ГОДИШНИК НА УНИВЕРСИТЕТА ПО АРХИТЕКТУРА, СТРОИТЕЛСТВО И ГЕОДЕЗИЯ
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COVID-19 AND THE ENVIRONMENT

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ABSTRACT

The coronavirus disease caused by the SARS-CoV-2 virus (COVID-19) completely changed the way of life of every single person on earth. But in addition to the impact of the related measures on human lives, these measures also affected the environment, both positively in the short term and negatively in the long term. This study aims at exploring the environmental impacts of the measures related to the COVID-19 pandemic by reviewing available sources. Positive and negative impacts are identified and discussed related to the global economic development affected by this disease and the corresponding measures taken worldwide. The ways out of the pandemic and the resulting negative environmental impacts should focus on reshaping our unsustainable production and consumption systems to achieve long-term benefits for the environment ant consequently for our life.

1. Introduction

At the end of December, 2019, the so-called COVID-19 appeared in Wuhan, China. It was quickly identified as a viral infectious disease caused by SARS-CoV-2 and was declared pandemic by the World Health Organization (WHO). Globally, as of 19 April, 2021 the virus was claimed to spread over 223 countries, areas or territories with the death of 3 012 251 humans from 140 886 773 confirmed cases reported to WHO [1], and the numbers were still increasing.

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Usually, the most common symptoms of COVID-19 infection include fever, dry cough, tiredness. Less common symptoms are sore throat, loss of taste or smell, aches and pains, vomiting, diarrhea and others [2]. Older people along with other underlying medical conditions are at a higher risk of mortality.

To control the spread of the virus, governments of many countries in the European Union restricted the movement of people, and all other organizations were closed to encourage people to stay at home. All public places such as typically bustling pubs, bars and theatres were closed, and the people were advised to stay at home. As of April 7, 2020, the World Economic Forum reported [3] that nearly 3 billion people were faced with some form of lockdown globally, and with people stuck indoors, iconic sites across the globe were deserted. The hustle and bustle of everyday life was, however, brought to a hushed standstill by the restrictive measures in response to the COVID-19 pandemic. Overall, the pandemic related measures caused huge global socio-economic disruption, which affected the environment in various ways, either by polluting it or by improvement of air and water quality. Moreover, the increased use of personal protective equipment (PPE) e.g. face masks, hand gloves, gowns, goggles, face shields, etc. and their haphazard disposal created environmental burden [4]. In this connection, the present study intends to explore the positive and negative environmental impacts of the COVID-19 pandemic and more precisely of the related restrictive measures, and to discuss possible related strategies for environmental sustainability.

2. Methodology

This study was performed by reviewing the available information sources – both official and non-government organizations (NGO), as well as some related case studies. The vast amount of profiled information was processed, filtered and structured, accordingly, with respect to the main components of the environment. Unlike many other COVID-19 pandemic studies, this one presents the information and data which are relevant to the environmental impacts of the restrictive measures in response to the declared COVID-19 pandemic and meet the study goals. The present review gives an overview of the COVID-19 pandemic, its area of spread and the environmental consequences of the related official measures.

The COVID-19 pandemic and the related measures caused unprecedented impacts worldwide and throughout Europe in particular, in the social, economic, medical, political and environmental spheres. These measures affected every part of our daily lives, and it seemed like the system in which we have lived in was brought into a “reset” mode.

On the one hand, the shutdown of industrial facilities, the decreased transportation, shipping and travel resulted in decreased levels of pollutants. Air quality has improved in many cities, besides, with a reduction in the water pollution in different parts of the world. Due to a reduction in commercial activities and public transportation, noise pollution was also reduced. Muhammad [5] found that the lockdown resulted in a 30 % decrease in air pollution (Europe) while mobility was curbed by approximately 90 %. However, these positive effects were only due to the lockdown in several countries particularly during the initial phase of the COVID-19 pandemic, and these positive impacts were only short-term benefits. As various activities recovered to normal levels, these positive environmental effects started to vanish.

On the other hand, coronavirus pandemic had negative long-term impacts that many countries faced directly. Mass usage of hand sanitizers and disinfection, which contain alcohol and isopropanol [6] were on the rise. All these chemicals are responsible for causing cancer, endocrine disruption and several neurological effects [7]. They also have an adverse impact on aquatic fauna. The increased use of PPE, their haphazard disposal, and generation of a huge amount of hospital waste had only negative impacts on the environment in the long-term.

3. Results and discussion

3.1. Positive environmental effects

3.1.1. Reduction of air pollution

As it is known, there are numerous sources of air pollution in urban and rural areas (Fig. 1).

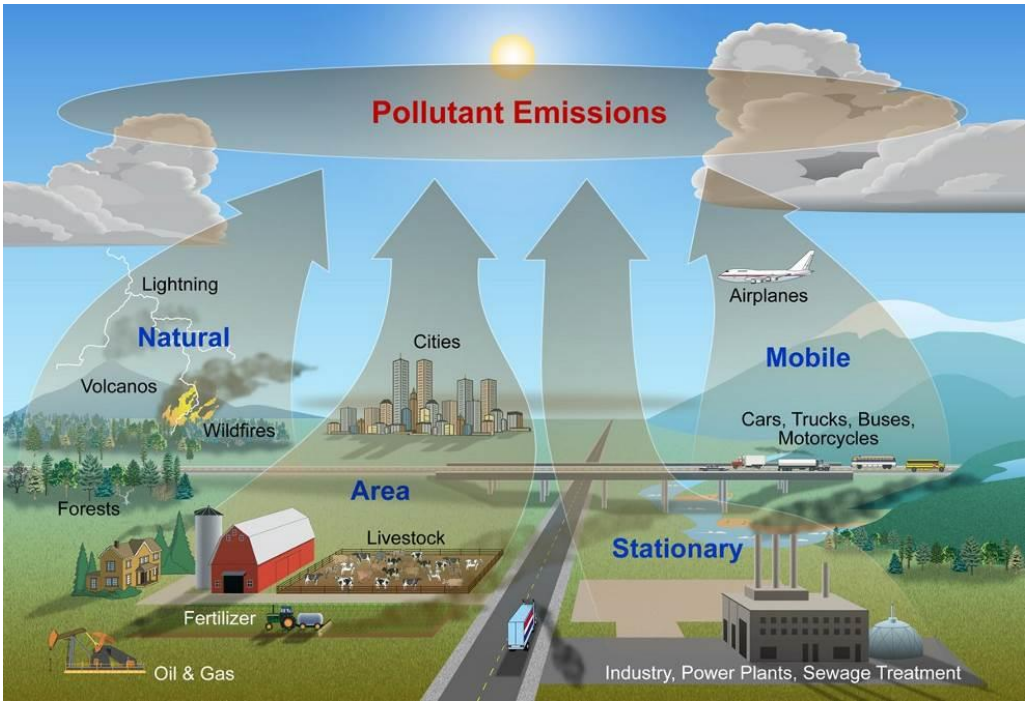

Figure 1. Sources of air pollution [8]

The WHO estimated [9] that in average, air pollution kills seven million people worldwide. Ambient air pollution accounts for an estimated 4,2 million deaths per year due to stroke, heart disease, lung cancer, acute and chronic respiratory diseases. Around 91 % of the world's population lives in places where air quality levels exceed WHO limits.

However, since people stayed home, the first months paved significant improvement in air quality. The lockdown and related measures implemented by many European countries led to a sudden decrease in economic activities, including a drop in road transport in many cities. To assess how this has affected concentrations of air pollution, the European Environment Agency (EEA) developed a viewer that tracks the weekly and monthly average concentrations of nitrogen dioxide (NO_2) and particulate matter (PM10 and PM2.5) [10].

Figure 2 shows the concentration of NO_2, PM2.5, and PM10 changes in Europe at two different times: 6th January 2020 before the outbreak of COVID-19 and 31st March 2020, when most of Europe countries introduced national lockdowns. Maps show low levels of selected pollutant concentration across Europe when lock-down measures were implemented to stop the spread of COVID-19. NO_2, PM2.5, and PM10 concentrations were significantly reduced, independent of meteorological conditions. The results of selected air pollutant average monthly

concentration data analysis from the EEA database show that the suspension of public transportation and habitant mobility restrictions, limited international flights, industry, construction, and other emission source shutdowns during the COVID-19 lockdown acted as significant cause of pollutants reduction in the atmosphere in the study area, compared to the same periods in 2018 – 2019.

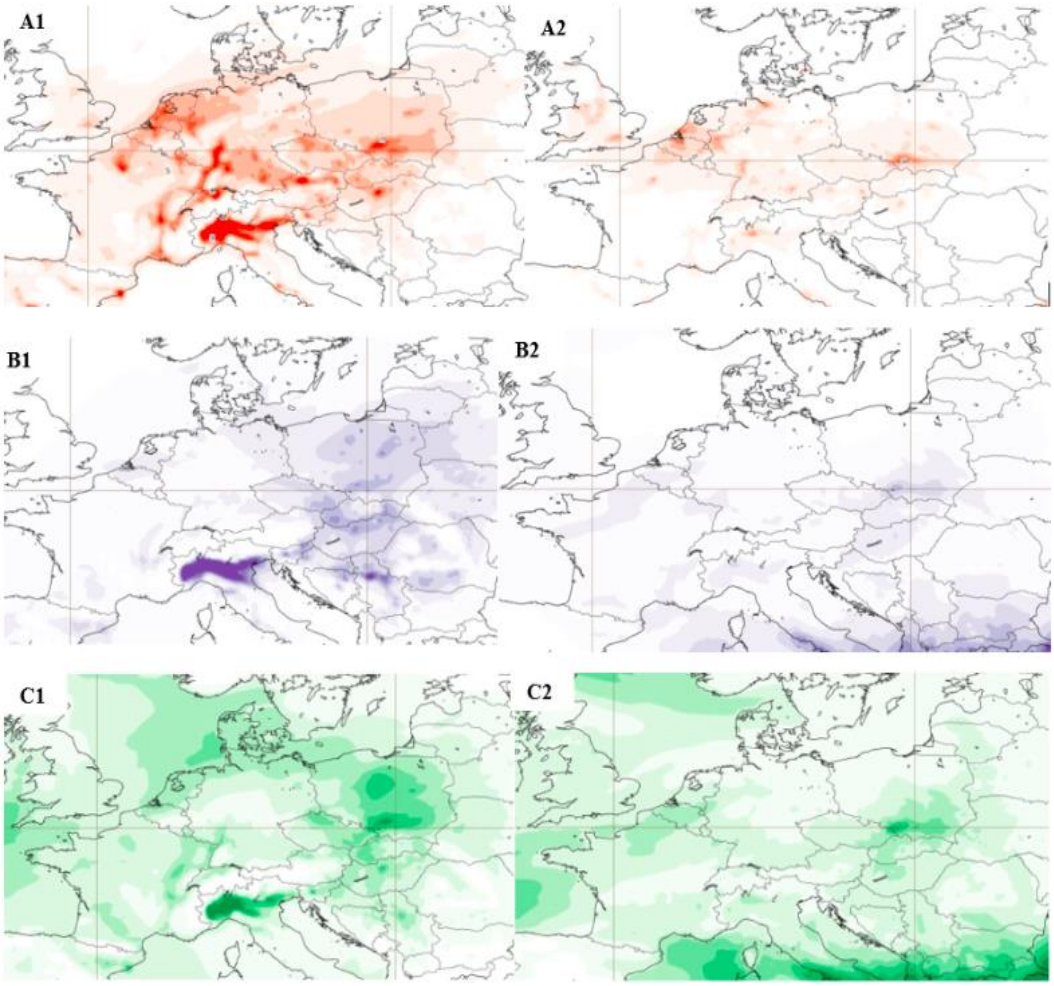

Figure 2. Air pollutants concentration changes in Central Europe: Panels on the left represent air pollutant concentration on the 6th of January; Panels on the right show air pollutant concentration during the lockdown on the 31st March. Top panels (A1, A2) are a comparison of NO_2 concentration [µg/m^3]; Panels (B1, B2) are a comparison of PM2.5 concentration [µg/m^3]; Panels (C1, C2) are a comparison of PM10 concentration [µg/m^3] [11]

In UK, considering that the local traffic intensity dropped by 77 – 79 % and in some countries flights dropped by 82 – 91 %, analysis results showed that the average concentration of NO_2 during the I period, when the national wide lockdown was announced, decreased by 31,9 % in the UK, compared to the pre-lockdown period in 2019. During the II period of

lockdown, the average concentration of NO_2 significantly decreased by 41,6 % compared to the same period in 2019. The average concentration of PM2.5 in 2020 decreased by 48,0 %, compared to the pre-lockdown period in 2019. The average concentration of PM10 continued to grow during the I period up to 21,1 $\mu g/m^3$ in 2020. The values were very similar to the concentration registered in 2018 – 2019 [11].

3.1.2. Reduction of water pollution

Water systems are complex, and potential water improvements depend on the level of urbanization of an area as well as on the physical characteristics of the soil that filters / retains most of the pollution and where pollutants can be stored for months before pouring into the aquifers. A flood or heavy rain could facilitate the sudden release of these substances. For this reason, many scientists believe that water improvements associated with COVID-19 were localized and short-lived [12].

Figure 3. Venice lagoons and waterways quality (top) in 2019 and after a month of pandemic lockdown in 2020 (bottom). During the lockdown in Venice, boats traffic strongly decreased which prevented rise of the sediments to the water surface, making the canal's water look cleaner. As the top image shows, captured on 13th April 2020, the traffic appears almost ceased in the Grand Canal compared to the same time previous year. Credit: Copernicus Sentinel data (2019 – 20), [14]

The COVID-19 related measures had beneficiary consequences on surface water quality in some regions as lockdown improved the water quality of some rivers, canals and seas [13]. One of the positive impacts of these measures (Fig. 3), according to satellite images, is that Venice canals for example became clearer after one month of lockdown. Niroumand-Jadidi [13] reported an almost 50 % reduction in total suspended matter (TSM) after lockdown using shallow-water inversion via Planet Scope imagery. Before the COVID-19, the concentration of TSM was 3 g/m^3 on average; however, it was reduced to 1,4 g/m^3 during COVID-19 lockdown. Because of a reduction in boat traffic, sediments settled causing a reduction in turbidity. Banning tourists during lockdown also reduced amounts of water pollutants released by tourists. This clearer water enabled other creatures such as fish, dolphins and swans to come back to these canals and waterways. Beaches on other places, including Acapulco (Mexico), Barcelona (Spain), and Salinas (Ecuador) had crystal clear waters since the reduction in tourist load.

3.1.3. Reduction of noise pollution

It is likely that there was a significant drop in noise levels during the COVID-19 lockdown, since noise pollution from traffic is typically correlated with NO_2 levels. Although we have grown accustomed to unhealthy noise levels in cities, the short-term reduction in ambient noise during lockdown allowed people to experience the immediate benefits of quieter cities. Several sources [15] also documented a dramatic fall in ground vibrations generated by human activities such as road traffic and industrial activities across the EU.

Environmental noise levels are usually reported over a prolonged period of time, as health effects appear when exposure is a long-term one. It is safe to say that a reduction in noise levels over a few months would not significantly reduce the annual noise level indicator used to measure the effects of noise, unless societal responses to COVID-19 result in longer-term reductions in traffic levels, air transport and other noise-producing activities [15].

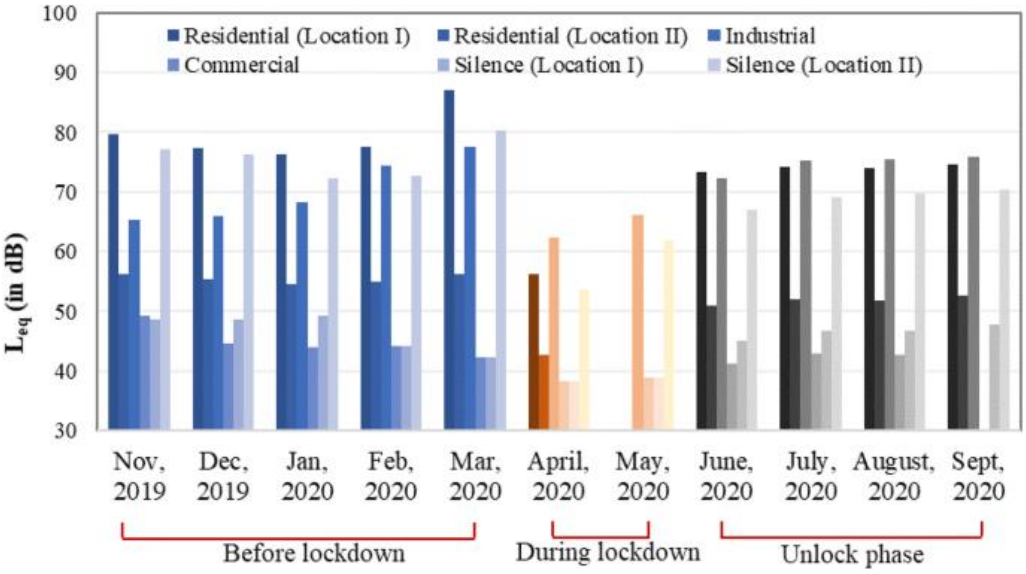

Figure 4. Monthly variation in L_{eq} according to different land use types, [17]

Long-term exposure to the levels of noise observed in many urban areas can cause health effects such as annoyance, sleep disturbance and heart problems [16]. However, even the short-

term reduction in noise during lockdown allowed many people to experience the immediate benefits of quieter cities, and this may have implications for future policies.

Here, a total number of six locations were cited for sound level measurements corresponding to residential, industrial, commercial, and silence zones. The equivalent continuous sound level data were averaged over 1 h (L_{eq}), and its monthly variation according to different land use types is presented in Fig. 4 [17].

The imposition of quarantine measures by most governments caused people to stay at home. With this, the use of private and public transportation decreased significantly. Also, commercial activities stopped almost entirely [18]. All these changes caused the noise level to drop considerably in most cities in Europe.

3.2. Negative environmental effects

3.2.1. Increased amounts of waste

The COVID-19 pandemic caused significant changes in the production and consumption of plastics, and in different types of waste, respectively. The pandemic led to a sudden surge in global demand for personal protective equipment (PPE) such as masks, gloves, bottled hand sanitizer, etc. During early efforts to stop the spread of the disease, the WHO estimated that each month, 89 million medical masks were required globally, together with 76 million examination gloves and 1,6 million sets of goggles [19].

The increase in PPE manufacture and distribution generated an equivalent increase in the waste stream, compounded by health and environmental risks along the waste management chain, especially in countries with an underdeveloped infrastructure. China produced approximately 240 tons of medical waste daily at the peak of pandemic in Wuhan, amounting to six times higher than before the disease outbreak (Fig. 5). Therefore, the local waste management agency deployed mobile incinerators in the city to dispose of the unprecedented quantities of discarded face masks, gloves, and other contaminated single-use protective gear. Similar increases in discarded face masks, hand gloves, and protective goggles were observed worldwide [20].

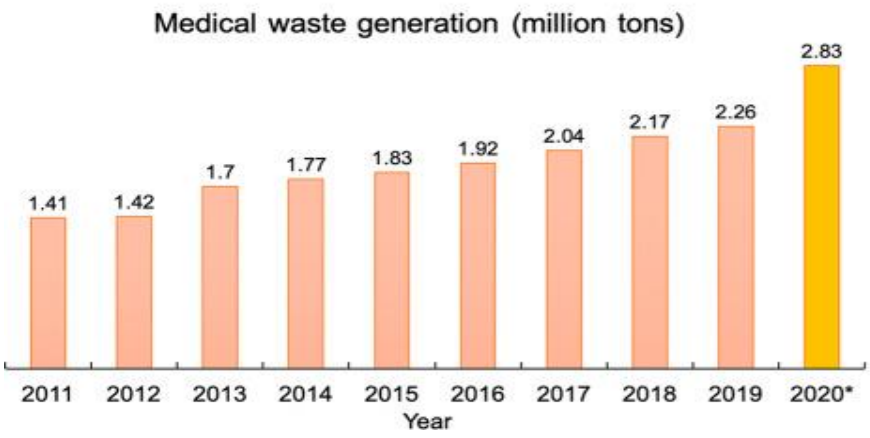

Figure 5. Increasing of medical waste generation in China [20]

All these face masks and personal protective equipment saved countless lives during the coronavirus pandemic, but without proper disposal, they posed a real threat to the environment.

The quarantine policies, established in most countries, led consumers to increase their demand for online shopping and for home delivery, respectively. And as we return to a 'new normal', research by DS Smith shows how our shopping habits have changed [21]. According to the research, 64 % of Europeans said that they shopped online more during COVID-19 lockdowns, and 89 % of respondents said that they would continue to shop online at the same level or even more post-lockdown [21]. With the increased use of PPE and online purchases, the production of plastic and therefore its environmental impact increases, too. The threats caused by plastics to the natural environment of our planet are well known, we would only mention here that different products made of plastic need from 10 – 20 to more than 450 years to completely decompose under natural conditions [22]. Furthermore, it is especially worrying that even without pandemic and intensive use of PPE and online shopping, the production and use of plastics worldwide constantly increases (Fig. 6).

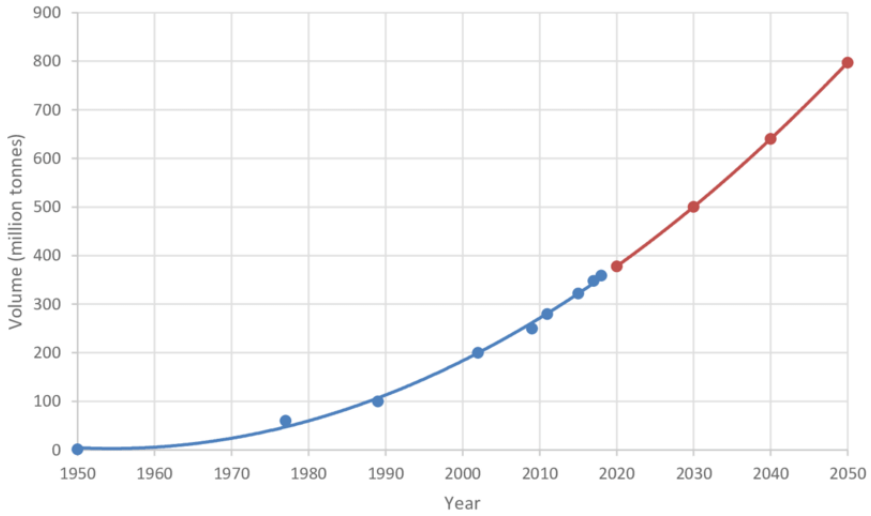

Figure 6. Global production volume of plastics. Blue line, production 1950 to 2018; orange line, forecast production 2020 to 2050, [23]

Figure 7. A young gull with a disposable face mask tangled round its legs [24]

Figure 8. A macaque monkey chews on a face mask. Mohd Rasfan/AFP/Getty Images [26]

The PPE products designed to keep us safe are actually harming animals around us, Fig. 7 [24], Fig. 8 [26]. It is striking that all the reported findings of entanglement, entrapment, ingestion, and incorporation of PPE into nests so far involved single-use products. Switching to reusables would result in a 95 % reduction in waste, according to the UCL Plastic Waste Innovation Hub (2020) [25].

3.2.2. Reduction in waste recycling

Waste recycling has always been a major environmental problem of interest to all countries. Recycling is a common and effective way to prevent pollution, save energy, and conserve natural resources [27], it was the first idea prior to the concept of Urban mining. In all European countries affected by the COVID-19, waste management was restricted and waste recyclers faced new problems.

For example, Italy prohibited infected residents from sorting their waste [27]. Businesses that once encouraged consumers to bring their own bags or containers increasingly switched to single-use packaging. In early March 2020, Starbucks announced a temporary ban on using reusable cups [28]. Furthermore, many people had more time to clean out their houses, cellars and attics. In Germany, this resulted in long lines in front of recycling centers accepting bulky waste and waste electrical & electronic equipment (WEEE). In Belgium, the collection containers for second-hand textiles were closed, and people had to keep the used clothes at home. And everywhere in Europe, the illegal dumping of waste increased, and an entire new waste stream entered streets and household bins [29].

The demand for recycled material from packaging businesses fell by 20 % to 30 % in Europe in the second quarter compared with the previous year, ICIS says. At the same time, people who stayed at home created more recycling waste, said Sandra Castro, CEO of Extruplas [30], Portuguese recycling firm which transforms recycled plastics into outdoor furniture.

3.2.3. Impact on soil and water ecosystems

The components of the ecosystem are intertwined with each other, Fig. 9 [7]. All activities such as washing hands more regularly with soap (in general – use of synthetic surface-active agents, SSAA), mass disinfection by government and local bodies, and production of single-use plastics containing bisphenol A (BPA) are destined to have negative impacts on soil and water quality and related ecosystems [7]. Alcohol containing products spilled in the water are toxic to aquatic fauna and spill in soil may also pollute the groundwater [6]. Soaps are the oldest known detergents. Discharged detergents cause foam in water bodies. Foam is produced due to lowered surface tension of water by soaps and other detergents. These substances form a protective surface film which acts as an obstacle at the air-water interface. 120 mg/l of soap can prevent the growth and development of algae [7]. Aquatic plants can be adversely affected by soaps. Accumulation of harmful pollutants in soil as a result of extensive use of SSAA definitely deteriorates the quality of the soil.

The soil supplies humanity with food, fuel, fiber, feed for animals and the plants themselves grow and develop in and through the soil, thus, we all depend on the condition of the soil. The deterioration and pollution of soils, especially through anthropogenic sources represents a serious threat to the global food security, particularly under the pandemic. During the COVID-19 outbreak and the following lockdowns, huge amounts of medical wastes were produced, part of which polluted the soils without any close and profiled monitoring. Hence, there is a strong need to address the role of soil science in understanding and mitigating problems caused by the COVID-19 crisis over the short and long terms.

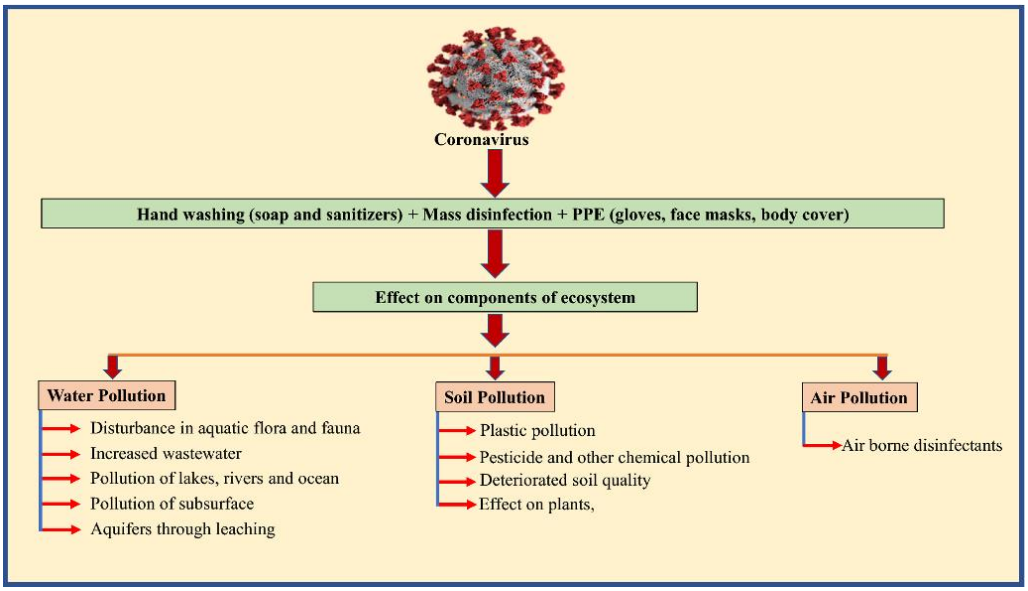

Figure 9. Cascade effect of Corona virus on different components of ecosystem such as water, soil and air pollution [31]

4. Conclusions

The COVID-19 pandemic and the related policies and measures caused different impacts on the environment, both positive and negative. On the one hand, the positive effects are not few, but they do not affect the future and they last for a short period of time. On the other hand, the negative impacts on the environment are still extremely dangerous and affect not only natural environment, but also humanity in the long- term. With the significant changes in the production and consumption of plastics and PPE in particular, as well as in the structure and amounts of waste, the dangers of soil and water pollution and consequently the extinction of various animal species are increasing.

People may have suffered from the coronavirus pandemic and subsequently recovered, but nature is getting sick of our amounts of waste. The nature of our planet gets sick of it, and sooner or later people will also be affected. Maybe, the catastrophe is already present, but the policy makers of the human kind still do not make the necessary to avoid to the worst consequences. Whether this threat is much more serious and large-scale than the COVID-19 pandemic? The lockdowns were lifted, but we should carefully analyze the positive effects of these restrictive measures to the environment and may not quickly forget all clearly identified negative ones. We should focus on reducing the latter ones and the related direct dangers to our civilization. Last but not least, besides the medical and social aspects of the COVID-19 pandemic, our world should identify it also as the last warning about a bundle of environmental problems that we must solve ourselves, as humanity, for the sake of our planet and our own future.

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COVID-19 И ОКОЛНАТА СРЕДА

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Ключови думи: *пандемия COVID-19, ограничителни мерки, околна среда*

РЕЗЮМЕ

Коронавирусната болест, причинена от вируса SARS-CoV-2 (COVID-19), изцяло промени начина на живот на всеки човек на земята. Но в допълнение към въздействието на съответните мерки върху човешкия живот, те се отразиха и на околната среда, както положително в краткосрочен, така и отрицателно в дългосрочен план. Това проучване има за цел да изследва въздействието върху околната среда на мерките, свързани с пандемията от COVID-19. Положителните и отрицателните въздействия се обсъждат във връзка с глобалното икономическо развитие, засегнато от тази пандемия и съответните мерки, предприети в световен мащаб. Пътищата за излизане от пандемията и произтичащите от това отрицателни въздействия върху околната среда трябва да се съсредоточат върху преустройство на нашите неустойчиви системи за производство и потребление за постигане на дългосрочни ползи за околната среда и нашия живот.

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