

REPERCUSSIONS OF COVID-19 ON ENVIRONMENT: BLESSINGS OR CURSE

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ABSTRACT

Unambiguously, Coronavirus disease (Covid-19) is one of the deadliest pandemics with an approximate death toll of 4310970 people over more than 220 countries till now. To tackle this difficult situation, many countries have ascribed lockdown so that the aggression of this lethal disease somewhat lessens. Circumstantially, the Bangladeshi government imposed an overall lockdown during April-May 2020 and a nationwide shutdown from July 1 to August 10, 2021, by constricting people's activity with complete or partial closure. A thorough study will show how the air and water waste has been diminished during and after the Covid-19 lockdown. Explicitly, maintaining this prolonged success, will be manifested the negative impact of Mask, PPE, sanitizing bottle pollution, the enhancement of plastic pollution and how can we restrain this before and after Covid-19. This restricted lockdown act exhibits a commendable influence on the entire environment of Bangladesh, especially Dhaka. According to the reports of the Department of Environment and Air Quality Monitoring Station of the U.S. Embassy, Dhaka; Air Quality Index (AQI) has improved during the lockdown from the city with the worst air quality. According to the DOE report, AQI of Dhaka was 164 on 1 May 2021 which is considered to be unhygienic according to Environmental Protection Agency (EPA). Contrarily, on 1 July 2021 (during lockdown), the AQI was 115 and AQI is currently 106 (according to US Consulate) and which is in the "Unhealthy for Sensitive Groups" range. According to EPA, 5 major pollutants are responsible for air pollution and they are PM_{2.5}, O₃, SO₂, CO and NO₂. DOE report distinguishes concentration of PM_{2.5}-24hr and CO-8hr on 18 February, 2021 was 224.28 µg/m³ and 2.25 ppm respectively but on 18 April, 2021 the concentration of PM_{2.5}-24hr and CO-8hr value was 94.12 µg/m³ and 1.51 ppm respectively. So, the pollutant concentration value has also decreased. The chronological study depicts that air quality has certainly improved due to the complete closure of industries and this lockdown is imposed due to Covid-19, creating a good impact on the environment. In a nutshell, medical equipment like masks, PPE, sanitizer bottles, and online package delivery waste are thrown here and there. For this reason, drain water is clogging but the overall impact is vast because the marine biodiversity entity is at stake. Masks and PPE do not dissolve and resulting in aquatic creature entanglement, violating the integrity of the ecosystem.

Keywords: Lockdown, Air Quality Index (AQI), Severe Plastic Pollution, Medical Waste, Biodiversity

1. INTRODUCTION

The population of Dhaka is estimated at approximately 20 million in 2021 with a density of 23234 people per square kilometre within a total area of 300 square kilometres and the city has shown a population growth of 4.2% annually according to worldpopulationreview.com. The outcome of this exalted level of population density is acute environmental contamination especially atmospheric and aquatic profanation. Industrial and vehicular emissions are the two predominant sources of air contamination in Dhaka city. Industrial emission sources for instance thousands of ready-made garment factories, chemical industries, brick kilns, pharmaceutical industries and so on. Vehicular emissions like

incompetent vehicular activities ejaculate fine particles due to combustion of fossil fuels and significantly emit several primary pollutants like Nitrogen Oxides (NO_x), Sulfur Oxides (SO_x), Carbon Monoxide (CO), Particulate Matters (PM), Volatile Organic Carbons (VOCs). It is widely accepted that particulate matter is the major pollutant of concern internationally and in Bangladesh (ADB 2006, UNEP 20120). A particulate matter is defined as a solid or liquid particle suspended in a gas which is usually air and particulate material is the term for particles found in the air, including dust, dirt, soot, smoke and liquid droplets (Hasan et al, 2016). Nitrogen Dioxide (NO₂) has some health impacts and is a well-known precursor to acid rain, which can reduce agricultural production and damage the environment (UNEP, 2012) and another major pollutant Sulphur dioxide (SO₂) has health impacts as a gas and also acts as a precursor to the formation of particulates and acid rain in the atmosphere (Haque et al, 2017). Along with those, industrial growth was also rose to 7.5% in the Fiscal Year 2011 (Bangladesh Bank, 2011) and polluted air also acts as 17.6% risk factor for most of the death and disability in Bangladesh (Armin, 2018). Air pollution is accountable for miscellaneous disorders like ischemic heart disease, stroke, chronic obstructive pulmonary disease (COPD), lung cancer and acute lower respiratory infections for children. But from NASA website, it was found that there was pollution and fog mixed at the base of the Himalayas in India in late December 2005 and this haze hangs so thickly over the region that the underlying ground surface is barely visible and in contrast, the air is much clearer over the Himalayas (Begum et al, 2013). According to the Department of Environment (DOE), the density of airborne particulate matter (PM) reaches 463 micrograms per cubic meter (mcm) in the city during December to March period, the highest level in the world. Mexico City and Mumbai follow Dhaka with 383 and 360 mcm respectively (Daily Star,2009). On the other hand, during Covid lockdown and the nationwide shutdown, air quality in Dhaka has undeniably heightened due to the inferior traffic mobility and complete closure of industrial and manufactural emission sources and thus particulate materials and other contaminants have been successfully reduced in our study areas (BARC and Darus Salam). In this study, we inspected the air quality before and during the lockdown, concentration of several gaseous substances including CO, NO₂ and SO₂, also too fine particulate material (PM_{2.5}) and Ozone have also been explored and then the alteration of concentration of various pollutants along with AQI variations prior and during the occurrence of lockdown have been exhibited and also elaborated.

The Nationwide lockdown may have been the reason for the overall development of air quality and water, so if we consider Covid-19 lockdown as a platform for the welfare of the overall climatic alteration of Bangladesh, at that time we are in illusive route as Coronavirus epidemic expanded throughout the world, World Health Organization has advised people to use a face mask, PPE and hand sanitizer while going outside to remain secure from this infectious disease and so production and usage of this medical equipment have also augmented rapidly. This is must and evident for this current pandemic situation but what creating the dreadful condition to the environment is that these implements are thrown here and there causing significant labyrinth to the marine biodiversity. According to a report published on BBC NEWS, globally we are using 129 billion face masks and 65 billion plastic gloves every month. Waterlogged face masks, gloves, hand sanitizer bottles and other coronavirus wastes are already found on sea beds, seashores and collapsing ocean ecosystems. Aside from the formation of micro and Nano plastics, wrongly disposed face masks can also have an unequivocal effect on wildlife through straight and transcendental ingestion-causing respiratory and gastrointestinal obstructions or death by starvation. If not properly cut, the string of face masks can also cause entanglements. According to Oceans Asia, "Plastic pollution kills an estimated 100000 marine mammals and turtles, over a million of seabirds, and even greater numbers of fish, invertebrates and other animals each year. And as plastic pollution has enhanced even more than ever due to these single-time usages of face masks and other medical equipment, ocean ecosystem and marine entity both are in hazardous circumstances. These one-time surgical face masks and other plastic bottles are causing blockage of drains due to indiscriminate disposal of these medical wastes into drains in our country. Due to the closure of shopping malls and Restaurants, online package delivery action has significantly incremented and thus various companies are using single-use plastic bags instead of reusable cloth bags which is also a potential source of plastic pollution enhancement during Covid-19. In this study, we will exhibit all the potential reasons for plastic pollution during Covid-19 and will also discuss how this upcoming catastrophe on the environment can be obstructed. So, in short, the objective of this study is to analyse

the positive impact on the environment during covid-19 lockdown and to elaborate the impertinent influence of Covid-19 on the environment and also disclose the steps to mitigate and reduce it.

2. METHODOLOGY

2.1 Data Extraction

In this study, we have shown time vs concentration graphs of several gaseous substances including concentrations of PM_{2.5}, O₃ and CO from July 18, 2018 to June 21, 2021 and have also shown the AQI variations from 1 August, 2018 to 1 July, 2021. These concentration values and AQI values are collected from the archive of Department of Environment (DOE) and Air Quality Index is calculated by using a formula given by US Environmental Protection Agency (US EPA, 2018). Although lockdown was imposed upon the nation during April-May 2020 and July 1 to August 10, 2021, we have collected concentration data from the year 2018 to perfectly show the variation between air quality data prior and during the lockdown and the development in air quality of Dhaka during the lockdown. DOE mainly monitors the criteria or major pollutants such as carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, PM₁₀ and PM_{2.5}. Monitoring is performed to unravel the acquirement or non-availability of national ambient air quality standards to evaluate the propensity of air pollution levels. The ambient air quality monitoring network Bangladesh comprises of eleven fixed Continuous Air Monitoring Stations (CAMS). The locations of the 11 CAMS are shown in the following figure:

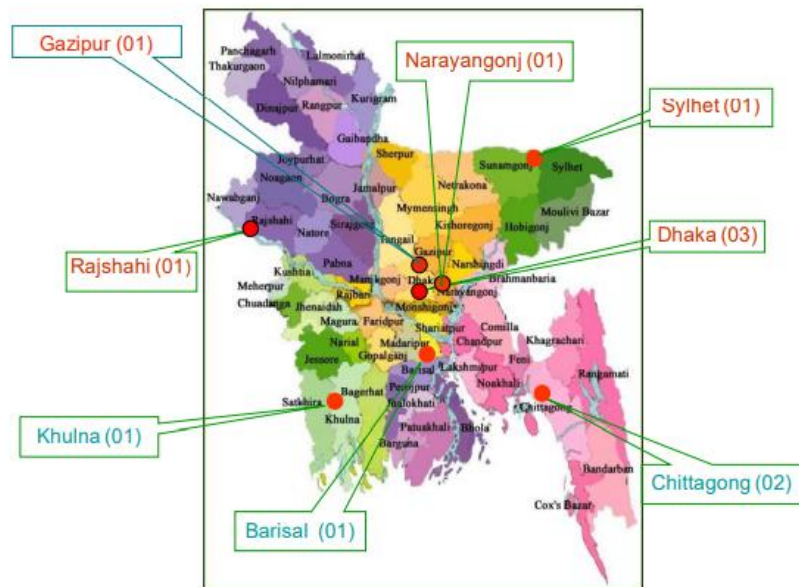


Figure 1: CAMS Location in Bangladesh

2.2 Air Quality Index

According to Wikipedia, Air Quality Index (AQI) is used by government agencies to announce to the public how polluted the air currently is or how polluted it is forecast to become. Public health risks increase as the AQI rises. Estimation of the AQI requires an air pollutant concentration over a specified averaging period, acquired from an air monitor or model. Here the specified time range was from 2018-2021 and DOE along with EPA were the air monitoring agencies. The AQI for major pollutants like PM_{2.5}, O₃ and CO has been calculated by using the following formula given by US EPA (2018).

The reckoning is done using the formula of breakpoints for the AQI,

$$I_p = \frac{I_{Hi} - I_{Lo}}{BP_{Hi} - BP_{Lo}} (C_p - BP_{Hi}) + I_{Lo}$$

Here,

I_p = the index for pollutant p

C_p = the truncated concentration of pollutant p
 BP_{Hi} = the concentration breakpoint that is greater than or equal to C_p
 BP_{Lo} = the concentration breakpoint that is less than or equal to C_p
 I_{Hi} = the AQI value corresponding to BP_{Hi}
 I_{Lo} = the AQI value corresponding to BP_{Lo}

Among these CAMS, we will work with the concentration and AQI data from BARC and Darus Salam, Dhaka.

Table 1: Ranges of AQI Values and their outcome upon health and hygiene

AQI Value	AQI Level	Color	Meaning
0 to 50	Good	Green	Air quality is considered satisfactory, and air pollution poses little or no risk.
51 to 100	Moderate	Yellow	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101 to 150	Unhealthy for Sensitive Groups	Orange	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151 to 200	Unhealthy	Red	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
201 to 300	Very Unhealthy	Purple	Health warnings of emergency conditions. The entire population is more likely to be affected.
301 to 500	Hazardous	Maroon	Health alert: everyone may experience more serious health effects.

3. RESULT DATA ILLUSTRATIONS

3.1 Variation of Air Quality Parameters

In the figure 1, variation of particulate matter (PM_{2.5}) is shown for two different place of Dhaka which are BARC (Bangladesh Agricultural Research Council) and Darus Salam. Though they show

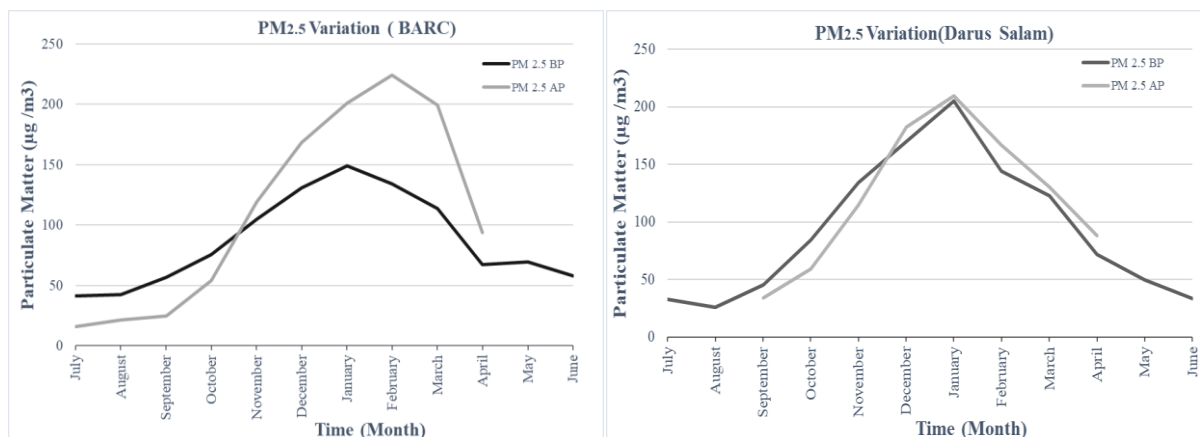


Figure 1: Variation of Particulate Matter (PM_{2.5}) Before pandemic (BP) and After Pandemic (AP)

different quantity due to unlike environment source and commercial importance, they show similar type of graph curvature variation.

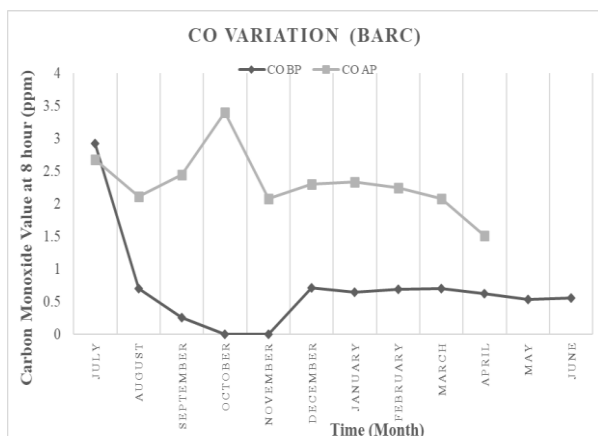


Figure 2: Carbon Monoxide Variation Before and After the Pandemic

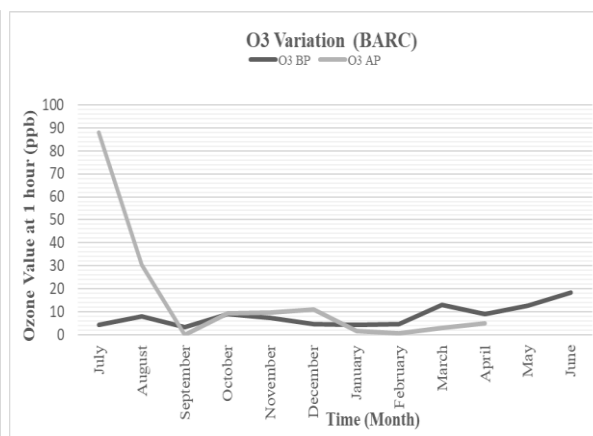


Figure 3: Ozone Variation Before and After the Pandemic

From the concentration data displayed above, it can be seen that the concentration of PM_{2.5} was 42.27 µg/m³ in August 2018 which in the Covid situation has been decremented to 15.92 µg/m³ on July 2020 at the time of partial lockdown in Dhaka. Similarly, the concentration of O₃ and CO has also faced a significant variation during Covid 19 situation. The concentration value of O₃ has dropped from 7.99 ppb in August 2018 to 0.47 ppb on February 2021 (during partial lockdown). Furthermore, a concentration drop of CO from 2.92 ppm in July 2018 to 1.51 ppm in April 2021 can also be seen in Fig 1. From Fig 2, it has been observed that AQI value was 349 which was in the “Hazardous” category according to US EPA (2018) during December 2018 and on August 2020, the value has been transfigured to 24 which was in the “Good” air range (during partial lockdown).

3.2 Air Quality Index Data Table

From Fig 2, it has been observed that AQI value was 349 which was in the “Hazardous” category according to US EPA (2018) during December 2018 and on August 2020, the value has been transfigured to 24 which was in the “Good” air range (during partial lockdown). In July 2018, PM_{2.5} concentration was 41.2 µg/m³ and if we calculate the AQI using Equation 1, then we can find AQI= 115 and in July 2020, AQI= 59 (from Equation 1) for PM_{2.5} = 15.92 µg/m³. The required graphs for the elaborated enhancement for BARC are exhibited

Table 2: Air Quality Index values with respect to Time (Month)

Month-Year	AQI	Month-Year	AQI	Month-Year	AQI
Aug 18	80	Aug 19	75	Aug 20	24
Sep 18	65	Sep 19	123	Sep 20	107
Oct 18	176	Oct 19	50	Oct 20	105
Nov 18	164	Nov 19	173	Nov 20	100
Dec 18	349	Dec 19	315	Dec 20	309
Jan 19	284	Jan 20	304	Jan 21	288
Feb 19	350	Feb 20	219	Feb 21	348
Mar 19	187	Mar 20	290	Mar 21	210
Apr 19	103	Apr 20	227	Apr 21	160
May 19	46	May 20	89	May 21	164
Jun 19	105	Jun 20	45	Jun 21	179
Jul 19	129	Jul 20	30	Jul 21	115

3.3 Interpretation of Obtained Test Results

A report published on November 26, 2019, on Daily Star, delineated that “Dhaka has the worst air quality in the world yesterday”, according to Air Visual, an air quality measuring application. From the above phenomenon, it can be seen that Air quality from October 18 to March 19 was one of the worst, mostly ranging from “Unhealthy” to “Hazardous” category, but Air quality from May 20 to August 20 (during lockdown) has transcended significant upliftment and AQI ranges from “Good” to “Moderate” category and that is unquestionably a commendable errand for Dhaka city. The reason behind this attainment is the complete shutdown of major pollutant ejecting factories, brick kilns, controlled activities of unfit vehicles and that means deficient combustion of fossil fuels and also too minor pollution. But in the above reports, we have also noticed that there is significant unpredictability in the concentration of various gaseous substances and air quality during and post lockdown. The reason behind this aspect is overall lockdown inducted upon the whole nation was only for 2 months in 2020 and 2021. When the AQI level commenced decrementing, then the contaminant-producing factories, brick kilns reopened again after lockdown or during partial lockdown with the sky-high movement of the vehicle. That’s why the reports imply so much alteration during and post lockdown. But from the above values during the lockdown, it is undeniably proved that if the major pollutants ejection can be controlled, then the Air Quality of Dhaka will certainly aggravate. So Bangladeshi Government will have to impose strict rules upon the contaminant ejecting factories so that they can obey the proper production guidelines and so that our environment and air quality remains secure and unharmed.

4. NEGATORY AFTER-EFFECTS ON CIRCUMAMBIENT ENVIRONMENT

4.1 Up-Shot and Consequences of Plastic Medicinal Appliances on Environment

From the above contexts, we have seen that the overall air quality has improved during the lockdown in Dhaka and we have also found out the provision for maintaining this advancement post lockdown. So, this is certainly authentic welfare for the overall atmosphere and environment. But as Covid 19 progressed we are also on the verge of a new challenge and this is the pollution of enormous medicinal appliances which are mostly prepared by using plastic including Face masks, Hand gloves, sanitizing bottles, Personal Protective Equipment (PPE). We all know these appliances are urgent to keep ourselves protected and immune from this deadly disease, but it is delegating a significantly contradictory effect upon ecology. Globally there are 52 billion face mask production in 2020 and the average weight of a single-use polypropylene face mask is 3-4 grams, according to a report published on April 13, 2021. According to Study in Environmental Advances, a single face mask can release 173000 microfibers per day into the seas. According to nationalgeographic.com, masks are mainly a mix of paper and polymers, including polyester and polypropylene and can’t be separated into pure streams of single materials for recycling. These materials are so small, can get caught in recycling machinery and cause breakdowns and these plastic products break down into microplastics; they can contaminate air, water and soil. These face masks will take as long as 450 years to break down slowly turning into microplastics. According to a study in Animal Biology, swans, seagulls, peregrine falcons and songbirds became fatally affected after entangling into face mask loops. Naturalproductsonline.co.uk expressed, “The glove or the mask that you take off...could easily be the glove or the mask that kills a whale”.

These labyrinths are also occurring in our country as we have throwaway culture. The Cox’s Bazar Sea Beach is flushed with one-way surgical face masks, hand sanitizer bottles and gloves as we have unique throwaway culture. The drains are choke-full of face masks and generate draining blockage. The water is now contaminated with scattered disposal of medical wastes and that’s why it is time to wake up and be vigilant. According to www.nbcnews.com, “It’s important to throw away face masks and gloves in garbage cans that have a lid and a garbage bag that will be tied together when it’s removed to keep them from falling out or blowing away and then they will not enter into earth’s ecosystem. Another way is that the ear loop of the mask should be cut to prevent animal entanglement. Reusable face masks are eco-friendlier and more biodegradable than a one-time surgical face mask. Organic cotton face masks,

double-layered masks with hemp and recycled polyester fabric, avocado with organic cotton face masks are recyclable and biodegradable and safe for the environment and animals also too for marine biodiversity.

4.2 Out-Turn and Consequences of Plastic Packaging Delivery Wastes on Environment

According to www.weforum.org, the quarantine economy has driven more people online, resulting in greater packaging waste from deliveries. Import and export restrictions, as well as declines in the availability of cargo transportation, mean that large amounts of food have also gone to waste. And as this organic waste decays, it will release greenhouse gases. According to www.nationalgeographic.com, the pandemic has seen increased production of disposable packaging, as consumers have brought more takeout food, and as bans of single-use plastics, including shopping bags, were suspended because of fears that reusables would spread the virus. According to a report published in Gaon Connection, we can see that e-commerce, or online shopping, has increased and so has packaging waste. This non-biodegradable waste breaks down into smaller fragments and contaminates soil and water, leading to several health problems and harming marine life. When burnt, it leads to high air pollution and is linked with the emission of cancer-causing pollutants. By burning waste, plastic gets into the human body through air and water. Such plastics contain complex chemicals, which are life-threatening. So, to protect and safeguard our environment, we must conduct reusable cloth bags for online packaging including cardboard boxes, biodegradable bags instead of single-use plastic bags which are non-biodegradable.

5. CONCLUSIONS

This study explored the decrement of the Air Quality Index in Dhaka during lockdown due to the decrease in major pollutants like PM_{2.5}, CO and O₃. So, the long-term solution should be a strict preventive measure against the production of these pollutants and to minimize the production of these contaminants, several catalysts can be used during production. We can see that AQI from May 20 to August 20 (during lockdown) showed significant improvement ranging from 24 to 89 which is on the scale of Good to Moderate category. The news of improvement in air quality is demolished by the huge burning question of plastic pollution. As the report published in BBC News showed us that the production of face masks and gloves are almost 129 billion and 65 billion respectively and single-use biodegradable face masks and gloves do not decompose, so it is way better to use natural face masks made from organic cotton, hemp, and recycled polyester fabric. Also, reusable cloth bags including cardboard boxes should be used instead of single-use non-biodegradable plastic bags for online packaging to protect the marine ecosystem from the deleterious effects of huge plastic contamination and to save our planet. In a nutshell, the reverberation of post - COVID situational circumference leaves undeniably its tremendous not only constructive but also negatory trace. Last but not the least, chronological data depicts pictorial-vivid representation of the resonance of impact of COVID on the sustaining environment.

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REFERENCES

Armin, M. Z. (2018). Air Pollutants and Their Impacts on Human Health in Dhaka City. Paper presented In A seminar paper.

- Begum, B. A., Hopke, P. K., and Markwitz, A. (2013). Air pollution by fine particulate matter in Bangladesh. *Atmospheric Pollution Research*, 4(1), 75-86.
- Begum, B. A., and Hopke, P. K. (2018). Ambient air quality in Dhaka Bangladesh over two decades: Impacts of policy on air quality. *Aerosol and Air Quality Research*, 18(7), 1910-1920.
- Chhabria, P. Coronavirus: "The masks you throw away could end up killing a whale": BBC, 2020, accessed on 31 October, 2021, <https://www.bbc.com/news/av/science-environment-53287940>
- Department Of Environment (DOE) (2018, 2019, 2020, 2021). Monthly Air Quality Monitoring Report, accessed on 31 October, 2021
- Epa, U. S. (2018). Technical assistance document for the reporting of daily air quality–The Air Quality Index (AQI). *Environmental Protection Agency*.
- Gaon Connection, The Pandemic Pollution: Handling the Packaging waste of increased online shopping, accessed on 31 October, 2021, <https://en.gaonconnection.com/the-pandemic-and-pollution-handling-the-packaging-waste-of-increased-online-shopping-during-covid-19/>
- Haque, H. A., Huda, N., Tanu, F. Z., Sultana, N., Hossain, M. S. A., and Rahman, M. H. (2017). Ambient air quality scenario in and around Dhaka city of Bangladesh. *Barishal University Journal, Part-1*, 4(1), 203-218.
- Hasan, M. R., Hossain, M. A., Sarjana, U., and Hasan, M. R. (2016). Status of air quality and survey of particulate matter pollution in Pabna city, Bangladesh. *American journal of engineering Research*, 5(11), 18-22.
- Mahmood, S. A. I. (2011). Air pollution kills 15,000 Bangladeshis each year: the role of public administration and governments integrity. *Journal of Public Administration and Policy Research*, 3(5), 129-140.
- NATIONAL GEOGRAPHIC, How to stop discarded face masks from polluting the planet, accessed on 31 October, 2021 <https://api.nationalgeographic.com/distribution/public/amp/environment/article/how-to-stop-discarded-face-masks-from-polluting-the-planet>
- Natural Products, The COVID-19 masks threatening the lives of whales, accessed on 31 October, 2021, <https://api.nationalgeographic.com/distribution/public/amp/environment/article/how-to-stop-discarded-face-masks-from-polluting-the-planet>
- OCEANSASIA, COVID-19 Facemasks and Marine Plastic Pollution, accessed on 31 October, 2021, <https://oceansasia.org/covid-19-facemasks/>
- WORLD ECONOMIC FORUM, How face masks, gloves and other coronavirus waste is polluting our ocean, accessed on 31 October, 2021, <https://www.weforum.org/agenda/2020/06/ppe-masks-gloves-coronavirus-ocean-pollution/>
- Worldpopulationreview.com, Dhaka Population 2021, <https://worldpopulationreview.com/world-cities/dhaka-population>
- www.nbcnews.com, How to reduce face mask pollution, according to experts, accessed on 31 October, 2021, <https://www.nbcnews.com/select/shopping/eco-friendly-face-mask-ncna1264810>
- U.S. Embassy In Bangladesh, Air Quality Data, <https://bd.usembassy.gov/embassy/air-quality-data/>