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Analyzing the Effects of Covid Lock down on Air Quality of Industrial Area

Dr.Subhashini sharma
Associate professor dept of chemistry Mmh college Ghaziabad U.P.India .

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ABSTRACT: All outdoor activities in India would be prohibited beginning on March 25, 2020 as a precautionary measure owing to the containment of COVID-19, according to the Indian government. In the Indian National Capital Region, the impacts of shutdown on ambient air quality will be studied in Delhi, Gurugram, Noida, Ghaziabad, and Faridabad. Data on air pollutants (PM10 and PM2.5, NOx, NO2, SO2, NH3, CO, and C6H6) were collected at 36 locations in the research area between March and May 2020. PM10 and PM2.5 concentrations dropped by 55–65 percent. The decrease of NOx and NO has been greatest (50–78%). During the lockdown time, the air quality index (AQI) went from a bad to a moderate to an acceptable level. At both the global and regional levels, numerous initiatives have been made to control air quality and climate change, but so far, no positive results have emerged. An economic growth-killing lockout (temporarily) was a sign that air quality standards were working.

Keywords: Containment, Lockdown, National, Capital, Moderate, Pandemic

I. INTRODUCTION

A new coronavirus was discovered in December in Wuhan, China, and rapidly spread across the world. On March 11, 2020, the WHO designated this virus to be a "global pandemic." As a result of the COVID-19 outbreak, a number of governments throughout the globe instituted lockdowns to limit the spread of the disease. Unexpected effects and environmental improvements were achieved as a consequence of constraints on human activities as well as the numerous productive activities of both companies as well as farms. Lockdowns prevented emissions from a wide range of sources, resulting in a considerable improvement in air quality throughout the world. Public health problems are becoming more common in many countries throughout the world because of excessive pollution levels in the atmosphere. More than 60 percent of the world's population lives in cities where air pollution is a major health hazard. Those with high incomes (56 percent) and countries with low incomes (98 percent) all fail to reach the WHO's recommended standards. More than 4.2 billion people have died as a result of air pollution-related health concerns, according to WHO data. Air pollution is directly causing a rising number of deaths. The WHO's Global Burden of Disease Project predicts that in 2016, outdoor particulate matter (PM2.5) pollution resulted in 1.1 million premature deaths.

Toward the end of December 2019, a new coronavirus, COVID-19, was discovered by the WHO in Wuhan, China. COVID-19 was declared a pandemic by the World Health Organization (WHO) in early March 2020 due to its rapid spread. Over 11 million people had been infected and 539,026 had died by the time it was declared eradicated on July 8, 2020, in 210 nations worldwide. Precautionary steps have been implemented by governments throughout the globe, the use of masks and sanitization of hands as well as large-scale COVID-19 screening tests. As a result, regional lockdowns lasted for 2–4 weeks, restricting economic activity throughout the globe and causing ripple effects in various parts of the world. Indian authorities took a series of unusual steps to prevent the spread of the disease both inside and beyond the country. On March 13, 2020, international travel and non-essential travel visas were halted. As of March 23, 2020, Indian Railways' operations would be suspended for the first time in 167 years. The lockdown was divided into stages, each indicated by a gradual loosening of restrictions on socioeconomic activity in areas that had not been affected.

II. LITERATURE REVIEW

Mohammad Sarmadi (2021) An chance to minimise pollution was offered by the COVID-19 epidemic notwithstanding the economic, social and health consequences. We wanted to see how the AQIs in major industrial, heavily inhabited, and

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capital cities throughout the globe will develop in the years leading up to and after 2020. These open datasets, such as the World Air Quality Index, were utilised in this ecological research (WAQI). Research on the relationships between weather-related and AQI-related factors was conducted using bivariate correlation analysis.

Meteorological factors that affect the AQI parameters were identified using multivariable linear regression analysis. Only carbon monoxide and ozone improved in 2020, but changes in 2021 have been reversed, which may be due to a relaxation in some countries' rules. Even though this increase in quality was only transitory, it serves as a useful planning tool for reducing pollution.

Kamal Jyoti Maji (2021) Lockdowns have been implemented in countries throughout the globe to limit the spread of the new coronavirus illness beginning at the end of 2019. As a consequence of these lockdowns, worldwide air quality suddenly improved. After four rounds of lockdown and one phase of relaxation, we examined surface air quality data in Delhi from a baseline period to see how the COVID-19 limitations affected the air pollution levels. Premature mortality associated with short-term exposure to PM2.5 and O3 was also evaluated to assess the health benefits of better air quality. Ground-level observations in Delhi at the same time period in previous years showed a decrease in PM10, PM2.5, and NO2 compared to same time period in the previous years concentrations decreased by an average of 49 percent, 39 percent, and 39 percent in 2020. Delhi had a smaller total decrease in O3 of around 19 percent. In Delhi's industrial and traffic areas, there was a modest rise in the concentration of O3. There was a significant reduction in the peak of the diurnal variation for all pollutants at every phase of the study There were a total of 904 fewer premature deaths in 2020 as a result of lower levels of PM2.5 and O3, a 60 percent improvement over the previous year. The lockdown was implemented to reduce anthropogenic emissions and improve air quality and human health by restricting human activity. According to the health impact assessment, a total of 904 short-term premature deaths (60 percent) might have been avoided had PM2.5 and O3 concentrations not decreased. Human activities have been restricted, which has reduced anthropogenic emissions and improved air quality and human health in one of the world's most polluted cities.

Karina Morales-Solís (2021) Contained and physical separation strategies adopted during the COVID-19 pandemic in central and southern Chile have been examined in terms of their impact on the levels of PM10, PM2.5, NO, NO2 and O3. Surface data and satellite data were used to compare the months of March to May in 2020 with the comparable months in 2017–2019. Analysis of lockdowns on air quality in urban areas was based on the relative percent changes in atmospheric pollutants and meteorological parameters observed between the two periods. Eleven out of the sixteen cities saw statistically significant shifts, according to the findings. In nine cities, significant increases in PM10 concentrations ranged from 14 percent to 33 percent, while statistically significant shifts in PM2.5 concentrations ranged from 6 percent to 48 percent in ten cities. Four of the five cities with NO2 data had substantial declines between –27 percent and –55 percent, whereas increases in O3, between 18 percent and 43 percent, were detected in four of the five cities with data. There were no major changes in the local meteorological variables between the two periods. Residential wood heating is a major source of particulate matter (PM) in all of the cities analysed. It's important to interpret these findings in light of the social, cultural, and economic aspects that might have an impact on air quality and emission patterns in metropolitan areas.

Feng Liu (2021) Although the COVID-19 epidemic has placed most of the globe on high alert, one unexpected benefit of this reaction has been an improvement in air quality. Lockdowns may have a negative impact on the environment, but few studies have looked at it from a global viewpoint. Various panel sizes, independent variables, and estimate methodologies had little effect on the accuracy of these findings. The lockdown effects are more noticeable in cities from lower-income, more industrialised, and more populated nations, according to the heterogeneity study of cities of various categories. As part of the COVID-19 lockdown, we also calculated how many premature deaths might be avoided if air pollution were reduced, and the estimated prevented premature deaths ranged from 99,270 to 146,649 across the 76 nations and areas participated in this research. COVID-19 pandemic underscores the need for continual air pollution management measures to safeguard human health and minimise social welfare losses during and after the epidemic.

Indrajit Chowdhuri (2022) As a result of COVID-19's prolonged shutdown, the ecosystem has benefited. As of the 24th of March, 2020, India has been under a state of emergency, which has been gradually extended. The COVID-19 pandemic's unexpected surge has resulted in a

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dramatic drop in air pollution levels in India. The subject of this essay was the influence of air pollution concentrations and climate variations on the Kolkata Metropolitan Area during the COVID-19 shutdown period. During the months of lockdown, air pollutants were greatly decreased, and the AQI (air quality index) rose. Airborne particulate matter values dropped by 54.94% compared to just before the shutdown. The COVID-19 shutdown period saw the greatest decrease in significant air pollutants such as PM2.5, PM10, sulphur dioxide (SO2), carbon monoxide (CO) and Ozone (O3). It has improved by 54.94 percent during the shutdown time. Since the impacts of shutdown on air quality and climatic variability have still to be fully understood, this study offers a unique chance for policymakers and decision makers to implement effective steps to reduce pollution.

Research Methodology

Continuous Ambient Air Quality Monitoring (CAAQM) data has been analysed for Delhi and its neighbouring main NCR towns, including Faridabad, Gurugram; Noida; Ghaziabad; and Faridabad. In addition, during the same time period mentioned above, CAAQM data was analysed for other major metropolises, in order to determine trends in air quality. It has been researched in three phases: prelockdown phase, lockdown phase-I, and lockdown phase-II (25th March – 19th April 2020). In accordance with the Government's recommendations, lockdown phase-II started on April 15th, but because certain extra activities were permitted beginning on April 20th, the lockdown phase-II period has been regarded from April 20th to May 3rd. A curfew was put in place on March 22nd, and numerous states followed suit during the following several days with their own restrictions, therefore that stretch of time from that date forward has been omitted from consideration.

Map 1: Study Area

Effect of lockdown on different air pollutant levels

From 17 March to 1 April 2020, the meteorological parameters showed relatively little fluctuation, according to this investigation. A one-way ANOVA test with a 0.05 threshold of significance was used to discover the differences between meteorological parameters.. From March 17 to April 1, there was no noteworthy change in the weather. As a result, the time from March 17 to April 1 has been excellent for studying the effects of lockdown because of the lack of meteorological disturbance. These eight days (17 March-24 March) were separated into two groups for the purposes of analysis: 1) eight days before lockdown and 2) eight days during lockdown (25 March-1 April). The concentration of all 10 contaminants reduced dramatically during the lockdown period as a consequence of many government restrictions. Table 1 shows the decreases in pollution levels. Similar reductions in PM2.5 (57.28 percent –68.32 percent) were also reported. NO was found to have the greatest reduction rate (up to 78.6 percent) among nitrogen oxides in all research sites, except in Noida, where NO2 and NOx were found to have the highest reduction rates. Between 49.76 percent and 78.59 percent of NO levels were reduced, with the greatest reductions occurring in Delhi, followed by Noida (which had the lowest decreases). With a range of 46.7 percent to 66.2 percent, NOx levels were reduced in Delhi and Faridabad, respectively. From 17.04 percent to 65.18 percent, NO2 concentrations were reduced. The decrease in SO2 concentrations varied from 12.55 percent to -56.23 percent. An first 8-day lockdown resulted in considerable reductions in CO (33.72%), Benzene (3267%), and NH3 (143.4%) levels, which varied from 14.34% –28.71% in each case. First days of lockdown were marked by a considerable decrease in O3 levels (9.37 percent –27.16 percent) in all sites, except Faridabad, where it slightly climbed (from 38.98 mg/m3 to 39.63 mg/m3).

Table 1 Variation in average air pollutant

There was a significant drop in PM2.5 measurements in Delhi during the pre-monsoon season due to rain. Because of the lifting of restrictions on industrial activity, industrial monitoring sites like MM and VV witnessed higher PM2.5 concentrations in 2020 than LDP-1, resulting in higher PM2.5 concentrations in ULP-1 than in LDP-1. There were greater concentrations of PM2.5 in ULP-1 than LDP-1 as a consequence of the relaxation of the ban on industrial activities. The average decrease in PM2.5 for LDP-1, LDP-2, LDP-3, LDP-4, and ULP-1 was 48.0%, 44.6%, 42.6%, 31.638.2%, and 29.8%, respectively.

Table 2. Average change in pollution levels throughout various stages of the year in 2020

There was a significant drop in PM2.5 measurements in Delhi during the pre-monsoon season due to rain. Because of the lifting of restrictions on industrial activity, industrial monitoring sites like MM and VV witnessed higher PM2.5 concentrations in 2020 than LDP-1, resulting in higher PM2.5 concentrations in ULP-1

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than in LDP-1. There were greater concentrations of PM2.5 in ULP-1 than LDP-1 as a consequence of the relaxation of the ban on industrial activities. In LDP-1, LDP-2, LDP-3, LDP-4, and ULP-1, the average drop in PM2.5 was 48.0 23.8 percent, 44.6 22.7 percent, 42.6 26.9 percent, 31.6 38.2 percent, and 29.8 28.5 percent, respectively.

Fig 1: PM2.5 levels during Lockdown

There was a downward tendency in various pollutants in NCR towns, which was more noticeable than in the NCT of Delhi, which was comparable to the downward trend in the latter. More than 50% decrease in PM2.5 and PM10 levels were detected during the first phase of lockdown in most nearby cities. The sharpest improvements were seen in Gurugram (61%) and Ghaziabad (54%) as compared to 2019 levels. PM2.5 levels dropped by 70% in Faridabad during the second phase of the lockdown, compared to 2019 levels during the same time period, although they were less noticeable or stayed stable in other areas. It is likely that restrictions on dust-generating activities are to blame for the significant reduction in PM10 levels in Gurugram, Noida, and Ghaziabad during the second phase of lockdown. NO2 levels in Noida (57 percent) and Ghaziabad (67 percent) decreased significantly during the first phase of lockdown compared to readings in 2019. The drop in NO2 levels was almost as noticeable in these locations during the second phase of the lockdown, suggesting that the number of cars on the road hasn't grown much. When it comes to NO2 emissions, this was not the case in Gurugram. During the pre-lockdown and phase-I of lockdown, NO2 emissions actually grew, while they only fell by 20% during phase-II of lockdown, as compared to the levels in 2019. It is possible that the closeness of Gurugram to thermal power plants is to blame for a rise in SO2 levels in Noida and Ghaziabad during the first phase of shutdown. As a result of this expansion, Gurugram's monitoring network will now include a total of four stations in 2020, up from the previous two in 2019. While Delhi's businesses have mostly shifted to gas-based and other cleaner energy systems, certain companies in NCR may still be utilising dirty fuels like coal, biomass, and so on while others in Delhi may have done the same.

In key NCR cities, the overall improvement in air quality may be clearly shown using Air Quality Index data. As compared to the same time period in 2019, the main NCR towns of Faridabad, Ghaziabad, Gurugram, and Noida saw a larger number of days in the Good and Satisfactory AQI categories. There was at least one very bad AQI day in the same month in 2019 compared to the lockdown period, which had no very poor AQI day and only several days with poor AQI levels, most of which happened in the middle of April, when a minor dust storm had affected the Delhi-NCR area.

Fig 2: Comparing Air Quality

III. RESULT AND DISCUSSION

Even in the most polluted places, such as Delhi and NCR, the CPCB, India set tolerable thresholds for air pollution levels during the lockdown. This region had a 61.6% drop in PM10 concentrations, an 81.6% decrease in PM2.5 concentrations, a 58.6 percent decrease in NOx concentrations, a 62.3 percent decrease in NO2 concentrations, and a 33.8% decrease in SO2 concentrations. As indicated in Table S4, same patterns have been detected in various research throughout the globe. PM10, PM2.5 (55–65 percent), and NOx (particularly NO level 5078 percent) were shown to have the greatest reductions. Across the globe, research has yielded the same conclusions. In light of the Indian Government's containment efforts relating to the cessation of transportation and industrial activity, this might be a possible explanation for this. Exhaust from vehicles, industrial pollution and high-temperature burning of fossil fuels are the main sources of NOx emissions from humans. There are a variety of small and medium-sized businesses in the cities under investigation, including chemical, petrochemical, metal casting, cars, steel and scrap metal sectors, as well as dye and paint companies. The decrease in NO was greater than the decrease in other pollutants.

The first week of lockdown had a fall in O3, whereas the next week saw a rise of 1927 percent. O3 levels dropped dramatically in the first several days of lockdown. O3 synthesis requires the presence of NOx.

Because of the loss of O3 (HO2+O3) rather than the cycling of peroxy radicals leading to net O3 chemical degradation, O3 synthesis declines with increases in NOx. It is possible to generate net O3 by the cyclic generation and destruction of HOx and NOx radicals at intermediate levels of NOx. Nitrogen oxides have a negative connection with ambient temperature, but ozone has a positive association, such that the photochemical oxidation of nitrogen oxides might be boosted, perhaps enhancing the formation of ozone. Solar radiation and temperature boost photochemical activity, which in turn leads to a rise in ozone

concentrations within the atmosphere. It is obvious from these data that photo-chemistry plays a significant role in the generation of tropospheric ozone in the atmosphere. According to our findings, when temperatures and solar radiations rise, oxidising agents react with nitrogen oxides, resulting in the creation of ozone.

IV. CONCLUSION

As a result of the COVID-19 outbreak, almost every country on the planet has implemented a lockdown. Due to a reduction in people's daily activities, transportation services like planes and trains, as well as the closure of most industries and educational institutions worldwide, pollution levels have decreased dramatically. A number of scenarios were used in this study to assess the impacts of lockdown on air quality throughout the world. Last but not least, the Air Quality Index and health hazards connected with it have improved for the same cities under lockdown compared to situations without lockdown. Parallel approaches have been used to test the AQI model in this study. Raw data and some graphical data were collected for comparison in order to arrive at the AQI index. According to the findings of this research, if we want better health and a higher quality of life, we must lessen our reliance on transportation and instead look to cleaner, greener alternatives. COVID-19-related shutdown has clearly reduced pollution levels in most of the world's regions, as shown by previous research and this new study. The economic consequences of the enacted system were unfavourable. To regulate pollution levels in certain cases a modified manner of different economic reservations might be utilised. For air pollution reduction measures, the results of this research are clearly a good starting point. In order for policymakers to avoid losing the lead they have gained in the fight against pollution increasing to critical levels, they must recognise the role of lockdown in reducing air pollution. Hopefully, the current circumstance will allow mankind to see the negative repercussions of human activity in a new light.

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