

REVIEW ARTICLE

Indirect Impacts of COVID-19 on the Environment: A Global Review

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Abstract

Coronavirus (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus, which has plagued the Earth for the past two years and brought much controversy along with it. This report aims to analyze how the Covid-19 pandemic has had indirect effects on the environment. The onset of the pandemic has not only caused havoc disrupting routine average and businesses, but also claimed at least five million lives worldwide. This prompted the governments and the World Health Organization (WHO) to formulate measures to contain the transmission and the impact of the disease on the populations. Quarantine measures, movement

restrictions, lockdowns and curfews, and travel bans are some of the most effective response methods that have helped the world contain the pandemic's spread. The adopted measures have had an indirect impact on the environment, opening the global community to numerous opportunities and threats. This report provides a critical analysis of how the Covid-19 pandemic has had indirect effects on the environment, examining how the response and containment measures have affected the environment. It focuses on air quality, water demand and quality, climate change, afforestation and deforestation, wildlife resurgence, littering, traffic congestion, noise reduction and changed human activities. It explores how the Covid-19 containment measures have had an environmental impact with a keen interest in the earlier areas.

Key Words: *Covid-19; Environment; Quarantine; Lockdown; Pandemic*

Introduction

COVID-19 is a form of pulmonary disease first reported in Wuhan (Hubei Province, China) on December 31, 2019. The causative agent of COVID-19 is novel coronavirus (2019-nCoV), and it is labeled as an acute respiratory syndrome-related coronavirus 2 (SARS-CoV-2). Those who have been affected by it have shown a wide range of symptoms such as fever, cough,

tiredness, loss of taste or smell, sore throat, headache, aches and pains, diarrhea, skin rash, eye irritation, moderate respiratory illness, difficulty breathing or shortness of breath, loss of speech or mobility, confusion, chest pain, and more [1]. The advent of the global COVID-19 (SARS-CoV-2) outbreak became a pandemic and a household name in early 2020. As of March 2020, Covid-19 has evolved as a significant threat to public health and humanity

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throughout the globe (Figure 1). By the end of

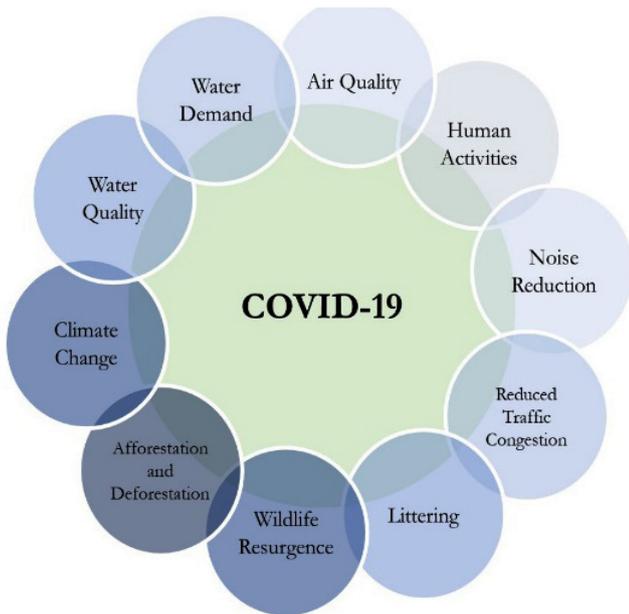


Figure 1) Effects of COVID-19 on the environment.

March 2022, close to 500 million individuals were confirmed to have been infected by the virus and more than 6 million succumbing globally, as indicated by the Johns Hopkins coronavirus resource center. The data available during this period indicates that the US has the most considerable infection rate, with over 80 million individuals getting the infection and almost one million dying of Covid-19 related complications. The rapid transmission of the coronavirus presented the enormous challenge of containing the disease. To reduce and control the spread of the SARS-CoV-2, governments worldwide resorted to instituting measures such as wearing masks, shutdowns, lockdowns, travel restrictions, curfews, curbing human gathering, and maintaining social distance. All these measures disrupted everyday human activities and industrial products throughout the globe, with social and economic facets of human life brought to a drastic halt. Reduction in industrial activities decimated economic growth, and as a result, millions lost their jobs and livelihoods. Moreover, the imposition of shutdowns and lockdowns brought the drivers of globalization to their knees as countries restricted international travel. Despite the severe

effects on social and economic activities, lower carbon emissions, improved air quality, low pollution levels, and enhanced ozone layer are some of the apparent positive results of these measures. The substantial decrease in fossil fuel use and the sharp decline in air, sea, and road travel throughout the COVID-19 period helped to scale down the net carbon emission across the globe. A significant reduction of greenhouse gases was remarkable in 2020 in that they almost met the initial emission targeted in Paris agreement. For instance, Barcelona, a city in Spain, experienced cleaner air during the lockdown, with air pollution levels dropping by 50%, as noted by [2]. In China, Adhikari et al., [3] indicated that carbon emissions were reduced by 25%, representing 1 million tons of carbonless compared to last year. A notable reduction in air-water pollution was recorded in Italy, with Venice’s water canals becoming more evident than in the pre-lockdown period, as indicated by [4]. Other regions around the globe recorded less air pollution, improved water quality, and noise reduction. Despite reduced pollution, COVID -19 still affects the environment adversely as a hefty amount of medical litter used domestically, in medical units, and a lack of initiative to recycle (Figure 2).



Figure 2) Timeline of COVID-19.

Positive and Negative Indirect Effects of Covid-19 on the Environment

Air quality

The Covid-19 period has been characterized by a significant reduction in CO₂ emissions that had contaminated the air, undermining its quality before the onset of the pandemic. The decrease in human mobility following lockdowns, curfews, and movement restrictions has significantly reduced the greenhouse gas emission that was responsible for negatively affecting the air quality in major towns and cities [5]. Increased usage of automobiles and traffic congestion in major cities and towns resulted in increased emissions that polluted the air. The emissions undermined the health of the environment, the wildlife, and the people, exposing them to degenerative health conditions such as chronic obstructed pulmonary disease (COPD) that also affected their livelihoods. Decreased emissions due to stay-at-home orders and movement restrictions have improved air quality, attracting wildlife to cities. Areas characterized by bad air quality have seen it improving significantly, thanks to the mobility restrictions and other Covid-19 protocols that compelled the companies and factories to suspend or even close their operations. Undoubtedly, improved air quality means healthy environments that promote and protect the health of the wildlife and the people.

Further, the Center for Research on Energy and Clean Air conducted a study that revealed significant improvement in air quality following the Covid-19 containment and safety rules. Travel bans and quarantines are among the most effective measures that have helped the world to contain and prevent the transmission of the pandemic that has claimed many lives [6]. According to the Center for Research on Energy and Clean Air, the two methods have resulted in a 25% reduction in carbon emissions in China. This significant change has improved

the air quality in a densely populated country [7]. A reduction in coal consumption, oil refining, and air traffic has since significantly improved air quality worldwide, thanks to the reduced emissions that compromised the air quality before the Covid-19 period. Despite its disruption of business and negatively ailing the global economies, one cannot overlook the contributions of the pandemic to improving air quality. The resumption of normalcy in many parts of the world and major cities, however, is likely to reverse the advancements made in air quality realization, although some governments are likely to formulate policies and regulations that could help sustain the reduction of the emissions.

Water demand

Water demand increased during the pandemic following the hygiene practices that required the people to wash hands regularly for at least 20 seconds with soap and water. This saw the demand for adequate, clean water for domestic use and sanitation to increase, straining the environmental resource as it was a critical part of the pandemic's spread. According to Lüdtke et al., [8], water demand in residential homes increased significantly because of the mandatory stay-at-home orders. The pandemic saw businesses and companies suspending or closing their operations, rendering many people jobless, with a few working from home. This resulted in increased demand for water in residential homes, resulting in some shortages due to increased use. Families not only incurred hiked water bills, but also financial constraints due to the restrictions caused by the pandemic. Following the closure of companies and industries, the standby water in pipes saw the growth of mold and other microbial organisms that undermined the quality of the piped water [9]. This forced businesses to close, as the mold growth that occurred during their suspension affected their water quality and safety, causing health issues with their employees and

customers. Undoubtedly, the high demand for water in residential homes during the pandemic has left the water supply and regulatory agencies with numerous lessons that could help them improve supply for the future crisis.

The developing countries, who were already experiencing water shortages and having little access to clean water, experienced increased shortages and strain trying to uphold the hygiene practices of washing hands with running water and soap. This resulted in the severe depletion of water sources that had previously supplied the ample amount needed for survival and livestock. The competition for the scarce available water, for sanitation and hygiene during the pandemic, negatively affected the environment, with the wildlife and other living things denied water for their survival. The increased demand for water led to the depletion of the environmental resource, exposing other living things to drought and famine due to inaccessible water. The competition for water between people and wildlife characterized the Covid-19 period, an aspect that undermined their wellbeing.

Water quality

Water quality has significantly improved during the pandemic period for various reasons. The clean atmosphere following reduced air pollution has seen rainwater quality improved, promoting and protecting the wellbeing of the wildlife and human beings. Previously, increased air pollution had seen contaminants saturating the atmosphere, making it poisonous. This has mixed with rainwater to form acidic rain that has threatened the survival of the living things and corroded buildings, causing fats corrosion, as Chu et al. [10] reported. Movement restrictions, reduced transport activities, the introduction of virtual events, and working from home arrangements have significantly reduced the emissions into the atmosphere, enhancing the quality of air and, consequently, rainwater. Previously, oil spillage and increased contamination of water in deep

seas also contributed to poor quality of water that threatened the survival of the aquatic animals [11]. Reduced movement activities due to travel bans, quarantines, lockdowns, and closure of businesses have helped reduce water contamination by the transport systems. Reduced human activities such as pesticides, fertilizers, and other agricultural chemicals, due to their shortage following disruption of supply chains, have seen the quality of water improve because of the elimination of the contaminants. Industrial and factory operations releasing wastewater and other contaminating chemicals had stopped during the pandemic period, helping to safeguard and improve the quality of underground water and other related sources, such as rivers. The indirect contributions of the pandemic to improving global water quality cannot be underestimated.

Climate change

The covid-19 pandemic, and the associated containment measures, have indirectly helped address climate change, which has remained a significant challenge to the world for many decades. Increased water, air, and land transport have been associated with increased emissions of CO₂ in the atmosphere, undermining the efforts to combat climate change. The Covid-19 pandemic has opened the world to numerous opportunities, such as virtual events and remote working arrangements, that have significantly reduced the need for said transport [12]. The world is likely to continue to realize the benefits of reducing these emissions, if it sustains virtual events and working from home arrangements, as they will minimize unnecessary transportation to the workplace. CO₂ has been known to deplete the ozone layer, exposing the world to extreme temperatures [13]. The increase in global temperatures, commonly known as global warming, has contributed to climate change undermining human and wildlife survival. The introduction of quarantines, virtual events, and working from home arrangements have

significantly improved the efforts to combat climate change, making it imperative for the international community to embrace the new normal and to continue realizing the associated benefits.

The Covid-19 pandemic has also led to reduced human activities responsible for climate change, an achievement that has improved the efforts to mitigate the associated effects. The suspension of industrial operations has significantly reduced emissions from factories that were previously responsible for air pollution and depletion of the ozone layer, both of which interfered with the global temperatures. Before the pandemic, increased transportation of the raw materials and finished goods from factories resulted in increased emissions. The movement restrictions, lockdowns, curfews, and travel bans have significantly reduced these activities, allowing the environment to replenish and to clear the excess carbon, and other greenhouse gases, in the atmosphere, as Gössling et al. [14] observed. Greenhouse gases are responsible for climate change and global warming. The containment measures adopted by governments to control the pandemic have indirectly had positive impacts on climate change, helping address some of the associated effects. The governments need to formulate policies and legislation that will promote the embrace of the new normal, and in turn, to sustain the positive achievements made during the pandemic period.

Afforestation and deforestation

The Covid-19 pandemic effects have resulted in increased deforestation, an activity that has had environmental implications affecting the wellbeing of wildlife and human beings. The pandemic negatively affected global economies, forcing businesses to suspend their operations or to shut down completely. Many people have been rendered jobless, yet they need to provide for their families, especially during the difficult period characterized by food shortages and

disrupted supply chains. The governments of most countries reallocated their resources to combating the pandemic, and in turn, neglected their efforts to protect the forest cover and illegal deforestation [15]. Many people embarked on cutting down trees to survive, with the tropical region and forests being affected the most. The forest cover has significantly been reduced during the Covid-19 period, an activity that has had adverse implications on climate change and environmental conservation. The increased deforestation and destruction of forest cover have also threatened the survival and wellbeing of wildlife due to the destruction of their habitats [16]. Scientists are projecting changes in rainfall patterns and an increase in global warming, as illegal deforestation has undermined the survival of diverse wildlife and ecosystems.

Wildlife resurgence

Reduced fishing activities, occasioned by the Covid-19 pandemic, had environmental implications that saw governments formulating strict measures, including travel bans and movement restrictions. According to Hu et al. [17], fish biomass has increased steadily, following the movement restrictions that suspended fishing activities. This has resulted in the fast growth of the number of fish, negatively affecting their prices in the market. The increased number of fishes in the seas has seen them transfer and distribute phosphorous in the water. This has seen nutrients and other minerals transferred between the shores and the deep seas. More so, the reduced fishing activities has allowed fish to invade places that were uninhabited before the pandemic. This has affected the ecosystem that once balanced itself with human activities. The suspension of fishing activities has also allowed ample time for the growth of undermined and endangered fish species [18]. Without a doubt, the pandemic has protected the survival and well-being of fish, and it allowed them to move freely in the seas and lakes without human interference.

Reduced activities in shores and lakes have also resulted in increased growth of water lilies and other aquatic vegetation, making it difficult for people to use those areas before the onset of the pandemic. According to Mantur [19], increased human activities in the sea scared aquatic animals away from shores and habitats. The pandemic period has seen such activities suspended for nearly two years, a time that has seen the resurgence of aquatic wildlife. This aspect is likely to cause human-wildlife conflict once the people resume their activities on the lake and shores. Increased vegetation cover in lakes and seashores has resulted in the disappearance of the once beautiful beaches that people enjoyed. These places are now inhabited by aquatic wildlife that threaten human health and life. The changes in the water bodies' environment and in its pH, due to reduced human activities and increased sea life activities, are indirectly attributed to movement restrictions in lakes and seas to contain the spread of the pandemic.

Littering

The Covid-19 pandemic has had implications for the appearance of the environment. In areas that once experienced congestion, reduced human activities have seen the environmental efforts to uphold cleanliness being upheld. For instance, increased trading activities in the markets and public places were characterized by increased littering and piling of solid waste that undermined the environmental and population health [20]. The authorities responsible for cleaning cities and towns worldwide have had ample time to do their jobs, thanks to the movement restriction, lockdowns, curfews, and stay-at-home orders that compelled the people to abstain from city centers. This has also made it easy to clean and manage solid waste effectively, practices that have led to the improved appearance and aesthetic of public places, which were once crowded, dirty, and undermined the global image of the major cities and towns. One cannot underestimate

the pandemic's environmental benefits, for it is a period characterized by cleanliness and the improved appearance of the once crowded, congested places with reformed waste and disposal practices.

Despite these improvements, new practices have emerged that have threatened the safety and well-being of the environment. The increased use of disposable face masks has seen manufacturers increasing their production to meet the global demand to contain the spread of the pandemic [21]. Countries have been supplied with these masks to protect their people from contracting the virus, as it has claimed lives and brought businesses to a standstill. Face masks and personal protective equipment have been prevalent in the pandemic, shielding its users from contracting the virus [22]. Poor disposal practices of the users' face masks and gloves have conversely exposed the people to further health risks, undermining the environmental wellbeing. Domestic animals have been at an increased risk of consuming littered face masks and gloves, threatening their health and wellbeing. Increased littering, characterized by face masks, has undermined and degraded environmental conservation.

Reduced traffic congestion

Increased use of automobiles characterized by traffic congestion was the day's order in many cities before the onset of the Covid-19 pandemic, but not during the pandemic. The world's major cities enjoyed infrastructural developments that have seen transport and communication being improved significantly to meet the changing needs of the people. Technological developments also improved the ease of movement, reduced traffic congestion, and promoted the smooth movement of people and automobiles. As Du et al. [23] reported, densely populated towns and cities still have issues with traffic congestion. This aspect has not only inconvenienced people, but also

negatively affected the environment. The pandemic has resulted in lockdowns, curfews, and movement restriction directives, all of which not only reduced traffic and congestion in major cities, but also strained the environment and its resources. The directives that only allowed essential services, such as medical services, transportation of food, and delivery of necessary items, saw these services improved, thanks to the reduction of environmental congestion and traffic jams, both of which had previously undermined the population's health with increased pollution emission from motorists.

Traffic congestion undermined the public's health, but that of the environment undermined the existence and survival of the ecosystems. An increased presence of people in certain areas has scared away wildlife, threatening their survival and existence [24]. The ban on international movements has significantly reduced traffic congestion in major cities, with tourist attractions allowing local communities to enjoy their biodiversity peacefully. The closure of international borders also saw oil and fossil fuel transportation reduced, especially following the disruption in supply chains [25]. This has significantly reduced the emission from automobiles that once undermined the health of people and the environment. Covid-19 negatively affected people's lives, disrupting their routine activities and operations, but it opened them to numerous opportunities from improved environmental health, wellbeing, and conducive surroundings. The pandemic has significantly saved the people in cities and towns from experiencing traffic, providing an opportunity to relax at home following the stay-at-home orders.

Noise reduction

Noise pollution has undermined the environment's wellbeing for decades, but when the pandemic struck, there were sudden reduced

noise levels, with the people enjoying relative peace and calmness. Previously, increased industrial operations in the major cities were routine, thus they were always accompanied by increased noise pollution [26]. The individuals and communities neighboring these noise producers have significantly benefitted from the pandemic, as it brought their activities to a standstill. Accordingly, operations such as mining, water drilling, manufacturing, and other significant events increase noise pollution in the background, adversely affecting the environment and health of the people [27]. Increased noise pollution undermines the wellbeing of living things, with humans being affected the most. Peace of mind is crucial for an individual to have good mental health and psycho-social wellbeing. Fortunately, the emergence of the Covid-19 pandemic has played a critical role in reducing the noise pollution that once disturbed cities, communities, and individuals.

The Covid-19 pandemic compelled governments worldwide to take radical measures that would assist in containing the spread of the disease. Those measures indirectly reduced noise pollution in areas previously characterized by increased noise, and they improved the environmental health and social wellbeing of the people [28]. The suspension of noisy factory activities has seen the surrounding communities living in peace, at least with minimal noise. This has also seen them living in conducive environments, free from noise pollution that previously undermined the environmental health and discouraged people from living in certain areas [29]. Major cities and towns have been characterized by increased noise due to factories, increased traffic congestion, the use of automobiles, and human activities that undermine noise reduction efforts. The neighborhoods close to recreation centers and clubs have also had an opportunity to live in serene and quiet environments, thanks to the suspension of large crowds, partying, and,

indirectly, noise production. Noise is a destructor that undermines the social and psychological wellbeing of a person. Undoubtedly, the pandemic period has seen people living in quiet environments that promote and protect their health.

Human activities

The Covid-19 pandemic has had positive and negative impacts on human activities that have, in turn, affected the environment. The pandemic spread made it imperative for governments worldwide to institute measures to contain the transmission of the disease, compelling businesses, organizations, and individuals to suspend their activities and operations to conform to the directives. This has resulted in the suspension of human activities with positive environmental impacts. According to Vandyck et al. [30], large-scale farming activities affected the air quality. They exposed the environment to sprays, agricultural pesticides, fertilizers, and chemicals that undermined the quality of air and the environment, negatively affecting the health of the environment and the population. The suspension of these activities has significantly improved environmental health, thus protecting the people's health, as Churkina et al. [31] noted. Reduced outdoor activities, such as outdoor sports, have reduced strain on ecological resources, allowed ample time for the growth of various species of plants, and enhanced environmental conservation efforts. The pandemic has positively impacted ecological conservation, thanks to the reduced outdoor activities that once threatened the environment through exposure of its vast threats and pollutants.

The pandemic has also led to increased human activities in some areas, which has had environmental implications. The closure of companies and suspension of their operations rendered many people jobless, with the majority resorting to farming on their lands to keep

themselves busy. Agribusiness operations have increased tremendously during the pandemic, with the demand for hiking fresh vegetables [32]. This has seen many people overusing their small, local lands to cultivate and grow vegetables, a move that saw them using farm chemicals to enhance growth and to meet the demand for their products in the market. Increased use of these substances has negatively affected the environment with sprays, pesticides, and fertilizers spilling, undermining environmental wellbeing [33]. The beauty of the environment, however, has improved, thanks to the beautification of the compounds of residential houses, as many people were compelled to work within their ranches and residences to follow the stay-at-home orders. The Covid-19 pandemic has reduced and increased human activities simultaneously, having an indirect impact on the environment in terms of air quality, water quality, and conservation efforts to uphold the sustainable use of environmental resources.

Conclusion

In conclusion, the Covid-19 pandemic has opened the world to opportunities and threats that have affected livelihoods, businesses, and the environment. The pandemic has disrupted routine activities and what used to be considered normal, making it imperative for the international community to adopt the new normal to survive. The pandemic prompted governments and the World Health Organization to formulate measures to prevent transmission and to enhance the containment of the disease. The adopted strategies such as quarantine, movement restriction, lockdowns, curfews, travel bans, and suspension of group gatherings have significantly helped contain the pandemic that has caused havoc and claimed many lives. Interestingly, the Covid-19 containment and preventive measures have indirectly had environmental effects (Figure 3). Although some effects have worsened and threatened

COVID-19: TREATMENT, PREVENTION, SCREENING AND COPING WITH STRESS

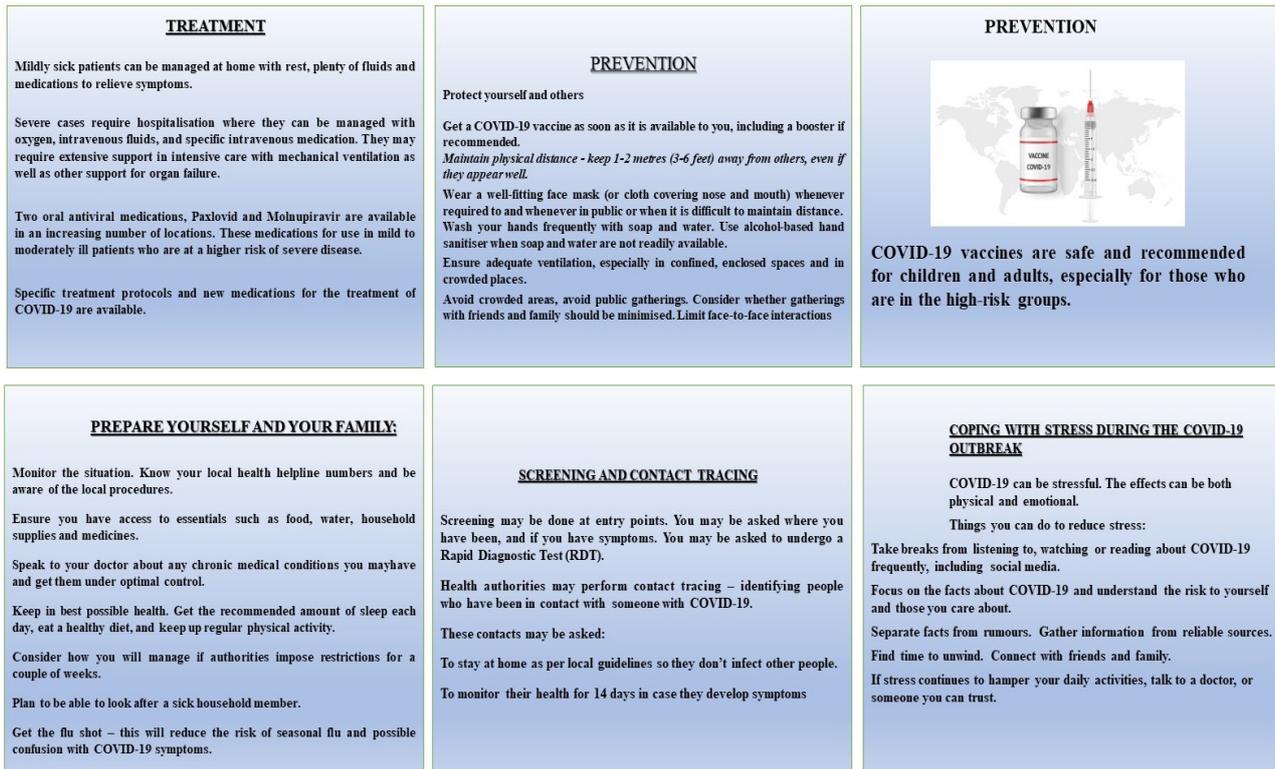


Figure 3) Treatment, prevention and related guidelines.

the conservation efforts, most containment measures have significantly improved the management of the environmental problems, ranging from air quality issues, water usage, water quality, environmental conservation, protection of wildlife, and the health of the population. The indirect positive effects of the Covid-19 pandemic outweigh its harmful effects (Figure 4). There is a need to sustain some of the Covid-19 response and containment

a need for embracing the new normal occasioned by the Covid-19 pandemic, for the world needs to continue to realize the indirect positive impacts the containment measures have had on the environment.

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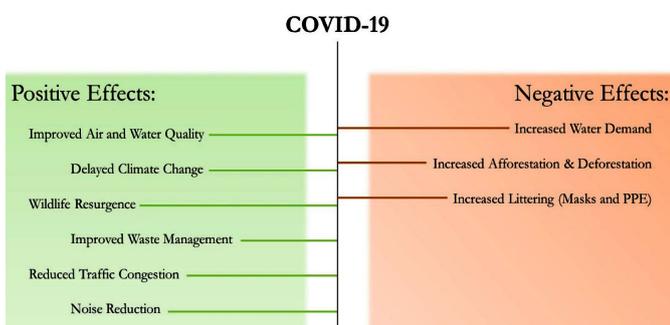


Figure 4) Negative and positive effects of COVID-19.

measures that have had positive implications on the environment, as they can enhance the efforts to address the environmental challenges undermining sustainable development. There is

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