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1. COVID 19 Outbreak: Emerging Views on Observed and Potential Impacts on Environment

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1.1 Introduction:

Globally, one of the serious issue is the change in the environment and its deleterious effects on us. A French word "environmer" which means "surround" is the root word from where the word "environment" originated. It ecological terms, it includes everything that surrounds us. All the biotic and abiotic factors and their interconnection and interdependence which also includes us constitutes our surroundings. Thus, environment is the totality of all the external conditions affecting the life, development and survival of an organism (UN, 1997). In past few decades the constant deterioration of the environment at an alarming rate has been the matter of concern worldwide.

This deterioration due to many natural and anthropogenic factors and the long term ecological effects have contributed to various acute and chronic ill effects. Also, all significant events have some impacts on the environment. Presently the most talked about issue globally is the outbreak caused by the pandemic COVID 19. This pandemic has significantly altered many customary ways in which different things and machinery work in the world drastically in a very short span of time. Many human activities and movements have been limited. Therefore, a proper understanding and estimation of the impact on environment in light of the COVID 19 outbreak becomes significant. COVID-19 is an acute respiratory disease caused by Corona virus Sars-Cov-2 (World Health Organization, 2020a). Since WHO declared COVID-19 as pandemic disease (World Health Organization, 2020b), many countries worldwide have responded seriously to this pandemic.

According to the World Health Organization (WHO), corona viruses are a family of viruses that cause illnesses ranging from the common cold to more severe diseases such as severe acute respiratory syndrome (SARS) and the Middle East respiratory syndrome (MERS). These viruses were originally transmitted from animals to people. SARS, for instance, was transmitted from civet cats to humans while MERS moved to humans from a type of camel. Several known corona viruses are circulating in animals that have not yet infected humans. The name corona virus comes from the Latin word corona, meaning crown or halo. Under an electron microscope, the looks like it is surrounded by a solar corona.

The novel corona virus, identified by Chinese authorities on January 7 and since named SARS-CoV-2, is a new strain that had not been previously identified in humans, now, although human-to-human transmission has been confirmed. This new virus can be transmitted just in minutes through droplets or even touching surface metals or other materials which have been infected from a person who has respiratory problems. Even though the elderly and the very young children are easily affected, nobody is immune to this new infectious disease once it hits the body, so all people are susceptible to its devastating effects (Bender, 2020; Meng, Hua, & Bian, 2020).

In the past two decades, the three corona viruses' outbreaks emerged that have caused considerable global health consternation. There is a new public health crises threatening the world with the emergence and spread of 2019 novel corona virus (2019-nCoV) or the severe acute respiratory syndrome corona virus 2 (SARS-CoV-2). The virus originated in bats and was transmitted to humans through yet unknown intermediary animals in Wuhan, China in December 2019 (Goel, 2020). Corona viruses are any of family Coronaviridae of large single-stranded, enveloped, non-segmented, positive sense RNA viruses ranging from 60 nm to 140 nm in diameter that have a lipid envelope studded with club-shaped spike proteins giving it a crown like appearance under the electron microscope, hence the name Corona virus, infecting birds and many mammals including humans with respiratory diseases. On the basis of antigenic relationships of the spike (S), membrane (M) and nucleocapsid (N) proteins, Corona viruses are classified into three groups. The Novel human corona viruses (HCoV), HCoVs229E and NL63 are group 1 Corona viruses, while OC43, HKU-1and SARS corona viruses are categorised into group 2 Corona virus. Group 3 corona viruses are found in basically avian species (Kupferschmidt et al., 2020). Genetic Recombination initiates between the members of the same and of different corona virus groups providing an opportunity for increased genetic diversity. The diverse bat corona viruses in both group 1 and group 2 are closely related phylogenetically to different mammalian corona viruses. The time between catching the virus and beginning of symptoms of the disease is known as incubation period. For COVID-19, it ranges from 1-14 days but most commonly around five days. The most common symptoms of COVID-19 are fever, tiredness, and dry cough. Some patients may have aches and pains, nasal congestion, runny nose, sore throat or diarrhoea. These symptoms are usually mild and begin gradually. Some people become infected but don't develop any symptoms and don't feel unwell. Most people (about 70 %) recover from the disease without needing special treatment. Around 1 out of every 6 people who get COVID-19 becomes seriously ill and develops difficulty in breathing. Older people and those with underlying medical problems like high blood pressure, heart problems or diabetes, are more likely to develop serious illness. It has given a severe impact on global and national economies irrespective of the level of virus impact on the people of individual nations.

The novel corona virus has no border, no religion and spread beyond cast and creed. It is highly contagious in nature and easily unpredictable. World was never prepared for this kind of pandemic, where we are in a race of developing a vaccine against its spread.

The COVID-19 spread around the world and severely affected the many sectors and related economies. The global disruption caused by the COVID-19 has brought about several effects on the environment and climate. Due to movement restriction and a significant slowdown of social and economic activities, air quality has improved in many cities with a reduction in water pollution in different parts of the world. Besides, increased use of PPE (e.g., face mask, hand gloves etc.), their haphazard disposal, and generation of a huge amount of hospital waste has negative impacts on the environment. Both positive and negative environmental impacts of COVID-19 are present. This article describes the impact of COVID-19 on environment and society including the possible ways in which the disease can be controlled has also been discussed therein and also how to mitigate its effects on environment.

The blow of the COVID-19 pandemic on the environment raise notice from the very commencement of the predicament, consisting of (a) explanation and analysis of the instant effects and (b) estimations related to long-standing changes. Qualitative assumptions are happening, while constant quantitative research must wait for appropriate data sets and supplementary data. Most facets of the environmental blow of the COVID-19 pandemic have not openly resulted from the virus itself. The consequence of rapidly restrictive or closing economic sectors, such as heavy industry, transport, or hospitality businesses, has affected the environment directly. Moreover, the blow of the COVID-19 pandemic on socio-ecological systems may be highly erratic, from radical changes in individual lifestyle, society and international affairs, to simply facilitating a quicker change than would normally have emerged. From an anthropocentric perception, the pandemic may show the way to a more sustainable future, including increased flexibility of the socio-ecological systems or shorter supply chains, which is a constructive progress.

Nevertheless, it is still probable that a number of nations will decide on for less sustainability by pursuing quick economic expansion and focusing less distress on the environment. While negative impacts on the economy and society in general are possibly vast, it is very likely that the global-scale decrease of economic conduct due to the COVID-19 emergency triggers a lot of reasonable improvements in environmental worth and climatic systems. However, not all the environmental consequences of the crisis have been or will be encouraging. This includes an increased volume of non-recyclable waste, the generation of large quantities of organic waste and difficulties in maintenance and monitoring of natural ecosystems. The temporal resolution of the corona virus impact ranges from instant (days to weeks), immediate (months) and lasting (years), and different examples are there. At the same time as the first impacts are divided between rapid environmental improvements, such as urban air and water quality, and pollution episodes, such as the ones caused by the sanitary disposals, the estimated short as well as long term impacts are mainly positive.

An ecosystem wishes three kinds of diversity namely biological, genetic and functional. Biological diversity refers to the opulence of species in a particular area; genetic diversity refers a way for a scrupulous species to adapt itself to changing environments while functional diversity equates to the biophysical processes that happen within the area.

The genetic diversity acts as a shield for biodiversity. Humans must recognize the levels and morals of biodiversity for the larger importance of the globe. Biodiversity or biological diversity refers to the continuation of a wide variety of plant and animal species in their natural environments or the diversity of plant and animal life in an exacting habitat.

The biodiversity is usually described at three levels: (a) genetic diversity, (b) species diversity and (c) ecosystem diversity. There is a requisite of ecological balance for widespread biodiversity. Anthropogenic actions and indefensible cultivation have several effects and perturb the ecological balance. The ecological equilibrium is a necessary need for human survival. Devoid of conserving the biodiversity and minimizing the anthropogenic activities, it is almost impossible to get the inclusive and sustainable development. The sustainable development is openly related with environmental beliefs and from time to time it seems to rethink and redefine the environmental ethics in current perspective. The climate change has massive brunt on biodiversity. Nature always favours and promotes the diversity and coexistence amid all the organisms by providing appropriate environment to all. Human is since exceedingly evolved product of evolution hence tried for all time to control the environment and its own society in order to get conducive ambience. But due to overexploitation of natural resources, augmented anthropogenic activities and human centric environmental loom, we are facing global warming and COVID-19 like unparalleled threats. Such global threats are compelling the academicians, policy makers and other stakeholders to introspect their visions and actions. Today, the World is a 'global village' due to the use of Information and Communication Technology and human are there and deriving all the benefits from Nature. When we are deriving the benefits, we must have to bear some responsibilities. We have to develop environment centric approach to utilize the natural resources in such a manner so that we can achieve the comprehensive and sustainable development with coexistence of all other species of organisms of the globe. The lockdown therefore provided us a prospect to shift our principles from anthropocentric or human centric worldview to eco-centric worldview. The former worldview puts the human beings in the centre giving them the chief status, considers man to be the most able for managing the planet earth, realizes that man is the planet's most important species and is the in-charge of the rest of nature. It emphasizes that earth has limitless resources for humans only and a healthy environment depends upon a healthy economy. The later worldview states that the earth resources are limited and belong to all the species that exist in nature. Though humans have right to draw their wishes from the environment but certainly not the extent that degrades the environment and harms other species and living beings. This eco-centric worldview is therefore based on earth-wisdom and urges us to live on this earth as a part of it, like any other creature of nature and live sustainably. It realizes that healthy economy depends upon a healthy environment (healthy environment does not depend upon a healthy economy). Due to lockdown, a large number of birds together with vultures are clearly on the go to appear. Insect pollinators have appeared in loads on crops and other plants. All these are good indication for ecological balance and biodiversity. Almost total lockdown due to COVID-19 outbreak has minimized the anthropogenic activities including overexploitation of natural resources. The major human population is bound to live in their homes, automatically prevented them to cause various types of pollution. The surrounding environment is reflecting clean and green. We all are observing a clean environment where almost all animals including birds etc. have started to flourish. Almost all humans are feeling healthy without any major clinical problems.

It is observed that during persistent lockdown period, the water of Brahmaputra, Ganga and Yamuna rivers in cities also became clear and transparent due less deposition of domestic and industrial effluents. During lockdown it was not possible to estimate the water quality parameters but the transparent condition of water of these holy rivers clearly indicate that pollution level definitely reduced to a great extent. These reductions in pollution level helped in flourishing the aquatic organisms including fishes.

1.2 Impact of COVID-19 on Environment:

The global disruption caused by the COVID-19 has brought about several effects on the environment and climate. Due to movement restriction and a significant slowdown of social and economic activities, air quality has improved in many cities. A significant reduction in water pollution in different parts of the world has also been reported. On the other hand, increased use of Personal Protective Equipment, (e.g., face mask, hand gloves etc.), their haphazard disposal, and generation of a huge amount of hospital waste has negative impacts on the environment.

1.3 Reduction of Air Pollution and GHGs Emission:

As many industries, transportation and companies have closed down; it has brought a sudden drop of greenhouse gases (GHGs) emissions. Compared with this time of last year, levels of air pollution in New York have reduced by nearly 50% because of measures taken to control the virus (Henriques, 2020). It was estimated that nearly 50% reduction of NO2 and CO occurred due to the shutdown of heavy industries in China (Caine, 2020). Also, emission of NO2 is one of the key indicators of global economic activities, which indicates a sign of reduction in many countries (e.g., US, Canada, China, India, Italy, Brazil etc.) due to the recent shut down (Biswal et al., 2020; Ghosh, 2020; Saadat et al., 2020; Somani et al., 2020). Usually, NO2 is emitted from the burning of fossil fuels, 80% of which comes from motor vehicle exhaust (USEPA, 2016). It is reported that NO2 causes acid rain with the interaction of O2 and H2O, and several respiratory diseases suffered by humans (USEPA, 2016). The European Environmental Agency (EEA) predicted that, because of the COVID-19 lockdown, NO2 emission dropped from 30-60% in many European cities including Barcelona, Madrid, Milan, Rome and Paris (EEA, 2020). In the US NO2 declined 25.5% during the COVID-19 period compared to previous years (Berman and Edisu, 2020). The level of NO2 demonstrated a reduction across Ontario (Canada) and found to be reduced from 4.5 ppb to 1 ppb (Adams, 2020). Up to 54.3% decrease of NO2 was observed in Sao Paulo of Brazil (Nakada and Urban, 2020). It was also stated that, the levels of NO2 and PM2.5 reduced by almost 70% in Delhi, the capital of India (Thiessen, 2020). Overall, 46% and 50% reduction of PM2.5 and PM10 respectively, was reported in India during the nationwide lockdown (IEP, 2020).

1.4 Reduction of Water pollution:

Water pollution is a common phenomenon of a developing country like India, and Bangladesh, where domestic and industrial wastes are dumped into rivers without treatment (Islam and Azam, 2015; Islam and Huda, 2016; Bodrud-Doza et al., 2020; Yunus et al., 2020).

During the lockdown period, the major industrial sources of pollution have shrunk or completely stopped, which helped to reduce the pollution load (Yunus et al., 2020). For instance, the river Ganga and Yamuna have reached a significant level of purity due to the absence of industrial pollution on the days of lockdown in India. It is found that, among the 36 real-time monitoring stations of river Ganga, water from 27 stations met the permissible limit (Singhal and Matto, 2020). This improvement of water quality at Haridwar and Rishikesh was ascribed to the sudden drop of the number of visitors and 500% reduction of sewage and industrial effluents (Singhal and Matto, 2020; Somani et al., 2020). Usually, huge amount of solid trashes is generated from construction and manufacturing process responsible for water and soil pollution, also reduced. Moreover, owing to the reduction of export-import business, the movement of merchant ship and other vessels are reduced globally, which also reduces emission as well as marine pollution.

1.5 Reduction of Noise Pollution:

Noise pollution is the elevated levels of sound, generated from different human activities (e.g., machines, vehicles, construction work), which may lead to adverse effects in human and other living organisms (Goines and Hagler, 2007; Zambrano-Monserrate et al., 2020). Usually, noise negatively effects on physiological health, along with cardiovascular disorders, hypertension, and sleep shortness of human (Kerns et al., 2018). It is reported that, globally around 360 million people are prone to hearing loss due to noise pollution (Sims, 2020). World Health Organization predicted that in Europe alone, over 100 million people are exposed to high noise levels, above the recommended limit (WHO, 2012). Moreover, anthropogenic noise pollution has adverse impacts on wildlife through the changing balance in predator and prey detection and avoidance. Unwanted noise also negatively effects on the invertebrates that help to control environmental processes which are vital for the balance of the ecosystem (Solan et al., 2016). However, the quarantine and lockdown measures mandate that people stay at home and reduced economic activities and communication worldwide, which ultimately reduced noise level in most cities (Zambrano-Monserrate et al., 2020). For instance, noise level of Delhi the capital of India, is reduced drastically around 40–50% in the recent lockdown period (Somani et al., 2020).

1.6 Increase of Biomedical Waste Generation:

Since the outbreak of COVID-19, medical waste generation is increased globally, which is a major threat to public health and environment. For sample collection of the suspected COVID-19 patients, diagnosis, treatment of huge number of patients, and disinfection purpose lots of infectious and biomedical wastes are generated from hospitals (Somani et al., 2020; Zambrano-Monserrate et al., 2020).

For instance, Wuhan in China produced more than 240 metric tons of medical wastes every day during the time of the outbreak (Saadat et al., 2020), which is almost 190 m tonnes higher than the normal time (Zambrano-Monserrate et al., 2020). Again, in the city of Ahmedabad of India, the amount of medical waste generation is increased from 550-600 kg/day to around 1000 kg/day at the time of the first phase of lockdown (Somani et al., 2020). Around 206 m tonnes of medical waste are generated per day in Dhaka, the capital of Bangladesh because of COVID-19 (Rahman et al., 2020).

1.7 Safety Equipment Use and Haphazard Disposal:

To protect from the viral infection, presently peoples are using face mask, hand gloves and other safety equipment, which increase the amount of healthcare waste. It is reported that, in USA, trash amount has been increasing due to increased PPE use at the domestic level (Calma, 2020). Since the outbreak of COVID-19, the production and use of plastic based PPE is increased worldwide (Singh et al., 2020).

For instance, China increased the daily production of medical masks to 14.8million since from February 2020, which is much higher than before (Fadare and Okoffo, 2020). However, due to lack of knowledge about infectious waste management, most people dump these (e.g., face mask, hand gloves etc.) in open places and in some cases with household wastes (Rahman et al., 2020). Such haphazard dumping of these trashes creates clogging in water ways and worsens environmental pollution (Singh et al., 2020; Zambrano- Monserrate et al., 2020).

1.8 Municipal Solid Waste Generation and Reduction of Recycling:

Increase of municipal waste (both organic and inorganic) generation has direct and indirect effects on environment like air, water and soil pollution (Islam et al., 2016). Due to the pandemic, quarantine policies established in many countries have led to an increase in the demand of online shopping for home delivery, which ultimately increase the amount of household wastes from shipped package materials (Somani et al., 2020; Zambrano-Monserrate et al., 2020).

However, waste recycling is an effective way to prevent pollution, save energy, and conserve natural resources (Ma et al., 2019). But, due to the pandemic many countries postponed the waste recycling activities to reduce the transmission of viral infection. For instance, USA restricted recycling programs in many cities (nearly 46%), as government worried about the risk of COVID-19 spreading in recycling facilities (Somani et al., 2020). Overall, due to disruption of routine municipal waste management, waste recovery and recycling activities, increasing the land filling and environmental pollutants worldwide.

1.9 Other Effects on the Environment:

Recently, huge amount of disinfectants is applied into roads, commercial, and residential areas to exterminate SARS-CoV-2 virus. Such extensive use of disinfectants may kill non-targeted beneficial species, which may create ecological imbalance (Islam and Bhuiyan, 2016).

Moreover, SARS-CoV-2 virus was detected in the COVID-19 patient's faeces and also from municipal wastewater in many countries including Australia, India, Sweden, Netherlands and USA (Ahmed et al., 2020; Nghiem et al., 2020; Mallapaty, 2020). So, additional measures in wastewater treatment are essential, which is challenging for developing countries like Bangladesh, where municipal wastewater is drained into nearby aquatic bodies and rivers without treatment (Islam and Azam, 2015; Rahman and Islam, 2016).

1.10 Potential Strategies of Environmental Sustainability:

It is assumed that, all of these environmental consequences are short term. So, it is high time to make a proper strategy for long-term benefit, as well as sustainable environmental management. The COVID-19 pandemic has elicited a global response and makes us united to win against the virus. Similarly, to protect this globe, the home of human beings, united effort of the countries should be imperative (Somani et al., 2020). Therefore, some possible strategies are proposed for global environmental sustainability.

a. Sustainable industrialization: Industrialization is crucial for economic growth; however, it's time to think about sustainability. For sustainable industrialization, it is essential to shift to less energy-intensive industries, use of cleaner fuels and technologies, and strong energy efficient policies (Pan, 2016). Moreover, industries should be built in some specific zones, keeping in mind that waste from one industry can be used as raw materials of the other (Hysa et al., 2020). After a certain period, industrial zones should have been shut down in a circular way to reduce emission without hampering the national economy. Again, industries especially readymade garments (RMG) and others where a huge number of people work, proper distance and hygienic environment should maintain to reduce the spread of any infectious communicable disease.

b. Use of green and public transport: To reduce emissions, it is necessary to encourage people to use public transport, rather private vehicles. Besides, people should encourage to use bicycle in a short distance, and public bike sharing (PBS) system (like China) should be available for mass usage, which is not only environment friendly but also beneficial for health.

c. Use of renewable energy: Use of renewable energy can lower the demand of fossil fuels like coal, oil, and natural gas, which can play an important role in reducing the GHGs emissions (Ellabban et al., 2014; CCAC, 2019). Due to the COVID-19 pandemic, global energy demand is reduced, which results in the reduction of emission and increased ambient air quality in many areas (Somani et al., 2020; Zambrano-Monserrate et al., 2020). But, to maintain the daily needs and global economic growth, it is not possible to cut-off energy demand like a pandemic situation. Hence, use of renewable energy sources like solar, wind, hydropower, geothermal heat and biomass can meet the energy demand and reduces the GHGs emission (Ellabban et al., 2014).

d. Wastewater Treatment and Reuse: To control the challenges of water pollution, both industrial and municipal wastewater should be properly treated before discharge. Besides, reuse of treated wastewater in non-production processes like toilet flushing and road cleaning can reduce the burden of excess water withdrawal.

e. Waste Recycling and Reuse: To reduce the burden of wastes and environmental pollution, both industrial and municipal wastes should be recycled and reused. Hence, circular economy or circularity systems should implement in the production process to minimize the use of raw material and waste generation (Hysa et al., 2020). Moreover, hazardous and infectious medical waste should be properly managed by following the guidelines (WHO, 2020c).

It is now clear that majority of the people (especially in developing countries) have a lack of knowledge regarding waste segregation and disposal issues (Rahman et al., 2020). So, government should implement extensive awareness campaign through different mass media, regarding the proper waste segregation, handling and disposal methods.

f. Ecological Restoration and Ecotourism: For ecological restoration, tourist spots should periodically shutdown after a certain period. Moreover, ecotourism practice should be strengthened to promote sustainable livelihoods, cultural preservation, and biodiversity conservation (Islam and Bhuiyan, 2018).

g. Behavioral Change in Daily Life: To reduce the carbon footprint and global carbon emission, it is necessary to change the behaviour in our daily life and optimum consumption or resources like; avoid processed and take locally grown food, make compost from food waste, switch off or unplug electronic devices when not used, and use a bicycle instead of a car for short distances.

h. International Cooperation: To meet the sustainable environmental goals and protection of global environmental resources, such as the global climate and biological diversity, combined international effort is essential (ICIMOD, 2020). Hence, responsible international authority like United Nations Environment Programme (UN Environment) should take effective role to prepare time-oriented policies, arrange international conventions, and coordination of global leaders for proper implementation. The detrimental effect of polluted environment is no more an unknown facet to us. In past due to poor air quality, compromised water quality and many more we have suffered a lot. Our lack of consciousness has cost us our health. Many people worldwide suffer from many diseases due to pollution which are our report cards of development at the cost of the environment. This sudden outbreak of the pandemic and a complete seizure of many human activities are the proof that it is us significantly contributing to environmental degradation. And some restrictions imposed on us can definitely give us a more green earth. We should wake up to the reality that as a species man is a part of the ecosystem and not at the pinnacle of it. Making environment the utmost priority we must turn the tide of ecological imbalance around and ensure that we have sustainably managed the environment for future generation only a long term global as well as individual commitment to the conservation of sustainable development can reverse the plethora of unimpeded environmental damage. A sound policy frame work keeping proper environmental health as a goal is the utmost important step. In mass awareness and sensitization on environmental protection and conservation is the need of the hour. Also a more holistic approach towards the environment can make this goal attainable one. Community awareness and equal participation from all the strata of the society can actually bring about a substantial change. Directly or indirectly, the pandemic is affecting human life and the global economy, which is ultimately affecting the environment and climate. It reminds us how we have neglected the environmental components and enforced human induced climate change. Moreover, the global response of COVID-19 also teaches us to work together to combat against the threat to mankind. A well maintained waste disposal system, encouraging local biodegradable as the alternative for usage of the harmful chemicals, identifying and trying to resolve many attitude based problems of wrong waste disposal, considering environmental ethics and global wellbeing before any major activity that possess threat to the environment are certainly some minimum points we can follow so that we can stride together a more green and clean environment.

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