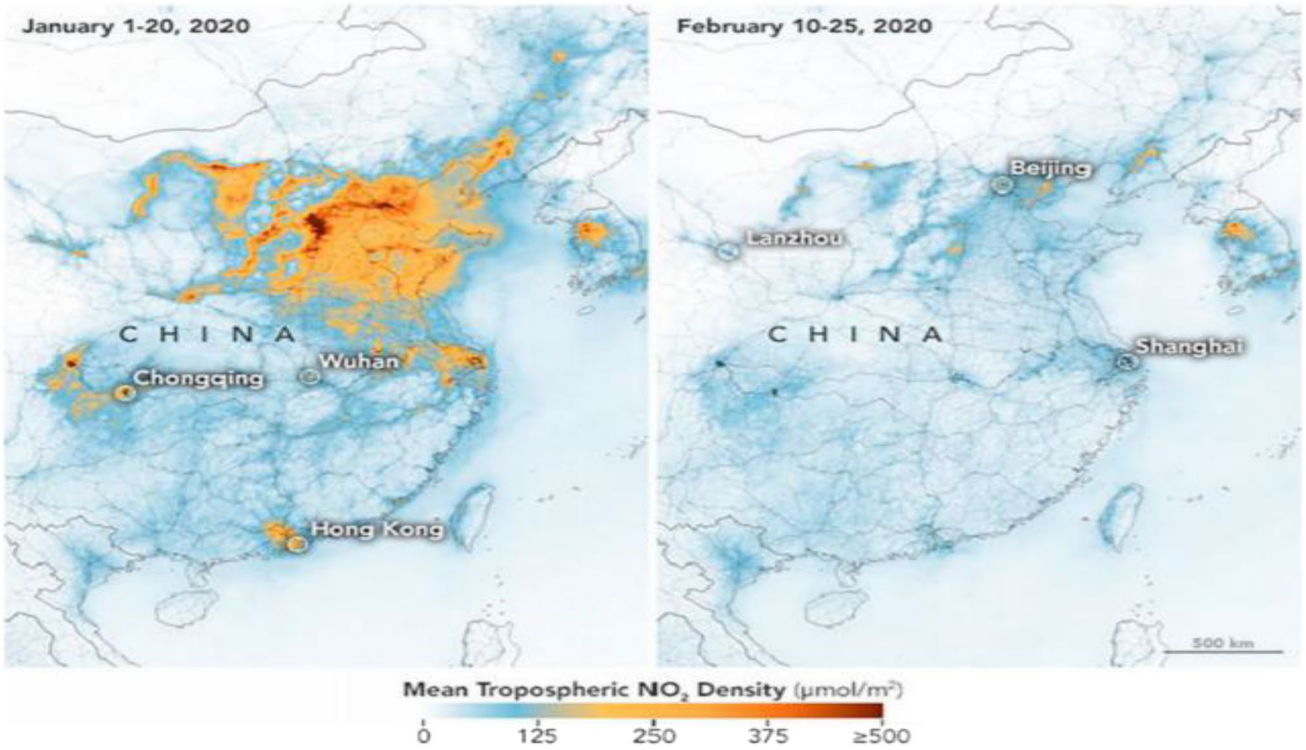

Fig. 3 NO2 concentrations in China during COVID-19 lockdowns (Gautam, 2020)

2020). This was correlated with the large industrial plants in Wuhan, which produced large quantities of pollutant gasses, which was very concerning. Since the end of February 2020, there has been an increase in the concentration of NO2 in the atmospheric environment. Chinese authorities have resumed industrial production since the outbreak is gradually under control. National Aeronautics and Space Administration (NASA) gives data on changes in NO2 emissions in Wuhan as shown in Fig. 4 (Wang & Su, 2020).

CO2 reductions

From natural activities such as wildfires, significant, but erratic, amounts of carbon dioxide are emitted into the air, including CO2, CO, and other substances. Carbon dioxide is emitted by a variety of human activities. Several of the above-mentioned sources have been closed due to quarantine measures imposed by COVID-19, particularly in transportation and industry. As a result, fewer gasses are released. These events are significantly fewer on February 2020 than they were on February 2019 due to the COVID-19 lockdown. Figure 5 shows that over East Asia and particularly over East and Southeast Asia, there is a noticeable loss in color intensity and a lack of fade on the polluted hotspots (Elsaid, Olabi, Sayed, Wilberforce, & Abdelkareemd, 2021).

Figure 6 shows that CO2 emissions in the US, EU 27 and UK, India, Brazil, China, and Japan decreased significantly from March to 2020 when compared to 2019 (Rupani et al., 2020).

Impact of the pandemic on O_3 healing

Three oxygen atoms are in the gas, two of them are normal forms of oxygen, and one is attached to the molecule, making it an unstable gas. There is a natural gas present in the atmosphere, between the troposphere and the stratosphere, which contributes to the protection of beings against UV radiation from the sun. As the concentration of ozone near the earth's surface increases, it harms human health. Depending on the reaction between discharge from industrial facilities and sunlight, it can be produced far from the primary source (Cohen et al., 2018). On a year-by-year basis, the north part of China experienced a $29 \pm 22\%$ reduction in NO2 and a $53 \pm 10\%$, reduction in SO2. By comparison, the amount of ozone has nearly doubled. PM2.5 and NO2 levels decreased by $31 + 6\%$ and $54 \pm 7\%$, respectively, while ozone levels rose by 220% in Wuhan, where PM2.5 and NO2 levels decreased by $31 \pm 6\%$ and $54 + 7\%$, respectively. A total of ten sites were used to obtain these results. Also, SO2 and NOx contaminations were observed similarly (Cohen et al., 2018; Shi & Brasseur, 2020).

At an approximate concentration of about 8 ppm, ozone O3 is an essential component of the atmosphere (Tobías et al.,

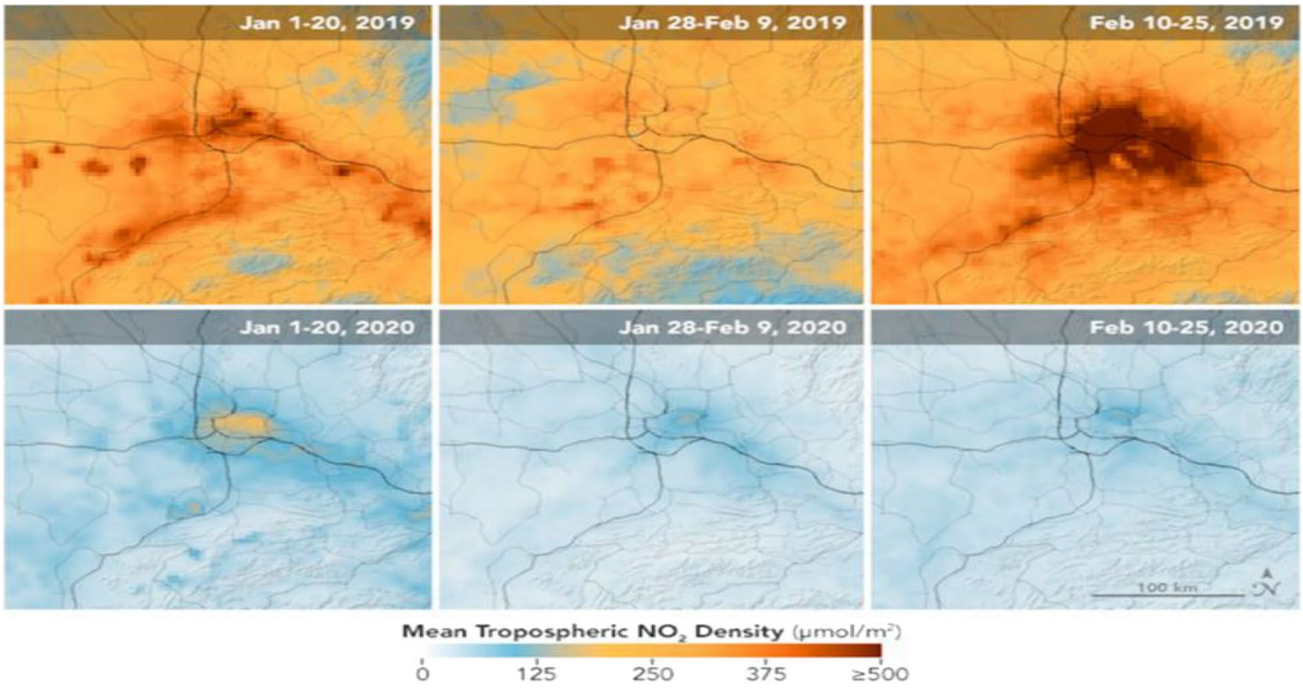

Fig. 4 China's emissions change (Wang & Su, 2020)

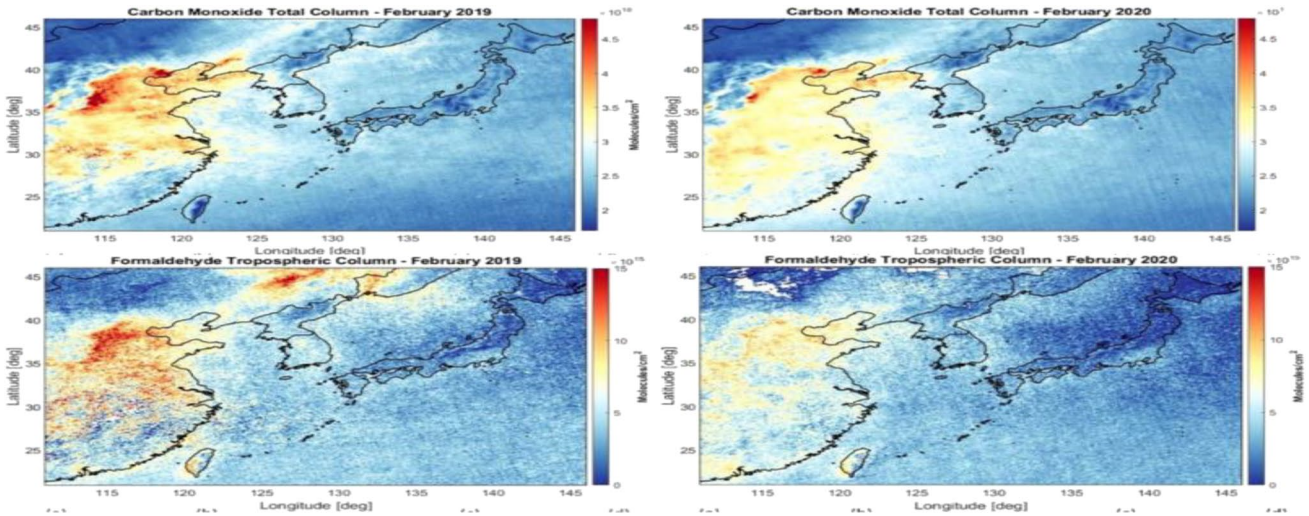

Fig. 5 Averaged for East Asia between February 2019 and February 2020, an illustration of the troposphere's column density of CO and HCHO(Elsaid et al., 2021)

2020). A relatively higher concentration of O3 was observed during COVID-19 lockdown and quarantine. According to the below reactions (1)–(3), the reduced NOx concentrations can be related to increased O3 concentrations. These reactions represent the network for oxides of nitrogen NO, NO2, and oxygen species O, O2, and O3 (Hashim, Al-Naseri, Al-Maliki, & Al-Ansari, 2021; Martorell-Marugán et al., 2021). In the equilibrium network, a change in any one species will cause a change in all of the other species as demonstrated by the reactions with O3, NO2, and NO (Elsaid et al., 2021).

$$NO_2 + h\upsilon(< 420\text{nm}) \leftrightarrow NO + O \quad (1)$$

$$O + O_2 \leftrightarrow O_3 \quad (2)$$

$$NO + O_3 \leftrightarrow NO_2 + O_2 \quad (3)$$

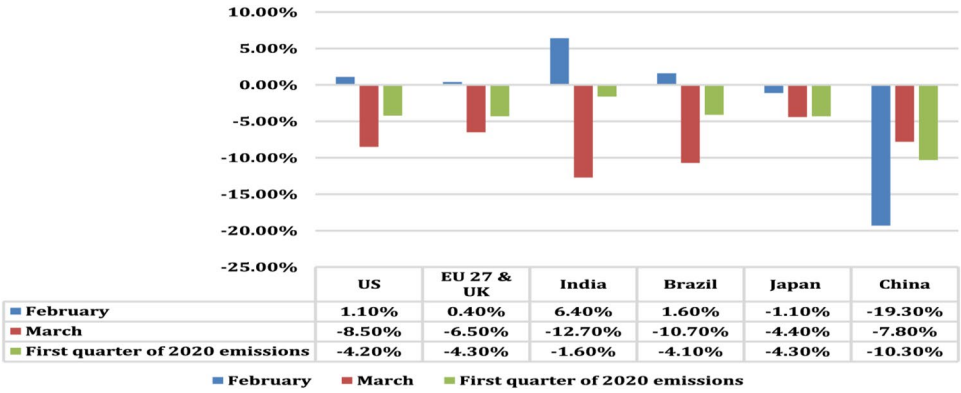

Fig. 6 CO2 emissions in 2020 compared to 2019 (Liu et al., 2020; Rupani et al., 2020)

Impact of the pandemic on water

Less industrial effluent discharge improved the water quality

As a result of the restrictions on motorboat traffic in Italy during the lockdown period, the water clarity in Venice has considerably improved, and seaweed is visible in clear waters. There was an unusual lack of industrial effluent discharge in Venice's canals during this period, so swans floated in the water, fish gathered in the water, and it was unusually quiet in the city (Bar, 2021; Mack, 2020). The lockdown is meant to purify the Ganges, India's holiest and most polluted river. SPM concentrations have decreased by 15.9% on average in Vembanad Lake, India, compared to the previous year, a reflection of the improvement in surface water quality (Yunus, Masago, & Hijioka, 2020). Pandemic relief relieved the environment from its stresses. One example is that Earth's water quality improved after the pandemic. The increased social distance and quarantine resulted in a decrease in tourism, which led to clean, world-renowned beaches. Pandemic relief relieved the environment from its stresses. The water quality on Earth improved after the pandemic, for instance. A decrease in tourism was due to social distances and quarantines, resulting in world-renowned beaches (Mandal & Pal, 2020; Saadat et al., 2020; Zambrano-Monserrate, Ruano, & Sanchez-Alcalde, 2020). Moreover, many states ordered further disinfection procedures to prevent further virus transmission via water. By adding more chlorine to wastewater, including factory wastewater, it is possible to destroy viruses. Most American neighborhoods are located near factories, which can cause wastewater to leak into the groundwater (Zambrano-Monserrate et al., 2020), and a third of Americans drink groundwater as their primary source of hydration (Singu et al., 2020). This pandemic may have helped in some way to save the environment, at least it may have made states re-evaluate how to deal with pollution.

Impact of the pandemic on ecology

There is a serious threat to biodiversity posed by the global animal market, which sells thousands of species every year ("DW," 2020). China temporarily bans the sale of wildlife products during the outbreak of COVID-19 in Hunan seafood markets (Chakraborty & Maity, 2020). Different countries also have permanent bans on wildlife tread as a result of its suspected origin from animals. This will be beneficial for wildlife health and restoring sustainable ecosystems. As part of a survey by a Hong Kong-based environmental NGO, Ocean Asia, a good number of masks were located along the high tide line of the seashore, along with other waste (Saadat et al., 2020). By mistake, eating these biomedical wastes as food, the biomedical garbage may cause infection and even death to animals and water life when not disposed of properly (Hellewell et al., 2020) and it may affect both the land and water ecosystems. Hence, COVID-19's medical waste management policies need to be restructured immediately.

Another new environmental issue is the handling of COVID-19 dead bodies. At present, there have been around 0.948 million deaths in COVID-19; the number is increasing every hour. In contrast to being given to family members for ritual burial, dead bodies must be buried in mass.

Influence on wildlife behavior

Animal behavior can be explored with the COVID-19 lockdown. Activity by humans dropped unusually, creating sudden silence that surprised the animals and caused them to display unusual behavior. It was interesting to see puma walk along the side of a street in Santiago, Chile, deer graze in Nara, Japan, and ducks swim across the street in Paris ("The Guardian.," 2020; "The Telegraph.," 2020) in the past, and these animals were hidden in shadows, but

now, they are out in the open, searching for food. A raccoon was spotted frolicking in broad daylight near a residential area in Central Park in New York on 16 April 2020. Hundreds of mountain goats filled Llandudno, Wales, the UK, on March 31. On the Great Orme, goats usually surf but come down to the streets when there are no tourists or people around. The landlords of Harold Hill Estate in London noted the presence of peahens on the property on April 4; leopards were spotted on Hyderabad Road in New Delhi during the lockdown; peahens were also seen in MN Margin London during that same lockdown shown in Fig. 6 ("The Guardian.," 2020; "The Telegraph.," 2020). We will have to see what will change when the lockdown is removed; other facts, such as wildlife using human-dominated zones, are rare. When people were at home during the lockdown, it may have appeared as if it was an unexpected vacation (Bar, 2021).

Influence of COVID-19 on aquatic life

Healthy water environments and aquatic life are enhanced with COVID-19 lockdown. While fewer people were at the port, several eagle rays were found watering at Dubai Marina ("CNN," 2020). Turtles found nesting in Florida despite beaches being closed in lockdown ("CNN," 2020). After nearly three decades, the Ganges dolphin which is a river dolphin from the south Asian region is back at Kolkata, India, according to the Times of India on Friday, 25 April 2020 ("Times of India.," 2020). Evidence suggests a correlation between all the evidence and the immediate changes in forest and water ecosystems.

Effect on birds' life behavior

Birds' lives are greatly impacted by noise pollution. Quiet lockdowns could help to protect birds from noise pollution. Partially, migratory birds in sanctuaries stay longer than usual, which is typical for partial migrants. By March, birds such as painted storks, open bill storks, gray herons, spoonbills, spot-billed pelicans, and ibises usually leave. Probably this year, the lockdown lasted longer than usual because fewer people were around, and less noise was being generated ("The Hindu.," 2020). Birds and butterflies have greatly increased in number across the country. The local bird population is increasing dramatically.

Effect on pets behavior

A pet can also perform routine activities. They become restricted during a lockdown period. They can sometimes behave abnormally and aggressively. Despite their likelihood of being infected, dogs, chickens, pigs, and ducks cannot be avoided by pet owners. Cats carry the virus and spread it ("Nature news.," 2020).

Food security of animals

Tourists and domestic animals feed the street dogs, cats, monkeys, crows, and free birds in the area. Food is in short supply during the lockdown, and sometimes, the students fight with one another. Then, the government forms "natural restaurants" in collaboration with nonprofit organizations. There may be a shortage of food contributing to wild animals roaming around residential areas. During the lockdown period, the deer in Nara Park, Japan, were no longer getting the food they were normally fed by visitors. They might have left the park to seek food on the streets of the city (Fig. 7) (Bar, 2021).

Discussion

The crisis surrounding COVID-19 offered many lessons, according to El Zowalaty et al. It is possible to perform several activities at home, such as teleconferencing, working, and studying, thus reducing fuel consumption and emissions (Albayati et al., 2021; El Zowalaty et al., 2020). COVID-19 has been associated with a variety of environmental impacts, and we discuss and analyze these different studies. As a result of the cessation of many commercial and industrial activities, there has been an improvement in air quality. Transportation lockdowns have also reduced fuel consumption, lowering pollution levels. Details about how the COVID-19 pandemic affected air and water quality, as well as wastewater and solid waste management (D Atoufi et al., 2021). Climate change has had a positive impact. Due to the decrease in transportation and manufacturing processes, there was a reduction in air pollution and global warming. A warmer climate may result in new infrastructures such as solar, wind, and electric vehicles. The COVID-19 recovered program has led to a new approach to utilizing sustainable energy for a flourishing future (Rosenbloom & Markard, 2020). Animals living in human-dominated areas are overcoming human restrictions because nature has a positive outcome. With transportation on hold, animals experience quiet areas in a people-dominated area. The globe is returning to good health at a rapid pace. There is no need to harm the environment dramatically by living a modern life (Rupani et al., 2020).

COVID-19 has a positive impact on climate change. The COVID-19 has resulted in more than 200 countries declaring full or partial lockdowns in response. Many governments have taken these measures. Because of this lockdown,

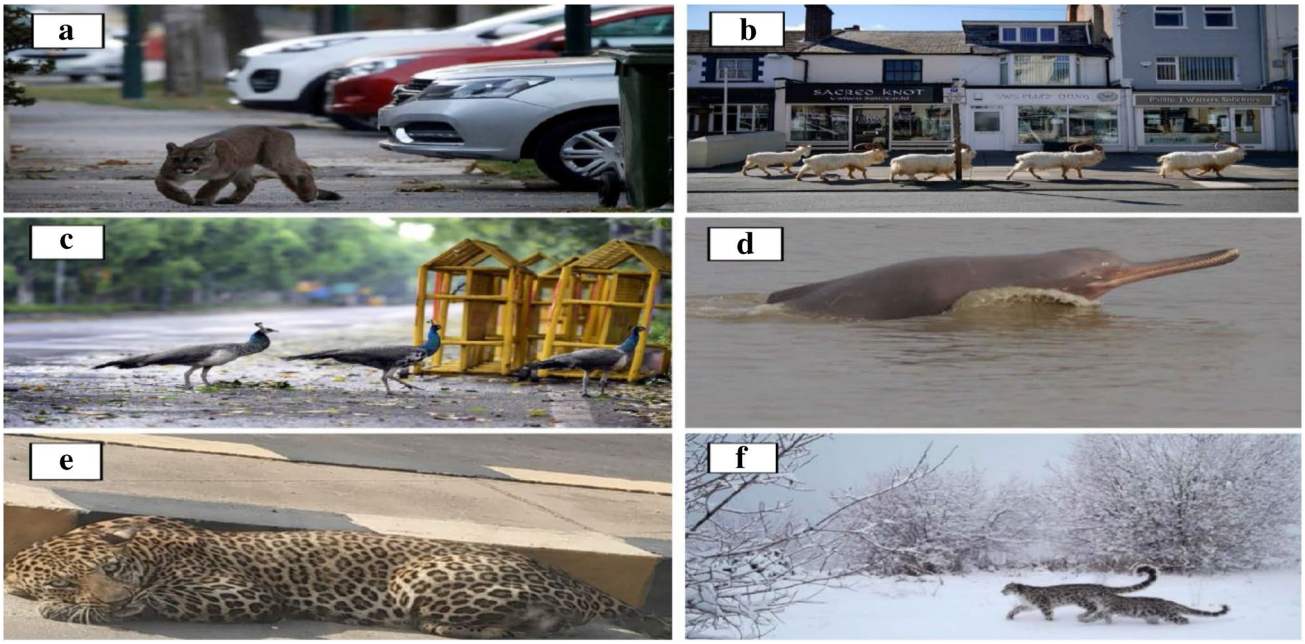

Fig. 7 The evidence of behavioral changes of animals and birds; **a** puma walking at the street in Santiago, Chile. **b** Mountain goats roaming at the streets of Llandudno, Wales, UK; **c** peahens observed at MN Marg, New Delhi, India; **d** dolphins spotted at Kolkata, India; **e** leopard lying on road at Hyderabad, India; **f** snow leopards spotted near the Big Almaty Lake, Kazakhstan (Bar, 2021)

industry and transportation facilities, particularly in large cities, were halted. These suspensions have led to a reduction in air pollution. Therefore, transportation emissions and the use of fossil fuels have decreased. The development of this enhancement drew researchers' attention to the use of renewable energy sources such as solar energy, wind energy, and electric vehicles. A pandemic could improve environmental health. A study found that:

1. To respond to the COVID-19, every country in the world has implemented quarantine with varying degrees of strictness. Because of the strict lockdown on NO2 and CO2, pollution has been drastically reduced in many cities around the world.
2. Furthermore, many areas of the world have also seen healing of the O3 layer, which has the potential to reduce global warming by a significant amount.
3. Human activity dropped unexpectedly, and the sudden silence caused animals to exhibit unusual behavior. Previously, animals were buried in jungles, but after this period of silence, they began to roam the streets looking for food.

Conclusion

COVID-19 transmission can only be controlled by a nationwide lockdown. It is obvious that the lockdown measure has reduced global economic growth, but certain benefits have accrued to the atmosphere and ecosystem. Major pollutants such as nitrogen oxides and carbon dioxide are significantly reduced by mass confinement. In Europe, NO2 concentration declined by 45–54% in different populated countries, and by 40–45% in China, India, and Bangladesh compared to last year's same period. As of the end of this year, carbon dioxide emissions are expected to fall by 7%. Due to the restriction of fossil fuel consumption by industries, power plants, and transportation during the lockdown period, NO2 and carbon emissions significantly decrease in the atmosphere. Water quality also improved as a result of this. Employing such a global lockdown intended to control the COVID-19 pandemic, it is reasonable to conclude that the atmospheric environment has partially recovered in all respects. Animals such as birds, butterflies, pet animals, and street animals have altered behavior as a result of human interference. The weather changes correlate with the behavior of animals during lockdowns. The article states that confinement in lockdown affects atmospheric oxygen levels and local ecosystems. In the future, there will be more research into how COVID-19 reduces heavy metal pollution,

agriculture, and rare earth elements. Moreover, we can use the results of this research to communicate information about nature in a way that we could never have imagined. Humans may be at risk if nature's resources are abused, as demonstrated in COVID-19. To avoid unessential consequences, it is imperative to teach people the rules and how to follow emergency plans. We encourage our staff to conduct their work and academic studies online whenever possible, rather than mixing fuel and arriving at the office to perform the same work. Our planet needs to be protected because we have nowhere else to go; the health of the planet is vital for our survival. Keeping the food chain balanced requires that we take care of other animals on the land. In our rush for development, we destroy wildlife habitats. It is the destruction of food webs and food chains, and their subsequent consequences are unfavorable for humans.

Because of time and resources constraints, the author focused only on air pollution (CO2 and NO2) and ozone healing. We are unable to address other positive effects such as the reduction of noise pollution. The authors do not mention other pollutants like carbon dioxide and sulfur dioxide. Although soil pollution was reduced during epidemics, lockdowns made obtaining data difficult. We may be able to address future directions for policymakers regarding how to leverage people's awareness about the environment to maintain a positive impact on the environment. In a future study, it might be possible to examine how gasses and other types of pollution, such as water pollution and soil pollution, especially pollution from heavy metals and rare earth, and noise pollution, relate to each other and find correlations.

Author contribution This idea was given by SN and ZW. SN wrote the complete paper, while ZW, SN, and SA read and approved the final version.

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Declarations

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Consent to the participate Not applicable.

Consent for publication Not applicable.

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References

Albayati N, Waisi B, Al-Furaiji M, Kadhom M, Alalwan H (2021). Effect of COVID-19 on air quality and pollution in different countries.J Transport & Health, 101061

Aydın S, Nakiyingi BA, Esmen C, Güneysu S, Ejjada M (2021) Environmental impact of coronavirus (COVID-19) from Turkish perceptive. Environ Dev Sustain 23(5):7573–7580

Bao R, Zhang A (2020) Does lockdown reduce air pollution? Evidence from 44 cities in northern China. Sci Total Environ 731:139052

Bar H (2021) COVID-19 lockdown: animal life, ecosystem and atmospheric environment. Environ Dev Sustain 23(6):8161–8178

Berman JD, Ebisu K (2020) Changes in US air pollution during the COVID-19 pandemic. Sci Total Environ 739:139864

Chakraborty I, Maity P (2020) COVID-19 outbreak: migration, effects on society, global environment and prevention. Sci Total Environ 728:138882

CNN. (2020). Retrieved from https ://editi on.cnn.com/trave l/artic le/marin e-conse rvati on-uae-spc-intl/index .html.

Cohen Y, Petetin H, Thouret V, Marécal V, Josse B, Clark H, . . . Blot R (2018) Climatology and long-term evolution of ozone and carbon monoxide in the upper troposphere–lower stratosphere (UTLS) at northern midlatitudes, as seen by IAGOS from 1995 to 2013. Atmos Chem Phys, *18*(8), 5415-5453

Datoufi H, Lampert DJ, & Sillanpää M (2021) COVID-19, a double-edged sword for the environment: a review on the impacts of COVID-19 on the environment. *Environ Sci Pollut Res*, 1–10

DW (2020) Retrieved from https://www.dw.com/en/opinion-faith-covid-19-and-the-push-for-a-healthy-environment/a-53270128 .

El Zowalaty M. E, Young SG, & Järhult JD (2020) Environmental impact of the COVID-19 pandemic–a lesson for the future. In: Taylor & Francis

Elsaid K, Olabi V, Sayed ET, Wilberforce T, & Abdelkareemd MA (2021) Effects of COVID-19 on the environment: an overview on air, water, wastewater, and solid waste. *J Environ Manage*, 112694

Eroğlu H (2021) Effects of COVID-19 outbreak on environment and renewable energy sector. Environ Dev Sustain 23(4):4782–4790

ESA-Copernicus-European Space Agency. (2020). Retrieved from-http://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Air_pollution_dropsin_Indiafollowing_lockdown.

Gautam S (2020) COVID-19: air pollution remains low as people stay at home. Air Qual Atmos Health 13:853–857

Gautam S, & Hens L (2020) COVID-19: impact by and on the environment, health and economy. In: Springer

Ghosh S, Das A, Hembram TK, Saha S, Pradhan B, Alamri AM (2020) Impact of COVID-19 induced lockdown on environmental quality in four indian megacities using landsat 8 OLI and TIRS-derived data and mamdani fuzzy logic modelling approach. Sustainability 12(13):5464

The Guardian. (2020). Retrieved from https://www.theguardian.com/world/gallery/2020/apr/22/animals-roaming-streetscoronavirus-lockdown-photos.

Hashim BM, Al-Naseri SK, Al-Maliki A, Al-Ansari N (2021) Impact of COVID-19 lockdown on NO2 O3 PM2 5 and PM10 concentrations and assessing air quality changes in Baghdad. Iraq. Sci Total Environ 754:141978

Hellewell J, Abbott S, Gimma A, Bosse NI, Jarvis CI, Russell TW, . . . Sun F (2020) Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. *The Lancet Global Health, 8*(4), e488-e496

The Hindu (2020) Retrieved from https://www.thehindu.com/news/national/tamil-nadu/pandemic-induced-lockdowngives-migratory-birds-and-animals-a-reason-to-cheer/article31458071.ece

Isaifan R (2020) The dramatic impact of Coronavirus outbreak on air quality: has it saved as much as it has killed so far? Glob J Environ Sci Manage 6(3):275–288

Kanniah KD, Zaman NAFK, Kaskaoutis DG, Latif MT (2020) COVID-19's impact on the atmospheric environment in the Southeast Asia region. Sci Total Environ 736:139658

Kemal K, Genc MS (2020) Effects of 2019 novel coronavirus (COVID-19) outbreak on global energy demand and the electricity production with renewables: a comprehensive survey. Sigma J Eng Nat Sci 38(3):1369–1380

Lal P, Kumar A, Kumar S, Kumari S, Saikia P, Dayanandan A, Khan M (2020) The dark cloud with a silver lining: assessing the impact of the SARS COVID-19 pandemic on the global environment. Sci Total Environt 732:139297

Liu Z, Deng Z, Ciais P, Lei R, Feng S, Davis S, . . . Zhou H (2020) Decreases in global CO $ _2 $ emissions due to COVID-19 pandemic

Lokhandwala S, Gautam P (2020) Indirect impact of COVID-19 on environment: a brief study in Indian context. Environ Res 188:109807

López-Feldman A, Chávez C, Vélez MA, Bejarano H, Chimeli AB, Féres J, . . . Viteri C (2020) Environmental impacts and policy responses to COVID-19: a view from Latin America. *Environ Res Econ*, 1–6

Mack E (2020) Global coronavirus shutdowns let the environment breathe a bit easier. In

Mahato S, Pal S, Ghosh KG (2020) Effect of lockdown amid COVID-19 pandemic on air quality of the megacity Delhi. India. Sci Total Environ 730:139086

Mahmood A, Eqan M, Pervez S, Alghamdi H A, Tabinda AB, Yasar A, . . . Pugazhendhi A (2020) COVID-19 and frequent use of hand sanitizers; human health and environmental hazards by exposure pathways. *Sci Total Environ, 742*, 140561

Mandal I, Pal S (2020) COVID-19 pandemic persuaded lockdown effects on environment over stone quarrying and crushing areas. Sci Total Environ 732:139281

Martorell-Marugán J, Villatoro-García JA, García-Moreno A, López-Domínguez R, Requena F, Merelo JJ, Lorente JA (2021) DatAC: a visual analytics platform to explore climate and air quality indicators associated with the COVID-19 pandemic in Spain. Sci Total Environ 750:141424

Mousazadeh M, Paital B, Naghdali Z, Mortezania Z, Hashemi M, Niaragh EK, . . . Sillanpää M (2021) Positive environmental effects of the coronavirus 2020 episode: a review. *Environment, Development and Sustainability*, 1–23

Nature news (2020) Retrieved from https://www.nature.com/articles/d41586-020-00984-8

Paital B (2020) Nurture to nature via COVID-19, a self-regenerating environmental strategy of environment in global context. *Science of the total environment, 729*. Retrieved from <Go to ISI>://WOS:000537434800010. https://doi.org/10.1016/j.scitotenv.2020.139088

Pata UK (2020) How is COVID-19 affecting environmental pollution in US cities? Evidence from asymmetric Fourier causality test. Air Qual Atmos Health 13(10):1149–1155

Rosenbloom D, & Markard J (2020) A COVID-19 recovery for climate. In: American Association for the Advancement of Science

Rupani PF, Nilashi M, Abumalloh R, Asadi S, Samad S, Wang S (2020) Coronavirus pandemic (COVID-19) and its natural environmental impacts. Int J Environ Sci Technol 17(11):4655–4666

Saadat S, Rawtani D, Hussain CM (2020) Environmental perspective of COVID-19. Sci Total Environ 728:138870

SanJuan-Reyes S, Gómez-Oliván LM, Islas-Flores H (2021) COVID-19 in the environment. Chemosphere 263:127973

Shakil M H, Munim Z H, Tasnia M, & Sarowar S (2020) COVID-19 and the environment: a critical review and research agenda. *Sci Total Environ* 141022

Shi X, Brasseur GP (2020) The response in air quality to the reduction of Chinese economic activities during the COVID-19 outbreak. Geophys Res Lett 47(11):e2020GL088070

Shrestha AM, Shrestha UB, Sharma R, Bhattarai S, Tran HNT, & Rupakheti M (2020) Lockdown caused by COVID-19 pandemic reduces air pollution in cities worldwide

Singu S, Acharya A, Challagundla K, Byrareddy SN (2020) Impact of social determinants of health on the emerging COVID-19 pandemic in the United States. Front Public Health 8:406

Tahir MB, & Batool A (2020) COVID-19: Healthy environmental impact for public safety and menaces oil market. *Science of the Total Environment, 740*, 140054. Retrieved from

The Telegraph (2020) Retrieved from https://www.telegraph.co.uk/news/2020/04/12/scientists-using-coronavirus-lockdown-understand-wildlife-behaves/

Times of India (2020) Retrieved from https://timesofindia.indiatimes.com/travel/things-to-do/lockdown-effect-gangeticdolphins-spotted-at-kolkata-ghats-after-30-years/as75375783.cms

Tobías A, Carnerero C, Reche C, Massagué J, Via M, Minguillón MC, . . . Querol X (2020) Changes in air quality during the lockdown in Barcelona (Spain) one month into the SARS-CoV-2 epidemic. *Science of the Total Environment, 726*, 138540

Wang Q, Li S, Jiang F (2021) Uncovering the impact of the COVID-19 pandemic on energy consumption: new insight from difference between pandemic-free scenario and actual electricity consumption in China. J Clean Prod 313:127897

Wang Q, Li S, Li R, Jiang F (2022) Underestimated impact of the COVID-19 on carbon emission reduction in developing countries–a novel assessment based on scenario analysis. Environ Res 204:111990

Wang Q, Su M (2020) A preliminary assessment of the impact of COVID-19 on environment–a case study of China. Sci Total Environ 728:138915

Wang Q, Su M, Zhang M, Li R (2021b) Integrating digital technologies and public health to fight Covid-19 pandemic: key technologies, applications, challenges and outlook of digital healthcare. Int J Environ Res Public Health 18(11):6053

Wang Q, Zhang F (2021) What does the China's economic recovery after COVID-19 pandemic mean for the economic growth and energy consumption of other countries? J Clean Prod 295:126265

Yunus AP, Masago Y, Hijioka Y (2020) COVID-19 and surface water quality: improved lake water quality during the lockdown. Sci Total Environ 731:139012

Zambrano-Monserrate MA, Ruano MA, Sanchez-Alcalde L (2020) Indirect effects of COVID-19 on the environment. Sci Total Environ 728:138813