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Indicators of Environmental Recovery during the First Lockdown of COVID-19 Pandemic: Is this a Permanent or a Temporary?

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Abstract

Upon the outbreak and spreading of COVID-19, several reduction measures have been implemented throughout the world to avert the COVID-19 pandemic risks such as entire lockdowns, social distancing, extensive travel bans, mass quarantines, etc. Many positive and negative indicators of this pandemic on the whole environmental compartments have been reported worldwide. These indicators may include promoting the air quality through a reduction in anthropogenic-based emissions (e.g., CO_2 and N_2O) and increase ozone concentration in addition to energy, water and wastewater, deforestation, and natural resources. This is the difficult equation concerningthe COVID-19 pandemic outbreak and its health, societal, economic, and environmental risks and how is the recovery of the environment? Is this recovery will be permanent or temporary? The answer to this question may be emphasized during the outcoming days or months. What will increase this global pandemic aggravation if the COVID-19 has appeared in many types, which enforce us to re-think again concerning the task?

Keywords: Carbon dioxide; Environmental degradation; Nitrogen dioxide; Ozone concentration; Pandemic; Deforestation

1. Introduction

After COVID-19 has been detected among some Chinese people at the end of 2019, it was identified as a novel coronavirus family member and then it was named COVID-19 (Schumacher, 2020). The people life worldwide has been extensively affecedby its emergence. As a result, governments' top focus has been and continues to be restricting and reducing the spread and transmission of COVID-19, with intensive efforts for supporting the local health systems and the unexpected responses of socioeconomic systems (OECD, 2020; El-Ramady et al., 2020a, b). As a result of initial uncertainty concerning its impacts and spreading in the societies, the interactions among peoples have been rapidly locked up through restricting the local, national, and international transmissions as many policymakers decided. This unexpected cemented lockdown had global impacts and triggered many changes in the socio-economic activities globally, for example,

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significant reductions in industrial production, abrupt changes in consumption, increase unemployment, modifications in the working conditions, changes in transport patterns, social interaction, and several further aspects. Conversely, the lockdown has also flattened the disease curve, subsequent environmental impacts (among other impacts) have gradually arisen (McCloskey and Heymann, 2020; Schumacher, 2020El-Ramady et al., 2021c, El-Ramady et al., 2021d).

The rapid outcomes of extensive procedures of virus control have led to a sudden and abrupt reduction in the global commercial activities resulting in some "temporary" improvements in the environment, for example, considerable local has been extensively in air pollution and greenhouse gases (GHGs) emission in many countriesworldwide especially in urban regions, thus the air qualityhas been improved considerably while decreasing the biodiversity loss. However, these influences may be temporaryones because governments adopted variable motivations to revive the economic growth, thus the environmental profits that were recently gained could even be reversed once a recovery is on the right track (McCloskey and Heymann, 2020; OECD, 2020). McCloskey and Heymann (2020) added that while some scientists believed that these changes will not have long-term impacts once the epidemic collapses, others claim that aspects associated with urban planning, allocation economy, teleworking, micro-mobility, public transports, tourism, etc., may become better. However, an important concern is whether COVID-19 will reduce the future environmental consequences or not when economic activities return to their "normality" (i.e., pre-COVID circumstances) (Freire Gonzalez and Vivancob, 2020).

This pandemic offers considerable potential to improve and "consolidating" the environmental circumstances and efforts. However regardless of what is realized through the environmental indicators, more procedures and efforts are be required to offset hidden recovery impacts and enable nations to implement far more environmental reforms as part of their economic recovery, maximizing the benefits of such prospective advances. New literature reveals that different economic means such as environmental taxation, resource pricing, or limiting resource consumption, can be quite beneficial for this goal(Freire Gonzalez and Vivancob, 2020; OECD, 2020). Furthermore, motivation actions can be a chance for investing in the economic transformation and technological inventions that are recognized to be essential to delivering the sustainable enhancements in people's lives that rely, among other matters, upon a healthful environment, and are necessary to increase the overall societies' resilience (OECD, 2020). These modifications have certainsignificants influence on the environmental footprint. All human-induced actions, no matter how minor, contribute to the environmental footprint. If a country's ecological resources are insufficient to meet its consumption, the result is a local ecological deficiency, thus this country will become an ecological debtor. If the situation is the reverse and the country has an ecological reservation, it is referred to as an ecological creditor (Khursheed et al., 2020). Many reports handled the environmental recovery during the COVID-19 pandemic in many sectors such as the global aviation industry (Dube et al., 2021), human behaviors (Shang et al. 2021), environmental stressors (Barouki et al., 2021), environmental awareness (Severo et al., 2021), global air transport industry (Fan et al., 2021; Gudmundsson et al., 2021), agriculture sector (Adhikari et al., 2021), food security (El-Ramady et al., 2021e; Han et al., 2021; O'Hara and Toussaint, 2021), global tourism activity (Zhang et al. 2021) and plastics as protector or polluter (Parashar and Hait, 2021).

Therefore, the present review outlines the aspects and the indicators of environmental improvements and profits during the COVID-19 epidemic closure. It also, highlights whether these improvements will be lasting, or it will be like a summer cloud in a dry place, and what are the opportunities for more environmental improvements.

2. Indicators of environmental recovery during COVID-19 pandemic

2.1 Air quality

It is demonstrated and stated in many researches thatanthropogenicactivities are the main causes for environmental pollution. Since lockdown for weeks, it is anticipated that environmental pollution loads also get declined. As predicted, within the pandimic days, the C emissions aresignificantly reduced. For example, as per the Chinese Ministry of Ecology and Environment, the air quality raised about 11% to become withinthe class 'good' in more than 337 cities (Table 1). As well, the Scripps Institute of Oceanography also stated that fossil fuel would reducedglobally by around 10% due to the COVID-19 spread (Yunus et al., 2020). Furthermore, NASA satellites and the Copernicus Atmosphere Monitoring Service of the European Space Agency (ESA) have recorded a considerabledeclinein air pollution in major cities across the world. It is expected that for two months of enhancing air quality in China only, it is possible to save thousands of children and older adult's lives. Besides, it is also possible to attainconsiderable health benefits when the pollution in the world's major cities decreased by 20 – 30% (SanJuan-Reyes et al. 2021). Unfortunatelythese reductionin levels of environmental pollution are believed to be temporary, as the current pollution levels in theatmosphere, biosphere, and hydrosphere exceeded those recordedduring the pre-COVID-19 time (Yunus et al., 2020). Khursheed et al. (2020) describedalso that this pandemic has led to a considerabledecline in greenhouse gases(GHGs) emissions and generally in air pollution worldwide. In China, for example, the decline in these emissions, as a result of lockdown, has been estimated by 25% and the days of good quality air have been increased in comparison tothe similarmonths in 2019 (Khursheed et al., 2020).

Although many scientists consider air pollution as an undesirablecontributor to this virus state by exacerbating the infection sensitivity, lower emissions in some way may temporarily diminishdeath rates, especially among the most vulnerable people who suffer from fundamental health conditions, such as heart and respiratory illnesses (Pena-Levano and Escalante, 2020). However, Schumacher (2020) reported that at the early stages of the lockdown of COVID-19, environmentalists were especially jubilant. The impact of the COVID-19 problem in Europe, as well as, its trade-related implications on the entire globe has been estimated, and considerable declines in significant environmental contaminants have been reported. There'searly evidence showing this not only helps to mitigate the impacts of COVID-19, but also decreases long-term pollutantsconcentration, which may aid dealing with this virus (Schumacher 2020). Thus, COVID-19 considers an earth's opportunity for cleaning the air and building a clear blue sky which creates an optimistic sense among the people regarding to a clean and healthier environment. Before COVID-19, the entire world was suffering from high levels of air pollution particularly in the forms of CO_2, NO_2, SO_2, and particulate matter (PM) (**Fig. 1**). The main responsibility of these high levelsis the anthropogenic activitiesrepresenting in industries, transport, and power stations. Although the international agencies announced a clean air program since the begging of the Third Millennium to reduce PM pollution levels for a healthier environment to decrease the total death and illness rates (Arora et al., 2020). As a result, despite the authorities throughout the world looked to be unable to manage air pollution levels despite numerous attempts, these levels have automatically dropped duringto the lockdown, making lockdown a viable alternative in the event of a major air pollution crisis (Khursheed et al., 2020).

Fig. 1 The impacts of COVID-19 on all our life sides already have been penetrated and these impacts may include the positive (improving the air quality and reduce the GHGs) and negative ones (increasing pollution, transportation, global trade and more) on the entire environment

Table 1 A summary of worldwide trends of air quality indicators during the COVID-19 pandemic

Air QualityIndicators	Site	The Effect	Reference
Carbon Dioxide (CO_2)	Global Average	Decrease from 11 to 25% in April 2020 compare to the mean level of emission in 2019	Arora et al. (2020)
	India	Decreased	Mele and Magazzino (2020)
	Global Average	Decreased	Siddique et al. (2020)
Carbon monoxide (CO)	India	Decreased by 10%	Arora et al. (2020)
	Korea	Decreased	Ju et al. (2021)
	Mexico	Increased by 1.1%	Kutralam-Muniasamy et al. (2020)
	India	Varied but generally decreased	Somani, et al. (2020)
Nitrogen Dioxide (NO_2)	New York	51%	Casado-Aranda et al. (2020)
	Italy, Spain and UK	18%	Khursheed et al. (2020)
	Wuhan	Decreased by 22.8 μg m^{-3}	Arora et al. (2020)
	China	Decreased by12.9 μg m^{-3}	Arora et al. (2020)
	Korea	Decreased	Ju et al. (2021)
	Mexico	Decreased by 29%	Kutralam-Muniasamy et al. (2020)
	India	Decreased	Mele and Magazzino (2020)
	Egypt	Decreased	Mostafa et al. (2021)
	Global Average	Sharpe decreased	Siddique et al. (2020)
	India	Decreased	Somani, et al. (2020)
	India	Decreased	Zambrano-Monserrate and Ruano (2020)
GHGs generally	Europe and USA	Decreased by 5%	Khursheed et al. (2020)
	China	Decreased by 25%	Khursheed et al. (2020)
	Egypt	Decreased	Mostafa et al. (2021)
Particulate matter (PM) PM_{10}	India	Decreased by 43%	Khursheed et al. (2020) Arora et al. (2020)
	Korea	Decreased	Ju et al. (2021)
	Mexico	Decreased by 11%	Kutralam-Muniasamy et al. (2020)
	Egypt	Decreased	Mostafa et al. (2021)
	Global Average	Decreased	Siddique et al. (2020)
	India	Decreased	Somani, et al. (2020)
Particulate matter (PM) $PM_{2.5}$	New York	Decreased by 35%	Casado-Aranda et al. (2020)
	India	Decreased by 31%	Khursheed et al. (2020)
	China	Decreased from 20 to 30%	Arora et al. (2020)
	Korea	Decreased	Ju et al. (2021)
	Mexico	increased by 19%	Kutralam-Muniasamy et al. (2020)
	Egypt	Decreased	Mostafa et al. (2021)
	India	Decreased	Mele and Magazzino (2020)
	Global Average	Decreased	Siddique et al. (2020)
	India	Decreased	Somani et al. (2020)
	Ecuador	Decreased	Zambrano-Monserrate and Ruano (2020)
Ozone	India	Decreased	Somani et al. (2020)
	Ecuador	Increased	Zambrano-Monserrate and Ruano (2020)
	Mexico	Increased by 63%	Kutralam-Muniasamy et al. (2020)
Air quality index	India	Improved from 15-44 %	Yunus et al. (2020)
	China	Improved by 32 %	Arora et al. (2020)
	Global Average	Improved by 11 %	Siddique et al. (2020)

2.2 Reduction of carbon dioxide emission

It has been recognized that CO_2 emissions were increased by 1% yearly during the previous decade before COVID-19. One of the positive impacts of COVID-19 lockdown is decreasing the CO_2 emissions by 17% (11 to 25%) in the first third of April 2020 compared to the average of the emissions level in 2019 (Arora et al., 2020). Furthermore, Somani et al. (2020) referred to that CO_2 emissions in the previous five years from 2015 to 2019 were 18% higher compared to from the years 2010 to 2014. However, over the 50 days lockdown, the emission in China (as the largest emitter of C) was predicted to be reduced by approximately 25% than pre-COVID. Somani et al. (2020) reported that CO_2 emission was lowered by 8% during this global lockdown. As well, Cazcarroa et al. (2020) stated that though some changes, that resulted from COVID-19, do not have powerful effects on local environmental stresses, transport constraints in the EU have markedly declined CO_2equivalentemission and, as well very favorably, decreased other pollutants that promptedhealth harms(Cazcarroa et al., 2020).

2.3 Reduction of nitrogen dioxide emissions

It is known that transportaion produced excessive concentrations estimated by70% of NO_2. This implies that any reduction in transportation would create a concurrent declines in $NO_2$and GHG emissions (this is already being recorded under the COVID-19 lockdown) . Furthermore, NO_2 emissions decreased significantly in Spain, Italy, and the UK (Khursheed et al., 2020), and reported that satellite images in Europe displayed that NO_2 emissions faded away over northern Italy, Spain, and the UK (Henriques, 2020; Xepapadeas, 2020). In addition, Lopez-Feldmana et al. (2020) reported that lockdown and movement restrictions in the cities of Latin America decreased economical activities and the usageof motor-powered cars. Consequently, air pollution in many Megacities in Latin American has been decreased in the short run. Thus, NO_2 concentrations have significantly decreased in these cities comparing with to their concentrationsbefore the pandemic (Lopez-Feldmana et al., 2020). SanJuan-Reyes et al. (2021) as well reported that air pollution in Asia, Europe, and America, declined in many cities, especially NO_2 concentration. NO_2 is a common indication of air pollution/industrial activity, which is associated with illness and death. People of any age, including healthy people who live in areas with long-term elevatedair pollution, are particularly vulnerable to chronic and infectious respiratory diseases (SanJuan-Reyes et al., 2021).

2.4 Reduction of particulate matter

Particulate matter (PM) in the air is thought to be the most important component of air pollution. PM is a variable collection of solid and liquid materials, both organic and inorganic are suspended in the air (Bianconi et al., 2020). It is known that transportation created excessive concentrations of about 30% of PM. This implies that any reduction in transport would create a significant decline in PM (Khursheed et al., 2020). For example, Lopez-Feldmanaet al. (2020) reported that PM_{10} and $PM_{2.5}$ levels have declined in Bogota, Buenos Aires, and Quito. While, in Mexico City, the reducionsin the levels of PM_{10} and $PM_{2.}$were moderate. Somani et al. (2020) stated that in March 2020 a sharp decline in PM_2occured in Mumbai which is dependent basically on transport and industrial contributions. SanJuan-Reyes et al. (2021) as well reported a decline in $PM_{2.5}$ in many cities in Asia, Europe, and America. Fine $PM_{2.5}$ suspended in the air has a greater probability to enter the lower respiratory tract, resulting in the developmentof a progressive and chronic inflammatory inducement with excessive production of mucus and ciliary epithelium dysfunction (the first defense mean in the respiratory tract) and stimulate persistent changes of the immune system making people more likely to exhibitsevere respiratory illnesses and viral infections (SanJuan-Reyes et al., 2021).

2.5 Increase in ozone concentration

The ozone (O_3) layer exists in the stratosphere in the highest atmospheric layer between 10 to 50 km above the earth. The O_3 layer plays a crucial role in absorbing harmful UV rays from the sun and works as a natural sunscreen. Chlorofluorocarbon (CFCs), hydrochloro-fluorocarbon (HCFCs), methyl chloride, and several halones are O_3-depleting substances (ODS) that destroy the O_3 layer in the stratosphere. Chlorine and bromine, which are responsible for this depletion are produced from reacting ODS with the UV sunlight O_3-depleting substances (ODS) which destroy the O_3 layer in the stratosphere. According to the calling of the international community in the Montreal Protocol regarding ODS 30 years ago, the production and the consumption of these substances should be regulated. By forbidding these compounds, the O_3depletion is declined whichmay enhance recovering back to the level of 1980. Though the efforts in banning human-made reasons of O_3 depletion before COVID-19, the COVID-19 lockdown in 2020 controlled the human-made depleting factors which have resulted in an increase in the average surface O_3 concentration by a factor of 1.5–2. This is because the ODS production and consumption are also decreased (Arora et al. 2020).

Khursheed et al. (2020) mentioned that the probability of the O_3 layer to restore itself has increased, mainly as a result of the drastic decline of vehicular traffic. SanJuan-Reyes et al. (2021) reported that O_3 concentrations have increased about 50%. Many researchers such as Pena-Levano and Escalante (2020) in Rio De Janero, Somani et al. (2020) in India, Casado-Aranda et al. (2020) in Brazil and China also reported an increase in O_3 concentrations in the lockdown periods.

2.6 Energy

The post-pandemic energy policy motivation packages are possibly to have negative long-term environmental impacts. The most important reasons for this are summarizing in the follows: 1) Although lockdown minimized human activities and transportation which lowered short-term gas emissions; yet, it elevated energy needs, which is mostly provided by fossil energy. 2) Short-term recovery will be annulled upon the reopening under no changes in energy policy systems. 3) The resource that will be dedicated to environmental regulations and GHG emission reduction in the future will be limited because shifting funding of the postpandemic recovering itno the ecological programs. 4) The implementation of policy tools (i.e., energy subsidies reform and C taxes) wouldsignificantly become more difficult post-pandemic because of the degree of current economic recession and financial constraints in welfare programs(Shehabi et al., 2020). Siddique et al. (2021) reported also that in recentmonths, the gas and oil sector has been extremely affected which may have a multitude of impacts and can transform the dynamics of the international market. As well, Pena-Levano and Escalante (2020) stated that oil has been significantly affected by lockdown regulations, car factories shutdown, energy use decline, increase in unemployment. Nevertheless, an oil consumption decrease may result in reductions in $CO_2$and other greenhouse gas emissions. Thus, the efforts for the transition into renewable energy can disrupt and hence this can spark a further debate about exploiting renewable energy resources against non-renewable ones. In contrast, an extended viral COVID-19 wave can further excavate the energy crisis. Therefore, there is a need for the prevailing scenario that triggers the need to wisely and responsibly react to this unprecedented crisis to minimalize the damages (Siddique et al.2021).

2.7 Water and Wastewater

The impacts of the COVID-19 have critical international implications on the water sector. Case studies have detected the viral RNA or live virus or in some infected patients' stool and urine, who were diagnosed with COVID-19 (Siddique et al., 2021; SanJuan-Reyes et al., 2021). However, the virus is continuously detectable in fecal samples in around 50–80 percent of individuals for a considerably longer time after their cases become negative after a specific period (more than 20 days in some cases). This has indicated a possible viral transmission pathwayvia wastewater, which coronaviruses live in sewage for around 3 dayss (Siddique et al., 2021; SanJuan-Reyes et al., 2021). However, SanJuan-Reyes et al. (2021) stated that sewage has not been announced as an infection route for COVID-19. Over 80% of the wastewater produced globally, over 95% in some least developed countries (LDCs), is discharged into the open environment without being treated. Because of spreading the pandemic throughout the world, the consequences on the water sector put a harsh highlight on the current inequalities (Siddique et al., 2021).

Monitoring water quality during COVID-19 was performed by many authors (e.g., Aman et al., 2020; Patel et al., 2020; Somani et al., 2020; Yunus et al., 2020; SanJuan-Reyes et al., 2021). Aman et al. (2020) used remote sensing techniques, which are more advantageous and accurate than the traditional, time-consuming, and costly sampling methods to monitor the water quality over the Indian River, Sabarmati. They estimated theSuspended Particulate Matter (SPM) concentrations to highlight turbidity levels before and after lockdown usingthe Landsat 8 OLI images. They found that the mean SPM has dropped by 36.48 % compared to the pre-lockdown time. Yunus et al. (2020) observed also, with the help of remote sensing data, that the concentration of SPM in the Vembanad Lake as the longest Indian freshwater lake decreased by 15.9% during the lockdown period than the pre-lockdown period. Somani et al. (2020) reported that the rigorous lockdown procedures have had an obvious effect on India'srivers and other ecosystems. The achieved water quality in Ganga, India's, as the longest river there, within a few lockdown weeks was more noticeable than what was accomplished by governmental policies and monitoring organizations in decades.

2.8 Deforestation

The importance of maintaining tropical forests has gotnew features with the outbreak of COVID-19, where tropical deforestation raises the likelihood of developing zoonotic diseases with spreading of the pandemic. Government policies have performed a significant role to keep pressure against the conversion of natural forests into agricultural and pastures, but the amount of commitment to enforcing or inhibiting deforestation varies substantially among tropical governments (**Fig. 2**). This pressure, however, may have been highlighted during the current pandemic. For example, closures and budgetary constraintsby environmental agencies in this pandemic may have restricted the field procedures for rightfulimplementation, which consider mainlycomplex within the limits of deforestation. Furthermore, previous sustainability conventionsmay have been diminished in the COVID-19 period to protect the supply of agroproducts to importing countries (Brancalionet al., 2020). Lopez-Feldmana et al. (2020) reported that the short-term environmental effects of the COVID-19 pandemic showed early warnings of increased pressure on forests across Latin America. However, it is very soon to formally evaluate the effects of the pandemic on both of land use-change and deforestation in a specific region. According to the available data, COVID-19 may have a detrimental influence on forest cover throughout the region. However, early indications of deforestation released from Peru showed that, whileit has decreased between mid of March to mid of April, it has increased after that and surpassed the observed levels during the same period in 2018. Although it cannot be professed that the outbreak triggered this risein deforestation, it definitely does not appear to have offered incentives to stop it. The lack of environmental observingin the COVID-19 period may have boostedthe unlawfulworks to benefit from this situation and exacerbate deforestation (Lopez-Feldmana et al. 2020). An emerging threat involvingdeforestation in the tropics and the COVID-19 has been also reported by Brancalion et al. (2020), whereas the COVID-19 social-economic impacts on the potential degradation of forests were stated by Golar et al. (2020).

2.9 Natural resources

Humans are a potential threat to a sustainable environment, where unbiased using of environmental resources leads scientists and decision-makers to consider the environmental restoration of our mother Earth. A comprehensive examination of the Anthropocene era's evolutionary trajectories showed the reality that the extraordinary occurrence of human-induced activities on Earth has fueled the demand for environmental and natural resource management at the local, global, and regional levels. As humans, as well as animals, get infected by this lethal virus, posing the biggest threat after World War II, the COVID-19 virus has raised awareness of individual and global connections with our environment (Khursheed et al. 2020). The virus has resulted in a disturbance in the local and global commerceof products and services derived from nature. In countries such as Costa Rica, the tourism is interlinked with nature; the upset to this industry might have undesirableimpacts on both of forests and biodiversity (Lopez-Feldman et al., 2020). Xepapadeas (2020) stated that the COVID-19 may have global negative impacts on the productive base and thus on the universalsustainability, whereasthe apparentlyadvantageous impacts on environmentalcapital (specificallyclimate) will be impermanentand its attribute to pre-pandemic conditions is most likely. Xepapadeas (2020) mentioned also that COVID-19 appears to have benefits for environmentalcapital, especially in the short time and the example for that is falling down the coal use at China’s (the six biggestpower plants) by 40% between the final three monthsof 2019 and first three months of 2020. On the other hand, Shaikh et al. (2021) stated that the influences of worldwide COVID-19 lockdown may have long-term effects on the agro-food trade. It can be expected changes in patterns of consumption and production of domestic and imported agro-food products can alter country-level utilization of consumption and production limits of cropland in the future which consider an important further research opportunity (Shaikh et al. 2021). Based on the influencesof the COVID-19 on the human health of several households, these households from worldwide are suffered from poor health in the wake of COVID-19 (Fiorella et al. 2020). The impacts of this pandemic on natural resources include the quality of environmental resources (**Fig. 2**) and different socio-economic perspectives as well (Suthar et al., 2021).

Fig. 2.After spreading and outbreaking the COVID-19, nearly all our life has been penetrated by this pandemic as presented in this figure including the sources of energy and its prices (the left 2 photos from upside), water resources, the petroleum production sector, agricultural sector, livestock production, the industrial sector and air pollution, the urbanization and the last photo belongs the forest industry

3. Is this recovery permanent or temporary?

Now the urgent question: are all changes resulted from COVID-19 permanent or temporary on the environments? Is the environment having the ability to recover from all problems of COVID-19? The answer may differ from city to city and from country to country depending on several factors. Macau, a famous Chinese tourism city, was the first city globally to re-open travel borders to all parts of China, which already established a prolonged tourism lockdown for over half a year due to COVID-19 (McCartney et al. 2021). No doubt, this pandemic has triggeredseveral unexpectedchanges in whole life aspects including manufactureand consumption, working conditions, transports, societalinteractions and many moresides. To contain and coexist this pandemic, the majority of such shifts have been precipitatedand implemented by the policies. The general approach included translating these changes into enhancementsin main environmental indicators like these main indicators (i.e., air quality, carbon emissions, and biodiversity loss). We have two author teams; the first claims that these changes will not cause long-lastingimpacts when this COVID-19 epidemic collapses. The second team argues that featureslinkedto urban planning, micro-mobility, allocationeconomy, teleworking, tourism, public transportations and others may getbetter. The most important question is whether the COVID-19 in the future will reduce many environmental impacts or not, when economic activity returns to normal conditions or pre-COVID (Freire-Gonzalez and Vivancob, 2020). Due to the expected long-term environmental impacts of the COVID-19, there is a need to re-assess the response of governments' stimulus packages, which should focus on the transition to efficient resource economies and low emissions as the main component of such a process. It could be noticed that the investment plans should be associated with the recovery process, which needs to be essentialin establishingthe environmental pathways for the next decades for avoiding dangerous climate changes (CC) (OECD 2020).

Across the world, an imposedlockdown withinCOVID-19 pandemic has reducedseveral human activities as reported in urban megacities such as India (Das et al., 2021; Srivastava et al., 2021), China (Fan et al., 2021), Pakistan (Ali et al., 2021), Korea and Japan (Hu et al., 2021). For example, the lockdown measures may have a short-term positive impact on decreasing urban pollutionin several places (e.g., Das et al., 2021; Hu et al., 2021; Srivastava et al., 2021) by decreasing particulate matter (Gayen et al., 2021; Venter et al., 2021) as mentioned before. The challenge now remainshow to avoid any returning to even similar or greateremissions, which were recorded before the pandemic outbreak (Lopez-Feldman et al., 2020). In case of the recoveries in 2021 will be recognized, it could be expected that the pre-pandemic scenario will resurface in terms of GHGs only if this pandemic maintains in powerful repeating waves, necessitating lengthy and continuous lockdowns. However, this conditioncould not be considered being the most probable outcome. If these emission levels are re-covered in the near or medium future, the estimated time frame for exceeding the 1.5 °C threshold based on to alternative emission pathways(Xepapadeas, 2020). It is expected that the COVID-19 will likely result in a wide changes globally, althoughtheir continuity and environmental impact are ambiguous, particularly if the secondary impacts of behavior, measurements, and policies are considered. Freire Gonzalez and Vivancob (2020) asked whether “they can acquire a certain level of permanence, even modifying the mindsets of agents with given the high uncertainty around this aspect, its real dimension could only be assessed ex-post”. It could also confirm that the health advantagesof this pandemic’s remarkableenvironmental may represent in gaining the quality of the air but this will be heightenedin case of such favorable conditions will be sustained to a longer period. However, COVID-19 pandemic demonstrated that the better-health could be continuedand guaranteednot only by using therapeuticmedications,but also *via* additionaldesirable environmental circumstancesif continuedthrough a longer time (Pena-Levano and Escalante, 2020).

4. Opportunities for improvements

The positive environmental impacts may be temporary, however individuals and governments should be learned from the lockdown on how to diminishpollution on a long-term(Arora et al., 2020). There are several indicators that have raised the hope whichrepresenting in the clear sky of improving the local water quality, reducing the noise and the pollution of air. Can mankind usher in a new period of altered lifestyle with reduced impacts on the environment due to reduced pollution rates? These hopes may become unclear particularly most places that overcomed the first wave of COVID-19 revertedto business as usual a lot of businesseshave already utilized this chance to increase subsidies or receive financial aids, to lobby for relaxed emissions standard and be able quickly to go back tothe pre-status of COVID-19. The main problem is represented in how can the world diminish thepollution levels and further rise in its levels again (Schumacher, 2020). The understanding of pandemic impacts on terrestrial and aquaticenvironments and on livelihood chancesfor local people may support the possiblecontribution to the policy design, which may enhance the environmental conservation and management (Lopez-Feldman et al. 2020).

On the basis of the widely held scientific hypothesis that “economic growth has pushed humanity into new ecological niches wherein humans and animals exchange novel, infectious viruses of which COVID-19 is just the latest in a considerable list of examples”. Moreover, global warming may hasten the emergence of novel viruses as warned by the Intergovernmental Panel on Climate Change (IPCC). It is thought also that the CC may have the potentiality to end up killing more people compared to COVID-19, although this is obtusely referred to as an “increased frequency and severity of natural disasters”. Therefore, the CC should be handled from a new dimension under COVID-19 pandemic. The relationship between CC and COVID-19 has been reported as a great challenge for food security and agriculture (Rasul 2021) and impacts on mental health (Marazziti et al., 2021). This dimension may include green motivationstrategies, which have many benefitscompared to usualfinancialmotivationsand the climate-optimisticplansalso can provide greaterprofitablecharacteristics (Koundouri, 2020). It can be concluded that there is a necessityto improve herdsmen's awareness of different ecosystem services, particularly under the current situation of the COVID-19 pandemic(Cai et al., 2020). The connectionbetween COVID-19 and its impacts on ecosystem services have been handled from different aspects such as Everard et al. (2020), Domis and Teurlincx (2020), and Espejo et al. (2020).

5. Conclusions

As a worldwidepandemic, COVID-19 has penetrated the entire environment with great attention from nearly all scientists and governments worldwide. This pandemic has threatened all countries causing serious harm on all levels including the environmental components. After the first wave of this virus, no one can know when this crisis will be ended. The critical question also is represented in whether this virus and its impacts on the environment will be permanent or temporary? This review tried to answer this question based on the positive and negative impacts of this pandemic but the reality enforced us to confess that there is an urgent need to get the evidence concerning this dilemma. Therefore, several further studies are needed to answer many questions like: when one cansay that there is a possibility for a transformed society with lowered environmental impacts due to reduced pollution rates? When the world can breathe clean air? How the humanity overcome both climate change and COVID-19? The answer may need more and more days or even years, particularly under so fast pandemic changes.

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6. References

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