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REVIEW ARTICLE

Towards the impact of COVID-19 on the Environment, Education, and Economy (EEE)

Harjot Kaur[1], Samarjeet Singh Siwal[1,*], Pariksha Bishnoi[1], Saptak Rarotra[2], Dai-Viet N. Vo[3], Vijai Kumar Gupta[4], Dave Robert[4], Vijay Kumar Thakur[4-7,*]

[1]*Department of Chemistry, M.M. Engineering College, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala, Haryana, 133207, India.*
[2]*Energy Research Institute, Nanyang Technological University, Research Techno Plaza, 50 Nanyang Drive, Singapore 637553, Singapore*
[3]*Center of Excellence for Green Energy and Environmental Nanomaterials (CE@GrEEN), Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam*
[4]*Biorefining and Advanced Materials Research Center, Scotland's Rural College (SRUC), Kings Buildings, Edinburgh, EH9 3JG, UK*
[5]*School of Engineering, University of Petroleum & Energy Studies (UPES), Dehradun 248007, Uttarakhand, India*
[6]*Centre for Research & Development, Chandigarh University, Mohali 140413, Punjab, India*
[7]*Department of Biotechnology, Graphic Era Deemed to be University, Dehradun 248002, Uttarakhand, India*
**Corresponding authors: samarjeet6j1@gmail.com, and Vijay.Thakur@sruc.ac.uk*

ABSTRACT

COVID-19 has intensified human suffering, undermined the economy, turned the lives of billions of people around the globe upside down, and significantly affected the health, economic, environmental, and social domains. This study aims to provide a comprehensive analysis of the impact of the COVID-19 outbreak on the ecological environment, the energy sector, society, and the economy and investigate the global preventive measures taken to reduce the transmission of COVID-19. This epidemic has caused severe demographic changes and unemployment, and economic activities have been shut down to save human lives. Transportation industries are most severely hit as global tourism has fallen to almost zero during these months. As a solution, financial institutes have introduced stimulus packages worth more than $6 trillion. However, restricted economic activities have also contributed to a cleaner environment. Here in this report, we have collected the literature based on the impacts of lockdown on (EEE); environment (such as; air pollution, water pollution, marine life, and wildlife, etc.), education (such as; positive drawbacks, and long-term effects) and economy (such as; GDP, street vendors, agriculture and food supply sector, and drug traffickers, etc.). Finally, we concluded our topic with affirmative and negative impacts of COVID-19 during the lockdown. To the best of our knowledge, this is a unique and one-of-its-kind review highlighting the essential impact of COVID-19 on the environment, education, and economy.

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1. Introduction

The environment has many affirmative effects on Corona Virus Disease-2019 (COVID-19). According to World Health Organisation (WHO), an estimated 4.2 million deaths per year were observed before the pandemic due to low air quality. During the lockdown, greenhouse gas emission is reduced. Due to this, the air quality and health are also improved. COVID-19 affects the environment, economy, and education system (Donthu & Gustafsson, 2020; Hepburn *et al.*, 2020; Pradhan *et al.*, 2021).

Governments worldwide took some steps to prevent the Corona Virus's spread. They gave guidelines such as quarantine, lockdown, wearing masks, etc. More common about the lockdown is that it ensures lasting affirmative impacts on the environment (Gorris *et al.*, 2021; Zambrano-Monserrate *et al.*, 2020). Skies are more apparent, and additional species of birds and aquatic animals can be seen. Even the water of rivers becomes more apparent, and more biodiversity is seen during the lockdown (Chowdhury *et al.*, 2021b; Sunny *et al.*, 2021). People remained inside their houses, and industries remained shut down; it provided great relief to nature and mother earth. Improvement in air quality has been shown together with reduced risks of COVID-19 (Siwal *et al.*, 2020b; Zhang *et al.*, 2021). Populated cities like New Delhi improved their quality of air and water. This pandemic changed our lives completely (Karuppasamy *et al.*, 2020). However, their drawbacks are also seen, like online purchases and more consumption of single-use plastics. Waste management is getting complicated, forsaking the environment and the durability of the program (Ncube *et al.*, 2021; Siwal *et al.*, 2021a). So, this pandemic has shown affirmative impacts and some drawbacks. It acts as a double-edged sword for the environment, which shows the overall effects of COVID-19.

A question arises: Why do the atmosphere and modernization always seem to contradict each other, or does the atmosphere lose its steadiness whenever any modernization occurs (Greenwood & Smith, 1997). Development is one of the reasons to destroy the environment because for the development of any nation, infrastructures and technologies have to be improved and to obtain all these, humans drastically damage the environment (Shah *et al.*, 2021; Sheoran *et al.*, 2022b; Siwal *et al.*, 2022a; Zulfiqar *et al.*, 2022). Transportation and chemical industries are the most suitable examples of daily life causing environmental pollution (Colvile *et al.*, 2001; Olah *et al.*, 2009). Different vehicles and chemical industries emanate poisonous gases such as carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2), etc., that drastically pollute the environment (Kaur *et al.*, 2022b; Rastogi *et al.*, 2022; Siwal *et al.*, 2021b; Siwal *et al.*, 2020a).

In China, an acute viral infection affecting the respiratory system was first reported in the last month of 2019, which is now known as novel coronavirus contaminated pneumonia (Singhal, 2020; Sohrabi *et al.*, 2020; Wu *et al.*, 2020). WHO declared it a global pandemic before January 2020 and named this acute infection COVID-19. Another name for this virus is severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), given by a Coronavirus Study Group (Gorbalenya *et al.*, 2020). The covid-19 virus affects the airway tract, gullet, snout, lungs, and sinuses (Contini *et al.*, 2020; Parvin *et al.*, 2020; Singh *et al.*, 2020). It can transmit from humans to humans and animals as well. The two main transmission paths are respiratory droplets, and close contact with patients is the primary transmission tool (Wang *et al.*, 2021b). Droplets of infected persons mixed with air can enter another person's body through inhalation.

The starting point of this virus was Wuhan City, from where it rapidly reached all parts of the world (Khan *et al.*, 2021). Many people lost their lives after getting this viral infection, while millions got infected. As per the WHO, up to May 16, 2020, due to coronavirus, about 4.62 and 0.3 million active cases and deaths were reported worldwide (Lotfi *et al.*, 2020). It caused deaths due to other health problems along with COVID-19, such as cardiac problems, diabetes, renal issues, etc. (Bradley *et al.*, 2020; Ogen, 2020). Lockdown slowed down the spread of COVID-19 infection and affected society. In this review article, we shed light on the optimistic and pessimistic effects of COVID-19 on the economy, education and environment globally.

As the lockdown conditions are released, countries try to patch their economies speedily. International students are now allowed to join their institute

back which helps them explore their field of study. A new variant named Omicron recently came into existence. Yet, the correct information about its symptoms and how severe it is from another variant of COVID-19 is not available.

2. Overview & history of COVID-19

Coronavirus disease, known as COVID-19, is a spreading disease. The coronavirus infected many people. In December 2019, there was a pandemic in a city in China named Wuhan. COVID-19 directly affects the human respiratory system (Brosnahan *et al.*, 2020; Hou *et al.*, 2020; Hua & Shaw, 2020). People who suffered from COVID-19 infections showed specific symptoms. However, in some cases, people without having symptoms also suffer from this infection (Jin *et al.*, 2020; Niu *et al.*, 2020). About 1/6th of patients showed severe issues such as difficulty in breathing. The condition became harsher for older people or having other health issues such as diabetes and cardiac diseases.

Common Symptoms

The most common symptoms of COVID-19 infection, as shown in Fig. 1, are fever, body pain, difficulty breathing, dry cough, fatigue, pressure in the chest, and loss of appetite. These symptoms are seen within 15 days when a person comes in contact with the virus. Other coronavirus symptoms include headache, painful throat, body shaking, and inability to taste and smell (Ciotti *et al.*, 2020).

The best way to control or slow down the spreading process of COVID-19 is to protect yourself from

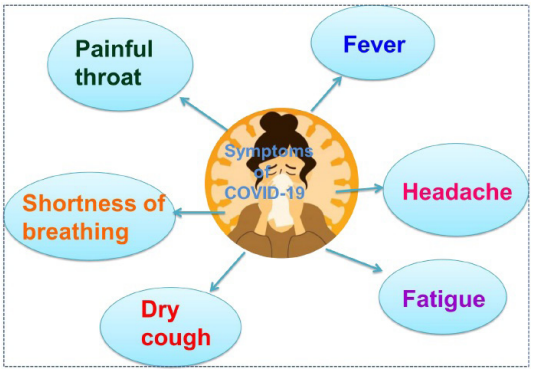

Figure 1. Common symptoms of COVID-19.

infection by following the guidance like washing your hands within a specific time of intervals, using a mask, social distancing, sanitiser, avoid to touching your face and intake healthy diet containing more amount of Vitamin C.

3. Positive impacts of COVID-19 on the environment during lockdown:

The lockdown is proved to be an opportunity to better the earth's atmosphere. Lesser domestic and industrial activities are the primary reason behind this improvement. Almost 90% of the people have been locked in their own houses. However, the natural outer world has persisted in blossoming, which implies our non-existence is advantageous for the natural environment. Here, in this segment, we shed light on some of the optimistic effects of lockdown on the climate, flora, and fauna.

3.1. Air pollution

We all know that the fresh air is not only good for humans but also animals. Because the fresh air improves blood pressure, boosts our immunity system, and reduces the chances of heart diseases. It also prevents lung cancer and many other conditions. The WHO estimated that globally, approximately seven million people die perennially due to air contamination (WHO 2020). During pandemics, people resided in their homes, which results in considerable enhancement in air quality due to highly reduced concentrations of CO, NO_2, particulate matter ($PM_{2.5}$, PM_{10}), and greenhouse gases (GHGs) (Ali *et al.*, 2021; Mostafa *et al.*, 2021). In turn, the concentration of ozone (O_3) drops sharply even in the most populated and biggest cities such as Wuhan, Beijing, Delhi, northern Italy, Paris and the urban cities of the USA (Bhat *et al.*, 2021). Fig. 2 shows the positive and negative impacts of COVID-19 on health, environment, economy, etc.

By comparing the data related to air quality, it has been observed that nearly half of the pollution intensity has declined in New York (USA). In China, the emission rate of toxic gases that causes air pollution has been reduced by nearly 25% and 30% for carbon and nitrogen emissions. The ministry of environment of China outlined that approximately 11.4% of the air was purified due to lockdown (Bhat *et al.*, 2021; Khan *et al.*, 2021; Martínez Rod, 2021; Constantinou, 2022).

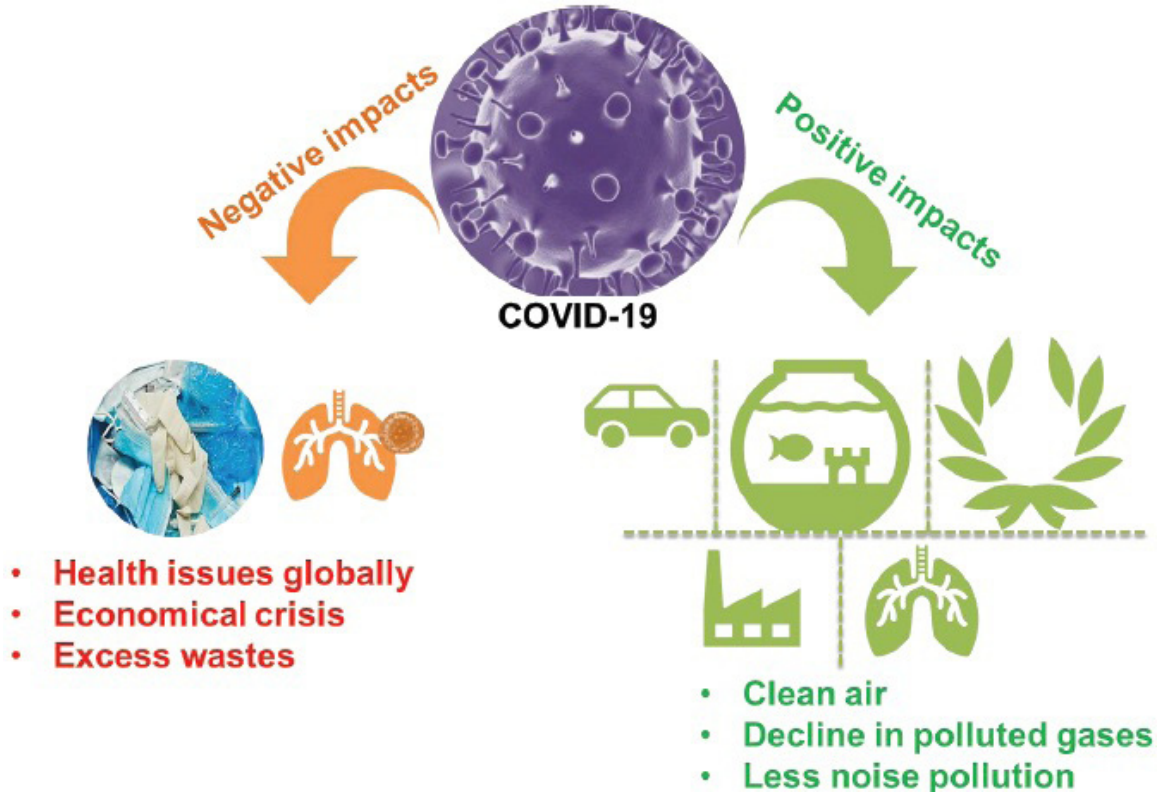

Figure 2. Positive and negative impacts of COVID-19 on health, environment and economy etc.

The smoke emitted from automobiles and chemical industries consists of toxic gases that mix with atmospheric air and contaminate breathing air. But found, the COVID-19 pandemic is a blessing to restoring the natural environment because of the restrictions imposed by the government authorities worldwide to control the growth of the virus (Bera *et al.*, 2021; Lokhandwala & Gautam, 2020). Climate scientists revealed that the level of GHGs in the atmosphere was dropped to the lowest ever since World War II (Nigam *et al.*, 2021). Balamadeswaran *et al.* (Balamadeswaran *et al.*, 2021) found that NO_2 in the atmosphere fell significantly during the lockdown. Few vehicles were running on the roads, and closed down industries. NO_2 is a poisonous gas, exceeded level of which can cause various breathing-related problems such as inflammation in the windpipe and Asthma. Mean dispense of different pollutants like NO_2, SO_2, $PM_{2.5}$, PM_{10}, and O_3 in two cities of India, Ankleshwar and Vapi, between March 25 and June 15 for session 2019-2020, is shown in Fig. 3 (Nigam *et al.*, 2021). The utmost drop in NO_2 is 80% and 91% in Ankleshwar in phase-2 and Vapi in phase-4, respectively. Ozone surged 192% in Ankleshwar and 310% in Vapi throughout phase 1 of lockdown. The reduction in the concentration of SO_2 was observed by 67% in 1st phase. In comparison, it reverts during unlock-1 by 28% in the case of Ankleshwar. In Vapi, it declined during phase 2 by -81% and rose by nearly 7% during phase 4. The range of $PM_{2.5}$ in Ankleshwar lay between -36 and -5% in the 2^{nd} and 5^{th} phase, respectively, while the decrease was observed during phase-4 and phase-3 by -48 and -19%, respectively, in Vapi. An identical trend was shown by PM_{10}; however, it did not decrease under 52% in Vapi and 295 in Ankleshwar. The concentration of CO surged continually by 120% in unlocking 1.0 in the case of Ankleshwar. In contrast, it changed from 132% to -38% in phase-1 and phase-3, respectively, in Vapi.

3.1.1. Particulate Matter (PM that is $PM_{2.5}$ and PM_{10})

Here is a term particulate matter, a dreadfully harmful form of air pollution. It is also known as a silent killer. Different types of PM are explained in Table 1. This is included in group 1,

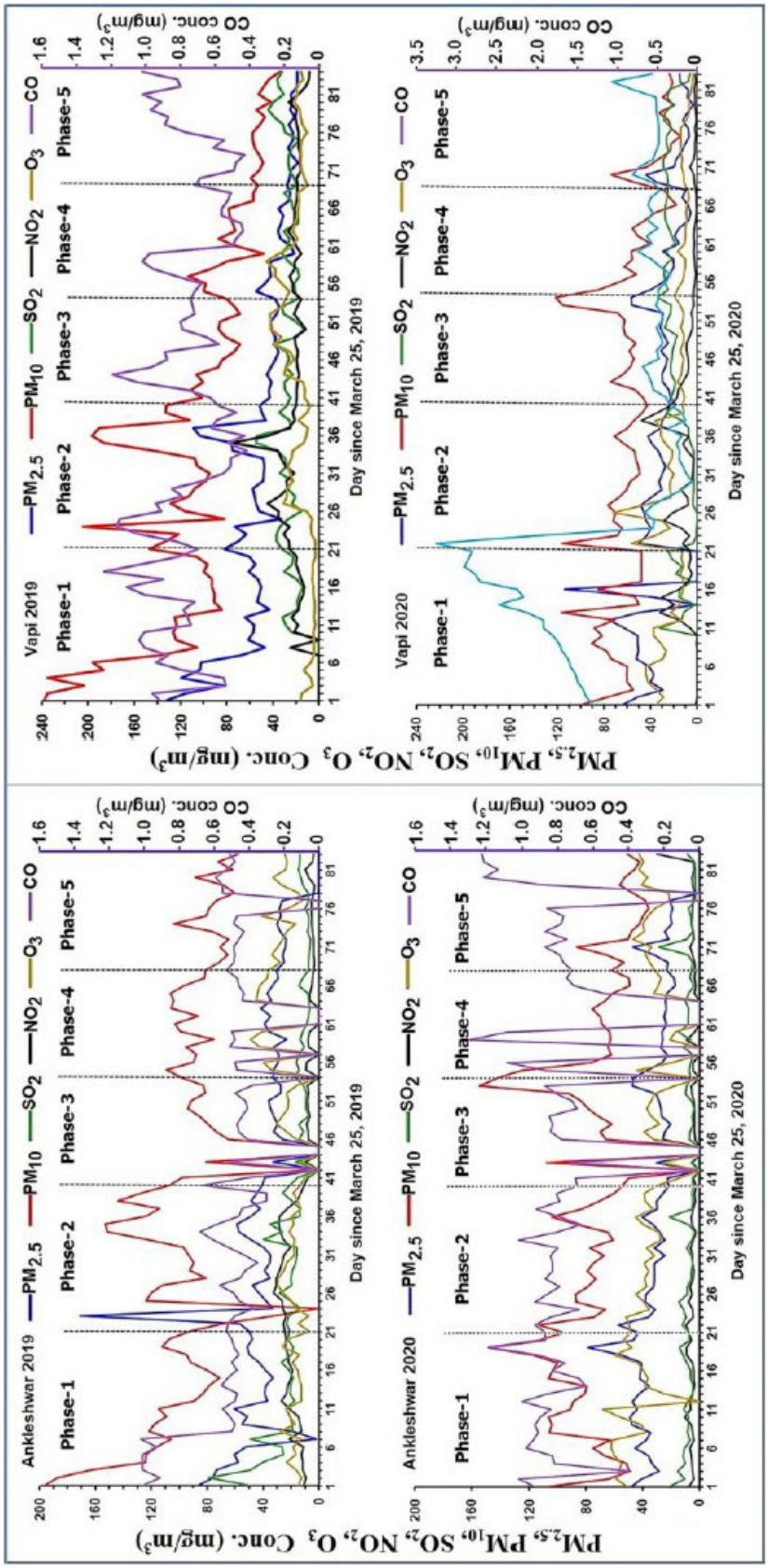

Figure 3. Mean level of air pollution concentrations from March 25 to June 15 for the years 2019-2020 (Reprinted with permission from (Nigam et al., 2021).

Flowing diameter	Particulate matter
< 10 mm	Thoracic Particles [PM_{10}]
< 2.5 mm	Fine Particles [$PM_{2.5}$]
< 0.1 mm	Ultrafine Particles
between 2.5 and 10 m	Coarse Particles [$PM_{2.5–10}$]

Table 1. Classification of particulate matters.

Carcinogen. Because of its minimal size can easily pass through the lungs to the bloodstream, which creates breathing struggles and cardiac arrest and early death. In various regions such as the USA, China and Europe, numerous reports have revealed the relation connecting COVID-19 with PM (Tung *et al.*, 2021). A higher level of mortality due to COVID-19 was observed in northern Italy than in other parts of the country because the north region is more polluted, having higher levels of $PM_{2.5}$ and PM_{10} (Martelletti & Martelletti, 2020). Epidemiologically PM could be considered a threat to the COVID-19 pandemic. However, its role in spreading the virus is not fully understood (Domingo *et al.*, 2020; Kumar, 2020). WHO predicted that $PM_{2.5}$ cause the death of above 4 million individuals per year globally as it causes numerous awful diseases. However, the positive news is that due to the lockdown, the $PM_{2.5}$ level is falling continuously worldwide (Khan *et al.*, 2021). This considerable reduction in air pollution is a diminution in transportation and industrialization.

Sources of PM

There are various shapes and sizes of PM consisting of different chemicals. A few particles are released from smoke, fields, construction sites, and unpaved roads. Cars, buses, and chemical industries emit smoke that contains toxic gases such as SO_2 and NOs; complex chemical reactions occur between these gases, which act as pollutants for PM. PM consists of minute solid particles or liquid droplets that can be inquired and become the reason for severe health problems. Several particles have a size below 10 mm, known as PM_{10}. In contrast, others have diameters below 2.5 mm, called $PM_{2.5}$, which can even enter the bloodstream.

3.2. Water pollution

Along with air, water sources also became more evident. A suitable example is the Ganga River of India, which showed significant improvement on numerous parameters during COVID-19 due to the stoppage of the waste from industries and commercial activities. In a lockdown, it has been observed that districts which fall under the Ganga basin (Casado-Aranda *et al.*, 2021; Surinaidu *et al.*, 2020) experienced surplus rainfall (about 60%) as compared to normal, as shown in Fig. 4. This results in a decreased concentration of water pollutants by reducing the concentration of nitrate (NO_3^-), biological oxygen demand (BOD), and surged amount of oxygen that dissolved into water (Dutta *et al.*, 2020). It improved the self-cleaning characteristics of rivers with an enhancement in water quality. Usually, untreated or moderately treated wastewater, either from industries or domestic activities that reach rivers, results in rigorous deterioration of water quality. Over the past few decades, the government has spent millions of dollars on improving the water quality of waterways but did not succeed much. In a lockdown, nearly 1300-1340 million litres of reduction in wastewater from industries were observed each day, and river water became fit for drinking purposes (Kaur *et al.*, 2022a; Loh *et al.*, 2021; Siwal *et al.*, 2022b; Siwal *et al.*, 2021c). A 40-50% improvement has been observed in the water quality of the Ganga". It is estimated that per day approximately 40 million litres of wastewater enter the rivers and other water sources in which only nearly 37% is adequately used. Within ten days, improvement in the water quality of Ganga was seen after lockdown (Muduli *et al.*, 2021). The leading causes of the poor water quality of Ganga include domestic waste from neighbouring villages and towns and industrial waste play's central role in the water pollution of this holy river of India. During the lockdown period, almost all industries remained shut down; they did not enter the waste materials into the Ganga, which meant zero pollution from industries and improved water quality. Other reasons such as fairs, bathing, tourism and ghat curtailed were also negligible

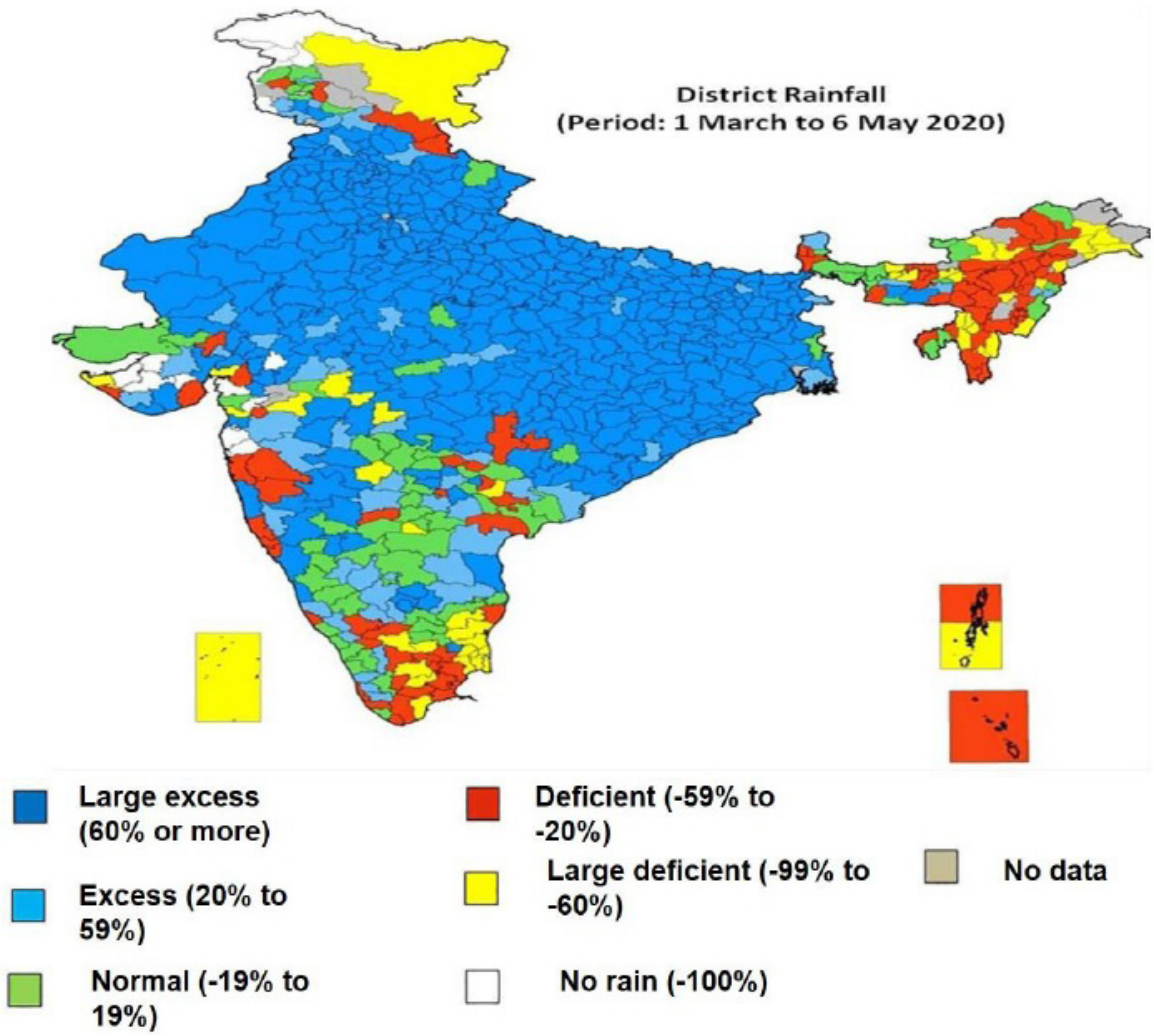

Figure 4. Heavy rainfall under Ganga Basin (Reprinted with permission from Dutta et al., 2020).

during the lockdown. An enhancement in the water quality of Yamuna River was also seen. The amount of dissolved oxygen in the river's watamount of dissolved oxygen in the river's water is 5 mg/L (Patel *et al.*, 2020). During the COVID-19 pandemic, water sources worldwide become more evident and cleaner. In Italy, the water of the Venice canal has become more prominent than past due to a reduction in tourists, water activities, and sediment churning (Saadat *et al.*, 2020).

3.2.1. Key water pollutants that influence the Immune system in living beings

Water quality is a paramount concern in the modern era because the number of clean water sources in the world is inadequate. The surging population is related to the enlargement of the manufacturing, pharmaceutical, and chemical sectors, raising the prospect of exposure to chemical compounds mainly utilizing water (Quinete & Hauser-Davis, 2021). Obtaining fresh water for our daily needs is essential to a healthy lifestyle. Some widespread H_2O pollutants are As, Pb, and Hg. They also contain chemicals such as phthalates and poly-fluoroalkyl substances (PFAS). Pollution of drinking water is not the latest hitch; it causes various water-based diseases (Levantesi *et al.*, 2012; Luby *et al.*, 2015). Chief water pollutants which have awful effects on the immune system are not increased as anticipated throughout and later than the COVID-19 pandemic due to fewer chemical industrial and agricultural proceedings.

Major metals that pollute water

Various metals which contaminate drinking water have been reported as water pollutants that cause severe health risks to humans (Muhammad *et al.*, 2011; Ravindra & Mor, 2019). Cu and Pb can be retained from water pipes. Pb causes numerous health problems such as blood disorders, neurological disorders, and cardiac and renal diseases in adults and children. It also affects the immune system, particularly in youngsters. The maximum contaminant level for Pb in water revealed by the United State Environmental Protection Agency is $0.005 mgL^{-1}$. But some studies showed that even a low concentration of Pb in drinking water harms human health. Hence, there is no safe level of Pb contamination (Haefliger *et al.*, 2009; Sheoran *et al.*, 2022a). Disclosure of Cu at deficient concentration can affect the production of genetic mutations, the tendency to produce cancer, infertility, and immunocompromised (Radbin *et al.*, 2014). The maximum contaminant level for Cu in drinkable water is $1.3 mgL^{-1}$. Arsenic contamination is related to undesirable effects on diabetes, cardiovascular diseases, kidney failure, cardiac arrest, cancers, pregnancy, and mortality of infants. It also negatively impacts the respiratory tract (Farzan *et al.*, 2013) as it is used as an alloying agent in textile, glass, paper wood, and metal adhesive processing. The maximum contaminant level of as in drinking water is $0.010 mgL^{-1}$. The maximum contamination level for Cd and Cr (VI) in drinking water is $0.005 mgL^{-1}$ and $0.05 mgL^{-1}$, respectively. Exposure to Cd has been correlated with damage to the heart and circulatory system, kidney and neurotoxicity, diabetes, cancer, and organ failure. In contrast, Cr (VI) exposure harms the liver, ventilatory and immune system (Satarug *et al.*, 2010; Shipkowski *et al.*, 2017; Shrivastava *et al.*, 2002).

3.3. Decreasing demand for oil

The oil market is indispensable as one of the world's energy sources. Oil demand is shattered globally as COVID-19 restricted the people of all nations to stay at home and avoid unimportant travelling. More than $2/3^{rd}$ of the global population stays in their homes during lockdown time, which means zero industrial activities and transportation processes were locked up except for emergency needs. Crude oil used as fuel is one of the significant reasons for air pollution. There was excess usage of automobiles before the pandemic that considerably contributed to environmental pollution. Due to COVID-19, people have stayed in their homes, and negligible vehicles were seen on roads which had an optimistic impact on the environment. The coronavirus crisis affects a wide range of energy markets–including coal, gas, and renewable but its impact on oil markets is particularly severe (Chang *et al.*, 2020; Hoang *et al.*, 2021). Dr Fatih Birol, Executive Director of IEA, stated that due to limitations on the movement of people and goods worldwide, demand for transport fuel declined. This was especially true in China, the largest energy consumer globally, which accounted for more than 80% of global oil demand growth in the past few years. Global oil demand decreased during the COVID-19 pandemic compared to the period before lockdown (Adedeji *et al.*, 2021). The change in oil price depends on the interlinkage between the demand for oil and its supply. Uncertainty in oil demand surged due to the risk of transfer of virus globally; government authorities insisted on shutting down the significant oil industries. As a result, this pandemic led to a considerable downturn in oil demand (Bourghelle *et al.*, 2021). The oil demand was previously seen at this rank in 1995 (Norouzi, 2021). The changes in oil price from 2000 to April 2020 of a company named West Texas Intermediate are shown in Fig. 5.

Nowadays, lockdown is open in almost every part of the world with cautions such as wearing masks in public places and using sanitizers. Transportation is again on the same track, although with a slow pace. Therefore, it is expected that the oil demand will surge again to the same level as before the pandemic.

3.4. Fruits and vegetable market

The spread of the COVID-19 virus has negatively impacted all food markets, including the fruit and vegetable market. Difficulties were faced in finding, scheduling and guaranteeing the safety of workers as the pandemic began before the harvesting season of various veggies and fruits. Administrative authorities urged to restrict the movement across countries, consequently shutting down the import system. Therefore, growers, retailers and workers face a financial crisis during lockdown (Aday & Aday, 2020;

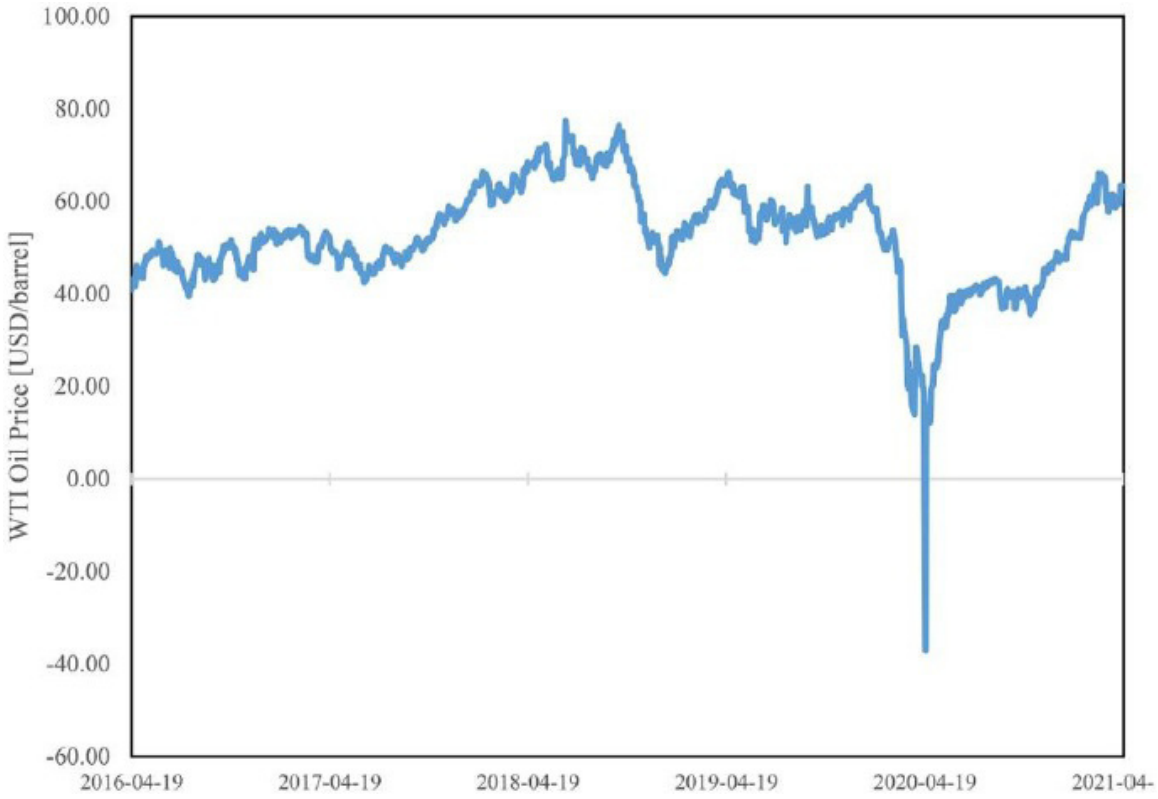

Figure 5. The oil price changes from 2000 to April 2020 of a West Texas Intermediate company (Reprinted with permission from.

Richards & Rickard, 2020). However, the inclined trend was observed for online grocery shopping. Conventionally, most people did not prefer online grocery shopping. Instead, they chose to buy fruits and vegetables from the market by visiting. Multinational companies such as Amazon had to establish their delivery network system in the grocery sector. However, workers were not available in much quantity, and owners of small stores could not expand their delivery network to fulfil the demand for online grocery shopping.

Again, it had some positive effects on the environment due to the restricted use of automobiles. At the same time, people rush to the markets in vehicles almost every day.

3.4.1. Disruption of trade channels

COVID-19 widespread produced disturbance in supply and demand across the globe. The lockdown disrupted the trade patterns, production system, and consumption (Hayakawa & Mukunoki, 2021; Arencibia-Jorge *et al.*, 2020; Santos Rocha & Ferreira Araújo, 2022). Industries (importing and exporting) were closed worldwide during the pandemic, which led to a dwindling global value chains (GVCs) trend. Within the first half of 2020, nearly 30% of international trade was decreased. Closed domestic shops resulted in reduced domestic production, negatively impacting trade flow. Trade channels depend on numerous organizations such as exporting-importing associations and domestic organizations of different countries. Fig. 6 represents the basic systematic outline of trade growth, focusing on manufacturing, competition and expenditure channels (Espitia *et al.*, 2021).

3.5. Wildlife

Wildlife around the globe suffered significantly, whether due to traffic on roads (road kills) or some other factors before the pandemic. It has been roughly calculated that around 29 and 194 million mammals and birds are killed on roads in Europe. Most decreases in the wildlife-vehicle collision were observed in Spain, Israel, and Estonia during the first week of COVID-19-related traffic flow reduction

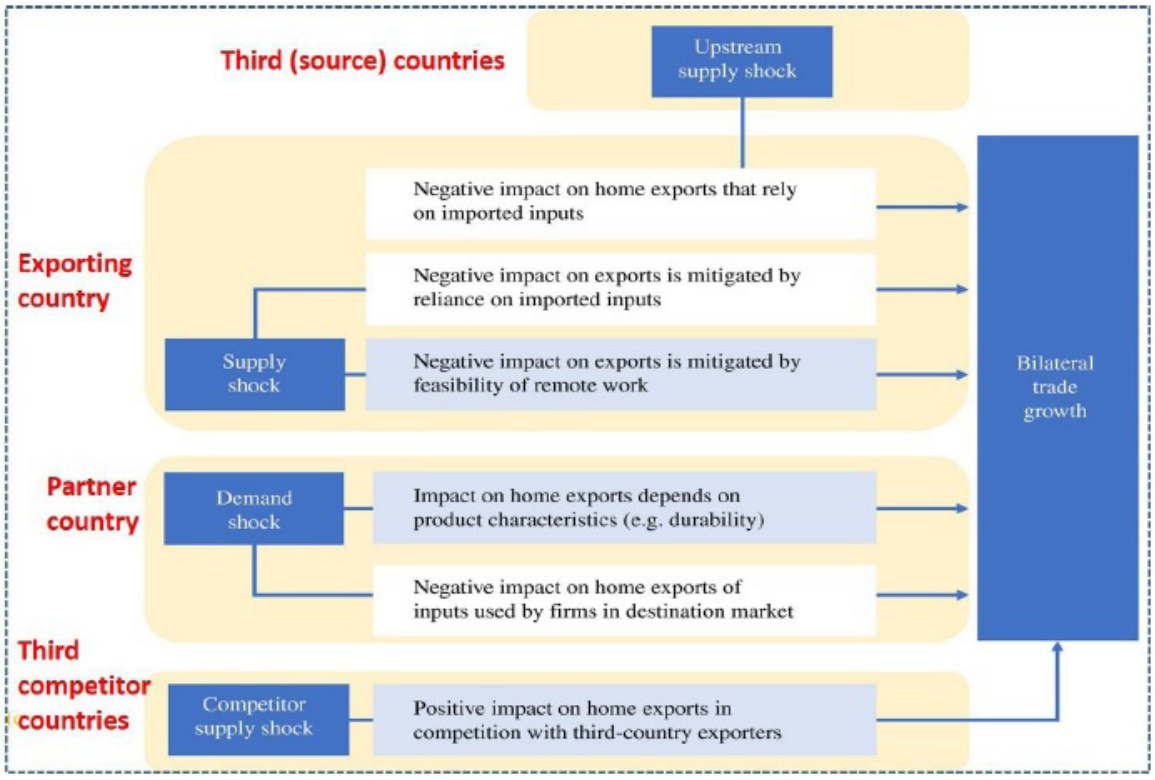

Figure 6. Systematic diagram representing the basic outline of trade growth (Reprinted with permission from Espitia *et al*., 2021).

(Bíl *et al.*, 2021; Paital, 2020; Schwartz *et al.*, 2020). Domestic activities which create noise reduce the number of birds chirping around local houses. Due to the COVID-19 lockdown, there was less traffic on roads and a reduction in a noisy environment, which leaves an optimistic impact on natural habitats and wildlife. More birds were seen chirping around houses in rural and urban areas, and animals were usually not found in local areas. That species can also be seen roaming in cities on roads during the lockdown period. For instance, mountain goats were seen wandering on the streets of Llandudno; spotted another piece of evidence in Hyderabad, Delhi, where a leopard was lying on the road (Bar, 2021). Animal also diminished hunting as people were restricted to staying at their homes. As a result, the wildlife population can be increased and is helpful, especially for endangered species. Fig. 7 shows the animals on the roads during the lockdown period.

Besides the positive impacts of lockdown on wildlife, there were some negative impacts, such as less or non-availability of food. The food crisis was more pronounced in local street dogs, cows, cats, crows and free birds, which depend

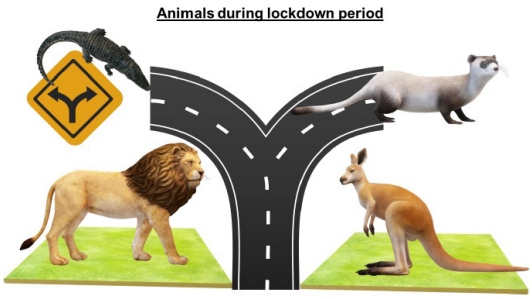

Figure 7. Animals on the road during lockdown period.

on the people of the locality and tourists for their food. Shortage of food is also one of the reasons for the wondering of wild animals in residential areas. There was a significant drop in the number of tourists in conservation parks which directly affects the economic system of these parks and forests. However, some government authorities took steps, making food available to animals.

3.5.1 Impact of intestinal flora

Intestinal flora is closely related to respiratory virus infection. It may influence the occurrence

and development of diseases through the gut-lung axis. Thus, the gut microbiota may play a potential role in treating lung diseases. Novel COVID additionally affects intestinal greenery. Contrasted and sound controls, COVID-19 patients had fundamentally diminished bacterial variety, a significantly higher relative bounty of short microbes. The gut microbiome of the COVID-19 gathering was overwhelmed by Streptococcus*, Rothia, Veillonella, Erysipelatoclostridium*, and *Actinomyces*. However, the microbiome of the well-being bunch was dominated by the genera *Romboutsia, Faecalibacterium, Fusicatenibacter*, and *Eubacterium hallii* bunch. Simultaneously, patients with COVID-19 were portrayed by sharp microorganisms' advancement and useful commensals' consumption. The pattern bounty of *Clostridium ramosum, Coprobacillus*, and Clostridium hathewayi related to COVID-19 seriousness, while the wealth of *Faecali bacterium prausnitzii* (a mitigating bacterium) was adversely connected with illness seriousness. *Bacteroides thetaiotaomicron, Bacteroides massiliensis, Bacteroides dorei, and Bacteroides ovatus* related contrarily with SARS-CoV-2 burden in faecal examples from patients all through hospitalization. Undoubtedly, collecting proof demonstrates that microbiota can balance the invulnerable reaction throughout both bacterial and viral contaminations, turning into a possible objective in administering every one of these sicknesses. The new pandemic instigated by COVID-19 advised us that the expected worth of the gut microbiota might be a remedial objective for COVID-19. It could be feasible to glance in the gut for an answer or alleviation of SARS-CoV-2 contamination.

Yet, there has been no systematic review and meta-analysis of studies reporting the relationship between COVID-19 and intestinal flora. A better understanding of the relationship between gut microbiota and COVID-19 to derive appropriate targets for prevention or treatment is needed. Therefore, we aim to ascertain the association between COVID-19 and intestinal flora that will facilitate the management or prevention strategies of COVID-19 (Saadat *et al.*, 2020).

3.5.2. Marine life

Human activities such as shipping, large-scale fisheries and leisure activities in seas and oceans deeply affect marine life than we realize by creating sounds and polluting the water. Industrial waste and agricultural run-off that directly or indirectly flows to seas or oceans threaten marine species (Mathavarajah *et al.*, 2021). We can remove these threats by diminishing these disturbances. Maritime shipping significantly supports ocean noise (Thomson & Barclay, 2020). From the day of the declaration of the COVID-19 lockdown, there has been limited marine fauna transportation and shipping. This led to less underwater sound; oceans became quieter and marine species could respite from the noisy environment. A more tranquil setting benefits cetaceans (dolphins and whales) because they use echolocation to find food, family, and communication. Due to the shutdown of industries, poisonous waste did not flow to water resources, which helped flourish aquatic life.

On the contrary, disposable plastic such as plastic bags and personal protective equipment was increased. Marine species can also be affected by plastic. Sometimes, these plastic pieces can be mistaken for food when they enter the ocean. One such example is the face mask foundat the Magellanic penguin was found dead, and the face mask in his stomach, as shown in Fig. 8 for his death (de Sousa, 2021).

4. Drawbacks of the pandemic on the environment

There are numerous drawbacks of a covid-19 pandemic to the environment, such as increased organic and plastic waste, the stress of being quarantined, and the fear of getting the virus was faced by people. Single-used plastic was the primary source of environmental pollution during the pandemic. Here, we elucidate these issues one by one.

4.1. Increasing the non-recyclable waste

To prevent the spread of the COVID-19 virus, different countries worldwide adopted some guidelines, including facemasks, PPE kits and gloves, etc. There has been an immense growth in facemask production globally; the market value of facemasks increased to 166 billion USD in 2020 compared to 2019 (Chowdhury *et al.*, 2021a). These guidelines proved to be a practical approach to slow down the spread of

Figure 8. Dead Magellanic penguin and facemask found in his stomach (Reprinted with permission from de Sousa, 2021).

the coronavirus but, at the same time, became hazardous to the environment. With the rise in production and using PPE kits and face masks, the execution of these plastic products has become a concern for all countries. They did not suitably plan a management system to handle solid and pandemic waste in developing and developed countries (Aragaw, 2020; Samuel & Garcia-Constantino, 2022). These face masks break down into small pieces in less than 5mm environments and contribute to microplastic pollution (Zhang *et al.*, 2021). These tiny particles enter water sources and landfills, quickly entering the food chain. Microplastic consumption has harmful effects on all living beings. As we all know, plastic materials take a long time to decay and continue to exist in the environment for hundreds of years.

4.2. Increasing Organic waste

Industries and government authorities seized the ban on single-use plastic items to prevent virus contamination because reusable items had more chances of transmission of the COVID-19 virus. Further, the demand for online shopping (whether the grocery or medically usable products) surged sharply during the lockdown. Single-use plastic bags or packaging were used for home delivery as single-use plastic is cheap and durable. Every minute approximately 10 million plastic bags are used by people worldwide (Filimonau, 2021). Consequently, medical and domestic waste has increased, as shown in Fig. 9, to a great extent that has detrimental effects on the environment.

4.3. Familialism: Challenges within the families

Lockdown effect human-beings psychologically as the COVID-19 pandemic led to the rearrangement of life every day. Family members had to deal with anxiety, stress, and reduced life quality due to quarantine and workforce (Luu, 2021). Pressure on parents was amplified as they had to take care of their children's home-schooling and work from home for their companies or institutions to keep their jobs. There was a fear of being at risk and losing family members who had the most significant possibility of being infected by the virus. It results in enormous psychological trauma in human beings. Some people even committed suicide under the stress of COVID-19 infections

Figure 9. Domestic waste of single-used plastic products.

due to the lack of emotional support because family members and friends were restricted from meeting with patients.

Another pressure on families was financial conditions. Joblessness, uncontrollable debts, and declined earnings put mental stress on parents or the families' earning members, significantly influencing the relations between family members. Dwindling socioeconomic status also contribute to disrupting relationships among people (Fegert *et al.*, 2020).

4.4 Trouble in working from home

4.4.1. Hindrance in network connectivity

Due to an unprecedented increase in online traffic consisting of online educational classes, entertainment and societal communication, and official work at home, most telecom suppliers faced troubles with surged demand (Favale *et al.*, 2020; Gutiérrez *et al.*, 2022). Subscribers were dealing with bandwidth problems, which repeatedly caused trouble in online video conferencing get-together inconceivable. Due to the restriction imposed by government authorities during the lockdown, technicians were not permitted to visit the areas troubled with a slower internet connection. Consequently, it could not solve network issues, and hindrances in online activities remained in those areas.

4.4.2. Non-availability of spares

No one was prepared for the lockdown at its announcement, so they didn't assemble electronic accessories such as cell phones, extra chargers and other portable devices. Many people faced troubles with their laptops and mobiles, and there was a need to repair spare parts, but due to the shutdown of service stores, they did not get any help from technicians. Furthermore, the problem was that only essential items were allowed to deliver by e-commerce companies. Information and communication technology products, unimportant items, cannot be bought through online services.

4.4.3. Insufficient communication

In an offline system, loads of contacts can take place casually, like during tea or coffee breaks. These options are not accessible in an online work atmosphere except for video conferences that contribute a little bit in this direction.

However, still, remote meeting usually is formal. The communication gap impacts the overall performance of employees due to the lack of understanding between them (Li *et al.*, 2021). Comprehensive and familiar communication with managers leads to better performance by understanding the needs and expectations of employees and consumers. The majority of managers are not sufficiently trained to do so in an online mode.

4.4.4. Enlarged working hours

There is no apparent difference in domestic activities and work time in an online work system that creates complexity in establishing an appropriate work routine, thus negatively impacting the output. The diminished limitations between private and professional lives were with the enlargement of working hours beyond regular employment hours. It profoundly affected women as they had many responsibilities of handling children, family members and official work together.

4.4.5. Surged time on screens

Throughout the lockdown period, as online modes almost worked, there was a considerable increase in screen time and working hours. An elevated screen time causes various ailments related to vision, such as dry eyes, blurred vision, and headaches due to radiation-emitting out from computer screens. Moreover, it acts as a risk factor for obesity as people used to sit continuously facing the computer screen for hours.

5. Impact on Education

5.1. Positive impact of COVID-19 on education

Due to the spread of COVID-19, colleges, schools and universities were closed. Educational institutions switched to e-learning from face-to-face teaching and learning system. The classes were conducted online through various apps and video callings, and students even learned from u-tube (Shahzad *et al.*, 2021). Teachers and students have enhanced their digital knowledge and moved towards computerized advances. Digital platforms came to light which was not recognized before the pandemic. The outbreak of COVID-19 provided a chance for a new framework of education from a traditional offline mode that might be considered an optimistic effect of lockdown. Informative organizations moved towards mixed ways of learning. It boosts energies among all teachers to learn something more innovative and changes their perspective on delivering the knowledge. A better approach for transference and appraisal of knowledge opened immense liberties for a noteworthy change in educational development and teaching techniques. Lock-down brings digital literacy globally (Nash, 2020).

5.2. Drawbacks of COVID-19 on education

The education segment has faced many problems during the COVID-19 pandemic due to the shutdown of educational institutes. It has produced pessimistic impacts on studies. Classes were suspended, and annual exams were postponed even at higher levels. Numerous entrance tests of prestigious medical and engineering institutions were cancelled, resulting in the dilation of admissions. Pupils were lacking in understanding the practical work that gave problems to students in future, especially in medical and engineering fields where practical knowledge is a significant concern. Students had difficulty resuming educational institutes after a considerable gap (Choi *et al.*, 2021).

Schools play a paramount role in the development of children; it raises social and moral values among children. Pupils not only study but perform various activities together, such as sports, which grow their social and mental abilities. However, through remote studies, they missed all this that reduces the overall growth of a child. In addition, the online method puts more pressure on parents of school-going children, and it might disturb parent-child relations (Preeti, 2020). In the case of higher education, the primary concern that came into the mind of graduates and postgraduates was employment and fear of the removal of employment offers from the private sector. In India, cancelled government-sector exams were, so unemployment was a critical issue during the pandemic.

5.2.1 Long-term challenges

Students who passed their exams through online mode or even without giving exams (in the case

of India at the starting of the transmission of a COVID-19 pandemic) would face problems in getting jobs. Online examination reduces the quality of students' degrees. It may happen that these students would give less preference than students who have degrees before and after the lockdown period, especially in the private sector. In such cases, scholars having more potential can face trouble. To rationalize the long-standing challenges, there is a need for a robust system that encounters these troubles.

(a) Implement learning revitalization programs
It must be ensured that there should be a directory prepared considering the students plunged behind in school learning. These students should be given the necessary encouragement to fasten up to the anticipated learning targets.

(b) Protect the education budget
Moreover, it is necessary to safeguard the education budget for stability in recovery. The schools in dire need of financial support should be advocated for and endorsed. To ensure the vulnerability of indigent students, governments should prioritize COVID-19 funding and resources to support these students. To promote school studies, incentives such as scholarships should be given to bright students.

(c) Prepare for future alarms
Presently, it's essential to recover from this pandemic situation and utilize this experience to grow better equipped for future calamities. Countries must develop and provide blended versions of education soon. Educational institutes must be ready to change quickly between face-to-face and online instruction. The preparation will safeguard student education during pandemics and other school closings, for example, natural disasters or unpleasant weather incidents. Short exercise courses are employed to improve their digital skills. It is necessary to construct a future education system that can be used in the post-pandemic period to provide more individualised education methodologies.

6. Impact on Economy

COVID-19 had adverse effects economy of developed as well as developing countries. The global shutdown negatively affected the financial sector as exporting importing system was stopped. Various companies were forced to stop production to control the spread of the COVID-19 virus. The pandemic lockdown did not affect industries such as coal, soda, agricultural, pharmaceutical and computer software. In contrast, hotels, restaurants, petroleum, and aircraft industries suffer more than the former (Chen & Yeh, 2021; Wang *et al.*, 2021a).

For years, if not centuries, people have tried to remain undetected by the government to avoid paying taxes or not to attract attention to illegal activities. As a result, a so-called shadow economy was formed that, on average, represents around 15-20% of the gross domestic product in advanced economies and about 30-35% of GDP in emerging economies (Kubiszewski *et al.*, 2013).

Many mistakenly believe it mainly consists of trafficking, unrecorded hard-cash deals, prostitution, illegal trades and drugs. All economic actions that are secreted from administrative authorities for financial or institutional motives contribute to the hidden economy. Thus, if your neighbor cuts your hair for money and you do not report it, this can be considered a part of the black economy.

6.1. Street vendors

Obviously, during the quarantines imposed due to the COVID-19 pandemic, it was impossible for street vendors to work, as they would risk being fined if the police saw them. All the stimulus packages approved by government authorities went to companies in the private sector to motivate them to keep their employees' jobs during the pandemic crisis. But most denizens of the shadow economy did not benefit from this. Greece, for example, has suggested the self-employed €800 (US$940) a month if the calamity lasts, provided they pay taxes. However, it is impossible without financial help (Tilaki *et al.*, 2021).

6.2. Agriculture and food supply sector

Several non-formal workers in the cultivation and food supply area lost their work because of the lockdown throughout the COVID-19 pandemic. According to the Food and Agriculture Organization of the United Nations, the shutdown of the marketplace and educational

institutes led to a drop in selling and purchasing opportunities. They decreased the demand for farming foodstuffs, thus lessening the need for farming labour (Larue, 2020). Other people, such as hairdressers, real estate agents and handypersons who could find work on the side because they had the contacts and access to equipment, survived this crisis.

6.3. Drug traffickers

In the case of traffickers, some drug supply chains have been disrupted, forcing them to search for alternative routes. With restrictions on air travel, synthetic drugs, such as methamphetamine, suffered a particularly drastic effect. Packaging vast loads of drugs into fewer container ships suggests that drug lords were prepared to take high-level chances to deliver their products. According to Bob Van Den Berghe, a senior law-enforcement officer at the United Nations Office on Drugs and Crime (UNODC), "Based on seizures of bigger-than-usual shipments of cocaine, it would be fair to say that Europe was flooded with cocaine ahead of lockdowns (Bergeron *et al.*, 2020)." At least they were creative enough to benefit from the information that Europe continued to trade in fruits, veggies, and other goods from South America. 5-ton cocaine cargo grabbed in port was hidden in a cold storage box containing squid from Latin America. However, drug shortages have triggered an increase in pharmaceuticals such as benzodiazepines. However, Dark Web Marketplaces (DWMs) have gained significant traffic during the COVID-19 pandemic. There was an enhancement in the sales of false medicines and diagnostic tests for the disease. It is also expected that initial delays in the availability of a cure and/or vaccine will dramatically increase public interest in the online shadow economy, posing concrete risks to public health. In conclusion, the shadow economy has also suffered during the COVID-19 pandemic. However, those people who could find alternative forms of work under lockdown managed to survive. As for everyone else, thousands of people lost their earnings, and who knows when things will return to normal. One of the concerns is that such money problems could spill over into unrest and protests. In this context, criminals and gangs might take advantage of the situation and recruit new members in exchange for financial assistance (Tobías *et al.*, 2020).

7. Second wave of COVID-19

The starting of the year 2021 has shown us the harsh reality that the COVID-19 calamity is far away from the end. In the last fifteen days of 2022, Boris Johnson, the prime minister of Britain, declared that a new strain of COVID-19 pandemic was acknowledged in Britain, which was 70% more spreadable and dangerous than the previous one. As a result, more complex rules were applied to lockdowns in the United Kingdom and other countries. The first few days of 2021 recorded massive cases, which were approximately 3,00,000 only in the United States, the uppermost ever recorded COVID-19 points for a particular day. It rapidly showed its effects in other parts of the world. Up to March 2021, India reported almost 40,000 fresh COVID-19 cases, nearly 78% more than the previous month's (Sv *et al.*, 2021). Consequently, the lockdown was re-established. Once again, shut down the schools, universities and industries, but this time retained it for a shorter period. This second wave was ascribed as a delta variant. Last year on 28 November, B.1.1.529, a new variant of the corona was attributed to Omicron which was the third wave. Several states re-enforce night curfews to restrict the spread of the virus (Pawar, 2020). A report revealed that Omicron is nearly seven times more contagious as compared to delta variant. However, the number of deaths and cases had declined, and serious aggravation was not found among the people infected by Omicron (El-Shabasy *et al.*, 2022). Overall, delta and omicron variants have more negligible effect on the environment, economy and education than the first wave.

Vaccination began in India in March for people over 60 and the topmost tycoons. They got their first dose in March 2021. Nearly 60 million individuals were vaccinated with the 1st doze at the last of the month. For the people aged 45 and above, the vaccination was started on 1st April. By the end of July 2021, almost 1/4th of the population of India was vaccinated (Foy *et al.*, 2021). Administrative health officials have said that both vaccines are currently being arranged in India. The Oxford-AstraZeneca vaccine manufactured by the Serum Institute of India as Covishield and Covaxin manufactured by the Bharat Biotech-Indian Council for Medical Research of India is helpful against the U.K. and Brazilian variants. Now it is found to be effective against all types of COVID-19 variants.

8. Conclusion and outlook

This study revealed that the COVID-19 pandemic dramatically affects all aspects of life, including health, education, economy, and the environment. COVID-19 has a long-lasting effect on people's lives all around the globe. It demonstrates a dramatic notion of the international and domestic transportation system. Along with it, lockdown decreased the economic circle in the world, which resulted in the shutting down of the manufacturing units and international trading.

The universal education division, which was previously sluggish to modify, has glimpsed a tremendous conversion with varying job geography, technical disorders, and the need for quality schooling. The pandemic generated additional surprises to the design, with academies moving to shut down during lockdown and the growth of scholars and professors to virtual classes. In India, about 250 million pupils were impacted owing to school closures at the beginning of the lockdown caused by COVID-19. The pandemic posed several general and private academic challenges, such as an anticipated elevation in dropouts, understanding losses, and increased digital range. The pandemic also named into query the society's enthusiasm, like faculties, to handle this situation and the sustainability of private academies.

Nevertheless, COVID-19 also played a catalyst towards virtual implementation in academy teaching. With academies reopening in numerous forms, they must make a thorough strategy to smoothen children's evolution back to school behind more than 15 months of home-based education. This transition has to consider the learning failures over the last year and accept a futuristic strategy to create a resilient approach that can oppose genuine amazement.

Residents worldwide are driving reliable endeavours for reducing viral communications and preserving human fitness. The pandemic prepares us that the exact promise must be committed to defending and maintaining the healthiness of Earth. Selecting better endurable activities for the planet describes the most significant hurdle towards the future of society. Currently, activities like sustaining the healing and growth of affected districts, preferring the stability of shore ecosystems and protecting their usefulness are intensely advised. Paradoxically, the public lockdown ensuing within numerous nations restricts the opportunity of conducting thorough and quantitative investigations of the consequences of lockdown. However, the mixture of media data and scant monitoring data clarifies the sophistication of lockdown effects on the multiple aspects of biodiversity. All the details must be fast documented and catalogued worldwide to generate immediate reactions to recent and forthcoming challenges towards nature protection, as already bore upon in medical and financial cases. The lockdown would have substantial economic and social effects in the long term, potentially disabling our ability to achieve good managing and protection efforts. Nevertheless, maintaining biodiversity preservation marks must be critical to the administrations. We should like to preserve the operations and support the functioning of the biosphere.

Guidelines that encourage endurable consequences and secure municipalities may implement suggested steps like social distancing and self-isolation, fetching a public benefit quickly. It is required to set preventative epidemiological standards to notice the happening of viruses like COVID-19 in the early stage. Additionally, administrations, policymakers, and stakeholders worldwide must take meaningful actions, like providing healthcare assistance for all residents, helping that functioning in frontline assistance and sorrowing substantial economic effects, confirming social distancing, and concentrating on assembling an endurable destiny. It is also suggested that more asset is needed for investigation and evolution to overwhelm this pandemic and stop any similar concern in the coming days.

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