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EFFECTS OF THE COVID-19 PANDEMIC ON THE ENVIRONMENT AND PROPOSALS FOR SUSTAINABLE STRATEGIES

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ABSTRACT
The outbreak of the coronavirus pandemic (COVID-19) first occurred in late December 2019 at the Hunan Seafood Market in Wuhan, China, and was declared an international public health emergency in a matter of weeks by the World Health Organization. The coronavirus disease (COVID-19) affects every area of human life, including the environment. Measures taken to control the spread of the virus and the slowdown in economic activities have significant positive effects on the environment. Through this study, the authors intend to track the impact caused by the COVID-19 pandemic on the environment by analyzing the available scientific literature. The study indicates that the pandemic situation significantly improves air quality in various cities around the world, reduces greenhouse gas emissions, reduces water pollution and noise, and reduces pressure on tourist destinations, which can help restore ecological systems. It is noted that there are some negative consequences of the pandemic, such as the increase in medical waste through the use and disposal of disinfectants, masks and gloves but also the burden of untreated waste that endangers the environment continuously. It seems that shortly after the pandemic the economic activities will return and the situation could change. Therefore, this study highlights the potential positive impacts of the pandemic on the environment in the long-term. It is expected that the correct implementation of the proposed strategies can be useful for the global sustainability of the environment.
Keywords: COVID-19, environment, positive effects, negative effects, sustainability

INTRODUCTION

The outbreak of the coronavirus pandemic (COVID-19) first occurred in late December 2019 at the Hunan Seafood Market in Wuhan, China, and was declared an international public health emergency in a matter of weeks by the World Health Organization. The coronavirus disease (COVID-19) affects every area of human life, including the environment (AHMED et al., 2020; RUME and ISLAM, 2020).
In general, the pandemic has caused huge socio-economic disruptions worldwide, which have directly or indirectly affected the environment, such as improved air and water quality, noise reduction and ecological restoration (CHAKRABORTY and MAITY, 2020).
Increased use of personal protective equipment (eg face mask, gloves, gowns, goggles, face shield, etc.) and their accidental disposal creates a burden on the environment. (FADARE and OKOFFO, 2020; RUME and ISLAM, 2020).
In these circumstances, this study intends to explore the positive and negative consequences for the environment in the context of the COVID-19 pandemic and to propose possible strategies as a future orientation for environmental sustainability (BODRUD-DOZA et al., 2020; RUME and ISLAM, 2020).

MATERIALS AND METHODS

This study was conducted by reviewing the available published literature, case studies and various information about governmental and non-governmental organizations in official

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reports and websites. This study compiles and presents data and information relevant to the environmental effects of COVID-19 and meets the objectives of the study. The selection criteria for the sources from which we were inspired, were with the thought of topicality, to have the most valid and current sources globally, so from each source we could get some important ideas. In order to carry out the work, we used, in addition to the specialized literature and include books, specialized works (AHMED et al., 2020; RUME and ISLAM, 2020; CHAKRABORTY and MAITY, 2020; FADARE and OKOFFO, 2020; BODRUD-DOZA et al., 2020; BISWAL et al., 2020; SAADAT et al., 2020; YUNUS et al., 2020; LENZEN et al., 2018; PEREIRA et al., 2017; RAHMAN, 2020; VAN DOREMALEN et al., 2020; ZAMBRANO-MONSERRATE et al., 2020; MA et al., 2019) and data of COVID-19 on environmental protection expenses extracted from (EUROPEAN ENVIRONMENT AGENCY, 2020; USEPA, 2016) on the basis of which we made our own interpretations, as presented further. The method of scientific research used was the analisation of the negativ and positive elements of the COVID-19 pandemic. From this alalisis we came to some important conclusions.

RESULTS

Effects of the COVID-19 on the environment

The global disruption caused by COVID-19 has had several effects on the environment and climate. Due to traffic restrictions and a significant slowdown in social and economic activities, air quality has improved in many cities and water pollution has reduced in different parts of the world (RUME and ISLAM, 2020).

Increased use of personal protective equipment (mask, gloves, etc.), their accidental disposal and the production of a huge amount of waste from hospitals have negative effects on the environment (RUME and ISLAM, 2020). Both the positive and negative environmental impacts of the COVID-19 are presented in *Figure 1*.

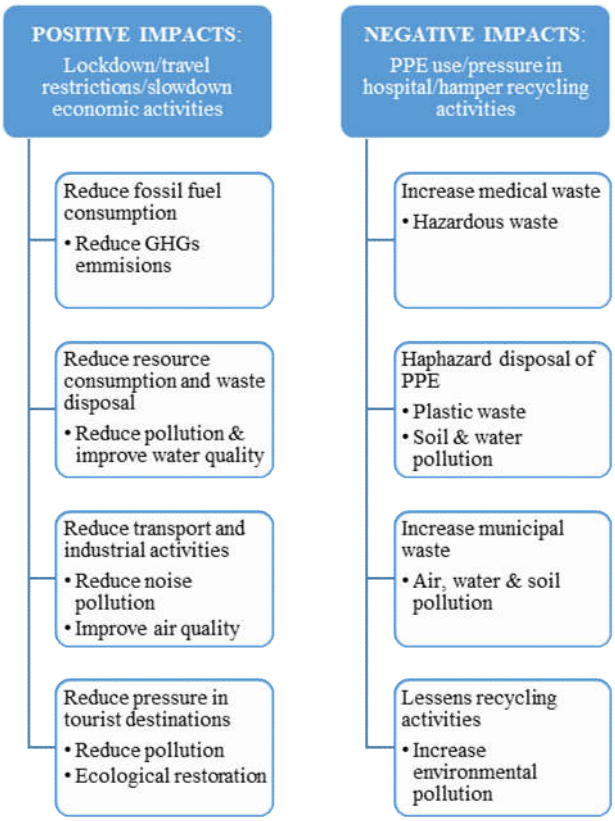

Figure 1. Positive and negative effects of the COVID-19 pandemic on the environment

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Positive effects on the environment

As industries, transports and companies closed, it brought about a sharp drop in greenhouse-gas emissions (GHG). Compared to this period of 2019, air pollution levels in New York have decreased by almost 50% due to measures taken to control the virus. It has been estimated that the reduction of N_2O and CO by almost 50% occurred due to the cessation of heavy industries in China (RUME and ISLAM, 2020) NO_2 emissions are also one of the key indicators of the global economy, indicating a decline in many countries due to the recent closures. (BISWAL et al., 2020; SAADAT et al., 2020). NO_2 is emitted from the burning of fossil fuels, 80% of which comes from the evacuation of vehicles (USEPA, 2016). NO_2 is reported to cause acid rain with the interaction between O2 and H2O due to which several respiratory diseases occur (USEPA, 2016). The European Environment Agency predicted that due to the COVID-19 blockade, NO_2 emissions had fallen from 30-60% in many European cities, including Barcelona, Madrid, Milan, Rome and Paris (EUROPEAN ENVIRONMENT AGENCY, 2020).

Lower fossil fuel consumption reduces GHG emissions which helps combat the global climate change. According to the International Energy Agency, global oil demand fell by 435,000 barrels in the first three months of 2020, compared to the same period in 2019. (EUROPEAN ENVIRONMENT AGENCY, 2020).

Reducing water pollution

Water pollution is a common phenomenon in a developing country where household and industrial waste is dumped into rivers without treatment (ISLAM and AZAM, 2015).

During the quarantine period, the main industrial sources of pollution decreased or stopped completely which contributed to the reduction of the pollution load (YUNUS et al., 2020).

Ecological restoration and assimilation of tourist places

In recent years, the tourism sector has witnessed remarkable growth due to technological advances and transport networks which contributes significantly to global gross domestic product (GDP). It is estimated that the tourism industry is responsible for 8% of global GHG emissions (LENZEN et al., 2018).

However, places of natural beauty (eg beaches, islands, national parks, mountains, deserts and mangroves) attract tourists. To facilitate and accommodate them, a lot of hotels, motels, restaurants, and bars are built, which consume a lot of energy and other natural resources (PEREIRA et al., 2017). For example, PUIG et al. (2017) calculated the carbon footprint of hotel services on the Spanish coast, and the reported consumption of electricity and fossil fuels shows that two-star hotels have the highest carbon emissions. Moreover, visitors throw away various wastes that affect natural beauty and create ecological imbalance (RUME and ISLAM, 2020). Due to the outbreak of COVID-19 and local restrictions, the number of tourists has decreased in tourist places around the world.

As a result of the restriction, the color of the sea water is changed which usually remains cloudy due to swimming and motor boats. Recently has been reported that due to the reduction of pollution, dolphins returned to the coast of the Bay of Bengal (Bangladesh) and to canals, waterways and ports in Venice (Italy) after a long decade (RAHMAN, 2020).

Negative effects on the environment

Increase in the production of biomedical waste

Since the outbreak of COVID-19, the production of medical waste has increased globally, posing a major threat to public health and the environment. The collection of samples of patients suspected with COVID-19, the diagnosis and the treatment of a large number of

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patients generates a lot of infectious and biomedical waste. For example, Wuhan in China produced more than 240 metric tons of medical waste every day during the outbreak (SAADAT et al., 2020) which is almost 190 m tons higher than in the pre-pandemic period (ZAMBRANO-MONSERRATE et al., 2020). Such a sudden increase in hazardous waste and its proper management has become a significant challenge for the local waste management authorities. According to the recently published literature, it is reported that the SARS-CoV-2 virus can exist for one day on cardboard and up to 3 days on plastic and stainless steel (VAN DOREMALEN et al., 2020). Therefore, hospital-generated waste (eg. needles, syringes, bandages, masks, gloves, used tissue, discarded medicines, etc.) should be properly managed to reduce additional infections and environmental pollution, which is now a concern on a global level. However, experts and responsible authorities suggest the proper disposal and separation of the household organic waste and the protective equipment based on plastic (hazardous medical waste), because the mixing of this waste increases the risk of disease transmission and exposure to virus of sanitation workers (MA et al., 2019).

Production of municipal solid waste and reduction of recycling

The increase in the production of municipal waste (both organic and inorganic) has direct and indirect effects on the environment, such as air, water and soil. Due to the pandemic, quarantine policies in many countries have led to an increase in online shopping for home delivery, which ultimately increases the amount of household waste from shipped packaging materials. However, waste recycling is an effective way to prevent pollution, save energy and conserve natural resources (MA et al., 2019). But because of the pandemic, many countries have postponed waste recycling activities to reduce the transmission of viral infection. For example, the US has restricted recycling programs in many cities (almost 46%), as the government has been concerned about the risk of COVID-19 spreading in recycling facilities. The United Kingdom, Italy and other European countries have also banned infected residents from sorting their waste (ZAMBRANO-MONSERRATE et al., 2020). In general, due to the disruption of routine in municipal waste management, waste recovery and recycling activities, increasing landfills and global environmental pollutants.

Other effects on the environment

Recently, a huge amount of disinfectant is applied on roads, commercial and residential areas to exterminate the SARS-CoV-2 virus. Such widespread use of disinfectants can kill non-target beneficial species, which can create an ecological imbalance (ISLAM and AZAM, 2015). Furthermore, the SARS-CoV-2 virus has been detected in patients with COVID-19 in feces and also in municipal wastewater in many countries, including Australia, India, Sweden, the Netherlands and the USA (AHMED et al., 2020). Therefore, additional measures in wastewater treatment are essential, which is a challenge for developing countries, where municipal wastewater is discharged into nearby bodies of water and untreated rivers (ISLAM and AZAM, 2015; RUME and ISLAM, 2020). China has already strengthened its disinfection process (increased use of chlorine) to prevent the spread of SARS-CoV-2 virus through wastewater. But excessive use of chlorine in water could generate a harmful by-product (ZAMBRANO-MONSERRATE et al., 2020).

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DISCUSSION

It is assumed that all these environmental impacts are short term.
Therefore, it is time to establish an appropriate strategy for long-term benefits as well as sustainable environmental management. The pandemic has provoked a global response and unites us to win against the virus. Therefore, we propose some possible strategies for the sustainability of the global environment.
Sustainable industrialization: Industrialization is crucial for economic growth; however, it is time to think about sustainability. For sustainable industrialization, it is essential to move to less energy consuming industries, to the use of cleaner fuels and technologies, and to stronger energy efficiency policies. Furthermore, industries should be built in certain specific areas taking into account that wastes from one industry can be used as raw materials in others.
Using public and green transport: To reduce emissions we need to encourage people to use public transport. In addition, people should encourage the use of bicycles over short distances, and the public bicycle sharing system should be available for mass use, which is not only environmentally friendly but also beneficial to health.
Use of renewable energy: The use of renewable energy can reduce the demand for fossil fuels such as coal, oil and natural gas, which play an important role in reducing GHG emissions. Due to the COVID-19 pandemic, global energy demand is reduced, leading to reduced emissions and increased ambient air quality in many areas. But in order to maintain daily needs and global economic growth, it is not possible to reduce energy demand. Therefore, the use of renewable energy sources such as solar, wind, hydropower, geothermal heat and biomass can meet energy demand and reduce GHG emissions.
Wastewater treatment and reuse: In order to control water pollution, both industrial and municipal wastewater should be properly treated before discharge.
Recycling and reuse of waste: To reduce the burden of waste and environmental pollution, both industrial and municipal waste should be recycled and reused. Therefore, the circular economy or circularity systems should be implemented in the production process in order to minimize the use of raw materials and waste generation.
Ecological restoration and ecotourism: For ecological restoration, tourist places should be closed periodically. Furthermore, ecotourism should be strengthened to promote sustainable livelihoods, cultural conservation and biodiversity conservation.
Changing behavior in everyday life: To reduce our carbon footprint and global carbon emissions, we need to change our behavior in our daily lives, to take locally grown food, to make compost from food waste, to disconnect electronic devices when not in use and to use a bicycle instead of a car for short distances.
Directly or indirectly, the pandemic affects human life and the global economy, which ultimately affects the environment and climate. COVID-19's global response teaches us to work together to combat the threat to humanity. Although the impact of COVID-19 on the environment is short-term, the joint and proposed effort over time can strengthen environmental sustainability and save the earth from the effects of global climate change.

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