A Comparative Study to assess the Air quality of Ludhiana, India amid COVID-19

Manmeet Kaur
Assistant Professor
Civil Engineering Department, Chandigarh University, Gharuan, Mohali, India

Abstract: Air quality Index (AQI) is a tool which is implemented to assess the qualitative and quantitative status of air pollutants. Four distinctive pollutants; PM10, PM2.5, SO₂ and NO₂ were used to compare the prevailing ambient air quality in the study region-Ludhiana, the industrial city in the north Indian state of Punjab. The AQI for Ludhiana has been compared and, the ambient air quality data for the same has been obtained for Punjab Agricultural University, Ludhiana from Central Pollution Control Board (CPCB). The data has been compared for fifteen days before and after the lockdown amid COVID-19. Air quality information uncovers that during lockdown period PM10 and PM2.5 levels were decreased by around 35 to 40%, which might be clarified as conceivable decrease from production sector, transportation, and residue. AQI of Ludhiana revealed that the primary reason for the poor air quality is P.M 10 and P.M 2.5 which significantly reduced to around 10 to 35 percent during pandemic lockdown.

Keyword: Air Quality, Air Quality Index, Air Pollution, COVID-19

1. Introduction

Specific air pollution impacts have presently ended up in the advancement of air pollution control methodologies and other pollution impact examination programs, have long been confronted with the essential ought to get the relative significance of source impacts. Air pollution is one of the major concerns across the world because it poses a great threat to human health. The excessive amount of PM10 [1–3], oxides of sulphur or oxides of nitrogen is related with many health issues. Many of the man-made sources of air pollutants which are responsible for degrading the air quality includes point source, open burning and mobile sources and. The Air Quality Index (AQI) is calculated by using a formula that is used by government agencies to determine the air quality of a specific area. The formula is designed on the basis of comprehensive assessment of the various air pollutants. AQI comprises of SO₂, NO₂, CO, O₃, PM2.5 and PM10. It considers the highest index value of various air pollutants [4–6]. The high population density in developing nations has made air
quality a complicated issue. Thus, ambient air quality is monitored regularly by Central Pollution Control Board (CPCB) in India. Ludhiana, the industrial city in the north Indian state of Punjab, has earned the undesirable level of air contamination according to World Health Organization (WHO) report. Due to the lockdown amid pandemic the pollution across the different cities reduced drastically [7–9].

But since January 2020 there has been an improvement in the air quality due to the prevalence of COVID-19. This, COVID-19 pandemic has forced the nations to impose nationwide lockdown and curfew. In India the Janta Curfew was imposed on March 22, 2020 and lockdown later on, which has brought about the noteworthy enhancement in the air quality within the nation, as uncovered by the statistics and information rendered by the meteorological department. In the ensuing paper the data has been analyzed and has been compared for fifteen days prior and before the authorization of limitations-Curfew and Lockdown [10–12].

2. **Purpose of the study**

The lockdown since 22nd March in the nation during prevalence of COVID-19, has brought about the noteworthy change in the air quality within the nation, as uncovered by information investigation and comparison of information for some time recently before the authorization of limitations. The major divisions contributing to air pollution are transport, businesses, power plants, development exercises, biomass burning, street clean resuspension and private exercises [13–16].

In expansion, certain exercises such as operation of diesel generators sets, eatery, landfill fires, etc. too contribute to air pollution. As a result of imposing travel limitations and closing down of non-basic exercises counting those of air polluting segments, air quality improvement has been observed in numerous towns and cities over the country. The main objective of this study is to comparatively analyze the air quality of Ludhiana during the prevalence of COVID-19 in India. A brief examination of information created from continuous ambient air quality monitoring network and findings have been comprehended in the ensuing segment.

The Primary objectives of the study are: to Study the Air Pollution Data for Ludhiana to identify patterns of spike in Air Pollution levels with respect to various monitored parameters Comparative study of the air quality index (AQI) for fifteen days prior and after the lockdown [17–19].

3. **Methodology**

**Study area:** Ludhiana is an industrial city in Punjab state of India. The latitude is 30.9010° N, 75.8573° E.
The location specific data has been analyzed for different ambient air quality parameters in Ludhiana- Punjab Agricultural University. In the paper, the data of air quality index for fifteen days before and after the lockdown has been analyzed and, represented by graphs. The AQI for Ludhiana has been compared and, the ambient air quality data for the same has been obtained for Punjab Agricultural University, Ludhiana. The data has been compared for fifteen days before and after the lockdown amid COVID-19. In the present descriptive and evaluation study, the air quality data for Ludhiana city has been gathered for analyzing the air quality before and after lockdown amid pandemic. For the comparative analysis the data of fifteen days prior and after the lockdown has been considered as obtained from the official website of (CPCB, 2014).

4. Results and Discussion

Due to lockdown and curfew during the prevalence of pandemic COVID 19, as consequence of the amalgamation of lessen vehicles, restricted operation of commercial sectors and climatic conditions, a notable decline has been discerned for PM2.5, PM10, NOx and SOx levels. Fifteen days prior to the Janta Curfew AQI of Ludhiana was “Moderate” as compared to the fifteen days after the shutdown. In the latter case, the AQI gradually moved forward from higher to lower side of the category. As per the analysis the quality fell in “Good” category during the lockdown. In general, up to 40% reduction in PM2.5 was seen in Ludhiana amid lockdown compared to previous 15 days. The PM10 declined by approximately 26% during the restricted fortnight in and around the city, see figure 1.

![Figure 1: Line Graph of PM10](image-url)
It has been inferred from the AQI data obtained that the corresponding index ranged from 40 to 80 prior to the lockdown. In other words it can be affirmed that the air quality of the area based on PM10 switched in between “good” and “moderate”. Whereas preceding the lockdown the AQI was observed in the range of 25 to 40 which is merely the “Good” level, see figure 2.

![Figure 2: Line Graph of PM2.5](image)

To further break the data, it can be interpreted that the average AQI which was observed prior and after the restriction was 58 and 31 respectively. Here, the air quality shifted from moderate to good. The reason for the same can be highlighted as the lessen number of vehicles on the road, non-operation of the industries, no commercial activity and many other. By this action the graph gradually decreased, that represents the improved quality of air in the particular realm.

![Figure 3: Line Graph of NO2](image)
Figure 2 shown, on the contrast the PM2.5 increased by 62% on the immediate next day as on the day a relaxation was rendered wherein the people can move to their respective native places. This, somehow, enhanced the locomotive activity (burning of fuel) on the road causing a rise in PM2.5. Withal the reduction in the same has been observed in the following subsequent days after the lockdown. On an average there has been approximately 40% less concentration of the PM2.5 particles. In the initial 15 days the AQI ranged from 55 to 130 which can be stated as “Moderate” and “Poor” level while for the later days it was majorly “good” and for some instance of day was “Moderate”. The figure 3 gives an insight of air quality improvement during the pandemic COVID-19.

After analyzing the NO2 and SO2 level it can be depicted that during the whole period they were under standard level so they were not posing any environmental harm. However, in figure 3 and 4, a twin crested with a larger crest prior the lockdown has been observed on weekends, which may be because of the higher vehicular emissions. On the other hand, the absence of vehicular emissions after the restrictions were imposed has been highlighted by a constant line, see figure 4.
5. Conclusion

The improvement in air quality of the city was noted as the greater part of the vehicles stayed off terrain and insignificant industrial units were shut during national wide lockdown. As a consequence of absolute curtailment imposed on non-essential automobile movement and business exercises, the emissions from development exercises and production units were halted. The on-street vehicles were generally sparse contrasted with ordinary days, therefore contribution from street dust resuspension and transport division was tremendously diminished. An expansive examination has been endeavored to comprehend the improved air contamination levels because of lockdown. Air quality information uncovers that during lockdown period PM10 and PM2.5 levels were decreased by around 35 to 40%, which might be clarified as conceivable decrease from production sector, and transportation, and residue. There might be some decrease from different exercises, for example, fuel burning, improper solid waste burning, air ports, and so on. Withal the NO2 and SO2 have been monitored to be in the good range but a large steep in the same has also been observed.

References

[1] Martín-Gámez C, Acebal M D C and Prieto T 2020 Developing the concept of ‘ecosystem’ through inquiry-based learning: a study of pre-service primary teachers J. Biol. Educ. 54 147–61
[2] Kumar V, Bhatti S S and Nagpal A K 2021 Assessment of Metal(loid) Contamination and Genotoxic Potential of Agricultural Soils Arch. Environ. Contam. Toxicol. 81 272–84
[3] Ochoa-Hueso R, Delgado-Baquerizo M, Risch A C, Schrama M, Morriën E, Barmentlo S H, Geisen S, Hannula S E, Resch M C, Snoek B L and van der Putten W H 2021 Ecosystem coupling: A unifying framework to understand the functioning and recovery of ecosystems One Earth 4 951–66
[4] Davis E L, Trant A J, Way R G, Hermanutz L and Whitaker D 2021 Rapid ecosystem change at the southern limit of the canadian arctic, torngat mountains national park Remote Sens. 13
[5] Amin A A, Yanuar A T, Salamah L N and Kurniawan A 2021 Analysis of salt location suitability in Tuban regency, East Java by using salt suitability index (SSI) AIP Conference Proceedings vol 2353, ed N H A M S A N C S J K B A M D M M N M N A N N W I C S Z S A W I H A Y Tafiq A, Susanto H. (American Institute of Physics Inc.)
[6] Gwenzi W 2021 Rethinking restoration indicators and end-points for post-mining landscapes in light of novel ecosystems Geoderma 387
[7] Tiwari N, Santhiya D and Sharma J G 2020 Microbial remediation of micro-nano plastics: Current knowledge and future trends Environ. Pollut. 265
[8] Ahmed M 2020 Introduction to Modern Climate Change. Andrew E. Dessler: Cambridge University Press, 2011, 252 pp, ISBN-10: 0521173159 Sci. Total Environ. 734
[9] Machado M X, Castellani T T and de Sá Dechoum M 2020 Integrating management techniques to restore subtropical forests invaded by Hedychium coronarium J. Köenig (Zingiberaceae) in a biodiversity hotspot Restor. Ecol. 28 1273–82
[10] Gupta A K, Negi M, Nandy S, Alatalo J M, Singh V and Pandey R 2019 Assessing the vulnerability of socio-environmental systems to climate change along an altitude gradient in the Indian Himalayas Ecol. Induc. 106
[11] Matishov G G, Usyagina I S and Kasatkina N E 2019 Current state and trends in the content of 137Cs and 90Sr in abiotic and biotic components of Arctic ecosystems (Barents and Kara Seas case study) IOP Conference Series: Earth and Environmental Science vol 302 (Institute of Physics Publishing)
[12] Sonkar M, Kumar M, Dutt D and Kumar V 2019 Treatment of pulp and paper mill effluent by a novel bacterium Bacillus sp. IITRDVM-5 through a sequential batch process Biocatal. Agric. Biotechnol. 20
[13] Frey A, Ramaker K, Röckendorf N, Wollenberg B, Lautenschläger I, Gébel G, Giemsa A, Heine M, Bargheer D and Nielsen P 2019 Fate and translocation of (nano)particulate matter in...
the gastrointestinal tract. Nanosci. Technol. 281–327
[14] de Moura R S T and Henry-Silva G G 2019 Food web and ecological models used to assess aquatic ecosystems submitted to aquaculture activities [Modelos tróficos e ecológicos aplicados a avaliação de ecossistemas aquáticos submetidos à atividades de aquicultura] Cienc. Rural 49
[15] Hadi M, Vahidinia M and Hrabovsky J 2019 Larger foraminiferal biostratigraphy and microfacies analysis from the ypresian (Ilerdian-cuisian) limestones in the sistan suture zone (Eastern Iran) Turkish J. Earth Sci. 28 122–45
[16] Sarowa S, Singh H, Agrawal S and Sohi B S 2018 Design of a novel hybrid intercarrier interference mitigation technique through wavelet implication in an OFDM system Digit. Commun. Networks 4 258–63
[17] Kumar S, Kumar M and Handa A 2018 Combating hot corrosion of boiler tubes – A study Eng. Fail. Anal. 94 379–95
[18] Singh U, Salgotra R and Rattan M 2016 A Novel Binary Spider Monkey Optimization Algorithm for Thinning of Concentric Circular Antenna Arrays ITEE J. Res. 62 736–44
[19] Chaudhary R, Jindal A, Aujla G S, Kumar N, Das A K and Saxena N 2018 LSCSH: Lattice-Based Secure Cryptosystem for Smart Healthcare in Smart Cities Environment IEEE Commun. Mag. 56 24–32