



Potential impact of COVID-19 pandemic lockdown on environmental parameters

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ABSTRACT

COVID-19 had an impact on the daily life, human activities, various sectors, and the environment. Accordingly, the aim of this research was to examine the effect of the COVID-19 pandemic lockdown (COVID-19 PL) on the environmental parameters. The studied environmental parameters were solid waste, noise, air, water, wastewater (WW), soil and green areas, natural environment and resources, light pollution, radiation pollution, energy and others. The main environmental issues were divided into seventy sub-parameters. Results revealed that COVID-19 PL increased a number of parameters, such as domestic and hospital wastes, noise at home, aquatic life and water quality, domestic WW amount, green areas, animal and birds movement, natural energy, rodents etc.; while, it decreased several factors for instance commercial/industrial solid waste, traffic and outdoor noises, air pollution and particles, water contamination, WW production, cutting trees and hunting, fuel extraction and mining, artificial light and radiation, fuel combustion, tourist etc. Alternatively, some parameters, such as black water, natural radiation, and normal lighting remained as before COVID-19 PL. Positive, nil, and negative impacts of the parameters on the environment due to COVID-19 PL were 81.43 %, 5.71 %, and 12.86 %, respectively. Positive impacts of the COVID-19 PL on the environment were greater than negative influences and lockdown was regarded as a respiration of the natural environment. Currently, prediction of seasonal impact on spreading COVID-19 is difficult.

1. Introduction

Coronaviruses started in the 1930s when it was found in domesticated chickens. In humans, it was initially documented in the 1960s. This virus contains severe respiratory tract infections (Khoshnaw et al., 2020). The coronavirus disease is a pandemic happening by an outbreak that occurred in late 2019 (COVID-19), caused by the coronavirus-2 virus of the severe respiratory syndrome (SARSCoV-2) (Ibarra-Vega, 2020). The COVID-19 was first recognized in December 2019 in

Wuhan-China between a group of patients that were presented with an unknown system of viral pneumonia with joint history of visiting the Huanan seafood market (Ibarra-Vega, 2020; Peeri et al., 2020). In the past, six main pandemic and epidemic outbreaks cleaned the planet from 2000 to 2019, namely Severe Acute Respiratory Syndrome (SARS) between 2002 and 2004, H1N1 influenza in 2009, Middle East respiratory syndrome (MERS) from 2012 to 2020, the West-African Ebola virus epidemic during 2013 to 2016, the Zika fever from 2015 to 2016, and Avian influenza between 2008

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and 2014. None of these attained the spatial level and the extensive impacts that the new COVID-19 did (Cheval et al., 2020).

To date of 28 July 2020 (10:34 am), there have been 16,301,736 confirmed cases of COVID-19, containing 650,069 deaths, according to WHO reports (<https://covid19.who.int/>). The COVID-19 caused acute international socioeconomic confusion, such as postponement and termination of politics, sports, religious, and cultural activities (Sarwar et al., 2020).

Human activities, industrialization, climate change, global warming, population increase, technologies, crisis etc. caused effect on the environment and enhanced the environmental contamination. On the other hand, natural phenomenon, such as volcanos, dust storm, fires, deforestation, flood etc. increased environmental pollution as well. COVID-19 PL affected the environmental issues via decreasing some factors and increasing others.

A number of researches regarding the effect of COVID-19 PL on air quality (Kerimray et al., 2020; Li et al., 2020), air pollution (He et al., 2020), air quality and water quality in India (Lokhandwala and Gautam, 2020), air quality and meteorological variables (Xu et al., 2020), air quality, noise, beaches, and recycling (Zambrano-Monserrate et al., 2020), surface water quality (Yunus et al., 2020), air and water quality (Cheval et al., 2020), GIS (Sarwar et al., 2020), solid waste (Ouhssine et al., 2020), stone quarrying and crushing areas (Mandal and Pal, 2020), solid waste and beach evaluation in Ecuador (Ormaza-Gonzales and Castro-Rodas, 2020) were published. But to date, there is no published research on the effect of COVID-19 PL on the environmental parameters like solid waste, noise, air, water, wastewater (WW), soil and green areas, natural environment and resources, light pollution, radiation pollution, energy and others.

Therefore, the objective of this research was to examine the impact of COVID-19 PL on the mentioned environmental parameters. To date, this kind of study is not available in the extant literature.

2. Materials and methods

The current work focused on the studying of the impact of COVID-19 PL on the environmental factors. Environmental issues comprise of numerous parameters such as solid waste, noise, air, water, WW, soil and green areas, natural environment and resources, light pollution, radiation pollution, energy and others. Each parameter was divided into sub-parameters. For this purpose, seventy environmental factors were studied during COVID-19 PL. The environmental limits were chosen and tested based on the experience, visiting site, and the references (Chadderton 2004; Wang et al., 2010; Aziz and Ali, 2018; Aziz et al., 2019; Rangwala, 2019). Assessment for the parameters were conducted. Effect of

COVID-19 PL on the environmental issues were labeled as increasing (+1), remained as before COVID-19 PL (0), or decreasing (-1). Additionally, positive, nil, and negative influences of the factors on the environment were studied. The current work focused on the Erbil City, Kurdistan Region (KR)-Iraq environment and the global environment as well. Data were collected from Erbil City and the sources. Tabulated data were compared to the published works. Partial lockdown and closing of some areas such as schools, universities, car shows, beauty salons etc. in Erbil City, KR-Iraq started at the end of February 2020. While, full lockdowns on 14 March 2020 to 23 April 2020, 24 to 26 May 2020, 1 to 3 June 2020 and 1 to 4 July 2020 were executed in Erbil City, Figure 1. For the periods 23 April 2020 and till 28 July 2020, partially lockdowns with application of various scenarios were performed.



a)



b)

Figure 1. Erbil City centre before (a) and during (b) COVID-19 PL

3. Results and Discussions

The details of the COVID-19 PL effect on the environmental issues such as solid waste, noise, and air are illustrated in Table 1 and Figure 2.

3.1. Solid Waste

Commonly the quantity of municipal solid waste (MSW) deceased during COVID-19 PL due to stopping and delaying activities such industrial, commercial, institutional etc. Lockdown caused decreasing of industrial, commercial, demolition, and construction etc.

Table 1
Impact of COVID-19 on Environmental Parameters-Part I

No.	Parameters	Details	During COVID-19 lockdown			Impact
			Decreased	Remained as before	Increased	
1	Solid waste	Municipal Solid Waste	-1			Positive
2		Hospital Waste			1	Negative
3		Hazardous waste	-1			Positive
4		Domestic waste			1	Negative
5		Commercial Waste	-1			Positive
6		Industrial Waste	-1			Positive
7		Construction and demolition	-1			Positive
8		Gardens and park waste	-1			Positive
9		Recyclable Materials	-1			Positive
10		Agricultural waste	-1			Positive
11		Mini and super markets			1	Negative
12	Noise	Activities waste	-1			Positive
13		Traffic noise	-1			Positive
14		Institutional noise	-1			Positive
15		Commercial areas	-1			Positive
16		Industrial areas	-1			Positive
17		Gardens and public areas	-1			Positive
18		Homes			1	Negative
19		Aircraft noise	-1			Positive
20		Worship areas	-1			Positive
21		Construction and demolition	-1			Positive
22		Mini and super markets			1	Negative
23	Air	Stadium and public activities	-1			Positive
24		Underground/Tube	-1			Positive
25		Air pollution	-1			Positive
26		Ozone problems	-1			Positive
27		CO and CO ₂	-1			Positive
28		Oxygen			1	Positive
29		Dust storm	-1			Positive
30		Greenhouse gasses	-1			Positive
31		Particles	-1			Positive
32		Nasty odour	-1			Positive

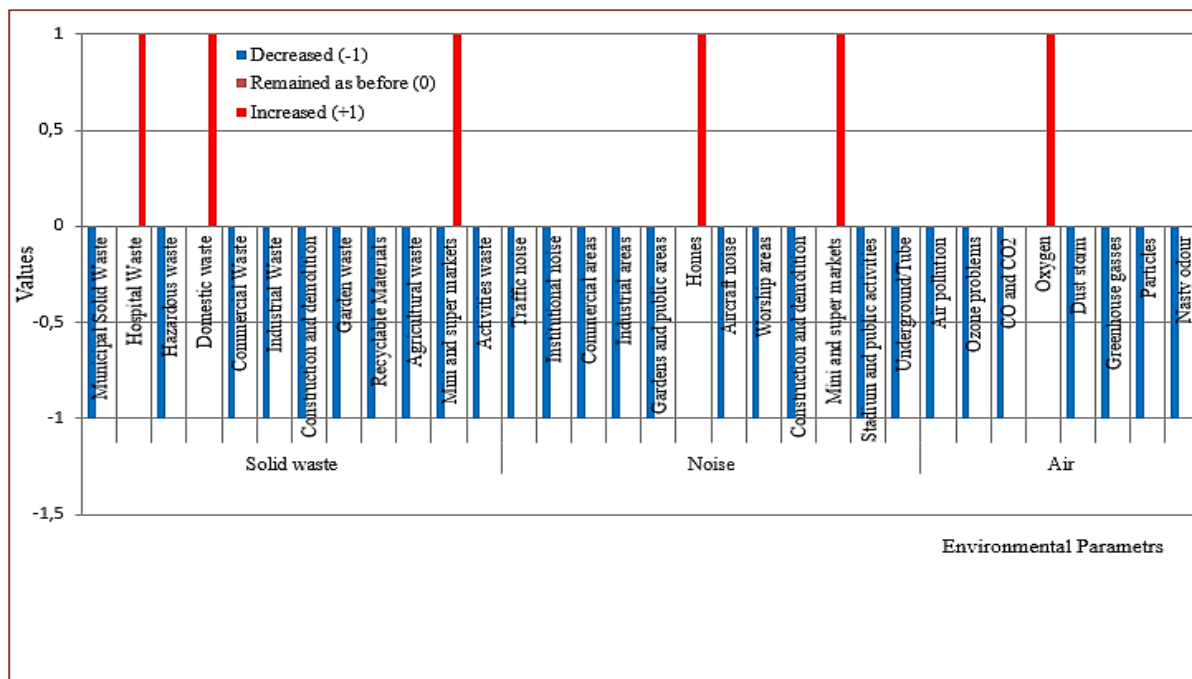


Figure 2. Impact of COVID-19 PL on Environmental Parameters - Part I

wastes, Table 1 and Figure 2. Researchers conducted a study on the MSW in Khenifra and Tighassaline-Morocco. The authors documented that the amount of MSW in Khenifra City in March 2019 and March 2020 were 2,572 tons and 2,456 tons, respectively. While, in Tighassaline City quantities of MSW for the same period were 136 tons and 126 tons, respectively. The research confirmed that COVID-19 PL resulted in decreasing amount of MSW (Ouhssine et al., 2020). In another research, authors reported that COVID-19 PL caused reduction in recycling solid waste (Zambrano-Monserrate et al., 2020). Ormazza-González and Castro-Rodas (2020) stated that amount of garbage and plastic decreased during COVID-19 PL at Salinas and Manta beaches in Ecuador.

Additionally, the beaches improved during the quarantine. On the other hand, hospital wastes increased during the lockdown due to increasing of patient numbers in the hospitals. People stayed at home and bought daily requirements in the markets, this led to enhancing of domestic and local market wastes in Erbil City. Published data confirmed solid waste information in Table 1 and Figure 2.

3.2. Noise Pollution

Noise pollution sources are traffic, aircraft, machines, conversation, sounds etc. (Aziz, 2012). COVID-19 PL causes closing of markets, industrial areas, institutional, sport areas, worship places etc. Lock downs resulted in decreasing noise at commercial, industrial, worship, and sport areas. In addition, it reduced traffic, aircraft, underground, machine noises as well (Table 1 and Figure 2).

Erbil-Kirkuk Main Road, Erbil-Iraq before and during COVID-19 PL is illustrated in Figure 3. This street is very crowded, especially during daily hours, because a number of Ministries (Ministry of higher education and Scientific Research, Communication and Transportation), Directorates (Water Resources, Agriculture, Zanco Bank, Central Library, Zanco Hospital, Heart Hospital, Traffic Police, and Transportation), Presidency of universities (Salahaddin University-Erbil, and Erbil Polytechnic University), colleges (Education, Arts, Science, and Engineering), and Institutes (Erbil Technical Institute, and Erbil Administration Institute), hotels, student hostels, stadium, car shows, restaurants, fuel stations, shops, markets etc. are located on this street, Figure 3.

Traffic noise pollution on this road was 58 to 85 dB before COVID-19 PL, and air craft noise was 73 dB before lockdown (Aziz, 2008; Aziz et al., 2012).

It is clear quarantine decreased traffic, aircraft and other noises in Erbil City. A number of researchers focused on the effect of COVID-19 PL on some environmental factors (for instance noise pollution) in China, USA, Italy, and Spain. They stated that the lockdown caused

reduction in environmental noise (Zambrano-Monserrate et al., 2020). At stone quarrying and crushing areas in India, noise level before and during COVID-19 PL were 85 dBA and 65 dBA, respectively (Mandal and Pal, 2020). The results confirm the noise information in Table 1 and Figure 2. Alternatively, people staying at home increased noise pollution at home and at residential areas.



a) 27 August 2019



b) 5 April 2020

Figure 3. Erbil-Kirkuk main road before (a) and during (b) COVID-19 PL

3.3. Air pollution

Air quality index (AQI) and concentrations for $PM_{2.5}$, PM_{10} , NO_2 , and O_3 in Erbil City before and throughout COVID-19 PL are shown in Figure 4 and Table 2. It is clear that generally lockdowns decreased AQI and concentration of $PM_{2.5}$, PM_{10} , NO_2 , and O_3 and improved air quality in Erbil City. Kerimray et al. (2020) stated that COVID-19 PL decreased concentration of air pollutants such as $PM_{2.5}$, NO_2 , and CO in Almaty, Kazakhstan. Cheval et al. (2020) outlined that COVID-19 PL enhanced air quality in the urban areas. At stone quarrying and crushing areas in India, PM_{10} before and during COVID-19 PL were 89 - 278 $\mu g/m^3$ and 50 - 60 $\mu g/m^3$ (Mandal and Pal, 2020). In a research conducted in Yangtze River Delta (YRD) Region - China, authors reported that COVID-19 PL reduced SO_2 , NO_x , $PM_{2.5}$, and VOCs emissions by approximately 16 - 26 %, 29 - 47 %, 27 - 46 %, and 37 - 57 % throughout Level I and Level II response periods, respectively (Li et al., 2020).

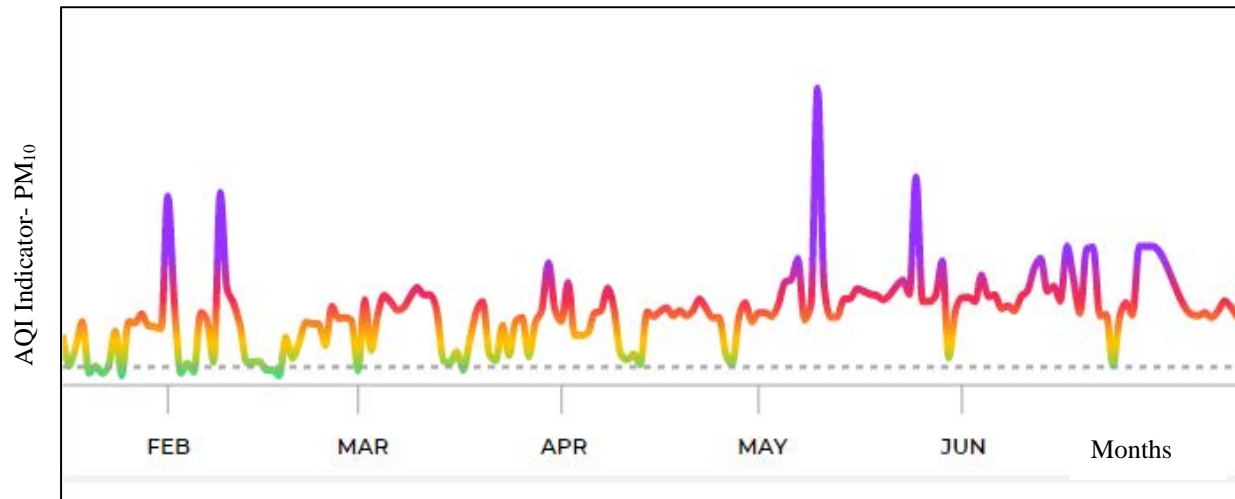


Figure 4. Air quality index in Erbil City before and during COVID-19 PL
(Air quality in Erbil, <https://air.plumelabs.com/air-quality-in-erbil-oPs>)

Table 2

Air quality parameters in Erbil City before and during COVID-19 PL (Air quality in Erbil, <https://air.plumelabs.com/air-quality-in-erbil-oPs>)

Date	AQI				Concentration ($\mu\text{g}/\text{m}^3$)				AQI Assessment	Description
	PM _{2.5}	PM ₁₀	NO ₂	O ₃	PM _{2.5}	PM ₁₀	NO ₂	O ₃		
17 January 2020	32	27	21	6	16	27	41	15	Average	Before Lock.
1 February 2020	103	285	7	25	55	377	13	56	Air apocalypse	Before Lock.
15 February 2020	11	14	30	7	5	14	54	17	Average	Before Lock.
1 March 2020	25	30	15	19	13	31	30	47	Average	Partially Lock.
15 March 2020	46	42	32	6	23	42	56	16	Poor	Full Lock.
1 April 2020	58	115	15	20	30	104	29	49	Very poor	Full Lock.
15 April 2020	52	117	25	4	26	106	45	10	Very poor	Full Lock.
1 May 2020	58	118	20	5	29	108	40	13	Very poor	Partially Lock.
15 May 2020	89	148	33	3	45	156	58	7	Very poor	Partially Lock.
1 June 2020	64	139	55	1	32	144	90	2	Very poor	Full Lock.
15 June 2020	62	157	30	8	31	171	53	20	Dire	Partially Lock.
1 July 2020	89	200	19	24	44	240	37	57	Extreme	Full Lock.
15 July 2020	61	164	44	4	31	183	71	10	Dire	Partially Lock.

A research carried out in locked down cities in China, authors documented that the AQI in the locked down cities was reduced by 19.84 points (PM_{2.5} down by 14.07 $\mu\text{g}/\text{m}^3$) (He et al., 2020). Reports from all over the world recognized that after COVID-19 PL, air quality improved and environment was promising (Lokhandwala and Gautam, 2020). Authors outlined that COVID-19 PL caused air quality improvement and reduction of greenhouse gases in China, USA, Italy, and Spain (Zambrano-Monserrate et al., 2020). Table 1 presented that air quality parameters reduced during quarantine. Improvement of green areas and reduction of air pollutants led to enhance the oxygen ratio. Published and collected data on air confirm the information in Table 1 and Figure 2.

3.4. Water

Influences of the COVID-19 PL on the quantity and quality of water are presented in Table 3 and Figure 5. Yunus et al. (2020) reported that COVID-19 caused

improvement of surface water quality in the Vembanad Lake, the longest freshwater lake in India. Cheval et al. (2020) reported that COVID-19 PL improved water quality in the urban areas. During lockdown at stone quarrying and crushing areas in India, adjacent river water was qualitatively enhanced due to stoppage of dust release to the river.

Total dissolved solids level in river water neighboring to crushing unit decreased by nearly two times (Mandal and Pal, 2020). Documents from all over the world are specifying that after COVID-19 PL, water quality in rivers improved and nature showed signs of recovery (Lokhandwala and Gautam, 2020).

Lockdown caused decreasing of water consumption in commercial, industrial, institutional, tourist, worship etc. areas. Additionally, stopping and postponing the activities led to decreasing pollutants in the water sources and enhancing water quality.

Quarantine minimized hunting which led to the increase of fish and other aquatic lives. Published works support the ideas in the Table 3 and Figure 5.

Table 3
Impact of COVID-19 on Environmental Parameters-Part II

No.	Parameters	Details	During COVID-19 lockdown			Impact
			Decreased	Remained as before	Increased	
1	Water	Water sources improvement			1	Positive
2		Water consumption	-1			Positive
3		Precipitation			1	Positive
4		Aquatic life improvement			1	Positive
5		Water quality			1	Positive
6	Wastewater (WW)	Municipal WW quantity	-1			Positive
7		Residential WW quantity			1	Negative
8		Black water quantity		0		Nil
9		Yellow water quantity		0		Nil
10		Grey water quantity	-1			Positive
11		Industrial WW quantity	-1			Positive
12		Commercial WW quantity	-1			Positive
13		WW quality			1	Positive
14	Soil and green areas	Soil contamination	-1			Positive
15		Green areas			1	Positive
16		Erosion	-1			Positive
17		Fire occurrence	-1			Positive
18	Natural Environment	Biodiversity			1	Positive
19		Animal movement			1	Positive
20		Bird movement			1	Positive
21		Natural environment improvement			1	Positive
22		Cutting trees and grass	-1			Positive
23		Hunting	-1			Positive
24	Natural Resources	Flood			1	Negative
25		Oil Extraction	-1			Positive
26		Mining	-1			Positive
27	Light Pollution	Quarry	-1			Positive
28		Natural		0		Nil
29	Radiation Pollution	Artificial	-1			Positive
30		Natural		0		Nil
31	Energy	Artificial	-1			Positive
32		Fuel Combustion	-1			Positive
33		Natural fuel source			1	Negative
34		Biogas			1	Positive
35	Others	Rodents			1	Negative
36		Pesticides	-1			Positive
37		Composting			1	Positive
38		Tourist and picnic	-1			Positive

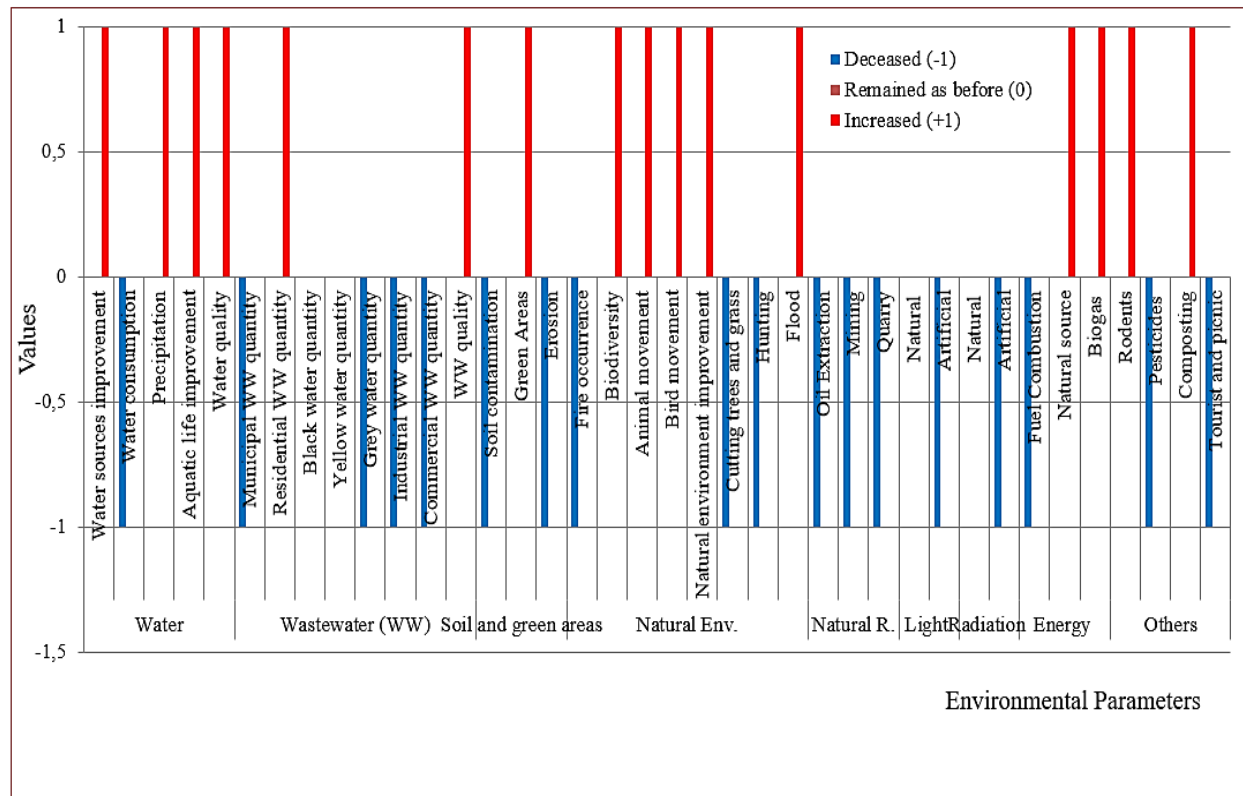


Figure 5. Impact of COVID-19 on Environmental Parameters-Part I

3.5. WW (Wastewater)

Effect of COVID-19 PL on the WW are shown in Table 3 and Figure 5. Of course, lockdown of commercial, industrial, institutional, tourist, worship and other areas caused decreasing of municipal WW (MWW) amount. Alternatively, black water and yellow water (urine) remain as before. Staying at homes led to increase of domestic WW quantity. Hospital WW discharge increased due to rising number of patients and other activities in the hospitals and labs. Industrial and commercial WWs decreased due to limitation of the industrial works. MWW characteristics improved and the

amount of water pollutants reduced due to stopping and delaying activities in several sectors.

3.6. Soil and Green Areas

COVID-19 PL caused restriction of the human activities and commonly eliminated tourist; this led to increase of green areas and decreasing soil contamination, Figure 6. When green areas enhanced, corrosion decrease gradually and enhance oxygen ratio and berating.

Details of influence of COVID-19 PL on soil and green areas are shown in Table 3 and Figure 5.



a) Zanco Q., Erbil City, 2 April 2020



b) Hujran area, Shaqlawa District, Erbil City, 27 April 2020

Figure 6. Green areas in Erbil City during COVID-19

3.7. Natural Environment and Natural Resources

Natural environment and natural resources were influenced by COVID-19 PL, Table 3 and Figure 5. COVID-19 PL can be regarded as a breathing of the natural environment and decreased contaminants, Figures 1, 3, and 6. Fire occurrence, hunting, and cutting of the trees were eliminated (or minimized) throughout COVID-19 PL due to control of human activities. Movement of animals and birds became more frequent, Figures 1 and 7. Oil extraction, mining, and quarry works were limited and it resulted in decreasing of environmental pollution.



Figure 7. Staying of animals inside Zanco Q.-Erbil City during COVID-19PL (27 March 2020)

3.8. Light and Radiation Pollutions

COVID-19 PL reduced artificial light and radiation pollutions, Table 3 and Figure 5. While, natural lighting and radiation normally remained as before COVID-19 PL. Throughout COVID-19 PL most of the commercial, industrial, institutional, worship, and other sectors were closed and this led to decreasing the light pollution.

3.9. Energy

Lockdown by COVID-19 resulted in decreasing of fuel consumption, Table 3 and Figure 5. On the other hand, the use of natural fuel sources and biogas commonly remained as before or increased, especially in the countryside areas.

3.10. Others

Lastly, COVID-19 PL increased some issues such as rodents and composting. While, it decreased others like pesticides and tourist, Table 3 and Figure 5. Due to control of human activities during COVID-19, appearance and movement of rodents and animals were more frequent than before the lockdown.

The use of pesticides decreased because of the lockdown as well. Instead, staying at home led to increasing of composting process by some people. Till 17 July 2020, tourist areas and public parks in Erbil City, KR-Iraq were generally closed.

Of course, closing of tourist zones and gardens directed to decreasing of environmental pollution such as noise, water, light and air and caused a decrease of solid waste.

3.11. Positive, nil, and negative impacts

Impacts of the environmental parameters on the environment are illustrated in Table 4.

Positive, nil, and negative impacts of the environmental issues on the environment during COVID-19 PL were detected. As a result, positive, nil, and negative effects of the parameters on the environment caused by COVID-19 PL were 81.43 %, 5.71 %, and 12.86 %, respectively.

Cheval et al. (2020) stated that COVID19-PL led to negative impacts on the environment such as shoreline contamination due to the disposal of sanitary consumables. Beside of the great threats and losing many things during COVID-19 PL, it served the environment in several directions and it regarded as a respiration of the environment.

Table 4

Positive, nil and negative impacts of the parameters on the environment

No.	Parameters	Positive	Nil	Negative	Total
1	Solid waste	9		3	12
2	Noise	10		2	12
3	Air	8			8
4	Water	5			5
5	WW	5	2	1	8
6	Soil and Green Areas	3			3
7	Natural Environment	7		1	8
8	Natural Resources	3			3
9	Light Pollution	1	1		2
10	Radiation Pollution	1	1		2
11	Energy	2		1	3
12	Others	3		1	4
Total		57	4	9	70
Ratio (%)		81.43	5.71	12.86	100

3.12. Living organisms and prediction for COVID-19 Spreading

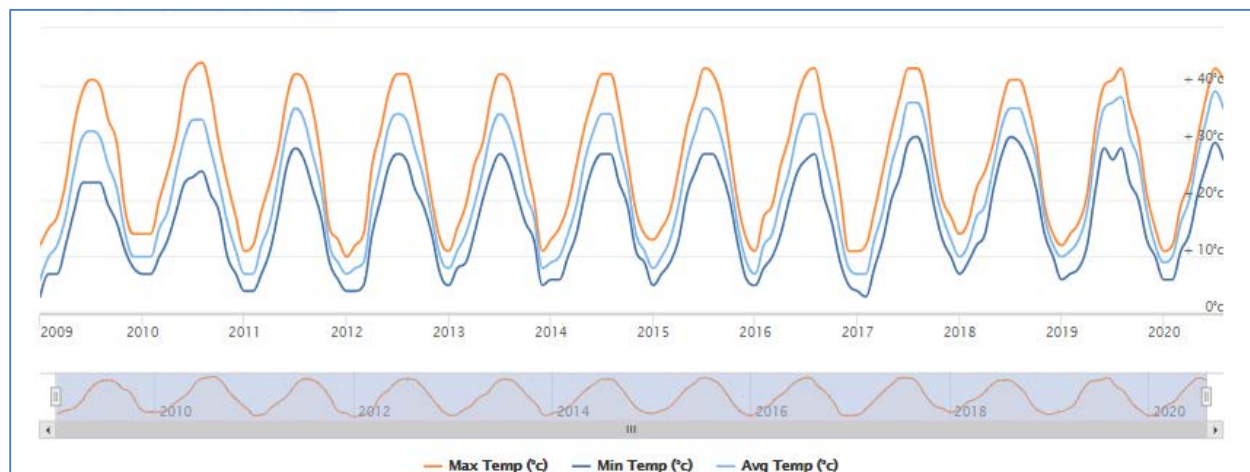
A number of factors, such as temperature, humidity etc., affect the living organisms (McEldowney and Fletcher, 1988; Rickard and Boulding, 2015). Variations of temperature, cloud and humidity, pressure, rainfall amount and rain days, and wind in Erbil City are shown in Figures 8. It can be seen from Figure 8 that temperature, and cloud and humidity commonly remained as before COVID-19, while, pressure decreased in 2020. Additionally, amount of rainfall and wind speed generally increased during COVID-19. In 2020, pressure, rainfall, and wind varied in Erbil City and they had an impact on living organisms. Sufficient historical data is essential for forecasting of COVID-19 spreading in different seasons. At the same time, no prediction is definite as the future infrequently repeats

itself in the same way as the past. Furthermore, estimates are affected by the dependability of the information, vested benefits, and what variables are being forecasted.

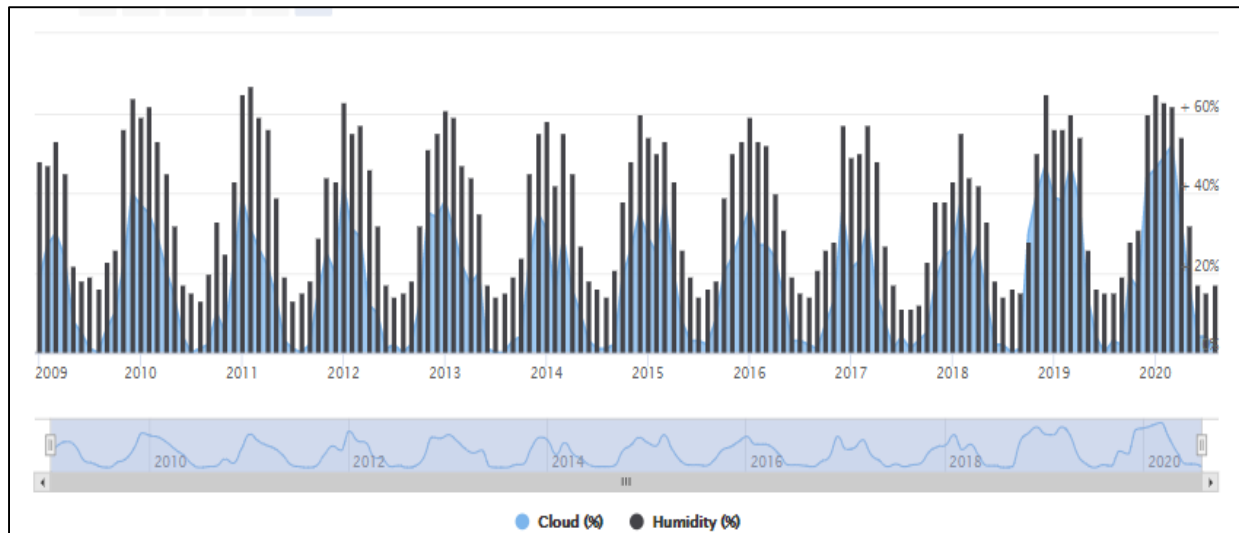
Correspondingly, psychological parameters play an important role in how people observe and respond to the risk from the disease and the anxiety that it may influence them personally (Petropoulos and Makridakis, 2020).

Additionally, Gupta et al. (2020) reported that the influence of weather on COVID-19 spread is poorly unstated. Limited published works have claimed that warm weather can probably decrease the global pandemic.

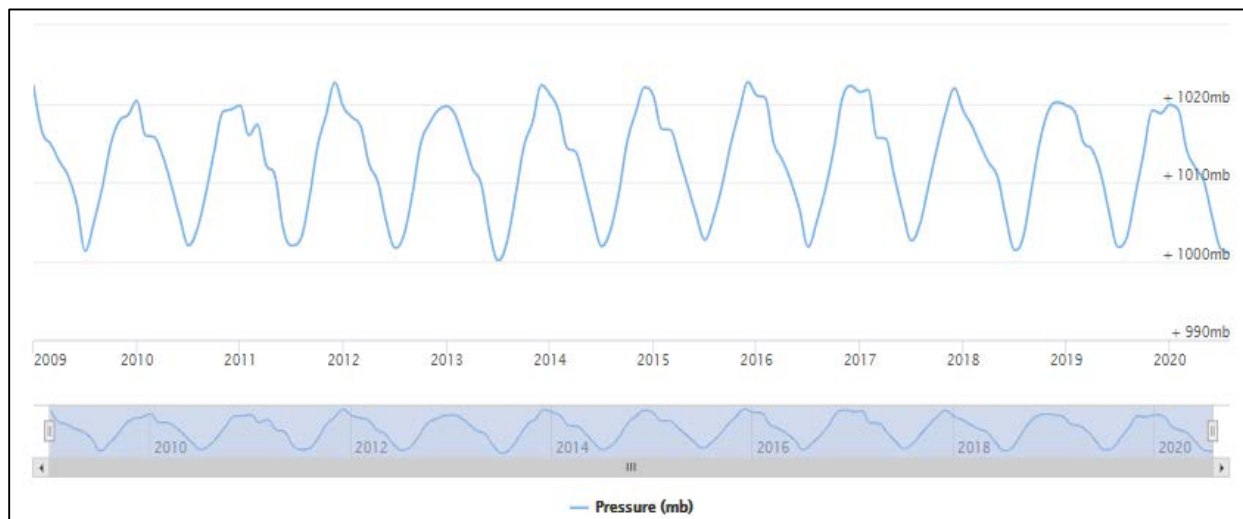
Mecenas et al. (2020) concluded that warm and wet climates seem to decrease the spread of COVID-19. The confidence of the confirmation generated was classified as low. Though, only temperature and humidity parameters could not clarify most of the changeability in disease transmission.



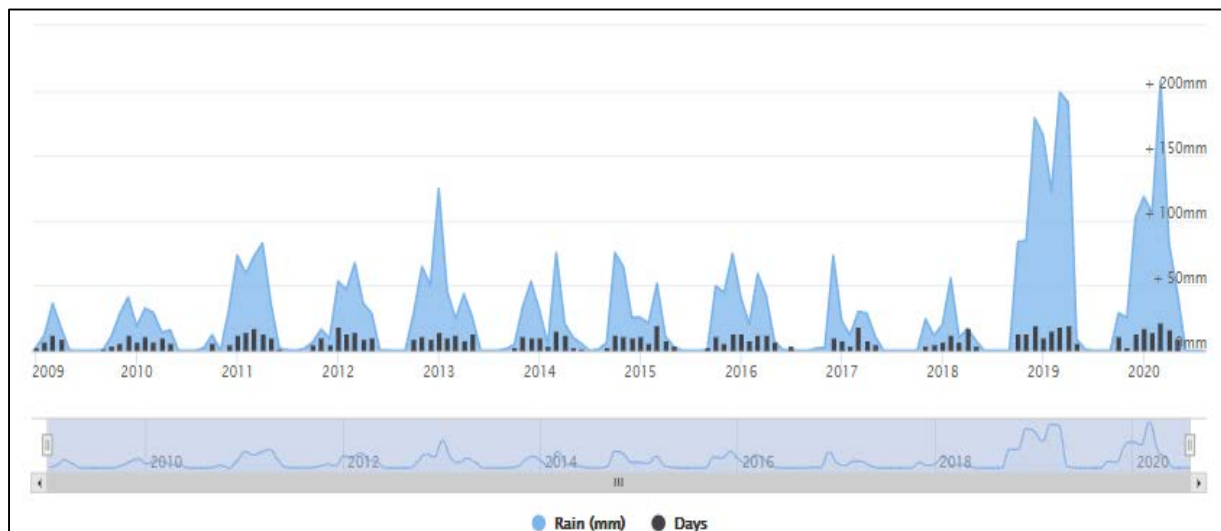
a)



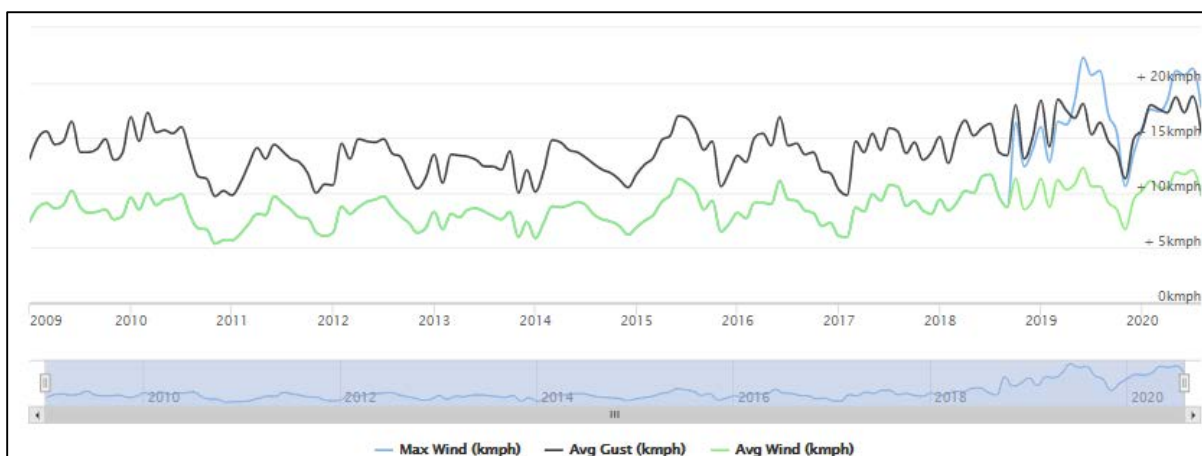
b)



c)



d)



e)

Figure 8. Variation of temperature (a), cloud and humidity (b), pressure (c), rainfall amount and rain days (d) and wind (e) in Erbil City (Erbil Monthly Climate Averages, <https://www.worldweatheronline.com/erbil-weather-averages/erbil/iq.aspx>)

4. Conclusions

Till 28 July 2020, 16,301,736 confirmed cases of COVID-19 were recognized by WHO, including 650,069 deaths. COVID-19 PL affected our life, movement, political, sports, business, industries, economy, oil, social relationship, journey, tourist, working hours, education etc. and it changed/inversed many things. It affected the natural environment as well. Results showed that COVID-19 PL increased a number of parameters, such as domestic and hospital wastes, noise at home, aquatic life and water quality, domestic WW amount, green areas, animal and birds movement, natural energy, rodents etc.; whereas, it decreased numerous factors, for example commercial/industrial solid waste, traffic and outdoor noises, air pollution and particles, water contamination, WW production, cutting trees and hunting, fuel extraction and mining, artificial light and radiation, fuel combustion, tourist and picnic etc.

Alternatively, some parameters such as black water, natural radiation, and ordinary lighting remained as before COVID-19 PL. Positive, nil, and negative influences of the factors on the environment caused by COVID-19 PL were 81.43 %, 5.71 %, and 12.86 %, respectively. Positive effects of the COVID-19 PL on the environment were superior than the negative impacts and lockdowns and can be regarded as a breathing period of the natural environment. In 2020, pressure, rainfall, and wind varied in Erbil City and they had the impact on microorganisms. Presently, forecasting of season influence on spreading COVID-19 is not easy.

References

Air quality in Erbil, <https://air.plumelabs.com/air-quality-in-erbil-oPs>, Accessed on 16 July 2020,
Aziz S. Q., Ismail S.O., Omar I. A., Recyclable Solid Waste Materials Management in Erbil City-Iraq,

International Journal of Engineering Inventions, 8 (1), 2019, 57-62,
Aziz S.Q., A Noise Pollution Study in Arbil City, ZANCO Journal of Pure and Applied Sciences, Salahaddin University-Erbil, 20 (5), 2008, 151-166,
Aziz S.Q., Environmental noise pollution in Erbil City, Iraq: Monitoring and solutions, Caspian Journal of Applied Sciences Research, 1 (2), 2012, 14-22,
Aziz S.Q., Lulusi Asaari F.A.H., Ramli N.A., Aziz H.A., Mojiri A., Umar M., Assessment of Traffic Noise Pollution in Bukit Mertajam, Malaysia and Erbil City, Iraq. Caspian Journal of Applied Sciences Research, 1 (3), 2012, 1-11,
Aziz S.Q., Ali S. M., Characteristics and potential treatment technologies for different kinds of wastewaters, ZANCO Journal of Pure and Applied Sciences, Salahaddin University-Erbil, 30 (S1), 2018, 122-134,
Chadderton D. V., Building Services Engineering, 4th Edition, Spon Press, London and New York, 2004, 378; ISBN 978-04-1531-534-0,
Cheval S., Adamescu C. M., Georgiadis T., Herrnegger M., Piticar A., Legates D. R., Observed and Potential Impacts of the COVID-19 Pandemic on the Environment, International Journal of Environmental Research and Public Health, 17, (11) 2020, 4140,
Erbil Monthly Climate Averages, <https://www.worldweatheronline.com/erbil-weather-averages/erbil/iq.aspx>, Accessed on 19 September 2020,
Gupta S., Raghuwanshi G. S., Chanda A., Effect of weather on COVID-19 spread in the US: A prediction model for India in 2020, Science of the Total Environment, 728, 2020, 138860,
He G., Pan Y., Tanaka T., The short-term impacts of COVID-19 lockdown on urban air pollution in China, Nature Sustainability, 2020,

- <https://doi.org/10.1038/s41893-020-0581-y>,
Ibarra-Vega D., Lockdown, one, two, none, or smart, Modeling containing COVID-19 infection. A conceptual model, *Science of the Total Environment*, 730, 2020, 138917,
- Kerimray A., Baimatova N., Ibragimova O. P., Bukenov B., Kenessov B., Plotitsyn P., Karaca F., Assessing air quality changes in large cities during COVID-19 lockdowns: The impacts of traffic-free urban conditions in Almaty, Kazakhstan, *Science of the Total Environment*, 730, 2020, 139179,
- Khoshnaw S. H. A., Shahzad M., Ali M., Sultan F., A quantitative and qualitative analysis of the COVID-19 pandemic model, *Chaos, Solitons and Fractals*, 138, 2020, 109932,
- Li L., Li O., Huang L., Wang Q., Zhu A., Xu J., Liu Z., Li H., Shi L., Li R., Azari M., Wang Y., Zhang X., Liu Z., Zhu Y., Zhang K., Xue S., Ooi M. C. G., Zhang D., Chan A., Air quality changes during the COVID-19 lockdown over the Yangtze River Delta Region: An insight into the impact of human activity pattern changes on air pollution variation, *Science of the Total Environment*, 732, 2020, 139282,
- Lokhandwala S., Gautam P., Indirect impact of COVID-19 on environment: A brief study in Indian context. *Environmental Research* 188, 2020, 109807,
- Mandal I., Pal S., COVID-19 pandemic persuaded lockdown effects on environment over stone quarrying and crushing areas, *Science of the Total Environment*, 732, 2020, 139281,
- McEldowney S., Fletcher M., The effect of temperature and relative humidity on the survival of bacteria attached to dry solid surfaces, *Letters in Applied Microbiology*, 7 (4), 1988, 83-86,
- Mecenas P., Bastos R. T. R. M., Vallinoto A. C. R., Normando D., Effects of temperature and humidity on the spread of COVID-19: A systematic review, preprint, *PLoS ONE* 15 (9), 2020, 0238339
- Ormaza-González F., Castro-Rodas D., COVID-19 Impacts on Beaches and Coastal Water Pollution: Management Proposals Post-pandemic, preprints 2020, 2020060186,
- Ouhsine O., Ouigmane A., Layati E., Aba B., Isaifan B. J., Berkani M., Impact of COVID-19 on the qualitative and quantitative aspect of household solid waste, *Global Journal of Environmental Science and Management*, 6 (SI), 2020, 41-52,
- Peeri N. C., Shrestha N., Rahman M. S., Zaki R., Tan Z., Bibi S., Baghbanzadeh M., Aghamohammadi N., Zhang W., Haque U., The SARS, MERS and novel coronavirus (COVID-19) epidemics, the newest and biggest global health threats: what lessons have we learned? *International Journal of Epidemiology*, 2020, 49 (3), 717-726,
- Petropoulos F., Makridakis S., 2020. Forecasting the novel coronavirus COVID-19, *PLoS ONE*, 15 (3), 231-236,
- Rangwala, Water supply and sanitary engineering (Including environmental engineering), 29th Edition, Charotar Publishing House, India, 2019, 800; ISBN: 978-93-8503-920-1,
- Rickard K. J. C., Boulding E. G., Effects of temperature and humidity on activity and microhabitat selection by *Littorina subrotundata*, *Marine ecology progress series*, 537, 2015, 163-173,
- Sarwar S., Waheed R., Sarwar S., Khan A., COVID-19 challenges to Pakistan: Is GIS analysis useful to draw solutions? *Science of the Total Environment*, 730, 2020, 139089,
- Wang L. K., Tay J., Tay S. T., Hung Y., *Environmental Engineering*, Volume 11, Humana Press, 2010, 867, ISBN: 978-1-60327-031-1,
- World Health Organization (WHO), <https://covid19.who.int/>, Accessed on 28 July 2020,
- Xu H., Yan C., Fu O., Xiao K., Yu Y., Han D., Wang W., Cheng J., Possible environmental effects on the spread of COVID-19 in China, *Science of the Total Environment* 731, 2020, 13921,
- Yunus A. P., Masago Y., Hijioka Y., COVID-19 and surface water quality: Improved lake water quality during the lockdown, *Science of the Total Environment*, 731, 2020, 139211,
- Zambrano-Monserrate M. A., Ruano M. A., Sanchez-Alcalde L., Indirect effects of COVID-19 on the environment, *Science of the Total Environment*, 2020, 728, 138813.

Potencijalni uticaj zabrane kretanja tokom COVID-19 pandemije na parametre životne sredine

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I Z V O D

COVID-19 je imao uticaj na svakodnevni život, ljudske aktivnosti, različite sektore i životnu sredinu. Shodno tome, cilj ovog istraživanja je bio ispitivanje uticaja zabrane kretanja tokom pandemije COVID-19 virusa na parametre životne sredine. Ispitivani su sledeći parametri životne sredine: čvrst otpad, buka, vazduh, voda, otpadna voda, zemljane i zelene površine, prirodno okruženje i resursi, svetlosno zagađenje, zagađenje radijacijom, energija i drugi. Glavni problemi zaštite životne sredine su podeljeni na sedamdeset podparametara. Rezultati su pokazali da je pandemija COVID-19 virusa uticala na povećanje brojnih parametara, kao što su kućni i bolnički otpad, buka u kući, vodeni život i kvalitet vode, količina otpadnih voda u domaćinstvu, zelene površine, kretanje životinja i ptica, prirodna energija, glodari i drugi. S druge strane, pandemija je uticala na smanjenje nekoliko drugih faktora, kao što su komercijalni/industrijski čvrsti otpad, buka u saobraćaju i na otvorenom, zagađenje vazduha i prisustvo čestica, zagađenje vode, zagađenje otpadnim vodama, seča drveća i lov, sagorevanje goriva i rudarstvo, turisti i drugi. Pored toga, neki parametri, poput crne vode, prirodne radijacije i normalnog osvetljenja, ostali su isti kao i pre pandemije COVID-19. Pozitivni, nulti i negativni uticaj parametara na životnu sredinu su iznosili 81,43 %, 5,71 % i 12,86 %. Pozitivni uticaj pandemije na životnu sredinu je bio veći od negativnog uticaja, a zabrana kretanja može da se posmatra kao period disanja prirodnog okruženja. Trenutno je teško predvideti sezonski uticaj na širenje COVID-19 virusa.